ISPEC

July 6-8, 2023 / Ordu, Türkiye

12. INTERNATIONAL CONFERENCE ON AGRICULTURE, ANIMAL SCIENCE & RURAL DEVELOPMENT

EDITORS

Prof. Dr. Özlem ÖNAL AŞCI

Prof. Dr. Mehmet Fikret BALTA

Assoc. Prof. Dr. Seyithan SEYDOŞOĞLU



CONFERENCE PROCEEDINGS BOOK

ISPEC INSTITUTE

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ISPEC

12th INTERNATIONAL CONFERENCE ON AGRICULTURE, ANIMAL SCIENCE and RURAL DEVELOPMENT

DATE – PLACE
July 06-08, 2023
Ordu, TÜRKİYE

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CONFERENCE PROGRAM

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12. INTERNATIONAL CONFERENCE ON AGRICULTURE, ANIMAL SCIENCE & RURAL DEVELOPMENT

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- The presentation will have 15 minutes (including questions and answers).
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- Moderator is responsible for the presentation and scientific discussion (question-answer) section of the session.

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- Make sure your computer has a microphone and is working.
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ÖNEMLİ

- Kongremizde Yazım Kurallarına uygun gönderilmiş ve bilim kurulundan geçen bildiriler için online (video konferans sistemi üzerinden) sunum imkanı sağlanmıştır.
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- Kongre programında yer ve saat değişikliği gibi talepler dikkate alınmayacaktır.

Zoom'a girişte sırayla salon numarasını ve soyadınızı yazınız (Salon-1, AŞCI)

Opening Speech

Date: 06.07.2023
Ankara Time: 09.00 -09.50

Prof. Dr. Özlem ÖNAL AŞCI
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Chairman of the Organizing Committee

Prof. Dr. Mehmet Fikret BALTA
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06.07.2023
THURSDAY / 10.00-12.30

Ordu Üniversitesi, Ziraat Fakültesi, Toplantı Salonu

MODERATOR: Prof. Dr. Özlem Önal Aşcı

AUTHOR	AFFILITION	ABSTRACT TITLE
Osman Serdar Ayşe Nur Aydin Abdullatif Ölçülü Taner Derman Işil Canan Çiçek Çimen Tuba Parlak Ak Ayşegül Pala Nuran Cikcikoğlu Yildirim	*Munzur University*	Determination of acute toxicity and biochemical parameters of chlorpyrifos (Cpf) pesticide active on *Chlorella vulgaris*
Ayşe Nur Aydin Osman Serdar	*Munzur University*	Determination of acethylchinesterase activity of lambda cyhalothrin pesticide in zebra mussel (*Dreissena polymorpha*), which is a non-target organism
Ayşe Nur Aydin Osman Serdar	*Munzur University*	Determınatıon of acetylholınesterase activity of cerium in dreissena polymorpha non-target organisms
Osman Serdar Ayşe Nur Aydin Abdullatif Ölçülü Taner Derman Işil Canan Çiçek Çimen Tuba Parlak Ak Ayşegül Pala Nuran Cikcikoğlu Yildirim	*Munzur University*	Determination of acute toxicity and biochemical parameters of chlorpyrifos pesticide on navicula cryptocephala var. veneta
Hanife Mut Erdem Gülümser Uğur Başaran Medine Çopur Doğrusöz	*Bilecik Şeyh Edebali University*	Forage quality of chicory (*Cichorium intybus* L.) genotypes in the natural flora of Bilecik province
Erdem Gülümser Uğur Başaran Medine Çopur Doğrusöz Hanife Mut	*Bilecik Şeyh Edebali University*	Forage quality of yellow sweet clover (*Melilotus officinalis* (L.) Lamb.) genotypes in the natural flora of Bilecik province
Timur Demir Ahmet Uluer Özkan Özbay Aylin Kocalmiş Nurten Özbey Gökhan Karakaya	*Elaziğ Fisheries Research Institute*	Some physio-chemical properties of tohma stream (Malatya)
Kadir Kirk Tuğba Cebeci	*Van Yuzuncu Yıl University*	The effects of semen collection frequency on spermatological characteristics and semen microbiology
Ihsan Serkan Varol Ali Ünlükara Mahmut Kaplan	*Erciyes University*	Changes in phenolic and antioxidant activity in alfalfa cultivars grown under different irrigation levels

06.07.2023
THURSDAY / 10.00-12.30

Ordu Üniversitesi, Ziraat Fakültesi, Toplantı Salonu

MODERATOR: Prof. Dr. Mahmut Kaplan

AUTHOR	AFFILITION	ABSTRACT TITLE
Fatma Akbay Seda Arıkan Mustafa Kızılşimşek	*Kahramanmaraş Sütçü İmam University*	Usage of lactic acid bacteria inoculant in silages
Seda Arikan Fatma Akbay Zehra Korkmaz Tuğba Günaydin Eylül Nezahat Kizilyar Mustafa Kizilşimşek	*Kahramanmaraş Sütçü İmam University*	The effect of cultivation of fodder peas with different ratios of barley and wheat on silage quality
Serkan ÇELIK Faruk Akyazi	*Ordu University*	Incidence and population densty of plant parasitic nematodes associated with cut flowers in greenhouses in Yalova province, Turkiye
Özlem Önal Aşci Umut Ertürk Salantur A. Özge Şimşek Soysal	*Ordu University*	The effects of different nitrogen doses on hay yield and some quality properties in sorghum x sudan grass hybrid
Mahmut Kaplan Idris Yildiz	*Erciyes University*	Determination of herbage yield, yield characteristics and silage quality of different silage sorghum genotypes
Sema Kaplan Hasan Kale	*Erciyes University*	Short-TERM effects of organic fertilizer supported with different doses combination of microbial and inorganic fertilizers on some soil properties
Nuray Çiçek Cengiz Yücedağ Hasan Uçak	*Çankiri Karatekin University*	Alleviating effect of silicon on abiotic and biotic stress factors
Elif Korkmaz Nuray Çiçek Cengiz Yücedağ	*Çankiri Karatekin University*	Evaluation of seaweed as organic fertilizer in plant production
Muhammet Gölcü Sevgi Yilmaz	*Atatürk University*	Analysis of the outdoor thermal comfort impact of different water forms in urban spaces using envi-met: Erzurum city center
Muhammet Gölcü Sevgi Yilmaz	*Atatürk University*	Analysis of the impact of different green area ratios on outdoor thermal comfort in urban spaces using envi-met: Atatürk University housing settlement
Mahmut Kaplan Kağan Kökten Selim Özdemir	*Erciyes University*	Determination of feed quality parameters of grains of some grass pea (*Lathyrus sativus* L.) gynotypes

06.07.2023
THURSDAY / 10.00-12.00

Zoom Meeting ID: 812 5934 6695
Zoom Passcode: 120012

SESSION-1, HALL-1 / OTURUM-1, SALON-1

MODERATOR: Assoc. Prof. Dr. Erdem GÜLÜMSER

AUTHOR	AFFILITION	ABSTRACT TITLE
Kamaladine Mahamat Djıbrıne Ramazan Topak	*Selçuk University*	Chad's agriculture and water resources potential: the case study
Djellouli Amir Berredjem Yamina Hattab Zhour Guesmia Hadjer Mokhtar Mhenni Azri Naima Sara Ncibi	*University of Soukahras*	The investigation of two saharan plants' phenolic compounds and their insecticidal potential
Caner Yerli Talip Cakmakci Ustun Sahin	*Van Yuzuncu Yıl University*	Water footprint of silage maize (*Zea mays*. L.) as a forage crop in Van province (Turkey)
Djellouli Amir Berredjem Yamina Guesmia Hadjer Mokhtar Mhenni Azri Naima Sara Ncibi	*University of Soukahras*	The oasis of biskra in algeria ecological analysis and detection of an artificial wetland at the dam of foum el kherza
Mehmet Zeki Kocak	*Igdır University*	Comparison of fatty acid compositions of some türkiye and foreign registered flax (*Linum usitatissimum* L.) varieties
Ayush Madan	*Deemed-to-be-University*	Beneficiary role of orchid-mycorrhiza association in plant growth
Erdem Gülersoy Canberk Balikçi Adem Şahan Ismail Günal	*Harran University*	Evaluation of cardiac damage in calves with neonatal diarrhea caused by cryptosporidium with and without sepsis
Djellouli Amir Berredjem Yamina Hattab Zhour Guesmia Hadjer Mokhtar Mhenni Azri Naima Sara Ncibi	*Université Mohammed Chérif Mesaadia de Souk-Ahras*	Employing reasonably priced bioadsorbents to remove pb aqueous waste

06.07.2023
THURSDAY / 10.00-12.00

Zoom Meeting ID: 812 5934 6695
Zoom Passcode: 120012

SESSION-1, HALL-2 / OTURUM-1, SALON-2

MODERATOR: Assist. Prof. Dr. Sümeyye ŞAHİN

AUTHOR	AFFILITION	ABSTRACT TITLE
Mücahit Yüngül Mustafa Dörücü Başar Altınterim Hacı Bayram Gökhan	*Fırat University*	A study on meat yield of capoeta sieboldii steindachner, 1864 in gölova dam lake (Sivas, Turkey)
Boughedir Nadia Bailiche Zohra	*Université de Tlemcen*	AG/SBA15 nanocatalysts for esterification of biodiesel as model vocs
Gözde Hafize Yildirim Nuri Yilmaz Yusuf Şavşatli	*Ordu University*	Effect of dicalcium phosphate application on some germination parameters in oat (*Avena sativa* L.) seeds under drought stress conditions
Olubukola Olayemi Olusola-Makinde	*Federal University of Technology*	Assessment of haemolytic activities of bacterial isolates from a municipal abattoir wastewater effluents and receiving water milieu
Gözde Hafize Yildirim Nuri Yilmaz Yusuf Şavşatli	*Ordu University*	Determination of the effects of 2,4-dichlorophenoxyacetic acid containing herbicide applications and dicalcium phosphate, on some germination parameters of triticale (X *Triticosecale Wittmack*) seeds
Moussa Chergui Mohamed Titaouine Djalel Eddine Gherissi	*University of Mohamed Kheider*	Challenges of camel farming under climatic and socio-economic changes in el oued algerian arid region
Halim Topaldemir Beyhan Taş	*Ordu University*	Ethnobotanic macrophites which show year in yeşilirmak lower basin terme wetland
Monika Chaudhary Amar P. Garg Dilfuza Jabborova	*NAAC "A" Grade Deemed-to-be University*	Combinatorial effect of serendipita indica and azotobacter chroococcum on yeild of rice with respect to sustainable agriculture
Gözde Kilinç Arda Onur Özkök	*Amasya University*	Use of phytobiotics to improve reproductive performance of poultry

06.07.2023
THURSDAY / 10.00-12.00

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SESSION-1, HALL-3 / OTURUM-1, SALON-3

MODERATOR: Prof. Dr. Kürşat Korkmaz

AUTHOR	AFFILITION	ABSTRACT TITLE
Gökhan Gökçe Mervan Bayraktar	*Cukurova University*	Effect of body condition score on colostrum quality and some milk components
Dilfuza Jabborova	*Institute of Genetics and Plant Experimental Biology*	Arbuscular mycorrhizal fungi and biochar improve growth and root morphological traits of fenugreek
Mervan Bayraktar Gökhan Gökçe	*Cukurova University*	Teat end condition and somatic cell count
Chikha Maria Khenenou Tarek Gherissi Djalel Eddine Sabry M. El-Bahr Anas Abu Sailik	*University of Souk-Ahras*	Qualitativeand quantitative evaluation of camel milk production during the last stage of lactation
Mehmet Başak Çetin Mutlu Shahid Farooq	*Harran University*	Habitat suitability of european wheat stem sawfly [*Cephus pygmeus* (L.) (*Hymenoptera: Cephidae*)]] under changing climate
Charif Rania Sriti Fatima Zohra	*University of Biskra*	Synthesis and characterization of a K2NIF4 structural material
Nazmi Serhat Üstün Recep Onur Uzun	*Manisa Celal Bayar University*	Mechanization opportunities and applications in tobacco harvest
Chorna Natalia	*A. Podgorny Institute of Mechanical Engineering Problems of NASU*	Power generation systems energy using renewable energy sources for agricultural facilities
Göknur Bayrak Yasemin Gedik	*Eskişehir Osmangazi University*	Cast and DGAT1 polymorphism in some sheep breeds reared in Eskisehir province

06.07.2023
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Zoom Meeting ID: 812 5934 6695
Zoom Passcode: 120012

SESSION-1, HALL-4 / OTURUM-1, SALON-4

MODERATOR: Assoc. Prof. Dr. Medine ÇOPUR DOĞRUSÖZ

AUTHOR	AFFILITION	ABSTRACT TITLE
Kadir Saltalı	*Kahramanmaras Sutçu Imam University*	A new model in agriculture; micro-catchment based integrated production model- virtual land consolidation
Bashir, M.B Ndaghu, A.A Anonguku, I Sani, U.M	*Ahmadu Bello University*	Management practices of cattle diseases and parasites among pastoralists in north-east, Nigeria
Yusuf Kizilkan	*Ataturk University*	Ordu province according to socio-economic development index in geographical terms
James. O.S. Banjo Oluwole S. Ajala Olufemi A. Adekunle	*Tai solarin University of Education*	Proficiency needed by agricultural education lecturers in utilization of information communication technology for instructional purposes in tertiary institutions in south-west, Nigeria
Emine Yilmaz Emrah Kara Hüseyin Çeken	*Muğla Sıtkı Koçman University*	Evaluation of rural tourism potential with swot analyses: the case of Ordu
James. O.S. Banjo Olufemi A. Adekunle Oluwole S. Ajala	*Tai solarin University of Education*	Work-Skills required in cassava production in agricultural education curriculum for students of colleges of education in south-west, Nigeria
Olcay Filiz Engin Takil Nihal Kayan	*Eskişehir Osmangazi University*	The effect of plant growth promoting rhizobacterıa and phosphorus applications on morphological characteristics of beans (*Phaseolus vulgarıs* L.)
Rana Choukri Mohamed Faize Maria Manuela Rigano Manuel Rodriguez-Concepcion Jaime F. Martinez-Garcia Michel Havaux Mourad Baghour	*University Mohammed I*	Intercropping of tomato with maize improved growth and drought tolerance in tomato plants
Yahye Omar Mohamud Murat Muştu	*Erciyes University*	Functional response of coccidoxenoides perminutus girault (Hymenoptera: Encyrtidae) on planococcus ficus (Signoret) (Hemiptera: Pseudococcidae.

06.07.2023
THURSDAY / 10.00-12.00

Zoom Meeting ID: 812 5934 6695
Zoom Passcode: 120012

SESSION-1, HALL-5 / OTURUM-1, SALON-5

MODERATOR: Doç. Dr. Faruk Akyazı

AUTHOR	AFFILITION	ABSTRACT TITLE
Mazlum Erol Cengiz Yücedağ Nuray Çiçek	*Burdur Mehmet Akif Ersoy University*	The role of urban green areas to mitigate air pollution in cities
Shahzad Hassan Riffat Asim Pasha Ghulam Murtaza	*University of Engineering and Technology*	Experimental strength investigation of reinforced composite material with notches
Gizem Öztürk Cengiz Yücedağ Nuray Çiçek	*Burdur Mehmet Akif Ersoy University*	Propagation and cultivation of *Lavandula officinalis* L. species
Patrick Emeka Aba Ismaila Onuche, Odugbo Samuel Chukwuneke Udem	*University of Nigeria*	Ethylacetate leaf extract of pterocarpus milbreadii and its gc-ms profile
Gizem Öztürk Cengiz Yücedağ Nuray Çiçek	*Burdur Mehmet Akif Ersoy University*	Use of lavandula species in landscaping
Ogunyinka, Margaret Abimbola Ogunyinka, Olawale Ige	*The Federal Polytechnic*	Waste to wealth: a shift pattern change in waste management for developing nations
Mazlum Erol Cengiz Yücedağ Nuray Çiçek	*Burdur Mehmet Akif Ersoy University*	Biomonitoring of traffic-related heavy metal pollution through woody landscape plants
Salma Elamiri Soumia Aboul-Hrouz Younes Essmlali Achraf Chakir Mohamed Zahouily	*assan II University - Casablanca*	Development, characterization and agronomic evaluation in the open field of new slow release fertilizer (SRF)
Hülya Sipahi	*Eskisehir Osmangazi University*	Bioinformatic Analyses Of Osca Gene Family In Opium Poppy

06.07.2023
THURSDAY / 12.30-14.30

Zoom Meeting ID: 812 5934 6695
Zoom Passcode: 120012

SESSION-2, HALL-1/OTURUM-2, SALON-1

MODERATOR: Doç. Dr. Hatice Bilir Ekbiç

AUTHOR	AFFILITION	ABSTRACT TITLE
Ayşe Evci Ayşegül Bulut Mehmet Burak Ateş Nermin Işık Uslu	*Selçuk University*	A case of coenurus cerebralis, oestrus ovis, cysticercus tenuicollis and coccidosis in a sheep
Olawale Ogunyinka .I Olayinka Hopewell .O	*The Federal Polytechnic*	Developing the agroindustry in nigeria through efficient and effective embedded system & robotics (ESR) skill acquisition (a study of the federal polytechnic, ilaro innovation centre)
Orhan Kandemir	*Kastamonu University*	Agriculture and rural development support institution contribution to agricultural production in kastamonu province: a regional analysis
Saida Id Ouaziz El Khomssi Mohammed	*University Sidi Mohamed Ben Abdellah*	Study of the local and global stability of a bioeconomic model SECHJ
Gül Binboğa Nevin Demirbaş	*Ege University*	Developments in the grain milling industry in türkiye in the last decade: problems and suggestions
Gül Binboğa Nevin Demirbaş	*Ege University*	Establishment location proposal for a medium-scale compound feed business in türkiye according to certain criteria
Nguyen Thi Hang	*Thai Nguyen University of Information and Communication Technology*	Developing business operations of enterprises in the green economy
Nuray Güzeler Elif Kiliç	*Cukurova University*	Tradıtıonal cheese produced from goat milk
Houndji Pamphile	*Université d'Abomey-Calavi*	La question de L'acces des jeunes au foncier agricole dans le contexte de L'etalement de L'arrondissement de seme-podji au benin
Gülşah Bengisu	*Harran University*	A Review: Maize (*Zea mays* L.) Silage

06.07.2023
THURSDAY / 12.30-14.30

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SESSION-2, HALL-2/OTURUM-2, SALON-2

MODERATOR: Doç. Dr. Erdem Gülümser

AUTHOR	AFFILITION	ABSTRACT TITLE
Ayşe Atalay Çiğdem Özkan Kahraman Figen Yıldız	*Ege University*	Research on the detection of fungal root and crown rot diseases in some indoor ornamental plants in Izmir province
Brakni Oumaima Kerboua Ziari Yasmina	*University of Science and Technology Houari Boumediene*	Exploring the impact of diverse flow field architectures in fuel cells
Gaurav Kasar Pooja Rasal Aman Upaganlawar	*SNJB'S SSDJ College of Pharmacy*	Effect of lycopene alone and along with coenzyme-q10 in streptozotocin induced peripheral neuropathy: biochemical & behavioral study
Mehmet Akif Kalender Ramazan Topak	*Selçuk University*	Agriculture and water potential of Konya closed basin
Aishah H.O. Al Shehhi Gul Ahmed Jokhio	*The British University in Dubai*	The environmental and economic impacts of the use of recycled asphalt during the preventive maintenance of roadways in the UAE
Mehmet Akif Kalender Elif Şahin Suci	*Selçuk University*	Irrigation water requirement and supply ratio in karaman plain irrigation association
P. Sabari Grish	*Annamalai University*	Management of rice sheath blight incited by rhizoctonia solani using trichoderma viride
Doğan Arslan Aynur Bilmez Özçınar	*Siirt University*	The composition and uses of mahlep (*Prunus mahaleb* L.)

06.07.2023
THURSDAY / 12.30-14.30

Zoom Meeting ID: 812 5934 6695
Zoom Passcode: 120012

SESSION-2, HALL-3/OTURUM-2, SALON-3

MODERATOR: Dr. Öğr. Üyesi Sümeyye Şahin

AUTHOR	AFFILITION	ABSTRACT TITLE
Elif Şahin Suci Mehmet Akif Kalender	*Selçuk University*	Agricultural product warehouses and licensed warehousing: the case of Konya
Ayoub Chaoui Salaheddine Farsad Aboubakr Ben Hamou Mohamed Ezzahery Noureddine El Alem	*Ibn Zohr University*	Removal of cationic dye by an activated biochar derived from anaerobic digestion digestate: effect of pyrolysis temperature
Elif Şahin Suci Nuh Uğurlu	*Selçuk University*	Current situation of grain warehouses in Konya province and evaluation of some properties
Alifiya Sulaiha Diah Ayu Setyowati Puja Ana Awahatillah Muhammad Sultan Mubarok	*State Islamic University K.H Abdurrahman Wahid*	Values of thought k.h. abdurrahman wahid (Gus Dur) and its relevance to islamic business ethics
Medet Şimşek Serkan Şahan	*Erciyes University*	Damages of pesticide on wheat plant
El Khatri Nabil Oulbi Sara Hadria Rachid	*Mohammed VI Polytechnic University*	Assessing carbon sequestration, carbon footprint, and life cycle analysis in moroccan olive groves: towards sustainable olive oil production
Mustafa Demirkaya	*Kayseri University*	The effects of osmotic conditioning and humidification treatments on seed germination of carrot seeds
Pooja Rasal Gaurav Kasar Aman Upaganlawar	*SNJB'S SSDJ College of Pharmacy*	Ameliorative effect of lycopene alone and in combination with co-enzyme q10 in streptozotocin-induced diabetic nephropathy in experimental rats

06.07.2023
THURSDAY / 12.30-14.30

Zoom Meeting ID: 812 5934 6695
Zoom Passcode: 120012

SESSION-2, HALL-4/OTURUM-2, SALON-4

MODERATOR: Dr. Öğr. Üyesi Nuray Çiçek

AUTHOR	AFFILITION	ABSTRACT TITLE
Ahmet Akçam Özge Can Niyaz	*Çanakkale Onsekiz Mart University*	Determination of effective variables on pesticide use behaviors of pear producers: the case of Bursa province
C.Vijai Worakamol Wisetsri M.Elayaraja	*King Mongkut's University of Technology North Bangkok*	Environmental and health impacts of air pollution: a review
Darwin H Pangaribuan Muhammad Kamal M Syamsoel Hadi Rahim Muhammad N Sari Aulia	*Universitas Lampung*	Growth response and yield of sweet corn (*Zea mays saccharata* sturt.) due to giving poc of moringa leaf and lamtoro leaf
Faiz Ibni Sabil Muhammad Sultan Mubarok Muhammad Taufiq Abadi	*K.H Abdurrahman Wahid State Islamic University*	Definition and object of study of islamic economic philosophy
Özbay Dede Rasim Kavalci	*Ordu University*	Determination of the effects of different potassium doses on yield and quality parameters of some potato (*Solanum tuberosum* L.) varieties
Vaishali Krishna	*Jawaharlal Nehru university*	Strategising human capital : a way forward for sustainability

06.07.2023
THURSDAY / 12.30-14.30

Zoom Meeting ID: 812 5934 6695
Zoom Passcode: 120012

SESSION-2, HALL-5 / OTURUM-2, SALON-5

MODERATOR: Doç. Dr. Şeyda Çavuşoğlu

AUTHOR	AFFILITION	ABSTRACT TITLE
Esra Gürsoy Behlül Sevim Tugay Ayaşan	*Ağrı İbrahim Çeçen University*	Possibilities of using sumac in animal nutrition
Nur Syahrlinda Ain Jainudin Nur Atickah Raymond Casey Neville Philemon	*Keningau Vocational College*	Tangy cream made of wild plants
Asli Aslan Hacer Tüfekci	*Yozgat Bozok University*	Parameters used in the evaluation of animal welfare in sheep and goat farms
Muhammad Sultan Mubarok Siti Zulkaidah Al Hayu Lestari Isna Amaliya	*K.H Abdurrahman Wahid State Islamic University*	Cooperatives as a solution to indonesia's populist economy
Hilal Tozlu Çelik Hacer Tüfekci	*Yozgat Bozok University*	Early breeding use and application of body condition scoring in detection of nutritional deficiencies in small ruminants
Kiki Arsi Wijayanti Muhammad Sultan Mubarok Muhammad Taufiq Abadi	*K.H Abdurrahman Wahid State Islamic University*	Benefits, objectives and characteristics philosophy of islamic economics
Işil Özdemir Reyhan Bağdat Bahtiyarca Cenk Yücel	*Kocaeli University*	Investigation of beneficial and harmful insect relationship by developing intercropping systems with camelina in central anatolia ecological conditions
Alivia Hendra Gusthyta Putri Nabila Antika Putri Muhammad Sultan Mubarok	*K.H Abdurrahman Wahid State Islamic University*	Ibnu khaldun's economic philosophy theories

06.07.2023
SATURDAY / 15.00-17.00

Zoom Meeting ID: 812 5934 6695
Zoom Passcode: 120012

SESSION-3, HALL-1/OTURUM-3, SALON-1

MODERATOR: Doç. Dr. Faruk Akyazı

AUTHOR	AFFILITION	ABSTRACT TITLE
Danish Riaz Fayyaz Rasool Shagufta Andleeb Syed Makhdoom Hussain Shakeela Parveen Ali Hassan Amina Ayub Sana Aziz Mati Ullah	*University of Education*	Partial phsio-chemical characterization and identification of microbial isolates strains from gut of major carp
Sara Shokrpoor Hirad Samazis Mahya Jarideh	*University of Tehran*	Histopathological observations on cutaneous masses in a dog
Sara Shokrpoor Parisa Haghi Fatemeh Qasempoor	*University of Tehran*	Histopathological observations on transmissible venereal tumor (TVT) in a dog
Arushi Jain	*University of Delhi*	Investigating the synergistic nexus: animal agriculture as a catalyst for food security and nutritional excellence
Sabir Souddi Abdelhalim Tabit Ahmed Algouti Abdellah Algouti Hanane Toudamrini Said Moujane Imane Nafouri Abdelfattah Aboulfaraj Saloua Agli	*University of Caddy Ayyad*	New contributions of the structural analysis by photosatellites of the deposits of bou-azzer: mineralogical and petrostructural study, in relation with the host, anti atlas Morocco
Charif Rania Makhloufi Rachid	*University of Biskra*	Synthesis and characterization of a mixed oxide $ZNSB_2O_4$
Sami Ur Rehman Federica De Castro Paolo Marini Alessio Aprile Michele Benedetti Francesco Paolo Fanizzi	*University of Salento*	Earthworms-mediated modification of biochar facilitates heavy metals contaminated soil remediation
Shitu, S. Sanusi, S.B. Shitu, M. L. Hussaini, I.M. Anyakudo M.M.C.	*Ahmadu Bello University*	Detection of aflatoxigenic fungi and level of aflatoxins contamination in stored millet grains sold in kaduna state, Nigeria

06.07.2023
SATURDAY / 15.00-17.00

Zoom Meeting ID: 812 5934 6695
Zoom Passcode: 120012

SESSION-3, HALL-2/OTURUM-3, SALON-2

MODERATOR: Prof. Dr. Kürşat Korkmaz

AUTHOR	AFFILITION	ABSTRACT TITLE
Mohamed Boullouz Mohammed Louay Metougi Ngonidzashe Chirinda	*Mohammed VI polytechnic university*	Assessing the impacts of various fertilizer formulas on bread wheat (*Triticum aestivum*) yield, crop growth, and greenhouse gas emissions in arid regions
Chike F Oguejiofor Obinna B Onyejekwe Onyinyechi I Onwuzurike	*University of Nigeria*	In vitro immobilizing and spermicidal effects of methanol leaf extract of *Euphorbia hirta* Linn. (*Euphorbiaceae*) on caprine spermatozoa
Terry Nzeakor Chukwunonso Obi Sandra Nzekwe Martin Omeje Efficience Aneru	*University of Nigeria*	Evaluation of the ethnoveterinary potential of picralima nitida (*Apocynaceae*) as an anthelmintic
Hnane Toudamrini Abdellah Algouti Ahmed Algouti Saber Souddi Agli Saloua Moujane Said Aboulfaraj Abdelfattah	*Cadi Ayyad University*	Application of machine learning algorithms (extreme gradient boosting) for mapping groundwater potentiality; mejjat, marrakech, Morocco
Maria El Ouazzani Abdelmajid Haddioui Naaila Ouazzani Mustapha Afdali	*Sultan Moulay Slimane University*	Physicochemical characterization of olive mill wastewater from the traditional extraction system: a case study of central Morocco
Hafiz Qadeer Ahmed Adil Shahzad	*University of Agriculture*	The effect of modified dried vinasse (bromass) and fermented tomato pomace powder on the rumen development, growth performance, worm load, immune status, serum profile, and methane emission in growing claves
Nwobi L.G. Obidike R.I. Odo R.I. Mbegbu E.C. Nwagwu C.S., Okpala M.I. Okorie O.K. Aneru G.E.	*University of Nigeria*	Effect of hydroethanolic extract of phoenix dactylifera fruit (date palm) on hormonal profile and some biochemical changes in cyclosphosphamide-treated albino rats
Mohamad Nurul Azman Mohammad Taib Nurhidayatullaili Muhd Julkapli	*King Fahd University of petroleum and Minerals*	Conversion and mechanism of agricultural-based cellulosic materials into highly potential multifunctional nano dimension materials

06.07.2023
SATURDAY / 15.00-17.00

Zoom Meeting ID: 812 5934 6695
Zoom Passcode: 120012

SESSION-3, HALL-3/OTURUM-3, SALON-3

MODERATOR: Assoc. Prof. Dr. Erdem Gülümser

AUTHOR	AFFILITION	ABSTRACT TITLE
C.Vijai, M.S.R.Mariyappan, M.Elayaraja	*Sagunthala R&D Institute of Science and Technology*	Emerging trends in agriculture: benefits and challenges
Ferag Aziza Gherissi Djallel Eddine Khenenou Tarek Boughanem Amel Hadj Moussa Hafida Maamour Amina	*University of Souk-Ahras*	Insights and implications of using temperature and humidity index to predict the success of artificial insemination in cows
Vikranti Patel Kapila Manoj	*Veer Narmad South Gujarat University*	Effect of spirulina powder incorporated with vegetable waste on the weight of IMC fish
Bello, R.M. Shuaeeb, A. I. Ndatsu, A. Masalachi, U.M. Koroka, M. U. S.	*Federal University of Technology*	Perception of peer-tutoring pedagogical approach among undergraduate students of federal university of technology, minna
Matanat Aliyeva Aziz	*Azerbaijan University of Economics*	Agriculture, livestock and rural development project of the turkic world and components of the 4th industrial revolution
Hina Moin Rana Hadi	*Jinnah University for Women*	An assessment of microplastic accumulation in offshore fishes from karachi, Pakistan
Rana Hadi Hina Moin Sayyeda Ghufrana Nadeem	*Jinnah University for Women*	Microplastics abundance and composition in sediments of clifton beach karachi, Pakistan

06.07.2023
SATURDAY / 15.00-17.00

Zoom Meeting ID: 812 5934 6695
Zoom Passcode: 120012

SESSION-3, HALL-4/OTURUM-3, SALON-4

MODERATOR: Dr. Kave Koorehpaz

AUTHOR	AFFILITION	ABSTRACT TITLE
Diwakar Kumar Singh	*The Neotia University*	HMGB1 Is a serological conserved protein among the parasites
Nishanthi V S Badal Kumar Mandal	*Vellore Institute of Technology*	Evaluation of toxic heavy metal ions in environmental samples by differential pulse voltammetry
Baiju Thomas	*Ramakrishna Mission Vivekananda Educational and Research Institute*	Exploring the impacts of climate change on farming and adaptation strategies involved in modern farming systems
Kave Koorehpaz	*Urmia University*	Positive aspects of sildenafil citrate on reproductive organ of male dogs with subfertility
Silpa Sunil Badal Kumar Mandal	*Vellore Institute of Technology*	Facile and cost-effective synthesise of fluorescent carbon dots doped graphitic carbon nitride for the detection of Fe3+
Lawal, W.S, Olayiwola, S.A. Olorundare, T.M	*Lawal W.S. Department of Animal Production Technology*	Organoleptic characteristics of herbal preservation of tiger nut drink (kunu ayaya) using adasonia digitata, tamarind, tumeric, pakia biglobasa and *Moringa olifera*
Khanza Monica Salsabila Ana Kadarningsih Michelle Rosa Pertiwi	*Universitas Dian Nuswantoro*	Good corporate governance as a profit-increasing driver for pharmaceutical companies
Restu Pratiwi Kinasih Ana Kadarningsih Luluk Tri Rahayu	*Universitas Dian Nuswantoro*	Company growth and total assets to improve company performance in Indonesia

06.07.2023
SATURDAY / 15.00-17.00

Zoom Meeting ID: 812 5934 6695
Zoom Passcode: 120012

SESSION-3, HALL-5/OTURUM-3, SALON-5

MODERATOR: Dr. Fırat İşlek

AUTHOR	AFFILITION	ABSTRACT TITLE
J.M. Kamali A. Vanmathi K. Devadharshini G. Kalaignazhal M.V. Silpa V. Sejian	*Rajiv Gandhi Institute of Veterinary Education and Research*	Techniques for measuring enteric methane emission in ruminants
Nurhan Keskin Şeyda Çavuşoğlu Sıddık Keskin	*Van Yüzüncü Yıl University*	Total phenolic compound and flavonoid content of batman (Gercüş) native grape varieties
Nurhan Keskin Şeyda Çavuşoğlu Sıddık Keskin	*Van Yüzüncü Yıl University*	Determination of antioxidant capacity of some native grape varieties with two different methods
Şeyda Çavuşoğlu Nurhan Keskin Sıddık Keskin	*Van Yüzüncü Yıl University*	Categorical principal components analysis in post-harvest 1-mcp treated tomatoes I: relationships between storage and some quality traits
Şeyda Çavuşoğlu Nurhan Keskin Sıddık Keskin	*Van Yüzüncü Yıl University*	Categorical principal components analysis in post-harvest 1-MCP treated tomatoes II: relationships between storage and total phenolic compound, antioxidant capacity, and enzyme
Şeyda Çavuşoğlu Fırat İşlek Nurettin Yılmaz	*Van Yüzüncü Yıl University*	Effective practices and storage performance in the preservation of some minimally processed vegetable types
Şeyda Çavuşoğlu Sercan Düzgün	*Van Yüzüncü Yıl University*	The importance of respiration after harvest in climacteric fruit species
Wilson, Emmanuel Okon	*Akwa Ibom State Polytechnic*	Phytochemical analysis of various parts of avocado plant (persea americana) for corosion inhibitor and lubricant suitability
Amir Hossein Khoshakhlagh Saeed Yazdanirad Safiye Ghobakhloo	*University of Medical Sciences*	Validity of the empirical heat stress indices in predicting the heat strain of outdoor occupations

07.07.2023
FRIDAY / 10.00-12.00

Zoom Meeting ID: 812 5934 6695
Zoom Passcode: 120012

SESSION-1, HALL-1/OTURUM-1, SALON-1

MODERATOR: Dr. Andaç Kutay SAKA

AUTHOR	AFFILITION	ABSTRACT TITLE
Füsun Gülser Siyami Karaca Bulut Sarğın	*Van Yuzuncu Yıl University*	Soil parent material and plant nutrients: exploring the linkages
Eka Febrianti Zaidan Zulfa Athallah Muhammad Sultan Mubarok	K.H Abdurrahman Wahid State Islamic University	The concept of ownership in Islam
Kalbiye Konanç	*Ordu University*	The evaluation of the biological activities of the plant of john's wort (*Hypericum* sp.) in poultry nutrition
Karimatuzzain Kiki Arsi Wijayanti Muhammad Sultan Mubarok Muhammad Taufiq Abadi	K.H Abdurrahman Wahid State Islamic University	Ontology ethics and deontology ethics
Cengiz Türkay Cenap Yilmaz	*Alata Horticultural Research Institute*	Alternative and strategic plant: prickly figs
Fahrani Nisrina Habibati Budiatman Satiawihardja Nugraha Edhi Suyatma	*IPB University*	Effect of temperature and extraction time on pectin production from edamame soybean pods
Emine Rengin İleri Sinem Öztürk Erdem Merve Karakoyun	*Bilecik Şeyh Edebali University*	The effect of different primining applications and treated waste water concentrations on the germany of jujuba (*Ziziphus jujuba* Mill.) seeds
Vignesh K Lokesh R Sathiya Aravindan V Manikandan K Sabari Grish P	*Annamalai University*	Collection and conservation methods of vegetable crops
Devran COŞKUN	*Siirt Üniversitesi*	Ambroksolun Mukokinetik Dışı Etkileri

07.07.2023
FRIDAY / 10.00-12.00

Zoom Meeting ID: 812 5934 6695
Zoom Passcode: 120012

SESSION-1, HALL-2/OTURUM-1, SALON-2

MODERATOR: Yeter Çilesiz

AUTHOR	AFFILITION	ABSTRACT TITLE
Şerife Tülin Akkaya Aslan Müge Kirmikil Merve Küçük	*Bursa Uludag University*	The possible effects of the new inheritance law on land consolidation
Rajendra Prasad Vivek Kumar Vipul Kumar	*Fiji National University*	Can azo-food dye metabolites interfere with dopaminergic pathways in CNS causing ADHD: A molecular structural investigation
Fereshteh Rezaei	*Baskent University*	Effects of seed priming on germination and seedling growth of buckwheat (*Fagopyrum esculentum* Moench.) cultivars
Emya Yusri Angga Sinulingga Dwi Yuni Hastati	*IPB University*	Effect of milk on the organoleptic characteristics of *Garcinia mangostana* L. Velva
Mehmet Altun Ustun Sahin	*Atatürk University*	The effect of different irrigation practices on stomatal conductivity in silage maize grown in soil amended with stabilized wastewater sludge
Lulut Alfaris Ruben Cornelius Siagian Aldi Cahya Muhammad Ukta Indra Nyuswantoro Nazish Laeiq Froilan Delute Mobo	*Philippine Merchant Marine Academy*	Classification of spiral and non-spiral galaxies using decision tree analysis and random forest model: a study on the zoo galaxy dataset
Ömer Faruk Keleş	*Van Yüzüncü Yıl University*	Complications caused by incorrect injection in sheep
Muhammad Faisal	*Director (HRIMS), Ministry of Human Rights Commission*	A study by dr faisal that rising of jobless young people in Pakistan
Nilay Kayin Serap Kizil Aydemir	*Bilecik Şeyh Edebali University*	Determination of photoxicity effect of some herbicides used in different doses on variety of common vetch

07.07.2023
FRIDAY / 10.00-12.00

Zoom Meeting ID: 812 5934 6695
Zoom Passcode: 120012

SESSION-1, HALL-3/OTURUM-1, SALON-3

MODERATOR: İlker Yüce

AUTHOR	AFFILITION	ABSTRACT TITLE
Hasan Kuraloğlu Serap Kulaç Halil Ünal	*Bursa Uludag University*	Operating parameters in milking robots with forced cow traffic
Sruba Saha Amitava Paul Sanjay J. Jambhulkar	*The Neotia University*	Induced polygenic variability on M2 and M3 generation of sesame (*Sesamum indicum* L.)
Serap Öründü Zekai Tarakçi	*Ordu University*	Determination of the properties of edible films produced from different fruits
K.R.Padma K.R.Don	*Sri Padmavati Mahila Visvavidyalayam (Women's) University*	Omicron variant progression and its therapy: unpredictable outbreak
Yusuf Güvenaltin Rezzan Kasim M.Ufuk Kasim	*Kocaeli University*	Optimization of led lighting systems used in indoor plant production systems in different plants
Ayesha Batool Farkhanda Anjum	*University of Agriculture*	Eating style of female students and its effect on their health
Sena Meriç Rezzan Kasim M.Ufuk Kasim	*Kocaeli University*	Usage of sistein in prevention of enzymatic browning in fresh-cut fruit and vegetables
Piyush Bachhav Rutuja Nikam Ganesh Sonawane	*Divine College of Pharmacy*	Rp- Hplc method deveopment and validation for estimation of linezolid in bulk drug and dosage form

07.07.2023
FRIDAY / 10.00-12.00

Zoom Meeting ID: 812 5934 6695
Zoom Passcode: 120012

SESSION-1, HALL-4/OTURUM-1, SALON-4

MODERATOR: Meliha Feryal Sarıkaya

AUTHOR	AFFILITION	ABSTRACT TITLE
Aykut Zerek	*Hatay Mustafa Kemal University*	A research on the attitudes and behaviors of beekeepers regarding the methods of protection from disease and pests in beekeeping enterprises facilities in Hatay province
Avishek Bardhan Thangapalam Jawahar Abraham Tapas Kumar Sar Ravindran Rajisha Edaparambil Krishnappan Nanitha Krishna Satyen Kumar Panda Prasanna Kumar Patil	*The Neotia University*	Plasma and bile pharmacokinetics and tissue distribution of florfenicol in *Oreochromis niloticus* (L.) post singular oral gavage
Sümeyye Şahin Melike İnal	*Ordu University*	Determination of the quality characteristics of some bewaxes
Vikas Saini Jyoti Sinha Vinod Kumar	*Sushant University*	Soaring the concentration of bioactive phytochemicals via agro-techniques in medicinal plants of haryana
Ahmad Alsaleh	*Yozgat Bozok University*	Investigating molybdenum variation in durum wheat: integrating chemical and genetic analysis through gwas
Maria Taj Muhammad Nasir Uddin Khan	*University of Karachi*	Clean and green environment by using agricultural waste with better cleaning properties than synthetic ones
Olajide Oluwamayowa Opeyimika Olayemi Michael Sunday	*Kogi State Polytechnic*	A survey of the challenges and strategies to create wealth from waste management practises in Nigeria

07.07.2023
FRIDAY / 10.00-12.00

Zoom Meeting ID: 812 5934 6695
Zoom Passcode: 120012

SESSION-1, HALL-5/OTURUM-1, SALON-5

MODERATOR: Assoc. Prof. Dr. Melekber Sülüşoğlu Durul

AUTHOR	AFFILITION	ABSTRACT TITLE
Melekber Sülüşoğlu Durul Mehmet Polat Kerem Mertoğlu	*Kocaeli University*	Minor fruits and their importance in fruit growing
Fariba Sharifian	*Cultural Heritage and Tourism Research Center of Iran*	Horse motif on sassanian seals
Gülşah Çalik Koç Gözde Kubat	*Başkent University*	Effect of three different doses of liquid vermicompost on saffron (*Crocus sativus* L.) flower parts
Musa, Fatima M Umar Fatima Jummai Muhammad Jamila	*Kaduna State University*	Analysis of bacterial contaminants in locally fermented cow milk product sold in kaduna, Nigeria
Fatih Ahmet Aslan Hilal Tozlu Çelik	*Ordu University*	Methods and current advances in estrus synchronization of sheep and goats
Musa, Fatima M Umar Fatima Jummai Muhammad Jamila	Kaduna State University	Antibacterial sensitivity of pathogens isolated from locally fermented cow milk product sold within kaduna, Nigeria to common antibiotics
Hüseyin Özpinar Ergül Ay Hülya Okkaoğlu Melek Akça Pelen	*Aegean Agricultural Research Institute*	Aegean region forage crops variety development studies (1967-2023)
Jusmawati Nurul Azhari Nabiilah Muhammad Sultan Mubarok Muhammad Taufiq Abadi	*K.H Abdurrahman Wahid State Islamic University*	Makna keadilan dalam bisnis

07.07.2023
FRIDAY / 12.30-14.30

Zoom Meeting ID: 812 5934 6695
Zoom Passcode: 120012

SESSION-2, HALL-1/OTURUM-2, SALON-1

MODERATOR: Muhammed Tatar

AUTHOR	AFFILITION	ABSTRACT TITLE
Cemile Ebru Onursal Mehmet Özdemir Derya Erbaş Mehmet Ali Koyuncu	*Batı Akdeniz Agricultural Research Institute*	Quality changes in shelf life conditions of purple passion fruit harvested at different maturity stages
Ben Ali Anis Chouikh Atef Haddad Larbi Ben Ali Rayan	*University Echahid Hamma Lakhdar*	Assessing the therapeutic and preventive potential of cyperus rotundus in various diseases
Bülent Akar Hatice Gül Ateş	*Gümüşhane University*	Green alga chlorella and use as food
Bahia Messai Rachid Makhloufi Aymen Benmakhlouf	*University of Biskra*	Impedance spectroscopy and dielectric properties of pzt-based ceramics
İsmail Oğuz Özdemir	*Sakarya Uygulamalı Bilimler University*	Determination of species parasitizing naturally-laid eggs of *Palomena prasina* L. (*Hemiptera: Pentatomidae*) in the west black sea hazelnut orchards of Turkey
Ishpreet Singh Chouhan Navrajanbir Singh Kalsi	*The Senior Study-II School*	Fabrication of electrical energy generation device using the concept of triboelectric charging
Selahattin Aygün Damla Bender Özenç	*Ordu University*	The effects of hazelnut husk and biochar and their extractions on bread wheat development
Khammar Farida Handel Naoual	*University of Souk Ahras*	Modélisation d'une cellule photovoltaïque multi jonction

07.07.2023
FRIDAY / 12.30-14.30

Zoom Meeting ID: 812 5934 6695
Zoom Passcode: 120012

SESSION-2, HALL-2/OTURUM-2, SALON-2

MODERATOR: Yeter Çilesiz

AUTHOR	AFFILITION	ABSTRACT TITLE
Gamze Kor Şimşek Filiz İçier	*Dimes Food and Drink Ind. & Inc.*	Energetic, exergetic and exergo-economic analyses of whole milk production in carton aceptic package
Rania Remmani Malek Miladi Rachid Makhloufi Antonio Ruiz Canales	*University of Biskra*	Assessment of locally sourced illite/kaolinite clay as an eco-friendly adsorbent for remediation of petroleum hydrocarbon-contaminated groundwater
Seyit Ahmet Gökmen Yusuf Cufadar Barişcan Curabay	*Selçuk University*	The effect of phytobiotic and probiotic addition to barley based laying hens diets on performance and egg quality traits
Mohammed Mohammed Sulaiman Ebrahim	*Business of Administration*	A study on the financial awareness among among undergraduate students in hodeida province in Yemen
Şükran Öztürk Öznur Ergen Akçin	*Ordu University*	Anatomical characteristics of *Alchemilla sericata* rchb., species, distributed in the eastern black sea region
Mónika Fekete Bálint Madarász Judit Forrai Zoltán Ungvári János Tamás Varga	*Semmelweis University*	Chronic respiratory diseases: can diet or vitamin-antioxidant supplementation help?
K. Meriç Uğurlutepe Hüseyin Sauk	*Ondokuz Mayıs University*	Ergonomic analysis of tomato harvesting in greenhouse agriculture
Mansi Pawar Tushar Nikam Ganesh Sonawane	*Divine College of Pharmacy*	Animal science : a review

07.07.2023
FRIDAY / 12.30-14.30

Zoom Meeting ID: 812 5934 6695
Zoom Passcode: 120012

SESSION-2, HALL-3/OTURUM-2, SALON-3

MODERATOR: Meliha Feryal Sarıkaya

AUTHOR	AFFILITION	ABSTRACT TITLE
Beyza Nur Yıldız Nuray Çömlekçioğlu Büşra Yapıcı Ezgi Gürsoy Ş. Şebnem Ellialtıoğlu	*Eskişehir Osmangazi University*	The effects of in vitro colchicine applications on embryo frequency in anther culture
Gréta Törős József Prokisch Ferenc Peles	*University of Debrecen*	Optimization of unique media production for enhanced bioactivity of *Pleurotus ostreatus mycelia*
Mustafa Yildirim Bengü Everest	*Çanakkale Onsekiz Mart Universitesi*	The role of women's cooperatives in rural development: the case of Çanakkale
Rutuja Nikam Piyush Bachhav Ganesh Sonawane	*Divine College of Pharmacy*	Cruelty to animals: a review
Malik Ergin Rabia Albayrak Delialioğlu Yasin Altay Özgür Koşkan	*Isparta Uygulamalı Bilimler University*	Bibliometric analysis of lactation curves in livestock
Armaelis Arfani Elsa Nadiya Febriyani Muhammad Sultan Mubarok	*K.H Abdurrahman Wahid State Islamic University*	Strategi kota pekalongan dalam pengembangan pariwisata kreatif berbasis industri batik
Sebiha Erol Emine Budakli Çarpici	*Bursa Uludag University*	The effect of salt stress in some sweet sorghum [*Sorghum Bicolor* Var. *Saccharatum* (L.) Mohlenbr.] varieties on germination characters
Saiqa Andleeb Summaya Yahya Abdul-Hameed Khan	*University of Azad Jammu and Kashmir*	Efficacy of vermi-compost on seed germination and seedling growth parameters of wheat (*Triticum aestivum* L.)

07.07.2023
FRIDAY / 12.30-14.30

Zoom Meeting ID: 812 5934 6695
Zoom Passcode: 120012

SESSION-2, HALL-4/OTURUM-2, SALON-4

MODERATOR: Dr. Ferda ÖZKORKMAZ

AUTHOR	AFFILITION	ABSTRACT TITLE
Levent Taşeri Ersin Karacabey Gamze Uysal Seçkin Taha Ahmet Güngör	*Tekırdağ Vıticulture Research Institute*	Drying kinetics and quality analysis of aronia dried in an solar dryer
Kalsoom Yasin Saleem Abbas	*Riphah International University*	Work related stress, burnout, job satisfaction and subjective happiness among employees working in textile industry
Umut Ateş	*Ordu University*	Comparison of the quality characteristics of fresh and dried white mulberry (*Morus alba* L.)
Mallikarjunamallu K Syed Khasim	*VIT-AP University*	Ablation methods for preventing atrial fibrillation: a review
İlker Şen Tunahan Sancak	*Sivas Cumhuriyet University*	Application of M.I.P.O technique in metacarpus fractures in kangal sheep
Vidya Padmakumar Murugan Shanthakumar	*Bangalore University*	The philippine eagle: a majestic but endangered raptor
Mehmet Akif Karagöl Merve Emine Dirik Tahsin Tonkaz Sümeyye Şahin	*Ordu University*	Determination of the chemical content of waste seeds and seed oils of some fruits used in the food industry
Jimena J. Hurtado Cassandra González Kalpana Nanjareddy Lourdes Blanco Miguel Lara Manojkumar Arthikala	*Universidad Nacional Autónoma de México*	Comprehensive analysis of *Phaseolus vulgaris* cyc gene family and their expression during rhizovial symbiosis

07.07.2023
FRIDAY / 12.30-14.30

Zoom Meeting ID: 812 5934 6695
Zoom Passcode: 120012

SESSION-2, HALL-5/OTURUM-2, SALON-5

MODERATOR: Assoc. Prof. Dr. Erdem Gülümser

AUTHOR	AFFILITION	ABSTRACT TITLE
Ezgi Edebali Murat Emre Terzioğlu İhsan Bakırcı	*Atatürk University*	Food safety and haccp applications in ice cream production
Sri Padma Kanta Mishra Deepak Bansal	*Indian Institute of Finance*	Economics Of oil prices and dynamic relationship with exchange rates and stock markets under uncertainty: a literature review
Büşra Turan Murat Emre Terzioğlu İhsan Bakirci	*Atatürk University*	Dioxin in milk and dairy products
Muhammad Irfan Rishmail Saleem Bilal Shoukat Hammad Hussain Shazia Shukrullah Muhammad Yasin Naz Saifur Rahman Abdulnour Ali Jazem Ghanim Grzegorz Nawalany Tomasz Jakubowski	*University of Agriculture Faisalabad*	Production of combustible fuels and carbon nanotubes from plastic wastes using an in-situ catalytic microwave pyrolysis process
Mehmet Akif Karagöl Zekai Tarakçi	*Ordu University*	Investigation of the effect of persimmon powder obtained by different drying methods on the physicochemical and sensory properties of ice cream
Intan Parwati Irkhamna Oktavia Pipit Fitriani Muhammad Sultan Mubarok	*Muhammad Sultan Mubarok*	K.H. abdurrahman wahid (gus dur): islam and people's economy (case study: wadas residents receive land acquisition, compensation payments reach 92 percent
Gamze Tarim Üzeyir Kement Mehmet Kabacik Faruk Yüksel	*Muğla Sıtkı Koçman University*	Local gastronomy cultural analysis: the case of ikizce
Cassandra González Kalpana Nanjareddy Manojkumar Arthikala	*Universidad Nacional Autónoma de México*	Role of nin-like protein down-regulation in regulating nodule formation and development in common bean

07.07.2023
FRIDAY / 15.00-17.00

Zoom Meeting ID: 812 5934 6695
Zoom Passcode: 120012

SESSION-3, HALL-1/OTURUM-3, SALON-1

MODERATOR: Dr. Andaç Kutay Saka

AUTHOR	AFFILITION	ABSTRACT TITLE
Abdurrahman Takcı Mehmet Buğra Kıvrak	*Sivas Cumhuriyet University*	Determination of the effectiveness of different postpartum applications on reproduction in cows
Naila Tamamil Asna Diah Ayu Setyowati Zaskia Fani Muszaki Muhammad Sultan Mubarok	*State Islamic University K.H Abdurrahman Wahid*	Islamic economic philosophy focus: islamic economic trilogy
Andaç Kutay Saka	*Ordu University*	Characterization and determination of fruit traits of some local tomato landraces
Minkhatul Maula Serlinda Ane Yulaicha Muhammad Sultan Mubarok	*State Islamic University K.H Abdurrahman Wahid*	Online buying and selling transactions in an islamic perspective (case study mh skin whitening)
Stanislava Stateva	*Institute Plant Genetic Resourses "Konstantin Malkov"*	Possibilities for controlled storage and propagation in medicinal plant species
Siti Nurlela Tri Murtia Ningrum Muhammad Sultan Mubarok Dwi Eti Widiana	*State Islamic University K.H Abdurrahman Wahid*	Economics and philosophy of criticism: a case study about the division of mattress production in kedondong village, sidoarjo district
Sevim Budak Hülya Küçük Bayraktar	*Kafkas University*	An investigation of the role of women's cooperatives in rural development through ayyildiz women's cooperative
Hassane Abd-Dada Said Bouda Abdelmajid Haddioui	*Sultan Moulay Slimane University*	*Euphorbia resinifera* o. berg in Morocco: a potential melliferous, medicinal and forage plant to remedy climate change: contribution of molecular and morphometric markers for management of its genetic resources

07.07.2023
FRIDAY / 15.00-17.00

Zoom Meeting ID: 812 5934 6695
Zoom Passcode: 120012

SESSION-3, HALL-2/OTURUM-3, SALON-2

MODERATOR: Assoc. Prof. Dr. Kanber Kara

AUTHOR	AFFILITION	ABSTRACT TITLE
Kanber Kara	*Erciyes University*	Comparison of macro and micro mineral contents of premium class dog foods with different protein contents
Kanber Kara	*Erciyes University*	Comparison of linoleic, alpha linolenic and epa+dha fatty acids in dried and canned types of different class dog food with nrc-2006 and fediaf-2021
Beyza Kübra Uluirmak Rahmi Doğan Irem Demirci Mesut Sirri Gülten Yazici Neslihan Bal	*Gazi University*	Curculonidae and pentatomidae family species with pistachio pests in Türkiye
Joy, O., Olayiwola Ojo, J., Adaramola	*Federal Polytechnic Ilaro*	Detection of maize disease using deep learning models
Irem Demirci Beyza Kübra Uluirmak Rahmi Doğan Mesut Sirri Gülten Yazici Neslihan Bal	*Gazi University*	Hazelnut pest curculionidae and pentatomidae familia species in Türkiye
Karim Houmanat Jamal Charafi Hakim Outghouliast	*National Institute for Agricultural Research*	Study of the adaptation potential of the pomegranate cultivar (sefri) with three different bioclimatic stages
Rahmi Doğan Irem Demirci Beyza Kübra Uluirmak Mesut Sirri Gülten Yazici Neslihan Bal	*Gazi University*	Canola pest curculonidae and pentatomidae familia species in Türkiye
Shraddha Bhattacharjee Jayanta Kumar Das	*The Neotia University*	Understanding the perception of farmers on climate change

07.07.2023
FRIDAY / 15.00-17.00

Zoom Meeting ID: 812 5934 6695
Zoom Passcode: 120012

SESSION-3, HALL-3/OTURUM-3, SALON-3

MODERATOR: Dr. Çağlar Okulmuş

AUTHOR	AFFILITION	ABSTRACT TITLE
İlknur Eskimez Kerem Mertoğlu Mehmet Polat Deniz Gülkaya Arıtürk Melekber Sülüşoğlu Durul	*Kocaeli University*	Adaptation of two different apple genotypes to Isparta ecological conditions for our country
Ramin Aslani Saeideh Esmaeili Ebrahim Molaee-Aghaee Mohamad Esmaeil Akbari Parisa Sadighara Shahrokh Nazmara	*Tehran University of Medical Sciences*	Determination of heavy metals in bottled water collected from market in Tehran, Iran: a health risk assessment
Ibrahim Şahin Inan Dursun Nevzat Çağlayan Abdurrahman Şimşek Nevzat Esim	*Bingöl University*	Comparison of the biological activities of honey obtained from four different (*Apis mellifera* L.) honey bee genotypes under Bingol conditions
Nacima Deghiche-Diab Marco Alberto Bologna Tesnim Deghiche Hassan Boukerker	*Roma Tre University*	An updated checklist of *Meloidae mylabrini* (*Coleoptera*) and host plants in a saharan oasis ecosystem in Algeria
Çağlar Okulmuş	*İzmır Veterıner Kontrol Enstıtüsü*	Importance of metabolic profile testing in dairy farming
Umama Mehmood Syed Mohsan Raza Shah Muqds Bukhari	*University of Education*	Exploring novel morpho-anatomical traits in convolvulus arvensis from the punjab, Pakistan
Fatih Arslan	*Adana Veteriner Kontrol Enstitüsü Müdürlüğü*	Impacts of viral pandemics
Kemajl Kurteshi Muharrem Ismaili	*University of Prishtina*	Microbiological estimation of water of lake përlepnica, during spring season 2018

07.07.2023
FRIDAY / 15.00-17.00

Zoom Meeting ID: 812 5934 6695
Zoom Passcode: 120012

SESSION-3, HALL-4/OTURUM-3, SALON-4

MODERATOR: Prof. Dr. Ali İSLAM

AUTHOR	AFFILITION	ABSTRACT TITLE
Emine Nakilcioğlu	*Ege University*	Nutritional properties of sea cucumber and its potential effects on human health
Kemajl Kurteshi Ilmije Vllasaku	*University of Prishtina*	Investigation of genotoxic effect of insecticide chromagor at fish goldfish (*Carassius auratus*), after 14 days of treatment
Abdoul Nasser Aboubacar Dan Badaou Üstün Şahin	*Atatürk University*	Changes in stomatal conductivity in silage maize under different irrigation regimes in organic fertilized soil
Aisha Nawaz Syed Mohsan Raza Shah	*University of Education*	Elucidating morpho-anatomical adaptations in *Achyranthes aspera* L. From Punjab, Pakistan
Selim Karagöl Ali İslam	*Ordu University*	Effects of rehabilitation on production and quality in tombul hazelnuts
Rasheed Olatunde Ajetunmobi Benjamin Ogbomena Omorojor Gabriel Semako Hojapoji	*Lagos State University of Education*	Navigating the evolving landscape: exploring emerging trends and challenges in data center security
Ali İslam Ali Turan Muharrem Yilmaz Sezgin Ayan Selim Karagöl Salih Çolak	*Ordu University*	Determination of rooting ratio of turkish hazelnut (*Corylus colurna* L.) genotypes selected from tosya
Muhammad Saqib Wafa Majeed Usman Haider Muhammad Saad Tariq Mahnoor Jamil Alishbah Roobi Wania Nasir Najeeb Ullah Khan Jawad Aslam Noreen Aslam Muhammad Naeem Faisal	*University of Agriculture Faisalabad*	Exposure and risk of development of metabolic dysfunction in a population consuming heavy metal-contaminated milk

07.07.2023
FRIDAY / 15.00-17.00

Zoom Meeting ID: 812 5934 6695
Zoom Passcode: 120012

SESSION-3, HALL-5 / OTURUM-3, SALON-5

MODERATOR: Dr. Andaç Kutay SAKA

AUTHOR	AFFILITION	ABSTRACT TITLE
Özbay Dede Esra Tatar	*Ordu University*	Effect of different doses of potassium and phosphorus on potato's (*Solanum tuberosum* L.) quality, yield and yield parameters
Sonali Kumari Abha Mishra	*Banaras Hindu University*	Molecular docking and molecular dynamic simulation studies of plant-based compounds for potential inhibition of alpha-amylase protein
Mustafa Özyücel	*Isparta Uygulamalı Bilimler University*	The examination of the impact of growth expectations on rural supports in Turkey using the todo-yamamoto method
Arigbo, Precious Obinna Chukwu, Chinonso Wilfred	*University of Nigeria*	Knowledge and resilience of rural households to covid-19 pandemic in nkanu east, enugu state, Nigeria
Ali İslam Salih Çolak	*Ordu University*	Rootstock selection in Turkish hazelnut (*Corylus colurna* L.) populations in Kastamonu
Syeda Sabika Zahra Naqvi Syed Mohsan Raza Shah Farah Bukhari	*University of Education, Lahore*	Morpho-anatomical modification in *Withania somnifera* (L.) dunal from the punjab, Pakistan: insights into adaptation
Fatih Öner Ferda Özkorkmaz	*Ordu University*	Determination of the effect of sweet corn (*Zea mays* L. Saccharata) and bean (*Phaseolus vulgaris* L.) intercropping system on the agronomic characteristics of sweet corn
Jasmina Najdovska Katerina Drogreshka Ljubcho Jovanov	*Ss. Cyril and Methodius University*	Comparative analysis of the macroseismic effects of two earthquakes from the same source. case study for skopje epicentral area
Gamze Kaya	*The Ministry of Agriculture and Forestry*	Variation in stomatal density and distribution on leaves of different radish cultivars

08.07.2023
SATURDAY / 10.00-12.00

Zoom Meeting ID: 812 5934 6695
Zoom Passcode: 120012

SESSION-1, HALL-1/OTURUM-1, SALON-1

MODERATOR: Dr. Gülcan Kaymak Bayram

AUTHOR	AFFILITION	ABSTRACT TITLE
Mehmet Can Gülcan Kaymak Bayram Özlem Önal Aşcı İlknur Ayan Zeki Acar	*Ondokuz Mayıs University*	Determination of the quality and nutritional content of some cowpea genotypes (*Vigna unguiculata* (L.) Walp) growed in Samsun ecological conditions
Elena Sierikova Serhii Saltevskyi	*National University of Civil Defence of Ukraine*	The dead animals impact on the environment
Gülcan Kaymak Bayram Utku Tunali Zeki Acar İlknur Ayan	*Ondokuz Mayıs University*	Determination of forage yıeld and some morphological characteristics of some cowpea genotypes (*Vigna unguiculata* (L.) Walp) growed in Samsun ecological conditions
Imoisi, C. Okhale, S.E. Egharevba, H.O.	*Mewar International University*	Gas chromatography-mass spectrometry (Gc-Ms) analysis of the essential oil from nigerian *Artemisia annua L.* at different growth stages
Emre Turan Atilla Şimşek Mehmet Çavuş	*Ordu University*	Determination of antioxidant and antimicrobial activity of green coffee extract rich in chlorogenic acid
Imoisi, C. Okhale, S.E.	*Mewar International University*	Characterization of the volatile bioactive compounds in ethylacetate leaf extract of *Annona muricata* linn
Emre Turan Atilla Şimşek	*Ordu University*	Black garlic: production, properties and food applications
Imoisi, C. Okhale, S.E. Josiah, J.G.	*Mewar International University*	In-Vitro evaluation of eucalyptus citriodora leaf essential oil and extracts on selected pathogens implicated in respiratory tract infections
Erol Yücel Haktan Birsel	*Havelsan Strategy Group Leader*	Agricultural intelligence decision support model with visual analytics: creation of sustainable agriculture and agricultural intelligence in Turkey

08.07.2023
SATURDAY / 10.00-12.00

Zoom Meeting ID: 812 5934 6695
Zoom Passcode: 120012

SESSION-1, HALL-2/OTURUM-1, SALON-2

MODERATOR: Dr. Mine Aydin Kurç

AUTHOR	AFFILITION	ABSTRACT TITLE
Umar Bilal Ibrahim Imrana Bello Sada Mujitafa Salisu Aminu	*Usmanu Danfodiyo University Sokoto State*	Evaluation of some parameters and determination of sulphate in industrial effluents
Gülru Yücel Natalia Borowska-Żuchowska Maciej Bisaga Hab. Bozena Kolano	*Ondokuz Mayıs University*	Chromosomal organization of satellite sequences in crepis
Sawera Tariq Syed Mohsan Raza Shah	*University of Education*	Assessment of morpho-anatomical characteristics of *Panicum antidotale* retz. from punjab, Pakistan
Mine Aydin Kurç	*Tekirdağ Namık Kemal University*	Phaeohyphomycosis caused by *Aureobasidium pullulans* in a cat diagnosed as malign mesenchimal tumor
Gaurav Ranjan Srijani Dasgupta	*Central University of South Bihar*	A review on tinospora cordifolia- a magical bullet for neurodegenerative diseases
Salisu Nuhu	College of Science And Technology Hussaini Adamu Federal Polytechnic Kazaure	Optimization of quicklime production from eggshell using response surface methodology
Muhammad Safdar	University of Education	Unveiling adaptive components for environmental heterogeneity in ipomoea carnea jacq
Hamit ISMAILI Kemajl KURTESHI	University of Prishtina	Estimation Of Genotoxic Effect Of Herbicid Randap 480 EC at Goldfish (Carassius auratus) Through Micronucleus Test and Nucleoplasmic Bridges After 10 Day Treatment

08.07.2023
SATURDAY / 10.00-12.00

Zoom Meeting ID: 812 5934 6695
Zoom Passcode: 120012

SESSION-1, HALL-3/OTURUM-1, SALON-3

MODERATOR: Assist. Prof. Dr. Yeter Çilesiz

AUTHOR	AFFILITION	ABSTRACT TITLE
Abdul Hameed Soomro Aftab Ahmed Khuhro Muhammad Ashir Khalil Chandio Muhammad Ashraf	*Mechanical Engineering Isra University*	Techno-economic analysis of hydrogen fuel cell technology for electric vehicles
Aftab Ahmed Khuhro Abdul Hameed Soomro	*Mechanical Engineering Isra University*	Investigating sustainable development through responsible innovation and infrastructure in agriculture and water treatment
Faqeer Muhammad Muhammad Ashan Hafiz Badaruddin Ahmad	*Bahauddin Zakarya University*	Exploring the production and analysis of hybrid halide perovskites with halogen substitution
M Barka Outbakat Redouane Choukr-Allah Mohamed El Gharous Aziz Soulaimani Khalil El Mejahed Kamal El Omari	*Polytechnic University*	Does phosphogypsum application affect salts, nutrients, and trace elements displacement from saline soils?
Eze, C.P., Obi, C.F., Idika, I.K., Nwosu, C.O.	*University Of Nigeria*	Toxicity and anti-coccidial effect of aqueous sacoglottis gabonensis (*Magnoliophyta, Humiriaceae*) stem bark extract in broiler birds experimentally infected with mixed eimeria species
Ibrahim, D.G., Bashir, M.B., Sabo, E., Garba, M.S	*Ahmadu Bello University*	Factors influencing farmer-herder conflict in ardo-kola and lau local government areas of taraba state, Nigeria
Syed Mohsan Raza Shah Mansoor Hameed Muhammad Sajid Aqeel Ahmad Farooq Ahmad Sana Fatima Sana Basharat Ansa Asghar Jazab Shafqat	*University Of Education Lahore*	Key determinants of invasiveness in ipomoea *Carnea jacq.* to climatic shift along altitudinal gradient
Nnenna T. Emejuo Jacinta N. Omeke Remigius. I. Onoja Shodeinde V.O. Shoyinka Arinzechukwu S. Ezema Amaechi L. Ogara Stella N. Ugwoke	*University Of Nigeria*	Alterations in haematology following administration of chromolaena odorata extract in rats with experimental benign prostatic hyperplasia

08.07.2023
SATURDAY / 10.00-12.00

Zoom Meeting ID: 812 5934 6695
Zoom Passcode: 120012

SESSION-1, HALL-4/OTURUM-1, SALON-4

MODERATOR: Dr. Maryam Saddiq

AUTHOR	AFFILITION	ABSTRACT TITLE
Maryam Saddiq	*Umaru Musa Yar'adua University*	Precipitation of asphaltenes from crude oil emulsion
Sanaz Alamdari Ahmad Farhad Talebi Arefe Abasian Aida Haji Taheri Mehrnaz Dadwar Nastaran Farhabod	*Semnan University*	Green synthesize of zink oxide nanoparticles using ferula extract
Sunday Samuel Olanrewaju	*Federal College Of Education*	Effects of solar and wind energy systems on academic performance of students in higher institutions of learning
Arshia Zia	*University Of Agriculture*	Application of proline as pre-sowing seed treatment on okra under water deficit conditions
M. Fauzi	*State Islamic University K.H Abdurrahman Wahid*	The impact of unempolyment on the national economy in Indonesia
Thorat Jayashri Sanjay	*Department Of Environmental Science*	Instability in food security leads to environmental degradation - a review
Sarra Zouaoui Rachid Rouabhi Ilhem Djaalali	*Bioactive Molecules And Applications Laboratory*	The pharmacological potential of medicinal plants: phytochemical analysis, antibacterial investigations, and antioxidant activity assessment in *Melissa officinalis* L.
Ukoha, J. C. I., Kalu, U. Anyanwu, E. V.	*Michael Okpara University Of Agriculture*	Perceived effect of soil erosion on arable crop production in abia state, Nigeria

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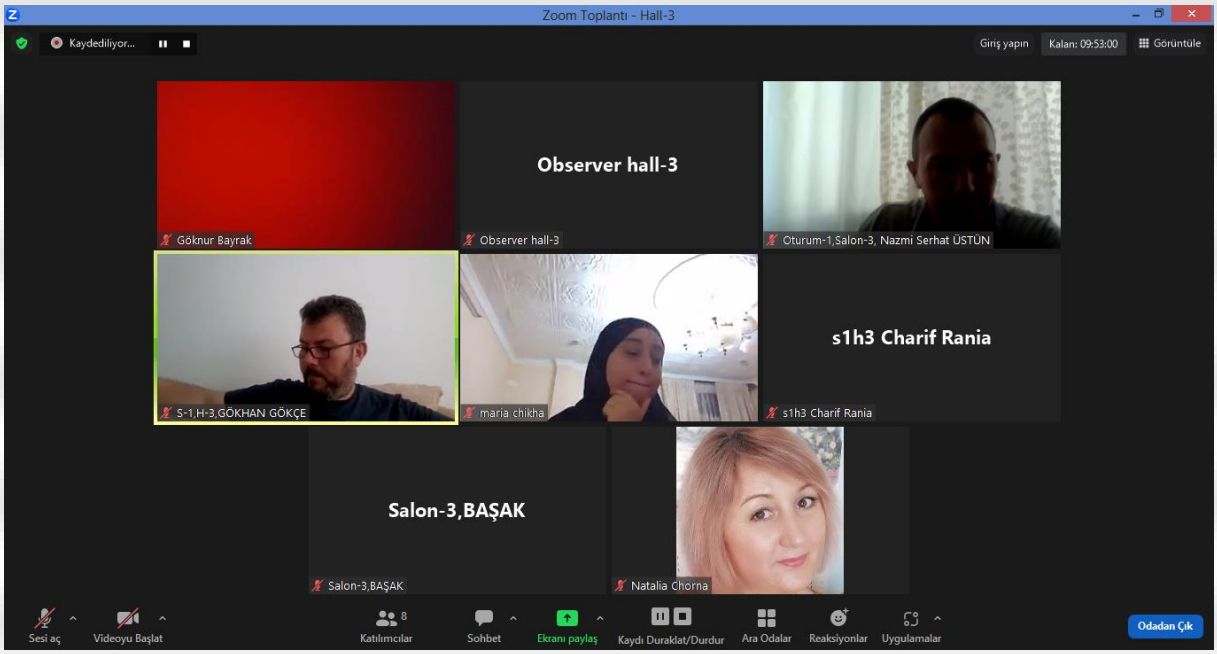



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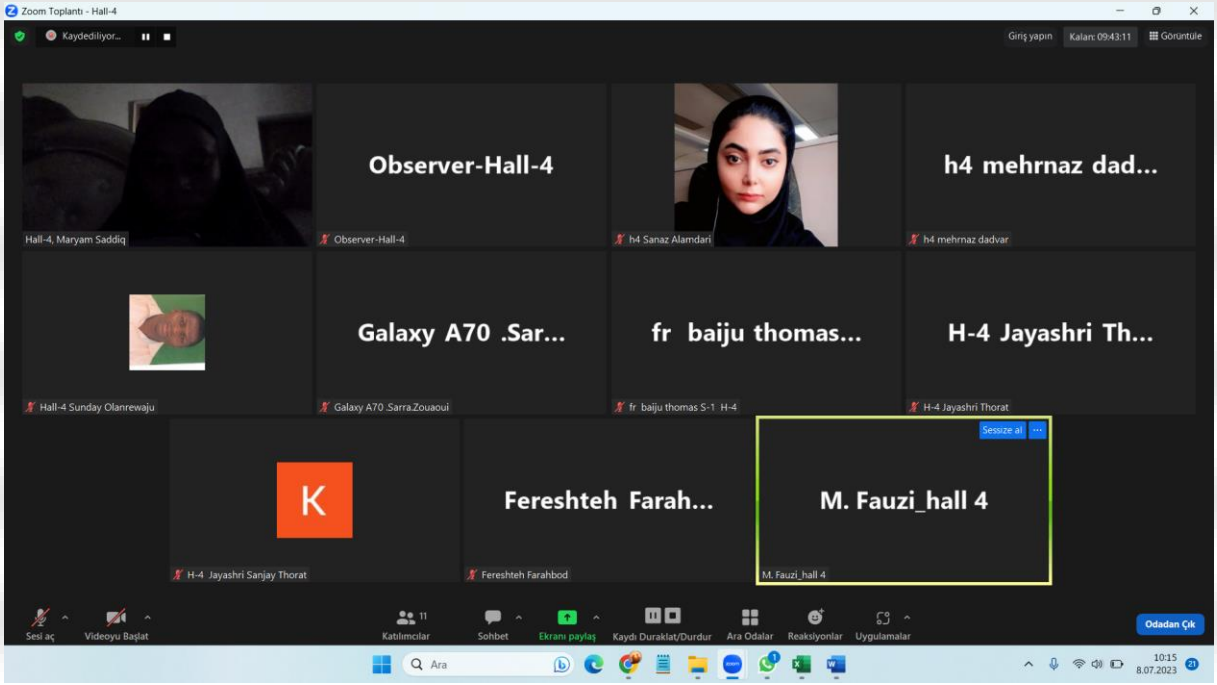



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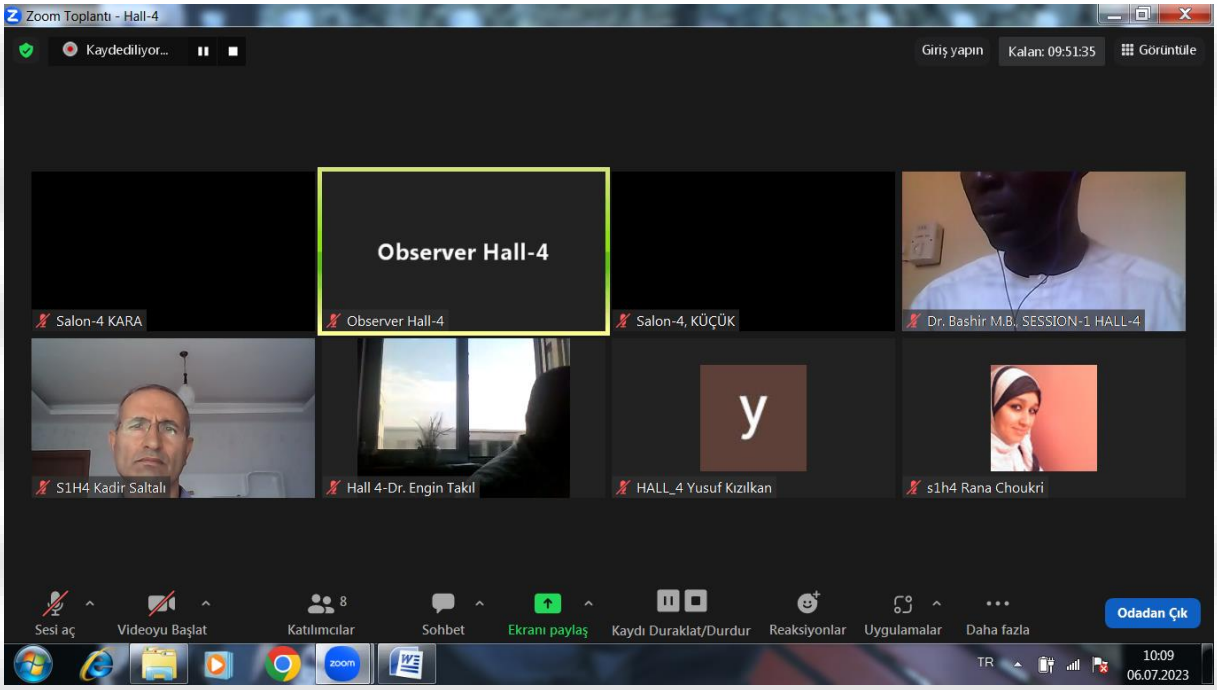

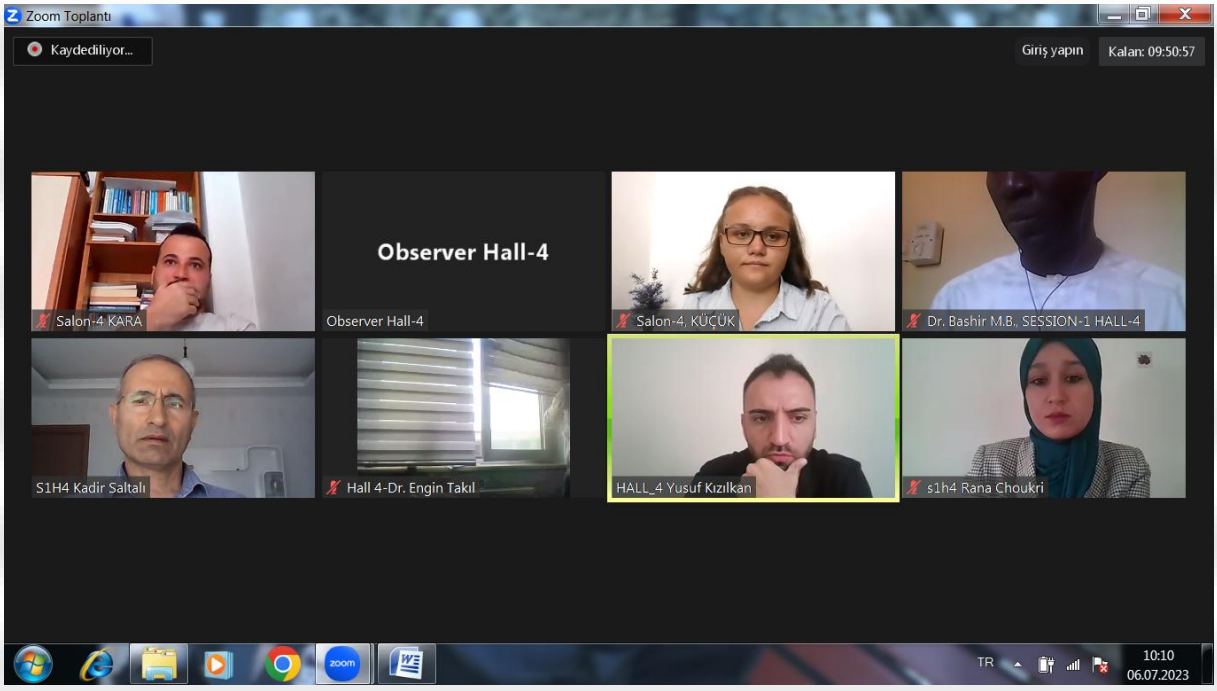

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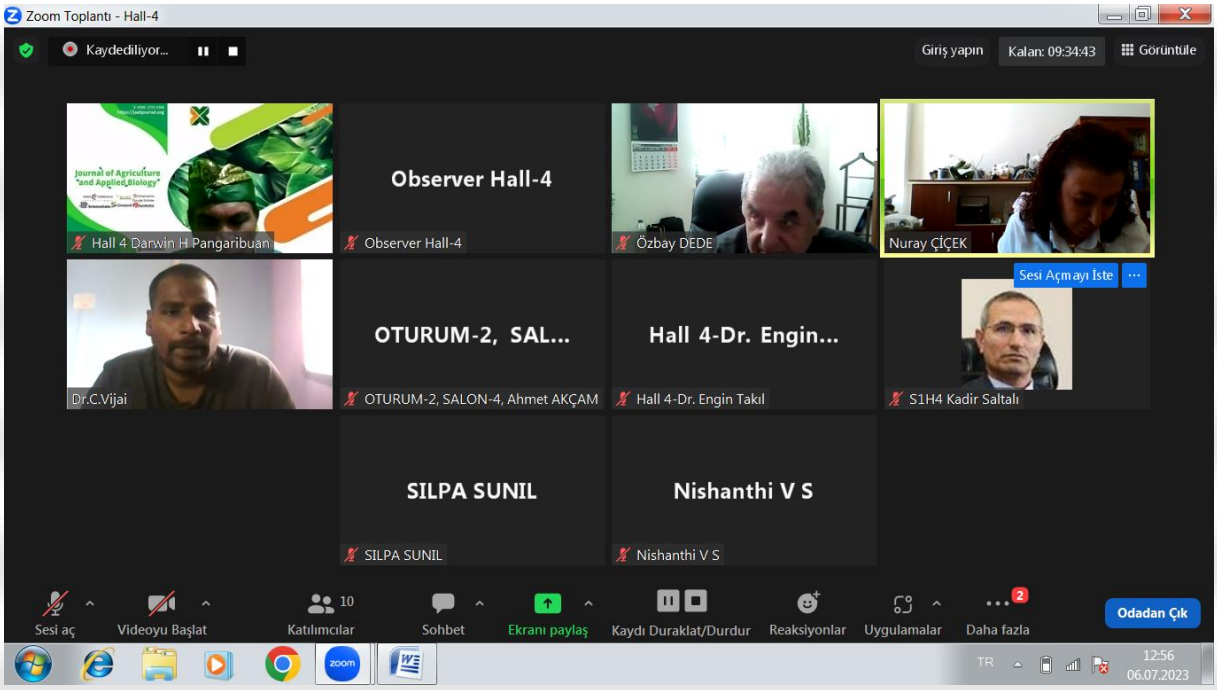

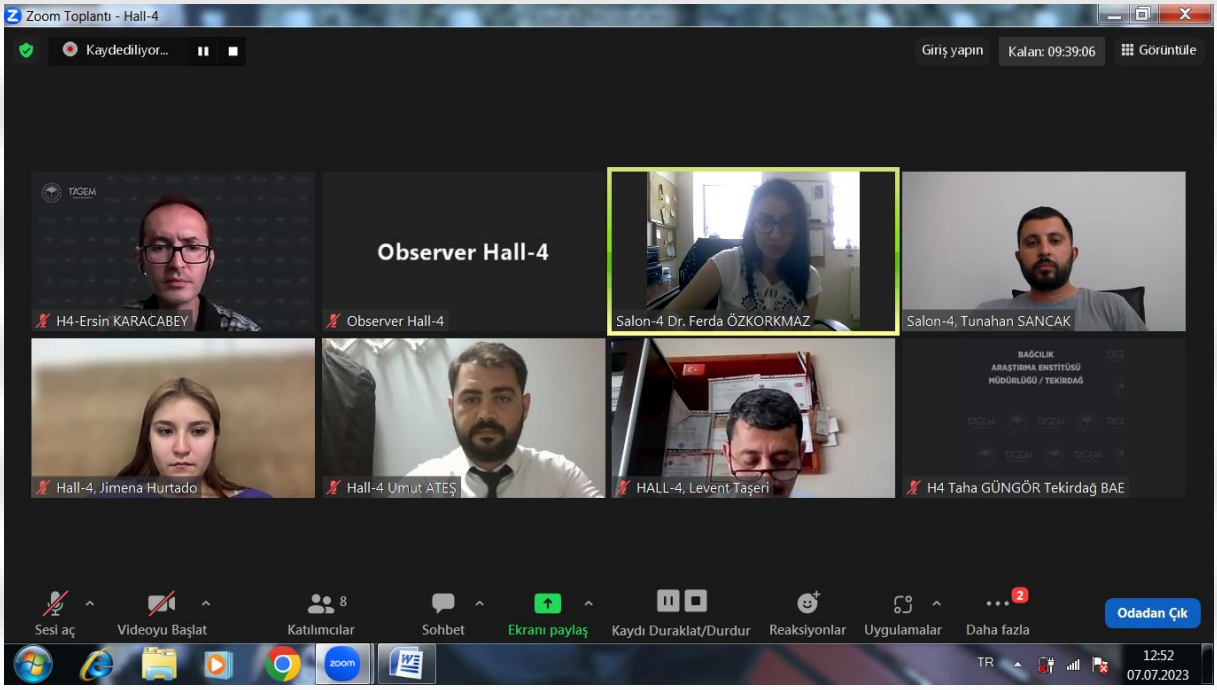

CONTENTS

CONGRESS ID		
PROGRAM		
PHOTO GALLERY		
CONTENTS		
Authors	**TITLE**	**Page Number**

ABSTRACTS

Özlem Önal Aşci Umut Ertürk Salantur A. Özge Şimşek Soysal	The effects of different nitrogen doses on hay yield and some quality properties in sorghum x sudan grass hybrid	2
Osman Serdar Ayşe Nur Aydin Abdullatif Ölçülü Taner Derman Işil Canan Çiçek Çimen Tuba Parlak Ak Ayşegül Pala Nuran Cikcikoğlu Yildirim	Determination of acute toxicity and biochemical parameters of chlorpyrifos (Cpf) pesticide active on Chlorella vulgaris	4
Osman Serdar Ayşe Nur Aydin Abdullatif Ölçülü Taner Derman Işil Canan Çiçek Çimen Tuba Parlak Ak Ayşegül Pala Nuran Cikcikoğlu Yildirim	Determination of acute toxicity and biochemical parameters of chlorpyrifos pesticide on navicula cryptocephala var. veneta	7
Timur Demir Ahmet Uluer Özkan Özbay Aylin Kocalmiş Nurten Özbey Gökhan Karakaya	Some physio-chemical properties of tohma stream (Malatya)	10
Kadir Kirk Tuğba Cebeci	The effects of semen collection frequency on spermatological characteristics and semen microbiology	13
Seda Arikan Fatma Akbay Zehra Korkmaz Tuğba Günaydin Eylül Nezahat Kizilyar Mustafa Kizilşimşek	The effect of cultivation of fodder peas with different ratios of barley and wheat on silage quality	15

Djellouli Amir Berredjem Yamina Hattab Zhour Guesmia Hadjer Mokhtar Mhenni Azri Naima Sara Ncibi	Employing reasonably priced bioadsorbents to remove pb aqueous waste	17
Djellouli Amir Berredjem Yamina Guesmia Hadjer Mokhtar Mhenni Azri Naima Sara Ncibi	The oasis of biskra in algeria ecological analysis and detection of an artificial wetland at the dam of foum el kherza	18
Djellouli Amir Berredjem Yamina Hattab Zhour Guesmia Hadjer Mokhtar Mhenni Azri Naima Sara Ncibi	The investigation of two saharan plants' phenolic compounds and their insecticidal potential	20
Mehmet Zeki Kocak	Comparison of fatty acid compositions of some türkiye and foreign registered flax (*Linum usitatissimum* L.) varieties	21
Ayush Madan	Beneficiary role of orchid-mycorrhiza association in plant growth	22
Erdem Gülersoy Canberk Balikçi Adem Şahan Ismail Günal	Evaluation of cardiac damage in calves with neonatal diarrhea caused by cryptosporidium with and without sepsis	23
Mücahit Yüngül Mustafa Dörücü Başar Altınterim Hacı Bayram Gökhan	A study on meat yield of capoeta sieboldii steindachner, 1864 in gölova dam lake (Sivas, Turkey)	25
Boughedir Nadia Bailiche Zohra	AG/SBA15 nanocatalysts for esterification of biodiesel as model vocs	27
Moussa Chergui Mohamed Titaouine Djalel Eddine Gherissi	Challenges of camel farming under climatic and socio-economic changes in el oued algerian arid region	28
Halim Topaldemir Beyhan Taş	Ethnobotanic macrophites which show year in yeşilirmak lower basin terme wetland	29
Monika Chaudhary Amar P. Garg Dilfuza Jabborova	Combinatorial effect of serendipita indica and azotobacter chroococcum on yeild of rice with respect to sustainable agriculture	31
Dilfuza Jabborova	Arbuscular mycorrhizal fungi and biochar improve growth and root morphological traits of fenugreek	32
Chikha Maria Khenenou Tarek Gherissi Djalel Eddine Sabry M. El-Bahr Anas Abu Sailik	Qualitativeand quantitative evaluation of camel milk production during the last stage of lactation	33

Mehmet Başak Çetin Mutlu Shahid Farooq	Habitat suitability of european wheat stem sawfly [Cephus pygmeus (L.) (Hymenoptera: Cephidae)]] under changing climate	34
Charif Rania Makhloufi Rachid	Synthesis and characterization of a mixed oxide ZNSB2O4	36
Nazmi Serhat Üstün Recep Onur Uzun	Mechanization opportunities and applications in tobacco harvest	37
Chorna Natalia	Power generation systems energy using renewable energy sources for agricultural facilities	39
Göknur Bayrak Yasemin Gedik	Cast and DGAT1 polymorphism in some sheep breeds reared in Eskisehir province	40
James. O.S. Banjo Oluwole S. Ajala Olufemi A. Adekunle	Proficiency needed by agricultural education lecturers in utilization of information communication technology for instructional purposes in tertiary institutions in south-west, Nigeria	42
Emine Yilmaz Emrah Kara Hüseyin Çeken	Evaluation of rural tourism potential with swot analyses: the case of Ordu	43
James. O.S. Banjo Olufemi A. Adekunle Oluwole S. Ajala	Work-Skills required in cassava production in agricultural education curriculum for students of colleges of education in south-west, Nigeria	45
Rana Choukri Mohamed Faize Maria Manuela Rigano Manuel Rodriguez-Concepcion Jaime F. Martinez-Garcia Michel Havaux Mourad Baghour	Intercropping of tomato with maize improved growth and drought tolerance in tomato plants	46
Yahye Omar Mohamud Murat Muştu	Functional response of coccidoxenoides perminutus girault (Hymenoptera: Encyrtidae) on planococcus ficus (Signoret) (Hemiptera: Pseudococcidae.	47
Hassane Abd-Dada Said Bouda Abdelmajid Haddioui	Euphorbia resinifera o. berg in Morocco: a potential melliferous, medicinal and forage plant to remedy climate change: contribution of molecular and morphometric markers for management of its genetic resources	48
Shahzad Hassan Riffat Asim Pasha Ghulam Murtaza	Experimental strength investigation of reinforced composite material with notches	49
Patrick Emeka Aba Ismaila Onuche, Odugbo Samuel Chukwuneke Udem	Ethylacetate leaf extract of pterocarpus milbreadii and its gc-ms profile	50
Salma Elamiri Soumia Aboul-Hrouz Younes Essmlali Achraf Chakir Mohamed Zahouily	Development, characterization and agronomic evaluation in the open field of new slow release fertilizer (SRF)	51
Olawale Ogunyinka I Olayinka Hopewell O	Developing the agroindustry in nigeria through efficient and effective embedded system & robotics (ESR) skill acquisition	52

Orhan Kandemir	Agriculture and rural development support institution contribution to agricultural production in kastamonu province: a regional analysis	53
Saida Id Ouaziz El Khomssi Mohammed	Study of the local and global stability of a bioeconomic model SECHJ	55
Houndji Pamphile	La question de L'acces des jeunes au foncier agricole dans le contexte de L'etalement de L'arrondissement de seme-podji au benin	56
Ayşe Atalay Çiğdem Özkan Kahraman Figen Yıldız	Research on the detection of fungal root and crown rot diseases in some indoor ornamental plants in Izmir province	57
Brakni Oumaima Kerboua Ziari Yasmina	Exploring the impact of diverse flow field architectures in fuel cells	59
Gaurav Kasar Pooja Rasal Aman Upaganlawar	Effect of lycopene alone and along with coenzyme-q10 in streptozotocin induced peripheral neuropathy: biochemical & behavioral study	60
Aishah H.O. Al Shehhi Gul Ahmed Jokhio	The environmental and economic impacts of the use of recycled asphalt during the preventive maintenance of roadways in the UAE	61
P. Sabari Grish	Management of rice sheath blight incited by rhizoctonia solani using trichoderma viride	62
Ayoub Chaoui Salaheddine Farsad Aboubakr Ben Hamou Mohamed Ezzahery Noureddine El Alem	Removal of cationic dye by an activated biochar derived from anaerobic digestion digestate: effect of pyrolysis temperature	63
Elif Şahin Suci Nuh Uğurlu	Current situation of grain warehouses in Konya province and evaluation of some properties	64
Alifiya Sulaiha Diah Ayu Setyowati Puja Ana Awahatillah Muhammad Sultan Mubarok	Values of thought k.h. abdurrahman wahid (Gus Dur) and its relevance to islamic business ethics	66
Medet Şimşek Serkan Şahan	Damages of pesticide on wheat plant	68
El Khatri Nabil Oulbi Sara Hadria Rachid	Assessing carbon sequestration, carbon footprint, and life cycle analysis in moroccan olive groves: towards sustainable olive oil production	70
Pooja Rasal Gaurav Kasar Aman Upaganlawar	Ameliorative effect of lycopene alone and in combination with co-enzyme q10 in streptozotocin-induced diabetic nephropathy in experimental rats	71
Ahmet Akçam Özge Can Niyaz	Determination of effective variables on pesticide use behaviors of pear producers: the case of Bursa province	72

Faiz Ibni Sabil Muhammad Sultan Mubarok Muhammad Taufiq Abadi	Definition and object of study of islamic economic philosophy	74
Vaishali Krishna	Strategising human capital: a way forward for sustainability	75
Darwin H Pangaribuan Muhammad Kamal M Syamsoel Hadi Rahim Muhammad N Sari Aulia	Growth response and yield of sweet corn (Zea mays saccharata sturt.) due to giving poc of moringa leaf and lamtoro leaf	76
Nur Syahrlinda Ain Jainudin Nur Atickah Raymond Casey Neville Philemon	Tangy cream made of wild plants	77
Muhammad Sultan Mubarok Siti Zulkaidah Al Hayu Lestari Isna Amaliya	Cooperatives as a solution to indonesia's populist economy	78
Kiki Arsi Wijayanti Muhammad Sultan Mubarok Muhammad Taufiq Abadi	Benefits, objectives and characteristics philosophy of islamic economics	79
Alivia Hendra Gusthyta Putri Nabila Antika Putri Muhammad Sultan Mubarok	Ibnu khaldun's economic philosophy theories	80
Danish Riaz Fayyaz Rasool Shagufta Andleeb Syed Makhdoom Hussain Shakeela Parveen Ali Hassan Amina Ayub Sana Aziz Mati Ullah	Partial phsio-chemical characterization and identification of microbial isolates strains from gut of major carp	81
Sara Shokrpoor Parisa Haghi Fatemeh Qasempoor	Histopathological observations on transmissible venereal tumor (TVT) in a dog	83
Sara Shokrpoor Hirad Samazis Mahya Jarideh	Histopathological observations on cutaneous masses in a dog	84
Arushi Jain	Investigating the synergistic nexus: animal agriculture as a catalyst for food security and nutritional excellence	85
Sabir Souddi Abdelhalim Tabit Ahmed Algouti Abdellah Algouti Hanane Toudamrini Said Moujane Imane Nafouri Abdelfattah Aboulfaraj Saloua Agli	New contributions of the structural analysis by photosatellites of the deposits of bou-azzer: mineralogical and petrostructural study, in relation with the host, anti atlas Morocco	86

Sami Ur Rehman Federica De Castro Paolo Marini Alessio Aprile Michele Benedetti Francesco Paolo Fanizzi	Earthworms-mediated modification of biochar facilitates heavy metals contaminated soil remediation	88
Shitu, S. Sanusi, S.B. Shitu, M. L. Hussaini, I.M. Anyakudo M.M.C.	Detection of aflatoxigenic fungi and level of aflatoxins contamination in stored millet grains sold in kaduna state, Nigeria	90
Mohamed Boullouz Mohammed Louay Metougi Ngonidzashe Chirinda	Assessing the impacts of various fertilizer formulas on bread wheat (Triticum aestivum) yield, crop growth, and greenhouse gas emissions in arid regions	91
Chike F Oguejiofor Obinna B Onyejekwe Onyinyechi I Onwuzurike	In vitro immobilizing and spermicidal effects of methanol leaf extract of Euphorbia hirta Linn. (Euphorbiaceae) on caprine spermatozoa	92
Terry Nzeakor Chukwunonso Obi Sandra Nzekwe Martin Omeje Efficience Aneru	Evaluation of the ethnoveterinary potential of picralima nitida (Apocynaceae) as an anthelmintic	93
Hanane Toudamrini Abdellah Algouti Ahmed Algouti Saber Souddi Agli Saloua Moujane Said Aboulfaraj Abdelfattah	Application of machine learning algorithms (extreme gradient boosting) for mapping groundwater potentiality; mejjat, marrakech, Morocco	94
Maria El Ouazzani Abdelmajid Haddioui Naaila Ouazzani Mustapha Afdali	Physicochemical characterization of olive mill wastewater from the traditional extraction system: a case study of central Morocco	95
Hafiz Qadeer Ahmed Adil Shahzad	The effect of modified dried vinasse (bromass) and fermented tomato pomace powder on the rumen development, growth performance, worm load, immune status, serum profile, and methane emission in growing claves	96
Nwobi L.G. Obidike R.I. Odo R.I. Mbegbu E.C. Nwagwu C.S., Okpala M.I. Okorie O.K. Aneru G.E.	Effect of hydroethanolic extract of phoenix dactylifera fruit (date palm) on hormonal profile and some biochemical changes in cyclosphosphamide-treated albino rats	98
Mohamad Nurul Azman Mohammad Taib Nurhidayatullaili Muhd Julkapli	Conversion and mechanism of agricultural-based cellulosic materials into highly potential multifunctional nano dimension materials	100

Ferag Aziza Gherissi Djallel Eddine Khenenou Tarek Boughanem Amel Hadj Moussa Hafida Maamour Amina	Insights and implications of using temperature and humidity index to predict the success of artificial insemination in cows	101
Shraddha Bhattacharjee Jayanta Kumar Das	Understanding the perception of farmers on climate change	103
Vikranti Patel Kapila Manoj	Effect of spirulina powder incorporated with vegetable waste on the weight of IMC fish	104
Bello, R.M. Shuaeeb, A. I. Ndatsu, A. Masalachi, U.M. Koroka, M. U. S.	Perception of peer-tutoring pedagogical approach among undergraduate students of federal university of technology, minna	105
Hina Moin Rana Hadi	An assessment of microplastic accumulation in offshore fishes from karachi, Pakistan	106
Rana Hadi Hina Moin Sayyeda Ghufrana Nadeem	Microplastics abundance and composition in sediments of clifton beach karachi, Pakistan	107
Diwakar Kumar Singh	HMGB1 Is a serological conserved protein among the parasites	108
Nishanthi V S Badal Kumar Mandal	Evaluation of toxic heavy metal ions in environmental samples by differential pulse voltammetry	109
Baiju Thomas	Exploring the impacts of climate change on farming and adaptation strategies involved in modern farming systems	110
Kave Koorehpaz	Positive aspects of sildenafil citrate on reproductive organ of male dogs with subfertility	111
Silpa Sunil Badal Kumar Mandal	Facile and cost-effective synthesise of fluorescent carbon dots doped graphitic carbon nitride for the detection of Fe3+	112
Lawal, W.S, Olayiwola, S.A. Olorundare, T.M	Organoleptic characteristics of herbal preservation of tiger nut drink (kunu ayaya) using adasonia digitata, tamarind, tumeric, pakia biglobasa and *Moringa olifera*	113
Khanza Monica Salsabila Ana Kadarningsih Michelle Rosa Pertiwi	Good corporate governance as a profit-increasing driver for pharmaceutical companies	114
Restu Pratiwi Kinasih Ana Kadarningsih Luluk Tri Rahayu	Company growth and total assets to improve company performance in Indonesia	116
J.M. Kamali A. Vanmathi K. Devadharshini G. Kalaignazhal M.V. Silpa V. Sejian	Techniques for measuring enteric methane emission in ruminants	118

Wilson, Emmanuel Okon	Phytochemical analysis of various parts of avocado plant (persea americana) for corosion inhibitor and lubricant suitability	120
Amir Hossein Khoshakhlagh Saeed Yazdanirad Safiye Ghobakhloo	Validity of the empirical heat stress indices in predicting the heat strain of outdoor occupations	121
Eka Febrianti Zaidan Zulfa Athallah Muhammad Sultan Mubarok	The concept of ownership in Islam	122
Kalbiye Konanç	The evaluation of the biological activities of the plant of john's wort (*Hypericum* sp.) in poultry nutrition	123
Karimatuzzain Kiki Arsi Wijayanti Muhammad Sultan Mubarok Muhammad Taufiq Abadi	Ontology ethics and deontology ethics	125
Cengiz Türkay Cenap Yilmaz	Alternative and strategic plant: prickly figs	127
Fahrani Nisrina Habibati Budiatman Satiawihardja Nugraha Edhi Suyatma	Effect of temperature and extraction time on pectin production from edamame soybean pods	129
Vignesh K Lokesh R Sathiya Aravindan V Manikandan K Sabari Grish P	Collection and conservation methods of vegetable crops	130
Rajendra Prasad Vivek Kumar Vipul Kumar	Can azo-food dye metabolites interfere with dopaminergic pathways in CNS causing ADHD: A molecular structural investigation	133
Emya Yusri Angga Sinulingga Dwi Yuni Hastati	Effect of milk on the organoleptic characteristics of *Garcinia mangostana* L. Velva	134
Lulut Alfaris Ruben Cornelius Siagian Aldi Cahya Muhammad Ukta Indra Nyuswantoro Nazish Laeiq Froilan Delute Mobo	Classification of spiral and non-spiral galaxies using decision tree analysis and random forest model: a study on the zoo galaxy dataset	135
Ömer Faruk Keleş	Complications caused by incorrect injection in sheep	137
Muhammad Faisal	A study by dr faisal that rising of jobless young people in Pakistan	139
Sruba Saha Amitava Paul Sanjay J. Jambhulkar	Induced polygenic variability on M2 and M3 generation of sesame (*Sesamum indicum* L.)	141
Serap Öründü Zekai Tarakçi	Determination of the properties of edible films produced from different fruits	142
K.R. Padma K.R. Don	Omicron variant progression and its therapy: unpredictable outbreak	144

Ayesha Batool Farkhanda Anjum	Eating style of female students and its effect on their health	145
Piyush Bachhav Rutuja Nikam Ganesh Sonawane	Rp- Hplc method deveopment and validation for estimation of linezolid in bulk drug and dosage form	146
Maryam Saddiq	Precipitation of asphaltenes from crude oil emulsion	147
Sanaz Alamdari Ahmad Farhad Talebi Arefe Abasian Aida Haji Taheri Mehrnaz Dadwar Nastaran Farhabod	Green synthesize of zink oxide nanoparticles using ferula extract	148
Sunday Samuel Olanrewaju	Effects of solar and wind energy systems on academic performance of students in higher institutions of learning	150
Arshia Zia	Application of proline as pre-sowing seed treatment on okra under water deficit conditions	151
M. Fauzi	The impact of unempolyment on the national economy in Indonesia	152
Thorat Jayashri Sanjay	Instability in food security leads to environmental degradation - a review	153
Sarra Zouaoui Rachid Rouabhi Ilhem Djaalali	The pharmacological potential of medicinal plants: phytochemical analysis, antibacterial investigations, and antioxidant activity assessment in *Melissa officinalis* L.	154
Ukoha, J. C. I., Kalu, U. Anyanwu, E. V.	Perceived effect of soil erosion on arable crop production in abia state, Nigeria	155
Abdul Hameed Soomro Aftab Ahmed Khuhro Muhammad Ashir Khalil Chandio Muhammad Ashraf	Techno-economic analysis of hydrogen fuel cell technology for electric vehicles	156
Aftab Ahmed Khuhro Abdul Hameed Soomro	Investigating sustainable development through responsible innovation and infrastructure in agriculture and water treatment	157
Faqeer Muhammad Muhammad Ashan Hafiz Badaruddin Ahmad	Exploring the production and analysis of hybrid halide perovskites with halogen substitution	158
M Barka Outbakat Redouane Choukr-Allah Mohamed El Gharous Aziz Soulaimani Khalil El Mejahed Kamal El Omari	Does phosphogypsum application affect salts, nutrients, and trace elements displacement from saline soils?	159
Eze, C.P., Obi, C.F., Idika, I.K., Nwosu, C.O.	Toxicity and anti-coccidial effect of aqueous sacoglottis gabonensis (*Magnoliophyta*, *Humiriaceae*) stem bark extract in broiler birds experimentally infected with mixed eimeria species	160

Syed Mohsan Raza Shah Mansoor Hameed Muhammad Sajid Aqeel Ahmad Farooq Ahmad Sana Fatima Sana Basharat Ansa Asghar Jazab Shafqat	Key determinants of invasiveness in ipomoea *Carnea jacq*. to climatic shift along altitudinal gradient	161
Nnenna T. Emejuo Jacinta N. Omeke Remigius. I. Onoja Shodeinde V.O. Shoyinka Arinzechukwu S. Ezema Amaechi L. Ogara Stella N. Ugwoke	Alterations in haematology following administration of chromolaena odorata extract in rats with experimental benign prostatic hyperplasia	162
Umar Bilal Ibrahim Imrana Bello Sada Mujitafa Salisu Aminu	Evaluation of some parameters and determination of sulphate in industrial effluents	164
Gülru Yücel Natalia Borowska-Żuchowska Maciej Bisaga Hab. Bozena Kolano	Chromosomal organization of satellite sequences in crepis	165
Sawera Tariq Syed Mohsan Raza Shah	Assessment of morpho-anatomical characteristics of *Panicum antidotale* retz. from punjab, Pakistan	166
Mine Aydin Kurç	Phaeohyphomycosis caused by *Aureobasidium pullulans* in a cat diagnosed as malign mesenchimal tumor	167
Gaurav Ranjan Srijani Dasgupta	A review on tinospora cordifolia- a magical bullet for neurodegenerative diseases	169
Salisu Nuhu	Optimization of quicklime production from eggshell using response surface methodology	170
Muhammad Safdar	Unveiling adaptive components for environmental heterogeneity in ipomoea carnea jacq	171
Elena Sierikova Serhii Saltevskyi	The dead animals impact on the environment	172
Imoisi, C. Okhale, S.E. Egharevba, H.O.	Gas chromatography-mass spectrometry (Gc-Ms) analysis of the essential oil from nigerian *Artemisia annua L*. at different growth stages	174
Imoisi, C. Okhale, S.E.	Characterization of the volatile bioactive compounds in ethylacetate leaf extract of *Annona muricata* linn	175
Imoisi, C. Okhale, S.E. Josiah, J.G.	In-Vitro evaluation of eucalyptus citriodora leaf essential oil and extracts on selected pathogens implicated in respiratory tract infections	176
Emre Turan Atilla Şimşek	Black garlic: production, properties and food applications	177
Erol Yücel Haktan Birsel	Agricultural intelligence decision support model with visual analytics: creation of sustainable agriculture and agricultural intelligence in Turkey	179

Sonali Kumari Abha Mishra	Molecular docking and molecular dynamic simulation studies of plant-based compounds for potential inhibition of alpha-amylase protein	181
Mustafa Özyücel	The examination of the impact of growth expectations on rural supports in Turkey using the todo-yamamoto method	182
Arigbo, Precious Obinna Chukwu, Chinonso Wilfred	Knowledge and resilience of rural households to covid-19 pandemic in nkanu east, enugu state, Nigeria	184
Ali İslam Salih Çolak	Rootstock selection in Turkish hazelnut (*Corylus colurna* L.) populations in Kastamonu	185
Syeda Sabika Zahra Naqvi Syed Mohsan Raza Shah Farah Bukhari	Morpho-anatomical modification in *Withania somnifera* (L.) dunal from the punjab, Pakistan: insights into adaptation	187
Fatih Öner Ferda Özkorkmaz	Determination of the effect of sweet corn (*Zea mays* L. Saccharata) and bean (*Phaseolus vulgaris* L.) intercropping system on the agronomic characteristics of sweet corn	188
Jasmina Najdovska Katerina Drogreshka Ljubcho Jovanov	Comparative analysis of the macroseismic effects of two earthquakes from the same source. case study for skopje epicentral area	190
Abdoul Nasser Aboubacar Dan Badaou Üstün Şahin	Changes in stomatal conductivity in silage maize under different irrigation regimes in organic fertilized soil	191
Aisha Nawaz Syed Mohsan Raza Shah	Elucidating morpho-anatomical adaptations in *Achyranthes aspera* L. From Punjab, Pakistan	192
Selim Karagöl Ali İslam	Effects of rehabilitation on production and quality in tombul hazelnuts	193
Ali İslam Ali Turan Muharrem Yilmaz Sezgin Ayan Selim Karagöl Salih Çolak	Determination of rooting ratio of turkish hazelnut (*Corylus colurna* L.) genotypes selected from tosya	195
Muhammad Saqib Wafa Majeed Usman Haider Muhammad Saad Tariq Mahnoor Jamil Alishbah Roobi Wania Nasir Najeeb Ullah Khan Jawad Aslam Noreen Aslam Muhammad Naeem Faisal	Exposure and risk of development of metabolic dysfunction in a population consuming heavy metal-contaminated milk	197
Ramin Aslani Saeideh Esmaeili Ebrahim Molaee-Aghaee Mohamad Esmaeil Akbari Parisa Sadighara Shahrokh Nazmara	Determination of heavy metals in bottled water collected from market in Tehran, Iran: a health risk assessment	199

Ibrahim Şahin Inan Dursun Nevzat Çağlayan Abdurrahman Şimşek Nevzat Esim	Comparison of the biological activities of honey obtained from four different (*Apis mellifera* L.) honey bee genotypes under Bingol conditions	201
Nacima Deghiche-Diab Marco Alberto Bologna Tesnim Deghiche Hassan Boukerker	An updated checklist of *Meloidae mylabrini* (*Coleoptera*) and host plants in a saharan oasis ecosystem in Algeria	204
Çağlar Okulmuş	Importance of metabolic profile testing in dairy farming	205
Umama Mehmood Syed Mohsan Raza Shah Muqds Bukhari	Exploring novel morpho-anatomical traits in convolvulus arvensis from the punjab, Pakistan	207
Fatih Arslan	Impacts of viral pandemics	208
Kemajl Kurteshi Muharrem Ismaili	Microbiological estimation of water of lake përlepnica, during spring season 2018	210
Joy, O., Olayiwola Ojo, J., Adaramola	Detection of maize disease using deep learning models	211
Karim Houmanat Jamal Charafi Hakim Outghouliast	Study of the adaptation potential of the pomegranate cultivar (sefri) with three different bioclimatic stages	212
Abdurrahman Takcı Mehmet Buğra Kıvrak	Determination of the effectiveness of different postpartum applications on reproduction in cows	213
Naila Tamamil Asna Diah Ayu Setyowati Zaskia Fani Muszaki Muhammad Sultan Mubarok	Islamic economic philosophy focus: islamic economic trilogy	215
Minkhatul Maula Serlinda Ane Yulaicha Muhammad Sultan Mubarok	Online buying and selling transactions in an islamic perspective (case study mh skin whitening)	217
Siti Nurlela Tri Murtia Ningrum Muhammad Sultan Mubarok Dwi Eti Widiana	Economics and philosophy of criticism: a case study about the division of mattress production in kedondong village, sidoarjo district	218
Sevim Budak Hülya Küçük Bayraktar	An investigation of the role of women's cooperatives in rural development through ayyildiz women's cooperative	219
Mehmet Akif Karagöl Zekai Tarakçi	Investigation of the effect of persimmon powder obtained by different drying methods on the physicochemical and sensory properties of ice cream	221
Muhammad Irfan Rishmail Saleem Bilal Shoukat Hammad Hussain Shazia Shukrullah Muhammad Yasin Naz Saifur Rahman Abdulnour Ali Jazem Ghanim Grzegorz Nawalany Tomasz Jakubowski	Production of combustible fuels and carbon nanotubes from plastic wastes using an in-situ catalytic microwave pyrolysis process	223

Intan Parwati Irkhamna Oktavia Pipit Fitriani Muhammad Sultan Mubarok	K.H. abdurrahman wahid (gus dur): islam and people's economy (case study: wadas residents receive land acquisition, compensation payments reach 92 percent	224
Cassandra González Kalpana Nanjareddy Manojkumar Arthikala	Role of nin-like protein down-regulation in regulating nodule formation and development in common bean	226
Levent Taşeri Ersin Karacabey Gamze Uysal Seçkin Taha Ahmet Güngör	Drying kinetics and quality analysis of aronia dried in an solar dryer	227
Kalsoom Yasin Saleem Abbas	Work related stress, burnout, job satisfaction and subjective happiness among employees working in textile industry	229
Umut Ateş	Comparıson of the quality characteristics of fresh and dried white mulberry (*Morus alba* L.)	230
Mallikarjunamallu K Syed Khasim	Ablation methods for preventing atrial fibrillation: a review	232
İlker Şen Tunahan Sancak	Application of M.I.P.O technique in metacarpus fractures in kangal sheep	233
Vidya Padmakumar Murugan Shanthakumar	The philippine eagle: a majestic but endangered raptor	235
Mehmet Akif Karagöl Merve Emine Dirik Tahsin Tonkaz Sümeyye Şahin	Determination of the chemical content of waste seeds and seed oils of some fruits used in the food industry	236
Jimena J. Hurtado Cassandra González Kalpana Nanjareddy Lourdes Blanco Miguel Lara Manojkumar Arthikala	Comprehensive analysis of Phaseolus vulgaris cyc gene family and their expression during rhizovial symbiosis	238
Aykut Zerek	A research on the attitudes and behaviors of beekeepers regarding the methods of protection from disease and pests in beekeeping enterprises facilities in Hatay province	239
Avishek Bardhan Thangapalam Jawahar Abraham Tapas Kumar Sar Ravindran Rajisha Edaparambil Krishnappan Nanitha Krishna Satyen Kumar Panda Prasanna Kumar Patil	Plasma and bile pharmacokinetics and tissue distribution of florfenicol in *Oreochromis niloticus* (L.) post singular oral gavage	241
Sümeyye Şahin Melike İnal	Determination of the quality characteristics of some bewaxes	243
Vikas Saini Jyoti Sinha Vinod Kumar	Soaring the concentration of bioactive phytochemicals via agro-techniques in medicinal plants of haryana	245
Ahmad Alsaleh	Investigating molybdenum variation in durum wheat: integrating chemical and genetic analysis through gwas	246

Maria Taj Muhammad Nasir Uddin Khan	Clean and green environment by using agricultural waste with better cleaning properties than synthetic ones	247
Olajide Oluwamayowa Opeyimika Olayemi Michael Sunday	A survey of the challenges and strategies to create wealth from waste management practises in Nigeria	248
Fariba Sharifian	Horse motif on sassanian seals	249
Musa, Fatima M Umar Fatima Jummai Muhammad Jamila	Analysis of bacterial contaminants in locally fermented cow milk product sold in kaduna, Nigeria	250
Musa, Fatima M Umar Fatima Jummai Muhammad Jamila	Antibacterial sensitivity of pathogens isolated from locally fermented cow milk product sold within kaduna, Nigeria to common antibiotics	251
Hüseyin Özpinar Ergül Ay Hülya Okkaoğlu Melek Akça Pelen	Aegean region forage crops variety development studies (1967-2023)	252
Jusmawati Nurul Azhari Nabiilah Muhammad Sultan Mubarok Muhammad Taufiq Abadi	Makna keadilan dalam bisnis	254
Ben Ali Anis Chouikh Atef Haddad Larbi Ben Ali Rayan	Assessing the therapeutic and preventive potential of cyperus rotundus in various diseases	255
Bülent Akar Hatice Gül Ateş	Green alga chlorella and use as food	256
Bahia Messai Rachid Makhloufi Aymen Benmakhlouf	Impedance spectroscopy and dielectric properties of pzt-based ceramics	258
İsmail Oğuz Özdemir	Determination of species parasitizing naturally-laid eggs of *Palomena prasina* L. (*Hemiptera: Pentatomidae*) in the west black sea hazelnut orchards of Turkey	259
Ishpreet Singh Chouhan Navrajanbir Singh Kalsi	Fabrication of electrical energy generation device using the concept of triboelectric charging	261
Selahattin Aygün Damla Bender Özenç	The effects of hazelnut husk and biochar and their extractions on bread wheat development	262
Khammar Farida Handel Naoual	Modélisation d'une cellule photovoltaïque multi jonction	264
Gamze Kor Şimşek Filiz İçier	Energetic, exergetic and exergo-economic analyses of whole milk production in carton aceptic package	265
Rania Remmani Malek Miladi Rachid Makhloufi Antonio Ruiz Canales	Assessment of locally sourced illite/kaolinite clay as an eco-friendly adsorbent for remediation of petroleum hydrocarbon-contaminated groundwater	266

Mohammed Mohammed Sulaiman Ebrahim	A study on the financial awareness among among undergraduate students in hodeida province in Yemen	268
Mónika Fekete Bálint Madarász Judit Forrai Zoltán Ungvári János Tamás Varga	Chronic respiratory diseases: can diet or vitamin-antioxidant supplementation help?	269
K. Meriç Uğurlutepe Hüseyin Sauk	Ergonomic analysis of tomato harvesting in greenhouse agriculture	271
Mansi Pawar Tushar Nikam Ganesh Sonawane	Animal science: a review	273
Beyza Nur Yıldız Nuray Çömlekçioğlu Büşra Yapıcı Ezgi Gürsoy Ş. Şebnem Ellialtıoğlu	The effects of in vitro colchicine applications on embryo frequency in anther culture	274
Gréta Törős József Prokisch Ferenc Peles	Optimization of unique media production for enhanced bioactivity of *Pleurotus ostreatus mycelia*	276
Rutuja Nikam Piyush Bachhav Ganesh Sonawane	Cruelty to animals: a review	277
Malik Ergin Rabia Albayrak Delialioğlu Yasin Altay Özgür Koşkan	Bibliometric analysis of lactation curves in livestock	278
Armaelis Arfani Elsa Nadiya Febriyani Muhammad Sultan Mubarok	Strategi kota pekalongan dalam pengembangan pariwisata kreatif berbasis industri batik	280
Saiqa Andleeb Summaya Yahya Abdul-Hameed Khan	Efficacy of vermi-compost on seed germination and seedling growth parameters of wheat (*Triticum aestivum* L.)	281
Kemajl Kurteshi Ilmije Vllasaku	Investigation of genotoxic effect of insecticide chromagor at fish goldfish (Carassius auratus), after 14 days of treatment	282
Charif Rania Sriti Fatima Zohra	Synthesis and characterization of a K2NIF4 structural material	283

FULL TEXTS

Gülcan Kaymak Bayram Utku Tunali Zeki Acar İlknur Ayan	Determination of forage yıeld and some morphological characteristics of some cowpea genotypes (Vigna unguiculata (L.) Walp) growed in Samsun ecological conditions	285
Mehmet Can Gülcan Kaymak Bayram Özlem Önal Aşcı İlknur Ayan Zeki Acar	Determination of the quality and nutritional content of some cowpea genotypes (Vigna unguiculata (L.) Walp) growed in Samsun ecological conditions	296

Andaç Kutay Saka	Characterization and determination of fruit traits of some local tomato landraces	312
Beyza Kübra Uluırmak Rahmi Doğan Irem Demirci Mesut Sirri Gülten Yazici Neslihan Bal	Curculonidae and pentatomidae family species with pistachio pests in Türkiye	336
Rahmi Doğan Irem Demirci Beyza Kübra Uluirmak Mesut Sirri Gülten Yazici Neslihan Bal	Canola pest curculonidae and pentatomidae familia species in Türkiye	345
Irem Demirci Beyza Kübra Uluirmak Rahmi Doğan Mesut Sirri Gülten Yazici Neslihan Bal	Hazelnut pest curculionidae and pentatomidae familia species in Türkiye	355
Özbay Dede Esra Tatar	Effect of different doses of potassium and phosphorus on potato's (Solanum tuberosum L.) quality, yield and yield parameters	377
Ayşe Nur Aydin Osman Serdar	Determination of acethylchinesterase activity of lambda cyhalothrin pesticide in zebra mussel (Dreissena polymorpha), which is a non-target organism	388
Ayşe Nur Aydin Osman Serdar	Determınatıon of acetylholınesterase activity of cerium in dreissena polymorpha non-target organisms	396
Fatma Akbay Seda Arıkan Mustafa Kızılşimşek	Usage of lactic acid bacteria inoculant in silages	406
Kamaladine Mahamat Djıbrıne Ramazan Topak	Chad's agriculture and water resources potential: the case study	418
Caner Yerli Talip Cakmakci Ustun Sahin	Water footprint of silage maize (Zea mays. L.) as a forage crop in Van province (Turkey)	440
Gözde Hafize Yildirim Nuri Yilmaz Yusuf Şavşatli	Effect of dicalcium phosphate application on some germination parameters in oat (Avena sativa L.) seeds under drought stress conditions	453
Gözde Hafize Yildirim Nuri Yilmaz Yusuf Şavşatli	Determination of the effects of 2,4-dichlorophenoxyacetic acid containing herbicide applications and dicalcium phosphate, on some germination parameters of triticale (X Triticosecale Wittmack) seeds	467
Olubukola Olayemi Olusola-Makinde	Assessment of haemolytic activities of bacterial isolates from a municipal abattoir wastewater effluents and receiving water milieu	477
Gökhan Gökçe Mervan Bayraktar	Effect of body condition score on colostrum quality and some milk components	486
Mervan Bayraktar Gökhan Gökçe	Teat end condition and somatic cell count	497
Kadir Saltalı	A new model in agriculture; micro-catchment based integrated production model- virtual land consolidation	507

Yusuf Kizilkan	Ordu province according to socio-economic development index in geographical terms	516
Olcay Filiz Engin Takil Nihal Kayan	The effect of plant growth promoting rhizobacterıa and phosphorus applications on morphological characteristics of beans (Phaseolus vulgarıs L.)	537
Gizem Öztürk Cengiz Yücedağ Nuray Çiçek	Propagation and cultivation of Lavandula officinalis L. species	548
Gizem Öztürk Cengiz Yücedağ Nuray Çiçek	Use of lavandula species in landscaping	565
Mazlum Erol Cengiz Yücedağ Nuray Çiçek	The role of urban green areas to mitigate air pollution in cities	573
Mazlum Erol Cengiz Yücedağ Nuray Çiçek	Biomonitoring of traffic-related heavy metal pollution through woody landscape plants	595
Ayşe Evci Ayşegül Bulut Mehmet Burak Ateş Nermin Işık Uslu	A case of coenurus cerebralis, oestrus ovis, cysticercus tenuicollis and coccidosis in a sheep	618
Gül Binboğa Nevin Demirbaş	Developments in the grain milling industry in türkiye in the last decade: problems and suggestions	632
Gül Binboğa Nevin Demirbaş	Establishment location proposal for a medium-scale compound feed business in türkiye according to certain criteria	649
Nguyen Thi Hang	Developing business operations of enterprises in the green economy	660
Nuray Güzeler Elif Kiliç	Tradıtıonal cheese produced from goat milk	671
Mustafa Demirkaya	The effects of osmotic conditioning and humidification treatments on seed germination of carrot seeds	685
C.Vijai Worakamol Wisetsri M.Elayaraja	Environmental and health impacts of air pollution: a review	691
Esra Gürsoy Behlül Sevim Tugay Ayaşan	Possibilities of using sumac in animal nutrition	702
Asli Aslan Hacer Tüfekci	Parameters used in the evaluation of animal welfare in sheep and goat farms	715
Hilal Tozlu Çelik Hacer Tüfekci	Early breeding use and application of body condition scoring in detection of nutritional deficiencies in small ruminants	723
Işil Özdemir Reyhan Bağdat Bahtiyarca Cenk Yücel	Investigation of beneficial and harmful insect relationship by developing intercropping systems with camelina in central anatolia ecological conditions	737
C.Vijai, M.S.R. Mariyappan M.Elayaraja	Emerging trends in agriculture: benefits and challenges	747

Matanat Aliyeva Aziz	Agriculture, livestock and rural development project of the turkic world and components of the 4th industrial revolution	759
Füsun Gülser Siyami Karaca Bulut Sarğın	Soil parent material and plant nutrients: exploring the linkages	778
Mehmet Altun Ustun Sahin	The effect of different irrigation practices on stomatal conductivity in silage maize grown in soil amended with stabilized wastewater sludge	788
Hasan Kuraloğlu Serap Kulaç Halil Ünal	Operating parameters in milking robots with forced cow traffic	801
Ibrahim D.G. Bashir M.B. Sabo E. Garba M.S.	Factors influencing farmer-herder conflict in ardo-kola and lau local government areas of taraba state, Nigeria	820
Gamze Kaya	Variation in stomatal density and distribution on leaves of different radish cultivars	831
Emine Nakilcioğlu	Nutritional properties of sea cucumber and its potential effects on human health	841
Hamit ISMAILI Kemajl KURTESHI	Estimation of Genotoxic Effect Of Herbicid Randap 480 EC at Goldfish (*Carassius auratus*) Through Micronucleus Test and Nucleoplasmic Bridges After 10 Day Treatment	848
Rasheed Olatunde Ajetunmobi Benjamin Ogbomena Omorojor Gabriel Semako Hojapoji	Navigating the evolving landscape: exploring emerging trends and challenges in data center security	855
Bashir, M.B Ndaghu, A.A Anonguku, I Sani, U.M	Management practices of cattle diseases and parasites among pastoralists in north-east, Nigeria	865
Stanislava Stateva	Possibilities for controlled storage and propagation in medicinal plant species	885
Ezgi Edebali Murat Emre Terzioğlu İhsan Bakırcı	Food safety and haccp applications in ice cream production	895
Büşra Turan Murat Emre Terzioğlu İhsan Bakirci	Dioxin in milk and dairy products	904
Sri Padma Kanta Mishra Deepak Bansal	Economics Of oil prices and dynamic relationship with exchange rates and stock markets under uncertainty: a literature review	914
Fatih Ahmet Aslan Hilal Tozlu Çelik	Methods and current advances in estrus synchronization of sheep and goats	922
Şükran Öztürk Öznur Ergen Akçin	Anatomical characteristics of Alchemilla sericata rchb., species, distributed in the eastern black sea region	956
Mahmut Kaplan Idris Yildiz	Determination of herbage yield, yield characteristics and silage quality of different silage sorghum genotypes	966
Ihsan Serkan Varol Ali Ünlükara Mahmut Kaplan	Changes in phenolic and antioxidant activity in alfalfa cultivars grown under different irrigation levels	974
Şeyda Çavuşoğlu Sercan Düzgün	The importance of respiration after harvest in climacteric fruit species	982

Şeyda Çavuşoğlu Fırat İşlek Nurettin Yılmaz	Effective practices and storage performance in the preservation of some minimally processed vegetable types	991
Gözde Kilinç Arda Onur Özkök	Use of phytobiotics to improve reproductive performance of poultry	1002
Erdem Gülümser Uğur Başaran Medine Çopur Doğrusöz Hanife Mut	Forage quality of yellow sweet clover (Melilotus officinalis (L.) Lamb.) genotypes in the natural flora of Bilecik province	1013
Hanife Mut Erdem Gülümser Uğur Başaran Medine Çopur Doğrusöz	Forage quality of chicory (Cichorium intybus L.) genotypes in the natural flora of Bilecik province	1026
Emre Turan Atilla Şimşek Mehmet Çavuş	Determination of antioxidant and antimicrobial activity of green coffee extract rich in chlorogenic acid	1038
Nurhan Keskin Şeyda Çavuşoğlu Sıddık Keskin	Determination of antioxidant capacity of some native grape varieties with two different methods	1054
Nurhan Keskin Şeyda Çavuşoğlu Sıddık Keskin	Total phenolic compound and flavonoid content of batman (Gercüş) native grape varieties	1062
Şeyda Çavuşoğlu Nurhan Keskin Sıddık Keskin	Categorical principal components analysis in post-harvest 1-mcp treated tomatoes I: relationships between storage and some quality traits	1070
Şeyda Çavuşoğlu Nurhan Keskin Sıddık Keskin	Categorical principal components analysis in post-harvest 1-MCP treated tomatoes II: relationships between storage and total phenolic compound, antioxidant capacity, and enzyme	1080
Mahmut Kaplan Kağan Kökten Selim Özdemir	Determination of feed quality parameters of grains of some grass pea (Lathyrus sativus L.) gynotypes	1090
Doğan Arslan Aynur Bilmez Özçınar	The composition and uses of mahlep (Prunus mahaleb L.)	1099
İlknur Eskimez Kerem Mertoğlu Mehmet Polat Deniz Gülkaya Arıtürk Melekber Sülüşoğlu Durul	Adaptation of two different apple genotypes to Isparta ecological conditions for our country	1107
Melekber Sülüşoğlu Durul Mehmet Polat Kerem Mertoğlu	Minor fruits and their importance in fruit growing	1117
Sema Kaplan Hasan Kale	Short-TERM effects of organic fertilizer supported with different doses combination of microbial and inorganic fertilizers on some soil properties	1124
Mehmet Akif Kalender Ramazan Topak	Agriculture and water potential of Konya closed basin	1132
Mehmet Akif Kalender Elif Şahin Suci	Irrigation water requirement and supply ratio in karaman plain irrigation association	1148
Cemile Ebru Onursal Mehmet Özdemir Derya Erbaş Mehmet Ali Koyuncu	Quality changes in shelf life conditions of purple passion fruit harvested at different maturity stages	1161

Elif Korkmaz Nuray Çiçek Cengiz Yücedağ	Evaluation of seaweed as organic fertilizer in plant production	1172
Elif Şahin Suci Mehmet Akif Kalender	Agricultural product warehouses and licensed warehousing: the case of Konya	1180
Sebiha Erol Emine Budakli Çarpici	The effect of salt stress in some sweet sorghum [Sorghum Bicolor Var. Saccharatum (L.) Mohlenbr.] varieties on germination characters	1194
Emine Rengin İleri Sinem Öztürk Erdem Merve Karakoyun	The effect of different primining applications and treated waste water concentrations on the germany of jujuba (Ziziphus jujuba Mill.) seeds	1208
Fereshteh Rezaei	Effects of seed priming on germination and seedling growth of buckwheat (Fagopyrum esculentum Moench.) cultivars	1219
Gamze Tarim Üzeyir Kement Mehmet Kabacik Faruk Yüksel	Local gastronomy cultural analysis: the case of ikizce	1230
Gülşah Çalik Koç Gözde Kubat	Effect of three different doses of liquid vermicompost on saffron (Crocus sativus L.) flower parts	1252
Serkan ÇELIK Faruk Akyazi	Incidence and population densty of plant parasitic nematodes associated with cut flowers in greenhouses in Yalova province, Turkiye	1264
Kanber Kara	Comparison of linoleic, alpha linolenic and epa+dha fatty acids in dried and canned types of different class dog food with nrc-2006 and fediaf-2021	1275
Kanber Kara	Comparison of macro and micro mineral contents of premium class dog foods with different protein contents	1282
Mustafa Yildirim Bengü Everest	The role of women's cooperatives in rural development: the case of Çanakkale	1288
Özbay Dede Rasim Kavalci	Determination of the effects of different potassium doses on yield and quality parameters of some potato (Solanum tuberosum L.) varieties	1300
Sena Meriç Rezzan Kasim M.Ufuk Kasim	Usage of sistein in prevention of enzymatic browning in fresh-cut fruit and vegetables	1311
Muhammet Gölcü Sevgi Yilmaz	Analysis of the outdoor thermal comfort impact of different water forms in urban spaces using envi-met: Erzurum city center	1322
Seyit Ahmet Gökmen Yusuf Cufadar Barişcan Curabay	The effect of phytobiotic and probiotic addition to barley based laying hens diets on performance and egg quality traits	1331
Nuray Çiçek Cengiz Yücedağ Hasan Uçak	Alleviating effect of silicon on abiotic and biotic stress factors	1346
Yusuf Güvenaltin Rezzan Kasim M.Ufuk Kasim	Optimization of led lighting systems used in indoor plant production systems in different plants	1354
Hülya Sipahi	Bioinformatic Analyses of Osca Gene Family in Opium Poppy	1382

Ogunyinka Margaret Abimbola Ogunyinka Olawale Ige	Waste to Wealth: A Pattern Shift In Waste Management For Developing Nations	1395
Muhammet Gölcü Sevgi Yilmaz	Kentsel Mekanlarda Farkli Yeşil Alan Oranlarinin Diş Mekân Termal Konfora Etkisinin Envi-Met İle Analizi: Atatürk Üniversitesi Lojmanlari	1410
Devran Coşkun	Non-Mucokinetic Effects of Ambroxol	1422
Gülşah Bengisu	A Review: Maize (Zea mays L.) Silage	1435
Abdoul Nasser Aboubacar Dan Badaou Üstün Şahin	Changes in stomatal conductivity in silage maize under different irrigation regimes in organic fertilized soil	1446
Nilay Kayin Serap Kizil Aydemir	Determination of photoxicity effect of some herbicides used in different doses on variety of common vetch	1455

ABSTRACTS

FARKLI AZOT DOZLARININ SORGUM x SUDAN OTU MELEZİNDE OT VERİMİ VE BAZI KALİTE ÖZELLİKLERİNE ETKİLERİ

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ÖZET

Amaç: Doğu Karadeniz Bölgesi sahil bölgesi ekolojik koşullarında farklı azot dozlarının Sorgum x Sudan Otu (Sorghum bicolor (L.) Moench x Sorghum sudanense (Piper) Stapf) melezinde ot verimi ve kalitesine etkisinin belirlemek amacıyla yürütülmüştür. **Materyal ve Yöntem:** Araştırma, 2021 ve 2022 yıllarında Giresun-Espiye ekolojik koşullarında kurulmuş ancak sadece 2021 yılında veri alınabilmiştir. Deneme tesadüf blokları deneme deseninde 4 tekrarlamalı olarak yürütülmüştür. Denemede azot dozları (0, 6, 12, 18, 24 ve 30 kg N/da) faktör olarak ele alınmıştır. Azotun yarısı ekimle birlikte, kalan yarısı bitkiler 30-35 cm boya ulaştığında serpme olarak uygulanmıştır. Araştırmada bitki boyu, bitkide kardeş sayısı, bitkide yaprak sayısı, bitkide yaprak, sap ve salkım ağırlıkları, ana sap çapı, yeşil ot ve kuru ot verimleri belirlenmiştir. Ot hasadı taneler hamur olum döneminde iken yapılmıştır. **Bulgular:** Yapılan varyans analizi sonucunda, kuru ot verimi bakımından azot dozları arasında istatistiki olarak önemli ($p<0.05$) farklılıklar bulunurken, araştırmada incelenen diğer özelliklerde ise azot dozları arasındaki farklılık istatistiki olarak önemsiz ($p>0.05$) bulunmuştur. En yüksek kuru ot verimi 30 kg N/da dozunda belirlenmekle birlikte kontrol hariç N uygulamalarının tamamı istatistiki olarak aynı grupta yer almıştır. **Sonuç:** Elde edilen bir yıllık sonuç ile tavsiyede bulunamamakla birlikte benzer ekolojilerde 6 kg N/da uygulamasının yeterli olabileceği düşünülmektedir.

Anahtar Kelimeler: Sorgum, Gübre, Verim

THE EFFECTS OF DIFFERENT NITROGEN DOSES ON HAY YIELD AND SOME QUALITY PROPERTIES IN SORGHUM x SUDAN GRASS HYBRID

ABSTRACT

Aim: This study was carried out to determine the effect of different nitrogen doses on the yield and quality of Sorghum x Sudan Grass (Sorghum bicolor (L.) Moench x Sorghum sudanense (Piper) Stapf) hybrid in the in the coastal region of the Eastern Black Sea Region. **Materials and Methods:** The research was established in Giresun-Espiye ecological conditions in 2021 and 2022, but data could only be obtained in 2021. The experiment was carried out in a randomized block design with 4 replications. Nitrogen doses (0, 6, 12, 18, 24 and 30 kg N/da) were considered as factors in the experiment. Half of the nitrogen was applied at sowing, and the remaining half was applied as topdressing when the plants reached 30-35 cm height. In the study, plant height, number of tillers per plant, number of leaves per plant, leaf, stem and panicle weights, main stem diameter, forage and hay yields were determined. Forage harvest was done while the seeds were in the dough period. **Results:** As a result of the analysis of variance, statistically significant ($p<0.05$) differences were found among nitrogen doses in terms of hay yield, while the difference among nitrogen doses was statistically insignificant ($p>0.05$) in other properties examined in the study. Although the highest hay yield was determined at a dose of 30 kg N/da, all of the N applications were statistically in the same group, except for the control. **Conclusion:** Although we cannot make a recommendation with the one-year result obtained, it is thought that 6 kg N/da may be sufficient in similar ecologies.

Keywords: Sorghum, Fertilizer, Yield

KLORPRİFOS (CPF) PESTİSİT ETKEN MADDESİNİN *Chlorella vulgaris* ÜZERİNDEKİ AKUT TOKSİSTESİ VE BİYOKİMYASAL PARAMETRELERİNİN BELİRLENMESİ

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ÖZET

Pestisitlerin hedef olmayan organizmalar üzerine olan olumsuz etkilerinin varlığı son yıllarda zirai mücadelede kullanımlarının sınırlanmasına yönelik çalışmaların artmasına neden olmuştur. Pestisit kalıntılarının çeşitli yollarla su ortamına karışması sucul organizmalarda pestisit birikimine neden olmakta ve organizmaya zararlar vermektedir. Besin zincirinin ilk halkalarında olan mikroalglerde oluşan pestisit birikimi besin zincirine girmekte ve bir üst basamakta bulunan canlıya geçerek insana kadar ulaşmaktadır. Yapılan bu çalışma da klorprifos (CPF) pestisit etken maddesinin *Chlorella vulgaris* üzerindeki akut toksistesi incelenmiştir. Mikroalglerde meydana gelen inhibisyon canlı hücrelerin sayımına dayanılarak

gerçekleştirilmiştir. Mikroalg İnhibisyon Testi OECD (2011)'de önerildiği şekilde 24, 48, 72 ve 96 saat süre ile uygulanmıştır. Test süresi normalde 72 saattir. Ancak, geçerlilik kriterlerinin karşılanabilmesi koşuluyla daha kısa veya daha uzun test süreleri kullanılabilir OECD (2011). Test ortamı olarak hacmi 15 ml olan steril cam tüpler kullanılmıştır. CPF çözeltisinden 9 ml, mikroalg kültüründen 1 ml alınarak toplam hacim 10 ml olacak şekilde test düzeneği hazırlanmıştır. Ölü/canlı mikroalg hücrelerinin tespiti için her bir test kabından 24, 48, 72 ve 96 saat süre sonlarında alınan 1 ml mikroalg CPF örneği, 0,1ml tripan mavisi boyar madde ile boyanıp 10 dk karanlık ortamda inkübe edilmiştir. Süre sonunda örnekler hemositometre (Neubauer) kullanılarak ışık mikroskobu altında sayılmıştır. Sayımlar her bir örnek için üç defa tekrar edilerek, ortalama değerler elde edilerek hesaplanmıştır. CPF pestisit etken maddesinin *C. vulgaris* üzerindeki etkisi probit analizi ile hesaplanan EC_{50} değerleri ortalama 4,86 ± 0,33 mg/L olarak hesaplanmıştır. Çalışma kapsamında yapılan biyodeneylerde 24, 48, 72, 96 ve 120. saatte alınıp muhafaza edilen örneklerde biyokimyasal yanıtların belirlenmesi için 0,5 gr örnek tartılıp 1/10 w/v oranında PBS tamponu (fosfat ile tamponlanmış tuz çözeltisi) (pH 7,4) eklenerek, buz ile birlikte homojenizatör kullanılarak homojenize edilmiştir. Homojenize edilen bu örnekler soğutmalı santrifüjde 17000 rpm'de 15 dakika santrifüj edilerek, elde edilen süpernatanlar -86 °C' de derin dondurucuda ölçüm işlemleri tamamlanıncaya kadar muhafaza edilmiştir. Elde edilen süpernatantlar ile süperoksit dismutaz enzimi (SOD), glutatyon peroksidaz enzimi (GSH-Px), katalaz enzimi (CAT), ile lipit peroksidasyon seviyesi (TBARS) ve redükte glutatyon (GSH) seviyeleri ELISA mikroplaka okuyucu ile belirlenmiştir. Mikroalgler CPF subletal konsantrasyonlarına maruz bırakılarak, deney sonunda kontrol ve deneme gruplarında biyobirikim ve eliminasyon miktarları ile biyokimyasal (TBARS ve GSH seviyesi ile SOD, CAT ve GPx aktiviteleri) değişiklikler belirlenmiştir. TBARS seviyelerinde bir artış olsa da istatiksel olarak anlamlı olmadığı tespit edilmiştir. GSH seviyeleri istatiksel açıdan önemli bir artış olduğu belirlenmiştir. SOD ve GPx aktivitelerinde anlamlı bir atış, CAT aktivitesinde azalmalar gözlemlenmiştir. Çalışma verileri incelendiğin de doğrudan CPF kirleticine maruz bırakılan *C. vulgaris'te* kullanılan biyobelirteçlerin yararlı birer parametre olduğu tespit edilmiştir.

Anahtar Kelimeler: Klorprifos, *Chlorella vulgaris*, Oksidatif stres

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DETERMINATION OF ACUTE TOXICITY AND BIOCHEMICAL PARAMETERS OF CHLORPYRIFOS (CPF) PESTICIDE ACTIVE ON *Chlorella vulgaris*

ABSTRACT

The presence of negative effects of pesticides on non-target organisms has led to an increase in studies aimed at limiting their use in agricultural control in recent years. The mixing of pesticide residues into the aquatic environment in various ways causes pesticide accumulation in aquatic organisms and harms the organism. Pesticide accumulation formed in microalgae, which is in the first rings of the food chain, enters the food chain and reaches the human being by passing through the living things in the next step. In this study, the acute toxicity of the pesticide active ingredient Chlorpyrifos (CPF) on *Chlorella vulgaris* was investigated. Inhibition in microalgae was carried out based on the count of viable cells. Microalgae Inhibition Test was applied for 24, 48, 72 and 96 hours as recommended in OECD (2011). Test duration is normally 72 hours. However, shorter or longer test times may be used, provided the validity criteria are met OECD (2011). Sterile glass tubes with a volume of 15 ml were used as the test medium. The test setup was prepared by taking 9 ml of CPF solution and 1 ml of microalgae culture, with a total volume of 10 ml. For the detection of dead/live microalgae cells, 1 ml microalgae CPF sample taken from each test dish after 24, 48, 72 and 96 hours was stained with 0.1 ml trypan blue dye and incubated in the dark for 10 minutes. At the end of the period, the samples were counted under the light microscope using a hemocytometer (Neubauer). Counts were calculated by repeating three times for each sample and obtaining average values. The average EC50 values calculated by the probit analysis of the CPF pesticide active ingredient on *C. vulgaris* were calculated as 4.86 ± 0.33 mg/L. In order to determine the biochemical responses in the samples taken and stored at 24, 48, 72, 96 and 120 hours in the bioassays conducted within the scope of the study, 0.5 g sample was weighed and 1/10 w/v ratio of PBS buffer (phosphate buffered saline solution) (pH 7.4) was added and homogenized using a homogenizer with ice. These homogenized samples were centrifuged at 17000 rpm for 15 minutes in a refrigerated centrifuge, and the supernatants obtained were stored in a deep freezer at -86 °C until the measurement procedures were completed. Superoxide dismutase enzyme (SOD), glutathione peroxidase enzyme (GSH-Px), catalase enzyme (CAT), lipid peroxidation level (TBARS) and reduced glutathione (GSH) levels were determined by ELISA microplate reader with the supernatants obtained. Microalgae were exposed to CPF subletal concentrations and bioaccumulation and elimination amounts and biochemical changes (TBARS and GSH level, SOD, CAT and GPx activities) were determined in the control and experimental groups at the end of the experiment. Although there was an increase in TBARS levels, it was found that it was not statistically significant. It was determined that there was a statistically significant increase in GSH levels. A significant increase in SOD and GPx activities and decreases in CAT activity were observed. When the study data were examined, it was determined that the biomarkers used in *C. vulgaris*, which were directly exposed to the CPF pollutant, were useful parameters.

Keywords: Chlorpyrifos, *Chlorella vulgaris*, Oxidative stress

Note: This study was supported by TUBITAK with project number 119Y592

KLORPRİFOS PESTİSİT ETKEN MADDESİNİN *Navicula cryptocephala var. veneta* ÜZERİNDEKİ AKUT TOKSİSTESİ VE BİYOKİMYASAL PARAMETRELERİNİN BELİRLENMESİ

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ÖZET

Tarımda verimliliği arttırmak amacıyla kullanılan pestisitler çevrede kalıntı oluşturarak çeşitli yollarla su ortamına girmekte ve sucul ortamda yaşayan organizmaların vücudunda birikerek organizmada ciddi hücre hasarına ve vücut deformasyonlarına neden olmaktadır. Yapılan bu çalışma da Klorprifos (CPF) pestisit etken maddesinin *Navicula cryptocephala var. veneta* üzerindeki akut toksistesi incelenmiştir. Mikroalglerde meydana gelen inhibisyon canlı hücrelerin sayımına dayanılarak gerçekleştirilmiştir. Mikroalg İnhibisyon Testi OECD (2011)'de önerildiği şekilde 24, 48, 72 ve 96 saat süre ile uygulanmıştır. Test süresi normalde 72 saattir. Ancak, geçerlilik kriterlerinin karşılanabilmesi koşuluyla daha kısa veya daha uzun test süreleri kullanılabilir OECD (2011). Test ortamı olarak hacmi 15 ml olan steril cam tüpler

kullanılmıştır. CPF çözeltisinden 9 ml, mikroalg kültüründen 1 ml alınarak toplam hacim 10 ml olacak şekilde test düzeneği hazırlanmıştır. Ölü/canlı mikroalg hücrelerinin tespiti için herbir test kabından 24, 48, 72 ve 96 saat süre sonlarında alınan 1 ml mikroalg CPF örneği, 0,1ml tripan mavisi boyar madde ile boyanıp 10 dk karanlık ortamda inkübe edilmiştir. Süre sonunda örnekler hemositometre (Neubauer) kullanılarak ışık mikroskobu altında sayılmıştır. Sayımlar her bir örnek için üç defa tekrar edilerek, ortalama değerler elde edilerek hesaplanmıştır. CPF pestisit etken maddesinin *Navicula cryptocephala var. veneta* üzerindeki EC_{50} değerleri probit analiz yöntemi ile gerçekleştirilmiştir. Çalışma kapsamında yapılan biyodeneylerde 24, 48, 72, 96 ve 120. saatte alınıp muhafaza edilen örneklerde biyokimyasal yanıtların belirlenmesi için 0,5 gr örnek tartılıp 1/10 w/v oranında PBS tamponu (fosfat ile tamponlanmış tuz çözeltisi) (pH 7,4) eklenerek, buz ile birlikte homojenizatör kullanılarak homojenize edilmiştir. Homojenize edilen bu örnekler soğutmalı santrifüjde 17000 rpm'de 15 dakika santrifüj edilerek, elde edilen süpernatanlar -86 °C' de derin dondurucuda ölçüm işlemleri tamamlanıncaya kadar muhafaza edilmiştir. Elde edilen süpernatantlar ile süperoksit dismutaz enzimi (SOD), glutatyon peroksidaz enzimi (GSH-Px), katalaz enzimi (CAT), ile lipit peroksidasyon seviyesi (TBARS) ve redükte glutatyon (GSH) seviyeleri ELISA mikroplaka okuyucu ile belirlenmiştir. Mikroalgler CPF subletal konsantrasyonlarına maruz bırakılarak, deney sonunda kontrol ve deneme gruplarında biyobirikim ve eliminasyon miktarları ile biyokimyasal (TBARS ve GSH seviyesi ile SOD, CAT ve GPx aktiviteleri) değişiklikler belirlenmiştir. İstatiksel olarak TBARS seviyelerinde anlamlı bir değişim gözlenmemiştir. GSH seviyelerinde 96 saat sonunda kontrole kıyasla anlamlı bir fark olduğu gözlenmiş, SOD aktivitesinde kontrole kıyasla anlamlı bir değişim olmamıştır, CAT aktivitesinde anlamlı azalmalar gerçekleşmiş, GPx aktivitesinde ki değişimler istatiksel olarak anlamlı bulunmuştur. Çalışma verileri incelendiğin de doğrudan CPF kirleticine maruz bırakılan *Navicula cryptocephala var. veneta*'te kullanılan biyobelirteçlerin yararlı birer parametre olduğu tespit edilmiştir.

Anahtar Kelimeler: Klorprifos, Oksidatif stres, *Navicula cryptocephala var. veneta*

Not: Bu çalışma TÜBİTAK tarafından 119Y592 proje numarası ile desteklenmiştir.

DETERMINATION OF ACUTE TOXICITY AND BIOCHEMICAL PARAMETERS OF CHLORPYRIFOS PESTICIDE ON *Navicula cryptocephala var. veneta*

ABSTARCT

Pesticides used to increase productivity in agriculture enter the aquatic environment in various ways by forming residues in the environment and accumulate in the body of organisms living in the aquatic environment, causing serious cell damage and body deformations in the organism. In this study, the pesticide active ingredient of Chlorpyrifos (CPF) was *Navicula cryptocephala var. veneta* Acute toxicity was studied. Inhibition in microalgae was carried out based on the count of viable cells. Microalgae Inhibition Test was applied for 24, 48, 72 and 96 hours as recommended in OECD (2011). Test duration is normally 72 hours. However, shorter or longer test times may be used, provided the validity criteria are met OECD (2011). Sterile glass tubes with a volume of 15 ml were used as the test medium. The test setup was prepared by taking 9 ml of CPF solution and 1 ml of microalgae culture, with a total volume of 10 ml. For the detection of dead/live microalgae cells, 1 ml microalgae CPF sample taken from each test dish after 24, 48, 72 and 96 hours was stained with 0.1 ml trypan blue dye and incubated in dark for 10 minutes. At the end of the period, the samples were counted under the light microscope using a hemocytometer (Neubauer). Counts were calculated by repeating three times for each sample and obtaining average values. CPF pesticide active ingredient is Navicula cryptocephala var. veneta on EC_{50} values were determined by the probit analysis method. In order to determine the biochemical responses in the samples taken and stored at 24, 48, 72, 96 and 120 hours in the bioassays conducted within the scope of the study, 0.5 g sample was weighed and 1/10 w/v ratio of PBS buffer (phosphate buffered saline solution) (pH 7.4) was added and homogenized using a homogenizer with ice. These homogenized samples were centrifuged at 17000 rpm for 15 minutes in a refrigerated centrifuge, and the supernatants obtained were stored in a deep freezer at -86 °C until the measurement procedures were completed. Superoxide dismutase enzyme (SOD), glutathione peroxidase enzyme (GSH-Px), catalase enzyme (CAT), lipid peroxidation level (TBARS) and reduced glutathione (GSH) levels were determined by ELISA microplate reader with the supernatants obtained. Microalgae were exposed to CPF subletal concentrations and bioaccumulation and elimination amounts and biochemical changes (TBARS and GSH level, SOD, CAT and GPx activities) were determined in the control and experimental groups at the end of the experiment. Statistically, no significant change was observed in TBARS levels. A significant difference was observed in GSH levels compared to the control after 96 hours, there was no significant change in SOD activity compared to the control, significant decreases were observed in CAT activity, and changes in GPx activity were found to be statistically significant. Examining the study data, there is *Navicula cryptocephala var. veneta*, which was directly exposed to the CPF contaminant. It has been determined that the biomarkers used are useful parameters.

Keywords: Chlorpyrifos, Oxidative stress, *Navicula cryptocephala var. veneta*

Note: This study was supported by TUBITAK with project number 119Y592

TOHMA ÇAYI (MALATYA)'NIN BAZI FİZİKO-KİMYASAL ÖZELLİKLERİ

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ÖZET

Tohma Çayı, yaklaşık 52,5 km uzunluğa sahip olup, Sivas il sınırlarından doğar, Darende-Malatya üzerinden geçerek Karakaya barajına dökülür. İki koldan oluşan Tohma Çayı'nın en uzun kolu olan Ayvalı-Tohma Çayı üzerinde, havuzlarda alabalık yetiştiriciliği yapılmaktadır. Bu çalışmada, 2018 yılının Ocak, Nisan, Temmuz ve Ekim aylarında Tohma Çayı'nın 5 farklı istasyonundan alınan yüzey suyu örneklerinde, bazı su kalitesi parametreleri mevsimsel olarak incelenmiştir. Örneklerden elde edilen analiz sonuçları, Kıta İçi Su Kaynakları Kalite Kriterleri Yönetmeliği (SKKY) ve ayrıca içme ve kullanma suları standartlarıyla (EC, WHO, EPA, TS 266) karşılaştırılmıştır. Buna göre su kalite değerleri bakımından, araştırma süresince belirlenen istasyonlardan alınan örneklerde, su sıcaklığı 5,6-20,9 ^{o}C ve NH4-N konsantrasyonu 0-0,12 mg/L değerleri ile I. sınıf, Oksijen miktarı 2,57-14,90 mg/L, NO3-N miktarı 2,84-9,93 mg/L ve PO4-P düzeyi 0,09-0,219 µg/L değerleri ile II. sınıf, NO2-N miktarı 0,052-0,315 mg/L değerleri ile IV. sınıf su kalite parametrelerinin limit değerleri arasında olduğu görüldü. Kıta İçi Yüzeysel Su Kaynakları Kalite Kriterleri'ne göre (KYSKK 2015) araştırma süresince belirlenen istasyonlardan alınan örneklerde ortalama toplam fosfor (TP) değeri 0,0139 mg/L ile I. sınıf su kalite parametrelerine ilişkin sınır değerler içerisinde olmasına karşın, ortalama toplam azot (TN) değeri 2,347 mg/L ile III. sınıf su kalite parametrelerine uygun olduğu görüldü. Akarsuların geçtiği bölgelerde, artan nüfus, sanayileşme, tarımsal sulama ve çevresel etkilere bağlı olarak, kullanılabilir özellikteki toprak ve suların kirlenmesi hızlanmış ve bu konu

önemli bir tehdit olmaya başlamıştır. Bu nedenle, akarsuların su kalitesinin araştırılması konusu önem taşımaktadır.

Anahtar Kelimeler: Fiziksel-kimyasal parametreler, su standartları, Tohma çayı

SOME PHYSIO-CHEMICAL PROPERTIES OF TOHMA STREAM (MALATYA)

ABSTRACT

The Tohma Stream has a length of about 52.5 km and originates from the provincial borders of Sivas, passes through Darende-Malatya and pours into the Karakaya dam. On the Ayvalı-Tohma Stream, which is the longest tributary of the Tohma Stream consisting of two branches, trout farming is carried out in the ponds. In this study, some water quality parameters were examined seasonally in surface water samples taken from 5 different stations of Tohma Stream in January, April, July and October of 2018. The results of the analysis obtained from the samples were compared with the Regulation on Quality Criteria for Continental Water Resources (RQCCW) as well as with the standards for drinking and potable water (EC, WHO, EPA, TS 266). Accordingly, in terms of water quality values, in the samples taken from the stations determined during the research, it was seen that the water temperature was between 5.6-20.9 ^{o}C and NH4-N concentration was between the I. class values with 0-0.12 mg/L, the oxygen amount was between 2.57-14.90 mg/L, the NO3-N amount was between 2.84-9.93 mg/L and the PO4-P level was between the II. class with 0.09-0.219 µg/L values, the NO2-N amount was between the limit values of 0.052-0.315 mg/L and the IV. class water quality parameters. According to the Quality Criteria for Intracontinental Surface Water Resources (QCISW 2015), the average total phosphorus (TP) value in the samples taken from the stations determined during the research period was within the limit values of the I. class water quality parameters with 0.0139 mg/L, but the average total nitrogen (TN) value was found to be in accordance with the III. class water quality parameters with 2.347 mg/L. In the regions where the rivers pass, due to the increasing population, industrialization, agricultural irrigation and environmental effects, the pollution of usable soil and water has accelerated and this issue has started to be an important threat. Therefore, the issue of investigating the water quality of streams is important.

Keywords: Physical-chemical parameters, Water standards, Tohma Stream

SPERMA TOPLAMA SIKLIĞININ SPERMATOLOJİK ÖZELLİKLER VE SPERMA MİKROBİYOLOJİSİ ÜZERİNE ETKİLERİ

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ÖZET

Ekstansif koşullarda, 4 yaşlı, 6 baş Norduz koç'un 15 gün süre ile, günde 3 defa yapay vajen yöntemiyle alınan sperma ejekülatının, sperma toplama günlerine ve gün içinde sperma toplama sıklığına bağlı olarak, sperma mikrobiyolojisinin spermatolojik özellikler üzerine etkileri belirlenmiştir. Koçlardan sabah öğle ve akşam olmak üzere, günde 3 defa alınan sperma ejekülatının, sperma toplama günleri ve gün içinde sperma toplama sıklığına bağlı olarak, spermatolojik özellik değişimi incelendiğinde, her 4 koçun 15 gün süre ile sabah, öğle ve akşam alınan taze sperma ejekülatlarının, spermatolojik özellikler ortalaması sırası ile; ejekülat miktarı 2.2-1.8 ml, 1.9-1.7 ml, 1.6-1.5 ml, pH 7.8-7.6, 7.4-7.3, 7.0-6.6, kitle hareketi 5.0-4.7, 4.9-4.7, 4.5-4.2, spermatozoa motilitesi %100.0-98.9, 96.3-94.5, 90.6-88.4, spermatozoa yoğunluğu 2.2-2.0±0.18, 1.9-1.7±0.11, 1.6-1.4±0.08X10^9/ml, anormal spermatozoa oranı %3.7-4.9, 5.1-5.8, 6.2-6.7 ve ölü-canlı spermatozoa oranı %3.2-3.7, 4.8-5.2, 6.9-7.3 gibi bazı makro ve mikro spermatolojik özellikler belirlenmiştir. ilk 4 gün makro ve mikro spermatolojik özelliklerin istatistiki olarak önemli düzeyde yüksek olduğu, 5. günden 15. güne doğru, spermatolojik özelliklerin, istatistiki olarak önemli düzeyde düştüğü, bu düşüşlerin öğlen ve akşam sperma toplama dönemlerinde, olumsuz etkiye sahip olduğu belirlenmiştir($P \leq 0.001$). Ejekülatların 11-15. günlerinin, öğlen ve akşam dönemlerinde, sperma miktarı, spermatozoa motilitesi, kitle hareketi ve spermatozoa yoğunluğunun istatistiki olarak önemli düzeyde düştüğü, sperma pH'sı, anormal spermatozoa oranı ve ölü canlı spermatozoa oranının önemli düzeyde arttığı, buna bağlı olarak çevre sıcaklığı ve olası çevresel kontaminasyon etkisi ile viskozitenin düştüğü, ejekülatlarda, ransit koku artışı ile birlikte, mikroorganizma aktivitesinin artmasına neden olduğu, bu mikroorganizma düzeyinin belirlenmesi için, benzer çalışmalar ile ejekülat e-coli varlığının tesbiti yapılmalıdır.

Anahtar Kelimeler: *Norduz,* spermatolojik özellikler, mikrobiyoloji

THE EFFECTS OF SEMEN COLLECTION FREQUENCY ON SPERMATOLOGICAL CHARACTERISTICS AND SEMEN MICROBIOLOGY

ABSTRACT

In extensive conditions, the effects of semen ejaculate from 4 years old, 6 heads of Norduz rams 3 times a day by artificial vagina method for 15 days, on spermatological characteristics were determined, depending on the semen collection days and the frequency of semen collection during the day. When semen ejaculate taken from rams 3 times a day in the morning, afternoon and evening is examined, depending on the semen collection days and the frequency of semen collection during the day, when the spermatological characteristics change is examined, it was determined that fresh semen ejaculates taken from each of the 4 rams in the morning, afternoon and evening for 15 days, spermatological in order of characteristics average. Total ejaculate 2.2-1.8 ml, 1.9-1.7 ml, 1.6-1.5 ml, pH 7.8-7.6, 7.4-7.3, 7.0-6.6, mass movement 5.0-4.7, 4.9-4.7, 4.5-4.2, spermatozoa motility %100.0-98.9, 96.3-94.5, 90.6-88.4, spermatozoa intensity 2.2-2.0±0.18, 1.9-1.7±0.11, 1.6-1.4±0.08X10^9/ml, abnormal spermatozoa rate %3.7-4.9, 5.1-5.8, 6.2-6.7 and dead-live spermatozoa rate %3.2-3.7, 4.8-5.2, 6.9-7.3 some macro and micro spermatological features such as. It was determined that the macro and micro spermatological characteristics were statistically high in the first 4 days, from the 5th day to the 15th day, the spermatological characteristics decreased statistically significantly, and these decreases had a negative effect in the afternoon and evening semen collection periods ($P \leq 0.001$). During the 11-15 of ejaculates, the midday and evening periods, the semen amount, sperm motility, mass movement and spermatozoa intensity decreased statistically, semen pH, abnormal spermatozoa rate and dead-live spermatozoa rate increased significantly, resulting in environmental temperature and possible environmental contamination. In order to determine the level of this microorganism, the presence of e-coli in the ejaculate should be determined by similar studies.

Key Words: Norduz, spermatolojik characteristics, microbiology

ARPA VE BUĞDAY İLE BİRLİKTE YETİŞTİRİLMESİNİN SİLAJ KALİTESİNE ETKİSİ

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ÖZET

Birlikte üretim hem çevresel hem de ekonomik açıdan çeşitli avantajlar sunarak tarımın geleceğini ve sürdürülebilirliğini güven altına almaya çalışan tarımsal üretim modelidir. Bu çalışmada, tek yıllık baklagil yem bitkilerinden yem bezelyesinin, serin iklim buğdaygil bitkilerinden arpa ve yulaf ile farklı oranlarda (%100, %75, %50, %25) birlikte yetiştirilmesinin silaj kalitesi üzerine etkileri incelenmiştir. Araştırma sonuçlarına göre; silajların KM oranı %26.47-35.39, pH değeri 4.07-4.39, Flieg puanı 29.93-42.63, HP %6.74-16.75, NDF %42.33-60.57, ADF %32.15-38.61, KMT %1.98-2.84, SKM %54.77-63.85 ve NYD 85.52-140.67 arasında değişim göstermiştir. Saf yem bezelyesinin buğday ve arpa ile farklı oranlarda yapılan silajlarda flieg puanı ve kuru madde içeriklerinin arttığı, pH değerinin ise düştüğü, silaj kalitesinin arttığı belirlenmiştir. Bununla birlikte, düşük ham protein oranına sahip serin iklim buğdaygillerin yem bezelyesi ile silolanmasının potansiyel beslenme değerini iyileştirdiği belirlenmiştir.

Anahtar Kelimeler: Birlikte üretim, silaj kalitesi, karışım oranı, yem bezelyesi, tahıl

THE EFFECT OF CULTIVATION OF FODDER PEAS WITH DIFFERENT RATIOS OF BARLEY AND WHEAT ON SILAGE QUALITY

ABSTRACT

A intercropping system is an agricultural production model that secures the future and sustainability of agriculture by offering various advantages in terms of both environmental and economic aspects. In this study, the effects of intercropping fodder pea with barley or oats at different rates (100%, 75%, 50%, 25%) on silage quality were investigated. As a result of the research, DM content, pH value, flieg score, CP ratio, NDF, ADF, DMI, DMM, RFV value were between 26.47-35.39%, 4.07-4.39, 29.93-42.63, 6.74-16.75%, 42.33-60.57%, %32.15-38.61%, 1.98-2.84%, 54.77-63.85% and 85.52-140.67 respectively. It was determined that the Flieg Score and dry matter content of pure fodder peas increased, the pH value decreased, and the silage quality increased in silages made from fodder pea mixtures with wheat or barley at different rates. Moreover, it was determined that the silage of the low crude protein cereals mixed with fodder peas improved the potential nutritional value.

Keywords: Intercropping, silage quality, mixed ratio, fodder pea, cereal

EMPLOYING REASONABLY PRICED BIOADSORBENTS TO REMOVE PB AQUEOUS WASTE

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ABSTRACT
This study's goal was to synthesize and construct biomaterials of the cationic and anionic types. These substances were utilized as adsorbents in waters that had been contaminated by various adsorbates that were probably prevalent in the environment. In order to describe the various materials, various approaches (IRTF, DRX, MEB, BET, and ATG/DTA) will be used. Studies on the adsorption by these substances will be conducted while changing a number of variables, including pH, mass, concentration, and temperature. Removal of effluents in aqueous media, particularly the adsorption technique, which appears to be well suited to remove pollutants due to its shown efficacy as well as for financial reasons, using inexpensive adsorbents such agricultural and industrial wastes.

Keywords: Characterization, Different materials, Water treatment, Bio adsorbents, adsorption

THE OASIS OF BISKRA IN ALGERIA ECOLOGICAL ANALYSIS AND DETECTION OF AN ARTIFICIAL WETLAND AT THE DAM OF FOUM EL KHERZA

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ABSTRACT
The ecological knowledge of the artificial wetlands in particular the lakes of dam, of the development of their biological richness and their potentialities and their bio-ecological and socio-economic potentialities. Due to their biological diversity and crucial ecological roles that they play, these natural regions are extremely significant. Due to their significant capacity to provide proteins, they are also regarded as among the most productive environments, making them of tremendous economic importance. There are various wetlands in Algeria, notably the Biskra region, which features a number of sites that are significant both locally and regionally both national and global. These are either natural sites, which are typically represented by wadis, or artificial sites, such as dams like the one in the Foum El Kherza study area, which, despite the diversity and richness of its natural resources, has received very little attention in terms of their knowledge and development. The dam that is the focus of our study is situated in the Saharan bioclimatic stage, where ecological elements are susceptible to significant daily and seasonal changes. Ecological elements are subject to significant daily and seasonal variations. Characterization of the site's biotic and abiotic components has been made possible

by the bio-ecology study of the biological resources undertaken from October 2019 to Mai 2020 on the 29 ha Foum El Kherza Dam artificial wetland. By examining and keeping track of a number of physico-chemical factors related to the soil, water, and the diversity of flora and fauna, it also enabled us to gain a general understanding of its significance. As a result, we identified the type of substrate, the physicochemical, bacterial, and biological quality of the water, as well as the presence of 33 plant species, 42 phytoplankton species, and 155 animal species, including 103 invertebrate species, 03 fish species, 04 amphibian species, 07 reptile species, 34 bird species, and 7 mammal species. This method allowed us to value the site's biological resources, assess their significance, and formulate management and conservation recommendations related to its socioeconomic status from the standpoint of long-term development.

Keywords: Ecological Diagnostic, Humid Zone, Barrage Foum El Kherza, Biodiversity, Physical-Chemistric Soil Analysis, Water Quality, Biskra

THE INVESTIGATION OF TWO SAHARAN PLANTS' PHENOLIC COMPOUNDS AND THEIR INSECTICIDAL POTENTIAL

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ABSTRACT
The present work, is about the dosage of the phenolic compounds of two Saharan plants, Anvillea radiata and Astragalus armatus and their insecticidal (Aphis gossypii) and microbial (Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa., Candida albicans) effectiveness. The dosage of the total polyphenols and flavonoids is carried out by the method of Folin-Ciocalteu and AlCl3 respectively, the phenol contents of Anvillea radiata ethanol = 91.06 ± 13.8., Astragalus armatus ethanol = 82.17 ± 10.8, Anvillea radiata chlorophorme = 24.17 ± 4.12 and Astragalus armatus chloroform = 35.28 ± 13.3µgEGA / mg DM. While the flavonoid contents remain low for all extracts (Anvillea radiata ethanol = 5.40 ± 2.8, Astragalus armatus ethanol = 0.3125 ± 0.2, Anvillea radiata chloroform = 1.6 ± 0.6 and Astragalus armatus chloroform = 0.312 ± 25.7 µg EGA / mg DM). Both chloroform and ethanolic extracts from A. radiata revealed antibacterial activity against staphylococcus aureus bacilli, with zones of inhibition of 10 ± 2.6 mm and 16.5 ± 2.1mm respectively,on the other hand the four extracts of the two plants showed an insecticidal effect for the three doses.

Keywords: Characterization; antioxidants; phenolic compounds; flavonoids; Saharan plants

COMPARISON OF FATTY ACID COMPOSITIONS OF SOME TÜRKİYE AND FOREIGN REGISTERED FLAX (*Linum usitatissimum* L.) VARIETIES

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ABSTRACT
Flaxseed (*Linum usitatissimum* L.) is an important crop for source of with the different uses of oil. Additionally, which has an important place in the world has a multi-purpose use area and have commercial importance. In addition to being known as a functional food being good source and flax for food, medicine reaches back to the most remote periods of history, flax draws attention to medical progress and its use in many diseases recently, is an important additive in functional foods and animal feeds. While not much is known about the health benefits of flaxseed towards the end of the 20th century or how to consume flax to get any health and nutritional benefits, there has been a lot of research recently. Because of its important contents such as oil (omega-3, omega-6), fatty acids (α-linolenic acid, linoleic acid), protein, fibers, lignan and secoisolariciresinol diglucoside (SDG); (cardiovascular disease, diabetes, anti-cancer, antibacterial, antiviral, anti-inflammatory, arthritis and osteoporosis) has many medical uses in terms of human health. In addition, owing to its significant functions, the present study was designed to investigate the fatty acid composition of flax cultivars (Karakız, BonnyDoon, Norman, McGregor, Dillman, Michael, Konya Beyazı, Florinda, Lirina, Nareum, Barbara, Atalanta, Milas, Zoltan, Mcduff). Accordingly, oil components, the highest percentage of α- linolenic acid was observed in Nareum (54.13%) and the lowest value of the relevant compound was ascertained in McGregor (39.21%). In order to reduce the dimension, correlate and visualize the assayed parameters, the relevant data of the study was subjected to heatmap clustering. The clear discrimination and scattering among the cultivars corresponding to the parameters were observed.

Keywords: Linseed, *Linum usitatissimum*, Crops, α-linolenic acid

BENEFICIARY ROLE OF ORCHID - MYCORRHIZA ASSOCIATION IN PLANT GROWTH

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ABSTRACT
Orchidaceae, world's largest flowering plant families, holds a prized position in cut flower and potted plant varieties. It has been identified mainly in tropics and subtropics and based onthe habitat, have been classified as perennial epiphytes, lithophytes and terrestrial. A single orchid capsule contains millions of seeds, which lack any metabolic machinery and do not have any endosperm to support germination. For successful seed germination, and early growth most orchids need symbiotic association with suitable mycorrhizal fungal partner. Mycorrhiza fungi can provide nutrients particularly carbohydrates, needed for their growth and also important for seed germination. The germination pattern followed by most seeds is the same. The fungus penetrates the testa of the seed and enters either through epidermal hairs or the suspensor of the undifferentiated embryo. After invagination of the plasma membrane the fungus forms pleton in the cell. The pleton remains active for some time, but then collapses. The fungus colonises further cells, and the Mycorrhiza spreads. This article surrounds the study of endophytic fungi in roots of mature plant of epiphyticorchid and to understand its potential in improving the growth and development in plants.

Keywords- Mycorrhiza, Pletons, Embryo, Epiphytic

SEPSİSLİ VE SEPSİSSİZ CRYPTOSPORİDİUM'UN NEDEN OLDUĞU NEONATAL İSHALLI BUZAĞILARDA KARDİYAK HASARIN DEĞERLENDİRİLMESİ

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ÖZET

Neonatal diyare, buzağılarda yüksek mortalite ve morbiditeye neden olan en önemli sağlık sorunlarından biridir. Cryptosporidium, buzağılarda neonatal diyarenin önde gelen etiyolojileri arasında yer alan bir protozoondur. Cryptosporidium'un neden olduğu neonatal diyareli buzağılarda kardiyak hasar geliştiğine dair bilimsel veriler mevcuttur. Ayrıca neonatal sepsisli buzağılarda diyareye bağlı sepsisin kardiyak hasara neden olduğu da iyi bilinen bir gerçektir. Ancak gelişen kalp hasarının diyarenin neden olduğu sepsise mi yoksa Cryptosporidium'a mı bağlı olduğuna dair bilimsel bir veri yoktur. Bu nedenle bu çalışmanın amacı neonatal diyareli buzağılarda gelişen kalp hasarının sepsise mi yoksa Cryptosporidium'a mı bağlı olduğunu belirlemektir. Bu çalışmanın hayvan materyalini, sepsis olmaksızın Cyptosporidium'un neden olduğu neonatal diyareli 7 buzağı (Sepsissiz Grup), Cyptosporidium'a bağlı neonatal diyareli sepsisli 7 buzağı (Sepsis Grubu) ve sağlıklı 7 buzağı (Kontrol Grubu) olmak üzere toplam 21 buzağı oluşturdu. Çalışmaya alınan tüm buzağılarda kardiyak hasarı belirlemek için serum kardiyak troponin I (cTnI) ve N-terminal B tipi natriüretik peptit (NT-proBNP) değerleri ölçüldü. Sonuç olarak, septik ve septik olmayan buzağıların cTnI ve NT-proBNP konsantrasyonları, sağlıklı buzağılardan istatistiksel olarak anlamlı derecede yüksekti (sırasıyla $p<0.001$ ve $p<0.05$). Ayrıca septik buzağıların cTnI konsantrasyonu (256.13±108.07 pg/mL) septik olmayan buzağılardan (107.74±40.85 pg/mL) daha yüksekti. Sonuç olarak, Cryptosporidium'un neden olduğu neonatal diyareli buzağılarda sepsis olmamasına rağmen kardiyak hasar oluşabileceği gözlendi. Ayrıca Cryptosporidium'un neden olduğu neonatal diyareli buzağılarda sepsis varlığında kardiyak hasarın daha şiddetli olabileceği düşünülmüştür. Sepsisli ve/veya sepsissiz Cryprosporidium'un neden olduğu neonatal diyareli buzağılarda tedavi stratejileri planlanırken gelişen kardiyak hasarın dikkate alınması gerektiği sonucuna varıldı.

Anahtar Kelimeler: Buzağı, Crypropridium, cTnI, Diyare, Non-sepsis, NT-proBNP, Sepsis

EVALUATION OF CARDIAC DAMAGE IN CALVES WITH NEONATAL DIARRHEA CAUSED BY CRYPTOSPORIDIUM WITH AND WITHOUT SEPSIS

ABSTRACT

Neonatal diarrhea is one of the most important health issue in calves causing high mortality and morbitidy. Cryptosporidium is a protozoan that among prominent etiologies of neonatal diarrhea in calves. There is a scientific data about that developing cardiac damage in calves with neonatal diarrhea caused by Cryptosporidium. Also, it is a well-known fact that sepsis due to diarrhea causes cardiac damage in calf with neonatal sepsis. However, there is no scientific data regarding whether developing cardiac damage is due to sepsis caused by diarrhea or the Cryptosporidium. Therefore, the aim of this study is to determine whether sepsis or Cryptosporidium is the cause of developing cardiac damage in calves with neonatal diarrhea. Animal material of this study consisted of 21 calves in total, 7 calves with neonatal diarrhea caused by Cyptosporidium without sepsis (Non-sepsis Group), 7 calves with neonatal diarrhea caused by Cyptosporidium with sepsis (Sepsis Group), and 7 healthy calves (Control Group). Serum cardiac troponin I (cTnI) and N-terminal B type natriuretic peptide (NT-proBNP) values were measured to determine cardiac damage in all calves enrolled in the study. As a result, cTnI and NT-proBNP concentrations of the septic and non-septic calves were statistically significantly higher than that of the healthy calves ($p<0.001$ and $p<0.05$, respectively). Also, cTnI concentration of the septic calves (256.13±108.07 pg/mL) was higher than the non-septic ones (107.74±40.85 pg/mL). In conclusion, it was observed that despite the absence of sepsis, cardiac damage may occur in calves with neonatal diarrhea caused by Cryprosporidium. Additionally, it was thought that cardiac damage may be more severe in the presence of sepsis in calves with neonatal diarrhea caused by Cryprosporidium. It was concluded that developing cardiac damage should be taken into consideration when planning treatment strategies in calves with neonatal diarrhea caused by Cryprosporidium with and/or without sepsis.

Keywords: Calf, Cryproproridium, cTnI, Diarrhea, Non-sepsis, NT-proBNP, Sepsis

GÖLOVA BARAJ GÖLÜ (SİVAS, TÜRKİYE)'NDEKİ *Capoeta sieboldii* STEİNDACHNER, 1864'ÜN ET VERİMİ ÜZERİNE BİR ARAŞTIRMA

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ÖZET

Bu çalışmada, Temmuz 2020 - Haziran 2021 tarihleri arasında Gölova Baraj Gölü'nden yakalanan 200 adet siraz balığı (*Capoeta sieboldii* Steindachner, 1864)'nın cinsiyet ve yaş gruplarına göre et verimliliği incelenmiştir. Yapılan inceleme sonucunda siraz balığında fileto ve karkas ağırlıklarının sırasıyla dişilerde %58,30±4,98 ve %67,92±5,02; erkeklerde %58,88±5,27 ve %68,33±5,24; tüm bireylerde %58,58±5,12 ve %68,12±5,12 olarak belirlenmiştir. Tüketilebilir kısım olan fileto verimi en yüksek IV. (%63,13±3,46), en düşük I. yaş grubunda (%52,11±1,94) belirlenirken; karkas ağırlığının en yüksek yine IV. yaş grubunda (%72,37±3,52), en düşük ise I. yaş grubunda (%62,07±2,16) olduğu tespit edilmiştir. Vücut kısımlarından iç organ, baş, yüzgeç, deri ve kemik ağırlıklarının vücut ağırlığına göre ortalama oranları da tüm bireyler için sırasıyla %14,36±4,49, %13,70±1,45, %3,82±0,51, %7,18±1,08 ve %2,35±0,42 olarak belirlenmiştir. *C. sieboldii*'nin et verimliliği ile çeşitli vücut kısımları arasındaki regresyon denklemi ve korelasyon katsayısı ile ilgili ilişkiler; balık ağırlığı-karkas ağırlığı için $y=0,4565x^{1,0643}$ ($R^2=0,9969$), balık ağırlığı-iç organ ağırlığı için $y=0,4402x^{0,8099}$ ($R^2=0,8462$), balık ağırlığı-baş ağırlığı için $y=0,2281x^{0,9166}$ ($R^2=0,9910$), balık ağırlığı-yüzgeç ağırlığı için $y=0,0693x^{0,9021}$ ($R^2=0,9835$), balık ağırlığı-deri ağırlığı için $y=0,0662x^{1,0115}$ ($R^2=0,9730$), balık ağırlığı-kemik ağırlığı için $y=0,0370x^{0,9243}$ ($R^2=0,9650$) ve balık ağırlığı-fileto ağırlığı için $y=0,3622x^{1,0772}$ ($R^2=0,9962$) olarak belirlenmiştir.

Anahtar Kelimeler: *Capoeta sieboldii*, Fileto Verimi, Karkas Verimi, Vücut Kısımları, Korelasyon

A STUDY ON MEAT YIELD OF *Capoeta sieboldii* STEINDACHNER, 1864 IN GÖLOVA DAM LAKE (SİVAS, TURKEY)

ABSTRACT

In this study, meat yield of 200 colchic khramulya (*Capoeta sieboldii* Steindachner, 1864) caught at Gölova Dam Lake between July 2020 and June 2021 were investigated by gender and age groups. As a result of the examination, mean meat yields of fillet and carcass weights in colchic khramulya were 58,30±4,98% and 67,92±5,02%, 58,88±5,27% and 68,33±5,24%, 58,58±5,12% and 68,12±5,12% for female, male and all the samples respectively. Whilst the lowest meat ratio was determined in the fillet, which is the consumable part, in the fourth age group (63,13±3,46%), the lowest meat ratio was found in the first age group (52,11±1,94%). The highest meat rate of carcass weight was found in the fourth age group (72,37±3,52%) and the lowest meat rate was again in the first age group (62,07±2,16%). The average ratios of viscera, head, fin, skin and bone by body weight from body parts were 14,36±4,49%, 13,70±1,45%, 3,82±0,51%, 7,18±1,08% and 2,35±0,42% respectively. Regression equation and correlation in *C. sieboldii* were found as $y=0,4565x^{1,0643}$ ($R^2=0,9969$) for fish weight-carcass weight, $y=0,4402x^{0,8099}$ ($R^2=0,8462$) for fish weight-viscera weight, $y=0,2281x^{0,9166}$ ($R^2=0,9910$) for fish weight-head weight, $y=0,0693x^{0,9021}$ ($R^2=0,9835$) for fish weight-fin weight, $y=0,0662x^{1,0115}$ ($R^2=0,9730$) for fish weight-skin weight, $y=0,0370x^{0,9243}$ ($R^2=0,9650$) for fish weight-bone weight and $y=0,3622x^{1,0772}$ ($R^2=0,9962$) for fish weight-fillet weight.

Keywords: *Capoeta sieboldii*, Fillet Yield, Carcass Yield, Body Parts, Correlation

Ag/sba15 NANOCATALYSTS FOR ESTERIFICATION OF BIODIESEL AS MODEL VOCs

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ABSTRACT
In this work, silver nanoparticles supported on SBA15 were prepared by the method of post-synthesis and direct synthesis with pluronic p123 is a symmetrical triblock copolymer comprising poly (ethylene oxide) (PEO), materials containing silver were synthesized by the hard matrix method and characterized by BET, DRX, TEM techniques. The catalytic activity was evaluated in the total esterification of fatty acids, chosen as model molecules of VOCs. The results we obtained emphasize that the catalytic activity of the mesoporous silver system with respect to the deep esterification of the fatty acid depends on the strength of the interaction between the silver and the amount of reducible oxygen species at the surface. The catalytic activity and above all the stability of gold catalysts strongly depends on both the state and the structure of the support and the specific interaction between the silver and the support.

Key words : Ag/SBA15, COV, esterification, fatty acids

CHALLENGES OF CAMEL FARMING UNDER CLIMATIC AND SOCIO-ECONOMIC CHANGES IN EL OUED ALGERIAN ARID REGION

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ABSTRACT
The objective of the current study is to discover several dromedary breeding systems in the El Oued region of southeast Algeria. It includes a study of the makeup and organization of camel herds, a socioeconomic analysis of camel breeders, and an assessment of the region's input levels and supply networks for feeding camels. To achieve this, 2.57% of the overall population in the research area consists of the 1,406 camels on 42 camel farms. The farms under study are dispersed across El Oued Wilaya's four regions, Mih Ouansa (19), El Oued (11), Guemar (05), and Magrane (07), with a sampling rate of roughly 46% of the estimated total number of camel herds in these regions. Data are collected using the Single-Visit Multiple-Subject Diagnostic Survey (SVMSDS) approach, which is supplemented by field observations. Based on their way of life and the movement of their animals, the poll classified camel drivers into three groups: nomads (69.05%), sedentary (16.67%), and semi-sedentary (14.29%). With populations ranging from 9 to 113, camel farms in the area have an average population size of 33.48 animals per breeder. The majority of the animals in the herds are female, mostly mature she-camels older than 36 months (52.84%), females in the sub-adult age (24–36 months) range came in second with 16.79% and 15.71% (12–24 months), with 11.74% of juvenile females (less than 12 months) being the least represented (02.92%). According to the animals' ages, 55.76% of them are over 36 months old, 16.79% are between 24 and 36 months old, 37.45% are under 36 months old, and 27.45% are young camels (calves) under 24 months old. The survival of the camel herd is totally dependent on the free availability of fodder from natural pastures; food supplementation is irregular and erratic, depending on the camel farmers' financial status. During the winter season, the state provides the majority of it in the form of subsidies (2 kg of barley per adult camel per day). According to the findings of this study, the traditional component remains prevalent. Additionally, we have seen a maybe reluctant and subtle tendency toward improved driving and productivity.

Keywords: Camel driver, Dromedary, Investigation, Livestock system

YEŞİLIRMAK ALT HAVZASI TERME SULAK ALANINDA YAYILIŞ GÖSTEREN ETNOBOTANİK MAKROFİTLER

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ÖZET

Hızlı nüfus artışı, göçler, küresel ısınma, tatlı su kaynaklarının azalması, türlerin yok olması, çölleşme ve son yıllarda ortaya çıkan Kovid-19 grip salgını gibi sebeplerle doğal beslenme ve sağlıklı yaşamın önemi artmıştır. Tarımsal alanda kimyasal gübre, ilaç ve pestisit kullanmadan doğal bitkilerle beslenmek ve bu bitkilerden elde edilen ilaçları tedavi amaçlı kullanmak sağlıklı yaşamı desteklemektedir. İnsanların sağlıklı yaşaması ve olası hastalıklarının tedavisinde bitkilerden yararlanmayı hedefleyen etnobotanik araştırmaların sayısı giderek artmaktadır. Araştırmada Samsun iline bağlı Terme ilçesinde yer alan bazı sulak alanında etnobotanik özelliği olan sucul makrofitlerin durumu incelenmiştir. Terme sulak alanı, Türkiye'nin kuzeyinde Orta Karadeniz Bölümü'nde Yeşilırmak Delta ovasının doğusunda yer alır. Terme ovasında farklı derinlikte ve genişlikte kanal, kanalet, dere, çay, göl ve geçici veya sürekli su bulunduran sulak alanlar bulunmaktadır. Zamansal ve mekânsal incelemelerin yapıldığı alanda 5 yıllık sürede (2017-2022) mevsimsel gözlemler yapılmıştır. Çalışmada sulak alanlardan etnobotanik potansiyeli olan makrofitler yöntemine uygun olarak toplanmış ve laboratuvar ortamına taşınmıştır. Laboratuvarda çeşitli teşhis anahtarları yardımıyla teşhisleri yapılmıştır. Ayrıca alanın fotoğraflaması yapılmış ve sulak alanların özellikleri de gözlemlenmiştir. Araştırmalar sırasında sulak alanların farklı mevsimlerde bazı makrofitlerin (*Azolla filiculoides, Wolffia arrhiza, Salvinia natans, Ceratophyllum demersum, Ranuncuşus sphaerospermus, Ranunculus trichophyllus*) yoğun yayılış gösterdikleri gözlemlenmiştir. Farklı özellikteki pek çok ekosistemin bulunduğu Terme sulak alanı, makrofit çeşitliliği bakımından da zengindir. Araştırmalar sırasında etnobotanik özelliğe sahip toplam 22 makrofit türü belirlenmiş ve teşhisleri yapılmıştır. Teşhisi yapılan makrofitler, emers, yüzen yapraklı, serbest yüzen ve submers hayat formlarına sahip türlerden oluşmaktadır. Etnobotanik özellikteki makrofitlerin yayılış göstermesi Terme sulak alanının bu konuda yapılacak araştırmalar için önemli olduğunun göstermektedir. Yapılan gözlemlerden elde edilen sonuçlar etnobotanik araştırmalara katkı sağlayabilir ve makrofitlerin ilaç sektöründeki etkisi ve katkısı artabilir. Makrofitlerin etnobotanik özelliğinin bilinmesi son yıllarda artan kuraklık ve kirlenme nedeniyle varlığı tehlike altında olan sulak alanların korunması çabalarını destekleyecektir. Ayrıca makrofitlerle ilgili ekonomik, ekolojik ve sosyokültürel alanda yapılacak araştırmalara da destek olabilir. Doğal dengenin ve biyoçeşitliliğin korunması, sürdürülebilirliğinin sağlanması bakımından sulak alanların korunması ve varlığını devam ettirmesi önemlidir. Gelecekte etkisini artırması beklenen küresel ısınmadan sulak alanların etkilenmemesine yönelik sulak alan yönetim planları oluşturulmalı ve uygulanmalıdır.

Anahtar Kelimeler: Etnobotanik, İnsan, Makrofit, Sağlık, Sulak Alan

ETHNOBOTANIC MACROPHITES WHICH SHOW YEAR IN YEŞILIRMAK LOWER BASIN TERME WETLAND

ABSTRACT

The importance of natural nutrition and healthy life has increased due to reasons such as rapid population growth, migrations, global warming, decrease in fresh water resources, extinction of species, desertification and the Kovid-19 flu epidemic that has emerged in recent years. Feeding with natural plants without using chemical fertilizers, pesticides and pesticides in the agricultural field and using the medicines obtained from these plants for therapeutic purposes supports a healthy life. The number of ethnobotanical studies aiming to benefit from plants for the healthy life of people and the treatment of possible diseases is increasing. In the study, the status of aquatic macrophytes with ethnobotanical features in some wetland areas in the Terme district of Samsun province were examined. Terme wetland is located in the east of Yeşilırmak Delta plain in the Central Black Sea Region in northern Turkey. There are canals, flumes, streams, streams, lakes and wetlands with temporary or permanent water in different depths and widths in the Terme plain. Seasonal observations were made over a period of 5 years (2017-2022) in the area where temporal and spatial investigations were made. In the study, macrophytes with ethnobotanical potential were collected from wetlands in accordance with the method and transported to the laboratory environment. Diagnoses were made in the laboratory with the help of various diagnostic keys. In addition, the area was photographed and the characteristics of the wetlands were observed. During the researches, it has been observed that some macrophytes (Azolla filiculoides, Wolffia arrhiza, Salvinia natans, Ceratophyllum demersum, Ranuncuchus sphaerospermus, Ranunculus trichophyllus) are densely distributed in different seasons of wetlands. Terme wetland, where there are many ecosystems with different characteristics, is also rich in macrophyte diversity. During the researches, a total of 22 macrophyte species with ethnobotanical characteristics were determined and identified. The identified macrophytes consist of species with emers, floating leaves, free-floating and submers life forms. The spread of macrophytes with ethnobotanical characteristics shows that the Terme wetland is important for research on this subject. The results obtained from the observations can contribute to ethnobotanical research and the impact and contribution of macrophytes in the pharmaceutical industry can increase. Knowing the ethnobotanical characteristics of macrophytes will support efforts to protect wetlands, which are endangered due to increased drought and pollution in recent years. It can also support the economic, ecological and socio-cultural researches on macrophytes. It is important to protect and maintain wetlands in terms of protecting the natural balance and biodiversity and ensuring its sustainability. Wetland management plans should be established and implemented to prevent wetlands from being affected by global warming, which is expected to increase its impact in the future.

Keywords: Ethnobotany, Human, Macrophyte, Health, Wetland

COMBINATORIAL EFFECT OF *SERENDIPITA INDICA* AND *AZOTOBACTER CHROOCOCCUM* ON YEILD OF RICE WITH RESPECT TO SUSTAINABLE AGRICULTURE

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ABSTRACT

India is a country with a strong agricultural economy, with 58% (roughly) of the people depending on agriculture for their major source of income. The success of sustainable agriculture depends on finding innovative ways to achieve the objectives of growing food without harming the environment. Improving food production is becoming more and more important to meet the demands of the expanding global population. Since we are unable to increase the area under cultivation, microbes must be used to overcome these obstacles and clear the way for sustainable agriculture. The microbial community can offer practical techniques for soil preservation and boosting crop output. All microorganisms in an ecosystem interact closely with one another, and the microbial communities in the rhizosphere create relationships with one another that serve as the foundation for a cumulative effect on plant growth, development and yield. One such root endophytic fungus, *Serendipita indica* (*S. indica*), promotes plant growth by acting as a biofertilizer, immunomodulator, stress reliever, and barrier against many biotic and abiotic threats. Increases in length, fresh weight, and dry weight of the root and shoot, proline content, total antioxidant capacity, and *P5CS* (pyrroline-5 carboxylate synthase) gene expression were also seen when *S. indica* was used to grow rice.The co-inoculation of crops with *S. indica* and *Azotobacter chroococcum* (*A. chroococcum*), two well-known rhizospheric bacteria renowned for their positive interactions with plants, has the most promise for sustainable agriculture. The synergistic interaction between *S. indica* and *A. chroococcum* may increase the amount of nutrients that plants take up from the soil to increase crop productivity, overall growth performances in the vegetative and reproductive stages, and NPK content. The use of this microbial consortia as bio-fertilizer in place of chemical fertilisers thus gives a realistic option for higher plant production. The combination of *S. indica* and *A. chroococcum* improve plant growth and yield.

Keywords: *Serendipita indica*, *Azotoobacter chroococcum*, Rhizosphere, Sustainability

ARBUSCULAR MYCORRHIZAL FUNGI AND BIOCHAR IMPROVE GROWTH AND ROOT MORPHOLOGICAL TRAITS OF FENUGREEK

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ABSTRACT

Improved activities are an indication of the stimulatory effect of biochar and Arbuscular mycorrhizal fungi (AMF) on the residential microbial population, many of which will possess plant growth promoting traits. AMF inoculation and biochar improve the growth and yield of plants. We investigated the effects of biochar and AMF on growth and root morphological traits of fenugreek (*Trigonella foenum-graecum*). Fenugreek growth was examined using pot experiments in a greenhouse at Division of Microbiology in New Delhi, India, to determine the effect of biochar and AMF. The experimental design was as follows; control (soil without biochar), biochar alone, AMF alone, and biochar + AMF. Harvest occurred at 40 days, at which point morphological traits were all measured. The root system was analyzed by a scanning system (Expression 4990, Epson, CA). The digital images of the root were investigated by Win RHIZO software (Québec, Canada). The plant inoculated with AMF alone significantly improved the plant height by 53.3% in comparison to the control, while the biochar alone significantly increased the plant height by 66.6%, the leaf number by 45.1%, and the nodule number by 35.9% as compared to control. The combined application of biochar and AMF treatment significantly increased plant height by 80.9% over the control. The maximum leaf number was recorded and the combined treatment with biochar and AMF resulted in a 59.1% increase with respect to the control. Combined application of biochar and AMF treatment showed a positive effect on branch and nodule numbers, with a significant increase in the number of branches (35.8%) and nodule number (60.3%) over control. Data regarding the root fresh weight showed that AMF treatment significantly increased the root fresh weight by 54.2% compared with the control. Treatment of biochar alone significantly increased the root fresh weight by 71.4% and the root dry weight by 25.0% compared with the control. However, the combined application of biochar and AMF showed a higher positive effect on root fresh weight (82.8%) and dry weight (37.5%) over control compared to a singular treatment with either component. Examination of root morphological traits revealed an increase in the total root length, root surface area, projected area, root diameter, and root volume in biochar treatment. Biochar significantly increased the total root length 40.1%, projected area 22.4%, root surface area (23.6%), root volume (71.4%), and root diameter (20.3%) in comparison to the control, while plants inoculated with AMF gradually enhanced the total root length (19.8%) and root volume (32.1%). However, the combination of biochar with AMF increased the total root length (68.9%), projected area (48.7%), root surface area (34.4%), root volume (34.4%), and root diameter (31.0%) over control. Our results recommend that the combination of biochar and AMF is advantageous in fenugreek growth.

Keywords: Fenugreek, Plant height, Nodule number, Total root length, Root surface area

QUALITATIVEAND QUANTITATIVE EVALUATION OF CAMEL MILK PRODUCTION DURING THE LAST STAGE OF LACTATION

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ABSTRACT
Camel milk plays a essentiel role in the food of the population of arid zones and semi-arid regions. under the harsh conditions of life , camel can produce good quntity of milk and for a longer time then other dairy animal. The present study aims to evaluate the quality and quantity of camel milk of ten milking females dromadery camels in a semi-intensive breeding system in a camel dairy farm named TDAJEN farm in the southeast of Algeria exactly in El Oued region in the last stage of lactation; by weighting the milk of each female camel after milking for the quantity evaluation and by using LACTOSCAN milk analyzer for the quality evaluation. The mean of the quantity of milk per day in the last stage of lactation reach 6.9 L and the mean of the percentages of the solids -not- fat, fat, protein, lactose, salts, ph, and density are 8,8%, 4,3% , 3,2% , 4,8 % , 0,71% , 5,5% , 29,5% respectively. This results show that camel milk in last stage of lactation has a different physico-chemecal characterestic compared to the other stages and it is distinctly different from other milks in the physico-chemecal characteristics, and it is useful to understand the characters of camel milk in the last stage of lactation.

Keywords: camel, qualitaty, quantity, last stage, lactation

İKLİM DEĞİŞİKLİĞİNE BAĞLI OLARAK AVRUPA EKİN SAPARISI [*Cephus pygmeus* (L.) (HYMENOPTERA: CEPHİDAE)]'NIN HABİTAT UYGUNLUĞU

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ÖZET

Avrupa ekin saparısı (*Cephus pygmeus* L.) dünya genelinde buğday verimine olumsuz etkileri olan önemli bir zararlıdır. İklim değişikliğinin farklı zararlı türlerinin dağılımı üzerinde önemli etkileri olması beklenmektedir. Bu çalışmada MaxEnt modeli kullanarak Avrupa ekin saparısının küresel habitat uygunluğu tahmin edilmiştir. Hedef türün küresel dağılış kayıtları GBIF ve çeşitli veritabanlarından toplanmıştır. Türün bulunduğu yerlere ait 19 farklı biyoiklim değişkenlere ait veriler ArcGIS'te "extract" fonksiyonu kullanılarak çekilmiştir. Korelasyon katsayısı >0.70 olan değişkenler elenmiş, modele daha fazla katkı sağlayan ve korelasyon katsayısı >0.70 olan biyoiklim değişkenleri modele dahil edilmiştir. Toplamda 10 biyoiklim değişkeni (bio3, bio4, bio5, bio6, bio8, bio11, bio13, bio14, bio16 ve bio19), türün mevcut ve gelecekteki iklim koşullarında habitat uygunluğunu tahmininde kullanılmıştır. Ayrıca türün gelecekteki habitat uygunluğu, düşük karbon emisyon senaryosu olan SSP1-2.6 ve yüksek karbon emisyon senaryosu olan SSP5-8.5 altında tahmin edilmiştir. Model verilerin %70'inde eğitilmiş ve kalan %30'unda test edilmiştir. Sonuçlar, MaxEnt modelinin hedef türün habitat uygunluğunu yüksek doğrulukla (ROC = 0.97) tahmin ettiğini göstermiştir. Model, zararlının Avrupa (Almanya, Fransa, Hollanda ve Belçika), Birleşik Krallık, Türkiye ve Kazakistan'da mevcut ve gelecekteki iklim koşullarında yayılacağını tahmin etmiştir. Genel olarak, zararlının habitat alanı küresel olarak daralacağı, ancak nadirende olsa popülasyonda bazı kaymalar olacağını göstermiştir. Model Türkiye'nin güneydoğu kısmının bu zararlı için mevcut ve gelecekteki iklim koşullarında en uygun yaşama ortamına sahip olacağını göstermiştir. Ayrıca model, Avrupa ekin saparısının habitatında yüksek düzeyde kayma yaşanmayacağını ortaya koymuştur. Bu nedenle, bu zararlıya karşı kontrol amaçlı zararlı yönetim stratejilerinin zararlıya en uygun yaşama ortamına sahip alanlarda yoğunlaştırılması gerektiği sonucuna varılmıştır.

Anahtar Kelimeler: İklim değişikliği, MaxEnt, Zararlı, Avrupa, Birleşik krallık

HABITAT SUITABILITY OF EUROPEAN WHEAT STEM SAWFLY [*Cephus pygmeus* (L.) (HYMENOPTERA: CEPHIDAE)]] UNDER CHANGING CLIMATE

ABSTRACT

European wheat stem sawfly, *Cephus pygmeus* (L.), is a significant pest exerting adverse impacts on wheat yield globally. Climate change is expected to exert significant impacts on the distribution of different pest species. This study predicted the global habitat suitability of European wheat stem sawfly by using MaxEnt model. Global occurrence records of the species were gathered from GBIF and various other sources. The values of 19 bioclim variables were extracted to the final occurrence records and correlation was computed among the extracted values. The variables with correlation scores >0.70 were eliminated. However, the bioclim variables with higher contribution towards the model and correlation coefficient >0.70 were retained. A total of 10 bioclim variables (i.e., bio3, bio4, bio5, bio6, bio8, bio11, bio13, bio14, bio16 and bio19) were used to predict the habitat suitability of the species under current and future climatic conditions. The future habitat suitability was predicted under two climate change scenarios, i.e., SSP1-2.6 (low carbon emission scenario) and SSP5-8.5 (high carbon emission scenario). The model was trained on 70% of the data and tested on the remaining 30%. The results revealed that MaxEnt model predicted the habitat suitability with high accuracy (ROC = 0.97). The model predicted that Europe (Germany, France, Netherlands, and Belgium), United Kingdom, Turkey and Kazakhstan had the highest suitable areas for the species under current and future climatic conditions. Overall, the suitable habitat will be contracted globally, while there will be rare niche shifts. The southeaster side of Turkey will have the highest suitable habitat under current and future climatic conditions of the country. The model revealed that the species would not experience dramatic niche shifts. Therefore, management strategies should be concentrated in the areas having the highest suitable habitat.

Keywords: Climate change, MaxEnt, Pest, Europe, United Kingdom

SYNTHESIS AND CHARACTERIZATION OF A MIXED OXIDE $ZnSb_2O_4$

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ABSTRACT
This work aims at the synthesis and characterization of a ceramic material of spinel structure and chemical formula $ZnSb_2O_4$. The spinel structure is a crystal structure characterized by a cubic arrangement of ions, where cations occupy the tetrahedral and octahedral sites within the crystal lattice. In the case of $ZnSb_2O_4$, the zinc cations (Zn^{2+}) and antimony cations (Sb^{3+}) are distributed in a specific arrangement within the spinel structure ; and he is of interest in materials science and solid-state chemistry due to its unique properties like optical properties , chemical stability , magnetic properties .The samples chosen for this study were prepared by several methods ; the ceramic method, the co-precipitation method and the molten salt method.Their characterization was carried out by different techniques, such as X-ray diffraction (XRD), scanning electron microscopy (SEM) and infrared spectroscopic analysis (IRTF)….etc ;

Keywords : Ceramic, Co-precipitation, Molten salt, $ZnSb_2O_4$, PXRD, FTIR

TÜTÜN HASADINDA MEKANİZASYON OLANAKLARI VE UYGULAMALAR

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ÖZET

Yaprak, tütün bitkisinin en önemli kısmıdır. Yaprağın büyüklüğü ve formu tütün çeşitlerine göre farklılık göstermektedir. Tütün yapraklarının hasat edilmesi ve sonrasındaki işlem basamaklarına bakıldığında üretim maliyeti ve birim işçiliklerde büyük yapraklı tütünlerin daha avantajlı olduğu bu sebeple büyük yapraklı tütünlerin yetiştirilmesinin daha yaygınlaştığı görülmektedir. Tütün yapraklarının hasat işlemi ise çoğunlukla el ile yani manüel olarak yapılmaktadır. Bu sebeple hasat işleminde birim maliyetlerde özellikle işçilik anlamında artış olmaktadır, bu artışın yanı sıra el ile hasat edilen ürünlerde verim düşüklüğü ve ıskarta miktarında da artış görülmektedir. Bu sebeple tarımsal üretim faaliyetlerinin etkinliğini artırmak, maliyetlerini azaltmak ve koşullarını iyileştirmek amacıyla uygulanan mekanizasyon yöntemleri önemli ve tamamlayıcı bir unsurdur. Bu mekanizasyon yöntemleri içerisinde en önemli olanı hasat mekanizasyonudur. Çünkü tütün yaprağı belirli olgunluğa eriştikten sonra kısa süre içerisinde hasat edilmeli ve hasat sonrası kurutma işlemine geçilmelidir. Bütün bu koşullar göz önünde bulundurulduğunda hasat mekanizasyonunun önemi daha iyi anlaşılmaktadır. Gelişen teknoloji ile beraber farklı tütün tiplerine göre farklı yaprak hasat yöntemleri geliştirilmiş ve bu yöntemler ile hasat kısa sürede tamamlanabilmekte ve ıskarta miktarını oldukça azaltmaktadır. Farklı tip hasat mekanizasyonu ile birlikte toplanan yapraklar kurutma işlemi için taşıma araçlarına kasalardan boşaltılmaktadır bu ise süreci oldukça kısaltmakta ve pratik hale getirmektedir. Oryantal tütün hasadında farklı yüksekliklerdeki yaprakları gruplar halinde kıran mekanizmalar olduğu gibi tüm yaprakların aynı anda hasat edildiği Virginia tipi tütünler ve toprak yüzeyinin biraz üzerinden (gövdesi ile beraber kesilerek) kök hasadı yapılan Burley tipi tütünler için de mekanik hasat imkânları bulunmaktadır. Bu çalışmada, farklı türdeki tütün bitkilerinin hasadında kullanılan makinelerin kabiliyet ve yetenekleri ile teknik özellikleri irdelenerek tütün hasadının mekanizasyonuna sağladığı katkılar ele alınmıştır.

Anahtar Kelimeler: Tarımsal mekanizasyon, tütün bitkisi, hasat

MECHANIZATION OPPORTUNITIES AND APPLICATIONS IN TOBACCO HARVEST

ABSTRACT

The leaf is the most important part of the tobacco plant. The size and form of the leaf differs according to the tobacco varieties. When we look at the harvesting of tobacco leaves and the subsequent processing steps, it has been seen that large-leaf tobacco is more advantageous in terms of production cost and unit labor, and therefore the cultivation of large-leaf tobacco has become more widespread. The harvesting process of tobacco leaves is mostly done manually. For this reason, there is an increase in unit costs, especially in terms of labor, in the harvesting process, along with this increase, there is a decrease in yield and an increase in the amount of scrap in the products harvested by hand. Mechanization methods applied in order to increase the efficiency of agricultural production activities, reduce their costs and improve their conditions are an important and complementary element. Harvest mechanization is the most important of these mechanization methods. Because after the tobacco leaf is harvested, the drying process should be started in a short time. In addition, the leaf must be harvested in a short time after reaching a certain maturity. Considering all these conditions, the importance of harvest mechanization is better understood. With the developing technology, different leaf harvesting methods have been developed according to different tobacco types, and with these methods, the harvest can be completed in a short time and the amount of reject is considerably reduced. The leaves collected with different types of harvesting mechanization are unloaded from the crates to the transport vehicles for the drying process, which shortens the process considerably and makes it practical. In oriental tobacco harvesting, there are mechanisms that break leaves at different heights in groups, as well as mechanical harvesting opportunities for Virginia type tobaccos where all leaves are harvested at the same time and Burley type tobaccos which are root harvested a little above the soil surface (cutting with the stem). In this study, the capabilities and technical characteristics of the machines used in the harvesting of different types of tobacco plants were examined and their contributions to the mechanization of tobacco harvesting were discussed.

Keywords: Agricultural mechanization, tobacco plant, harvest

POWER GENERATION SYSTEMS ENERGY USING RENEWABLE ENERGY SOURCES FOR AGRICULTURAL FACILITIES

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ABSTRACT

Objectives: Currently, renewable energy sources (RES) are being actively developed and introduced, which is associated with the depletion of fossil fuel reserves and the desire to improve the ecological state of the environment. In this regard, for the power supply of small agricultural facilities, autonomous power plants of relatively small capacity based on RES are used. The need for uninterrupted power supply to consumers requires the presence of a guaranteed power source as part of an autonomous power plant that can provide the consumer with the necessary electrical energy during periods of wind calm and weak winds. In autonomous power plants, batteries are most often used as such a source. **Methods:** In this paper, for a guaranteed energy supply of an agricultural facility, it is proposed to use a metal-hydride hydrogen storage system with further use of hydrogen in fuel cells. To study metal hydride technologies for the accumulation and storage of hydrogen, a scheme of a wind power plant has been developed, shown in fig. 1.

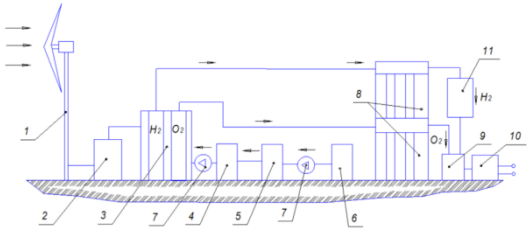

Fig. 1 – Scheme of a wind power plant with a hydrogen energy storage device: 1 – wind generator;
2 – control system; 3 – high pressure electrolyzer; 4 – tank of desalinated water; 5 – desalination block; 6 – technical water tank; 7 – pumps; 8 – balloon gas storage system (H_2, O_2); 9 – fuel cell module; 10 – inverter; 11 – hydrogen metal-hydride accumulator

During the operation of the wind generator 1, the generated electricity is fed through the control system 2 to the high-pressure electrolyzer 3. For the operation of the electrolyzer, technological equipment 4–7 is used, which ensures its continuous and stable operation. In the process of the reaction of electrochemical decomposition of the liquid alkaline electrolyte, the resulting oxygen and hydrogen enter the balloon gas storage system 8, which are used to operate the fuel cell module 9. Inverter 10 is used to convert the received DC voltage into AC voltage. Then the converted electricity is supplied to the consumer. During the hours when the power of the wind generator is excessive, hydrogen is accumulated in the metal-hydride battery 11 together with the gas storage system. Thus, wind energy is accumulated for subsequent autonomous energy supply to consumers. During peak hours (morning and evening), as well as in the event of a sharp and prolonged decrease in wind speed, hydrogen and oxygen from the storage system is used to generate additional electricity using the fuel cell module. **Expected results:** As a result of carrying out a complex of researches, including calculation-theoretical and experimental study of thermodynamic and thermophysical processes of the system «fuel cell - metal-hydride battery» using innovative methods, scientific and practical recommendations will be developed to increase the efficiency of storage and use of hydrogen and original hydride with improved performance.

Keywords: Energy, agriculture, thermodynamic

ESKİŞEHİR İLİNDE YETİŞTİRİLEN BAZI KOYUN IRKLARINDA CAST VE DGAT1 POLİMORFİZMİ

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ÖZET

Hızlı nüfus artışı ile birlikte artan gıda ihtiyacı hayvansal üretime baskıları her geçen gün artırtmaktadır. İlk evcilleştirilen hayvan türlerinden biri olan koyunun et, süt, yapağı gibi birçok veriminden yararlanılmasıyla birlikte elde edilen kazancın önemli bölümünü et verimi oluşturmaktadır. Ancak hayvan başına düşen verimler oldukça azdır. Koyunculukta esas olan hayvan sayısını arttırmak yerine, kaliteyi ve hayvan başına düşen verimi artırmaktır. Hayvanın verim yeteneği, çevre ve bu verimle ilgili genler tarafından yani hayvanın genotipi tarafından belirlenir ve genotipin izin verdiği ölçüde olur. Hayvanlarda verim özelliklerini belirleyen genlerin tanımlanması, bu genlerin klasik ıslah ve seleksiyonda kullanılabilmesi üzerine moleküler genetik alanındaki çalışmalar önem kazanmıştır. Koyunlarda et verimi üzerine etkili olan genlerden iki tanesi Calpastatin (CAST) ve Diacylglycerol acyltransferase1 (DGAT1) genidir. Koyunlarda 5. kromozom üzerinde bulunan CAST geni, kesim sonrası etin yumuşamasında ve kas gelişiminde önemli rol oynar. DGAT1, adipositlerde trigliseritlerin sentez oranını kontrol etmede anahtar enzimdir. DGAT1 geni, yağ ve enerji metabolizmasındaki görevi sebebiyle koyunlarda et kalite özellikleri ve karkasta yağ birikimi özelliklerini etkilemesinde rol oynar ve 9. kromozom üzerinde yer alır. Bu çalışmada Eskişehir ilinde halk elinde küçük ölçekli işletmelerde yetiştiriciliği yapılan bazı koyun ırklarında CAST ve DGAT1 genotiplerinin belirlenmesi amaçlanmıştır. Polimorfizmlerin belirlenmesi PCR-RFLP yöntemi ile yapılmıştır.

Anahtar Kelimeler: CAST, DGAT1, Polimorfizm, Koyun

Not: Bu çalışma ikinci yazarın danışmanlığındaki birinci yazarın yüksek lisans tezinden türetilmiştir.

CAST AND DGAT1 POLYMORPHISM IN SOME SHEEP BREEDS REARED IN ESKISEHIR PROVINCE

ABSTRACT

With a rapidly growing population, the demand for food is increasing the pressure on animal production. Sheep, which is one of the first domesticated animal species, provides many yields such as meat, milk and wool, and meat yield constitutes an important part of the income. However, the yield per animal is quite low. Rather than an increase in the number of animals, the most important thing in sheep farming is an increase in the quality and yield per animal. Both the environment and the genes associated with that productivity i.e the animal genotype determine the animal productivity, and is as high as the genotype allows. Molecular genetics studies have gained importance through the identification of genes that determine production traits in animals and their use in classical breeding and selection. The calpastatin (CAST) and diacylglycerol acyltransferase1 (DGAT1) genes are two of the genes that affect meat yield in sheep. The CAST gene plays an important role in post-slaughter tenderness and muscle development in sheep, located on chromosome 5. DGAT1 is the key enzyme in controlling the synthesis rate of triglycerides in adipocytes. Due to its role in fat and energy metabolism, the DGAT1 gene plays a role in affecting meat quality characteristics and carcass fat accumulation in sheep and is located on chromosome 9. The aim of this study was to determine the CAST and DGAT1 genotypes of some sheep breeds reared on small farms in Eskişehir province. Polymorphisms were determined by PCR-RFLP method.

Keywords: CAST, DGAT1, Polymorphism, Sheep

Note: This study is derived from the master's thesis of the first author under the supervision of the second author.

PROFICIENCY NEEDED BY AGRICULTURAL EDUCATION LECTURERS IN UTILIZATION OF INFORMATION COMMUNICATION TECHNOLOGY FOR INSTRUCTIONAL PURPOSES IN TERTIARY INSTITUTIONS IN SOUTH-WEST, NIGERIA

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ABSTRACT
This study identified the proficiency needed by agricultural education lecturers' in utilization of information and communication technology and also identified ICT facilities and tools needed by agricultural education lecturers in utilization of ICT for pedagogical effectiveness in tertiary institutions in south-west, Nigeria. This study was carried out in South-western, Nigeria. The descriptive survey research design was used for this study. Five research questions and four null hypotheses guided the study. The population of the study consist of Two hundred and ninety seven (297) respondents comprising of 180 Agricultural education lecturers and 117 Agricultural technologists. The total of 157 respondents comprising of 92 agricultural education lecturers and 65 agricultural technologists were selected from randomly selected three states in south-west, Nigeria using multi-stage sampling techniques and total sampling techniques due to the relative small number of the respondents. Relevant literatures were reviewed for the development of the instrument for collecting data which was a structured Questionnaire tagged "PSNBAEDQ". The internal consistency of the instrument was determined to be 0.99 using the Cronbach. Alpha Model for both needed and performance category. Data collected were analyzed using SPSS version 26.0 with the percentage used for research question 1, the Improvement Need Index (INI) for research questions 2. The findings of the study revealed that 27 out of the 30 ICT facilities and tools were needed for pedagogical effectiveness in the teaching of agricultural education. It also revealed that Lecturers of agricultural education required proficiency skills in 89 skills out of the 93 skills in the 3 clusters of skills for instructional purposes; The researchers therefore recommended that governing bodies of tertiary institutions should organize in-service training through seminars and workshops for lecturers in the use of ICT, financial support through government at all levels and non-governmental organizations should invest in purchasing ICT facilities and tools, a review of the agricultural education curriculum to incorporate fully ICT utilization amongst others.

Keywords: Proficiency, Agricultural Education Lecturers, Utilization, Information Communication Technology, Instructional Purposes, Tertiary Institutions, South-West, Nigeria

KIRSAL TURİZM POTANSİYELİNİN SWOT ANALİZİ İLE DEĞERLENDİRİLMESİ: ORDU İLİ ÖRNEĞİ

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ÖZET

21. yüzyılda mekânsal ve zamansal olarak dönüşüm ve değişime uğrayan turizm olgusu özellikle az gelişmiş ve gelişmekte olan ülkeler için bir çıkış yolu olarak görülmektedir. Doğal kaynaklar açısından jeo-ekonomik, sosyo-kültürel ve değer temelli kaynaklar açısından zenginlik arz eden ve farklılık gösteren ülkeler, bu arz değerlerini ekonomik fayda sağlayacak ve ülke refahını arttıracak şekilde değerlendirmek istemektedir. Bu bağlamda, kırsal turizm seçeneği ön plana çıkmaktadır. Kırsal turizm, kırsal alanlarda doğal kaynaklara bağlı bir şekilde gerçekleştirilen, kırsal kültürü, kırsal yaşamı ve gelenekselliği ön planda tutan bir turizm türü olarak açıklanabilir. Kırsal turizmin, kent ve kır arasındaki sosyokültürel farklılıkları azaltması, kırsal kalkınmayı sağlaması, yerel halkın refahını arttırması, kırsal istihdamı desteklemesi ve altyapıyı geliştirmesi açısından önemli etkileri bulunmaktadır. Doğu Karadeniz Bölgesi'nde yer alan Ordu ili, sahilden 3000 rakıma uzanan bir alana yayılmıştır. Dağları, dereleri, gölleri, şelaleleri, yaylaları ve yerel mimarisiyle kendine özgü bir çekiciliği olan Ordu ilinin kırsal turizm açısından önemli bir potansiyele sahip olduğu düşünülmektedir. Dolayısıyla, kırsal turizm ile ilgili planlamalar yapılıp geliştirilmesi, yerel bazda Ordu iline, ulusal bazda ülke ekonomisine katkı sağlarken, ülkemizin uluslararası rekabet edebilirliği üzerinde de kuşkusuz büyük faydaları olacaktır. Bu çalışmada, Ordu ilinin kırsal turizm potansiyeli mevcut haliyle değerlendirilerek, güçlü-zayıf yönleri ile tehdit ve fırsatların belirlenmesi amaçlanmıştır. Bu doğrultuda öncelikle kırsal turizm kavramı açıklanmıştır. Daha sonra, Ordu ilinin coğrafi yapısı ve yer şekilleri, sosyo-ekonomik yapısı ve kırsal turizm arz kaynaklarına ait bilgilere yer verilmiştir. Son bölümde literatürden hareketle Ordu ilinin kırsal turizm potansiyeline ilişkin bir SWOT analizi gerçekleştirilmiştir. Elde edilen bulgular sonucunda; ilin kırsal turizm açısından zengin doğal kaynaklara, tarihsel ve kültürel mirasa sahip olması en güçlü yönünü oluştururken, kırsal alanlarda bulunan konaklama tesislerinin yetersiz kalması, kırsal turizme yönelik bilincin yetersiz ve gelişmemiş olması, kırsal alanlardaki ulaşım ve altyapı sorunları ve kırsal turizm açısından örnek teşkil edebilecek girişimci ve iş yeri eksikliğinin olması yörenin zayıf yönleri arasındadır. Ayrıca Karadeniz bölgesinin yeni pazarlara açılmaya başlaması Ordu ili için bir yandan fırsat iken, diğer yandan ilin kırsal turizm anlamındaki rakip destinasyonlarının varlığı bir tehdit olarak ortaya çıkmaktadır.

Anahtar Kelimeler: Kırsal Turizm, Ordu, SWOT Analizi

EVALUATION OF RURAL TOURISM POTENTIAL WITH SWOT ANALYSES: THE CASE OF ORDU

ABSTRACT

In the 21st century, the phenomenon of tourism, undergoing spatial and temporal transformation and change, is seen as an outlet, particularly for underdeveloped and developing countries. Countries that possess richness in terms of natural resources, geo-economic factors, socio-cultural aspects, and value-based resources, and that exhibit diversity, seek to utilize these assets to generate economic benefits and increase national welfare. In this context, rural tourism emerges as a prominent option. Rural tourism can be described as a type of tourism that takes place in rural areas, relying on natural resources, and emphasizing rural culture, rural life, and tradition. Rural tourism significantly reduces sociocultural differences between urban and rural areas, promotes rural development, improves local communities' well-being, supports rural employment, and enhances infrastructure. Ordu province, located in the Eastern Black Sea Region, extends over an area ranging from the coast to an altitude of 3000 meters. It is believed that Ordu province, with its mountains, streams, lakes, waterfalls, plateaus, and local architecture, possesses a unique charm and significant potential for rural tourism. Therefore, making plans and developing rural tourism in Ordu province at the local level will undoubtedly contribute to the province's economy and, on a national scale, to the country, while also bringing significant benefits to our country's international competitiveness. This study aims to evaluate the rural tourism potential of Ordu province, taking into account its current state and identifying its strengths, weaknesses, threats, and opportunities. In this regard, the concept of rural tourism is initially explained. Then, information about the geographical structure, topography, socio-economic structure, and rural tourism supply sources of Ordu province is provided. In the final section, a SWOT analysis of Ordu province's rural tourism potential is conducted based on the literature. The findings reveal that the province's strongest aspect lies in its rich natural resources, historical and cultural heritage in terms of rural tourism. However, the region's weaknesses include inadequate accommodation facilities in rural areas, insufficient awareness and underdevelopment of rural tourism, transportation, infrastructure issues in rural areas, and a lack of entrepreneurial initiatives and businesses that could serve as examples of rural tourism. Furthermore, while the opening of new markets for the Black Sea region presents an opportunity for Ordu province, the existence of competing destinations in terms of rural tourism poses a threat.

Keywords: Rural Tourism, Ordu, SWOT Analysis

WORK-SKILLS REQUIRED IN CASSAVA PRODUCTION IN AGRICULTURAL EDUCATION CURRICULUM FOR STUDENTS OF COLLEGES OF EDUCATION IN SOUTH-WEST, NIGERIA

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ABSTRACT
This study identified works skills required by students of colleges of education in cassava production enterprise in South-West, Nigeria. It employed descriptive survey research design. Six research questions and three hypotheses guided the researcher. This study was carried out in South western states of Nigeria. A total population of Eight hundred and eighty six (886) respondents comprising of one hundred and forty (140) Agricultural education lecturers and seven hundred and forty-six (746) Agricultural extension officers was used for the study while a total of three hundred and sixty-eight respondents were selected using multi-stage sampling techniques. Instrument for data collection was a structured Questionnaire. The internal consistency of the instrument was determined to be 0.99 using the Cronbach. Alpha Model. The SPSS version 26.0 was used to analyse the data using the mean and standard deviation. The findings of the study revealed that N.C.E students required 5 items on work-skills in site selection and land preparation for cassava production, 12 items on work skill were needed in planting of cassava and 17 items on work-skill were needed in post-planting operations of cassava. It was recommended by the researchers that the identified work-skills should be incorporated into the curriculum of agricultural education programmes and also the government of south –west states should develop training skills modules with these identified work-skills to be used in training youths in the different skills acquisition centres, innovative vocational centres etc. located within and outside their geographical region.

Keywords: Work-skills, Graduates, Colleges of Education, Agricultural Education, Curriculum, South-west

INTERCROPPING OF TOMATO WITH MAIZE IMPROVED GROWTH AND DROUGHT TOLERANCE IN TOMATO PLANTS

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ABSTRACT
Water stress has become the main limiting factor to crop production worldwide, which will challenge current agricultural systems. Climate change can strongly increase drought stress by changing rainfall patterns, and increasing evaporation, which reduces water availability and affect water quality especially in the arid and semi-arid regions. Persistent drought episodes can influence food insecurity as this has been recorded in many previous reseaches. Drought will challenge current farming systems. However, intercropping (IC) is an alternative food production systems to combat many biotic and abiotic stresses. IC enhances resilience against abiotic stress challenges associated to climate change. Intercropping is a farming practice involving two or more crop species, or genotypes, growing at same time on the same piece of land. Here we evaluated drought tolerance of three tomato cultivars co-cultivated with maize or grown in monoculture by analyzing growth, physiological and biochemical parameters. The results found here show that plants grown in an intercropping system are more tolerant to water stress. Therefore, intercropping is a very good alternative to monoculture, because the intercropping system brings advantages in terms of optimizing the agricultural area used, allows mitigation of losses and misuse of irrigation water and increases farm productivity.

Keywords: Intercropping, drought, tomato, maize, climate change

FUNCTIONAL RESPONSE OF *COCCIDOXENOIDES PERMINUTUS* GIRAULT (HYMENOPTERA: ENCYRTIDAE) ON *PLANOCOCCUS FICUS* (SIGNORET) (HEMIPTERA: PSEUDOCOCCIDAE)

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ABSTRACT
Coccidoxenoides perminutus (Hymenoptera: Encyrtidae) is a solitary parasitoid worldwide used in biological control of pest mealybugs. This parasitoid has a high biocontrol potential against *Planococcus ficus*, a significant pest that affects vineyards worldwide. The objective of this study was to investigate the functional responses of the parasitoid *C. perminutus* on *Planococcus ficus*. The experiments were conducted using different densities of *P. ficus* (2, 5, 10, 20, 30, 40, 50, and 60). The trials were carried out in climate chambers with controlled temperature (20 °C), relative humidity of 60±10%, and a long-day photoperiod (16:8). Each density of mealybugs was replicated 20 times. The functional responses of *C. perminutus* to *Planococcus ficus* was determined at the end of the experiments. The results showed that, the functional response was relevance with Holling's Type II curve. The Handling Time (Th) was calculated as 0.3181 hours while, the Attack Rate (a') value was found to be 0.0279. These findings demonstrate that *C. perminutus* has the potential to be used as a biological control agent for managing *P. ficus* populations at low temperature. The study provides valuable information for future biological control programs.

Keywords: Functional response, *Coccidoxenoides perminutus*, *Planococcus ficus*, Biological control, Parasitoid

EUPHORBIA RESINIFERA O. BERG IN MOROCCO: A POTENTIAL MELLIFEROUS, MEDICINAL AND FORAGE PLANT TO REMEDY CLIMATE CHANGE: CONTRIBUTION OF MOLECULAR AND MORPHOMETRIC MARKERS FOR MANAGEMENT OF ITS GENETIC RESOURCES

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ABSTRACT
To evaluate the genetic diversity of *Euphorbia resinifera O. Berg* using ISSR markers. 12 natural populations were chosen from its geographical area of and analysed. Using 14 ISSRs primers generated 101 polymorphic bands corresponding to a percentage of polymorphism nearly 80%. This high percentage of polymorphism suggests that there is an important genetic diversity in this melliferous and medicinal species in Morocco. While the mean of I and Ht indicates that there is a high genetic diversity in this species. Thus, the high values of PIC and Rp parameters show that the ISSR primers are very informative and effective to analyse the genetic diversity of *E. resinifera*. The results of the AMOVA showed that the high degree of variability is present within population. The high value of FST suggest that the studied populations are highly differentiated in agreement with very limited gene flow between each population. Additionally, the genetic structuring of populations into two groups obtained from UPGMA and Structure analysis revealed a dependence on the geographical origin of the populations. The data obtained will be useful to define conservation strategies and improvement programs of this melliferous and medicinal species.

Keywords: *Euphorbia resinifera*; genetic diversity; medicinal; ISSR; polymorphism; Morocco

EXPERIMENTAL STRENGTH INVESTIGATION OF REINFORCED COMPOSITE MATERIAL WITH NOTCHES

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ABSTRACT
Fiber Reinforced Polymer (FRP) Composite Laminates are increasingly preferred in various applications due to their impressive strength-to-weight ratio. However, the incorporation of notches into these laminates, aimed at meeting functional requirements and reducing additional weight, results in a reduction in strength. This research focuses on investigating the impact of notch size in carbon/epoxy and glass/epoxy FRP composite laminates through experimentally. Tension tests are performed on specimens with different notch shapes and sizes, revealing that CFRP composite laminates exhibit greater strength compared to GFRP composite laminates. Specifically, for the UD configuration, CFRP composite laminates demonstrate approximately 66 percent higher tensile strength than GFRP composite laminates when circular notches are considered. Similarly, for the UD configuration, CFRP composite laminates exhibit around 57 percent higher tensile strength than GFRP composite laminates for square notches.

Keywords: Fiber Reinforced Polymer (FRP), Glass/epoxy FRP composite, Carbon/ epoxy FRP composite, Unidirectional (UD)

ETHYLACETATE LEAF EXTRACT OF *PTEROCARPUS MILBREADII* AND ITS GC-MS PROFILE

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ABSTRACT
Pterocarpus milbreadii (PM) locally called "*Oha*" in Igbo, Rosewood in English, is a leafy vegetable used in preparing soup. Despite PM's preference compared to other culinary vegetables, its phytochemical constituents have not been fully investigated. This study therefore employed Gas Chromatography-Mass Spectrometry (GC-MS) to separate, identify and suggest the possible phytochemical contents in the leaves of the vegetable. The PM leaves were collected, air-dried, pulverized and extracted with ethylacetate using cold maceration method. The dried extract was reconstituted with ethylacetate and subjected to GC-MS assay. The instrument was fixed at an initial temperature of 40 °C and ramp 5 °C/min to 115 °C. The oven temperature was increased up to 250 °C. Injection port temperature was set at 250 °C. The ionization voltage was set at 70 eV. The ion source temperature was maintained at 230 °C. The spectra obtained were matched with NIST 17. The results of the study revealed that the ethylacetate leaf extract of PM contained different phytochemicals that eluted at various retention times with varying peaks. The compounds obtained include 1,4-Diacetyl-3-acetoxymethyl-2,5 methylene-I-rhamnitol, 1,5 Anhyro-d-mannitol, Galacto-heptulose, Phytol, n-Hexadecanoic acid, Octaethylene glycol monododecyl ether, [1,1-Bicyclopropyl]-2-octanoic acid, Dodecanoic acid in the decreasing order of abundance. Hexadecanoic acid recorded the highest intensity counts. Literature search revealed that the suggested phytochemicals have antidiabetic, antioxidant, antimicrobial, and anti-cholesterolemic activities. It was concluded that the ethylacetate leaf extract of PM contains important phytochemicals with therapeutic potentials.

Keywords: Biological activities, Gas chromatography-mass spectrometry, *Pterocarpus milbreadii,* Phytochemical compounds

DEVELOPMENT, CHARACTERIZATION AND AGRONOMIC EVALUATION IN THE OPEN FIELD OF NEW SLOW RELEASE FERTILIZER (SRF)

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ABSTRACT

In order to reduce the cost of fertilizers as well as their influence on the environment, scientists are paying more and more attention to slow-release or controlled-release fertilizers, which are prepared from abundantly available biodegradable natural materials such as biopolymers. Based on this context, a novel matrix-based fertilizer was prepared by encapsulation of a fertilizer containing nitrogen, phosphorus and potassium (NPK) in presence of alginate and PAM as a matrix and cross-linked by calcium chloride. The prepared materials were characterized by Fourier-transform infrared spectroscopy (FT-IR), X-ray diffraction (XRD), thermogravimetric analysis (TGA), scanning electron microscopy (SEM), water retention capability was also evaluated. The fertilizers release profile in water of the synthesized fertilizers was in good agreement with the European standard EN 13266 indicating its excellent controlled release property with a maximum release rate of 65% (nitrogen); 52% (phosphorus); and 43% (potassium) for 56 days. We also followed the release profile in the soil, and the results show a maximum release rate of 33% (nitrogen), 26% (phosphorus); 22% (potassium) for 35 days. These good characteristics revealed that the prepared S-CRF beads can be practically used in agricultural applications.

Keywords: Slow-Controlled Release Fertilizer (SCRF), Encapsulation, NPK

DEVELOPING THE AGROINDUSTRY IN NIGERIA THROUGH EFFICIENT AND EFFECTIVE EMBEDDED SYSTEM & ROBOTICS (ESR) SKILL ACQUISITION

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ABSTRACT
The output of farming operations is what keeps the agroindustry alive. However, for the agroindustry to flourish efficiently and effectively in Nigeria, farming practices must be smart and intelligent. Farming instruments and techniques like drones, Embedded Systems & Robotics needs to be deployed. This study tends to utilize the descriptive research method to evaluate prior technical research works that were intended to improve and increase crop yields in order to analyze the level of improvements at enhancing crop yields in order to achieve the needed development in the agroindustry. The actions of the research case study at creating the necessary knowledge and equipment for smart farming locally are reviewed in this study using the same research methodology. The results of this study demonstrate that several local efforts have been undertaken to enhance farming techniques in order to improve local food security and raise yields required for the production of raw materials for the agroindustry. Additionally, the case study's findings demonstrate that local ability exists to create local drone assembly and ESR skills required to enhance farming practices. Additionally, this demonstrates how Nigeria might lower its foreign exchange expenditures by improving indigenous ESR and drone assembly skills. The study comes to the conclusion that if the case study's efforts receive additional funding through government assistance and grants from the agricultural industry, local development of smart farming instruments and skills is feasible.

Keywords: Embedded Systems & Robotics, Drone Assembly, Drones, Smart and Intelligent Farming, Agroindustry

TARIM VE KIRSAL KALKINMAYI DESTEKLEME KURUMUNUN KASTAMONU İLİ TARIMSAL ÜRETİMİNE KATKISI: BÖLGESEL BİR ANALİZ

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ÖZET

Covid salgını gıda arzı ve tarımsal üretimin öneminin tüm dünyada anlaşılmasını sağlamıştır. Katılım Öncesi Mali Yardım Aracı-IPA, AB'nin Türkiye gibi aday ve potansiyel aday ülkelere sağladığı tüm katılım öncesi mali yardımları kapsayan bir programdır. Bahsedilen bu mali yardımların temel amacı, Topluluk politikalarına uyum dolayısıyla aday ve potansiyel ülkelerin Avrupa Birliği üyeliğine hazırlanmalarına destek sağlamaktır. Türkiye'de AB Katılım Öncesi Yardım Aracı (IPA) bileşenlerinden birisi olan kırsal kalkınma (IPARD) yardımlarından yararlanmak için 2007 yılında 5648 sayılı kanunla Tarım ve Orman Bakanlığı'na bağlı Tarım ve Kırsal Kalkınmayı Destekleme Kurumu (TKDK) kurulmuştur. Mevcut potansiyelin hayata geçirilmesi ve yerel girişimcinin desteklenmesine odaklanan içsel kalkınma yaklaşımlarında, AB fonlarından kırsal kalkınmaya yönelik destek alabilmek TKDK'nın projeye bağlı çağrıları ile mümkün olabilmektedir. Kurum, tabandan-tavana yönelen yeni bölgesel kalkınma anlayışında önemli bir aktördür. Bugün 42 ilde kurulu bulunan koordinatörlükler, önce 2008 yılında 1.faz kapsamında 20 il ile başlamış, sonra bu illere 2. faz olarak 2012 yılında 22 il daha eklenmiştir. Kastamonu İli, ikinci grup iller arasında yer almakta olup, TKDK Kastamonu İl Koordinatörlüğü, 2013 yılında 9.başvuru çağrı ilanı döneminde başvuru sahipleri ile sözleşme imzalamaya başlamıştır. Çalışmada TKDK'nın Kastamonu İli tarımsal üretimine dolayısıyla kırsal kalkınmasına katkısını tespit etmek için, karşıt durum etki değerlendirme yöntemi kullanılmıştır. Bu yöntemde kamu politikalarının etkisi müdahale edilen birim/grup ile müdahale edilmeyen birim/grubun (kontrol grubu) mukayese edilmesine dayanmaktadır. Çalışmada müdehale birimi olan Kastamonu İli ile kontrol birimleri olarak ele alınan ve TKDK kurulu olamayan komşu iller Sinop ve Karabük ile karşılaştırılmıştır. Analiz Tarımsal GSYİH, bitkisel ve hayvansal tarımsal üretim değerleri ile ekilen tarım alanları gibi değişkenlerin 2013-2020/2021 (mevcut son yıl verileri) dönemi artış oranlarının karşılaştırması şeklinde yapılmıştır. Analiz bulguları, Kastamonu İlinin artış oranlarının genellikle komşu iller Sinop ve Karabük'ten daha yüksek olduğunu göstermiştir.

Anahtar Kelimeler: Kırsal Kalkınma, Kastamonu, TKDK

AGRICULTURE AND RURAL DEVELOPMENT SUPPORT INSTITUTION CONTRIBUTION TO AGRICULTURAL PRODUCTION IN KASTAMONU PROVINCE: A REGIONAL ANALYSIS

ABSTRACT

The Covid pandemic made the world realize the importance of food supply and agricultural production. The Instrument for Pre-Accession Assistance-IPA is a program that covers all pre-accession financial assistance provided by the EU to candidate and potential candidate countries such as Turkey. The main objective of this financial assistance is to support the preparation of candidate and potential candidate countries for membership of the European Union through alignment with Community policies. In Turkey, the Agriculture and Rural Development Support Institution (ARDSI) under the Ministry of Agriculture and Forestry was established in 2007 with Law No. 5648 in order to benefit from rural development (IPARD) aid, one of the components of the EU Instrument for Pre-Accession Assistance (IPA). In endogenous development approaches that focus on realizing the existing potential and supporting local entrepreneurs, it is possible to receive support from EU funds for rural development through project-related calls of ARDSI. The Institution is an important actor in the new bottom-up approach to regional development. The coordinatorships, which are established in 42 provinces today, started with 20 provinces within the scope of the 1st phase in 2008, and then 22 provinces were added to these provinces in 2012 as the 2nd phase. Kastamonu Province is among the second group of provinces and ARDSI Kastamonu Provincial Coordination Office started to sign contracts with applicants in the 9th application call announcement period in 2013. In the study, the counterfactual impact assessment method was used to determine the contribution of ARDSI to the agricultural production and thus rural development of Kastamonu Province. In this method, the impact of public policies is based on comparing the intervention unit/group with the non-intervention unit/group (control group). In the study, Kastamonu Province, which is the intervention unit, is compared with the neighboring provinces of Sinop and Karabük, which are considered as control units and which do not have ARDSI. The analysis was carried out by comparing the growth rates of variables such as agricultural GDP, crop and animal agricultural production values and cultivated agricultural areas for the period 2013-2020/2021 (last available year data). The findings of the analysis show that the growth rates of Kastamonu Province are generally higher than the neighboring provinces of Sinop and Karabük.

Keywords: Rural Development, Kastamonu, ARDSI

STUDY OF THE LOCAL AND GLOBAL STABILITY OF A BIOECONOMIC MODEL SECHJ

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ABSTRACT
The proposed model for such a corruption virus includes the essential theories and concepts of mathematical modeling. We build a novel SECHJ epidemiology model that accounts for two strains. Stability is the subject of much research. When $R 0$ is less than one, we assert that the corruption-free equilibrium is stable. Only when $R 0 > 1$ does the endemic equilibrium show up, indicating the fact that there is corruption in the community. As well as we use a modified Lotka-Volterra model to study global stability. We carry out comprehensive numerical simulations to support the analytical results based on Pontryagin's maximum principle and an evaluation of the conditions for optimal management of corruption spread.

Keywords: Lotka-Volterra Model, Corruption, Stability

LA QUESTION DE L'ACCES DES JEUNES AU FONCIER AGRICOLE DANS LE CONTEXTE DE L'ETALEMENT DE L'ARRONDISSEMENT DE SEME-PODJI AU BENIN

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Résumé
L'arrondissement de Sèmè-Podji connaît une forte croissance démographique et spatiale engendrant le problème d'accès de la jeunesse à la terre agricole. L'objectif général de cette recherche vise à étudier les effets de l'étalement urbain sur l'accès de la jeunesse au foncier agricole dans l'arrondissement de Sèmè-Podji. L'approche méthodologique utilisée est basée sur la recherche documentaire et les enquêtes de terrain pour la collecte des données, leur traitement et l'analyse des résultats. 80 ménages ont été enquêtés. L'analyse des résultats a été faite suivant le modèle PEIR (Pression, Etat, Impact, Réponse). Les résultats montrent la perte de terres cultivables au profit des habitations. L'espace urbanisé entre 2005 et 2021 a connu une forte augmentation de superficie passant de 201 ha à 485 ha. Les ventes de terre à des fins spéculatives sont une menace pour les terres agricoles. S'il est difficile d'avancer des chiffres pour montrer l'ampleur de ce phénomène d'accaparement des terres agricoles compte tenu de l'état de morcellement des domaines vendus (généralement des domaines de 500 m2), il est aussi incontestable que l'importance de ces espaces vides avec plaques dans tous l'arrondissement témoigne de la forte pression sur les terres agricole. Ainsi, les jeunes agriculteurs rencontrent de difficultés pour accéder aux terres agricoles.

Mots clés : Sèmè-Podji ; foncier agricole ; étalement ; urbanisation ; croissance démographique

İZMİR İLİ BAZI İÇ MEKAN SÜS BİTKİLERİNDE GÖRÜLEN FUNGAL KÖK VE KÖK BOĞAZI HASTALIKLARININ SAPTANMASI ÜZERİNE ARAŞTIRMALAR

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ÖZET

Bu çalışmada İzmir ilinde iç mekan süs bitkisi üretiminin yoğun olduğu Bayındır ve Urla ilçelerinde bulunan üretim alanlarında, yetiştiricilik açısından ve ekonomik açıdan öneme sahip bitkilerde kök ve kök boğazı hastalıklarına sebep olan etmenlerin morfolojik tanısının yapılması ve konukçu bitkilerdeki virulensliğin ortaya konulması hedeflenmiştir. Bu amaçla süs bitkisi yetiştiriciliği yapılan Bayındır ve Urla ilçelerinden hastalık belirtisi gösteren, asimptomatik olarak belirti göstermeyen ve hastalıklı bitkilerin yakınında bulunan bitkilerden toplam 65 adet bitki örneklemesi yapılmıştır. Survey aşamasında toplanan bitki örnekleri arasında 36 adet *Pelargonium* sp. (sardunya), 14 adet *Primula vulgaris* (çuha çiçeği), 6 adet *Pelargonium* sp. (sakız sardunya) ve 9 adet *Cyclamen* sp. (sıklamen) bitkisi bulunmaktadır. Yapılan izolasyonlar sonucu Bayındır'dan toplanan ve örneklemenin büyük bir bölümünü oluşturan sardunya bitkisi örneklerinden, %71 *Fusarium* spp. , %71 *Rhizoctonia* spp., %47 oranında *Cylindorcarpon* spp. elde edilmiştir. Urla ilçesinden toplanan sardunya bitkisi örneklerinden elde edilen izolatlar ise, %33 *Fusarium* spp., %20 *Rhizoctonia* spp. ve %26 oranında *Cylindrocarpon* spp. olarak belirlenmiştir. Örneklemede toplanan diğer süs bitkileri olan çuha çiçeği, sakız sardunya ve sıklamen bitkilerinden elde edilen izolatlar arasında da *Fusarium* spp., *Rhizoctonia* spp., *Cylindorcarpon* spp., *Pythium* spp., *Macrophomina* spp., *Aspergillus* spp., *Alternaria* spp., *Myrothecium* spp., *Pestalotia* spp. *Ulocladium* spp. ve *Botrytis* spp. yer almaktadır. Elde edilen izolatlar, morfolojik tanıları yapıldıktan sonra, patojenisite testine tabi tutulmuştur. Patojenisite testinde en virülent bulunan izolatlar, *Fusarium spp*. genusuna ait olan F4 ve F12 olarak isimlendirilen izolatlar ile, *Pythium* genusuna ait olan P2 olarak isimlendirilen izolat olmuştur.

Anahtar Kelimeler: Kök ve kök boğazı hastalıkları, *Fusarium* spp., İç mekan süs bitkileri, Fungal patojenler

RESEARCH ON THE DETECTION OF FUNGAL ROOT AND CROWN ROT DISEASES IN SOME INDOOR ORNAMENTAL PLANTS IN IZMIR PROVINCE

ABSTRACT

In this study, it was aimed to carry out the diagnosis of the fungal pathogens causing root and crown rot diseases in the production areas of Bayındır and Urla districts, where indoor ornamental plant production is intense, in plants that are important for cultivation and economically, and to reveal the virulence of the host plants, in İzmir province. For this purpose, a total of 65 plant samples showing disease symptoms and found asimptomatically that are located near the diseased plants, were collected from Bayındır and Urla districts where ornamental plants are grown. Among the collected samples, there were 36 *Pelargonium* sp. (Geranium), 14 *Primula vulgaris* (primrose), 6 *Pelargonium* sp. (Hanging geraniums) and 9 *Cyclamen* sp. (Cyclamen) ornamental plants. As a result of the isolation studies, the isolates obtained from the geranium plant samples collected from Bayındır constituting the majority were 71% *Fusarium* spp., 71% *Rhizoctonia* spp. and 47% *Cylindorcarpon* spp. The isolates obtained from geranium plant samples collected from Urla district were 33% *Fusarium* spp., 20% *Rhizoctonia* spp., and 26% *Cylindrocarpon* spp. have been determined. From other samples taken from ornamental plants such as primrose, hanging geraniums, and cyclamen, *Fusarium* spp., *Rhizoctonia* spp., *Cylindorcarpon* spp., *Pythium* spp., *Macrophomina* spp., *Aspergillus* spp., *Alternaria* spp., *Myrothecium* spp., *Pestalotia* spp., *Ulocladium* spp. and *Botrytis* spp. were isolated. After the morphological diagnosis of the isolates, the pathogenicity tests was carried out on test plants. The most virulent isolates in the pathogenicity tests were found the F4 and F12 isolate from *Fusarium* spp. and P2 isolate from *Pythium* spp.

Keywords: Root and crown rot diseases, *Fusarium* spp., Indoor ornamental plants, Pathogenic fungi

EXPLORING THE IMPACT OF DIVERSE FLOW FIELD ARCHITECTURES IN FUEL CELLS

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ABSTRACT
In this numerical study, a three-dimensional model was developed to investigate the performance of proton exchange membrane (PEM) fuel cells with straight and serpentine flow fields. This model incorporates the key transport phenomena involved in a fuel cell, considering essential chemical processes. The conservation equations for mass, momentum, and species are presented, accurately describing the reactant and chemical species fluxes within the cell. The model takes into account the electrochemical reactions at the electrodes, where reactive oxygen and hydrogen species interact with catalysts present on the electrode surfaces. Electric potential fields are also considered as they play a crucial role in the movement of electric charges across the membrane and current collector. Using a computational method based on fluid dynamics, such as the finite volume method in ANSYS FLUENT software, the transport and chemical equations are numerically solved to determine the distributions of oxygen and hydrogen molar concentrations, as well as the current density inside the fuel cell. The modeling results revealed that the serpentine flow field exhibits better current density distribution, suggesting an enhancement in the efficiency of the chemical reaction and overall fuel cell performance. This information is crucial for the design and optimization of proton exchange membrane fuel cells, providing valuable insights into the transport and chemical mechanisms governing their operation.

Keywords: Chemical processes, Electrochemical reactions, Transport phenomena, Proton exchange membrane.

EFFECT OF LYCOPENE ALONE AND ALONG WITH COENZYME-Q10 IN STREPTOZOTOCIN INDUCED PERIPHERAL NEUROPATHY: BIOCHEMICAL & BEHAVIORAL STUDY

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ABSTRACT

Diabetic Neuropathy (DN) is a major chronic consequence of diabetes. DN is developed due to chronic hyperglycemia which is related to the production of oxidative stress (OS) and alteration in neuronal function. The present study was envisaged to find the possible neuroprotective effect of natural antioxidants i.e., lycopene and coenzyme Q10 (CoQ10) as monotherapy or concomitant administration in rats subjected to DN induced by streptozotocin (STZ). A single subcutaneous injection of STZ (55 mg/kg) was used to induce DN in male Wistar rats (200–250 g). Significant neuropathy was observed after four weeks of streptozotocin injection. Neuropathy was evaluated by behavioral parameters using mechanical allodynia, mechanical hyperalgesia, heat/thermal hyperalgesia and walking track analysis. Oxidative stress was determined by assessment of malondialdehyde (MDA), superoxide dismutase (SOD), catalase (CAT), reduced glutathione (GSH), and nitric oxide (NO) and also the membrane-bound ATPases activity (Na^+/K^+, Ca^{2+}, Mg^{2+}) in sciatic nerve homogenate. STZ significantly alters all behavioral as well as biochemical parameters. Treatment with lycopene (5mg/kg/p.o.), CoQ10 (10mg/kg, p.o.) and their combination for four weeks significantly reduced blood glucose level. The pain threshold of DN rats was significantly increased and the sciatic functional index was significantly improved. The level of antioxidant parameters such as LPO and NO were decreased and SOD, GSH and CAT levels significantly increased. ATPases activity was significantly improved with the combination of lycopene and CoQ10. The combination of both antioxidants significantly reversed the streptozotocin-induced neuropathy in rats compared to the alone antioxidants as well as the diabetic neuropathy group. It is concluded that the neuroprotective effect of lycopene, CoQ10 alone and in combination might be due to their strong antioxidant property.

Keywords: Diabetic neuropathy, Oxidative stress, Streptozotocin, Lycopene, CoQ10, Antioxidant

THE ENVIRONMENTAL AND ECONOMIC IMPACTS OF THE USE OF RECYCLED ASPHALT DURING THE PREVENTIVE MAINTENANCE OF ROADWAYS IN THE UAE

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ABSTRACT

Roadways are one of the significant important elements in infrastructure because they are characterized simply as the point of interaction between societies and people. Any country in the world needs to create roadways so that citizens and visitors can travel easily and smoothly. Mainly roadways have been the main source by which whole economies and societies have emerged and developed over the years. This study seeks to assess the application of recycled asphalt in roadways maintenance by comparing it to the current roadway maintenance procedures in terms of technical parameters in construction procedures, timelines …etc. Furthermore, the environmental and economical requirements are highlighted and explored. This will enable the study to identify the possible benefits of using recycled asphalt pavement in roadway maintenance. One of the benefits of using this construction material includes the economic benefits of saving on cost in material consumption, energy conservation in the processes, and environmental protection, which are imperative attributes in the development of sustainable human activities. However, other studies have indicated that asphalt has numerous disadvantages that should be considered before it can be fully adopted. Some of the challenges regard the technical aspects, mechanical considerations, and other quality concerns. This implies that while recycled asphalt can be used as a sustainable material, there is a need to conduct an in-depth analysis to verify and quantify the effectiveness of the material, where the information is limited in the current literature. This study addresses the importance of using recycled asphalt with the integration of road maintenance procedures in the road network. This element is considered the main element of any national infrastructure development plan. The research aims to study and highlight the using recycled asphalt as a suggested sustainable method for road maintenance procedures. Therefore, the study elaborates on the historical use of recycled asphalt, its advantages, and disadvantages. Besides that, the maintenances process categories to ensure the suitable type that ensures the best quality of the network. Since roadway pavement assessment is based on quality as well as different characteristics parameters such as rutting, cracking, pavement quality Index, and roughness The realization of addressing the factors is an important matter to prevent any threats and challenges during the life cycle of the road network. This can be done by establishing a new implementing process such as using recycled asphalt in pavement rather than the traditional pavement. The new process may provide unique outcomes from environmental, social, and economic perspectives and dedicate policy and strategy to enhancing the quality of roadways. In addition to other parameters. The selected case study for this research is the Dibba-Masafi E89 roadway in UAE where the research methodology is conducted by elaborating the current situation of the roadway performance and the conduct recycled asphalt as solution to ensure better performance.

Keywords: Recycled asphalt, roadway maintenance, pavement parameter, condition index

MANAGEMENT OF RICE SHEATH BLIGHT INCITED BY *Rhizoctonia solani* USING *Trichoderma viride*

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ABSTRACT
Rice (*Oryza sativa* L.) is one of the most important and staple crops grown around the world. Rice crop is majorly affected by various pathogenic diseases including fungal, bacterial, Phytoplasmal and viral diseases. Among the fungal diseases, Sheath blight caused by *Rhizoctonia solani* causes yield loss of more than 25%. The pathogen *Rhizoctonia solani* is both seed as well as soil borne. In seeds, it survives in the form of mycelium and in soil it persists as resting spore sclerotia. Management of this pathogenic disease using chemical method is not recommended as it causes environmental hazards. So, this disease can be managed using the fungal bio control agent *Trichoderma viride* by seed treatments, foliar and soil application. For seed treatment 4g of *T. viride* was mixed with 1 kg of paddy seeds, for foliar application 20% concentration of *T. viride* was sprayed after the disease infestation and for soil application 2.5kg/ha of *T. viride* was mixed with 50kg of well decomposed farm yard manure. The efficacy of the fungal antagonist was tested using dual culture technique in which inhibition zone was observed, known to control the growth of pathogen. Thus, *Trichoderma viride* can be used in various methods to control the sheath blight disease of rice.

Keywords: Rice, *Rhizoctonia solani*, *Trichoderma viride*, dual culture technique

REMOVAL OF CATIONIC DYE BY AN ACTIVATED BIOCHAR DERIVED FROM ANAEROBIC DIGESTION DIGESTATE: EFFECT OF PYROLYSIS TEMPERATURE

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ABSTRACT
This research aimed to investigate the impact of activating activated carbon derived from digestate obtained through the anaerobic digestion process of poultry by-product pyrolysis at temperatures of 500 and 600 °C using caustic potash and nitric acid. The objective was to assess the effectiveness of the activated carbon in removing methylene blue dye (MB) from water through adsorption. The structural and chemical properties of the obtained activated carbon adsorbents were analyzed using X-ray diffraction (XRD) spectroscopy, Fourier transforms infrared (FTIR) spectroscopy, and scanning electron microscopy (SEM) in conjunction with energy-dispersive X-ray spectroscopy (EDX). The optimal conditions for significant removal of MB dye from the aqueous solution were determined to be a pH value of 10, an adsorbent dose of 0.6 g/L, a contact time of 20 minutes, and an initial dye concentration of 300 mg/L. Among the tested adsorbents, BC500_HNO3 exhibited the highest adsorption capacity with a maximum value of 101 mg/g. Reaction kinetics analysis revealed that the adsorption process followed the pseudo-second-order kinetic model. BC600_KOH demonstrated the highest reaction rate constant of 0.058 and a strong correlation coefficient value of 0.9997. The adsorption behavior of MB was well described by the Freundlich isotherm model, indicating multilayer adsorption.

Keywords: Biochar, adsorption, dyes, environment

KONYA İLİNDEKI HUBUBAT DEPOLARININ MEVCUT DURUMU VE BAZI ÖZELLİKLERİ BAKIMINDAN DEĞERLENDİRİLMESİ

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ÖZET

Bu çalışma, tahıl depolarının mevcut durumunu ortaya koymak, teknik ve yapısal özelliklerini belirlemek ve sorunlara çözüm önerileri getirmek amacıyla Konya bölgesinde profesyonel depoculuk yapan 30 işletmede gerçekleştirilmiştir. Araştırmada, yürütülen anket ve saha çalışmalarından elde edilen verilere göre bölgedeki hububat depoları çeşitli kategorilerde değerlendirilmiştir. İncelenen depolama yapılarının %65'i lisanslı, %16'sı ticari, %13'ü TMO'dan kiralık ve %6'sı kuruluş işletmesidir. Siloların %42'si düz tabanlı çelik silo, %24'ü konik tabanlı çelik silo, %27'si beton silo ve %7'si yatay beton depo şeklinde tasarlanmıştır. Toplam depolama kapasitesi ise düz tabanlı çelik siloların 741850 ton, konik tabanlı çelik siloların 184050 ton, beton siloların 69845 ton ve yatay beton depoların 152250 ton olmak üzere, işletmelerin toplam depolama kapasitesi 1 147 995 tondur. İşletme başına ortalama depolama kapasitesi yaklaşık 38267 ton olup, işletme başına silo (depo) sayısı ise 20 adettir. Ürünlerin depolanma süresi 3 haftadan 36 aya kadar değişiklik göstermesine rağmen depolama süresi genellikle bir sezondur (6-9 ay). İşletmelerin %40'ının doluluk oranı %0-25, %30'unun doluluk oranı %26-51, %20'sinin doluluk oranı %51-75 iken, %10'unun doluluk oranı %76-100 arasında değişmektedir. Depoların %93'ünde mekanik havalandırma sistemleri ile havalandırma yapılmasına rağmen %7'sinde havalandırma sistemi bulunmamaktadır. Arazi çalışmaları sırasında, havalandırma sistemlerinin genellikle solunum ve radyasyondan kaynaklı fazla ısıyı dışarıya atmakta yetersiz kaldığı gözlemlenmiştir. Ayrıca bazı dönemlerde havalandırma kapasitesinin yetersizliğinden dolayı ürünlerde tutukluk, bozuşma ve çürümeden dolayı kayıplar meydana gelmektedir. Depolama yapılarının %89.4'ü tek kanatlı, %6.1'i kepenk, %1.8'i sürgülü, %0.9'u çift kanatlı ve %1.3'ü endüstriyel seksiyonel kapıya sahiptir. Depolama yapılarının %89.4'ünde konik çatı sistemi ve %10.1'inde beşik çatı sitemi bulunmasına rağmen %0.5'inde çatı bulunmamaktadır. Beşik çatıya sahip depoların yaklaşık %80'inde çatı malzemesi olarak trapez galvanizli sac kullanılmakta iken yaklaşık %12'sinde ise sandviç panel kullanılmıştır. Konik çatılı siloların tamamında ise trapez kesitli galvanizli sac kullanılmıştır. Birim alanda daha fazla ürün depolanabilmesi, düşük iş gücü gereksinimi, otomasyon sistemlerinin verimliliği ve inşa kolaylığı gibi sebeplerden dolayı Konya ilinde çelik silolar tahıl depolamaya daha uygun olacaktır.

Anahtar Kelimeler: Tahıl Depoları, Çelik Silo, Beton Depo, Depolama Yapıları, Kapasite

CURRENT SITUATION OF GRAIN WAREHOUSES IN KONYA PROVINCE AND EVALUATION OF SOME PROPERTIES

ABSTRACT

This study was carried out in 30 professional warehousing enterprises in Konya region in order to reveal the current situation of grain warehouses, to determine their technical and structural features and to offer solutions to problems. In the research, the grain storages in the region were evaluated in various categories according to the data obtained from the survey and field studies. 65% of the storage structures are licensed, 16% are commercial, 13% are leased from TMO and 6% are establishments. Of the silos examined, 42% are designed as flat bottom steel silos, 24% conical bottom steel silos, 27% concrete silos and 7% horizontal concrete grain storages. The total storage capacity of the enterprises is 1 147 995 tons, including 741850 tons of flat bottom steel silos, 184050 tons of conical bottom steel silos, 69845 tons of concrete silos and 152250 tons of horizontal concrete silos. The average storage capacity per enterprise is approximately 38267 tons, and the number of silos per enterprise is 20. Although the storage period of the products varies from 3 weeks to 36 months, the storage period is usually one season (6-9 months). While the occupancy rate of 40% of the enterprises is 0-25%, the occupancy rate of 30% is 26-51%, the occupancy rate of 20% is 51-75%, the occupancy rate of 10% varies between 76-100%. Although 93% of the grain storages are ventilated with mechanical ventilation systems, 7% of them do not have a ventilation system. During field studies, it has been observed that ventilation systems are generally insufficient to remove excess heat from respiration and radiation. In addition, in some periods, due to the insufficient ventilation capacity, losses occur in the products due to deterioration and decay. 89.4% of the storage structures have single leaf doors, 6.1% shutters, 1.8% sliding doors, 0.9% double leaf doors and 1.3% industrial sectional doors. Although 89.4% of the storage structures have a conical roof system and 10.1% have a cradle roof system, 0.5% do not have a roof. While trapezoidal galvanized sheet is used as roof material in approximately 80% of storage houses with cradle roofs, sandwich panels are used in approximately 12%. Trapezoidal galvanized sheet metal is used in all silos with conical roofs. Steel silos will be more suitable for grain storage in Konya province due to reasons such as more product storage per unit area, low labor requirement, efficiency of automation systems and ease of construction.

Keywords: Grain Warehouses, Steel Silos, Concrete Warehouses, Storage Structures, Capacity

VALUES OF THOUGHT K.H. ABDURRAHMAN WAHID (GUS DUR) AND ITS RELEVANCE TO ISLAMIC BUSINESS ETHICS

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ABSTRACT

Purpose: This paper aims to explain the Values of Thought of K.H.Abdurrahman Wahid (Gus Dur) and Its Relevance to Islamic Business Ethics by formulating the following questions: first, what is Islamic Business ethics? Second, what are the basic axioms of Islamic Business Ethics? Third, what are the values of K.H. Abdurrahaman Wahid's thoughts Fourth, what is the relevance of the values of K.H. Abdurrahman Wahid Fifth, what is the function of Business Ethics. **Design/methodology/approach:** This paper uses a qualitative approach, because data sources and research results are in library research, inductive data analysis, grounded theory (toward the direction of developing a theory based on data). **Findings:** First, Islamic business ethics is morals in carrying out business according to Islamic values, so in carrying out its business there is no need worry because it is believed to be something which is good and true.
Second, the axiom principles, namely there are five concepts, are called the basic axioms of ethics Islamic business, which consists of its general principles assembled into a single unit consisting of: Unity (Tawhid / Unity, Balance (Justice Equilibrium), Free Will (Ikhtiyar / Free Will), Accountability (Responsibility), Courtesy.
Third, THINKING VALUES K.H. ABDURRAHMAN WAHID namely:
1. Monotheism
2. Humanity
3. Justice
4. Equality.
5. Liberation
6. Simplicity
7. Chivalry
8. Wisdom Tradition

Fifth, THE FUNCTION OF ISLAMIC BUSINESS ETHICS Namely:
A. Business ethics seeks to find ways to harmonize and harmonizing various interests in the business world.
B. Business ethics also has a role to play to change the awareness of the community about business, especially Islamic business

C. Business ethics, especially Islamic business ethics, can also play a role provide a single solution to various business problems This modern era is increasingly far from ethical values. **Originality/value:** This paper describes comprehensively the Values of Thought of K.H. Abdurrahman Wahid (Gus Dur) and Its Relevance to Islamic Business Ethics

Keywords: Islamic Business Ethics, the basic axioms of Islamic Business Ethics, the values of K.H. Abdurrahman Wahid, the relevance of K.H. Abdurrahman Wahid on Islamic Business Ethics, function of Islamic Business Ethics

BUĞDAY BİTKİSİNDE PESTİSİT ZARARLARI

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ÖZET
Pestisitler günümüzde modern tarım açısından vazgeçilmez unsurlar olmaktadır. Fakat kontrolsüz ve bilinçsiz biçimde kullanılan pestisitlerin çevre ve insan sağlığına ciddi oranda zarar vermekte olduğu yapılan çalışmalarda elde edilen bulgular arasında yer almaktadır. Pestisitlerin bunun yanında depolanması ve artan ilaçların bertarafı esnasında ortaya çıkan hatalara bağlı olarak da çevre kirliliğinin meydana gelmesi söz konusu olmaktadır. Buna bağlı olarak pestisitler çok sayıda canlı üzerinde toksik etkiye sahip olduğundan bahsetmek gereklidir. Bu çalışmada maksat pestisitlerin araştırılarak insan sağlığı üstündeki etkilerinin ortaya konulmasıdır. Buğday bitkisinde yer alan pestisit kalıntılarının miktar açısından incelenmesi ve sonuçlarının değerlendirilmesi çalışma kapsamında hedeflenmektedir. Çalışmada buğday bitkisinde kalıntı halde bulunan pestisitlerin analiz edildiği farklı çalışmalar taranmıştır. Buna bağlı olarak pestisitlerin insan sağlığı üstünde ciddi etkilerinin bulunduğu ve bazı pestisit türlerinin yasaklandığı sonucuna erişilmiştir. Oldukça toksik maddeler olan pestisitlerin insan sağlığı üstünde kanserden böbrek rahatsızlıklarına dek çok sayıda hastalığa neden olduğu yapılan araştırmalarda elde edilen neticeler içinde yer almaktadır. Bu nedenle pestisit kullanımının bilinçli olması ve bu konuda uzman olan kişiler tarafından yapılmasının gerekliliği öne çıkmaktadır. Ayrıca pestisitlerin insan sağlığına ve çevreye daha az zararlı olanları tercih edilmelidir.

Anahtar Kelimeler: Buğday, Pestisit, Pestisit Kalıntıları

DAMAGES OF PESTICIDE ON WHEAT PLANT

ABSTRACT

Pesticides are indispensable elements in modern agriculture today. However, it is amongthe findings obtained in studies that pesticides used in an uncontrolled and unconscious way cause serious harm to the environment and human health. In addition to this, environmental pollution occurs due to the errors that occur during the storage of pesticides and the disposal of excess drugs. Accordingly, it is necessary to mention that pesticides have toxic effects on many living things**.** The aim of this study is to investigate pesticides and to reveal their effects on human health. The aim of the study is to examine the pesticide residues in the wheat plant in terms of quantity and to evaluate the results. In the study, different studies were scannedin which pesticides found in the wheat plant were analyzed. Accordingly, it has been concluded that pesticides have serious effects on human health and that some pesticide types are prohibited. It is among the results obtained in researches that pesticides, which are highly toxic substances, cause many diseases on human health, from cancer to kidney disorders. Forthis reason, it is important to be conscious of pesticide use and to be done by experts inthis field. In addition, pesticides that are less harmful to human health and the environment should be preferred.

Keywords: Wheat, Pesticide, Pesticide Residues

ASSESSING CARBON SEQUESTRATION, CARBON FOOTPRINT, AND LIFE CYCLE ANALYSIS IN MOROCCAN OLIVE GROVES: TOWARDS SUSTAINABLE OLIVE OIL PRODUCTION

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ABSTRACT
Climate change poses significant threats to global ecosystems, underscoring the urgent need to ensure the sustainability of both natural and agroecosystems. Mitigating its impacts requires concerted efforts to reduce greenhouse gas (GHG) emissions and enhance carbon sequestration and storage. Olive trees, known for their resilience and adaptability, offer considerable potential in mitigating climate change due to their ability to store carbon in aboveground biomass and soil. This study investigates the carbon footprint and sequestration potential of different olive cultivation systems in Morocco's Marrakech-Safi region, ranging from extensive to super-intensive management, with the aim of mitigating climate change effects. Our findings reveal that olive tree plantations, especially those employing high-density plantings, exhibit significant CO2 storage capacity. The net carbon balance demonstrates encouraging results, with negative values indicating carbon sequestration. Notably, our study reveals that the production of one liter of olive oil contributes to the fixation of 5.7 kg CO2-eq in the soil, resulting in an average carbon balance of -4.37 kg CO2-eq in irrigated intensive cultivation systems. Furthermore, our research highlights the exceptional productivity and environmental efficiency of super-intensive cultivation systems, as they showcase a remarkable ability to sequester atmospheric CO2. Specifically, olive groves in the Marrakech-Safi region can store an average of 68.7 tons of CO2-eq in the soil per hectare per year. This study provides valuable insights for the development of innovative solutions aimed at mitigating GHG emissions and fostering sustainability in Morocco's agricultural sector, particularly in the face of ongoing global environmental changes.

Keywords: Olive tree, Climate change, Carbon footprint, Sequestration, Carbon balance, Sustainability

AMELIORATIVE EFFECT OF LYCOPENE ALONE AND IN COMBINATION WITH CO-ENZYME Q10 IN STREPTOZOTOCIN-INDUCED DIABETIC NEPHROPATHY IN EXPERIMENTAL RATS

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ABSTRACT
Diabetic nephropathy (DN) has become an utmost reason for long-standing renal dysfunction and end-stage renal disease globally. Oxidative stress induced by persistent hyperglycaemia is considered a fundamental element in the evolution of DN. The goal of this research was to discover the outcome of appendages of natural antioxidants such as lycopene and co-enzyme Q10 (CoQ10) in DN rats and to observe the preventive effects in DN. A diabetes model was developed in a Wistar strain of male rats (200 – 250 gm) by subcutaneous injection of streptozotocin (55 mg/kg). Development of nephropathy was assessed by renal function tests including blood glucose, creatinine, albumin, total protein, total bilirubin, uric acid, total cholesterol, triglycerides, and CRP level. Oxidative stress markers such as LPO and GSH content and activity of membrane-bound Na^+/K^+ ATPases were measured in kidney homogenate. Renal damage was assessed by performing a histopathological analysis. DN rats showed a significant elevation in creatinine, albumin, total protein, total bilirubin, uric acid, total cholesterol, triglycerides, CRP, and LPO levels whereas a significant reduction in creatinine clearance and GSH level. Treatment with antioxidants such as lycopene (5mg/kg/p.o.) and CoQ10 (10 mg/kg/p.o.) along with their combination for 4 weeks notably altered the level of renal function biomarkers and oxidative stress markers. These antioxidants and their combination also protected the kidney from abnormal morphological changes. The present findings suggest that the combined administration of lycopene and CoQ10, which are antioxidants, exhibits synergistic effects in mitigating renal injury by reducing hyperglycaemia, oxidative stress markers, and histopathological alterations.

Keywords: Antioxidants, CoQ10, Diabetic nephropathy, Lycopene, Oxidative stress, Streptozotocin

ARMUT ÜRETİCİLERİNİN PESTİSİT KULLANIM DAVRANIŞLARININ İNCELENMESİ: BURSA İLİ ÖRNEĞİ

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ÖZET

Tarımsal üretimde verim ve kalite artışı sağlamak amacı ile kimyasal mücadele yöntemleri yaygın olarak kullanılmaktadır. Pestisitler tarımsal ürünleri hastalık, zararlı ve yabancı otların etkisinden koruyabilmek ve kaliteli üretimi güvence altına alabilmek için kullanılan kimyasal mücadele preparatlarıdır. Pestisitler uygun miktar ve sıklıkta kullanılmadığında insan sağlığı ve çevre açısından tehdit oluşturmaktadır. Türkiye tarımsal üretimde dünyada ilk on sırada yer almaktadır. Buna paralel olarak da Türkiye'de pestisit kullanımı oldukça yoğundur. Çiftçiler, tarımsal üretimde pestisit kullanım kararını veren ana aktörledir. Davranışsal iktisat çerçevesinde çiftçilerin pestisit kullanım davranışlarının ve bu davranışlar üzerinde etkili faktörlerin araştırılması önemli görülmektedir. Tarımsal ilaç kalıntısının en yoğun kullanıldığı bitkisel ürün grubu, meyve ve sebzelerdir. Bu amaçla araştırmada Türkiye'nin 2021 yılında dünya üretiminde 5. sırada olduğu armut, ürün olarak seçilmiştir. Bursa ili Türkiye armut üretiminin % 39,4'ünü tek başına karşılamaktadır. Bu çalışmanın amacı, Türkiye açısından önemli bir tarımsal üretim potansiyeline sahip olan ve buna paralel olarak Türkiye'nin en fazla tarım ilacı kullanan illerinden biri olan Bursa ilinde, armut üreticilerinin tarım ilacı kullanım davranışlarının belirlenmesidir. Buna göre Oransal Örnekleme Formülü ile belirlenmiş 290 armut üreticisi ile yüz yüze anket yapılmıştır. Elde edilen birincil verilerin analizinde temel istatistiki yöntemlerden yararlanılmıştır. İlk olarak armut üreticilerinin demografik özellikleri incelenmiştir. Görüşme yapılan çiftçilerin tamamı erkektir. Çiftçilerin yaş ortalaması 48,3 olarak belirlenmiştir. Çiftçilerin eğitim durumları incelendiğinde % 60'dan fazlasının ortaokul veya daha altı seviyede eğitim gördüğü tespit edilmiştir. Bu çalışma kapsamında çiftçilerin pestisit kullanım davranışları da incelenmiştir. İlk olarak çiftçilerin armutta zirai ilaçlamaya karar verme zamanları incelendiğinde % 80'inin önleyici amaç ile zararlıyı veya hastalığı görmeden önce ilaçlama yaptıkları belirlenmiştir. Araştırma kapsamındaki çiftçilerin ilaç kullanım dozu belirleme yöntemlerine göre dağılımı incelendiğinde ise % 50'sinin özel ziraat mühendislerinin tavsiyelerine göre ilaç dozunu belirledikleri görülmüştür. Bunu sırası ile çiftçilerin kendi tecrübelerine göre ve gözkararı (% 31) ve ilaç pestisit prospektüsüne göre (% 15) seçenekleri izlemektedir. Çiftçilerin % 50'den fazlası uyguladıkları pestisitleri, kendi sağlıkları açısından ''son derece tehlikeli'' olarak nitelendirmektedir. Yine çiftçilerin yarısından fazlası kullandıkları pestisitleri çevre açısından orta derecede veya son derece tehlikeli olarak nitelendirmektedir.

Anahtar Kelimeler: Çiftçi, Çanakkale, Davranış, Pestisit

Not: Bu çalışma Çanakkale Onsekiz Mart Üniversitesi Lisansüstü Eğitim Enstitüsü bünyesinde hazırlanan ''Armut Üreticilerinin Pestisit Kullanım Davranışları Üzerinde Etkili Değişkenlerin Belirlenmesi: Bursa İli Örneği'' konulu tezden derlenmiştir. Ayrıca TÜBİTAK 1002 Hızlı Destek Projeleri tarafından fonlanmıştır.

DETERMINATION OF EFFECTIVE VARIABLES ON PESTICIDE USE BEHAVIORS OF PEAR PRODUCERS: THE CASE OF BURSA PROVINCE

ABSTRACT

Chemical control methods are widely used in order to increase yield and quality in agricultural production. Pesticides are chemical control preparations used to protect agricultural products from the effects of diseases, pests and weeds and to ensure quality production. Pesticides pose a threat to human health and the environment if they are not used in appropriate amounts and frequency. Türkiye ranks first in the world in agricultural production. In parallel with this, the use of pesticides in Turkey is quite intense. Farmers are the main actors who make the decision to use pesticides in agricultural production. In the framework of behavioral economics, it is important to investigate the pesticide use behaviors of farmers and the factors affecting these behaviors. The herbal product group in which pesticide residues are used most intensively is fruits and vegetables. For this purpose, the pear, which Turkey ranks 5th in world production in 2021, was chosen as the product in the research. Bursa province alone meets 39.4% of Türkiye's pear production. The aim of this study is to determine the pesticide use behaviors of pear producers in Bursa, which has an important agricultural production potential for Turkey and is one of the most pesticide-using provinces in Turkey. Accordingly, a face-to-face survey was conducted with 290 pear producers determined by the Proportional Sampling Formula. Basic statistical methods were used in the analysis of the primary data obtained. First of all, the demographic characteristics of pear producers were examined. All of the interviewed farmers are male. The average age of the farmers was determined as 48.3. When the educational status of the farmers is examined, it has been determined that more than 60% of them have been educated at secondary school or below. In this study, pesticide use behaviors of farmers were also examined. First of all, when the time of the farmers to decide on pesticides in pears was examined, it was determined that 80% of them applied pesticides before they saw the pest or disease for preventive purposes. When the distribution of the farmers within the scope of the study was examined according to the drug use dose determination methods, it was seen that 50% of them determined the drug dose according to the recommendations of private agricultural engineers. This is followed by the options according to the farmers' own experience and discretion (31%) and according to the pesticide package insert (15%). More than 50% of the farmers describe the pesticides they apply as "extremely dangerous" for their own health. Again, more than half of the farmers describe the pesticides they use as moderately or extremely dangerous for the environment.

Keywords: Farmer, Çanakkale, Behavior, Pestisit

DEFINITION AND OBJECT OF STUDY OF ISLAMIC ECONOMIC PHILOSOPHY

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ABSTRACT

Purpose: This paper aims to explain the Introduction to Islamic Economic Philosophy by formulating the following questions: First, What is the Definition of Islamic Economic Philosophy?. Second, What is the object of study of Islamic economic philosophy?. **Design/methodology/approach:** This paper uses a qualitative approach, because data sources and research results in library research, inductive data analysis, grounded theory (towards the direction of theory building based on data). **Findings:** First, "Islamic Economic Philosophy". Based on this it can be defined that the Islamic Economic Philosophy is an attempt to know and investigate with reason about the nature of everything that exists and why, where the origin and the law and the values contained in the Islamic economic science as a discipline. Second, the object of study of Islamic economic philosophy (1) Formal Objects (2) Material Objects. Islamic economic philosophy also discusses things that are ABSTRACT, (1) The meaning of the life of mankind (2) The basic nature of man who likes the world (3) Muhasabah fardhiyah in the form of recognition and introspection of oneself (4) Aqidah as a guide in conducting economic activities (5) Islamic production, distribution and consumption (6) The questions that must be answered (7) Distribution in Islamic Economics (8) Fair in Islamic economics.

Keywords: Philosophy, Economics, Philosophy of Man, Islamic Philosophy of Economics

STRATEGISING HUMAN CAPITAL: A WAY FORWARD FOR SUSTAINABILITY

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ABSTRACT

In this globalised world sustainability is important for each one of us to provide and think for the present and the future generations. Sustainability is based on Environmental, Economic and Social development. It is a social objective about the ability of people to synchronise to exist on the globe over a longer period. In everyday use, sustainability often focuses on countering major environmental problems. These include climate change and loss of biodiversity, loss of ecosystem, land degradation, and air and water pollution. Strategic Human Resource management makes the most of human potential and opportunity in today's unstable climate where Human resources are being upgraded from administrative players to strategic performers. Countries having good and stable relations with each other in international relations tend to share their inventions and innovations .The technique of attracting, developing, rewarding, and retaining people for the benefit of both the employees as individuals and the organisation as a whole is known as strategic human resource management.Strategy for promoting sustainability in all activities that include the use of resources and retention of resources to fulfil the needs of the present and the next generation. As Sustainable development is a combination of environmental issues with socio-economic issues which is common for all developing countries. India over the past 2 decades has made remarkable progress in reducing extreme poverty since world bank is partnering with the government in this effort by helping strengthen policies, institutions, and investments to create a better future for the country and it's people through green resilient, and inclusive development. With the rise in geopolitical tensions India has kept itself balanced in overall development and tried to sustain during the global pandemic and also in this situation of turmoil in the global environment due to war in Russia and Ukraine, India got the opportunity to head the G20 presidency and SCO where it is getting chance to demonstrate its thought process to focus on seeking finance for sustainable development and enhancing socio - economic development through innovative, responsible and cost efficient digital public goods . India will and is encouraging collective solutions to deal with major global challenges such as food and energy security. India's 1.3 billion human capital as a large developing economy and its ambitious adaptation to climate is not only transformational for India but for the entire globe. There is a need for elaborate study of sustainable Development goals in the context of Human Resource management and it's strategic importance.

Keywords: Sustainability, economic, social

GROWTH RESPONSE AND YIELD OF SWEET CORN (*Zea mays saccharata* Sturt.) DUE TO GIVING POC OF MORINGA LEAF AND LAMTORO LEAF

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ABSTRACT
The growth and yield of sweet corn are influenced by environmental factors such as soil fertility. Soil fertility can be improved by using organic fertilizers. The aim of the experiment was to determine the response to growth, yield and postharvest quality of sweet corn (Zea mays saccharata Sturt.) Bonanza F1 variety, due to the application of liquid organic fertilizers of moringa and lamtoro leaves. The experiment was conducted in Sepang Jaya City, Bandar Lampung, Lampung Province from November 2022 to March 2023. The experiment used a Completly Randomized Block Design (RCDB) with 7 treatment levels and four replications. Treatment namely (P0) control without fertilizer; (P1) recommended dosage of 100% inorganic fertilizer; (P2) liquid organic fertilizer for Moringa leaves; (P3) Moringa leaf liquid organic fertilizer + inorganic fertilizer recommended dose of 50%, (P4) Lamtoro leaf liquid organic fertilizer; (P5) lamtoro leaf liquid organic fertilizer + 50% recommended dosage of inorganic fertilizer, and (P6) 50% dose of Moringa leaf liquid organic fertilizer + 50% recommended dose of lamtoro leaf liquid organic fertilizer + 50% recommended inorganic fertilizer. Homogeneity of variance was tested using Bartlett's test and data additivity was tested using Tukey's test. If the assumptions are met, an anara test is performed and the mean is separated by the Least Significant Difference (LSD) test at the 5% level. The use of liquid organic fertilizers, recommendations for inorganic fertilizers, or a combination of both had a significant effect on almost all of the observed variables. The combination of liquid organic fertilizer for Moringa leaves at a dose of 50% + liquid organic fertilizer for Lamtoro leaves at a dose of 50% + inorganic fertilizer at a recommended dose of 50% showed the highest results in the number of leaves, the level of greenness of the leaves, fresh chestnut weight, and production per hectare, so that the dose can be solution for increasing yields of optimum sweet corn.

Keywords: liquid organic fertilizer, moringa leaves, lamtoro leaves, NPK, sweet corn

TANGY CREAM MADE OF WILD PLANTS

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ABSTRACT
The purpose of this project was to create a new type of sauce made from Bilimbi, a tropical fruit, and torch ginger, a well-known plant in Asian cuisine, as an alternative condiment for the community's staple food as well as snack. Bilimbi grows abundantly in the region but it is hardly consumed by the locals which causes the fruit to wither and rot as organic waste. On the other hand, torch ginger is typically used as spice in food preparation but many do not know the potential use of this plant as main ingredient. Thus, this project aimed to create sauce out of these two plants since the locals are fond of eating staple like rice or bread with spicy sauce known as "sambal". Bilimbi and torch ginger grow wildly across the country but it is rarely consumed by the community due to its lack of aesthetic appeal and its limited economic value. This research was conducted on a selected number of respondents who sampled the sauce with some dishes and rate the sauce based on several criteria including taste, aroma, texture, appearance and its nutritious content. The findings revealed that this sauce made of torch ginger and bilimbi can be commercialized throughout the state and it can help to empower the villagers who have access to these plants as natural resources that grow in their backyards.

Keywords: bilimbi, torch ginger, sauce

COOPERATIVES AS A SOLUTION TO INDONESIA'S POPULIST ECONOMY

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ABSTRACT
This research aims to provide an overview of Indonesia's economic conditions and interpret them subjectively, and propose an Indonesian-style populist economy. A nation that has low capabilities in the economic sector will become an easy market for various goods and services produced by other nations which will gradually affect the decline of the industrial sector and domestic production. This condition is desired by capitalist countries and multinational corporations that want to make a nation an easy target in the consumption of goods and services from their country, so as to destroy the domestic industrial and service sectors. Here I will provide some portraits, interpret subjectively about the portrait of Indonesia and offer an Indonesian-style populist economy. This qualitative research method uses data obtained from the media, namely rice yield data, data on rice and corn imports, seaweed, salt, and oil palm. then the data obtained is subjectively analyzed to give an explanation of the conditions behind the portrait of Indonesia. The results show that Indonesia's rich natural resources ranging from land, sea, and air do not necessarily make Indonesia an independent country. Import activities are still chosen as a solution to meet domestic needs. To become independent, it is necessary to apply the Indonesian version of the populist economic paradigm by forming a socio-economic movement to raise awareness of economic independence and unhealthy competition based on Islamic values. Forming a business entity, namely a cooperative, is an alternative solution offered.

Keywords: Koperasi, Independence, Economy

BENEFITS, OBJECTIVES AND CHARACTERISTICS PHILOSOPHY OF ISLAMIC ECONOMICS

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ABSTRACT

Purpose: This paper aims to explain about first, What are the benefits and objectives of Islamic economic philosophy?. Second, What are the characteristics of Islamic economic philosophy? **Design/methodology/approach:** This paper uses a qualitative approach, because data sources and research results in library research, inductive data analysis, grounded theory (towards the direction of theory building based on data). **Findings:** First, the existence of Islamic economic philosophy in economic activities will create an economy that is organized and does not conflict with Islamic teachings, and can create an economy that is in accordance with economic ideals in Islam, namely achieving falah, not only related to the world but also the hereafter (Rusyaida & et al, 2021). Second, Islamic economic philosophy has distinctive characteristics that are different from other philosophies (1) Divine Revelation (2) Logic (3) Qalbu or Heart.

Keywords: Purpose of Islamic Economic Philosophy, Benefits of Islamic Economic Philosophy, Characteristics of Islamic Economic Philosophy

IBNU KHALDUN'S ECONOMIC PHILOSOPHY THEORIES

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ABSTRACT

Purpose: This paper aims to explain about Ibn Khaldun's Theories of Economic Philosophy by formulating the following questions: first, What is the biography of Ibn Khaldun? Second, how is Economics according to Ibn Khaldun? Third, how is the extrapolation of Ibn Khaldun's thoughts? Fourth, How is the relevance between Ibn Khaldun's Economic Theory with Modern Economic Theory? **Design/methodology/approach:** This paper uses a qualitative approach, because data sources and research results in library research, inductive data analysis, grounded theory (towards the direction of theory building based on data). **Findings:** First, the full name of Ibn Khaldun is Waliyuddin Abdurrahman bin Muhammad bin Muhammad bin Muhammad bin Hasan bin Jabir bin Muhammad bin Muhammad bin Abdurrahman bin Khaldun. Of his many teachers, Ibn Khaldun placed two of his teachers in a special place and gave him great appreciation (respect) because of the breadth of knowledge of these two teachers. namely: First, Abu Muhammad bin Abdul Muhaimin bin Abdul Muhaimin alHadhramy, who is an imam of hadith experts and nahwu sciences in religious sciences in Morocco.The works of Ibn Khaldun which have been widely discussed by experts to date are al-'Ibar, Muqaddimah, and al-Ta'rif. Actually the book Muqaddimah and al-Ta'rif is part of the book al-'Ibar which consists of seven volumes. Muqaddimah is the introduction to al-'Ibar, and al-Ta'rif is the closing part. Second, Ibn Khaldun and Economics, Ibn Khaldun gave much enlightenment to economics, both microeconomics and macroeconomics. Third, extrapolation is defined as projecting a law that applies to one case to other cases. Ibn Khaldun's keen observation and ability to make extrapolations is especially compelling The relationship between umara symptoms and economic activities makes his historical work a material for studying economics. Fourth, the Relevance of Ibn Khaldun's Economic Theory with Modern Economic Theory there is a lot of relevance of Ibn Khaldun's thought in the modern economy both microeconomic and macroeconomic. **Originality/value:** This paper comprehensively describes Ibn Khaldun's economic philosophy theories.

Keywords: Philosophy, Ibn Khaldun, Economic Theory, Islamic Economic Philosophy

PARTIAL PHSIO-CHEMICAL CHARACTERIZATION AND IDENTIFICATION OF MICROBIAL ISOLATES STRAINS FROM GUT OF MAJOR CARP

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ABSTRACT
The present research was conducted to investigate the partial physio-chemical characterization and identification of microbial isolates strains from gut of major carp species to contribute in sustainable aquaculture practice. These microbial isolates by using culture dependent and culture-independent approaches with LB and MRS nutritive media. Thesis microbial isolates were morphologically, physio-chemically and molecular techniques such as 16s gene sequences were employed for taxonomic identifications. Further taxonomic identification and phylogenetic analysis are underway to gain a comprehensive understanding gut microbial community and diversity. There were eight microbial isolated successfully cultured on MRC and LB media. Among these isolates, two involved in the hallow zone formation in CaCO3 chemical analysis. These sequences of isolated microbial were blast and submitted in gene bank

of NCBI. Moreover, this research sets the stage for further studies exploring tha manipulation and modulations of gut microbial community to enhance the health, growth, and disease of exotic species (*Oreochromis niloticus*) in aquaculture practice.

Keywords: Major carps, gut microbiota, physio-chemical characterization, 16s gene sequences, Blast, NCBI, Aquaculture

HISTOPATHOLOGICAL OBSERVATIONS ON TRANSMISSIBLE VENEREAL TUMOR (TVT) IN A DOG

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ABSTRACT
Canine transmissible venereal tumor (TVT) is a contagious neoplasm of young and sexually active dogs. This tumor affects the oral, nasal, and the skin, with or without genital involvement. A 4-year-old male dog, weighing 4 kg, was presented to a veterinary clinic with a 2-month history of lesions that were affected the oral, nasal tissue. The firm, nodular and red lesions were approximately 0.5 to 5 cm in diameter. Some lesions were ulcerated and cauliflower-like. The lesion biopsies were performed using a biopsy punch. Tissue samples were fixed in 10% neutral buffered formalin, routinely processed, dehydrated, embedded in paraffin wax, sectioned at 5µm in thickness and stained with Hematoxylin and Eosin. Immunohistochemical studies were performed using vimentin, cytokeratins, S-100, and CD34. Microscopically, the lesions were composed of round to ovoid with large round to oval nuclei, prominent nucleoli and scanty cytoplasm. Mitotic figures and infiltration of macrophages, lymphocytes and plasma cells were also observed. The neoplastic cells were negative for S-100, cytokeratins and CD34. Immunoreactivity was intensely positive for vimentin. Based on histopathological findings, TVT was diagnosed. The dog was treated for 7 weeks, with vincristine. Four weeks after ending chemotherapy, the results of a CBC and urinalysis were normal. Several treatment protocols have been established for TVT, similar to this case, the vincristine is an effective chemotherapeutic agent in the treatment of TVT despite its many side-effects. It has been found to cause mitotic arrest of the neoplastic cells leading regression of the lesions.

Keywords: Dog, Oral, Pathology, TVT, Treatment

HISTOPATHOLOGICAL OBSERVATIONS ON CUTANEOUS MASSES IN A DOG

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ABSTRACT
Infundibular keratinizing acanthoma is a benign and encapsulated neoplasm showing differentiation to the squamous epithelium of the follicular isthmus and infundibulum. In December 2022, a 5-year-old female terrier dog with multiple masses on the tail and limbs. Based on owner information, the masses had increased rapidly in size. On gross examination, the masses had a central pore and were approximately from 0.5 to 2 cm in diameter. Finally, complete surgical removal was selected. On cut section, there was accumulation of keratin in the center of the masses. Tissue samples of the masses were fixed in 10% neutral buffered formalin, routinely processed, dehydrated, embedded in paraffin wax, sectioned at 5 µm in thickness and stained with Haematoxylin and Eosin. Microscopically, the masses were composed of pores that were lined by a stratified squamous keratinizing epithelium with prominent intracytoplasmic keratohyaline granules. The center of pores was aggregation of keratin, which was formed concentric lamellae. Beneath the keratin, the wall of the neoplasm was consisted of large, pale-staining keratinocytes. Cords of epithelial cells with one or two cells thickness extended outward from the peripheral zone of the cyst wall. Cellular pleomorphism and mitotic figures were minimal. Based on clinical and pathological findings, the mass was diagnosed as IKA. No recurrence of the tumors was observed three months following the surgical procedures. Similar to the present case, surgical removal was recommended for Infundibular keratinizing acanthoma in dogs. IKA should be distinguished from well differentiated squamous cell carcinoma and other follicular tumors.

Keywords: Dog, Skin, Pathology, Neoplasm

INVESTIGATING THE SYNERGISTIC NEXUS: ANIMAL AGRICULTURE AS A CATALYST FOR FOOD SECURITY AND NUTRITIONAL EXCELLENCE

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ABSTRACT

This paper aims to investigate the synergistic nexus between animal agriculture, food security, and nutritional excellence in the context of India. With a rapidly growing population and increasing demand for food, India faces significant challenges in ensuring food security and meeting the nutritional needs of its people. Animal agriculture, encompassing livestock production, plays a crucial role in addressing these challenges by providing a sustainable source of food and essential nutrients. The paper begins by examining the current state of food security in India, highlighting the persistent issues of undernutrition, malnutrition, and micronutrient deficiencies. It emphasizes the importance of a diversified and balanced diet that includes animal-sourced foods, such as meat, milk, eggs, and fish, which are rich in high-quality protein, vitamins, and minerals essential for human health. Furthermore, the research explores the various ways in which animal agriculture contributes to food security in India. It analyzes the role of livestock in enhancing agricultural productivity through nutrient recycling, organic manure production, and efficient land use. The paper also discusses the significance of livestock as a source of income and livelihood for millions of smallholder farmers, particularly in rural areas, contributing to poverty alleviation and economic development. Additionally, the study delves into the nutritional benefits of animal-sourced foods in combating malnutrition and improving dietary diversity. It investigates the specific nutrients provided by animal products and their role in addressing prevalent deficiencies, such as protein-energy malnutrition, iron-deficiency anemia, and vitamin A deficiency. Furthermore, the paper examines the potential of animal agriculture to contribute to the nutritional needs of vulnerable populations, including women, children, and the elderly. The research further explores innovative approaches and interventions within animal agriculture that can enhance food security and nutritional excellence in India. It discusses sustainable livestock management practices, including improved animal health, efficient feed utilization, and reduced environmental impacts. The paper also examines technological advancements, such as precision livestock farming and biotechnology, that can optimize animal production and improve the nutritional quality of animal-sourced foods. Eventually, this research paper provides a comprehensive analysis of the synergistic nexus between animal agriculture, food security, and nutritional excellence in India. It highlights the pivotal role of animal agriculture in addressing food security challenges and improving the nutritional well-being of the population. The findings and recommendations of this study aim to inform policymakers, researchers, and stakeholders in formulating strategies and interventions that harness the potential of animal agriculture for a healthier and food-secure India.

Keywords: animal agriculture, food security, nutritional excellence, India, malnutrition, micronutrient deficiencies, diversified diet, precision livestock farming

NEW CONTRIBUTIONS OF THE STRUCTURAL ANALYSIS BY PHOTOSATELLITES OF THE DEPOSITS OF BOU-AZZER: MINERALOGICAL AND PETROSTRUCTURAL STUDY, IN RELATION WITH THE HOST, ANTI ATLAS MOROCCO

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ABSTRACT
The region of Bou Azzer-El Graara is known for its differentiation in terms of minerals that have been mined since antiquity. They are the result of a long geological history that has endured the region (Hercynian and Pan-African orogeny). Weather plays an important role in mines, especially in the discovery of new areas for mineral exploration. Consequently, the use of old techniques (field mapping, etc.) allows it to be wasted despite its validity. Remote sensing solves this problem, either by using multispectral or hyperspectral imagery, it allows to

considerably reduce the cost of exploration, by directing mining research towards favorable regions of a large surface, which are sometimes inaccessible. The approach adopted within the framework of this communication is the use of space remote sensing techniques which can be deployed downstream of conventional exploration programs which require significant technical and financial resources and above all accessibility which remains very difficult in the field. Central Anti-Atlas. An aspect to which this approach can easily respond. The Cryogenian Ophiolite Complex West of Bou Azer outcrops as three massifs and related flakes. From east to west, we distinguish the Bou Froukh massif, the serpentinite scale, the Lakhder massif. This complex is represented by the following components: 1 serpentinized mantle peridotites; 2 basal veins intersecting these peridotites, spilitized basalts and diabases; and 3 a volcano-sedimentary ensemble. The Bou Froukh study area is known by five zones of mineralization, in which there are abandoned sites and others in operation, Taghouni and Moukhazni, and Lakhder. The most exploited mineralizations are cobalt, iron, copper, asbestos (in the past), and barite., allowed us to produce geological and structural maps, and also maps for the indices indicating the hydrothermal alterations (1/5000 and 1/10000) of the zone of study and which were validated by the geological maps of Bou Azzer (scale 1/50000).

Keywords: Mineral exploration, research and minerals resources, Geological and structural mapping, Central Anti-Atlas, Bou-Azzer buttonhole, Cobalt mineralization, Bou Frokh, Taghouni

EARTHWORMS-MEDIATED MODIFICATION OF BIOCHAR FACILITATES HEAVY METALS CONTAMINATED SOIL REMEDIATION

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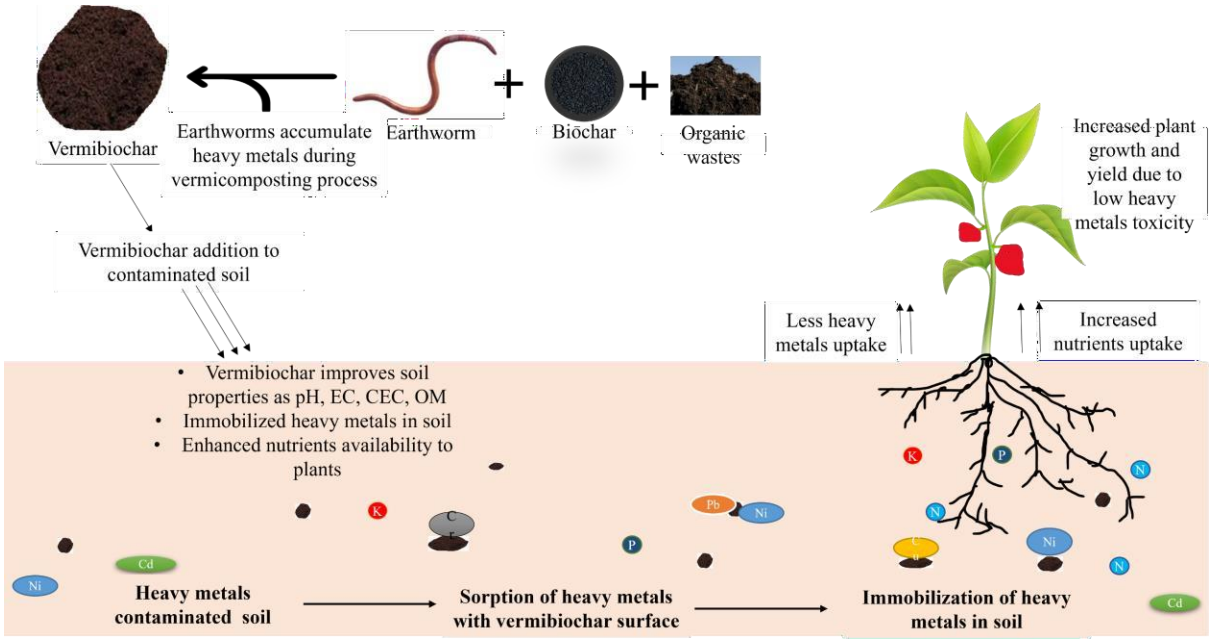
ABSTRACT
Industrialization and extensive use of broad-spectrum agrochemicals in crop production led tothe accumulation of heavy metals and other toxic elements in agricultural land. Heavy metals pose severe hazards to the environment, plants, and human health. There are several limitations to the use of current remediation techniques. Consequently, an eco-friendly technique is neededto combat environmental pollutants. Earthworms-mediated activation of biochar (vermibiochar) demonstrates great potential in reducing heavy metal concentrations in contaminated soil. Its large surface area and high cation exchange capacity boost the contaminants' sorption onto the vermibiochar surface, thus reducing their bioavailability. This study highlights the global scenario of heavy metals pollution, their impact on soil, plant and aquatic environment and detoxification and immobilization by earthworms and biochar. It alsodiscussed the existing remediation techniques, vermibiochar production, and its effects on soilproperties and plant growth. Vermibiochar could be used for the restoration of soil fertility in metals-polluted environments thus, reducing the environmental risks posed by heavy metals.

Keywords: heavy metals, vermicompost; biochar

GRAPHICAL ABSTRACT



DETECTION OF AFLATOXIGENIC FUNGI AND LEVEL OF AFLATOXINS CONTAMINATION IN STORED MILLET GRAINS SOLD IN KADUNA STATE, NIGERIA

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ABSTRACT
Fungal contamination of crops has continuously raised global food safety concerns while pre- and post-harvest toxigenic fungi contamination of grains imposed risks to food security secondary to released toxic secondary metabolites (especially aflatoxins). In this current study, incidence of Aflatoxigenic fungi and level of aflatoxins contamination in millet grains stored and sold in Kaduna State were investigated. Proximate composition of the samples was determined using standard methods of food analysis. Enzyme Link Immunosorbent Assay (ELISA) method was used for detecting and quantifying aflatoxins in the millet grain samples. The results showed that 40 (47.0%) out of 85 stored samples contained toxigenic fungi. *A. flavus and Aspergillus parasiticus* were isolated and identified in the samples with *A. flavus* constituting the major contaminant. Aflatoxins were detected in 24 (28.2%) of the 85 stored samples analyzed. The levels of aflatoxins found in some of the samples exceeded the acceptable limit (4µg/kg) as recommended by the competent food regulatory authorities. The findings of this study provide substantial evidence that the incidence of aflatoxigenic fungi and level of aflatoxins contamination of millet grain is still a critical challenge in Kaduna State agricultural sector as per marketing of agricultural commodities is concerned. Therefore, urgent attention and necessary action should be necessitated.

Keywords: Aflatoxigenic fungi, Aflatoxins contamination, Nigeria, Millet grains

ASSESSING THE IMPACTS OF VARIOUS FERTILIZER FORMULAS ON BREAD WHEAT (*Triticum aestivum*) YIELD, CROP GROWTH, AND GREENHOUSE GAS EMISSIONS IN ARID REGIONS

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ABSTRACT

Introduction: Bread wheat is a staple food in Morocco, Statistics indicates that Morocco needs at least 10.8 MMT per year to meet its local demand, which mean 288 kg per capita. Between 300 kg/ha NPK and 200 Kg/ha NPK fertilizer is recommended for basal application, while for top dressing application usually 100 kg/ha urea or 150 kg/ha Ammonium nitrate, and or both of them is recommended for farmers. However, mostly the recommendation is widely depends on water availability. **Scopus of work:** This study investigates how different fertilizer formulae affect the development and productivity of bread wheat, a staple food crop in Morocco. With an emphasis on nitrogen dynamics, the study investigates the relationship between different fertilizer formula recommended by the local authorities, greenhouse gas emissions, and crop yield. This study aims to advance our understanding of nitrogen fertilizer management under different conditions by examining the nitrogen uptake by plants and subsequent loss to the environment. **Methodology**: The experimental design consists of randomized plots, each subjected to a specific fertilizer treatment. Multiple types of fertilizers, as well as varying application rates, will be considered. The study area will be representative of typical wheat-growing conditions in Morocco, with different soil and climatic conditions. Data collection will include regular monitoring of crop growth parameters such as biomass accumulation, soil N content, soil moisture, and Gas emissions. Additionally, the yield of bread wheat will be measured at the end of the growing season. Greenhouse gas emissions, particularly nitrous oxide (N2O) and carbon dioxide (CO2), will be quantified using established methods, such as gas chromatography. **Results and conclusions:** The findings of this research showed that different fertilizer formula resulted in different trend s of biomass accumulation and different yields. While it was observed that the soil Nitrogen content positively correlated with Nitrogen content of each formula especially for NH4+. The findings will provide valuable insights into optimizing crop production and enhancing fertilizer management practices in arid regions. By evaluating the effects of different fertilizer formulas on crop growth, yield, and greenhouse gas emissions, this study aims to contribute to sustainable agriculture and promote environmental stewardship.

Keywords: fertilizer formulas, crop growth, yield, greenhouse gas emissions, nitrogen dynamics, bread wheat, arid regions, sustainable agriculture

IN VITRO IMMOBILIZING AND SPERMICIDAL EFFECTS OF METHANOL LEAF EXTRACT OF *Euphorbia hirta* Linn. (*Euphorbiaceae)* ON CAPRINE SPERMATOZOA

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ABSTRACT

Purpose: To investigate the in vitro effects of methanol leaf extract of E. hirta (MLEEH) on the motility, viability and morphology of caprine spermatozoa. Methods: The effect of MLEEH treatment (1.25, 2.5, 5, 10 and 20 mg per mL) on caprine sperm percentage total and progressive motility, viability and total abnormalities were evaluated at 1, 5 and 10 min post-treatment. Sperm revival test was used to evaluate the reversibility of sperm incapacitation following MLEEH treatment. Results: There were significant interactions ($p < 0.001$) between the effects of MLEEH concentration and the duration of treatment on sperm total motility, progressive motility and viability. Increase in MLEEH concentration and the duration of treatment caused significant decreases ($p < 0.05$) in sperm total motility, progressive motility and viability, whereas sperm morphology was not altered. Washing and supplementation of MLEEH-treated sperm failed to revive sperm motility. Conclusion: E. hirta treatment causes concentration-dependent and time-dependent decreases in total and progressive sperm motility and sperm viability, as well as irreversible immobilization of spermatozoa. These findings suggest possible adverse effects of E. hirta on the fertility of males. Thus, the extract can be potentially developed as an antifertility or contraceptive agent.

Keywords: Caprine spermatozoa, Euphorbia hirta, Sperm morphology, Sperm motility, Sperm viability, Spermicidal

EVALUATION OF THE ETHNOVETERINARY POTENTIAL OF *PICRALIMA NITIDA* (*APOCYNACEAE*) AS AN ANTHELMINTIC

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ABSTRACT
Objectives: To evaluate the anthelmintic potentials of P. nitida used as a decoction by the local inhabitants of south-eastern Nigeria for the treatment of helminthosis in both man and animals. Methods: Up and down method of acute toxicity was used to determine the acute toxicity of the ethanol seed extract of Picralima nitida (ESEPN) up to 2,000 mg/kg body weight given orally. The anthelmintic efficacy of ESEPN was investigated in vitro using the egg hatch assay and in vivo using thirty adult male albino mice randomly divided into 6 groups (A–F) of 5 mice each and experimentally infected with Heligmosomoides bakeri (with the exclusion of mice in Group A which was the negative control group). Graded doses of ESEPN (250mg/kg, 500mg/kg and 1,000mg/kg) and Albendazole (25mg/kg) were administered to mice in groups D – F and C respectively. The body weight, packed cell volume, erythrocyte, total leucocyte and faecal egg counts (FEC) were assessed. Results: No death or sign of toxicity was observed in the mice following acute toxicity assay. A pre-patent period of 7±3 days was observed. Anaemia, weight loss and leucocytosis were observed following infection. A dose dependent increase to near pre-infection values of the body weight and haematological parameters was observed following treatment with either albendazole or ESEPN. A drop in FEC was observed till days 9 and 10 post treatment for ESEPN and Albendazole respectively however; none was able to clear the helminth infection. Conclusion: ESEPN showed more promising in vitro anthelmintic activity than in vivo.

Keywords: *Picralima nitida*, anthelmintic resistance, ethnoveterinary medicine

APPLICATION OF MACHINE LEARNING ALGORITHMS (EXTREME GRADIENT BOOSTING) FOR MAPPING GROUNDWATER POTENTIALITY; MEJJAT, MARRAKECH, MOROCCO

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ABSTRACT
Groundwater recharge is essential for the sustainable management of freshwater resources, particularly in arid regions. The aim of this study is to process the different groundwater recharge parameters using the Extreme gradient boosting algorithm, which has been validated to provide predictions when mapping groundwater recharge potential. A database of water point inventories was prepared and grouped arbitrarily, with 75% of the inventory forming the learning base and 25% used for validation. Groundwater recharge potential maps are generated using several effective factors, such as elevation, LS factor, topographic moisture index, fault density, multi-resolution valley floor flatness index, curvature, precipitation, lithology, drainage density, distance to rivers, normalized difference vegetation index and normalized difference water index. Next, the groundwater recharge potential maps from the two machine learning algorithms were validated using the ROC-AUC (Receiver Operating Characteristic - Area Under Curve) curve. Based on this validation, the XGBoosting algorithm achieved better results, with an AUC magnitude greater than 0.80. Finally, a method for confirming the usability of thematic maps based on the flow rates of wells and springs in the study area showed that these models are highly accurate, with satisfactory results.

Keywords: Groundwater, Machine Learning, Algorithms, Nappe Mejjat, Random Forest

PHYSICOCHEMICAL CHARACTERIZATION OF OLIVE MILL WASTEWATER FROM THE TRADITIONAL EXTRACTION SYSTEM: A CASE STUDY OF CENTRAL MOROCCO

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ABSTRACT
Olive Mill Wastewater (OMW) is the main olive processing residual product, which poses a significant environmental concern in Mediterranean countries, especially Morocco, due to the large-scale olive oil production in the country. The discharge of untreated OMW during the olive oil extraction process can negatively affect various ecosystems and water resources, due to its high organic and mineral content with the complex mixture of phenolic compounds, The aim of this study was to evaluate the physicochemical quality of olive mill wastewater, collected from extraction units of olive oil with a traditional system, located in the high Atlas Mountains in Morocco. The results of the physicochemical analyses indicate that all the samples of OMW during the milling season, exhibit an acidic pH and possess a high concentration of organic matter, expressed by the average of the: electrical conductivity “EC” (10,70 mS/cm to 56,51 mS/cm), Total Dissolved Solids “TDS”, (5064 mg/l to 6930 mg/l), total suspended solids “TSS”, (520 mg/l to 700 mg/l.), biological oxygen demand “BOD_5” (1800 mg/l to 2850 mg/l), chemical oxygen demand “COD”, (6700 mg/l to 9800 mg/l). A biodegradability index of “COD/BOD_5” with more than 3.7 reveals a higher level of resistance to biological degradation. The obtained results show that the OMW effluents are non-conform to the international wastewater discharge standards, and require a specific treatment before reuse or direct environmental release.

Keywords: olive mill wastewater, physicochemical analysis, traditional extraction system.

THE EFFECT OF MODIFIED DRIED VINASSE (BROMASS) AND FERMENTED TOMATO POMACE POWDER ON THE RUMEN DEVELOPMENT, GROWTH PERFORMANCE, WORM LOAD, IMMUNE STATUS, SERUM PROFILE, AND METHANE EMISSION IN GROWING CLAVES

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ABSTRACT

In recent times, there has been a surge in interest regarding the management of by-products within the food processing industry, coupled with the exploration of their potential as alternative animal feeds. This trend can be attributed to heightened environmental and economic concerns, as the majority of food by-products present challenges in the realm of environmental preservation. This waste generates a substantial quantity of agro-industrial by-products, posing environmental challenges. However, these by-products present an opportunity to establish a circular economy that enhances economic and environmental sustainability. The inclusion of agroindustrial by-products, co-products, and food residues in animal feed presents a viable solution for mitigating the environmental repercussions associated with the food industry. This practice also offers economic benefits and enhances the valorization of agricultural by-product. Moreover, incorporating these materials in animal diets facilitates the conversion of low-quality substances into high-quality food sources, such as meat, while concurrently reducing the reliance of livestock on feed resources that could otherwise be consumed by humans. Vinasse is a residual product derived from the industrial production of substances like yeast, citric acid, alcohol, or other similar materials through the process of molasses fermentation. It is characterized by its composition, which includes proteins, amino acids, vitamins, minerals, organic acids, and growth factors that are synthesized by microorganisms during the fermentation process. Its composition makes it a potential probiotic with the ability to maintain a balanced intestinal microflora and improve digestion and nutrient utilization. Additionally, vinasse contains glycine betaine, an osmoprotectant that safeguards proteins from denaturation. With higher total phenolic content and antioxidant capacity compared to molasses, vinasse presents itself as a valuable feed source with nutritional value and economic benefits. Although previously restricted due to high ash and potassium content, recent modifications have made it usable as a feedstuff by reducing potassium levels. The modified dried vinasse (MDV), known as BroMass, comprises concentrated vinasse, wheat bran, dried distillers grains, corn embryo meal, plant oil, and glycerol, with a potassium content of approximately 2% and a dry matter content exceeding 60%. The varying results observed in the usage of different vinasses can be attributed to differences in manufacturing processes. Likewise tomato pomace, a solid by-product of tomato processing, primarily consists of peels, seeds, and a small amount of pulp and dried to use in animal feed as wet tomato paste cannot be used for longer time due to its shelf life. According to proximate analysis, this particular by-product exhibits a notable nutrient profile, encompassing significant amounts of crude protein, crude fiber, ether extract, α-tocopherol, lutein, β-carotene, nitrogen-free extract, and lycopene. These components serve to mitigate the effects of oxidative reactions. Recognized as a potential feed ingredient for animal

utilization, it is particularly rich in high fiber content and serves as a valuable protein source. The chemical composition of tomato cannery wastes suggests a protein content of 20 to 25%, with 13% more lysine than soybean meal protein. Numerous investigations have been carried out on ruminants to explore the separate utilization of the ingredients found in vinasse and tomato pomace. However, there is a dearth of data regarding the combined effects of these ingredients. Both vinasse and tomato pomace contain polyphenols, antioxidants, CP contents, yeast wall, betaine, and other substances that hold promise in influencing growth, worm load, antioxidant status, rumen fermentation, and methane production. Therefore, research studies have been designed to examine the impact of incorporating modified dried vinasse and fermented dried tomato pomace.

Keywords: Modified dried Vinasse, fermented Tomato Pomace Powder, rumen development, growth performance, Worm load, immune status, serum profile, methane emission, growing claves

EFFECT OF HYDROETHANOLIC EXTRACT OF *PHOENIX DACTYLIFERA* FRUIT (DATE PALM) ON HORMONAL PROFILE AND SOME BIOCHEMICAL CHANGES IN CYCLOSPHOSPHAMIDE-TREATED ALBINO RATS

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ABSTRACT

Introduction: Cyclophosphamide (CP) is a drug widely used as an antitumor and immune-suppressant for the treatment of various cancers as acute and chronic leukemia, multiple myeloma, lymphoma and breast cancers. In spite of its therapeutic importance, cyclophosphamide has been shown to have adverse effects on male reproductive functions; as reported in CP treatment in humans and experimental animals. Also, there has been folkloric beliefs that date palm enhances male reproductive functions and as such has sexual (aphrodisiac) potential. This has made it a fruit of choice in preparation of aphrodisiac portions and mixtures across the length and breadth of Africa. **Aim**: The aim of the study was to evaluate the effect of hydroethanolic extract of *Phoenix dactylifera* fruit (Date Palm) on hormonal profile and some biological changes in cyclophosphamide-treated rats. **Methods**: Fifty-six male albino rats used for this study were randomly divided into seven groups of eight rats each. **Control Groups:** Group I: Treated with 5mg/kg of normal saline (Intraperitoneally). Group II: Treated with 5mg/kg of Cyclophosphamide injection for 4weeks. **Treatment Groups:** Group III: Treated with 5mg/kg of CP and treated with 200mg/kg of DP extract for 4weeks. Group IV: Treated with 200mg/kg of DP extract for 4weeks. Group V: Treated with 5mg/kg of CP and treated with 400mg/kg of DP extract for 4weeks. Group VI: Treated with 400mg/kg of DP extract for 4weeks. Group VII: Treated with 5mg/kg of CP and treated with 100mg/kg of Vitamin E Injection for 4weeks. The hormonal profile (Testosterone, Luteinizing hormone and Follicle Stimulating hormone) were determined using the corresponding Immunoenzymometric assay for each. Also, oxidative stress markers such as Malondialdehyde (MDA), Catalase

(CAT) and Superoxide dismutase (SOD) were also determined using the modified thiobarbituric acid method, visible light method and hydroxylamine method respectively. **Results**: The study showed significant decrease in the 3 hormones sampled especially across the groups that were treated with cyclophosphamide while there was significant increase especially across the groups that were treated with only the *Phoenix dactylifera* extract at varying doses. Also, for the oxidative stress markers sampled, the study showed significant increase in the 3 oxidative stress markers especially within the cyclophosphamide treated groups while there was significant decerease in the 3 oxidative stress markers sampled within the *Phoenix dactylifera* extract treated group. **Conclusion**: This study showed the performance of *Phoenix dactylifera* extract to possess both spermatoprotective fuction and oxidative stress protection ability.

Keywords: Fruit, extract, biochemical

CONVERSION AND MECHANISM OF AGRICULTURAL-BASED CELLULOSIC MATERIALS INTO HIGHLY POTENTIAL MULTIFUNCTIONAL NANO DIMENSION MATERIALS

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ABSTRACT
In this study, Nanocellulose has been synthesized via the conversational method of acid hydrolysis process. During this process, the breakage of glycosidic bond to produce smaller or individual of cellulose in uniform nano sized particles has been occurred. Several parameters has been considered, including the acid concentration, temperature and hydrolysis duration to produce nanosized cellulose based on the particle analyzer distribution (PSD) analysis to understand the physical and chemical properties of nanosized cellulose, further characterization on its dimension, morphology, density, thermal and crystallinity was carried out accordingly. There were two mechanism occurred during the hydrolysis process; which were hydrolytic cleavage of cellulose glycosidic bonds and disruption of inter/intra hydrogen bonds of cellulosic polymeric bonds. The nano cellulose synthesis catalyzed with hydrochloride, releasing of the hydronium (H^+) ion for hydrolytic cleavage of glycosidic bonds in cellulose molecular chains within amorphous regions. This consequently brought to the breakdown of the cellulose structures into nanocellulose. Consequently, the H+ ion attacked on the glycosidic bonds of cellulose ring. The H^+ ions tend to react with the O_2 elements on the glycosidic bonds between two anhydro glucose units to promote the protonation of the O_2 elements and hence hydrolytic cleavage of glycosidic bonds. This study brought a new path on conversion of bio-based cellulosic materials into highly potential multifunctional materials in nano dimension.

Keywords: Lignocellulosic; Cellulose; Hydrolysis; Catalysis; Nanomaterials

INSIGHTS AND IMPLICATIONS OF USING TEMPERATURE AND HUMIDITY INDEX TO PREDICT THE SUCCESS OF ARTIFICIAL INSEMINATION IN COWS

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ABSTRACT
This study investigated the effect of temperature and humidity index (THI) on the success of artificial insemination in cows using 4062 artificial insemination data for 2020, obtained from the National Center of Artificial Insemination and Genetic Improvement Algeria from the region of Chlef, characterized by a sub-humid Mediterranean climate. The study aimed to determine whether the THI can be used as a predictor of the success or failure of artificial insemination in cattle. The results using the different statistical analyses, logistic regression, the odds ratio (0.813), and The Khi2 test, revealed that THI plays a crucial role in the success of artificial insemination in cows, with any increase in THI leading to a decrease in the insemination success probability, highlighting the importance of monitoring THI levels during artificial insemination procedures. Moreover, to further analyse the data, an SVM model was created to predict the success or failure of artificial insemination based on previous training data. The model was developed by standardizing the feature variables, initializing the SVM model with a linear kernel and regularization parameter C=10, and fitting the model to the training data. The model's performance was evaluated on the testing data using various classification metrics, and a prediction function was defined to predict the success or failure of artificial insemination in a given input data with an accuracy of 79%. The study provides valuable insights into the importance of monitoring THI levels during artificial insemination procedures in cows. The developed SVM model can be a useful tool to predict the success or failure of artificial insemination based on previous training data. The findings of this study can

help improve the success rates of artificial insemination in cattle and aid in developing strategies to enhance the overall reproductive performance of cows.

Keywords: artificial insemination, cows, linear kernel, prediction, temperature and humidity index (THI), SVM model.

UNDERSTANDING THE PERCEPTION OF FARMERS ON CLIMATE CHANGE

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ABSTRACT
Understanding the climate change perceptions among small farmers is crucial to the successful implementation and adoption of climate-resilient agricultural policies. Our study explores the level of climate change perception among small farmers in three geographically distinct regions, the Coastal, Terai, and Red-laterite regions of West Bengal, India, through a reliable and valid climate change perception index developed as a part of the study and examines the relationship of how climate change perception among farmers may vary with thirty (30) selected socio-economic parameters. Data from one hundred fifty (150) small farmers from all three regions (50 each from three regions) were collected using purposive as well as simple random sampling method. The logistic regression modelling technique was used to analyze and interpret the relationship between climate change perception levels with the socio-economic parameters of each region of farmers. The results from the logistic regression model show 78, 92, and 80 percent of prediction accuracy in classifying the level of climate change perception of the farmers for the Coastal, Red-laterite, and the Terai regions, respectively. So far as the pooled is concerned the overall model, which includes thirty (30) socioeconomic characters, has a prediction accuracy of almost ninety one (90.60) per cent. The observed data showed that fourteen farmers (14) farmers out of one hundred fifty (150) had low perception; however, the model predicted these 14 farmers to have high perception with 20 percent accuracy. Furthermore, we see that one hundred thirty five (135) farmers out of total one hundred fifty (150) farmers have a high perception, but the model predicts that these one hundred thirty five (135) farmers will also have a high perception with eighty (80) per cent accuracy. So, it can be said that the majority of the farmers (> 50 per cent) have a high level of perception of climate change. Through the Omnibus model coefficient chi-square test, in the case of pull data, it is revealed that two agro-climatic zones, the logistic regression models were statistically significant. However, the model's result for the Red lateritic zone was not statistically significant.

Keywords: Perception, Climate change, Small farmers, Adaptation, Logistic regression model, Omnibus model coefficient chi-square test

EFFECT OF *SPIRULINA* POWDER INCORPORATED WITH VEGETABLE WASTE ONTHE WEIGHT OF IMC FISH

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ABSTRACT
Indian Major Carps are the commonly cultured fishes from the cyprinidae family. Catla,Rohu and Mrigal are the three commonly known fishes from IMC and they are cultured together. IMC are the nutritious fishes and they required high nutrient rich food for the growthand maintenance of their body health. For the nutrients they are generally fed on high protein rich fishmeal feed which makes the feed too costly. To reduce this cost of fish feed, the ingredients like fishmeal was replaced with some nutritious vegetable waste and to enhance the protein value of vegetable waste-based feed *Spirulina* powder was incorporated in this feed.feed was given to the fishes for 6 months and growth was measured as a weight and calculatedas SGR %, weight gain % and Average Daily Gain and we found high growth in fish fed on *Spirulina* incorporated vegetable waste feed at the end of the 6th month of the experiments as the SGR % was found 0.000 %, 0.068 % and 0.254 % in the fishes fed on F-1 (commercial feed contained fishmeal), F-2 (control feed) and *Spirulina* incorporated with vegetable waste feed respectively. And the survival rate was found 100 % in fish fed on *Spirulina* incorporatedwith vegetable waste feed.

Keywords: *Spirulina*, Vegetable waste, Indian Major Carps

PERCEPTION OF PEER-TUTORING PEDAGOGICAL APPROACH AMONG UNDERGRADUATE STUDENTS OF FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

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ABSTRACT
This study investigated the Perception of a Peer-Tutoring Pedagogical Approach Among Undergraduate Students of the Federal University of Technology, Minna. Nine schools were used in selected from the Federal University of Technology, Minna was used as the population of the study. Descriptive survey research was employed, and Undergraduate Students of the Federal University of Technology, Minna, were used as the research samples. Four research questions guided the study, and a 20-item questionnaire was used as an instrument for data collection. The questionnaire was validated by the project supervisors and test and measurement experts. The pilot study was carried out, and reliability coefficients of 0.89 were obtained for the questionnaire. Data collected from the administration of the research instruments were analyzed using descriptive statistics of Mean and Standard Deviation. A decision rule was set, in which a mean score of 4.0 and above was considered Agreed or 4aware while a mean score below 3.0 was considered Disagreed or unperceived. Findings revealed that Undergraduates Students Perception of the Peer Tutoring Pedagogical Approach (PTPA) is unperceived by the respondents. Based on the results, it was recommended that Science students keep improving in their pedagogical approach to help them take an interest in learning ABSTRACTs topics and improve in their science subjects.

Keywords: Pedagogical Approach, students, school

AN ASSESSMENT OF MICROPLASTIC ACCUMULATION IN OFFSHORE FISHES FROM KARACHI, PAKISTAN

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ABSTRACT
An assessment of the quantity of microplastic present in the digestive tracts in 244 specimens of some offshore fish species of Karachi coast, Pakistan was carried out. The study revealed that spiny check grouper (*Epinephelus diacanthus*) has the highest number of microplastic particles (13,680 pieces/g) and *Megalaspis cordyla* has the lowest (710 microplastic pieces/g). Observed microplastic consisted of fibers and fragments of multiple colors. Microplastics were observed to be mainly polyethylene terephthalate (PET), polypropylene (PP), polyvinyl chloride *(*PVC*)*, polyethylene (PE), polystyrene (PS), ethylene-vinyl acetate (EVA), as evident through Fourier-transform infrared spectroscopy (FTIR) and confirmed through UV spectroscopy.

Keywords: Pakistan, microplastic, fish

MICROPLASTICS ABUNDANCE AND COMPOSITION IN SEDIMENTS OF CLIFTON BEACH KARACHI, PAKISTAN

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ABSTRACT

The contamination of microplactics in coastal sediments from Clifton beach, Karachi were investigated. In present study the microplastics have been found in abundant quantity in sediments of Clifton coast. The concentration of microplastics were found high at recreational sites of coast. Diversity, gradation of weather and reservoirs of microplastics particles in the sediments were evaluate. The microplastics were categorize according size, color and forms with the help of stereoscopic microscope. Microfibers were identify as the commonest type of microplastics. Pink, blue, white, and transparent were most dominant colors in fibers. Four types of polymer were detected by FTIR i.e Polystyrene (PS) 45%, polypropylene (PP) 35%, polyethylene terephthalate (PET) 20% and Polyvinyl chloride (PVC) 5%. Polystyrene is common polymer in summer and winter seasons. The difference in abundance of microplastics between summer and winter seasons was not constant. In coastal sediments microplastics contamination was due to maximum anthropogenic activities and influence of human as sewage effluents from hotels, laundry facilities, tourist activities and land-based effluents.

Keywords: Microplastic, Pakistan, microfiber

HMGB1 IS A SEROLOGICAL CONSERVED PROTEIN AMONG THE PARASITES

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ABSTRACT

HMGB-1 is one of the well studied Danger Associated Molecular Pattern (DAMP) in human and animal immune system. It is a nuclear factor that gets released during necrosis of cells and also is actively released by activated macrophages. Mammalian HMGB-1 has two dominant domains viz., Box-A and Box-B. The Box-B induces inflammation while Box-A being non-inflammatory. Curiously, genomes of many protozoan / matazoan pathogens viz., Plasmodia, Entamoeba, Giardia, Trichomonas, Toxoplasma, Trypanasoma, Schitosoma and filarial nematodes also contain homologues of mammalian Box-B of HMGB-1 without Box-A equivalent. The respective parasite genes are successfully transcribed and translated during the pathophysiological situation. HMGB1 protein is released by parasites during the infection and modulates the immunological signature of host cell. The HMGB1 is present in different protozoan/metazoan parasites has different typological configuration but conserved among the species. The parasites HMGB1 protein has strong association with Host HMGB1 protein while the antibody of PfHMGB1 is not cross react with human but react significantly with different parasites. This studies will definitely fill the lacuna in science and strengthen the HMGB1 potential as a drug candidate in further research.

Keywords: HMGB1, Molecular, protein

EVALUATION OF TOXIC HEAVY METAL IONS IN ENVIRONMENTAL SAMPLES BY DIFFERENTIAL PULSE VOLTAMMETRY

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ABSTRACT
Industrialization promised the production of goods and the eradication of poverty. However, the goal has been ruined in the long run due to the exploitation of environmental resources and life on land. Especially, heavy metals released by the industries are a major threat to the environment and life on Earth. The major source of lead and cadmium is from the paint, mining, battery, and automobile industries; and from burning fossil fuels. The permissible amount for lead and cadmium, according to World Health Organization (WHO) is 10 and 3 parts per billion (ppb) respectively. Differential pulse voltammetry (DPV) is one of the most sensitive electrochemical techniques for the monitoring of heavy metals in real samples. For this study, we have developed an Ethylenediaminetetraacetic acid-reduced graphene oxide-modified glassy carbon electrode (ErGO/GCE) for differential pulse voltammetric quantitation of lead and cadmium present in environmental water and soil samples. ErGO was prepared by functionalizing graphene oxide (GO) with EDTA, followed by its reduction using a biomaterial, tyrosine. The physiochemical characterization of the synthesised materials was done by XRD, FTIR, TGA, Raman, and -potential studies, and the electrochemical characterization and real sample analysis were done by cyclic voltammetry, differential pulse voltammetry, and electrochemical impedance spectroscopy techniques. For the real sample analysis, water samples were collected from the River Palar, Vellore, and soil samples were collected near battery manufacturing sites in Vellore. The novel electrode substrate displayed an adequate linear range, excellent sensitivity and selectivity, good repeatability and stability, minimal interference from other metal ions, and an acceptable low detection limit of 1.02 and 2.52 ppb for cadmium and lead ions, respectively. Lead ions found in real river water were 200.2 ± 0.38 ppb, and in soil samples, they were between 0.9 and 4.9 ppm.

Keywords: heavy metals, reduced graphene oxide, electrocatalytic detection

EXPLORING THE IMPACTS OF CLIMATE CHANGE ON FARMING AND ADAPTATION STRATEGIES INVOLVED IN MODERN FARMING SYSTEMS

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ABSTRACT

The current study discusses exploring the impacts of climate change on farming and adaptation strategies involved in modern farming systems. There are several ways in which climate change and the adverse effects of biological and environmental constraints on farming in a region are linked. The potential for direct and indirect impacts on farming makes climate change a key concern. Symptoms of climate change include shifts in the optimal times for planting and harvesting crops and increased frequency with which natural disasters such as droughts and floods occur. The impact of climate change on farming production and prices will probably enhance agricultural insecurity in the future. Food costs may increase as electricity prices rise due to climate change adaptation efforts. Due to drought and the rise in farm water usage, there will need to be more water to keep farming operating at its current level shortly. With the now-apparent significant trends in climate change, the prospect of more changes, and the growing extent of possible climatic effects, it is imperative that farmers adapt in a disciplined way. Indian farmers play an essential part in the economy of the nation and food safety. Farmer suicide is a significant problem in modern India for several reasons, including low income, high debt loads, a lack of market access, new technology and irrigation facilities, and the sale of farms to the private sector. Contract farming, climate change, food insecurity, water scarcity, issues associated with droughts and floods, and the lack of financial benefit from cultivating land have all disproportionately harmed farmers in disadvantaged areas and on tiny pieces of land. The national suicide rate remains shockingly high despite the government's many initiatives and technological advancements. Nowadays, it's not uncommon for farmers to face precarious financial situations. Farmers and their families need access to free medical care and education, a subsidized food package, health insurance, a larger consumer market, better roads, and more efficient transportation options. Numerous chances for adaptation exist, usually in the form of variants on present techniques for managing climate risks, when only minor modifications are made to standard farming operations. We show that even little climate changes can provide farmers with opportunities if they adapt their methods accordingly. The adverse impacts of climate change on farming are getting worse, and it is uncertain how well these impacts may be mitigated through adaptation strategies in the farming system.

Keywords: Exploration, Impacts, Climate Change, Farming, and Adaptation Strategy

POSITIVE ASPECTS OF SILDENAFIL CITRATE ON REPRODUCTIVE ORGAN OF MALE DOGS WITH SUBFERTILITY
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ABSTRACT
Sildenafil citrate is the drug that approved two decades ago and act as Phosphodiesterase 5 inhibitor (PDE5). In last years the wonderful effect of sildenafil citrate approved exactly on erectile dysfunction (ED). Nowadays, it is clearly enlightened that sildenafil citrate can have effective benefit in each organ such as heart, liver, kidney, brain, intestines and etc. our investigation demonstrated the great effect of usage of this drug on male dogs with erectile dysfunction and low motile sperm and progressive motility. Sildenafil citrate, potent and specific inhibitor of cGMP-specific PDE5, which is the most common PDE in the corpus cavernosum, can prevent cGMP breakdown by inhibitor acting and therefore increasing intracavernosal pressure and penile erection. The drug is relatively lipophilic and would therefore be expected to distribute into the seminal fluid. PDE5 inhibitor sildenafil citrate can improve both sperm parameters such as progressive motility and acrosomal reaction of sperm. In our investigation, Sildenafil citrate were given oral consumption route to 15 subfertile male dogs with less than 50 percent progressive motility on their fresh ejaculations. Totally 20 dogs divided on 4 groups consist of control group and sildenafil groups with different consumption doses. variety doses of sildenafil citrate were given in doses (20-30-40-50mg) orally for 30 days. effect of sildenafil citrate on sperm parameters evaluated in this study after 1month exposure of sildenafil citrate. Sperm analysis was done after 1 month of starting procedure. Progressive motility of the sperm of those dogs with 40mg oral consumption of sildenafil was remarkable higher compared with other groups.

Keywords: Sildenafil citrate, Fertility, Male dog

FACILE AND COST-EFFECTIVE SYNTHESISE OF FLUORESCENT CARBON DOTS DOPED GRAPHITIC CARBON NITRIDE FOR THE DETECTION OF Fe^{3+}

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ABSTRACT

Carbon dots (C-dots) have better water solubility, biocompatibility, environmental friendliness, and non-blinking fluorescence than any other materials. Due to the numerous advantages of carbon quantum dots (CQDs) over semiconductor quantum dots, studies on synthesis and fluorescence-based sensing in biocompatible carbon quantum dots (CQDs) have recently become a frequently discussed field of research. In this work, photoluminescent small-sized Carbon dots doped graphitic carbon nitride has been synthesized through the hydrothermal method as well as their potential application in sensing Fe^{3+} selectively. The photoluminescence properties of Carbon Dot, graphitic carbon nitride (g-C_3N_4), and Carbon dots doped graphitic carbon nitride (CQD/g-C_3N_4), have been studied, and the results show that they have a strong blue luminescence with excitation wavelength-independent, pH-sensitive, and ionic strength dependent luminescence features. The as-prepared CQDs generated a vivid blue fluorescence with a strong emission at 450nm and a 335 nm excitation. The fluorescent carbon dots and composite not only exhibit good photoluminescence capabilities and water solubility, but they also demonstrated an extraordinary multifunctional fluorescence sensor for pH probing and (Fe^{3+}) ion-detecting applications. Various spectroscopic techniques were used to analyze the morphological structure, optical characteristics, and chemical compositions of Carbon dots, graphitic carbon nitride, and carbon dots doped graphitic carbon nitride composites, including fluorescence spectrometer, X-ray diffraction (XRD), Scanning electron microscope (SEM), Fourier transforms infrared spectrometer (FTIR). Metal ion pollution has become a pressing concern in the environmental field due to the grave harm they pose to our natural environment and human health. iron is one of the hazardous metal ions, and its stability causes significant damage to our environment and health. A wide range of analytical methods, including atomic absorption and emission spectroscopy (AAS, AES), and inductively coupled plasma mass spectrometry, have been developed in recent years for the detection of with excellent sensitivity and precision. In comparison to other methods, fluorescence spectroscopy is preferred because of its great sensitivity, superior selectivity, ease of operation, and low cost. The addition of Fe^{3+} ions causes a significant fluorescence quenching effect of the CQDs due to the enhanced electronic characteristics and surface chemical reactivity generated by N atoms in CQD of CQD/g-C_3N_4. There was a linear relationship between ln(F0 /F) and the concentration of Fe^{3+} ions in an "on-off" luminescent CQDs nanoprobe, with a measured LOD of 2.8 nM and a linear range of 20-100 M under optimal conditions. Furthermore, CQD fluorescence was restored by using ascorbic acid (AA) to convert Fe^{3+} to Fe^{2+} ions. Furthermore, the measurement of Fe^{3+} ions in drinking water, tap water, and lake water samples revealed that the suggested method has the potential to be applied in environmental metal analysis.

Keywords: Carbon dots, Graphitic Carbon nitride, Fluorescence, Fe^{3+}

ORGANOLEPTIC CHARACTERISTICS OF HERBAL PRESERVATION OF TIGER NUT DRINK (KUNU AYAYA) USING ADASONIA DIGITATA, TAMARIND, TUMERIC, PAKIA BIGLOBASA AND MORINGA OLIFERA

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ABSTRACT
Tiger nut drink (Kunu ayaya) is a local drink that has a life span of one day immediately after preparation because spoilage set in. instead of using a preservative that contains chemical, five (5) different herbal material that has antioxidant properties will be tried to preserve the drink and study the effect of each of them on organoleptic characteristics. The plant parts have been screened and tested for invitro experiment, 2kg of Tiger nut is used and graded levels of the herbal plants are used as 2g, 4g and 6g of each of the herbal materials (Adasonia digitata, Tamarind, Tumeric, Pakia biglobasa and Moringa olifera) are blended with the 2kg of Tiger nut and are kept in a separate bottle covered with paper foil in the laboratory at room temperature for a week to study the shelf life, organoleptic characteristics is then carried out on a daily basis. At the end of the fifth day, it was observed that those stored with Pakia biglobosa is only better, followed by Adasonia digitata ($P<0.05$).

Keywords: Drink, antioxidant, herbal

İLAÇ ŞİRKETLERİ İÇİN KÂRI ARTAN BİR SÜRÜCÜ OLARAK İYİ KURUMSAL YÖNETİM

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ÖZET

Endonezya'daki ilaç endüstrisi uzun süredir büyümektedir, bu nedenle Endonezya ilaç pazarının yüksek bir büyüme yaşayacağı tahmin edilmektedir. Endonezya'daki ilaç endüstrisinin, 2018'den 2021'e kadar son dört yılda artan ilaç endüstrisi sayısının kanıtladığı gibi, zamanla birlikte daha fazla büyümek için büyük bir fırsatı var. Bu çalışma, şirketin sermaye yapısının, varlıklarının ve iyi kurumsal yönetiminin Endonezya'daki ilaç endüstrisinin kârını artırmada bir etkisinin olup olmadığını incelemeyi amaçlamaktadır. Araştırma verileri, 2008'den 2021'e kadar Endonezya Menkul Kıymetler Borsası'nda işlem gören 10 ilaç firmasına ait 131 finansal veriden oluşmaktadır. Analiz yöntemi, doğrusal regresyon analizi çoklu, klasik varsayım testi, belirleme katsayısı ve T testidir. Bu çalışmada kullanılan analitik test aracı SPSS versiyon 24'tür. Sonuçlar, ilaç şirketlerinin karlarının artmasında sermaye yapısı ve varlıklarının önemli bir etkiye sahip olduğunu göstermiştir. Sermaye yapısı ilaç firmalarının karlarını olumsuz ve anlamlı bir şekilde etkilemektedir. Şirketin borç sermayesi ne kadar küçükse, ilaç şirketlerinin karı o kadar yüksek olur. Varlıkların ilaç şirketlerinin karları üzerinde olumlu ve önemli bir etkisi vardır. İlaç şirketlerinin sahip olduğu varlıklar ne kadar büyükse, ilaç şirketlerinin kar potansiyeli de o kadar yüksektir. Bağımsız bir komisyon üyesi tarafından temsil edilen şirket yönetiminin iyi kurumsal yönetişimi, Endonezya'daki ilaç şirketlerinin kar artışını etkileyemez.

Anahtar Kelimeler: Kârlılık, Sermaye Yapısı, Varlıklar, İyi Kurumsal Yönetim

GOOD CORPORATE GOVERNANCE AS A PROFIT-INCREASING DRIVER FOR PHARMACEUTICAL COMPANIES

ABSTRACT

The pharmaceutical industry in Indonesia has been growing for a long time, so that the Indonesian pharmaceutical market is predicted to experience high growth. Along with time, the pharmaceutical industry in Indonesia has a great opportunity to grow further, as evidenced by the increasing number of pharmaceutical industries in Indonesia during the last four years, from 2018 to 2021. This study aims to review whether the capital structure, assets and good corporate governance of company has an impact on increasing the profits of the pharmaceutical industry in Indonesia. The research data consists of 131 financial data from 10 pharmaceutical companies listed on the Indonesia Stock Exchange from 2008 to 2021. The method of analysis is linear regression analysis multiple, classical assumption test, coefficient of determination, and T test. The analytical test tool used in this study was SPSS version 24. The results showed up to capital structure and assets have a significant influence on the increase in profits of pharmaceutical companies. Capital structure has a negative and significant effect on pharmaceutical company profits. The smaller the company's capital from debt, the higher the profit of pharmaceutical companies. Assets have a positive and significant influence on the profits of pharmaceutical companies. The greater the assets owned by pharmaceutical companies, the higher the profit potential of pharmaceutical companies. Good corporate governance by company management, which is represented by an independent commissioner, cannot influence the profit increase of pharmaceutical companies in Indonesia.

Keywords: Profitability, Capital Structure, Assets, Good Corporate Governance

ENDONEZYA'DA ŞİRKET PERFORMANSINI İYİLEŞTİRMEK İÇİN ŞİRKET BÜYÜMESİ VE TOPLAM VARLIKLAR

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ÖZET

Covid-19 salgını sırasında emlak ve emlak şirketleri için satışlar yüzde elli ila altmış arasında azaldı. İnşaat sektörü için yeni sözleşmeler veya iş projeleri de Covid-19 salgını nedeniyle sekteye uğradı. Endonezya hükümeti, geliştirme altyapısına kıyasla korona virüsünü ele almaya öncelik veriyor. Hükümet bütçesinden neredeyse tüm faaliyetler veya projeler, Covid-19 ile başa çıkmak için kesildi ve yeniden yerleştirildi. Araştırmanın amacı, Endonezya Menkul Kıymetler Borsası 2019-2021'de kayıtlı Gayrimenkul, Gayrimenkul ve İnşaat İnşaat şirketinde şirket büyüklüğünün, varlık devrinin ve satış büyümesinin finansal performans üzerindeki etkisinin ne kadar büyük olduğunu bulmaktır. Bu çalışmada örneklem olarak 60 şirket ve 169 finansal veri elde etmek amacıyla amaçlı örnekleme yöntemi kullanılarak örneklem alınmıştır. Bu çalışmada çift doğrusal regresyon analizi yöntemi kullanılmaktadır. Araştırma sonuçları, şirket büyüklüğünün finansal performans üzerinde negatif ve anlamlı bir etkiye sahip olduğunu göstermektedir. Küçük şirketler, büyük şirketlere kıyasla finansal performanslarını iyileştirmeyi daha kolay bulmaktadır. Aktif devir hızı ve şirket büyümesi, Endonezya'daki emlak, gayrimenkul ve inşaat şirketlerinin finansal performansı üzerinde olumlu ve önemli bir etkiye sahiptir. Yüksek varlık devri ve artan satışlardan şirket büyümesi, şirketin finansal performansını artırabilir.

Anahtar Kelimeler: Büyüklük, Aktif Ciro, Şirket Büyümesi, Finansal Performans

COMPANY GROWTH AND TOTAL ASSETS TO IMPROVE COMPANY PERFORMANCE IN INDONESIA

ABSTRACT

During the Covid-19 pandemic, sales decreased by fifty to sixty percent for property and real estate companies. For the construction industry, new agreements or work projects have also been hampered due to the Covid-19 pandemic. The Indonesian government prioritizes handling the corona virus compared to development infrastructure. Almost all activities or projects from the government budget have been cut and relocated to deal with Covid-19. The aim of the research is to find out how big the influence of company size, asset turnover, and sales growth on financial performance in Property, Real Estate and Building Construction company registered at Indonesia Stock Exchange 2019-2021. Samples taken using purposive sampling method, in order to obtain 60 companies and 169 financial data as sample in this study. This study uses the method of regression analysis double linear. The results of the research show that the company size has a negative and significant effect on financial performance. Small companies find it easier to improve their financial performance compared to large companies. Asset turnover and company growth have an effect positive and significant impact on the financial performance of property, real estate and building construction companies in Indonesia. High asset turnover and company growth from increased sales can improve the company's financial performance.

Keywords: Size, Asset Turnover, Company Growth, Financial Performance

TECHNIQUES FOR MEASURING ENTERIC METHANE EMISSION IN RUMINANTS

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ABSTRACT
Methane (CH_4) emissions are a significant source of greenhouse gas (GHG) emissions and are mostly produced during feed fermentation by rumen bacteria. A number of measurement methods of CH_4 emission have been developed and improved in recent years, which is employed for long-term and short-term measurements in individual animals or grouped animals directly as well as indirect prediction of CH_4 emissions. Among these methods, the respiration chamber technique is still regarded as the gold standard method, due to its higher accuracy and reproducibility in CH_4 measurements. The sulphur hexafluoride (SF_6) tracer technique can be employed with a high level of confidence by implementing current recommendations for technique improvement. The chamber technique can be utilised with the same level of accuracy as the SF_6 method with the implementation of new suggestions for technique improvement. In general, short-term CH_4 measuring approaches attract significant animal- and within-animal-variation. If measurements could be taken at different times of the day related to the diurnal cycle of CH_4 production, short-term measuring approaches, Greenfeed and methane hood systems are probably more suitable for evaluating CH_4 mitigation experiments. Sniffer and other short-term breath analysis techniques, such as the carbon dioxide and CH_4 ratio, are better suited for on-farm screening of large numbers of animals to identify low CH_4-producing individuals for genetic selection. In recent years, various indirect measuring approaches have also been researched. The medium- and long-term mitigation measures that could be used on farms to achieve significant reductions in CH_4 emissions and to successfully reduce the carbon footprint of livestock production systems should be the focus of future study. This study

includes recent advancements in measurement techniques and dietary reduction of enteric CH_4 emissions, as well as critical appraisal of those discoveries. The methodologies discussed so far were some of the effective and advanced one, researchers are working towards improvising and identifying even better strategies for CH_4 emissions from ruminants. The methodology adopted for CH_4 emission depend on several factors like aim of the study, equipment knowledge, funding level, etc. However the interpretation of the results can be improvised if one has prior knowledge about the advantages and disadvantages of the adopted methodology and when they are used accordingly during the planning of experiments.

Keywords: Enteric methane, measurement method, ruminants

PHYTOCHEMICAL ANALYSIS OF VARIOUS PARTS OF AVOCADO PLANT (PERSEA AMERICANA) FOR CORRION INHIBITOR AND LUBRICANT SUITABILITY

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ABSTRACT
The fast and rapid depletion of petroleum reserves coupled with its unrecyclable nature has warranted the envisage of other environmentally, recyclable raw material for the production of industrial chemicals such as lubricants. To this end research has been undertaken with the view of developing lubricants from a blend of vegetable oil (avocado, i.e, Persea Americana) and lubricant additives. To this end the characterisation of the extracts from the vegetable oil was mandatory. Avocado leaves, bark, seeds, and fruit skin were screened for phytochemicals. Distilled water, 65% ethanol, and acetone were used to extract the active components from the avocado plant portion. To detect and identify the numerous classes of phyto compounds present, qualitative tests were performed on the supernatant derived from the different plant portions of the Avocado using different chemical assays. The screening indicated the presence of alkaloids, flavonoids, terpenoids, saponins, tannins, and other compounds. The phenolics and flavonoids were investigated further in order to quantify them. As seen by the phyto chemical tests conducted on the various parts of the avocado (Persea Americana), the plant parts of the avocado showed good results and hence this study ascertains that avocado extracts have very high potential to be used in conjunction with other additives as corrosion inhibitors and lubricants.

Keywords: Phytochemical analysis, lubricants, corrosion, recycling, screening

VALIDITY OF THE EMPIRICAL HEAT STRESS INDICES IN PREDICTING THE HEAT STRAIN OF OUTDOOR OCCUPATIONS

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ABSTRACT

Introduction: Heat strain indices have been developed to evaluate the risk level of thermal strain. Empirical indices are one of important groups of heat strain indices that limited studies performed on investigating their validity, particulary in outdoor occupations such as farmers. Therefore, this study aimed to investigate the validity the empirical heat stress indices in predicting the heat strain of outdoor occupations. **Methods:** This cross-sectional study was performed with 90 male farmers in warm and humid conditions. In first step, demographic information was gathered. After the rest for 30 minutes, the heart rate and tympanic temperature of the participants were measured. People then returned to their workplace and started their routine work. At the end of 90 minutes workers' heart rate and tympanic temperature were measured again. Additionally, researchers estimated their metabolism rate and clothing thermal insulation. Environmental parameters were also collected including dry temperature, wet temperature, globe temperature, relative humidity and air flow speed at 30, 60 and 90 minute timepoints. Additional information needed to calculate environmental indicators was recorded. Then, the values of each of the environmental indicators were calculated. Finally, the validity of each index was evaluated under the different conditions. **Results:** Results showed that CET (0.853) and WBGT (0.844) had the highest correlations with tympanic temperature, respectively. Also, TSI (0.681) and OT (0.668) obtained the highest correlation with heart rate, respectively. Based on these results, the highest diagnostic accuracies of ROC curves for tympanic temperature were related to indices of WBGT and CET, respectively. **Conclusion:** In total, the results showed that the two indices of WBGT and CET have the best validity among the empirical indices in warm and humid conditions.

Keywords: Validity, empirical indices, heat stress, heat strain, core temperature, heart rate

THE CONCEPT OF OWNERSHIP IN ISLAM

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ABSTRACT
Ownership is one of the important aspects of human life which involves individual rights to property and resources. In Islam, the concept of ownership has a strong foundation and is integrated with religious teachings as revealed through the Qur'an and hadith. The purpose of this research is to investigate the concept of ownership in Islam, analyze the research methods used, and describe related research results. The research method used in this study is a qualitative approach by gathering information from primary sources such as the Qur'an, hadith, and their commentaries. In addition, this study also refers to relevant Islamic literature and the works of prominent scholars to gain a more comprehensive understanding of the concept of ownership in Islam. The results of the research show that the concept of ownership in Islam is based on the main principles, namely individual rights to ownership, social responsibility, and distributive justice. Islam recognizes individual rights to own and control property, but also emphasizes the importance of fulfilling social obligations towards the people and society. The concept of ownership in Islam also avoids exploitation, monopoly and injustice in the distribution of wealth. This study concludes that the concept of ownership in Islam teaches a balance between individual rights and social responsibility. This concept encourages Muslims to use property wisely, respect the rights of others, and contribute to building a just and equitable society. A deep understanding of the concept of property in Islam can provide guidance for Muslim individuals and communities in managing their relationship to property and resources.

Keywords: Ownership, Islam, Al-Qur'an, Hadith, Social responsibility, Distributive justice

KANATLI HAYVAN BESLEMEDE SARI KANTARON (*Hypericum* sp.) BİTKİSİNİN BİYOLOJİK AKTİVİTELERİNİN DEĞERLENDİRİLMESİ

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ÖZET

Kanatlı hayvanlar, kısa dönemde üretim imkana sahip olup, insanlara protein, temel mikro besin maddeleri ve enerji sağlayarak beslenmeye önemli ölçüde katkıda bulunmaktadır. Bu nedenle tavukçuluk sektörü özellikle gelişmekte olan ülkelerde hızla ilerlemektedir. Sektörün hayvan beslemede kullanılabilecek ve insan sağlığını tehdit edici unsurlar içermeyen, alternatif ve doğal yem katkı maddeleri arayışı da artmaktadır. Büyümeyi teşvik edici etkisi, bağışıklığı arttırıcı ve mikrobiyal yetenekleri nedeniyle, çeşitli kaynaklardan ve miktarlardan elde edilen bitkisel ekstraktlar, kanatlı hayvan endüstrisinde antibiyotikler ve sentetik ürünler yerine alternatif olarak kullanılabilmektedir. Birçok canlının tedavisinde yıllardan beri kullanılan tıbbi bitkiler tüm dünyada olduğu gibi Türkiye'de de hala kullanılmaktadır. Etnobotanik bitkiler olarak bilinen ve tıbbi amaçlı yaygın olarak kullanılan ve ticari olarak da ulaşılabilen bir bitki türü de *Hypericum* sp.'dir. *Hypericum* türlerinin genel olarak antidepresan, antienflamatuar, antioksidan, antimikrobiyal ve sitotoksik etkileri gibi biyolojik aktiviteleri bulunur. Örneğin türlerden bir tanesi çokça yara ve yanık tedavisi, antiparaziter ve ağrı kesici amacıyla kullanılan geleneksel tıbbi bitkiler arasında halk tarafından da tanınan *Hypericum perforatum*'dur. Yapısındaki hiperforin ve hiperisin gibi maddeler bitkiye, antibakteriyel ve antiviral özellikler de katmaktadır. Farklı kantaron türlerinin kanatlılar için tıbbi amaçlı kullanılabilirliğinin hayvan beslemede yardımcı olup olmayacağını görmek için yapılan bu derlemenin sonuçlarına göre, sarı kantaron bitkisinin üzüm çekirdeği yağı ile birlikte kullanıldığında yemden yararlanma oranını, ayrıca yumurta kabuğu ağırlığı, albümin indeksi ve Haugh birimleri gibi bazı yumurta kalite parametrelerini de iyileştirdiği bildirilmiştir. Sarı kantaron tozunun bağışıklık güçlendirici etki gösterdiğini belirten birçok literatüre de ulaşılmıştır. Özellikle etlik ve yumurtacı piliçlerde sarı kantaron ile birlikte yeme veya suya katılan bitki ekstraktlarının ısı stresinin olumsuz sonuçlarını hafifletmek için önemli olduğu da vurgulanmıştır. Bu değerlendirmelere göre, yüksek biyolojik aktivite varlığı tespit edilen sadece *Hypericum perforatum* ile değil sarı kantaron bitkisinin farklı çeşitleri ile de kanatlı türleri çalışılarak endüstriyel kanatlı çiftliklerinde yem katkı maddesi olarak kullanılması önerilmektedir.

Anahtar Kelimeler: *Hypericum*, sarı kantaron, kanatlı hayvan besleme, büyüme performansı

THE EVALUATION OF THE BIOLOGICAL ACTIVITIES OF THE PLANT OF JOHN'S WORT (*Hypericum* sp.) IN POULTRY NUTRITION

ABSTRACT

Poultry has short-term production possibilities and contributes significantly to nutrition by providing protein, essential micronutrients and energy to humans. For this reason, the poultry sector is progressing rapidly, especially in developing countries. The industry's demand for alternative natural feed additives that can be used in animal nutrition and do not threaten human health is also increasing. Herbal extracts obtained from various sources and amounts can be used as an alternative to antibiotics and synthetic products in the poultry industry, due to their growth promoting effect, immune-enhancing and microbial abilities. Medicinal plants, which have been used for years in the treatment of many living things, are still used in Turkey as well as all over the world. Another plant species known as ethnobotanical plants, widely used for medicinal purposes and commercially available, is Hypericum sp. Hypericum species generally have biological activities such as antidepressant, anti-inflammatory, antioxidant, antimicrobial and cytotoxic effects. For example, one of the species is Hypericum perforatum, which is widely known among the traditional medicinal plants used for wound and burn treatment, antiparasitic and pain relief. Substances such as hyperforin and hypericin in its structure also add antibacterial and antiviral properties to the plant. According to the results of this review, which was carried out to see whether the medical use of different St. John's Wort species for poultry would be helpful in animal nutrition. The use of St. John's Wort together with grape seed oil has also been reported to improve the feed conversion ratio, as well as some egg quality parameters such as eggshell weight, albumin index and Haugh units. Many literatures indicating that St. John's Wort powder have an immune-enhancing effect have also been evaluated. It was also emphasized that plant extracts added to the feed or water together with St. John's Wort are important to alleviate the negative consequences of heat stress, especially in broiler and layer chickens. According to these evaluations, it is suggested to be used as a feed additive in industrial poultry farms by studying not only Hypericum perforatum but also different varieties of St. John's Wort with high biological activity.

Keywords: *Hypericum*, St. John's Wort, poultry nutrition, growth performance

ONTOLOGY ETHICS AND DEONTOLOGY ETHICS

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ABSTRACT

Purpose: This paper aims to explain about ontology ethics and deontology ethics by formulating the following questions; first, What is the meaning of ontology ethics?. Secondly, What is the ethical concept of ontology?. Third, What is the meaning of deontological ethics? Fourth, What are the ethical theories and principles of deontology? Fifth, How is the application of Deontology Ethics related to employment of PT TRISAKTI CIPTA NUSANTARA in Surabaya - East Java? **Design/methodology/approach:** This paper uses a qualitative approach, because the source of data and research results in library research, inductive data analysis, theory from the basis / grounded theory (leading to the direction of compiling theories based on data). **Findings:** First, Ontology comes from the Greek word 'Ontos' which has the meaning of being something that really exists and that existence is true, or also real reality. While for 'logos' has the meaning of science or teachings or also thought. Many figures explain the meaning of ontology. One of them, according to Suriasumantri who explained that ontology is a discussion of what we want to know how far we want to know, or in other words a study of theories about existing. Second, Ethical Concepts ontology (1) General (universal) and Specific (particular) (2) Substance and Accident (3) ABSTRACT and Concrete (4) Essence and existence (5) Determinism and indeterminism. Third, deontological ethics assesses the ethicality of an action or decision based on the motivation of the decision maker. As already mentioned earlier, the word deontology comes from the Greek words deon (obligation) and logos (science) (Bertens, 2014). According to deontology, an action or decision is ethically justified not on the basis of a positive result or rejected not on the basis of the negative impact obtained but on the basis of the decision maker's motivation or action that is to fulfill what is understood as his obligation. So what is the basis for good and bad deeds is obligation. The obligation is absolute. Fourth, Ethical Theory of Deontology (1) Rational Monism (2) Traditional Deontology (3) Intuitionistic Pluralist. Principles in deontology ethics (1) For Actions to have moral values (2) Moral values of an Action (3) Both principles have an effect. Fifth, Application of deontology ethics related to employment at PT. Trisakti Cipta Nusantara on the principle of obedience is still not going well because there are still employees who still object to obeying company regulations. This is shown by there are still employees who violate the permit not to come to work. Then obedience to superior instructions is also still lacking, especially when employees experience collisions with previous work that has not been

completed. **Originality/value:** This paper describes comprehensively the ethics of ontology and deontology

Keywords: Ontology Ethics, Deontology Ethics, Islamic Business Ethics

ALTERNATİF VE STRATEJİK BİR BİTKİ: DİKENLİ İNCİR

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ÖZET

Dikenli incirin ana vatanı Amerika kıtasıdır. Kuzey Afrika, Akdeniz ve Orta Doğu ülkelerinde de yaygın bir şekilde bulunmaktadır. Çoğunlukla yabani olarak yetişen dikenli incirin; başta Meksika olmak üzere Şili, Brezilya, Arjantin, İtalya ve A.B.D. gibi birçok ülkede kültüre alınarak yetiştiriciliğinin yapıldığı görülmektedir. Dikenli incir meyveleri genellikle taze olarak tüketilmektedir. Bunun yanında meyve suyuna işlenerek, kurutularak, reçel, marmelat gibi ürünlere dönüştürülerek de değerlendirilebilmektedir. Meyvede çok sayıda bulunan çekirdekler, önemli bir yağ ve protein kaynağı olarak insan beslenmesinde ve yem sanayinde kullanılmaktadır. Dikenli incirin kladotları kurak bölgelerde hayvan yemi olarak son derece değerlidir. Genellikle, kladotlar pektin, müsilaj ve mineraller; meyveler ise vitamin, aminoasitler ve betalainler açısından zengindir. Tohum endosperminin arabinanca zengin polisakkaritlerden oluştuğu bildirilirken, tohum kabuklarında D-ksilan bulunur. Tohumlar yağ bakımından çok zengindir ve buna ek olarak antosiyaninler de bulunur. Dikenli incir ülkemizde Akdeniz ve Ege Bölgelerinin özellikle sahil kuşağında yaygın olarak yetiştirilen ve özellikle güney sahil bölgelerimizde sevilen ve tüketilen bir meyvedir. Dikenli incir; diğer yerel isimleriyle Firenk İnciri, Lap İnciri, Kaynana Dili, Pabuç İnciri, Barbar İnciri, Hint inciri, Babutsa olarak anılan meyve Cactaceae familyasına ait bir bitkidir. Dikenli incir genellikle subtropik bölgelerde yetiştirilmektedir. Bu bölgeler genellikle ılık kış, sıcak yaz iklimine ayrıca ortalama yıllık 100-600 mm yağışa ve en az 2-5 ay kurak bir döneme sahip özelliktedir. Ülkemiz Akdeniz sahil kuşağında 0-800 rakım arasında yetiştirilmektedir. Ülkemizde mevcut durumda düzenli bahçe bulunmamakla birlikte çoğunlukla çit bitkisi olarak, ana tarım alanlarının kenarında veya dışında dağınık veya toplu plantasyonlar halinde bulunmaktadır. Bu bitki ve plantasyonların genellikle sahipleri bulunmakta ve meyveleri bu kişiler tarafından üretilmekte veya pazarlanmaktadır. Son yıllarda bu tür ile hafif tuzlu veya kurak-yarı kurak alanlarda düzenli meyve bahçesi kurma teşebbüsleri söz konusudur. Bu çalışmada Ülkemizde atıl tarım arazilerinin değerlendirilmesinde kullanılabilecek dikenli incir bitkisinin genel özellikleri ele alınmış ve öneriler geliştirilmiştir.

Anahtar Kelimeler: Dikenli incir, Türkiye, Alternatif bitki

ALTERNATIVE AND STRATEGIC PLANT: PRICKLY FIGS

ABSTRACT

The homeland of the prickly fig is the American continent. It is also widely found in North African, Mediterranean and Middle Eastern countries. The prickly fig, which grows mostly wild; It is seen that it is cultivated and cultivated in many countries such as Mexico, Chile, Brazil, Argentina, Italy and the USA. Prickly fig fruits are generally consumed fresh. In addition, it can also be evaluated by processing into fruit juice, drying, turning into products such as jam and marmalade. The seeds, which are found in large numbers in the fruit, are used as an important source of oil and protein in human nutrition and in the feed industry. The cladotus of the prickly fig is extremely valuable as animal feed in arid regions. Generally, cladotes are pectin, mucilage and minerals; fruits are rich in vitamins, amino acids and betalains. It has been reported that the seed endosperm is composed of arabinan-rich polysaccharides, while the seed coats contain D-xylan. The seeds are very rich in oil and, in addition, they contain anthocyanins. Prickly fig is a fruit that is widely grown in the Mediterranean and Aegean regions, especially in the coastal zone, and is loved and consumed especially in the southern coastal regions. Prickly Fig; The fruit, which is called Firenk Fig, Lap Fig, Mother-in-law, Shoe Fig, Barbarian Fig, Indian Fig, Babutsa by other local names, is a plant belonging to the Cactaceae family. Prickly figs are usually grown in subtropical regions. These regions generally have a mild winter and hot summer climate, with an average annual precipitation of 100-600 mm and a dry period of at least 2-5 months. It is grown between 0-800 altitudes in the Mediterranean coastal belt of our country. Although there is no regular garden in our country, it is mostly found as a hedge plant, in scattered or collective plantations on the edge or outside of the main agricultural areas. These plants and plantations usually have owners and their fruits are produced or marketed by these people. In recent years, there have been attempts to establish regular orchards with this species in slightly saline or arid-semi-arid areas. Cares are available as multiple hedge plants, scattered or collective plantations on or off main farming trips, although there is currently no regular garden. These plants and plantations usually have owners and their fruits are produced or marketed by these people. In recent years, there have been attempts to establish regular orchards with this species in slightly saline or arid-semi-arid areas. In this study, the general characteristics of the prickly fig plant, which can be used in the evaluation of idle agricultural lands in our country, were discussed and suggestions were developed.

Keywords: Prickly fig, Türkiye, Alternative plant

EFFECT OF TEMPERATURE AND EXTRACTION TIME ON PECTIN PRODUCTION FROM EDAMAME SOYBEAN PODS

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ABSTRACT
Pods of Edamame soybeans (*Glycin max* (L.) Merril as a by-product of edamame soybean still has many benefits. Unlike regular soybean pulp, this waste has not been utilized. In addition to nutritional value, edamame soybean pods contain a certain amount of pectin. So far the need for pectin is met from imported products, even though other pectin sources such as soybean pods have the potential to be an alternative source of pectin. This study aims to determine the effect of temperature and extraction time on the quality of pectin produced by edamame soybean pods and find the right combination to obtain the best results. The experimental design was carried out with two factors and two levels of treatment, namely temperature factors at 80 ° C and 95 ° C and heating time (30 and 60 minutes). Pectin soybean pods are extracted using hydrochloric acid. Based on the Bayes method, the best pectin produced is pectin extracted at 95°C for 60 minutes. Pectin produced from the combination of these processes is known to contain pectin of 5.16%, 14.80% moisture content, 8.02% ash content, 1867.3773 equivalent weight, 3.74% methoxyl content, 30.41% galacturonic acid content, 68.99% esterification degree, and a relative viscosity of 10.5 mPa.s. While commercial pectin was obtained from CV. Nura Jaya (Indonesia) showed 7.57% moisture content, 18.66% ash content, 49825.8706 equivalent weight, 3.70% methoxyl content, 21.37% galacturonic acid content, 98.30% esterification degree, and a relative viscosity of 4133.3 mPa.s. This study shows the potency of using Edamame soybean pod as an alternative to pectin source.

Keywords: Edamame soybean pod, pectin, pectin extraction, methoxyl content, galacturonic acid

COLLECTION AND CONSERVATION METHODS OF VEGETABLE CROPS

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ABSTRACT
The status of conservation of vegetable crops germplasm has always received less attention than that of the major staple crops such as cereals and legumes. Germplasm conservation underpins global efforts to ensure future food security by capturing natural and existing crop diversity and developing new crops for agriculture. Germplasm conservation is the most successful method to conserve the genetic traits of endangered and commercially valuable species. Germplasm conservation is mainly aimed to ensure the proper preservation and storage of germplasm belonging to economically important plants (Gosal et al., 2010). Cryopreservation is one of the cost-effective and long-term storage methods of germplasm, in which biological material is stored at a very low temperature of about −196°C.

Keywords: underutilized crops, germplasm, genetic resources, conservation, cryopreservation, in-situ conservation and ex- situ conservation

YENİ MİRAS KANUNUNUN ARAZİ TOPLULAŞTIRMASINA OLASI ETKİLERİ

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ÖZET

Ülkemizde tarımsal işletmelerin sahip olduğu arazilerinin birçoğu parçalı ve dağınık yapıdadır. Tarımsal arazilerdeki parçalılığın nedenlerinin başında arazilerin miras ve arazi alım- satımları gelmektedir. Tarım arazilerinin çok sayıda küçük parsele bölünmesi ve tarımsal işletmeye ait parsellerin birbirinden uzakta bulunması tarımsal faaliyetleri olumsuz etkilemektedir. Arazilerin parçalı ve dağınık yapıda olması arazilere yol, su, drenaj, tesviye vb. altyapı hizmetlerinin ulaştırılmasını ve tarımsal üretimi zorlaştırmaktadır. Arazilerdeki parçalılık ve dağınıklığın olumsuz etkilerinin giderilmesi amacıyla arazi toplulaştırma çalışmaları yapılmaktadır. Mevcut durumda parçalı ve dağınık halde bulunan tarımsal arazilerin birleştirilerek tarıma etkili ve verimli bir şekilde tekrar kazandırılması amacıyla yapılan arazi toplulaştırma projelerinin yanı sıra, birleştirilen parsellerin tekrar bölünüp parçalanmasını önleyici gerekli tedbirler alınmalıdır. Ülkemizde arazilerin parçalanmasını önleyici birçok yasal düzenleme yapılmıştır. Tarım arazilerinde parçalanmayı önlemeye yönelik yapılan son yasal düzenleme 2014 yılında yürürlüğe giren "6537 sayılı Toprak Koruma ve Arazi Kullanımı Kanununda Değişiklik Yapılması Hakkında Kanun"dur. Bu kanunda "asgari tarımsal arazi büyüklüğü" ve "yeterli gelirli tarımsal arazi büyüklüğü" ve "ekonomik bütünlük" olmak üzere üç önemli kavram öne çıkmaktadır. 2014'te yürürlüğe giren yeni miras kanunu ile arazilerin parçalanarak bölünmesinin önüne geçilmesi amacıyla getirilen bir dizi kısıtlamalar, toplulaştırma çalışmaları sırasında işletme sahiplerinin parsellerinin birleştirilmesini istememelerine neden olabilmektedir. Kanunun arazi toplulaştırma çalışmalarına olası etkilerinin belirlenebilmesi amacıyla yeni miras kanunundan önce toplulaştırma çalışması gerçekleştirilmiş olan Çankırı-Kızılırmak-Karamürsel köyü ile kanundan sonra toplulaştırma çalışması gerçekleştirilmiş olan Bursa-Yenişehir-Yazılı köyü "asgari tarımsal arazi büyüklüğü" ve "yeterli gelirli tarımsal arazi büyüklüğü" ve "ekonomik bütünlük" kavramları yönünden incelenmiştir. Konuyla ilgili mevcut yasa ve yönetmeliklerde arazi toplulaştırması projeleri ile yeni oluşacak parsellerde işletme büyüklüğü yeterli ise ekonomik bütünlük oluşturacak şekilde parsellerin birleştirilmesi yönünde bir düzenleme yapılması toplulaştırma çalışmalarının daha etkin ve verimli yerine getirilebilmesini sağlayacaktır. Böylece arazi toplulaştırma çalışması tamamlanan alanlarda arazi toplulaştırma sonrasında tekrar meydana gelebilecek arazi parçalanmasının önüne geçilebilecektir.

Anahtar Kelimeler: Arazi parçalılığı, Asgari tarımsal arazi büyüklüğü, Yeter gelirli tarımsal arazi büyüklüğü, Ekonomik bütünlük

THE POSSIBLE EFFECTS OF THE NEW INHERITANCE LAW ON LAND CONSOLIDATION

ABSTRACT

In our country, most of the lands owned by agricultural enterprises in our country are fragmented and scattered. The main reasons for the fragmentation in agricultural lands are the inheritance of lands and land purchases-sales. The division of agricultural lands into many small parcels and the fact that the parcels belonging to agricultural enterprises are far from each other adversely affect agricultural activities. The fragmented and scattered nature of the lands makes it difficult to provide roads, water, drainage, leveling etc. infrastructure services to the land and agricultural production in the lands. Land consolidation projects are carried out in order to eliminate the negative effects of fragmentation and scattering in the lands. In addition to the land consolidation projects carried out for the purpose of reintegrating the fragmented and scattered agricultural lands in the current situation, necessary measures should be taken to prevent the re-dividing and fragmentation of the combined parcels. In our country, many legal arrangements have been made to prevent the fragmentation of lands. The last legal regulation to prevent fragmentation in agricultural lands is the “Soil Conservation and Land Use No: 6537”, which entered into force in 2014. Three important concepts come to the fore in this law: "minimum agricultural land size", "agricultural land size with sufficient income" and "economic integrity". With the new inheritance law that came into force in 2014, a series of restrictions introduced to prevent the division of lands by fragmentation may cause agricultural enterprises not to want their parcels to be combined during consolidation projects. In order to determine the possible effects of the law on land consolidation projects, Çankırı-Kızılırmak-Karamürsel village, where consolidation project was carried out before the new inheritance law, and Bursa-Yenişehir-Yazılı village, where consolidation project was carried out after the law, "minimum agricultural land size", "agricultural land size with sufficient income" and "economic integrity" analyzed in terms of concepts. In the existing laws and regulations on the subject, if the size of the business is sufficient in the new parcels to be formed by land consolidation projects, making a regulation to combine the parcels in a way that will create economic integrity will ensure that the consolidation projects can be carried out more effectively and efficiently. Thus, in areas where land consolidation project has been completed, land fragmentation that may occur again after land consolidation will be prevented.

Keywords: Land fragmentation, Minimum agricultural land size, Agricultural land size with sufficient income, Economic integrity

CAN AZO-FOOD DYE METABOLITES INTERFERE WITH DOPAMINERGIC PATHWAYS IN CNS CAUSING ADHD: A MOLECULAR STRUCTURAL INVESTIGATION

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ABSTRACT
This study explores link between occurrence of ADHD and hydroxylated amine metabolites of permitted azo food dyes and grades the dyes for their relative potency. These metabolites are generated either by the action of body's own enzymes or by the intestinal microbiome. The blood brain barrier (BBB) penetration and competitive binding abilities of metabolites with dopamine-receptors in the brain are investigated. Geometries of metabolites were optimized using quantum chemical Austin Model 1. Lipophilicity, diffusion coefficient, topological polar surface area and hydrogen bonding atom distances were calculated for the metabolites in the optimized geometries. Based on BBB penetrability as well as competitive binding abilities of metabolites with dopamine-receptors, it is concluded that metabolites of Amaranth dye are likely to cause strongest ADHD effect followed by Ponceu 4R and Allura Red. Dyes Sunset yellow, Azorubine and Tartrazine could cause milder ADHD effects in that order. Besides relative grading of water soluble food dyes for their ADHD potential, study provides an alternative model for molecular basis of origin of ADHD and reasons for its differential manifestation in different children.

Keywords: ADHD, Attention Deficit Hyper Activity, Azo Dye, Food Color, Metabolite

EFFECT OF MILK ON THE ORGANOLEPTIC CHARACTERISTICS OF GARCINIA MANGOSTANA L. VELVA

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ABSTRACT
The mangosteen (*Garcinia mangostana L.*) has anti-inflammatory and antioxidant effects. Even though the mangosteen fruit has the highest antioxidant content of any fruit, its utilization as a processed product is still limited. Mangosteens are usually eaten fresh as dessert. The fleshy or seedless segments traditionally produce syrup, jam, and canned goods. The seeds are sometimes added to enhance the flavor. This study aimed to utilize mangosteen the fleshy fruit in Velva fruit products and assess consumer approval of Velva fruit products. Two phases are involved in the transformation of mangosteen pulp into Velva fruit. The first stage is the pureeing of mangosteen fleshy fruit, and the second stage is the production of Velva fruit. A hedonic test was used to assess consumer acceptance of Velva fruit products, with data processed using ANOVA (analysis of variance), consisting of 70 participants. Velva fruit was tested with a different preparation. Different formulations were created by varying the milk-mangosteen puree ratios, which were 1:1, 1:2, and 1:3. The panelists evaluated the taste, color, aroma, and texture. The hedonic test on Velva fruit products revealed that the variation in the ratio between milk and puree of mangosteen pulp utilized was not statistically different or did not alter the panelists' degree of preference for the characteristics of color, taste, texture, and aroma. The formulation chosen was a 1:3 milk-to-mangosteen pulp puree ratio based on the most used mangosteen pulp.

Keywords: Mangosteen, velva fruit, antioxidant, formulation

CLASSIFICATION OF SPIRAL AND NON-SPIRAL GALAXIES USING DECISION TREE ANALYSIS AND RANDOM FOREST MODEL: A STUDY ON THE ZOO GALAXY DATASET

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ABSTRACT

The goal of this research is to create a precise prediction model that can differentiate between spiral and non-spiral galaxies using the Zoo galaxy dataset. Decision tree analysis and random forest models will be used to construct the model, and various conditions within the dataset will be employed to classify the data accurately. The model's performance will be evaluated using a confusion matrix, and the probability of predicting spiral galaxies will be analyzed. The research will also investigate the differences in Total Power among signal types and identify Peak Frequency and Bandwidth values consistent across all signal types. This study is expected to provide important insights into galaxy classification and signal characteristics, specifically in the fields of astronomy and astrophysics. This study utilized the decision tree analysis research method to create a predictive model for identifying spiral galaxies using the Zoo galaxy dataset. The research approach focused on analyzing data before constructing a prediction model. The study did not involve random sampling, making it an observational study. Decision tree analysis was employed to classify galaxies into homogeneous groups, and a random forest model was used to classify galaxy types. This research provides insights into how decision tree analysis can be utilized to comprehend galaxy classification and can serve as a foundation for future research. To strengthen the conclusions, combining this research with other approaches such as experiments or random sampling can be considered. This study developed a predictive model for classifying galaxies based on their Spiral type using decision tree analysis on the Zoo galaxy dataset. The model divided the data into specific groups based on certain conditions, and the results demonstrated exceptional accuracy of the random forest model in categorizing galaxy types. In addition, the study investigated various signal types in galaxies and found variations in Total Power, but consistent values for Peak Frequency and Bandwidth at 2 in all signals. These findings provide valuable insights into galaxy classification and signal characteristics, which could have practical applications in communication, signal processing, and analysis. The utilization of decision tree analysis and random forest models for galaxy

classification and signal analysis represents an innovative approach in this field. The novelty of this research lies in the new approach to categorizing galaxy types using decision tree and random forest models. Previously, the approach used to categorize galaxy types was through visual methods and observations via telescopes. This new approach provides a new and potentially more efficient way of processing galaxy image data, resulting in faster and more accurate categorization. Moreover, this research contributes to the development of signal analysis applications such as Total Power, Peak Frequency, and Bandwidth, which were previously only used in the fields of astronomy and astrophysics. However, they have the potential for wider applications in the fields of communication, signal processing, and analysis beyond astronomy

Keywords: Galaxy classification, Decision tree analysis, Random forest model, Spiral and non-spiral galaxies, Signal characteristics

KOYUNLARDA HATALI ENJEKSİYON SONUCU OLUŞAN KOMPLİKASYONLAR

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ÖZET

Farklı zamanlarda ve farklı yetiştiriciler tarafından, enjeksiyon uygulaması sonrasında koyun ve kuzularda ölümler görülmesiyle, Fakültemizin Patoloji Anabilim Dalına nekropsisi yapılmak üzere getirildi. Anamnezde, koyun ve kuzulara aşı uygulamaları veya herhangi bir hastalık sonucunda reçete edilmiş bir ilacın enjeksiyon ile (intramüsküler ve subkutan) hayvanlara uyguladıktan bir gün sonra topallama, şişlik ve sonrasında bir çoğunda ölümler meydana geldiği bildirilmiştir. Bu hayvanlara yapılan sistemik nekropsilerde, makroskobik olarak enjeksiyon uygulanan alanlarda şiddetli hemorajik-nekrotik miyozitis (akut gangrenöz miyozitis), hematom, ödem ve bir çoğunda krepitasyon sesi saptandı. Ayrıca 2 vakada ise enjeksiyon uygulamasının nervus ischiadicus'a denk gelmesi sonucunda paraliz şekillendiği tespit edilmiştir. Bu alanlardan alınan doku örnekleri % 10'luk tamponlu formaldehite konularak fikse edildi ve rutin doku takibi yapıldı. Lamlar hematoksilen & eozin ile boyanarak ışık mikroskobunda incelenerek fotoğraflandı. Yapılan mikroskobik incelemede; kas demetlerinde nekroz, interstisyumda fibrinopurulent eksudasyon, lökosit infiltrasyonu, vaskülitis, ödem ve psödokistik boşluklar şeklinde gözlenen çok sayıda gaz kabarcıkları tespit edildi. Makroskobik ve mikroskobik incelemeler sonucunda, hatalı enjeksiyon kaynaklı yanıkara hastalığı, malign ödem ve paraliz şekillendiği saptanmıştır. Bu sonuçlar sonrasında yetiştiricilerden enjeksiyon uygulamalarının detayları alınmıştır. Tüm yetiştiriciler, enjeksiyonları kendileri veya çobanları tarafından birkaç enjektör ile tüm sürüye uygulama yaptıklarını ifade ettiler. Sonuç olarak; bilinçsiz ve asepsi kurallarına uymadan yapılan enjeksiyon uygulamalarında, enjektörün toprakta bol miktarda bulunan Clostridium septicum ve Clostridium chauvoei etkenleri ile kontamine olması veya sindirim yolu ile bu etkenleri almış fakat inaktif şekilde dokularda kalan etkenler, hatalı enjeksiyon ile anaerobik mikro ortam oluşturarak aktif hale gelmesiyle yanıkara hastalığı ve malig ödem gibi durumlardan dolayı binlerce koyun ve kuzunun muzdarip olması ve yüzlercesinin ölmesi ciddi bir ekonomik kayıp oluşturmaktadır.

Anahtar Kelimeler: Hatalı Enjeksiyon, Koyun, Yanıkara, Malig Ödem

COMPLICATIONS CAUSED BY INCORRECT INJECTION IN SHEEP

ABSTRACT

It was brought to our Faculty's Pathology Department for necropsy, after death was observed in sheep and lambs after injection by different breeders at different times. In the anamnesis, it has been reported that lameness, swelling, and death in most of the sheep and lambs occurred one day after vaccination or administration of a prescribed drug by injection (intramuscular and subcutaneous). In the systemic necropsies performed on these animals, macroscopically, severe hemorrhagic-necrotic myositis (acute gangrenous myositis), hematoma, edema and crepitation sound were detected in the injection areas. In addition, in 2 cases, it was determined that paralysis occurred as a result of the injection application coinciding with the nervus ischiadicus. Tissue samples taken from these areas were fixed in 10% buffered formaldehyde and routine tissue follow-up was performed. The slides were stained with hematoxylin & eosin, examined under a light microscope and photographed. In the microscopic examination, necrosis in the muscles, fibrinopurulent exudation in the interstitium, leukocyte infiltration, vasculitis, edema and numerous gas bubbles observed as pseudocystic spaces were detected. As a result of macroscopic and microscopic examinations, it was determined that black leg, malignant edema and paralysis were formed due to incorrect injection. After these results, the details of the injection practices were obtained from the breeders. All the breeders stated that they applied the injections by themselves or their shepherds to the whole herd with a few injectors. As a result, in the injection applications made unconsciously and without following the rules of asepsis, contamination of the injector with Clostridium septicum and Clostridium chauvoei agents, which are abundant in the soil, or the agents that have taken these agents through the digestive tract but remain in the tissues in an inactive form become active by creating an anaerobic microenvironment with incorrect injection. Thus, the suffering of thousands of sheep and lambs and the death of hundreds of them due to conditions such as black leg disease and malignant edema constitute a serious economic loss.

Keywords: Incorrect Injection, Sheep, Black Leg, Malignant Edema

A STUDY BY DR FAISAL THAT RISING OF JOBLESS YOUNG PEOPLE IN PAKISTAN

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ABSTRACT

31% of Pak youth right now jobless, numerous with proficient degrees Dr. Faisal Shows that more than 31% of Pakistan's childhood are presently jobless, out of this, 51% are females, 16% are guys, with a large number of them holding proficient degrees. Last year, Dr Faisal suggested in his exploration article that 40% of taught (undergrad or graduate) ladies were likewise jobless countrywide. It is likewise showed that the joblessness rate in Pakistan had arrived at 16%, which was disconnected to cases of it being 6.5 percent advanced. Pakistan, especially among the young with proficient degrees, requires a thorough methodology including different partners, including the public authority, instructive establishments, confidential area, and people themselves. Here are a few likely procedures to diminish joblessness in Pakistan. Upgrade school system: Spotlight on adjusting the instructive educational program to showcase requests and arising ventures. Support professional preparation and business instruction to foster viable abilities and advance independent work amazing open doors. Encourage industry-the scholarly community coordinated effort: Advance associations between instructive organizations and enterprises to overcome any issues between hypothetical information and useful abilities. Energize entry level positions, apprenticeships, and hands on preparing projects to furnish understudies with involved insight. Advance business venture: Establish a favorable climate for business by offering monetary motivators, admittance to capital, and business improvement support. Empower the foundation of startup hatcheries, gas pedals, and mentorship projects to cultivate enterprising development. Put resources into framework and industry: Foster foundation activities and backing businesses that can possibly make occupations. Focus on areas like assembling, horticulture, data innovation, environmentally friendly power, and the travel industry, which have the ability to ingest countless talented experts. Support unfamiliar speculation: Execute strategies to draw in unfamiliar direct venture by offering motivators, guaranteeing simplicity of carrying on with work, and giving a stable monetary climate. FDI can prompt the foundation of new businesses and occupation creation. Further develop admittance to fund: Work with admittance to credit for hopeful business people and little and medium-sized ventures through drives, for example, microfinance programs, low-interest advances, and improved on credit techniques. Reinforce vocation advising and work situation administrations: Lay out profession directing focuses in instructive organizations to direct understudies in picking reasonable vocation ways and give data on work market patterns. Upgrade work situation benefits and make online stages to associate work searchers with expected managers. Energize public-private associations: Team up with the confidential area to foster expertise based preparing projects and occupation creation drives. Public-private organizations can prompt the production of open positions and the improvement of applicable abilities. Upgrade advanced education: Elevate computerized proficiency projects to furnish people with the abilities important to flourish in the computerized age. This incorporates giving admittance to PCs, the web, and innovation preparing in provincial and underserved regions. Support territorial and worldwide joint effort: Encourage cooperation with adjoining nations and global associations to investigate work open doors, expertise trades, and information sharing. This should be possible through drives, for example, reciprocal arrangements, trade programs, and territorial monetary collaboration. It's critical to take note of that tending to joblessness is a perplexing and long-haul process requiring supported endeavors from all

partners. The public authority, confidential area, instructive organizations, and people should cooperate to establish an empowering climate that advances work creation and furnishes the adolescent with the abilities required for the gig market.

Keywords: Exploration, instructive, environmentally, Reinforce, perplexing, adolescent

INDUCED POLYGENIC VARIABILITY ON M_2 AND M_3 GENERATION OF SESAME (*Sesamum indicum* L.)

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ABSTRACT
Experiment carried out for the studied of polygenic variability in M_2 and M_3 generation of sesame by inducing variability through gamma ray to know the status of genetic variability parameters like GCV, PCV, Heritability and Genetic advance percent of mean. The genotypes differed significantly for all characters. For all characters, phenotypic coefficient of variation was higher than genotypic coefficient of variation indicating that there was environmental influence on these traits. The results obtained in M_2 and M_3 indicated to work with a reduced volume of mutagenized material, by rejecting 'roughage' and selecting desirable ones in M_2, and obtain to higher estimates of genetic parameters, consequently, resulting in higher frequencies of promising progenies. Higher estimates of heritability and genetic advance for different traits were observed in both generations. Thus, tremendous scope exists for improving the seed yield plant^{-1} and its components traits by exercising selection in M_2 and M_3.

Key words: Polygenic variability, M2 and M3 generation, GCV, PCV, Heritability, Sesame

FARKLI MEYVELERDEN ÜRETİLEN YENİLEBİLİR FİLMLERİN ÖZELLİKLERİNİN TESPİTİ

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ÖZET

Yenilebilir filmler, gıda maddelerinin raf ömrünü uzatmak için kullanılan ve gıda yüzeylerine uygulanan bir tür koruyucu kaplamalardır. Yenilebilir filmler, gıdalarda oksidasyonu önler; nem, gaz, aroma ve lipit bariyerleri gibi özellikler sergileyerek gıda maddesinin kalitesini korur. Ayrıca mikroorganizma büyümesini kontrol altında tutarak, gıda bozulmasını yavaşlatır. Yenilebilir filmler, geleneksel plastik ambalajlara kıyasla çevre dostu bir alternatif sunmaktadır ve kullanılan hammaddelere bağlı olarak ürünlerin albenisini artırabilmektedir. Çalışmamızda yenilebilir film üretimi için, beyaz üzüm (*V. vinifera L. cv. Sultani)*, kokulu kara üzüm (*V. labrusca L.)* ve güz yemişi (*Elaeagnus umbellate)* meyvelerinin şıralarından elde edilen pestil çözeltileri kullanılmıştır. Sodyum aljinat çözeltisine (%2 w/v), üç farklı konsantrasyonda gliserol (plastikleştirici) (%30-40-50 w/w sodyum aljinat), kalsiyum klorür (%0.01 w/v) ve pestil çözeltisi (20g/100 mL çözelti) katılarak film çözeltisi elde edilmiştir. Bu çözelti 9 cm çaplı petri kutularına 15 g olacak şekilde dökülerek 40 °C'de 16 saat boyunca kurutulmuş ve ardından filmler petri kutularından çıkarılarak %53 nispi nem içeriğine sahip doymuş magnezyum nitrat (Mg $(NO_3)_2$) içeren desikatörde 3 gün bekletildikten sonra analiz edilmiştir. Analiz sonuçları TOPSIS (çok kriterli karar verme yöntemi) yöntemiyle değerlendirilmiş ve en iyi film özellikleri gösteren film karakterizasyonu belirlenmiştir. Bu değerlendirmede filmlerin opaklık, oksijen geçirgenliği (OG), gerilme (G,) kopma uzaması (KU), % suda çözünürlük ve su buharı geçirgenliği (SBG) değerleri kullanılmıştır. Meyvelerden üretilen filmlerde, gliserol konsantrasyonu filmlerin nem, kalınlık, suda çözünürlük, *L**, *a**, *b** ve SBG değerleri üzerine istatistiksel açıdan önemli etki göstermemiştir ($p>0.05$). Gliserol konsatrasyonunun artışı filmlerin opaklık, OG ve G değerlerini azaltmış, KU değerlerini ise artırmıştır ($p<0.05$). TOPSIS sonucunda güz yemişi pestil çözeltisi ve %40 gliserol içeren film optimum ambalaj özellikleri göstermiştir. Üretilen yenilebilir filmlerinin gıda ambalajlamada kullanılabilirliği çalışma sonucunda değerlendirilmiştir.

Anahtar Kelimeler: Yenilebilir Film, Ambalajlama, Gliserol, TOPSIS

DETERMINATION OF THE PROPERTIES OF EDIBLE FILMS PRODUCED FROM DIFFERENT FRUITS

ABSTRACT

Edible films are a type of protective coating applied to food surfaces and used to extend the shelf life of foodstuffs. Edible films prevent oxidation in foods and protect the quality of the foodstuff by exhibiting properties such as moisture, gas, aroma and lipid barriers. They also slow down food spoilage by controlling microorganism growth. Edible films offer an environmentally friendly alternative to conventional plastic packaging and, depending on the raw materials used, can increase the attractiveness of products. In our study, pestil solutions obtained from the juice of white grape (V. *vinifera L. cv. Sultani*), isabella grape (*V. labrusca L.*) and autumn olive (*Elaeagnus umbellate*) fruits were used to produce edible films. Sodium alginate solution (2% w/v) was added to three different concentrations of glycerol (plasticizer) (30-40-50% w/w sodium alginate), calcium chloride (0.01% w/v) and pestil solution (20g/100 mL solution) to obtain a film solution. This solution was poured into 9 cm diameter petri dishes (15 g) and dried at 40 °C for 16 hours and then the films were removed from the petri dishes and kept in a desiccator containing saturated magnesium nitrate ($Mg(NO_3)_2$) with 53% relative moisture content for 3 days and then analyzed. The analysis results were evaluated by TOPSIS (multi-criteria decision making method) and the best film characterization was determined. Opacity, oxygen permeability (OG), tensile (G,) elongation at break (KU), % water solubility and water vapor permeability (SBG) values of the films were used in this evaluation. Glycerol concentration had no statistically significant effect on moisture, thickness, water solubility, *L**, *a**, *b** and SBG values of the films produced from fruits ($p>0.05$). The increase in glycerol concentration decreased the opacity, OG and G values of the films and increased the KU values ($p<0.05$). As a result of TOPSIS, autumn olive pestil solution and 40% glycerol containing film showed optimum packaging properties. The usability of the produced edible films in food packaging was evaluated at the end of the study.

Keywords: Edible Film, Packaging, Glycerol, TOPSIS

OMICRON VARIANT PROGRESSION AND ITS THERAPY: UNPREDICTABLE OUTBREAK

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ABSTRACT
Since its outbreak, the severe acute coronavirus disease 2019 (COVID-19) pandemic has undergone a few iterations. Coronavirus 2 associated with respiratory illness, of which the Omicron variation is a subtype (B.1.1.529). Omicron is the most prevalent variation. The enhanced SARS-CoV-2 variant's rapid spread and immune evasion abilities have sparked global worries. Due to its strong transmissibility, Omicron has soon replaced Delta as the predominant form in some regions. The Omicron version, however, exhibits less pathogenicity when cell tropism is altered, according to recent studies. Omicron is also very resistant to the neutralising effects of vaccines, convalescent serum, and the majority of antibody therapies. On November 26, 2021, the World Health Organisation (WHO) nonetheless designated the SARS-CoV-2 Omicron (B.1.1529) strain as a variation of concern (VOC). The number of modifications in the Omicron version is unheard of, especially those that could have an impact on the biological and therapeutic properties of the spike protein. We have emphasised SARS-CoV-2 in our article, in particular the Omicron strain, as well as its propensity for hospitalisation and fatalities. What effects does it show when it is treated with natural products further? We can only hope that the work will point future researchers in the proper areas for studying how to reduce the effects of pandemics.

Key words: Omicron, SARS-CoV-2, World Health Organization (WHO), Neutralizing effects treatment, Natural products

EATING STYLE OF FEMALE STUDENTS AND ITS EFFECT ON THEIR HEALTH

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ABSTRACT
Eating style is way of eating that is influenced by culture, behavior and society. Like few things considered good or healthy in one culture but simultaneously people from other culture do not like to eat those things. Healthy or nutritional eating is a way of balancing the food a person eats to keep his/her body to be strong, energized and well nourished. This study was conducted to explained that eating habits of females directly affect their health. It was observed during the study that female students who do not take their meals on time faced health issues which also effected their academic performance as well. In this study objectives were set to get a comprehensive explanation of problems faced by female students in university regarding their nutritional health. The questionnaire was developed in the light of research objectives which was pre-tested from 20 respondents. Data were collected through simple random technique. 120 respondents were interviewed from three universities of District Faisalabad, 40 respondents from each university respectively. It was observed and analyzed that about 96.3% respondents thought that poor nutritional and imbalance diet is a cause of their poor health. In the same study 72.3% female accepted that due to lack of healthy and nutritional food in their habits they are facing many health issues to great extent. Majority of the respondents 68.8% thought that their eating habits affect their health to great extent. 46.9% of the respondents thought that junk food affect their heath to some extent. Only 28.1% of the female respondents were taking vitamins and minerals to maintain good health. The bi-variate analysis demonstrated that there is a significant relationship between monthly family income and eating habits. From the conducted study it was concluded that most of the students do not take care of their when they are away from home specially the ones who are living in hostels. Their eating habits became so much unhygienic and unhealthy. After conducting this research it is recommended that female students should must be aware about healthy eating lifestyle through seminars, conferences etc. They must visit a nutritionist at least once in a month to check that whether they are taking nutritional food or not.

Keywords: Eating Style, Female Students, Health

RP- HPLC METHOD DEVEOPMENT AND VALIDATION FOR ESTIMATION OF LINEZOLID IN BULK DRUG AND DOSAGE FORM

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ABSTRACT
A high-performance liquid chromatography is best separation technique to separate, quantify and detect the mixture of drugs. One spectrophotometric and several HPLC methods have been reported for determination of Linezolid in drugs and in pharmaceutical dosage forms. Hence, in the present study, a new, sensitive, suitable and robust reversed-phase high performance liquid chromatography method was developed and validated for the determination of Linezolid in bulk drug and in tablet formulation. In RP-HPLC method, (Methanol and Water 70:30 %v/v) was used as mobile phase, at a flow rate of 1.0 ml/min, on HPLC system containing UV-detector with Open lab EZchrome software and Water Kromasil C18 column (250 mm x 4.6; 5µm). The detection was carried out at 258 nm. The method gave suitable retention time i.e. 3 min for Linezolid the results of analysis in the method were validated in terms of Filter study, and as per ICH guidelines. Solution stability, specificity, Linearity, accuracy, precision (Repeatability and intermediate precision), Limit of detection, limit of quantification and robustness. A simple and precise method was developed for the assay of linezolid in bulk drug and in tablet formulation. The method needs regular reagents for doing analysis and also less time consuming, it can be performed routinely in industry for routine analysis of bulk drug and marketed product linezolid**.**

Keywords: HPLC, Linezolid, Analytical Method Development, Validations etc.

PRECIPITATION OF ASPHALTENES FROM CRUDE OIL EMULSION

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ABSTRACT
Asphaltenes precipitation and deposition are drastic issues in the petroleum industry. Asphaltenes behave like blood cholesterol in that they deposit on the inner walls of the transportation pipes thereby narrowing the internal diameters. This poses great dangers including pipe bursts. This work aimed at removal of Asphaltenes from crude oil sourced from Kaduna Refinery and Petrochemicals Company, Nigeria by solvent precipitation. The crude oil was found to be light crude as a result of low specific gravity (<0.84) and an API gravity of 36.95^0 due to high proportion of light hydrocarbon fractions. Methanol was used as a demulsifier to break the emulsion that happens to occur in the crude oil and the asphaltenes were precipitated by soxhlet extraction using n-heptane. The physicochemical properties were studied via FT-IR technique. The result revealed that, asphaltene was made up of C-H, C=C and C-O stretching vibrations which are characteristics absorption bands of C_7 asphaltenes. Therefore, asphaltenes precipitate in crude oil but the precipitation strongly depends on nature of the precipitation method as well as well as solvent used in the precipitation.

Keywords: Asphaltenes, Precipitation, Demulsifier, Emulsion, Soxhlet

GREEN SYNTHESIZE OF ZINK OXIDE NANOPARTICLES USING FERULA EXTRACT

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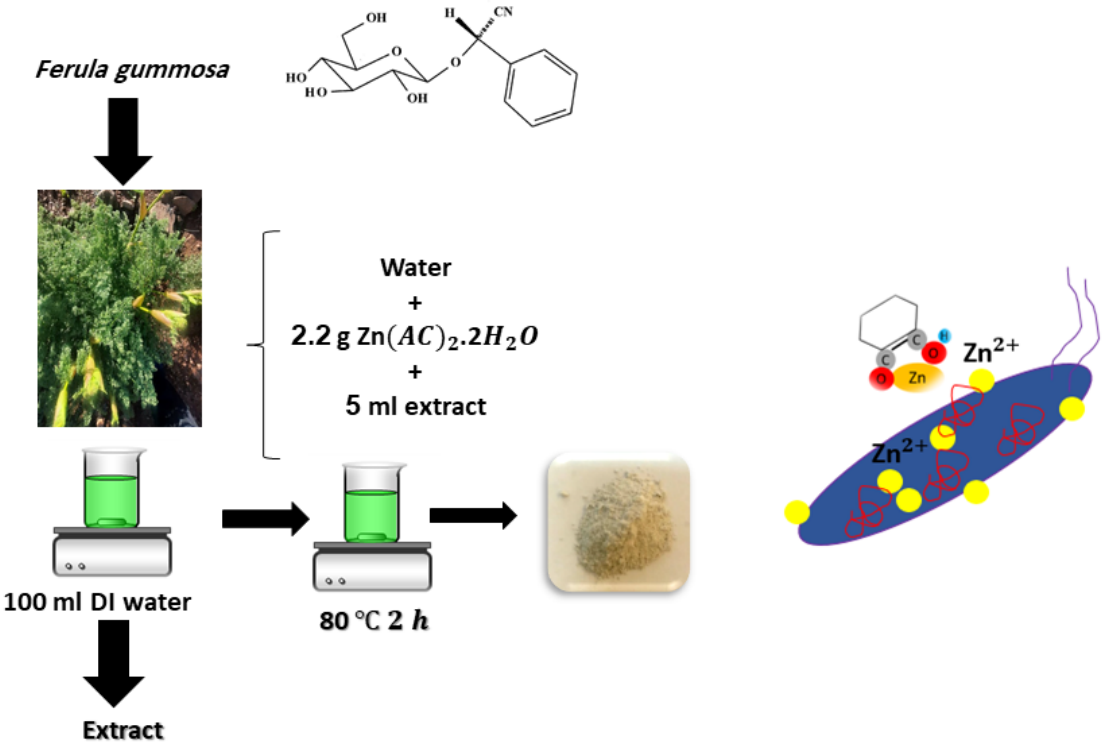
ABSTRACT
Herbal extract (HE) is highly regarded as a prime source of bioactive compounds, garnering significant attention, particularly for its antimicrobial properties. They could also decrease the environmental side-effects comparing to industrial linkers and surfactant. In this study we utilized the extract from *Ferula gummosa* extract leaves to synthesize zinc oxide nanoparticles (ZnO NPs) and examined their structural and antibacterial characteristics. The X-ray diffraction (XRD) analysis demonstrated that the ZnO NPs produced possessed a highly crystalline structure, specifically a wurtzite crystal structure. The average size of the crystalline particles in the prepared NPs was approximately 19 nm. These environmentally friendly synthesized NPs exhibited strong antibacterial activity against of Gram-positive and Gram-negative bacteria. The biosynthesized ZnO NPs exhibited a considerable zone of inhibition for *Staphylococcus aureus* compared with pure extract. The results revealed that ZnO NPs could stop the growth of pathogens in the concentration of 0.17 mg/L. However, the required concentration of green synthesized NPs to kill the cells is about 0.3 mg/L. Our results imply that *F. gummosa* extract may provide a new outlook in biomedical green synthesize of NPs. The obtained results demonstrated that the biosynthesized ZnO NPs reveal interesting characteristics for medical potential applications in the future. We recommend that the potential applications, on cancer cell lines and control of pathogens be assayed in further investigations.

Keywords: ZnO nanoparticles*; Ferula gummosa*; extract; Antibacterial activity; Green synthesize

GRAPHICAL ABSTRACT



Schematic illustration of the synthetic route for production of ZnO nanoparticles (NPs).

EFFECTS OF SOLAR AND WIND ENERGY SYSTEMS ON ACADEMIC PERFORMANCE OF STUDENTS IN HIGHER INSTITUTIONS OF LEARNING

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ABSTRACT
This research paper seeks to identify the effect of solar and wind energy systems on the academic performance of students in higher institutions of learning in Oyo, Oyo State, Nigeria. It takes into consideration the different elements of renewable energy and their effects on student performance, such as accessibility, cost effects, and efficiency. Data from existing literature and survey responses from students in higher education institutions are employed to assess the effects. The population of the study was 250 respondents from three higher institution of learning in Oyo metropolis. A total of one hundred and fifty (150) respondents from three higher institution formed the sample size for the study. Findings revealed that there are no enough solar lighting system facilities in most of our higher institutions of learning. Also findings from the research suggest that students with access to solar and wind energy systems are more likely to have improved academic performance. A cost-benefit analysis is used to demonstrate that solar and wind energy systems can significantly improve the academic performance of students in higher education institutions. The research contributes to the literature on renewable energy systems and their effects on students' performance. Finally, it was recommended among others that governments, stakeholders in education should make provision for availability of enough solar lighting system in lecture halls, lecture rooms, hostels and campuses.

Keywords: Solar power system, Wind energy system, Academic performance

APPLICATION OF PROLINE AS PRE-SOWING SEED TREATMENT ON OKRA UNDER WATER DEFICIT CONDITIONS

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ABSTRACT

Okra (*Abelmoschus esculentus* L.) is a flowering plant belongs to Malvaceae family and it is one of the most well-known and frequently used species. A pot experiment was carried out at Old Botanical Garden, University of Agriculture, Faisalabad, to examine the effect of proline as pre-sowing seed treatment on okra. In the Pots, two okra (*Abelmoschus esculentus* L.) varieties i.e. Sabzpari and Roshni were used for sowing. There were 3 replicates of each treatment. Five kg soil was used in each pot. Okra seeds were pre-soaked in three levels of proline i.e. H2O, 10 and 20 mM for 12 h to investigate the effect of proline. Two levels of drought (normal watering as control and 60% Field Capacity) were maintained. Experimental layout was completely randomized design (CRD). After 15 days maintaining of drought growth and biochemical related attributes were studied. Results indicated that morphological parameters (shoot length, plant length, shoot fresh and dry weight, root fresh and dry weight, plant fresh and dry weight) were decreased under drought stress. Proline implementation overcame drought effects by increasing these morphological parameters. Antioxidant activities i.e. catalase (CAT), superoxide dismutase (SOD) and peroxidase (POD) also enhanced under drought by the implementation of proline. While reactive oxygen species malondialdehyde (MDA) and hydrogen peroxide (H2O2) contents decreased by the application of proline. Mineral shoot ions (Na^+, K^+, Ca^{2+}) showed positive role in okra plant by the application of proline. Roshni showed better performance than Sabzpari. Best response was recorded at 20 mM proline level.

Keywords: Proline, Okra, morphological parameters

THE IMPACT OF UNEMPOLYMENT ON THE NATIONAL ECONOMY IN INDONESIA

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ABSTRACT

This study aims to analyze the impact of unemployment on the national economy in Indonesia. This research is a library research where data sources are obtained from document materials and library materials as well as other supporting documents. The results of the study concluded that in Indonesia, unemployment has a significant influence on national economic conditions. The level of people's welfare decreases, because they lose their livelihood will become a national economic problem. The rate of economic growth is declining, because people's purchasing power is also falling and this will lead to sluggishness in businessmen to invest. Revenues in the form of taxes will decrease, because the level of economic activity is low, tax objects will be narrow and sources of state revenue will decrease. The actual GNP achieved is lower than the potential GNP, because production factors are not utilized optimally. Unemployment will also affect inflation, where there is a continuous increase in the price of goods which can cause a decrease in people's purchasing power because in real terms their income level also decreases. If inflation increases, the level of welfare will be disrupted, and the result will be a decrease in people's purchasing power. The level of social welfare is an indicator in measuring the economic stability of a country and also the level of poverty.

Keywords: İmpact of Unemployment, National Economy, İndonesia

INSTABILITY IN FOOD SECURITY LEADS TO ENVIRONMENTAL DEGRADATION - A REVIEW

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ABSTRACT
Instability of food insecurity occurs due to land grabbing, conflict wars and violence, fast placed population growth, climate change, wastage of food, soil erosion, water shortage, water pollution. It has already on record that growth rate of Indian population increasing continuously. It has increased food demand and its directly impact on environment. Present study conducted to understand instability in food security and its impacts on environment and various environmental issues. This study is based on secondary data and systematic review of published articles in research journals and government reports. It has been studied that food insecurities have very high negative impacts on natural resources, biodiversity and overall natural environmental services. As per this study it has also concluded that over population may leads to more food insecurity and it will create more burden on environment which will leads for more environmental degradation.

Keywords: Food Insecurity, Environmental Degradation, Global Hunger Index, Environmental Issues

THE PHARMACOLOGICAL POTENTIAL OF MEDICINAL PLANTS: PHYTOCHEMICAL ANALYSIS, ANTIBACTERIAL INVESTIGATIONS, AND ANTIOXIDANT ACTIVITY ASSESSMENT IN MELISSA OFFICINALIS L.

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ABSTRACT
Melissa Officinalis L. (lemon balm) is a species widely employed in traditional medicine for its biological qualities, which are mostly attributable to polyphenols, and is therefore often utilized as a natural source of antioxidants. The purpose of this research was to determine the chemical make-up of Melissa Officinalis aqueous extract and test its antibacterial and antioxidant capabilities. Phytochemical tests based on colouring reactions or precipitation by specific chemical reagents was used to identify the various plant components. The extract of Melissa Officinalis is high in polyphenols, flavonoids, and tannins, all of which have antioxidant properties. Using the method established by Mohammedi H. et *al*., the ability of the M. Officinalis L. extract to suppress the DPPH free radical was determined. The DPPH antioxidant activity was increased (IC50= 25.98 1.63 g/mL). The agar disc diffusion method was used to evaluate antibacterial activity. Utilizing a concentration (MIC) below which growth is inhibited. Based on our findings, Melissa Officinalis L. has potent antibacterial activity against several different types of dangerous bacteria. Compounds like rosmarinic acid and caffeic acid are present, and these have been found to impede the growth of germs like Staphylococcus aureus, Escherichia coli, and Pseudomonas aeruginosa. As a promising therapeutic plant, Melissa Officinalis L. has antibacterial and antioxidant capabilities thanks to a number of different bioactive components.

Keywords: Antibacterial activity, Melissa Officinalis, Phytochemical analysis, Antioxidants

PERCEIVED EFFECT OF SOIL EROSION ON ARABLE CROP PRODUCTION IN ABIA STATE, NIGERIA

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ABSTRACT
This study assessed the perceived effect of soil erosion on arable crop production in Abia State, Nigeria. A Multi-staged sampling procedure was adopted in the selection of one hundred and twenty arable crop farmers that participated in the study. Descriptive and Inferential statistics were used to analyze the data collected. Major findings revealed that Sand mining ($\bar{x}$=3.59), Poor road construction ($\bar{x}$=3.58), Crops that attract human traffic ($\bar{x}$=3.55), Slope of the land ($\bar{x}$=3.52), Quarrying of rocks ($\bar{x}$=3.35), Excessive bush burning ($\bar{x}$=3.31), High Population density ($\bar{x}$=3.24), Rain water run off ($\bar{x}$=3.14), Overgrazing ($\bar{x}$=2.84) and Deforestation ($\bar{x}$=2.71) were the perceived major causes of soil erosion on arable crop production. However, the perceived effect of soil erosion on arable crop production in the study area included Increase in pests infestation ($\bar{x}$=3.39), Loss of fertile soils ($\bar{x}$=3.38), High cost of farming ($\bar{x}$=3.07), Reduction in crop yield ($\bar{x}$=3.27), Increase in diseases attack ($\bar{x}$=3.26) and Loss of crops ($\bar{x}$=3.22). Furthermore, Cross strip (83.3%), strip cropping (80.8%), construction of diversion ditch (80.8%) and use of organic manure (80.8%) were among the various soil erosion management strategies practiced by arable crop farmers to curtail the perceived effects of soil erosion. The grand mean ($\bar{x}$= 3.27) showed that the perceived effect of soil erosion on arable crop production was severe. The hypothesis result showed that there was a significant relationship between perceived effect of erosion on arable crop production and the various erosion management strategies practiced by the farmers in the study area. The study concluded that the perceived effect of soil erosion on arable crop production was severe and therefore recommended that farmers should be empowered by the Government to practice effective management practices to check the ravaging effect of soil erosion on arable crop production in the study area.

Key words: Perceived Effect, arable crop production, soil erosion

TECHNO-ECONOMIC ANALYSIS OF HYDROGEN FUEL CELL TECHNOLOGY FOR ELECTRIC VEHICLES

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ABSTRACT
The automobile sector is one of the most crucial sectors in the economy and has a huge impact on global warming as well. The prediction is that fossil fuels will deplete around 2060. Moreover, renewable options such as biodiesel, ethanol, and methanol are not so promising to replace fossil fuels effectively. Hence, hydrogen-based fuel cells are considered favorite candidates for future automobiles. Hydrogen fuel cells utilize hydrogen as fuel which most abundant gas on earth and produce electricity and water as by-products. This technology has already been used in some regions such as Europe. This study focuses on the technical and economic challenges hydrogen fuel cell is currently facing technologically and economically. This paper will discuss specifically the potential of fuel cells for future electric vehicles. Certain other aspects such as infrastructure and key challenges associated with cost-related challenges are discussed. Furthermore, hydrogen is difficult and store and challenges occur during hydrogen refueling infrastructure build-up in third-world countries like Pakistan. This study will help future engineers and researchers to comprehend the challenges of hydrogen fuel cells and what it holds for us in the near future

Keywords: Automobile, Fossil Fuels, Hydrogen, Electric Vehicles, Fuel Cells

INVESTIGATING SUSTAINABLE DEVELOPMENT THROUGH RESPONSIBLE INNOVATION AND INFRASTRUCTURE IN AGRICULTURE AND WATER TREATMENT

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ABSTRACT
As the world population would reach around 9 Billion in a few more decades, serious challenges include climate change, water shortage, fossil fuel depletion, unequal growth patterns in world economies, ecosystem threats, and rising global temperatures. In addition, if these trends continued at the same pace, humanity's very existence and survival would be a stake. Agriculture people face serious challenges from fruit fly bugs which causes puncturing of fruit and laying eggs inside it. These eggs or more specifically bacteria cause the degradation of fruit cells. Fruit decay is enhanced by increased pathogens, making fruit unusable for humans. Thus what do farmers do they turn to an easy and effective method to kill these insects while compromising their health and others as well. Not only that they put the environment at risk as well. The more sustainable way can be nanofiber build small sheets which attract these fruit flies and instantly kill them without causing any damage to farmer health and the environment. This study will focus on achieving sustainable goals by use of nanofibers sheets instead of fertilizers to kill fruit flies and the economic aspects of it as well. This study aims to achieve sustainable development goals with the help of nanofibers. The use of fertilizers and chemicals degrades the water, environment, and fruits as well. Thus a viable solution is required which does not put pressure on natural resources and protects the environment and the economy at the same time.

Keywords: Population, economies, Agriculture, environment, water

EXPLORING THE PRODUCTION AND ANALYSIS OF HYBRID HALIDE PEROVSKITES WITH HALOGEN SUBSTITUTION

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ABSTRACT
Organic and inorganic hybrid perovskites, known for their easy processing, have emerged as a promising new type of optoelectronic semiconductors with various applications. In a relatively short span of focused research, perovskite solar cells, designed with various configurations, have demonstrated impressive progress in efficiency, with advancements approaching approximately 20%. The advancement in achieving this milestone can be attributed to the innovation of diverse methodologies in synthesizing and depositing hybrid perovskite films, allowing for precise control over their composition and morphology. Progress in material synthesis and device fabrication has also led to advancements in other optoelectronic applications such as light-emitting diodes, photodetectors, and transistors. Significant progress has been made in understanding the fundamental aspects of organic-inorganic hybrid perovskites through both experimental and theoretical investigations. These studies have provided crucial insights into the behavior of these materials. Additionally, recent research has shown promising advancements in tackling the stability issues that have been a major challenge for further exploration of halide perovskites. This article gives an in-depth description of recent advances in hybrid perovskites, including their chemical and crystal structures, as well as the synthesis strategies used for both bulk and nano crystal forms. We emphasize the importance of understanding the fundamental features of hybrid perovskites, particularly their chemical and structural stability.

Keywords: Hybrid perovskites, Optoelectronic semiconductors, Perovskite solar cells, Efficiency advancements, Chemical and structural stability

DOES PHOSPHOGYPSUM APPLICATION AFFECT SALTS, NUTRIENTS, AND TRACE ELEMENTS DISPLACEMENT FROM SALINE SOILS?

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ABSTRACT
Salinity and sodicity are the most agricultural challenges in arid and semi-arid regions. A pot experiment was undertaken, to evaluate the effect of Phosphogypsum (PG) and Gypsum (G), to remove salts, nutrients and trace elements in leached water from saline and saline-sodic soils. In order to determine the efficiency and safety of these amendments, as an affordable strategy, for overcoming salinity and sodicity stress. The PG at 0, 15, 30 and 45 t/ ha and G at 15 t/ha were mixed with the upper 9 cm soil in the pot before being leached. The soils were collected from Sed El Masjoune and Sidi El Mokhtar areas of morocco with ECe of 140.6 mS/cm and 11.7 mS/cm respectively. The highest doses of PG (≥30 t/ha) removed significant amount of salts and nutrients. Calcium sulfate supplies calcium ions to replace salt ions (sodium, especially). The replaced salts are leached from the soil. The PG was more efficient compared to G in terms of salts leaching. Quantities of trace elements in the leachate, for most analyzed elements, were below the recommended limits of drinking and irrigation water. Because the experiment's alkaline conditions (basic water and soil) reduce the solubility and mobility of trace elements.

Keywords: soil salinity and sodicity, phosphogypsum, gypsum, leached water, plant nutrients, trace elements.

TOXICITY AND ANTI-COCCIDIAL EFFECT OF AQUEOUS *SACOGLOTTIS GABONENSIS* (MAGNOLIOPHYTA, HUMIRIACEAE) STEM BARK EXTRACT IN BROILER BIRDS EXPERIMENTALLY INFECTED WITH MIXED *EIMERIA* SPECIES

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ABSTRACT
The aqueous stem bark extract of *Sacoglottis gabonensis* (ASBESG) was evaluated for its toxicity and anti-coccidial efficacy in broiler chickens. A hundred and nineteen, four-week-old, broiler birds were used for this study. The toxicity of SGSBE was evaluated by administering graded doses of the extract once and for 21 days. The anticoccidial effect of ASBESG was determined using 25 birds arbitrarily divided into five groups (A – E) of five birds each. Groups A – D were orally infected with 200,000 sporulated mixed *Eimeria* species while group E served as the uninfected control. Groups A and B birds were treated orally with ASBESG (200 mg/kg) once and daily for five consecutive days respectively while group C birds were treated with amprolium daily for five days. Birds in group D remained infected-untreated. The birds were observed for clinical signs, body weight changes, oocyst output, and some haemato-biochemical parameters. Mild signs of toxicity were detected with mortality only in the group that received the highest dose of ASBESG following toxicity tests. Clinical signs of coccidiosis were observed following infection of the birds. Oocyst output, clinical signs and lesions were significantly reduced ($p<0.05$) while body weight, survivability and hemato-biochemical indices of the birds were significantly improved ($p<0.05$) in ASBESG treated groups. Moreover, five days consecutive treatment with ASBESG yielded better results. It was therefore concluded that ASBESG is relatively safe and possesses anti-coccidial efficacy against mixed *Eimeria* infections.

Keyword: Broiler chicken, Toxicity, Anti-coccidial efficacy, *Sacoglottis gabonensis*, *Eimeria* species, Nigeria

KEY DETERMINANTS OF INVASIVENESS IN *IPOMOEA CARNEA* JACQ. TO CLIMATIC SHIFT ALONG ALTITUDINAL GRADIENT

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ABSTRACT
Ipomoea carnea Jacq. is wide spread invasive plant that particularly invades whole country from deserts to wetlands and plains to mountains. Investigation of adaptive strategies in this invasive species along elevation gradient is first study. Plants samples were collected from six diverse elevation gradient, viz 400, 800, 1200, 1600, 2000 and 2400 m from Punjab and Azad Jammu and Kashmir. Structural and functional traits responded differently along elevation gradient to invade adverse environmental conditions at high elevations. Flavonoids, phenolics, soluble sugars and proteins, free amino acids, glycine betaine and proline consistently increased along elevation gradient to enables the plant to survive in freezing temperature and helps in osmotic adjustment. Chlorophyll *a* decreased at high altitudes, while chlorophyll *b* showed an increase. Vascular bundle and metaxylem significantly reduced at high elevation. Reduction in cortical region in root, stem and leaf is a modification to survive at high altitude. Stomatal size was the maximum at moderate elevation, but consistently decreased at high elevations. The smaller stomata are capable of efficient regulation of transpiration. All these modifications reflect the invasive success of *I. carnea* at high elevation facing different environmental stresses like drought and freezing temperature.

Keywords: Adaptive strategies; elevation gradient; invasive species, structural attributes

ALTERATIONS IN HAEMATOLOGY FOLLOWING ADMINISTRATION OF *CHROMOLAENA ODORATA* EXTRACT IN RATS WITH EXPERIMENTAL BENIGN PROSTATIC HYPERPLASIA

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ABSTRACT

Background: Benign prostatic hyperplasia (BPH) is an age-related disease in animals and man that leads to prostate enlargement which constrict the urethra to cause urinary outflow obstruction. The adverse effect of chemotherapy and surgery used in the treatment of the condition has led to the preference for phytotherapeutics in its management. **Purpose:** Thus, we investigated the effects of hydro-methanol extract of *Chromolaena odorata* (CO) on the hematology and serum biochemistry of rats with testosterone propionate (TP)-induced BPH. **Method**: A total of forty-two 10-12 weeks old male Sprague-Dawley outbred albino rats (*Rattus norvegicus*) weighing 200-250 g were randomly assigned into six equal groups of seven rats each based on body weight as follows: A: Control, B: Testosterone propionate (TP) only, C:TP plus finasteride, D:TP plus 200 $mgkg^{-1}$ CO, E:TP plus 400 $mgkg^{-1}$ CO and F:TP plus 800 $mgkg^{-1}$ CO once daily for 28 days. At the end of treatment, blood was collected for hematology and serum biochemical analysis. **Results:** The PCV, Hb concentration, RBC, WBC, lymphocyte and neutrophil counts in the untreated BPH Group B was significantly ($P<0.05$) higher compared to the uninduced control group A, while the CO extract treated groups D, E and F showed a significantly ($P<0.05$) lower PCV, Hb concentration, RBC, WBC, lymphocyte

and neutrophil counts compared to the untreated BPH Group B. **Conclusion:** Thus, the results of this study suggest that *C. odorata* has the potential to prevent stress, post-renal azotemia and erythrocytosis associated with BPH.

Keywords: Benign prostrate hyperplasia, *Chromolaena odorata*, haematology, rats

EVALUATION OF SOME PARAMETERS AND DETERMINATION OF SULPHATE IN INDUSTRIAL EFFLUENTS

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ABSTRACT
Gravimetric method is one of the convenience way to determine the sulpahate ion from aqueous media. This study evaluate parameter such as densty, Total Solid (TS) and Total Suspended Solid (TSS) and the result were compared with some regulatory standard; Federal Ministry of Environment (FME) in Nigeria and the World Health Organization. The values of Density, TSS and TS were in the range of 2.950 g/ml – 8.976 g/ml, 87 ppm – 2551 ppm and 628 mg/L- 3700 mg/L respectively. While the percentage of sulphate obtained from each sample were 17.65%, 8.35%, 6.79, 17.43% and 19.01% for GTW, KSR, MYK, NILEST and KCV respectively. A new technological treatment process is recommended for these industries to provide good ways on waste management that are economically viable.

Keywords: Sulphate Ion, Industrial Effluent and Gravimetric method

CHROMOSOMAL ORGANIZATION OF SATELLITE SEQUENCES IN *Crepis*

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ABSTRACT
Tandem repetitive sequences are the major components of eukaryotic genomes. Except evolutionary conserved sequences coding rRNA, this repeat type consists of diverse groups of satellite families (satDNAs). SatDNA is one of the most dynamic components of genomes, undergoing rapid changes in array size and sequence composition within a short evolutionary period. SatDNAs are excellent chromosome markers that are widely used for the identification of chromosomal alterations in evolutionary studies. In the present research, identification and characterisation of new satellite DNA repeats in genomes of three *Crepis* species (*C. palaestina, C. conyzifolia* and *C. taraxacifolia*) were performed. The selected *Crepis* species represent three evolutionary lineages of *Crepis sensu lato*. Several different satellite families were identified and cloned from each analysed species. The newly isolated repeats were further used in comparative analyses of genomic organisation and chromosomal distribution in the genomes of closely related species. Different numbers of satellite families, from five to nine, were identified in the studied *Crepis* species. The *Crepis* species also differed in the genome proportion of satellite repeats. The highest total genome proportion of satellite repeats was revealed in *C. taraxacifolia,* about 2.26 %, while in the genome of *C. conyzifolia,* the total proportion of satellite repeats was lower than 0.15%. The comparative analyses showed that most studied satellite repeats were specific to a small group of closely related species. This fraction of repeatome evolves very fast, and even closely related species differ in their genomic and chromosomal organisation.

Keywords: *Crepis*; satellite DNA, chromosome

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ASSESSMENT OF MORPHO-ANATOMICAL CHARACTERISTICS OF *Panicum antidotale* RETZ. FROM PUNJAB, PAKISTAN

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ABSTRACT
Panicum antidotale Retz, a member of the Poaceae family, encompasses a vast array of over 600 species. Commonly known as blue panic or giant panic, bansi grass, blue grass, and Murrot, this species predominantly thrives in Southeast Asia. It exhibits exceptional resilience to various environmental stresses, including drought and salinity. The objective of this study was to investigate the morphological and anatomical adaptations of *P. antidotale* in response to diverse ecological conditions. Plants were carefully collected from their natural habitats and subjected to meticulous preservation for the documentation of morpho-anatomical traits. Transverse sections of roots, stems, and leaves were prepared using the free hand sectioning technique. The findings revealed the species' ability to endure different environmental stressors such as salinity, frost, aridity, drought, waterlogging, and ion toxicity by demonstrating plasticity in both morphological and anatomical characteristics. Noteworthy anatomical features encompassed root anatomy (including root area, epidermal and endodermal thickness, vascular bundle area, metaxylem and phloem area), stem anatomy (comprising stem cross-sectional area, cortical cell area and thickness, and vascular bundle area), leaf sheath anatomy (involving leaf sheath thickness, metaxylem and phloem area, and vascular bundle area), and leaf blade anatomy (entailing midrib and lamina thickness, vascular bundle area, cortical cell area and thickness).

Keywords: *Panicum antidotale*, morphological, adaptation

MALİGN MEZENKİMAL TÜMÖR TANILI BİR KEDİDE *Aureobasidium pullulans*' ın NEDEN OLDUĞU FEOHİFOMİKOZ

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ÖZET

Feohifomikoz, *Aureobasidium* cinsini içeren dematiaceous mantarların (black fungi) neden olduğu fırsatçı bir enfeksiyondur. Yaygın olmayan patojen olarak tanımlanan bu mantar cinsi, hastane kontaminantı olarak da bilinmektedir. *Aureobasidium* türleri, toprak ve bitki gibi çevresel kaynaklardan travmatik implantasyon yoluyla bulaşarak, insanlarda ve hayvanlarda enfeksiyona neden olabilmektedir. Bu türün, diğer önemli enfeksiyon etkenlerinden ayırt edilmesi oldukça zordur. Bu vakada, kedinin burun boşluğundaki tespit edilen kitlenin küretajla temizlenmesi sonrasında, nazal bölgedeki dikişli kısımda gelişen ve pürülan salgıyla seyreden alandan alınan örnekten enfeksiyon etkeninin izolasyonu ve tanımlanması amaçlanmıştır.
Tekirdağ'da yaşayan bir kişinin 5 yaşındaki erkek tekir kedisinde; sıklıkla tekrarlayan hapşırık ve burundan kan gelmesi şikayetleri üzerine, İstanbul Üniversitesi Cerrahpaşa Veteriner Fakültesi Cerrahi Anabilim Dalı, KBB Kliniği'nde tespit edilen kitleye, malign mezenşim tümör teşhisi konulmuştur. Burun boşluğunda bulunan kitle küretajla temizlendikten sonra, nazal bölgede dikişli kısımda oluşan delik büyüyerek pürülan salgıyla seyreden enfeksiyon gelişmiştir. Bu salgıdan etkenin belirlenmesi için örnek alınmıştır. Alınan kültür örneğinin Sabouraud Dekstroz agar (SDA)' a ekimi yapılmış 25°C ve 37°C'de inkübe edilmiştir. İnkübasyon sonrasında gelişen mantar kolonilerinden konvansiyonel yöntemlerle identifikasyon yapılmıştır. Kültür sonrasında, kolonilerin makroskopik ve mikroskopik özellikleri incelendiğinde *Aureobasidium pullulans* mantar yapıları gözlenmiştir. Takiben, MALDI-TOF MS (Matris Destekli Lazer Desorpsiyon/İyonizasyon Uçuş Süresi Kütle Spektrometresi) ile tanı doğrulanmıştır. Feohifomikoz tanısı genellikle sitoloji veya histoloji ile mantar tespitine dayanır. Ancak, kesin teşhis ve tür tanımlaması için kültür gereklidir. Günümüzde, *A. pullulans* enfeksiyonlarına ilişkin raporlar oldukça azdır. Bu vaka raporunda, hayvanlarda cerrahi işlemler sonrasında çevresel mantarların patojenik potansiyelini göz önünde bulundurmanın önemi ve kedilerde *A. pullulans*' ın fırsatçı enfeksiyona neden olabileceği vurgulanmaktadır.

Anahtar Kelimeler: Feohifomikoz, Malign Mezenşimal Tümör, *Aureobasidium pullulans*

PHAEOHYPHOMYCOSIS CAUSED BY *Aureobasidium pullulans* in A CAT DIAGNOSED AS MALIGN MESENCHIMAL TUMOR

ABSTRACT

Phaeohyphomycosis is an opportunistic infection caused by the dematiaceous fungus (black fungi), including the *Aureobasidium* spp. This fungal genus is defined as an uncommon pathogen, and also as a hospital contaminant. Aureobasidium species can cause infection in humans and animals through traumatic implantation from environmental sources, such as soil and plants. Its difficult to differentiate this strain from other important pathogens. In this case, it was aimed to isolate and identify the infectious agent from the purulent secretion developed in the sutured part of the nasal region after the mass in the cat's nasal cavity cleared by curettage. In a 5-year-old male tabby cat of a person living in Tekirdağ; on complaints of frequent sneezing and bleeding from the nose, the mass was detected and diagnosed as malignant mesenchymal tumor in the Department of Surgery, Ear Nose and Throat Clinic, Istanbul University Cerrahpasa Faculty of Veterinary Medicine. After the mass in the nasal cavity was cleared by curettage, the hole formed in the sutured part of the nasal region was enlarged with a purulent secretion. A sample was taken from this secretion to determine the causative agent and was inoculated onto Sabouraud Dextrose agar (SDA) , incubated at 25°C and 37°C'. Mould colonies were identified with conventionel methods. Macroscopic and microscopic characteristics of the colonies suggested, Aureobasidium pullulans. Subsequently, the diagnosis was confirmed by MALDI-TOF MS (Matrix Assisted Laser Desorption/Ionization Time-of-Flight Mass Spectrometer). The diagnosis of phaeohyphomycosis is usually based on the fungal detection by cytology or histology. However, culture is required for definitive diagnosis and species identification. Currently, there are few reports about *A. pullulans* infections. This case report, highlights the importance of considering the environmental fungi as potential pathogens after surgical procedures in animals and *A. pullulans* as an opportunistic fungal pathogen in cats.

Keywords: Phaeohyphomycosis, malignant mesenchymal tumor, *Aureobasidium pullulans*

A REVIEW ON *Tinospora cordifolia*- A MAGICAL BULLET FOR NEURODEGENERATIVE DISEASES

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ABSTRACT
Tinospora cordifolia also known as Guduchi an important drug of ayurvedic system of medicine belonging to family Menispermaceae is a large deciduous climbing shrub having greenish yellow flowers. It consists of various active components like alkaloids, steroids, aliphatics, lactones, diterpenoids and glycosides that can be obtained from parts of plant or whole plant. The plant constitutes of various medicinal properties such as anti-allergic, anti-oxidant, anti-inflammatory, anti-arthritic, anti-neoplastic and immunomodulatory activities. It also shows protective effects against Alzheimer's disease and various neurodegenerative diseases. The butanol extract of Tinospora cordifolia shows neuroprotective potential by preventing degeneration of neurons induced by glutamate. It can be applied in the polyherbal formulation for general amendment of memory function. This review brings the beneficial health effects of Tinospora cordifolia that results in suppressive effects and its phytochemical constituents on inflammation.

Keywords: Tinospora *cordifolia*, immunomodulatory, neurodegenerative, polyherbal, phytochemical.

OPTIMIZATION OF QUICKLIME PRODUCTION FROM EGGSHELL USING RESPONSE SURFACE METHODOLOGY

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ABSTRACT
This study developed empirical response surface models for optimizing the quicklime characteristics. The calcination process parameters evaluated were calcination temperature, calcination time, and eggshell particle size. Two process models were successfully developed and validated for RSM models. The modeling validation runs were within the 95% prediction interval of the developed models and their residual errors compared to the predicted values were less than 5%. Results from this study shows that the significant parameters that influenced the quicklime yield and reactivity are calcination temperature, calcination time and eggshell particle size. The RSM approach shows that a compromised setting of calcination temperature of 945.91^{o}C and calcination time of 180.82 min will produce quicklime of optimal yield of 99.6608 % and optimum level of calcination time of 210 min and calcination temperature of 895.03^{o}C produced optimum quicklime reactivity of 0.467835^{o}C/s. The RSM models developed in this study can be used in the quicklime production industries to find the settings of the calcination process that will maximize quicklime quantity and quality. This will reduce the downtime encountered by industries having problems caused by variation in the quality of purchased quicklime.

Keywords: RSM, quality, quicklime

UNVEILING ADAPTIVE COMPONENTS FOR ENVIRONMENTAL HETEROGENEITY IN *IPOMOEA CARNEA* JACQ

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ABSTRACT
Environmental heterogeneity is an important factor that affects species richness and provides conditions for adaptation of existing species. Factors affecting the diversity gradient are climatic variation, biotic interactions, territory, ambient vigor, productivity, available water resources and some other factors that direct the historical process by the evaluation of climatic history and phylogeny of niche conversation. Naturally adapted populations of *Ipomoea carnea* Jacq. were collected from various ecological regions of Punjab province to investigate their adaptive components that have been developed under heterogeneous environmental conditions. Multivariate redundancy analysis (RDA) and correlation analysis were done to evaluate the association of soil physiochemical features with different morpho-anatomical and physiological characteristics. *I. carnea* is an invasive species that can rapidly grow, spread and adapt from xerophytic to aquatic habitats. This species showed better growth and biomass production near water bodies. Additionally, it also exhibited some specific anatomical modifications such as aerenchyma formation, sclerification, xylem ray thickness, leaf thickness and large metaxylem area that enable it to survive under harsh environmental conditions. Populations from highly saline habitats showed higher value of osmolytes and ionic contents (K^+ and Ca^{2+}). Furthermore, the populations from highly saline areas also exhibited the maximum uptake of Na^+ content and the lowest uptake of K^+ and Ca^{2+} content. In conclusion, *I. carnea* showed very specific modifications in morpho-anatomical and physiological traits that reveal its ecological success from aquatic to xerophytic habitats.

Keywords: *Ipomoea carnea* Jacq, RDA, ion

THE DEAD ANIMALS IMPACT ON THE ENVIRONMENT

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ABSTRACT

There is a significant number of wild animals in the world that die in natural conditions, but recently, problems of wild animals' mass death or entire herds of livestock farms have become increasingly relevant as a result of sudden nature and technogenic disasters (e.g., flooding, earthquakes) or military impacts [1-3]. In such cases, the decomposition of dead animals could have a significant impact on the environment. Therefore, it is important to investigate and understand the consequences that accompany the process of animal carcass decomposition. The impact on soil is the main aspect of the environmental impact of animal decomposition. Organic matter has been released, which could have both positive and negative effects on soil fertility. For example, some organic matter could serve as a food source for soil microorganisms, which contributes to the decomposition and recycling of organic matter. However, large masses of animal carcasses could lead to oversaturation of the soil with nutrients, which could cause pollution and reduce soil quality. For example, the decomposition of a pig corpse results in a significant increase in soil pH, total nitrogen, phosphorus, and phospholipids [4]. The impact on water resources is the second most important process, which includes the release of various substances that could enter groundwater and lead to water sources pollution and adversely affect ecosystems that depend on the preservation of water resources. For example, the release of ammonia and other nitrogenous compounds from animal carcasses could cause eutrophication of water bodies, leading to excessive growth of algae and aquatic plants. This could upset the ecosystem balance, reduce the dissolved oxygen level in the water, and negatively impact fisheries and other species that depend on clean water environments. Research results confirm that decomposition of corpses increases the number and diversity of antibiotic resistance genes in a large volume of drinking water, regardless of time, demonstrating the temporary persistence of these genes, thereby revealing the harmful effects of animal carcasses [5]. Air exposure occurs when gases such as hydrogen sulfide, methane, ammonia, and other odorous compounds are released. These gases could have a negative impact on air quality, causing an unpleasant odor and the possibility of health problems for people living in close proximity to the places where the corpses decompose. Finally, the environmental impact of animal carcasses could have a significant impact on biodiversity. The decomposition of corpses could attract wild predators and natural decomposers, which could affect the distribution and interaction of species in the natural environment. Depending on the number of corpses and species subject to decomposition, there may be a change in the ecological balance and structure of the ecosystem. The animal carcasses impact on the environment could have a significant negative environmental impact and disrupt ecosystem stability. The decomposition of carcasses contributes to soil and water pollution, reduces air quality, and affects biodiversity. The release of harmful substances and odors during the decomposition process could lead to negative impacts on ecosystems that depend on clean water environments. Related problems could have consequences for human health and natural ecosystems. It is necessary to implement management and engineering measures to prevent and minimize negative environmental impacts: the civil protection system should develop Action Plans to eliminate negative consequences in case of mass animal deaths, which would include measures to search for,

disinfect and properly dispose of animal corpses; monitoring the water sources condition, in particular for the presence of bacteria, viruses and other pollutants.

Keywords: environmental safety, dead animals, corpses decomposition, environmental protection measures, environment

GAS CHROMATOGRAPHY-MASS SPECTROMETRY (GC-MS) ANALYSIS OF THE ESSENTIAL OIL FROM NIGERIAN *ARTEMISIA ANNUA* L. AT DIFFERENT GROWTH STAGES

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ABSTRACT
Artemisia annua is a reputable medicinal plant with long history of use as antimalarial and has characteristic pleasant aroma. The aim of this study is to investigate the volatile oils from the aerial part of *Artemisia annua* from pre-flowering stage through to post-flowering growth stage using gas chromatography-mass spectrometry (GCMS). The colorless essential oils were obtained by hydrodistillation with yield ranging from 0.2% to 0.4% w/w. The major bioactive chemical compounds identified in the volatile oils at the various developmental stages were camphor (5. 67-16.84%), artemisia ketone (1.62-7.67%), eucalyptol (3.25-6.48%), arteannuic acid (1.36-4.27%), α-pinene (0.59- 3.62%), myrtenol (1.11-2.98%), caryophyllene (1.56-3.89%), copaene (0.68-1.72%), and deoxyartemisinin (0.19-0.6 4%). The volatile constituents of *Artemisia annua* were more at the post-flowering stage, the essential oil content increased with delay in harvest. From the results, the chemical composition of *Artemisia annua* volatile constituents varied depending on the developmental stage.

Keywords: Arteannuic acid, *Artemisia annua*, Artemisia ketone, Camphor, Deoxyartemisinin, Volatile oils

CHARACTERIZATION OF THE VOLATILE BIOACTIVE COMPOUNDS IN ETHYLACETATE LEAF EXTRACT OF *ANNONA MURICATA* LINN.

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ABSTRACT
Annona muricata Linn (*A. muricata*) leaf has long history of folkloric use for the management of cancer, infections and arthritis. The hexane, ethyl acetate, methanol successive and straight run methanol extracts were screened against standard strains of *Salmonella paratyphi* (ATCC 9150), *Candida albicans* (ATCC 22015) and clinical isolates of *Pseudomonas aeroginosa* ATCC 27853, *Staphylococcus aureus*, *Escherichia coli*, *Bacillus subtilis* and *Klebsiella pneumoniae* from NIPRD clinic using agar dilution method. The ethyl acetate extract exhibited the strongest antimicrobial activity against *Salmonella paratyphi* (ATCC 9150), *Pseudomonas aeruginosa*, *Candida albicans* (ATCC 2876), *Klebsiella pneumonia* ATCC 13883 and *Escherichia coli* (clinical isolate) at 2000µg/ml, while the hexane, methanol successive and straight run methanol extracts showed no activity against all the test micro-organisms. Amoxicillin, which was used as standard, inhibited the growth of all the test micro- organisms at the same concentration. The ethyl acetate extract was subjected to gas chromatography-mass spectrometry (GC-MS) characterization to identify volatile bioactive compounds. The GC-MS analysis revealed 22 different volatile bioactive compounds including 2,8-dimethylundecane (8.79%), n-hexadecane (8.17%), phytol (8.11%), n-tetradecane (7.76%), 3,7-dimethyl-1,6-octadiene (7.59%), (Z, Z)-α-farnesene (6.98%), 1,11-dodecadiene (6.95%), palmitic acid (6.31%) and α-tridecene (5.05%). These compounds maybe responsible for the observed antimicrobial activities of the ethyl acetate extract.

Keywords: *Annona muricata*, Antimicrobial, Bioactive, Ethylacetate, GC-MS, Leaf

IN-VITRO EVALUATION OF *EUCALYPTUS CITRIODORA* LEAF ESSENTIAL OIL AND EXTRACTS ON SELECTED PATHOGENS IMPLICATED IN RESPIRATORY TRACT INFECTIONS

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ABSTRACT
Public health challenge due to respiratory tract infections has necessitated vehement research for promising substances against the causative agents. The leaves of *Eucalyptus citriodora* (*E. citriodora*, *Myrtaceae*) are used in Nigeria as tea, infusion or steam inhalation by patients as an alternative medicine to clear the airway and relieve symptoms; however, no scientific evidence exists to support or debunk this claim. This study aimed to evaluate the in-vitro antimicrobial effect of *E. citriodora* leaf essential oil and crude extracts against selected pathogens implicated in respiratory tract infections. The fresh leaves of *E. citriodora* were collected, identified and subjected to exhaustive fractionated extraction. The leaf essential oil was obtained by hydrodistillation using Clevenger-type apparatus and characterized using GC-MS. Aqueous extracts were obtained by hot infusion and decoction and characterized using HPLC-UV-DAD. The susceptibility of test pathogens *Pseudomonas aeruginosa* ATCC 27853, *Staphylococcus aureus* ATCC 25923, *Escherichia coli* ATCC 25922, *Salmonella paratyphi* ATCC 9150 *Candida albicans* ATCC 10231, *Klebsiella pneumonia* and *Streptococcus pneumonia* to the extracts were evaluated by agar well diffusion and agar dilution methods. Hydrodistillation gave colourless essential oil in yield of 3.5% (v/w). Monoterpenoids, citronellal (47%), isopulegol (8%), citronellol (8%), tetradecane-3- of (5%), citronellic acid (4%), p-methane-3,8-diol (4%), citronellylacetae (3%) and eucalyptol (1%) were the most abundant bioactive components. HPLC analysis of the infusion and decoction extracts revealed the presence of chlorogenic acid, caffeic acid, rutin, and ferulic acid. The essential oil and extracts produced good antimicrobial activities against the selected pathogens. The leaves of *E. citriodora* have bioprospecting potential in drug discovery for respiratory tract infections.

Keywords: Antimicrobial, COVID-19, Essential oil, *Eucalyptus citriodora*, Respiratory tract infection (RTI)

SİYAH SARIMSAK: ÜRETİMİ, ÖZELLİKLERİ VE GIDA UYGULAMALARI

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ÖZET

Siyah sarımsak, bütün taze sarımsağın kontrollü yüksek sıcaklık ve nem koşullarında, ilave bir işleme tabi tutulmadan belirli bir süre boyunca doğal fermantasyonu ile üretilir. Üretim sürecinin sonunda sarımsağın duyusal özelliklerinde ve besin içeriğinde önemli değişiklikler meydana gelirken, biyoaktif özellikleri de gelişmektedir. Siyah sarımsak, üretim sürecinden kaynaklanan karakteristik organoleptik özelliklere sahiptir. Taze sarımsağın rahatsız edici kokusu giderildiği için siyah sarımsak sadece kabuğu soyularak doğrudan tüketilebilir. Taze sarımsak ile karşılaştırıldığında, siyah sarımsağın fenolik madde içeriği oldukça yüksektir. Siyah sarımsak polifenoller, flavonoidler, β-karbolin türevleri, ve S-allil-sistein ve S-allil-merkaptosistein gibi organosülfür bileşikler dahil olmak üzere çok sayıda antioksidan bileşik içerir. Öte yandan, son çalışmalar siyah sarımsağın biyoaktif özellikleri ile ilişkili olarak insan sağlığına faydalı etkilere sahip olduğunu ortaya koymuştur. Günümüzde, tüketici farkındalığının artmasının bir sonucu olarak fonksiyonel gıda terimi oldukça popüler hale gelmiştir. Bu kapsamda, siyah sarımsağın zengin biyoaktif bileşenleri, sağlık yararları ve duyusal özellikleri nedeniyle fonksiyonel bir bileşen olarak gıdalarda kullanımına olan ilgi giderek artmaktadır. Sonuç olarak, siyah sarımsak oksidatif reaksiyonları geciktirmek, duyusal kabul edilebilirliği artırmak ve fonksiyonel özellikleri geliştirmek gibi çeşitli amaçlar için gıdalarda kullanılmaktadır. Bu derlemede, siyah sarımsağın çeşitli özellikleri ve farklı gıdalardaki uygulamaları özetlenmiştir.

Anahtar Kelimeler: Siyah sarımsak, Fonksiyonel Gıda, Antioksidan

BLACK GARLIC: PRODUCTION, PROPERTIES AND FOOD APPLICATIONS

ABSTRACT

Black garlic is produced by natural fermentation of whole fresh garlic under controlled high temperature and humidity conditions for a certain period of time without any additional processing. At the end of the production process, significant changes occur in the sensory properties and nutritional content of garlic and its bioactive properties are also improved. Black garlic has characteristic organoleptic properties resulting from the production process. Since the unpleasant odor of fresh garlic is removed, black garlic can only be peeled and consumed directly. Compared to fresh garlic, the phenolic substance content of black garlic is quite high. Black garlic contains numerous antioxidant compounds, including polyphenols, flavonoids, β-carboline derivatives, and organosulfur compounds such as S-allyl-cysteine and S-allyl-mercaptocysteine. On the other hand, recent studies have revealed that black garlic has beneficial effects on human health in relation to its bioactive properties. Nowadays, the term functional food has become very popular as a result of increasing consumer awareness. Within this scope, there is growing interest in the use of black garlic as a functional ingredient in foods due to its rich bioactive constituents, health benefits, and sensory properties. As a result, black garlic is used in foods for various purposes, such as retarding oxidative reactions, increasing sensory acceptability, and improving functional properties. In this review, various properties of black garlic and its applications in different foods were summarized.

Keywords: Black Garlic, Functional Food, Antioxidant

GÖRSEL ANALİTİK İLE TARIM ZEKÂSI KARAR DESTEK MODELİ: TÜRKİYE'DE SÜRDÜRÜLEBİLİR TARIM VE TARIM ZEKASININ YARATILMASI

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ÖZET

Günümüzde küresel boyutta güvenli besin kaynakları alanında iki önemli sorun ortaya çıkmıştır. Bunlardan birincisi 8 milyara ulaşmış olan dünya nüfusunun her geçen gün yükselmeye devam etmesi, diğeri de güvenli besinin ana kaynağı olan tarım faaliyetlerinin yükseliş ivmesindeki küresel nüfusa yetecek oranda destek verememesidir. Tarım ürünlerinin yetiştirilmesi konusunda yetersiz kalınmasının iki ana sebebi vardır. Bunlar modern bir bakış açısı ile tarımsal faaliyetlerin doğru planlanamaması ve ülkeler arasındaki işbirliğinin eksikliğidir. Sekiz milyara ulaşmış dünya nüfusu içinde yetersiz beslenme ile karşı karşıya kalan insan sayısı her geçen gün artmaktadır. Bu çerçevede BM tarafından yayınlanan resmi istatistik verilerine göre, yetersiz beslenme kapsamında 4.680 milyon nüfusu ile Asya Kıtası ilk sırada yer almaktadır. Kıtada yiyeceğe ulaşamayan insan sayısı 489 milyondur (%10) ve her yıl bu değer %10'luk bir artış ile büyümektedir. İkinci sırada ise %52'lik bir oran ile Afrika Kıtasıdır. (1.373 milyonluk toplam nüfusun 795 milyonu açlık sınırının altında, 322 milyonu yiyecek bulamaz durumdadır). Ancak bu değerler 1.119 milyon nüfuslu gelişmiş ülkelerin oluşturduğu Avrupa Kıtasında 89 ve 17 milyon şeklindedir. ABD'de ise değerler daha da düşüktür. Kıtasal ölçekte Türkiye önemli bir tarım üreticisi olabilme potansiyeline sahipken, tarım politikalarının hatalı uygulamaları nedeniyle potansiyel üretim değerinin çok altındadır. Bu nedenle kıtasal boyuttaki tarım üretimi dikkate alınarak bu hususun incelenmesi önem taşımaktadır. Bu çerçevede bildirinin iki amacı vardır. Birincisi Türkiye'nin çevre ülkeleri ile beraber tarım üretim ekonomisini değerlendirmek, ikincisi ise tarım zekasının oluşturulmasını sağlamaktır. Bu bağlamda kıtasal ve bölgesel tarım üretimleri, ithalat ve ihracatları, görsel analitik metodu kullanılarak Türkiye özelinde ve Türkiye'nin yakın çevre ülkeleri kıyaslamaları ile beraber incelenecektir. Bildiride görsel analitik metodu ile "The Food and Agriculture Organisation of The United Nations" tarafından oluşturulan tarım ürünleri istatistik verilerinin birincil derecede insan ihtiyacı tarım ürün grupları detaylı bir şekilde analiz edilebilmesi için "Tarım Zekâsı Karar Destek Modeli" sunulacaktır. Analiz sonucunda ortaya çıkarılan veriler üzerinden başta Türkiye tarım faaliyetleri olmak üzere Türkiye'nin yakın çevresindeki ülke gruplarının tarım faaliyetleri ile beraber değerlendirilecektir. Değerlendirme sonucunda verimli ve güvenli tarım sistemi oluşturulması için gerekli tarım zekasının yaratılması ve Türkiye ile yakın çevre ülkelerinin koordineli ve iş birliğine dayalı ortak bir uluslararası tarım politikası tesis etmesinin gerekliliği vurgulanacaktır.

Anahtar Kelimeler: Görsel Analitik, Tarım, Türkiye, Tarım Zekâsı, Karar Destek Modeli

AGRICULTURAL INTELLIGENCE DECISION SUPPORT MODEL WITH VISUAL ANALYTICS: CREATION OF SUSTAINABLE AGRICULTURE AND AGRICULTURAL INTELLIGENCE IN TURKEY

ABSTRACT

Today, two important problems have emerged in the field of safe food sources on a global scale. The first is that the world population, which has reached 8 billion, continues to rise day by day, and the other is that agricultural activities, which are the main source of safe food, cannot provide sufficient support to the global population that is on the rise. There are two main reasons for the inadequacy of growing agricultural products. These are the lack of correct planning of agricultural activities with a modern point of view and the lack of cooperation between countries. The number of people facing malnutrition among the world population of eight billion is increasing day by day. In this context, according to official statistics published by the UN, Asian Continent ranks first with a population of 4.680 million in terms of malnutrition. The number of people who do not have access to food on the continent is 489 million (10%) and this value is growing with an increase of 10% every year. In the second place is the African Continent with a rate of 52%. (Out of the total population of 1,373 million, 795 million are below the hunger line, 322 million are unable to find food). However, these values are 89 and 17 million in the European Continent, which consists of developed countries with a population of 1.119 million. In the USA, the values are even lower. While Turkey has the potential to become an important agricultural producer on a continental scale, it is well below its potential production value due to faulty practices of agricultural policies. For this reason, it is important to examine this issue by considering the agricultural production at the continental scale. In this context, the paper has two purposes. The first is to evaluate the agricultural production economy of Turkey together with the surrounding countries, and the second is to ensure the creation of agricultural intelligence. In this context, continental and regional agricultural productions, imports and exports will be examined using the visual analytic method, especially in Turkey and with comparisons of Turkey's neighboring countries. In the paper, the "Agricultural Intelligence Decision Support Model" will be presented in order to analyze the agricultural product statistical data created by "The Food and Agriculture Organization of The United Nations" with the visual analytical method in detail for the agricultural product groups that are primarily human needs. The data obtained as a result of the analysis will be evaluated together with the agricultural activities of the country groups in the immediate vicinity of Turkey, especially the agricultural activities of Turkey. As a result of the evaluation, it will be emphasized that the necessary agricultural intelligence should be created for the establishment of an efficient and safe agricultural system and that Turkey and the neighboring countries should establish a coordinated and cooperative international agricultural policy.

Keywords: Visual Analytics, Agriculture, Turkey, Agricultural Intelligence, Decision Support Model

MOLECULAR DOCKING AND MOLECULAR DYNAMIC SIMULATION STUDIES OF PLANT-BASED COMPOUNDS FOR POTENTIAL INHIBITION OF ALPHA-AMYLASE PROTEIN

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ABSTRACT
Diabetes mellitus is a chronic disorder in the endocrine gland and is related to many enzymes like alpha-glucosidase, alpha-amylase, and DPP4. Alpha-amylase is one of the reasons for glucose level enhancement, as it converts starch into maltose; therefore, its inhibition helps to control diabetes. So, in order to discover natural alpha-amylase inhibitors, we selected medicinal plants with antidiabetic potential and created a library of 300 phytochemicals. Then docking and molecular dynamic simulation studies were conducted using Auto Dock 4.2 (MGL Tools 1.5.6) and GROMAC 2020 software. The 3D structure of the Alpha-amylase enzyme was acquired from RCSB Protein Data Bank. Out of 300 phytochemicals, 50 showed better binding energies ranging from -10.29 kcal/ mol to - 6.16 kcal/mol than the standard drug acarbose, with a binding score of -6.13 kcal/mol. All 50 phytoconstituents were further filtered based on ADMET and Drug-likeness properties. After that, four compounds, viz. Hemidescine, Sitosterol, Emidine, Campesterol acetate, and reference drug acarbose were chosen for a 100 ns simulation study. RMSD, RMSF, Radius of Gyration, and SASA were observed as they determined the protein-ligand interactions. The native alpha-amylase and the four protein-ligand complexes (Hemidescine, Sitosterol, Emidine, and Campesterol acetate) were found to be stable throughout the simulation of 100 ns. They followed the same pattern as the reference protein-acarbose complex. After simulation, the binding pattern of the protein-ligand complex confirmed that all the ligands remain attached to the active site of alpha-amylase, like acarbose. These phytochemicals could be targeted to treat type 2 diabetes by targeting the alpha-amylase enzyme with lesser side effects.

Keywords: Medicinal plant; Phytochemicals; Computational study, Alpha-amylase; Type 2 diabetes mellitus

TÜRKİYE'DE BÜYÜME BEKLENTİLERİNİN KIRSAL DESTEKLER ÜZERİNE ETKİSİNİN TODO-YAMAMOTO YÖNTEMİ İLE İNCELENMESİ

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ÖZET

Gelişen ve hızla büyüyen Dünyada insan ihtiyaçlarında artışlar görülmektedir. İnsan ihtiyacının sürekli artışı ve zamana bağlı olarak değişmesi sonucunda ülkelerde farklı üretim yöntemleri ele alınmaktadır. Üretim tekniklerindeki değişim ülkelerin gelişmişlik potansiyellerine bağlı olarak değişim göstermektedir. Gelişmiş ülkelerde uygulamaya konulan teknolojik üretim yöntemleriyle birlikte çeşitli sektörlerde üretim artışları gözlemlenmiştir. Sektörler arasında tarım sektöründe makineleşmenin artmasıyla birlikte sektörde üretim artışları belirgin hale gelmiştir. Gelişmemiş ülkelerde ise üretim geleneksel yöntemlerle yapılmaktadır. Bu tip ülke sınıflarında üretim yapma potansiyelleri ülkelerin kendi iç dinamiklerine bağlı olarak değişmektedir. Temel makro göstergeler çerçevesinde gerekli sermaye yapısına sahip olan gelişmiş ülke konumunda olan ülkelerde üretim süreçleri rahatlıkla sürdürülebilmektedir. Bu duruma karşın gerekli sermaye yapısına sahip olmayan gelişmekte olan ülkelerde ise zaman zaman üretim süreçlerinde aksamalar görülmektedir. Türkiye'de ise üretim artışı artan bir görünüm göstermektedir. Türkiye'de üretim artışının sağlanması için kamu sektörü tarafından üreticilere çeşitli destekler verilmektedir. Türkiye'de üreticilere destekler çeşitli kamu kuruluşları tarafından verilmektedir. Üreticilere destekler Gıda Tarım ve Hayvancılık Bakanlığı, Ticaret Bakanlığı ve Tarım ve Kırsal Kalkınmayı Destekleme Kurulu aracılığıyla verilmektedir. Gıda Tarım ve Hayvancılık Bakanlığı ve Ticaret Bakanlığı tarafından sıfır sermaye ile işe başlayacaklara destekler verilirken, Tarım ve Kırsal Kalkınmayı Destekleme Kurulu tarafından ise yatırım yapacağı sektöre bağlı olarak belirli bir yüzdede sermayesi olması gerekmektedir. Kamu kurumları tarafından üreticilere verilen bu destekler kimi zaman ayni kimi zaman ise nakdi destek şeklinde olmaktadır. Kamu ekonomisi tarafından sağlanan bu destekler Türkiye'nin yıllık büyüme oranlarına etki yapmaktadır. Yapılan çalışmada Türkiye'de kırsal kalkınma amaçlı verilen desteklerin büyüme üzerine etkisi ele alınmıştır. T.C. Merkez Bankasından alınan veriler Todo-Yamamoto yöntemi ile analiz edilmiştir. Yapılan çalışma sonucunda Türkiye'de kırsal kalkınma destekleri ile büyüme beklentileri arasındaki nedensellik durumu incelenmiştir.

Anahtar Kelimeler: Kalkınma, Kırsal Kalkınma, Ekonomik Destekler

THE EXAMINATION OF THE IMPACT OF GROWTH EXPECTATIONS ON RURAL SUPPORTS IN TURKEY USING THE TODO-YAMAMOTO METHOD

ABSTRACT

In the rapidly developing and growing world, there is an increase in human needs. The constant increase and changes in human needs over time have led to the adoption of different production methods in countries. The changes in production techniques vary depending on the development potential of countries. Advanced countries have observed an increase in production in various sectors with the implementation of technological production methods. In the agricultural sector, for example, the increase in mechanization has resulted in significant production growth. In underdeveloped countries, on the other hand, production is still carried out using traditional methods. The potential for production in such countries depends on their internal dynamics. In countries classified as underdeveloped, the ability to produce is subject to the necessary capital structure. In countries classified as developed, which have the necessary capital structure according to basic macro indicators, production processes can be easily sustained. However, in developing countries that lack the necessary capital structure, production processes may experience disruptions from time to time. In Turkey, there is a visible increase in production. In order to achieve production growth in Turkey, various supports are provided to producers by the public sector. These supports are provided to producers by various public institutions such as the Ministry of Food, Agriculture, and Livestock, the Ministry of Trade, and the Board of Agriculture and Rural Development Support. While the Ministry of Food, Agriculture, and Livestock and the Ministry of Trade provide support to those who start a business with zero capital, the Board of Agriculture and Rural Development Support requires a certain percentage of capital depending on the sector in which investment will be made. The support provided to producers by public institutions can be in the form of both in-kind and cash assistance. These supports provided by the public economy have an impact on Turkey's annual growth rates. The study conducted in this regard examines the impact of the supports provided for rural development in Turkey on economic growth. The data obtained from the Central Bank of the Republic of Turkey is analyzed using the Todo-Yamamoto method. The study examines the causality between rural development supports and growth expectations in Turkey.

Keywords: Development, Rural Development, Economic Supports

KNOWLEDGE AND RESILIENCE OF RURAL HOUSEHOLDS TO COVID-19 PANDEMIC IN NKANU EAST, ENUGU STATE, NIGERIA

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ABSTRACT
The study was carried out to assess the knowledge and resilience level of rural households to the COVID-19 Pandemic in Nkanu East, Enugu State, Nigeria. Specifically, the study described the socioeconomic characteristics of the respondents, ascertained the perception of the respondents to the COVID-19 Pandemic, determined the knowledge and resilience level of the respondents to COVID-19 pandemic and the relationship between the knowledge level and resilience level to the pandemic, and between resilience level and selected socioeconomic variables. A multistage sample procedure was used to select a sample size of 144 respondents. Data were collected with a questionnaire and were analysed using percentages, mean and chi-square. The result showed that the majority (53.3%) of the respondents were males. The mean age of the respondents was 42.7 years. The average monthly income was ₦51, 781.9. There was a high perception ($\bar{x}$=2.92) of the COVID-19 pandemic among the respondents. The majority (62.5%) had a high knowledge of the COVID-19 pandemic and the majority (70.8%) also had a normal resilience level to the pandemic. The chi-square (X^2= 0.94, p = 0.625) showed that there was no significant relationship between the knowledge level of COVID-19 and the level of resilience. Also, there were no significant relations between the resilience level and selected socioeconomic variables (Gender, Age, Education and income). The study recommended that the knowledge level of the respondents should be sustained through more enlightenment and sensitisation programmes as some of the respondents still have a wrong perception of the virus.

Keyword: Knowledge, Resilience and COVID-19

KASTAMONU İLİ TÜRK FINDIĞI (*Corylus colurna* L.) POPÜLASYONLARINDA ANAÇ SELEKSİYONU

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ÖZET

Bu çalışma, Kastamonu ilinde farklı lokasyonlarda bulunan Türk Fındığı (*Corylus colurna* L.) genotiplerinin anaçlık özelliklerini incelemek için 2020-2022 yılları arasında yürütülmüştür. Çalışmada 5 farklı bölgede 8 lokasyon gezilerek yaklaşık 1100 genotip morfolojik yönden incelenmiş ve bu genotiplerden 203 adetinde örnekleme yapılmıştır. Örnekleme yapılan genotiplerden tartılı derecelendirme (14 genotip) ve araştırmacı gözlemleri sonucu (15 genotip) toplam 29 genotip ümitvar olarak seçilmiştir. Aynı zamanda seçilen bu genotiplerin akrabalık ilişkilerini belirlemek için moleküler karakterizasyon (ISSR) yapılmıştır. Çalışmada ayrıca, Türk Fındığı'nın çoğaltılabilirliğini ölçmek için odun çelikleri ile köklendirme denemesi kurulmuştur. Çalışmada, tartılı derecelendirme sonucu KPÇ2 ve KPÇ3 genotipleri 500'er puanla en yüksek puanı alırken, KTS11 genotipi 270 puanla en az puan alan genotip olmuştur. İncelenen 203 genotipden 183'nün dip sürgün vermediği, 190'nının dik habitüse sahip olduğu ve 196'sının kuvvetli gelişim gösterdiği tespit edilmiştir. KPÇ2 ve KPÇ3 genotipleri 6'şar cm ile yıllık sürgünde en fazla boğum aralığına sahip bireyler olurken, KPY4 genotipi 1.16 cm ile en az boğum aralığına sahip birey olmuştur. Genotiplerde, dallanma yüksekliği 15 cm (KTU4) ile 800 cm (KMU54), gövde çevresi 7 cm (KTU5) ile 504 cm (KMU55), taç eni 1 m (KTU2 – KTU28) ile 22 m (KAK11) ve taç boyu 1.7 m (KTU5) ile 27 m (KAK12) arasında değiştiği tespit edilmiştir. İncelenen genotiplerin yaşları tahmini olarak 7-400 arasında değiştiği belirlenmiştir. ISSR moleküler karakterizasyon yöntemi sonuçlarına göre, seçilen Türk Fındığı genotipleri arasındaki korelasyon matrisi değerleri 0.28 – 0.91 arasında belirlenmiştir. Elde edilen sonuçlar doğrultusunda genetik olarak en uzak hatların KTS11 ile KMU32 arasında, en yakın hatların ise KMU62 ile KMU59 arasında olduğu belirlenmiştir. Çelikle çoğaltma denemesinde yapılan ölçümlerde en fazla canlı çelik ve sadece kallus oluşturan çelik sayısı sırasıyla %60 ve %26.7 oranlarıyla kontrol grubunda tespit edilmiştir. En fazla köklenen çelik sayısı %25 oranıyla 5000 ppm IBA uygulamasında, köklenen çeliklerde ortalama kök sayısı en fazla 8 adet ile 1000 ppm IBA uygulamasında, en fazla ortalama kök uzunluğu 14.3 cm ile 1000 ppm IBA uygulamasında, sürgün uzunluğu ortlama 9.7 cm ile en fazla kontrol grubunda ve en fazla yaprak sayısı 7.7 adet ortalama ile kontrol grubundan elde edilmiştir. Araştırma sonucu olarak, tartılı derecelendirme ve araştırmacı gözlemlere dayanılarak ümitvar olarak seçilen 29 genotip, sonraki ıslah çalışmalarına genetik kaynak olarak büyük katkı sağlayacaktır.

Anahtar Kelimeler: *Corylus colurna*, Türk Fındığı, ISSR, Çelik, Çoğaltma

ROOTSTOCK SELECTION IN TURKISH HAZELNUT (*Corylus colurna* L.) POPULATIONS IN KASTAMONU

ABSTRACT

This study was carried out 2020-2022 to examine the rootstock characteristics of Turkish Hazelnut (*Corylus Colurna* L) genotypes in different locations in Kastamonu. In this study, 8 locations in 5 different regions were visited and approximately 1100 genotypes were examined morphologically and 203 of these genotypes were sampled. A total of 29 genotypes were selected as promising as a result of weighted grading method (14 genotypes) and researcher observations (15 genotypes) from the sampled genotypes. At the same time, molecular characterization (ISSR) was performed to determine the relationships of these selected genotypes. In the study, a rooting experiment was established with wood cuttings to measure the rooting performance of Turkish Hazelnut. In the study, as a result of weighted grading method, KPÇ2 and KPÇ3 genotypes received the highest score with 500 points each, while the KTS11 genotype was the lowest score with 270 points. It was determined that 183 of the 203 genotypes examined did not give suckers, 190 of them had an upright habitus and 196 of them showed strong growth. While KPÇ2 and KPÇ3 genotypes were the individuals with the highest internode spacing of 6 cm in annual shoot, the KPY4 genotype was the individual with the lowest internode spacing with 1.16 cm. Genotypes were determined that branching height was 15 cm (KTU4) to 800 cm (KMU54), the trunk circumference was 7 cm (KTU5) to 504 cm (KMU55), the crown width was 1 m (KTU2 – KTU28) to 22 m (KAK11) and the crown length was 1.7 m (KTU5) to 27 m (KAK12). It was determined that the genotypes examined ranged between 7-400 years of age. According to the results of ISSR molecular characterization method, correlation matrix values between selected Turkish Hazelnut genotypes were determined between 0.28 and 0.91. According to the results obtained, it was determined that the genetically farthest lines were between KTS11 and KMU32, and the closest lines were between KMU62 and KMU59. In the measurements made in the propagation experiment with cuttings, the highest number of live cuttings and only callus-forming cuttings were determined in the control group with the ratios of 60% and 26.7%, respectively. Maximum number of rooted cuttings with 25% in 5000 ppm IBA application, average number of rooted cuttings with maximum 8 in 1000 ppm IBA application, maximum shoot length with 9.7 cm in control group and the maximum number of leaves was obtained from the control group with an average of 7.7. As a result of the research, 29 genotypes selected as promising based on weighted grading and investigative observations will contribute greatly to future breeding studies as a genetic resource.

Keywords: *Corylus colurna*, Turkish Hazelnut, ISSR, Cutting, Propagate

MORPHO-ANATOMICAL MODIFICATION IN *Withania somnifera* (L.) DUNAL FROM THE PUNJAB, PAKISTAN: INSIGHTS INTO ADAPTATION

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ABSTRACT
The Solanaceae family, commonly known as the deadly nightshade or potato family, encompasses a wide range of important food plants and medicinal species. Among these is *Withania somnifera* (L.), also known as Ashwagandha or Winter cherry, an evergreen shrub native to India, the Middle East, and certain regions of Africa. This study focused on the collection of plant material from twelve different ecotypes in the Punjab region, including Shadan Lund, Layyah, Kot Adu, Jam Pur, Vodor, DG canal, Kala, Chah Jeand Wala, Faisalabad, DG Khan, Jang, and Multan, to investigate morphological and anatomical variations. The collected samples were preserved in a 70% alcohol solution, and freehand sectioning and double staining methods were employed. Microscopic examination using a digital ocular camera facilitated the analysis of various anatomical structures in the roots, stems, and leaves. Morphological and anatomical features were carefully observed and documented. Results indicated that the Jam Pur ecotype exhibited the maximum root epidermal thickness, while the Faisalabad ecotype displayed the largest root radius. Stem characteristics varied significantly among the ecotypes, with the Vodor ecotype exhibiting the highest cortical cell area, Jam Pur ecotype displaying the greatest epidermis thickness, and the Shahdan Lund ecotype showing the thickest sclerenchyma layer. The Vodor and Jang ecotypes had the highest abaxial stomatal area and number of trichomes. Statistical analysis, utilizing Analysis of Variance (ANOVA) at a 5% probability level, confirmed the significance of the observed results in terms of morphology and anatomy.

Keywords: ANOVA, *Withania somnifera*, adaption

ŞEKER MISIR (*Zea mays* L. *saccharata*) VE FASULYE (*Phaseolus vulgaris* L.) KARIŞIK EKİM SİSTEMİNİN ŞEKER MISIRIN BAZI BİTKİSEL ÖZELLİKLERİ ÜZERİNE ETKİSİNİN BELİRLENMESİ

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ÖZET

Ülkemizde ve Dünyada tarım alanlarının azalması ve hızlı nüfus artışı, yetiştiricileri tarım alanlarından en verimli şekilde yararlanma yollarını aramaya yöneltmektedir. Birim alandan elde edilen verimi arttırmak amacıyla yapılan uygulamalardan biri de aynı alanda ve aynı zamanda birden fazla bitkinin birlikte yetiştirilmesi olarak tanımlanan karışık ekim sistemleridir. Ülkemizde Karadeniz bölgesi mısır ve fasulyenin çokça yetiştirildiği ve tüketildiği bir bölgedir. Bu bilgiler doğrultusunda bu çalışma 2021 yılında Samsun ili Bafra ilçesinde şeker mısır ve fasulye karışık ekim sisteminin şeker mısırın bazı agronomik özellikleri üzerine etkisinin belirlenmesi amacıyla yürütülmüştür. Deneme tesadüf blokları deneme desenine göre üç tekerrürlü olarak kurulmuştur. Karışık ekim sistemi olarak kapama mısır; 1 sıra mısır, 1 sıra fasulye; 1 sıra mısır, 2 sıra fasulye karışık ekimleri denenmiştir. Çalışmada koçan boyu, koçan çapı, koçanda sıra sayısı, sırada tane sayısı, bitki boyu, ilk koçan yüksekliği, koçan sayısı ve koçan ağırlığı gibi agronomik özellikler incelenmiştir. Elde edilen verilere göre bitki boyu 224-239 cm, ilk koçan yüksekliği 70-78 cm, koçan sayısı 1.2-1.3 adet, koçan ağırlığı 271-381 g, koçan boyu 19-20 cm, koçan çapı 39-42 cm, koçan sıra saysı 15-16 adet, sırada tane sayısı 39-42 adet olarak belirlenmiştir. Elde edilen verilerde varyans analizi yapılmış, en yüksek alan eşdeğer oranı (LER değeri) hesaplanmıştır. Önemli çıkan özelliklerden elde edilen verilerde Tukey karşılaştırma testi yapılmıştır. Çalışma sonucunda karışık ekim uygulamalarının koçan ağırlığı, koçan boyu ve koçanda sıra sayısı üzerinde etkisi önemsiz çıkarken diğer özelliklerde etkisi önemli olarak belirlenmiştir. Elde edilen veriler sonucu en iyi sonuçların 1 sıra mısır 1 sıra fasulye karışık ekim düzenlemesinden elde edildiği belirlenmiştir.

Anahtar Kelimeler: Ekim düzenlemeleri, Koçan özellikleri, Bitkiler arası rekabet

DETERMINATION OF THE EFFECT OF SWEET CORN (*Zea mays* L. *saccharata*) AND BEAN (*Phaseolus vulgaris* L.) INTERCROPPING SYSTEM ON THE AGRONOMIC CHARACTERISTICS OF SWEET CORN

ABSTRACT

The decrease in agricultural lands and rapid population growth in our country and in the world lead growers to seek ways to benefit from agricultural lands in the most efficient way. One of the applications made in order to increase the yield obtained from the unit area is the mixed planting systems, which is defined as the cultivation of more than one plant in the same area at the same time. In our country, the Black Sea region is a region where corn and beans are widely grown and consumed. In line with this information, this study was carried out in order to determine the effect of sweer corn and bean mixed planting system on some agronomic properties of ssweet corn in Bafra district of Samsun province in 2021. The experiment was arrenged in a randomized block design with three replications. Covering corn; 1 row of corn, 1 row of beans; 1 row of corn, 2 rows of beans were tried as a mixed planting system. In the study, agronomic characteristics such as ear length, ear diameter, number of kernels per ear, ranged grain number, plant height, first ear height, number of ear and weight of the ear were investigated. According to the data obtained, plant height 224-239 cm, first ear height 70-78 cm, number of ear 1.2-1.3, ear weight 271-381 g, ear length 19-20 cm, ear diameter 39-42 cm, number of kernels per ear 15-16 pieces, ranged grain number was determined as 39-42 pieces. Analysis of variance was performed on the obtained data, and the highest area equivalent ratio (LER value) was calculated. The Tukey comparison test was performed on the data obtained from the important features. As a result of the study, the effect of mixed planting practices on ear weight, ear length and row number was found to be insignificant, while the effect on other characteristics was determined to be significant. As a result of the data obtained, it was determined that the best results were obtained from the mixed planting arrangement of 1 row of corn and 1 row of beans.

Keywords: Planting arrangements, Ear characteristics, Competition between plants

COMPARATIVE ANALYSIS OF THE MACROSEISMIC EFFECTS OF TWO EARTHQUAKES FROM THE SAME SOURCE. CASE STUDY FOR SKOPJE EPICENTRAL AREA

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ABSTRACT
According to the available database of the Seismological Observatory in Skopje, one of the most seismically active areas in the Vardar seismic zone and the Republic of North Macedonia as a whole, the Skopje epicentral area has been affected by several moderate to strong earthquakes in history. The aim of this research is to analyze the spatial variances in the macroseismic effects of two earthquakes registered at the considered region in the past century – the earthquake from 26.7.1963, 05:17 a.m. with a local magnitude of M_L6.1 and maximal epicentral intensity $I_0 = IX$ according to European Macroseismic Scale (EMS-98) and the earthquake from 11.9.2016, 3:10 p.m. with a local magnitude of M_L5.3 and maximal epicentral intensity $I_0 = VII$ according to EMS-98, on the environment and the building stock at the epicenter and nearby places. For this purpose, previously constructed isoseismal maps for both earthquakes were analyzed in detail. Furthermore, a comparison of the source parameters – fault surface, the volume of the source and the maximal linear dimension of the rupture was done with the aim to define if both of the earthquakes were produced by the same source. Finally, an analysis of the attenuation of the macroseismic effects was made, in order to find differences in the source– the Skopje-Kyustendil fault behavior.

Keywords: Macroseismic effects, earthquake, Skopje, source parameters, isoseismal map

CHANGES IN STOMATAL CONDUCTIVITY IN SILAGE MAIZE UNDER DIFFERENT IRRIGATION REGIMES IN ORGANIC FERTILIZED SOIL

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ABSTRACT
Soil moisture management affects microbial activity that causes carbon mineralization. In frequent irrigation events that cause low stress on the soil, an increase in mineralization and hence nitrogen release is expected in a soil containing farm (cattle) manure. Silage maize actively uses nitrogen and water for high yield. Therefore, nitrogen earning with a good soil water management can increase crop growth and productivity. Because stomata control both water loss and CO_2 uptake, they can be an important indicator of the manageability of stress with the contribution of nitrogen recovery from the soil. In this study, the seasonal variation of stomatal conductivity values in silage maize applied three different irrigation regimes (the irrigations when the sum of the difference "Evapotranspiration - effective precipitation" reaches 20, 40 and 60% of the available water in the soil) in an organic fertilized soil was compared with that in mineral fertilized soil. As a result, the stomatal conductivity decreased with the increase in the irrigation regime, the values were determined higher in the organic fertilization than the mineral fertilization, and resulting in more silage yield.

Keywords: Cattle manure, Irrigation regime, Stomatal Permeability, Silage maize

ELUCIDATING MORPHO-ANATOMICAL ADAPTATIONS IN *ACHYRANTHES ASPERA* L. FROM PUNJAB, PAKISTAN

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ABSTRACT
The Amaranthaceae family comprises approximately 70 genera and 1000 species, including annual and perennial herbs, some of which are climbing. These plants have successfully adapted to salty soils and dry environments. The family also encompasses shrubs and small trees. In this study, we investigated the anatomical changes in *Achyranthes aspera*, a species belonging to the Amaranthaceae family. We selected specimens from different ecozones to evaluate the anatomical characteristics and responses of ecotypes adapted to diverse conditions. The samples were collected from various habitats in the Punjab region and preserved in 70% ethyl-alcohol for anatomical studies. Anatomical aspects of the root, stem, and leaf were evaluated using the free-hand sectioning method. For staining, we employed a double staining technique with safranin and fast green, followed by placing the dyed sections on slides and sealing them with a cover slip for microscopic photography. The obtained results, including three replications, were subjected to Analysis of Variance (ANOVA) using Conoco 4.5 software for Windows to compare the anatomical alterations among different habitats. The findings revealed significant structural adaptations in saline habitats, such as decreased stomatal area and density, increased root thickness, a thickened endodermal layer, large stem area, broad root metaxylem vessels, large stem cortical cells, and intensive sclerification in leaves and stems.

Keywords: ANOVA, *Achyranthes aspera*, root

TOMBUL FINDIK ÇEŞİDİNDE REHABİLİTASYON UYGULAMALARININ VERİM VE KALİTEYE ETKİLERİ

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ÖZET

Bu araştırma 2019 ve 2020 yıllarında Ordu ilinde fındık yetiştiriciliği yapılan 3 farklı bahçede (Altınordu Oğmaca, Altınordu Işıklı ve Fatsa Ilıca) yürütülmüştür. Çalışmada Tombul çeşidi kullanılmıştır. Kontrol ve rehabilitasyon uygulamaları için, her bahçe 100 ocak bulunan (2 da) 2 ayrı parsele bölünmüştür. Çalışmada rehabilitasyon uygulaması olarak ayrılan alanlarda toprak analizi yapılmış, sulama, gübreleme, budama ve hastalık-zararlı mücadelesi, yabancı ot kontrolü düzenli bir şekilde yürütülmüş, kontrol parsellerinde ise üreticinin geleneksel uygulamaları devam ettirilmiştir. Araştırmada, bitki başına verim (g), çotanaktaki meyve sayısı (adet) ve gövde kesit alanına verim (g/cm²) kabuklu ve iç meyve ağırlığı (g), kabuklu ve iç meyve boyutları, kabuk kalınlığı, kusurlu meyve oranları ve yağ ve protein miktarı incelenmiştir. Çalışma sonucunda verim bakımından rehabilitasyon uygulamalarının kontrole göre istatistiksel olarak önemli olduğu, ilk yıl için ortalama %67 ikinci yıl için ise ortalama %60 oranında bitki başına verim artışı, GKAV değerlerinde ise ilk yılda ortalama %29.8 ikinci yılda ise ortalama %53.8 artış olduğu tespit edilmiştir. İki yıllık rehabilitasyon uygulamaları sonucunda rehabilitasyon ve kontrol bahçelerinde sırasıyla meyve ağırlığı 2.46 g ile 1.98 arasında, iç oranı %56.34 ile %49.12 arasında, kabuk kalınlığı ise 1.00 mm ile 1.03 mm olup meyve özellikleri bakımından rehabilitasyon ve kontrol arasındaki farklılıklar istatistiki olarak önemsiz bulunmuştur. Yağ ve protein oranları rehabilitasyon ve kontrol bahçeleri arasında sırasıyla; %61.29 ile %56.75 ve %19.10 ve %17.74 arasında bulunmuştur. Sonuç olarak rehabilitasyon uygularının özellikle verim değerini önemli oranda artırdığı, kusurlu meyve oranını azalttığı dolayısı ile kalite üzerine de olumlu etki yaptığı söylenebilir.

Anahtar Kelimeler: *Corylus avellana*, iç oranı, sulama, gübreleme, budama

EFFECTS OF REHABILITATION ON PRODUCTION AND QUALITY IN TOMBUL HAZELNUTS

ABSTRACT

This research was carried out in 3 different orchards (Altınordu Oğmaca, Altınordu Işıklı and Fatsa Ilıca) in Ordu province in 2019 and 2020. The Tombul variety was used in the study. For control and rehabilitation applications, each orchard is divided into 2 separate parcels with 100 'Ocaks' (2 da). In the study, soil analysis was carried out in the areas allocated as rehabilitation application, irrigation, fertilization, pruning and disease-pest control, weed control were carried out regularly, and the traditional practices of the producer were continued in the control plots. In the study, different parameters; yield per plant (g), number of nuts per cluster and the yield of cross sectional of trunk (GKAV, g/cm²), nut and kernel weight (g) nut and kernel dimensions, shell thickness, internal cavity, defective nut rate (blank, shriveled nuts) and oil and protein contents were investigated. As a result of the study, it was determined that the rehabilitation practices were statistically significant compared to the control in terms of yield, an average of 67% increase in yield per plant was achieved in the first year and an average of 60% in the second year and an average increase of 29.8% in the first year and an average of 53.8% in the second year in GKAV values. As a result of two-year rehabilitation practices, nut weight was between 2.46 g and 1.98, nut, kernel ratio was between 56.34% and 49.12%, and the shell thickness was 1.00 mm and 1.03 mm in the rehabilitation and control orchards, respectively, and the differences between the rehabilitation and control studies in terms of kernel characteristics were found to be statistically insignificant. The oil and protein contents are between rehabilitation and control gardens, respectively; It was found between 61.29% and 56.75% and between 19.10% and 17.74%. As a result, it can be said that rehabilitation practices increase the yield values significantly, reduce the rate of defective fruit, and therefore have a positive effect on quality.

Keywords: *Corylus avellana*, Nut ratio, Irrigation, Fertilization, Pruning

TOSYA'DAN SELEKTE EDİLEN TÜRK FINDIĞI (*Corylus colurna* L.) GENOTİPLERİNDE ÇELİKLE KÖKLENME ORANLARININ BELİRLENMESİ

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ÖZET

Çalışma 2020-2022 yılları arasında Kastamonu ili Tosya ilçesinde seleksiyon ıslahı yoluyla seçilen anaçlık Türk fındığı genotiplerinin köklenme oranlarının tespit edilmesi amacıyla yürütülmüştür. Araştırmada bir yaşlı sürgünlerden alınan odun çelikleri kullanılmıştır. Üç tekerrürlü olarak planlanan çalışmada her tekerrürde 20 çelik kullanılmış ve 0, 500, 1000, 2000, 3000, 4000, 5000 ve 6000 ppm IBA dozları uygulanmıştır. 25 cm uzunluğunda hazırlanan çeliklere hormon uygulanmış bu çelikler tavalara (perlit ortamında) 2/3'ü gömülerek köklenmeye alınmıştır. Köklenmeye alınan çeliklerde canlı çelik (%), kallüslenme (%), köklenme oranı (%), kök sayısı (adet), kök uzunluğu (cm), sürgün uzunluğu (cm) ve yaprak sayısı (adet) özellikleri incelenmiştir. İncelenen özellikler üzerine uygulama dozlarının etkisi yaprak (adet) sayısı dışındaki tüm özellikler için önemli bulunmuştur ($p<0.05$). Araştırmada en yüksek köklenme oranı %25 ile 5000 ppm IBA uygulamasında elde edilirken en düşük kontrol uygulamasında (%1.7) tespit edilmiştir. En yüksek kök sayısı ise 1000 ppm uygulamasında kaydedilirken en yüksek kök uzunluğu 1000 ve 5000 ppm IBA uygulamalarından elde edilmiştir. Tüm veriler değerlendirildiğinde 5000 ppm IBA uygulamasının Türk fındığının odun çelikleri ile köklendirilmesi için kullanılabileceği söylenebilir.

Anahtar Kelimeler: *Corylus colurna,* Çelik, Fındık, Köklenme

DETERMINATION OF ROOTING RATIO OF TURKISH HAZELNUT (*Corylus colurna* L.) GENOTYPES SELECTED FROM TOSYA

ABSTRACT

The study was carried out to determine the rooting of the rootstock Turkish hazelnut genotypes selected through selection breeding in Tosya district of Kastamonu province between the years 2020-2022. The research was carried out on wood cuttings taken from one-year-old shoots. The study was planned as three replications, 20 steels were used in each replication and doses of 0, 500, 1000, 2000, 3000, 4000, 5000 and 6000 ppm IBA were applied. Then, these hormone-treated cuttings were rooted by burying 2/3 of them in pans (perlite). Live cuttings (%), callus (%) and rooting rate (%), number of roots (number), root (cm) and shoot length (cm) and number of leaves (number) were investigated. The effect of application doses on the investigated traits was found to be significant for all traits except the number of leaves ($p<0.05$). In the work, the highest rooting rate was obtained in the 5000 ppm IBA application with 25%, while the lowest was detected in the control application (1.7%). The highest number of roots was recorded in the 1000 ppm application with 8%. And in the root length, 1000 and 5000 ppm IBA applications were better results than the others. As a result, it can be said that 5000 ppm IBA application can be applied for rooting in Turkish hazelnut wood cuttings.

Keywords: *Corylus colurna*, Cutting, Hazelnut, Rooting

EXPOSURE AND RISK OF DEVELOPMENT OF METABOLIC DYSFUNCTION IN A POPULATION CONSUMING HEAVY METAL-CONTAMINATED MILK

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ABSTRACT
Milk and most dairy products are likely to be contaminated with heavy metals. Heavy metal distribution in cattle milk and their products has not been well investigated. This study aims to assess the heavy metals in various milk supplies and consider the impact of heavy metals exposure on the risk of the development of metabolic dysfunction in the population. Samples of milk from various types of cows from different farms and flocks were gathered in pre-washed bottles. Milk samples were collected from cows offered groundwater, tap water hand pump water either on standard cattle feed or household feed. Their milk samples and blood samples were collected. A nutritional survey based on the type of milk which is used by the population like household milk, milk from dairy farms, and Tetra-packed processed milk was taken. Heavy metal concentrations in their blood samples were evaluated with other biochemical parameters like glycemic, lipid oxidative stress, and inflammatory profile. About 18 male albino rats

weighing 150 to 250 grams were taken. Group, I was an unexposed control group that was given saline solution and standard feed; the second group was exposed to heavy metals like cadmium at the dose rate of 3ml without receiving any other treatment. The third group was exposed to heavy metals like cadmium antioxidant agents like quercetin and vitamin E (25mg/kg + 100mg kg). Blood samples were taken from the rats' tails for serum biochemical parameters. In this study, significant reductions were observed in heavy metal levels like cadmium when animals were treated with antioxidants (quercetin and vitamin E), and significant reductions were also observed in ALT, AST, creatinine, Uric acid and HDL, LDL, and cholesterol levels in antioxidant treated rats.

Keywords: Heavy metals, oxidative stress, HDL and LDL

DETERMINATION OF HEAVY METALS IN BOTTLED WATER COLLECTED FROM MARKET IN TEHRAN, IRAN: A HEALTH RISK ASSESSMENT

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ABSTRACT

Humans require safe and high-quality drinking water to survive and remain healthy. Municipal tap water and bottled water are the most common ways of accessing safe drinking water. In recent decades, bottled water consumption has increased dramatically. Contrary to most people's belief that bottled water is safer than tap water, previous research illustrated that bottled water may contain many contaminants, such as heavy metals, nitrates, microplastics, radioelements, etc. Among them, heavy metals are of considerable importance. They can adversely affect human health, including cancer, neurological disorders, diminished growth, infertility, cardiovascular problems, kidney and liver disorders, and digestive diseases. Our study aimed to determine aluminum, barium, cadmium, copper, iron, lithium, manganese, nickel, molybdenum, and zinc in the 60 bottled water samples, including 30 bottled mineral waters and 30 bottled drinking waters collected from the marketplace in Tehran, Iran. The samples were analyzed using inductively coupled plasma-optical emission spectroscopy (ICP-OES). The mean concentration of Ba, Cu, Li, Mn, Ni, and Zn was 10.13, 0.04, 2.21, 0.02, 1.49, and 2.86 µg/L, respectively. Al, Cd, Fe, and Mo contents in all samples were below the detection limit (LOD for Al, Cd, Fe, and Mo were 0.307, 0.179, 0.160, and 1.666 µg/L, respectively). The mean concentrations of Ba, Li, and Ni in the bottled mineral water samples were higher than in bottled drinking water, while the mean concentrations of Cu, Mn, and Zn

in the bottled drinking water samples were more than in bottled mineral water. The heavy metal concentrations detected in the samples were compared with the values established by WHO and INSO (Iranian Standard). The concentration of none of the heavy metals exceeded the maximum allowable concentrations (MACs). Furthermore, health risk assessments were evaluated through the intake of heavy metals from bottled water. HQ values in all cases were less than one and acceptable. The findings of this study indicate that heavy metal contents in bottled water samples are safe range and acceptable, although given the detrimental consequences of heavy metals and other contaminants in water on human health, ongoing surveillance of bottled water is recommended.

Keywords: Heavy Metals, Bottled Water, ICP-OES, Health Risk Assessment

BİNGÖL KOŞULLARINDA DÖRT FARKLI (*Apis mellifera L.)* BAL ARISI GENOTİPİNDEN ELDE EDİLEN BALLARIN BİYOLOJİK AKTİVİTELERİNİN KARŞILAŞTIRILMASI

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ÖZET

Bal arıları (*Apis mellifera L.)* kutuplar gibi ekstrem koşullar dışında hemen hemen dünyanın pek çok yerinde yaşayabilmektedirler. Bal arılarının bu kadar geniş alanlarda yaygınlaşarak nesillerini devam ettirmeleri, onların yüksek adaptasyon yetenekleri ile ilişkilendirilmektedir. Bingöl coğrafi konum itibariyle üç farklı fitocoğrafik bölgenin kesişim noktasında bulunması sonucu zengin bir floral çeşitliliğe sahip olup arıcılık faaliyetinin yoğun olarak yapıldığı bir ildir. Gezginci arıcılığın yoğun olarak yapıldığı bir il olmasından dolayı arıcılar belirli bir ırk veya ekotip ile çalışmamaktadır. Bu çalışmada Bingöl ilinde yoğun olarak kullanılan dört farklı (*Apis Mellifera L.*) bal arısı genotipinden bal elde edilmiştir. Çalışmada 10 adet *Apis Mellifera Caucasica'nın* Posof genotipinin melezi (F1), 10 adet *Apis Mellifera Caucasica'nın* Camili genotipinin melezi (F1), 10 Adet *Apis Mellifera Carnica'nın* melezi (F1) ve 10 Adet Bingöl ilinden dışardan arı giriş çıkışının olmadığı sabit arıcılık yapan arıcılardan alınan Bingöl arısı kullanılmıştır. Bal arısı genotiplerinden nektar akımının azaldığı Ağustos ayı sonunda bal hasadı yapılmıştır. Hasat edilen bal örneklerinin toplam fenolik madde içeriği, toplam flavonoid madde içeriği, DPPH, ABTS ve CUPRAC antioksidan aktivite yöntemleri ile antioksidan aktiviteleri belirlenmiştir. Dört farklı (*Apis Mellifera L.)* bal arisi genotipinden elde edilen balların biyolojik aktivitelerinin karşılaştırılması yapılmıştır. Yapılan analiz sonuçlarına göre en yüksek toplam fenolik madde içeriği ve en yüksek toplam flavonoid madde içeriği sırasıyla 37,71± 0,09 mg GAE/100 g bal ve 198,13±0,51 mg Q.E./100 g bal olarak Posof genotipinin melezinde (F1) tespit edilmiştir. Antikoksidan aktivite analizlerinde en yüksek aktivite Posof genotipinin melezi (F1) ile elde edilen balda tespit edilmiştir. Bu aktivite değerleri; DPPH

antioksidan aktivite analiz yöntemine göre 35,82±0,32 mg T.E. / 100 g bal, ABTS antioksidan aktivite analiz yöntemine göre 3,81±0,02 mg T.E. / 100 g bal ve CUPRAC antioksidan aktivite analiz yöntemine göre 52,09±0,45 mg T.E./100 g bal olarak tespit edilmiştir. Biyolojik aktivite olarak Posof genotipi melezi (F1) ile elde edilen bal çalışılan diğer genotiplere göre ön plana çıktığı tespit edilmiştir.

Anahtar Kelimeler: Bal arısı, Bal, Toplam Fenolik Madde, Toplam Flavonoid Madde, Antioksidan aktivite

COMPARISON OF THE BIOLOGICAL ACTIVITIES OF HONEY OBTAINED FROM FOUR DIFFERENT (*Apis mellifera* L.) HONEY BEE GENOTYPES UNDER BINGOL CONDITIONS

ABSTRACT

Honey bees (*Apis mellifera* L.) can live almost in many parts of the world, except in extreme conditions such as the poles. The fact that honey bees continue their generation by becoming widespread in such large areas is associated with their high adaptability. Bingöl has a rich floral diversity as a result of being at the intersection of three different phytogeographic regions due to its geographical location and is a province where beekeeping activities are carried out intensively. Since it is a province where mobile beekeeping is done intensively, beekeepers do not work with a certain race or ecotype. In this study, honey was obtained from four different (Apis Mellifera L.) honey bee genotypes, which are used extensively in Bingöl province. In the study, 10 Apis Mellifera Caucasica's Posof genotype hybrids (F1), 10 Apis Mellifera Caucasica's Camili genotype hybrids (F1), 10 Apis Mellifera Carnica's hybrids (F1), and 10 Apis Mellifera Caucasica hybrids (F1), and 10 no bee entry and exit from Bingöl province. Bingöl bee taken from beekeepers engaged in fixed beekeeping was used. Honey was harvested at the end of August when the nectar flow from the honey bee genotypes decreased. Total phenolic content, total flavonoid content, DPPH, ABTS and CUPRAC antioxidant activity methods and antioxidant activities of harvested honey samples were determined. The biological activities of honey obtained from four different (Apis Mellifera L.) honey bee genotypes were compared. According to the results of the analysis, the highest total phenolic substance content and the highest total flavonoid substance content were 37.71± 0.09 mg GAE /100 g honey and 198.13± 0.51 mg Q.E. /100 g honey, respectively. It was detected in the hybrid of the Posof genotype (F1) as /100 g honey. In antioxidant activity analysis, the highest activity was determined in honey obtained with Posof genotype hybrid (F1). These activity values are; It was determined as 35.82±0.32 mg T.E./100 g honey according to DPPH antioxidant activity analysis method, 3.81±0.02 mg T.E./100 g honey according to ABTS antioxidant activity analysis method and 52.09±0.45 mg T.E./100 g honey according to CUPRAC antioxidant activity analysis method. In terms of biological activity, it was determined that honey obtained with Posof genotype hybrid (F1) came to the forefront compared to other genotypes studied.

Keywords: Honey bee, Honey, Total Phenolic Substance, Total Flavonoid Substance, Antioxidant activity

AN UPDATED CHECKLIST OF MELOIDAE MYLABRINI (COLEOPTERA) AND HOST PLANTS IN A SAHARAN OASIS ECOSYSTEM IN ALGERIA

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ABSTRACT
The distribution of Mylabrini species in the oasis ecosystem is scarcely known, our study aimed to improve the knowledge of the beetle fauna in this very peculiar and severe habitat, represented by isolated spots in the desert. Tree large oases at the wilaya of Ouled Djellal (Oued El Assel, Oued Djdai and Saad), northern Algeria were chosen for collecting insects. In each palm grove five pitfall traps were setup and visited every week. The content of each trap was stored in labelled vial and identified using binocular and confirmed by one of us. The updated checklist of the Coleopetera Meloidae from Algeria indicated the presence of 29 genera and 118 species belonging to the tribes Cerocomini, Epicautini, Lyttini (s.l.), Mylabrini, Meloini, Nemognathini. From the trap sampling we obtained 3 species; *Croscherichia litigiosa* (Chevrolat, 1840), *C. gilvipes* (Chevrolat, 1840), and *Mylabris impressa* Chevrolat, 1840. During our samplings, different spontaneous and weeds plants were identified from each palm groves. Among these, the most frequent plant species feed by blister beetles were flowers of *Silybium marianum* (Asteraceae), *Hedysarum carnosum* (Fabaceae), *Raphanus raphanistrum, Moricandia arvensis* (Brassicaceae) and *Aizoon hispanicum* (Aizoaceae) species. Even though the new records do not represent a significant range extension of the species, our collections will improve the knowledge also on their host plants in this ecosystem.

Keyswords: Faunistics, oasis ecosystem, blister beetles, checklist

SÜT İŞLETMECİLİĞİNDE METABOLİK PROFİL TESTLERİNİN ÖNEMİ

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ÖZET

Süt işletmeciliği, dünyada önemli bir tarımsal faaliyettir ve süt ürünleri endüstrisinin temelini oluşturur. Yüksek oranda süt verimi, süt kalitesi ve sağlıklı hayvanların yetiştirilmesi, bir süt işletmesinin başarısı için hayati öneme sahiptir. Süt üretim işletmelerinde metabolik profil testleri, hayvanların sağlık durumlarını değerlendirme, metabolik hastalıkların erken teşhisi, üreme performansının iyileştirilmesi ve beslenmenin yönetilmesi için önemli bir araçtır. Bu testler, hayvanların metabolizma ve enerji dengesini değerlendirerek, beslenme durumunu, sindirim sağlığını, organ fonksiyonlarını, genel sağlık durumunu ve mineral ve vitamin düzeyini anlamak için kan veya süt örneklerinin biyokimyasal analizini içerir. Düzenli olarak yapılması, hastalıkların erken teşhisini sağlayarak hayvanların sağlığını korumaya, süt verimliliğini artırmaya, hayvanların beslenme programlarının ve yönetiminin optimize edilmesine katkıda bulunur. Hayvan işletmelerinde metabolik profil testlerinin uygulama sıklığı, hayvan türü, işletme büyüklüğü, üretim hedefleri, hayvanların yaşam dönemleri ve sağlık durumları gibi birçok faktöre bağlıdır. Uygulama sıklığı genellikle işletme ve hayvanların özelliklerine bağlı olarak değişir. Bazı işletmeler, tüm hayvanları belirli aralıklarla metabolik profil testlerine tabi tutarken, diğerleri yalnızca riskli durumlarda veya belirli hayvan gruplarına odaklanır. Özellikle işletmeye yeni katılan hayvanlar, riskli dönemler, üreme dönemi, hastalık şüphesi ve rutin izlem dönemlerinde bu testler yaptırılmaktadır. Metabolik profil testleri, işletme hekiminin hastalık şüphesine göre değişmekle birlikte genellikle Glukoz (Glu), Trigliserit (TG), Non-Esterifiye Yağ Asitleri (NEFA), Beta-Hidroksibütrik Asit (BHBA), Kan Üre Azotu (BUN), Aspartat Transaminaz (AST), Alanin Aminotransferaz (ALT), Laktat Dehidrogenaz (LDH), Kalsiyum (Ca), Fosfor (P), Sodyum (Na) ve Potasyum (K^+) parametrelerini içerir. Bu testlerin düzenli ve bilinçli yapılması, süt işletmelerinin verimliliğini artırmaya ve karlılığını sağlamaya büyük katkı sağlar. Dolayısıyla, süt işletmecileri, metabolik profil testlerini aktif bir şekilde kullanmalı ve hayvan sağlığı ve işletme performansını iyileştirmek için bu değerli bilgilerden yararlanmalıdır.

Anahtar Kelimeler: Metabolik Sağlık, Erken teşhis, Beslenme yönetimi

IMPORTANCE OF METABOLIC PROFILE TESTING IN DAIRY FARMING

ABSTRACT

Dairy farming is a significant agricultural activity worldwide and forms the foundation of the dairy products industry. Achieving high milk yield, milk quality, and raising healthy animals are crucial for the success of a dairy farm. In dairy production operations, metabolic profile testing plays an important role in assessing the health status of animals, early diagnosis of metabolic diseases, improving reproductive performance, and managing nutrition. These tests involve the biochemical analysis of blood or milk samples to understand the animals' metabolism, energy balance, nutritional status, digestive health, organ functions, and mineral and vitamin levels. Regularly conducting these tests contributes to maintaining animal health by enabling early disease diagnosis, increasing milk productivity, and optimizing the animals' feeding programs and management. The frequency of metabolic profile testing in dairy farming depends on various factors such as animal species, farm size, production goals, life stages of animals, and their health status. The frequency of testing generally varies based on the characteristics of the farm and animals. Some farms subject all animals to metabolic profile testing at specific intervals, while others focus on specific animal groups or risky situations. These tests are commonly conducted for newly introduced animals, during risky periods, reproductive phases, suspected illness cases, and routine monitoring periods. Metabolic profile tests typically include parameters such as Glucose (Glu), Triglycerides (TG), Non-Esterified Fatty Acids (NEFA), Beta-Hydroxybutyric Acid (BHBA), Blood Urea Nitrogen (BUN), Aspartate Transaminase (AST), Alanine Aminotransferase (ALT), Lactate Dehydrogenase (LDH), Calcium (Ca), Phosphorus (P), Sodium (Na), and Potassium (K^+). These tests provide valuable information for optimizing dairy farm productivity and profitability when conducted regularly and conscientiously. Therefore, dairy farmers should actively utilize metabolic profile testing and leverage the valuable insights obtained from these tests to improve animal health and farm performance.

Keywords: Metabolic health, Early diagnosis, Nutrition management

EXPLORING NOVEL MORPHO-ANATOMICAL TRAITS IN *CONVOLVULUS ARVENSIS* FROM THE PUNJAB, PAKISTAN

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ABSTRACT
The Convolvulacae family, commonly known as the bindweeds or morning glories, family, encompasses a wide range of important food plants and medicinal species. Among these is *Convolvulus arvensis* (L.), also known as Leli an evergreen shrub native to India, the Middle East, and certain regions of Africa. This study focused on the collection of plant material from twelve different ecotypes in the Punjab region, including Shadan Lund, Layyah, Kot Adu, Jam Pur, Vodor, DG canal, Kala, Chah Jeand Wala, Faisalabad, DG Khan, Jang, and Multan, to investigate morphological and anatomical variations. The collected samples were preserved in a 70% alcohol solution, and freehand sectioning and double staining methods were employed. Microscopic examination using a digital ocular camera facilitated the analysis of various anatomical structures in the roots, stems, and leaves. Morphological and anatomical features were carefully observed and documented. Results indicated that the Jam Pur ecotype exhibited the maximum root epidermal thickness, while the Faisalabad ecotype displayed the largest root radius. Stem characteristics varied significantly among the ecotypes, with the Vodor ecotype exhibiting the highest cortical cell area, Jam Pur ecotype displaying the greatest epidermis thickness, and the Shahdan Lund ecotype showing the thickest sclerenchyma layer. The Vodor and Jang ecotypes had the highest abaxial stomatal area and number of trichomes. Statistical analysis, utilizing Analysis of Variance (ANOVA) at a 5% probability level, confirmed the significance of the observed results in terms of morphology and anatomy.

Keywords: ANOVA, *Convolvulus arvensis*, anatomical features

VİRAL PANDEMİLERİN ETKİLERİ

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ÖZET

Salgın hastalıklar dünya tarihinde çok önemli yer tutmaktadır. Geçmişten günümüze bakıldığında bu hastalıkları tetikleyen birçok faktör vardır. Dünya genelinde ticaret, göç ve savaşlar her geçen gün insanlar arasındaki etkileşimleri artırarak virüslerin mutasyona uğramasına ve hastalıklara sebep olmaktadır. Özellikle artan seyahat, entegrasyon ve şehirleşme çalışmaları pandemilerin olmasını etkileyen faktörlerdir. Yaşanan pandemiler sosyal hayatta birçok değişikliğe sebep olduğu gibi ekonomik hayatı da etkilemiştir. Coronavirus salgınıyla beraber bu durum açıkça gözler önüne serilmiştir. Sağlıktan sosyal hayata, eğitimden ekonomiye, insanlar arasındaki davranışsal farklılıklara kadar bir çok değişikliğe sebep olduğu görülmüştür. Ülkeler arası ulaşımın kısıtlanması, ülkeler arası seyahatlerde istenilen şartların değişmesi, kara sınırlarının kapatılması, ekonomik sektörlerin sekteye uğraması (özellikle tarım ve hayvancılık), pandemiyle beraber oluşması muhtemel kıtlıklar, temel ürünlerinde gerçekleşen fiyat artışları beraberinde birçok olumsuzlukları getirmiştir. Geçmişte viral pandemiler dünyada çok önemli etkiler bırakmasıyla beraber çok fazla kayıplara da neden olmuştur. İspanyol Gribi, Hong Kong Gribi, Sars, Covid bunun başlıcalarını oluşturmaktadır. Pandemi ile birlikte meydana gelen ekonomik dar boğaz işsizliklere, temel ürünlerdeki artışa bağlı olarak yaşanılan sıkıntılara ve tüketicinin ihtiyaçlarını sağlamasına çok büyük darbe vurmuştur. Bilimsel araştırmalara bakıldığında salgın hastalıkların sosyal ve siyasi açıdan önemli sonuçlarının olabileceğini, devletler ile halk arasında anlaşmazlıklara neden olabileceğini, devlet gücünün zayıflaması, nüfusun sürekli değişmesi, sosyal ayrımcılığın ortaya çıkması ile ayrımcılığın tetiklenmesine neden olabileceğini göstermektedir. Salgın hastalıkların önemli sosyal etkileri de vardır. Bu tür salgın hastalıklar korku ve paniğe neden olabilmektedir. Bununla birlikte halkta geri dönülmeyecek travmalara sebebiyet vermektedir.
Hızlı dönüşümler, iklim değişiklikleri, insanoğlunun daha fazla para kazanma isteği, temiz su kaynaklarının azalması, hızlı kentleşme birçok neden pandemilere sebep olmaktadır. Virusların mutasyon sebebinin bu kadar çok olduğu bir dönemde yeni pandemiler kaçınılmazdır. Pandemilerin her an olabileceğini unutmamalı ve hayatımızın içerisinde varolabileceğini düşünerek önlemlerimizi almalı ve tedbirlerimizi elden bırakmamalıyız.

Anahtar Kelimeler: Pandemi, Virus, Toplumsal etkileri

IMPACTS OF VIRAL PANDEMICS

ABSTRACT

Pandemic diseases hold a significant place in world history. Looking from the past to the present, there are many factors that trigger these diseases. Global trade, migration, and wars increase interactions among people every day, causing viruses to mutate and lead to diseases. Particularly, increased travel, integration, and urbanization are factors that influence the occurrence of pandemics. Pandemics have caused numerous changes in social and economic life, as evidenced by the recent coronavirus outbreak. It has been observed that it has led to various changes ranging from health to social life, education to the economy, and behavioral differences among people. Restriction of international travel, changes in the required conditions for international travel, closure of land borders, disruption of economic sectors (especially agriculture and livestock), potential scarcity due to the pandemic, and price increases in basic products have brought many disadvantages. In the past, viral pandemics have had significant impacts and caused significant losses worldwide. The Spanish Flu, Hong Kong Flu, SARS, and COVID-19 are among the most notable ones. The economic downturn caused by the pandemic has dealt a severe blow to unemployment, difficulties due to increases in basic product prices, and the ability of consumers to meet their needs. Scientific research indicates that pandemics can have significant social and political consequences, leading to disagreements between governments and the public, weakening of state power, constant changes in the population, emergence of social discrimination, and triggering of discrimination. Pandemic diseases also have significant social impacts. Such diseases can cause fear and panic among the population, leading to irreparable traumas. Rapid transformations, climate change, human desire for greater financial gain, decreasing clean water sources, and rapid urbanization are among the many reasons that cause pandemics. In an era where the mutation of viruses is so prevalent, new pandemics are inevitable. We should not forget that pandemics can occur at any moment and can be part of our lives. Therefore, we should take precautions and not let go of our preventive measures.

Keywords: Pandemic, Virus, Social impacts

MICROBIOLOGICAL ESTIMATION OF WATER OF LAKE PËRLEPNICA, DURING SPRING SEASON 2018

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ABSTRACT
The main objective of this study is to assess the quality of water, of the lake Përlepnica during spring season, 2018 year, through the microbiological analysis. Lake Përlepnica located in south - east part of Kosovo, nearby the city Gjlani. Samples for microbiological analyses are collected in three localities along the lake. Based on achieving results led us to conclude: The waters of water of lake Përlepnica it is moderate polluted by bacteria at all localities. Registered the high number of all microorganism, at all locality. On base of coliform bacteria according to Tumpling system the waters of "Përlepnica" lake belongs at second class of pollution.

Keywords: Microbiological, analysis, water, lake, Përlepnica

DETECTION OF MAIZE DISEASE USING DEEP LEARNING MODELS

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ABSTRACT
The maize crop, the world's most important crop, is plagued by a variety of diseases that reduce yield and degrade crop quality. This paper addresses the issues and provides a deep learning application for detecting and classifying diseases in maize crops using deep learning models. The diseases being considered include three common maize leaf diseases (Leaf Blight, Common Rust, and Leaf Spot) and their healthy ones. DenseNet121, MobileNetv2, ResNet50, and InceptionV3, are the transfer learning architectural modes that were used in the training and classification of maize health conditions for accurate detection. A cutting-edge experimental simulating environment known as Python was used to implement the recommended solution, conduct experimentations, and measure performance. Python was used as well as computer vision libraries for implementation. The performance of the four deep learning models will be compared and the best model will be able to be developed and deployed to help farmers and plant pathologists diagnose diseases accurately and administer suitable remedies more quickly and correctly. From the results, it is concluded that the deep learning model could be used for the automatic detection and classification of different types of maize diseases. Consequently, farmers who identify plant diseases manually can save time and reduce their concerns about incorrect detection.

Keywords: Crop, Deep Learning Model, Maize Diseases, Python, Transfer Learning

STUDY OF THE ADAPTATION POTENTIAL OF THE POMEGRANATE CULTIVAR (SEFRI) WITH THREE DIFFERENT BIOCLIMATIC STAGES

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ABSTRACT
Climate change and increasing climate variability is recently seen as a major concern around the world due to its very apparent very negative effects on fruit trees. Altered climatic parameters affect crop physiology, biochemistry, floral biology, biotic stresses such as disease incidence and ultimately results in reduction of fruit crop yield and quality. The promotion of pomegranate cultivation in areas affected by climate change and especially in the foothills and altitudes of less than 1200 m requires support in the right varietal choice, the control of the water needs of this species in these areas and the study of the profitability of the crop compared to other crops in the region. This study is carried out in three different sites: two pomegranate production orchards of the "Sefri" variety, located in Khémisset and El-hajeb, in addition to the Ain Taoujdate experimental estate of INRA. In this context, interesting results have been found to facilitate the subsequent study of this genotype in the genetic improvement programs of the species.

Keywords: Climate change, pomegranate, Sefri, different bioclimatic stages

İNEKLERDE POSTPARTUM FARKLI UYGULAMALARIN REPRODÜKSİYON ÜZERİNE ETKİNLİĞİNİN BELİRLENMESİ

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ÖZET

İneklerde postpartum (doğum sonrası) dönem metabolik ve enfeksiyöz birçok hastalığın daha fazla oluştuğu bir dönemdir. Süt işletmelerinde reproduksiyon başarısı için postpartum sürecin çok iyi idare edilmesi gerekmektedir. Son yıllarda ineklerde verim kapasitesi artıkça buna bağlı olarak doğum sonrası problemlerde artmıştır. Bu durumun giderilmesi için postpartum farklı dönemlerde muayeneler yapılmaktadır. Bu muayeneler kimi zaman enfeksiyon varlığını belirlemek için kimi zaman ise puerperal fizyolojinin düzgün işleyip işlemediği belirlemek için yapılmaktadır. Doğum sonrası 25-30. günlerde yapılan muayeneler; ineğin izleyen dönemde fertilitesine katkı sağlamaktadır. Bu dönemde yapılan muayene ile uterus involüsyonu, bakteriyel eliminasyon ve ovaryumun siklik aktiviteye yeniden başlaması gibi postpartum fizyolojik prosesler hakkında çok erken bilgi sahibi olunmaktadır. Belirtilen proseslerde aksaklıkları gidermek için yapılan manipülasyonlarla izleyen dönemde oluşacak sıkıntıların önüne geçilebilmektedir. Bu bağlamda mevcut çalışmada 3-6 yaş aralığında multipar (birden fazla kez doğurmuş) 120 baş İsviçre Esmeri ırkı inek her grupta 30 inek olacak şekilde 4 gruba ayrılmıştır. Gruplardaki inekler postpartum 30. güne gelince Grup 1'deki ineklere intra uterin infuzyon yoluyla Sefapirin benzatin, Grup 2'deki hayvanlara intra uterin infuzyon yoluyla ozon, Grup 3'deki hayvanlara intra musküler olarak 25 mg prostaglandin F2α (dinoprost), Grup4'deki hayvanlara ise hiçbir uygulama yapılmamıştır, Tüm hayvanlara postpartum 60. günde Ovsynch Plus senkronizasyon yöntemi uygulanıp sabit zamanlı suni tohumla yapılmıştır. Tohumlamadan 35 gün sonra ultrasonografik yöntemle gebelik muayenesi yapılmıştır. Gruplarda sırasıyla 21,19,18 ve 16 tane gebelik elde edilmiştir. Gruplar arasında gebelik açısından istatistiki fark oluşmamıştır. Tüm bilgiler ışığında kullanımı sonrası komlikasyonların olmayışı ve düşük maliyetli olması sebebiyle gebeliğe katkı sağlamak için postpartum süreçte ozon ve prostaglandin F2α uygulamaları avantajlı gözükmektedir.

Anahtar Kelimeler: Fizyoloji, Gebelik, İnek, Postpartum, Süt, Verim

DETERMINATION OF THE EFFECTIVENESS OF DIFFERENT POSTPARTUM APPLICATIONS ON REPRODUCTION IN COWS

ABSTRACT

The postpartum period in cows is a period in which many metabolic and infectious diseases occur more frequently. For the success of reproduction in dairy farms, the postpartum process must be managed very well. In recent years, as the yield capacity of cows has increased, postpartum problems have increased accordingly. In order to eliminate this situation, examinations are carried out in different periods of postpartum. These examinations are sometimes performed to determine the presence of infection and sometimes to determine whether the puerperal physiology is functioning properly. 25-30 postpartum. examinations on days; It contributes to the fertility of the cow in the following period. With the examination performed in this period, very early information is obtained about postpartum physiological processes such as uterine involution, bacterial elimination and resumption of ovarian cyclic activity. With the manipulations made to eliminate the malfunctions in the specified processes, the problems that will occur in the following period can be prevented. In this context, in the current study, 120 heads of multiparous (cow that calving more than once) Swiss Brown cows between the ages of 3-6 were divided into 4 groups, with 30 cows in each group. When the cows in the groups come to the postpartum 30th day, the cows in Group 1 receive Cefapirin benzathine by intrauterine infusion, the animals in Group 2 receive ozone by intrauterine infusion, the animals in Group 3 receive 25 mg prostaglandin F2α (dinoprost) intramuscularly, the animals in Group 4 On the other hand, no application was made, Ovsynch Plus synchronization method was applied to all animals on postpartum 60th day and it was done with fixed time artificial insemination. Pregnancy examination was performed by ultrasonographic method 35 days after insemination. 21,19,18 and 16 pregnancies were obtained in the groups, respectively. There was no statistical difference between the groups in terms of pregnancy. In the light of all information, ozone and prostaglandin F2α applications in the postpartum period seem to be advantageous to contribute to pregnancy due to the absence of complications and low cost after use.

Keywords: Physiology, Pregnancy, Cow, Postpartum, Milk, Yield

ISLAMIC ECONOMIC PHILOSOPHY FOCUS: ISLAMIC ECONOMIC TRILOGY

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ABSTRACT

Purpose: This paper aims to explain the focus of Islamic economic philosophy: the trilogy of Islamic economics by formulating the following questions: first, what is Islamic economic theology, second, what is Islamic economic cosmology, third, what is Islamic economic anthropology? **Design/methodology/approach:** This paper uses a qualitative approach, because the data sources and research results are in library research, inductive data analysis, grounded theory (toward the direction of developing a theory based on data). Findings**:** first, theology is how religious belief (Islamic creed) can be used as a strength and motivation for development economy as a solution offer so that the Indonesian economy is brighter in facing a more promising future. In the paradigm that economic development uses the paradigm of the capitalist system which is essentially all the rules of people's life that are not taken from religion, but are fully left to humans, and what is seen as beneficial to themselves. This theological relationship with the economy can be understood and drawn from the essence of the doctrine of every religious teaching which requires its adherents to uphold virtue values in conducting business activities. Because, ethics can be interpreted as a source of action values in every aspect of plural human life. Besides that, this relationship can also be traced from how a religious teaching is considered to motivate the work ethic of business people The principles of economic theology are 1) Tawhid 2) Istikhlaf (Representative of Allah) 3) Ihsan 4) equality. Second, economic cosmology is "the science that views the universe as an integral whole." Can be interpreted. The meaning of cosmology is a systematic set of universal beliefs and views about humans and the universe, or in general regarding 'being' -there-(being). In Islamic Cosmology begins with the knowledge that the universe holds the key to the immortality of our souls. This view sees the cosmos as laden with meaning and purpose. which the cosmos veils and reveals by its own essence. The goal is for humans to understand the oneness of God Third, Islamic economic anthropology is the principle of monodualism and monopluralism in economic activity because the economy is part of human activity. In this stage, the economy is a monodual activity, meaning that it is not only a physical need but also a spiritual one. The

physical is part of the cosmos and the spiritual is part of theos. **Originality/value:** This paper describes comprehensively the focus of Islamic economics: Islamic economic theology.

Keywords: Islamic economic focus: Islamic economic theology, Islamic economic cosmology, Islamic economic anthropology

ONLINE BUYING AND SELLING TRANSACTIONS IN AN ISLAMIC PERSPECTIVE (CASE STUDY MH SKIN WHITENING)

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ABSTRACT

Purpose: This study aims to find out whether the implementation of online buying and selling transactions implemented by MH whitening skin is in accordance with an Islamic perspective. **Design/methodology/approach:** The method used in research is a qualitative approach with descriptive case studies. Case studies are qualitative research that seek to find meaning, investigate processes and gain insight and in-depth understanding of individuals, groups or situations. Data collection was carried out by interviewing informants in this study who were MH whitening skin agents. In addition, interviews were also conducted with several consumers. **Findings:** MH whitening skin is a beauty product for facial care, this product comes from Makassar. MH whitening skin has also expanded its wings to various international markets such as Singapore, Malaysia, America, Canada and Saudi Arabia. Many business people sell MH whitening skin products online, of course there are some business people who do not apply Islamic business ethics. The researcher found a complaint from an owner who said that there were several agents and resellers from other regions/cities who committed several violations, such as counterfeiting goods, prices that were not in accordance with the price list rules that had been set in each area. Because there were many elements of violations that occurred in the MH whitening skin business, researchers felt interested in further researching MH whitening skin online buying and selling transactions from an Islamic perspective. By looking at these problems, problems like this need to be considered, because in muamalah buying and selling is done with the values of justice avoiding elements of maisir, harmful gharar. **Originality/value:** This article describes comprehensively the violations committed by MH whitening agents and resellers

Keywords: Transaction, Satisfaction, implementation

ECONOMICS AND PHILOSOPHY OF CRITICISM: A CASE STUDY ABOUT THE DIVISION OF MATTRESS PRODUCTION IN KEDONDONG VILLAGE, SIDOARJODISTRICT

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ABSTRACT

Purpose: This papper aims to explain the economic potential in Sidoarjo Regency, especially in small industries, home industries, mattress production, and furniture production. In addition, this article also explains the importance of economics in achieving social welfare and its relationship with individual decision making in allocating resources. **Design/methodology/approaches:** This papper uses a qualitative approach with a case study typeof research. The selection of research subjects was carried out using a purposive sampling technique, namely eight families. Methods of data collection is done by using interviews, observation, and documentation. Data analysis was carried out through the stages of data reduction, data display, and verification as well as drawing conclusions. **Findings:** This papper has a relationship with economic philosophy because it raises basic concepts and questions in economics, such as individual decision making, resource allocation, andeconomic efficiency. Economic philosophy studies the principles and values that underlie economic theory, and tries to understand the philosophical assumptions associated with economicstudies. An understanding of economics and how resources are allocated efficiently is an important aspect that helps explain the economic concepts introduced. In addition, economic philosophy alsoinvolves ethical considerations and social values in an economic context. The philosophy of criticism regarding the flow of criticism which is a blend of rational and empirical schools which describes the economic situation of the regional autonomy of Sidoarjobecomes an event where the achievement of a maximum and advanced goal can be rationalized with human reason. Thus, this study brings elements of economic philosophy into discussions about economic potential in Sidoarjo Regency, which involves consideration of the values, ethics, and philosophical assumptions that underlie economics. **Originality/value:** This papper describes comprehensively the implementation of Islamic economic philosophy in Kedondong Village, Sidoarjo Regency.

Keywords: Critical Philosophy, Islamic Economic Philosophy, Implementation of Economic Philosophy

KIRSAL KALKINMADA KADIN KOOPERATİFLERİNİN ROLÜNÜN AYYILDIZ KADIN KOOPERATİFİ ÜZERİNDEN İNCELENMESİ

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ÖZET

Kırsal kalkınma, kırsal topluluklar için yaşam kalitesini artırmayı, sürdürülebilir tarımı teşvik etmeyi, istihdam fırsatları yaratmayı, yoksulluğu ve eşitsizliği azaltmayı hedeflemektedir. Bununla birlikte kırsal nüfusun refahının sağlanması ve kadın emeğinin öne çıkması açısından da kırsal kalkınma oldukça önemlidir. Kadın emeğinin görünür kılınmasında ve kadının ekonomiye dahil olmasında sivil toplum kuruluşları oldukça etkin role sahiptir. STK'lar hedef grupları, faaliyetleri ve projeleri ile kırsalda kalkınmanın sağlanmasında ve kırın kapasitesinin gelişmesinde temel aktörlerden biri olarak görülmektedir. Kadınlar, tarımsal ekonominin ve kırsal kalkınmanın sağlanmasında oldukça önemli bir yere sahiptir. Türkiye'de de tarım yapan ailelerde yapılacak işlerle ilgili kadın-erkek arasındaki görev dağılımında gelenekler ön plana çıkmaktadır. Ülkemizde kırsal alanın temel uğraşısı olan tarımsal üretimde kadın emeği %50'lere varan oranlarda rol oynamakta iken; erkeklerin ise genellikle sadece tarımsal işlerin belirli bir kısmını yaptığı görülmektedir. Buna karşın kadınlar, hem yeniden üretim hem de ailenin yaşamını devam ettirebilmesi için gereken tüm ihtiyaçları karşılamak için çalışmaktadır. Dayanışma ve iş birliğini amaçlayan kooperatifler ekonomik ve sosyal açıdan dezavantajlı grupların sorunlarını çözmek açısından önemli rol üstlenmektedirler. Kadın kooperatifleri de kadınların yoksulluğunun azaltılmasında ve kadınların güçlendirilmesinde önemli rol oynamaktadırlar. Bu çalışmanın amacı kırsal kalkınmada kadın emeğini ve kadın örgütlenmesinin mücadelesini kadınların ekonomik faaliyetlere katılımını teşvik eden bir kooperatif olan Ayyıldız Kadın Kooperatifi üzerinden değerlendirmektir. Çalışma nitel araştırma yöntemi kullanılarak hazırlanmıştır. Bu kapsamda kooperatifin kurucuları ile yarı yapılandırılmış mülakat görüşmesi yapılarak kooperatifin kurulma sürecinde kadınların ekonomiye katılmada yaşadığı zorluklar, örgütlenme çabaları ve kentteki diğer aktörlerle ve merkezi yönetim ile olan ilişkisi incelenecektir. Bununla birlikte çalışmada seçilen Ayyıldız Kadın Kooperatifi SWOT analizi üzerinden değerlendirilerek kooperatifin güçlü, zayıf yönleri, fırsatları ve tehditleri ortaya konulacaktır.

Anahtar Kelimeler: Kırsal Kalkınma, Kadın, Sivil Toplum Kuruluşları, Ayyıldız Kadın Kooperatifi

AN INVESTIGATION OF THE ROLE OF WOMEN'S COOPERATIVES IN RURAL DEVELOPMENT THROUGH AYYILDIZ WOMEN'S COOPERATIVE

ABSTRACT

Rural development aims to improve the quality of life for rural communities, promote sustainable agriculture, create employment opportunities, and reduce poverty and inequality. However, rural development is very important in terms of ensuring the welfare of the rural population and the prominence of women's labor. Non-governmental organizations have a very active role in making women's labor visible and women's inclusion in the economy. NGOs are seen as one of the main actors in ensuring rural development and developing rural capacity with their target groups, activities and projects. Women have a very important place in ensuring the agricultural economy and rural development. Traditions come to the fore in the distribution of duties between men and women regarding the work to be done in families engaged in agriculture in Turkey. While women's labor plays a role up to 50% in agricultural production, which is the main occupation of rural areas in our country; On the other hand, it is seen that men generally only do a certain part of agricultural work. On the other hand, women work to meet all the needs both for reproduction and for the continuation of the family. Cooperatives aiming at solidarity and cooperation play an important role in solving the problems of economically and socially disadvantaged groups. Women's cooperatives also play an important role in reducing women's poverty and empowering women. The aim of this study is to evaluate women's labor and the struggle of women's organization in rural development through Ayyıldız Women's Cooperative, a cooperative that encourages women's participation in economic activities. The study was prepared using the qualitative research method. In this context, semi-structured interviews will be conducted with the founders of the cooperative, and the difficulties experienced by women in participating in the economy during the establishment of the cooperative, their efforts to organize and their relationship with other actors in the city and the central government will be examined. In addition, the selected Ayyıldız Women's Cooperative in the study will be evaluated through SWOT analysis and the strengths, weaknesses, opportunities and threats of the cooperative will be revealed.

Keywords: Rural Development, Women, Cooperative, Ayyıldız Women's Cooperative

FARKLI KURUTMA YÖNTEMLERİYLE ELDE EDİLEN TRABZON HURMASI TOZUNUN, DONDURMANIN FİZİKOKİMYASAL VE DUYUSAL ÖZELLİKLERİNE ETKİSİNİN İNCELENMESİ

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ÖZET

Trabzon hurması (*Diospyros kaki)* ordu yöresinde bolca yetişen ve bölge ekonomisine katkıda bulunan bir meyvedir. Trabzon hurması meyvesi; askorbik asit, vitaminler (özellikle A ve E) ve fenolik bileşikler açısından zengin olmasının yanı sıra karbonhidratlar ve tanen içerikleri sebebiyle de oldukça önemli bir yere sahiptir. Çabuk bozulduğundan olgunlaşmasını takiben muhafazası önem arz etmektedir. Meyvelerin muhafazasında en çok kullanılan yöntemlerden biri kurutarak muhafaza yöntemidir. Meyvelere uygulanan kurutma işleminde sonra direk tüketilebildiği gibi başka gıda ürünlerine katılarak fonksiyonel ürünler elde edilebilmektedir. Dondurma, bu kuru meyve ve tozlarının rahatlıkla kullanılabileceği bir süt ürünüdür. Dondurma karbonhidrat, protein ve yağa ilaveten A, D, E, K, B1, B2, B6, B12 ve C vitaminlerini bünyesinde barındıran; demir, çinko, fosfor, potasyum, sodyum ve magnezyum minerallerini de içeren besleyici bir tatlıdır. Bu çalışmada, çabuk bozulabilen bu meyvenin muhafazasını sağlayarak dondurma üretiminde kullanılması ve dondurmanın fonksiyonel özelliğinin geliştirilmesi ile duyusal açıdan tercih edilebilirliğinin artırılması amaçlanmıştır. Ordu piyasasından temin edilen yeterli olgunluktaki Trabzon hurmalarının kabukları soyulmuş ve pulp haline getirilmiştir. Elde edilen pulp Liyofilize, Vakum etüv ve normal etüv olmak üzere üç farklı yöntemle kurutulmuştur. Kurutulmuş meyve tozları, ön denemelerle belirlenen dondurma miksine, %1, %3, %5 oranlarında olacak şekilde karıştırma aşamasında eklenmiştir. Üretilen dondurma örneklerinde kuru madde tayini, kül tayini, pH değerinin belirlenmesi, asitlik tayini, ilk damlama süresinin belirlenmesi, viskozite tayini, renk tayini ve duyusal analiz uygulanmıştır. Kurutma yöntemleri içinde Trabzon hurması meyvesinin turuncu renginin en ideal şekilde korunduğu yöntem liyofilize kurutma yöntemi olarak belirlenmiştir. İlk damlama süresi ve viskozite tayini sonuçlarına göre liyofilize kurutma yöntemiyle üretilen tozlarla üretilen dondurma örneklerinin stabilitesinin daha iyi olduğu, duyusal değerlendirme sonuçlarına göre de daha çok beğenildikleri belirlenmiştir. Tüm dondurma örneklerinde meyve tozu oranı arttıkça kuru madde oranı, kül oranı, asitlik oranı, ilk damlama süresi ve viskozite değerlerinin arttığı ve pH değerinin düştüğü belirlenmiştir.

Anahtar Kelimeler: Trabzon Hurması, Dondurma, Kurutma

INVESTIGATION OF THE EFFECT OF PERSIMMON POWDER OBTAINED BY DIFFERENT DRYING METHODS ON THE PHYSICOCHEMICAL AND SENSORY PROPERTIES OF ICE CREAM

ABSTRACT

Persimmon (*Diospyros kaki*) is a fruit that grows abundantly in Ordu and contributes to the economy of the region. Persimmon fruit; Besides being rich in ascorbic acid, vitamins (especially A and E) and phenolic compounds, it also has a very important place due to its carbohydrates and tannin contents. Since it spoils quickly, it is important to preserve it after maturation. Drying is one of the most widely used methods of preserving fruits. After the drying process applied to the fruits, they can be consumed directly, or by adding them to other food products, functional products can be obtained. Ice cream is a dairy product where these dried fruits and powders can be used easily. In addition to carbohydrates, protein and fat, ice cream contains vitamins A, D, E, K, B1, B2, B6, B12 and C; It is a nutritious dessert containing iron, zinc, phosphorus, potassium, sodium and magnesium minerals. In this study, it was aimed to use this perishable fruit in the production of ice cream by ensuring its preservation, and to improve the functional properties of ice cream and to increase its preferability in terms of sensory. Persimmons of sufficient maturity obtained from the Ordu market were peeled and pulped. The pulp obtained was dried by three different methods as Lyophilized, Vacuum Oven and Normal Oven. Dried fruit powders were added to the ice cream mix determined by preliminary experiments at the rate of 1%, 3%, 5% at the mixing stage. Determination of dry matter, ash, pH value, acidity, first dripping time, viscosity, color and sensory analysis were applied to the produced ice cream samples. Among the drying methods, the method in which the orange color of the persimmon fruit is preserved in the most ideal way has been determined as the lyophilized drying method. According to the results of the first dripping time and viscosity determination, it was determined that the stability of the ice cream samples produced with the powders produced by the lyophilized drying method was better and they were more appreciated according to the sensory evaluation results. It was determined that as the fruit powder ratio increased in all ice cream samples, dry matter ratio, ash ratio, acidity ratio, first dripping time and viscosity values increased and pH value decreased.

Keywords: Persimmon, Ice Cream, Drying

PRODUCTION OF COMBUSTIBLE FUELS AND CARBON NANOTUBES FROM PLASTIC WASTES USING AN IN-SITU CATALYTIC MICROWAVE PYROLYSIS PROCESS

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ABSTRACT

This study performed in-situ microwave pyrolysis of plastic waste into hydrogen, liquid fuel and carbon nanotubes in the presence of Zeolite Socony Mobil ZSM-5 catalyst. In the presented microwave pyrolysis of plastics, activated carbon was used as a heat susceptor. The microwave power of 1 kW was employed to decompose high-density polyethylene (HDPE) and polypropylene (PP) wastes at moderate temperatures of 400–450 °C. The effect of plastic composition, catalyst loading and plastic type on liquid, gas and solid carbon products was quantified. This in-situ CMP reaction resulted in heavy hydrocarbons, hydrogen gas and carbon nanotubes as a solid residue. A relatively better hydrogen yield of 129.6 mmol/g as a green fuel was possible in this process. FTIR and gas chromatography analysis revealed that liquid product consisted of C13+ fraction hydrocarbons, such as alkanes, alkanes, and aromatics. TEM micrographs showed tubular-like structural morphology of the solid residue, which was identified as carbon nanotubes (CNTs) during X-ray diffraction analysis. The outer diameter of CNTs ranged from 30 to 93 nm from HDPE, 25–93 nm from PP and 30–54 nm for HDPE-PP mixture. The presented CMP process took just 2–4 min to completely pyrolyze the plastic feedstock into valuable products, leaving no polymeric residue.

Keywords: Plastic Wastes, CNT, HDPE

K.H. ABDURRAHMAN WAHID (GUS DUR): ISLAM AND PEOPLE'S ECONOMY (CASE STUDY: WADAS RESIDENTS RECEIVE LAND ACQUISITION, COMPENSATION PAYMENTS REACH 92 PERCENT

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ABSTRACT

Purpose: This case study aims to explain how economic thinking according to K.H. Abdurrahman Wahid (Gus Dur) where he grew up among the students and fought with the people. This background shaped most of his economic thinking, including when he became president. He prefers to use the term "people's economy" rather than "populist economy" to ensure that what is happening on the ground is an economic movement that is controlled and carried out by the (small) people. For example, when deciding to acquire land for an infrastructure development project, the government must first talk to the affected land owners and local communities. In addition, the government must provide fair compensation and consider other alternatives that can provide balanced benefits for the whole community. By formulating the following questions: first, how is the application of people's economic theory according to Gus Dur? Second, what is the purpose of the people's economic theory according to Gus Dur? Third, how is the settlement of land acquisition according to Gus Dur?. **Design/methodology/approach:** This article uses a qualitative approach, with the type of research in the form of case studies (Case Studies). The data source in the research was generated from Library Research, with data analysis techniques, namely literature studies. **Findings:** First, the application of people's economic theory according to Gus Dur, namely an economic concept that focuses on the welfare of the common people or the less fortunate. Gus Dur was of the opinion that the people's economy must be able to create jobs, reduce social inequality, and improve people's quality of life. Some of the implementation of the people's economy according to Gus Dur include: Building cooperatives as a form of people's economy, Developing agriculture as the main sector in the people's economy, Developing small and medium industries (IKM) as part of the people's economy. Providing easy and affordable access to finance for small communities through programs such as People's Business Credit (KUR), Improving the quality of education and community skills through affordable training and education programs so that they can be better prepared and competent in facing global competition, and Encouraging development tourism based on local culture. Second, the goal of the people's economy according to Gus Dur is to build an economic system that is just and democratic, where the rights and interests of small communities can be accommodated and

protected, Encouraging the development of human resources and community skills through education and training programs, so that they can compete economically health in the global market, and increasing the independence and empowerment of small communities in managing local economic resources such as agriculture, fisheries and forestry. Third, the settlement of land acquisition according to Gus Dur is by prioritizing dialogue, consultation and prioritizing the participation of local communities before making decisions that affect them. So that it can ensure that the policy does not harm the community and provides balanced benefits for the whole community. **Originality/value:** This case study describes comprehensively the economic thinking of K.H. Abdurrahman Wahid (Gus Dur) where he uses the theory of populist economics which can be implemented in cases of small community land acquisition.

Keywords: Gus Dur's Thoughts, People's Economy, Land Acquisition

ROLE OF NIN-LIKE PROTEIN DOWN-REGULATION IN REGULATING NODULE FORMATION AND DEVELOPMENT IN COMMON BEAN

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ABSTRACT

NIN-Like Proteins (NLPs) are a family of transcription factors known to exert a significant influence on the nitrate signaling pathway by facilitating the activation of downstream target genes. Consequently, they play a crucial role in the primary response to nitrate within the nucleus. While previous studies have identified 12 members of the NLP family in *Phaseolus vulgaris*, however, their specific functions are not yet fully comprehended. Therefore, the objective of this study was to investigate and characterize the function of the *NLP4* gene to understand its impact on the development and phenotype of Phaseolus vulgaris nodule formation. To accomplish this, a 256 bp segment from the non-conserved 3´UTR regionwas selected and amplified using P. vulgaris root cDNA. Subsequently, was cloned into the RNAi binary vector through Gateway cloning technology. The resulting construct, named PvNLP4-RNAi, was then transformed into *Agrobacterium rhizogenes* K599 to generate transgenic hairy roots. An empty vector was utilized as the control. The transgenic roots were identified and selected using a fluorescent stereomicroscope based on the GFP marker. Then, the plants were inoculated with *Rhizobium tropici* for nodule formation. In this study, we noticed a remarkably low occurrence of infection events in the roots with PvNLP-RNAi at 10 dpi. Furthermore, we observed a significant decrease in the number of nodules compared to the control roots at 28 dpi. The quantitative data clearly demonstrates a reduction in size and weight of the RNAi nodules. Moreover, we exclusively observed the formation of nodule primordia in the transgenic roots, which did not fully develop in the process, while no such observations were made in the control group. The nodule anatomy provides evidence supporting the limited infection of rhizobium. Overall, this study concludesthat NLP4 plays a crucial role in the formation and establishment of nodules in bean plants. We thank PAPIIT-UNAM for partially financing this research for grant no. IN216321 to K.N andIN216321 to M.K.A.

Keywords: *NLP4*, Nodules, *Phaseolus vulgaris*

GÜNEŞ ENERJİSİNDE KURUTULMUŞ ARONYANIN KURUTMA KİNETİĞİ VE KALİTE ANALİZİ

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ÖZET

Aronya veya siyah chokeberry (Aronia melanocarpa), beslenme özellikleri ve biyoaktif bileşenleri nedeniyle insan sağlığı açısından giderek daha fazla önem kazanmaktadır. Öte yandan, çok çeşitli ürünlere işlenmesinde önemli bir hammaddedir ve bilimsel incelemeye göre oldukça etkili kimyasal bileşime sahip tıbbi bitki olarak sınıflandırılmaktadır. Bu araştırmada temel amaç, güneş enerjili sistemde kurutulmuş aronyanın kurutma kinetikleri ve kalite özelliklerinin belirlenmesidir. Aronya meyveleri Tekirdağ Bağcılık Araştırma Enstitüsünde kurulu bulunan güneş enerjili bir kurutma sisteminde 2022 yılı Ekim ayında kurutulmuştur. Kurutma denemelerinde elde edilen verilere göre; kurutulan örneklerin ortalama nem değeri, 85.5 saatin sonunda %68'den %10,5'e düşmüştür. Taze ve kurutulmuş örneklerde yapılan kalite analizlerinde sırasıyla; toplam tanen miktarı 21,14 g TA/kg ve 22,45 g TA/kg; toplam fenolik madde miktarı 17627,27 mg GAE/kg ve 19572,42 mg GAE/kg; toplam antosiyanin madde miktarı 4790,41 (siyanidin-3-glikozid) mg/kg ve 1916,83 (siyanidin-3-glikozid) mg/kg; toplam antioksidan aktivite değeri ortalama 35,31 mM troloks/g ve 72,90 mM troloks/g olarak tespit edilmiştir. Renk değerleri ölçümü sonuçlarına göre taze örneklerin L, a ve b değerleri kurutmadan sonra azalmıştır. Elde edilen sonuçlara göre, güneş enerjili kurutucuda kurutulmuş aronya meyvelerinde taze ürüne göre toplam fenolik, toplam tanen ve antioksidan aktivite değerleri yükselmiştir. Buna karşın aronya meyveleri kurutulduktan sonra taze ürüne göre toplam antosiyanin değeri ve renk değerleri azalmıştır.

Anahtar Kelimeler: Aronya, güneş enerjili kurutucu, kurutma kinetiği, kalite değerleri

DRYING KINETICS AND QUALITY ANALYSIS OF ARONIA DRIED IN AN SOLAR DRYER

ABSTRACT

Aronia or black chokeberry (Aronia melanocarpa) is gaining more importance for human health due to its nutritional properties and bioactive components. On the other hand, it is an important raw material in the processing of a wide variety of products and is classified as a medicinal plant with highly effective chemical composition according to scientific review. The main purpose of this research is to determine the drying kinetics and quality properties of aronia dried in the solar system. Aronia fruits were dried in October 2022 in a solar drying system installed in Tekirdağ Viticulture Research Institute. According to the data obtained in the drying trials; The average moisture value of the dried samples decreased from 68% to 10.5% at the end of 85.5 hours. In the quality analyzes made on fresh and dried samples, respectively; total tannin content is 21.14 g TA/kg and 22.45 g TA/kg; total amount of phenolic substances 17627.27 mg GAE/kg and 19572.42 mg GAE/kg; total amount of anthocyanin substance 4790.41 (cyanidin-3-glycoside) mg/kg and 1916.83 (cyanidin-3-glycoside) mg/kg; total antioxidant activity value was determined as 35.31 mM trolox/g and 72.90 mM trolox/g. According to the results of color values measurement, L, a and b values of fresh samples decreased after drying. According to the results, total phenolic, total tannin and antioxidant activity values increased in aronia fruits dried in solar dryer compared to fresh product. On the other hand, after drying aronia fruits, the total anthocyanin value and color values decreased compared to the fresh product.

Keywords: Aronia, solar dryer, drying kinetics, quality values

WORK RELATED STRESS, BURNOUT, JOB SATISFACTION AND SUBJECTIVE HAPPINESS AMONG EMPLOYEES WORKING IN TEXTILE INDUSTRY

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ABSTRACT
The major purpose of the current study was to investigating the relationship between Effects of Job-related Stress, Burnout, Job Satisfaction and Happiness in employees working at textile industry. After the detail review of the literature following hypotheses were formulated. 1) There would be significant relationship between Effects of Job-related Stress, Burnout, Job Satisfaction and Happiness in employees working at textile industry. 2) Job-related Stress would predict Burnout, Job Satisfaction and Happiness in employees working at textile industry. Sample of this study was consisted of total 300 employees working at textile office sites from major industrial cities of Pakistan. Data was collected from different textile sectors located in Lahore, Karachi and Faisalabad –Pakistan through Purposive sampling. For this study Job Satisfaction Scale (Spector, 1985), Oldenburg Burnout Inventory (Demerouti & Bakker, 2008), the Brief Job Stress Questionnaire (Ministry of Health, Labor and Welfare, Japan. 2015) and Subjective Happiness scale (Lyubomirsky & Lepper, 1999) were used. Data was analyzed by using SPSS-23 version. Descriptive and inferential statistics including t Pearson correlation, linear regression and t-test analysis was used to calculate the results of this study. Both hypotheses of this study were approved (P>0.05). The limitations, implementations, recommendations and suggestions of the study are also mentioned.

Keywords: Job Stress, Burnout, Job Satisfaction, Happiness, Textile Employees

TAZE VE KURUTULMUŞ BEYAZ DUTUN (*Morus alba* L.) KALİTE ÖZELLİKLERİNİN KARŞILAŞTIRILMASI

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ÖZET

Bu çalışma beyaz dut (*Morus alba* L.) meyvelerinin taze ve kurutulmuş tüketim şekilleri arasındaki biyokimyasal değişimlerini belirlemek amacıyla yürütülmüştür. Çalışmanın bitkisel materyali Samsun İli İlkadım ilçesindeki bir üretici bahçesinden temin edilmiştir. Kurutma işlemi, meyvelerin nem içeriği yaklaşık %15'e ulaşana kadar 70°C sıcaklıkta fanlı bir kurutucu kullanılarak gerçekleştirilmiştir. Çalışmada, suda çözünebilir kuru madde içeriği (SÇKM), titre edilebilir asit (TA), toplam fenolik, toplam flavonoid ve antioksidan aktivitesi (DPPH ve FRAP) gibi kalite özellikleri incelenmiştir. Yapılan analizler neticesinde kurutmanın meyve kalitesi üzerine önemli etkisi bulunmuştur. Taze meyvelerde SÇKM içeriği taze meyvelerde %18.00 olarak bulunurken, kuru meyvelerde %71.96'ya yükselmiştir. Taze ve kurutulmuş meyvelerin TA miktarı ise sırasıyla; %0.32 ve %1.42 olarak ölçülmüştür. Taze meyvelerde toplam fenolik içerik 123.3 mg GAE kg^{-1}, toplam flavonoid içerik 56.5 mg QE kg^{-1} olarak belirlendi. Kuru meyvelerde ise toplam fenolik içerik 299.0 mg GAE kg^{-1}, toplam flavonoid içerik ise 66.7 mg QE kg^{-1} olarak ölçüldü. Antioksidan aktiviteler açısından FRAP aktivitesi taze meyvelerde 1674 mmol TE kg^{-1}, kuru meyvelerde 3918 mmol TE kg^{-1} olarak belirlenmiştir. DPPH aktivitesi ise taze meyvelerde 434.6 mmol TE kg^{-1}, kuru meyvelerde 571.6 mmol TE kg^{-1} olarak ölçüldü. Sonuçlar kurutmanın biyoaktif içerikler üzerine olumlu etkisinin olduğunu göstermiştir. Bu araştırma, taze ve kurutulmuş beyaz dutların biyokimyasal içeriğinin ve antioksidant aktivitesinin değişimini açıkça ortaya koymaktadır.

Anahtar Kelimeler: Antioksidan, *Morus alba* L., SÇKM, Toplam fenol, Toplam flavonoid

COMPARISON OF THE QUALITY CHARACTERISTICS OF FRESH AND DRIED WHITE MULBERRY (*Morus alba* L.)

ABSTRACT

This study was carried out to determine the biochemical changes between fresh and dried consumption patterns of white mulberry (*Morus alba* L.) fruits. The plant material of the research was obtained from a producer garden in İlkadım district, Samsun. The drying process was carried out using a fan dryer at a temperature of 70°C until the moisture content of the fruits reached approximately 15%. In the study, the quality characteristics of soluble solids content (SSC), titratable acid (TA), total phenolic, total flavonoid and antioxidant activities (DPPH and FRAP) were investigated. As a result of the analysis, the effect of drying on fruit quality was found to be significant. The SSC content was found to be 18.00% in fresh fruits, whereas in dried fruits, it increased to 71.96%. The TA amount of fresh and dried fruits are respectively; It was measured as 0.32% and 1.42%. In fresh fruits, the total phenolic content was determined as 123.3 mg GAE kg^{-1}, and the total flavonoid content was 56.5 mg QE kg^{-1}. On the other hand, in dried fruits, the total phenolic content was measured as 299.0 mg GAE kg^{-1}, while the total flavonoid content was 66.7 mg QE kg^{-1}. In terms of antioxidant activities, the FRAP activity was determined as 1674 mmol TE kg^{-1} for fresh fruits and 3918 mmol TE kg^{-1} for dried fruits. The DPPH activity, on the other hand, was measured as 434.6 mmol TE kg^{-1} for fresh fruits and 571.6 mmol TE kg^{-1} for dried fruits. The results showed that the drying process of white mulberry fruit has a positive effect on the bioactive contents. This research clearly reveals the change of biochemical content and antioxidant activity of fresh and dried white mulberries.

Keywords: Antioxidant, *Morus alba* L., SSC, Total phenol, Total flavonoid

ABLATION METHODS FOR PREVENTING ATRIAL FIBRILLATION: A REVIEW

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ABSTRACT

Objectives: The primary objective of this systematic review and pooled analysis was to determine how many atrial fibrillation ablation procedures exist and how many of them are currently in use. Methods: Cardiac ablation can be performed through two distinct methods: catheter ablation utilising radiofrequency for heat cauterization and cryoablation for freeze cauterization. There are several types of radiofrequency ablation techniques available today. These include radiofrequency ablation with a pulse, radiofrequency ablation with water cooling, and cryoneurolysis. Cryoablation is a procedure that uses a balloon catheter to disable the heart cells responsible for an irregular pulse in order to restore normal cardiac rhythm. Recently, the Pulsed Field Ablation (PFA) technique has been introduced. PFA is a non-thermal ablative mechanism that influences the destabilisation of ultrarapid electric fields. This allows ablation treatments to be completed in a shorter time and the risk of damage to neighboring tissues is reduced. Results: More than 75,000 ablation treatments are done annually in the United States to treat individuals with atrial fibrillation. In Europe, almost 50 000 catheter ablations are done each year. Ablation type, procedure cost, and success rate are included in the below table.

Table: Ablation Specifications

S. No	Type of Ablation	Treatments Covered	Procedure Cost	Success Rate
1	Catheter Ablation	United States	12,000 US	90%
2	Pulsed Field Ablation	24 European centres	36463.57 Euro	99.9%

Conclusion: According to our review experience, utilising the PFA for atrial fibrillation ablation is safe, quick, and simple to learn.

Keywords: Atrial Fibrillation Ablation, Catheter Ablation, Pulsed Field Ablation

KANGAL IRKI KOYUNLARDA METACARPUS KIRIKLARINDA M.I.P.O TEKNİĞİNİN UYGULANMASI

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ÖZET

Veteriner hekimlikte kırık tedavisinde plak osteosentezi oldukça fazla uygulanmaktadır. Kırık iyileşmesinde, minimal invaziv plak ile osteosentez (M.I.P.O) tekniğinin kontaminasyon riskini azalttığı, fonksiyonun daha hızlı geri döndüğü, kan akışının korunması ile daha hızlı kaynama ve iyileşme şekillendiği çalışmalarla ortaya konulmuştur. Çalışma materyalini 1 yaşında kangal ırkı iki koyun oluşturdu. Koyunlarda yapılan klinik ve radyolojik değerlendirmeler sonrasında her iki koyunda da metacarpusların diyafiz seviyesinde olgu no 1 de parçalı, olgu no 2 de transversal kırık tespit edildi. Kırıklara M.I.P.O tekniğinin uygulanmasına karar verildi. Koyunların her ikisine de 0.2 mg/kg dozda xylazine'in intramuskuler enjeksiyonunu takiben 20 mg/kg dozda ketamin HCL intramuskuler yolla uygulanarak genel anesteziye alındı. Bölgenin kılları uzaklaştırıldıktan sonra bölgeye asepsi antisepsisi uygulandı, bölge daha sonra steril örtülerle kapatıldı. Kırık hattının proksimal ve distaline, kemiğin proksimal ve distalindeki eklemlere yakın bir düzeyden 2 cm uzunluğunda cranial yüzeyden ensizyon yapıldı. Derialtı dokular kuralına uygun şekilde diseke edilerek, her iki düzeyde de kemiğe ulaşıldı. Kırık hattına elle manipülasyon yapılarak kırığın redüksiyonu sağlanmaya çalışıldı. Olgu no 1 için 3.5 mm'lik 7 delikli DCP plak, olgu no 2 için 3,5 mm'lik 8 delikli DCP plak seçildi. Plaklar distalde yapılan ensizyon hattından kemiğin anterior yüzeyine temas edecek şekilde distalden proksimale doğru uygulandı. Her iki düzeyde de plak kemiğin anterior yüzeyine ortalandıktan sonra hem proksimalde hem distalde 2 adet 3,5 mm'lik kortikal vidalarla fiksasyonu gerçekleştirildi. Bölge rutin şekilde kapatıldı. Postoperatif antibiyoterapi 1 hafta boyunca uygulandı. Postoperatif 10., 21., 30. ve 45. gün radyografileri çift yönlü olarak alındı. Postoperatif 55. günün sonunda her iki olguda da klinik iyileşme gözlendi. Kangal ırkı koyunlarda yapılan bu çalışmada, koyunlarda ilk defa uygulanan M.I.P.O. tekniğinin klinik ve radyolojik sonuçlarının değerlendirilmesi amaçlanmıştır.

Anahtar Kelimeler: Kangal koyunu, kırık, minimal invazif plak osteosentezi

APPLICATION OF M.I.P.O TECHNIQUE IN METACARPUS FRACTURES IN KANGAL SHEEP

ABSTRACT

Plate osteosynthesis is widely used in the treatment of fractures in veterinary medicine. Studies have shown that minimally invasive plate and osteosynthesis (M.I.P.O) technique in fracture healing reduces the risk of contamination, returns function faster, and provides faster union and healing with preservation of blood flow. The study material consisted of two 1-year-old Kangal sheep. After clinical and radiological evaluations in sheep, comminuted fractures in case no 1 and transversal fractures were detected in case no 2 at the diaphysis level of the metacarpus in both sheep. It was decided to apply the M.I.P.O technique for the treatment of fractures. After intramuscular injection of 0.2 mg/kg dose of xylazine HCL to both sheep, 20 mg/kg dose of ketamine HCL was administered intramuscularly to general anesthesia. After the hairs were removed, the area was covered with sterile drapes in accordance with the rules of asepsis and antisepsis. A 2 cm long incision was made from the cranial surface, proximal and distal to the fracture line, close to the joints proximal and distal to the bone. The subcutaneous tissues were dissected in accordance with the rule, and the bone was reached at both levels. Reduction of the fracture was attempted by manual manipulation of the fracture line. A 3.5 mm 7-hole DCP plate was selected for case number 1, and a 3.5 mm 8-hole DCP plate was selected for case number 2. Plates were applied from distal to proximal in contact with the anterior surface of the bone from the distal incision line. After the plate was centered on the anterior surface of the bone at both levels, its fixation was performed with two 3.5 mm cortical screws both proximal and distal. The area was routinely closed. Postoperative antibiotic therapy was administered for 1 week. Postoperative 10th, 21st, 30th and 45th day radiographs were taken bilaterally. At the end of the postoperative 55th day, clinical improvement was observed in both cases. In this study conducted in Kangal sheep, M.I.P.O. It was aimed to evaluate the clinical and radiological results of the technique.

Keywords: Kangal sheep, fracture, minimally invasive plate osteosynthesis

THE PHILIPPINE EAGLE: A MAJESTIC BUT ENDANGERED RAPTOR

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ABSTRACT
The Philippine eagle (*Pithecophaga jefferyi*) is a spectacular and rare bird of prey endemic to the Philippines. It inhabits the remaining fragments of tropical rainforest on four major islands and is the national bird of the country. However, this magnificent raptor is critically endangered due to habitat loss, hunting, and human persecution. This review paper examines the biology, ecology, and conservation status of the Philippine eagle. Its distinctive features, such as its large size, powerful talons, long crest, and blue-gray eyes, are described. Its diet, which consists mainly of monkeys, flying lemurs, civets, and other arboreal mammals, is discussed. Its unique breeding behavior, which involves a monogamous pair bond, a long courtship period, and a single egg clutch every two years, is highlighted. The challenges and opportunities for its conservation, such as the establishment of protected areas, captive breeding programs, community education campaigns, and international collaborations, are explored. The paper concludes that the Philippine eagle is a remarkable but critically endangered species that deserves more attention and support from both local and global stakeholders.

Keywords: Philippine eagle; *Pithecophaga jefferyi;* conservation; habitat loss; hunting

GIDA SANAYİNDE KULLANILAN BAZI MEYVELERİN ATIK ÇEKİRDEKLERİNİN VE ÇEKİRDEK YAĞLARININ KİMYASAL İÇERİĞİNİN BELİRLENMESİ

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ÖZET

Gerek Türkiye'de gerekse Dünya genelinde gıda endüstrisinde kivi, kızılcık ve kuşburnu meyvelerinin kullanımı artmaktadır. Bu meyveler genellikle, meyve suyu endüstrisinde ve kozmetik sektöründe kullanılmakta ve çekirdekleri atık madde olarak açığa çıkmaktadır. Hem açığa çıkan atık maddelerden azami ölçüde faydalanmak hem de potansiyel fonksiyonel ürün elde edilmesi önem arz etmektedir. Bu çalışmada Ordu ve çevre illerde bolca yetiştirilen Kivi, kızılcık ve kuşburnu meyvelerinin çekirdekleri kullanılmıştır. Öğütme işlemi uygulanan meyve çekirdeklerinin kuru madde oranı, yağ oranı, kül oranı belirlenmiş ve elde edilen yağların antioksidan aktivitesi ile yağ asidi kompozisyonu belirlenmiştir. Kivi, kızılcık ve kuşburnu çekirdeklerinin kuru madde oranları sırasıyla %93.88±0.15, %82.58±0.02 ve %89.11±0.03, kül oranları sırasıyla %2.53±0.04, %1.3±0.01 ve %1.95±0.03, yağ oranları sırasıyla %31.30±0,72, %9.54±0.12 ve %7.8±0.1 olarak belirlenmiştir. Değerler incelendiğinde kivi çekirdeğinin kuru madde, yağ ve mineral madde bakımında daha zengin olduğu görülmekle beraber meyve-çekirdek oranının düşük olması dezavantajıdır. Elde edilen yağlarda DPPH yöntemi ile antioksidan aktivite tayini yapılmış ve % inhibisyon değerleri sırasıyla %66.33±1.27, %18.74±0.63 ve %61.38±3.11 olarak tespit edilmiştir. Örneklerin yağ asidi kompozisyonları incelendiğinde palmitik asit ve stearik asit değerlerinin birbirine yakın olduğu belirlenmiştir. Kızılcık yağındaki yağ asitleri incelendiğinde cis-oleik asit oranının (%60.79) yüksek olduğu görülmekte, bunu cis-linoleik asit (%28.93) takip etmektedir. Kivi yağındaki yağ asitleri incelendiğinde ise en yüksek oran linolenik asitte (%63.64) belirlenirken bu değeri cis-linoleik (%14.24) ve cis-oleik asit (%12.39) takip etmektedir. Kuşburnu yağıdaki yağ asitleri incelendiğinde en yüksek yağ asidi cis-linoleik asit (%41.59) olarak belirlenirken bunu cis-oleik asit (%31.71) ve linolenik asit (%17.80) takip etmektedir.

Anahtar Kelimeler: Atık Meyve Çekirdeği, Yağ, Antioksidan, Yağ Asidi Kompozisyonu

DETERMINATION OF THE CHEMICAL CONTENT OF WASTE SEEDS AND SEED OILS OF SOME FRUITS USED IN THE FOOD INDUSTRY

ABSTRACT

The use of kiwi, cranberry and rosehip fruits in the food industry is increasing both in Turkey and around the world. These fruits are generally used in the fruit juice industry and cosmetics industry, and their seeds are released as waste material. It is important both to make maximum use of the waste materials and to obtain potential functional products. In this study, the seeds of kiwi, cranberry and rosehip fruits grown abundantly in Ordu and surrounding provinces were used. Dry matter ratio, oil ratio, ash ratio of the fruit seeds applied to the grinding process were determined and the antioxidant activity and fatty acid composition of the obtained oils were determined. Dry matter ratios of kiwi, cranberry and rosehip seeds were determined as 93.88±0.15%, 82.58±0.02% and 89.11±0.03%, ash ratios were determined as 2.53±0.04%, 1.3±0.01% and 1.95±0.03%, fat ratios were determined as 31.30±0.72%, 9.54±0.12 and 7.8±0.1%, respectively. When the values are examined, it is seen that the kiwi seed is richer in terms of dry matter, oil and mineral matter, but its disadvantage is that the fruit-seed ratio is low. Antioxidant activity was determined by DPPH method in the obtained oils and the % inhibition values were determined as 66.33±1.27%, 18.74±0.63% and 61.38±3.11%, respectively. When the fatty acid compositions of the samples were examined, it was determined that palmitic acid and stearic acid values were close to each other. When the fatty acids in cranberry oil are examined, it is seen that the cis-oleic acid ratio (60.79%) is high, followed by cis-linoleic acid (28.93%). When the fatty acids in kiwifruit were analyzed, the highest rate was determined in linolenic acid (63.64%), followed by cis-linoleic (14.24%) and cis-oleic acid (12.39%). When the fatty acids in rosehip oil were examined, the highest fatty acid was cis-linoleic acid (41.59%), followed by cis-oleic acid (31.71%) and linolenic acid (17.80%).

Keywords: Waste Fruit Seed, Fat, Antioxidant, Fatty Acid Composition

COMPREHENSIVE ANALYSIS OF *PHASEOLUS VULGARIS* CYC GENE FAMILY AND THEIR EXPRESSION DURING RHIZOVIAL SYMBIOSIS

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ABSTRACT
The Cyclin Gene Family (CYC) is important in regulating the cell cycle in eukaryotes, as they encode proteins that function as regulators of cyclin-dependent kinases (*CDKs*), which in turn regulate the progression of the cell cycle. The plant cyclin proteins active while cell division that results in formation of new organs and tissues. Unlike the other plants, the legumes also form a specialized organs called root nodules. However, knowledge about the symbiosis specific *CYCs* are poorly understood. In this study, we identified 51 members of *CYCs* in *Phaseolus vulgaris* genome. The phylogenetic analysis shows two major clades of *CYCs*. Among the 11 chromosomes, maximum *CYCs* were found on chromosome 9 and minimum on chromosome 6 whereas, no *CYCs* were located on chromosome 4 of *Phaseolus*. Next, the gene structural analysis shows a divergence in exon numbers ranging from 2 to 22 demonstrating loss and gain of exons during evolution. When 2kb promoter was analyzed for *cis* regulatory elements, we found 90% of *cis* elements are growth and development, 9% hormonal regulation and 1% light-responsive elements. The conserved protein motifs show 3 main groups, with 33 genes in group 1, group 2 abundant in all genes, and group 3 found in 37 genes. Finally, we identified key *Rhizobium* induced cyclin genes that are essential for nodule formation in *Phaseolus*. Together, our data show that *CYCs* plays a vital role in the induction of meristematic activity in root cortical cells and in the establishment of nodule primordia during *Phaseolus-Rhizobium* symbiosis. We thank the PAPIIT-UNAM for partially financing this research for grant no. IN216321 to K.N and IN213221 to M.K.A.; and CONACyTCF-316538 to M.-K.A.

Keywords: CYC, *Phaseolus vulgaris*, genome-wide analysis, symbiosis

HATAY İLİNDEKİ ARICILIK İŞLETMELERİNDE HASTALIK VE ZARARLILARDAN KORUNMA YÖNTEMLERİ İLE İLGİLİ ARICILARIN TUTUM VE DAVRANIŞLARI ÜZERİNE BİR ARAŞTIRMA

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ÖZET

Ilıman iklimin hüküm sürdüğü Hatay yöresi, narenciye bahçeleri ve farklı türdeki kültür bitkileriyle zengin bir flora ve vejatasyona sahiptir. Sahip olduğu bu özellikleriyle arıcılık için son derece uygun olan bu bölge, ayrıca gezginci arıcıların yoğun olarak tercih ettikleri önemli kışlatma alanlarından birisidir. Gezginci arıcılık faaliyetlerinin fazla olması yörede koloni giriş çıkışının yoğunluğunu artırmaktadır. Bu durumda bulaşıcı arı hastalık ve zararlıları koloniler arasında yayılma imkânı bulmaktadır. Bu çalışma, Hatay ilindeki arıcılık işletmelerinde hastalık ve zararlılardan korunma yöntemleri ile ilgili arıcıların tutum ve davranışlarının belirlenmesi amacıyla 2022 yılı Mart ayında yapılmıştır. Bu amaçla Hatay ilinin 5 ilçesinde toplam 62 arı yetiştiricisine anket çalışması yapılmıştır. Anket sonucunda elde edilen verilere göre; arı hastalık ve zararlıları ile mücadelede işletmelerin %37'si tarım il-ilçe müdürlüklerine, %24'ü tecrübeli arıcılara, %15'i üniversitelere müracaat ederken, %24'ü hiçbir yere müracaat etmemiştir. Kışa girerken işletmelerin %29'u kovanda nem önleyici tedbirler alırken, %71'i tedbir almadıklarını beyan etmiştir. Kışlatma kayıplarının %50'sinin ana arı kaybından, %35'inin hastalık ve zararlılardan, %15'inin ise diğer sebeplerden ileri geldiği bildirilmiştir. Kışa girerken işletmelerin yarısından fazlasının (%55'inin) kovan içerisine yaklaşık olarak 11-15 kg, %35'inin 6-10 kg ve %10'unun 16-20 kg arasında bal bıraktıkları belirlenmiştir. Zayıf ve güçlü koloniler arasında çerçeve değişimi yapan ve yapmayan işletmelerin oranları birbirlerine yakın olup sırasıyla %52 ve %48'dir. Benzer şekilde, kovanların ve kullanılan diğer arıcılık malzemelerinin dezenfeksiyonunu (asetik asit) yapan ve yapmayan işletmeler sırasıyla %48 ve %52 oranlarıyla birbirlerine yakın tespit edilmiştir. Varroosis hastalığına karşı işletmelerin %87'si Rulamit-VA'yı kullanırken, %13'ü Perizin kullandıklarını belirtmişlerdir. Yavru çürüklüğü hastalıklarına karşı %71'i Terramycin kullandıklarını bildirirken, %29'u hiç ilaç kullanmadıklarını beyan etmişlerdir. İşletmelerin %48'i nosemosis hastalığına karşı bitkisel ürün (kekik, sarımsak, nane vb.), %18'i Fumidil-B, %8'i sirke kullanırken, %26'sı hiç ilaç kullanmadıklarını belirtmişlerdir. Bu çalışmadan elde edilen sonuçlara göre, kışlatma kayıplarının en önemli sebepleri sırasıyla anasızlık ile hastalık ve zararlılardır. Ayrıca zayıf ve güçlü koloniler arasında çerçeve değişimi yapan işletmeler ile, kovan ve diğer arıcılık malzemelerinin dezenfeksiyonu yapmayan işletmelerin oranı yaklaşık %50'dir. Sonuç olarak, işletmelerin ana arıyı kontrol etme, arı hastalık ve zararlılarıyla etkili mücadele yapma ve koruyucu önlemler almada eksikliklerinin olduğu saptanmıştır.

Anahtar Kelimeler: Hatay, Arıcılık İşletmesi, Hastalık ve Zararlılar, Anket

A RESEARCH ON THE ATTITUDES AND BEHAVIORS OF BEEKEEPERS REGARDING THE METHODS OF PROTECTION FROM DISEASE AND PESTS IN BEEKEEPING ENTERPRISES FACILITIES IN HATAY PROVINCE

ABSTRACT

Hatay region, where temperate climate prevails, has a rich flora and vegetation with citrus groves and different kinds of cultivated plants. This region, which is extremely suitable for beekeeping with these features, is also one of the important wintering areas preferred by migratory beekeepers. The high number of migratory beekeeping activities increases the density of colony entry and exit in the region. In this case, infectious bee disease and pests find the opportunity to spread between colonies. This study was carried out in March 2022 in order to determine the attitudes and behaviors of beekeepers regarding the methods of protection from disease and pests in beekeeping enterprises in Hatay province. For this purpose, a survey study was conducted with a total of 62 beekeepers in 5 districts of Hatay province. According to the data obtained as a result of the survey; In the fight against bee disease and pests, 37% of the enterprises applied to the provincial-district directorates of agriculture, 24% to experienced beekeepers, 15% to universities, while 24% did not apply to any place. While entering the winter, 29% of the enterprises took measures to prevent moisture in the hive, while 71% declared that they did not take any precautions. It has been reported that 50% of the overwintering losses are due to queen loss, 35% due to disease and pests, and 15% due to other reasons. It has been determined that more than half of the enterprises (55%) leave approximately 11-15 kg honey, 35% 6-10 kg and 10% 16-20 kg honey into the hive while entering the winter. The ratios of enterprises that do and do not exchange frames between weak and strong colonies are close to each other and are 52% and 48%, respectively. Similarly, businesses that disinfect (acetic acid) the hives and other beekeeping materials and those that do not disinfect were found to be close to each other with the rates of 48% and 52%, respectively. While 87% of the enterprises used Rulamit-VA against varroosis disease, 13% stated that they used Perizin. While 71% of them reported that they used Terramycin against foulbrood diseases, 29% of them declared that they did not use any medicine. Against nosemosis disease, 48% of the enterprises herbal products (thyme, garlic, mint, etc.), 18% Fumidil-B, 8% vinegar used, 26% stated that they did not use any medicine. According to the results obtained from this study, the most important causes of overwintering losses are queenless, disease and pests, respectively. In addition, the ratio of enterprises that exchange frames between weak and strong colonies, and those that do not disinfect hive and other beekeeping materials is approximately 50%. As a result, it has been determined that the enterprises have deficiencies in controlling the queen, fighting bee disease and pests effectively, and taking protective measures.

Keywords: Hatay, Beekeeping **E**nterprise, Disease and Pests, Survey

PLASMA AND BILE PHARMACOKINETICS AND TISSUE DISTRIBUTION OF FLORFENICOL IN *Oreochromis niloticus* (L.) POST SINGULAR ORAL GAVAGE

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ABSTRACT

The USFDA-approved dose is 10-15 mg/kg biomass/day for 10 consecutive days although little reports are available on its pharmacokinetic study in tropical Indian conditions. The experiment was carried out in 2 groups of *O. niloticus* viz., control and 1× oral gavage group at 50 numbers/tank. A period of 12 hours of starvation was observed before oral gavage in both the groups. The samples of plasma, bile and targeted tissues were collected on 0, 2nd, 3rd, 4th, 6th, 8th, 12th, 16th, 24th, 32nd, 48th, 64th, $96^{th,}$ and 128th hour post-administration. The concentrations of FFC and florfenicol amine (FFA) were determined by LC-MS/MS method followed by subjecting them to two compartmental model analysis using PHARMKIT software. The peak plasma FFC concentration (C_{max}) was calculated to be 12.15 µg/mL whereas the time to peak plasma FFC concentration was (T_{max}) 24.00 h. Similarly for bile, C_{max} and T_{max} were observed to be 77.92 µg/mL and 24.00 h respectively. The elimination half-life ($T_{½}\beta$) of plasma and bile was obtained as 28.17 h and 26.88 h respectively. Pharmacokinetics of FFA from plasma also followed similar 2 compartmental model. Post-singular gavage FFC tissue residues were observed to be in the order muscle > intestine > skin > liver > kidney > gill whereas FFA residues followed the hierarchy kidney > skin > liver > muscle > gill > intestine > brain. Although water temperature had a slight effect on FFC and FFA elimination, the pharmacokinetic variables suggest bile to be one of the most important FFC elimination

pathway. Future studies focusing on FFC pharmacokinetics in kidney, liver and gill are warranted.

Keywords: *Oreochromis niloticus L.*, Pharmacokinetics, Tissue Distribution

BAZI BAL MUMLARININ KALİTE KARAKTERİSTİK ÖZELLİKLERİNİN BELİRLENMESİ

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ÖZET

Bal mumu, yüzeyi kristale benzeyen petek hücreleri şeklinde olup *Apis* cinsi (*A. dorsata*, *A. indica*, *A. florea* ve *A. mellifera*) genç işçi arıların, karın halkaları arasındaki mum salgı bezlerince salgılanan maddedir. Salgılandığı ilk anda beyaz renkli ve sıvı halde olan bal mumu; hava ile temas ettiğinde katılaşarak kahverengi veya sarı renge dönüşür. Arı bal mumunu çiğneyerek elde ettiği maddeyi petek örmek, yavru yetiştirmek, bal ve polen depoladığı petek gözlerinin üzerini örtmek için kullanır. Arıların bal mumu üretimi için daha fazla enerjiye yani bal tüketmelerine gereksinimleri vardır. Dünya genelinde doğal ve sağlıklı beslenme trendiyle bal talebi de artmıştır. Artan bu talebi karşılayabilmek için, daha fazla bal üretimi, bunun için de daha fazla bal mumuna ihtiyaç duyulmuştur. Ancak arıların kendi ürettiği doğal bal mumu yeterli olmadığından, bunun yerine sanayinin ürettiği yapay bal mumu kullanımı yaygınlaşmaya başlamıştır. Literatürde diğer arı ürünleri ile ilgili çok sayıda çalışma yapılmasına rağmen bal mumu ile ilgili pek çalışma bulunmamaktadır. Bu çalışmada doğal bal mumu (karakovan), külçe bal mumu, temel petek ve balı boşaltılmış petek olmak üzere toplam dört çeşit bal mumunun kimyasal içeriği ve fizikokimyasal özellikleri değerlendiririlmiştir. Değerlendirilen parametreler kuru madde, kül ve yağ miktarı, sabunlaşma sayısı, peroksit değeri, iyot sayısı, asit sayısı ve yağ asiti kompozisyonudur. Veriler istatiksel olarak değerlendirildiğinde; en yüksek kuru madde içeriği temel petekde, en yüksek kül içeriği doğal bal mumunda, en yüksek asit sayısı balı boşaltılmış petek ile doğal bal mumunda, en yüksek sabunlaşma sayısı külçe bal mumu ile balı boşaltılmış petekte, en yüksek iyot sayısı temel petekte en yüksek peroksit sayısı ise balı boşaltılmış petekte bulunmuştur. Bal mumu örneklerinde yağ asitlerinden sırasıyla palmitik, elaidik, oleik, 11-eikosenoik ile erüsik asitler baskın bulunmuştur. Trans yağ aside olan elaidik asit en az doğal balmumunda tespit edilmiştir.

Anahtar Kelimeler: Balmumu, Temel Petek, Peroksit Sayısı, Yağ Asidi, Karakovan

DETERMINATION OF THE QUALITY CHARACTERISTICS OF SOME BEWAXES

ABSTRACT

Beeswax is the substance secreted by the wax glands between the abdominal rings of young worker bees of the genus *Apis* (*A. dorsata, A. indica, A. florea* and *A. mellifera*) and its surface is in the form of crystal-like honeycomb cells. When the beeswax is secreted, it is white in color and in liquid form. Then, when it comes into contact with air, it solidifies and turns brown or yellow. Bee uses the material obtained by chewing the wax to weave honeycombs, raise young, and cover the honeycomb eyes where it stores honey and pollen. For beeswax production, bees need more energy, that is, honey consumption. The demand for honey has increased with the trend of natural and healthy nutrition around the world. In order to meet this increasing demand, more honey production, and for this, more beeswax was needed. Since the natural beeswax produced by the bees is not sufficient, the use of artificial beeswax produced by the industry has started to become widespread. Although there are many studies on other bee products in the literature, there are not many studies on beeswax. In this study, the chemical content, and physicochemical properties of a total of four types of beeswax, namely natural beeswax (karakovan), ingot beeswax, basic honeycomb, and emptied honeycomb, were evaluated. Evaluated parameters are dry matter content, ash content, oil content, saponification number, peroxide value, iodine number, acid number and fatty acid composition. When the data is evaluated statistically; the highest dry matter content was found in the basic honeycomb, the highest ash content was found in the natural wax, the highest acid number was found in the natural beeswax and in honeycombs whose honey was emptied, the highest saponification number was found in the ingot beeswax and in the honeycombs whose honey was emptied, the highest iodine count was found in the basic honeycomb, the highest peroxide was found in the honeycombs whose honey was emptied. Palmitic acid, elaidic acid, oleic acid, 11-eicosenoic acid and erucic acid were found to be dominant in all bee waxes, respectively. The lowest content of elaidic acid, a trans fatty acid, was found in natural beeswax.

Keywords: Beeswax, Basic Honeycomb, Peroxide Number, Fatty Acid, Karakovan

SOARING THE CONCENTRATION OF BIOACTIVE PHYTOCHEMICALS VIA AGRO-TECHNIQUES IN MEDICINAL PLANTS OF HARYANA

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ABSTRACT
India is a treasure trove of medicinal plants, owing to its rich biodiversity, and a gold mine of medicinal knowledge. As per World Health Organization (WHO), traditional therapy of Ayurvedic, Siddha and Unani (ASU) drugs will be touch 05 trillion US$ by 2050. As per the literature, India is the second highest producer of medicinal herbs in the world followed by China. India has dividing in to 15 Agro-Climatic zones that comprise around more than 18,000 types of plants, of which 8000 have known therapeutic potential and the distribution of medicinal plants are based on their biogeographic regions, diverse habitats and landscapes. The importance of medicinal plants and derivatives is growing rapidly with human progress in pharmaceutical fields. The demand for medicinal herbs is increasing thanks in part to a reputation for fewer side effects. They are also considered to be a cost-effective means of developing new and breakthrough drugs. Around 70% of India's medicinal plants are found in the tropical areas and around 30% in the temperate and alpine areas. In India around more than 50 species (Euphorbiaceae, Apiaceae, Convolvulaceae etc.) of medicinal plants used for the treatment of various life threating disorder belonging to different families have been reported in Haryana. As per the 'All India Trade Survey of Prioritised Medicinal Plants, 2019', there is a huge gap between the supply and demand of medicinal plants to manufacture. Hence, in view of this adopting good Agro techniques in cultivation of genuine, authentic variety of plants may be the only way to have raw material of required quality, this will not only full fill our requirements of medical plants but also offers opportunities for crop diversification. The demand for medicinal plants is growing worldwide and has the potential to fetch good income for the farmers compared to that of traditional crops. This project is encouraging small farmers to implement a shift of resources in the cultivated area, from cereals and low-value crops to high-value medicinal and aromatic plants. These high-value plants require less inputs and hence relate to better income realization for farmers along with facilitating their production in balance with nature.

Keywords: Traditional therapy, Agro techniques, Bioactive Phytochemicals, Medicinal plants, Haryana, Farmers, Cultivation

INVESTIGATING MOLYBDENUM VARIATION IN DURUM WHEAT: INTEGRATING CHEMICAL AND GENETIC ANALYSIS THROUGH GWAS

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ABSTRACT

Molybdenum, a crucial micronutrient that occurs naturally in grains, plays a pivotal role in the growth and development of durum wheat (*Triticum turgidum subsp. durum*). This study represents the first attempt to explore the Molybdenum contents in a panel of 130 durum wheat genotypes, aiming to assess genotypic diversity chemically and genetically variability. The genotypes included local commercial Turkish and foreign cultivars, as well as ex-situ and in-situ landraces. Molybdenum contents were analyzed using inductively coupled plasma mass spectrometry. The results showed a significant range of Molybdenum concentrations across the panel, ranging from 0.34 to 2.09 mg/kg, with an average of 0.74 mg/kg. Turkish cultivars demonstrated a diverse range, with an average concentration of 0.71 mg/kg and values ranging from 0.34 to 1.56 mg/kg. Foreign cultivars exhibited a range, spanning from 0.35 to 1.07 mg/kg, and the lowest average concentration of 0.61 mg/kg. Ex-situ landraces showcased wider content, ranging from 0.39 to 2.09 mg/kg, with the highest average concentration of 0.81 mg/kg. In-situ landraces displayed a narrower range, varying from 0.43 to 1.10 mg/kg, and an average concentration of 0.78 mg/kg. Furthermore, a Genome-Wide Association Study has shown a significant association between the "*wmc657-bp132"* marker located at the 4B locus and Molybdenum content, explaining approximately 10% of the variation in this trait and highlighting the genetic underpinnings of this characteristic. The variation observed in Molybdenum concentrations within the durum wheat panel further emphasizes the influence of various factors, including sources and genetic factors. These findings contribute to understanding the presence and distribution of Molybdenum in durum wheat and provide insights for breeding programs and food safety regulations to promote consumer health.

Keywords: Molybdenum, Variation, MTA, GWAS

CLEAN AND GREEN ENVIRONMENT BY USING AGRICULTURAL WASTE WITH BETTER CLEANING PROPERTIES THAN SYNTHETIC ONES

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ABSTRACT

The plant material was found to be rich with surfactant properties. The comparative study between synthetic and natural surfactant was carried out using spectrophotometry, and conductometric measurement. The natural surfactant plant gave CMC values 4.4×10^{-4}M. It is the point where their monomer aggregates to form micelles, which are far below the CMC point of most of thesynthetic surfactants. The role of temperature was also monitored in comparison to the synthetic surfactants. The pH was used to find the nature of surfactants and number of replaceable protons in the system. The surfactant interaction properties were monitored against a variety of dyes cationic (CTAB), and anionic (methylene blue and neutral red). The interactions were monitored from pre- to post micellar concentrations of both natural and synthetic surfactants. The change in concentration of the surfactant led to the change in interaction behaviour. Wide range of temperatures were selected to monitor the behaviour and interactions of the natural and synthetic surfactants as these interactions are temperature dependent and found to be favourable at lower temperatures. The self-degradation was observed at ambient temperature and in the darkboth in aerobic and anaerobic conditions. Based on its behavior and degradation properties, the proposednatural surfactant is a cheap and good alternative to the synthetic surfactants. These natural surfactants were found to have surfactant properties and even efficient from synthetic counterparts and biodegradable thus environmentally friendly. Moreover, the natural surfactant helps to degrade many environmentally toxin dyes which are even non degradable in fenton presence.

Keywords: Environment, CTAB, agricultural waste

A SURVEY OF THE CHALLENGES AND STRATEGIES TO CREATE WEALTH FROM WASTE MANAGEMENT PRACTISES IN NIGERIA

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ABSTRACT
The aim of this work is to identify the challenges and evaluate strategies for creating wealth from waste management practices in Nigeria. The study was carried out in Nigeria, a sub-Saharan African country. The data used for this analysis were collected using the questionnaire method. It was analysed using SPSS with a one sample binomial and chi-square test. The paper found that the existing waste management methods were ineffective and that comprehensive waste management, proper implementation and enforcement of environmental regulations and laws needed to be adopted. It also examined the benefits derived from the adoption of proper solid waste management techniques. It is observed from the survey that 95 percent of the population agreed to the fact that generating wealth is possible, it can assist in lifting people out of poverty. There is a need for the establishment of private or public agencies that will solely be in charge of waste management, who will come up with strategies for collecting waste from homes.

Keywords: Waste, Wealth, Poverty, Binomial, Chi-square

HORSE MOTIF ON SASSANIAN SEALS

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ABSTRACT
Indo-Europeans were the first people who domesticated animals around the fifth millennium BC. horses were originally for sacrifice in front of the gods in the past. In old Iran, in the life of the ancient people horse motifs had been so effective that it has been widely used in historical works, including rock reliefs, seals, pottery and textiles, carpets, and other works. The frequent use of the name of this animal in the Avesta indicates its importance among the ancient Iranians, Zoroaster asks Ahura to grant him the abilities of a horse. The connection of the horse with the elements of nature, such as the sun, water, and wind, as well as its connection with deities such as Ardvisour Anahid, Mehr, Bahram, Tishtar, and Souroush, is the sanctity of this animal in Iran. The presence of many Iranian names in which the word horse is used is another proof of this importance. "Pouroshasp" is the name of Zoroaster's father, meaning the owner of an old horse, who himself had a four-horse cart. A horseshoe is a symbol of good luck in most societies. In this article, the author tries to reflect the importance of the motif of horses in Sasanian seals. Who were the owners of horse-shaped seals and for what purpose did they use these seals? The relationship between horse and warfare will not be ineffective in answering this question.

Keywords: Sasanian; Seal; Sealing; Horse; Motif

ANALYSIS OF BACTERIAL CONTAMINANTS IN LOCALLY FERMENTED COW MILK PRODUCT SOLD IN KADUNA, NIGERIA

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ABSTRACT
Locally fermented milk in Nigeria is usually hawked by the Fulani dialect in Nigeria. It is commonly called (nono). The nono is usually ganished with a processed millet called fura and sold within and outside Kaduna state. This study was conducted to analyse the bacterial contaminants in locally fermented milk product sold within Tudunwada area of kaduna state of Nigeria. A total of 60 samples of "fura da nono" sold around the different area of Tudun Wada Kaduna were collected. Out of the 60 samples collected, Zango road had the highest mean count of 16.7 x 10^6 and the least mean count was found in Faskari road (4.1 x 10^6) CFU/ml which was not statistically significant ($P<0.05$). The mean counts were higher than the $1*10^5$CFU/ml standard that is set for diary food drinks or beverages under regulations (FAO). The highest coliform count was found in zango road 54.0x10^6 while the least colifom count was found in Kasuwan Barci (3.6x10^6) CFU/ml. The other types of bacteria isolated from the milk cereal mixture 'fura da nono' were identified as *Pseudomonas spp, Enterococcus spp, Staphylococcus aureus, Staphylococcus saprophyticus, Escherichia coli, Lactobacillus spp* and *Corynebacteria.* Results from this study has shown that the locally fermented milk product (Fura da nono) is loaded with many bacterial isolates which can pose health harzard on its consumers. Therefore, proper measures should be taken by relevant agencies to ensure that only contamination free Fura da nono are sold to the populace.

Keywords: Fermented cow milk, Fura da nona mixture, Bacteria, Contaminants

ANTIBACTERIAL SENSITIVITY OF PATHOGENS ISOLATED FROM LOCALLY FERMENTED COW MILK PRODUCT SOLD WITHIN KADUNA, NIGERIA TO COMMON ANTIBIOTICS

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ABSRACT
Locally fermented milk product commonly referred to as Fura da nono is a special Fulani delicacy in Nigeria. Previous studies have shown that these Fura da nono are not being handled properly during processing and as a result, a lot of pathogens which may be detrimental to health are being introduced into the drink. This study is aimed at analyzing the antibacterial sensitivity of pathogens isolated from Fura da nono sold in tudun wada area of Kaduna state of Nigeria. Antibacterial sensitivity test carried out on the isolates showed that Enterococcus species, S. aureus, S. saprophyticus and Lactobacillus species, Pseudomonas species, E. coli and Corynebacteria. Were susceptible to Septrin (30µg), Streptomycin (30µg), Ampiclox (30µg) and Gentamycin (10µg), while Pseudomonas spp, E. coli, Corynebacteria, Lactobacillus spp, S. aureus, S. saprophyticus, and Enterococcus spp were resistant to Chloramphenicol (30µg), Ciprofloxacin(30µg), Sparfloxacin(10µg), Amoxacillin(30µg), Augmentin(10µg), Pefloxacin(30µg), Ofloxacin(10µg), Zinnacef (20µg), Rocephin(25µg) and Erythromycin(10µg). These results indicate that infection with the resistant strains of the pathogens consumed from Fura da nono might pose a health risk on its consumers which would be detrimental to health. It is therefore recommended that Fura da nono quality should be assessed by relevant agencies before they are allowed to be sold by vendors. This would go a long way in safeguarding the health of the nation.

Keywords: Antibacterial, Fermented cow milk, Antibiotics, Sensitivity, Resistance

EGE BÖLGESİ YEM BİTKİLERİ ÇEŞİT GELİŞTİRME ÇALIŞMALARI (1967-2023)

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ÖZET

Ege Bölgesinin ekolojik koşullarına ve tarla sistemine uygun, ot ve tohum verimi yüksek, hastalıklara mukavim, tekyıllık ve çok yıllık baklagil ve buğdaygil yem bitkileri türlerinde çeşit geliştirmek amacı ile 1967 yılında Ege Tarımsal Araştırma Enstitisünde ıslah çalışmaları başlatılmıştır. Farklı ıslah metodlarının kullanıldığı çalışmalarda genel olarak Türkiye'nin çeşitli lokasyonlarından toplanan yerel populasyonlar ve doğadan toplanan genetik kaynakları değerlendirilmiştir. Çalışmaların ilk çıktıları 1979 yılında tescil edilen bir adet adi fiğ, bir adet Macar fiği ile iki adet tüylü fiğ çeşitleri ile olmuştur. Devam etmekte olan ıslah çalışmalarında şimdiye kadar kışlık ara bitki olarak kullanılan 12 adet adi fiğ, 3 adet Macar fiği, 1 adet yem bezelyesi, 2 adet tüylü fiğ ve iki adet koca fiğ, 1 adet acem üçgülü, 1 adet te İskenderiye üçgülü çeşidi geliştirilmiş ve tescil edilmiştir. Tek yıllık buğdaygil yem bitkileri ıslah çalışmaları sonucunda 5 adet tek yıllık çim (İtalyan çimi) çeşidi geliştirimiştir. Hayvancılıkta en önemli yem bitkilerinin başında gelen yonca ile ilgili yapılan ıslah çalışmalarıyla tarım sisteminde rotasyona giren 3 adet yonca çeşidi de geliştirilip tescil olmuştur. Mera ıslahında ve yapay mera karışımlarında kullanılmak üzere de 1 adet kamışsı yumak, 2 adet kılçıksız brom, 2 adet gazal boynuzu çeşidi ıslah edilmiş ve tescil edilmiştir. Uzun yıllardan beri süren tek ve çok yıllık baklagil ve buğdaygil yem bitkileri çeşit geliştirme çalışmalarının en önemli kavşakları; 1982 yılında erkenci daha kararlı bir adi fiğ çeşidini geliştirilmesi, melezleme çalışmaları neticesinde erkenci, kuru madde ve tohum verimleri yüksek, 2010 ve 2013 yıllarında geliştirilen 3 adet adi fiğ çeşidi ile ilk soğuğa dayanıklı orta erkenci, tohum verimi yüksek Macar fiği çeşidi, ilk erkenci, tohum verimi yüksek yem bezelyesi çeşidinin geliştirilmesidir. Çok yıllık yem bitkisi türlerinde ise ilk nondormant yonca çeşidinin geliştirilmesi ve ilk kamışsı yumak çeşidinin geliştirilmesidir. Geliştirilen çeşitler, bölgemiz ve benzer iklim koşullarına uygunluğu ve yüksek verimleri ile önemli bir ekiliş alanına sahip olup sertifikalı tohumluk üretimine dolayısıyla ülke tohumculuğuna büyük katkı sağlamıştır. Çeşit geliştirme çalışmaları yonca, yem bezelyesi, İtalyan çimi, kamışsı yumak türlerinde yoğunlaşarak devam etmektedir.

Anahtar Kelimeler: Yem bitkileri, ıslah, erkencilik, kuru madde, tohum verimi

AEGEAN REGION FORAGE CROPS VARIETY DEVELOPMENT STUDIES (1967-2023)

ABSTRACT

Breeding studies were initiated in the Aegean Agricultural Research Institute in 1967 with the aim of developing varieties for annual and perennial legumes and grasses of forage crops with high forage and seed yield, tolerant to diseases , which are suitable for the ecological conditions and field system of the Aegean Region. Local populations collected and genetic resources collected from nature and various locations in Türkiye were evaluated, by using different breeding methods. The first outputs of the studies were one common vetch, one Hungarian vetch and two hairy vetch varieties registered in 1979. In the ongoing breeding studies, 12 common vetch, 3 Hungarian vetch, 1 fodder pea, 2 hairy vetch and 2 narbon vetch, 1 Persian clover, 1 Berseem clover variety as winter intermittent crops, have been developed and registreted so far. As a result of the breeding studies of annual ryegrass (Italian ryegrass), 5 varieties have been developed. With the improvement studies carried out on alfalfa, which is one of the most important forage crops in animal husbandry, 3 alfalfa varieties, have been developed and registered. In order to be used in pasture improvement and artificial pasture establishment, 1 tall fescue, 2 smooth brome, 2 birdsfoot trefoil varieties have been developed and registered. The most important milestones of the variety development studies of annual and perennial legume and grass forage crops that have been going on for many years are; development of an early and more determinent common vetch variety in 1982, with hybridization studies, developing 3 common vetch cultivars with high dry matter and seed yields in 2010 and 2013, first cold resistant medium early Hungarian vetch variety with high seed yield, development of the first early, high seed yielding forage pea variety. Moreover, in perennial forage crops, development of the first nondormant alfalfa variety and first tall fescue variety. The developed varieties have tented to have improtant cultivation area with their suitability for our region and similar climatic conditions and their high yields therefore have contributed to the production of certified seed so to the country’s seed production industry. Variety development studies continue on alfalfa, fodder pea, Italian ryegrass and tall fescue species.

Keywords: Forage crops, breeding, earliness, dry matter, seed yield

MAKNA KEADILAN DALAM BISNIS

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ABSTRACT

Purpose: Makalah ini bertujuan untuk menjelaskan apa yang dimaksud dengan keadilan, makna keadilan dalam konteks bisnis, dan nilai keadilan dalam perspektif Islam
Design/methodology/approach: Makalah ini menggunakan pendekatan kualitatif, sebab sumber data maupun hasil penelitian dalam penelitian kepustakaan (library research), analisa data secara induktif, teori dari dasar/grounded theory (menuju pada arah penyusunan teori berdasarkan data). **Findings:** Pertama, keadilan menurut kamus umum bahasa Indonesia dan beberapa tokoh (1) Georges Gurvitch, (2) Adam Smith. Kedua, keadilan dalam konteks bisnis yaitu: Pertama, keadilan legal, menyangkut hubungan antara individu atau kelompok masyarakat dengan negara. Kedua, keadilan komutatif, hubungan antara orang yang satu dengan yang lain dalam hubungan yang setara dana seimbang antara pihak satu dengan yang lainnya. Ketiga, keadilan distributif, distribus ekonomi yang merata bagi semua warga negara dalam pembagian kekayaan ekonomi atau hasil-hasil pembangunan. Ketiga, keadilan Ilahi seperti yang diamandemenkan didalam syariah Islam, sebagai berikut: Pertama, perusahaan tidak diperbolehkan hanya berfokus pada pihak-pihak yang memberikan kontribusi. Kedua, perusahaan harus berfokus pada pihak-pihak yang tidak memiliki kontribusi. Ketiga, harus dilakukan dengan cara-cara yang adil berdasarkan atas potensi internal yang dimilikinya. Keempat, dapat meingkatkan kesejahteraan manusia. **Originality/value:** Makalah ini medeskripsikan secara komprehensif tentang makna keadila dalam bisnis

Keywords: Keadilan dalam bisnis

ASSESSING THE THERAPEUTIC AND PREVENTIVE POTENTIAL OF *Cyperus rotundus* IN VARIOUS DISEASES

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ABSTRACT

Cyperus rotundus, commonly known as nutgrass or purple nutsedge, is a perennial herb that has been recognized for its medicinal properties in various traditional systems of medicine. This summary highlights the valuation of Cyperus rotundus in the treatment and prevention of certain diseases. *Cyperus rotundus* has a long history of use in traditional medicine, particularly in Ayurveda, Chinese medicine, and traditional African healing practices. The plant contains a diverse range of bioactive compounds, including flavonoids, alkaloids, phenols, and essential oils, which contribute to its therapeutic potential. Studies have revealed that *Cyperus rotundus* possesses significant antioxidant, anti-inflammatory, antimicrobial, and anticancer activities. These properties make it potentially beneficial in the treatment and prevention of several diseases, including: Gastrointestinal Disorders: *Cyperus rotundus* has been traditionally used to alleviate symptoms of gastrointestinal disorders such as indigestion, diarrhea, and stomachache. Its anti-inflammatory and antispasmodic effects may help soothe the digestive system and provide relief. Diabetes and Metabolic Disorders: Research suggests that *Cyperus rotundus* exhibits antidiabetic properties by regulating blood glucose levels and improving insulin sensitivity. It may also have a positive impact on lipid metabolism, making it potentially useful in managing metabolic disorders. Inflammation and Pain: The anti-inflammatory properties of *Cyperus rotundus* have been studied extensively. It may help reduce inflammation and alleviate pain associated with conditions like arthritis, rheumatism, and other inflammatory diseases. Antimicrobial Activity: Various studies have reported the antimicrobial efficacy of *Cyperus rotundus* against a range of bacteria, fungi, and parasites. It may be beneficial in combating infections caused by these pathogens. Cancer Prevention: Preliminary studies suggest that *Cyperus rotundus* possesses anticancer potential due to its ability to induce apoptosis (programmed cell death) and inhibit the proliferation of cancer cells. However, further research is needed to explore its full potential in cancer treatment. Despite its promising medicinal properties, it is important to note that *Cyperus rotundus* should be used cautiously and under proper guidance, as high doses or interactions with other medications may lead to adverse effects.

Keywords: *Cyperus rotundus*, Therapeutic**,** diseases**,** treatment and prevention

YEŞİL ALG CHLORELLA VE GIDA OLARAK KULLANIMI

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ÖZET

Son zamanlarda artan insan populasyonu ve buna bağlı olarak da ortaya çıkan besin ihtiyacı alternatif besin kaynağı arayışı zorunluluğunu ortaya çıkarmıştır. Özellikle zengin mineral, vitamin ve protein içeriğinden dolayı mikroalgler alternatif gıda olarak en çok tercih edilen organizma gruplarından birisidir. Tek hücreli kokkoid yeşil alg olan *Chlorella* Beijerinck cinsi üyeleri (Trebouxiophyceae, Chlorophyta), deniz ve tatlı su habitatlarında yetişen gıda olarak kullanımlarının yanı sıra ilaç, kozmetik, biyoyakıt ve biyoremediasyon gibi alanlarda da yaygın kullanımı olan mikroalg cinslerinden birisidir. *Chlorella* kelimesi Latince dilinde 'taze yeşil, küçük, manasına gelen 'chloros' sözcüğünden türetilmiştir. *Chlorella* cinsi tanımlanmış 32 tür içermekle birlikte bunlar içerisinde gıda olarak yararlanılan ve üzerinde en fazla çalışma yapılan *Chlorella vulgaris* Beijerinck türüdür. *Chlorella vulgaris*, yüksek verimlilikle kolay yetiştirme ile karakterize edilen ve yapısında klorofil, lutein, protein ve diğer birçok gerekli mikro besin içeriğinden oluşan tek hücreli küresel formda bir yeşil alg türüdür. *Chlorella vulgaris* hücreleri 5-10 µm aralığındadır. Birçok çalışmada *Chlorella*, "süper gıda" olarak adlandırılır. Ayrıca *C. vulgaris*; FDA tarafından güvenli alg türü olarak belgelenmiş birkaç alg türünden birisidir. *C.vulgaris* yüksek oranda protein, çok sayıda vitamin, aminoasit, demir, potasyum, kalsiyum ve fosfor içeren zengin bir besin kaynağıdır. İçeriğinde tüketiciler için gerekli esansiyel aminoasitleri önemli konsantrasyonlarda içermektedir. *Chlorella vulgaris*'in hayvan ve insan diyetlerine eklenmesi sonucunda antihipertansif, antoksidatif, hipokolesterolemik ve antitümör aktiviteler, hipoglisemik ve hipolipidemik etkiler gibi faydalı fizyolojik etkilerin olduğunu ortaya çıkarmıştır. *Chlorella*'nın insan sağlığındaki diyet değerinin araştırılması, 1950'lerin başlarında başladığı bildirilmiştir. *Chlorella* ilk olarak Asya'da özellikle Japonya'da üretilip tüketilmiştir. Daha sonrasında dünya çapında bilinen bir gıda takviyesi olarak kullanılmaya başlanmıştır. Günümüzde, *Chlorella vulgaris* ticari olarak gıdalarda kullanılmak üzere üretilmektedir. Birçok çalışma *Chlorella* hücrelerinin insan sağlığını destekleyen ve belirli hastalıkları önleyen çeşitli besinler ve biyoaktif bileşikler içerdiğini göstermiştir. Bundan dolayı gelecekte *Chlorella vulgaris*'den türetilen doğal bileşiklerin ilaç sektörü için pozitif yönde katkılar sağlaması muhtemeldir.

Anahtar Kelimeler: Algler, Chlorella vulgaris, Gıda, Sağlık

GREEN ALGA CHLORELLA AND USE AS FOOD

ABSTRACT

In recent times, it has become necessary to search for alternative food sources due to the increasing human population. Microalgae are one of the most preferred groups of organisms as an alternative food because of its rich content of minerals, vitamins and proteins. Members of the genus *Chlorella* (Trebouxiophyceae, Chlorophyta), a single-celled coccoid green algae, are one of the microalgae that grows in marine and freshwater habitats and has widespread use in pharmaceuticals, cosmetics, biofuels and bioremediation as well as food. *Chlorella* word is derived from the Latin word 'chloros', which means “small, fresh green”. The genus *Chlorella* includes 32 species. Among these species, *Chlorella vulgaris* Beijerinck is the most studied and used as food. *Chlorella vulgaris* is a unicellular and the cells are spherical. It is characterized by simple cultivation with high productivity, and contains chlorophyll, lutein, protein and many other essential micronutrients in its structure. The cells are 5-10 µm in diameters. In many studies, *Chlorella* is referred to as "superfood". Also *C. vulgaris* is one of the few algae species that has been certified by the FDA as Generally Recognized as Safe. C. vulgaris is a rich food source containing high protein, many vitamins, amino acids, iron, potassium, calcium and phosphorus. It contains essential amino acids required for consumers in significant concentrations. *Chlorella vulgaris* in animal and human diets showed positive physiological effects such as antihypertensive, anoxidative, hypocholesterolemic and antitumor activities, hypoglycemic and hypolipidemic effects. Researches on the dietary value of *Chlorella* on human health have been begun in the early 1950s. Firstly, *Chlorella* was cultivated and consumed in Asia, especially in Japan. Later, it started to be used as a food additive on global sclae. Today, *Chlorella vulgaris* is commercially produced for use in food. It has been shown that cells of *Chlorella* have a variety of bioactive compounds and nutrients that support human health and prevent some illness in many studies. Therefore, in the future, It is possible that natural compounds derived from *Chlorella vulgaris* will make positive contributions to the pharmaceutical industry.

Keywords: Algae, Chlorella vulgaris, Food, Health

IMPEDANCE SPECTROSCOPY AND DIELECTRIC PROPERTIES OF PZT-BASED CERAMICS

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ABSTRACT

In this study, solid-state synthesis was used to create the $SrCO_3$ modified Lead Zirconate Titanate ceramic with Zr/Ti = 43/52 near the morphotropic phase boundary (MPB), whose chemical formula is $Pb_{1-x}Sr_x$ $(Zr_{0.43}Ti_{0.52})$ $(Al_{0.5}Sb_{0.5})_{0.05}O_3$. Tetragonal and Rhombohedral symmetry phases coexisted in the system, according to the powder x-ray diffraction (PXRD) analysis of phase formation. A microstructural analysis using a scanning electron microscope (SEM) revealed a non-uniform distribution of large grains over the sample surface as well as the presence of a few micro-sized pores. We studied frequency and temperature dependencies of impedance and electric modulus in a wide frequency range (0.1kHz-1MHz) at different measuring temperatures (300-700K). The results showed the contributions of grains to the material's capacitive and resistive properties. As seen from the Nyquist graph, grains contribute to the resistance and capacitance of the complex impedance plots. The Nyquist plot was applied to an electrical circuit that was equivalent. At all temperatures, precise fitting steps were used to determine the grain resistance and capacitance values. It is assumed that the substitution of Sr^{2+} ions at the Pb-site causes an increase in the dielectric constant at higher temperatures.

Keywords: Perovskite, PXRD, SEM, impedance, capacitive, resistive properties

BATI KARADENİZ FINDIK BAHÇELERİNDE *PALOMENA PRASİNA* L. (HEMİPTERA: PENTATOMİDAE)'NIN DOĞAL OLARAK BIRAKILAN YUMURTALARINI PARAZİTLEYEN TÜRLERİN BELİRLENMESİ

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ÖZET

Fındığın anavatanı olan Türkiye, Dünya'nın en büyük fındık üreticisi ve ihracatçısıdır. Batı Karadeniz'deki Sakarya ve Düzce fındık bahçeleri üretimin önemli bir kısmını karşılayarak bölge ekonomisine önemli bir katkı sağlamaktadır. Fındıkta verim ve kaliteyi önemli derecede etkileyen, yaygınlık ve yoğunluğu en yüksek pis kokulu böcek türlerinden biri olan *Palomena prasina* L. (Hemiptera: Pentatomidae), fındık yetiştirilen alanların tamamında bitki fenlojisine bağlı olarak farklı tipte zarara sebep olmaktadır. Ülkemizde zararlı ile mücadelede tek seçenek kimyasal insektisitlerdir. Bu zararlıya karşı biyolojik mücadele gibi etkili, alternatif çevre dostu yöntemlerin geliştirilmesine ihtiyaç duyulmaktadır. Bu çalışma, 2022 yılında Sakarya ve Düzce illerindeki 17 farklı fındık bahçesinden *P. prasina*'nın doğal olarak bıraktığı yumurta paketleri toplanarak yumurtaların parazitlenme oranlarını ve parazitlemeyi yapan türlerin kompozisyonunu belirlemeyi amaçlamaktadır. Böceğin toplanan yumurta paketleri laboratuvara getirildi ve iklimlendirme kabininde (25 °C, %70 N ve 16:8 I:K) ergin parazitoitlerin çıkışları için takip edildi. Elde edilen parazitoitler alkolde muhafaza edildi ve morfolojik olarak teşhisleri yapıldı. Çalışmanın tamamının yürütüldüğü tüm bahçelerden 158 yumurta paketi (27.06±0.23) toplamda 4276 yumurta toplandı. Tüm alan için genel parazitlenme oranı %21.98 olduğu belirlendi. *Trissolcus belenus* en baskın türdü ve %41.81 oranında parazitleme gerçekleştirdi bunu *Telenomus turesis* (%26.60), *Trissolcus cultratus* (%24.36) ve *Telenomus heydeni* (%7.23) takip etti. Sonuç olarak, bu çalışmada belirlenen *P. prasina*'nın yumurta parazitoitleri, böcek tarafından doğal olarak bırakılan yumurtalarda daha yüksek bir parazitleme ve tür kompozisyonunun artışı yanı sıra fındık bahçelerinde biyolojik mücadele açısından önemli bir potansiyele tanıklık etmektedir.

Anahtar Kelimeler: Pis Kokulu Böcek, Doğal Düşman, Biyolojik Mücadele, Yumurta Parazitoiti, Parazitleme Oranı

Teşekkür: Morfolojik teşhisler konusunda destek sağlayan Dr. Francesco Tortorici'ye teşekkür ederim.

DETERMINATION OF SPECIES PARASITIZING NATURALLY-LAID EGGS OF *PALOMENA PRASINA* L. (*HEMIPTERA: PENTATOMIDAE*) IN THE WEST BLACK SEA HAZELNUT ORCHARDS OF TURKEY

ABSTRACT

Türkiye, the hazelnut's homeland, is the world's largest hazelnut producer and exporter. Sakarya and Düzce hazelnut orchards of the Western Black Sea contribute significantly to the local economy by providing an important amount of overall production. *Palomena prasina* L. (Hemiptera: Pentatomidae), one of the most prevalent and dense stink bug species that has a significant effect on the yield and quality of hazelnut, causes different types of damage depending on plant phenology in all hazelnut growing areas. Chemical insecticides are the only option for managing the insect in Türkiye. There is a need to develop effective alternative eco-friendly methods such as biological control against the insect. The purpose of this study is to assess the composition of the parasitizing species and parasitization rates of the eggs by collecting egg packages naturally laid by *P. prasina* from 17 different hazelnut orchards of Sakarya and Düzce provinces in 2022. The insect egg masses were transferred to the laboratory and the emergence of adult parasitoids was monitored in the incubator (25°C, 70% RH, and 16:8 L:D). The parasitoids were preserved in the alcohol and identified morphologically. A total of 4276 eggs were collected from 158 egg masses (27.06±0.23) from all orchards where the study was conducted. The overall parasitism rate for all egg masses collected was 21.98%. *Trissolcus belenus* was the predominant species, parasitizing 41.81% of all eggs, followed by *Telenomus turesis* (26.60%), *Tr. cultratus* (24.36%), and *Te. heydeni* (7.23%). In conclusion, the egg parasitoids of *P. prasina* revealed in this study witnessed to a higher parasitization and expansion of species composition in naturally laid down eggs by the bug, as well as an important potential for biological control in hazelnut orchards.

Keywords: Stink Bug, Natural Enemy, Biological Control, Egg Parasitoid, Parasitism Rate

Acknowledgement: Thanks in particular to Dr. Francesco Tortorici for his assistance with morphological identification.

FABRICATION OF ELECTRICAL ENERGY GENERATION DEVICE USING THE CONCEPT OF TRIBOELECTRIC CHARGING

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ABSTRACT
The various sensors and devices are required these days for modern agriculture and animal health monitoring requirements. For self-powering of these devices, we have fabricated a simple waste based electrical energy generation source utilizing human motion as input mechanical energy. This device generates electricity using a simple concept of 12th grade Physics of triboelectric charging by friction or rubbing of objects. Alternating electric voltage signals are obtained from hand tapping and thus eliminates the need of battery or other power source device. Thus the electric energy can be generated using this device at any remote place. The generated alternating current signals can be converted into direct current using a simple half wave or full wave rectifier, the concept we have studied in 12th grade Physics subject. We have also power up LED's using our fabricated device known as triboelectric nanogenerator. This device is also as per the goal 7 of United Nations Sustainable Development Goals 2030 Agenda, which suggest us to develop clean and green source of electrical energy.

Keywords: Triboelectric Charging, Sensors, Self-Powered Devices, Electricity

FINDIK ZURUFU VE BİYOKÖMÜRÜ İLE EKSTRAKSİYONLARININ EKMEKLİK BUĞDAY GELİŞİMİNE ETKİLERİ

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ÖZET

Bu çalışmada, zuruf ve zuruftan üretilen biyokömür ve bunlardan elde edilen çay uygulamalarının buğday gelişimi üzerine etkileri araştırılmıştır. Tarla denemeleri 2019-2020 yıllarında tesadüf blokları faktöriyel deneme desenine göre, 4 farklı uygulama (zuruf, zuruf çayı, biyokömür, biyokömür çayı), 4 doz (0-1-2-3 t/da) ve 3 paralelli olarak kurulmuştur. Buğday bitkisinin bitki boyu, başak uzunluğu, bayrak yaprak alanı, m^2'de başak sayısı, başakta tane sayısı, bin tane ağırlığı, tane verimi, hektolitre ağırlığı, hasat indeksi gibi agronomik özellikleri ve temel besin elementi içerikleri (N, P, K) belirlenmiştir. Buğday bitkisinin incelenen agronomik özellikleri yıllara göre değişmiş; bitki boyu, m^2'de başak sayısı, başakta tane sayısı, 1000 tane ağırlığı, tane verimi, hektolitre ağırlığı 2. yıl artmış, başak uzunluğu ve bayrak yaprak alanı ise azalmıştır. Uygulanan materyallerin etkisi tüm özelliklerde istatistiki olarak önemli farklılık meydana getirmemekle birlikte bitki boyu üzerine biyokömür ve biyokömür çayının, m^2'de başak sayısı üzerine zuruf uygulamasının, başakta tane sayısı, 1000 tane ağırlığı ve tane verimi üzerine zuruf, zuruf çayı ve biyokömür uygulamalarının etkisi öne çıkmıştır. Diğer yandan uygulama dozlarındaki artışa göre başak uzunluğu dışındaki tüm agronomik özelliklerde artış meydana gelmiştir. Buğday bitkisinin gelişimi için 2 t/da doz uygulamasının yeterli olduğu bulunmuştur. Bitkide toplam azot ve toplam fosfor içeriği 1. yıl, toplam potasyum içeriği ise 2. yıl daha yüksek bulunmuştur. Materyallerin uygulama dozlarındaki artışa bağlı olarak bitkinin azot, fosfor ve potasyum konsantrasyonlarında artış meydana gelmiştir. Bitki azot ve potasyum konsantrasyonunda zuruf materyalinin, fosfor konsantrasyonunda biyokömür uygulamasının 3 t/da dozu etkili doz olarak belirlenmiştir. Tüm veriler değerlendirildiğinde, buğday bitkisinin agronomik özellikleri ve besin elementi içeriklerinde materyallerin etkisi net olarak öne çıkmamıştır. Zuruf hammaddesinden üretilen materyallerinin etkilerinin görülebilmesi için denemelerin uzun dönem çalışılması gerektiği düşünülmektedir.

Anahtar Kelimeler: Biyokömür, Ekstraksiyon, Fındık Zurufu, *Tiriticum aestivum* L.

THE EFFECTS OF HAZELNUT HUSK AND BIOCHAR AND THEIR EXTRACTIONS ON BREAD WHEAT DEVELOPMENT

ABSTRACT

In this study, the effects of husk and biochar produced from hazelnut husk and the application of tea obtained from them on wheat growth were investigated. Field trials were established according to the randomized blocks factorial trial design, with 4 different applications (hazelnut husk, husk tea, biochar, biochar tea), 4 doses (0-1-2-3 t/da) and 3 parallels in 2019-2020. Agronomic characteristics and basic nutrient content (N, P, K) of wheat plant such as plant height, spike length, flag leaf area, number of spikes per m^2, number of grains per spike, 1000 grain weight, grain yield, hectoliter weight, harvest index were determined. The examined agronomic characteristics of the wheat plant have changed over the years; plant height, number of spikes per m^2, number of grains per spike, 1000 grain weight, grain yield, hectoliter weight increased in the 2nd year, spike length and flag leaf area decreased. Although the effect of the applied materials did not make a statistically significant difference in all properties, the effects of biochar and biochar tea on plant height, husk application on the number of spikes per m^2, husk, husk tea and biochar applications on the number of grains per spike, 1000 grain weight and grain yield were prominent. On the other hand, according to the increase in application doses, all agronomic characteristics except spike length increased. It was found that 2 t/da dose application was sufficient for the development of the wheat plant. The total nitrogen and total phosphorus content of the plant was higher in the first year, and the total potassium content in the second year was higher. Depending on the increase in the application doses of the materials, the nitrogen, phosphorus and potassium concentrations of the plant increased. The effective dose was determined as 3 t/da dose of husk material in plant nitrogen and potassium concentration and biochar application in phosphorus concentration. When all the data were evaluated, the effect of the materials on the agronomic properties and nutrient content of the wheat plant did not come to the fore. It is thought that the trials should be studied for a long time in order to see the effects of the materials produced from husk raw material.

Keywords: Biochar, Extraction, Hazelnut Husk, *Tiriticum aestivum* L.

MODELISATION D'UNE CELLULE PHOTOVOLTAÏQUE MULTI JONCTION

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ABSTRACT
Photovoltaic energy, one of the most used renewable energies and the least harmful to the environment and non-polluting, consists of directly transforming radiation into electrical energy. This happens through a means of conversion called photovoltaic cell, based on the effect photovoltaic, and semiconductors and high-efficiency solar cells based on multi-layer semiconductors, this present work aims to study and simulate for two types of single-junction and multi-junction cells, the simulator is used AFORS-HET then presented some preliminary notions on the cell system and how it works photovoltaics and semiconductors and I presented the results of the simulation which show that the multi-junction cell is better than the single-junction cell. The problem encountered in photovoltaic energy is related to the increase in efficiency compared to recoverable energy; among the solutions the researchers and research turned to new structures to improve the number of layers of semiconductor in the photovoltaic cell. In this context we are interested in the simulation of triple junction cells and with single junction based on semiconductor and for the purpose of studying photovoltaic performance with the help of the AFORS-HET simulation software. The materials composing our cells are gallium nitride (Gan), gallium arsenide (GaAs) and germanium (Ge) and the second ones compose them are Zinc oxide (ZnO), and Crystalline silicone Si (p). The simulation with Afors-het software of ZnO/Si(p) and Gan/GaAs/Ge solar cells made it possible to observe the influence of the thickness of the front contact and the base and the doping of silicon and the temperature in the cells.

Keywords : Solar cells, energy, semiconductors, AFORS-HET, simulation

ENERGETIC, EXERGETIC AND EXERGO-ECONOMIC ANALYSES OF WHOLE MILK PRODUCTION IN CARTON ACEPTIC PACKAGE

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ABSTRACT

Milk is a white liquid food produced by mammals. More than six billion people worldwide consume milk and milk products, and between 750 – 900 million people live in dairy-farming households. Cow milk is one of the most consumed dairy drinks in the world. According to 2022 global consumption of fluid milk numbers by country, 85 million tons milk consumed in the India and the next largest consumption of milk was in the European Union, at 23.8 million tons and nearly 500 million tons in the worldwide. Overall the whole energy consumption in the dairy industry, 35% energy consumption was determined in the pasteurized – based dairy products such as whole milk. The number of the studies about energy, exergy and exergo-economy is increasing every year depending upon the increasing responsibility and awareness about saving the limited energy sources around the whole world. But industrial scale studies for performance analyses including exergo-economy in food and beverage sector are very rare and limited to the best of authors' knowledge. In this study, it was aimed to analyse industrial scale production performance of whole milk beverages in carton aseptic packaging from raw material to the final product in the secondary package. The overall energy and exergy efficiencies of whole milk beverages production lines were determined as 75.94% and 24.51% respectively. The exergy cost for destructed exergy was determined in the whole milk production (66.75 $/MJ). In addition, exery cost for unit production was determined as 135.09 $/MJ. The exergetic performances of each equipment in the related process line were compared. It is thought that this study will contribute valuable information on the exergo-economic performance of whole milk process lines to the food industry and literature. PhD Thesis titled as "Evaluation of Different Process Lines in Coffee Beverage Production via Sustainability Analyses".

Keywords: Performance, industrial scale, beverage, carton aseptic filling

ASSESSMENT OF LOCALLY SOURCED ILLITE/KAOLINITE CLAY AS AN ECO-FRIENDLY ADSORBENT FOR REMEDIATION OF PETROLEUM HYDROCARBON-CONTAMINATED GROUNDWATER

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ABSTRACT

The present study aimed to comprehensively evaluate the efficacy of locally sourced Illite/Kaolinite clay as an eco-friendly adsorbent for remediating petroleum hydrocarbon-contaminated groundwater. The raw clay, obtained from the prestigious Algerian Society of Kaolin (SOALKA), underwent a meticulously controlled acid activation process using a 5M sulfuric acid solution at 95°C for a duration of 1 hour. To ascertain the improvement in sorption properties resulting from the activation process, a systematic characterization and evaluation of the clay were performed utilizing advanced analytical techniques, namely X-ray diffraction, the BET method, and Fourier transform infrared spectroscopy. The obtained characterization results provided compelling evidence of the presence of clayey minerals, specifically Illite and Kaolinite, alongside quartz, as well as a significantly porous structure, as clearly demonstrated by their commendable specific surface area of 20.4121 m^2/g and 22.4981 m^2/g subsequent to activation. Subsequently, batch laboratory-scale experiments were meticulously executed employing a precisely determined water-to-clay ratio of 1:1 to meticulously explore the adsorption behavior of the clay materials. The efficacy of the adsorbents was meticulously evaluated, with a particular focus on the abatement of chemical oxygen demand (COD), biological oxygen demand (BOD_5), and critical hadrochemical parameters. Encouragingly, the comprehensive findings showcased remarkable COD removal efficiencies, attaining an impressive magnitude of 93.51% (raw clay) and a significantly enhanced 98.41% (activated clay) for oil-contaminated groundwater, and an equally noteworthy 92.6% (raw clay) and an astonishingly complete removal of 100% (activated clay) for gas-contaminated groundwater. Analogously, the BOD_5 removal percentages exhibited considerable magnitudes, reaching 80% (raw clay) and 85% (activated clay) for oil-contaminated groundwater, and an even more impressive 94.7% (raw clay) and an exceedingly high removal of 99.7% (activated clay) for gas-contaminated groundwater. The compliance of the treated groundwater samples with the irrigation standards was established through the rigorous application of the Wilcox diagram, thus affirming their suitability for irrigation purposes. Given the achieved results, the local Illite/Kaolinite clay emerges as an exceptionally promising candidate for water decontamination endeavours. However, in order to comprehensively evaluate the process's economic feasibility and long-term sustainability, further research endeavours, particularly

encompassing meticulous scale-up studies, are indispensable. The forthcoming comprehensive investigations will undoubtedly facilitate the seamless integration and practical implementation of this remarkable clay-based remediation strategy in real-world scenarios, thereby offering a tangible solution to the persistent challenges posed by petroleum hydrocarbon-contaminated groundwater.

Keywords: Illite/Kaolinite Clay, Adsorbent, Groundwater, Petroleum Hydrocarbon Contamination, Eco-Friendly, Acid Activation, Sorption Properties

A STUDY ON THE FINANCIAL AWARENESS AMONG AMONG UNDERGRADUATE STUDENTS IN HODEIDA PROVINCE IN YEMEN

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ABSTRACT

This study aims to identify the Level of Financial Awareness and financial knowledge Among Undergraduate Students in Yemen by using the measure Lusardi and how demographic factors influence their financial awareness. Students attending educational institutions of a higher level are expected to be responsible for managing their own expenses. As a result, the purpose of this study is to evaluate the level of financial awareness among students at Hodeida University and how demographic factors influence their level of financial awareness. Primary data were used in the research, and participants were chosen at random for the study. The population of the study comprises 180 respondents (A sample from Hodeida University in Yemen). The data for this research were collected using a technique known as convenience sampling. As the study's population is large and difficult to encompass, this method has been utilized frequently in previous studies. The results show that there is no difference in mean between gender on financial awareness, and the same result also shows for marital Status. It is also found that there is a significance difference between the mean among specializations. The result shows that both genders show an equal understanding of the concept of financial awareness students Married and Single have the same amount of knowledge on financial awareness. The finding also shows that students from the business administration and accounting department have higher financial awareness than those from the other Specialization. The conclusion the level of understanding of financial awareness among students is very high, and theoretically, they are able to understand matters related to finance.

Keywords: Financial awareness, financial literacy, financial knowledge

CHRONIC RESPIRATORY DISEASES: CAN DIET OR VITAMIN-ANTIOXIDANT SUPPLEMENTATION HELP?

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ABSTRACT
Currently, there is increasing evidence that vitamin C, vitamin D, vitamin E, carotenoids, omega-3 fatty acids and a plant-based diet can assist in protecting against the progression of chronic respiratory diseases. Recently, the role of diet and antioxidants in mitigating the effects of environmental pollution has also been publicized. This review evaluates the evidence for dietary interventions, including vitamin and antioxidant supplementation, and its potential to mitigate chronic respiratory disease. It appears that a Mediterranean diet is beneficial for patients with respiratory diseases, and its application has a beneficial effect on asthma, COPD, and lung cancer. However, further studies are necessary to investigate the effects of dietary interventions. It is challenging to design such studies due to interfering factors such as comorbidities, medication treatments, obesity, and environmental exposure. Nonetheless, until such studies arise, it is appropriate to consider formulating dietary recommendations and evaluating the role of appropriate diets and dietary supplements in individuals who are susceptible or at risk.

Keywords: Mediterranean diet, vitamins, minerals, antioxidants, asthma, COPD, lung cancer, omega-3 polyunsaturated fatty acids

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ÖZET

Bu çalışma, sera ortamında yetiştirilen salkım domateslerin el ile hasadında çalışanların maruz kaldığı zorlanmaları ve buna bağlı olarak ortaya çıkan ergonomik riskleri belirlemek amacıyla yapılmıştır. Türkiye domates yetiştiriciliğinde yıllara bağlı olarak değişmekle birlikte ilk üç sırada yer almaktadır. TÜİK 2021 yılı verilerine göre domates üretimi yaklaşık 32 milyon tondur. Serada yetiştirilen domates miktarı ise yaklaşık 5,5 milyon ton olmuştur. Domates yetiştiriciliğinin, iç ve dış pazarda ülke ekonomisine önemli katkısı bulunmaktadır. Tarım ürünlerinin yetiştirilmesinde, yapılan işler içersinde insan işgücü ve zaman bakımından en büyük payı hasat işlemi almaktadır. Ülkemizde sera tarımında işler çoğunlukla manuel gerçekleştirilmektedir. İşçiler hasat sırasında yapılan işe göre farklı zorlanmalara maruz kalmaktadır. Domates hasadında, çeşide bağlı olarak domateslerin olgunlaşma zamanları farklı olabilmektedir. Bu durum hasat işleminin tek seferde yapılmasını engellemektedir. Dolayısıyla hasat esnasında yapılan işler ve sergilenen vücut duruşları tekrarlanmaktadır. Domates hasadı sırasında meyveler el ile koparılmakla birlikte bu durum meyvenin etli bölümüne zarar vererek değerini düşüreceği için istenmemektedir. Hasat yaparken genellikle budama makası kullanılmaktadır. Domates hasadında iş istasyonları; meyvelerin salkımlarından kesilmesi, kasalara yerleştirilmesi ve kasaların depo alanına taşınması işlerinden oluşmaktadır. İşçiler, salkımları keserken farklı oturma şekilleri ya da uzanma şekilleri sergilemektedir. Hasat boyunca işçilerin çalışma duruşlar kayıt altına alınmış ve Ergo Fellow 2.0 paket programı ile REBA ve RULA yöntemleriyle analiz edilmiştir. Ayrıca tarım alanında kullanılmak üzere geliştirilen AWBA yöntemi ile de karşılaştırılmıştır. Budama makası kullanmanın, pençe kuvvetine etkisini belirlemek amacıyla pençe kuvveti ölçüm cihazı kullanılmıştır. Kuvvet ölçümleri hasat öncesinde, dinlenme esnasında ve hasat sonrasında yapılmıştır. Çalışmanın sonunda el ile domates hasadında meydana gelen ergonomik riskler belirlenmiş ve çözüm önerilerinde bulunulmuştur.

Anahtar Kelimeler: Ergonomik Risk, AWBA, REBA, RULA, Domates Hasadı

ERGONOMIC ANALYSIS OF TOMATO HARVESTING IN GREENHOUSE AGRICULTURE

ABSTRACT

This study was carried out to determine the strains experienced by the workers in the manual harvest of cluster tomatoes grown in the greenhouse environment and the ergonomic risks that arise accordingly. Turkey ranks in the top three in tomato cultivation, although it changes depending on the years. According to TUIK 2021 data, tomato production is approximately 32 million tons. The number of tomatoes grown in the greenhouse was approximately 5.5 million tons. Tomato cultivation has a significant contribution to the national economy in the domestic and foreign markets. In the cultivation of agricultural products, the harvesting process takes the most significant share in terms of human labor and time. In our country, work in greenhouse agriculture is mainly carried out manually. Workers are exposed to different strains according to the work done during the harvest. In tomato harvest, tomatoes' ripening times may differ depending on the variety. This prevents the harvesting process from being done in one go. Therefore, the work done and the body postures exhibited during the harvest are repeated. Although the fruits are plucked by hand during the tomato harvest, this is undesirable as it will damage the fleshy part of the fruit and reduce its value. Pruning shears are generally used when harvesting. Workstations in tomato harvest; These consist of cutting the fruits from their clusters, placing them in crates, and transporting the boxes to the storage area. Workers exhibit different sitting or lying down shapes while cutting the grapes. During the harvest, the working postures of the workers were recorded and analyzed with the Ergo Fellow 2.0 package program and REBA and RULA methods. It was also compared with the AWBA method developed for use in agriculture. A claw force measuring device was used to determine the effect of using pruning shears on claw strength. Force measurements were made before, during, and after harvest. At the end of the study, ergonomic risks in manual tomato harvesting were determined, and solutions were suggested.

Keywords: Ergonomic Risk, REBA, AWBA, RULA, Tomato Harvesting

ANIMAL SCIENCE: A REVIEW

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ABSTRACT
In India, seventy per cent of livestock farmers belong to the category of small marginal farmers and landless labourers and hence, complete privatization of veterinary services is not advisable so as to protect their interests. Instead, implementation of cost recovery measures for selected veterinary services would be a feasible option, which could reduce the financial burden on Government and improve the quality of the veterinary services. Further, while implementing the cost frecovery measures, the costs for different services can be fixed taking in to consideration the costs of inputs involved in providing those services. For instance, nominal service charge can be collected for services like minor surgical treatment, pregnancy diagnosis, deworming and vaccination, nominal service charge with subsidy on the cost of inputs supplied can be collected for services like artificial insemination, diagnostic services, major surgical, medical gynaecological and obstetrical treatment whereas the extension services like livestock advisory services and supply of publications must be provided free of cost by the Government.

Keywords: Animals, farmer, surgical treatment

IN VITRO KOLHİSİN UYGULAMALARININ ANTER KÜLTÜRÜNDE EMBRİYO VERİMİ ÜZERİNE ETKİLERİ

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ÖZET

Kolhisin, *Colchicum* cinsinin bitkilerinden ekstrakte edilen, birçok türde dihaploidizasyon çalışmaları için en çok tercih edilen ve antimitotik ajan olarak kullanılan toksik doğal bir üründür. Bu çalışmada, *in vitro* farklı kolhisin uygulamalarının anter kültüründe embriyo verimine ve embriyoların gelişmesine etkisi incelenmiştir. Çalışmada 30 g L^{-1} sukroz, %0.25 aktif kömür, 4 mg L^{-1} NAA, 0.1 mg L^{-1} BAP, 15 mg L^{-1} $AgNO_3$ ve 8 g L^{-1} agar içeren MS ortamı kontrol ortamı olarak kullanılmıştır. Anterler %0.00 (kontrol), %0.3, %0.4 ve %0.6 dozlarında kolhisin ilave edilen yarı katı ve çift fazlı ortamlarda kültüre alınmıştır. Anterler kültüre alınışının 14. ve 21. gününde kolhisin, aktif kömür ve $AgNO_3$ içermeyen rejenerasyon ortamına transfer edilmiştir. Uygulanan farklı kolhisin dozlarının anter kültürü ile elde edilen embriyo oranına etkileri önemli bulunmuştur. Elde embriyo oranına ortam, doz, 'ortam x doz', 'süre x doz' ve 'ortam x süre x doz' interaksiyonları %1 önem seviyesinde önemli etkide bulunmuştur. En yüksek embriyo oranı (%27.30) yarı katı ortamda 14 gün süreyle %0.6 kolhisin dozunda belirlenmiştir. Bunu 21 gün süreyle %0.4 kolhisin uygulaması %26.57 embriyo oranıyla izlemiştir. Çift fazlı ortamlarda en yüksek embriyo oranı %25.94 ile 14 gün %0.00 (kontrol) uygulamasından elde edilmiştir. Yarı katı ortam %23.70 embriyo oranı ile çift fazlı ortamdan (%14.44) daha başarılı olarak tespit edilmiştir. Elde edilen embriyoların tamamı gelişip tam bir bitkiye dönüşmemiştir. Embriyoların bitkiye dönüşüm oranlarında doz, 'ortam x doz' ve 'ortam x süre x doz' interaksiyonu önemli bulunmuştur. En yüksek bitki gelişim oranı %0.4 kolhisin uygulanan yarı katı ortamda %50.90 ve çift fazlı ortamda %50.70 olarak hesaplanmıştır. En düşük bitki gelişim oranı (%29.08), %0.3 kolhisin uygulamasından elde edilen embriyolarda belirlenmiştir.

Anahtar Kelimeler: Kolhisin, anter kültürü, embriyo

THE EFFECTS OF *IN VITRO* COLCHICINE APPLICATIONS ON EMBRYO FREQUENCY IN ANTHER CULTURE

ABSTRACT

Colchicine is a toxic natural product extracted from plants of the genus *Colchicum*, most preferred for dihaploidization studies in many species and used as an antimitotic agent. In this study, the effects of different *in vitro* colchicine applications on embryo yield and development of embryos in anther culture were investigated. MS nutrient medium containing 30 g L^{-1} sucrose, 0.25% activated charcoal, 4 mg L^{-1} NAA, 0.1 mg L^{-1} BAP, 15 mg L^{-1} $AgNO_3$ and 8 g L^{-1} agar was used as control treatments. Anthers were cultured in semi-solid and double-layer medium which colchicine was added at 0.00% (control), 0.3%, 0.4% and 0.6% doses. Anthers were transferred to regeneration medium without colchicine, activated charcoal and $AgNO_3$ on the 14th and 21st days of culture. The effects of different colchicine applications on the embryo rate obtained by anther culture were found to be significant. It was determined that medium, dose, the interaction of 'medium x dose', 'time x dose' and 'environment x time x dose' had a significant effect on the embryo ratio at the 1% significance level. The highest embryo rate (27.30%) was determined in semisolid medium at 0.6% colchicine dose for 14 days. This was followed by the application of 0.4% colchicine for 21 days with a rate of 26.57% embryos. In double-layer medium, the highest embryo rate was obtained with 25.94% and 0.00% (control) application for 14 days. Semi-solid medium was found to be more successful than double-layer medium (14.44%) with 23.70% embryo rate. All of the embryos obtained didn't develop into a complete plant. The interaction of 'medium x dose', and 'medium x time x dose' was found to be important in the conversion rates of embryos to plants. The highest plant growth rate was calculated as 50.90% in semi-solid medium and 50.70% in double-layer medium applied 0.4% colchicine. The lowest (29.08%) plant growth rate was determined from embryos obtained from 0.3% colchicine application.

Keywords: Colchicine, anther culture, embryo

OPTIMIZATION OF UNIQUE MEDIA PRODUCTION FOR ENHANCED BIOACTIVITY OF *PLEUROTUS OSTREATUS* MYCELIA

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ABSTRACT

The *Pleurotus ostreatus* (oyster mushroom) play an important role in improving and balancing gut microbiota composition. The objective of this study is to investigate the impact of mushroom liquid-based solid media on the growth rate and morphology of *P. ostreatus*, aiming to develop a feed supplement that contains a huge amount of antimicrobial and prebiotic agents. To prepare the media, raw mushrooms were appropriately washed, sliced, and placed in a sealed pressure cooker. The pressure cooker was then kept in a drying cabinet at 90±0.1 °C for 24 hours. After 4 hours, the pressure cooker was removed from the drying cabinet. The solid and liquid fractions were separated using a centrifuge (1200 rpm for 8-10 minutes), then the final liquid was characterized by spectrophotometric and ICP-OES methods. Medias with various concentrations were prepared by combining oyster mushroom liquid with 0%, 25%, 50%, and 75% distilled water (LGA). The growth rate and morphology of *P. ostreatus* mycelia on different solid media, including its own liquid in different dilutions and *A. bisporus* mushroom liquid-based solid media (CSGA) without dilution, as well as Malt extract media as a control, were determined. Autoclaving (121 °C, 20 minutes, 1.5-2.0 bar) and the mycelia transfer were carried out next to aseptic conditions. Based on the spectrophotometric measurements, the average values of DPPH were found to be 27.53±7.14 SC%, the total polyphenol content was 98.87±21.19 mg GAE/100 g, and the flavonoid content was 9.94±12.90 mg CE/100 g for the original matter. The average values of Ca (89.9±17.6 mg/l), K (1947±150.2 mg/l), Mg (105.6±9.9 mg/l), Na (49.6±4.1 mg/l), and P (424.4±66 mg/l) for the original matter were determined using ICP-OES analysis. The density of mycelia colonized in 100% oyster liquid media was the highest and most compact, while the colony grown on MEA agar was significantly less dense. Whole colonization was achieved within 6 days on LGA and MEA. However, it took an additional 8 days to utilize the nutrients from *A. bisporus* liquid-based media. According to the results, it can be said that the best media for mycelial growth is its own liquid. However, further studies are required to identify the most optimal and cost-efficient method for producing mycelia with increased bioactivity and develop effective feed supplements.

Keywords: mycelia, increased bioactivity, colonization; density, growth rate

CRUELTY TO ANIMALS: A REVIEW

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ABSTRACT
Animal Cruelty cases make headlines around the world every day, whether it's the person who kills the neighbor's cat, the hoarder of sick and dying animals, or the family whose freezing, starving dog is tied up outside in the middle of the winter. Animal Cruelty has several types which may be Simple Neglect, Gross Neglect, Intentional Abuse, Animal Hoarding and Organized Abuse, Ritualistic Abuse, or Animal sexual assault. These cases of Cruelty cannot be overlooked as it has proven to have severe implications ranging from the fact that it is linked to other crimes, to the factual truth that these practices inflict great pain on these animals that have nobody to speak for them. Combating this menace of Animal Cruelty is a Journey that must be undertaken and everybody including the Government, NGOs, and even Culture has a major role to play in this. This review looks at Animal Cruelty in the world while paying a little more attention to Nigeria.

Keywords: Animals, world, Nigeria

ÇİFTLİK HAYVANLARINDA LAKTASYON EĞRİLERİNİN BİBLİYOMETRİK ANALİZİ

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ÖZET
Bu çalışma, 1980 ile 2023 yılları arasında WOS veri tabanındaki 1455 çalışmadan elde edilen verilere dayanarak, çiftlik hayvanlarında laktasyon eğrisi modellemesinin bibliyometrik analizini sunmaktadır. Elde edilen sonuçlarda, 26 çalışmayla öne çıkan yazar Macicotta NPP ve çalışma sayısı açısından Cornell Üniversitesi önde gelen kurum olarak görülmüştür. Bu alanda en önemli dergi olarak Journal of Dairy Science, 393 makaleyle öne çıkmaktadır. Temsil edilen ülkeler arasında Türkiye, 44 çalışma ile 13. sırada yer almakta ve bu çalışmaların çoğunluğu yerel yazarlarla iş birliği içinde yürütülmektedir. Bu bulgular, laktasyon eğrileri alanında gelecekteki araştırma çalışmaları için değerli bir perspektif sunmakta ve ortak yazar seçimi, dergi seçimi ve ilgili anahtar kelimeler konusunda rehberlik sağlamaktadır. Çalışmanın sonucunda, çiftlik hayvanlarında laktasyon eğrilerinin kullanımı için farklı matematik modellerin kullanılması ve yaygınlaşması gerektiği düşünülmektedir.

Anahtar Kelimeler: bibliyometrik analiz, laktasyon eğrisi, laktasyon eğrisi modelleri, süt verimi

BIBLIOMETRIC ANALYSIS OF LACTATION CURVES IN LIVESTOCK

ABSTRACT

This study presents a bibliometric analysis of lactation curve modeling in livestock based on 1455 articles from the WOS database spanning 1980 to 2023. It highlights the prominent researcher Macicotta NPP with 26 publications and identifies the University of Cornell as the leading institution in terms of publication count. The Journal of Dairy Science emerges as the most relevant journal in the field, with 393 papers. Among the countries represented, Turkey ranks 13th with 44 studies, primarily conducted in collaboration with other local authors. These findings offer valuable insights for future research endeavors in the domain of lactation curves and provide guidance on coauthor selection, journal selection, and relevant keywords. Therefore, it is suggested in this study that the lactation curve studies should be supported with different math models in livestock.

Keywords: bibliometric analysis, lactation curve, models of lactation curve, milk yield

STRATEGI KOTA PEKALONGAN DALAM PENGEMBANGAN PARIWISATA KREATIF BERBASIS INDUSTRI BATIK

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ABSTRACT

Purpose/Tujuan: Tujuan dari penelitian studi kasus adalah untuk memahami kompleksitas yang terjadi pada kasus yang diambil dan memahami makna dari situasi atau isu yang terjadi di lapangan. Penelitian ini menggunakan studi kasus sebagai pendekatan penelitian. Penelitian studi kasus didefinisikan sebagai strategi penelitian. Melalui penelitian ini, diharapkan dapat diambil pelajaran dari Kota Pekalongan mengenai strategi yang telah dilakukan oleh para pelaku pariwisata kreatif berbasis industri batik. **Design/methodology/approach:** Penelitian ini menggunakan metode penelitian studi kasus kualitatif. Data primer yang dibutuhkan dikumpulkan melalui observasi kegiatan di museum batik dan kampung batik, serta wawancara dengan para pengambil kebijakan, pengelola museum dan pelaku industri batik. Sementara itu, data sekunder dikumpulkan dari dinas-dinas terkait instansi terkait. **Findings/Temuan:** Pertama, Karakteristik Pelaku Pariwisata Kreatif di Kota Pekalongan, dengan kreatifitas masyarakat pekalongan dapat Meningkatkan Kemakmuran bagi masyarakat lokal serta meningkatkan keberhasilan usaha lokal. Kedua, Kedudukan dan keunikan seni/budaya, dan kerajinan local yang ditawarkan. Penawaran tur atau paket wisata kreatif pembuatan batik baik oleh Museum Batik maupun Kampung Batik ini memberikan kesempatan yang berbeda bagi wisatawan. Kegiatan wisata kreatif batik ini dapat memberikan pegalaman yang unik, berkesan, dan bermanfaat bagi wisatawan. Ketiga, Akomodasi dan infrastuktur penunjang pengembangan wisata kreatif. Kegiatan wisata tidak hanya sebatas pemenuhan terhadap atraksi pada destinasi wisata, namun termasuk juga pemenuhan terhadap kebutuhan akan jasa-jasa selama wisatawan berada di destinasi wisata. Jasajasa dalam wisata diantaranya adalah sarana dan pelayanan akomodasi. Pelayanan akomodasi ini diantaranya adalah berupa penginapan, dan restoran. Keempat, Kesadaran dari Masyarakat Kota Pekalongan mengenai pengembangan Batik di Kota Pekalongan tidak hanya untuk kaum dewasa saja tatpi juga kesadaran dan minat kaum muda terhadap Pengembangan Batikdi Kota Pekalongan.Kelima, Kebijakan Pemerintah Kota Pekalongan terkait Pengembangan Pariwisata Kreatif berbasis Industri Batik, hal ini dilakukan dengan cara (1) Penataan lingkungan (2) Peningkatan kapasitas sumber daya manusia (3) Melakukan promosi (4) Integrasi pariwisata kreatif dengan pariwisata budaya dan belanja (5) Pengembangan industri pendukung batik.(6) Inovasi pemasaran dan pengenalan Batik melalui berbagai cara baik offline maupun online. **Originality/value/Nilai:** Penelitian ini menemukan bahwa wisata kreatif berbasis batik ini sangat unik dan memiliki kedudukan yang strategis di Kota Pekalongan yang merupakan saah satu sentra industri batik di Pulau Jawa

Keywords: Pariwisata Kreatif, Batik, Strategi Pelaku

EFFICACY OF VERMI-COMPOST ON SEED GERMINATION AND SEEDLING GROWTH PARAMETERS OF WHEAT (*Triticum aestivum* L.)

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ABSTRACT
Fertilizers made of chemical not only demolished the ground fertility but also eliminate the growth of beneficial soil microorganisms. Vermicompost is used as natural organic biofertilizer for the production of crops and ornamental plants. Therefore, The aim of this study was to see how cow dung-based vermicompost affected seed germination and seedling growth in *Triticum aestivum* L. (Wheat). Media for germination (soil + sand) and different concentrations of vermicompost were used in the current analysis. i.e., 10%, 15%, 20%, 25%, 30% and 35% were prepared. Cow dung + soil (Tcc) and soil + sand (To) was used as control germination media. Various seed germination parameters were evaluated, including seed germination speed, germination initiation, germination percentage, germination value, peak value, mean daily germination, and mean germination time. Similarly, vegetative growth parameters like whole length of plant, shoot length, root length, leaf area, fresh weight of shoot, dry weight of shoot, fresh weight of root, and dry weight of root were observed. During germination temperature and moisture contents of media for germination were also observed for each treatment. Results revealed that the best seed germination of *Triticum aestivum* L. (Wheat) was recorded in 15% vermicompost amended germination media while vegetative growth parameters were recorded in 35% vermicompost amended germination media compared to control treatments and other vermicompost amended germination media. We observed that wheat output is more robust when vermicompost is used., could be suitable for preparing the wheat seedlings than other soil media, and could be produced at commercial level. Further, the seed germination and growth parameters showed significant results under shade house. Vermicompost is both cost-effective and environmentally friendly, and it helps to improve soil health. So, we need to try in open conditions as well to promote the values of vermi-composts in Azad Jammu and Kashmir, Pakistan for the better use as agricultural purposes.

Keywords: *Triticum aestivum*, compost, seed

INVESTIGATION OF GENOTOXIC EFFECT OF INSECTICIDE CHROMAGOR AT FISH GOLDFISH (CARASSIUS AURATUS), AFTER 14 DAYS OF TREATMENT

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ABSTRACT
The main objective of this study is to estimate the genotoxic effect of insecticide chromagor, in erythrocytes of fish goldfish, after 14 days of treatment. Concentrations of insecticide chromagor, it was in first aquarium 6 ml insecticide chromagor / 40 liter water, in second aquarium 4 ml insecticide chromagor / 40 liter water, in third aquarium 2 ml insecticide chromagor / 40 liter water, in fourth aquarium 1 ml insecticide chromagor / 40 liter water. Fifth aquarium uses as control, without insecticide chromagor, contain only drinking water. The frequency of micronuclei and nuclear buds were estimated by counting 2000 cells in extensions. In each aquarium put ten (10) fish, total number of fish is 50 fish. Obtained results show that number of micronucleus and nuclear buds at treated fishes is higher, compared with fish of control group.

Keywords: Genotoxic effect of insecticide zchromagor at fish goldfish (Carassius auratus)

SYNTHESIS AND CHARACTERIZATION OF A K2NIF4 STRUCTURAL MATERIAL

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ABSTRACT
This work aims at the synthesis and characterization of K2NiF4 structural materials. This structure presents the first member (n=1) of the Ruddlesden-Popper (RP) phases, with a general formula An+1BnO3n+1. The structure of K2NiF4 is generally described as a tetragonal layered structure, considered as an alternating arrangement of fluoride ion layers and potassium and nickel ion layers. Materials with this type of structure have several interesting properties, such as superconductivity, ionic and electronic conduction, photocatalysis, magnetism and magnetoresistance. These properties may vary depending on the specific conditions and possible dopings of the K2NiF4 structure. We are going to prepare these solid solutions of general formula A2B0.5B'0.5O4 [A2In0.5Sb0.5O4 (A: Sr, Ba)] by solid method. Their characterization was carried out by different techniques, such as X-ray diffraction (XRD), scanning electron microscopy (SEM) and infrared spectroscopic analysis (IRTF).

Keywords: perovskite, K2NiF4, XRD, SEM

FULL TEXTS

SAMSUN EKOLOJİK KOŞULLARINDA YETİŞTİRİLEN BAZI BÖRÜLCE ÇEŞİTLERİNİN (*Vigna unguiculata* (L.) Walp) OT VERİMİ VE BAZI MORFOLOJİK ÖZELLİKLERİNİN BELİRLENMESİ

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ÖZET

Börülce sıcak mevsim baklagillerinden olup, küresel iklim değişikliği nedeniyle gittikçe sıcaklığın arttığı ve suyun tükendiği günümüz ve gelecekte, dikkat çekici bir bitki olacaktır. Börülce baklagiller içerisinde sıcağa ve kurağa dayanımı en iyi olan bitkilerden birisidir. Börülce genellikle insan ve hayvan beslenmesinde ve yeşil gübre bitkisi olarak kullanılır. Bu çalışma Samsun ekolojik koşullarında iki lokasyonda (Kurupelit ve Çarşamba) yetiştirilen bazı börülce genotiplerinin kuru ot verimi ve tarımsal özelliklerini belirlemek amacıyla yürütülmüştür. Denemede yem amaçlı Ülkem börülce çeşiti ile bir börülce genotipi, yemeklik börülce çeşitleri Sırma, Amazon ve Karagöz-86 kullanılmıştır. Çalışma Tesadüf Blokları Deneme Deseninde 4 tekrarlamalı olarak kurulmuştur. Ekim işlemi Kurupelit lokasyonunda 30 Mayıs 2019, Çarşamba lokasyonunda 31 Mayıs 2019 tarihlerinde yapılmıştır. Ot üretimi amacıyla hasat bitkilerin alt baklalarında tanelerin belirginleştiği dönemde Kurupelit lokasyonunda 8 Ağustos 2019, Çarşamba lokasyonunda 7 Ağustos 2019 tarihlerinde yapılmıştır. Çalışmada bitki boyu, ana sap kalınlığı, yeşil ve kuru ot verimi özellikleri incelenmiştir. Lokasyonların ortalaması olarak bitki boyu 40.42-80.08 cm arasında, ana sap kalınlığı 6.91-10.44 mm arasında belirlenmiştir. Yeşil ot verimi 1263.02-5493.59 kg/da arasında, kuru ot verimi ise 324.12- 1276.84 kg/da arasında değişmiş, en yüksek kuru ot verimi Çarşamba lokasyonunda Ülkem çeşitinde belirlenmiştir. Kurupelit lokasyonunda bitki boyu 40.42 -63.42 cm, ana sap kalınlığı 6.91 – 9.79 mm, yeşil ot verimni 1263.02 – 1926.04 kg/da ve kuru ot verimi ise 324.12 – 535.39 kg/da arasında belirlenmiştir. Çarşamba lokasyonunda bitki boyu değerleri 54.25 – 80.08 cm, ana sap kalınlığı 7.44 – 10.44 mm, yeşil ot verimi 3440.10 – 5493.59 kg/da ve kuru ot verimi 805.17 - 1276.84 kg/da aradında değişmiştir. Bölgemizde kaba yem açığının azaltılabilmesi için, yazlık yem bitkisi olarak yemlik börülce çeşit/genotipleri yetiştirilebilir.

Anahtar Kelimeler: Yemlik Börülce, Yeşil Ot Verimi, Kuru Ot Verimi, Lokasyon

DETERMINATION OF FORAGE YIELD AND SOME MORPHOLOGICAL CHARACTERISTICS OF SOME COWPEA GENOTYPES (Vigna unguiculata (L.) Walp) GROWED IN SAMSUN ECOLOGICAL CONDITIONS

ABSTRACT

This study was carried out to determine hay yield and agricultural characteristics of some cowpea genotypes grown in Samsun ecological conditions in two locations (Kurupelit and Çarşamba). In the experiment, Ülkem cowpea cultivar and a cowpea genotype, edible cowpea cultivars Sırma, Amazon and Karagöz were used. The study was set up in a Random Blocks Trial Design with 4 replications. The sowing process was carried out on 30 May 2019 at Kurupelit location and on 31 May 2019 at Çarşamba location. Harvesting for forage production was performed on 8 August 2019 at Kurupelit location and on 7 August 2019 at Çarşamba location during the period when the grains were evident in the lower pods of the plants. In the study, plant height, main stem thickness, green forage and hay characteristics were examined. Plant height was determined between 40.42-80.08 cm and main stem thickness was between 6.91-10.44 mm as the average of the locations. Green forage yield ranged between 1263.02-5493.59 kg/da, hay yield ranged between 324.12-1276.84 kg/da, and the highest hay yield was determined in Ülkem variety in Çarşamba location. Plant height was determined between 40.42 -63.42 cm, main stem thickness 6.91 - 9.79 mm, green forage yield between 1263.02 - 1926.04 kg/da and hay yield between 324.12 - 535.39 kg/da in Kurupelit location. Plant height values changed between 54.25 – 80.08 cm, main stem thickness 7.44 – 10.44 mm, green forage yield between 3440.10 – 5493.59 kg/da and hay yield between 805.17 – 1276.84 kg/da in Çarşamba location. Forage cowpea varieties/genotypes can be grown as summer fodder crops in order to reduce the roughage deficit in our region.

Keywords: Cowpea, Green Forage Yield, Hay Yield, Location

GİRİŞ

Yem bitkileri üretimi, sağlanan önemli artışa rağmen halen ihtiyacı karşılamaktan uzaktır. Bunun sebeplerinden biri zaten uzun yıllara dayanan yüksek düzeyde bir yem açığının olmasıdır. Özellikle yaz aylarında eraların kuruması nedeniyle kış aylarında ve yaz ortasında yem eksikliği daha yüksek seviyelere ulaşmaktadır (Acar ve ark. 2020). Dolayısıyla bu dönemdeki yem açığını kapatmak için sıcak mevsim bitkilerine ihtiyaç vardır.

Börülce (*Vigna unguiculata* L. Walp.) tek yıllık, otsu yapıda, sıcak mevsim baklagil bitkisidir. Börülce insan beslenmesi yanında hayvan yemi olarakta kullanılmaktadır. Ayrıca köklerinde yaşayan *Rhizobium* bakterileri sayesinde havadaki serbest azotu toprağa bağlayarak toprağın zenginleşmesini sağlar. Ayrıca kuraklık ve yüksek sıcaklığa kültürü yapılan birçok bitkiye göre daha toleranslıdır (Can ve ark. 2021). Börülce genellikle insan ve hayvan beslenmesinde ve yeşil gübre bitkisi olarak kullanılır. Hayvan beslenmesinde yeşil ve kuru ot, silaj (özellikle sorgum ve darılarla) ve kuru taneleri kullanılmaktadır. Yüksek bir besleme değerine sahip olan börülcenin yeşil yemi % 14-21, taneleri ise % 18-26 oranında ham protein içermektedir (Adeyanju ve ark., 2007; Ali ve ark., 2004). Ayrıca, mera olarak otlatılarak da kullanılmaktadır. Yeşil yem üretiminde alt baklaların tane doldurmaya başladığı dönemde biçilmekte ve dekara 1500 – 2000 kg verim elde edilmektedir. Dane verimi ise 100-250 kg/da olup, daneleri ham protein içeriği (% 23-31), lysin ve tryptophan bakımından zengindir (Gençkan, 1983). Börülcenin yeşil ot amaçlı yalnız yetiştirildiğinde dekara 2907.5 kg verim elde edilebileceği, silaj için mısır, sorgum ve darılar ile karışık yetiştirilebileceği belirtilmektedir (FAO, 2009).

Börülce, Türkiye'de tarım sisteminde ana ürün veya ikinci olarak yetiştirilebilir (Can ve ark. 2020). Tek yıllık ve baklagil bitkisi olması nedeniyle özellikle tahıl yetiştiriciliği yapılan alanlarda ekim nöbetine dahil edilebilir. Börülce tarımı hem ülkemizde, hem de Orta Karadeniz Bölgesi'nde son yıllarda artmaktadır. Bununla birlikte tarımı hala oldukça sınırlı bir alanda yapılmaktadır. Hem bitkisel özellikleri, hem de yetiştiriciliği bakımından fasulyeye benzerliği nedeniyle çiftçiler tarafından yadırganmamaktadır. Yaptığımız gözlemler sonucunda, börülce bitkisi kuruduğunda sapları sağlam olduğu için kırılmamakta, yaprakları çok fazla ufalanıp dökülmemekte ve kuru otta meydana gelen fiziksel kayıplar az olmaktadır. Börülce, bölgede yalnız ve karışık olarak ekilebilir. Yalın ekimleri daha çok yeşil/kuru ot, karışık ekimler ise silaj amaçlı yapılabilir. Bölgede yapılan birinci ürün çalışmaları sonucunda yemlik börülcenin 30 – 50 cm sıra aralığı ile yetiştirilebileceği önerilmektedir (Ayan ve ark., 2012 ve Ayan ve ark., 2017).

Bu çalışma Samsun ekolojik koşullarında iki lokasyonda (Kurupelit ve Çarşamba) yetiştirilen bazı börülce genotip/çeşitlerinin kuru ot verimi ve bazı tarımsal özelliklerini belirlemek amacıyla yürütülmüştür.

MATERYAL ve METOT

Bu çalışma farklı börülce çeşitlerinin kuru ot verimi ve bazı morfolojik özelliklerini belirlemek amacıyla Samsun ekolojik koşullarında iki lokasyonda (Kurupelit ve Çarşamba) Tesadüf Blokları Deneme Desenine göre 4 tekrarlı olarak yürütülmüştür. Bitki materyali olarak, Ondokuz Mayıs Üniversitesi Ziraat Fakültesi tarafından yem üretimi amaçlı geliştirilen Ülkem börülce çeşiti ile börülce genotipi (Hat-8), kuru tane tüketimi (yemeklik) amacıyla geliştirilen Sırma ve Amazon börülce çeşitleri ile Çoker Tohumculuk tarafından sertifikalı tohumluk üretimi yapılan Karagöz 86 börülce çeşitleri kullanılmıştır. Ekim işlemi Kurupelit lokasyonunda 30 Mayıs 2019, Çarşamba lokasyonunda 31 Mayıs 2019 tarihlerinde yapılmıştır. Ekimden önce toprak analiz sonuçları dikkate alınarak, dekara 4 kg N olacak şekilde amonyum sülfat ve 8 kg P_2O_5 olacak şekilde triple süper fosfat gübresi verilmiştir. Çalışmada her bir parsel 4 metre uzunluğunda ve 4 sıradan oluşmuştur. Tohumlar sıra arası mesafesi 30 cm, sıra üzeri 10 cm olacak şekilde parsellere ekilmiştir. Ot hasatı, bitkilerin alt baklalarında tanelerin belirginleştiği dönemde Kurupelit lokasyonunda 8 Ağustos 2019, Çarşamba lokasyonunda 7 Ağustos 2019 tarihlerinde yapılmıştır. Hasat sırasında her parselde seçilen 10 bitkide dğal bitki boyu ve ana sap kalınlığı ölçülmüştür. Parseller içilerek hasat edildikten sonra yeşit ot verimi ve alınan ot örneklerinin 60 ^{0}C'de sabit ağırlığa gelene kadar kurutulmuş ve dekara kuru ot verimi hesaplanmıştır.

Denemeden elde edilen sonuçlar SPSS 25.0 V. İstatistik Paket programı kullanılarak, Tesadüf Blokları Deneme Desenine göre analiz edilmiştir. Ortalamalar arasındaki farklar Duncan Çoklu Karşılaştırma Testi kullanılarak değerlendirilmiştir (Açıkgöz, 1993; Gülümser ve ark., 2013).

Deneme Yerinin Özellikleri

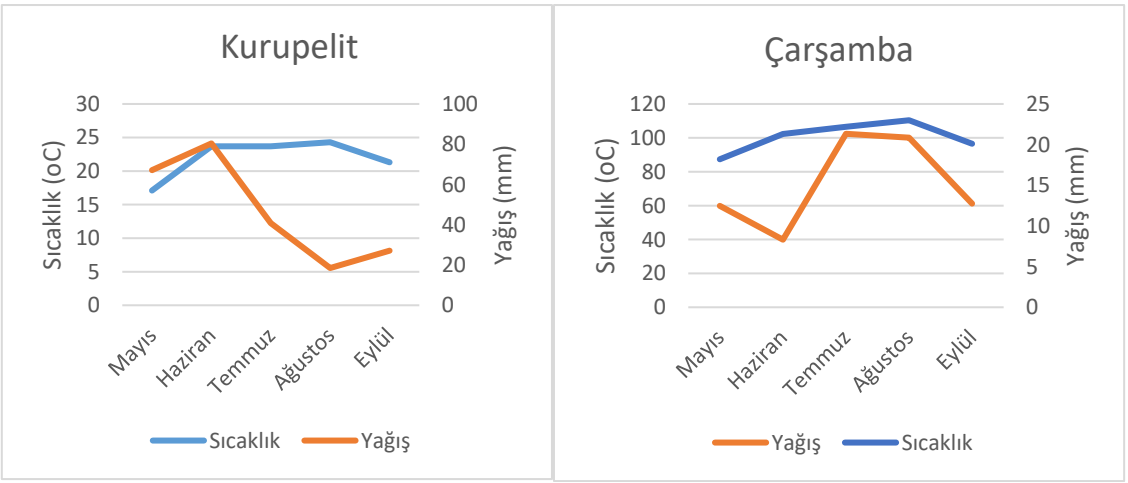
Deneme Kurupelit ve Çarşamba lokasyonlarında yürütülmüştür. Kurupelit lokasyonu; Ondokuz Mayıs Üniveristesi, Ziraat Fakültesi araştırma ve uygulama Arazisinde yer almakta olup, denizden yüksekliği yaklaşık olarak 120 metredir. Çarşamba lokasyonu ise Karadeniz Tarımsal Araştırma Enstitüsü Müdürlüğü'nün Çarşamba– Ambarköprü'de bulunan uygulama ve araştırma alanında yürütülmüştür. Deneme yerinin denizden yüksekliği yaklaşık olarak 3 metredir.

Çizelge 1. Denemenin yürütüldüğü lokasyonalara ait toprak analiz sonuçları*

	Kurupelit		Çarşamba	
	Değeri	Derecesi	Değeri	Derecesi
Tekstür (%)	28.0 kum, 26.9 silt, 45.0 kil	Killi	30.4 kum, 37.72 silt, 32.88 kil	Killi tın
pH	6,34	Hafif asit	7,54	Hafif alkali
Toplam tuz (mmhos/cm)	0,48	Tuzsuz	0,03	Tuzsuz
Kireç ($CaCO_3$ %)	2,18	Az kireçli	10,5	Kireçli
Organik madde (%)	3,37	Yüksek	1,23	Az
Alınabilir fosfor (P_2O_5 ppm)	65,4	Çok yüksek	61	Çok yüksek
Potasyum (ppm)	340	Çok yüksek	360	Çok yüksek

*Toprak analizleri Ondokuz Mayıs Üniversitesi Ziraat Fakültesi Toprak Bilimi ve Bitki Besleme Bölümünde yapılmıştır.

Kurupelit ve Çarşamba lokasyonları toprak tekstürü bakımından birbirinden farklı yapıya sahiptir. Kurupelit lokasyonu killi yapıya sahipken Çarşamba lokasyonu killi tınlı bir yapıya sahiptir. Deneme alanı toprağı Kurupelit lokasyonunda az kireçli, Çarşamba lokasyonunda ise kireçlidir. Organik madde içeriği ise Kurupelit lokasyonunda yüksek, Çarşamba lokasyonunda ise az olarak belirlenmiştir (Çizelge 1).



Şekil 1. 2019 yılı börülce bitkisinin yetiştiği dönemde Kurupelit ve Çarşamba lokasyonlarına ait iklim diyagramları (MGM, 2020)

Meteoroloji Genel Müdürlüğü verilerine göre börülce bitkisinin yetiştiği dönemlerde Kurupelit ve Çarşamba lokasyonlarında en yüksek ortalama sıcaklık Ağustos ayında, en az yağış Kurupelit lokasyonunda Ağustos ayında, Çarşamba lokasyonunda ise Haziran ayında düşmüştür (Şekil 1).

BULGULAR ve TARTIŞMA

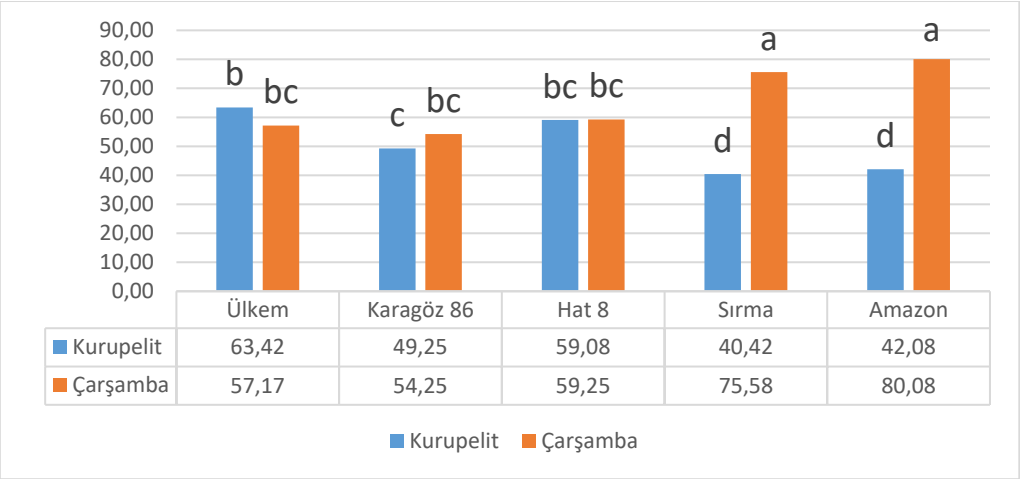
Samsun ekolojik koşullarında iki lokasyonda (Kurupelit ve Çarşamba) yetiştirilen bazı börülce genotip/çeşitlerinin kuru ot verimi ve bazı tarımsal özelliklerini belirlemek amacıyla yürütülen bu çalışmada belirlenen bitki boyu, ana sa kalınlığı, yeşil ot verimi ve kuru ot veriine ait ortalama değerler ve ortalamalar arasındaki farklılıklar Çizelge 2 ve Şekil 2, 3, 4 ve 5'de verilmiştir.

Bitki boyu bakımından lokasyonlar arasındaki farklılıklar ve lokasyon x genotip/çeşit interaksiyonu önemli bulunmuştur. En yüksek ortalama doğal bitki boyu Çarşamba lokasyonunda Amazon (80.08 cm) ve Sırma (75.58 cm) genotiplerinde belirlenmiştir. En düşük ortalama bitki boyu ise Kurupelit lokasyonunda Sırma genotipinde 40.42 cm olarak belirlenmiştir (Çizelge 2, Şekil 2). Samsun koşullarında yürütülen bir çalışmada kuru tane amacıyla geliştirilen börülce çeşitleri farklı ekim zamanlarında, çevre ve ekim sıklığında yetiştirilmiş ve ortalama bitki boyunun 65.18-140.5 cm arasında değiştiği belirlenmiştir (Çulha ve Bozoğlu, 2016). Samsun koşullarında yemlik börülce çeşit ve genotipleri ile yürütülen bir çalışmada bitki boyunun 101.0 – 122.4 cm arasında değiştiği belirlenmiştir (Başaran ve ark., 2011). Hem çeşitler hem de genotip bitki boyu bakımından lokasyonlarda farklı tepkiler göstermişlerdir.

Çizelge 2. İki lokasyonda (Kurupelit ve Çarşamba) yetiştirilen bazı börülce genotip/çeşitlerinin kuru ot verimi ve bazı tarımsal özellikleri

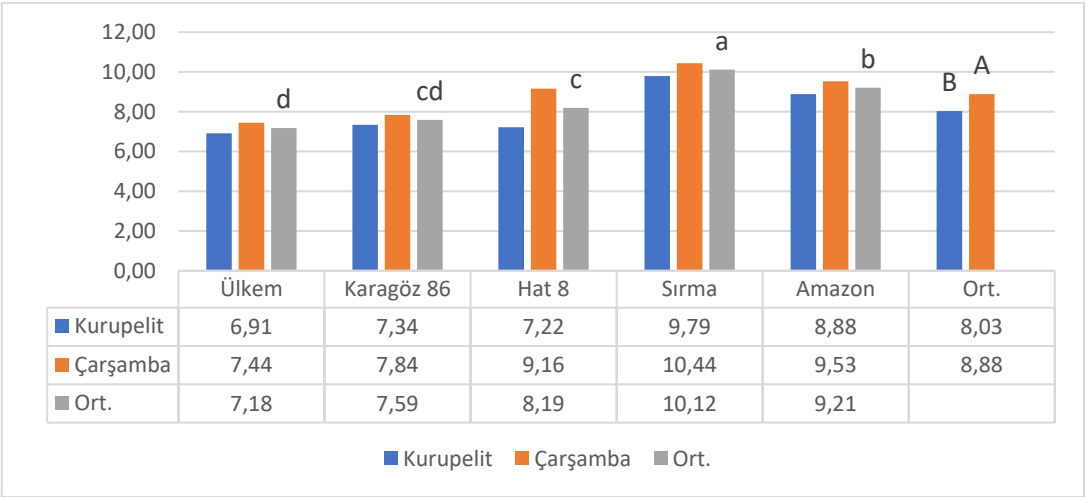
Lokasyon	Çeşitler	Bitki Boyu	Ana sap kalınlığı	Yeşil ot verimi	Kuru ot verimi
Kurupelit	Ülkem	63.42 b	6.91	1263.02	324.12
	Karagöz 86	49.25 c	7.34	1356.25	433.65
	Hat 8	59.08 bc	7.22	1926.04	523.08
	Sırma	40.42 d	9.79	1806.25	426.84
	Amazon	42.08 d	8.88	1907.81	535.39
ort.		50.85 B	8.03 B	1651.88 B	448.62 B
Çarşamba	Ülkem	57.17 bc	7.44	5493.59	1276.84
	Karagöz 86	54.25 bc	7.84	3440.10	805.17
	Hat 8	59.25 bc	9.16	5341.15	1142.41
	Sırma	75.58 a	10.44	3892.71	870.22
	Amazon	80.08 a	9.53	4925.00	1105.64
ort.		65.27 A	8.88 A	4618.51 A	1040.06 A
Lokasyon		**	**	**	**
Çeşit		ö.d	**	**	ö.d
Lokasyonxçeşit		**	ö.d	ö.d	ö.d

(**) 0.01 düzeyinde önemli, ö.d. : önemli değil. Aynı sütunda aynı harfle gösterilen ortalamalar arasında fark yoktur.



Şekil 2. İki lokasyonda (Kurupelit ve Çarşamba) yetiştirilen bazı börülce genotip/çeşitlerinin bitki boyu değerleri (cm)

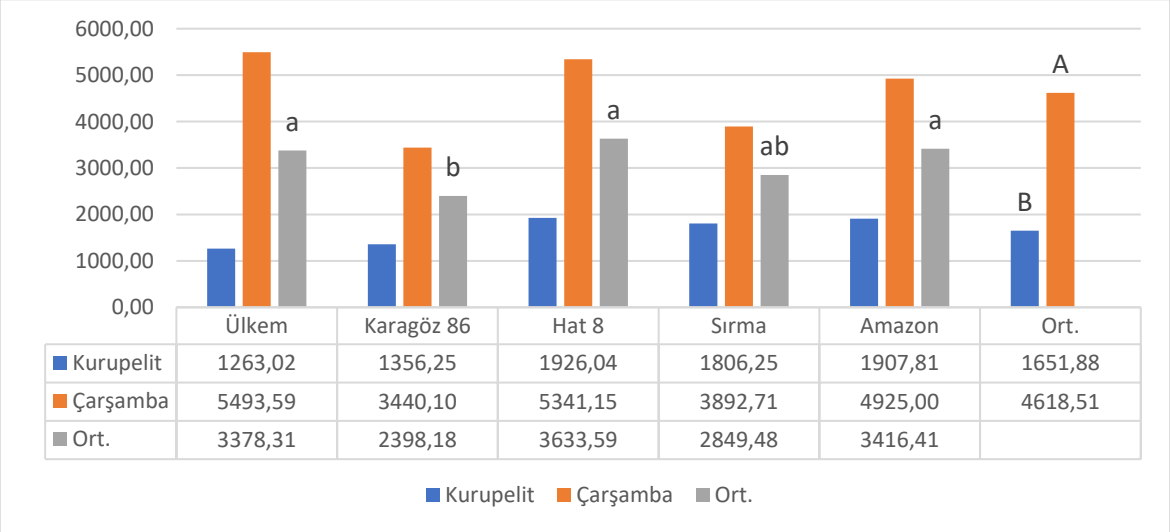
Ana sap kalınlığı açısından lokasyonlar ve çeşitler arasında önemli farklılıklar belirlenmiştir. Ortalama ana sap kalınlığı Çarşamba lokasyonunda 8.88 mm, Kurupelit lokasyonunda ise 8.03 mm olarak belirlenmiştir. Çeşitler arasında ise ortalama en yüksek ana sap kalınlığı Sırma (10.44 mm), en düşük ise Ülkem çeşitinde 7.17 mm olarak belirlenmiştir (Çizelge 2, Şekil 3). Başaran ve ark. (2011), Orta Karadeniz Bölgesinde 9 börülce genotipi ile iki yıl yürüttükleri çalışmada ana sap kalınlığının 8.7-9.8 arasında değiştirdiğini bildirmişlerdir. Suluova-Amasya koşullarında yürütülen bir çalışmada ise ana sap kalınlığının 8.83-10.8 mm arasında değiştiği belirlenmiştir (Ayan ve ark. 2017). Elde ettiğimiz bulgular bu çalışmaların bulgularıyla benzerlik göstermektedir.



Şekil 3. İki lokasyonda (Kurupelit ve Çarşamba) yetiştirilen bazı börülce genotip/çeşitlerinin ana sap kalınlığı (mm)

Kurupelit ve Çarşamba lokasyonlarında yetiştirilen börülce genotip ve çeşitlerinde belirlenen yeşil ot verimi açısından lokasyonlar arasında önemli farklılıklar belirlenmiştir. Ortalama yeşil

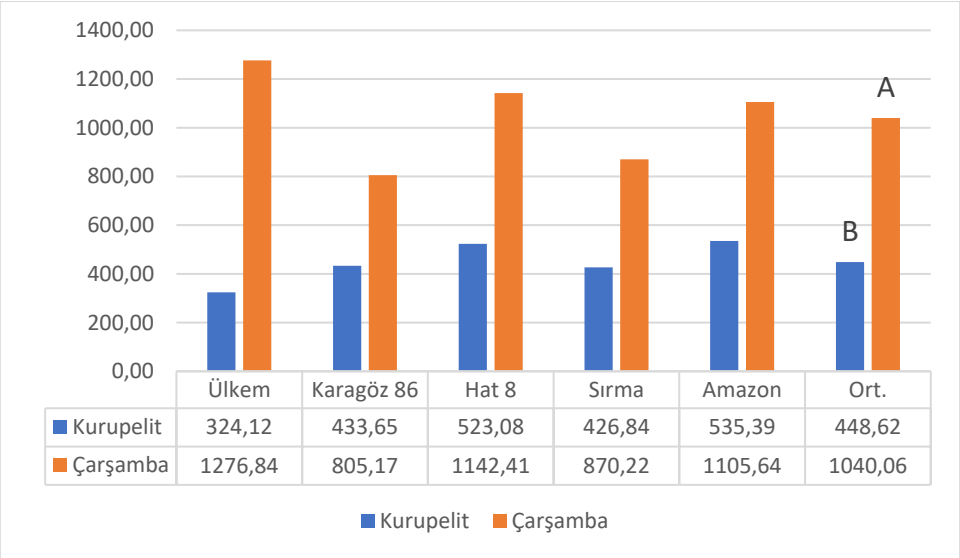
ot verimi Çarşamba lokasyonunda 4618.51 kg/da, Kurupelit lokasyonunda ise 1651.88 kg/da olarak belirlenmiştir (Çizelge 2 ve Şekil 4). Kahramanmaraş koşullarında farklı sıra aralıklarında yetiştirilen börülce çeşitlerinin yeşil ot verimi 1971.38 - 5840.75 kg/da arasında değiştiği belirlenmiştir (Beycioğlu, 2016). Çanakkale koşullarında ise börülce ve sakız fasulyesi bitkilerinin yalın ve buğdaygil/baklagil ikili karışımlarının hasıl verimi ve kalitesi ile silaj verimi ve kalitesini belirlemek amacıyla yürütülen çalışmada yalın börülce parsellerinden 2786 kg/da yeşil ot elde edilmiştir (Alaca, 2017).



	Ülkem	Karagöz 86	Hat 8	Sırma	Amazon	Ort.
Kurupelit	1263,02	1356,25	1926,04	1806,25	1907,81	1651,88
Çarşamba	5493,59	3440,10	5341,15	3892,71	4925,00	4618,51
Ort.	3378,31	2398,18	3633,59	2849,48	3416,41	

Şekil 4. İki lokasyonda (Kurupelit ve Çarşamba) yetiştirilen bazı börülce genotip/çeşitlerinin yeşil ot verimi (kg/da)

Dekara kuru ot verimi açısından lokasyonlar arasında önemli farklılıklar belirlenmiştir. Ortalama kuru ot verimi Çarşamba lokasyonunda 1040.06 kg/da, Kurupelit lokasyonunda ise 448.62 kg/da olarak belirlenmiştir. Kurupelit lokasyonunda en üşük kuru ot verimi Ülkem çeşitinde 324.12 kg/da, en yüksek kuru ot verimi ise 535.39 kg/da ile Amazon çeşidinde belirlenmiş olup, istatistiki farklılık yoktur. Çarşamba lokasyonunda ise, en yüksek kuru ot verimi 1276.84 kg/da ile Ülkem çeşidinde belirlenirken, kuru ot verimi Hat 8 genotipinde 1142.41 kg/da ve Amazon çeşidinde 1105.64 kg/da olarak belirlenmiştir (Çizelge 2 ve Şekil 5). Şanlıurfa ekolojik koşullarında yürütülen bir çalışmada ise farklı zamanlarda ekilen börülceden 162.25-791.00 kg/da kuru ot verimi elde edildiğini bildirmişlerdir (Polat, 2017). Ayan ve ark. (2012) Samsun ekolojik koşullarında yemlik börülce çeşit ve hatlarından 586 - 876.00 kg/da, Ayan ve ark. (2017) Suluova şartlarında 978.0 - 1587.0 kg/da arasında kuru ot verimi elde etmişlerdir. Elde ettiğimiz kuru ot verimleri birçok araştırıcının verileri ile benzerdir.



Şekil 5. İki lokasyonda (Kurupelit ve Çarşamba) yetiştirilen bazı börülce genotip/çeşitlerinin kuru ot verimi (kg/da)

SONUÇ

Bölgemiz tarım sistemi içerisinde yem bitkisi amaçlı börülce yetiştirmeye uygundur. Küresel iklim değişikliği nedeniyle sıcaklığın artışını da göz önünde bulundurursak börülcenin üzerinde çalışılması gereken bir bitki olduğu ortaya çıkmaktadır.

Yaz döneminde meraların kuruması yazlık olarak yetiştirilen bitkilerin önemini artırmaktadır. Hayvan rasyonlarına mısır/sorgum ile beraber baklagil kaynağının eklenmesiyle daha kaliteli ve dengeli bir beslenme olması kaçınılmazdır. Ancak yaz döneminde yetiştiriciliği yapılan baklagil yem bitkisi sayısı kısıtlıdır. Bu çalışmadan elde edilen sonuçlara göre, bölgemizde kaba yem açığının azaltılabilmesi için, yazlık yem bitkisi olarak yemlik börülce çeşit/genotipleri yetiştirilebilir.

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SAMSUN EKOLOJİK KOŞULLARINDA YETİŞTİRİLEN BAZI BÖRÜLCE ÇEŞİTLERİNİN (*Vigna unguiculata* (L.) Walp) KALİTE VE BESİN ELEMENTİ İÇERİKLERİNİN BELİRLENMESİ

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ÖZET

Börülce baklagiller içerisinde sıcağa ve kurağa dayanımı en iyi olan bitkilerden birisidir. Börülce genellikle insan ve hayvan beslenmesinde ve yeşil gübre bitkisi olarak kullanılır. Hayvan beslenmesinde yeşil ve kuru ot, silaj (özellikle sorgum ve darılarla) ve kuru taneleri kullanılmaktadır. Bu çalışma Samsun ekolojik koşullarında iki lokasyonda (Kurupelit ve Çarşamba) yetiştirilen bazı börülce genotiplerinin yem kalitesi ve mineral madde içeriğini belirlemek amacıyla yürütülmüştür. Denemede yem amaçlı Ülkem börülce çeşiti ile bir börülce genotipi, tane amaçlı (yemeklik) börülce çeşitleri Sırma, Amazon ve Karagöz kullanılmıştır. Çalışma Tesadüf Blokları Deneme Deseninde 4 tekrarlamalı olarak kurulmuştur. Ekim işlemi Kurupelit lokasyonunda 30 Mayıs 2019, Çarşamba lokasyonunda 31 Mayıs 2019 tarihlerinde yapılmıştır. Ot üretimi amacıyla hasat bitkilerin alt baklalarında tanelerin belirginleştiği dönemde Kurupelit lokasyonunda 8 Ağustos 2019, Çarşamba lokasyonunda 7 Ağustos 2019 tarihlerinde yapılmıştır. Bu çalışmada, lokasyonların ortalaması olarak ADF oranı 27.06-34.38 arasında, NDF oranı 31.27-41.58 arasında, NYD değeri 140.10-200.65 arasında, ham protein oranı 16.58-23.05 arasında değiştiği belirlenmiştir. Kuru otun fosfor oranı 0.33-0.41 arasında, potasyum oranı 1.15-2.48 arasında, kalsiyum oranı 1.21-1.95 arasında, magnezyum oranı ise 0.45-0.60 arasında değişmiştir. Kurupelit lokasyonunda ortalama ADF oranı %29.57 iken Çarşamba lokasyonunda ise %33.71, ortalama NDF oranı Kurupelit lokasyonunda %33.76 iken Çarşamba lokasyonunda %38.55, ortalama NYD değeri Kurupelit lokasyonunda 183.76 iken Çarşamba lokasyonunda 153.87 olarak belirlenmiştir. En yüksek ham protein oranı Kurupelit lokasyonunda Sırma çeşidinde (%23.04), Çarşamba lokasyonunda ise Ülkem çeşidinde (%20.90) tespit edilmiştir. Kuru otun kalsiyum değerleri Çarşamba lokasyonunda %1.77-1.95, Kurupelit lokasyonunda ise %1.21-1.57 arasında, ortalama potasyum oranı Kurupelit lokasyonunda %2.22 iken, Çarşamba lokasyonunda %1.35 olarak belirlenmiştir. Kuru otun fosfor içeriği Çarşamba lokasyonunda %0.33-0.36, Kurupelit lokasyonunda ise %0.37-0.41

arasında, ortalama magnezyum oranı Çarşamba lokasyonunda 0.59 iken, Kurupelit lokasyonunda 0.46 olarak tespit edilmiştir. Bu çalışmanın yürütüldüğü her iki lokasyonda börülce kuru otunun nispi yem değeri bakımından kaliteli, ham protein oranının yüksek ve mineral madde içeriğinin ise geviş getiren hayvanlar için tavsiye edilen değerler arasında olduğu belirlenmiştir.

Anahtar Kelimeler: Yemlik Börülce, Nispi Yem Değeri, Mineral Madde İçeriği

DETERMINATION OF THE QUALITY AND NUTRITIONAL CONTENT OF SOME COWPEA GENOTYPES (*Vigna unguiculata* (L.) Walp) GROWED IN SAMSUN ECOLOGICAL CONDITIONS

ABSTRACT

This study was carried out to determine forage quality and mineral substance content of some cowpea genotypes grown in Samsun ecological conditions in two locations (Kurupelit and Çarşamba). In the experiment, Ülkem cowpea cultivar and a cowpea genotype, edible cowpea cultivars Sırma, Amazon and Karagöz were used. The study was set up in a Random Blocks Trial Design with 4 replications. The sowing process was carried out on 30 May 2019 at Kurupelit location and on 31 May 2019 at Çarşamba location. Harvesting for forage production was done on 8 August 2019 at Kurupelit location and on 7 August 2019 at Çarşamba location during the period when the grains were evident in the lower pods of the plants. In the study, ADF, NDF, RFV, crude protein, phosphorus, potassium, calcium and magnesium contents of cowpea hay were investigated. It was determined that the ADF ratio ranged between 27.06-34.38, the NDF ratio between 31.27-41.58, the RFV value between 140.10-200.65, and the crude protein ratio between 16.58-23.05 as the average of the locations. Phosphorus ratio of hay varied between 0.33-0.41, potassium ratio between 1.15-2.48, calcium ratio between 1.21-1.95 and magnesium ratio between 0.45-0.60. ADF ratio, NDF ratio and NYD value were determined 29.57%, 33.76% and 183.76 in Kurupelit location while ADF ratio, NDF ratio and NYD value were determined 33.71%, 38.55% and 153.87 in Çarşamba location, respectively. The highest crude protein content was found in the Sırma cultivar (23.04%) in Kurupelit location while that was found in Ülkem cultivar (20.90%) in Çarşamba location. The calcium value of hay was determined between 1.77%-1.95% in Çarşamba location while that was determined between 1.21-1.57% in Kurupelit location. The average potassium ratio was 2.22% in Kurupelit location while that was 1.35% in Çarşamba location. The phosphorus content of hay was determined between 0.33-0.36% in Çarşamba location while that was determined between 0.37-0.41% in Kurupelit location. In addition, the average magnesium ratio was 0.59 in Çarşamba location while that was 0.46 in Kurupelit location. In both locations where this study was carried out, it was determined that cowpea hay is quality in terms of relative feed value. In both locations, crude protein content of cowpea is high and its mineral contents are among the recommended values for ruminant animals.

Keywords: Cowpea Forage, Relative Feed Value, Mineral Content

GİRİŞ

Tarımsal üretimin sürdürülebilirliği ve bu çerçevede yeterli ve sağlıklı gıda üretiminin güvence altına alınması günümüz dünyasının öncelikli sorunudur. İklim değişikliği, gıda güvenliğini küresel, bölgesel ve yerel düzeyde çok fazla etkilemektedir. İklim değişikliği, gıda kullanılabilirliğini bozabilir, gıdaya erişimi azaltabilir ve gıda kalitesini etkileyebilir. Türkiye küresel ısınmadan en fazla etkilenecek ülkeler arasında yer almaktadır. Küresel ısınma tehdidi birçok ürünün yetişmesini kısıtlayacağından, zaten zor durumda olan tarım sektörü bir başka darboğaza girecektir (Uğur, 2008). Değişen şartlara uyum sağlayabilecek yeni türler belirlenerek gerekli önlemler şimdiden alınmaya başlanmalıdır.

Türkiye sahip olduğu ekolojik koşullar ve topoğrafik yapısı sayesinde çoğu yem bitkisinin yetiştirilmesine imkan sağlamaktadır. Farklı ekolojik bölgelerimiz için uygun yem bitkisi çeşitlerinin geliştirilmesi, bunlardan yeterli miktarda yem üretimi önemlidir. Mevcut tarımı yapılan yem bitkilerimizin yanı sıra alternatif yem bitkilerinin de gerekli yer ve zamanlarda devreye sokulması, kaba yem açığının azaltılmasında önemli katkılar sağlayacaktır. Yem bitkileri ekim oranını daha üst düzeylere çıkarabilmek için, ekim nöbeti sistemleri içerisinde yem bitkilerine daha fazla yer verilmelidir.

Börülce (*Vigna unguiculata* L. Walp.) tek yıllık, otsu yapıda, sıcak mevsim baklagil bitkisidir. Börülce insan beslenmesi yanında hayvan yemi olarakta kullanılmaktadır. Ayrıca köklerinde yaşayan Rhizobium bakterileri sayesinde havadaki serbest azotu toprağa bağlayarak toprağın zenginleşmesini sağlar. Ayrıca kuraklık ve yüksek sıcaklığa kültürü yapılan birçok bitkiye göre daha toleranslıdır (Can ve ark. 2021). Börülce genellikle insan ve hayvan beslenmesinde ve yeşil gübre bitkisi olarak kullanılır. Hayvan beslenmesinde yeşil ve kuru ot, silaj (özellikle sorgum ve darılarla) ve kuru taneleri kullanılmaktadır. Protein ve özellikle amino asit kompozisyonu itibariyle hayvansal proteinlere yaklaşan, vitamin ve mineral besin elementlerince zengin olan börülce yem bitkisi olarak oldukça önemlidir. Yüksek bir besleme değerine sahip olan börülcenin yeşil yemi % 14-21, taneleri ise % 18-26 oranında ham protein içermektedir (Adeyanju ve ark., 2007; Ali ve ark., 2004). Ayrıca, mera olarak otlatılarak da kullanılmaktadır. Yeşil yem üretiminde alt baklaların tane doldurmaya başladığı dönemde biçilmekte ve dekara 1500 – 2000 kg verim elde edilmektedir. Dane verimi ise 100-250 kg/da olup, daneleri ham protein içeriği (% 23-31), lysin ve tryptophan bakımından zengindir (Gençkan, 1983). Börülcenin yeşil ot amaçlı yalnız yetiştirildiğinde dekara 2907.5 kg verim elde edilebileceği, silaj için mısır, sorgum ve darılar ile karışık yetiştirilebileceği belirtilmektedir (FAO, 2009).

Karadeniz Bölgesinde tarım sistemi içerisinde hem 1. ürün, hem 2. ürün olarak yem bitkisi amaçlı börülce yetiştirilebilir. Bölgemiz gibi ılıman iklimin hakim olduğu kıyı kesimlerde, kışlık sebze üretimi önemli bir yer tutmaktadır. Özellikle organik sebze yetiştirilecek alanlarda börülce ekim nöbeti sisteminde önemli bir yere sahip olacaktır. Bu çalışma Samsun ekolojik koşullarında iki lokasyonda (Kurupelit ve Çarşamba) yetiştirilen bazı börülce genotip/çeşitlerinin yem kalitesi ve mineral madde içeriğini belirlemek amacıyla yürütülmüştür.

MATERYAL ve METOT

Bu çalışma farklı börülce çeşitlerinin kuru otunun kalitesi ve mineral madde içeriğini belirlemek amacıyla kurulmuştur. Çalışma Samsun ekolojik koşullarında iki lokasyonda (Kurupelit ve Çarşamba) Tesadüf Blokları Deneme Desenine göre 4 tekrarlamalı olarak kurulmuştur. Bitki materyali olarak Ondokuz Mayıs Üniversitesi Ziraat Fakültesi tarafından yem üretimi amaçlı geliştirilen Ülkem börülce çeşiti ile bir börülce genotipi (Hat-8), yemeklik(tanelik) börülce amacıyla geliştirilen Sırma ve Amazon çeşitleri ile sertifikalı tohumluk üretimi Çoker Tohumculuk tarafından yapılan Karagöz-86 çeşitleri kullanılmıştır. Ekim işlemi Kurupelit lokasyonunda 30 Mayıs 2019, Çarşamba lokasyonunda 31 Mayıs 2019 tarihlerinde yapılmıştır. Ekimden önce toprak analiz sonuçları dikkate alınarak, dekara 4 kg N olacak şekilde amonyum sülfat ve 8 kg P_2O_5 olacak şekilde triple süper fosfat gübresi verilmiştir. Çalışmada her bir parsel 4 metre uzunluğunda ve 4 sıradan oluşmuştur. Tohumlar sıra arası mesafesi 30 cm, sıra üzeri 10 cm olacak şekilde parsellere ekim işlemi yapılmıştır. Parsellerden kenar tesirleri alınarak ot üretimi amacıyla hasat bitkilerin alt baklalarda tanelerin belirginleştiği dönemde Kurupelit lokasyonunda 8 Ağustos 2019, Çarşamba lokasyonunda 7 Ağustos 2019 tarihlerinde yapılmıştır. Parsellerden kenar tesirleri alınarak ot üretimi amacıyla hasat bitkilerin alt baklalarında tanelerin belirginleştiği dönemde Kurupelit lokasyonunda 8 Ağustos 2019, Çarşamba lokasyonunda 7 Ağustos 2019 tarihlerinde yapılmıştır. Araziden alınan ot örneklerinin ADF, NDF, nispi yem değeri, ham protein oranı, Ca, P, K ve Mg içerikleri belirlenmiştir. Yaş ot örnekleri 60°C'de sabit ağırlığa gelene kadar kurutulmuş ve elek çapı 1 mm olan değirmende öğütülerek analize hazır duruma getirilmiştir. Ham protein, ADF, NDF, K, P, Ca ve Mg oranları Foss NIRSystems (Hoy ve ark., 2002) Model 6500 Win ISI II v1.5 cihazında IC-0904FE kalibrasyon programı kullanılarak belirlenmiştir.

Elde edilen sonuçlar SPSS 25.0 programı kullanılarak analiz edilmiştir. Ortalama değerler arasındaki farkların belirlenmesinde Duncan testi kullanılmıştır.

Deneme Yerinin Özellikleri

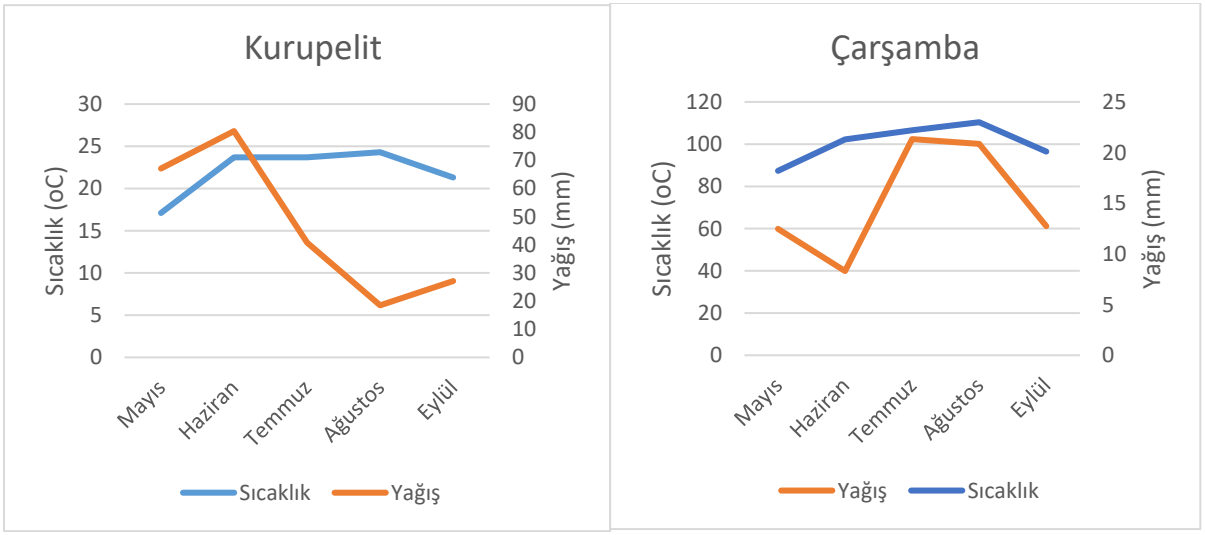
Deneme iki lokasyonda (Kurupelit ve Çarşamba) yürütülmüştür. Kurupelit lokasyonu; Ondokuz Mayıs Üniveristesi, Ziraat Fakültesi Araştırma ve Uygulama Arazisinde ve denizden yüksekliği yaklaşık olarak 120 metredir. Çarşamba lokasyonu ise Karadeniz Tarımsal Araştırma Enstitüsü Müdürlüğü'nün Çarşamba– Ambarköprü' de bulunan uygulama ve araştırma alanında olup, deneme yerinin denizden yüksekliği yaklaşık olarak 3 metredir.

Çizelge 1. Denemenin yürütüldüğü lokasyonalara ait toprak analiz sonuçları*

	Kurupelit		**Çarşamba**	
	Değeri	Derecesi	Değeri	Derecesi
Tekstür (%)	28.0 kum, 26.9 silt, 45.0 kil	Killi	30.4 kum, 37.72 silt, 32.88 kil	Killi tın
pH	6,34	Hafif asit	7,54	Hafif alkali
Toplam tuz (mmhos/cm)	0,48	Tuzsuz	0,03	Tuzsuz
Kireç ($CaCO_3$ %)	2,18	Az kireçli	10,5	Kireçli
Organik madde (%)	3,37	Yüksek	1,23	Az
Alınabilir fosfor (P_2O_5 ppm)	65,4	Çok yüksek	61	Çok yüksek
Potasyum (ppm)	340	Çok yüksek	360	Çok yüksek

*Toprak analizleri Ondokuz Mayıs Üniversitesi Ziraat Fakültesi Toprak Bilimi ve Bitki Besleme Bölümünde yapılmıştır.

Kurupelit ve Çarşamba lokasyonları toprak tekstürü bakımından birbirinden farklı yapıya sahiptir. Kurupelit lokasyonu killi yapıya sahipken Çarşamba lokasyonu killi tınlı bir yapıya sahiptir. Deneme alanı toprağı Kurupelit lokasyonunda az kireçli, Çarşamba lokasyonunda ise kireçlidir. Organik madde içeriği ise Kurupelit lokasyonunda yüksek, Çarşamba lokasyonunda ise az olarak belirlenmiştir. Alınabilir fosfor içeriği ve potasyum içeriği her iki deneme alanında çok yüksek olarak belirlenmiştir (Çizelge 1).



Şekil 1. 2019 yılı börülce bitkisinin yetiştiği dönemde Kurupelit ve Çarşamba lokasyonlarına ait iklim diyagramları (MGM, 2020)

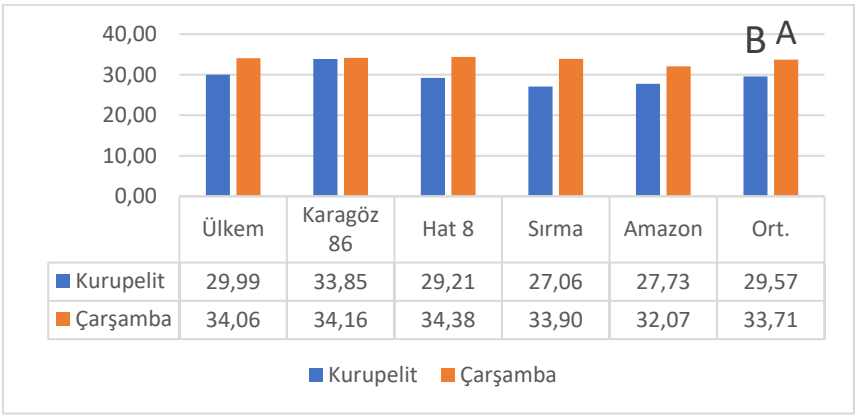
Meteoroloji Genel Müdürlüğü verilerine göre börülce bitkisinin yetiştiği dönemlerde Kurupelit ve Çarşamba lokasyonlarında en yüksek ortalama sıcaklık Ağustos ayında, en az yağış Kurupelit lokasyonunda Ağustos ayında, Çarşamba lokasyonunda ise Haziran ayında düşmüştür.

BULGULAR ve TARTIŞMA

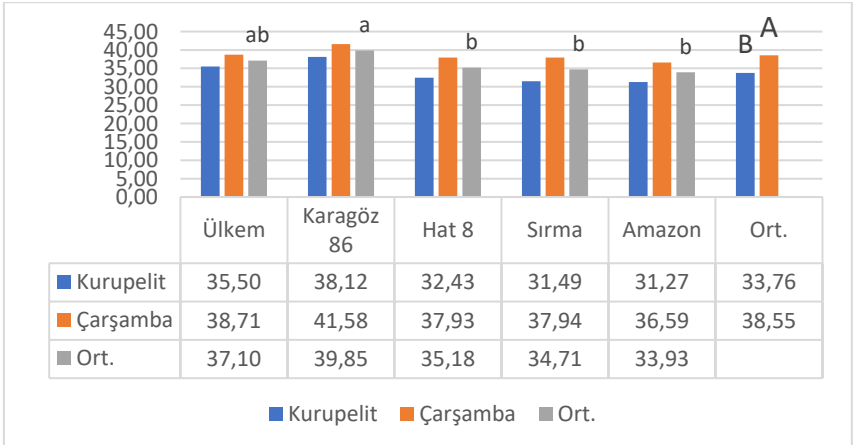
Samsun ekolojik koşullarında iki lokasyonda (Kurupelit ve Çarşamba) yetiştirilen bazı börülce genotip/çeşitlerinin yem kalitesi ve mineral madde içeriğini belirlemek amacıyla yürütülen bu çalışmada, kuru otta belirlenen ADF oranı, NDF oranı, ham protein oranı, K, P, Ca ve Mg oranlarına ait ortalama değerler ve ortalamalar arasındaki farklılıklar Çizelge 2, 3 ve Şekil 2, 3, 4, 5, 6, 7, 8 ve 9'de verilmiştir.

Yapılan varyans analizi sonucuna göre ADF oranı bakımından lokasyonlar arasındaki fark önemli bulunmuştur. Kurupelit lokasyonunda ortalama ADF oranı %29.57 iken Çarşamba lokasyonunda ise %33.71 olmuştur. Her iki lokasyona da çeşitler arasında istatistiki olarak farklılık belirlenmemiştir. Çarşamba lokasyonunda en yüksek ADF oranı %34.38 değeri ile Hat 8 genotipinde ve en düşük oran %32.07 değeri ile Amazon çeşitinde belirlenmiştir. Kurupelit lokasyonunda ise en yüksek ADF oranı %33.85 değeri ile Karagöz 86 çeşitinde , en düşük değer ise %22.08 değeri ile Sırma çeşidinde belirlenmiştir (Çizelge 2 ve Şekil 2). Etiyopya'nın kuzeyinde yürütülen bir çalışmada börülce genotiplerinin ADF oranları %47.1-57.2 arasında değiştiği belirlenmiştir (Gebreyowhans ve Gebremeskel, 2014). Kaba yemlerde ADF oranı sindirilebilirliğin belirlenmesi açısından önemli bir ölçüttür (Rayburn 2004). Amerikan Yem Bitkileri ve Mera Konseyinin belirttiği ADF içeriği değerleri incelendiğinde (% 31 – 35 = çok iyi, % 36 – 40 = iyi, % 41 – 42 = orta, % 43 – 445 = kötü) börülce otunun çok iyi kalitede

olduğu söylenebilir (AFGC, 2009). Çalışmadan elde ettiğimiz sonuçlara göre börülce çeşitlerinin ADF oranı çok iyi sınıfta yer aldığı belirlenmiştir. Samsun ekolojik koşullarında iki lokasyonda (Kurupelit ve Çarşamba) yetiştirilen bazı börülce genotip/çeşitlerinde belirlenen NDF oranları bakımından lokasyonlar arasında önemli farklılıklar tespit edilmiştir. Ortalama NDF oranı Kurupelit lokasyonunda %33.76 iken Çarşamba lokasyonunda biraz daha yüksek %38.55 olmuştur (Çizelge 2 ve Şekil 3). Samsun koşullarında iki lokasyonda yürütülen bir çalışmada (Samsun/Merkez – Kavak), NDF oranı %33.08-36.76 arasında değiştiği belirlenmiştir (Ayan ve ark. 2012). NDF oranı bitkideki hücre duvarı maddeleri oranının bir tahminidir (Rayburn, 2004). NDF oranı ruminantların beslenmesinde kullanılan kaba yemlerin hücre duvarı maddelerinden olan selüloz, lignin ve hemiselülozdan oluşmaktadır. Kaba yemler NDF içeriklerine göre %41-46 arasında olanlar çok iyi, %47-53 arasında olanlar iyi, %54-60 arasında olanlar orta, %61-65 arasında olanlar kötü kalite sınıflarında değerlendirilmektedir (AFGC, 2009).



Şekil 2. İki lokasyonda (Kurupelit ve Çarşamba) yetiştirilen bazı börülce genotip/çeşitlerinin ADF oranları



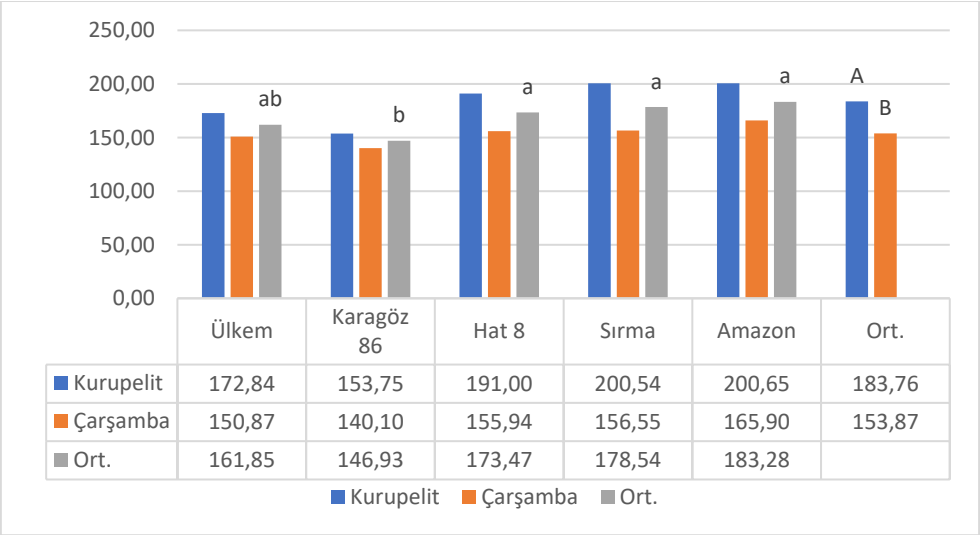
Şekil 3. İki lokasyonda (Kurupelit ve Çarşamba) yetiştirilen bazı börülce genotip/çeşitlerinin NDF oranları

Çizelge 2. İki lokasyonda (Kurupelit ve Çarşamba) yetiştirilen bazı börülce genotip/çeşitlerinin ADF, NDF, NYD ve ham protein oranları

Lokasyon	Çeşitler	ADF	NDF	NYD	Ham protein
	Ülkem	29,99	35,50	172,84	20,90
	Karagöz 86	33,85	38,12	153,75	16,58
Kurupelit	Hat 8	29,21	32,43	191,00	20,60
	Sırma	27,06	31,49	200,54	23,05
	Amazon	27,73	31,27	200,65	20,87
ort.		29,57 B	33,76 B	183,76 A	20,40 A
	Ülkem	34,06	38,71	150,87	20,70
	Karagöz 86	34,16	41,58	140,10	20,27
Çarşamba	Hat 8	34,38	37,93	155,94	19,17
	Sırma	33,90	37,94	156,55	19,65
	Amazon	32,07	36,59	165,90	19,39
ort.		33,71 A	38,55 A	153,87 B	19,84 B
Lokasyon		**	**	**	ö.d.
Çeşit		ö.d.	**	**	**
Lokasyonxçeşit		ö.d.	ö.d.	ö.d.	ö.d.

(**) 0.01 düzeyinde önemli, ö.d. : önemli değil. Aynı sütunda aynı harfle gösterilen ortalamalar arasında fark yoktur.

Farklı iki lokasyonda yetiştirilen börülce genotip/çeşitlerinin kuru otlarının ortalama nispi yem değerleri bakımından (NYD) lokasyonlar arasında önemli farklılıklar belirlenmiştir. Ortalama NYD Kurupelit lokasyonunda 183.76 iken Çarşamba lokasyonunda 153.87' ye gerilemiştir. Çeşitlerden elde edilen kuru otun NYD değerleri ADF ve NDF içeriğine bağlı olarak değişiklik göstermiştir. En düşük NYD değeri her iki lokasyonda da Karagöz 86 çeşitinde belirlenmiştir (Çizelge 2 ve Şekil 4). Nispi yem değeri yemin ADF ve NDF oranlarından hesaplanan, yem kalitesinin sayısal bir ifadesidir. Yonca için nispi yem değeri 100 kabul edilir ve bu değerin altına düştükçe yem kalitesi de düşmektedir (Richardson, 2001). Lacefield (1988) Nispi Yem Değeri kalite standartlarını NYD ≥ 151 en iyi kalite, 1. kalite (125-151), 2. kalite (103-124), 3. kalite (87 – 102), 4. kalite (75-86) ve 75 ≤ 5. kalite olarak belirtmiştir. Elde ettiğimiz sonuçlara göre börülce kuru otu en iyi kalite sınıfında yer almaktadır.

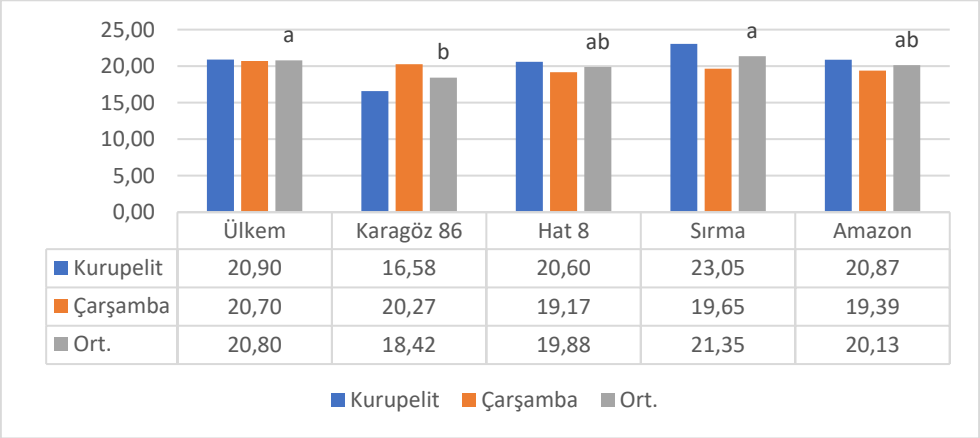


	Ülkem	Karagöz 86	Hat 8	Sırma	Amazon	Ort.
Kurupelit	172,84	153,75	191,00	200,54	200,65	183,76
Çarşamba	150,87	140,10	155,94	156,55	165,90	153,87
Ort.	161,85	146,93	173,47	178,54	183,28	

Kurupelit Çarşamba Ort.

Şekil 4. İki lokasyonda (Kurupelit ve Çarşamba) yetiştirilen bazı börülce genotip/çeşitlerinin Nispi Yem Değerleri

Samsun ekolojik koşullarında iki lokasyonda yetiştirilen bazı börülce genotip/çeşitlerinde belirlenen ham protein oranı bakımından börülce genotipleri arasında önemli farklılıklar belirlenmiştir. Lokasyonların ortalaması olarak, en yüksek ortalama ham protein oranı Sırma genotipinde %21.35, en düşük ise Hat 8 börülce genotipinde 18.42 olarak belirlenmiştir. En yüksek ham protein oranı Kurupelit lokasyonunda Sırma çeşidinde (%23.04), Çarşamba lokasyonunda ise Ülkem çeşidinde (%20.90) belirlenmiştir (Çizelge 2 ve Şekil 5). Bitkilerde ham protein oranı genetik yapı, bitki gelişim dönemi ve azotlu gübrelemeye (Wilson, 1984; Gökkuş, 1990; Açıkgöz, 2001) bağlı olarak değişmektedir. Amasya- Suluova koşullarında yürütülen bir çalışmada yemlik börülcenin ham protein oranı %18.61-20.22 arasında değiştiği belirlenmiştir (Ayan ve ark. 2017). İdikut ve ark. (2015)'nın yürüttükleri çalışmada ise Kahramanmaraş koşullarında ikinci ürün olarak yetiştirilen yerel börülce genotiplerinin ham protein oranı %18.0-21.0 arasında değiştiği belirlenmiştir.



	Ülkem	Karagöz 86	Hat 8	Sırma	Amazon
Kurupelit	20,90	16,58	20,60	23,05	20,87
Çarşamba	20,70	20,27	19,17	19,65	19,39
Ort.	20,80	18,42	19,88	21,35	20,13

Kurupelit Çarşamba Ort.

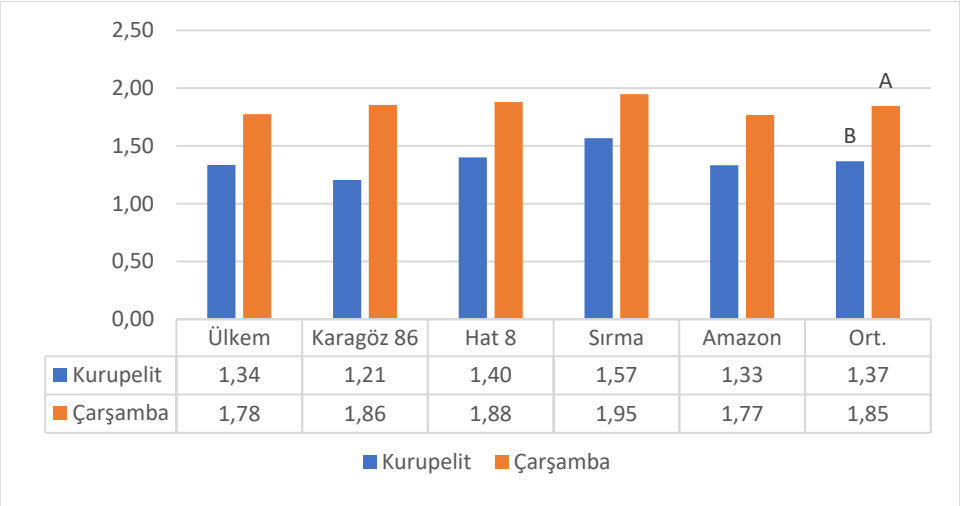
Şekil 5. İki lokasyonda (Kurupelit ve Çarşamba) yetiştirilen bazı börülce genotip/çeşitlerinin ham protein oranları

Börülce genotip/çeşitlerinin kuru otun kalsiyum içeriği bakımdan lokasyonlar arasında istatistiki olarak önemli farklılıklar belirlenmiştir. Çarşamba lokasyonunda kuru otun ortalama kalsiyum değeri %1.85 iken Kurupelit lokasyonunda %1.37 olarak belirlenmiştir. Genotip/çeşitlerin kalsiyum değerleri Çarşamba lokasyonunda %1.77-1.95, Kurupelit lokasyonunda ise %1.21-1.57 arasında belirlenmiştir (Çizelge 3 ve Şekil 6). Çarşamba lokasyonunda bitkiler topraktaki kalsiyumdan daha fazla yararlanmışlardır. Börülce kuru otunun Ca içeriğinin Ayan ve ark. (2012) % 1.04 – 1.32, Ayan ve ark. (2017) % 1.40 – 1.73 arasında değiştiğini belirlemişlerdir. Tajeda ve ark. (1985) geviş getiren hayvanlar için yemlerde en az % 0.30 oranında Ca bulunması gerektiğini bildirmişlerdir. Belirlenen değerler tavsiye edilen değerin üzerindedir. Ancak, süt sığırlarının 1.8 -4.4 g/kg Ca, 0.4 - 1 g/kg Mg, 6 – 8 g/kg K and 1.8 – 3.9 g/kg P ihtiyacı olduğu bildirilmektedir (NRC, 1996; Tekeli ve Ateş, 2005). Börülce kuru otunda belirlenen Ca içerikleri bu değerden biraz düşüktür.

Çizelge 3. İki lokasyonda (Kurupelit ve Çarşamba) yetiştirilen bazı börülce genotip/çeşitlerinin Ca, K, P, ve Mg oranları

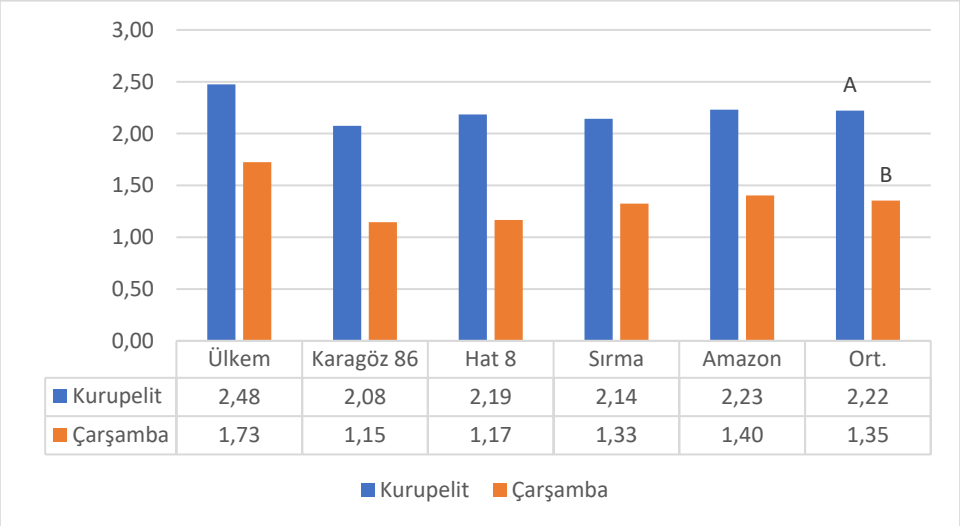
Lokasyon	Çeşitler	Ca	K	P	Mg
Kurupelit	Ülkem	1,34	2,48	0,41	0,45
	Karagöz 86	1.21	2.08	0.37	0.45
	Hat 8	1.4	2.19	0.41	0.47
	Sırma	1.57	2.14	0.41	0.49
	Amazon	1.33	2.23	0.4	0.46
ort.		1.37 B	2.22 A	0.4 A	0.46 B
Çarşamba	Ülkem	1.78	1.73	0.36	0.56
	Karagöz 86	1.86	1.15	0.35	0.6
	Hat 8	1.88	1.17	0.33	0.6
	Sırma	1.95	1.33	0.33	0.6
	Amazon	1.77	1.4	0.33	0.57
ort.		1,85 A	1,35 B	0,34 B	0,59 A
Lokasyon		**	**	**	**
Cesit		ö.d.	ö.d.	ö.d.	ö.d.
Lokasyonxçeşit		ö.d.	ö.d.	ö.d.	ö.d.

(**) 0.01 düzeyinde önemli, ö.d. : önemli değil. Aynı sütunda aynı harfle gösterilen ortalamalar arasında fark yoktur.



Şekil 6. İki lokasyonda (Kurupelit ve Çarşamba) yetiştirilen bazı börülce genotip/çeşitlerinin kalsiyum oranları

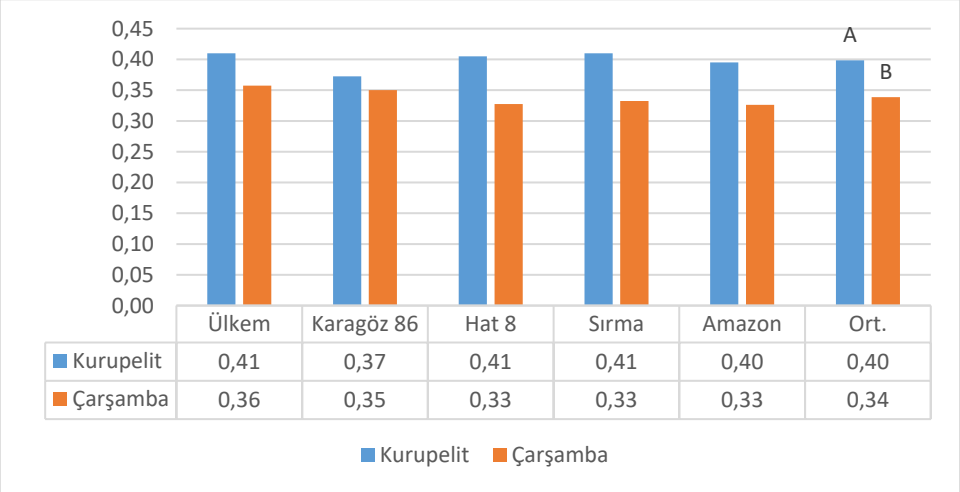
Farklı iki lokasyonda yetiştirilen börülce genotip/çeşitlerinin kuru otlarının potasyum içeriği bakımından lokasyonlar arasında önemli farklılıklar belirlenmiştir. Ortalama potasyum oranı Kurupelit lokasyonunda %2.22 iken, Çarşamba lokasyonunda %1.35 olarak belirlenmiştir. Börülce genotip/çeşitlerinden elde edilen kuru otun potasyum oranı Kurupelit lokasyonunda %2.08-2.48, Çarşamba lokasyonunda ise %1.15-1.73 arasında değişmiştir (Çizelge 3 ve Şekil 7). Kurupelit lokasyonunda deneme alanı topraklarında potasyum içeriğinin daha fazla olması, kuru otun potasyum içeriğini artırmış olabilir. Ayan ve ark. (2017) börülce kuru otunun potasyum oranının % 1.53-2.19 arasında değiştiğini belirlemişlerdir. Çalışmadan elde ettiğimiz değerler aynı ekolojik bölgede yetiştirilen börülcenin potasyum içeriğine benzerdir.



Şekil 7. İki lokasyonda (Kurupelit ve Çarşamba) yetiştirilen bazı börülce genotip/çeşitlerinin potasyum oranları

Samsun ekolojik koşullarında iki lokasyonda (Kurupelit ve Çarşamba) yetiştirilen bazı börülce genotip/çeşitlerinde belirlenen fosfor içeriği bakımından yapılan varyans analizi sonuçlarına göre lokasyonlar arasında önemli farklılıklar bulunmuştur. Kuru otun fosfor içeriği Çarşamba

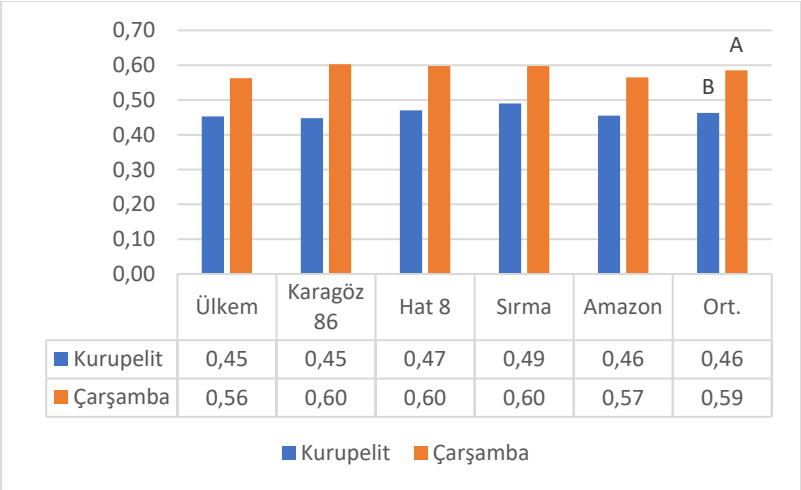
lokasyonunda %0.33-0.36, Kurupelit lokasyonunda ise %0.37-0.41 arasında değişmiştir (Çizelge 3 ve Şekil 8). Börülce kuru otunun P içeriğinin Ayan ve ark. (2012) % 0.33 – 0.38, Ayan ve ark. (2017) % 0.34 – 0.37 arasında değiştiğini belirlemişlerdir. Bu çalışmada belirlenen değerlerin az da olsa fazla olması, deneme toprağının fosfor içeriğinin iyi olmasından kaynaklanabilir (Çizelge 3.1). Kuru otun P içeğinin sığırlar için % 0.17 – 0.39 (NRC, 1996) ve koyunlar için % 0.16 – 0.38 (NRC, 1985) arasında olması gerektiği belirtilmektedir.



	Ülkem	Karagöz 86	Hat 8	Sırma	Amazon	Ort.
Kurupelit	0,41	0,37	0,41	0,41	0,40	0,40
Çarşamba	0,36	0,35	0,33	0,33	0,33	0,34

Şekil 8. İki lokasyonda (Kurupelit ve Çarşamba) yetiştirilen bazı börülce genotip/çeşitlerinin fosfor oranları

Börülce genotip/çeşitlerinin kuru otun magnezyum içeriği bakımından lokasyonlar arasında istatistiki açıdan önemli farklılıklar belirlenmiştir. Elde edilen kuru otun ortalama magnezyum oranı Çarşamba lokasyonunda 0.59 iken, Kurupelit lokasyonunda 0.46 olarak belirlenmiştir. Kuru otun magnezyum içeriği Kurupelit lokasyonunda %0.45-0.47, Çarşamba lokasyonunda ise %0.56-0.60 arasında değişmiştir (Çizelge 3 ve Şekil 9). Lokasyonlarda ulunan deneme topraklarının Mg içeriği kuru ottaki Mg içeriğini etkilemiş olabilir. Kidambi ve ark. (1989), kaba yemlerin geviş getiren hayvanlar için en az % 0.1 oranında Mg içermesi gerektiğini belirtmektedirler. Çalışmadan elde edilen değerler Kidambi ve ark. (1989) ve NRC (1996) tarafından tavsiye edilen en az değerin (% 0.1) üzerindedir. Börülce otunun Mg içeriğini Ayan ve ark. (2012) % 0.46 – 0.51, Ayan ve ark. (2017) % 0.46 – 0.55 arasında belirlemişlerdir.



Şekil 9. İki lokasyonda (Kurupelit ve Çarşamba) yetiştirilen bazı börülce genotip/çeşitlerinin magnezyum oranları

SONUÇ

Küresel iklim değişikliği nedeniyle sıcaklığın artışı dikkate alındığında börülcenin üzerinde çalışılması gereken bir bitki olduğu ortaya çıkmaktadır. Ayrıca yazlık olarak yetiştirilebilecek bir tek yıllık baklagil yem bitkisi olması önemini artırmaktadır. Bu çalışmanın yürütüldüğü her iki lokasyonda börülce kuru otunun nispi yem değeri bakımından kaliteli, ham protein oranının yüksek ve mineral madde içeriğinin ise geviş getiren hayvanlar için tavsiye edilen değerler arasında olduğu belirlenmiştir.

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BAZI YEREL DOMATES POPÜLASYONLARININ KARAKTERİZASYONU VE MEYVE ÖZELLİKLERİNİN BELİRLENMESİ

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ÖZET

Domates yerel çeşitleri, dünyanın birçok bölgesinde yerel kullanım ve tüketim için hali hazırda yetiştirilmektedir. Yerel çeşit ve genotipler verim ve kalite açısından modern çeşitlere (F1 hibritler) göre düşük performans göstermelerine rağmen, içerdikleri genetik zenginlikten dolayı yeni çeşit geliştirilmesinde oldukça önemli bir yere sahiptirler. Bu çalışmada; Karadeniz Bölgesinden toplanan 5 adet domates genotipi ve 4 şahit çeşit olmak üzere toplamda 9 domates genotipi kullanılmıştır. Toplanan 5 genotipin morfolojik özellikleri, meyve kalite özellikleri ve biyokimyasal içerikleri belirlenerek karakterizasyonları yapılmıştır. Morfolojik özellikler UPOV kriterlerine göre değerlendirilmiştir. UPOV kriterlerine göre 38 kriterde morfolojik gözlemler yapılmış ve bu gözlemlerden elde edilen verilere dayalı Temel Bileşen Analizi yapılmıştır. Toplanan genotiplerde bitki gelişme şekli, bitki gelişme gücü, çekirdek evi büyüklüğü, yaprak duruşu, yaprak rengi, meyve şekli, meyve dilimliliği, olgun meyve rengi, çekirdek evi sayısı ve meyve tabanı şekli gibi özellikler birbirinden farklılık göstermiştir. Toplanan genotiplerde yüzde kuru madde miktarları %5.9-12.0, meyve genişliği 25.45-71.40 mm, meyve yüksekliği 34.07-62.74 mm arasında değişim göstermiştir. C vitamini değerleri 6.65-15.95 mg 100 g-1, suda çözünebilir kuru madde içerikleri 6.1-7.2 brix ve meyve suyu pH'ları 4.49-4.71 arasında bulunmuştur. Sertlik değerleri incelenen genotiplerde meyve sertliği değerleri %26-%49 olarak belirlenirken meyve eti sertlikleri %18-%26 olarak tespit edilmiştir. Genotipler arasında renk değerleri bakımından önemli farklılıklar belirlenmiştir. Chroma değerleri 32.40-54.11 arasında değişim gösterirken Hue açısı değerleri 43.25-50.56 arasında değişmiştir. İncelenen morfolojik özellikler baz alınarak domates genotiplerinde temel bileşen analizi yapılmış benzerlik katsayıları 0.11-0.82 arasında hesaplanmış ve morfolojik dendogram oluşturulmuştur. Genotip ve çeşitler 2 ana grup, 4 alt gruba ayrılmıştır. Yürütülen bu çalışmada Karadeniz bölgesinden toplanan yerel domates popülasyonlarının morfolojik özellikleri ile beraber meyve özellikleri bakımından karakterizasyonları yapılmış ve gelecekte yapılacak ıslah çalışmalarında kullanılabilecek ümit var genotipler ortaya çıkarılmıştır.

Anahtar Kelimeler: Brix, C vitamini, Domates, Genotip, Kümeleme analizi

CHARACTERIZATION AND DETERMINATION OF FRUIT TRAITS OF SOME LOCAL TOMATO LANDRACES

ABSTRACT

Tomato landraces are already cultivated for local use and consumption in many parts of the world. Although local cultivars and genotypes show poor performance compared to modern cultivars (F1 hybrids) in terms of yield and quality, they have a very important place in the development of new cultivars due to the genetic richness they contain. In this study; a total of 9 tomato genotypes, 5 tomato genotypes and 4 witness varieties collected from the Black Sea Region, were used. Morphological characteristics, fruit quality characteristics and biochemical contents of the 5 collected genotypes were determined and their characterizations were made. Morphological features were evaluated according to UPOV criteria. According to the UPOV criteria, morphological observations were made in 38 criteria and Principal Component Analysis was performed based on the data obtained from these observations. In the collected genotypes, features such as plant growth pattern, plant growth vigor, seed house size, leaf position, leaf color, fruit shape, fruit slicing, ripe fruit color, number of seed houses and fruit base shape differed from each other. Percent dry matter content of the collected genotypes is 5.9-12.0, fruit width is 25.45-71.40 mm, fruit height is 34.07-62.74 varied between. Vitamin C values were found between 6.65-15.95 mg 100 g-1, water-soluble dry matter contents were between 6.1-7.2 brix and fruit juice pH was between 4.49-4.71. While the fruit firmness values were determined as 26%-49% in the genotypes whose firmness values were examined, the fruit firmness values were determined as 18-26%. Significant differences in color values were determined between genotypes. Chroma values varied between 32.40-54.11 and Hue angle values varied between 43.25-50.56. Based on the morphological characteristics examined, principal component analysis was performed on tomato genotypes, and similarity coefficients were calculated between 0.11 and 0.82 and a morphological dendogram was formed. Genotype and cultivars are divided into 2 main groups and 4 subgroups. In this study, local tomato populations collected from the Black Sea region were characterized in terms of fruit characteristics as well as morphological features, and promising genotypes that could be used in future breeding studies were revealed.

Keywords: Brix, Vitamin C, Tomato, Landraces, Cluster analysis

GİRİŞ

Türkiye, dünya ülkeleri arasında sebze üretim değerleri ve genetik kaynaklar açısından büyük potansiyele sahiptir. Sebzecilik alanında yıldan yıla önemli gelişmeler meydana gelmiştir. Domates, içerdiği besin maddeleri ve besleyicilik açısından oldukça önemli, dünyada yetiştiriciliği patatesten sonra en fazla yapılan majör bir sebze türüdür.

Bitki genetik kaynaklarını yeni çeşitler, ıslah hatları, gen havuzlarında bulunan genotipler, eski çeşitler, ekotipler, yerel çeşitler ve kültür bitkilerinin yabani akrabaları meydana getirmektedir (Taş ve Kırcalıoğlu, 2017). Ülkemiz birçok sebze türünün anavatanı olmamasına karşın önemli bir bitki çeşitliliğine sahiptir. Ülkemizde yetiştirilen birçok domates genetik materyali bulunmaktadır. Ancak filogenetik ilişkileri ile ilgili çalışmalar sınırlıdır. (Oğuz ve ark., 2014). Domates bitkilerinde genetik çeşitliliğin öneminin anlaşılmasıyla birlikte yöre halkı domates türlerinin genetik çeşitliliğinin artırılmasına büyük önem vermiş ve son yıllarda bu tür çalışmalara ağırlık verilmiştir. Yerel çeşitlerin tanımı yapılacak olursa, farklı bitkisel özelliklere sahip, çoğunlukla genetik olarak birbirlerinden farklı olmanın yanında bitki ıslahına tabi olmamış, yerel olarak yetiştikleri alandaki çevre koşullarına uyum sağlamış, geleneksel tarım sistemi ile bütünleşmiş, tarihsel geçmişi olan ve tarımı yapılan ürünlerin dinamik popülasyonlarıdır (Camacho Villa ve ark., 2005). Geçmiş yıllardan beri zirai üretimlerde yerel çeşitleri kullanmayı tercih eden üreticiler, o bölgenin abiyotik ve biyotik faktörlerine karşı adaptasyon kazanan bitki türlerini tercih etmişlerdir. Bu sayede uzun generasyonlar sonucunda, günümüzde yerel çeşitler olarak isimlendirilen o bölgeye özgü bitki popülasyonları ortaya çıkmıştır. Aile tipi üretim yapan çiftçilerin zirai üretimden vazgeçmeleri ve ticari hibrit çeşit kullanımına yönelmek gibi nedenlerden ötürü dünyada ortalama her hafta iki yerel çeşidin neslinin tükendiği düşünüle gelmektedir (Scialabba ve Hattam, 2002; Scialabba, 2003).

Anaç seçiminin yapıldığı gen havuzundaki genotiplerin varyasyonlarının bilinmesi, domates çeşit geliştirme çalışmalarının başarısını etkileyen önemli bir faktördür. Yerel çeşitler istenilen özelliklere sahip yeni domates çeşitlerini geliştirmek için ıslah programlarında kullanılabilen gen havuzunu temsil etmelerinden dolayı büyük öneme sahiptirler. Ayrıca yerel çeşitler bir bölgenin kültürel ve tarımsal mirasının korunmasına da yardımcı olmaktadırlar. Yerel domates genotiplerinin toplanarak çeşit olma özelliği taşıyan adayların belirlenmesi konusunda son yıllarda ülkemizde yapılan araştırmalar hız kazanmıştır. Karadeniz Bölgesinde yetiştirilen yerel domates genotiplerinin morfolojik özelliklerinin belirlenmesi ile ilgili çalışmaların varlığı çok azdır. Bu tür çalışmalar ile domates yetiştiriciliğinde taze tüketim (sofralık) için başlangıç hatları elde edilebilmekte ve sanayide kullanılabilecek (salça, konserve, kurutma vb.) genotiplerin seçimi yapılabilmektedir. Bu çalışmada, Karadeniz bölgesinden toplanan bazı

yerel domates popülasyonlarının morfolojik ve biyokimyasal özelliklerinin incelenmesi, baskın genotipin belirlenmesi ve ıslah programlarına materyal sağlanması amaçlanmıştır.

MATERYAL ve YÖNTEM

Materyal

Çalışma 2018 yılında Ordu Üniversitesi Ziraat Fakültesi Araştırma Uygulama arazisi (6 m rakım, 40°58' K, 37°56' D) ile Bahçe Bitkileri Bölümü laboratuvarlarında gerçekleştirilmiştir. Genetik tohum materyali olarak yetiştiriciler tarafından yaygın olarak yetiştirilen 4 adet ticari çeşit ile Karadeniz Bölgesinden toplanan 5 adet yerel genotip olmak üzere toplamda 9 adet domates genotipi incelenmiştir (Çizelge 1).

Çizelge 1. Denemede Kullanılan Çeşit ve Genotipler

Kod	Çeşit	Tohum firması
Ç1	H2274	Arzuman tohum
Ç2	SC-2121	Balıkesir tohumculuk
Ç3	Margol F1	Yüksel tohum
Ç4	Ege pembesi	Tarmen tohum
Kod	**Genotip**	**Toplanan yer**
A8	Şavşat domatesi	Artvin-Şavşat
G1	Salkım domates	Giresun-Merkez
G3	Pembe domates	Giresun-Bulancak
S8	Bafra kurutmalık	Samsun-Bafra
T6	Arsin 2	Trabzon-Arsin

Denemenin yürütüldüğü 4 Haziran 2018-15 Ekim 2018 tarihleri arasında ve uzun yıllarca (1980-2018) kaydedilen toplam yağış, maksimum ve minimum sıcaklık ile ortalama sıcaklık ve ortalama nem değerleri Çizelge 2'de verilmiştir. Deneme boyunca sıcaklık ve ortalama nispi nem değerleri uzun yıllar ortalamasının üzerinde seyretmiştir. Toplam yağış miktarı uzun yıllar ortalamasının altında gerçekleşmiştir. Yüksek nem hastalık riski oluştursa da çalışma boyunca hastalık ve zararlılarla karşılaşılmamıştır.

Çizelge 2. Deneme Alanına Ait Sıcaklık (°C), Toplam Yağış (mm) ve Ortalama Nem Miktarına (%) İlişkin Meteorolojik Değerler (Anonim, 2022)

		Haziran	Temmuz	Ağustos	Eylül	Ekim	Ortalama
2018	Sıcaklık (°C)	22.6	25.0	25.1	21.9	18.4	**22.6**
	Toplam Yağış (mm)	37.4	109.0	34.0	95.4	126.7	**80.5**
	Ort. nem (%)	73.8	76.3	71.7	76.2	81.4	**75.8**
Uzun yıllar (1980-2018)	Sıcaklık (°C)	20.6	23.5	24.0	20.6	16.5	**21.0**
	Toplam Yağış (mm)	70.8	60.5	63.6	82.5	140.6	**83.6**
	Ort. nem (%)	72.0	71.8	71.7	72.2	74.2	**72.3**

Yöntem

Tohum firmalarından temin edilen domates tohumları ve yerel popülasyonların tohumları 2:1 oranında hazırlanmış torf:perlit karışımı içeren viyollere 25 Nisan tarihinde ekilmiştir. Fideler açık araziye 4 Haziran 2018 tarihinde dikilmiştir. Dikime hazır haldeki fidelerin dikim işlemi

her genotip ve çeşitten toplam 20 bitki olacak şekilde hazırlanan masuralara 65x50 cm sıra arası ve sıra üzeri dikim mesafesi ile yapılmıştır. Çalışmada her genotipten 6 adet bitki belirlenmiş ve bu bitkilerde gözlem ve ölçümler yapılmıştır. Dikimden sonra, IPGRI (Uluslararası Bitki Genetik Kaynakları Enstitüsü) (Anonim, 1996) ve UPOV (2013), tarafından tanımlanan deskriptörler kullanılarak bitkilerin çeşitli morfolojik ve agronomik özellikleri tanımlanmıştır. Belirlenen özellikler; fide özellikleri, fenolojik gözlemler, bitki özellikleri ve meyve özellikleridir (Çizelge 3). Morfolojik özelliklerin yanı sıra yaprak klorofil içeriği, bitki başına verim, meyve kalite özellikleri ve bazı biyokimyasal özellikler de belirlenmiştir.

Çizelge 3. İncelenen morfolojik özellikler

Hipokotillerde antosiyanin oluşumu: (0): Yok, (1): Var	Meyve dilimliliği (1):Yok veya çok az, (2):az, (3):orta, (4):güçlü ve (5):çok güçlü
Bitki gelişme şekli: (1): yer, (2): sırık	Olgun meyve rengi: (1): açık kırmızı, (2): kırmızı, (3): turuncu kırmızı, (4): koyu kırmızı, (5): pembe, (6): turuncu; (7): sarı; (8): yeşil
Bitki gücü: (1): zayıf, (2): orta, (3): sırık	Olgunlaşmadan önce meyvede yeşil yaka: (0): yok, (1): var
Gövdede antosiyanin oluşumu: (1): var, (2): yok	Meyve olgunlaşma süresi: (1): çok erken 50-55 gün, (2): erken 55-60 gün, (3): orta 60-70 gün, (4): geç 70-75 gün, (5): çok geç >75 gün
Gövdede tüylülük: (1): yok, (2): az, (3): orta, (4): çok	Olgunlaşmadan önce meyvede yeşil çizgililik (gölge): (1): var ve (0): yok
Gövdede boğum arası uzunluk: (1): kısa, (2): orta, (3): uzun	Ortalama meyve ağırlığı: (1): ≤35g, (2): 35-70g, (3): 70-105g, (4): 105-140g, (5): 140-175 g, (6): ≥175g
Gövdede boğum arası kalınlık: (1): ince, (2): orta, (3): kalın	Meyve genişliği: (1): ≤40 mm, (2): 40-50mm, (3): 50-60mm, (4): 60-70mm, (5): ≥70mm
Yaprak duruşu: (1): yarı dik, (2): yatay, (3): yarı sarkık, (4): karışık	Meyve yüksekliği: (1): ≤ 40mm, (2): 40-50mm, (3): 50-60mm, (4): ≥60mm
Yaprak ayası tipi: (1): basit, (2): bileşik	Meyve rengi: (1): krem, (2): sarı, (3): turuncu, (4): pembe, (5): kırmızı, (6): kahverengi, (7): yeşil
Yaprak rengi: (1): açık yeşil (2): orta yeşil, (3): koyu yeşil	Meyve eti rengi: (1): krem, (2): sarı, (3): turuncu, (4): pembe, (5): kırmızı, (6): kahverengi, (7): yeşil
Yaprak genişliği: (1): dar, (2): orta, (3): geniş	Meyve sertliği: (1): çok yumuşak, (2) yumuşak, (3): orta, (4): sert, (5): çok sert
Yaprak kabarcıklanma durumu: (1): zayıf, (2): orta, (3): güçlü	Olgun meyve eti kalınlığı: (1): ≤4mm, (2): 4-5mm, (3): 5-6mm, (4): ≥6mm
Yaprak parlaklığı: (1): zayıf, (2): orta, (3): güçlü	Olgun meyvede kabuk kalınlığı: (1): ≤0.15mm, (2): 0.15-0.20mm, (3): 0.20 – 0.25, (4): ≥0.25
Çiçek burnu şekli: (1): nokta, (2): yıldız, (3): düzensiz, (4): ışınsal	Olgun meyvede et rengi: (1): açık kırmızı, (2): pembe kırmızı, (3): kırmızı, (4): koyu kırmızı
Çiçek rengi: (1): sarı, (2): turuncu	Meyvenin enine kesit şekli: (1): yuvarlak, (2): köşeli, (3): düzensiz, (4): oval
Salkım tipi (2. ve 3. salkım): (1): basit, (2): bileşik, (3): karışık	Çekirdek evi sayısı: (1): ≤3, (2): 3-5, (3): 5-7, (4): ≥7
Meyve şekli: (1): düz basık, (2): az basık, (3): yuvarlak, (4): yuvarlak basık, (5): oval hafif basık, (6): yuvarlak hafif basık, (7): kalp şeklinde, (8): oval, (9): ters oval, (10): armut şeklinde, (11): ters kalp şeklinde	Çekirdek evi büyüklüğü: (1): küçük, (2): orta, (3): büyük, (4): düzensiz
	Meyve tabanı şekli: (1): basık, (2): düz, (3): sivri

Yaprak Klorofil İçeriği; ölçüm bitkilerinin yaşlı, orta ve genç yapraklarında (Konica Minolta SPAD-502, Japonya) SPAD metre yardımı ile günün erken saatleri arasında yapraklarda mevcut klorofil konsantrasyonu cci (Chlorophyll Content Index) cinsinden ifade edilmştir.

Bitki Başına Verim; domates genotiplerinde ortalama meyve ağırlıkları kaydedildikten sonra bitki başına düşen ortalama meyve sayısı ile çarpılması sonucunda bitki başına kg cinsinden hesaplanarak ifade edilmiştir.

Meyve Genişliği; Hasat sırasında hasat edilen olgun domateslerde her genotipten 10 adet domatesin meyve enleri 0.01 mm'ye duyarlı dijital kumpas (Insize 1112, Almanya) kullanılarak mm cinsinden hesaplanmıştır.

Meyve Yüksekliği; hasat sırasında hasat edilen sağlıklı domates meyvelerinde her genotipten 10 meyve ile 0,01 mm'ye duyarlı bir dijital kumpas (Insize 1112, Almanya) kullanılarak mm cinsinden ifade edilmiştir.

Meyve kalite özellikleri olarak meyve sertliği, meyve eti sertliği, kuru madde içeriği, toplam suda çözünebilir kuru madde (SÇKM), meyve rengi ve ortalama meyve ağırlıkları belirlenmiştir.

Meyve sertliği ve meyve eti sertliği dijital durometre (Agrosta, Fransa) ile meyvenin dış kabuğuna hafifçe bastırılarak yüzde (%) olarak belirlenmiştir.

Kuru madde içeriği 100 g meyve örneği tartıldıktan sonra 80°C'de 48 saat etüvde kurutulmuş ve kuru madde içeriği belirlenmiştir.

SÇKM (briks) değeri, hasat edilmiş meyvelerden elde edilen meyve suyu örneklerinde dijital refraktometre (PAL-1, McCormick Fruit Tech., Yakima, ABD) ile belirlenmiş ve % olarak verilmiştir.

Meyve renk değerleri belirlenirken hasat edilen domates meyvelerinin farklı eksen bölgelerinde renk ölçer (Konica, Minolta CR-300, ABD) kullanılmıştır. CIE renk sistemine göre L*, a*, b* renk değerleri ve ilgili formüller yardımı ile hue° renk açı değeri ve kroma değerleri hesaplanmış, renk değerlerinin skala değerleri McGuire (1992),'ye göre ifade edilmiştir.

$$°h = tan - 1\left(\frac{b}{a}\right)$$

(1)

$$C^* = \sqrt{[(a^2 + b^2)]}$$

(2)

Ortalama Meyve Ağırlığı; hasat edilen meyvelerin toplam ağırlıklarının hasat edilen meyve sayısına oranlanması ile gram cinsinden ifade edilen kalite özelliğidir.

Biyokimyasal özellikler olarak C vitamini, meyve suyu pH'sı ve titre edilebilir asitlik özellikleri belirlenmiştir.

C vitamini içerikleri Öztürk ve Özer (2019)'e göre belirlenmiştir. C vitamini değerleri Reflectoquant Plus 10 marka cihaz (Merck RQflex plus 10, Türkiye) kullanılarak mg 100 g^{-1} cinsinden ifade edilmiştir.

Meyve suyu pH'sı domates meyvelerinin suyunda pH metre (WTW 3110 Set 2 pH Meter, Almanya) ile belirlenmiştir (Karaçalı, 2009).

Titre edilebilir asitlik analizi Öztürk ve ark., (2016)'nın modifiye ettikleri protokole göre gerçekleştirilmiştir. Hasat sonrasında elde edilen meyve suyu 10 mL saf su ile seyreltilerek, değer pH 8.1'e değerine gelene kadar 0.1 N sodium hidroksit (NaOH) ile titre edilmiş ve sitrik asit cinsinden (g malik asit 100 mL^{-1}) ifade edilmiştir.

Çalışmadan elde edilen verilerin istatistiksel değerlendirmesi yapılırken SPSS 25.0 istatistik programında morfolojik özelliklerin basit tanımlayıcı istatistikleri ve kovaryans matrisi kullanılarak Past 3 istatistik programında temel bileşenler analizi yapılmıştır. Ayrıca domates genotiplerinin morfolojik özelliklerine göre benzerliğini ortaya koymak için elde edilen veriler NTSYSpc v.2.11 programında Nei, (1978) tarafından Dice, (1945) benzerlik indeksine göre UPGMA kümeleme yöntemi ile analiz edilmiştir.

BULGULAR ve TARTIŞMA

Morfolojik Bulgular

Araştırmada Karadeniz bölgesinden toplanan domates genotiplerine ait morfolojik özelliklerin belirlenmesi için 33 adet kriter UPOV'un belirlediği skalalar baz alınrak tanımlanmıştır. Araştırmada ortaya konmak istenen morfolojik karakterlerin yanında fenolojik gözlemler de belirlenmiştir. Karadeniz bölgesinden elde edilen domates genotipleri ile ticari çeşitlere ait morfolojik özellikleri fide özellikleri, bitki (gövde, yaprak, çiçek) özellikleri ve meyve özellikleri oluşturmaktadır.

Fide çıkış süresi, ilk çiçeklenme süresi ve %50 çiçeklenme süresine ait minimum maksimum gün değerleri Çizelge 4'te verilmiştir. Fide çıkış süresi en erken 5 gün olarak Ç3 çeşidinde belirlenmiştir. Genotipler değerlendirildiğinde ise G3 genotipi 7 günde çıkış gösterirken en geç çıkış süresi (16 gün) S8 ve T6 genotiplerinde kaydedilmiştir. Yapılan bir çalışmada domates genotiplerinin fide çıkış süreleri maksimum 17 gün olarak belirlenirken diğer genotipler 8-10 gün arasında çıkış süresine sahiptir (Iordachescu ve ark., 2021). Bu anlamda G3 genotipinin çıkış süresi ümit var bulunmuştur.

İlk çiçeklenme en erken (8 gün) Ç3 çeşidinde gözlemlenirken genotiplerden en erken çiçeklenen genotipler T6 (16 gün) genotipi olmuştur. En geç (28 gün) çiçeklenmenin görüldüğü

genotip ise G3 genotipidir. İlk çiçeklenmeye kadar geçen gün sayısı çalışmada incelenen genotip ve çeşitlerde 19.2 gün olarak belirlenmiştir. Domates genotiplerinde yapılan çalışmalarda elde edilen sonuçlara göre elde edilen ilk çiçeklenme süresi ortalama değerlerin altında bulunmuştur. Jamal ve ark., (2021) bu süreyi 4 domates genotipinde 22.7-26.5 gün arasında, Srinivasulu ve Singh (2021), ise 27 domates genotipinde 18.2-27.9 gün arasında kaydetmişlerdir.

%50 çiçeklenmeye kadar geçen süre en erken 14 gün ile Ç3 çeşidinde görülürken en erken çiçeklenmenin olduğu genotip T6 (26 gün) olmuştur. En geç %50 çiçeklenmeye kadar geçen süre 34 gün ile G1 genotipinde gözlemlenmiştir. Singh ve Janeja (2018) %50 çiçeklenme süresini ortalama 30.7 bulurken Srinivasulu ve Singh (2021) ise 31.1 gün bulmuşlardır. Çalışmamızda incelenen genotiplerde ise bu süre 30.2 dir.

Çizelge 4. Domates genotip ve çeşitlerine ait fide çıkış ve çiçeklenme süreleri

Fenolojik bulgular	Min-Max	Ortalama	Std. Sapma	% CV
Fide Çıkış Süresi (gün)	5-16	9.7	3.92	40.1
İlk Çiçeklenmeye Kadar Geçen Süre (gün)	8-28	19.2	7.85	40.8
%50 Çiçeklenmeye Kadar Geçen Süre (gün)	14-34	25.3	7.24	28.6

Çalışmada UPOV kriterleri göz önüne alınarak yapılan morfolojik karakterizasyonda bütün genotip ve çeşitlere ait 33 farklı özellik belirlenmiştir (Çizelge 5). Bitki gelişme şekli incelenen yerel domates genotiplerinin 5'i (%55.5) sırık şeklinde, 4 adedi ise (%44.5) yer domatesi şeklindedir. Domates genotiplerinde bitki gücünün 7 genotipte (%77.8) orta güçte ve 2 genotipte (%22.2) güçlü olduğu belirlenmiştir. Çekirdek evi büyüklükleri gözlemlendiğinde 2 genotip küçük, 2 genotip orta, 4 genotip büyük ve 1 genotip ise düzensiz çekirdek evi büyüklüğüne sahip olarak belirlenmiştir. Çekirdek evi sayıları ise 5 genotipte 3 veya daha az, 1 genotipte 3-5 arası ve 3 genotipte 7'den fazla olmuştur. Gövdede antosiyanin oluşumuna ise yalnızca 2 genotipte rastlanmıştır. Çiçek burnu şekli bakımından genotiplerin 9 tanesi nokta, 2 tanesi düzensiz şekilli tespit edilmiştir. Salkım tipini belirlemek için domates genotiplerinde yapılan morfolojik gözlemler sonucunda 5 genotipin basit, 4 genotipin de bileşik salkım yapısında olduğu belirlenmiştir. Meyve dilimliliği kriteri incelendiğinde 5 genotipin yok veya çok az, 2 genotipin az, 1 genotipin orta ve 1 genotipin güçlü dilimlikte olduğu belirlenmiştir. Çalışmada incelenen bütün genotiplerin çiçek renkleri sarı renk olarak belirlenmiştir. Yaprak duruşları incelendiğinde 5 genotipin yarı dik, 4 genotipin ise yatay yaprak duruşuna sahip olduğu belirlenmiştir. Yaprak renkleri ise 3 genotipte açık, 2 genotipte koyu olurken 4 genotip yeşil renklidir. Yaprak kabarcıklanma durumu özelliğine bakıldığında 5 genotipte zayıf kabarcıklanma 4 genotipte orta kabarcıklanma mevcuttur. Meyve olgunlaşma süreleri incelendiğinde 1 genotip çok erken, 2 genotip erken, 3 genotip orta ve 3 genotip geçci

olgunlaşma süresine sahip olmuşlardır. Önemli bir kalite özelliği olan ortalama meyve ağırlığı özelliği ise 2 genotipte 35 g'dan küçük, 1 genotipte 35-70 g arası, 1 genotipte 70-105 g arası, 2 genotipte 105-140 g arası, 2 genotipte 140-175 g arası ve1 genotipte 175 g'dan yüksek çıkmıştır. Olgunlaşmadan önce meyvede yeşil yaka oluşumuna ise yalnızca 1 genotipte rastlanılmıştır. Meyve rengi 8 genotipte kırmızı renkli olurken yalnızca 1 genotip pembe meyve rengine sahiptir. Olgunlaşmadan önce meyvede yeşil çizgililik (gölge) özelliği sadece 1 genotipte var olarak kaydedilmiştir. Meyvenin enine kesit şekli incelendiğinde 8 genotipin yuvarlak, 1 genotipin ise düzensiz kesit şekline sahip olduğu görülmektedir.

Çizelge 5. Çeşit ve Genotiplere ait bazı morfolojik özellikler

	BGŞ	GT	ST	MŞ	MTŞ	MD	ÇES	ÇEB	ÇBŞ	MS	OMA
A8	sırık	az	karışık	az basık	basık	orta	küçük	≥7	düzensiz	yumuşak	105-140 g
G1	sırık	Orta	karışık	az basık	düz	az	büyük	≤3	nokta	orta	140-175 g
G3	sırık	Çok	basit	oval	düz	Yok	orta	3-5	nokta	orta	≤35g
S8	yer	orta	basit	oval	düz	Yok	orta	≤3	nokta	sert	70-105 g
T6	sırık	orta	basit	az basık	basık	az	düzensiz	≥7	düzensiz	orta	35-70 g
Ç1	yer	az	basit	az basık	düz	Yok	büyük	≤3	nokta	orta	140-175 g
Ç2	yer	orta	karışık	düz basık	düz	güçlü	küçük	≥7	nokta	orta	≥175g
Ç3	sırık	az	basit	yuvarlak	düz	Yok	büyük	≤3	nokta	orta	≤35g
Ç4	yer	az	karışık	yuvarlak	düz	Yok	büyük	≤3	nokta	sert	105-140 g

BGŞ: Bitki gelişme şekli, GT: Gövdede tüylülük, ST: Salkım tipi, MŞ: Meyve şekli, MTŞ: Meyve tabanı şekli, MD: Meyve dilimliliği, ÇES: Çekirdek evi sayısı, ÇEB: Çekirdek evi büyüklüğü, ÇBŞ: Çiçek burnu şekli, MS: Meyve sertliği, OMA: Ortalama meyve ağırlığı

Çiçek, yaprak ve meyve karakterleri, domates genotipleri arasındaki varyasyonun belirlenmesinde önemli ayırt edici göstergelerdir (Delices ve ark, 2021). Morfolojik özelliklerin belirlenmesi, genotiplerin belirli ekolojik koşullarda performanslarının değerlendirilmesiyle genetik varyasyonu değerlendirmek için basit bir uygulama sağlar, ancak morfolojik karakterler genellikle çevresel faktörlerden etkilenmektedir (Kouam ve ark., 2018). Domateste morfolojik bulgular ışığında birçok araştırıcı tarafından yürütülen karakterizasyon çalışmaları mevcuttur. Domates meyvelerinin özellikleri, domates genotiplerinin morfolojik anlamda farklılıklarının ortaya konulması bakımından umut verici belirteçlerdir (Patel ve ark., 2001).

Domateste, meyve şekil özelliklerinin yüksek derecede genetik varyasyona sahip olduğu bilinmektedir. Meyve şekli ve büyüklüğü hem tüketici hem de pazarlama açısından oldukça önemli bir özelliktir. Meyve şekli, domates genotipinin kesin olarak tanımlanmasında kullanılabilecek en umut verici özelliklerden biridir (Salim ve ark., 2020). Çalışma sonucunda genotiplerden 4 farklı meyve şekli belirlenmiştir. Olgunlaşmadan önce meyvede yeşil yaka

oluşumu, yapılan benzer karakterizasyon çalışmalarında incelenmiş olup var yada yok şeklinde belirlenmiştir (Sacco ve ark., 2015).

SPAD ve Bitki Başına Verim

Domates genotip ve çeşitlerinde yaprak klorofil indeksi 32.4 (A8)-61.1 (Ç1) CCI arasında değişim göstermiştir. Çalışmada incelenen domates genotip ve çeşitlerine ait sonuçlar Çizelge 6'da verilmiştir. Genotipler kendi içinde değerlendirildiğinde en yüksek klorofil indeksi G1 genotipinde kaydedilmiştir. Hassan ve ark., (2021) yerel domates genotiplerinin yapraklarındaki yaprak klorofil indeksini 43.47-64.73 arasında tespit etmişlerdir. Çalışmadan elde edilen sonuçlar bu çalışmayla benzerlik göstermiştir.

Çizelge 6. SPAD ve bitki başına verim değerleri

Kod	SPAD (cci)	Bitki Başına Verim (kg bitki^{-1})
A8	32.4	0.32
G1	56.0	0.75
G3	44.7	0.10
S8	47.7	0.24
T6	41.5	0.17
Ç1	61.1	0.14
Ç2	54.8	0.81
Ç3	51.6	1.20
Ç4	50.4	0.48
Ortalama	48.9	0.46
Minimum	32.4	0.1
Maksimum	61.1	1.2
Standart Sapma	8.59	0.36
% Varyans	17.5	78.9

Domates genotip ve çeşitlerinde hesaplanan bitki başına ortalama verim değerleri Çizelge 6'da verilmiştir. Verim değerleri 0.1-1.1 kg bitki^{-1} arasında değişim göstermiştir. En yüksek bitki başına verimi Ç3 (1.2 kg bitki^{-1}) çeşidi verirken genotiplerden en yüksek verim G1 (0.75 kg bitki^{-1}) genotipinden kaydedilmiştir. G3 genotipi ise en düşük verime (0.1 kg bitki^{-1}) sahip genotip olmuştur. Yapılan yerel domates karakterizasyon çalışmalarında farklı verim aralığında sonuçlar bulunmuştur. Ciulca ve ark., (2015) 0.2-8.2 kg, Scarano ve ark., (2020) 1.67-5.67 kg ve Henareh ve ark., (2020) 1.4-3.3 kg arasında bitki başına verim değerleri hesaplamışlardır. Araştırmamızda yer alan genotiplerin bitki başına verim değerleri bu sonuçların altında kalmıştır. Bitki başına verim özelliğinin varyansa katkısı %78.9 olarak hesaplanmıştır. Varyans yüzdesinin yüksek çıkması yorumlandığında verim özelliğinin karakterizasyon çalışmalarına önemli etki yaptığı sonucuna varılmaktadır.

Renk Özellikleri

Domates genotiplerinden hasat edilen domates meyvelerinde renk ölçer yardımıyla belirlenen renk değerleri Çizelge 7'de verilmiştir. L* parlaklık değeri 34.97 (G3)-44.58 (T6) arasında, a* değeri 18.14 (Ç3)-39.43 (T6) arasında ve b* değeri 25.02 (G3)-37.05 (T6) arasında değişmiştir. Kroma değerleri ise 32.4 (G3)-54.1 (T6) arasında ve Hue açısı değerleri 43.2 (T6)-59.2 (Ç3) aralığında kaydedilmiştir. İlbi ve ark., (2020) Türkiye'nin çeşitli bölgelerinden topladıkları yerli domates genotiplerinde L* değerini 37.13-54.17 aralığında, a* değerini 12.33-32.44 ve b* değerini ise 16.05-40.20 aralığında bulmuşlardır. Kroma ve Hue açısı değerleri ise sırasıyla 25.88-49.66 ve 32.45-72.51 arasında bulunmuştur. Elde edilen bulgular meyve renk özellikleri açısından yerli genotiplerin önemli farklılıklara sahip olduklarını ortaya koymuştur. Tespit edilen sonuçlar, yerli domates genotiplerinin meyveleri arasında renk özellikleri açısından önemli farklılıkların olduğunu rapor eden Kaya (2012)'nın bulgularıyla uyum göstermektedir.

Çizelge 7. Domates genotiplerinde renk özelliklerine ait değerler

Kod	L	a	b	Chroma	Hue
A8	43.19	34.43	35.37	49.36	45.70
G1	41.09	30.68	33.30	45.28	47.34
G3	34.97	20.59	25.02	32.40	50.56
S8	43.30	32.25	36.34	48.61	48.43
T6	44.58	39.43	37.05	54.11	43.25
Ç1	38.38	33.50	33.41	47.32	44.89
Ç2	43.39	20.68	28.46	35.18	53.99
Ç3	39.89	18.14	30.63	35.62	59.25
Ç4	38.95	33.12	33.44	47.07	45.26
Ortalama	40.86	29.20	32.56	43.88	48.74
Minimum	34.97	18.14	25.02	32.4	43.25
Maksimum	44.58	39.43	37.05	54.11	59.25
Standart Sapma	3.1058	7.47044	3.90109	7.55616	5.11943
% Varyans	7.6	25.6	12.0	17.2	10.5

Meyve Kalite Özellikleri ve Biyokimyasal İçerikler

Araştırmada analizi yapılan meyve kalite özellikleri ve biyokimyasal içeriklere ait bulgular Çizelge 8'de verilmiştir.

Çalışmada SÇKM değerleri %6.1-7.3 arasında değişim göstermiştir. Yüksek SÇKM değerlerinin meyve ağırlığı bakımından ufak meyvelere sahip genotiplerden elde edildiği görülmüştür. Çeri domates tipinin ağırlık olarak geleneksel olarak nitelendirilen domateslere kıyasla daha yüksek SÇKM değerine sahip olduğu araştırıcılar tarafından söylenmiştir (Srivalli ve ark., 2016). Çalışmada en yüksek SÇKM değeri T6 genotipinde kaydedilmiştir. Çalışmada incelenen genotiplerin ortalama SÇKM değeri %6.6 olurken Lazaro (2017), yaptığı çalışmasında domates genotiplerinin ortalama SÇKM değerini %6.73 olarak bildirmiştir.

Çizelge 8. Domates genotiplerinde meyve kalite özelliklerine ait değerler

Kod	SÇKM (%)	KM (%)	MG (mm)	MY (mm)	MS (%)	MES (%)	MOS (gün)	OMA (g)
A8	6.3	8.2	71.4	48.9	46.0	18	72	119.9
G1	6.3	5.9	57.8	51.0	37.4	23	74	150.0
G3	6.9	8.8	25.4	34.0	46.4	26	73	14.4
S8	6.1	12.1	66.2	62.7	27.6	19	69	91.1
T6	7.2	9.6	63.7	45.6	46.2	23	63	46.1
Ç1	6.6	5.7	60.3	55.5	38.0	13	66	142.1
Ç2	6.5	10.0	67.5	39.3	52.0	18	59	222.2
Ç3	7.3	9.0	29.2	28.8	38.0	15	54	16.4
Ç4	6.6	7.2	59.0	55.5	51.8	24	58	131.2
Ortalama	6.6	8.5	55.6	46.8	42.6	19.8	65.3	103.7
Minimum	6.1	5.7	25.4	28.8	27.6	13	54	14.5
Maksimum	7.3	12.1	71.4	62.7	52	26	74	222.2
Std. Sapma	0.41	2.01	16.62	11.1	7.95	4.37	7.24	68.7
% Varyans	6.2	23.6	29.9	23.5	18.7	21.9	11.1	66.2

SÇKM: Suda çözünebilir kuru madde, KM: Kuru madde, MG: Meyve genişliği, MY: Meyve yüksekliği, MS: Meyve sertliği, MES: Meyve eti sertliği, MOS: Meyve olgunlaşma süresi, OMA: Ortalama meyve ağırlığı

Araştırmada incelenen domates meyvelerinin kuru madde içeriği 5.7-12.1 arasında değişmiştir. En yüksek kuru madde miktarını S8 genotipi vermiştir. S8 genotipinden elde edilen kuru madde miktarı literatürdeki verilerle karşılaştırıldığında oldukça yüksek bulunmuştur (Renna ve ark., 2019; Mellidou ve ark., 2020; Murariu ve ark., 2021).

Meyve genişlikleri 25.4-71.4 mm arasında tespit edilmiştir (Çizelge 8). En geniş meyveler A8 genotipinden elde edilmiştir. Ziaf ve ark., (2016) da yaptıkları çalışmada meyve genişliklerini 21.24-72.59 mm arasında bulmuşlardır.

Meyve yükseklikleri 28.8-62.7 mm arasında değişim gösterirken en yüksek meyveler S8 genotipinde kaydedilmiştir. Elde edilen meyve yükseklikleri Henareh ve ark., (2015)'nın bulduğu sonuçlarla benzerlik göstermiştir.

Araştırmada belirlenen meyve sertlikleri %27.6-52.0 arasında değişim göstermiştir. En sert meyveler G3 genotipinden elde edilirken çeşitlerden ise Ç2 en sert meyvelerin bulunduğu çeşittir. Meyve eti sertlikleri ise %13-26 arasında ölçülmüştür.

Meyve olgunlaşma süreleri incelendiğinde en erkenci genotip T6 (63 gün) genotipi olarak karşımıza çıkmaktadır. Erkenci bir hibrit çeşit olan Ç3 çeşidi 54 gün ile 9 genotip arasında en erken olgunlaşan domates meyvelerine sahip genotiptir. Yapılan çalışmalara göre araştırmadan elde edilen meyve olgunlaşma süreleri önceki çalışmalara genotip havuzunda erkenci çeşitlerin olduğunu ortaya koymuştur (Pradeepkumar ve ark., 2001; Nawaz ve ark., 2015).

Çalışmada incelenen ortalama meyve ağırlıkları geniş bir aralıkta belirlenmiş olup oldukça yüksek bir varyasyona sahiptir. İncelenen ortalama meyve ağırlıkları 14.5-222.2 g arasında

değişim gösterirken en ağır meyveler Ç2 çeşidinden (222.2 g), genotipler kendi içinde değerlendirildiğine G1 genotipinden (150 g) ölçülmüştür. En düşük ortalama meyve ağırlığına sahip domates meyveleri ise G3 genotipinden (14.4 g) elde edilmiştir. Morfolojik kriterler bakımından değerlendirildiğinde genotiplerin ortalama meyve ağırlık değerlerine göre oldukça geniş bir varyasyon gösterdikleri görülmüştür. Pradeepkumar ve ark., (2001) domateste ortalama meyve ağırlıklarının 1.40-115.0 g arasında, yürütülen farklı bir araştırmada ise ortalama meyve ağırlığının ortalama 18.18-332.45 g arasında olduğunu bildirmişlerdir (Turhan ve Şeniz, 2009). Araştırma sonucunda domates genotiplerinin ortalama meyve ağırlık değerleri çeşitlerin ortalama meyve ağırlıklarından düşük belirlenmiştir. Elde edilen ortalama meyve ağırlığı sonuçlarına göre, farklı ortalama meyve ağırlığı gruplarına ait genotipler ıslah çalışmalarında kullanılabilecek varyasyonu meydana getirmiştir. Domates genotiplerinden G3 ve T6 çeri domates olarak, diğer genotipler ise sofralık olarak tüketime uygun gruba dahil olmaktadır. Ortalama meyve ağırlığı özelliği çalışmadaki kriterler açısından varyansa en yüksek katkı sağlayan özellik olmuştur (%66.2).

Domates genotiplerinde incelenen biyokimyasal özelliklere ait değerler Çizelge 9'da verilmiştir. pH değerleri 4.33-4.81 arasında bulunmuştur. Çeşitlerin genotiplere kıyasla meyve suyu pH'larının daha asidik oldukları belirlenmiştir.

Çizelge 9. Domates genotiplerinde biyokimyasal özelliklere ait değerler

Kod	pH	TA (%)	C vit. (mg 100 g^{-1})	TF (mg GAE g^{-1})	Flavonoid (mg QE 100 g^{-1})	DPPH (mmol TE 100 g^{-1} fw)	FRAP (mmol TE 100 g^{-1} fw)
A8	4.54	0.38	13.3	108.6	112.6	1.26	2.24
G1	4.81	0.34	22.2	92.6	101.2	0.85	1.95
G3	4.49	0.58	20.5	103.2	96.5	1.05	2.12
S8	4.71	0.36	31.9	114.6	108.9	1.03	1.86
T6	4.61	0.37	42.0	119.7	112.4	0.62	1.42
Ç1	4.71	0.32	36.4	57.6	50.7	0.41	1.68
Ç2	4.68	0.32	33.5	44.9	41.9	0.16	1.10
Ç3	4.56	0.45	38.9	74.3	39.9	0.42	2.06
Ç4	4.33	0.32	32.8	48.8	43.9	0.21	0.93
Ortalama	4.60	0.38	30.1	84.9	78.7	0.66	1.70
Minimum	4.33	0.32	13.3	44.8	39.9	0.16	0.94
Maksimum	4.81	0.58	42	119.7	112.6	1.26	2.24
Std. Sapma	0.14	0.08	9.47	29.1	33.31	0.39	0.46
% Varyans	3.1	21.6	31.4	34.3	42.3	59.5	27.1

TA: Titre edilebilir asitlik, C vit.: C vitamini, TF: Toplam fenolikler, DPPH: Antioksidan kapasitesi, FRAP: Antioksidan gücü

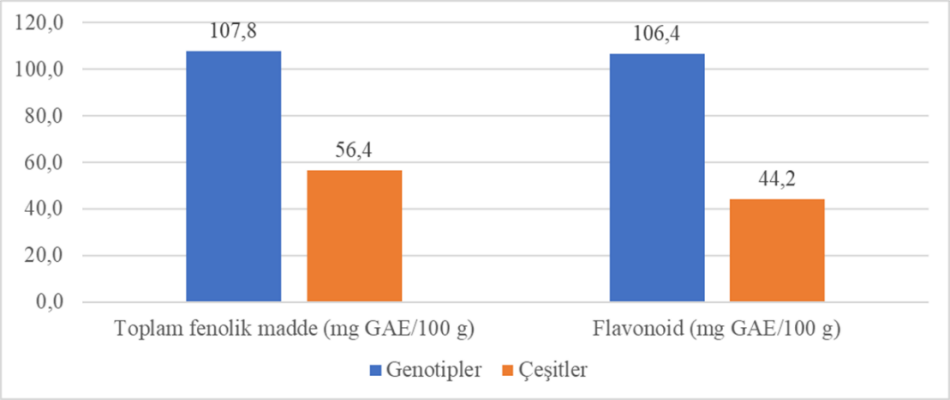
Yerel domates genotiplerinde yapılan bazı çalışmalarda pH değerinin araştırmamızdan elde edilen pH aralıklarına çok yakın değerlerde olduğu bildirilmiştir (Bakır ve ark., 2020; Murariu ve ark., 2021; Athindorou ve ark., 2021).

Yerel domates genotiplerinde titre edilebilir asitlik değeri %0.32-0.58 arasında bulunmuştur. Domates genotiplerinde ortalama asitlik değeri %0.38'dir. Titre edilebilir asitlik değerlerinde

genotiplerin çeşitlere göre yüksek ortalama değerler verdiği görülmüştür. G3 genotipinde en yüksek değer (% 0.58) kaydedilmiştir. Scarano ve ark., (2020) da %0.38-.053 arasında değişen benzer asitlik değerleri elde etmişlerdir.

C vitamini değerleri 13.3-42.0 mg 100 g^{-1} arasında değişim gösterirken en yüksek C vitamini değeri T6 genotipinde belirlenmiştir. Önceki çalışmalarda elde edilen sonuçlar araştırmamızın sonuçları ile uyum göstermektedir (Grozeva ve ark., 2020).

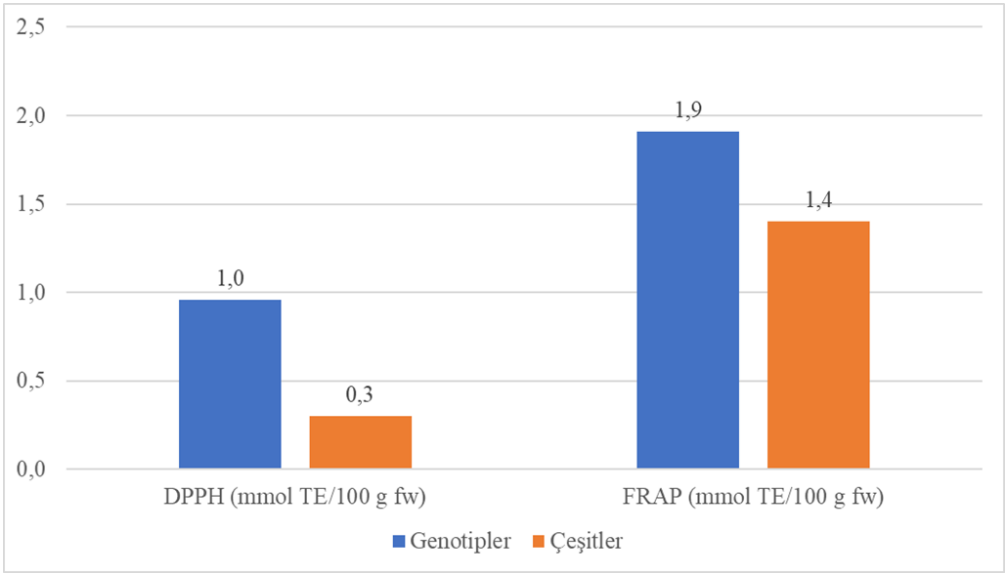
Toplam fenolik maddeler 44.8-119.7 mg GAE 100 g^{-1} aralığında değişmiştir. En yüksek toplam fenolik madde içeriği T6 genotipinden elde edilmiştir. Genotipler çeşitlere oranla daha yüksek toplam fenolik madde içeriğine sahiptir (Şekil 1). Literatürde toplam fenolik madde içerikleri incelendiğinde çalışmamızdan elde edilen sonuçlara yakın değerler verdiği görülmüştür (Kavitha ve ark., 2014; Asensio ve ark., 2019).



Şekil 1. Genotip ve çeşitlerin Toplam fenolik madde ve flavonoid madde ortalamaları

Flavonoid 39.9-112.6 mg GAE 100 g^{-1} aralığında değişmiştir. En yüksek flavonoid madde içeriği A8 genotipinden elde edilmiştir. Genotipler çeşitlere oranla daha yüksek toplam fenolik madde içeriğine sahiptir (Şekil 1).

DPPH değerleri 1.26-0.16 mmol TE 100 g^{-1} fw aralığında değişmiştir. En yüksek DPPH antioksidan kapasitesi A8 genotipinden elde edilmiştir. Genotipler çeşitlere oranla daha yüksek toplam fenolik madde içeriğine sahiptir (Şekil 2). Bhandari ve ark., (2016) da yaptıkları çalışmada yerli genotiplerin ticari çeşitlere göre daha yüksek DPPH aktivitesine sahip olduğunu göstermiştir.



Şekil 2. Genotip ve çeşitlerin Toplam fenolik madde ve flavonoid madde ortalamaları

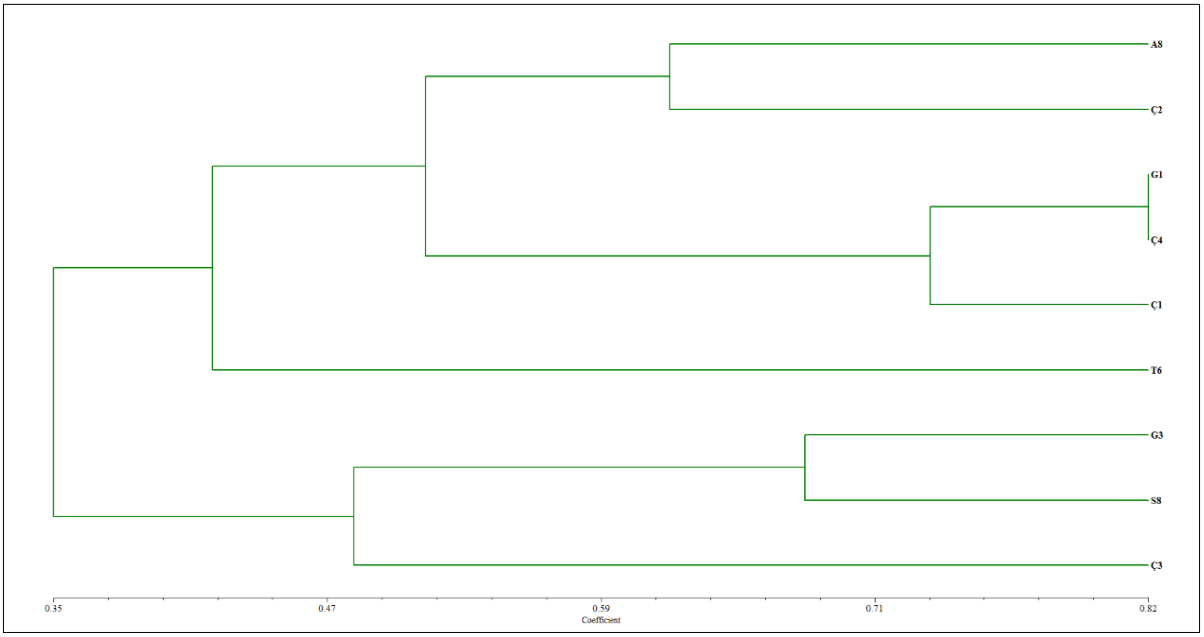
FRAP eğerleri ise 0.94-2.24 mmol TE 100 g-1 fw aralığında değişmiştir. En yüksek DPPH antioksidan kapasitesi A8 genotipinden elde edilmiştir. Genotipler çeşitlere oranla daha yüksek toplam fenolik madde içeriğine sahiptir (Şekil 2).

Domates Genotiplerinin Morfolojik Özelliklere Göre Kümeleme (Cluster) Analizi

Yerli domates genotiplerinin morfolojik verileri kullanılarak yapılan kümeleme analizi sonuçları Şekil 3'te gösterilmektedir. Morfolojik özellikler göz önüne alınarak gerçekleştirilen analizde domates genotiplerinin %11 ile %82 arasında benzerlik gösterdiği, korelasyon matrisi ile bu ilişkinin görsel ifadesi olan dendrogramın birbiri ile uyumunu açıklayan kofenetik korelasyon değeri r=0.71 olarak hesaplanmıştır. Oğuz (2010), yaptığı kümeleme analizi sonucunda bu katsayıyı 0.60 olarak bulmuştur. Küme analizine göre Karadeniz bölgesinden toplanan domates genotipleri test edilen kriterlere göre 2 ana gruba ayrılmış, oluşturulan ana gruplar ise 4 alt gruba ayrılmıştır.

2.grupta yer alan G1 ve Ç4 en benzer genotipler olurken birbirine en uzak iki genotip A8 ve Ç3 olmuştur. Domates genotipleri içerisinde 1. grupta bulunan A8 domates genotipi yüksek fenolik madde, flavonoid madde ve antoksidan özellikleri ile ön plana çıkmıştır. A8 genotipi Ç2 çeşidi ile birinci grubu meydana getirmiştir. İkinci grupta ise daha çok ticari çeşitler yer almıştır. G1 genotipi ise bu çeşitlerle aynı gruba girmiştir. 3.grubu T6 genotipi tek başına oluştururken, C vitamini, fenolik madde içeriği, SÇKM, meyve eti sertliği ve erkencilik açısından ümit var bulunmuştur. 4. grupta G3, S8 genotipleri ile Ç3 çeşidi yer almıştır. G3 genotipi çeri domates olarak değerlendirilebilecek ümit var sonuçlar vermiştir. Bu grupta bulunan S8 genotipi ise salçalık ve kurutmalık olarak işleme sanayiinde kullanılabilecek yüksek kuru madde miktarı içermektedir. Cluster analizi sonucunda yapılan kümelemede genotiplerin getirildiği, ekolojileri

birbirinden farklı olan bölgelerin herhangi bir etkiye sahip olmadığı ve istenilen düzeyde çeşitliliğin olduğu söylenebilir. Gerçekleştirilen yerel domates karakterizasyonu çalışmalarında araştırıcılar kümeleme analizi sonucunda 2 ana grup elde etmiş (Osei ve ark., 2014; Binbir ve ark., 2020), Henareh ve ark., (2015) ise genotiplerden 5 grup elde etmiştir.



Şekil 3. Domates Genotip ve Çeşitlerinin Kümeleme (Clustering) Analizi

Domates Genotiplerinin Morfolojik Özelliklere Göre Temel Bileşen Analizi (TBA)

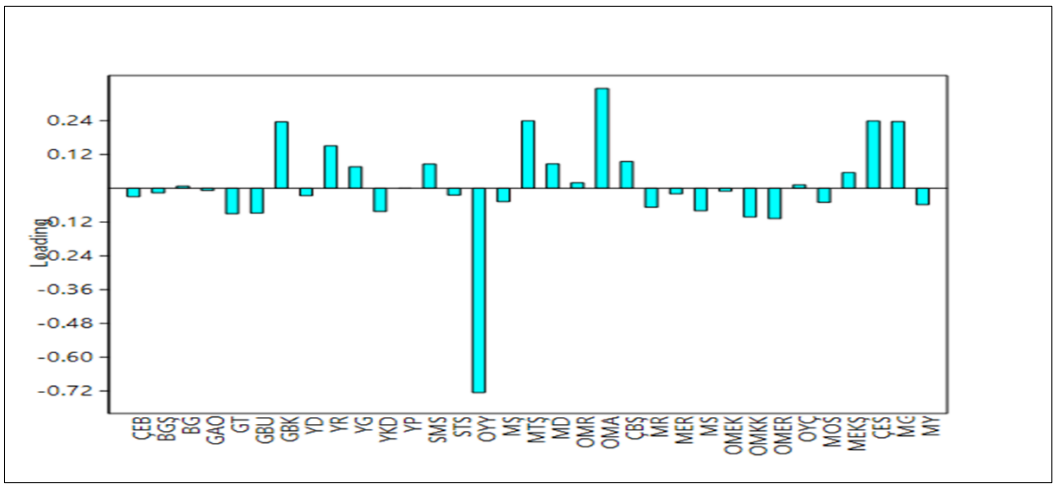
UPOV kriterlerine göre tanımlanan özelliklerin kullanıldığı temel bileşen analizinin sonuçları Tablo 10'da sunulmuştur. Temel bileşen eksenlerinden ilk 6 ekseninin özdeğerleri 1'den büyüktür. Temel bileşenlere bakıldığında ilk 2 eksenin açıkladığı varyansın (%37,1 ve %22,1) diğer temel bileşen eksenlerinin açıkladığı toplam varyansa göre daha yüksek olduğu görülmüştür. Özdeğerleri 1'den büyük olan altı ana eksen, toplam varyansın %95'ini açıklamaktadır. İlk 2 eksen toplam varyansın %50'sinden (%59,1) fazlasını açıklamaktadır. Bu sonuçlara göre morfolojik değerlendirmenin verimli olduğu söylenebilir. Morfolojik karakterizasyon çalışmalarında ilk 2 veya 3 temel bileşen ekseninin açıkladığı varyans oranının %25'ten büyük olduğu bildirilmiştir (Iezzoni ve Pritts, 1991).

Çizelge 10. Temel bileşen eksenlerinin varyansa katkıları ve öz değerler

	PC 1	PC 2	PC 3	PC 4	PC 5	PC 6
Varyans (%)	37.1	22.1	14.1	9.3	7.9	4.6
Toplam Varyans (%)	37.1	59.1	73.2	82.5	90.4	95.0
Öz değer	11.9	7.13	4.54	3.00	2.55	1.47

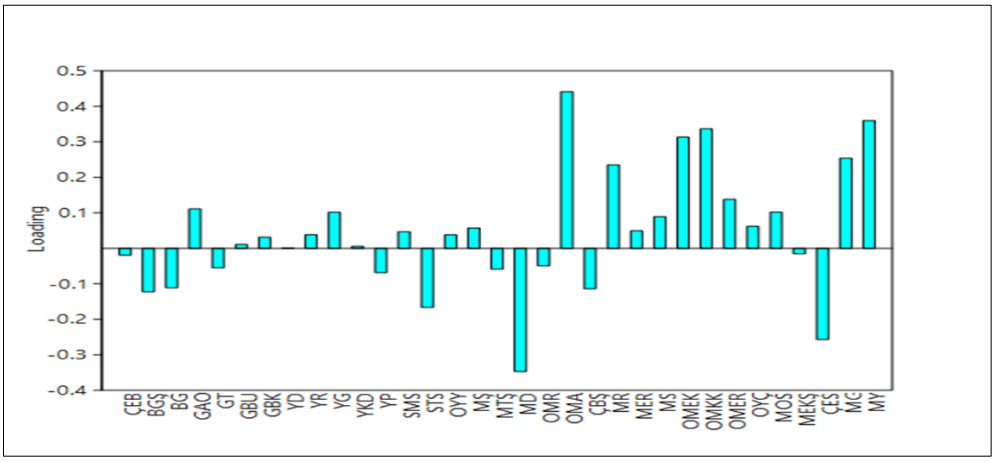
İlk temel bileşen ekseninde olgunlaşmadan önce yeşil yaka varlığı (OYY), çekirdek evi sayısı (ÇES), meyve genişliği (MG) ve meyve tabanı şekli (MTŞ) ve gövdede boğum arası uzunluk

(GBU) özelliklerinin varyansa katkıları yüksek bulunmuştur (Şekil 4). Bu özellikler, genotipler arasındaki farklılıkları açıklayan özellikler olarak tanımlanırken birinci temel bileşen ekseni toplam varyansın %37.1'ini açıklamaktadır.

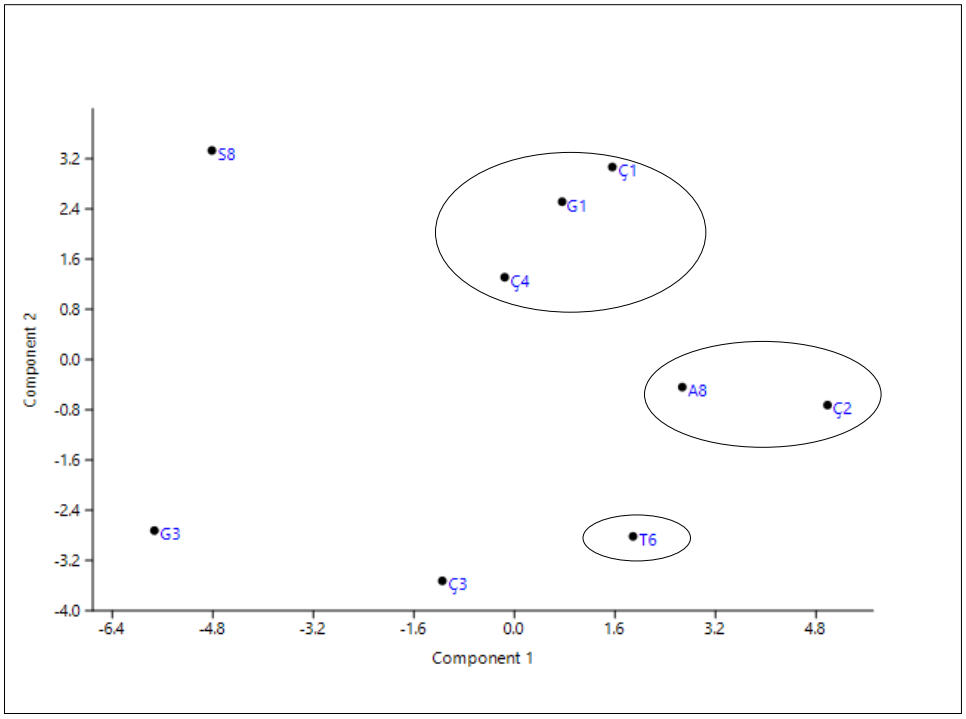


Şekil 4. İlk temel bileşen ekseninde morfolojik özelliklerin varyasyona katkısı

İkinci temel bileşen ekseninde ortalama meyve ağırlığı (OMA), olgun meyvede et kalınlığı (OMEK), olgun meyvede kabuk kalınlığı (OMKK), meyve yüksekliği (MY) ve meyve dilimliliği (MD) özellikleri varyansa büyük katkı sağlamaktadır (Şekil 5). Bu özellikler, genotipler arasındaki farklılıkları açıklayan özellikler olarak tanımlanmış, ikinci temel bileşen ekseni ise toplam varyansın %22,1'ini açıklamıştır.



Şekil 5. İkinci temel bileşen ekseninde morfolojik özelliklerin varyasyona katkısı



Şekil 6. Morfolojik özellikler bakımından temel bileşen analizi ile domates genotiplerinin 2 boyutlu düzlemde dağılımı

Çalışmada incelenen genotiplerin temel bileşen analizi sonrasında iki boyutlu düzlemde dağılımı Şekil 6'da verilmiştir. Daha önceki çalışmalarda sunulan sonuçlara benzer şekilde, morfolojik karakterizasyonda temel bileşenler analizi sonucunda, morfolojik tanımlayıcıların genotipleri ayırt etmede önemli olduğu, çalışma sonucunda meyve ve yaprak özelliklerinin ön plana çıktığı tespit edilmiştir.

SONUÇ ve ÖNERİLER

Araştırma sonucunda elde edilen sonuçlar özetlenecek olursa salçalık ve kurutmalık olarak işleme sanayiinde kullanılacak yüksek kuru madde miktarı içeren S8 genotipi ön plana çıkmıştır. C vitamini, fenolik madde içeriği, SÇKM, meyve eti sertliği ve erkencilik açısından T6 genotipi, Flavonoid madde miktarı, DPPH antioksidan kapasitesi ve FRAP antioksidan gücü bakımından değerlendirildiğinde A8 genotipi ve çeri domates olarak değerlendirilebilecek G3 genotipi yapılan analizler sonucunda gelecek ümit var sonuçlar vermiştir.

Araştırma bulgularına göre, genotipler içerisinde farklı pazar isteklerine göre tiplerde (kiraz, kokteyl, salkım, tane ve iri) meyve büyüklüğüne sahip farklı genotipler bulunmuştur. Morfolojik özelliklere göre gerçekleştirilen gruplamalar, domates genotiplerinin tespit edilen birçok kriter bakımdan farklı varyasyonlar gösterdiğini ortaya koymuştur. Çalışma sonucunda en yüksek varyasyon yüzdesi bitki başına verim ve ortalama meyve ağırlığı özelliklerinde, en düşük varyasyon yüzdesi ise SPAD değeri ve asitlik özelliklerinde gözlemlenmiştir.

Yerel domates genotipleri ile yapılan bu çalışma, domates ıslahı ve genetiği için değerli bilgilerin literatüre kazandırılmasının yanı sıra yerli domates genotiplerinin çeşitliliği ve adaptasyonu hakkında ıslah alanında çalışan araştırmacılara bakış açısı kazandırmayı hedeflemiştir. Ayrıca belirli bölgelere adapte olabilecek veya gelişmiş agronomik özelliklere sahip yeni domates çeşitlerinin geliştirilmesine kaynak olması hedeflenmiştir.

Çalışmanın bir sonraki adımı olarak genotiplerin tohum özelliklerinin belirlenmesi, hastalık ve zararlılara karşı dayanıklılık çalışmaları, biyotik ve abiyotik stres faktörlerine karşı dayanıklılık testlemelerinin gerçekleştirilmesi, hasat sonrasında ürünlerin muhafazası, depolanması ve raf ömrü performanslarının ortaya çıkartılması gibi ileri düzeyde yapılacak çalışmalarla, bu çalışmalardan çıkarılacak sonuçların pekiştirilmesi çalışmanın tam manasıyla amacına ulaşmasına katkı sağlayacaktır.

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TÜRKİYE'DE ANTEPFISTIĞI ZARARLISI CURCULONIDAE VE PENTATOMIDAE FAMILYASI TÜRLERİ

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ÖZET

Bu çalışmada Türkiye'de özellikle Güneydoğu Anadolu Bölgesinde yetiştirilen ekonomik değeri oldukça yüksek çeşitli vitamin ve mineraller bakımından zengin ve yüksek antioksidan aktivitesiyle dikkat çeken antepfıstığında (*Pistacia vera* L.) görülen zararlı Curculionidae (Coleoptera) ve Pentatomidae (Heteroptera) familya türleri ve bu türlerin antepfıstığı bitkisi üzerinde ne tür etkileri olduğu hakkındaki bilgiler ilgili çalışmalardan faydalanılarak derlenmiştir. Türkiye'de antepfıstığı zararlısı olarak Curculionidae familyasından 11 tür **(***Bangasternus orientalis, Aulacobaris coerulescens, Coelides rubricus, Polydrusus ponticus, Polydrusus roseiceps, Sitona crinitus, Sitona humeralis* Stephens 1831, *Sitona puncticollis, Ceutorrhynchus sp., Sibinia sp., Lixus sp.*); Pentatomidae familyasından 6 tür (*Piezodorus lituratus, Dolycoris baccarum, Acrosternum heegeri, Mustha longispinis, Palomena mursili, Stagonomus bipunctatus* görülmektedir. Bu çalışmada Türkiye'de özellikle Güneydoğu Anadolu Bölgesinde yetiştirilen, ekonomik değeri oldukça yüksek çeşitli vitamin ve mineraller bakımından zengin ve yüksek antioksidan aktivitesiyle dikkat çeken Antepfıstığında (*Pistacia vera* L.) görülen zararlı Curculionidae (Coleoptera) ve Pentatomidae (Heteroptera) familyalarına ait türleri antepfıstığı da meydana getirdiği zararlılar ilgili çalışmalardan faydalanılarak derlenmiştir.

Anahtar Kelimeler: Curculionidae, Antepfıstığı, Pentatomidae, Pest, Türkiye

CURCULONIDAE AND PENTATOMIDAE FAMILY SPECIES WITH PISTACHIO PESTS IN TÜRKİYE

ABSTRACT

In this study, the harmful Curculionidae (Coleoptera) and Pentatomidae (Heteroptera) family species seen in pistachio (*Pistacia vera* L.) grown in Turkey, especially in the Southeastern Anatolia Region, which is rich in various vitamins and minerals with high economic value and attracts attention with its high antioxidant activity, and the pistachio of these species. The information about what kind of effects it has on the plant has been compiled by making use of related studies. As a result, 11 species **(***Bangasternus orientalis*, *Aulacobaris coerulescens*, *Coelides rubricus*, *Polydrusus ponticus*, *Polydrusus roseiceps*, *Sitona crinitus*, *Sitona humeralis*, *Sitona puncticollis*, *Ceutorrhynchus* sp., *Sibinia* sp., *Lixus* sp.) from Curculionidae family as Pistachios pests in Turkey; There are 6 species (*Piezodorus lituratus*, *Dolycoris baccarum*, *Acrosternum heegeri*, *Mustha longispinis*, *Palomena mursili*, *Stagonomus bipunctatus* from Pentatomidae family.

Keywords: Curculionidae, *Pistacia vera*, Pentatomidae, Pest, Türkiye

INTRODUCTION

Turkey is the homeland of Eastern and Southeastern Anatolia Regions and pistachios, as well as many fruits. Other Regions where pistachios are grown; It extends to Azerbaijan, Iran, Afghanistan, Turkmenistan, Southern Kazakhstan, Northwest India and Kyrgyzstan (Özbek, 1978).

Pistachio cultivation in Turkey has been practiced since ancient times, especially in the Southeastern Anatolia Region. Turkey has a great potential in terms of fruit species and production (Şimşek & Kara, 2016; Şimşek & Gülsoy, 2017; Sırrı, 2019). The contribution of this fruit to the country's economy is high at a level that cannot be underestimated. As of 2014, pistachios are grown in Uzbekistan, USA, Tunisia, Syria, Pakistan, Mexico, Madagascar, Kyrgyzstan, Jordan, Italy, Iran, Greece, Cyprus, China, Azerbaijan, Afghanistan, Morocco, Ivory Coast and Mauritus. Iran has the most important share in world pistachio production and ranks first, followed by the U.S.A., Turkey, Syria and China (Anonymous 2014). Turkey is one of the important pistachio producer countries with 14.08% (Şimşek, 2018). Pistachio is called the golden tree in the Southeastern Anatolia Region due to its economic importance (Özbek, 1978). This delicious and nutritious fruit, which can be grown economically even in stony rocky areas and poor soils without irrigation, is also known as "golden tree", "green gold", "king of fruits" and "fruit of kings" (Ayfer, 1990). Considering the total pistachio production by regions in Turkey, the Southeastern Anatolia Region ranks first, the Aegean Region ranks second and the Western Black Sea Region ranks last (TSI, 2015). Turkey is the homeland of many nuts such as pistachio, walnut, hazelnut, chestnut, almond (Sykes, 1975; Soylu, 1984; Köksal, 2002; Akça, 2009; Gülsoy et al., 2016). Pistachios are one of the most popular tree nuts in the world (Aldars-Garcia et al., 2016). This fruit is important for heart health; It is the richest source of fatty acids, metals, phytosterols, phenolics and other compounds, and their consumption has become increasingly popular in the last decade (Dreher, 2012). In the food industry, pistachios are used for biscuits, pies, fudge, cakes, ice cream and peanut butter. It is the main ingredient of many Turkish desserts. This fruit contains 16% carbohydrates, 25% protein and 55% fat (Aktaş & Polat, 2007). There are many studies on the detection and control of harmful insect species in Pistachio trees in Turkey. These studies; Günaydın, 1978; Mart et all 1995; Bolu et al., 1999; Kaplan & Cinar, 2000; Kaplan & Mart, 2004; Bolu & Uygun, 2005; Özgen & Tok, 2009; Özgen & Karsavuran, 2011.

In 2001, Yanık and Yücel determined the pests, population development and damage status of pistachio in Şanlıurfa with the study of " **The pistachio (*P. vera* L.) pests, their population development and damage state in Şanlıurfa province**". *Dolycoris baccarum* (L.) from the

Pentatomidae family was the pest species, while *Coeliodes sp*. from the Curculionidae family was the pest species in pistachio.

Bolu in his study titled '**Determination of insect and mite fauna in pistachio fields of Southeastern Anatolia Region**' in 2002 found *Arosternum heegeri* Fieb and *Dolycoris baccarum* L. from Pentatomidae family in pistachio; *Aurigena lugubris* F., *Agrilus viridicerulans* Mars., *Coelides rubricus* (Gyll.), *Ceutorrhynchus sp.*, *Polydrusus ponicus*, *Polydrusus roseiceps* Pes., *Polydrusus sp.*, *Sitona crinitus* (Herbst), *Sitona humeralis* Stephens, *Sitona puncticollis* Stephens, *Sibinia sp.* from Curculiondae were reported as pest species in pistachio.

Özgen, Gözüaçık, Karsavuran and Fent carried out '**Investigations on the Pentatomidae (Heteroptera) Fauna in Apricot, Cherry, Olive and Pistachio Plantations in East and Southeastern Anatolia Region Turkey'** in 2005, 3 species belonging to the Pentatomidae family; *Acrosternum heegeri*, *Dolycoris baccarum* and *Mustha longispinis* were identified from the field and Bolu (2002) reported that *A. heegeri* and *D. baccarum* were found among the pest species in pistachios. Mart and Yanık (1995) reported that *A. heegeri* and *Mustha sp*. species were found in pistachio fields. It is thought that A. heegeri may cause significant damages in pistachio and researches on the biology and ecology of this pest should be carried out (Özgen et al., 2005).

Şimşek and Bolu in their study '**Determination of the harmful insect fauna in pistachio (*Pistaciae vera* L.) orchards in Diyarbakır Province**' in 2017, *Acrosternum heegeri* Fieber and *Mustha sp*. from Pentatomidae family; *Ceutorrhynchus sp*., *Lixus sp*., *Polydrosus roseiceps* Pesarini and *Sitona crinitus* Herbst from Curculionidae family were identified as pistachio pests.

Sabuncu, Mamay and Özgen revealed the biodiversity of pest and beneficial insects overwintering in pistachio orchards in the Middle Euphrates Valley in Şanlıurfa province of Turkey with their '**Study on overwintering insect (Arthropoda: Insecta) biodiversity in pistachio orchards in the Middle Euphrates Valley**, Turkey' in 2021. As a result of the study, *Piezodorus lituratus* and *Dolycoris baccarum* from Pentatomidae family; *Bangasternus orientalis* and *Aulacobaris coerulescens* from the Curculionidae family are seen as pistachio pests. In particular, the detected grain pest *D. baccarum* is thought to come from nearby barley and lentil fields. It has been reported in many studies that the aforementioned pests cause significant damage in red lentil, wheat and barley fields (Mutlu et al., 2016; Mutlu et al., 2018a; Mutlu et al., 2018b).

MATERIAL and METHOD

In this study, Pentatomidae and Curculionidae species which are pests on pistachio in Turkey were investigated. It was compiled from the studies (Yanık & Yücel, 2001; Bolu, 2002; Özgen et al., 2005; Şimşek & Bolu, 2017; Sabuncu et al., 2021), which were carried out on pistachios, which is one of the important crops especially for the Southeastern Anatolia Region, and how they cause damage to the plant.

RESULTS and DISCUSSION

Adults of *Dolycoris baccarum* (L.) species caused great damage to pistachio in 1996 in orchards in Bozova region. In the first half of June, the damage caused by *D. baccarum* is as follows. Adults suck from the panicle bases causing fruit drop, causing immature green fruit to drop. In addition, it causes the production of dark sticky substances in fruits and then fruit drying. (Yanık & Yücel, 2001) *Dolycoris baccarum* L has been observed to cause damage to pistachio from time to time. It was observed in the 2000s that it caused significant damage to the pistachio orchards located on the migration route, especially in the summer months, after the grain (Graminae) dried out, while leaving the grain fields to the high mountains (Kaplan et al., 2018).



Figure 1. Damage caused by a species of Pentatomidae on pistachio (Anonim, 2023)

The adult of *Coeliodes rubricus* causes damage by gnawing the leaves of the pistachio tree. The gnawing often looks like a string of lace from the edge of the leaves, and these parts of the leaf remain membranous. Adults feed mostly on fresh leaves. In Greece, it is reported that they feed on pollen dust on male pistachio flowers at the beginning of April, and at the same time, the larvae open a gallery in these flowers, so that the flowers dry up, fall to the ground or deteriorate in such a way that they cannot be fertilized (Günaydın, 1978).

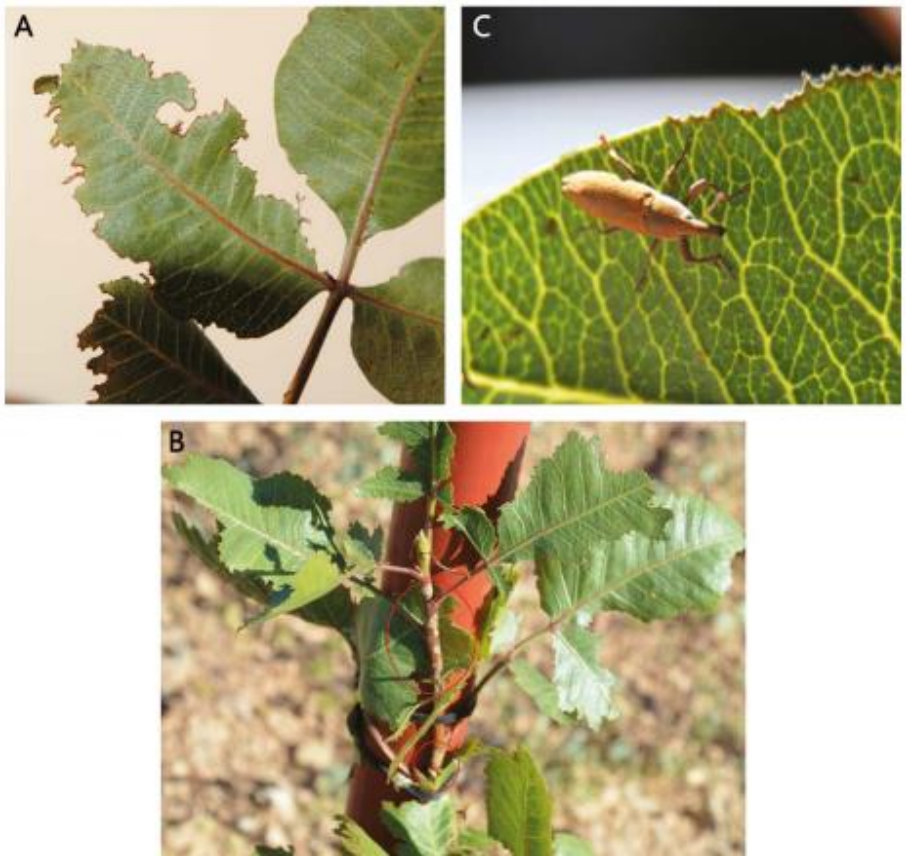

Figure 2. Pistachio tree damage caused by A.) *Otiohynchus cribricollis*, B.) *Polydrusus subglaber*, C.) *Lixus acicularis* (Fernández-Carrillo et al., 2022)

As a result, in the light of the studies carried out for our country, the most common pest species from the Curculionidae family on pistachio plants are *Polydrosus roseiceps*, while the most common pest species from the Pentatomidae family are *Arosternum heegeri* Fieb. and *Dolycoris baccarum*. In Turkey, 6 species (*Piezodorus*, *Dolycoris*, *Acrosternum*, *Mustha*, *Palomena*, *Stagonomus*) belonging to 6 genera (*Piezodorus lituratus* (Fabricius, 1794), *Dolycoris baccarum* (Linnaeus, 1758), *Acrosternum heegeri* Fieber, 1861, *Mustha longispinis* Reuter, 1890, *Palomena mursili* Linnavuori, 1984, *Stagonomus bipunctatus* Linnaeus, 1758), while the pest of the family Curculionidae belongs to 8 genera (*Aulacobaris*, *Bangasternus*, *Coelides*, *Polydrusus*, *Sitona*, *Ceutorrhynchus*, *Sibinia* and *Lixus*) 11 species (*Bangasternus orientalis* (Capiomont, 1873), *Aulacobaris coerulescens* (Scopoli, 1763), *Coelides rubricus* (Gyllenhal, 1837), *Polydrusus ponticus* (Faust, 1888), *Polydrusus roseiceps* Pesarini, 1975, *Sitona crinitus* (Herbst) 1795, *Sitona humeralis* Stephens 1831, *Sitona puncticollis* Stephens 1831, *Ceutorrhynchus sp.*, *Sibinia sp.*, *Lixus sp.*). If we compare the samples of the two families, Pentatomidae samples do not cause more serious problems than an agricultural pest family such as Curculionidae.

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TÜRKİYE'DE KANOLA ZARARLISI CURCULONIDAE VE PENTATOMIDAE FAMILYASI TÜRLERİ

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ÖZET

Bu çalışmada Türkiye'de yetiştirilen Bitkisel yağ kaynağı olarak ülkemize II. Dünya savaşı sırasında Bulgaristan ve Romanya'dan gelen göçmenler vasıtasıyla giren Kanola'da (*Brasicca napus* L.) görülen zararlı Curculionidae (Coleoptera) ve Pentatomidae (Heteroptera) familya türleri ve bu türlerin kanola bitkisi üzerinde ne tür etkileri olduğu hakkındaki bilgilerden derlenmiştir. Sonuç olarak Türkiye'de kanola zararlısı olarak Curculionidae familyasından 5 tür **(***Ceutorhynchus obstrictus, Ceutorhynchus picitarsis***,** *Ceutorhynchus assimilis, Aulacobaris cribellata, Lixus ochraceus*; Pentatomidae familyasından 9 tür (*Dolycoris baccarum, Carpocoris fuscispinus, Carpocoris purpureipennis, Carpocoris pudicus, Eurydema ornata, Holcostethus vernalis, Nezara viridula, Eysarcoris inconspicuus, Eysarcoris fabricii* görülmektedir.

Anahtar Kelimeler: Curculionidae, Kanola, Pentatomidae, Pest, Türkiye

CANOLA PEST CURCULONIDAE AND PENTATOMIDAE FAMILIA SPECIES IN TÜRKİYE

ABSTRACT

In this study, as a source of vegetable oil grown in Turkey, II. Information about the harmful Curculionidae (Coleoptera) and Pentatomidae (Heteroptera) family species seen in Canola (Brasicca napus L.), which entered through immigrants from Bulgaria and Romania during the World War II, and what kind of effects these species have on the canola plant were compiled. As a result, 5 species **(***Ceutorhynchus obstrictus*, *Ceutorhynchus picitarsis***,** *Ceutorhynchus assimilis*, *Aulacobaris cribellata*, *Lixus ochraceus* from Curculionidae family as canola pests in Turkey; There are 9 species (*Dolycoris baccarum* (Linnaeus, 1758), *Carpocoris fuscispinus*, *Carpocoris purpureipennis*, *Carpocoris pudicus*, *Eurydema ornata*, *Holcostethus vernalis*, *Nezara viridula*, *Eysarcoris inconspicuus*, *Eysarcoris fabricii* from Pentatomidae family.

Keywords: Curculionidae, *Brasicca napus*, Pentatomidae, Pest, Türkiye

INTRODUCTION

Canola (*Brasicca napus*: Brassiceae) is one of the most important oil and alternation crops cultivated in Turkey. Its production has increased over time in Turkey and it has a large production area especially in the Thrace region. There are many pests on the canola plant, as in other cultivated plants (Altın & Özder, 2020).

Canola, also known as rapiska, rapitsa, and rapeseed in Turkey, is an oil plant with two physiological periods: winter and summer. It is an important oil plant with 38-50% oil and 16-24% protein in canola grain. It is an oil plant containing 40% crude oil and 60% pulp in canola seeds. Canola production in Turkey does not have a long history. Canola is one of the plants used as a raw material in the production of biodiesel. This plant was brought to Turkey under the name of rapeseed in the 1960s with immigrants from the Balkans and started to be cultivated in Thrace. However, the cultivation of this plant was banned in 1979 due to the presence of erucic acid in its oil, which is harmful to human health (Süzer, 2001). The erucic acid content of 45-50% in the varieties formerly called rapeseed was reduced to 0% by breeding studies, allowing rapeseed to be re-produced for vegetable oil need. In Turkey, efforts are underway to expand canola cultivation in order to close the vegetable oil deficit (Algan, 1990).

İkbal Altın and Nihal Özder determined harmful insect species in canola production areas in Çorlu (Thrace) in 2017-2018 in their study titled "**Research on Harmful Insect Species in Canola Production Areas in Tekirdağ Province Çorlu District**". According to their study, the most common species from Curculionidae family was *Ceutorhynchus picitarsis* (G.) as of April, and *Dolycoris baccarum* (L.) species from Pentatomidae family was found to be effectively harmful in May. Apart from these species, *Aulacobaris cribellata* (L and *Lixus ochraceus* (B.) species from Curculionidae family and *Carpocoris purpureipennis* (D.) and *Eurydema ornata* (L.) from Pentatomidae family) have been reported to be harmful to canola (Altın & Özder, 2020). Likewise, they stated that *Ceutorhynchus picitarsis* started to appear as of April and that adults and larvae were harmful, and the larvae formed tumors on the roots of the host plants.

Canola (*Brassica napus* L.) is one of the most important members of the Cruciferae. *B. napus* is an important source of vegetable oil and the second largest oilseed crop after soybean Food and Agriculture Organization (2007). In recent years, with the increasing need for vegetable oil in the world, the use of canola oil as a fuel in vehicles has come to the fore, the price of oil has increased, and the production of canola has become widespread and increasing all over the world, including Turkey (Esentürk, 2009).

While the canola cultivation area in Turkey was at a very low level of 7000 da (Anonymous, 2005) according to the statistics of 2005, it was determined as 54,000 da (Anonymous, 2006) according to the statistics of 2006 and 107.000 da (Anonymous, 2007a) according to the statistics of 2007. Canola can be grown in almost all regions of our country, especially in Thrace. According to the verbal interviews we made with the managers and technical staff of S. S. Tekirdağ Önder Çiftçi Production and Marketing Cooperative, they stated that the canola cultivation area was 270,000 decares in 2008, and 95% of this area was in the Thrace region. As seen above, canola cultivation is spreading rapidly (Suyaran, 2009).

Nihat Demirel, in his study titled "**Determination of Heteroptera species in canola plants of Hatay province**", which he conducted in 2009, aimed to determine Heteroptera species in canola plants in order to improve the integrated control of harmful species in Hatay province. During the study, the most Miridae family on Canola cultivars in Hatay region; It is noteworthy that species belonging to the Pentatomidae family are in the second rank.

Esentürk's 2009 master's thesis titled "**Research on the Effects of *Ceutorhynchus assimilis* Paykull.'A Beta Cyflutrin and Acetamiprid Harmful on Canola in Tekirdağ Province**" investigated the effects of 2 drugs that may affect the *Ceutorhynhus assimilis* species, which is a canola pest.

MATERIAL and METHOD

In this study, it was aimed to determine the Curculionidae (Coleoptera) and Pentatomidae (Heteroptera) species of plant protection pests that are a problem in the production areas of canola, which is a globally important industrial plant. Curculionidae (Coleoptera) and Pentatomidae (Heteroptera) species, which have been produced and determined in Turkey so far, constitute the main material in the study (Demirel, 2009; Esentürk, 2009, Altın & Özder, 2020).

RESULTS and DISCUSSION

Five species of Curculionidae pests of canola in Turkey; *Ceutorhynchus obstrictus* (Marsham, 1802), *Ceutorhynchus picitarsis* Gyllenhal, 1837, *Ceutorhynchus assimilis* (Paykull, 1792), *Aulacobaris cribellata* (Kiesenwetter, 1864) and *Lixus ochraceus* Boheman, 1843, while 9 Pentatomidae species (*Dolycoris baccarum* (Linnaeus, 1758), *Carpocoris fuscispinus* (Boheman, 1850), *Carpocoris purpureipennis* (De Geer, 1773), *Carpocoris pudicus* (Poda, 1761), *Eurydema ornata* (Linnaeus, 1758), *Holcostethus vernalis* (Wolff, 1804), *Nezara viridula* (Linnaeus 1758), *Eysarcoris inconspicuus* (Herrich-Schaeffer, 1844) and *Eysarcoris fabricii* (Kirkaldy, 1904).

Pentatomidae are well-known groups and are easily recognized by their round or oval shape and five-segmented antennae (Borror et al., 1989). They are found in all zoogeographic regions. Many species are recognized for their economic importance as crop pests (Panizzi et all., 2000). Most stink bugs are herbivorous and nymphs and adults can damage plants by piercing plant tissues and sucking nutrients (Grazia et al., 2015). They especially suck sap from leaves, stems and reproductive parts (Pedigo, 1999).



Figure 1. *Dolycoris baccarum* (Heteroptera: Pentatomidae) adult (1) (Anonim, 2019a) and nimf (2) (Anonim, 2019b)

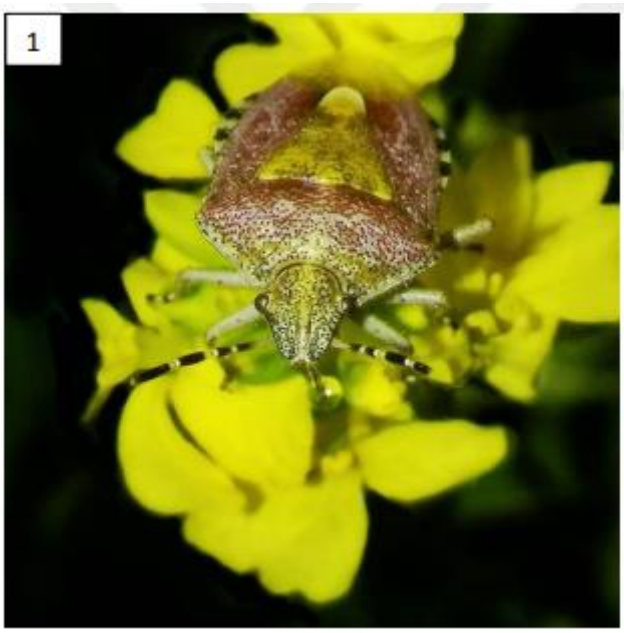

Figure 2. *Dolycoris baccarum* (Heteroptera: Pentatomidae) adult in canola (Anonim, 2019c)

Damages occur as a result of feeding of nymphs and adults on the above-ground parts of plants. It was also determined during the researches that the generative organs of the plants were fed more than the vegetative organs. It causes discoloration and yellowing at the feeding points of the plant leaf. It has been observed that as a result of feeding on flowers and buds, it sometimes

dries these parts and prevents seed setting. It has been determined that when it is fed on developing seeds, it has negative effects on quality and quantity, thus causing significant damage (Karsavuran, 1986).

Population densities of *E. ventrale* gradually increased from late March and peaked in mid-April. Population densities of *D. baccarum* and *H. vernalis* peaked in mid and late March. *Carpocoris spp.* (*Carpocoris fuscispinus* (Boheman, 1850), *Carpocoris purpureipennis* (De Geer, 1773), *Carpocoris pudicus* (Poda, 1761)) were found from the beginning of sampling and population densities peaked in March and April. It was observed that the general population densities of Pentatomidae decreased in flower and pod stages of canola (Demirel, 2009). It can be said that the population levels of Pentatomidae species are too low to cause serious injuries to canola plants (Demirel, 2009).

Curculionidae are known as "proboscis beetles" because of the proboscis formed by the forward extension of the head of the members of the family. This group is one of the richest families of Coleoptera (Borror et al., 1989).

Members of the Curculionidae family are all phytophagous with a few exceptions (Ross, 1963). This large group also causes great damage to many plants of economic importance (Hoffmann, 1950). There may be more than one species on parts of plants such as roots, stems, leaves or fruits, and both larvae and adults of the same species may cause damage on the same plant (Mihajlova, 1978). Family species usually spend the winter in adult form. With the start of insect activity in the spring, adults start to cause damage. The female insect makes holes on the host plant with its rostrum. She usually lays one egg into these holes. The larva emerges from the egg and begins to feed where it is found. The most damaging period is the larval stage. After spending the pupal stage on the same plant or in the soil, the emerging adult continues to cause damage (Richard & Davies, 1977).



Figure 3. Damage pattern of *Ceutorhynchus obstrictus* (Anonim (2023)

Harm form of *Ceutorhynhus assimilis* females lay their eggs on immature carobs. In general, each carob contains one larva, but in large epidemics, it is also seen that there are 2 larvae in a carob. The fully grown larva emerges from the carob and pupae in the soil. After a few weeks the adults emerge and spread as the crop matures. Before dispersal, the newly emerged adults poke holes in mature canola seeds and feed, thus reducing the seed weight and oil content, ultimately reducing the viability and reproductive power of the seeds (Buntin et al., 1995). Studies investigating crop loss due to *C. assimilis* revealed that each larva eats 5-6 seeds (Gould, 1975). Apparent symptoms in plants begin with the larvae leaving the damaged carob after feeding on the seeds during maturation, as seen in Figure 4. Damaged seeds remain in the carob until they mature, and the only visible symptom is the small exit hole with a diameter of 1 mm (Esentürk, 2009).



Figure 4. Larvae damage in carob and damaged carob (Esentürk, 2009)

As a result, in the light of the studies conducted for Turkey, the most common pest species on Canola plant from Curculionidae family is *Ceutorhynchus assimilis*, while the most common pest species from Pentatomidae family is *Dolycoris baccarum*. While 9 species ((*Dolycoris baccarum* (Linnaeus, 1758), *Carpocoris fuscispinus* (Boheman, 1850), *Carpocoris purpureipennis* (De Geer, 1773), *Carpocoris pudicus* (Poda, 1761), *Eurydema ornata* (Linnaeus, 1758), *Holcostethus vernalis* (Wolff, 1804), *Nezara viridula* (Linnaeus 1758), *Eysarcoris inconspicuus* (Herrich-Schaeffer, 1844), *Eysarcoris fabricii* (Kirkaldy, 1904) belonging to 6 genera (*Carpocoris*, *Dolycoris*, *Eurydema*, *Holcostethus*, *Nezara*, *Eysarcoris)* of Pentatomidae pests are observed in canola in Turkey, 5 species **(***Ceutorhynchus obstrictus* (Marsham, 1802), *Ceutorhynchus picitarsis* Gyllenhal, 1837**,** *Ceutorhynchus assimilis* (Paykull, 1792), *Aulacobaris cribellata* (Kiesenwetter, 1864), *Lixus ochraceus* Boheman, 1843) belonging to 3 genera (*Aulacobaris*, *Ceutorhynchus*, *Lixus)* of Curculionidae pests are observed. In addition, both family members damage the generative organs of the plant rather than the vegetative organs. If we compare the samples of the two families, Pentatomidae samples do not cause more serious problems than an agricultural pest family such as Curculionidae.

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ÖZET

Bu çalışmada Türkiye'de yetiştirilen ve ihraç edilen en önemli kabuklu meyvelerinden biri olan fındık'ta (*Corylus avellana* L.) görülen zararlı Curculionidae (Coleoptera) ve Pentatomidae (Heteroptera) familya türleri ve bu türlerin fındık üzerinde ne tür etkileri olduğu hakkındaki bilgilerden derlenmiştir. Sonuç olarak araştırmada Türkiye'de fındık zararlısı olarak Curculionidae familyasından 16 tür (*Curculio nucum, Anoplus roboris, Lymantor coryli* Wood & Bright, 1992, *Xyleborinus saxesenii, Xyleborus dispar, Xyleborus germanus, Xyleborus monographus, Xyleborus dryographus, Xylesandrus crassiusculus, Monarthrum fascinatum, Hypothenemus eruditus, Hypoborus ficus, Taphrorychus ramicola, Taphrorychus hirtellus, Taphrorychus villifrons, Hylesinus vestitus*; Pentatomidae familyasından 15 tür (*Palomena prasina, Halyomorpha halys, Apodiphus Amygdali, Dolycoris baccarum, Graphosoma lineatum, Holcostethus vernalis, Pentatoma. rufipes, Piezodorus lituratus, Raphigaster nebulosa, Carpocoris purpureipennis, Carpocoris. pudicus, Eurydema oleraceum, Eysarcoris inconspicuus, Pentatoma rufipes, Nezera viridula* görülmektedir.

Anahtar Kelimeler: Curculionidae, Fındık, Pentatomidae, Pest, Türkiye

HAZELNUT PEST CURCULIONIDAE AND PENTATOMIDAE FAMILIA SPECIES IN TÜRKİYE

ABSTRACT

In this study, information about the harmful Curculionidae (Coleoptera) and Pentatomidae (Heteroptera) family species seen in hazelnut (Corylus avellana L.), one of the most important exported agricultural products and shell fruits grown in Turkey, and the effects of these species on hazelnut. As a result, 16 species (*Curculio nucum, Anoplus roboris, Lymantor coryli, Xyleborinus saxesenii, Xyleborus dispar, Xyleborus germanus, Xyleborus monographus, Xyleborus dryographus, Xylesandrus crassiusculus, Monarthrum fascinatum, Hypothenemus eruditus, Hypoborus ficus, Taphrorychus ramicola, Taphrorychus hirtellus, Taphrorychus villifrons, Hylesinus vestitus* from Curculionidae family as canola pests in Turkey; There are 15 species (*Palomena prasina, Halyomorpha halys, Apodiphus Amygdali, Dolycoris baccarum, Graphosoma lineatum, Holcostethus vernalis, Pentatoma. rufipes, Piezodorus lituratus, Raphigaster nebulosa, Carpocoris purpureipennis, Carpocoris. pudicus, Eurydema oleraceum, Eysarcoris inconspicuus, Pentatoma rufipes, Nezera viridula* from Pentatomidae family in this study.

Keywords: Curculionidae, Hazelnut, Pentatomidae, Pest, Türkiye

INTRODUCTION

World hazelnut production was 888 thousand tons in 2018, and with 515 thousand tons of product, Turkey was recorded to meet 58% of world production (FAO, 2020). Therefore, hazelnut production has significant social and economic effects in the Black Sea Region (Kayalar and Özçelik, 2012). Due to the favorable ecological conditions in Turkey, hazelnut has spread over a wide area for thousands of years (Ayfer et al., 1986; Yılmaz, 2009). Ordu province, which ranks first in hazelnut production, is followed by Giresun, Samsun, Sakarya, Trabzon, Düzce and Zonguldak (TÜİK, 2020).

Hazelnuts are used not only as food, but also in the field of industry and health. Hazelnut contains high fat (64%) and significant amount of protein (16.5%), carbohydrates (14%), minerals and vitamins (Anıl et al. 2018). Oil is obtained from hazelnut kernels and the remaining hazelnut pulp is used as animal feed in the feed industry. In addition, it has been recorded that the nut shell is consumed as fuel and the leaves are used as natural fertilizer in agricultural areas (Ayfer et al., 1986).

There are many harmful insects in hazelnut orchards in Turkey. However, 10-15 of these insects cause economic damage by varying according to regions and years (Işık et al., 1987). According to many studies, although it has been reported that the main pest of hazelnut is the hazel worm (*Balaninus nucum* L.), printer insects also cause significant damage to hazelnut orchards (Tuncer and Ecevit, 1996; Saruhan and Tuncer, 2001). In addition to hazelnut, printer beetles cause significant damages in hard and soft stone fruit trees, kiwi, forests and ornamental plants (Mani et al., 1990; Raulder, 2003; Kaya, 2004; Ak et al., 2006 a and b; Ak et al., 2010). Although there are many insect species causing economic damage in Turkish hazelnut orchards, the most important species causing economic damage are hazelnut weevil, *Curculio nucum* L. (Coleoptera: Curculionidae) and hazelnut skunk or hazelnut green skunk, *Palomena prasina* L. (Hemiptera: Pentatomidae) (Işık et al., 1987).

While other pests in hazelnut orchards adversely affect the quality and quantity of the product, printer insects dry young and old hazelnut branches, causing the hazelnut groves to die completely. In addition, since these pests spend a significant part of their lives in the wood tissue of their host, an effective chemical control cannot be made against them. The first study in our region on these species, which cause significant damage to hazelnut orchards, was done by Işık (1984). Later, as a result of the fauna determination studies carried out in the hazelnut orchards of the Eastern Black Sea Region, it was determined that there were 3 species (*X. dispar*, *X. xylographus* and *Dryocoetes coryli*) belonging to the Scolytinae family (Tuncer and Ecevit, 1996).

Ecevit, Tuncer and feltci, in their 1993 study titled "**Studies on the description of Anoplus roboris Suffrian (Coleptera: Curculionidae)**", defined *Anoplus roboris*, one of the internal pests seen in hazelnuts in the central and eastern parts of the Black Sea region of Turkey. There is little research on the biology and description of this pest. Işık et al., (1992) reported that *A.roboris* caused significant damage in Giresun and Trabzon provinces in recent years. In this study, detailed information is given on the pest by stating that the pest begins to lay eggs in early April, the larvae open a gallery between the leaf epidermis, and the adults are harmful by eating the buds and leaves. Also, İren. and Ahmed (1973), *A.plantaris* Naezen, Işık et al., (1987) state that *A.setulosus* Kirsch is harmful to hazelnuts in Turkey.

Tuncer and Ecevit, 1996, in their review study titled '**Current Status of Hazelnut Pests in Turkey**', examined the studies on insects and mites on hazelnut in the Black Sea region until today. In addition, a list of all pests found in the hazelnut ecosystem of the Black Sea region was given. *Curculio nucum* and *Xyleborus dispar* from Curculionidae family, *Palomena prassina* from Pentatomidae family were listed as serious pests, while *Anoplus ruburis* from Curculionidae family was included in the list of minor pests.

Saruhan and Tuncer, in their study of '**Population densities and seasonal fluctuations of hazelnut pests in Samsun, Turkey' conducted in 2001**, stated that the most important and common pests were the hazelnut weevil (*Curculio nucum*) and *Xyleborus dispar*.

Ak, Uysal and Tuncer, in their study titled '**The Injury Level of Bark Beetles (Coleoptera: Scolytidae) in Hazelnut Orchards in Giresun, Ordu and Samsun Provinces of Turkey**' in 2005, are the most important pests of printer insects whose damage is increasing in hazelnut orchards in Giresun, Ordu and Samsun provinces of the Black Sea Region. It was aimed to determine the total damage levels of the species *Lymantor coryli* Perris and *Xyleborus dispar* (Fabricius) in the mentioned provinces. In all the orchards where the study was carried out, it was determined that the damage level of the printer insects increased from April, and the main significant increase was in July and August.

In the master's thesis titled "**Research on Bark Beetle Species (Coleoptera: Scolytidae) seen in Hazelnut Orchards in Düzce**" conducted by Şahin in 2015, 4 species, *Xyleborus dispar* Fabricius, *Xyleborus saxeseni* Ratzeburg, *Xyleborus germanus* Blanford and *Lymantor coryli* Perris, were found as pests in hazelnut production areas of Düzce province.

In the study of "**Comparison of sticky and non-sticky traps against harmful shothole weevils (Coleoptera: Curculionidae: Scolytinae) in hazelnut orchards**" that Ak did in 2016, information was given on the practical identification of harmful printer insect species in

hazelnut orchards and the advantages and disadvantages of traps against these pests were mentioned. According to this study, harmful printer insects; *Xyleborus dispar* (Fabricius, 1792), *Xyleborinus saxesenii* (Ratzeburg, 1837) and *Xylosandrus germanus* (Blandford, 1894) are the most damaging to hazelnut orchards.

According to Tuncer, Knizek and Hulcr 2017 study titled '**Scolytinae in hazelnut orchards of Turkey: clasification of species and identification key (Coleoptera, Curculionidae)**', the most common pest species in Turkish hazelnut orchards are *Xyleborus dispar*, *Xylosandrus germanus* and *Xyleborinus saxesenii*. Although *Lymantor coryli*, *Hypoborus ficus*, *Taphrorychus ramicola* and *Taphrorychus hirtellus* species are rare printer beetles and do not harm living plants, Karayiğit, Öztemiz and Hızal stated in 2023 that '**Infection Rate of *Anisandrus dispar* (Fabricius, 1792) (Coleoptera: Curculionidae: Scolytinae) in Hazelnut Orchards in Akcakoca District (Duzce)'**, they investigated the transmission rate of *Anisandra dispar* in Akçakoca hazelnut orchards. Especially in recent years, it has been observed that Printer Insects have caused significant damage in the coastal and middle belts., 1895), *Xylosandrus germanus* (Blandford, 1894), *Xyleborinus saxesenii* (Ratzeburg, 1937) and *Xyleborus xylographus* (Say, 1826) are a polyphagous pest that damages pome and stone fruits and forest trees (Grüne, 1979; Kovach, 1986). ; Mani et al., 1986; Peck, 1994; Özbek et al., 1995; Çanakçıoğlu & Mol, 1998; Selmi, 1998; Mandelshtam & Popovichev, 2000; Saruhan and Tuncer, 2001; Tuncer et al., 2003; Kaya, 2004; Ak et al., 2010; Ak et al., 2011; Anonim, 2011). Tuncer, Özdemir and Kushıyev in their study titled '**Hazelnut Diseases and Pests; Current Situation and Risks**' in 2018 stated the diseases and pests seen in hazelnut and the situation and risks caused by them. It was emphasized that the most important pests were *Curculio nucum* (Curculionidae), *Palomena prasina* (Pentatomidae), *Halyomorpha halys* (Pentatomidae) species.

Ateş and Kaçar in their 2020 study' **Determination of Damage Rates of Nut Weevil (*Curculio nucum* L.) (Coleoptera: Curculionidae) and Green Shield Bug (*Palomena prasina* L.) (Hemiptera: Pentatomidae) in Sakarya'** located in the Western Black Sea Region, it was aimed to determine the damage rates of the hazelnut weevil *Curculio nucum* L. (Colepotera: Curculionidae) and hazelnut green skunk *Palomena prasina* L. (Hemiptera: Pentatomidae). Another study conducted by the same duo in 2021, '**Population Dynamics of Green Shield Bug (*Palomena prasina* L.) and Nut Weevil (*Curculio nucum* L.) in Sakarya Province of Turkey'**, provided information on the population development of hazelnut green skunk and hazelnut green skunk, which are harmful in the same province.

Özdemir and Tuncer in their 2021 study '**A New Invasive Polyphagous Pest in Turkey, Brown Marmorated Stink Bug [*Halyomorpha halys* (Stål, 1855) (Hemiptera: Pentatomidae)]: Identification, Similar species and Current Status**', the most similar species to *Halyomorpha Halys* was compared with *Rhaphigaster nebulosa* and the parts to be considered in identification were shown. In addition, other species of stink bugs in the fauna of Turkey that may be confused with this pest are given and the current status and potential threat of the pest are discussed.

In their study **Current Status of Hazelnut Weevil, Curculio nucum L. (Col.: Curculionidae) in Duzce and Sakarya Provinces of Turkey**' conducted by Çöpoğlu and Karabörklü in 2022, it was aimed to determine the prevalence, population density and fruit damage level of the hazelnut weevil (*Curculio nucum*) pest in Düzce and Sakarya provinces, which causes significant product and quality loss in hazelnut production areas in our country.

With the master's thesis titled 'Population Status And Detrıments Of *Halyomorpha Halys*'ın Hazelnut Gardens In The Provınce of Artvin' by Lena Özen in 2022, information was given about the population status and damages of *Halyomorpha Halys*, which was first seen in Istanbul and then started to be seen more intensively in Artvin and Rize provinces.

Özdemir, Tuncer and Uluca in their study titled '**A New Pest Species in Turkish Hazelnut Orchards; The Fruit Trees Stink Bug *Apodiphus amygdali* (Germar, 1817) (Hemiptera: Pentatomidae)**' in 2021, the description, distribution, hosts, damage and biology of *A. amygdali* were put forward to help future studies since it is a new pest species in hazelnut.

Ak, Uluca and Tuncer, in their study titled '**Distribution and population density of *Halyomorpha halys* (Stål, 1855) (Hemiptera: Pentatomidae) in the Black Sea Region of Turkey**' they conducted in 2023, determined a high population density of *Halyomorpha halys* in all locations of Artvin and Rize provinces. has been done. *Halyomorpha halys*, a polyphagous pest, has also been reported to have a wide host range including fruit, vegetables, ornamental plants and forest plants.

MATERIAL and METHOD

In this study, Pentatomidae and Curculionidae species that are harmful on Hazelnut *Corylus avellana* in Turkey were investigated. Since Turkey is a country that meets 58% of world production, hazelnut is a very important product in terms of socio-economic impact. The Curculionidae (Coleoptera) and Pentatomidae (Heteroptera) pests on hazelnuts in Turkey were compiled from the studies (Ecevit et al., 1993; İren & Ahmed, 1973; Işık et al., 1987; Tuncer & Ecevit, 1996; Saruhan & Tuncer, 2001; Ak et al., 2005; Şahin, 2015; Ak, 2016; Tuncer et al., 2017; Tuncer et al., 2018; Ateş & Kaçar, 2020; Ateş & Kaçar, 2021; Özdemir & Tuncer, 2021;

Çöpoğlu & Karabörklü, 2022**;** Özen, 2022; Özdemir et al., 2021; Ak et al., 2023) carried out and what kind of damage they cause on the plant.

RESULTS and DISCUSSION

Xyleborus dispar (Fabricius, 1792)

In case of weakness of the host in hazelnut orchards, they open galleries in the wood by piercing the hazelnut branches from the shoot bases intensively at the beginning. They cause sap flow through the entrance holes in hazelnut branches and as a result of the development of saprophytic fungi on this sap flow, the plant shows a weeping symptom. In addition, the most important symptoms are the fresh sawdust on the bottom of the hearths and on the leaves of fresh bottom shoots in the infected hearths. Apart from hazelnuts, in some years, they also cause significant damage by drying out kiwifruit (Ak et al., 2011; Ak, 2016).

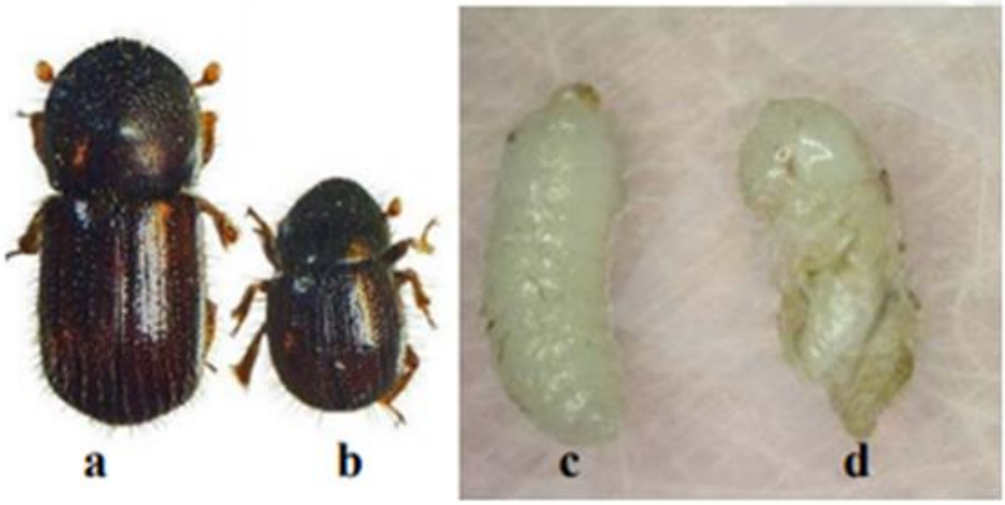


Figure 1. *Xyleborus dispar* (Fabricius, 1792) a: Female; b: Male; c: Larvae; d: Pupae (Hantaş et al., 2008)

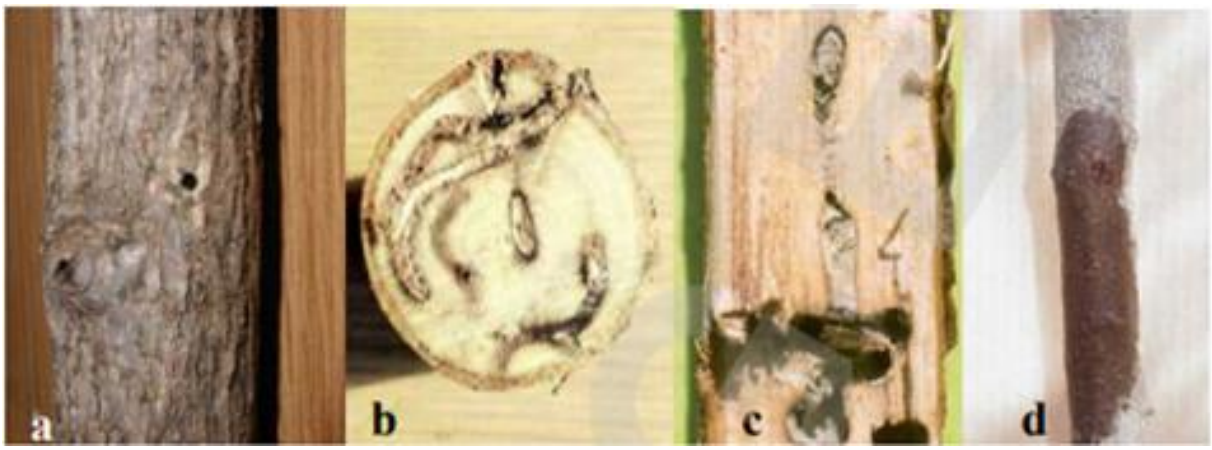


Figure 2. The entrance hole opened by the *X. dispar* female in the branch (a), the horizontal (b) and vertical (c) galleries opened in the cambium tissue, the plant sap leaking from the entrance hole (d) (Hantaş et al., 2008).

Adult females enter by drilling round holes with a diameter of 2 mm from the shoot bottoms of hazelnut branches. In the place where the insect enters, currents occur and weeping spots occur on the branch. The insect, which enters the branch, opens galleries here and lays eggs and in this way continues its generation. Due to the holes and galleries opened by the insect, the hazelnut branches dry or break. In this way, the branches that produce crops are eliminated and directly damaged (Anonim, 2011).

***Xyleborinus saxesenii* (Ratzeburg, 1837)**

This species ranks second in hazelnut orchards after *X. dispar* in terms of prevalence and density (Ak et al., 2005a,b, 2006a, 2014). In some studies conducted in the Black Sea Region, this species was previously misdiagnosed and reported as *Lymantor coryli* (Kurt, 1982; Işık et al., 1987; Ak et al., 2004, 2010, 2011). *Xyleborus saxesenii* is found in hazelnut orchards together with other species and is harmful. The entrance hole in hazelnut branches can be anywhere on the branches, not at the bottom of the shoot as in *X. dispar*. This type is very easily recognizable by leaving fresh and fine chips around the entrance hole. It is reported that this species causes significant losses, especially in kiwis, apart from hazelnuts (Ak et al., 2010; Ak, 2016).

***Xylosandrus germanus* (Blandford, 1894)**

X. germanus ranks third in terms of prevalence and density in hazelnut orchards. This species was identified and reported *as Xyleborus xylographus* in some studies conducted in the Black Sea Region (Işık et al., 1987; Ak, 2004, 2005a, 2006a, 2011, 2014). Although *Xylosandrus germanus* is not very dense and common in hazelnut orchards, it attacks the hazelnut branches collectively in the orchards and hearths, causing the branches to dry out suddenly. Similar damage to the sudden and shock drying caused on hazelnut branches has also been observed in kiwi (Ak et al., 2011). This species initially attacks hazelnut branches close to the soil surface of the hearths and gradually moves towards the upper part of the branches. Other species can also be found on the infected branches. Besides the fact that it can dry hazelnut branches and hearths instantly and the leaves look as if they have been scorched by the heat, the most important symptom is the sawdust they produce in the entrance holes. *Xylosandrus germanus* can be easily recognized by the cylindrical protrusion of approximately 1 cm made of sawdust compressed from the entrance hole. In the gardens where this species is found, it is called a dangerous species by the technical staff and farmers due to sudden deaths in the hearth and branches (Ak, 2016).

Hazelnut weevil (*Curculio nucum*: Col.: Curculionidae), which is one of the important pests of hazelnut, is less complained from hazelnut producers compared to the past, although its damage varies according to places, regions and years. However, hazelnut weevil is still one of the most

important pests affecting the yield because it is directly harmful on the fruit and has a high economic importance (Tuncer et al., 2018).

It has been recorded that hazelnut weevil adults cause yellow and black barberry, black barberry damages, empty fruit and wormy fruit formation (Akça, 2003; Saruhan & Şen, 2012b). In hazelnuts, fruits with no internal development in the form of yellow and black worms are quite common. This type of damage is associated with hazelnut weevil and hazelnut green skunk in some sources. It has been revealed by cage studies that some of the damage, which is named as yellow-bark, is increased by stinging sucking insects, especially the common species Hazelnut green skunk (Tuncer et al., 2005) and hazelnut weevil (Akça & Tuncer, 2005). As a result of the sucking caused by hazelnut weevil and hazelnut green skunk on the fruits, the damage caused by the yellow color of the fleshy part of the fruit until the normal size of the fruit and the formation of a depression in the shell is called "yellow barberry". As a result of the damage caused by these two pests after the fruit reaches normal size, the damage caused by the blackening of the inside of the fruit and the leakage of a black liquid from the cracks in the peel is called "black barberry" (Ateş & Kaçar, 2020). In studies conducted in different provinces, it has been reported that these two pest species cause serious crop loss as they cause damage to hazelnut fruits called yellow barberry and black barberry as well as deterioration of fruit quality (Ural, 1957; Tuncer et al., 2002; Akça, 2003; Akça & Tuncer, 2005; Tuncer et al., 2005; Akça & Tuncer, 2007; Saruhan & Tuncer, 2009; Saruhan & Şen, 2012a; Tuncer et al., 2014).

Hazelnut weevil is harmful by feeding on fruits and laying eggs. Adults first damage the cloves. Later, it gnaws the fruit shell of the hazelnut with the mouthparts at the end of its proboscis and feeds on the soft fleshy part inside the shell. In this way, the fleshy part in the shell deteriorates and turns yellow in the damaged fruits until they reach normal size and this color appears on the shell later. This form of damage is called "Yellow Barberry". If the fruit that reaches normal size is damaged (if the adult feeds on the fruit that reaches normal size), the inside of the fruit turns black, a black discharge zuluf out of the cracks in the fruit shells and contaminates the shell, and in this way, the damage called "Black Barberry" occurs (Anonim, 2011).

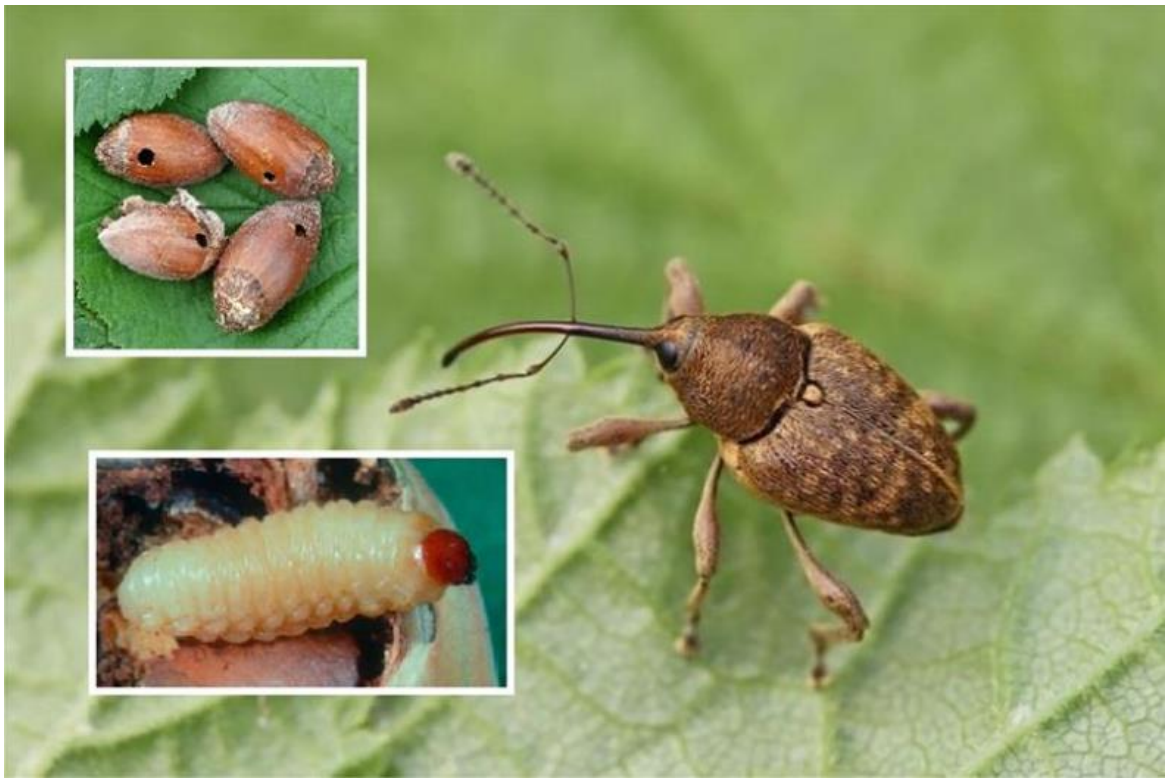


Figure 3. Hazelnut weevil (Curculio nucum: Col.: Curculionidae) (Anonim, 2023)



Figure 4. Hazelnuts damaged by the *Curculio nucum* larvae (a) and the inside of the hazelnut that the larva feeds on (b) (Hantaş et al., 2008).

The adults of *Curculio nucum* species cause significant yield and quality loss in hazelnuts by causing damage to cloves, hazelnut fruit shell and fruit, and the larvae damage the fruit and cause fungal diseases to enter the fruit and move to the storage (Akça, 2003; Karabörklü & Altın, 2018). It has also been reported that hazelnut weevil causes significant yield losses due to the transfer of hazelnut weevil damage to the storage of hazelnut fruits (Karabörklü & Altın, 2018). Hazelnut weevil causes damage in all hazelnut growing regions, especially in the middle and high regions (Çöpoğlu & Karabörklü, 2022).



Figure 5. Yellow and black barberry damage in hazelnut (Tuncer et al., 2018)

Hazelnut green skunk (*P. prasina*: Hem: Pentatomidae), which is one of the insect species with the highest prevalence and density affecting both yield and quality in hazelnut, is a serious problem in all hazelnut growing areas in Turkey (Tuncer et al., 2005). While this pest affects the yield with its damage in the early period, it causes damages affecting the fruit quality such as spotted inner and wrinkled inner with its feeding during fruit development. Although the damage in the form of spotted inner (Figure 3) can be removed to a certain extent, some of them cause complaints in the exported product because they are not visible from the outside (Tuncer et al., 2018).



Figure 6. Adult of *Palomena prasina*, Eggs, Nymphs (Hantaş et al., 2008)

Adults and young (nymphs) become harmful by sucking on hazelnut fruits. As a form of damage, it causes yellow barberry and black barberry as in hazelnut worm. In addition to these, they form collapsed fruits as a result of feeding (in July) in ripe (beginning to ripen) fruits, which are important for export. In this way, the damage causes both product loss (Barberry+shapeless interior) and emgilled interior (shapeless+stained interior) formation, which significantly affects product quality (Hantaş et al., 2008).



Figure 7. Spotted (urous) internal damage and adult caused by *P. prasina* (Tuncer et al., 2018)

There are dozens of harmful species in terms of hazelnut pests in the Black Sea Region. *H. halys* has become an important pest of annual and perennial crops in infested countries (Lee, 2015). The fact that *H. halys* is a polyphagous pest that can voraciously feed on more than 300 cultivated plant species, together with the fact that adults can fly long distances, facilitates its spread (Tuncer, 2019). In addition, *Halyomorpha halys* (Hem.: Pentatomidae), an invasive species first detected in Istanbul, although in small numbers, has recently started to be seen more intensely in Artvin and Rize provinces. This pest has been seen in Oregon (USA), Italy and Georgia hazelnut orchards in previous years (Bosko et al., 2017; Hedstrom et al., 2014) and has become an important pest. *H.halys*, which is expected to spread rapidly from the Georgian border to Turkey, is a highly polyphagous species and is an important threat to other plants. However, especially in terms of hazelnut production, it is likely to become an important problem threatening both yield and quality. At a time when hazelnut exports have to deal with

the internal quality problem created by the hazelnut green skunk, it is likely to face the negative consequences of encountering a new pest that does the same damage and moreover gives more generations. As a matter of fact, between 2015 and 2017, this pest caused a very serious loss of yield and quality in Georgian hazelnut orchards (Tuncer et al., 2018).



Figure 8. *Halyomorpha halys*; egg, nymph, adult and damage (Tuncer et al., 2018)

Brown Skunk Beetle also causes serious damage in terms of quality in hazelnuts (Tuncer et al., 2005). Comparing the damage of brown skunk and hazelnut green skunk; It is observed that they cause similar damage to each other. Forms of damage; It causes damage in the form of wrinkled fruit formation, empty fruit formation and stained interior. *H. halys* pest causes the formation of empty fruit and wrinkled fruit in the early development period, while it reveals the damage in the form of stained (urous) interior in the later periods. There is deformation, pitting, browning of the fruit color in the fruits damaged by suction, and in addition, there is an intense

bitterness in the fruit flavor according to the degree of damage to the fruit by *H. halys*. Although *H. halys* is damaged in the same way as *P. prasina* (Hazelnut Skunk), it is an important pest that poses a threat to hazelnuts and other vegetables and fruits due to its more progeny and more greedy feeding.

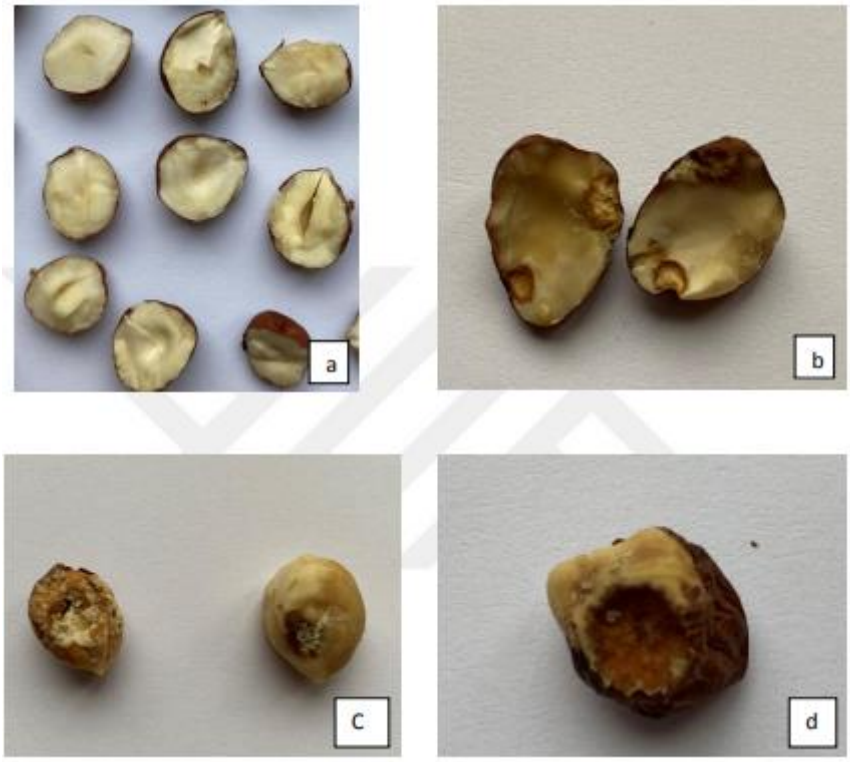


Figure 9. Types of damage caused by *H. halys* feeding on hazelnuts: a) firm kernel; b) stained interior; c) stained fruit and d) wrinkled and stained interior (Özen, 2020)

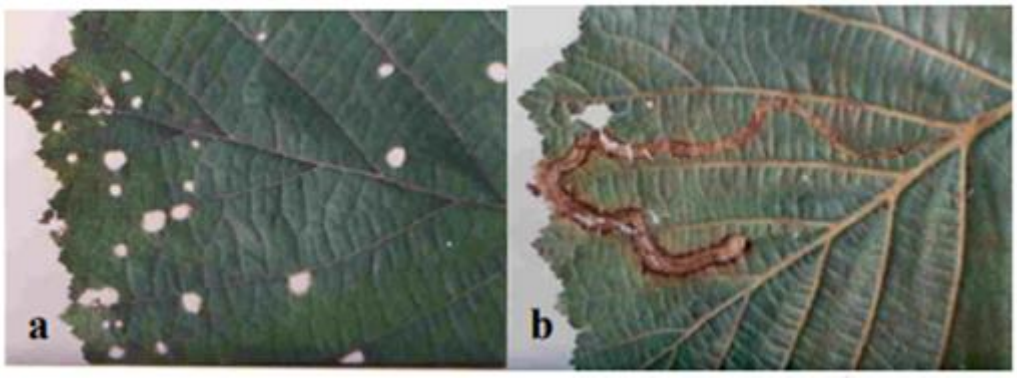


Figure 10. Head and pronotum (a), antennae (b) and connexivum and membrane part (c) of *Apodiphus*

Adults and nymphs of the *Apodiphus amygdali* species feed by sucking the sap from leaves, stems, fruits and flowers, thanks to their stinging sucking mouthparts. Feeding of the pest on the fruits is the primary damage and causes the quality and yield loss by creating necrotic areas in the fruit (Schuh & Slater, 1995).

Anoplus roboris

In the spring, the adults make many small holes in the young leaves. As the leaf grows, these holes also widen. In summer and autumn, they make very frequent and small holes on the lower surface of the leaves. In addition, as adults lay their eggs in the veins, they cause breakage and developmental disorders in the veins. They cause an average of 20% damage to leaves and buds. Larvae feed by opening galleries under the epidermis of young leaves in spring. When the leaves develop, these galleries expand and tears occur. During this period, the damaged gardens have a brown appearance. The pest causes significant damage in gardens where it is infected. It is not important because it is only epidemic in narrow areas.



Damage pattern of hazelnut leafroll adult (a) and larva (b) (Hantaş et al., 2008).

As a result, in the light of studies conducted for Turkey, the most common pests on Hazelnut plant from Curculionidae family are *Curculio nucum* (Linnaeus, 1758) and Printer beetles (especially: *Xyleborus dispar* (Fabricius, 1792)) from Curculionidae family, while Palomena prasina most common pests from Pentatomidae family. and *Halyomorpha halys*, which has the potential to be seen in Artvin and Rize provinces, which were first registered in Istanbul.

While there are 15 species (*Palomena prasina* (Linnaeus, 1761), *Halyomorpha halys* Carl Stål, 1885, *Apodiphus amygdali* (Germar, 1817), *Dolycoris baccarum* (Linnaeus,1758), *Graphosoma lineatum* (Linnaeus,1758), *Holcostethus vernalis* (Wolff, 1804), *Pentatoma rufipes* (Linnaeus,1758), *Piezodorus lituratus* (Fabricius, 1794), *Raphigaster nebulosa (Poda, 1761)*, *Carpocoris purpureipennis* (De Geer, 1773), *Carpocoris. pudicus* (Poda, 1761), *Eurydema oleraceum* (Linnaeus, 1758), *Eysarcoris inconspicuus* (Herrich-Schaeffer, 1844), *Nezera viridula* (Linnaeus, 1758) belonging to 13 (*Palomena*, *Halyomorpha*, *Apodiphus*, *Dolycoris*, *Graphosoma*, *Holcostethus*, *Pentatoma*, *Piezodorus*, *Raphigaster*, *Carpocoris*, *Eurydema*, *Eysarcoris*, *Nezera*) harmful genera of Pentatomidae family seen on hazelnuts in Turkey, there are 16 species (*Curculio nucum* (Linnaeus,1758), *Anoplus roboris* Suffrian, 1840, *Lymantor coryli* Wood & Bright, 1992, *Xyleborinus saxesenii* (Fabricius, 1792), *Xyleborus*

dispar (Fabricius, 1792), *Xyleborus germanus* (Blandford, 1894), *Xyleborus monographus* (Fabricius, 1792), *Xyleborus dryographus* **(**Ratzeburg 1837*)*, *Xylesandrus crassiusculus* (Motschulsky, 1866), *Monarthrum fascinatum* Wood & Bright, 1992, *Hypothenemus eruditus* Westwood, 1836, *Hypoborus ficus* Erichson, 1836, *Taphrorychus ramicola* (Reitter, 1894), *Taphrorychus hirtellus* Eichhoff, 1878, *Taphrorychus villifrons* (Dufour, 1843), *Hylesinus vestitus* Mulsant & Rey, 1861) belonging to 11 harmful genera (*Curculio, Anoplus, Lymantor, Xyleborinus, Xyleborus, Xylesandrus***,** *Monarthrum, Hypothenemus, Hypoborus, Taphrorychus, Hylesinus)* belonging to Curculionidae family. Both family members cause serious problems in Hazelnut. Its effects on mostly shelled fruit are quite large.

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FARKLI POTASYUM VE FOSFOR DOZLARININ PATATES'TE (*Solanum tuberosum* L.) VERİM VE VERİM UNSURLARI ÜZERİNE ETKİLERİNİN BELİRLENMESİ*

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ÖZET
2014 yılında Ordu ili Kabadüz ilçesinde yürütülen bu çalışmada farklı dozlarda fosfor (0, 5, 10 kg/da) ve potasyum (0, 5, 10, 20 kg/da) uygulamalarının patatesin verim ve verim unsurları üzerine olan etkisi incelenmiştir. Araştırmada Agria çeşidi materyal olarak kullanılmış olup, deneme tesadüf bloklarında bölünmüş parseller deneme desenine göre 3 tekerrürlü olarak yürütülmüştür. Araştırma sonucunda bitki boyunun 45.6-60.3 cm, ocak başına sap sayısının 3.4-4.6 adet/ocak, ocak başına yumru sayısının 4.5-6.3 adet, ortalama yumru ağırlığının 81-97.7 g, pazarlanabilir yumru veriminin 1836.6-2793.5 kg/da, kuru madde oranının %17.89-21.53, nişasta oranının da %13.99-16.05 arasında değişim gösterdiği belirlenmiştir. İncelenen özelliklerden bitki boyu, ocak başına yumru sayısı, kuru madde ve nişasta oranı üzerine fosfor ve potasyumun interaksiyon etkisi istatistiki olarak önemli, diğer özellikler üzerine olan etkiler ise istatistiki olarak önemsiz bulunmuştur.

Anahtar Kelimeler: Agria, Bitki besleme, Gübreleme, Nişasta

*: Bu çalışma Ordu Üniversitesi Bilimsel Araştırma Projeleri Koordinatörlüğünün TF-1445 numaralı projesi ile desteklenmiştir.

EFFECT OF DIFFERENT DOSES OF POTASSIUM AND PHOSPHORUS ON POTATO'S (*Solanum tuberosum* L.) QUALITY, YIELD AND YIELD PARAMETERS

ABSTRACT

In this study conducted in Kabadüz district of Ordu province in 2014, the effect of different doses of phosphorus (0, 5, 10 kgda-1) and potassium (0, 5, 10, 20 kgda-1) applications on the yield and yield components of potato were investigated. In this research, Agria was used as material and the experiment was carried out in randomized blocks with three replications at the split-plot design. As a result of the research, it was observed that the obtained values changed for plant height between 45.6-60.3 cm, for stem number per hillbetween 3.4-4.6, for number of tubers per hill 4.5-6.3, for average tuber weight 81-97.7 g, for marketable tuber yield between 1836.6-2793.5 kg da-1, for dry matter content between 17.89-21.53%and for starch rate between 13.99-16.05%. The interaction effects of phosphorus and potassium were statistically significanton plant height, number of tubers per hill, dry matter and starch ratio, while the effects were statistically insignificanton other properties examined in this research.

Keywords: Agria, Plant nutrition, Fertilization, Starch

GİRİŞ

Patates (*Solanum tuberosum* L.), Solanaceae (patlıcangiller) familyasından yumruları kullanılan, kökeni Türkiye olmayan ender tek yıllık kültür bitkilerimizden birisidir. Yeni Dünya bitkisi olarak bilinen patates, Güney Amerika'nın And dağlarından gelerek Avrupa'da ilk kez süs bitkisi olarak tanınmıştır. Değişik kaynaklara göre, Türkler patates tarımına 19. yüzyılın sonlarında Erzurum ovasında başlamışlardır.

Patates, dünyada insanların dengeli beslenmesinde tahıllardan (buğday, mısır, çeltik) sonra en çok üretimi yapılan dördüncü kültür bitkisidir (Günel ve ark., 2010). Patates, önemli miktarda nişasta halinde karbonhidrat, protein, vitamin ve mineral madde içeren bitkisel kaynaklarımızdandır. Yumrular %75-80 su, %15-20 nişasta, %2 protein, %1 yağ, A, C, B1, B2, B3, B6, B12, folik asit gibi vitaminler ve potasyum, magnezyum, çinko, demir, kalsiyum gibi bazı mineraller maddeler içermektedir. Ülkemizde insan beslenmesi için gerekli olan enerjinin %5.5'i, C vitaminin %26.2'si, B grubu vitaminlerinin %9.8-16.4'ü patates bitkisinden elde edilmektedir (Karadoğan ve ark., 1997). Patates bitkisi bu özellikleri bakımından insan beslenmesinin yanı sıra endüstri ham maddesi ve hayvan beslenmesinde de kullanılmaktadır. Önemli bir endüstri hammaddesi olan patatesten endüstride nişasta, pudra, çocuk maması, tutkal, ispirto, un, gevrek, çubuk, kızartma gibi birçok farklı ürünün yapılmasında faydalanılmaktadır. Konserve kurutma halinde tüketimi her yıl artmaktadır. Hayvan beslenmesinde insan gıdası olarak pazarlanamayan küçük yumrular ve fabrika artığı küspe (posa) kullanılmaktadır (Er ve Uranbey, 2009).

Bitkilere yetiştiricilik aşamasında besin maddelerinin uygun miktarlarda ve zamanında verilmesi, bitki yetiştirme sistemleri içerisinde mutlak gerekli işlemlerdendir. Büyüme mevsimi boyunca besin maddesi eksikliğini gidermek, beslenme yönünden optimum koşulları yaratmak, ekonomik olarak elde edilen en üst düzey verimliliği ve verimliliğin sürdürülebilirliğini sağlar. Bitkiler uygun bir şekilde büyüme ve gelişme gösterebilmek için en az 17 bitki besin elementine ihtiyaç duymaktadırlar. Bu zorunlu bitki besin elementleri bitki yaşamı için mutlak gerekli olan ve diğer bitki besin elementleri tarafından yerleri doldurulamayan elementlerdir (Stark ve Hopkins, 2015). Bunlardan en önemlileri ve en çok kullanılanları azot, fosfor ve potasyumdur.

Fosfor ve potasyum bitkiler için hayati önem taşıyan metabolik, fizyolojik ve biyokimyasal işlevlerin meydana gelmesinde önemli elementlerdir. Fosfor hücre içerisinde enerjinin üretimi ve taşınması, membran sentezi, nitrojen fiksasyonu için gereklidir. Yeterli fosfor, bitki gelişimini hızlandırmakta ve don tehlikesi olan alanlarda bitkiler daha az zarar görmektedir. Potasyum enzim aktivitesine, fotosenteze, bitki besin elementlerinin ve fotosentez ürünlerinin taşınmalarına yardım eder, protein kapsamını artırır, turgoru düzenler, bitkilerde su

yitmesini ve solmayı önler. Potasyum bitkilerde kök gelişmesine ve büyümesine olumlu etki ettiğinden bitkilerin yatmasını önler, soğuğa dayanıklılığını artırır, erkencilik sağlar, azotun alımını artırır, hastalık ve zararlılara karşı dayanıklılık sağlar (Kacar, 2005).

Ordu ilinde patatesin birim verimliliği oldukça düşüktür (1200-1500 kg/da). Bu nedenle, birim alan verimliliğini artırma konusunda araştırmaların yapılması oldukça büyük önem arz etmektedir. Bu düşünceden hareketle yapılan bu çalışmada, farklı potasyum ve fosfor dozlarının mevcut ekolojik koşullarda patatesin verim ve kalite parametreleri üzerine olabilecek etkilerinin belirlenmesi amaçlanmıştır.

MATERYAL ve METOT

Deneme Alanının Konumu, İklim Ve Toprak Özellikleri

Farklı patates çeşitlerinin ve potasyum uygulamalarının patatesin bitki gelişimi, verim ve kalite özelliklerine etkilerinin belirlenmesi amacıyla yürütülen bu çalışma, Ordu ili Kabadüz ilçesi Yukarı Kirazdere mevkiinde yürütülmüştür. İlçede Karadeniz iklimi hüküm sürmektedir. Yazları serin, kışları ılık ve bol yağışlı geçmektedir. Bu iklime bağlı olarak burada görülen tabi bitki örtüsü ormandır. Çalışmanın yürütüldüğü 2014 yılı vejetasyon dönemine ve uzun yıllara ait ortalama sıcaklık, oransal nem ve toplam yağış değerleri çizelge 1'de verilmiştir.

Çizelge 1. Denemenin Yürütüldüğü Ordu İli Kabadüz İlçesine Ait İklim Verileri*

	ORT. SICAKLIK (°C)		ORANSAL NEM (%)		TOPLAM YAĞIŞ (mm)	
AYLAR	2014	Uzun Yıllar	2014	Uzun Yıllar	2014	Uzun Yıllar
NİSAN	5.1	10.5	56.7	85.7	20.2	45.2
MAYIS	6.2	12.7	64.9	86.6	88.5	71.2
HAZİRAN	10.4	16.5	64.0	89.0	43.0	66.1
TEMMUZ	13.2	18.6	55.2	91.0	74.4	62.0
AĞUSTOS	18.1	18.5	76.8	90.0	124.6	65.6
EYLÜL	14.2	15.2	87.0	89.9	83.2	53.3
ORTALAMA	11.2	15.3	67.43	88.7		
TOPLAM					433.9	363.4*

*: Anonim, 2014a

Deneme alanının toprak özelliklerini belirlemek için, deneme alanını temsilen 0-30 cm derinlikten tekniğine uygun olarak alınan toprak örnekleri Ordu Üniversitesi Ziraat Fakültesi Toprak Bölümü Laboratuvarında analiz edilmiş olup; deneme alanı toprağının kireçsiz ve tuzsuz, toplam N bakımından çok fazla, yarayışlı P ve K bakımından ise yetersiz olduğu belirlenmiştir (Çizelge 2).

Çizelge 2. Denemenin Alanı Toprak Analiz Sonuçları ve Değerlendirilmesi

Analizler	Tekstür	pH	Organik Mad. (%)	Toplam N (kg da^{-1})	P (mg kg^{-1})	K (mg kg^{-1})
Sonuç	Kumlu Tınlı	4.39	11.07	0,32	2.51	72.69
Değerlendirme		Asidik	Çok fazla	Çok fazla	Yetersiz	Yetersiz

Araştırmada bitki materyali olarak Agria patates çeşidi kullanılmıştır. Agria çeşidi 90-120 günlük vejetasyon süresine (orta erkenci) sahiptir. Agria çeşidinin sap sayısı 4-5 arasında değişmekte olup; kalın, dik ve yaygın bir vejetatif aksama sahiptir. Yapraklar oldukça iri ve aşağıya sarkık, koyu yeşil, ana yaprakçıklar oldukça iri ve enlidir. Çiçek rengi ise beyazdır. Yumru şekli uzun oval ve patates iç rengi sarıdır. Ortalama göz sayısı 5'tir. Niğde şartlarındaki gözlemlerde sap sayısı 4.4, nişasta oranı %13.7, ortalama yumru ağırlığı 160 g, dekara verim 5738 kg/da olarak saptanmıştır (Anonim, 2014b).

Yöntem

Agria çeşidinin materyal olarak kullanıldığı bu araştırma, bölünmüş parseller deneme desenine göre 3 tekerrürlü olarak yürütülmüştür. Parsellere yumru dikim işlemi 24 Nisan 2014 tarihinde, 70 cm sıra arası ve 30 cm sıra üzeri mesafelerle yarı otomatik patates dikim makinesi ile yapılmıştır. Araştırmada, ana parsellere fosfor, alt parsellere potasyum dozları dikimle birlikte uygulanmıştır. Vejetasyon dönemi boyunca iki kez çapalama, 3 kez de mildiyö hastalığına karşı koruyucu olarak ilaçlanmıştır. Hasat olgunluk belirtilerini müteakiben, 17 Eylül 2014 tarihinde elle hasat yapılmıştır.

İstatistik analizler SAS-JMP-5.01 paket programı kullanılarak yapılmıştır. Varyans analizleri sonuçlarına göre istatistiksel olarak önemli bulunan özellikler, LSD çoklu karşılaştırma testine göre gruplandırılmıştır (Acar ve Gizlenci, 2006).

BULGULAR ve TARTIŞMA

Yapılan bu araştırmada incelenen özelliklere ait ortalama değereler ile istatistiksel olarak önemli bulunan özelliklerin LSD grupları çizelge 3'te verilmiştir.

Çizelge 3'te verilen bitki boyu değerleri incelenecek olursa; patateste uygulanan fosfor miktarı arttıkça bitki boyu da artış göstermiş olup, ortalama olarak en yüksek bitki boyu (57.5 cm) 10 kg/da fosfor uygulamasından elde edilmiştir. Diğer bir uygulama olan potasyum dozları incelenecek olursa en yüksek bitki boyu değeri kontrol dozundan, en düşük değer ise 20 kg/da K uygulamasından elde edilmiştir. Potasyum ve fosfor gübre dozlarının birlikte uygulanmasının

bitki boyu üzerine olan etkisi istatistiki açıdan çok önemli bulunmuş olup, en yüksek değer P10 x K0 interaksiyonundan (60,3 cm), en düşük değer ise P5 x K20 ve kontrol dozunda belirlenmiştir. Konu ile ilgili olarak; Zelalem ve ark. (2009), Chala ve ark. (2017) ile Gebrimariam ve ark. (2016) fosfor dozu arttıkça bitki boyunun da artış gösterdiğini bildirmiş olup yapılan bu çalışma sözkonusu araştırıcıların tespitlerini doğrular niteliktedir.

Yapılan bu çalışmada tespit edilen ocak başına sap sayısı değerleri 3.4-4.6 adet arasında değişim göstermiştir. Uygulanan fosfor ve potasyum gübre dozlarının sap sayısı üzerine olan etkisi istatistiksel olarak önemsiz bulunmuştur. Materyal olarak kullanılan Agria çeşidinin özelliklerinde ortalama sap sayısı 4-5 olarak bildirilmiştir. Burada tespit edilen ortalama değerlerde yaklaşık olarak bu değerlerle paralellik göstermektedir. Konu ile ilgili yapılan benzer çalışmalarda; Kara ve ark. (2002) Erzurum şartlarında fosfor dozları uygulanan patateslerde sap sayısının 3.3 -3.4 adet arasında değişim gösterdiğini, Tunçtürk ark. (2004) ise Van ekolojik şartlarında sap sayısının 3.6-3.7 adet arasında, Kavurmacı (2008) ise sap sayısı değerlerinin 5.11- 5.54 adet arasında tespit ettiklerini bildirmişlerdir.

Ocak başına yumru sayısı bakımından elde edilen veriler incelenecek olursa, uygulanan fosfor ve potasyum dozlarının etkisinin birbirinden bağımsız olmadığı, başka bir ifade ile fosforXpotasyum interaksiyon etkisinin istatistiksel olarak % 5 düzeyinde önemli olduğu görülmektedir. Buna göre; ocak başına en fazla yumru 6.3 adet/ocak değeri ile P_{10} X K_{10} dozundan elde edilirken, en düşük değer (4.5 adet/ocak) ise P_0 X K_{10} dozundan elde edilmiştir. Farklı ekolojik koşullarda yapılan bazı çalışmalarda; Kavurmacı (2008) fosfor dozu arttıkça ocak başına yumru sayısının artış gösterdiğini (4.04- 4.81 adet), Tunçtürk ve ark. (2004) ocak başına yumru sayısının kontrol dozunda 7.2 adet iken 15 kg/da P dozunda 7.8 adete yükseldiğini, Karadoğan (1996) ocak başına yumru sayısı değerlerinin 8.03-8.65 arasında değişim gösterdiğini belirtmişlerdir. Yapılan bu çalışmada elde edilen değerler etki bakımından diğer çalışmalarla paralellik arz ederken rakamsal değerler olarak farklılık göstermektedir. Ki, ekolojik farklılıklar ve çeşit farklılıkları gözönüne alındığında bu durum olağan karşılanabilmektedir.

Tek yıllık olarak yapılan bu çalışmada tespit edilen ortalama yumru ağırlığı değerleri 75.8-97.7 g arasında değişim göstermiş olup, faktör olarak uygulanan gübreler ve dozlar arasındaki farklılıklar istatistiksel olarak önemsiz bulunmuştur. Bazı araştırıcılar (Zewide ve ark. 2012, Masrie ve ark. 2015, Belachew 2016) artan fosfor dozlarının, bazı araştırıcılar da (Moinuddin ve ark. 2004, Sing ve Lal 2012) artan potasyum dozlarının ortalama yumru ağırlığını arttırdığını ifade etmektedirler. Yapılan bu çalışmada uygulanan gübreler ve dozlar arasında olan farklılıklar her ne kadar istatistiksel olarak önemsiz olsada, en yüksek ortalama

yumru ağırlığının (97.7 g) her iki gübrenin en yüksek dozlarının uygulandığı parsellerden elde edilmiş olması ve en düşük değerin de kontrol parsellerinden elde edilmiş olması sözkonusu araştırıcıların tespitleri ile benzerlik göstermektedir.

Çizelge 3. İncelenen özelliklere ait ortalama değerler ve LSD grupları

Fosfor (P_2O_5) Dozları (kg/da)	Potasyum (K_2O) Dozları (kg/da)	Bitki Boyu (cm)**	Ocak Başına Sap Sayısı (adet)	Ocak Başına Yumru Sayısı (adet)*	Ortalama Yumru ağırlığı (g)**	Pazarlanabilir Yumru verimi (kg/da)*	Kuru Madde Oranı (%)**	Nişasta oranı (%)**
0	0	47.4e	4.1	5.1 cd	75.8	2031.5	21.53 a	16.05 a
	5	53.2 cd	4.1	4.8 cd	86.5	1914.0	20.70 bc	15.58 bc
	10	49.6 de	4.6	4.5 d	88.0	2025.3	20.97 ab	15.73 ab
	20	48.7 de	4.3	5.6 abc	88.7	2148.6	19.77 e	15.05 e
Ort.		49.7 A	4.2	5.0 B	84.7	2029.8 B	20.74 A	15.60 A
5	0	56.8 abc	3.9	5.1 cd	84.0	1968.1	20.51 bcd	15.47 bcd
	5	52.2 cd	4.0	4.9 cd	82.5	2021.4	20.27 cde	15.34 cde
	10	58.7 ab	3.8	5.1 cd	81.0	1836.6	19.92 de	15.14 de
	20	45.6 e	3.9	5.1 cd	88.7	2169.4	19.01 f	14.63 f
Ort.		53.3 AB	3.9	5.1 B	84.0	1998.9 B	19.93 B	15.14 B
10	0	60.3 a	4.0	6.2 ab	93.2	2654.4	20.19 cde	15.29 cde
	5	55.5 bc	3.4	4.8 cd	97.2	2231.0	17.89 g	13.99 g
	10	55.1 bc	4.1	6.3a	81.1	2533.8	20.02 de	15.20 de
	20	58.9 ab	3.9	5.4 bcd	97.7	2793.5	18.63 f	14.41 f
Ort.		57.5 A	3.8	5.7 A	92.3	2553.2 A	19.18 C	14.72 C
	K_0 Ort.	*54.8 A*	*4.0*	5.4	84.3	*2218.0*	*20.74 A*	*15.60 A*
	K_5 Ort	*53.6 AB*	*3.8*	4.8	88.7	*2055.5*	*19.62 C*	*14.97 B*
	K_{10} Ort	*54.5 A*	*4.1*	5.3	83.4	*2131.8*	*20.30 B*	*15.36 C*
	K_{20} Ort	*51.0 B*	*4.0*	5.4	91.7	*2370.5*	*19.13 D*	*14.70 D*
	LSD P	*4.50*		0.38		389,77	0.36	0.20
	LSD K	*2.65*		---		----	0.34	0.19
	LSD PxK	*4.59*		0.92		----	0.59	0.33

•(P>0.05) ve ** (P>0.01): Aynı sütunda aynı harfle gösterilen ortalamalar arasındaki fark istatistiksel olarak önemli değildir.

Patateste birim alandan elde edilen pazarlanabilir yumru miktarı ne kadar yüksek olursa ekonomik getiri de o kadar yüksek olmaktadır. Yapılan bu çalışmada elde edilen verilerin istatistiki analizinde, pazarlanabilir yumru verimi bakımından yalnızca fosfor dozlarının % 5 düzeyinde önemli olduğu belirlenmiş olup, ortalama pazarlanabilir yumru miktarı en yüksek (2553.2 kg/da) 10 k P_2O_5/da dozundan elde edilmiştir. Potasyum uygulamasında ise pazarlanabilir yumru verimi 5 kg/da dozunda 2055.5 kg iken 20 kg dozunda 2370.5 kg'a yükseldiği ancak bu rakamsal farklılığın istatiksel açıdan önemli olmadığı belirlenmiştir. Konu ile ilgili benzer çalışmalarda fosfor ve potasyum uygulamalarında doz arttıkça pazarlanabilir yumru veriminin de arttığı ifade edilmektedir (Gebrimariam ve ark.2016, Masrie ve ark.2015, Belachew 2016, Ekin ve ark. 2013, Kumar ve ark. 2017).

Farklı dozlarda fosfor ve potasyum uygulamalarının patateste verim ve verim unsurları üzerine olan etkisinin incelendiği bu araştırmada tespit edilen kuru madde oranları %17.89-21.53 arasında değişim göstermiş olup, en yüksek değer hiç gübreleme yapılmayan kontrol parselinden elde edilirken en düşük değer de her iki gübrenin de en fazla uygulandığı P_{10} X K_{20} dozundan elde edilmiştir (çizelge 3). Yapılan istatistiksel değerlendirmede hem ana faktörlerin dozları hem de fosfor X potasyum interaksiyonu %1 düzeyinde önemli bulunmuştur. Daha önce yapılan bazı çalışmalarda fosfor dozu arttıkça kuru madde oranının azaldığı (Zelalem ve ark. 2009, Rosen ve Bierman 2007), bazı çalışmalarda ise arttığı (Gebrimariam ve ark. 2016, Chala ve ark.2017), yine potasyum dozları arttıkça kuru madde oranının azaldığı (Zhang ve ark. 2018) yada potasyum dozuna bağlı olarak kuru madde oranının arttığı (Pervez ve ark. 2013, Sing ve Lal 2012, Sarikhani ve Aliasgharzad 2012) şeklinde literatürler bulunmaktadır. Dolayısıyla farklı ekolojik koşullar ve çeşitlerle yapılan araştırmalarda farklı sonuçların elde edilmesi genotip X çevre interaksiyonun da incelenmesi gerekliliğini ortaya koymaktadır.

Patateste kuru maddenin çok büyük bölümü nişastadan ibarettir Dolayısıyla incelenen faktörlerin kuru madde oranı üzerine olan etkisinin aynı şekilde nişasta oranı üzerinde de olması beklenilen bir durumdur. Nitekim elde edilen verilerin istatistiksel analizinde kuru madde oranına benzer etki nişasta oranında da tespit edilmiş olup, hem ana faktörler hemde interaksiyon % 1 düzeyinde önemli bulunmuştur. Çizelge 3'te verilen nişasta oranına ilişkin ortalama veriler incelenecek olursa; en yüksek nişasta oranı % 16.05 ile kontrol parsellerinden, en düşük ise % 14.41 ile P_{10} X K_{20} dozundan elde edilmiştir.

SONUÇ ve ÖNERİLER

Fosfor ve potasyum gübrelerinin patateste bitki gelişimi, yumru verimi ve kalitesi üzerine olan etkilerinin belirlenmesi amacıyla yapılan bu araştırmada; bitki boyu, ocak başına yumru sayısı, kuru madde ve nişasta oranı üzerine fosfor ve potasyumun birlikte etkili olduğu (interaksiyon etkisi), pazarlanabilir yumru verimi üzerine ise fosfor dozlarının etkili olduğu belirlenmiştir. En yüksek pazarlanabilir yumru verimi 200 kg/ha fosfor dozundan (25532 kg/ha) elde edilmiştir. Ancak, araştırmanın tek yıllık olması nedeniyle kesin bir tavsiyenin yapılması öngörülmemektedir.

TEŞEKKÜR

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HEDEF DIŞI ORGANİZMA OLAN ZEBRA MİDYE (*Dreissena polymorpha*)'DE LAMBDA CYHALOTHRİN PESTİSİTİNİN ASETİLKOLİNESTERAZ AKTİVİTESİNİN BELİRLENMESİ

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ÖZET

Tarımsal üretimi ve verimi arttırmak için tarım alanlarını zararlılardan korunmak amacıyla kullanılan pestisitlerin istemeden de olsa hedef dışındaki organizmalara, çevreye ve insan sağlığına olan birçok etkileri bulunmaktadır. Asetilkolinesteraz (AChE) canlı organizmanın nörolojik sistemini dengede tutan sistemdir, AChE sisteminin etki altında kalması organizmada davranış bozukluklarına neden olmakta ve ileri bir düzeyde canlı organizmanın kısa süreli felç geçirmesine neden olmaktadır. *Dreissena polymorpha* yerli ırk olmayan, istilacı bir tür olan, seçici beslenme davranışı olmayan, bulunduğu ortam koşullarına hızlı adapte olan biyotik ve abiyotik koşullara toleransı yüksek istilacı bir Tatlısu midyesi türüdür. Yapılan bu çalışmada Lambda Cyhalothrin (LCH) etken maddeli pestisitin *D. polymorpha'*da meydana getirdiği AChE aktivitesi incelenmiştir. Bu amaçla *D. polymorpha* bireylerinin 1 ay süreyle 500 litrelik fiberglas tanklarda adaptasyonu sağlanmıştır. Model organizmaların bulunduğu tankların su sıcaklığı chiller cihazıyla 20±1 °C'de sabitlenmiştir. Denemede uygulanan sublethal konasntrasyonlar literatür taraması yapılarak belirlenmiştir. Model canlı *D. polymorpha,* biri kontrol grubu 3'ü LCH'nin farklı konsantrasyonları olmak toplamda 4 deney grubu (0,00, 1,75, 3,50 ve 7,00 mg/L LCH) oluşturulmuştur. *D. polymorpha* bireyleri 24 ve 96 saat süreyle 1 litrelik akvaryumlarda LCH konsantrasyonuna maruz bırakılmıştır. Her gruba 7 adet *D. polymorpha* bireyi eklenmiş, deneysel uygulama 3 tekrarlı gerçekleştirilmiştir. Uygulama gruplarındaki test organizmalarınnın her birinden 0,5 gr vücut doku örneği diseksiyon işlemi ile alınmıştır. Doku numuneleri tartılmış ve AChE aktivitesini ölçmek için 1/5 w/v oranında PBS tamponu (fosfat ile tamponlanmış tuz solüsyonu) eklenerek homojenize edilmiştir. AChE enzim aktivitesi CUSABIO marka CSB-E17001Fh katalog numaralı kitlerle ELISA yöntemine göre mikroplate okuyucu ile belirlenmiştir. LCH'nin AChE aktivitesinde ki etkileri incelendiğinde 96 saatlik süre sonunda AChE aktivitesini inhibe ettiği ve istatistiksel açıdan anlamlı azalmaların meydana geldiği belirlenmiştir.

Anahtar Kelimeler: *Dreissena polymorpha.* Pestisit, Asetilkolinesteraz

DETERMINATION OF ACETHYLCHINESTERASE ACTIVITY OF LAMBDA CYHALOTHRIN PESTICIDE IN ZEBRA MUSLE (*Dreissena polymorpha*), WHICH IS A NON-TARGET ORGANISM

ABSTRACT

Pesticides, which are used to protect agricultural areas from pests in order to increase agricultural production and efficiency, have many unintentional effects on non-target organisms, the environment and human health. Acetylcholinesterase (AChE) is the system that keeps the neurological system of the living organism in balance, under the influence of the AChE system causes behavioral disorders in the organism and causes a short-term paralysis of the living organism at an advanced level. *Dreissena polymorpha* is an invasive species of Freshwater mussel that is not a native breed, is an invasive species, does not have selective feeding behavior, and quickly adapts to the environmental conditions it is in, with a high tolerance to biotic and abiotic conditions. In this study, the AChE activity of Lambda Cyhalothrin (LCH) active ingredient pesticide on *D. polymorpha* was investigated. For this purpose, *D. polymorpha* individuals were adapted for 1 month in 500 liter fiberglass tanks. The water temperature of the tanks containing the model organisms was fixed at 20±1 °C with the chiller device. Sublethal concentrations applied in the experiment were determined by literature review. Model live *D. Polymorpha*, one control group and 3 different concentrations of LCH, a total of 4 experimental groups (0.00, 1.75, 3.50 and 7.00 mg/L LCH) were formed. *D. polymorpha* individuals were exposed to LCH concentration in 1-liter aquariums for 24 and 96 hours. 7 *D. polymorpha* individuals were added to each group, and the experimental application was carried out in 3 replications. 0.5 g of body tissue samples were taken from each of the test organisms in the application groups by dissection. Tissue samples were weighed and homogenized by adding 1/5 w/v PBS buffer (phosphate buffered saline solution) to measure AChE activity. AChE enzyme activity was determined with a microplate reader according to the ELISA method with kits with catalog number CUSABIO brand CSB-E17001Fh. When the effects of LCH on AChE activity were examined, it was determined that it inhibited AChE activity at the end of 96 hours and statistically significant decreases occurred.

Keywords: *Dreissena polymorpha.* Pesticide, Acetylcholinesterase

GİRİŞ

Pestisitler, bir veya daha fazla hedef organizma üzerinde açık bir şekilde toksik etki gösterme niyetiyle çevreye getirildikleri için çoğu endüstriyel organik kimyasaldan farklıdır. Ne yazık ki, toksisiteleri genellikle uygulandıkları yerle sınırlı değildir. Çeşitli fiziksel taşıma süreçleri yoluyla başka yerlere ve çevresel bölümlere ulaşarak, var olan organizmaları olumsuz yönde etkilerler (Deneer, 2000). Toplum, sağlıklı su ekosistemlerinin değerinin yanı sıra insan faaliyetlerinin bu ekosistemler üzerindeki etkilerinin giderek daha fazla farkına varıyor. Son yıllarda, birçok kentsel ve endüstriyel kirlilik kaynağının azaltılma veya ortadan kaldırılma çabaları mevcuttur. Tarımla uğraşılan bilimsel çalışmalarda, tarımsal kimyasalların saha dışına taşınmasını azaltmak için çalışmaktadır, ancak bunların tarımda kullanımı hala artarak devam etmektedir. Ekinlere uygulanan pestisitlerin <%1 ila %2 olduğu tahmin edilen küçük bir bölümü, yağış olayları sırasında tarlalardan kaybolur ve yakındaki nehirlere karışır. Birçok durumda suda yaşayan organizmalar, kimyasalların karışımlarına maruz kalır ve bu, tek kimyasallar için geleneksel risk değerlendirmelerine dayalı olarak tahmin edilenden daha fazla hedef dışı riske yol açabilir (Battaglin ve Fairchild, 2002).

Son yıllarda tatlı su ekosistemi, endüstriyel atıklar, tarımsal faaliyetler, kentsel atık yönetimi sorunları ve kentleşmedeki artış gibi insan faaliyetlerinden kaynaklanan ciddi tehditlerle karşı karşıya kalmıştır (Meijide ve ark., 2018; Zhu ve ark., 2018). Ayrıca, iklim değişikliğinin etkileri, yağış ve sıcaklık seviyeleri gibi abiyotik faktörlerde meydana gelen değişiklikler, üreme ve beslenme dahil olmak üzere su ekosistemlerinin normal işlevini etkilemiştir. Bu kirlilik seviyeleri, sucul flora ve faunanın yaşam alanlarını da etkilemiştir (Schmeller ve ark., 2018). Bu nedenle, küresel alanda tatlı su türlerini korumak ve ekosistemlerin normal işlevlerini sağlamak için, ana kirlilik faaliyetlerini, kaynaklarını ve mekansal dağılımları da dahil olmak üzere su ortamındaki akıbetlerini belirlemek çok önemlidir (Liu ve ark., 2018; Zhao ve ark., 2018). Bunların başarılması, tatlı suda yaşayan canlıları antropojenik faaliyetlerden korumak için daha gerçekçi önlemler alma konusunda daha sürdürülebilir ve kalıcı önlemler sağlayacaktır (Sumon ve ark., 2018). Doğal süreçlerin etkisinin anlaşılması, tatlı su ortamının bozulmasını önlemek için koruma programları ve politikaları geliştirmeye yardımcı olabilir (Schmeller ve ark., 2018). Bu nedenle, çalışmanın temel amacı, pestisitlerin tatlı su organizmaları üzerindeki etkilerine odaklanmak ve meydana getirdiği etki mekanizmasını inceleyerek su kirliliğine etkisini araştırmaktır. Bu amaçla çalışmada *Dreissena. polymorpha* kullanılmıştır. Zebra midyesi (*D. polymorpha*), dünyanın tatlı sularındaki en büyük istilacı zararlılardan biridir. Ayrıca, zebra midyeleri nehirlerin ve göllerin ekolojisinde sistem

düzeyinde değişikliklere neden olabilir ve birçok sucul türün doğrudan yok olmasına yol açmıştır (Aldridge ve ark., 2004).

Asetilkolinesteraz, merkezi ve periferik sinir sistemlerinde çok sayıda kolinerjik iletimde nörotransmitter asetilkolinin hızlı hidrolizi ile impuls iletiminin sonlandırılmasında rol oynar (Colovic ve ark., 2013). Asetilkolinin aşırı birikmesine ve sinir uçlarında uzun süreli elektriksel aktiviteye neden olan AChE'nin inhibisyonu, organofosfor ve karbamat pestisitler için anahtar bir toksisite mekanizması içerir.

Bu çalışmada tatlı sularda yaşayan Zebra Midye (*D. Polymorpha*)'nin tüm vücut dokularında, zararlılarla mücadele de etkli olarak kullanılan bir pestisit olan Lambda Cyhalothrin (LCH)'nin AChE aktivitesi üzerindeki etkisinin araştırılması amaçlanmaktadır.

MATERYAL ve METOD

D. polymorpha bireyleri Fırat Nehri'nden (38º 48 '25 "K, 38º 43' 51" D) toplandı. Organizmalar laboratuvara hızlı bir şekilde plastik şişelerde getirildi. Deneylerde kullanılmadan önce laboratuvar koşullarına adaptasyonları için en az 15 gün, sıcaklığı 18 C'ye ayarlı, 500 L havalandırmalı tanklarda, 12:12 saat aydınlık:karanlık döngüsünde doğal yaşam koşullarına benzer ortamda mikroalglerle ile beslenmiştir. Çalışma için benzer gelişim aşamasındaki sağlıklı görülen organizmalar seçilmiş ve deneysel çalışma süresince beslenmemiştir.

Deney Dizaynı

Model organizmaların bulunduğu tankların su sıcaklığı chiller cihazıyla 20±1 °C'de sabitlenmiştir. Denemede uygulanan sublethal konasntrasyonlar literatür taraması yapılarak belirlenmiştir. Model canlı *D. polymorpha,* biri kontrol grubu 3'ü LCH'nin farklı konsantrasyonları olmak toplamda 4 deney grubu (0,00, 1,75, 3,50 ve 7,00 mg/L LCH) oluşturulmuştur. *D. polymorpha* bireyleri 24 ve 96 saat süreyle 1 litrelik akvaryumlarda LCH konsantrasyonuna maruz bırakılmıştır. Her gruba 7 adet *D. polymorpha* bireyi eklenmiş, deneysel uygulama 3 tekrarlı gerçekleştirilmiştir. Deneme dizaynında oluşturulan gruplar aşağıdaki gibi oluşturulmuştur.

C0 : (Kontrol): Herhangi bir LCH konsantrasyonuna maruz bırakılmayan, organizmaların doğal ortamından alınan suda bekletildi.

C1 : 24 ve 96 saatlerde 1,75 mg/L LCH konsantrasyona maruz bırakılan grup

C2: 24 ve 96 saatlerde 3,50 mg/L LCH konsantrasyona maruz bırakılan grup

C3: 24 ve 96 saatlerde 7,00 mg/L LCH konsantrasyona maruz bırakılan grup

Deneysel araştırmada tüm çalışmalar üç tekrarlı olarak yürütülmüştür.

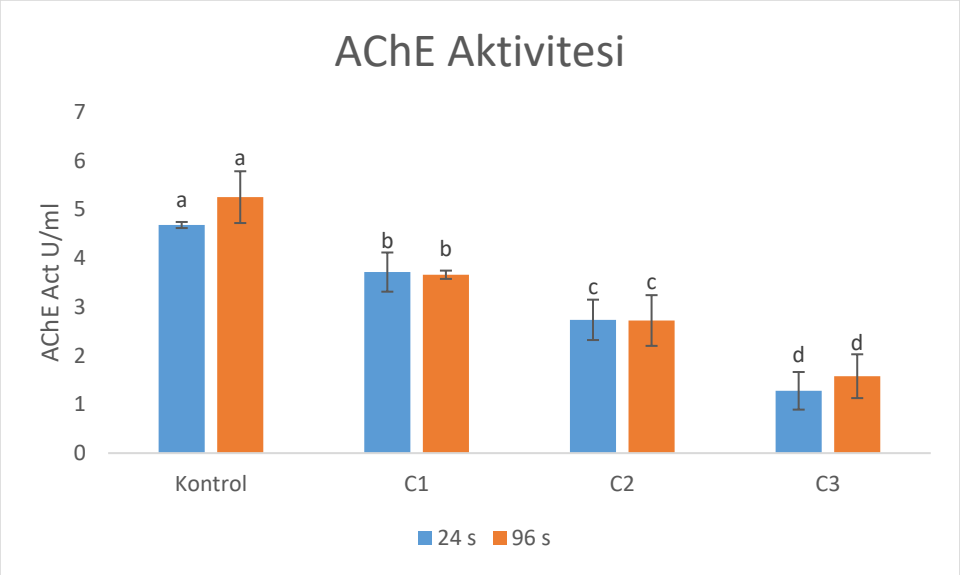
Biyokimyasal Analizler

Uygulama gruplarındaki test organizmalarınnın her birinden 0,5 gr vücut doku örneği diseksiyon işlemi ile alınmıştır. Doku numuneleri tartılmış ve AChE aktivitesini ölçmek için 1/5 w/v oranında PBS tamponu (fosfat ile tamponlanmış tuz solüsyonu) eklenerek homojenize edilmiştir. AChE enzim aktivitesi CUSABIO marka CSB-E17001Fh katalog numaralı kitlerle ELISA yöntemine göre mikroplate okuyucu ile belirlenmiştir. LCH'nin AChE aktivitesinde ki etkileri incelendiğinde 96 saatlik süre sonunda AChE aktivitesini inhibe ettiği ve istatistiksel açıdan anlamlı azalmaların meydana geldiği belirlenmiştir.

BULGULAR

AChE Aktivitesi

Bu çalışmada farklı konsantrasyonlarda LCH etken maddeli insektisite maruz bırakılan *D. polymorpha*'da AChE enzim aktiviteleri üzerine etkileri belirlenmiştir (Tablo 1).



Şekil 1. Lambda Cyhalothrine maruz bırakılan *D. polymorpha*'da AChE (U/ml) aktivitesi
Sütun üzerindeki farklı harfler gruplar arasında istatistiksel olarak anlamlı (p<0,05) farkı, * işarteti ise aynı grupta farklı zamanlar arasındaki istatistiksel olarak anlamlı (p<0,05) farkı ifade etmektedir.

Lambda cyhalothrin etken maddeli insektisite maruz bırakılan *D. polymorpha*'da AChE enzim aktiviteleri kontrole kıyasla hem maruz bırakılma süresine bağlı olarak hem de derişim miktarına bağlı olarak istatistiksel açıdan anlamlı (p<0,05) azalmaların olduğu tespit edilmiştir.

SONUÇ ve TARTIŞMA

Pestisitlerin ve diğer kirleticilerin su ortamına ve sucul organizmalara olan etkisini araştıran ve literatüre katkı sağlayan çalışmalar bulunmaktadır. Ren ve ark. (2015) yapmış oldukları

çalışmada, diklorvos (DDVP)'un *Daphnia magna*'nın AChE aktivitesine olan etkisini incelemişler ve sonucunda DDVP'nin AChE aktivitesini inhibe ettiğini belirtmişlerdir. Fornstrom ve ark. (1997) yapmış oldukları çalışmada terbufos a maruz bırakılan *Procambarus clarkii'nin* AChE aktivitelerini değerlendirmişler ve sonuç olarak AChE aktivitesinde azalmalar olduğunu tespit etmişlerdir. Pan ve ark. (2017) de yapmış oldukları çalışmada kadmiyuma maruz bıraktıkları *Danio rerio* da bazı oksidatif stres parametrelerini incelemişler ve AChE aktivitesinin inhibe edildiğini belirtmişlerdir. Pereira ve ark. (2012) endosülfana maruz bıraktıkları *D. rerio*'da AChE aktivitesinde azalmalar gözlemdiğini belirtmişlerdir. Barata ve ark. (2004) yapmış oldukları çalışmada *Daphnia magna'*da malathion, klorpirifos ve karbofuran pestisitlerinin etkilerini incelemişler ve AChE aktivitesinin inhibe edildiğini belirtmişlerdir. Ren ve ark. (2016), deltametrinin *D. rerio*'da AChE aktivitesini incelemişler ve konsantrasyon yükseldikçe azalmaların arttığını belirtmişlerdir. Guilhermino ve ark. (1996) yaptıkları çalışmada *D. magna'*da parathion, paraokson, kadmiyumun AChE etkilerini incelemişler ve inhibe edildiğini belirtmişlerdir. Jemec ve ark. (2007) yapmış oldukları çalışma da krom, kadmiyum ve diazinona maruz kalan *D. magna*'da asetilkolinesteraz (AChE) aktivitesini incelemişler ve anlamlı azalmalar olmadığını belirtmilerdir. Diamantino ve ark. (2000) yaptıkları çalışmada *D. magna*'da hem sodyum dikromat hem de sodyum molibdatın AChE aktivitesini inhibe ettiğini belirtmişlerdir. Printes ve ark. (2004), paration, klorpirifos, malathion ve asefata maruz bıraktıkları *D. magna* da AChE aktivitesinin inhibe edildiğini belirtmişlerdir.

Yapılan çalışma verileri literatürde bulunan çalışmalar ile paralellik göstermektedir. Sucul organizma bünyesine herhangi bir yol ile giren pestisit ve benzeri kirleticiler canlı bünyesinde hücresel değişimlere neden olarak, canlının biyolojik yaşamını ve davranışlarını etkilemektedir, bu etki maruz kalma şekline ve konsantrasyonuna göre ölümle dahi sonuçlanabilmektedir. Pestisit benzeri kirleticilerin su ortamına kontaminasyonu engellenmeli ve pestisit kullanımının bilinçli şekilde yapılması önerilmektedir.

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SERYUMUN ZEBRA MİDYE (*Dreissena polymorpha*) ÜZERİNDEKİ ASETİLKOLİNESTERAZ AKTİVİTESİNİN BELİRLENMESİ

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ÖZET

Her geçen gün kullanım alanı genişlemekte olan Nadir Toprak Elementlerinin (NTE) artan konsantrasyonlarda kullanılması çevre ve su ortamında istenmeyen oluşumlara neden olmaktadır. Canlı bünyesinde bulunan kirleticiler hücrede istenmeyen etkilere neden olmaktadır. Organizmalarda ölüme yol açan nöromüsküler felce neden olan asetilkolinesterazı (AChE) inhibe etmektir. Bu çalışma da geniş kullanım alanına sahip olan NTE'lerden olan Seryum (Ce)'un sucul bir organizma olan tatlı su midyesi *Dreissena polymorpha* üzerindeki asetilkolinesteraz (AChE) aktivitesinin belirlenmesi amaçlanmıştır. Model organizma *D. polymorpha* Fırat Nehri'nden toplanarak Su Ürünleri Fakültesi laboratuvarlarına getirilmiştir. Deneysel çalışmada; en az bir ay süre ile laboratuvar koşullarına adapte edilen organizmaların benzer boyutta sağlıklı olan bireyleri seçilmiştir. *D. polymorpha* bireyleri 24 ve 96 saat süreyle 1 litrelik akvaryumlarda Ce'nin 3 farklı subletal konsantrasyon (0,075, 0,15 ve 0,30 mg/L)'una maruz bırakılmıştır. Model organizmaların bulunduğu akvaryum su sıcaklığı chiller cihazıyla 20±1 °C'de sabitlenmiştir. Canlıların oksijen ihtiyacı için akvaryumlara harici hava motoru ile oksijen takviyesi yapılmıştır. Deneysel uygulamaların tümü üç tekrarlı olarak yürütülmüştür. Bireylerden vücut örnekleri alınmak her bir canlıdan 0,5 gr vücut doku örneği diseksiyon işlemi ile alınmıştır. Doku numunelerinde AChE aktivitesini ölçmek için 1/5 w/v oranında PBS tamponu (fosfat ile tamponlanmış tuz solüsyonu) eklenerek homojenize edilmiştir. *D. polymorpha* bireylerinde AChE enzim aktivitesi CUSABIO marka CSB-E17001Fh katalog numaralı kitlerle ELISA yöntemine göre mikroplate okuyucu ile belirlenmiştir. Ce uygulanan tüm gruplarda AChE aktivitesi kontrol grubuna göre değişimler gözlemlenmiş ancak bu değişimler istatistiksel açıdan anlamlı bulunmamıştır ($p>0.05$). Yapılan çalışma sonucuna göre sadece en yüksek konsantrasyon grubu (C3) ile kontrol grubu arasında anlamlı fark ($p<0,05$) tespit edilmiştir. Ce'nin AChE aktivitesinde ki etkileri incelendiğinde 96 saatlik süre sonunda AChE aktivitesiniistatistiksel açıdan değişikliklerin meydana geldiği belirlenmiştir.

Anahtar Kelimeler: Asetilkolinesteraz, Seryum, *Dreissena polymorpha*

DETERMINATION OF ACETYLCHOLINESTERASE ACTIVITY OF CERIUM ON ZEBRA MUSSEL (*Dreissena polymorpha*)

ABSTRACT

Increasing concentrations of Rare Earth Elements (REE), whose usage area is expanding day by day, causes undesirable formations in the environment and aquatic environment. Pollutants in living things cause undesirable effects in the cell. It is to inhibit acetylcholinesterase (AChE), which causes neuromuscular paralysis leading to death in organisms. In this study, it was aimed to determine the acetylcholinesterase (AChE) activity of Cerium, which is one of the REEs with a wide range of uses, an organism freshwater amphipod *Dreissena polymorpha*. The model organism *D. polymorpha* was collected from the Euphrates River and brought to the laboratories of the Faculty of Fisheries. In the experimental study; Healthy individuals of similar size of organisms adapted to laboratory conditions for at least one month were selected. D. polymorpha individuals were exposed to 3 different concentrations of Ce (0.075, 0.15 and 0.30 mg/L) in 1-liter aquariums for 24 and 96 hours. The aquarium water temperature with the model organisms was fixed at 20±1 °C with a chiller device. For the oxygen needs of living things, oxygen was supplemented with an external air motor to the aquariums. All of the experimental applications were carried out in triplicate. Body samples were taken from individuals and 0.5 g of body tissue samples were taken from each living creature by dissection. To measure AChE activity in tissue samples, they were homogenized by adding 1/5 w/v of PBS buffer (phosphate buffered saline solution). AChE enzyme activity in *D. polymorpha* individuals was determined with a microplate reader according to the ELISA method with kits with catalog number CUSABIO brand CSB-E17001Fh. Changes in AChE activity were observed in all Ce-treated groups compared to the control group, but these changes were not statistically significant ($p>0.05$). According to the results of the study, a significant difference ($p<0.05$) was found only between the highest concentration group (C3) and the control group. When the effects of Ce on AChE activity were examined, it was determined that statistically changes occurred in AChE activity at the end of the 96 hour period.

Keywords: Acetylcholinesterase, Cerium, *Dreissena polymorpha*

GİRİŞ

Teknolojinin hayatımızdaki yerinin hızla artmasına paralel olarak Nadir Toprak Elementlerinin de (NTE) kullanım alanı her geçen gün hızla artmaktadır. Günümüzde NTE'ler savunma sanayisinden uzay teknolojisine, LED aydınlatmalardan cep telefonlarına kadar hayatımızın neredeyse her alanında var olmakla birlikte çok önemli ticari anlam kazanmıştır. Bunlar arasında ilk dikkat çeken uzun ömürlü pillerde kullanılan Lityum (Li) ve elektronik sanayiinde vazgeçilmez hale gelen yarı iletkenlerde kullanılan Seryum (Ce) en yaygın hale gelen elementler olarak bilinmektedir (Terzi, 2019)

Seryum, optik sektöründe, aydınlatma sistemlerinde, demir alaşımlarında, organik kimya da, televizyon ekranlarında, fotoğrafçılıkta, dokuma sanayisinde kullanılması gibi bir çık alanda kullanılmaktadır.

NTE'lerin teknoloji, sanayi ve endüstriye birçok kazanımı ve faydası olduğu yadsınamaz bir gerçektir fakat bu maddelerin aşırı kullanımı ve atık maddelerinin çevreye bırakılması çevre de ciddi kirlenmeler ve birikmeler meydana getireceği düşünülmektedir. Nitekim çevreye bilinçli veya bilinçsiz şekilde bırakılan herhangi bir kirleticinin son durağı su ortamıdır. Su ortamına giren bir kirletici sucul organizmaların vücuduna girerek, organizmaya ciddi zararlar vermektedir. Su ortamın kirlenmesi, doğal dengeyi de bozarak, beslenme yolu ile insana kadar her canlıyı etki altına almaktadır. Doğal dengenin korunması için su kirliliğinin tespit edilerek gerekli önlemlerin alınması gerekmektedir. Su kirliliğini araştırmak için ekotoksikoloji testleri uygulanmaktadır. Ekotoksikoloji testleri, sucul ortam test organizmalarına ve suda çözünebilir kimyasal bileşiklerin su kirlenmesindeki önemini ortaya koymada yaygın olarak kullanılmaktadırlar. Su kirliliğinin araştırılmasında ortamdaki kirliliği tespit etmeyi kolaylaştıracak bazı spesifik türler bulunmaktadır. Bu indikatör organizmalar kirletici maddenin alımı, atılımı ve biyokullanılabilirliliğinin izlenmesinde ve toksik etkilerin belirlenmesinde kullanılabilir, var oldukları su ortamları ile temas halinde bulunduklarından su ortamındaki kirleticileri alarak vücutlarında biriktirebilirler ve bu nedenle ortamın kirlilik durumu hakkında bilgi verebilirler (Taylan ve Özkoç, 2007).

Su ortamının kirliliğinin belirlenmesinde midyeler, kabuklular, balıklar gibi organizmalar kullanılmaktadır. Bulundukları sucul ortamıda filtreleme ile beslenen sedanter organizmalar olarak midye türleri, sudaki element mevcudiyetine karşı özellikle savunmasızdır. Türlerin kirletici madde biriktirme kabiliyeti (Pousse ve ark., 2020) ve geniş coğrafi dağılımı nedeniyle, *D. polymorpha*, ortamdaki değişikliğe ve kirlilikten etkilenmeye eğilimlidir. *D. polymorpha* güçlü bir oksidatif savunmaya sahip olduğundan ve ksenobiyotiklere nispeten yüksek dirence

sahip olmasından dolayı, ekotoksikolojik deneylerde yaygın olarak kullanılmaktadır (Faria ve ark., 2009; Serdar ve ark., 2021).

Oksidatif strese yol açan redoks dengesizliğinde çeşitli NTE'lerin rolü, hem bitki hem de hayvan modellerinde yürütülen bir dizi bağımsız çalışmada gösterilmiştir ve pek çok NTE'nin oksidatif strese neden olduğu rapor edilmiştir (Tseng ve ark., 2012; Wang ve ark., 2012; Zhao ve ark., 2013). Omurgalıların ve omurgasızların sinir sisteminde çok önemli bir enzim olan asetilkolinesteraz (AChE), birkaç ksenobiyotiğin fonksiyonel hedefidir; bunlardan bazıları farmakolojik özelliğe sahiptir, ancak aynı zamanda tarım kimyasalları olarak kullanılan pestisitler veya kimyasal savaşta kullanılan ilaçlar gibi diğerleri de vardır (Carr ve Chambers, 1996; Porcelli ve ark., 1999). AChE aktivitesinin ölçülmesi bazı ekotoksikolojik çalışmalarda kullanılmaktadır (Bradbury ve ark., 2008). AChE enziminin inhibisyonu, sinir sonlarında asetilkolin birikimi ve elektriksel aktivitenin uzamasıyla sonuçlanmakta ve gastrointestinal sistem ve solunum bozukluklarının meydana gelmesine neden olmaktadır (Chuiko, 2000). AChE inhibisyonu sinir sistemi fonksiyonunu bozmakta ve solunum, beslenme ve davranış gibi çeşitli fonksiyonlarda olumsuz etkilere sebep olabilmektedir. AChE aktivitesi akuatik sistemlerin çevresel kirlilik izleme programlarında ve ekotoksikolojik risk değerlendirme çalışmaları için teşhis anahtarı olarak kullanılmaktadır (De La Torre ve ark., 2002).

Bu çalışmada tatlı sularda yaşayan Zebra Midye (*D. Polymorpha)*'nin tüm vücut dokularında, yaygın olarak kullanılan NTE Ce'nin AChE aktivitesi üzerindeki etkisinin araştırılması amaçlanmaktadır.

MATERYAL ve METOD

Canlı Organizma Temini ve Labratuvar Ortamına Adaptasyonu

D. polymorpha bireyleri Fırat Nehri'nden (38º48'25"K, 38º43'51"D) toplanmıştır. Organizmalar laboratuvara hızlı bir şekilde plastik kaplarda getirilmiştir. Deneylerde kullanılmadan önce 15 gün 18 °C'de tutulan bir odada 20 L havalandırmalı bir akvaryumda doğal yaşam koşullarına benzer ortam dizayn etmek için 12:12 saatlik aydınlık: aranlık döngüsünde plankton ile beslenmiştir. Çalışma için benzer gelişim aşamasındaki organizmalar seçilmiş, deneysel çalışma süresince beslenmemiş ve 24 saatte bir kontrol edilmiş, ölü bireyler sayılmış ve deneysel akvaryumdan çıkarılmıştır.

Kimyasal Madde Temini

Çalışmada kullanılan NTE Seryum (Ce) ticari firma olan Bostonchem'den %99,99 saflık derecesinde temin edilmiştir.

Subletal Konsantrasyonların Belirlenmesi

Tüm toksikolojik çalışmalarda olduğu gibi Ce uygulama çalışmamızda da belirlenen uygulama konsantrasyonları çevreye salınım oranları dikkate alınarak uygulama konsantrasyonları bu aralıktaki değerlerine oranla sublethal konsantrasyonlar belirlenmiştir.

Deney Dizaynı

Her biri 1 litreden oluşan cam akvaryumlara benzer büyüklükte ve sağlıklı 8'er adet model canlı yerleştirilmiştir. Canlıların O_2 ihtiyacı hava motorları ile sağlanmıştır. Deneysel çalışma biri kontrol grubu olmak üzere 4 gruptan oluşturulmuştur. Dört grup için 2 zaman dilimi (24 ve 96 saat) belirlenmiştir.

C1 (Kontrol): Herhangi bir Ce konsantrasyonuna maruz bırakılmayan, organizmaların doğal ortamından alınan suda bekletilmiştir.

C2: 24 ve 96 saatlerde 0,075 mg/L Ce konsantrasyona maruz bırakılan grup

C3: 24 ve 96 saatlerde 0,15 mg/LCe konsantrasyona maruz bırakılan grup

C4: 24 ve 96 saatlerde 0,30 mg/L Ce konsantrasyona maruz bırakılan grup

Deneysel araştırmada tüm çalışmalar üç tekrarlı olarak yürütülmüştür.

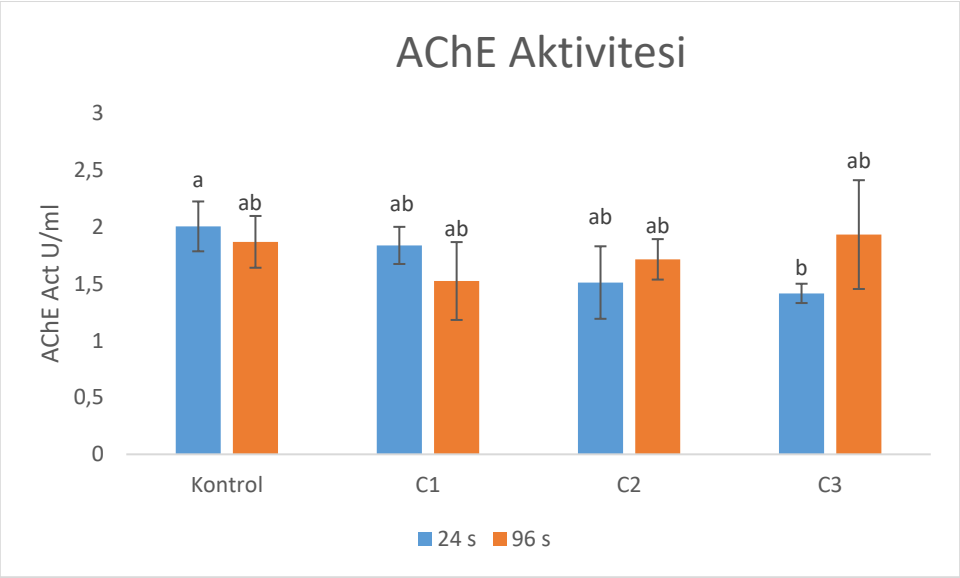
Biyokimyasal Analizler

Uygulama gruplarındaki akvaryumdan test organizmalarının tüm vücut örnekleri alınmış ve her bir canlıdan 0,5 gr vücut örneği diseksiyon işlemi yapılmıştır. Doku numuneleri tartılmış ve AChE aktivitesini ölçmek için 1/5 w/v oranında PBS tamponu (fosfat ile tamponlanmış tuz solüsyonu) eklenerek homojenize edilmiştir. AChE enzim aktivitesi CUSABIO marka CSB-E17001Fh katalog numaralı kitlerle ELISA yöntemine göre mikroplate okuyucu ile belirlenmiştir.

BULGULAR

AChE Aktivitesi

Bu çalışmada farklı konsantrasyonlarda Ce NTE'ine maruz bırakılan *D. polymorpha*'da AChE enzim aktiviteleri üzerine etkileri belirlenmiştir (Grafik 1).



Şekil 1. Seryuma maruz bırakılan *D. polymorpha*'da AChE (U/ml) aktivitesi
Sütun üzerindeki farklı harfler gruplar arasında istatistiksel olarak anlamlı (p<0,05) farkı, * işarteti ise aynı grupta farklı zamanlar arasındaki istatistiksel olarak anlamlı (p<0,05) farkı ifade etmektedir.

Seryum NTE'ye maruz bırakılan *D. polymorpha*'da AChE enzim aktiviteleri kontrole kıyasla istatistiksel açıdan anlamlı yalnızca 24 saatlik C3 uygulama grubunda kontrole kıyasla istatistiksel açıdan anlamlı farkın (p<0,05) olduğu gözlemlenmiş olup, diğer gruplardaki değişimin istatsitiksel açıdan anlamsız (p>0,05) olduğu gözlenmiştir.

SONUÇ ve TARTIŞMA

NTE'lerin kullanım alanlarının artmasıyla birlikte bu maddeler ve bunların çevreye olan etkileri üzerine yapılan çalışmalarda artmaktadır. Firidin ve Kargın, 2019 yapmış oldukları çalışmada *Oreochromis niloticus' ta* Cu ve Cu+Ca karışımlarının dokulardaki AChE aktivitesini incelemişler ve sonuç olarak AChE aktivitesinde azalmalar olduğunu bildirmişlerdir. Yıldırım ve ark., 2022 yaptıkları çalışmada *D. polymorpha'da* organofosforlu dimethoate ve malathion etken maddeli insektisit karışımlarının etkisinin AChE üzerine olan etkisini araştırmışlar ve sonuç olarak AChE düzeylerinin azaldığını bildirmişlerdir. Turan, 2012 yapmış olduğu çalışmada 2,4 Diklorofenoksiasetik asit (2,4- D)' nin *Xiphophorus helleri* de ki AChE aktivitesini inceleme ve Karaciğer dokularında AChE düzeyinin arttığını belirtmiştir. Köktürk ve Sulukan, 2022 yapmış oldukları çalışmada sulfoxaflor (SFX) insektisitinin zebra balığı embriyo ve larvalarında gelişimsel toksisitesini inceleyerek AChE aktivitesini değerlendirmiş ve AChE aktivitesinin arttığını belirtmiştir. Korkmaz, 2014 yaptığı çalışmada Danio rerio' da organofosfat grubu pestisitlerden fosalon ve piretroit grubu pestisitlerden sipermetrinin bazı biyolojik belirteçlerini incelemiş ve AChE aktivitesinin attığını belirtmiştir. Rhee ve ark., 2013 yaptıkları çalışmada *Brachionus koreanus*'u farklı konsantrasyonlarda klorpirifos (pozitif

kontrol) ve altı farmasötik maddeye maruz bırakıldıktan sonra AChE aktivitesini değerlendirmiş ve sonuç olarak AChE aktivitesinin inhibe edildiğini belirtmişlerdir. Doran ve ark., 2001 klorpirifos'un üç sırtlı midye *Amblema plicata'da* sinir sistemi enzimi AChE aktivitesi üzerindeki etkileri incelenmiştir ve 96 ssatin sonunda AChE düzeylerinde düşüşler olduğunu belirtmişlerdir. Kopecka-Pilarczyk, 2010, yapmış olduğu çalışmada *Mytilus trossulus da* bakır, kadmiyum ve carbaryli farklı sıcaklıklarda uygulayarak AChE aktivitesini incelemiş ve İki sıcaklık arasında AChE aktivitesinde önemli farklılıklar olduğunu belirtmiştir. Tsangaris ve ark., 2008 yapmış oldukları çalışmada *Mytilus galloprovincialis'* da Ni ve Cr maruziyeti sonucu oluşan AChE aktivite değişimleri gözlemlenmiş ve AChE inhibisyonu olduğunu belirtmişlerdir. Kopecka-Pilarczyk, 2009 yaptığı çalışmada pestisitlere (diklorvos, klorpirifos, fenitrothion, karbofuran ve karbaril) ve metallere (Cu, Zn, Cd, Hg, Pb) *Mytilus trossulus' un* çeşitli dokularında AChE aktivitesini incelemiş ve sonucunda bazı dokularda AChE' nin %50 oranında inhibe olduğunu belirtmiştir. Attig ve ark 2010 yapmış oldukları çalışmada Ni maruziyetine bıraktıkları *M. galloprovincialis de* AChE aktivitelerini incelemişler ve sonuç olarak AChE aktivitelerinde düşüşler olduğunu belirtmişlerdir.

Yapılan bu çalışma sonuçlarına göre Ce gibi NTE'lerin canlı organizma da birikmesi sonucu canlı bünyesinde gerçekleşen biyolojik aktiviteleri etkilediği belirlenmiştir ve Se gibi maddelerin kullanılması esnasında daha daha dikkatli ve bilinçli olması gerektiği vurgulanmaktadır. Su ortamına bu tür NTE atıklarının bırakılması engellenmelidir.

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SİLAJLARDA LAKTİK ASİT BAKTERİ İNOKULANT KULLANIMI

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ÖZET
Silaj kalitesi büyük ölçüde laktik asit bakterilerinin (LAB) fermantasyon sürecindeki etkinliğine bağlı olarak değişebilmektedir. Bu derlemede silolama öncesi LAB inokulant kullanımının fermantasyon, yem kalitesi ve hayvan performansı üzerine etkilerin belirlenmesi amaçlanmıştır. LAB silaj içerisinde oluşması istenmeyen mikroorganizmaları (klostridia, enterobakteriler, maya, küf ve listeria) engelleyerek, pH'ın hızlı bir şekilde düşmesini sağlayabilmektedir. LAB inokulantları silajların besin madde (karbonhidratlar, ham proteinler, uçucu serbest yağ asitleri ve mineraller gibi) ve kuru madde kaybını en aza indirirken, aynı zamanda aerobik stabiliteyi ve hayvan performansını arttırabilmektedir. Bununla birlikte, sera gazı emisyonlarına katkıda bulunan enterik metan (CH_4) üretimini de azaltabilmektedir. Bilimsel çalışmalar, silaj kalitesi ve fermantasyon yönünün büyük ölçüde LAB türüne, yoğunluğuna, bitki çeşidine, KM içeriğine, çevre etmenlerine bağlı olarak değişebileceğini göstermiştir.

Anahtar Kelime: LAB, silaj kalitesi, fermantasyon, inokulant

USAGE OF LACTIC ACID BACTERIA INOCULANT IN SILAGES

ABSTRACT

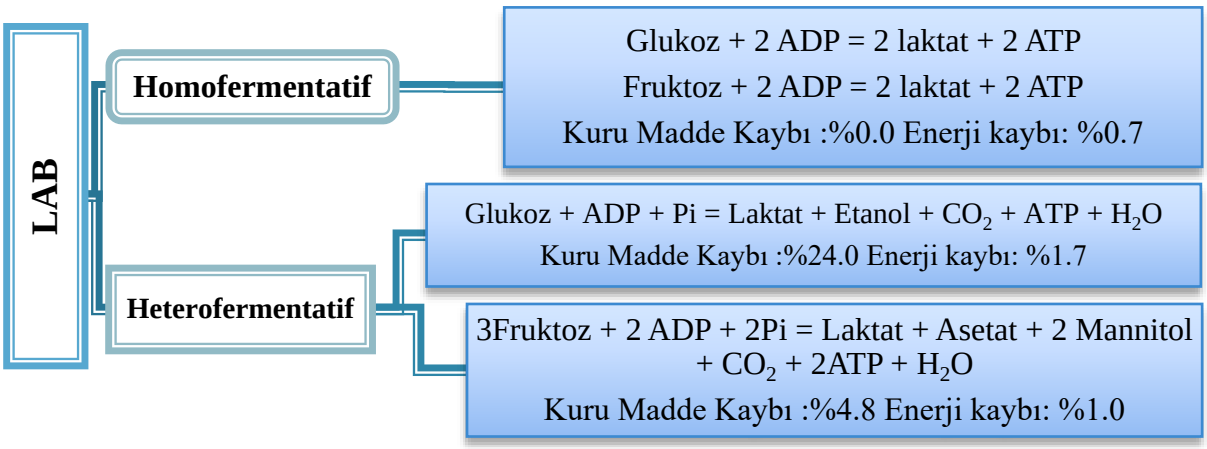
Fermentation and quality of silage can vary greatly depending on the activity of lactic acid bacteria (LAB) in the fermentation process. This review aims to determine the effects of the use of LAB inoculant before silage (fresh material) on fermentation, forage quality and animal performance. LAB, inhibits the formation of undesirable microorganisms (clostridia, enterobacteria, mold, yeast and listeria) in the silage and thus can rapidly decline the pH. LAB inoculants can minimize the loss of nutrients (such as carbohydrates, proteins, volatile fatty acids and minerals) and can improves dry matter recovery while also improving aerobic stability and animal performance. Additions, it can also reduce the production of enteric methane (CH_4), which contributes to greenhouse gas emissions. Scientific studies have shown that the quality of silage and the direction of fermentation can vary greatly depending on the type of LAB, density, plant type, DM content, environmental factors.

Keywords: LAB, silage quality, fermentation, inoculant

GİRİŞ

Yeşil ve su içeriği yüksek (%50'den fazla) bitkilerin anaerobik koşullarda laktik asit bakteri tarafından suda çözünen karbonhidratları (SÇK) fermente ederek laktik aside dönüştürmesine, diğer bir ifadeyle yemlerin ekşitilerek saklanmasına "silolama", buradan elde edilen yeme "silaj" veya "silo" denilmektedir. Silajın en önemi amacı ekonomik ve çevresel sürdürülebilirlik çerçevesinde, hayvanların ihtiyaç duyduğu kaliteli yemin yıl boyu erişebilirliğini sağlayabilmektir.

Silajlarda pH'ın düşürülmesi ve besin içeriklerinin uzun süre korunmasından laktik asit bakterileri (LAB) sorumludur, bu nedenle LAB silaj için kilit görevini görmektedir (Ávila ve ark., 2020). LAB bitki materyali üzerindeki epifitik florada bulunurlar. Yoncada 10^{1}-10^{5} (cfu/g taze materyal), çok yıllık çimde 10^{6} (cfu/g taze materyal), mısır ve sorgum bitkilerinde ise 10^{7} (cfu/g taze materyal) yoğunluğunda bulunabilir (Pahlow ve ark., 2003). Başarılı fermantasyon için LAB bitkilerde (inokulantlı, inokulantsız) en az 10^{5} (cfu/g taze materyal) yoğunluğunda bulunmalıdır (Kaiser et ark., 1997). Bitki üzerindeki LAB yoğunluğu, bitkinin çeşidine, kuru madde içeriğine, bitkinin gelişme dönemine, yapraklar üzerindeki besin maddesi varlığına, toprak özelliklerine, rakıma ve iklim şartları gibi birçok faktöre göre değişkenlik göstermektedir (Kızılşimşek ve ark., 2016).



Şekil 1. LAB grupları ve biyokimyasal özellikleri (McDonald, 1981)

Laktik asit bakterileri anaerobik koşullar altında fruktoz, galaktoz, glikoz, laktoz, maltoz ve mannitol gibi çok çeşitli karbonhidratları laktik aside dönüştürmek için kullanabilirler. Karbonhidratları kullanım şekilleri göre laktik asit bakterileri homofermantatif ve heterofermantatif olarak ikiye ayrılmaktadır. Zorunlu homofermantatif bitkiler glikoz ve hegzosları fermente etmelerine karşın pentosları fermente edemezler ve yaklaşık %85'den fazla

laktik asit üretirler. Zorunlu heterofermantatifler hem hegzozları hem de pentozları fermente edebilmelerine karşın, fermente sonucu laktik asit, asetik asit, etanol ve CO_2 üretirler. Seçici heterofermantatifler ise hegzozlardan laktik asit üretebildikleri gibi bazı pentozları da laktik asit, asetik asit ve etanole fermente edebilirler (Drihehuis ve Oude Elferink, 2000). Silaj üretimi için genellikle *Lactobacillus, Pediococcus, Enterococcus, Lactococcus, Weissella* ve *Bacillus* türleri kullanılmaktadır (Ellis ve ark., 2016).

Son zamanlarda silajların kalitesini arttırmak için mikrobiyal aşıyıcılar birçok araştırmanın odak noktası olmuştur (Carvalho ve ark., 2021). Bu nedenle, mikrobiyal inokulantların silajlar üzerindeki etkisi değerlendiren çalışmaların sayısı da gün geçtikçe artmıştır. Bu derlemede kısa başlıklar altında silaja katkı maddesi olarak kullanılan laktik asit bakterilerin etkisi incelenmiştir.

Silaj Kalitesi Üzerine Etkileri

Baklagil bitkileri yüksek tampon kapasitesi ve düşük suda çözünür karbonhidrat (SÇK) içeriği nedeniyle, zor silolanan bitkiler grubuna dahil edilmektedir (Jaurena ve Pichard, 2001). Silolamanın temel amaçlarından biri pH'ın hızla düşüşünü sağlamaktadır. Bu konuyla ilgili birçok ülkede çeşitli çalışmalar yapılmıştır. Zao ve ark (2021), düşük KM içerikli yonca silajına ticari laktik asit bakterisi inokulantının kontrole kıyasla yüksek bir laktik asit üretimi sağlayarak düşük pH değerinin elde edilmesini sağladığını bildirmişlerdir. Günaydın ve ark. (2023), yonca silajlarına 6 farklı LAB inokulantları denemişler, sonuç olarak LAB inokulantlarının kontrol silajlarına kıyasla fermantasyon kalitesini iyileştirdiğini, *L. gasseri* inokulantı uygulanmış silajlarda KM kaybının en az olduğunu bildirmişlerdir. Oliveria ve ark. (2017), yonca, mısır, sorgum ve diğer baklagil yem bitkilerine *L. plantarum, P. pentosaceus, E. faecium, L. rhamnosus* uyguladıkları çalışmalarında, LAB türlerinden bağımsız olarak ılıman ve tropik otlar ile yonca ve diğer baklagillerde silaj fermantasyonunu önemli ölçüde iyileştirdiğini ve KM kaybının azaldığını, fakat mısır, sorgum ve şeker kamışı silajlarının fermantasyonun ise iyileşmediğini bildirmişlerdir. Kleinschmit ve Kung (2006), meta-analiz çalışmasında, mısır bitkisine heterofermantatif *L. buncheri*'yi 10^5 (cfu/g taze materyal)'den daha yoğun aşılamada, KM kazanımında %1 oranında etkili olduğunu bildirmişlerdir. Dolayısıyla, LAB etkinliğinin tür ve doza bağlı olarak değişebileceği söylenebilir. Bir başka çalışmada, LAB inokulantlarının fermantasyonun son ürünlerine etkisinin önemli olduğu, kontrole kıyasla ^{homo}LAB ile aşılanmış kuşkonmaz silajlarında asetik asit, propiyonik asit içeriklerinin düştüğünü, laktik asit içeriklerinin ise arttırdığı bildirilmiştir (Akbay ve ark., 2023).

Tabacco ve ark. (2011), LAB inokulantlarının NDF, ADF ve ADL içeriklerini etkilemediğini bildirmişlerdir. Filya ve ark (2007), farklı biçim dönemlerinde yonca bitkisine 14 farklı özelliğe sahip mikrobiyal aşıyıcıların etkisini incelemişler, birinci biçimde en düşük ADF ve NDF içeriğinin *E. faecium* C inokulantında, en yüksek ADF ve NDF değerinin Biomax5 ve *L. plantarum* MTD1 inokulantından elde edildiğini bildirmişlerdir. İkinci biçimde ise kontrole kıyasla tüm inokulant uygulamalarında daha düşük ADL içeriğinin elde edildiğini bildirmişlerdir. Araştırmacılar, laktik asit bakteri uygulan yemlerin 48 saatlik inkübasyonu sonucu *in vitro* gerçek kuru madde sindirilebilirliğinin iyileşmediğini bildirmişlerdir. Weinberg ve ark., (2007), *L. plantarum* MTD-1 ve *L. buchneri* 40788 aşılanmış mısır silajının 24 saatlik *in vitro* inkübasyonu sonucu NDF sindirilebilirliğinin arttığını bildirirken, Hu ve ark. (2009) tarafından *L. buchneri*, *L. plantarum* veya ikili kombinasyonlarının mısır silajlarının NDF sindirilebilirliği etkilemediğini bildirilmiştir.

LAB aşılama ile protein bozulmasının engellediği, fakat bu durumun LAB türüne göre değişebileceği söylenebilir. Nitekim, silolama öncesi yonca bitkisine *L. brevis* (LS-55-2-2), *L. citerum* (LS-70-6-1), *L. bifermentans* (LS-65-2-1), *L. plantarum* (LS-3-3) ve *L. plantarum* (LS-72-2) inokulantları uygulanmış, protein değerleri arasında önemli farklılıklar bulunmuş ve *L. plantarum* (LS-72-2) inokulantından en yüksek ham protein değeri elde edilmiştir (Ertekin ve Kızılşimşek, 2020). Hu ve ark. (2009), mısır silajlarında *L. buchneri* ilavesinin NH_3-N konsantrasyonunu arttırırken, *L. plantarum* ilavesi azalttığını bildirmişlerdir. Kung ve ark. (1990), yonca'nın tüm biçim dönemlerinde LAB aşılaması ile silajların NH_3-N miktarının azaldığını bildirmişlerdir. Filya (2003), *L. buchneri* ile *L. plantarum* kombinasyon halinde uygulanan mısır ve sorgum silajlarında protein bozulmasının daha düşük oranlarda gerçekleştiğini bildirmişlerdir. Sun ve ark. (2021), *L. plantarum* CGMCC No.13318, *L. buchneri* CGMCC No.16534 ve melasın karışımı ile aşılanmış *Cyperus esculentus* L. silajlarının besin içeriklerinin arttığını rapor etmişlerdir.

Aerobik Stabilite Üzerine Etkisi

Aerobik stabilite, açılan bir silaj yüzeyinin yoğun O_2 ile teması sonrası, bozulmadan kaldığı süre olarak tanımlanmaktadır ve silaj kalitesini etkileyen önemli faktörler arasında yer almaktadır (Ashbell ve ark., 1991). Mısır yüksek KM içeriği ve ŞÇK içeriği, düşük tamponlanma kapasitesi ile kolayca fermente edilebilir (Nussio ve ark., 2001). Bu nedenle dünyada en fazla silajı yapılan bitkiler arasında yer alır. Fakat aerobik dayanımı zor silolanan baklagil bitkisi yoncaya kıyasla oldukça düşüktür. Dünyada ve Türkiye'de oldukça geniş ekim alanına sahip mısırın aerobik dayanımınım arttırılması büyük önem taşımaktadır. Her ne kadar

aerobik bozulma kaçınılmaz olsa da bozulmadan kaynaklı etmenler minimize edilerek aerobik stabilite arttırabilir.

LAB inokulantları antimikrobiyal, antifungal ve probiyotik özellikleri ile mikrobiyal kontaminasyonu engelleyebilir, aerobik bozulmayı azaltabilirler ve iyi bir fermantasyonun sürekliliği konusunda da etkin bir rol oynayabilirler (Muck, 2010). Fakat, LAB inokulantların aerobik stabilite üzerine etkisinde çelişkili sonuçların elde edilmiştir. Bir çalışmada, süt olum döneminde hasat edilen mısır bitkisine inokulant-1188 ve Maize-All aşıyıcıları 1.5 x 10^6 cfu/g düzeyinde kullanılmış ve inokulant-1188 yüksek bir CO_2 üretimine yol açarak silajların aerobik stabilitesini düşürdüğünü, buna karşılık Maize-All aşıyıcısının ise silajların aerobik stabilitesini etkilemediği belirlenmiştir (Sucu ve Filya, 2006). Benzer şekilde, homofermatatif özellik gösteren inokulant-1174 ile süt olum dönemindeki ayçiçeği bitkisi aşılanmış ve aerobik stabilitenin etkilenmediği belirlenmiştir (Koç ve ark., 2009).

Homofermantatif LAB laktik asit düzeyini arttırma, asetik asit, bütirik asidi ise azaltma eğilimdedirler. Ancak, fermantasyon son ürünü asetik asit maya ve küflerin oluşmasını engellediğini için aerobik dayanımı arttırmaktadır (McDonald ve ark., 1991). Heterofermentatif LAB silaj fermantasyon döneminden sonra laktik asidi yavaşça asetik aside dönüştürerek pH'ı yükseltir ve silajın aerobik stabilitesini iyileştirir (Muck, 2018). İlk olarak 1995 yılında heterofermantatif bakterilerden *L. buchneri*'nin maya ve küf üremesini engellediği bildirilmiş, 1996 yılında ise silajlarda kullanılması önerilmiştir (Muck,1996). Muck (2002), aerobik stabiliteyi iyileştirmede en iyi performansın heterofermantatif özellik taşıyan *L. buchneri*'nden elde edildiği bildirmiştir. Benzer şekilde, Kleinschmit ve ark. (2006), standart hata bildiren 23 kaynaktaki 43 deneyden elde edilen silajlara *L. buchneri* eklemişler, yapılan meta-analiz sonucunda *L. bucheri*'nin aerobik stabiliteyi arttırdığını rapor etmişlerdir. Son zamanlarda ^{homo}LAB fermantasyon özelliklerini arttırıcı ve ^{heto}LAB aerobik stabiliteyi arttırıcı özelliklerinden dolayı iki yönlü (kombinasyon) halinde kullanılmaya başlanmıştır. Örneğin; Zhang ve ark. (2023), *Lactobacillus plantarum, Lactobacillus buchneri* ve *Lactobacillus plantarum* ile *Lactobacillus buchneri*'nin kombinasyon halinde uygulamışlardır. Heterofermantatif özellik taşıyan *Lactobacillus bunhneri*'nin diğer inokulantlara göre aerobik stabiliteyi iyileştirmede daha başarılı olduğunu belirlemişlerdir.

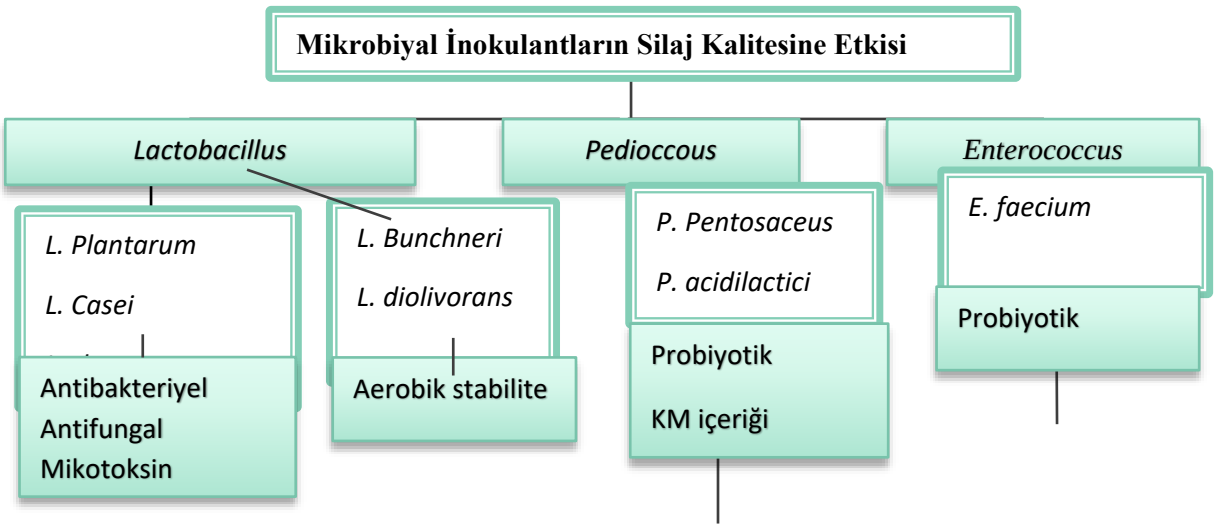
Hayvan Performansı Ve Enterik Metan Üretimine Etkileri

Ruminant hayvanlar üzerinde yapılan deneyler bu bakterilerin sadece silaj kalitesini değil aynı zamanda hayvan verimini de etkileyebileceğini göstermiştir. Örneğin, Nkosi ve ark. (2009), düşük kuru madde içerikli mısır bitkisine ^{heto}LAB *(Bonsilage mais flussig* ve *Lalsil*

Fresh Lactobacillus buchneri) uygulanmış silajlarla beslenen kuzuların performansının iyileştiğini bildirmişlerdir. Fakat, LAB ile aşılanmış silajların hayvan performansını nasıl artırdığının sebebi tam olarak açıklanamamaktadır. Bazı araştırmacılar bunun nedenini rumende oluşan mikrobiyal değişiklikle ilişkilendirmişlerdir. Rumen pH'ı 5.5-7.0 arasında değişmektedir (Murphy ve ark., 1987) ve yem katkı maddeleri rumen mikroorganizmalarının sayılarını, oranlarını ve sindirim aktivitelerini etkileyebilmektedir. Özellikle, ruminal laktik asit düzeyini artıran rasyonlarda, ruminal pH ile laktik asit düzeyi arasında yüksek derecede bir ilişki görülmektedir (Özel ve Sarıçiçek, 2009). İnokulantlı silajlarda LAB türüne bağlı olarak laktik asit üretiminin arttığı, artan laktik asitlerin ruminant beslenmesini de etkileyebileceği düşünebilir. Bazı araştırmacılar, LAB canlılığını koruyarak, rumen sıvısına geçtiğini ve rumen pH'ını artırarak rumen sıvısının düzenlendiğini bildirmişlerdir (Weinberg ve ark. 2004). Bununla birlikte, Gollop ve ark. (2005), LAB rumende zararlı mikroorganizmaları inhibe edebilen bakteriyosin benzeri antibakteriyel aktivite sergilediğini rapor etmişlerdir. Weinberg ve ark. (2007) ise, 10 farklı LAB aşıyıcılar ile yapılan buğday silajlarının, rasyona katılmasının sindirilebilirlik üzerinde olumlu etkileri olduğunu ve yüksek verimli süt ineklerini beslemek için daha fazla kullanılabileceğini bildirmişlerdir. Oliveria ve ark. (2017), LAB aşılaması ile silaj protein içeriklerinin korunduğunu (yani azaltılmış NH_3-N) ve kuru madde alınımından bağımsız olarak ruminal mikrobiyal protein sentezinin arttırabileceğini ve böylece süt veriminde artış sağlanılabileceğini belirlemişlerdir. Nitekim, bilimsel çalışmalarda LAB ile aşılanmış silajlarda %47 oranında süt veriminin (Kung ve Muck, 1997) ve sütteki yağ, protein oranının da arttığını (Oliveira ve ark., 2016) göstermiştir. Buna karşılık Arriola ve ark. (2021), 158 çalışmanın meta-analiz sonucunda inokulantlı silajla beslenen sığırların süt verimi, kuru madde alımı ve yemden yararlanma düzeylerinin etkilenmediği belirlemişlerdir. İlerleyen çalışmalarda ise silolama sırasında LAB kullanımının *in vitro* rumen sindirilebilirliğini iyileştirdiği görülmüştür (Xie ve ark., 2023).

Metan (CH_4) gazının barındırdığı enerjiden ruminant hayvanlar faydalanamaz ve burun veya ağız yoluyla atmosfere atılır (Jafari ve ark., 2019). CH_4 emisyonun %65'ini geviş getiren hayvanlar oluşturmaktadır. Yemlerle alınan enerjinin hayvan tarafından kullanılmayıp havaya salınması hem ekonomik kayba hem de küresel ısınmaya neden olarak büyük bir problem oluşturmaktadır. Avrupa Komisyon (2019)'u gelişmiş ülkelerin 2050 yılına kadar metan (CH_4) emisyonunu %80 oranında azaltılması gerektiği bildirmiştir. CH_4 gazının azaltılması, yem (yeşil ot, silaj veya saman) kalitesinin ve sindirilebilirliğinin iyileştirilmesiyle sağlanabilmektedir. Birçok bilimsel çalışma LAB inokulant kullanımı ile hayvanlarda CH_4

emisyonunu azaltabileceğini ortaya koymuştur (Cao ve ark., 2011; Elis ve ark., 2016; Kaewpila ve ark., 2021).



Şekil 2. Mikrobiyal İnokulantların Silaj Kalitesine etkisi (Soundharrajan ve ark., 2021)

Soundharrajan ve ark. (2021) tarafından da mikrobiyal inokulantların silaj kalitesine etkisi Şekil 2'de tanımlanmıştır. Mikrobiyal inokulantların silaj kalitesindeki etki ve etki düzeylerinin farklı olduğu, özellikle bu etkilerin mikrobiyal inokulantların türüne, hatta aynı türün farklı suşlarına göre değişebileceği bilimsel çalışmalarla da açıklanmıştır. Sonuç olarak LAB inokulatları silaj kalitesi ve çiftlik hayvanların performansı üzerinde olumlu etkileri bulunmaktadır.

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ÇAD'IN TARIM VE SU KAYNAKLARI POTANSİYELİ: DURUM DEĞERLENDİRMESİ

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ÖZET

Bu çalışmada, Çad Cumhuriyeti'nin toprak ve su kaynakları potansiyeli ve tarımsal üretimi değerlendirilmiştir. Bu bağlamda Çad; genel özellikleri, arazi varlığı ve mevcut kullanım durumu, su kaynakları potansiyeli, tarım arazi varlığı, bitkisel ve hayvansal üretimi yönünden analiz edilmiştir. Bu çalışmanın veri kaynaklarını Çad hakkında yayınlanmış makale ve raporlar ile ülkesel bazlı veri paylaşımına açık uluslararası organizasyonlar oluşturmuştur. Elde edilen bulgulara göre; yüzölçümü bakımından Afrika'nın 5 büyük ülkesi olan Çad, 128.4 milyon hektar yüzölçümüne sahip olup, yarıdan fazlası çölden oluşmaktadır. Çad, kuzeyden güneye 100 mm ile 1000 mm arasında değişen yağışlardan etkilenen farklı iklim ve tarım koşulları ile karakterize edilen üç agro-ekolojik bölgeye ayrılmıştır. Belirli doğal ve üretken potansiyellere sahip bu agro-ekolojik bölgeler, Güneyden Kuzeye, Sudan bölgesi, Sahel bölgesi ve Sahra bölgesidir. Sudan bölgesi, ulusal toprakların yaklaşık %10'unu kaplar ve yıllık yağış miktarı 500 ile 1000 mm arasında değişmektedir. Sahel bölgesi ülke topraklarının yaklaşık %43'ünü kaplar ve bu bölgenin yağışı 100 ile 500 mm arasındadır. Sahra bölgesi, Çad yüzölçümünün %47'sini kaplamakta ve bu alan, yıllık ortalama 100 mm'den az yağış almaktadır. Ülkede, fiilen tarımsal üretim yapılabilecek 5.2 milyon hektar civarında arazi mevcuttur ve yaygın olarak tarla tarımı yapılmaktadır. Sorgum, darı, yerfıstığı, diğer tahıllar, susam, pamuk, mısır, çeltik ve kuru fasulye en çok ekilen bitkilerdir. Çad hayvancılık bakımından zengin bir ülke olup, yaklaşık olarak 134.4 milyon hayvanı bulunmaktadır. Bunun yaklaşık 33 milyonu sığır, 85 milyonu ise koyun ve keçiden oluşmaktadır. Ülke, 11.5 milyar m^3 yeraltı ve 44.2 milyar m^3 yerüstü olmak üzere toplam 55.7 milyar m^3 yenilenebilir su potansiyeline sahiptir. Kısaca ifade etmek gerekirse, Çad tarıma uygun arazi varlığı ve hayvan varlığı bakımından zengin, su kaynakları potansiyeli kısıtlı olan bir ülkedir.

Anahtar Kelimeler: Çad, İklimi, Arazi varlığı, Tarımsal üretim, Su kaynakları potansiyeli

CHAD'S AGRICULTURE AND WATER RESOURCES POTENTIAL: THE CASE STUDY

ABSTRACT

In this study, Chad Republic were evaluated in terms of soil and water resources potential and agricultural production. In this regard Chad were analyzed in terms of general characteristics, land existence and current use, water resources potential, agricultural land existence, crop and animal production data. The data sources of this study were the international organizations open to country-based data sharing with articles and reports published about Chad. According to the findings; Chad, which is the 5th largest country in Africa in terms of surface area, has an area of 128.4 million hectares and more than half of it is desert. Chad is divided into three agro-ecological regions characterized by different climatic and agricultural conditions affected by precipitation ranging from 100 mm to 1000 mm from north to south. These agro-ecological regions with certain natural and productive potentials are South to North, Sudan region, Sahel region and Sahara region. The Sudanese region occupies about 10% of the national territory and the annual precipitation varies between 500 and 1000 mm. The Sahel region covers approximately 43% of the country's territory and the precipitation in this region is between 100 and 500 mm. The Sahara region covers 47% of Chad's land area and receives an average of less than 100 mm of precipitation annually. In Chad, there is about 5.2 million hectares of land that can actually be used for agricultural production in today conditions, and field crops farming is widespread. Sorghum, barley, peanuts, other cereals, sesame, cotton, maize, paddy and dry beans are the most produced field crops. Chad is a rich country in terms of livestock and has approximately 134.4 million animals. Those approximately 33 million are cattle, and 85 million are sheep and goats. The country has a total renewable water potential of 55.7 billion m^3, of which 11.5 billion m^3 is groundwater and 44.2 billion m^3 is above ground. Briefly, Chad is a countryrich in agricultural land and livestock, with limited water resources potential.

Keywords: ÇAD, Climate conditions, Land existence and use, Agricultural production, Water resources potential

ÇAD CUMHURİYETİ

Genel Bilgiler

Çad, Afrika'nın ortasında 7 ve 24 derece kuzey enlemleri ile 13 ve 24 derece doğu boylamları arasında yer almaktadır. 1284000 km2'lik bir yüzölçümüne sahip olup, 1700 km kuzeyden güneye ve 1000 km doğudan batıya uzanan bir ülkedir (Anonymous, 2013; Anonymous, 2020). Başkenti Encemine'dir. Yüzölçümü bakımından Afrika'nın en büyük ülkeleri arasındadır. Kongo demokratik cumhuriyeti, Cezayir, Libya ve Sudan'dan sonra Afrika kıtasının beşinci büyük ülkesidir. Kuzeyde Libya, doğuda Sudan, güneyde Orta Afrika Cumhuriyeti ve batıda Kamerun, Nijerya ve Nijer ile ortak sınırlara sahiptir (Şekil 1). Çad, herhangi bir deniz kıyısına sınırdaş olmayan bir ülkedir. Çad'a en yakın liman Komşusu Nijerya'da (Port Harcourt) bulunmakta olup, Çad'ın başkenti olan Encemine'ye 1700 km uzaklıktadır (Gauquelin, 2008). Çad, Afrika'nın sahel kuşağı bölgesi olarak adlandırılan ülkelerden biridir (Şekil 2). Sahel, kuzeyde Sahra Çölü ile güneyde tropikal savanlar arasında Afrika kıtası boyunca uzanan yarı kurak bir otlak ve fundalık geçiş bölgesidir (Hermann, 2005). Sahil kabaca 200 mm (kuzey) ile 600 mm (güney) yıllık yağış çizgileri arasında kalan Afrika topraklarıdır. Yaklaşık 3 milyon km^2'lik bir alana yayılan Sahel Kuşağı; Senegal, Moritanya, Mali, Burkina Faso, Nijer, Nijerya, Çad, Sudan, Eritre, Kamerun, Gambiya, Gine'yi kapsamaktadır (UNEP, 2012; Savaş, 2020). Birbiriyle iç içe geçmiş Sahel bölgesi ve Sahra çölü, enerji kaynakları bakımından oldukça zengin bir alandır. Bölgede petrol, uranyum, elmas, manganez ve kobalt gibi doğal kaynaklar yer almaktadır (Savaş, 2020).



Şekil 1. Çad'ın Afrika'daki yeri

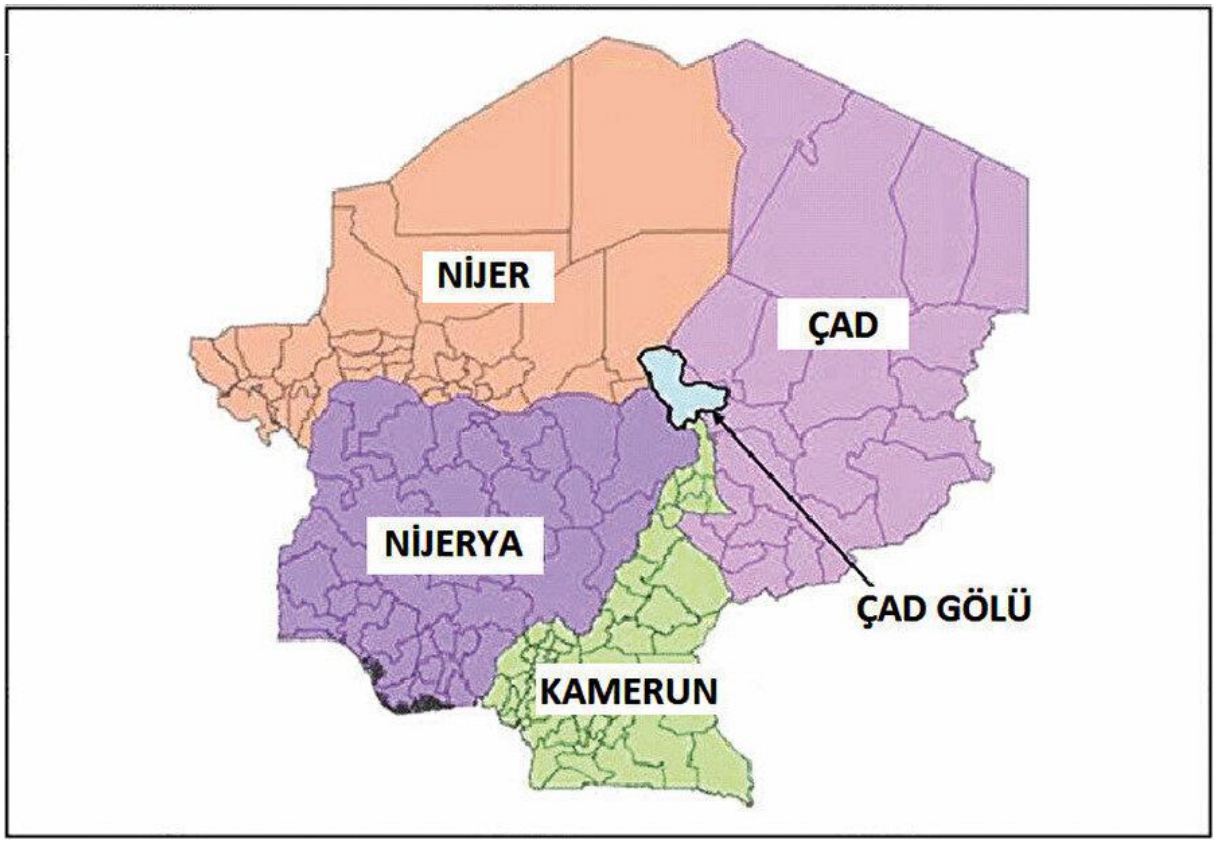


Şekil 2. Afrika kıtası Sahel kuşağı bölgesi

Kuzey Çad, Sahra Çölü'nün bir parçasıdır. Yani ülkenin büyük kısmı Sahra Çölü'nün kuzeydeki yükseltilerinin güneye doğru uzantısıdır. Kuzeybatıdaki Tibesti dağları, Büyük Sahra Çölü'nün en yüksek bölgesini oluşturur ve Çad sınırları içinde yer alır. Ülkenin kuzeydoğusunda Ennedi Platosunun kumtaşı tepeleri, doğusunda Ouaddai dağlık bölgesi, güneyinde ise Oubangui Platosu yer alır. Çad'ın genel bitki örtüsü coğrafi olarak bulunduğu iklim kuşağına göre değişmektedir. Ülkede Sahra (Kuzey), Sahel (Orta) ve Sudan (Güney, subtropikal) olarak adlandırılan üç iklim kuşağı bulunmaktadır. Ülkenin güneyi ormanlıktır ve bol yağış alır, otlaklar ve tarıma elverişli alanlar bu bölümde bulunur. Ülkenin orta kuşağında savana, çap ve bozkır bitkileri bulunmaktadır. Ülkenin kuzey bölümü bitki yetişmesine elverişli olmayan çöller ve dağlardan ibarettir. Ancak bu bölümde yer alan vahalarda hurma yetiştirilmektedir (Kavas, 2017; Mahamat ve ark, 2020).

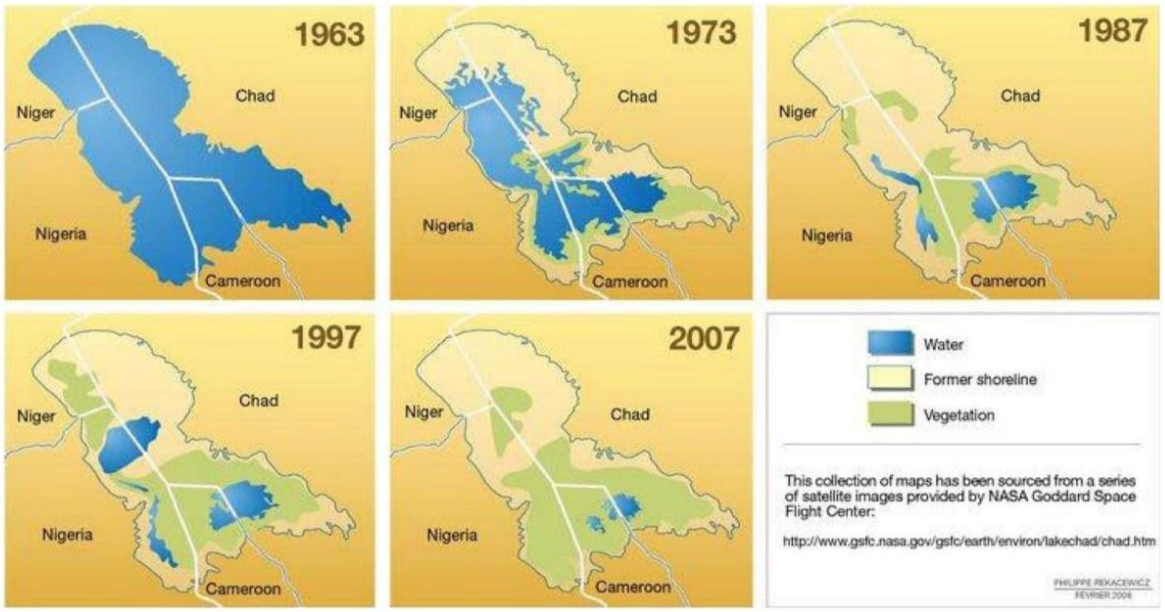
Ülkeye adını veren Çad Gölü, bir zamanlar Afrika' nın ikinci büyük gölü iken son elli yılda normal büyüklüğünün %90'ını kaybederek, daha doğrusu bu kısımlardan göl çekilerek %10'luk kısmı mevcudiyetini sürdürmektedir. Çad Gölünün havzası dağlarla çevrilidir. Çevresindeki bölgenin yaşam kaynağı olan Çad Gölü, Sahraaltı Afrika'da, Sahel-Sahra kuşağında; Çad, Nijer, Nijerya ve Kamerun'un ortasında yer almaktadır. Bu ülkelerin oluşturduğu havzaya Çad Gölü havzası denilmektedir (Şekil 3). Çad Gölü, bu havza ülkeleri açısından hayati öneme sahiptir. Çad Havzası'nın en büyük gölüdür. Göl aslında Çad'ın en batısında, Nijerya'nın kuzeydoğusundadır. Şari Irmağı, Nijer ve Nijerya'dan gelen Yobe Irmağı'nın taşıdığı az

miktarda su ile beraber gölün %90'lık su kaynağını oluşturur (https://www.goller.gen.tr/cad-golu.html).



Şekil 3. Çad Gölü havzası ülkeleri

Çad Gölü, uzun süreli kuraklık ve sıcaklığa bağlı olarak küçülmekte ve çölleşmektedir (Şekil 4). Çad Gölü 1963'te yaklaşık 25 000 km^2'lik bir alana sahipti, ancak 1973'teki kuraklığın ardından Temmuz ayında alanı sadece 9 000 km^2 ve sularının hacmi yaklaşık 30 milyar m^3'tür. Su seviyesindeki bu düşüş, 1975 ve 1976'da kuzey havzasının kurumasına neden olmuştur. 1983 ve 1984 yılları arasında gölün seviyesi 1570 km^2'ye düşmüştür. Daha sonra, kurak dönemlerden sonra su seviyesinde bir artış olmuştur. Ancak 90'lardan bu yana gölün seviyesi her yıl değişmekte ve 1500 ile 2000 km^2 arasında değişmektedir (Magrin ve ark., 2015).



Şekil 4. Çad Gölünde yaşanan değişim (1963-2007)

Çad, idari olarak 23 yönetim bölgesine ayrılmış olup, 53 ilden oluşmaktadır. Ülkenin bölgeleri Şekil 5'de verildiği gibidir



Şekil 5. Çad'ın idari 23 yönetim bölgesi

Çad yerel yönetimler sisteminde, bölgesel yönetim en üst seviyededir. Bölge, devletin ekonomik ve sosyal eyleminin tasarım ve bölgesel planlama düzeyini oluşturur. Bölgesel konsey, hizmetlerin koordinasyonunu, denetimini ve bölgesel görevlerin yerine getirilmesini sağlamaktadır. Bölge; aynı ekonomik, sosyal ve kültürel alanı oluşturan birkaç ilden ve uygun bir mekânsal planlama çerçevesinden oluşmaktadır. Bölge, tüzel kişiliği ve finansal özerkliği olan bölgesel bir kamu otoritesidir (Mahamat ve ark, 2020).

İklim

Ülkenin kuzeyi çöl ve güneyi ise savan iklimine sahip olması dolayısıyla birbirinden farklı ildim özellikleri görülmektedir. Çad, sıcak, ılıman ve tropikal iklimin birlikte yaşandığı bir ülkedir. Kuzeyinden güneyine kadar Afrika'nın ortasında adeta bir koridor gibi uzanan ve çöl ikliminden tropikal iklimine geçişin çok rahatlıkla takip edilebildiği değişken bir coğrafyaya sahiptir. Çöl iklimi, ülkenin yarıdan fazlasını kaplamaktadır. Oldukça yüksek ağaçlarla başlayan güneydeki ormanlar başkent Encemine'ye yaklaşırken tamamen yok olmaktadır. Ancak bu şehrin çevresi ve Çad Gölü' ne doğru uzanan bölgeleri de özellikle Arap zamkı ağaçlarıyla kaplıdır (Kavas, 2017).

Ülkedeki yağış dağılımı ve bitki örtüsü, bölgeyi üç ana biyoklimatik bölgeye ayırmayı mümkün kılar (Şekil 6). Ülkenin Kuzeyinde 16^0-23^0 Kuzey paralelleri ile 15^0- 24^0 Doğu meridyeni arası Sahra bölgesinden oluşmaktadır. Sahra bölgesi 600350 km²'lik alanı ile ülke topraklarının %48'ini kaplar. Sahra bölgesinin güneyi 200 mm yağış çizgisi ile sınırlı olup, çok düşük yağış ile karakterize edilir. Neredeyse kalıcı bir kuraklık ile karakterizedir ve bu bölgede yağmurlar nadirdir. Ülkenin sahra bölgesinde tarım ve hayvancılık faaliyetleri sadece vahalar etrafında yapılabilir durumdadır. Ülkede 11-16 derece Kuzey paralelleri arasındaki Sahel kuşağı 490570 km²'lik (ülkenin dörtte biri) bir alanı kaplar ve 200 ile 800 mm yağış çizgileri arasında yer alır. Yağışlı mevsimden daha uzun bir kurak mevsim ile karakterizedir. Güneyden kuzeye gidildikçe yağış miktarı azalır. Buradaki ana faaliyet ağırlıklı olarak hayvancılıktır. Çad'ın Güneyinde 8 - 12 derece Kuzey paralelleri arasında yer alan Sudan bölgesi, ülkenin dörtte birini kaplar ve 800 mm ile 1200 mm yağış çizgileri arasındaki alandan oluşmaktadır. Burası ülkenin en yağışlı bölgesidir. Yılda 800 mm'yi aşan bol yağış ile karakterizedir. Yağışlı mevsimin uzunluğu kabaca kurak mevsimin uzunluğuna eşittir ve yaklaşık altı aydır. Tarımsal faaliyetler için elverişli bir iklimdir (Anonymous, 2016.

Güney bölgesinde tropik iklim hakim olup, mayıs-ekim arasında bol miktarda yağış düşmektedir. Orta kesimde özellikle kuzeyinde kurak ve yarı kurak bir iklim hakimdir. Sahra bölgesinde ise az yağışlı sıcak bir iklim hüküm sürer.

Sahel iklimi, uzun bir kurak mevsim ve kısa bir nemli mevsim ile karakterizedir (Nicholson, 1995). Sahel ekosistemi, büyük ölçüde değişken ve öngörülemeyen yağışla kontrol edilmektedir. Yıllık ortalama yağış miktarı kuzeyde 200 mm ile güneyde 600 mm arasında değişmektedir (Visser ve Sterk, 2007). Yağışlı mevsim yoğundur ve uzun süreli kurak dönemlerle birlikte yaklaşık 4 ay sürer (Giannini ve ark., 2008).

Güneyinde tropik iklim görülmekte ve yağışın etkisi tüm Çad'da hissedilmektedir. Mayıs ve Ekim ayları döneminde, ülke topraklarına 800- 1200 mm arası yağış düşmektedir. Ayrıca tropik iklim sonucunda çeşitli tropik meyveler yetişmektedir. Ülkenin orta kesimlerinde ise, yarı kurak bir iklim görülmektedir ve yılda 200-800 mm arası yağış düşmektedir. Kuzeyde ise, çölden kaynaklanan sıcak iklim görülür ve yağış miktarı görece azdır. Ülkenin sıcaklık ortalaması, 12°C-50°C arasında değişmektedir (Mahamat ve ark, 2020).



Şekil 6. Çad'ın iklim bölgeleri

Nüfus

Dünya Bankası verilerine göre Çad'ın nüfusu, 2020 yılı itibariyle yaklaşık 16 425 860 olup çok sayıda kabile ve etnik gruptan oluşmaktadır (Tavuk, 2021). Topraklarının genişliğine rağmen Çad'ın nüfusu azdır ve kilometrekareye ortalama 8 kişi düşmektedir. Ülke nüfusun % 47.4'ü 0-14 yaş grubunda, %17.8'i 15-24 yaş grubunda, %27.1'i 25-54 yaş ve %5.7'si ise 55 ve üstü yaşta bulunmaktadır. Bu verilerden de görülebileceği gibi nüfusun yarıya yakını 15 yaş altından oluşmakta, yine toplam nüfusun %65'i 25 yaş altı nüfustan oluşmaktadır. Kısaca ifade etmek gerekirse ise ülke genç bir nüfus yapısına sahiptir. 2018 yılında yayınlanan Dünya Sağlık Örgütü (DSÖ) verilerine göre, Çad'da ortalama ömür 54.3 yıldır. Yıllık ortalama nüfus artış hızının yüksek olması (%2.1) Çad'ın nüfusunu genç tutmaktadır (Tavuk, 2021).

Ortalama hane büyüklüğü tahmini 5.3'tür. Ülkenin nüfusu %75 Müslüman, %20 Hristiyan ve diğer insanlardan oluşmaktadır (INSEED, 2009). Ticaret Bakanlığı (2022) tarafından hazırlanmış olan "Çad Ülke Profili" adlı raporda 2022 yılı ekim ayı itibari ile Çad'ın nüfusu 17 414 000 olarak bildirilmektedir. Çad'ın nüfus dağılıma bakıldığında ise; nüfusun %76.9'u kırsal ve %23.1'i ise kentsel nüfustur (AQUASTAT, 2023;Bouyebri, 2022). Bu veriler, Çad nüfusunun çok büyük bir bölümünün kırsalda yaşadığını ve tarımla uğraştığını göstermektedir. Çad'da çalışma yaşındaki nüfusun 6 milyon kişi olduğu tahmin edilmektedir. Bunların 1.276.000'i istihdam edilmektedir. İstihdamda birincil sektörler olan (tarım, balıkçılık ve hayvancılık) faaliyetlerinde çalışanlar geçmişte iş gücünün %95'ini temsil ederken, 2016 yılına geldiğinde şehir merkezine yapılan kırsal göç nedeniyle bu oran %72'ye gerilemiştir. İkincil sektörler görece yoğun olmayan ve çeşitlendirilmemiş tarım şirketleri (bira, sigara, şeker) ve pamuk işleme tesislerinden (pamuk lifi, yağ değirmeni, sabun) oluşmaktadır. Üçüncül sektörler ise iş gücünün yaklaşık dörtte birini temsil eden ticaret, lojistik ve el sanatları olmakla birlikte, bu sektörler tarafından yaratılan katma değerdir (CNUCED, 2016).

Ekonomisi

Çad dünyanın en fakir ülkelerinden biridir. Petrol, madencilik ve tarım ekonominin önemli sektörlerdir. Tarım ve hayvancılık faaliyeti genelde halkın kendi ihtiyacını karşılayacak kadardır. Çad ekonomisi petrole dayalıdır. Çad 2003 yılında petrol üreticisi haline gelmiş ve aynı yılda da petrol ihraç etmeye başlamıştır. Çad'ın yaklaşık olarak 1.5 milyar varil civarında bir petrol rezervinin olduğu tespit edilmiştir. Ülkenin petrol rezervi, diğer üretici ülkelerinkine göre çok düşüktür. 2015 yılı verilerine göre günlük petrol üretimi 120 bin varil, günlük ihraç edilen ise 105 bin varil seviyesindedir. Petrol rezervlerinin çoğu Çad'ın güney bölgesindedir. Güneyde bulunan Doba bölgesi, ülkenin en önemli petrol sahasıdır. Mangara ve Badila diğer

petrol sahalarıdır. Ülkede üretilen Petrolün ihracatı, Dünya Bankası'nın da katkılarıyla kurulan boru hattı ile Kamerun üzerinden Atlantik kıyılarına taşınarak gerçekleştirilmektedir (DEİK, 2017).

Petrol haricinde ülke ekonomisindeki en önemli sektör tarım ve hayvancılıktır. Halkın çoğunluğunun en önemli geçim kaynağıdır. Ancak, iklim ve coğrafi koşullar tarımsal üretimi olumsuz etkilemektedir. Üretimi yapılan başlıca ürünler pamuk, buğday, mısır ve susamdır. Ayrıca, hurma, fıstık ve pirinç üretilen diğer ürünlerdir. Pamuk ve susam tohumu (ve akasya ağacından elde edilen arap zamkı) ihraç edilen sektörel ürünlerdir. Diğer ürünlerin üretimi daha ziyade halkın kendi tüketimine yöneliktir.

Ülkede işgücünün sektörel dağılımı tarım %75.4, hizmetler sektörü %22.7 ve sanayi sektörü ise %1.9 şeklindedir (TOB, 2022). Kısacası ülke ekonomisinde, petrol sektörü Gayri Safi Yurtiçi Hasıla(GSYH)'nın yaklaşık %30'unu karşılamaktadır. Hayvancılık ve tarım sektörü (GSYH'nın %31,9'u) ve hizmetler sektörü (% 32,3) Çad'ın diğer önemli ekonomik sektörleridir. İmalat sektörü ise düşük bir öneme sahiptir ve GSYH'nın % 2,6'sını oluşturmakta olup şeker ve pamuk üretimine dayanmaktadır. Pamuk üretimi, 2 milyondan fazla kişinin doğrudan veya dolaylı geçim kaynağıdır (Yacoub, 2018). GSYH'nın sektörel dağılımı bir başka kaynakta (TOB, 2022) şöyle bildirilmektedir: Tarım %52.3, sanayi %14.7 ve hizmetler sektörü %33.1'ni karşılamaktadır. Çad, diğer doğal ve mineral kaynakları (altın, elmas, demir, boxit, uranyum, kaolin) yönünden de zengin bir ülkedir. Sadece kaolin yatakları ticari olarak kullanılmaktadır.

TOPRAK VE SU KAYNAKLARI POTANSİYELİ

Arazi Varlığı ve Kullanım Durumu

Çad Cumhuriyeti'nin 1 284 000 km^2'lik ülke yüz ölçümünün yaklaşık %60'ı çölden oluşmaktadır (Mahamat ve ark, 2020). Ülke yüzölçümünün yaklaşık %60'ını oluşturan sahra bölgesi ülkenin kuzey bölümünü oluşturmaktadır. Çad arazi varlığı ve kullanım durumuna ilişkin veriler FAOSTAT (2023)'dan derlenerek Tablo 1'de verilmiştir. Tablo 2 verilerine göre, Çad yüzölçümünün yaklaşık %35'i çayır-mera alanları, %55.6'sı sahra çölünden oluşmaktadır. Mevcut durumda ülke topraklarının sadece %4'ünde, yani 5.23 milyon hektarında tarım yapılmakta ve %3.36'sı ise orman alanlarından oluşmaktadır. Tarım alanlarının yaklaşık 38 000 hektarı dikili bitkilerden (meyve ve diğer ağaçlar) oluşurken, geri kalanı ekilebilir alanlardan oluşmaktadır. Yine tarım alanlarının yaklaşık %12.4'ü nadasa bırakılmaktadır (FAOSTAT, 2023). Yıllık ekilen alanların 2/3'ü Sahelian bölgesinde ve 1/3'ü Sudanian bölgesinde bulunmaktadır (Anonymous, 2013).

Günümüz koşullarında Çad'ın tarım yapılan arazi miktarı 5.23 milyon hektar olmakla birlikte, başkaca kaynaklarda tarıma elverişli arazi miktarının bunun çok üzerinde olduğu görülmektedir. Söz gelimi Yacoub (2021) ve TOB (2022) Çad'ın 39 milyon hektarlık ekilebilir bir tarım alanına sahip olduğunu, ancak günümüzde çok küçük bir miktarında üretim yapıldığını bildirmektedirler. Bu durum, Çad'daki mera alanlarının çok büyük bir kısmının bitkisel üretim için uygun hale getirilebileceğini göstermektedir.

Tablo 1. Çad'ın arazi varlığı ve kullanım durumu (FAOSTAT, 2023)

Kullanım durumu		Yüzölçümü (hektar)	Oranı (%)
Çayır-mera alanları		45 000 000	35.05
Mevcut Tarım alanı		5 238 000	4.08
	Dikili alan (meyve + diğer)	38000	
	Fiilen ekilebilir alan	4 554 290	
	Nadas alanı	645710	
Orman-fundalık alan		4 313 000	3.36
Diğer alanlar (sahra)		71 369 000	55.60
Su yüzeyleri		2 480 000	1.93
Toplam		128 400 000	100

Ülkedeki nüfusun da ağırlığının yaşadığı Çad Gölü Havzası ile batıda Encemine doğuda Abeşe şehirlerinin oluşturduğu hattın güneyi toprak kalitesi ve yağış bakımından tarıma elverişlidir. Nihai kertede tarımsal üretim, her yıl yağışlı sezonda (yaz ayları) alınan yağmur miktarıyla doğrudan bağlantılı olmaktadır. Ülkede ekilebilir arazilerin yaklaşık yüzde 6'sı kullanılabilmektedir. Bu durum iklim değişikliği, toprak tükenmesi, bitki zararlıları, yetersiz su yönetimi ve kaliteli tohuma erişmenin zorluğu gibi sebeplerden kaynaklanmaktadır (TOB, 2022).

Su Kaynakları

Su kaynaklarının birden fazla işlevi ve kullanımı vardır. Biyo-çeşitliliğin korunmasında yüzey suları gerekliyse, tarım, balıkçılık ve hayvancılıkta, gıda güvenliğinin kilit unsurlarında ve ayrıca Çad ekonomisinin önemli kesimlerinde kilit bir rol oynamaktadır. Yeraltı suyu, hayvancılık ve tarım sektörlerine önemli ölçüde katkıda bulunmasının yanı sıra, Çad nüfusunun neredeyse %90'ı tarafından içme suyu olarak kullanıldığı için eşit derecede önemlidir (Bouyebri, 2022).

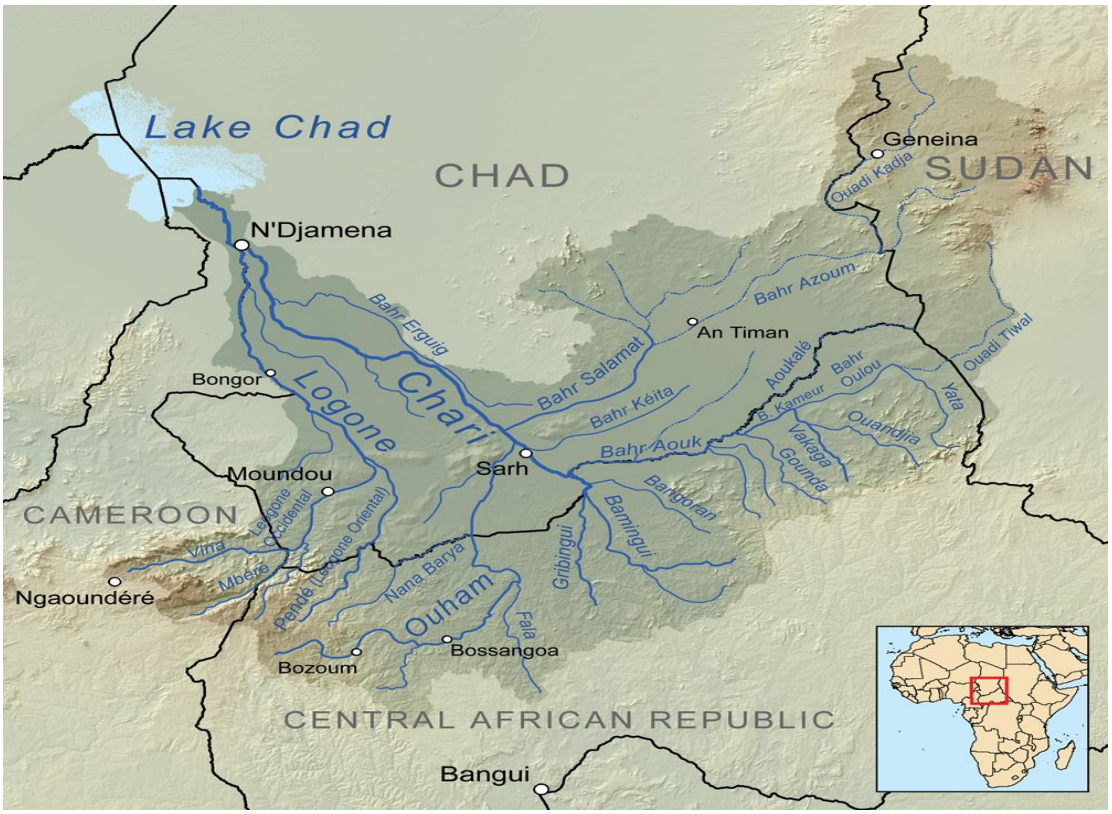
Çad su kaynakları kısıtlı olan bir ülkedir. Çad'ın su kaynaklarını göl ve akarsular oluşturmaktadır. En önemli su kaynağını Çad gölü oluşturmaktadır. Çad Gölü, Çad Cumhuriyeti sınırları içinde yer alan bataklık bir göldür. Göl suyu, çok az tuzludur. Dışarıya

hiç bir akıntısı olmadığı gibi beslenmesi de çok azdır. Bu sebeple gölün suyu her geçen sene azalmaktadır. Ülkenin güneyinden gelen Şari nehri ve onun önemli kolu olan Logon suları Çad Gölüne dökülür(https://www.cografya.gen.tr/siyasi/devletler/cad.htm). Ülkede Çad Gölü dışında dört önemli göl daha bulunmakta olup bunlar Fitri, Iro, Lere ve Terem gölleridir(Kavas, 2017).

Erişilebilir yüzey suyu esas olarak ülkenin güney kesiminde, özellikle büyük taşkın yataklarının bulunduğu Şari-Logon havzasında yoğunlaşmıştır. Çad'ın en önemli akarsuları Şâri ve Logon ırmaklarıdır. Her ikisi de güneyde sık ağaçlı bölgededir. Bunlardan Şari ırmağı Bahr Salâmat, Uham ve Erging ırmaklarının birleşmesiyle meydana gelir. Şari Nehri, Orta Afrika Cumhuriyeti'nden doğarak Çad'a doğru akar ve Çad'ın başkenti Encemine ile Kamerun sınırını oluşturan Logon Nehri ile birleşerek, tek yatak halinde Çad Gölü'ne boşalır. Başkent Encemine ve Sarh şehri de dâhil olmak üzere Çad nüfusunun büyük kısmı bu nehrin kıyılarında yoğunlaşmıştır. Nehir, Çad Gölü'nü besleyen kaynakların toplamda %90'ını oluşturur (https://tr.wikipedia.org/wiki/Chari_Nehri). Logon, Kamerun'daki Adamaoua masifinin Vina ve Mbere nehirlerinin birleşmesinden oluşur. 250 km uzunluğunda Çad ve Kamerun arasındaki sınır boyunca yer almaktadır. Logon toplam 900 km uzunluğunda, Encemine'de Şari nehri ile birleşmektedir. Çad Gölü için önemli bir su kaynağıdır (Gauquelin,2008). Bu iki nehrin yağış havzası Şekil 7'de gösterilmiştir. AQUAATAT (2023) verilerine göre Çad'ın yıllık akarsu potansiyeli 44 milyar m^3 kadardır.

Çad, ülke genelinde dağılmış önemli yeraltı suyu kaynaklarına sahiptir. Yeraltı suyunu taşıyan akiferler ülkenin neredeyse toplam alanının dörtte üçünü teşkil eder. Bunlar üç jeoklimatik bölgeye dağılmış olup, çoğunlukla Çad'ın kuzey, batı ve güneyinde yer almaktadır. Yenilenebilir yeraltı suyu miktarı farklı farklı kaynaklarda farklı ifade edilmektedir. Söz gelimi Bouyebri (2022) yaklaşık 20 milyar m^3 ve FAOSTAT (2023) ise 11.5 milyar m^3 olduğunu bildirirken, büyük akiferlerin kullanılabilir kaynaklarının 260 milyar ile 540 milyar m^3 arasında olduğu tahmin edilmektedir (Bouyebri, 2022).

Çad'ın bu günkü nüfusu (16 425 000 kişi) ve yenilenebilir yıllık toplam su kaynakları potansiyeli (55.7 milyar m^3) dikkate alındığında, kişi başına 2750 m^3 su düşmektedir.



Şekil 7. Şari ve Logon nehirleri yağış alanı

TARIMSAL ÜRETİM DURUMU

Bitkisel Üretim

Çad, her şeyden önce bir tarım ülkesidir. Nitekim tarım, Çad ekonomisinin en önemli bileşenidir. Bu sektör işgücünün %75'inden fazlasını istihdam etmektedir (Yacoub, 2021). Ülke topraklarının %40'ı tarıma elverişlidir; ancak ekilebilir toprakların payı %4'tür. Tarım, toplam servetin ana kaynaklarından birisidir. Ülkedeki üretim zenginliğinin %38'ini kapsamaktadır. Tarım sektörünün gelişmesine yardımcı olabilecek büyük bir potansiyel vardır: Ekilebilir arazinin yaklaşık 39 milyon hektar olduğu tahmin edilmektedir ve bunlar içinde 5,6 milyon sulanabilir arazi ve yer üstünde ve altında önemli su kaynakları bulunmaktadır. Üretim sistemi genel olarak geçimlik tarıma dayanır. Yani üretim 20-50 dekarlık bir alanda küçük aile çiftlikleri tarafından yapılan tarım faaliyetlerine dayanmaktadır. Ülkede başlıca mısır, buğday, sorgum, darı, pirinç, susam, yer fıstığı, börülce, nohut, soya, biber, sarımsak, soğan, domates, mango, papaya, guava, muz, spirulina, shea fındık, Arap zamkı, pamuk, şeker kamışı ve tütün gibi bitkilerin tarımı yapılmaktadır(Yacoub, 2018; TOB, 2022).

Petrol haricinde ülke ekonomisindeki en önemli sektör tarım ve hayvancılıktır. Halkın çoğunluğunun en önemli geçim kaynağıdır. Ancak, iklim ve coğrafi koşullar tarımsal üretimi

olumsuz etkilemektedir. Üretimi yapılan başlıca ürünler pamuk, buğday, mısır ve susamdır. Ayrıca, hurma, fıstık ve pirinç üretilen diğer ürünlerdir. Pamuk ve susam tohumu (ve akasya ağacından elde edilen arap zamkı) ihraç edilen sektörel ürünlerdir. Diğer ürünlerin üretimi daha ziyade halkın kendi tüketimine yöneliktir. Başta pamuk üretimi olmak üzere, sektör verimliliğin artırılmasına yönelik (tohum, gübre, sulama konularında) yabancı yatırıma ve teknik desteğe ihtiyaç duyulmaktadır (DEİK, 2017).

Çad'da tarımı yapılan bitkilerin üretim alanları ve bitkisel üretim miktarları 2015 ve 2021 yılları için FAOSTAT (2023) veri tabanından derlenerek Tablo 2'de verilmiştir. Tablo 2'den görüleceği gibi, Çad'da aktif üretim yapılan tarım alanı 2015 yılında yaklaşık 4.6 milyon hektar iken 2021 yılında üretim alanının 5 milyon hektarı aştığı görülmektedir. Ekiliş alanı büyüklüğü bakımından hem 2015 ve hem de 2021 yılında bir milyon hektarın üzerinde tarımı yapılan iki üründen biri sorgum diğeri de darıdır. 2021 yılı verilerine göre ekiliş alanı büyüklüğü bakımından bunları 754252 hektarla yerfıstığı, 461196 hektarla diğer tahıllar, 396235 hektarla susam, 320000 hektarla pamuk, 225741 hektarla kuru fasulye ve 184086 hektar ile çeltik izlemektedir. Tabloda yer alan diğer bitkilerin ekiliş alanları düşük olup, 1600 ile 48000 hektar arasında değişim göstermektedir. Tabloda gösterilen bitkiler bazında 2015 yılında toplam olarak 5 milyon ton ürün elde edilmiş, 2021 yılında ise toplam 5.37 milyon ton üretim gerçekleştirilmiştir. 2015 ve 2021 yıllarında birim alan başına elde edilen ürün miktarları sırasıyla 1098 kg/ha ve 1071 kg/ha olup, aralarında önemli bir fark yoktur. Ülkede, bitkisel ürün miktarı olarak en çok sorgum, yerfıstığı ve darı üretilmektedir. Bunu sırasıyla tahıllar(diğer), yerelması ve şekerkamışı izlemektedir. Bu 6 bitkiden elde edilen ürün miktarı, tabloda gösterilen bitkilerin toplamından elde edilen ürün miktarının %68.4'ü gibi çok büyük bir miktarını oluşturmaktadır.

Tablo 2 verileri incelendiğinde, bitkilerin ürün verimlerinin çok düşük gerçekleştiği dikkat çekmektedir. Tablo 3'de verilen Çad'ın 2021 yılı bitkilerin üretim alanı ve ürün miktarları birlikte değerlendirildiğinde; bitki bazında en yüksek ürün verimin 104.7 t/ha ile yerelmasında olduğu, bunu ise 13.39 t/ha ile kuru soğan, 10.23 t/ha ile patates, 10.1 t/ha ile sebzeler(diğer), 9.59 t/ha ile yerelması ve 8.81 t/ha ile manyok izlemektedir. Kısaca ifade etmek gerekirse, Çad'da tarımı yapılan bitkilerde verim ve dolayısıyla üretilen ürün miktarları çok düşük seviyede gerçekleşmektedir.

Tablo 2. Çad'da ekseriyetle üretilen bitkiler, üretim alanları ve üretim miktarları(FAOSTAT, 2023)

Bitkiler	**Ekiliş Alanları ve Üretim miktarları**				
	2015		2021		
	Üretim alanı (ha)	Üretim Miktarı(ton)	Üretim alanı (ha)	Üretim Miktarı(ton)	Ürün verimi (t/ha)
Sorgum	1 074 356	835405	1 129 564	895778	0.800
Darı	1 098 366	592124	1 117 818	621367	0.556
Yerfıstığı	577895	720138	754252	797952	1.06
Tahıllar(Diğer)	408083	431056	461196	494352	1.07
Susam	305882	152624	396235	196903	0.497
Mısır	304942	349560	324517	364630	1.124
Pamuk tohumu	280000	172727	320000	173880	0.543
Kuru fasulye	204282	138088	225741	151696	0.672
Çeltik	172012	243478	184086	242646	1.318
Yerelması	49609	476049	48013	460286	9.587
Kavun tohumu	34347	23565	34839	23875	0.685
Manyok	24290	140971	33476	295061	8.814
*Meyveler(Diğer)	18514	67895	18270	69942	3.828
Bakliyat(Diğer)	59355	48780	49867	43935	0.881
Tatlı patates	13189	97128	29142	195842	6.720
Hurma	10435	20506	10331	21134	2.046
Taro	10542	20274	11570	26160	2.261
Mangolar, Mangostenler, Guavalar	8520	34707	8600	36103	4.198
**Diğer sebzeler	8410	86512	8594	86658	10.084
Şekerkamışı	4420	454585	3917	410102	104.698
Patates	3446	33079	3788	38763	10.233
Soğan(Kuru)	1566	21541	1624	21745	13.390
Toplam-1.098	**4 570 986**	**5 019 961**	**5 020755**	**5 379 239**	

*: papaya, limon, portakal, Nar, muz ;**Domates,marul, biber, bamya, ıspanak, havuç, patlıcan, karpuz

Hayvansal Üretim

Çad hayvancılık bakımından Sahel ülkeleri arasında çok önemli bir konuma sahiptir. Çiftlik hayvanlarının yaklaşık %80'i çok çeşitlendirilmiş mobil pastoral (göçebe, yaylacılık, yarı-göçmen) sistemi ile yönetilip büyük ölçüde doğal kaynaklara bağlıdır. Çad'ın Sahra (çöl) bölgesinde hayvancılık göçebe sistemi ile yönetilmekte ve bölgenin ana ekonomik faaliyeti sayılmaktadır. Çad'ın Sahel bölgesinde hayvancılık; yaylacılık ve Sedanter sistemi ile yönetilmektedir. Yağışlı mevsimlerde hayvanların beslenme ve sulanma koşulları oldukça yeterli olup, kuru veya kıt mevsimlerde bu durum zorlaşmaktadır. Çünkü genel olarak hayvanların beslenme ve sulanma koşulları doğal ve geleneksel bir şekilde gerçekleşmektedir (TOB, 2022).

Çad'ın Sudan bölgesinde ise hayvancılık genel olarak çok yaygın, geniş ve Sedanter sistemiyle yönetilmektedir. Çad, bölgesel ticaret açısından önemli gelişme fırsatları sunmaktadır. Hayvancılık sektörünün verimliliğini artırma konusunda da önemli bir potansiyele sahiptir. Ancak Çad'da çiftçilik kısa döngülüdür ve süt üretim endüstrisi hala gelişmemiştir (TOB, 2022).

Hayvancılık, çöl ve stepte en önemli faaliyettir. Sığır, keçi, koyun ve deve beslenmektedir. Çad Gölü'nün kuzeydoğusunda bulunan Kanem bölgesinde su sığırları yetiştirilmektedir. Ayrıca göl ve nehirlerinde balık da tutulmakta; hayvan derileri komşu ülkelere ihraç edilmektedir. Çad'ın denize kıyısı olmayan konumu, ithal mallar için yüksek nakliye maliyetlerine ve komşu ülkelere bağımlılığa neden olmaktadır (DEİK, 2017; Mahamat ve ark, 2020).

Çad'ın hayvan potansiyeli büyükbaş, küçükbaş ve kanatlı hayvan bazında olmak üzere FAOSTAT (2023) veri tabanından derlenerek 2015 ve 2021 yılları için Tablo 3'de verilmiştir. Tablo 3'den görüleceği gibi, Çad'ın hayvan varlığı toplamda 2015 yılında 94.26 milyon adet iken 2021 yılında 134.48 milyona ulaşmış durumdadır. Hayvan varlığı, 2015-2021 dönemini kapsayan 6 yılda yaklaşık olarak 40 milyon artış göstermiştir. Tablo 3'de verilen Çad'ın 2021 yılı hayvan verileri incelendiğinde; sayıca en çok küçükbaş hayvana sahip olduğu görülmektedir. Toplam hayvan varlığının %63.58'i koyun ve keçiden oluşmaktadır. Küçükbaş varlığının yarısına yakını keçi ve diğer yarısı da koyundan oluşmaktadır. Hayvan varlığının %24.75'i sığır, %6.99'u deve ve %4.58'i ise kanatlı hayvandan oluşmaktadır.

Tablo 3. Çad'ın hayvan varlığı (FAOSTAT, 2023)

Çiftlik hayvanları	2015 yılı		2021 yılı	
	Adet	Oran(%)	Adet	Oran(%)
Sığır	24 892 098	26.41	33 287 209	24.75
Deve	6 413 521	6.80	9 401 892	6.99
Keçi	30 519 349	33.44	43 735 657	32.52
Koyun	26 436 170	28.05	41 771 929	31.06
Kanatlı (Tavuk)	5 900 000	6.26	6 169 000	4.58
Domuz	100000	0.10	113110	0.08
Toplam	**94 261 138**	**100**	**134 478 797**	**100**

Çad'da hayvansal üretime ilişkin veriler FAOSTAT veri tabanından derlenerek, Tablo 4'de verilmiştir. Tablo 4'de, büyükbaş, küçükbaş, tavuk ve arılardan sağlanan üretim miktarları tavuk yumurtası hariç yıllık ton olarak ifade edilmiştir. Bu tabloda gösterilen 2021 yılı

verilerine göre; en çok üretilen hayvansal ürünün et olduğu, et üretiminde de başı sığır etinin çektiği, bunu koyun ve keçi etinin izlediği görülmektedir. 2021 yılı verilerine göre Çad'da 491710 ton sığır eti, 206070 ton koyun ve 139814 ton keçi eti üretildiği görülmektedir. 2015 yılı üretim miktarları ile kıyaslandığında, 2021 yılında sığır, koyun ve keçi eti üretim miktarları önemli ölçüde artış göstermiştir. Bu ürünlerdeki artış, sığır etinde %28.12, keçide %40 ve koyunda ise %57.85 seviyesinde olmuştur. Bu üç hayvandan elde edilen toplam et üretimi 2015 yılında 614380 ton iken 2021 yılında ise 837594 tona ulaşmıştır. 2015 yılına göre bu hayvanlardan elde edilen toplam et üretimindeki artış oranı ise %36.33 olmuştur. Bu üç hayvan eti haricinde, 2021 yılında Çad'da, 8021 ton deve, 6596 ton tavuk, 5541 ton av hayvanı eti üretimi yapıldığı dikkat çekmektedir.

Tablo 4. Hayvansal üretim verileri (FAOSTAT, 2023)

	Ürün	2015 yılı üretim miktarı (ton)	2021 yılı üretim miktarı (ton)
Sığır	Karkas et	384022	491710
	Süt	200800	244279
	Sakatat	65283	83590
	Deri	59907	76706
Deve	Et	5411	8021
	Süt	27044	33539
	Sakatat	725	1074
	Deri	-	-
Keçi	Et	99840	139814
	Süt	97370	120362
	Sakatat	16972	23768
	Deri	18370	25725
Koyun	Et	130518	206070
	Süt	36948	47249
	Sakatat	18852	29765
	Deri	21753	34346
Tavuk	Et	6120	6596
	Yumurta(adet)	90 000 000	90 000 000
Av hayvanı	Et	5183	5541
Arı	Bal	1029	1050
At	Et	480	1103
	Sakatat	57	131
Domuz	Karkas Et	2200	2558
	Sakatat	164	190

Tablo 4 verileri dikkate alındığında, Çad'da sığır, deve, koyun ve keçi sütü üretimi toplamı 2015 yılında 362162 ton seviyesinde iken, 2021 yılında %23'lük önemli bir artış göstererek 445429 tona ulaşmıştır. Tablodan görüldüğü gibi, toplam süt üretiminin yarıdan fazlası sığır sütünden oluşmaktadır. Bunu sırasıyla keçi, koyun ve deve sütü izlemektedir. Kısaca ifade etmek gerekirse, Çad'da süt verimi ve dolayısıyla süt üretimi çok düşük seviyede gerçekleşmektedir. Ayrıca Çad'da, hayvansal ürünler arasında tavuk yumurtası ve bal üretiminin de yapıldığı görülmektedir. Bu bağlamda 2021 yılında 90 milyon adet yumurta ve 1050 ton bal üretimi gerçekleştirilmiştir.

SULAMA

Çad, ulusal toprakların %30'unu temsil eden 39 milyon hektar potansiyel ekilebilir araziye sahip olup, bunun yaklaşık 5.6 milyon hektarı sulanabilir araziden oluşmaktadır. Sulanabilir arazinin yaklaşık 335000 hektarı kolayca sulanabilecek özelliktedir. Sahel kuşağında, arazinin tadil edilmesi gereken kumlu yapısından dolayı üretime uygunluğu düşüktür. Verimli ekilebilir toprakların azlığı, optimal koşullarda nadasa izin vermez. Öte yandan, Sudan bölgesinde, lateritik veya killi yapıya sahip topraklar, büyük ölçüde erozyon olaylarına maruz kalmaktadır ve bu durum, orman kaynakların iyi yönetimini ve erozyon önleyici ve verimliliği koruma uygulamalarının benimsenmesini gerektirmektedir. Ülkede hali hazırda tespit edilen kolayca sulanabilir 335 000 hektar arazinin; 80000 hektarı Şari-Logone vadisinde, 90000 hektarı Çad Gölü çevresinde dağılmış arazi, 10000 hektarı Sahel bölgesinde Kanem ve Lac'da, 15000 hektarı Fitri Gölü çevresinde, 20000 hektarı Sudan bölgesinde Şari vadisinde ve 115000 hektarı da Logone'da bulunmaktadır (Anonymous, 2013).

Bağımsızlığından bu yana Çad, farklı tiplerde olmak üzere yaklaşık 40 000 hektarlık bir tarım alanı sulamaya açılmış durumdadır. FAO'nun 2015 yılında yapılan bir araştırmasına göre, ülkedeki mevcut sulu tarım geliştirmelerinin %78'i durma aşamasında ve %23 ise çok düşük performans gösterir haldedir (Anonymous, 2018).

SONUÇ

Bu çalışma ile Çad Cumhuriyeti toprak ve su kaynakları potansiyeli ile tarımsal arazi varlığı, bitkisel ve hayvansal üretimi yönünden analiz edilmiştir. Ülke, 128.4 milyon hektar yüz ölçüme sahip olup, bunun yaklaşık 40 milyon hektarı tarıma uygun olup, yaklaşık 5.2 milyon hektarında fiilen üretim yapılmaktadır. Çad'ın 2021 yılı verilerine göre yaklaşık 85 milyonu küçükbaş olmak üzere toplam 135 milyon hayvan varlığı bulunmakta olup, yine 2021 yılında sığır, koyun ve keçi eti olarak toplam 837594 ton et üretimi gerçekleştirilmiştir. Ülkede, sorgum, darı ve

yerfıstığı ekiliş alanı büyüklüğü bakımından ilk üç sırayı almakta ve toplam üretim alanının ise yaklaşık %60'ını oluşturmaktadırlar.

Çad, tarım arazileri varlığı ve hayvan potansiyeli yönünden oldukça zengin fakat su kaynakları potansiyeli bakımından kısıtlı bir ülkedir. Günümüzde, tarıma uygun arazilerin ancak %13'ünde üretim yapılabilmektedir. Özellikle ülkede sulu tarımın gelişmediği ve bitkisel üretimin yağışlı sezona bağlı kaldığı anlaşılmaktadır. Ülkede özellikle hem bitkisel ve hem de hayvansal üretimde verim çok düşük seviyede gerçekleşmektedir. Kısaca ifade etmek gerekirse, ülkede tarımsal üretimde verimliliğin arttırılmasına yönelik politikaların öncelikle devreye sokulması gerekmektedir.

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YEM BİTKİSİ OLARAK SİLAJLIK MISIRIN (*Zea mays.* L.) VAN İLİNDE SU AYAK İZİ

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ÖZET

Çeşitli sebeplerle temiz su kaynakları üzerindeki artan baskı temiz suyun kirlenmesine ve azalmasına neden olmakta bu durum özellikle tarım sektörünü olumsuz etkilemektedir. Bu nedenle bitkisel ürünlerin su ayak izinin belirlenmesi ile temiz su kaynaklarının sürdürülebilirliğinin sağlanması ve buna uygun su yönetimi stratejilerinin geliştirilmesi gerekmektedir. Su ayak izi kavramı doğrudan ve dolaylı su tüketimini dikkate alarak diğer su yönetim modellerinden ayrışmakta ve suyun sadece hacmini değil suyun ne zaman ve nerede kullanıldığını ve suyun türünü de (mavi su: sulama suyu ve yeşil su: yağış suyu) belirterek daha kapsamlı bilgi sunmaktadır. Böylece bu çalışmada küçükbaş hayvan varlığı ile Türkiye illeri arasında ilk sırada olan Van ilinde hayvan yemini karşılamaya yönelik silajlık mısır üretiminin su ayak izinin belirlenmesi amaçlanmıştır. Sonuçlar silajlık mısırın üretiminde birim ürün başına toplam su ayak izinin (209.9 m^3 ton^{-1}) % 66.8'inin mavi sudan (140.3 m^3 ton^{-1}) ve % 33.2'sinin yeşil sudan (69.6 m^3 ton^{-1}) oluştuğunu ve silajlık mısırın üretiminde ortalama yıllık 982 863 m^3 mavi ve 487 601 m^3 yeşil su tüketimi gerçekleştiğini göstermiştir. Böylece Van ilinde silajlık mısırın üretiminde mavi suyun yeşil suya göre baskınlığı göz önüne alındığında, yarı kurak bir bölge olan Van ilinde silajlık mısırın üretiminde yeşil su ayak izini artırmaya ve böylece mavi su ayak izini azaltmaya yönelik yaklaşımların geliştirilmesine ihtiyaç olduğu söylenebilir. Bu kapsamda silajlık mısırın ekim dönemi öncesi toprağın su tutma kapasitesini geliştirici yönde toprak nemini korumaya ve artırmaya ve silajlık mısırın ekim-hasat dönemlerini yeşil su ayak izinden daha fazla yararlanacak döneme denk getirmeye yönelik çalışmaların yürütülmesi bu çalışma sonucunda önerilebilir olarak bulunmuştur.

Anahtar Kelimeler: Mavi su ayak izi, yeşil su ayak izi, silajlık mısır, Van ili, su ayak izi

WATER FOOTPRINT OF SILAGE MAIZE (*Zea mays.* L.) AS A FORAGE CROP IN VAN PROVINCE (TURKEY)

ABSTRACT

The increasing pressure on freshwater resources for various reasons causes pollution and reduction of freshwater, which adversely affects the agricultural sector in particular. For this reason, it is necessary to determine the water footprint of crop products, to ensure the sustainability of freshwater resources and to develop appropriate water management strategies. The concept of water footprint differs from other water management models by considering direct and indirect water consumption and provides more comprehensive information by not only specifying the volume of water, but also when and where the water is used, and the type of water (blue water: irrigation water, green water: precipitation water). Thus, in this study, it was aimed to determine the water footprint of the silage maize production to meet the animal feed in the province of Van, which is in first place among the provinces of Turkey with the presence of small ruminants. The results showed that in the production of silage maize, 66.8% (140.3 m^3 ton^{-1}) and 33.2% (69.6 m^3 ton^{-1}) of the total water footprint (209.9 m^3 ton^{-1}) per unit product consisted of blue water and green water and that mean annual consumption of 982 863 m^3 blue water and 487 601 m^3 green water was realized in the production of silage maize. Thus, considering the dominance of blue water over green water in the production of silage maize in Van province, it can be said that there is a need to develop approaches to increase the green water footprint and thus reduce blue water footprint in the production of silage maize in Van province, a semi-arid region. In this context, it was found to be advisable to carry out studies to protect and increase soil moisture in a way to improve the water-holding-capacity of the soil before the sowing period of silage maize and to coincide with sowing-harvest periods of silage maize with the period that will benefit more from the green water footprint.

Keywords: Blue water footprint, green water footprint, silage maize, Van province, water footprint

INTRODUCTION

Silage maize, which is one of the C4 crops that makes the best use of solar energy with its high dry matter production feature (Atakul et al., 2006), is one of the most suitable forage crops for silage production with its significant dry matter and green grass yield (Guney et al., 2010). Silage maize has the advantage of being able to be ensiled alone with its fermentation feature without the need for additives (Denek et al., 2004). In a study conducted by Guney (2005), it was reported that among the silage qualities of maize, sunflower, millet and sudangrass, the best quality was obtained from silage maize. In addition, the ease of storage and use, low loss rate, high energy value and easy digestibility of silage maize increase its use as animal feed (Ozata et al., 2012). Silage maize, which can adapt to almost all climate and soil conditions, ranks first in terms of total production in the world. In addition, increasing roughage feed prices and demands in recent years have increased the demand for silage maize to increase yield in meat and dairy farming (Erdal et al., 2009).

When the positive characteristics of silage maize, expressed as animal feed, are evaluated, the production and production potential of silage maize, which is the most sowed grain after wheat and paddy in an area of approximately 202 million hectares in the world (FAO, 2022), comes to the fore in Van province, which ranks first among Turkey's provinces with 3.384 million small ruminants (TUIK, 2023a). According to TUIK data, 60 062 tons of silage maize was produced in an area of 1210 ha in Van province in 2022 (TUIK, 2023b). However, the high water consumption of silage maize may increase the already existing water scarcity due to the high use of freshwater, especially in arid and semi-arid regions such as Van province. For this reason, it is necessary to develop water management strategies for the results obtained by determining the water consumption of crops with water management models (Yerli and Sahin, 2022).

Water management models aim to develop water management strategies by addressing issues such as effective and planned irrigation, water distribution and management, conservation and management of resources. However, the concept of water footprint differs from other water management models in that it takes into account direct and indirect water consumption (Hoekstra, 2003). The concept of water footprint, which aims to provide better water management by providing information about changing alternative processes, shows not only the volume of water, but also when and where water is used and the type of water as green water and blue water (Yerli et al., 2019). The concept of water footprint, which is defined as the water potential consumed in the entire production chain to produce a product (Hoekstra and Mekonnen, 2012), reveals the green and blue water usage rates of a product based on numerical

analyzes and environmental, economic and social analyzes and leads their management and planning with comparative analyzes (Yerli et al., 2019; Yerli and Sahin, 2022). Within the total water footprint, green water constitutes the part fed by precipitation in the production of the product, and blue water constitutes the part fed by surface and subsurface water resources. For this reason, it is desirable for the sustainability of freshwater resources that the consumption rate of green water is higher than blue water in the production of a product.

Thus, in this study, it was aimed to determine the green and blue water footprints of silage maize production for animal feed and the total water footprint from their sum in the province of Van, located in the east of Turkey, which has a semi-arid climate.

MATERIAL and METHOD

Study Area

Van province (38°29'39" N, 43°22'48" E) located in the Eastern Anatolia Region of Turkey, with a mean altitude of 1750 m, has a surface area of 23.334 km^2. According to TUIK data, the population of Van province is 1.129 million in 2022 (TUIK, 2023c), the majority of this population is engaged in agriculture, animal husbandry and trade. Agriculture and animal husbandry are the main income sources of Van province (Anonymous, 2022). Van province ranks first among Turkey's provinces in terms of small ruminant population. According to TUIK data, the total number of small ruminants in Van province in 2021 is 3.384 million (TUIK, 2023a). For this reason, the production of forage crops, especially silage maize based on animal feed production, is of great importance in the Van province.

The majority of the soils in the province of Van, which has a medium texture, consist of sandy clay loam and the remaining part consists of sandy loam and sandy clay soils (Tufenkci et al., 2009). While approximately one-fourth of the region's soils are shallow soils, the remaining part is deep soils (Karaca et al., 2019). 28% of the total surface area of Van is operated as agricultural land and irrigated agriculture is carried out in approximately one-third of these agricultural areas (Anonymous, 2022). Approximately one-fourth of the agricultural lands in Van province are left fallow due to insufficient precipitation and irrigation water resources (Cakmakci et al., 2016).

According to the climate data for many years (1990-2022), the province of Van has a semi-arid climate with an annual precipitation of 396.9 mm, which is close to the drought limit (360 mm) (Anonymous, 2023). Since the precipitation (91.9 mm) during the active crop production period (May-September) in Van province corresponds to 23.2% of the total annual precipitation (Table 1), irrigation in crop production is obligatory. Thus, this situation reveals the addiction to blue

water. In the province of Van, where the continental climate is dominant, the mean temperature, wind speed and relative humidity and total evaporation during the active crop production period (May-September) are 19.3°C, 2.2 m s^{-1}, 45.6 % and 995.8 mm, respectively (Table 1).

Table 1. Climate data for many years (1990-2022) in the vegetative production period in Van province (Anonim, 2023)

	May	June	July	Aug	Sep	Total or Mean
Temperature (°C)	13.5	19.0	22.8	23.0	18.4	19.3
Precipitation (mm)	44.5	16.2	7.2	5.4	18.6	91.9
Wind speed (m s^{-1})	2.3	2.3	2.3	2.2	2.1	2.2
Relative humidity (%)	55.4	46.7	42.3	40.3	43.4	45.6
Evaporation (mm)	140.9	196.6	248.0	236.6	173.7	995.8

Method

The water footprint of silage maize in Van province was determined according to Hoekstra et al. (2011). Since the accuracy of the results in the water footprint calculation is highly related to the quality of the entered data (Godar et al., 2015), an up-to-date and realistic national and international database covering a long time period was used to determine the water footprint of silage maize in Van province, instead of estimated data.

The part of the crop water consumption that is met by the effective precipitation creates the green water footprint of the crop, while the remaining irrigation water requirement creates the blue water footprint (Hoekstra et al., 2011). Crop water consumption of silage maize in Van province was obtained from the Turkey Irrigated Crop Water Consumption Guide, calculated for each month in ten-day periods with the FAO-Penman Monteith approach (TAGEM and DSI, 2017) and the sowing and harvesting dates and vegetation period of silage maize in Van province were obtained from the same guideline. Considering that not all of the precipitation can be used by the crop, the effective amount of monthly precipitation during the vegetation period of silage maize in Van province was calculated with CROPWAT 8.0 software according to the United States Department of Agriculture Soil Conservation Service approach and monthly precipitations below 25 mm were accepted as effective precipitation according to the same approach (Yerli et al., 2019). Precipitation values were obtained from Van Meteorology stations as the meteorological data of the period covering the years 1990 and 2022 (Anonymous, 2023) and used in this study (Table 1).

Unlike the water footprint calculations available in the literature, the moisture in the soil at the time of sowing was used to determine the green water footprint with the soil moisture approach from the winter. Another point that supports this approach is the lack of irrigation due to

sufficient soil moisture for the germination of the crop in May, which is the sowing period of silage maize in Van Province (Yerli and Sahin, 2022). The water-holding-capacity of the soils where silage maize is grown in the province of Van was accepted as trouble-free soils and was determined as 140 mm m^{-1} according to FAO (2018). Thus, the residual precipitation from the winter was determined from the water-holding-capacity value of the soils and included in the green water footprint of silage maize in Van province. The effective root depth of silage maize was taken as 90 cm according to Kanber (2010).

Data on the production amount and production area of silage maize in Van province between 2004 and 2022 were obtained from TUIK (2023b), and by proportioning these data, the mean yield values of silage maize in Van province for the same years were determined, and as a result, in the period covering 19-years (2004- 2022), the production amount, production area and the mean yield values of silage maize in Van province were obtained.

After calculating the blue and green water consumption of silage maize in Van province, the blue and green water footprints were determined separately for the unit ton production of silage maize in Van, by proportioning it to the mean yield of silage maize, and the total water footprint was obtained from the sum of these for the unit ton of silage maize in Van province.

RESULTS and DISCUSSION

The monthly and seasonal green, blue and total water consumptions of silage maize in Van province are given in Table 2. Accordingly, the seasonal total water consumption of silage maize in Van province was 595.0 mm and 66.8% (397.7 mm) and 33.2% (197.3 mm) of the total water footprint consumption were blue water and green water, respectively. Due to the precipitation left over from the winter, blue water consumption did not occur in May and June, which covers the first two-month period from germination of silage maize, but due to the low effective precipitation (12.6 mm) in the following periods (July and August), blue water consumption increased considerably. In addition, the low effective precipitation (88.7 mm) in the all vegetation period of silage maize in Van increased the dependence of silage maize on blue water.

Table 2. Monthly and seasonal green, blue and total water consumptions of silage maize in Van province

	May	June	July	Aug	Sep	Total
Number of days	31	30	31	31	2	125
Crop water consumption (mm)	38	123	225	200	9	595
Effective precipitation (mm)	41.3	16.2	7.2	5.4	18.6	88.7
Blue water footprint (mm)	-	-	195.3	194.6	7.8	397.7
Green water footprint (mm)	41.3	16.2	7.2	5.4	1.2	71.3+126.0★=197.3
Total water footprint (mm)	41.3	16.2	202.3	200.0	9.0	595.0

★: Precipitation left over from winter

The green, blue and total water footprints of silage maize per unit product on mean and in 19-year period (2004-2022) in Van province are given in Figure 1. Accordingly, the mean green, blue and total water footprints per unit product of silage maize in Van province during the 19-year production period were 69.6 m^3 ton^{-1}, 140.3 m^3 ton^{-1} and 209.9 m^3 ton^{-1}, respectively. In the 19-year production period, there were differences in green, blue and total water footprints per unit product depending on the yield values of silage maize (TUIK, 2023b), but in the last 9 years production period (2014-2022), similar values were observed in green, blue and total water footprints per unit product of silage maize in Van province.

The green, blue and total water footprints of silage maize per unit year on mean and in 19-year period (2004-2022) in Van province are given in Figure 2. Accordingly, the mean green, blue and total water footprints per unit year of silage maize in Van province during the 19-year production period were 487 601 m^3 $year^{-1}$, 982 863 m^3 $year^{-1}$ and 1 470 464 m^3 $year^{-1}$, respectively. There were differences in green, blue and total water footprints per unit year depending on the production amount of silage maize in the 19-year production period (TUIK, 2023b). While the green, blue and total water consumption per unit year of silage maize was lower between 2004-2012 and 2014-2019, there has been an increase in green, blue and total water consumption per unit year of silage maize in 2013 and between 2020-2022 due to the increasing production amount of silage maize in Van province (TUIK, 2023b).

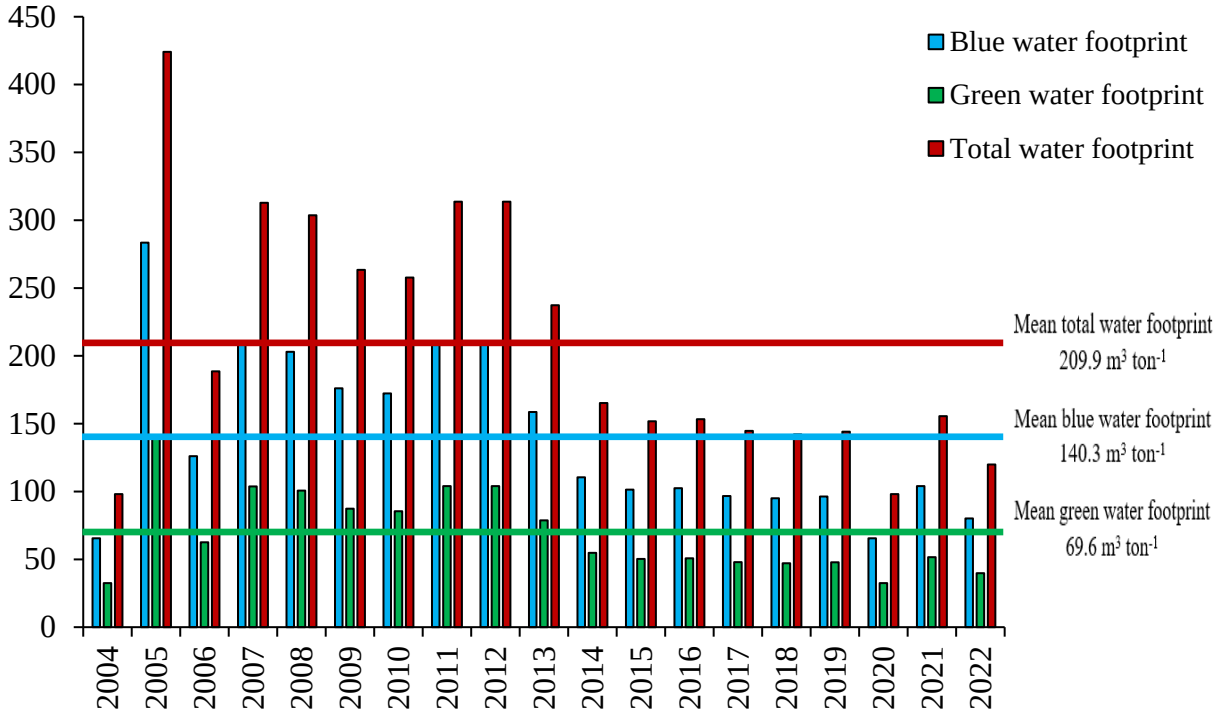

Figure 1. Green, blue and total water footprints of silage maize per unit product on mean and in 19 year period (2004-2022) in Van province

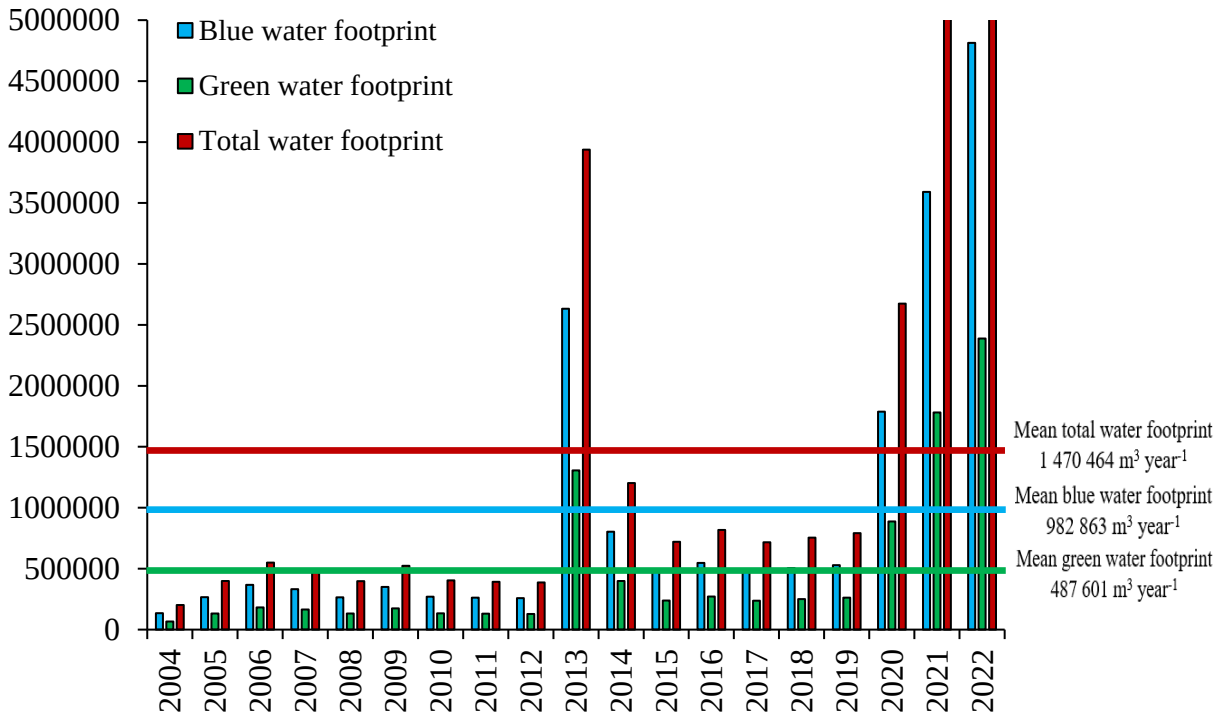

Figure 2. Green, blue and total water consumptions of silage maize per unit year on mean and in 19 year period (2004-2022) in Van province

DISCUSSION

Gerbens-Leenes et al. (2009) and Soltani et al. (2021) reported that the water footprint of silage maize per unit product are153 m^3 ton^{-1} and 300 m^3 ton^{-1}, respectively, while Huang et al. (2012) stated that the total water footprint for one ton of silage maize production is 868 m^3. Mekonnen and Hoekstra (2011a) indicated that green and blue water footprints of silage maize per unit product in the Lombardia region as 410 m^3 ton^{-1} and 91 m^3 ton^{-1}, respectively, while Cao et al. (2015) reported that 43% of the water footprint of maize consists of blue water and the remaining part consists of green water. In a different study, green and blue water footprints for different silage maize varieties produced in the Küçük Menderes Basin were calculated between 192 m^3 ton^{-1} to 773 m^3 ton^{-1}, and 463 m^3 ton^{-1} to 3840 m^3 ton^{-1}, respectively, (Esetlili et al., 2022). Nana et al. (2014) reported that the water footprint consumed in the production of one kg of maize grain was 479 m^3, and Palhares and Pezzopane (2015) stated that 131 m^3 is consumed in the production of one ton of maize silage and that 4408 m^3 water footprint is consumed for the production of one ton of crude protein from maize silage. Chiu et al. (2009) evaluated the water footprints per unit product of silage maize in different regions and pointed out that the water footprint of silage maize differs between 263 m^3 ton^{-1} and 956 m^3 ton^{-1} in different regions. Mekonnen and Hoekstra (2011b) reported that the world means water footprint of silage maize is 1222 m^3 ton^{-1} in their study in which they compile the water footprints of different crops based on the world mean.

The differences or similarities of the findings, which mean green, blue and total water footprints of silage maize per unit product in Van province are 69.6 m^3 ton^{-1}, 140.3 m^3 ton^{-1} and 209.9 m^3 ton^{-1}, respectively, in this study compared to the studies mentioned above can be explained depending on the regional conditions. The climate, soil and water resource factors are important factors governing the blue and green water footprints in the evaluation of the crop water footprint. Especially the climate factor is the main criterion affecting the water consumption of silage maize (Yerli and Sahin, 2022). Insufficient precipitation conditions and high evaporation values increase the demand for freshwater, resulting in increased blue water consumption (Mekonnen and Hoekstra, 2011a). However, the high demand for blue water poses a risk to the sustainability of water resources, especially in arid and semi-arid regions (Mali et al., 2018). For this reason, it is desirable that the green water footprint per unit product is higher than the blue water footprint in crop production. Since the increasing ratio of green water footprint per unit product according to blue water footprint in crop production shows less freshwater consumption per unit product and the crop benefiting from more precipitation, it is very important to prevent the increasing water crisis in today's conditions (Yerli et al., 2019). In

addition, the fact that the moisture in the soil during sowing was used to determine the green water footprint with the soil moisture approach from the winter may explain the difference in the water footprint of silage maize according to the studies mentioned above.

CONCLUSION

In this study, in which the water footprint consumed in the production of silage maize to meet animal feed in Van province was determined, the mean blue and green water footprints per unit product were 140.3 m^3 ton^{-1} and 69.6 m^3 ton^{-1}, and on an annual basis, a mean of 982 863 m^3 $year^{-1}$ blue water consumption and 487 601 m^3 $year^{-1}$ green water consumption was realized in the production of silage maize in the province of Van. In this study, in which the mean total water footprint of silage maize per unit product and unit year is 209.9 m^3 ton^{-1} and 1 470 464 m^3 $year^{-1}$, since 66.8% of the total water footprint of silage maize is blue water and 33.2% is green water, there is a need to develop approaches to increase the green water footprint in silage maize production and thus reduce the blue water footprint. In this context, it can be recommended to carry out studies to protect and increase the soil moisture in a way to improve the water-holding-capacity of the soil before the sowing period of the silage maize and to coincide with the sowing and harvesting periods of the silage maize with the periods that will benefit more from the precipitation. In addition, in the province of Van, which is a semi-arid region, it is necessary to evaluate the water footprints of different crop products by considering the whole crop production pattern and to increase the efficiency of the unit green water footprint by reducing the supply to blue water with studies such as the protection of precipitation water in the soil and precipitation harvesting, reducing evaporation and increasing modern irrigation methods.

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DIKALSIYUM FOSFAT UYGULAMASININ KURAKLIK STRESİ KOŞULLARINDA UYGULANAN YULAF (*Avena sativa* L.) TOHUMLARINDA BAZI ÇİMLENME PARAMETRELERİNE ETKİSİ

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ÖZET

Kuraklık hemen hemen her iklim tipinde belli periyotlarda görülebilen bir sorun olup, nemli ve verimli iklim alanlarında bile kuraklık sorunu görülebilmektedir. Tarım alanında yetiştirilen bitkiler (buğday, yulaf, mercimek vb.) kuraklık stresinden en fazla etkilenen bitkiler olarak görülmektedir. Tarımsal kuraklık stresini önleyebilmek için ilk akla gelen sulama olsa dahi bu çözüm maliyetli olup, toprağın pH değerinin artmasına, su kıtlığının yaşanmasına ve sürdürülebilirlik açısından büyük problem teşkil etmesine neden olmaktadır. Son yıllarda su ihtiyacını ve tüketimini dengelemek hem bitkiler hem de insanlar için büyük önem taşımaktadır. Fosfor, bitkiler tarafından azottan sonra en çok kullanılan besin elementidir. Optimum büyüme ve gelişme için mutlak gerekli, makro besin elementlerinden bir tanesidir. Ayrıca fosfor, bitkilerde meydana gelen birçok fizyolojik ve biyokimyasal olaylarda bulunmakla birlikte bitki kuru ağırlığının yaklaşık olarak %0,2'sini oluşturmaktadır. Fosforun bitki gelişimi ve metabolizma açısından başlıca etkilerine bakılacak olursa; bitkilerde protein, enzimler, koenzimler, nükleik asitler ve fosfolipitlerin önemli yapısal bileşenini oluşturmakta hem fotosentez hem de solumda gerekli olan NAD, NADH, ADP ve ATP gibi fosfor içeren enerji bakımından zengin bileşiklerin sentezinde mutlak gerekli element olmakla birlikte çiçeklenme, tohum bağlama, erken olgunlaşma ve kök oluşumunu teşvik edici etkileri sıralanabilir.Bu araştırma, 2020 yılında Ordu Üniversitesi Ziraat Fakültesi Laboratuvarında kurulmuştur. Bu çalışmada, PEG 6000 ile oluşturulan beş farklı kuraklık stresi (0,-0.12,-0.24,-0.36,-0.48 atm), Dikalsiyum Fosfat (1.3 mM) uygulaması ve Diriliş yulaf çeşidi kullanılmıştır. Deneme tesadüf parsellerinde faktöriyel deneme desenine göre 3 tekerrürlü olarak kurulmuştur. Çalışmadan elde edilen sonuçlara göre denemede kullanılan uygulamaların etkisi ile çimlenme oranı, fide uzunluğu, kök uzunluğu, kök kuru ağırlığı, kök/sürgün ve sürgün/kök uzunluk oranları çok önemli, sürgün uzunluğu, fide yaş ağırlığı, kök yaş ağırlığı özellikleri ise önemli bulunmuştur. İncelenen diğer parametreler bakımından ise çeşitler arasında önemli fark elde edilmemiştir.

Anahtar Kelimeler: Dikalsiyum Fosfat, Kuraklık, PEG 6000, Yulaf

EFFECT OF DICALCIUM PHOSPHATE APPLICATION ON SOME GERMINATION PARAMETERS IN OAT (*Avena sativa* L.) SEEDS UNDER DROUGHT STRESS CONDITIONS

ABSTRACT

Drought is a problem that can be seen in almost every climate type in certain periods, and drought problems can be seen even in humid and fertile climate areas. Plants grown in agriculture (wheat, oats, lentils, etc.) are considered to be the plants most affected by drought stress. Even if irrigation is the first thing that comes to mind to prevent agricultural drought stress, this solution is costly and leads to an increase in the pH value of the soil, water scarcity and poses a major problem in terms of sustainability. In recent years, balancing water demand and consumption is of great importance for both plants and humans. Phosphorus is the nutrient most utilized by plants after nitrogen. It is one of the macronutrients absolutely necessary for optimum growth and development. In addition, phosphorus is involved in many physiological and biochemical events occurring in plants and constitutes approximately 0.2% of plant dry weight. If we look at the main effects of phosphorus in terms of plant development and metabolism; It is an important structural component of proteins, enzymes, coenzymes, nucleic acids and phospholipids in plants, it is an absolute essential element in the synthesis of phosphorus-containing energy-rich compounds such as NAD, NADH, ADP and ATP, which are necessary for both photosynthesis and respiration, as well as promoting flowering, seed binding, early maturation and root formation. This research was established in 2020 at Ordu University Faculty of Agriculture Laboratory. In this study, five different drought stresses (0,-0.12,-0.24,-0.36,-0.48 atm), Dicalcium Phosphate (1.3 mM) application and Diriliş oat variety were used. The experiment was established according to the factorial experimental design in randomized plots with 3 replications. According to the results obtained from the study, germination rate, seedling length, root length, root length, root dry weight, root/shoot and shoot/root length ratios were found to be very significant, shoot length, seedling wet weight and root wet weight were found to be significant. No significant difference was found between the varieties in terms of the other parameters examined.

Keywords: Dicalcium Phosphate, Drought, PEG 6000, Oats

GİRİŞ

Her yıl dünya genelinde 23 milyon ton, Türkiye'de ise 265 bin ton yulaf (*Avena sativa* L.) taneleri elde edilmektedir. Türkiye, 2.42 ton/ha verimle (dünya ortalaması olan 2.34 ton/ha'nın üzerinde) yüksek yulaf verimine sahip olup, yulaf üretiminde dünya sıralamasında 6. sıradadır (FAO, 2018). Yulaf, diğer tahıl ürünleriyle kıyaslandığında, düşük verimli topraklar da dahil olmak üzere marjinal alanlarda düşük girdili bir üretim için daha uygundur (Yıldırım ve Yılmaz 2022). Yulaf taneleri, besin içeriği bakımından diğer tahıl türlerine kıyasla yüksek miktarda protein, β-glukan, karbonhidrat, yağ, yağ asitleri, vitaminler, mineraller, bazı antioksidanlar ve anti-kanserojen maddeler içermektedir, bu da onu sağlık açısından oldukça faydalı kılmaktadır. Son araştırmalar, yulaf tüketiminin kardiyovasküler hastalık riskinin azalmasından bazı kanser türlerinin önlenmesine kadar bir dizi sağlık yararı sağladığını göstermektedir (Mut vd., 2018). Bitkisel üretimde, verimliliği en çok etkileyen faktörlerden biri, kuşkusuz kuraklıktır. Kuraklık, bitkilerin su miktarını ve turgor basıncını azaltarak, büyümeyi ve hücre bölünmesini engeller. Kuraklık, fotosentez aktivitesinin yavaşlaması ile birlikte, verim ve kalite düşüklüğüne sebep olur. Bu nedenle, kuraklığın yol açtığı üretim ve tüketim yetersizlikleri, beslenme ve sağlık sorunlarına neden olabilir. (Tunçtürk, 2021)

Asitli topraklarda, Al, Mn ve Fe gibi elementlerin toksik etkisi artar ve K, Ca, Mg, P ve Mo gibi elementlerin eksiklikleri ortaya çıkabilir. Öte yandan, alkalin topraklarda yüksek pH değeri, özellikle fosfor gibi bitki besin elementlerinin Ca ile çözünmez Ca-fosfat bileşikleri şeklinde bağlanarak kullanılamaz hale gelmesine neden olan bir özellik gösterir. Fosfor, asidik topraklarda Fe, Al ve Mn gibi katyonlarla birleşerek düşük çözünürlüklü bileşikler oluştururken, alkalin topraklarda pH yükseldikçe dikalsiyum fosfat ($CaHPO_4$) ve trikalsiyum fosfat ($Ca_3(PO_4)_2$) şeklinde bağlanır. pH 8.2 sınırına kadar fikslenir. pH 8.1'in üzerine çıktığında, toprakta yüksek miktarda sodyum iyonu bulunması nedeniyle çözünürlüğü yüksek sodyum fosfatlar oluşur. Ancak, yüksek pH nedeniyle bitkilere fayda sağlamazlar. Bu çalışmanın amacı, farklı kuraklık stresi koşullarında dikalsiyum fosfat uygulamasının yulafın çimlenme değerleri üzerindeki etkisini belirlemektir (Maltaş, 2013).

MATERYAL ve METOT

Bu çalışmada, 5 beş farklı kuraklık stresi dozu (0,-0.1,-0.2,-0.3,-0.4 atm) ile Dikalsiyum fosfat (1 mM) ve Diriliş yulaf çeşidi kullanılmıştır. Deneme tesadüf parsellerinde faktöriyel deneme desenine göre 3 tekrarlı olarak planlanmıştır.

Çimlendirme Yöntemi

Ön çimlendirme testlerinden sonra solüsyonlar hazırlanmıştır (Yıldırım ve Yılmaz 2023; Yıldırım ve Bilgen 2022). PEG 6000 ile beş farklı kuraklık stresi solüsyonu hazırlanmıştır. Tek

kullanımlık plastik petri kutuları içerisine, 2 ml kuraklık, 2 ml Dikalsiyum fosfat sıvı çözeltisi eklenerek filtre kâğıdı nemlendirilmiştir. Üzerine sterilize edilmiş tohumlar pens yardımıyla düzenli biçimde yerleştirilmişlerdir. Tohum ekimi tamamlanarak etrafı streç film ile kapatılan petri kutuları sıcaklığı 20±5 °C olan etüve konularak karanlık koşullarda tohum çimlenme denemeleri başlatılmıştır. (40 adet yulaf tohumuna, 4 ml solüsyon kullanılması, yapılan ön çimlendirme çalışmasına göre önceden belirlenmiştir.) Çimlenme için radikulanın 2 mm testadan çıkmış olması esas kabul edilmiştir. Toplamda 10 günün sonunda ölçümler alınmıştır. Araştırmada; çimlenme oranı (gücü) (%), fide uzunluğu (mm), sürgün uzunluğu (mm), kök uzunluğu (mm), fide yaş ağırlığı (mg), sap yaş ağırlığı (mg.), kök yaş ağırlığı (mg.), sap kuru ağırlığı (mg.), kök kuru ağırlığı (mg.), sürgün/kök-kök/sürgün yaş ağırlık oranı (%), sürgün/kök-kök/sürgün uzunluk oranı (%), gibi parametreler değerlendirilmiştir.

Çimlenme Oranı (Gücü) (%): 10. gün sonunda çimlenen tohumlar sayılarak, (çimlenen tohum sayısı/toplam tohum sayısı) x 100 formülü ile çimlenme oranı % olarak hesaplanmıştır (Akıncı ve Çalışkan, 2010).

$$G.R.\ (\%) = \frac{Number\ of\ Total\ Germinated\ Seeds}{Total\ Number\ of\ Seeds\ Tested}\ X\ 100$$

Fide, Sürgün ve Kök Uzunluğu (cm): Sürgün ve kök uzunluğu milimetrik cetvelle ölçülerek belirlenmiştir. Deneme sonunda tesadüf olarak seçilen 10 bitkinin sap uzunluğu milimetrik cetvelle ölçülerek belirlenmiştir. (Yılmaz ve Kısakürek 2021).

Fide, Sürgün ve Kök Yaş Ağırlığı (mg.): Her bir gruptan rastgele seçilen bitkilerin (5 adet) yeşil aksamları ayrılarak, taze ağırlıkları hassas terazi ile mg cinsinden tartılmıştır. (Yıldız ve Özgen, 2004)

Sürgün ve Kök Kuru Ağırlığı (mg.): Yaş ağırlık belirlenen kökler 70°C hava dolaşımlı fırında durağan ağırlığa gelinceye kadar kurutulduktan sonra hassas terazide tartılarak kuru ağırlıkları (mg bitki-1) belirlenmiştir (Yılmaz ve Kısakürek 2021).

Sürgün/Kök ve Kök/Sürgün Yaş Ağırlık Oranı (%): Her bitkinin sürgün ve kök yaş ağırlıklarının tartılıp birbirlerine oranlanması ile bulunmuştur. Toplamda 10'ar bitkide ölçüm yapılmış ve ortalaması alınmıştır.

Sürgün/Kök ve Kök/Sürgün Uzunluk Oranı (%): Her bitkinin sürgün ve kök uzunlukları milimetrik cetvel ile ölçülmüş ve birbirlerine oranlanmıştır. Toplamda 10'ar bitkide ölçüm yapılmış ve ortalaması alınmıştır.



Şekil 1: Tohumların çimlenmesi

İstatistiksel Analiz

İstatistiki analizler JMP13 programında, varyans analizi ANOVA testi, çoklu karşılaştırmalara ise Tukey testi ile yapılmıştır.

BULGULAR ve TARTIŞMA

5 farklı kuraklık stresi dozunda (0,-0.12,-0.24,-0.36,-0.48 atm), Dikalsiyum Fosfat (1.3 mM) uygulamasının, Diriliş yulaf Çeşidinde bazı çimlenme parametreleri üzerindeki etkilerine ait bulgular Çizelge 1'de verilmiştir.

Çizelge 1. Dikalsiyum Fosfat Uygulamasının Kuraklık stresi koşullarında çimlenme oranı, sürgün uzunluğu, kök uzunluğu ve fide boyuna etkileri

Uygulamalar	**Ç.O.**	**F.U.**	**K.U.**	**S.U.**
	**	**	**	*
DCP+0 MPa	20.00^{c}	21.87^{a}	9.54^{a}	12.93^{a}
DCP+-0.12 MPa	93.33^{a}	19.88^{ab}	6.94^{bc}	12.32^{ab}
DCP+-0.24 MPa	53.33^{bc}	18.01^{bc}	6.06^{c}	11.96^{ab}
DCP+-0.36 MPa	80.00^{ab}	17.10^{c}	5.90^{c}	11.20^{b}
DCP+-0.48 MPa	86.67^{ab}	21.53^{a}	8.78^{ab}	12.76^{a}
VK (%)	0.012	0.046	0.105	0.043

(**p<0.01, *p<0.05, **ö.d.:** önemli değil). **Ç.O.:** Çimlenme Oranı (%); **F.U.:** Fide Uzunluğu (cm); **K.U.:** Kök Uzunluğu (cm); **S.U.:** Sürgün Uzunluğu (cm). ***VK (%):*** Varyasyon Katsayısı

Çizelge 2. Dikalsiyum Fosfat Uygulamasının Kuraklık stresi koşullarında fide, sürgün ve kök yaş ağırlığına etkileri

Uygulamalar	**F.Y.A.**	**S.Y.A.**	**K.Y.A.**
	*	**ö.d.**	*
DCP+0 MPa	0.16^{a}	0.19	0.03^{b}
DCP+-0.12 MPa	0.14^{ab}	0.10	0.04^{ab}
DCP+-0.24 MPa	0.12^{ab}	0.09	0.04^{ab}
DCP+-0.36 MPa	0.12^{ab}	0.09	0.04^{ab}
DCP+-0.48 MPa	0.15^{ab}	0.11	0.06^{a}
VK (%)	0.116	0.593	0.235

(**p<0.01, *p<0.05, **ö.d.:** önemli değil). **F.Y.A.:** Fide Yaş Ağırlığı (mg); **S.Y.A.:** Sürgün Yaş Ağırlığı (mg); **K.Y.A.:** Kök Yaş Ağırlığı (mg); ***VK (%):*** Varyasyon Katsayısı

Çizelge 3. Dikalsiyum Fosfat Uygulamasının Kuraklık stresi koşullarında sürgün ve kök kuru ağırlığına etkileri

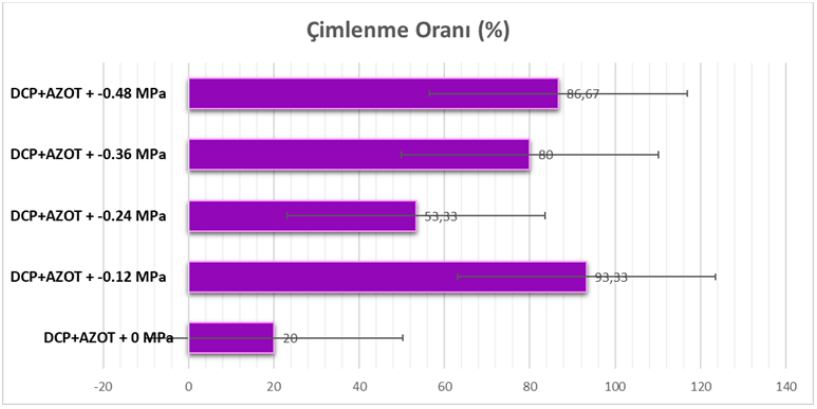
Uygulamalar	**S.K.A.**	**K.K.A.**
	ö.d.	******
DCP+0 MPa	0.003	0.001^{c}
DCP+-0.12 MPa	0.011	0.001^{c}
DCP+-0.24 MPa	0.008	0.002^{b}
DCP+-0.36 MPa	0.008	0.004^{a}
DCP+-0.48 MPa	0.006	0.005^{a}
CV (%)	0.374	0.102

(**p<0.01, *p<0.05, **ö.d.:** önemli değil). **S.K.A.:** Sürgün Kuru Ağırlığı (mg); **K.K.A.:** Kök Kuru Ağırlığı (mg); ***VK (%):*** Varyasyon Katsayısı

Çizelge 4. Dikalsiyum Fosfat Uygulamasının Kuraklık stresi koşullarında kök/sürgün ve sürgün/kök uzunluk ve ağırlık ortalamalarına etkileri

Uygulamalar	**K/S Y.A.O.**	**S/K Y.A.O.**	**K/S U.O.**	**S/K U.O.**
	ö.d.	**ö.d.**	******	******
DCP+0 MPa	31.22	320.67	77.47^{a}	954.44^{a}
DCP+-0.12 MPa	34.27	291.88	53.75^{b}	694.44^{bc}
DCP+-0.24 MPa	31.61	513.27	52.86^{b}	605.56^{c}
DCP+-0.36 MPa	53.91	232.36	50.85^{b}	590.00^{c}
DCP+-0.48 MPa	58.58	174.47	68.84^{ab}	877.78^{ab}
VK (%)	0.451	0.665	0.119	0.105

(**p<0.01, *p<0.05, ö.d.: önemli değil). K/S Y.A.O.: Kök/Sürgün Yaş Ağırlık Oranı (%); S/K Y.A.O.: Sürgün/Kök Yaş Ağırlık Oranı (%); K/S U.O.: Kök/Sürgün Uzunluk Oranı (%); S/K U.O.: Sürgün/Kök Uzunluk Oranı (%). VK (%): Varyasyon Katsayısı

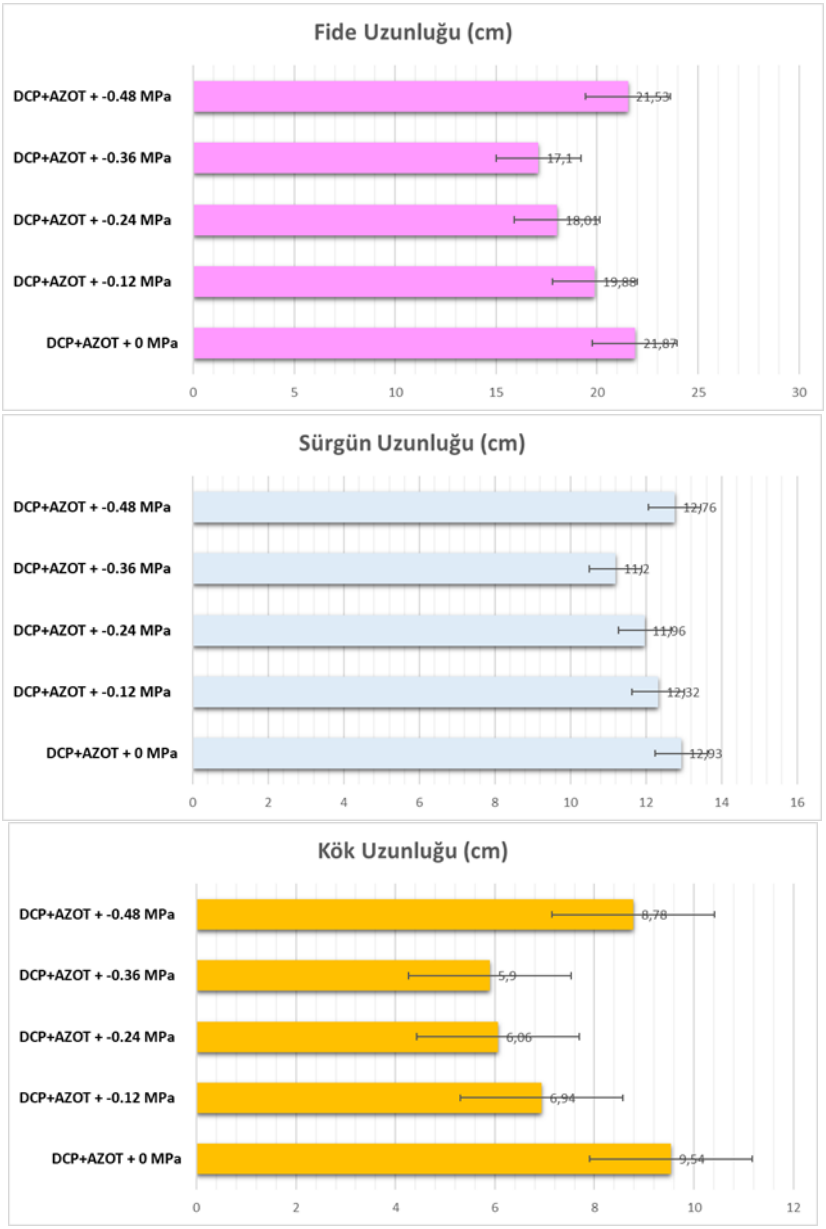


Şekil 2. Dikalsiyum Fosfat Uygulamasının Kuraklık stresi koşullarında çimlenme oranına etkileri

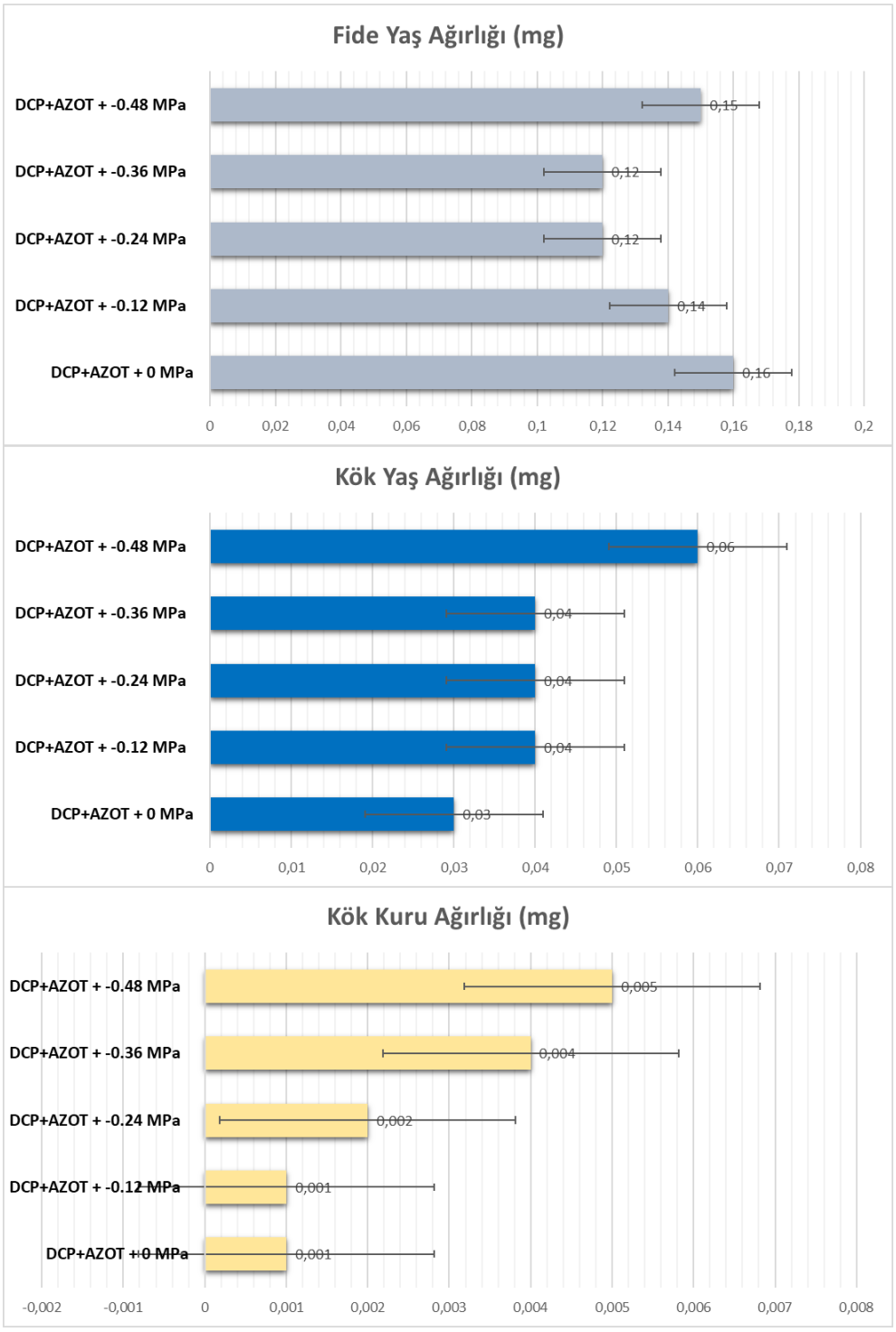
Çimlenme Oranı (gücü) (%)

Çizelgeden ve şekillerden görüldüğü gibi çimlenme oranları %93.33-20 arasında tespit edilmiştir. Uygulamaların çimlenme oranına etkisi istatistiksel olarak çok önemli bulunmuştur. En yüksek çimlenme oranı DCP+-0.12 MPa uygulamasından tespit edilmiştir. En düşük çimlenme oranı ise DCP+0 MPa uygulamasından bulunmuştur (Çizelge: 1, Şekil: 2). Kuraklık

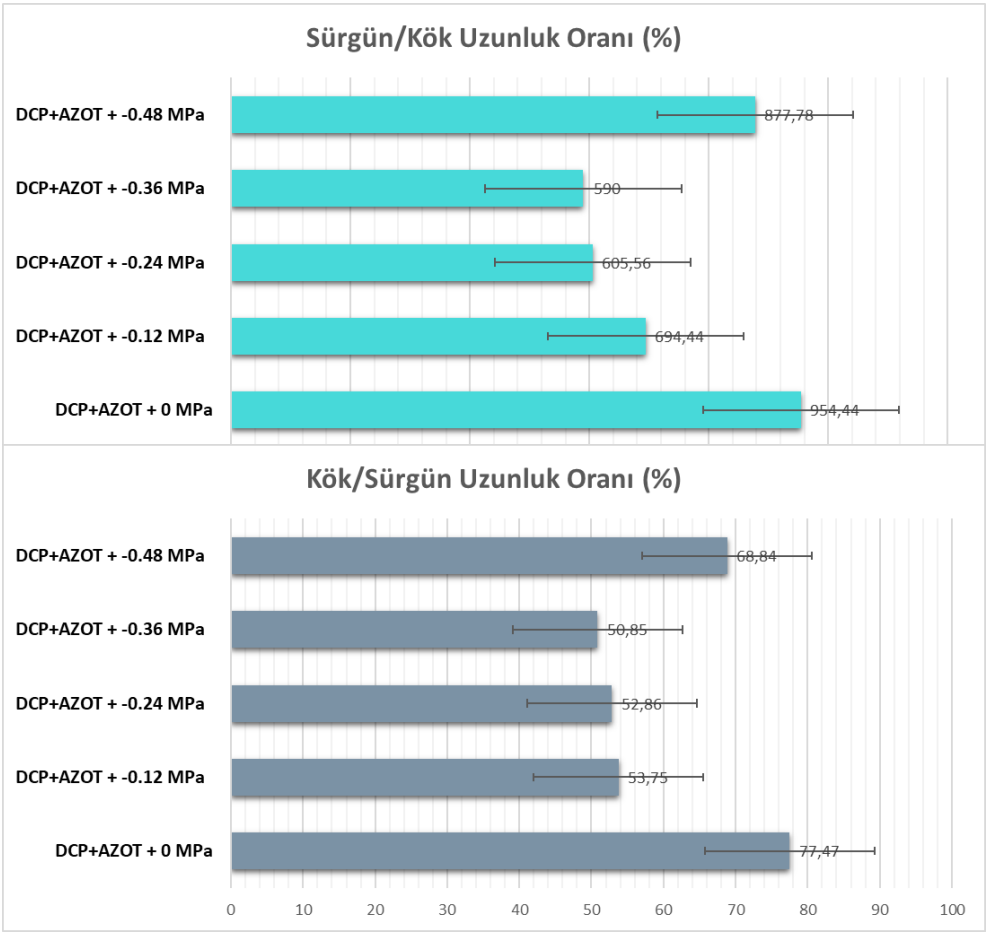
dozu, çimlenme oranına birbirlerinden farklı etkilerde bulunmuş ama genel olarak kuraklık şiddeti arttıkça çimlenme oranı artmıştır. Bu değişkenliğe neden olarak, tohumların homojen saflıkta olmama ihtimali düşünülebilir. Fakat stres koşullarının artmasına bağlı olarak çimlenme oranının yükselmesi, stres durumundaki tohumların dikalsiyum fosfatı daha fazla değerlendirmesi ya da dikalsiyumfosfatın stres durumundaki bitkilerde (stres olmayan koşula göre) daha etkili olduğunu göstermektedir. Elkatmış, (2013) ve Wang ve ark. (1995)'ın fosfor ile yaptıkları çalışmada, fosforun verimi veya büyümeyi desteklediği bildirilmiştir. Bu çalışmada da dikalsiyumfosfatın, stres koşulunda çimlenme oranını arttırdığı görülmüştür.



Şekil 3. Dikalsiyum Fosfat Uygulamasının Kuraklık stresi fide, sürgün ve kök uzunluğuna etkileri



Şekil 4. Dikalsiyum Fosfat Uygulamasının Kuraklık stresi koşullarında fide yaş ağırlığı, kök yaş ağırlığı ve kök kuru ağırlığı üzerine etkileri



Şekil 5. Dikalsiyum Fosfat Uygulamasının Kuraklık stresi koşullarında kök/sürgün ve sürgün/kök uzunluk oranına etkileri

Fide, Sürgün ve Kök Uzunluğu (cm)

Çizelgeden ve şekillerden görüldüğü gibi fide uzunluğu, kök uzunluğu özellikleri uygulamalar bakımından istatistiki olarak çok önemli, sürgün uzunluğu ise önemli bulunmuştur. Fide uzunluğu değerleri 21.87 ile 17.10 cm arasında ortalama değişiklik göstermiştir. Fide uzunluğu bakımından en yüksek değer DCP+0 MPa uygulamasından, en düşük değer DCP+-0.36 MPa uygulamasından tespit edilmiştir. Kök uzunluğu değerleri 9.54 ile 5.90 ortalama değerleri arasında değişkenlik göstermiştir. Kök uzunluğunda en yüksek değer DCP+0 MPa uygulamasından, en düşük değer ise DCP+-0.36 MPa uygulamasından bulunmuştur. Sürgün uzunluğu bakımından değerler 12.93 ile 11.20 arasında değişmiş olup en yüksek değer DCP+0 MPa uygulamasından elde edilmiş, en düşük değer DCP+-0.36 MPa uygulamasından elde edilmiştir. Dikalsiyum fosfat uygulamasının, artan kuraklık koşulları altında farklı etkilerde bulunduğu görülmektedir. Fide uzunluğuna ait değerler uygulamalar bakımından oldukça değişkenlik göstermiştir, kök uzunluğunda özellikle düşük basınçta en iyi sonuç elde edilmiştir, sürgün uzunluğunda gene genel olarak en düşük basınç altında en iyi değerler elde edilmiştir

(Çizelge: 1, Şekil: 2). Ünsal (2007), yaptığı çalışmada, yetiştirme ortamına artan dozlarda humik asit ve çinko uygulamasının, iki farklı nohut bitkisinin gelişimine ve N, P, K içeriklerine etkisinin belirlenmesini amaçlamıştır. Temel gübreleme olarak 5 kg/da amonyum sülfat formunda azot ve 6 kg/da fosfor olacak şekilde TSP uygulamıştır. Humik asit (0, 40 kg/da) ve çinkonun üç farklı dozunu (0, 2, 4 kg/da) kullanmıştır. Çalışma sonucunda, uygulamalar çeşitlerin tane ve gövdede N ve K içeriklerinde artış gözlerken, P içeriğinde azalan bir seyir izlemiştir. Verimin ve bazı agronomik parametrelerin artmasında pek çok takviye besin maddesi oldukça etkilidir. Kurak koşullarda ise tolerans sağlamasında etkili olabileceği görülmektedir. Fakat, her çeşidin kuraklığa tepkisi farklı olabilir. Tohumların biyolojik saflığı da bu sonuçların değişken olmasında ve uygulamaların net bir yorumlamaya sahip olmamasına etkili olduğu düşünülmüştür. Tunçtürk ve Tunçtürk (2021), nemli bir makro besin elementi olan fosfor; nükleoproteinlerin yapısına giren, hücre bölünmesinde rol oynayan, potasyumun bitkiler tarafından alınmasını sağlayan, kök gelişimi ve olgunlaşmayı teşvik ederek bitkilerde direnç artışını sağlamaktadır. Fosforlu gübreleme ile bitkilerde kök gelişimi artmakta ve kökün topraktaki değinim yüzeyi genişleyerek bitkilerin diğer besin maddelerinden yararlanma oranını artmaktadır. Fosforlu gübreler tohum verimi ve kalitesinin yükselmesinde de oldukça önemlidir. Ayrıca, fosforlu gübreler nodülasyonu ve nitrogenaz aktivitesini etkileyerek topraktaki azotun yararlanılabilirliğini arttırmaktır. Pek çok çalışmada, fosforun bitki gelişimi üzerinde farklı etkilerinin olduğu bildirilmektedir. Bu çalışmada da uzunluk değerleri bakımından etkili olduğu belirlenmiştir (Çizelge 2 ve Şekil 3).

Fide, Sürgün ve Kök Yaş Ağırlığı (mg)

Denemede kullanılan uygulama çeşitlerinin fide yaş ağırlığı ve kök yaş ağırlığı bulgularına etkileri istatistiksel olarak önemli bulunmuş ve sürgün yaş ağırlığına ise önemli bulunmamıştır. Fide yaş ağırlığı değerleri 0.16 ile 0.12 mg ortalama değerleri arasında, kök yaş ağırlığı değerleri 0.06 ile 0.03 mg ortalama değerleri arasında bulunmuştur. En yüksek fide yaş ağırlığı DCP+0 MPa uygulamasından, en düşük fide yaş ağırlığı ise DCP+-0.36 MPa ve DCP+-0.24 MPa uygulamalarından elde edilmiştir. En yüksek kök yaş ağırlığı DCP+-0.48 MPa uygulamasından ve en düşük kök yaş aralığı DCP+0 MPa uygulamasından bulunmuştur. Genel olarak bakıldığı zaman fide yaş ağırlığında basıncın azalması etkili olmuştur, kök yaş ağırlığında ise basıncın artması daha etkili sonuç vermiştir (Çizelge: 2, Şekil: 4). Karaca (2001) Adi Fiğ (*Vicia sativa* L.) + Arpa (*Hordeum vulgare* L.) karışımında azotlu ve fosforlu gübrelemenin verim ve kaliteye etkilerini belirlemek amacıyla yaptığı çalışmada, adi fiğ D-120 hattı ve Tokak 157 arpa çeşitlerini kullanmış ve azotlu gübrelemenin bitki boyu, yeşil ot verimi, kuru ot verimi, azot içeriği, ham protein oranı ve potasyum içeriğini, fosforlu gübrelemenin ise

karışımın fosfor içeriğini arttırdığını, en yüksek yeşil ot ve kuru ot verimlerini dekara 6 kg N ve 12 kg P2O5 tekabül eden dozlarda sırasıyla 668 kg/da ile 291 kg/da olarak tespit ettiğini bildirmiştir. Çakmak (2002) Koca fiğde (*Vicia narbonensis* L.) tohumluk miktarının, çeşitli bitkisel özellikler ile ot ve tohum verimine etkilerini belirlemek amacı ile kurduğu denemede; değişik tohumluk miktarlarının, yeşil ot, kuru ot ve tohum verimi için istatistiki olarak önemli sayılacak düzeyde etkilediğini belirtmiştir. Fosfor ve benzeri besin maddelerinin, bitki beslemedeki faydaları, bizim çalışmamızda da, farklı basınç seviyeleri ile kombine olarak etkili bulunmuş ve söz konusu araştırmacıların sonucu ile benzer sonuç elde edilmiştir.

Sürgün ve Kök Kuru Ağırlığı (mg)

Çizelge 3'ten ve şekil 3'ten görüldüğü gibi sürgün kuru ağırlığı, uygulamaların etkisi ile istatistiksel olarak önemli bulunmamıştır. Kök kuru ağırlığı ise istatistiki olarak çok önemlidir. En yüksek kök kuru ağırlığı DCP+-0.48 MPa uygulamasından, en düşük kök kuru ağırlığı ise DCP+0 MPa ve DCP+-0.12 MPa uygulamalarından elde edilmiş ve genel itibarıyla basınç arttıkça kök kuru ağırlığı değerinde artış olduğu görülmüştür (Çizelge: 3, Şekil: 4). Kahraman 2019, Bitki gelişimi için "mutlak gerekli" olan makro besin elementlerinden birisi olan fosfor, bitkilerde organik ve inorganik bileşikler şeklinde bulunmaktadır. Bitkide vejetatif büyüme sürecinde büyüme performansının en etkin şekilde sergilenmesi için bitki kuru ağırlığının %0.3-0.5"i kadar fosfor gerekmektedir. Genel olarak fosforun bitkide, besinlerin taşınması, meyve tutumu ve çiçeklenmenin artırılması, olgunlaşmanın hızlandırılması gibi birçok fizyolojik ve biyokimysal olaylarda önemli rol almaktadır (Aydın, 2011). Bu etkilerin bizim çalışmamızda kök kuru ağırlığı bakımından dikkat çektiği görülmektedir.

Kök ve Sap Yaş Ağırlık Oranları (%)

Denemede kullanılan uygulamaların kök/gün yaş ağırlık oranı ve sürgün/ kök yaş ağırlık oranına etkileri istatistiksel olarak önemli değildir (Çizelge: 4). Tarım topraklarımızda en fazla noksanlığı görülen bitki besin elementlerinden azot ve fosfor bitki gelişimi için önem arz etmektedir. Azot büyük miktarda amino grup asitlerin, proteinlerin, klorofilin ve çeşitli vitaminlerin sentezi için olması gerek ve karbondan sonra bitki dokularında en fazla bulunan ikinci elementtir (Whitehead 2000).

Kök ve Sap Uzunluk Oranı (%)

Çizelge 4'te ve şekil 5'te görüldüğü gibi kök/sürgün ve sürgün/ kök uzunluk oranları uygulamalar bakımından istatistiki olarak çok önemli bulunmuştur. Kök/ sürgün uzunluk oranı 77.47 ile 50.85 arasında değişmiştir, en yüksek kök/ sürgün uzunluk oranı DCP+0 MPa uygulamasından elde edilmiş en düşük ise DCP+-0.36 MPa uygulamasından alınmıştır. Sürgün/kök uzunluk oranı 954.44 ile 590 arasında ortalama değerleri bulunmuştur, en yüksek

değer DCP+0 MPa uygulamasından ve en düşük değer ise DCP+-0.36 MPa uygulamasından tespit edilmiştir (Çizelge: 4, Şekil: 5).

SONUÇ

Bu araştırma 5 farklı kuraklık dozunda dik kalsiyum fosfat uygulamasının yulaf çeşidinde bazı çimlenme parametrelerine etkilerinin belirlenmesi amacıyla kurulmuştur. Çalışmadan elde edilen sonuçlara göre denemede kullanılan uygulamaların etkisi ile çimlenme oranı, fide uzunluğu, kök uzunluğu, kök kuru ağırlığı, kök/sürgün ve sürgün/kök uzunluk oranları çok önemli, sürgün uzunluğu, fide yaş ağırlığı, kök yaş ağırlığı özellikleri ise önemli bulunmuştur. İncelenen diğer parametreler bakımından ise ugulamalar arasında önemli fark elde edilmemiştir.

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2,4-DİKLOROFENOKSİASETİK ASİT İÇERİKLİ HERBİSİT UYGULAMALARI İLE DİKALSİYUM FOSFATIN, TRİTİKALE (x *Triticosecale Wittmack*) TOHUMLARINA BAZI ÇİMLENME PARAMETRELERİNE ETKİLERİNİN BELİRLENMESİ

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ÖZET

Herbisitler, çeşitli yabani ot zararlılarının dayattığı mahsul-ot rekabetini azaltarak tarımsal gıda üretiminin arttırılmasında önemli bir rol oynamaktadır. Ancak herbisitlerin hedeflenmeyen canlılara potansiyel toksik etkileri göz ardı edilmemelidir. Herbisit kalıntıları, biyolojik birikim nedeniyle toprak, su kaynakları, yeraltı suları ve besin zinciri üzerinde ciddi çevresel ve sağlık sorunlarına yol açmaktadır. Artan herbisit kullanımı zamanla toprak yapısına ve canlılara zarar vermekte ve özellikle kalıntıları ise çimlenme esnasındaki bitkileri etkilemektedir. Toksik etkiler, Al, Mn ve Fe gibi elementlerin var olduğu asitli topraklarda artarken, eksiklikler ise K, Ca, Mg, P ve Mo gibi elementlerin meydana geldiği asitli topraklarda ortaya çıkabilir. Fosfor, bitkiler tarafından azottan sonra en çok kullanılan besin elementidir. Optimum büyüme ve gelişme için mutlak gerekli, makro besin elementlerinden bir tanesidir. Ayrıca fosfor, bitkilerde meydana gelen birçok fizyolojik ve biyokimyasal olaylarda bulunmakla birlikte bitki kuru ağırlığının yaklaşık olarak %0,2'sini oluşturmaktadır. Fosforun bitki gelişimi ve metabolizma açısından başlıca etkilerine bakılacak olursa; bitkilerde protein, enzimler, koenzimler, nükleik asitler ve fosfolipitlerin önemli yapısal bileşenini oluşturmakta hem fotosentez hem de solumda gerekli olan NAD, NADH, ADP ve ATP gibi fosfor içeren enerji bakımından zengin bileşiklerin sentezinde mutlak gerekli element olmakla birlikte çimlenme, erken olgunlaşma ve kök oluşumunu teşvik edici etkileri sıralanabilir. Bu sebeple, farklı herbisit uygulamaları ile Dikalsiyum fosfatın, tritikalede bazı çimlenme parametreleri üzerine etkilerinin belirlenmesi amaçlanmıştır. Bu araştırma, beş farklı herbisit dozu (%0, %0.2, %0.4, %0.6, %0.8) uygulaması ile Dikalsiyum fosfat (1 mM) ve Tatlıcak Tritikale çeşidi kullanılmıştır. Bu araştırma, 2023 yılında Ordu Üniversitesi Ziraat Fakültesi Laboratuvarında kurulmuştur. Çalışmada tek kullanımlık plastik petri kapları kullanılmıştır. Deneme tesadüf parsellerinde faktöriyel deneme desenine göre 3 tekerrürlü olarak kurulmuştur. Çalışmanın sonucuna göre denemede kullanılan uygulamaların etkisi ile çimlenme oranı, kök uzunluğu, sürgün kuru ağırlığı, sürgün/kök uzunluk oranı istatistiksel olarak çok önemli bulunmuş ancak incelenen diğer özellikler bakımından ise uygulamalar arasında önemli fark elde edilememiştir.

Anahtar Kelimeler: Dikalsiyum fosfat, Herbisit, Tritikale

DETERMINATION OF THE EFFECTS OF 2,4-DICHLOROPHENOXYACETIC ACID CONTAINING HERBICIDE APPLICATIONS AND DICALCIUM PHOSPHATE, ON SOME GERMINATION PARAMETERS OF TRITICALE (x *Triticosecale Wittmack*) SEEDS

ABSTRACT

Herbicides play an important role in increasing agricultural food production by reducing crop-weed competition imposed by various weed pests. However, the potential toxic effects of herbicides to non-target species should not be ignored. Herbicide residues cause serious environmental and health problems in soil, water resources, groundwater and the food chain due to bioaccumulation. Increased herbicide use damages soil structure and living organisms over time, and especially residues affect plants during germination. Toxic effects increase in acidic soils where elements such as Al, Mn and Fe are present, while deficiencies can occur in acidic soils where elements such as K, Ca, Mg, P and Mo occur. Phosphorus is the most utilized nutrient element by plants after nitrogen. It is one of the macronutrients absolutely necessary for optimum growth and development. In addition, phosphorus is involved in many physiological and biochemical events occurring in plants and constitutes approximately 0.2% of plant dry weight. If we look at the main effects of phosphorus in terms of plant development and metabolism; it is an important structural component of proteins, enzymes, coenzymes, nucleic acids and phospholipids in plants, it is an absolute essential element in the synthesis of phosphorus-containing energy-rich compounds such as NAD, NADH, ADP and ATP, which are necessary for both photosynthesis and respiration, and its effects on germination, early maturation and root formation can be listed. Therefore, it was aimed to determine the effects of different herbicide treatments and dicalcium phosphate on some germination parameters in triticale. In this research, five different herbicide doses (0%, 0.2%, 0.4%, 0.6%, 0.8%) and Dicalcium phosphate (1 mM) and Tatlıcak Triticale variety were used. This research was established in 2023 at Ordu University, Faculty of Agriculture Laboratory. Disposable plastic petri dishes were used in the study. The experiment was established with 3 replicates according to the factorial trial design in randomized plots. According to the results of the study, germination rate, root length, shoot dry weight, shoot/root length ratio were found to be statistically very significant with the effect of the treatments used in the experiment, but no significant difference was obtained between the treatments in terms of other traits examined.

Keywords: Dicalcium phosphate, Herbicide, Triticale

GİRİŞ

Tritikale bitkisi, buğday ve çavdarın melezi olarak, ABD, Polonya, Kanada ve Meksika gibi birçok ülkede uzun süren ıslah çalışmaları sonucunda geliştirilmiş bir bitkidir. Bu çalışmaların temel amacı, marjinal ve verimsiz tarım alanlarında yetişen bu bitkinin dekar başına verimini artırmak ve hızla artan Dünya nüfusunun gıda ihtiyacını karşılamaktır. Tritikale, buğdayın yüksek verim potansiyeli ve kalite özelliklerini taşırken çavdarın çevresel streslere ve hastalıklara karşı dayanıklılığını bir arada bulundurmayı hedefle (Yıldırım ve Yılmaz 2022). Bu nedenle tritikale, özellikle düşük yağış oranına ve sulama imkanının olmadığı kıraç koşullarda diğer tahıl türlerine göre daha verimli bir seçenek olarak öne çıkar (Boru, 2020).

Herbisitler, tarımsal gıda üretiminin artırılmasında önemli bir role sahip olup, çeşitli yabani otların bitkilerle rekabetini azaltmaktadır. Ancak herbisitlerin hedeflenmeyen canlılara potansiyel toksik etkileri göz ardı edilmemelidir. Herbisit kalıntıları, biyolojik birikim nedeniyle toprak, su kaynakları, yeraltı suları ve besin zinciri üzerinde ciddi çevresel ve sağlık sorunlarına yol açmaktadır. Son zamanlarda, geniş yabani ot kontrolü sağlama ve etkili uygulanabilirlik özellikleri nedeniyle herbisit karışımlarının kullanımı artmaktadır (Sulukan ve Köktürk, 2023). Bu nedenle, artan kullanım miktarıyla birlikte toprakta herbisit kalıntılarının birikmesi, toprak bileşimine zarar verebilmektedir.

Toksik etkiler, Al, Mn ve Fe gibi elementlerin var olduğu asitli topraklarda artarken, eksiklikler ise K, Ca, Mg, P ve Mo gibi elementlerin meydana geldiği asitli topraklarda ortaya çıkabilir. Bununla birlikte, alkalin topraklar yüksek pH değerine sahiptir ve bu durum, özellikle fosforun kullanılamaz hale gelmesine neden olan çözünmez Ca-fosfat bileşikleri oluşumuna yol açar. Fosfor, asidik topraklarda Fe, Al ve Mn gibi katyonlarla birleşerek çözünürlüğü zor bileşikler oluştururken, alkalin topraklarda pH yükseldikçe CaHPO4 ve Ca3(PO4)2 şeklinde sabitlenmeye başlar. pH 8.2'nin üzerine çıktığında ise toprakta fazla miktarda bulunan Na iyonu nedeniyle çözünürlüğü yüksek sodyum fosfatlar oluşur. Ancak, yüksek toprak pH'sı nedeniyle bitkilere faydalı olamazlar (Maltaş, 2013). Bu sebepler dolayısıyla bu araştırmanın amacı, 2,4-Diklorofenoksiasetik Asit içeren bir herbisit uygulamasının Dikalsiyum fosfat üzerindeki etkilerini tritikale tohumlarının çimlenme değerleri üzerinde incelemektir

MATERYAL ve METOT

Bu çalışmada, beş farklı herbisit dozu (%0, %0.2, %0.4, %0.6, %0.8) uygulaması ile Dikalsiyum fosfat (1 mM) ve Tatlıcak Tritikale çeşidi kullanılmıştır. Denemede 2,4-Diklorofenoksiasetik Asit içerikli ticari marka herbisit ilacı kullanılmıştır. Deneme tesadüf parsellerinde faktöriyel deneme desenine göre 3 tekrarlı olarak planlanmıştır.

Çimlendirme Yöntemi

Ön çimlendirme testlerinden sonra solüsyonlar hazırlanmıştır (Yıldırım ve Yılmaz 2023); Yıldırım ve Bilgen 2022). Tek kullanımlık plastik petri kutuları içerisine, 2 ml herbisit solüsyonu, 2 ml Dikalsiyum fosfat sıvı çözeltisi eklenerek filtre kâğıdı nemlendirilmiştir. Üzerine sterilize edilmiş tohumlar pens yardımıyla düzenli biçimde yerleştirilmişlerdir. Tohum ekimi tamamlanarak etrafı streç film ile kapatılan petri kutuları sıcaklığı 20±5 °C olan etüve konularak karanlık koşullarda tohum çimlenme denemeleri başlatılmıştır. (50 adet tritikale tohumuna, 4 ml solüsyon kullanılması, yapılan ön çimlendirme çalışmasına göre önceden belirlenmiştir.) Çimlenme için radikulanın 2 mm testadan çıkmış olması esas kabul edilmiştir. Toplamda 10 günün sonunda ölçümler alınmıştır. Araştırmada; çimlenme oranı (gücü) (%), fide uzunluğu (mm), sürgün uzunluğu (mm), kök uzunluğu (mm), fide yaş ağırlığı (mg), sap yaş ağırlığı (mg.), kök yaş ağırlığı (mg.), sap kuru ağırlığı (mg.), kök kuru ağırlığı (mg.), sürgün/kök-kök/sürgün yaş ağırlık oranı (%), sürgün/kök-kök/sürgün uzunluk oranı (%), gibi parametreler değerlendirilmiştir.

Çimlenme Oranı (Gücü) (%): 10. gün sonunda çimlenen tohumlar sayılarak, (çimlenen tohum sayısı/toplam tohum sayısı) x 100 formülü ile çimlenme oranı % olarak hesaplanmıştır (Akıncı ve Çalışkan, 2010).

$$G.R.\ (\%) = \frac{Number\ of\ Total\ Germinated\ Seeds}{Total\ Number\ of\ Seeds\ Tested}\ X\ 100$$

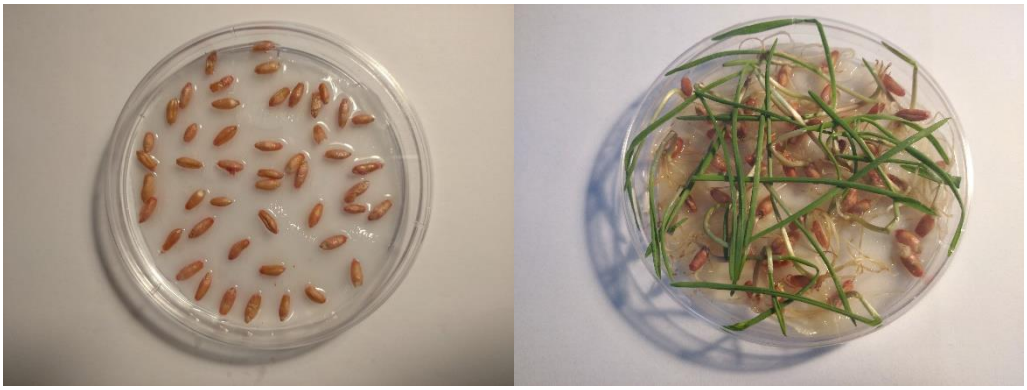
Fide, Sürgün ve Kök Uzunluğu (cm): Sürgün ve kök uzunluğu milimetrik cetvelle ölçülerek belirlenmiştir. Deneme sonunda tesadüf olarak seçilen 10 bitkinin sap uzunluğu milimetrik cetvelle ölçülerek belirlenmiştir. (Yılmaz ve Kısakürek 2021).

Fide, Sürgün ve Kök Yaş Ağırlığı (mg.): Her bir gruptan rastgele seçilen bitkilerin (5 adet) yeşil aksamları ayrılarak, taze ağırlıkları hassas terazi ile mg cinsinden tartılmıştır. (Yıldız ve Özgen, 2004)

Sürgün ve Kök Kuru Ağırlığı (mg.): Yaş ağırlık belirlenen kökler 70°C hava dolaşımlı fırında durağan ağırlığa gelinceye kadar kurutulduktan sonra hassas terazide tartılarak kuru ağırlıkları (mg bitki-1) belirlenmiştir (Yılmaz ve Kısakürek 2021).

Sürgün/Kök ve Kök/Sürgün Yaş Ağırlık Oranı (%): Her bitkinin sürgün ve kök yaş ağırlıklarının tartılıp birbirlerine oranlanması ile bulunmuştur. Toplamda 10'ar bitkide ölçüm yapılmış ve ortalaması alınmıştır.

Sürgün/Kök ve Kök/Sürgün Uzunluk Oranı (%): Her bitkinin sürgün ve kök uzunlukları milimetrik cetvel ile ölçülmüş ve birbirlerine oranlanmıştır. Toplamda 10'ar bitkide ölçüm yapılmış ve ortalaması alınmıştır.



Şekil 1: Tohumların çimlenmesi

İstatistiksel Analiz

İstatistiki analizler JMP13 programında, varyans analizi ANOVA testi, çoklu karşılaştırmalara ise Tukey testi ile yapılmıştır.

BULGULAR ve TARTIŞMA

Bu araştırma, beş farklı herbisit dozu (%0, %0.2, %0.4, %0.6, %0.8) uygulaması ile Dikalsiyum fosfat (1 mM)'ın, Tatlıcak Tritikale çeşidinde bazı çimlenme parametreleri üzerindeki etkilerine ait bulgular Çizelge 1'de verilmiştir.

Çizelge 5. Farklı herbisit dozu uygulaması altında dikalsiyum fosfatın çimlenme oranı, sürgün uzunluğu, kök uzunluğu ve fide boyuna etkileri

Uygulamalar	Ç.O. **	F.U. ö.d.	K.U. **	S.U. ö.d.
DCP+ %0	80.00^{b}	15.93	2.77^{b}	4.39
DCP+ %0.2	93.33^{ab}	23.17	10.07^{a}	4.37
DCP+ %0.4	100.00^{a}	17.83	7.90^{a}	3.31
DCP+ %0.6	80.00^{b}	23.33	10.90^{a}	4.14
DCP+ %0.8	93.33^{ab}	23.33	9.47^{a}	4.62
VK (%)	0.067	0.198	0.184	0.253

(**p<0.01, *p<0.05, **ö.d.:** önemli değil). **Ç.O.:** Çimlenme Oranı (%); **F.U.:** Fide Uzunluğu (cm); **K.U.:** Kök Uzunluğu (cm); **S.U.:** Sürgün Uzunluğu (cm). ***VK (%):*** Varyasyon Katsayısı
0,2 0,4 0,6 0,8

Çizelge 6. Farklı herbisit dozu uygulaması altında dikalsiyum fosfatın fide, sürgün ve kök yaş ağırlığına etkileri

Uygulamalar	F.Y.A. ö.d.	S.Y.A. ö.d.	K.Y.A. ö.d.
DCP+ %0	0.16	0.11	0.02
DCP+ %0.2	0.24	0.14	0.03
DCP+ %0.4	0.18	0.11	0.02
DCP+ %0.6	0.20	0.12	0.03
DCP+ %0.8	0.24	0.14	0.03
VK (%)	0.194	0.176	0.250

(**p<0.01, *p<0.05, **ö.d.:** önemli değil). **F.Y.A.:** Fide Yaş Ağırlığı (mg); **S.Y.A.:** Sürgün Yaş Ağırlığı (mg); **K.Y.A.:** Kök Yaş Ağırlığı (mg); ***VK (%):*** Varyasyon Katsayısı

Çizelge 7. Farklı herbisit dozu uygulaması altında dikalsiyum fosfatın sürgün ve kök kuru ağırlığına etkileri

Uygulamalar	S.K.A. **	K.K.A. ö.d.
DCP+ %0	0.007^{c}	0.003
DCP+ %0.2	0.008^{bc}	0.003
DCP+ %0.4	0.011^{abc}	0.004
DCP+ %0.6	0.013^{ab}	0.007
DCP+ %0.8	0.014^{a}	0.006
CV (%)	0.180	0.412

(**p<0.01, *p<0.05, **ö.d.:** önemli değil). **S.K.A.:** Sürgün Kuru Ağırlığı (mg); **K.K.A.:** Kök Kuru Ağırlığı (mg); ***VK (%):*** Varyasyon Katsayısı

Çizelge 8. Farklı herbisit dozu uygulaması altında dikalsiyum fosfatın kök/sürgün ve sürgün/kök uzunluk ve ağırlık ortalamalarına etkileri

Uygulamalar	K/S Y.A.O. ö.d.	S/K Y.A.O. ö.d.	K/S U.O. ö.d.	S/K U.O. **
DCP+ %0	15.74	649.24	63.03	276.67^{b}
DCP+ %0.2	23.41	434.86	233.56	1006.67^{a}
DCP+ %0.4	20.59	491.73	400.02	790.00^{a}
DCP+ %0.6	22.01	462.89	260.63	1090.00^{a}
DCP+ %0.8	21.88	458.67	205.08	946.67^{a}
VK (%)	0.145	0.160	0.719	0.184

(**p<0.01, *p<0.05, **ö.d.:** önemli değil). **K/S Y.A.O.:** Kök/Sürgün Yaş Ağırlık Oranı (%); **S/K Y.A.O.:** Sürgün/Kök Yaş Ağırlık Oranı (%); **K/S U.O.:** Kök/Sürgün Uzunluk Oranı (%); **S/K U.O.:** Sürgün/Kök Uzunluk Oranı (%). ***VK (%):*** Varyasyon Katsayısı

Çimlenme Oranı (gücü) (%)

Çizelgeden ve şekillerden görüldüğü gibi çimlenme oranları %100-80 arasında tespit edilmiştir. Uygulamaların çimlenme oranına etkisi istatistiksel olarak çok önemli bulunmuştur. En yüksek çimlenme oranı DCP+ %0.4 uygulamasından tespit edilmiş bunu sırasıyla DCP+ %0.2 ve DCP+ %0.8 uygulamaları izlemiştir (Çizelge: 1, Şekil: 1). Elkatmış, (2013), hümik asit ve farklı fosfor dozları uygulamalarının nohutta verim ve verim öğelerine etkisini belirlemek üzere kurulan çalışmada üç farklı fosfor (0, 4 ve 8 kg/da) ve üç farklı hümik asit dozu (0, 30 ve 60 kg/da) dozları uygulanmıştır. Denemenin sonunda hümik asit ve fosfor dozlarının verim ve verim öğelerinde önemli artışlar sağladığı belirlenmiştir. Wang ve ark. (1995), buğday bitkisinde alkali topraklarda, fosforun dönüşümü üzerine humik asidin etkisini hem saksı ve hem de tarla denemelerinde araştırdıkları çalışmada toprağa fosforla birlikte humik asit ilavesinin suda çözünebilir fosfat miktarını önemli derecede artırdığını, fosfor alınımını ve buğday verimini %25 artırdığını bildirmişlerdir. Altıparmak (2016), ICARDA'dan temin edilen Lübnan kökenli H1;5143 numaralı koca fiğ hattı, Türkiye kökenli H2; 5226 numaralı koca fiğ hattıve Irak kökenli H3; 5538 numaralı koca fiğ hatlarında, fosforun dört farklı dozu dozları P_2O_5'e tekabül edecek şekilde Triple Süper Fosfat formunda gübre dozlarının verim ve verim unsurları üzerine etkisi incelenmiştir. Sonuç olarak fosforun ancak belirli miktarda olması, optimum verimi sağladığını göstermiştir. Araştırmacıların bildirdiği gibi, fosforlu besinlerin çimlenme oranı üzerinde olumlu etkileri görülmüştür. Ayrıca herbisit uygulaması, çimlenme oranında artışa neden olmuştur.

Fide, Sürgün ve Kök Uzunluğu (cm)

Fide ve sürgün uzunluğu bakımından; uygulamalar arasında istatistiksel olarak önemli farklar bulunamamıştır. Kök uzunluğu bakımından ise uygulamalar istatistiki olarak çok önemli farklılıklara sahiptir. Çizelgeden ve şekillerden görüldüğü gibi fide uzunluğu 23.33-15.93 cm, sürgün uzunluğu 4.62-3.31 cm arasında tespit edilmiştir. Kök uzunluğu değerleri 10.90-2.77 cm arasında bulunmuştur. En yüksek kök uzunluğu DCP+ %0.6 uygulamasından tespit edilmiş ancak 0'lık uygulama hariç diğerleri ile aynı gruba dahil olmuş ve aralarında istatistiki olarak fark bulunamamıştır (Çizelge: 1, Şekil: 1). Çalışmada artan herbisit dozu ve dikalsiyumfosfat uygulamaları, uzunluk değerlerini genel olarak arttırmıştır. Herbisitin, fide tarafından besinsel olarak kullanılabileceği düşünülmektedir. Dikalsiyumfosfat, artan herbisit dozu uygulamaları ile etkisini arttırmış olabilir. Zira fosfor türevi besinler, bitkilerin büyümesi için yardımcı maddelerdendir (Ünsal (2007).

Fide, Sürgün ve Kök Yaş Ağırlığı (mg)

Denemede kullanılan uygulamalar bakımından, fide, sürgün ve kök yaş ağırlığı istatistiki olarak önemli bulunmamıştır. Fide yaş ağırlığı 0.24 ile 0.16 mg, sürgün yaş ağırlığı 0.14 ile 0.12 mg ve kök yaş ağırlığı 0.03 ile 0,02 mg arasında ortalama değerlere sahiptir (Çizelge: 2).

Kök ve Sürgün Kuru Ağırlığı (mg)

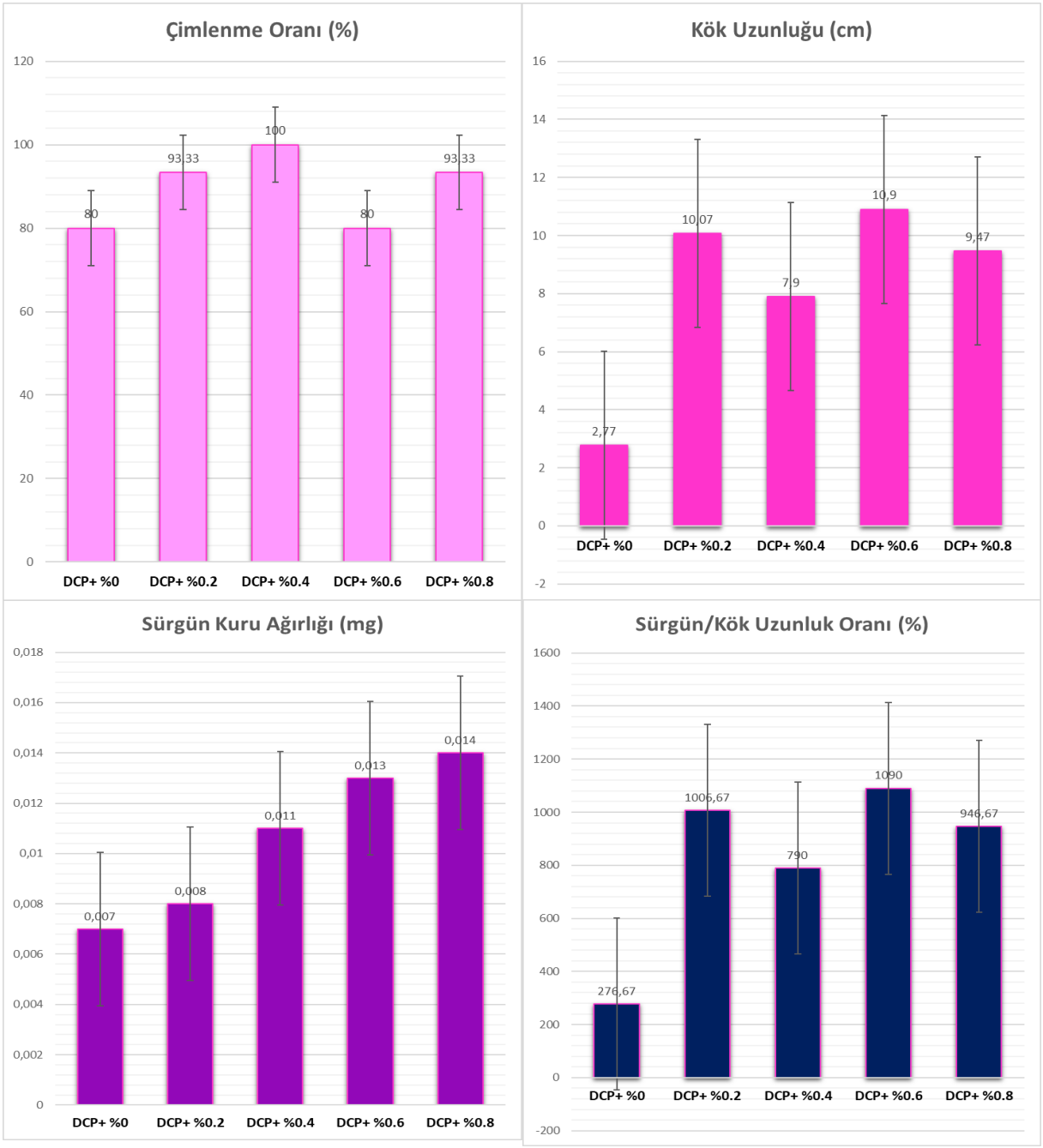
Uygulamaların kök ve sürgün kuru ağırlığına etkileri incelendiği zaman, çizelge 3'te görüldüğü gibi sürgün kuru ağırlığına etkisi istatistiksel olarak çok önemli, kök kuru ağırlığına ise önemli bulunmamıştır. Sürgün kuru ağırlığı değerleri 0.014 ile 0.007 mg arasında değişkenlik göstermiş ve en yüksek sürgün kuru ağırlığı DCP+ %0.8 uygulamasından, en düşük sürgün kuru ağırlığı ise DCP+ %0 uygulamasından tespit edilmiştir. Artan basınç seviyeleri ile birlikte sürgün kuru ağırlığında da artışlar meydana gelmiştir (Çizelge: 1).

Kök ve Sap Yaş Ağırlık Oranları (%)

Kök/sürgün yaş ağırlık oranı ve sürgün/ kök yaş ağırlık oranı incelendiğinde uygulamalar bakımından istatistiki olarak önemli sonuçlar elde edilmemiştir. Kök/sürgün yaş ağırlık oranı 23.41 ile 15.74 arasında, sürgün/kök yaş ağırlık oranı ise 649.24 ile 434.86 arasında değişkenlik göstermiştir (Çizelge: 4).

Kök ve Sürgün Uzunluk Oranı (%)

Kök/sürgün uzunluk oranı ve sürgün/kök uzunluk oranı değerleri incelendiğinde uygulamaların sürgün/kök uzunluk oranına etkisi çok önemli, kök/sürgün uzunluk oranına ise önemli bulunmamıştır. Sürgün/kök uzunluk oranı 1090.0 ile 276.67 değerleri arasında değişkenlik göstermiştir. En yüksek sürgün/kök uzunluk oranı DCP+ %0.6 uygulamasından ve en düşük oran ise DCP+ %0 uygulamasından alınmıştır (Çizelge: 4, Şekil: 1).



Şekil 2. Farklı herbisit dozu uygulaması altında dikalsiyum fosfatın çimlenme oranı, kök uzunluğu, sürgün kuru ağırlığı ve sürgün/kök uzunluk oranı üzerine etkileri

SONUÇLAR ve ÖNERİLER

Bu araştırma 5 farklı herbisit dozu ile dikalsiyum fosfatın tritikale çeşitlerinde bazı çimlenme parametreleri üzerine etkileri incelenmiştir. Çalışmanın sonucuna göre denemede kullanılan uygulamaların etkisi ile çimlenme oranı, kök uzunluğu, sürgün kuru ağırlığı, sürgün/kök uzunluk oranı istatistiksel olarak çok önemli bulunmuş ancak incelenen diğer özellikler bakımından ise uygulamalar arasında önemli fark elde edilememiştir.

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ASSESSMENT OF HAEMOLYTIC ACTIVITIES OF BACTERIAL ISOLATES FROM A MUNICIPAL ABATTOIR WASTEWATER EFFLUENTS AND RECEIVING WATER MILIEU

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ABSTRACT

This study evaluated haemolytic activities of bacteria isolated from Onyearugbulem abattoir wastewater and its environs. A total of one hundred and eighty two (182) bacterial isolates were tested for haemolytic activity using plate based zone of inhibition method. Eighty two (82) bacterial isolates showed growth on the blood agar but no haemolysis (Gamma haemolysis). Fifty three (53) isolates showed no growth on sheep blood agar while twenty (20) and twenty seven (27) isolates showed partial (alpha haemolysis) and complete haemolysis (beta haemolysis) on the sheep blood agar plates respectively. Eighty two (82) bacterial isolates also showed growth on the cow blood agar plates but no haemolysis (Gamma haemolysis), forty three (43) isolates showed no growth on the agar, while twenty four (24) and thirty three (33) isolates showed partial (alpha haemolysis) and complete haemolysis (beta haemolysis) on cow blood agar plates. This work revealed the presence of hemolytic bacteria in studied wastewater and water samples, this indicates that the water sources contain virulent bacteria thus, serve as potential sources of risks to the public and environmental health.

Keywords: Bacterial, Gamma, Alpha, Beta, Haemolysis, Wastewater, Public healt

INTRODUCTION

The abattoir industry is an important component of livestock industry in Nigeria, providing meat supplies to over 150 million people and employment opportunities for the teaming population (Nafarnda *et al.,* 2012). An abattoir, also called a slaughterhouse, is a facility where apparently healthy animals are killed for consumption as food products (Neboh *et al.,* 2013). Although the slaughtering of animals results in significant meat supplies, a good source of protein and production of useful by-products such as leather, skin and bones, the processing activities involved result in environmental pollution and other health hazards to man and animals (Akinro *et al.,* 2009, Abdullahi *et al.,* 2017). Earlier in the year 2012, the Nigeria Veterinary Medical Association (NVMA) warned of imminent outbreak of diseases in the country abattoirs and slaughter slabs nationwide if nothing was done to bring sanity into their operations. The meat processing industry continues to produce large volumes of slaughterhouse wastewater due to the slaughtering and processing of animals and cleaning of the slaughterhouse facilities and meat processing plants (Padilla-Gasca *et al*., 2011; Bustillo-Lecompte; Mehrvar, 2015).

Haemolytic microorganisms are microorganisms that produce haemolysins to degrade blood cells. Haemolysins are proteins that lyse red blood cells and their action is usually receptor-mediated (Cin *et al.,* 2016). There are many classes of haemolysins, including α, β and γ-haemolysins. Delta (δ) haemolysin has been classified as a phenol-soluble modulin (PSM) that does not require a receptor for its haemolytic activity. α-haemolysin is the most well studied member of staphylococcal haemolysins. This small β-barrel pore-forming cytotoxin lyses red blood cells and leukocytes, but not neutrophils (Valeva *et al.,* 1997), via binding to its proteinaceous receptor ADAM10, a disintegrin and metalloproteinase (Wilke *et al.,* 2010).

In sepsis, synergistic action of α-toxin on myeloid cells and platelets has been shown to kill host animals and ADAM10 knockout models appear to be protected from the lethal effects of this toxin (Powers *et al.,* 2015). Upon binding of the toxin with its receptor, pore formation on cell membranes will cause Ca^{2+} influx and K^{+} efflux; this disruption in homeostasis, in turn, leads to necrotic cell death (Valeva *et al.,* 1997). Beta-haemolysin is non-pore-forming and has been characterized as a sphingomyelinase (Powers *et al.,* 2015). The toxin hydrolyses sphingomyelin and also lyses monocytes; however, it only lyses erythrocytes at low temperatures and it has no cytolytic effect on lymphocytes and granulocytes (Walev *et al.,* 1996). Even though its target cells are known, the toxin's mode of action is still unclear. It has been postulated that as β-haemolysin acts mostly on sphingomyelin, the toxin most probably

destabilizes the cells' plasma membrane bi-lipid layer and causes irregularity in plasma membrane fluidity (Vandenesch *et al.,* 2012).

Gamma-haemolysin is haemolytic to rabbit erythrocytes and its membrane damaging activity is also apparent in leukocytes (neutrophils, monocytes, granulocytes, and macrophages) (Vandenesch *et al.,* 2012). This group of haemolysins are bi-component and made up of polypeptides designated as S (slow, HlgA or HlgC) and F (fast, HlgB), where the S components are proposed to influence cell type susceptibilities to these toxins (Meyer *et al.,* 2009).

Haemolysins are lytic proteins that act on membranes of mammalian cells, thereby leading to cellular lysis (Goni and Ostolaza, 1998). Haemolysins are one of the major virulence factors in pathogenic bacteria and, in certain cases, are vital for the growth of the respective microbe (Zhang and Austin, 2005; Singh *et al.,* 2010). To date, haemolysins have been identified in other Actinomycetes, including *Mycobacterium avium* (Maslow *et al.,* 1999) and *Mycobacterium tuberculosis* (Rahman *et al.,* 2010).

This study is aimed at evaluating haemolytic activities of bacteria isolated from a municipal abattoir wastewater and its environs.

MATERIALS and METHODS

Wastewater and water samplings was done at Onyearugbulem abattoir in Akure, Ondo State, Southwestern Nigeria and the tests were carried out in the Microbiology Department laboratory, School of Life Sciences, Federal University of Technology Akure, Nigeria.

Resuscitation of Bacterial Isolates

Bacterial isolates from abattoir wastewaters were resuscitated by streaking on nutrient agar (Biolab) at 37 ^{0}C for 24 hours. The bacterial isolates was isolated and presumptively identified in Olusola-Makinde *et al.* (2018).

Haemolytic Activity of Isolates From Onyearugbulem Abattoir Samples

Eighteen hour old strains in nutrient broth (Biolab) were tested for haemolytic activity on nutrient agar base (Biolab) supplemented with 5% defibrinated sheep blood with incubation at 37 ^{0}C for 24 hours (Singh *et al.,* 2010). Haemolytic activity was also compared with 5% defibrinated cow blood. Strains were streaked on chocolate agar plates (prepared from heating nutrient agar base (Biolab) containing 5% defibrinated sheep blood to 80 ^{0}C) and incubated for 24 hours at 37 ^{0}C.

Bacterial isolates were standardized by adjusting 18-hour broth culture to 0.08-0.1 OD_{600}. Five microliters was spotted on nutrient agar base (Biolab) supplemented with 5% defibrinated sheep blood in triplicate. Plates were incubated at 37 ^{0}C for 48 hours. The presence of a distinctive translucent halo around the inoculums site indicates positive haemolytic activity. Bacterial

growth with translucent ring indicates beta (β) or complete haemolysis, bacterial growth with greenish-black halo ring indicates alpha (α) or incomplete haemolysis and bacterial growth with no colour change around the colony indicates gamma (γ) haemolysis. Haemolytic index (Hi) was determined as the ratio obtained by dividing the diameter of the colony by the total diameter of the colony plus the translucent halo (Yigit *et al.*, 2009).

RESULTS

Figures 1 and 2 showed haemolytic activity of bacterial isolates from Onyearugbulem abattoir wastewater on 5% defibrinated sheep and cow blood respectively. A total of 182 bacterial isolates were tested for haemolytic activity. Eighty two bacterial isolates showed growth on the blood agar but no haemolysis (Gamma haemolysis). Fifty three isolates showed no growth on sheep blood agar while 20 and 27 isolates showed partial (alpha haemolysis) and complete haemolysis (beta haemolysis) on the sheep blood agar plates respectively. Eighty two bacterial isolates also showed growth on the cow blood agar plates but no haemolysis (Gamma haemolysis), 43 isolates showed no growth on the agar, while 24 and 33 isolates showed partial (alpha haemolysis) and complete haemolysis (beta haemolysis) on cow blood agar plates.

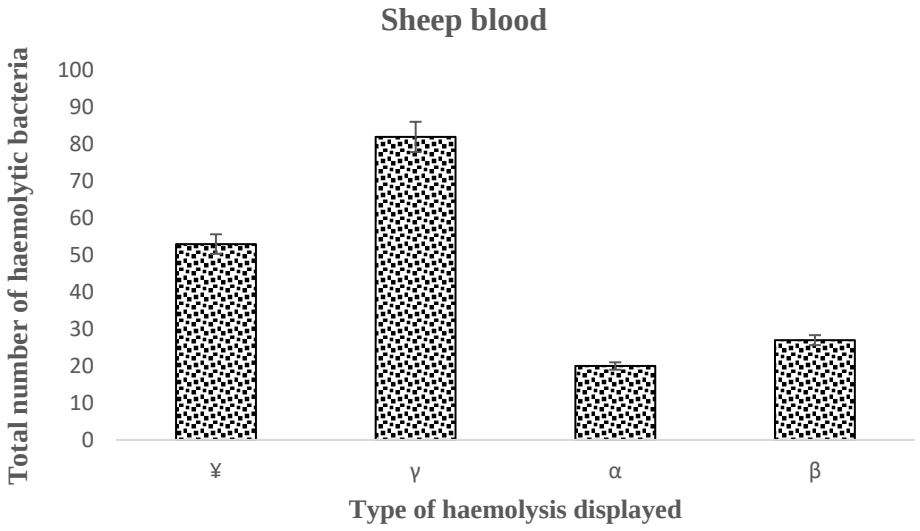

Figure 1: Haemolytic activity of Onyearugbulem abattoir bacterial isolates on 5% defibrinated sheep blood

Key: ¥ = no growth on blood agar, γ = Gamma or no haemolysis, α = Alpha or partial haemolysis and β = Beta or complete haemolysis

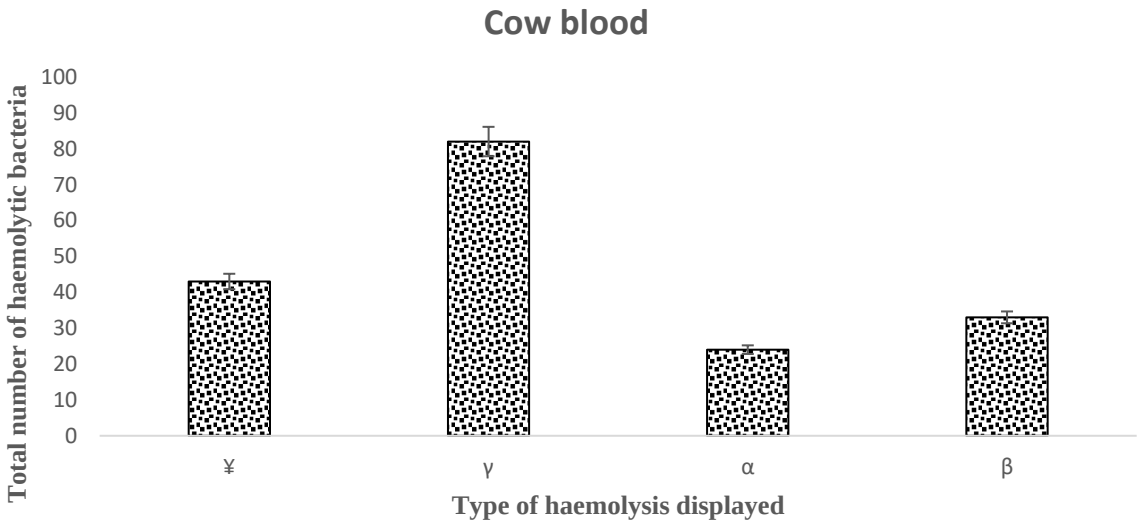

Figure 2: Haemolytic activity of Onyearugbulem abattoir bacterial isolates on 5% defibrinated cow blood

Key: ¥ = no growth on blood agar, γ = Gamma or no haemolysis, α = Alpha or partial haemolysis and β = Beta or complete haemolysis.

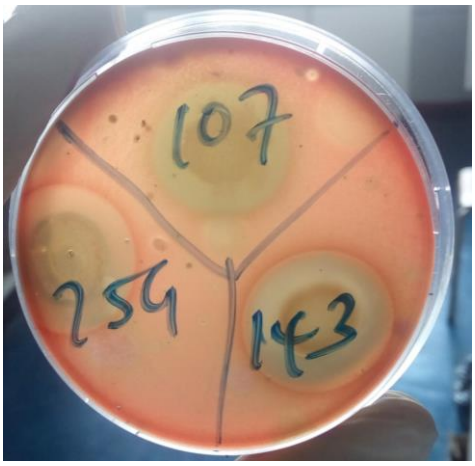

Plate 1: Haemolytic activity of isolates 75, 107 and 143 on sheep blood agar plate

DISCUSSION

Haemolysins are exotoxins produced by bacteria that cause lysis of red blood cells *in vitro*. The haemolytic activity of isolates from Onyearugbulem abattoir revealed the diverse ability of bacteria to haemolyse. The isolates displayed the three different types of haemolysis; that is β (complete) haemolysis, α (partial) haemolysis and γ (no) haemolysis. The ability of microorganisms to acquire elemental iron has been shown to be pivotal importance in their survival. There is essentially no free iron in the host, most microorganisms acquire iron

indirectly from commonly available iron containing compounds such as haemoglobin form which is major component of abattoir wastewaters. In order to do so, however, the pathogen should be equipped with a mechanism that destroys the heme moiety and enables it to extract the elemental iron (Yigit *et al.*, 2009). The enzymes involved in this activity are classified as haemolysins (Manns *et al.*, 1994; Luo *et al.*, 2001; Lineras *et al.*, 2007; Shinobu *et al.*, 2007; Tsang *et al.*, 2007). The plate assay method enables a morphological approach to the activity of haemolysin on blood agar plates.

CONCLUSION

This work revealed the presence of hemolytic bacteria in studied wastewater and water samples, this indicates that the water sources contain virulent bacteria thus, serve as potential sources of risks to the public and environmental health.

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VÜCUT KONDİSYON SKORUNUN KOLOSTRUM KALİTESİ VE BAZI SÜT BİLEŞENLERİNE ETKİSİ

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ÖZET
Bu çalışma, vücut kondisyon skorunun kolostrum kalitesi ve bazı süt bileşenleri üzerindeki etkisini belirlemek amacıyla yapılmıştır. Çalışmada ikinci laktasyonunda ve çeşitli vücut kondisyonunda olan 60 baş sığır materyal olarak kullanılmıştır. Çalışmada Siyah Alaca inekler vücut kondisyon puanlarına göre 3 gruba ayrılmıştır. Kondisyon 1. grup vücut kondisyon skoru VKS≤3 olan 14 inekten oluşurken, Kondisyon 2. grup vücut kondisyon skoru 3<VKS<4 arasında değişen 38 inekten, Kondisyon 3. grup ta vücut kondisyon skoru VKS≥4 olan 8 inekten oluşmuştur. Çalışmamızda vücut kondisyon skorunun kolostrum kalitesi, laktoz ve süt verimi üzerinde etkili olduğu tespit edilirken (P<0.05); kuru madde, yağ ve proteini etkilemediği anlaşılmıştır (P>0.05).

Anahtar Kelimeler: Vücut Kondisyon Skoru, Kolostrum, Siyah Alaca

EFFECT OF BODY CONDITION SCORE ON COLOSTRUM QUALITY AND SOME MILK COMPONENTS

ABSTRACT

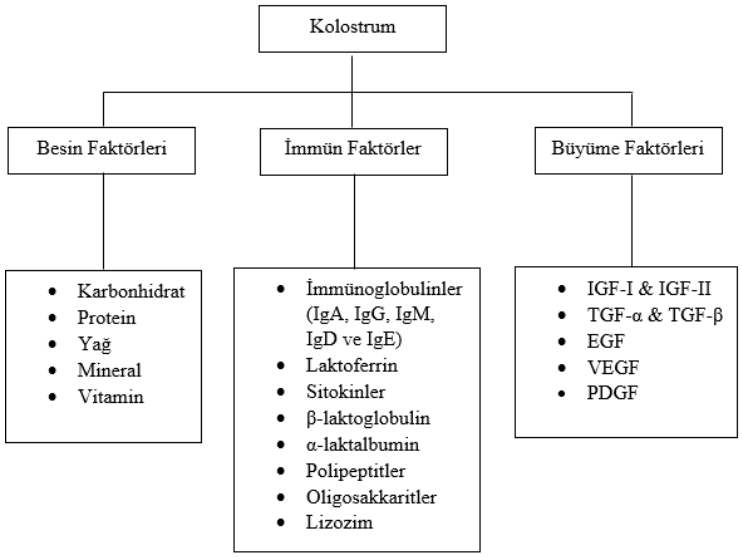
This study was carried out to determine the effect of body condition score on colostrum quality and some milk components. In the study, 60 cows in their second lactation and in different body conditions were used as material. Holstein cows were divided into 3 groups according to their body condition scores in the study. Condition 1 group consisted of 14 cows with body condition score of BCS ≤3, Condition 2 group consisted of 38 cows with body condition score between 3< BCS <4, and Condition 3 group consisted of 8 cows with body condition score of BCS ≥4. In our study, it was determined that body condition score was effective on colostrum quality, lactose and milk yield ($P<0.05$); it was found that it did not affect dry matter, fat and protein ($P>0.05$).

Keywords: Body Condition Score, Colostrum Quality, Holstein

GİRİŞ

Doğum sonrası meme bezlerinden salgılanan pek çok özellik ve komponent içeren ilk sekresyona kolostrum denir. Kolostrum yalnızca protein, karbonhidrat, yağ, vitamin ve mineral gibi besin kaynağı değil, aynı zamanda spesifik fonksiyonlar için gerekli olan biyolojik aktif moleküller içermektedir. Kolostrumdaki en önemli biyoaktif komponentler antimikrobiyel faktörler ile büyüme faktörleridir (Aydoğdu, 2014).

Kolostrum, bağışıklık sağlayan antikorlar (immünoglobulinler) içerdiğinden yeni doğan buzağı için hayati önem taşır. Ayrıca büyüme için gerekli olan enerji ve besinler açısından da zengindir. Hayata iyi bir başlangıç için süt buzağılarının ilk besin olarak kaliteli kolostruma ihtiyacı vardır (Anonim, 2023).



Şekil 1. Kolostrum içeriği (Karlıdağ, 2020)

Ruminant hayvanlarda varolan plasenta tipinden dolayı immünoglobulinlerin yavruya geçişi sağlanamamakta ve yavrunun immünitesi, doğum sonrası alınan kolostrum ile edinilmektedir (Yılmaz ve Akgül, 2014).

Doğumun erken saatlerinde kolostrum yoluyla pasif antikor alımı buzağıların hayatta kalması için çok önemlidir. Yüksek kaliteli kolostrum tüketimi ölüm oranını azaltabilir, bağışıklığı güçlendirebilir ve buzağıların yaşayabilirliğini artırabilir. Bu nedenle buzağılar doğumdan sonra mümkün olan en kısa sürede kolostrum tüketerek pasif bağışıklıklarını sağlamalıdır (Yanuartono ve ark., 2022). Buzağılar kendi aktif bağışıklığını sentezleyene kadar doğum sonrası dönemde zararlı patojenik mikroplara karşı direnç oluşturmada doğumdan sonraki ilk bir saat içinde tükettikleri kolostrumdan sağladıkları immünoglobulinler ihtiyaç

duyarlar (Floren ve ark., 2006). Ayrıca kolostrumda bulunan immunoglobulinler, özellikle IgG, buzağıyı çeşitli hastalıklardan koruyabilmektedir (Besser ve ark., 1991; Godden, 2008).

Bağışıklığın pasif aktarımına ilişkin araştırmalar, 1892 ile 1893 yılları arasında, maternal antikorların yeni doğan hayvanlara nasıl aktarıldığını inceleyen Paul Ehrlich'in çalışmasıyla başladı. Ehrlich, aktif ve pasif bağışıklık arasında ayrım yapan ilk kişiydi (Silverstein, 1996).

Vücut kondisyon skoru (VKS), süt sığırlarının vücut yapılarının 1 ve 5 arasındaki kategoride, zayıf veya aşırı yağlı oluşlarının değerlendirilmesidir. Vücut kondisyon skoru 5'lik bir sistem olup, bu sistemde 1 aşırı zayıf hayvanı, 2 zayıf, 3 orta, 4 şişman, 5'de obez hayvanı ifade etmektedir. Vücut kondisyon skorunun devamlı olarak takibi; sağlıklı ve verimli bir sürünün elde tutulmasına imkan sağlamaktadır. Aynı zamanda sürünün dengeli beslenmesi ve doğru sürü yönetimi için yaygın olarak kullanılan pratik bir uygulamadır (Ayaşan ve ark., 2012).

Varışlı ve Tekin (2011), ise vücut kondisyon skorunun buzağılama aralığı, süt verimi, gebelik oranı, buzağılama zorluğu, sütten kesim ağırlığı, doğum-ilk kızgınlık, doğum ilk ovulasyon, doğum-ilk tohumlama sürelerindeki artışla ilişkili olduğunu saptamışlardır.

Yüksek vücut kondisyon skoruna sahip ineklerin kolostrumunun düşük vücut kondisyonuna sahip ineklerden daha fazla immünoglobülin içerdiği bildirilmektedir (Odde, 1997; Koyuncu ve Karaca, 2018).

Bu çalışmanın amacı vücut kondisyon skoru ile kolostrum kalitesi arası ilişkinin değerlendirilmesi ve bununla ilgili literatüre katkı sağlamaktır.

MATERYAL ve METOT

Çalışmanın hayvan materyalini, Ç.Ü. Ziraat Fakültesi, Süt Sığırcılığı Araştırma Uygulama Biriminde bulunan 60 baş ikinci laktasyondaki Siyah Alaca inek oluşturmuştur. Birimde, inekler doğumdan bir hafta önce doğumhaneye alınmakta ve buzağılamadan sonraki üç gün süresince bu bölmelerde gözetim altında tutulmaktadır. Bu süre zarfında buzağılar kendi analarının sütünü biberondan kontrolü olarak almakta ve buzağılar doğumdan sonraki 1 saat içerisinde canlı ağırlığının %5-6'sı kadar, 24 saat içerisinde de canlı ağırlığının %9-10'nu kadar kolostrumu alması sağlanmaktadır. Buzağılar sütle besleme süresince bireysel kulübelerde barındırılmaktadırlar. Bu çalışmada, kolostrum kalitesi, kolostrum immunoglobulin içerigi ile kolostrum yoğunlugu arasındaki ilişkiyi esas alan kolostrometreler kullanılarak tespit edilmiştir. Kolostrometre, kolostrumdaki Ig miktarı ile özgül ağırlık arasındaki ilişkiye dayalı sonuç vermektedir. Her inekten doğum sonrası elde edilen kolostrum 20°C' ye kadar

soğutulduktan sonra kendi özel ölçüm beheri içerisine konulmuş ve kolostrometre ile özgül ağırlığı tespit edilmiştir. Kolostrumun sınıflandırılmasında Çizelge 1'de verilen özgül sınıflandırma esas alınmıştır (Kaygısız ve Köse, 2007).

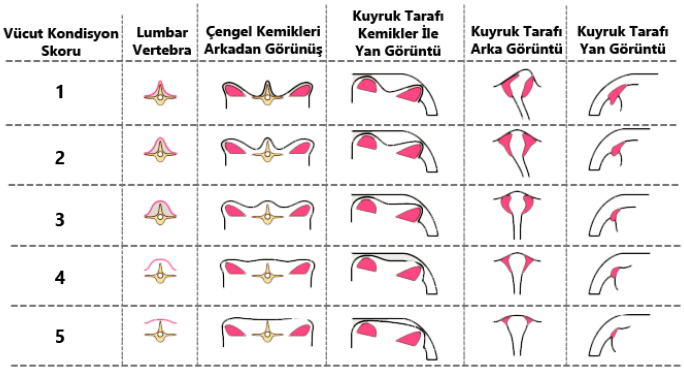
Çizelge 1. Kolostrum sınıflandırılması

Kolostrum Özgül Ağırlığı	**Kalite**
>1.045* g/ml	İyi kalite
1.035- 1.045 g/ml	Orta Kalite
< 1.035 g/ml	Düşük Kalite

*1.045 g/mL =1045 g/L

Süt kompozisyonunun belirlenmesi için laktasyonun 30. gününde her inekten 200 ml olacak şekilde alınan süt örneği analiz yapılıncaya kadar derin dondurucuda (-27^{0}C) depolanmıştır. Analizden önce 38°C'deki su banyosunda çözdürülmüş ve daha sonar analiz için hazırlanmıştır. Süt örneklerinin laktoz, kuru madde, yağ ve protein içerikleri LactoScop MK2 kullanılarak (Delta Instruments, Netherland) belirlenmiştir.

Vücut kondisyon puanlaması Edmonson ve ark. (1989) tarafından geliştirilen ve dünya çapında yaygın olarak kabul gören 5'lik skaladaki gözleme dayalı yönteme göre laktasyonun 70. gününde yapılmıştır. Kullanılan yönteme göre, hayvanlar 1- 5 puan aralığında 0,25'lik artışlarla değerlendirilmiştir. Değerlendirme hayvana arkadan ve yandan bakılarak yapılmıştır. Hayvanlara arkadan ve yandan bakıldığında değerlendirilen bölgeler, kuyruk sokumu ve bel, kemikli yapıların (omurlar, kalça ve oturak yumruları, yumrular arasındaki açı, vb.) oluşturduğu dışarıdan gözlenen çıkıntılar ve kendileri ve birbirleri arasında oluşturdukları açılardır.



Şekil 1. Vücut kondisyon skoru uygulamasında değerlendirilen vücut kısımları (Anonim, 2023b)

Çalışmamızda inekler VKS'lerine göre 3 gruba ayrılmıştır. Birinci grup VKS≤3 olan 14 inekten, 2. grup 3<VKS<4 arasında değişen 38 inekten ve 3. grup VKS≥4 olan 8 inekten oluşmuştur.

Araştırma sonunda elde edilen verilerin normal dağılışa uygunluğu Kolmogorov-Smirnov (veri sayısı 50'den büyük) normallik testi ile belirlenmiştir. Normallik testine göre normal dağılım gösteren verilere tek yönlü varyans analizi (ANOVA) ve grup ortalamaları arası farklılıkları ortaya koymak amacıyla da Duncan çoklu karşılaştırma testi uygulanmıştır

BULGULAR ve TARTIŞMA

Ortalama %88'i su olan inek sütü 100'den fazla farklı bileşen içerir. Asitlik, yoğunluk, yağ içeriği, yağsız kuru madde gibi değişkenler çiğ sütün özelliklerini belirlemektedir. Tablo 1'de çalışmada kullanılan sığırlardan elde edilen sütlerin süt kompozisyonu verilmiştir. Süt bileşimi incelendiğinde kuru maddenin %12,48, laktozun %4,44, yağın %3,44 ve proteinin %3,53 olduğu görülmektedir. Bu sonuçlar birçok araştırıcı tarafından tespit edilen sonuçlar ile örtüşmektedir (Ayaşan ve ark., 2012; Göncü ve ark., 2022).

Tablo 1. Kondisyon puanının kolostrum kalitesi, süt bileşimi ve verimine etkisi.

Sütün Bileşimi	**Kondisyon 1* n:14**	**Kondisyon 2* n:38**	**Kondisyon 3* n:8**	**P**
Kolostrum Kalitesi (g/L)	1035,71±1,269^{a}	1048,16±0,852^{b}	1059,38±1,752^{c}	,000
Laktoz (%)	4,44±0,032^{a}	4,60±0,016^{b}	4,53±,026^{b}	,000
Kuru Madde (%)	12,48±0,017	12,47±0,015	12,55±0,018	,111
Yağ (%)	3,44±0,020	3,34±,022	3,37±0,041	,052
Protein (%)	3,53±0,019	3,52±0,014	3,51±0,029	,824
Süt Verimi (kg)	5956±89,698^{a}	7044±72,254^{b}	6848±128,308^{b}	,000

*Kondisyon 1: Vücut kondisyon skoru VKS≤3 olan grup
*Kondisyon 2: Vücut kondisyon skoru 3<VKS<4 olan grup
*Kondisyon 3: Vücut kondisyon skoru VKS≥4 olan grup
$^{a\ b}$ İstatistiki olarak önemli (p<0,05)

Çalışmada kullanılan ineklerin ortalama laktasyon süt verimleri Kondisyon 1. grupta 5956 kg, Kondisyon 2. Grupta 7044 kg ve Kondisyon 3. Grupta 6848 kg olarak saptanmıştır. Tablo 1 incelendiğinde vücut kondisyon skorunun ele alınan ölçütlerden kolostrum kalitesi, laktoz ve süt verimi üzerine etkisinin istatistikî yönden önemli olduğu (P<0.05); buna karşılık kuru madde, yağ ve protein üzerine olan etkisinin önemsiz olduğu saptanmıştır (P>0.05).

Kolostrum kalitesine, doğum sonrası üretilen süt miktarı, ineğin geçirdiği hastalıklar, ineğin yaşı, buzağılama mevsimi, beslenme seviyesi, ırk, gebelik öncesi besleme düzeyi, güç doğum, doğum sonrası canlı ağırlık, kuruda kalma süresi gibi faktörler etki etmektedir (Göncü ve ark., 2014). Mulder ve ark. (2017), ana tarafından üretilen kolostrumun kalitesini çeşitli

faktörlerin etkileyebileceğini belirtmiştir. Kolostrum kalitesini etkileyen çeşitli faktörlerin önemlilerinden biri de kuru dönemdeki besleme düzeyidir (Winkelman ve ark., 2008).

Benzer şekilde Weaver ve ark., (2000) ve Gavin ve ark., (2018), kolostrumdaki Ig içeriğinin, üretilen kolostrum miktarı, doğum koşulları, kuru dönem bakım-beslemesi gibi faktörlerden etkilendiğini ifade etmişlerdir.

Laktoz doğada sadece sütte bulunur. Laktoz sütün tek karbonhidratıdır. Gebelik ve emzirme döneminde az miktarda kan ve idrarda da bulunabilir. İnek sütündeki miktarı %4.7-4.8 civarında olup, süt kurumaddesinin yaklaşık 1/3'ünü oluşturur (Gürsoy, 2015). Yapılan çalışmada, vücut kondisyon skorunun süt laktoz düzeyine olan etkisi istatistiki olarak önemli bulunmuştur. Laktoz oranı Kondisyon 1. grupta %4,44, Kondisyon 2. grupta %4,60 ve Kondisyon 3. grupta da %4,53 olarak tespit edilmiştir. Yapılan çalışmalardada süt laktoz düzeyi %4,6-4,7 civarında tespit edilmiştir (Schroeder, 2012; Önal ve ark., 2021).

Süt sığırı sütündeki kuru madde içeriği, su uzaklaştırıldıktan sonra sütte bulunan katı bileşenlerin yüzdesini ifade eder. Sütün besin değerine katkıda bulunan proteinler, yağlar, karbonhidratlar, mineraller ve vitaminler dahil olmak üzere kalan maddeleri temsil eder. Kuru madde içeriği, sütün kalitesini ve bileşimini değerlendirmek için kullanılan önemli bir parametredir. Sütün kuru madde içeriği ırk, laktasyon dönemi, besleme ve bireysel hayvan varyasyonları gibi faktörlere bağlı olarak değişebilir. Ortalama olarak inek sütünün kuru madde içeriği %12 ile %13,5 arasında değişmektedir. Bu, ortalama olarak sütün yaklaşık %87 ila %88'inin su olduğu anlamına gelir. Kuru madde içeriğinin süt üretimi ve işlenmesinin çeşitli yönlerini etkilediğine dikkat etmek önemlidir. Daha yüksek bir kuru madde içeriği, sütün besin değerine ve işlenme özelliklerine katkıda bulunan proteinler ve yağlar gibi temel bileşenlerin daha yüksek konsantrasyonlarını gösterebilir. Ayrıca peynir ve süt tozu gibi sütten elde edilen süt ürünlerinin verimini ve kalitesini de etkileyebilir.

Çalışmamızda sütün kuru madde içeriğinin vücut kondisyonundan etkilenmediği tespit edilmiştir. Cihan, (2013) yaptığı araştırmada süt kuru madde oranının çalışmamıza benzer şekilde %12 olarak tespit etmiştir.

Süt sığırı sütünün yağ içeriği, ırk, laktasyon dönemi, rasyon bireysel hayvan varyasyonları gibi faktörlere bağlı olarak değişebilir. Ortalama olarak, inek sütü tipik olarak yaklaşık %3-4 oranında yağ içerir. Bununla birlikte, yağ içeriğinin bazı durumlarda %2'den %6'ya kadar değişebileceğini not etmek önemlidir. İnek sütündeki yağ, enerji sağlamak, yağda çözünen vitaminleri (A, D, E ve K vitaminleri gibi) taşımak ve süt ürünlerinin tadına, dokusuna ve ağızda bıraktığı hissine katkıda bulunmak gibi birçok önemli işleve hizmet eder. Çalışmamızda süt yağı üzerine vücut kondisyonunun etki etmediği tespit edilmiştir. Süt yağ

oranı Kondisyon 1. grupta %3,44, Kondisyon 2. grupta %3,34 ve Kondisyon 3. grupta da %3,37 olarak bulunmuştur. Kibar, (2018), yaptığı çalışmada süt yağını %3,57 olarak tespit etmiştir. Başka bir araştırıcı yaptığı çalışmada süt yağını %3,66 olarak bildirmiştir (Güler ve ark., 2017).

Süt sığırı sütündeki protein içeriği, besin değeri ve fonksiyonel özelliklerine katkıda bulunan önemli bir bileşendir. Sütün protein içeriği, çeşitli faktörlere bağlı olarak değişebilir. Ancak inek sütünün ortalama protein içeriği %3-4,5 civarındadır. Çardak, (2008) yaptığı çalışmada süt protein oranını %3,41 olarak tespit etmiştir.

Vücut kondisyonu ile süt üretimi arasında bir ilişki vardır. Optimum vücut kondisyon puanına sahip inekler, daha iyi enerji rezervlerine sahip olma eğilimindedir ve daha fazla süt üretebilir. Bununla birlikte, aşırı yüksek veya düşük vücut kondisyon puanları, süt üretimini ve bileşimini olumsuz etkileyebilir.

Düşük vücut kondisyon puanına sahip inekler, yetersiz enerji rezervleri nedeniyle süt üretimini azaltmış olabilir. Öte yandan, vücut kondisyon puanı çok yüksek olan ineklerde, süt üretimini de etkileyebilen yağlı karaciğer sendromu gibi metabolik sorunlar olabilir. Bu nedenle, vücut kondisyon puanı süt üretimini dolaylı olarak etkileyebilirken, sütün kendi bileşimi ile doğrudan ilişkili değildir. Süt bileşimi öncelikle ırk, laktasyon aşaması ve rasyon gibi daha önce belirtilen faktörlerden etkilenir.

Yapılan çalışmada, vücut kondisyon skorunun süt verimine olan etkisi istatistiki olarak önemli bulunmuştur. Süt verimi Kondisyon 1. grupta 5956 kg, Kondisyon 2. grupta 7044 kg ve Kondisyon 3. grupta da 6848 kg olarak tespit edilmiştir. Tapkı ve ark., (2005), ineklerin kuru dönemde orta düzeyde vücut kondisyonunda olmalarının, bir sonraki laktasyon süt verimi ve kompozisyonu üzerine olumlu, aşırı yağlı kondisyonda olmalarının ise olumsuz etki yaptığını bildirmişlerdir.

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MEME BAŞI KONDİSYONU VE SOMATİK HÜCRE SAYISI

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ÖZET
Bu çalışma, meme başı kondisyon skorunun somatik hücre sayısı (SHS) üzerindeki etkisini belirlemek amacıyla yapılmıştır. Çalışmada ikinci laktasyonunda ve değişik meme başı kondisyonunda olan 60 baş inek materyal olarak kullanılmıştır. Çalışmada Siyah Alaca inekler meme başı kondisyon skorlarına göre 4 gruba ayrılmıştır. Meme ucu kondisyon skoru grup 1'de somatik hücre sayısı 387444±13237, grup 2'de 388093±7645, grup 3'te 393923±7803 ve grup 4'te 419500±13378 hücre/ml olarak tespit edilmiştir. Tüm gruplarda somatik hücre sayısı Türk Gıda Kodeksi Çiğ Süt Tebliğinde belirtilen üst sınır olan 500000 hücre/ml'nin altındadır. Yine analiz sonucu meme ucu kondisyonunun somatik hüce sayısı üzerine istatistiki olarak etkili olmadığı sonucuna ulaşılmıştır ($p>0,05$).

Anahtar Kelimeler: Siyah Alaca, Meme Ucu Kondisyonu, Somatik Hücre Sayısı

TEAT END CONDITION AND SOMATIC CELL COUNT

ABSTRACT

This study was carried out to determine the effect of teat end condition score on somatic cell count (SCC). In the study, 60 cows in their second lactation and in different teat end conditions were used as material. In the study, Holstein cows were divided into 4 groups according to their teat end condition scores. Teat end condition score was 387444±13237 cells/ml in group 1, 388093±7645 in group 2, 393923±7803 in group 3 and 419500±13378 cells/ml in group 4. The number of somatic cells count in all groups is below 500000 cells/ml, which is the upper limit specified in the Turkish Food Codex Raw Milk Communiqué. Again, as a result of the analysis, it was concluded that teat end condition was not statistically effective on the number of somatic cell count ($p>0.05$).

Key Words: Holstein Fresian, Teat End Condition, Somatic Cell Count

GİRİŞ

İnekleri sağmanın temel ön koşulları; sağımın hızlı, temiz, eksiksiz ve nazikçe yapılmasıdır. Mastitisin makineli sağım ile ilgili mekanizmaları patojen transferi, memenin tam boşaltılıp boşaltılmaması, sağım sıklığı, meme başı kanalının bakteri girişini artırma, meme ucunun bakteri istilasına karşı direncidir. Neredeyse tüm enfeksiyonlar memeye meme ucundan girer. Sağımın patojenlerin dışarı atılmasında olumlu bir rolü vardır, ancak sağım makinesi bakterilerin meme başı kanalına, meme sinüsüne veya bez sinüsüne girmesinde de aktif bir rol oynayabilir. Bir vektör olarak makine sağımının rolü son yıllarda sıklıkla incelenmiştir (Neijenhuis, 2001). Bir vektör rolüne ek olarak, sağım makinesi meme başında travmaya neden olarak onu kolonizasyon ve enfeksiyona karşı daha duyarlı hale getirebilir.

Aşırı sağım, süt verimi ve süt kalitesi taleplerini karşılamak için inek memeleri, mastite karşı ilk savunma hattı işlevi görmesi açısından önemlidir. Meme ucunun fiziksel kimyasal savunması, meme derisi ve meme kanalından oluşur. Meme başı kanalı, mastitis patojenlerinin memeye invazyonuna karşı güçlü ve önemli bir birincil bariyerdir (Hamann, 1987; Shearn ve Hillerton, 2009). Meme kanalını çevreleyen sfinkter kası sağımlar arasında sıkıca kapanır ve meme başı açıklığından bezin iç kısmına bakteri girişini engeller (Nickerson, 1994).

Makine sağımı sırasındaki mekanik kuvvetler, meme ucu dokusunda değişikliklere neden olabilir. Meme ucu nasırlığı laktasyonun yaklaşık 4. ayına kadar oluşur ve daha sonra azalır (Neijenhuis ve ark., 2000). İnek meme ucunun şekli, meme ucunun konumu, meme ucunun uzunluğu, süt verimi, laktasyon aşaması ve parite gibi faktörler meme ucu nasırlığının derecesi ile ilişkilidir (Bakken, 1981; Graf, 1982; Sieber ve Farnsworth, 1984; Neijenhuis ve ark., 2000).

Buzağıları tarafından emzirilen ineklerin meme uçlarında, makine ile sağılan ineklere kıyasla daha az şişlik ve meme ucu nasırlaşmasında yalnızca küçük bir artış görülmektedir (Sieber ve Farnsworth, 1984; Hamann ve ark., 1994).

Makine sağımı, meme başı ucundaki nasır oluşumunu etkileyebilir (Sieber, 1980; Hamann, 1987; OShea, 1987; Ebendorff ve Ziesack, 1991). Bu nedenle meme başı kondisyonu, makineli sağım kalitesinin değerlendirilebileceği parametrelerden biri olarak görülebilir. Seykora ve McDaniel (1985), somatik hücre sayısının ülseratif ve meme ucu nasırlaşması ile tanımlanan meme başı lezyon skorundan etkilendiğini ifade etmişlerdir. Ayrıca, Farnsworth (1995) nasır ve ülser olan ciddi erozyonlu meme uçlarının daha yüksek mastitis prevalansı gösterdiğini bulmuştur. Ayrıca, meme başı lezyonları sıklıkla stafilokoklar ve Streptococcus dysgalactiae tarafından kolonize edilir. Bu nedenle, memenin daha derin kısımlarında potansiyel bir enfeksiyon kaynağıdırlar. Hiçbir zaman doğrudan kanıtlanmamasına rağmen

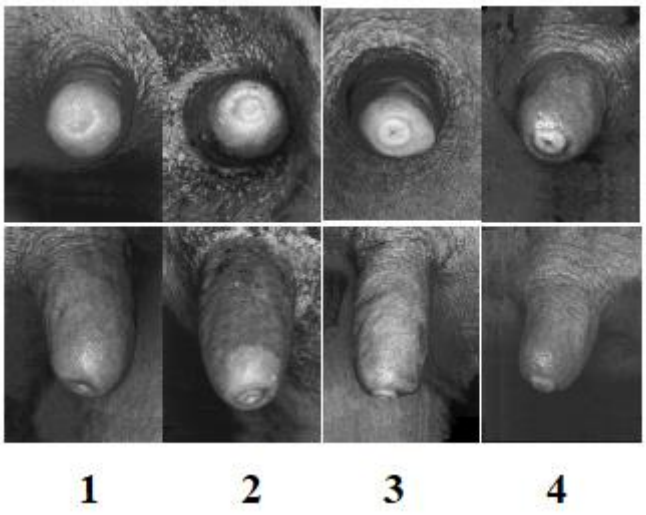
(Graf ve Gedek, 1983), şiddetli kaba nasır halkalarına sahip meme başı uçları genellikle meme içi enfeksiyonla ilişkilendirildiği ifade edilmiştir.

Meme başı kondisyon puanlaması, günümüzde araştırmalarda yaygın olarak takip edilen bir parametredir. Sektörde meme başının durumu sağım kalitesi için bir gösterge olarak kabul edilmiştir. Bu nedenle meme ucu kondisyonu için birçok sistem geliştirilmiştir (Sieber ve Farnsworth, 1981; Graf ve Gedek, 1983; Seykora ve McDaniel, 1985; Ebendorff ve Ziesack, 1991; Shearn ve Hillerton, 2009). Bu sistemler hem parametrelerinde hem de parametre kategorilerinin sayısında farklılık gösterir. Bu nedenle, farklı puanlama sistemleri tarafından elde edilen sonuçları doğrudan karşılaştırmak zordur.

MATERYAL ve METOT

Çalışmanın hayvan materyalini Çukurova Üniversitesi Ziraat Fakültesi Araştırma ve Uygulama Çiftliğinde bulunan ve ikinci laktasyonlarında olan 60 baş Siyah Alaca sığır oluşturmuştur. Meme başı kondisyonu skorlaması laktasyonun 90. Gününde akşam sağımından sonar Neijenhuis (2000)'de gösterilen yönteme göre yapılmıştır. Yine aynı sağımdan elde edilen sütlerdeki Somatik Hücre Sayıları DeLaval (Cell Counter DCC, Sweden) Somatik Hücre Sayım cihazı ile tespit edilmiştir. Süt örnekleri sağım makinasına takılan örnek alma kabları ile otomatik olarak alınmıştır.

Meme skorlarına göre gruplandırılan hayvanlara ait veriler tek yönlü varyans analizine tabi tutulmuş ve gruplar arasındaki farklılılarda Duncan testi ile SPSS paket programında incelenmiştir.



Şekil 1. Meme başı kondisyonu skorlaması (Neijenhuis, 2000)

Tablo 1. Meme başı kondisyonu puanlama kriterleri.

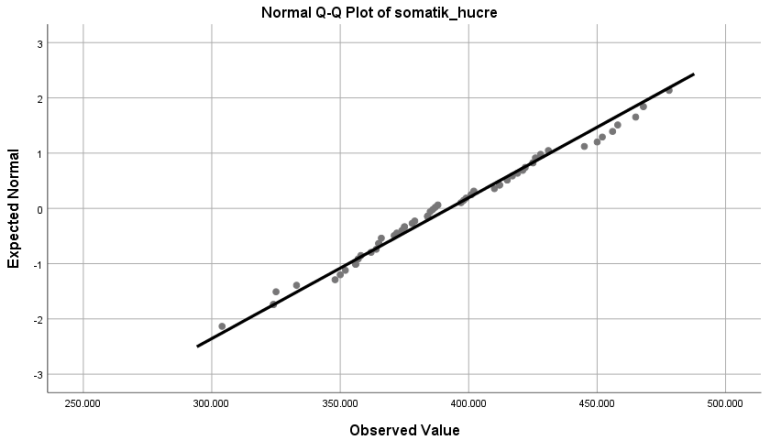
Puan	
1	Halka yok
2	Meme ucunun etrafında pürüzsüz, ince nasırlı halka
3	Kenarlarda biraz yıpranmış, orta derecede pürüzlü nasırlı halka
4	Çok fazla yıpranmış çok kaba nasırlı halka

BULGULAR ve TARTIŞMA

Çalışmamızda elde edilen veriler Kolmogorov-Smirnov normallik testi ile test edilmiş ve normal dağılış gösterdiği saptanmıştır.

Tablo 2. Somatik hücre sayısına ait verilerin normallik testi.

	df	**Sig.**
SHS	60	0,200



Grafik 1. Normallik testi Q-Q Plot grafiği.

Çalışmada elde edilen bulgular Tablo 3'te verilmiştir. Meme ucu kondisyon skoru grup 1'de somatik hücre sayısı 387444±13237, grup 2'de 388093±7645, grup 3'te 393923±7803 ve grup 4'te 419500±13378 hücre/ml olarak tespit edilmiştir. Tüm gruplarda somatik hücre sayısı Türk Gıda Kodeksi Çiğ Süt Tebliğinde belirtilen üst sınır olan 500000 hücre/ml'nin altındadır. Yine analiz sonucu meme ucu kondisyonunun somatik hüce sayısı üzerine istatistiki olarak etkili olmadığı sonucuna ulaşılmıştır (p>0,05).

Tablo 3. Meme başı kondisyon puanının somatik hücre sayısına etkisi.

	Skor 1	**Skor 2**	**Skor 3**	**Skor 4**	**p**
	n:9	**n:32**	**n:13**	**n:6**	
SHS (hücre/ml)	387444±13237[a]	388093±7645[a]	393923±7803[a]	419500±13378[a]	0,338

p>0,05

Yavuz ve Kaygısız (2015), 29 baş Siyah-Alaca süt sığırların süt verimi, somatik hücre sayısı ile bazı meme ve vücut ölçüleri arasındaki ilişkiler incelenmişler ve somatik hücre sayısı ortalamasını 419.88±67.5*10^3 adet/ml olarak tespit etmişlerdir. Yine çalışmamıza benzer şekilde Kaya ve ark., (2011) yaptıkları çalışmada genel ortalama somatik hücre sayısını 264.200 hücre/mL (n=5646) olarak saptamışlardır.

Meme ucunun durumu ile klinik mastitis arasında bir ilişki genellikle sahada varsayılır. Şiddetli meme ucu lezyonları (erozyonlar veya kabuklanmalar), subklinik mastit prevalansı ile pozitif olarak ilişkilidir (Sieber ve Farnsworth, 1981). Çiftlik düzeyinde, SHS ile meme ucu durumu derecesi arasında bir ilişki tespit edilememiştir (Shearn ve Hillerton, 2009). Bazı araştırıcılar (Breen ve ark., 2009) meme ucu durumunun Somatik Hücre Sayımı ve bakteriyolojiye dayanarak meme sağlığı için bir kriter olmadığını belirtmişlerdir ki çalışmamızda benzer şekilde meme ucu kondisyonunun somtik hücre sayısı üzerine etkili olmadığı tespit edilmiştir.

Wieland ve ark., (2019), sağıma başlamanın gecikmesi ve düşük akış hızının meme başı kondisyonu üzerine etkili olduğunu ifade etmişlerdir. Meme dokusu durumunda makine sağımının neden olduğu değişikliklerin derecesi, yeni meme içi enfeksiyon riski ile ilişkili olabileceği ifade edilmiştir (Zecconi ve ark., 1992).

Aşırı sağım, bazı çalışmalarda (Natzke ve ark., 1982; Osteras ve Lund, 1988; Neijenhuis ve ark., 2001), enfekte olmuş çeyrek insidansındaki artış, klinik mastitis insidansı ve daha yüksek somatik hücre sayısı ile ilişkilendirilmiştir, ancak diğer çalışmalarda böyle bir ilişki bildirilmemiştir. (Natzke ve ark., 1982). Benzer şekilde, bazı araştırmalar aşırı sağımın meme başı durumu üzerinde bir etkisi olduğunu bildirirken (Hillerton ve ark., 2002), diğer bazı araştırıcılar karşı tespitlerde bulunmuşlardır (Natzke ve ark., 1982; O'Callaghan ve ark., 1998; Gleeson ve ark., 2003).

Bununla birlikte, birkaç çalışma meme sağlığı ile meme ucunun durumu arasında ilişkiler olduğunu bildirmiştir. Neijenhuis ve ark. (2001), klinik mastitisin, mastitisin ortaya çıkmasından 3 ay öncesine kadar daha yüksek meme ucu nasırlılığı ile ilişkili olduğunu bildirmiştir.

Meme başı durum değişiklikleri kısa, orta ve uzun vadeli olarak sınıflandırılır (Mein ve ark., 2001; Gleeson ve ark., 2003). Dolaşım bozukluğunun neden olduğu en önemli kısa vadeli değişiklikler meme uçlarının renginin değişmesi, şişmesi ve meme başı kanalının açılmasıdır. En önemli uzun vadeli etki hiperkeratozdur. Kısa vadeli değişiklikler bir sağımdan diğerine ve hatta birkaç saat içinde tersine çevrilebilir (Strapák ve ark., 2018). Bu kısa vadeli değişikliklerin dikkatli bir şekilde gözlemlenmesi, yetersiz sağım makinesi ayarlarının doku üzerinde neden olduğu uzun vadeli etkileri önlemek için kullanılabilir. Çalışmalar, makine kaynaklı değişikliklerin tersine çevrilebilirliğinin, meme ucunun farklı parametrelerine, özellikle de sarnıç çapı ve meme başı kanalına göre değiştiğini ve bunların da ırklar arasında farklılık gösterdiğini tespit etmiştir (Vetter ve ark., 2014; Martin ve ark., 2018).

Sağım makinesi ve başlıklar bir buzağının emmesini ve bunun meme başı bütünlüğüne olan minimum etkisini taklit etmeye çalışsa da, sağım işleminde dokuya uygulanan vakum ve pulsasyonlar sıklıkla meme ucu tıkanıklığı veya hiperkeratoz gibi patolojik değişikliklerle sonuçlanmaktadır. Meme başı dokusu bütünlüğü üzerindeki risk faktörleri belirlenmiştir. Makine ayarları açısından bu faktörler, sistem vakum seviyeleri, sıkıştırma yükü seviyesi, meme başı vakum dalgalanmaları olarak sınıflandırılabilir (Bruckmaier, 2001).

SONUÇ

Süt inekçiliğinde meme başı ve meme başı kanalının hastalıklarından kaynaklanan ekonomik zararlar her geçen yıl artmaktadır. Meme başı ve kanalında şekillenen lezyon ve bozukluklar doğrudan meme sağlığını olumsuz etkileyerek mastitis gibi ciddi problemlere yol açabilmektedir. Sağım makinalarının yapısal ve işlevsel özellikleri, meme sağlığına zarar vermeden memedeki sütün tamamının kısa zamanda sağılabilmesi için önemlidir (Korkmaz, 2008). Sağım makinesi, meme sağlığı ve sağımın tam yapılması açısından son derece önemli olup, sağım makinesı düzenli olarak temizlenmeli, eskiyen lastikleri değiştirilmeli ve belirli aralıklarla bakımı yapılarak teste tabi tutulmalıdır. Sağım makinasının inekle temas eden tek parçası meme ve bu parçaların eskimesi, yırtılması, esnekliğini kaybetmesi ve sağım makinesinin vakum ayarlarının bozulması mastitis riskini arttırmaktadır (Eser ve Bilgücü, 2019). İnekleri sağlıklı bir meme yapısına sahip olması ve sürüde uzun yıllar verimli bir şekilde kalması için sağım makinelerinin kontrollerinin ve bakımlarının düzenli olarak yapılması gerekliliği kaçınılmazdır.

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TARIMDA YENİ BİR MODEL; MİKRO HAVZA BAZLI BÜTÜNLEŞİK ÜRETİM MODELİ- SANAL ARAZİ TOPLULAŞTIRMASI

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ÖZET

Son yıllarda dünyada ve ülkemizde gıda ürünleri arzının talebi karşılayamadığı vurgulanmaktadır. Tarım alanlarının ekolojik özelliklerine ve toprakların yeteneklerine göre ölçek ekonomisinin kuralları çerçevesinde kullanılamaması gıda arzının azalmasına neden önemli faktörlerden birisi olarak gösterilmektedir. Ekolojik özelliklere göre tarımsal üretimin planlanması gıda kısıt'ına neden olan birçok faktörlerin ortaya çıkmasını engellemektedir. Bu bağlamda ülkemiz farklı ekolojik özelliklere ve avantajlara sahip dünyada nadir ülkelerden birisidir. Tarımsal üretimde ekolojik avantajlar olsa bile küçük ve dağınık arazilerde de standart ve kaliteli bir üretim yapılamamaktadır. Türkiye ürettiği sebze ve meyvenin ancak % 5.5'ni ihraç edebiliyor ve yaklaşık % 20-25 tüketiciye ulaşmadan çürüyor. Bu nedenle ölçek ekonomisinde üretim yapabilmek için ekolojik avantajlar mikro havza bazlı bütünleşik üretim modeli ile ekonomik avantajlara dönüştürülebilir. Bu modelde bölgenin ekolojik özellikleri dikkate alınarak, bölgenin hangi ürüne uygun olduğuna karar verilir ve entegre üretim için fiziksel sınırlar kaldırılır. Havzada yapılan tüm iş ve işlemler tek bir parselmiş gibi yürütülür. Havza içerinde arazisi bulunan çiftçiler girdi ve masraflar çıkarıldıktan sonra arazileri oranında üretimden pay alırlar. Havza içerinde yapılacak işler için ortak alet, donanım ve makine parkı da oluşturulabilir ve havzadaki iş ve işlemler tek elden yürütülebilir. Havzada bulunan çiftçiler Üretici Birlikleri, Üretici Ajansları, Üretim Kooperatifi gibi isimlerle yasal zemine oturtulabilir. Bu modelin uygulanması ile kırsal alanda sanal arazi toplulaştırmasının yapılması ile tarımda standart ve kaliteli üretim de yapılabilir.

Anahtar Kelimeler: Mikro havza, arazi, toplulaştırma, sanal, üretim

A NEW MODEL IN AGRICULTURE; MICRO-CATCHMENT BASED INTEGRATED PRODUCTION MODEL- VIRTUAL LAND CONSOLIDATION

ABSTRACT

In recent years, it has been emphasized that the supply of food products in the world and in our country cannot meet the demand. The inability to use agricultural lands within the framework of the rules of scale economy according to the ecological characteristics of the soils and the capabilities of the soils is shown as one of the important factors causing the decrease in food supply. Planning of agricultural production according to ecological characteristics prevents the appearance of many factors that cause food constraints. In this context, our country is one of the rare countries in the world with different ecological characteristics and advantages. Even if there are ecological advantages in agricultural production, a standard and quality production cannot be made in small and scattered lands. Turkey can only export 5.5% of the vegetables and fruits it produces, and approximately 20-25% is wasted before reaching the consumer. For this reason, ecological advantages can be transformed into economic advantages with a micro-watershed-based integrated production model in order to produce in economies of scale. In this model, considering the ecological characteristics of the region, it is decided which product the region is suitable for and individual field boundaries are removed for integrated production. All work and operations in the basin can be carried out as if it were a single parcel. Farmers who have land in the basin receive a share from the production in proportion to their land after inputs and expenses are subtracted. A common tool, equipment and machinery park can be created for the works to be carried out in the basin, and the works and operations in the basin can be carried out from a single source. Farmers in the basin can be placed on legal ground with names such as Producer Unions, Producer Agencies, Production Cooperatives. With the application of this model, virtual land consolidation in rural areas is also possible. Thus, standard and high quality agricultural production can be obtained in the basin.

Keywords: Micro-catchment, land consolidation, virtual, agricultural production

GİRİŞ

Son yıllarda dünyada ve ülkemizde gıda ürünleri konusunda arz ve talep arasında bir dengesizlik olduğu; nüfus artışı, gelir artışı gibi faktörlerle gıda talebi artarken, tarım alanlarının ekolojik özelliklerine ve toprakların yeteneklerine göre kullanılmaması, çoraklaşma, kuraklık, erozyon vb nedenlerle gıda arzının aynı oranda artırılamadığı görülmektedir. Benzer şekilde ülkemizde de son yıllarda tarımsal altyası yatırımları (sulama, drenaj, arazi toplulaştırması, arazi tesviyesi vb) ve teknik tarım uygulamaları (sertifikalı tohum, ilaçlama, gübreleme vb) artmasına rağmen henüz birim alandan alınan ürün miktarı ve kalitede beklenen seviyeye ulaşamamıştır. Ülkemizde tarımsal üretimde beklenen seviyeye ulaşılamamasın nedenleri olarak tarımsal işletmelerinde mülkiyet sorunu, arazilerinin dağınık ve küçük olması gösterilmektedir. Bu tür sorunlar tarımsal bünye sorunu olarak değerlendirilmektedir (Yeşilsoy, 1995).

Aynı zamanda, ülkemizde kırsal alanlardan şehirlere göç, kırsal alanlarda arazilerin terk edilmesine ve atıl kalmasına neden olmaktadır. Bu yüzden hem altyapı, hem de teknik ve bünye bozukluklarından kaynaklı sorunları en aza indirebilmek için orta ve uzun vadede tarımsal üretimde yeni arayışlara ve uygulamalara ihtiyaç vardır.

Ülkemizde 2007-2008 yıllarında Tokat-Turhal yönünde sağ sahil sulama kanalı kuzeyinde kalan sulanamayan ve orta eğimli alanlarda, Tokat GOP Üniversitesi Ziraat Fakültesi ile Meyve suyu üreten firma ve ilgili köy temsilcileri "Mikro Havza Bazlı Bütünleşik Üretim Modeli-Sanal Arazi Toplulaştırması" yaklaşımı kapsamında bir araya geldi. Taraflar arasında meyve suyu üreten firmanın da desteği ile üzüm üretimi konusunda fikir birliği oluştu. Ancak, meyve suyu üreten firmanın şaraplık üzüm üretimi talebi ve çiftçilerin bu talebe olumsuz yaklaşımı nedeniyle proje uygulama aşamasına geçemedi. Bu durum, proje uygulamalarında yöresel hassasiyetlerin göz önüne alınması gereğinin açık bir göstergesidir (Saltalı, 2008, Kişisel tecrübe).

Mikro havza-sanal arazi toplulaştırması konseptinde benzer bir uygulamanın 2009 yılında Yozgat, Kadışehri, Kabalı Projesi kapsamında 803 parsel arazi birleştirilerek 564 ha arazi kamu-özel sektör-vatandaş işbirliği ile Türkiye'nin en büyük, Avrupa'nın ikinci büyük meyve bahçesi oluşturulmuştur (Avşaroğlu ve Arısoy, 2021). Ülkemizde bu tür uygulamaların kırsal kalkınma, kaliteli ve standart tarımsal üretim için yaygınlaştırılmasına ihtiyaç vardır.

Ülkemizde farklı kırsal kalkınma projelerinin uygulanmıştır. Bunlardan mikro havza düzeyinde Çoruh Nehri Katılımcı Havza Rehabilitasyonu Master Plan Çalışması kapsamında Bayburt, Savsat, Yusufeli, Uzundere, İspir ve Oltu'da 6 adet mikro havza oluşturulmuştur. Bu

havzalarda doğal kaynakların rehabilitasyonu, bölgede tarım ve hayvancılığın desteklenmesi ve insan kaynaklarının sosyal ve ekonomik yönden geliştirilmesi amaçlanmıştır (Anonim, 2004).

HAVZA VE ARAZİ TOPLULAŞTIRMASI KAVRAMI

Mikro Havza Bazlı Bütünleşik Üretim Modeli diğer bir deyişle Sanal Arazi Toplulaştırması kavramında geçen "havza" ve "arazi toplulaştırması" terimlerinin açıklanmasına ihtiyaç vardır. Havza; bölge, mıntıka, etrafı dağ veya tepeler ile sınırlanmış, kendine özgü özelliklere sahip alan manalarına gelmekte olup, havza planlamalarında ekolojini temel faktörlerinin (jeoloji, jeomorfoloji, iklim, toprak ve biyoçeşitlilik vb) dikkate alınmasında fayda vardır (Garipoğlu, 2012).

Arazi toplulaştırması ise, parçalı ve dağınık halde olan arazilerin tekniğine uygun olarak belli bir alanda bir bütün haline getirilmesidir. Arazi toplulaştırması yatırımları ile tarla içi geliştirme hizmetleri (tesviye, drenaj, tarla içi yollar, sulama kanalları vb) birlikte yürütüldüğünde başarılı olmaktadır. Bu nedenle, arazi toplulaştırması ve tarla içi geliştirme hizmetleri yüksek finansmanlı pahalı yatırımlardır. Ülkemizde son yıllarda hızlanan arazi toplulaştırma çalışmalarının tarımsal altyapı sorununun çözümüne katkı sağlayacağı düşünülmektedir. Ancak arazi toplulaştırma çalışmaları, daha çok üretim potansiyeli yüksek birinci ve ikinci sınıf arazilerde yürütülmektedir.

Türkiye Tarım Havzaları Üretim ve Destekleme Modeli

Havza bazlı ve ekolojinin temel faktörleri dikkate alınarak tarımsal üretimin planlanmasının tarımsal üretimi ve kaliteyi artıracağı düşünülmekte ve bu konuda farklı yaklaşımlar mevcuttur. Bunlardan birisi, Türkiye'de 2006 yılında çıkarılan Tarım Kanununun 14. Maddesine istinaden 2009 yılında uygulamaya konulan "Havza Bazlı Üretimi Destekleme Modeli" uygulamasıdır. Bakanlar Kurulunun 29.06.2009 tarihli ve 15173 sayılı kararında; Madde 1'de Tarımsal üretimin kendi ekolojisine uygun alanlarda yoğunlaşması, desteklenmesi, örgütlenmesi, ihtisaslaşması, entegre bir şekilde yürütülmesi ve tarım envanterinin hazırlanması amacıyla ilçe sınırlarını da kapsayan 30 adet tarım havzası belirlenmiştir (RG 23.07.2009, Şekil 1). Daha sonra, Bakanlar Kurulunun 17/10/2016 tarihli kararında ilçe sınırları içerisinde kalan alan ayrı bir tarım havzası olarak belirlenmiştir. Bakanlar Kurulu kararları ve ilgili mevzuata bakıldığında, mevcut uygulamanın isminden de anlaşılacağı üzere 945 tarım havzalarında ürünleri destekleme esaslı olduğu görülmektedir. Tarım ve Orman Bakanlığı tarafından uygulanan bu proje tarımsal işletmelerin ve sahip olduğu arazilerin bir araya getirilmesi konusunu kapsamamakta.



Şekil 1. Türkiye'de üretimi destekleme amaçlı oluşturulan tarım havzaları

Türkiye ve AB Ülkelerinde Tarımsal İşletmeler

Ülkemizde tarımsal işletmelerin bünye sorunu hala güncelliğini korumaktadır. Türkiye'de tarımsal işletmelere bakıldığında, ülkemizde 3.076.649 adet tarım işletmesi, 12.3 milyon adet parselde ve 18.4 milyon hektar alanda faaliyet göstermekte ve bu durumda işletme başına yaklaşık 6 hektar arazi düşmektedir. İşletmelerin tarım arazisi parça sayısı incelendiğinde, işletme başına düşen tarım arazisi parça sayısı 5,9 adet olup tarım arazisi ortalama parça büyüklüğü ise 12,9 dekardır (TÜİK, 2016a).

AB'de tarım işletmeleri verilerine göre, mevcut tarım işletmesi sayısı 6.954.300 adet, buna karşılık ekilen alan 128.7 milyon hektardır. Bu durumda işletme başına düşen arazi genişliği 18,5 hektardır. AB İşletme başına düşen arazi miktarının en yüksek olduğu ülkeler sırasıyla İngiltere, Lüksemburg ve Fransa, en düşük olduğu ülkeler ise Yunanistan, İtalya ve Portekiz'dir. İşletme başına düşen arazi miktarı İngiltere'de 69.3, Lüksemburg'da 42.5, Fransa'da 41.7 ha'dır. Buna karşılık işletme başına Yunanistan'da 4.3, İtalya'da 6.4, Portekiz'de 9.2 ve İspanya 12.9 hektar arazi düşmektedir (Bülbül ve Beşparmak, 2002). AB ülkelerinde, işletme başına düşen arazi miktarı düşük olan Yunanistan, İtalya ve Portekiz ve İspanya olası gıda krizinde en fazla etkilenecek ülkeler olarak değerlendirilmektedir. Çünkü işletmelerde üretilen ürünler ve elde edilen gelirler işletmenin sürdürülebilirliğini kısıtlamaktadır.

Türkiye'nin Tarımsal Üretim Durumu

Ülkemizde 2022 yılında tarımın toplam istihdam içerinde payı % 15.8 olarak belirlenmiştir (TÜİK, 2022b). 2022 yılında tarımsal ihracatın payı %13.4'dir (TİM, 2022). Ülkemizde toplam meyve, içecek ve baharat bitkileri üretimi 26.8 milyon ton, sebze üretimi ise 31,6 milyon ton olarak gerçekleşmiştir (TÜİK, 2022c). İhracattaki en büyük sıkıntı, kaliteli ve standart meyve

ve sebze üretimi yapılamaması ve üretilen ürünlerin yaklaşık % 25'nin üretim, dağıtım ve tüketim aşamalarında çürüyerek heba olmasıdır. Bu durumun asıl nedeni tarımsal altyapı ve bünye sorunlarıdır.

Çalışmanın Amacı ve Yöntem

Bu çalışmanın amacı, ülkemizde kırsal alanlardan şehirlere göç nedeniyle atıl kalan arazilerden ve kırsal alanlardan başlamak üzere tarımsal altyapı ve bünye bozukluklarını en aza indirebilecek ya da çözebilecek modeli sunmaktır. Bu modelin adı; "Mikro Havza Bazlı Bütünleşik Üretim Modeli- Sanal Arazi toplulaştırması" dır.

Bu çalışmada, deneysel bir çalışma olmayıp ülkemizde tarımsal üretimde, altyapı ve bünye kaynaklı sorunların azaltılması ve sanal olarak arazilerin toplulaştırılması yaklaşımını kapsamaktadır. Bu çalışmada fikirlerin oluşmasında, şahsımın "Arazi Toplulaştırması ve Tarla İçi Geliştirme Hizmetleri" projesinde şantiye şefi ve mühendis olarak çalışması sırasında elde edilen birikim, havza çalışmaları, arazi toplulaştırma çalışmaları, ülkemizde uygulanan havza bazlı üretimi destekleme modeli yaklaşımı altlık olarak değerlendirilmiştir.

BULGULAR VE TARTIŞMA

Mikro Havza Bazlı Bütünleşik Üretim Modeli

Ülkemizde tarım işletmelerinin dağınık ve küçük parçalar halinde bulunmasından kaynaklı tarımsal bünye bozuklukları, entegre ve kontrollü ürün yönetimi ve iyi tarım uygulamalarında karşılaşılan sorunların en aza indirebilmesi için ülkemiz koşullarında "Mikro Havza Bazlı Bütünleşik Üretim Modelin' in uygulanmasına ihtiyaç vardır. Bu modelde bölgenin jeoloji, iklim, toprak, topografya, rakımı vb özellikleri gibi ekolojik koşulların sunduğu avantajlar dikkate alınarak tarımın hangi alanında (sebzecilik, meyvecilik, küçükbaş veya büyükbaş hayvan yetiştiriciliği, arıcılık vb) faaliyette bulunulması gerektiğine havzada yaşayan insanların da görüşleri alınarak karar verilir. Karar aşamasında bilimsel ve teknik veriler, karar verilen ürünün daha önce havzada yetiştirilip yetiştirilmediği, havzada yaşayan insanların sosyal yapısı, demografik yapısı, ortak çalışma ve iş yapma kültürü gibi konular incelenir. Ortak üretimin avantajları ve dezavantajları insanlara anlatılır.

Mikro havza bazlı bütünleşik üretimi kabul eden köy veya alanlarda, havzada hastalık ve zararlılar ile entegre mücadele, bitki besleme, sulama ve entegre üretim içintapu sınırları esas olmak üzere fiziksel sınırlar ve engeller kaldırılır. Havzada yapılan tüm iş ve işlemler tek bir parselmiş gibi yürütülür. Havza içerinde yapılacak işler için ortak alet, ekipman ve makine parkı da oluşturulabilir ve havzadaki iş ve işlemler tek elden yürütülebilir. Havzada Tarım ve Orman

Bakanlığının teknik elemanları görev yapabileceği gibi, gerekirse havza adına çalışan teknik elemanlar ve işçilerde çalıştırılabilir. Havzada bulunan çiftçiler Üretici Birlikleri, Üretici Ajansları, Üretim Kooperatifi gibi isimlerle yasal zemine oturtulabilir. Havza içerinde arazisi bulunan çiftçiler girdi ve masraflar çıkarıldıktan sonra tapuda kayıtlı arazileri oranında üretimden pay alırlar.

Böylece kırsal alanlarda arazi toplulaştırma işlemi havzada yaşayan insanların zihinlerinde (SANAL toplulaştırma) yapılmış olur. Ülkemizde arazi toplulaştırılması proje aşamasından uygulama aşamasına kadar uzun yıllar almakta ve maliyeti yüksek bir uygulama olduğu için yavaş yürümektedir. Mikro havza bazlı bütünleşik üretim modeli ile kırsal bölgelerde ve eğimli arazilerde toplulaştırma projelerine gerek kalmadan kırsal havzadaki araziler insanların zihinlerinde toplulaştırılmakta ve ortak üretim fırsatı yaratmaktadır. Bu tür uygulama projelerine devlet desteği de sağlandığı takdirde (ortak makine parkı, ortak sulama alt yapısı, entegre bitki besleme, entegre hastalık ve zararlılar ile mücadele soğuk hava deposu vb) hem araziler zihinlerde toplulaştırılır hem de daha kaliteli ve standart ürünler elde edilir. Bu çalışmalar öncelikle geçit bölgelerinde atıl durumda olan terkedilmiş ve kullanılmayan arazilerden başlanması uygundur. Örneğin Akdeniz ikliminin görüldüğü, eskiden hayvanlar ile sürülen, ancak şu an aktif olarak kullanılmayan arazi yetenek sınıfı düşük alanlar sanal arazi toplulaştırma modeli ile keçiboynuzu, defne, alıç vb bitkiler tarımı ile tekrar tarımsal üretim alanlarına dönüştürülebilir.

Konunun daha iyi anlaşılması için örnek olarak K.Maraş-Elbistan Sultan korusu havzası ele alınabilir (Şekil 2). Havzanın haritada çizili alanı 11.934 hektardır (Şekil 1). Şekl 1'de gösterilen alanın % 60' bu model için tarımsal faaliyette kullanıldığında yaklaşık 7.160 hektar eder. Burada 12 köy bulunmakta ve köylerin nüfusu şehirlere göç nedeniyle azalmıştır. Köylerde genellikle kuru tarım yapılmakta ve arazilerinin yaklaşık % 50'de her yıl tarımsal üretim yapılmamaktadır. Köylere ait arazilerin rakımı 1600-1750 m arasında değişmektedir. Köylerin kuzey yönü yüksek dağlarla kaplıdır ve kışın çok set soğuklarından korunmaktadır. Bölgede yaklaşık 20 metre derinlikten sulama suyu elde edilebilmektedir. Bölgenin ekolojik olarak kiraz ve armut üretimi için uygun olduğu düşünülmektedir. Bu havzada kirazın temmuz ayı ortalarında hasadı başlayacağı düşünüldüğünde, piyasada kiraz olmayacağı için hem iç piyasadan hem de dış piyasadan talepler gelebilecektir. Mikro havza bazlı üretim modeli (Sanal arazi toplulaştırması) ile bu tür atıl kalmış ve ya da terkedilmiş alanların üretime kazandırılması hem köylere geri dönüşü başlatacak hem de standart ve kaliteli üretim yapılabilecektir. Modelin uygulanmasına daha küçük alanlarda başlanabilir ve model belli bir yıl ile sınırlı kalmak (dikimi

yapılan meyvenin ekonomik ömrü) kaydıyla ulusal ve uluslararası özel sektör yatırımlarına dönüştürülebilir.



Şekil 2. K.Maraş-Elbistan Sultan Korusu Havzası

SONUÇLAR ve ÖNERİLER

Mikro Havza Bazlı Üretim Modeli-Sanal Arazi Toplulaştırması yaklaşımı model bir paradigmadır. Bu tür modellerin pilot uygulaması ülkemizin kalkınmasında orta vadeli ve uzun vadeli planlar çerçevesinde uygulamaya aktarılabilir. Model belli bir yıl ile sınırlı kalmak kaydıyla ulusal ve uluslararası özel sektör yatırımlarına dönüştürülebilir. Modelin uygulamasına terk edilmiş alanlardan ve arazi yetenek sınıflarına göre 3, 4, 5 ve 6 sınıf arazilerden başlanabilir. Modelin uygulanmasına öncelikle meyve üretiminden başlanılması daha uygun olabilir. Çünkü 1 ve 2 sınıf araziler tarla bitkileri tarımı yapılmaktadır. Modelin uygulanması ile hem sanal olarak arazi toplulaştırması yapılmış olur hem de kaliteli ve standart ürün elde edilmiş olur.

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COĞRAFİ AÇIDAN SOSYO-EKONOMİK GELİŞMİŞLİK İNDEKSLERİNE GÖRE ORDU İLİ

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ÖZET

Kalkınma konusu gerek coğrafya bilimi gerekse farklı bilimlerce çok boyutlu yönleriyle araştırılan bir olgudur. Ulusal ve uluslararası kurumlarca kalkınmanın demografik ve çevresel faktörlerine yönelik birçok hesaplama yöntemleri geliştirilerek özellikle sosyo-ekonomik gelişim yönlerine ilişkin indeksler bulunmaktadır. Uluslararası kapsamda kullanılabilecek indekslerde dikkati çeken en belirgin unsurlar ise coğrafi özellikleri de içinde barındıran nüfus, sosyal güvenlik, sağlık, yaşam memnuniyeti, yaşam kalitesi, eğitim ve finans gibi değişkenlerdir. Bu kapsamda T.C Sanayi ve Teknoloji Bakanlığı tarafından 1996, 2004 ve 2022 yıllarında gerçekleştirilen il ve ilçe boyutlu sosyo-ekonomik gelişmişlik indeksleri idari coğrafya açısından Ordu iline bağlı olan ilçeler için coğrafi boyutlarıyla incelenmiştir. Bu çalışmada seçili yıllarda elde edilen verilere göre ise Coğrafi Bilgi Sistemleri ile Ordu ilindeki sosyo-ekonomik gelişmişliğin dağılımı yapılmıştır. Seçili yıllarda yapılan araştırmalara göre geçmişten günümüze Altınordu, Fatsa, Ünye, Gülyalı ve Perşembe ilçelerinin sosyo-gelişmişlik açısından diğer ilçelere göre ön plandadır. Ordu iline bağlı olan diğer ilçelerin ise sosyo-ekonomik gelişmişlik değerleri açısından gerileme süreçleri tespit edilmiştir. Araştırma alanında yatırım yönelimi ve gelişme olgusunu desteklemek için coğrafi koşulları dikkate alan planlama kaynaklarının öncülleri araştırmada sunulmaktadır. Sonuç olarak bu araştırma Ordu ilindeki kalkınma süreçleri içinde sosyo-ekonomik eğilimlere yönelik genel yaşam koşullarındaki iyileşme ve ilerlemenin sadece kıyı kesiminde yer alan ilçeler için değil aynı zamanda tüm araştırma sahasını kapsaması gerekliliği önerilerle vurgulanmıştır.

Anahtar Kelimeler: Coğrafya, Kalkınma, Sosyo-Ekonomik Gelişmişlik, Ordu

ORDU PROVINCE ACCORDING TO SOCIO-ECONOMIC DEVELOPMENT INDEX IN GEOGRAPHICAL TERMS

ABSTRACT

The issue of development is a phenomenon studied by both geography and other sciences with its multidimensional aspects. National and international organizations have developed numerous calculation methods for demographic and environmental factors of development, and there are indices specifically related to socio-economic aspects of development. The main elements that receive attention in the indices that can be used internationally are variables such as population, social security, health, life satisfaction, quality of life, education, and finance, which also include geographical characteristics. In this context, the provincial and district socio-economic development indices conducted by the Ministry of Industry and Technology of the Republic of Turkey in 1996, 2004 and 2022 were analyzed for the districts of Ordu province with their geographical dimensions. In this study, the distribution of socio-economic development in Ordu Province was prepared based on the data obtained in the selected years using geographic information systems. According to the researches conducted in selected years, Altınordu, Fatsa, Ünye, Gülyalı and Persembe districts are at the top compared to other districts in terms of social development from past to present. On the other hand, the regression processes of the other districts of Ordu province were determined in terms of socio-economic development values. The antecedents of planning resources that take into account geographical conditions to support investment orientation and development phenomena in the research area are presented in the research. As a result, this research underlines that the improvement and progress of the general living conditions for the socio-economic trends in the development processes in the province of Ordu should apply not only to the districts located in the coastal region, but to the entire study area.

Keywords: Geography, Development, Socio-Economic Development, Ordu

GİRİŞ

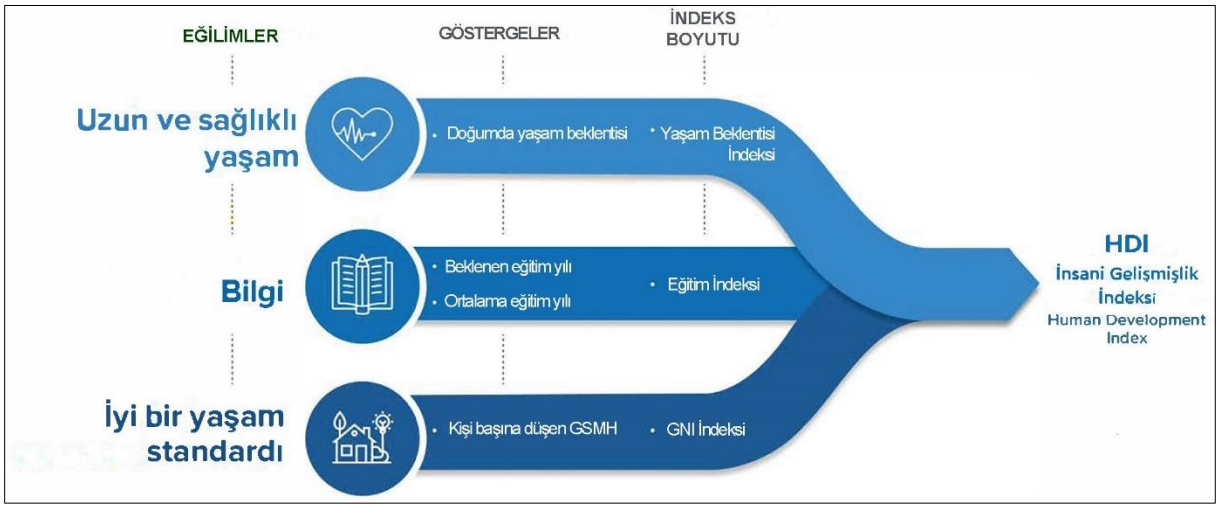
Tüm canlı sistemleri, hücreler, organizmalar, ekonomiler ve toplumlar, yaşam boyunca zaman kısıtlamaları altında gelişerek fırsatları değerlendirme, planlı bir şekilde ilerleme veya değişim yaşamıştır (Devezas & Corredine, 2001). İlerlemeler ve değişimler bölgesel ve küresel çapta meydana gelen olgular ile geçmişten günümüze ilişkilendirilmiştir. Özellikle küreselleşme ile birlikte ortaya çıkan sosyal ve ekonomik yöndeki geniş kapsamlı etkilenmeler, bölgelerin ve ülkelerin uluslararası ortamlardaki gelişmişliğini olumlu veya olumsuz yönde etkileme eğilimi içine girmiştir. Birleşmiş milletlere göre ekonomilerinin büyüklüğü ve gücü göz önüne alındığında, ülkeler genellikle gelişmiş, gelişmekte olan ve az gelişmiş olarak sınıflandırılır. Ancak ilk temel fikirlerin yarattığı etki aslında kalkınmanın da tanımını oluşturan salt bir üretim ve kişi başına düşen milli gelirlerin hesaplanması üzerine kuruludur. Bu görüş kalkınmanın günümüzden 50 yılı aşkın süre öncesinde ekonomik olarak üretim ve tüketimin artması şeklinde algılanmasına neden olmuştur (Morris, 2005). Ancak bu algı sadece ekonomik kriterlere göre çok dar bir anlamla ortaya çıkmaktadır. Üretim ve tüketim süreçlerine ekonomik olmayan olgularında dahil edilmesi ve algılanan kalkınma biçiminin ekonomik olduğu kadar sosyal, politik ve ekolojik faktörleri de barındırması gerekliliği son dönemlerde yaygın bir biçimde kabul edilmektedir (Hodder, 2000). Sosyo-ekonomik açıdan gelişmişlik eğilimi ilk fikirleri itibariyle;

- Yoksullukla mücadele,
- Uzun vadeli ekonomik ve sosyal kalkınma olarak benimsenmiştir (Szirmai, 2015).

Sosyo-ekonomik açıdan kalkınma kavramı sadece ekonomik ilerleme veya gelişme anlamında değil aynı zamanda çok boyutlu olarak gerek kentsel gerekse kırsal mekânlarında kapsamına alan tüm toplumsal süreçleri ifade etmektedir. Toplumsal yapıdaki değerler, sosyal nitelikler, eğitim, nüfus yapısı, kurumların yönetim çeşitliliği, çalışan tutumları, kaynakların kalkınma amaçlı kullanımı vb. sürecindeki zamansal ve mekânsal dağılımı bir değişim trendi içindedir. Bu değişim sürecinin temelde ülkelerin bulunmuş olduğu mutlak konumları ve göreceli konumlarına göre değişiklik göstermesi farklı kalkınma modellerinin de ön plana çıkmasına neden olmuştur (Oakley & Garforth, 1985; McGillivray & White, 1993).

Nitekim günümüzde "*kalkınmanın ekonomik ölçüleri*" arasında kişi başına düşen milli gelir ve işgücü payının sektördeki dağılımı bulunmaktadır. Bu ölçütlerin yanında kalkınmanın çok yönlü kalkınma modellerinin ortaya çıkarılması amaçlı "*ulusal refahın ekonomik olmayan ölçüleri*" benimsenmiştir. Kalkınma kavramını çok yönlü olarak açıklayabilecek insani gelişmişlik indeksleri içinde ortalama yaşam süresi, okuryazarlık durumu, eğitim beklentisi (Tümertekin & Özgüç, 2020; Ünal 2007) ve ülkelere göre detaylandırılabilecek yaşam

memnuniyeti indeksleri artık daha fazla kullanılmakta ve gelişmişlikler bu sisteme göre belirlenmektedir. Ülke ve toplumların sosyo-ekonomik gelişim göstergeleri için kullanılmış olan ilk raporlama Birleşmiş Milletler Kalkınma Programı (UNDP) tarafından 1990 yılında yayımlanmıştır (UNDP, 1990). Dünyayı daha iyi anlamak ve insanlığın yaşam koşulları, toplum, ekonomi, çevre, sosyal koşullarının belirlenmesi kapsamında insani gelişim indeksleri çok boyutlu olarak gerek Birleşmiş Milletlere gerekse ülkelere göre gelişmeye başlamıştır (Sagar & Najam, 1998). Günümüzde UNDP tarafından yayımlanan insani gelişmişlik indekslerinde doğumda yaşam beklentisi, beklenen eğitim yılı, ortalama eğitim yılı, kişi başına düşen GSMH verileri kullanılmaktadır (Şekil 1). Ancak HDI aksine mental iyilik hali, güçlendirme, siyasi özgürlük, sosyal ilişkiler, toplum refahı, eşitsizlikler, çalışma koşulları, boş zaman koşulları, siyasi güvenlik, ekonomik güvenlik ve çevre koşulları gibi yaklaşımların ölçme sistemlerine dâhil edilmesi gerekliliği vurgulanmaktadır (Ranis vd.2006).



Şekil 1. İnsani gelişmişlik indeksinde yer alan eğilimler, göstergeler ve indeks boyutları (Kaynak: UNDP görsellerindeki bilgilerin çevirisi ile oluşturulmuştur; https://hdr.undp.org/data-center/human-development-index#/indicies/HDI).

HDI sıralamasına göre Türkiye 2021 yılında 0,838 puan ile 191 ülke arasında 48. sırada yer almaktadır. Bu sıralama ile Türkiye "*çok yüksek insani gelişme*" sınıflandırması içinde bulunmaktadır. 2022 yılında yayımlanan rapora göre sıralamada kişi başına düşen milli gelir bakımından Türkiye'den daha az gelire sahip olan Yunanistan, Hırvatistan gibi ülkeler üst sıralarda yer almaktadır. Ancak bu ülkelerde ekonomik göstergeler ile sosyal göstergeler arasındaki bağlantının daha güçlü olduğu, Türkiye'deki ekonomik büyümenin ise sosyal göstergelere yeteri kadar yansımadığı konusunda ipuçları vermiştir (Göçer & Çıracı, 2003).

Bu kapsamda Türkiye'de gerçekleştirilen sosyo ekonomik indekslerde kullanılan değişkenlerin eğilimi ve sıralama için kullanılan çeşitli gelişmişlik indeksleri ile bağlantılı bir şekilde

bulguların geleceğe yönelik planlanma yönüyle araştırılarak ön plana çıkarılması önemlidir. Araştırma, Ordu ilinde gerçekleştirilmiş olan sosyal ve ekonomik araştırma indekslerinin mekânsal dağılımı ve bu dağılıma etki eden değişkenler ve yapıların açıklanması, coğrafi bilgi ile güçlendirilmesi örneği kapsamında tasarlanmıştır.

Araştırma Sahasının Yeri ve Sınırları

Karadeniz bölgesi kıyı kuşağında yer almakta olan Ordu ili; 40°19'49.15"- 41° 08'10.18" Kuzey paralelleri ile 36°41'13.77"- 38° 04'8.16" Doğu boylamları arasında yer almaktadır. Ordu ili idari coğrafya açısından güneyde Sivas, doğuda Giresun, batıda Tokat ve Samsun illeriyle çevrilidir. 5914 km^2'lik yüz ölçüme sahip olan Ordu ilinde 19[1] ilçe bulunmaktadır. Bu ilçelerden Altınordu metropol ilçe statüsündedir (Şahin, 2018; Harita 1).



Harita 1. Ordu ilinin lokasyon haritası

[1] *Akkuş 697 km^2, Altınordu 410 km^2, Aybastı 250 km^2, Çamaş 81 km^2, Çatalpınar 101 km^2, Çaybaşı 102 km^2, Fatsa 363 km^2, Gölköy 421 km^2, Gülyalı 62 km^2, Gürgentepe 185 km^2, ikizce 148 km^2, Kabadüz 343 km^2, Kabataş 74 km^2, Korgan 254 km^2, Kumru 296 km^2, Mesudiye 1046 km^2, Perşembe 217 km^2, Ulubey 295 km^2 ve Ünye 569 km^2'lik yüzölçümü bakımından büyüklüğe sahiptir* (https://www.harita.gov.tr/il-ve-ilce-yuzolcumleri).

Ordu ili ve çevresinin jeolojik oluşumu ve gelişimi, Türkiye'nin üzerinde bulunduğu kara parçaları ve özellikle Kuzey Anadolu Dağlarının gelişim sistematiğiyle ilgilidir. Jeomorfolojik açıdan ise Ordu ili kıyıdan itibaren yükselen dağlık bir topografyaya sahiptir (Gürgen, 2018) Yükselti ve eğim faktörü temelde ordu ili kıyı alanları ve kıyı alanları ardıl kesimlerine doğru jeomorfolojik özellikler değişiklik göstermekte ve bu faktörler sosyo-ekonomik gelişim açısından farklılıklara neden olmaktadır. Ordu ili sınırları içinde kısa mesafeler içinde denize ulaşan akarsuların yanı sıra uzun mesafeler kat eden Turnasuyu, Melet, Civil, Bülbül, Perşembe, Elekçi, Curi gibi dere ve ırmaklar yer almaktadır (Gürgen, 2018a).

Sosyo-ekonomik gelişme açısından iklim faktörü gerek yaşam koşullarını gerekse üretim süreçlerini etkileyen coğrafi özelliklerden biridir. Ordu ili genel olarak ılıman bir iklime sahip olup kışları ılık yazları ise serin geçer. Bu özellik, Karadeniz'e kıyısı bulunan ilçeler ile kıyı ardı kesimde yer alan ilçelerde farklılıklar göstermektedir (Gönençgil, 2018). Fiziki coğrafya özelliklerinin yanı sıra coğrafi özellikler bakımından sosyo-ekonomik gelişme özellikleri temelde nüfus, yerleşme, sanayi, ulaşım, üretim, istihdam, tarım ve hayvancılık gibi süreçlerin nasıl geliştirildiğine bağlıdır.

Ordu ili bulunduğu konum itibariyle iklim şartları uygunluğuna bağlı olarak tarım ve hayvancılık için elverişli yapılara sahiptir. İlde yaylacılık faaliyetliernin yaygın olması mera hayvancılığına imkan sağlamaktadır. Bunun yanı sıra kıyı alanlardaki sığır besiciliğine ek olarak yaylalar şeridinde büyükbaş ve küçükbaş hayvancılık sosyo-ekonomik açıdan il ekonomisine katkıda bulunmaktadır (Bulut, 2018).

2022 yılı Türkiye İstatistik Kurumu Adrese Dayalı Nüfus Kayıt Sistemi (ADNKS) sonuçlarına göre Ordu ili'nin toplam nüfusu 763.190 kişidir. Bu nüfus miktarı içinde Altınordu ilçesi 235.096 kişi, Ünye ilçesi 132.432 kişi, Fatsa ilçesi ise 126.775 kişi ile toplam nüfusun %51,3'ünü barındırmaktadır.

Sosyo-ekonomik gelişme açısından sanayi alanlarının varlığı ve sanayi altyapısının geliştirilmesi önem arz etmektedir. Ordu ilinin sanayi yapısı incelendiğinde sosyo-ekonomik kalkınma açısından gelişme sürecinde olan özellikle küçük işletme, atölye tesisleri, fındık işleme ve tekstil ön plana çıkmaktadır. Özellikle fındık üreticiliği ve pazarlaması ildeki en önemli ekonomik faaliyet ve sanayi süreçler kolunu oluşturmaktadır (Özdemir, 2018). Kent merkezinde, Fatsa ve Ünye ilçelerinde olmak üzere 3 adet organize sanayi bölgesi, Ordu merkezde 2, Fatsa'da 1, Ünye'de 1, Mesudiye'de 1 Adet ve Korgan ilçesinde arsa alım aşamasında olan 6 adet küçük sanayi sitesi bulunmaktadır. (İl Durum Çevre raporu, 2022).

Sosyo-ekonomik açıdan gelişim altyapısını oluşturan en önemli etmenlerden biri de ulaşım altyapısının gelişmişliğidir. Ordu ili gerek Karadeniz sahil yolu gerekse Ordu-Giresun

Havalimanı varlıkları ile ulaşım yönünden gelişmiş bir alan olarak ön plana çıkmaktadır. Ancak kıyı kesiminin iç alanlarına yönelik bağlantı yolları altyapı bakımından geliştirme sürecindedir. Özellikle Ordu ilindeki şehir içi ulaşım halk tarafından önemli bir problem olarak görülmektedir (Ertek, 2018).

Özellikle doğa ve kültür turizmi yönüyle zengin olan Ordu ili alternatif turizm türleriyle ön plana çıkan bir varlığa sahiptir. Gerek kıyı kesmi gerekse iç kesimlerde geliştirilen turizm altyapısı ve olanakları sosyo-ekonomik açıdan gelişme için alana olumlu etkilerde bulunmaktadır (Zaman, 2018).

MATERYAL ve YÖNTEM

Paralel karma desen yöntemi ile incelenen araştırmada gezi-gözlem metodu ile nicel ve nitel veriler kullanılmıştır. Araştırma, 1996-2004-2022 yılları arasındaki Sanayi ve Teknoloji Bakanlığı tarafından yayınlanan *İlçelerde Sosyo-Ekonomik Gelişmişlik İndeksi* raporlarına göre değerlendirilmiştir. Arcgis 10.8 programı ile desteklenen araştırma Coğrafi Bilgi Sistemleri yardımı ile seçili yıllardaki farklılaşmanın ortaya çıkarılması açısından görselleştirilmiştir. 1996 yılında "*nüfus, istihdam, eğitim, sağlık, imalat sanayii, mali göstergeler, inşaat, tarım ve diğer göstergeler*" kapsamında toplam 70 göstergeye kullanılmıştır. Ancak analizlerin doğrululuğu ve tutarlılığı kapsamında ise ilçe düzeyinde 32 göstergeye göre tespitler yapılmıştır. 2004 yılındaki SEGE hesaplamalarına göre ise "*demografik, istihdam, eğitim, sağlık, sanayi, tarım, mali ve diğer refah*" göstergeleri olmak üzere toplam 32 gösterge kullanılmıştır. 2022 SEGE sosyo ekonomik gelişmişlik indeksinde "*demografik, istihdam ve sosyal güvenlik, eğitim, sağlık, finans, rekabetçilik, yenilikçilik ve yaşam kalitesi değişkenlerini*" içeren 56 değişken kullanılmıştır. Bu çalışma, çeşitli yıllarda kullanılan değişken niteliklerinin ve bu nitelikleri etkileyen coğrafi faktörlerin incelenmesini, Ordu ilindeki sosyo-ekonomik gelişimin yıllara göre dağılışının yapılmasını ve alandaki sosyo-ekonomik özellikleri etkileyecek olguların coğrafi açıdan tespit edilerek öneriler sunulmasını amaçlamaktadır.

BULGULAR VE TARTIŞMA

Coğrafi Açıdan Sosyo-Ekonomik Gelişmişlik İndeks Değişkenleri

Demografya ve Coğrafya Açısından Sosyo-Ekonomik Gelişim

Türkiye'deki idari bölünüş açısından il ve ilçelerin soyo-ekonomik gelişmişlik sıralamalarının belirlenmesine yönelik araştırmalarda sadece Gayri Safi Yurtiçi Hasıla değil aynı zamanda ilçe bazlı ve il bazlı ekonomik, sosyal ve kültürel özelliklere göre veri setleri kullanılmaktadır (Kavasoğlu, 2007). Coğrafya biliminin doğası gereği, mekânsal ve bölgesel farklılıklar,

yerleşmelerin yer ile insan ve doğal süreçlerin ilişkisi nedeniyle nüfusun çok boyutlu incelenmesi gerek toplumların yaşadığı çevre gerekse sosyo-ekonomik açıdan bütünleştirici bir çerçeve sunmaktadır (Özgür & Yakar, 2021). Özellikle ekonomik ve sosyal ilişki çerçevesinde demografik veriler içinde nüfusun yapısı, doğum ve ölüm arasındaki değişkenler ve ulusal ve uluslararası göçlerde (Birinci, 2017) gelişmişlik düzeyleri etkili olmaktadır (Doğan, 2011). Türkiye'de nüfus artışının yanı sıra hızlı şehirleşmenin ile göç olgusu özellikle kırsal ve gelişmemiş alanlardan kentlere doğru bir göç eğilimini de beraberinde getirmiştir (Garipağaoğlu, 2010). Bu durum temel olarak kırsal alanlardan gelişmiş kentsel alanlara doğru sosyo ekonomik gelişim açısından büyük bir dengesizliği meydana getirmiştir (Avcı, 2003; Tümertekin, 1968; Sönmez, 2010; Coşkun, 2008).

İstihdam, Sosyal Güvenlik ve Coğrafya Açısından Sosyo-Ekonomik Gelişim

Türkiye'de devlet planlama teşkilatı kalkınma planları, kurum ve kuruluşlar tarafından yayımlanan raporlara göre ülkedeki bölgeler arasındaki sosyo-ekonomik gelişmişlik farklılıklarının giderilmesi açısından çeşitli politika ve hedefler belirlenmiştir (Yılmaz, 2005; Doğan, 2013; Balaban, 2008). Özellikle sanayi faaliyetleri ile ilişkili olarak gelişen istihdam dengesinin kırsal ve kentsel alanlara yönelik mekânsal özellikler gözetilerek yapılması sosyo-ekonomik gelişmişliğin coğrafi bölgeler kapsamında şekillenmesini sağlayan niteliklere sahiptir. İstihdam ve sosyal güvenlik açısından günümüzde daha önemli bir hale gelen ve çalışma hayatında daha fazla yer edinen kadın çalışanların yanı sıra aktif çalışan ve kişilerin ortalama kazanç miktarlarının dağılımı gelişmişlik indekslerinde kullanılan hesaplama yaklaşımlarından bazılarıdır (Özgüç, 1998; Doğanay vd. 2007).

Eğitim

Günümüzde eğitim süreçleri ekonomik, sosyal ve kültürel kalkınmayı hızlandıran en önemli faktörlerden biri olarak ön plana çıkmaktadır (Öztürk, 2005). Gerçekten de sosyo-ekonomik gelişmişliğin belirlenmesi için bir nüfus kitlesinde, okuma çağındaki nüfusun eğitim düzeyi ve eğitimlerinin durumu konusu temel göstergeler arasındadır (Doğanay & Orhan, 2021; Koday, 2005). Son yıllarda ise ülkelerin gelişme indeksleri ifade edilirken sahip oldukları nitelikli insan sayısı ve eğitim durumlarının ne olduğu da önemli bir gösterge olarak kullanılmaktadır (Kara & Atasoy, 2018). Nitekim bir toplumun eğitim durumunun yüksek veya düşük olması sosyal ve ekonomik anlamda olumlu ve olumsuz etkiler oluşturarak gelişmişlik düzeyine etki eder (Hoşgörür & Zengin, 2005; Şahin, 2015; Akbulut, 2010; Ayhan, 2019). Günümüzde sosyo-ekonomik gelişmişlik indeksleri eğitim değişkenleri hesaplama sistemlerinde özellikle eğitim durumu veya okuryazar sayılarının aksine okullaşma oranları, ortaokul, lise ve üniversite sınavlarından elde edilen puan ortalamaları da kullanılmaktadır.

Sosyo Ekonomik Gelişim Kapsamında Sağlık ve Coğrafya

Coğrafi mekânlardaki nüfus baskısına paralel olarak artan tüketim ve alan kullanımındaki değişimler, kırsal ve kentsel alanlardaki büyümeye neden olmaktadır. Bu büyüme ise özellikle sağlık hizmetlerine erişimi ve sağlık hizmetlerini de içeren ihtiyaçların artmasına neden olmuştur (Deniz vd. 2021;). Sağlık coğrafyasındaki doğal çevre şartlarından kaynağı alan ve nüfusun yaşadığı ortam ilişkisi çerçevesiyle sosyo-ekonomik açıdan gelişmişliğine etki eden süreçlerin bütünü olarak ifade edilmektedir (Özçağlar, 2006; Karakuzulu, 2004; Özey, 2021; Günay, 2008; Özdoğan, 2021). Türkiye'de Sanayi ve Teknoloji Bakanlığı tarafından geliştirilen sosyo-ekonomik gelişim indeksi (SEGE) hesaplamalarında il ve ilçelere yönelik sanayi değişkenlerinde bebek ölüm hızı, kişi başına düşen hekim, kişi başına düşen diş hekimi, kişi başına düşen sağlık personeli kişi başına düşen hastane yatağı ve kişi başına düşen eczane sayısı kriterleri kullanılmaktadır.

Coğrafi Özellikler Kapsamında Finans, Rekabetçilik ve Yenilikçilik

Temel olarak coğrafi bir mekânda gerçekleşen ekonomik faaliyetler iktisadi yaklaşımlar içinde çok fazla yer bulamamıştır (Özdemir & Başkol, 2010). Krugman tarafından literatüre kazandırılan yeni ekonomik coğrafya modelinin günümüzde yaygınlaşması ile birlikte ekonomik ve sosyal gelişimin makro ve mikro düzeydeki araştırmaları (Krugman, 1991) temel olarak alanın coğrafi özelliklerin kaynağını alan değişkenlerine dayandırılmaktadır (Tümertekin & Özgüç, 2020; Atakişi, 2012). Sosyo-ekonomik gelişim indeksleri finans değişkeni kapsamında hesaplama yöntemleri arasında dikkat edilen alandaki gelir gider dengesi veya satın alma işlemleri olmasına rağmen temelde bu değişkenlerin doğrudan bağlı olduğu alanlardaki ekonomik coğrafya fonksiyonlarının durumudur.

Coğrafi Özellikler Kapsamında Rekabetçilik

Sosyo-ekonomik gelişmişlik temelde coğrafi açıdan rekabetçilik, mekanlarda oluşturulan ekonomik faaliyetlerin, bu ekonomik faaliyetleri sürdüren yapının ve küresel rekabet gücünün nasıl korunduğuna yönelik araştırmalar gerçekleştirir (Malecki, 2002) Küreselleşme süreçleri ile birlikte ilerleyen ve sürdürülen rekabetçilik temelde coğrafi kaynağın geliştirilmesine, üretim ve işletme yeterliliğine bağlıdır (Tümertekin ve Özgüç, 2020). Sosyo-ekonomik gelişme indekslerinin oluşturulması kullanılan değişkenler Türkiye'de faal ve kurulan işletme sayıları, sanayi alanlarındaki elektrik tüketimi, gayrimenkul satış verileri, yatırım teşvik belgeli yatırım tutarları, kişi başı tarımsal ürün üretim değeri ve OSB parsel sayılarıdır.

Coğrafi Özellikler Kapsamında Yenilikçilik

Ülke ekonomilerinin verimlilik düzeyleri ve üretim kalıpları, sosyo-ekonomik açıdan güçlü bir büyümeyi ve refah artışını etkilemektedir (Belgin & Avşar, 2019). Sosyo-ekonomik gelişme

indekslerin kullanılan değişkenler Ar-Ge (R&D) altyapısına yöneliktir. Bu değişkenlere yönelik öncelikli bilgi, firma ve yapılacak proje geliştirmelerine ilişkin coğrafi özelliklerden kaynağını alan nitelikler ve engellerin üstesinden gelme becerisidir (Lahiri, 2010). Yenilikçilikle ilgili değişkenler, gerek ülkelerin ekonomik durumu gerekse eğitim ve alanlardaki sosyo-ekonomik özelliklere bağlı coğrafi yaklaşımların bilinmesiyle ilgilidir. Türkiye'de yenilikçilik değişkenleri olarak Arge girişimleri sayısı, bulut bilgi sistemleri vb. sayısı, patent ve fikri mülkiyetler, faydalı model gibi veriler kullanılmaktadır.

Yaşam Kalitesi Değişkenleri

Helburn (1982) tarafından yapılan çalışmada yaşam kalitesini, kamu yararı, kamu refahı veya ortak refah olarak tanımlanan kavramların yeniden ifade edilmesi şeklinde yorumlamıştır. Yaşam memnuniyetiyle ilişkilendirilen yaşam kalitesi temel olarak ulusal ve uluslararası milli gelir ölçütlerinin yanı sıra ekonomik olmayan veya insanlar tarafından hissedilen değerler olarak algılanabilmektedir. Özellikle ülkemizde istatistiki bölgelere ve mülki idari bölünüş alanlarına göre bu ölçümler TÜİK (Türkiye İstatistik Kurumu) tarafından yapılan anketler neticesinde belirlenmektedir. Yaşam kalitesi ölçülmesi özellikle eğitim, sağlık, konut, güvenlik, gelecekten beklenti gibi değişkenler üzerinde yoğunlaşmaktadır.

Ordu ilinin Sosyo-Ekonomik Gelişmişlik İndekslerine Göre Değerlendirilmesi

Araştırmada coğrafyanın yaşam kalitesi içindeki rolü ise aslında uygulamalı ve geleneksel araştırmalarda tüm insanlığın yaşam kalitesi iyileştirici ve yaşamları zenginleştirici rollerinin bulunduğunu vurgulamıştır. Yaşam kalitesi ve göstergeleri aslında fiziki ve beşeri coğrafyadan kaynağını alan nüfus, eğitim, sağlık, altyapı, konut, sosyal destek, gelir, güvenlik, iş yaşamı ve boş zaman faaliyetleri gibi değişkenleri barındırmaktadır (Boylu & Paçacıoğlu, 2016). Nitekim sosyo-ekonomik yaşam özelliklerine etki eden yaşam memnuniyeti değişkenleri farklı bilim dallarına göre değişiklik gösterse de Sanayi ve Teknoloji Bakanlığı tarafından yapılan sosyo ekonomik gelişim indekslerinde yaşam kalitesi değişkenlerinde "*atık hizmeti verilen nüfus oranı, kişi başına kiralanabilir avm alanları, adsl abone sayısı, kadın sürücü belgesi sayısı, pasaport sahipliği ve kişi başına mesken elektrik üretimi*" verileri kullanılmıştır.

Temel olarak Ordu ilindeki sosyo-ekonomik gelişmişlik değerlendirmesini kıyı kesimi ve kıyı ardı kesimi olarak incelemek mümkündür. Fonksiyonel özellikler dikkate alındığında bu sahalardan Altınordu, Ünye ve Fatsa ilçeleri (Fotoğraf 1) şehir yerleşmeleri olarak kabul edilirken Perşembe, Gülyalı, Aybastı, Gölköy, Mesudiye Kabadüz, Ulubey, Kumru, Çamaş, Gürgentepe, Kabataş, Akkuş, Korgan İkizce, Çatalpınar ve Çaybaşı ilçeler kasaba yerleşmesi niteliğindedir (Özdemir, 2018). Buna bağlı olarak sosyo-ekonomik gelişmişliğin Ordu ilindeki gelişimi fonksiyonel açıdan alandaki tarım, nüfus, eğitim, sanayi, hizmet sektörleri gibi beşeri

coğrafya faktörlerinin yanı sıra fiziki coğrafya özelliklerinden eğim, yükselti, karasallık-denizellik, iklim gibi faktörlerinin etkisi altında değişim göstermektedir.



Şekil 1. Ordu ilinde Sosyo-ekonomik özellikler ve fonksiyonel bakımından gelişmiş şehirsel alanlara yönelik örnekler (a. Altınordu sahil, Perşembe sahil, c. Fatsa sahil, d. Ünye Cumhuriyet meydanı)

1996 yılı sosyo-ekonomik gelişmişlik indeksine göre Altınordu ilçesi (Merkez ilçe) 1,823 değer ile diğer 18 ilçe arasında 1. sırada yer alırken 858 ilçe arasında 54. sıradadır. Bu değer ile Altınordu ilçesi 2. gelişmişlik kademesindeki iller arasına dâhil edilmektedir. Ordu iline bağlı ilçelerde gelişmişlik kademelerine göre Fatsa ve Ünye ilçeleri 3., Gülyalı, Perşembe, Aybastı, Gölköy, Mesudiye, Kabadüz ve Ulubey ilçeleri 4., Kumru, Çamaş, Gürgentepe, Kabataş, Akkuş ve Korgan 5., İkizce, Çatalpınar ve Çaybaşı ilçeleri ise 6. kademede yer almaktadır (Tablo 1; Harita 2).

Tablo 1. Ordu iline bağlı ilçelerde sosyo-ekonomik gelişmişlik kademeleri, değerleri ve sıralamaları (1996).

İlce Adı	Sege 1996	Gelişmişlik Kademesi	858 İlçe İçinde Sıralama
Merkez	1,823	2	54
Fatsa	0,328	3	207
Ünye	0,156	3	245
Gülyalı	-0,232	4	414
Perşembe	-0,251	4	422
Aybastı	-0,563	4	610
Gölköy	-0,576	4	622
Mesudiye	-0,583	4	632
Kabadüz	-0,618	4	651
Ulubey	-0,625	4	657
Kumru	-0,650	5	671
Çamaş	-0,728	5	713
Gürgentepe	-0,733	5	715
Kabataş	-0,747	5	721
Akkuş	-0,823	5	752
Korgan	-0,830	5	758
İkizce	-0,840	6	760
Çatalpınar	-0,877	6	775
Çaybaşı	-0,915	6	787

Kaynak: Sanayi ve Teknoloji Bakanlığı SEGE (1996) verilerinden faydalanılmıştır.

2004 yılında Altınordu, Ünye ve Fatsa gelişmişlik kademelerini korurken Türkiye genelindeki 872 ilçe sıralamasında kullanılan gelişmişlik değeri bakımından gerek puan bazlı gerekse sıralama bazlı düşüş yaşamıştır. Ünye ve Fatsa ilçelerinde ise gelişmişlik kademesi aynı kalırken (3. kademe) ilçe sıralamaları içinde gerilemeler görülmektedir (Tablo 2). 2004 yılında kademe artışı gözlemlenen ilçeler arasında Gülyalı ve Perşembe ilçeleri (4. kademeden 3. kademeye) bulunmaktadır. Bu durum aslında gerek sosyo ekonomik açıdan gelişen yeni ilçelerin sıralama dâhil edilmesinin yanı sıra kıyı kesiminde meydana gelen fonksiyonel çeşitlenme ve gelişmişliğin sadece Altınordu ilçesine değil aynı zamanda kıyı kesiminde yer alan ilçelere yönelimiyle ilgilidir. Gölköy 4. sıradan 5. sıraya Kumru 5. sıradan 4. sıraya, Akkuş 5. sıradan 6. Sıraya; en yüksek gelişim ise Çatalpınar ilçesinde 6. sıradan 4.gelişmişlik kademesi şeklindedir (Tablo 2; Harita 2). Çatalpınar ilçesinin Karadeniz Bölgesini Aybastı-Reşadiye yönüyle ulaşım bakımından İç Anadolu Bölgesine bağlaması ve 1990 yılı sonrasında ilçe statüsü kazanması, alanın sosyal ve ekonomik yönden gelişmesine katkıda bulunmuştur (Özdemir, 2018; Ertek, 2018).

Tablo 2. Ordu İline Bağlı İlçelerde Sosyo-Ekonomik Gelişmişlik Kademeleri, Değerleri ve Sıralamaları (2004).

İlce Adı	Sege 2022	Gelişmişlik Kademesi	872 İlçe İçinde Sıralama
Merkez	1,681	2	55
Fatsa	0,358	3	216
Ünye	0,238	3	244
Gülyalı	0,040	3	316
Perşembe	-0,198	3	427
Aybastı	-0,459	4	573
Gölköy	-0,622	5	662
Mesudiye	-0,526	4	611
Kabadüz	-0,596	4	650
Ulubey	-0,561	4	632
Kumru	-0,484	4	598
Çamaş	-0,401	4	564
Gürgentepe	-0,652	5	684
Kabataş	-0,652	5	683
Akkuş	-1,072	6	806
Korgan	-0,794	5	752
İkizce	-0,768	5	739
Çatalpınar	-0,567	4	636
Çaybaşı	-0,900	6	781

Kaynak: Sanayi ve Teknoloji Bakanlığı SEGE (2004) verilerinden faydalanılmıştır.

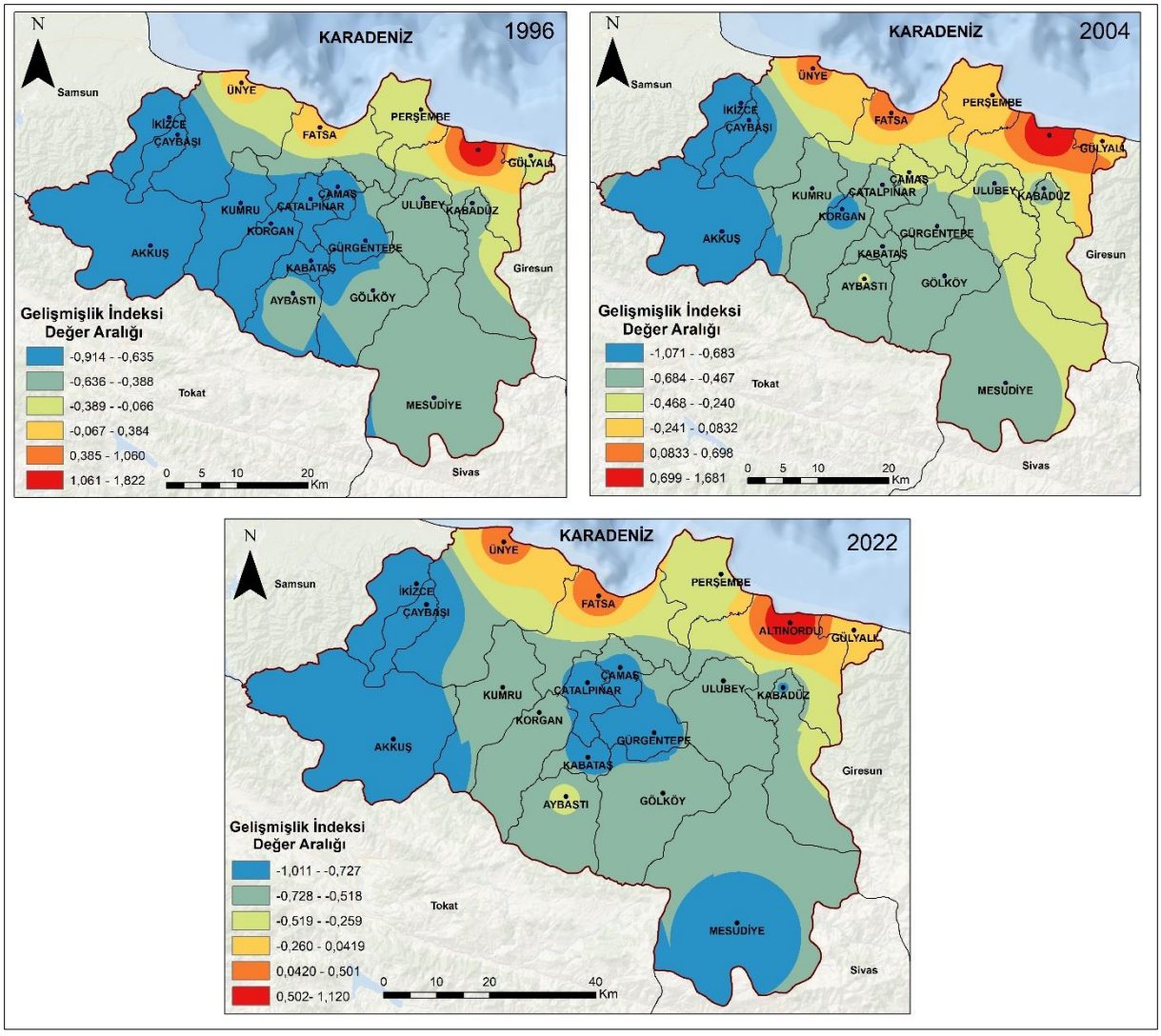
2022 yılındaki sosyo-ekonomik indekse değerlerine göre Altınordu ilçesinde gerek Türkiye ilçe gelişmişlik sıralaması gerekse gelişmişlik hesaplamalarına göre bir gerileme söz konusudur. Sosyo-ekonomik gelişmişlik indeksleri çalışmasının yayımlandığı 2022 yılında iç kesimler ile kıyı kesimleri arasında yer alan ilçelerde sosyo-ekonomik gelişmişlik farklılıklar artma eğilimi göstermiştir. Özellikle nüfus ve göç hareketliliğinin yaşam kalitesi bakımından kıyı kesimlerde yer alan Altınordu, Fatsa, Ünye ilçelerinde yoğunlaşması ve yatırımların özellikle bu üç ilçede belirginleşmesi ildeki sosyo-ekonomik kalitenin dağılımında dengesizliğe neden olmuştur. Altınordu ilçesi 1,121 değerle sosyo-ekonomik indeks sıralamasında 2. kademe gelişmiş ilçeler arasındadır. Fatsa 0,363 ve Ünye 0,266 değer ile 3. kademe gelişmiş ilçeler arasında yer almaktadır. Perşembe ve Aybastı ilçeleri 4., Gölköy, Kabadüz, Ulubey, Kumru, Çamaş, Kabataş Ve Korgan ilçeleri 5., Mesudiye, Gürgentepe, Akkuş, İkizce, Çatalpınar ve Çaybaşı ilçeleri ise sosyo-ekonomik açıdan 6. gelişmişlik kademesinde yer alan ilçeler arasındadır (Harita 2; Tablo 3). Temel olarak Altınordu (Merkez) ilçesinin seçili sosyo-ekonomik gelişmişlik indeksleri içinde 1. sırada yer alması yönetim fonksiyonun yanı sıra sosyo-ekonomik gelişme yönüyle nüfus, eğitim, sağlık, sanayi ve ticaret yönleriyle ön planda olmasından kaynaklanmaktadır. Altınordu ilçesi cazibe merkezi olarak Ordu ilinin

gelişmişliğini tanıtan niteliklere sahip olup ve bu nitelikleri ön planla çıkarmaktadır (Bulut 2018; Zaman 2018; Şahin, 2018).

Tablo 3. Ordu İline Bağlı İlçelerde Sosyo-Ekonomik Gelişmişlik Kademeleri, Değerleri ve Sıralamaları (2022).

İlce Adı	Sege 2022	Gelişmişlik Kademesi	924 İlçe İçinde Sıralama
Altınordu	1,121	2	113
Fatsa	0,363	3	246
Ünye	0,266	3	266
Gülyalı	-0,145	3	398
Perşembe	-0,418	4	566
Aybastı	-0,464	4	603
Gölköy	-0,610	5	724
Mesudiye	-0,842	6	864
Kabadüz	-0,744	5	809
Ulubey	-0,730	5	801
Kumru	-0,606	5	720
Çamaş	-0,776	5	823
Gürgentepe	-0,859	6	871
Kabataş	-0,805	5	841
Akkuş	-1,012	6	912
Korgan	-0,704	5	784
İkizce	-0,979	6	907
Çatalpınar	-0,854	6	868
Çaybaşı	-0,932	6	890

Kaynak: Sanayi ve Teknoloji Bakanlığı SEGE (2022) verilerinden faydalanılmıştır.



Harita 2. Ordu İlinde Sosyo-Ekonomik Gelişmişlik İndeksi Değerlerinin İlçelere Göre Dağılışı

SONUÇ

Coğrafi açıdan ekonomik, sosyal ve çevresel bütünlüğün gerek kırsal gerekse şehirsel alanlarda sağlanması, hem sürdürülebilirlik hem de kalkınma niteliklerini destekleyici olgulara etki etmektedir. Nitekim İnan (2020) tarafından Ordu ilinin sosyo-ekonomik açıdan gelişmişlik durumu için yapılan araştırmada gerek Türkiye sıralaması gerekse coğrafi bölge içindeki gelişmişliğinin yeterli olmadığını tespit etmiştir. Bu durumun nedenleri arasında ise bölgenin coğrafi yapısını ile ilişkili olduğu sonucuna varılmıştır. Özellikle küresel köy haline gelen bazı alanlardaki ekonomik kutuplaşmanın belirginleştiği ve yeni ekonomik kutuplaşma bölgelerinin de gerek kırsal alanlarda gerekse şehirsel alanlarda arttığı gözlemlenmektedir. Temelde bu durum özellikle düğüm noktalarını oluşturan büyükşehir metropol kentlerinde daha da belirgin bir durumdadır (Kaygalak & Şevket, 2007).

Ordu ili için ise kıyı ardı ve kıyı kesimi olarak nitelendirilen sosyo-ekonomik gelişmişlik arasındaki farklılıkların ortadan kaldırılması ve planlanmasına için gereken unsurlar coğrafya ile ilişki kapsamında şu şekilde sıralanabilir;

- Bölgenin coğrafi avantajlarını dikkate alan temel ve alternatif geçim türlerini ekonomik açıdan çeşitlendirme;

Ordu ilinin sahip olduğu kıyı şeridi, dağları ve yaylaları da dâhil olmak üzere bu alanların sadece tarım ve turizm sektörleri gibi tek bir sektöre bağlı kalınan aşırı güvenin azaltılması gerekmektedir. Bu kapsamda coğrafi potansiyel içeren alanlarda sürdürülebilir tarım, sürdürülebilir hayvancılık gibi alternatif ekonomik faaliyet üretkenliğinin alanda yaygınlaştırılması önemlidir. Özellikle tarım turizminin ve tarımsal ürünlerdeki çeşitlendirmenin artması kalkınma projeleri geliştirmesinin için ön adımı olabilir.

- Kıyı ardı yerleşim alanları ile iç bölgelere erişilebilirliğin iyileştirilmesi için bütünleşik altyapının geliştirilmesi;

Bölgesel entegrasyonun teşvik edilmesi, ulusal ve uluslararası ticaret, sanayi, hammadde, turizm, tarım gibi sektörlerdeki gelir oranlarının arttırılması için ekonomik pazarlarla dâhil olan alanlarla birlikte bütünleşik bir ulaşım ve pazarlama altyapısı yaklaşımının koordine edilmesi gerekmektedir (Örn; Yeşil Yol Projesi).

- Yerel kaynak yönetiminin teşvik edilmesi;

Özellikle alandaki toprak, su ve bitki kalitesinin arttırılması amaçlı iklimsel değişimlere dayanıklı türlerin üretilmesi, günümüz ve gelecekteki sürdürülebilir kalkınma yönlerinin iyileştirilmesi açısından önemlidir. Ordu ili genelindeki temel geçim türünü oluşturan tarım ve hayvancılık kaynaklı üretim türlerindeki planlı yenileme, izleme ve kontrolün arttırılması, çevresel bütünlüğü, sorumlu üretim ve tüketim kalıplarını gerçekleştirecek atılımların ve örneklerinin alanda çoğaltılması gerekmektedir.

- Eğitim ve beceri eğitimi yoluyla beşeri sermayenin geliştirilmesi;

Yerel, ulusal ve uluslararası ekonomik sektörlerle ilgili inovasyon ve girişimcilik kültürünün ve alanda katma değerli ürün üretimi için eğitimler ile desteklere ilişkin uygulama örneklerinin arttırılması gerekmektedir. Mesleki eğitim yolları ile vasıflı bir iş gücünü geliştirmek Ordu ilinin diğer alanlara göre avantajlı ve rekabet edebilir yönleri ortaya çıkarmada büyük bir fırsat barındırmaktadır. Özellikle fındık, gıda işleme ve turizm gibi sektörlerdeki var olan eğitim programlarının yaygınlaştırılması hem beşeri sermayenin gelişimini hem de Ordu ilini eşsiz coğrafyası ile uyumlu bir hale getirebilir.

- Sosyal refahın sağlanması ve sosyo-ekonomik gelişmişlik açısından kutuplaşan kırsal ve şehirsel alanların kaynaştırılması;

Hükümet, yerel topluluklar, sivil toplum ve özel sektör dâhil olmak üzere iç ve dış paydaş işbirliğinin bütünleşmesine yönelik stratejilerin uygulanması, Ordu ilinin coğrafi çeşitliliği, üretim ve istihdam dengesini olumlu bir şekilde yönlendirilmesine imkân sağlayacaktır. Özellikle sosyal refahı etkileyen en önemli sektörlerden olan tarım için katma değerli ürün üretimi kapsamında uygulamalı proje geliştirilmesinin yaygınlaştırılması, turizm için ise kırsal turizm niteliklerinin kapsayıcı şekilde yerel halk paydaşlığını içeren niteliklerle çoğaltılması gerekmektedir.

- Sürdürülebilir kalkınmayı teşvik etmek;

Özellikle sürdürülebilir kırsal kalkınma, yenilenebilir enerji, sürdürülebilir tarım ve hayvancılık, sürdürülebilir arazi yönetimi, bütünleşik sanayi zonları gibi Ordu ilinde sürdürülebilir kalkınma hedefleri için amaçların ve ortaklıkların çoğaltılması gerekmektedir. Ordu ilinde gerçekleştirilen Türkiye'nin *ilk kırsal kalkınma eğitim merkezi ve organik gıda işleme tesisi protokolü* buna bir örnek teşkil etmektedir.

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BİTKİ GELİŞİMİNİ TEŞVİK EDEN BAKTERİ VE FOSFOR UYGULAMALARININ FASULYE (*Phaseolus vulgaris* L.)'DE MORFOLOJİK ÖZELLİKLER ÜZERİNE ETKİSİ

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ÖZET

Yüksek verim ve kaliteli ürün için mutlak gerekli elementlerin optimum düzeyde olması ve bitki tarafından alınabilirliğini engelleyici toprak koşullarının bulunmaması gerekmektedir. Ülkemiz tarım alanlarında eksikliği en fazla hissedilen besin elementlerinden biri fosfordur. Bitki büyümesini teşvik eden bakteriler topraktaki inorganik fosforun çözünürlüğünü artırarak bitkilere fosfor sağlayabilmektedirler. Bu araştırma 2017-2018 yılları bitki yetiştirme döneminde iki yıl süre ile Eskişehir Osmangazi Üniversitesi Ziraat Fakültesi deneme tarlalarında yürütülmüştür. Deneme tesadüf blokları faktöriyel deneme desenine göre üç tekerrürlü olarak kurulmuştur. Araştırmada azot bağlama ve fosfat çözücü özelliği olan beş farklı biyogübre [Bontera (*Bacillus amyloliquefociens, Bacillus pumilus, Bacillus subtilis, Bacillus licheniformis, Bacillus megaterium, Trichoderma harzianum, Trichoderma kanigi*), Bactoboost (*Bacillus subtilis, Bacillus magaterium, Loctococcus* spp.), Köklendirici (*Bacillus subtilis, Bacillus magaterium, Loctococcus* spp.) Lifebac NP (*Bacillus subtilis, Bacillus magaterium*) ve NSAH (% 15 organik madde, % 6 organik karbon, % 13 humik+ fulvik asit)], bir Rhizobia bakterisi (*Rhizobium leguminosorum*) ve kontrol olmak üzere yedi uygulama ile üç fosforlu gübre dozu (0, 3 ve 6 kg/da P_2O_5) üç tekerrürlü olarak uygulanmıştır. Fasulyede incelenen morfolojik özellikler araştırmanın birinci yılında daha yüksektir. Bunun nedeni olarak ikinci yıl sıcaklıkların daha yüksek olması düşünülmektedir. Artan fosfor dozları bitki boyu, ilk bakla yüksekliği ve tane verimini olumlu yönde etkilemiştir. Araştırmamızda morfolojik özellikler bakımından etkili olan biyogübre NSAH olmuştur. Bitki gelişimini teşvik edici bakterilerin etkisi bakteri tür ve sayısı, bitki-bakteri kombinasyonu, bitki genotipi, gelişme dönemi, hasat tarihi, bitkisel parametreler, toprak tipi, toprak organik madde miktarı ve çevresel koşullara bağlı olarak değişmektedir. Bitki gelişimini teşvik edici bakteri uygulamaları laboratuar, sera ve tarla koşullarında yürütülmekte, ancak tarla denemelerinde önceden tahmin edilemeyen bazı koşullar bazen uygun sonuçların alınmasını zorlaştırmaktadır. Kullanılan mikrobiyal gübrelerin tarla koşullarında gelecek yıllarda denenmesi sonuçların daha kesinlik kazanması açısından önemli olacaktır.

Anahtar Kelimeler: PGPR, fosfor, fasulye, morfolojik özellikler

THE EFFECT OF PLANT GROWTH PROMOTING RHIZOBACTERIA AND PHOSPHORUS APPLICATIONS ON MORPHOLOGICAL CHARACTERISTICS OF BEANS (*Phaseolus vulgaris* L.)

ABSTRACT

The essential elements should be at optimum level for high yield and quality product and their availability by the plant should not be hindered. Phosphorus is one of the most deficient nutrients in agricultural areas in Turkiye. Plant growth promoting rhizobacteria can provide phosphorus to plants by increasing the solubility of inorganic phosphorus in the soil. The field experiment was conducted during 2017 and 2018 in the experimental area of the Faculty of Agriculture, Eskisehir Osmangazi University, Eskisehir, Turkey. It was designed as a factorial arrangement in a randomized complete block design with three replications. The effect of three phosphorus doses (0, 30, and 60 kg ha^{-1} P_2O_5) with a control and different commercial biofertilizers (Bontera (*Bacillus amyloliquefociens, Bacillus pumilus, Bacillus subtilis, Bacillus licheniformis, Bacillus megaterium, Trichoderma harzianum, Trichoderma kanigi*), Bactoboost (*Bacillus subtilis, Bacillus magaterium, Loctococcus* spp.), Koklendirici (*Bacillus subtilis, Bacillus magaterium, Loctococcus* spp.), Lifebac NP (*Bacillus subtilis, Bacillus magaterium*), NSAH (15% organic matter, 6% organic carbon, 13% humic + fulvic acid), and Rhizobia (*Rhizobium leguminosorum*)) were investigated. Morphological characteristics are higher in the first year than second year in beans due to higher temperature in second year. Increasing phosphorus doses positively affected plant height, first pod height and grain yield. The most effective biofertilizer in terms of morphological characteristics was NSAH in our study. The effect of plant growth promoting rhizobacteria depending on the type and number of bacteria, plant-bacteria combination, plant genotype, development period, harvest date, plant parameters, soil type, soil organic matter amount and environmental conditions. Plant growth promoting rhizobacteria applications are carried out in laboratory, greenhouse and field conditions. However, some unpredictable conditions in field trials make it difficult to obtain positive results. It is important to test these microbial fertilizers used in field conditions in the coming years.

Keywords: PGPR, phosphorus, bean, morphological characteristics

GİRİŞ

Yüksek verim ve kaliteli ürün için mutlak gerekli elementlerin optimum düzeyde olması ve bitki tarafından alınabilirliğini engelleyici toprak koşullarının bulunmaması gerekmektedir. Bunlardan birinin veya bir kaçının olması ürünün niteliği ve niceliğini etkilemektedir. Türkiye topraklarının verimliliğini sınırlandıran bir faktör de toprak pH'sının yüksekliği ve buna bağlı olarak başta fosfor ve çinko olmak üzere diğer elementlerin alınımlarının engellenmesidir. Tarımsal üretim yapılan alanlara uygulanan fosforlu gübrenin %10-30'u bitkilerce kullanılabilmektedir (Gilani ve ark. 1983). Geri kalan miktar toprakta Fe, Al ve $CaCO_3$ ile çözünemez bileşikler oluşturarak fiksasyona uğramaktadır. Sundara ve ark. (2002) yaptıkları çalışma sonucunda fosfat çözücü bakteriler ile aşılanan şeker kamışının ihtiyaç duyduğu fosforlu gübre miktarının %25 daha az olabileceğini ortaya koymuşlardır.

Doğrudan ve dolaylı olarak bitki gelişimini olumlu etkileyen bakteriler "bitki gelişimini teşvik eden bakteriler (Plant Growth Promoting Rhizobacteria=PGPR)" olarak adlandırılmaktadır. PGPR esas olarak iki gruba ayrılmaktadır. Bunlar bitki gelişiminde, tohum çıkışında veya ürün veriminde direkt olarak etkili olan PGPR ve biyo-kontrol ile bitki gelişmesine dolaylı olarak yararlı olan PGPR'dır (Glick. ve ark. 1999). Doğrudan etki mekanizmaları değişik yollarla bitki büyümesinin direkt olarak teşvik edilmesidir. Asimbiyotik azot fiksasyonu, inorganik fosforun çözünürlüğünün arttırılması ve organik fosfor bileşiklerinin mineralizasyonu, siderofor üretimi yoluyla demir ve organik asit üretimi ile diğer bazı iz elementlerin alımını arttırılması ile faydalı bakteriler bitkilerin mineral beslenmesini iyileştirerek büyümeyi teşvik edebilirler. Ayrıca, oksinler, gibberelinler, sitokininler gibi bitkisel hormonların üretilmesi, 1-Aminocyclopropane-1- karboksilat (ACC) deaminaz enzim aktivitesi yoluyla etilen sentezinin engellenmesi, çevresel stresi azaltma; bakteri-bitki ilişkisinde uyum, vitamin sentezi, kök geçirgenliğini artırma yoluyla da bitki büyümesi doğrudan artırılabilir.

Ülkemiz tarım alanlarında eksikliği en fazla hissedilen besin elementlerinden biri fosfordur. Topraklarda fosforun büyük kısmı (%20-80 oranında) organik formda depolanmakta ve bu fosforun çözünerek bitki tarafından kullanılabilmesi mikrobiyal aktivite ile gerçekleşmektedir. Bazı bakteri türleri önemli düzeylerde asit fosfataz aktivitesine sahip olup organik fosfatın çözülmesine katkı yapmaktadırlar. Fosforu çözebilen mikroorganizmalarla bitkilerin aşılanması ile çözünen fosforun bitki tarafından alımı hızlandırılmakta ve bitki gelişimi olumlu yönde etkilenmektedir (Subba, 1982; Khan ve ark. 2009; Küçük ve Güler 2009).

Yapılan çalışmada fasulye bitkisine farklı beş adet mikrobiyal gübre ve rhizobia bakterisi uygulanmış ve bu gübrelerin fosforlu gübre ile etkileşimleri incelenmiştir. Yaptığımız uygulamaların morfolojik özellikler üzerine olan etkileri araştırılmıştır.

MATERYAL ve YÖNTEM

Bu araştırma 2017-2018 yılları bitki yetiştirme döneminde iki yıl süre ile Eskişehir Osmangazi Üniversitesi Ziraat Fakültesi deneme tarlalarında yürütülmüştür. Eskişehir, Orta Anadolu Bölgesinin Batı Geçit kuşağında yer alıp denizden yüksekliği 798 metredir. Denemenin kurulduğu bölge 30° 28' Doğu boylamı ile 39° 45' Kuzey enlemlerinde bulunmaktadır.

Deneme alanından alınan toprak örneklerinin Geçit Kuşağı Tarımsal Araştırma Enstitüsü Müdürlüğü Toprak ve Su Araştırmaları Birimi'nde analizleri yaptırılmıştır. Analiz sonuçlarına göre deneme alanı topraklarının bazı fiziksel ve kimyasal özellikleri Çizelge 1'de sunulmuştur. Araştırmanın birinci yılında topraklar hafif alkali, kireçli, organik madde içeriği çok az, fosfor, mangan ve demir içeriği düşük, potasyum, çinko ve bakır yeterli düzeyde, diğer elementler bakımından zengindir. Araştırmanın ikinci yılında ise topraklar hafif alkali, orta kireçli, organik madde içeriği az, fosfor, potasyum, kalsiyum ve bakır yeterli, mangan çok az, demir ve çinko içeriği orta, magnezyum zengin düzeydedir.

Çizelge 1. Araştırma yerine ilişkin toprak analiz sonuçları

Toprak derinliği (cm)	Doymuşluk (%)	pH	Kireç (%)	Organik madde (%)		Bitkilerde yarayışlı				Cu (ppm)	Mn (ppm)	Fe (ppm)	Zn (ppm)
					Fosfor P_2O_5 kg/da	Potasyum K_2O kg/da	N (%)	Ca (mg/kg)	Mg (mg/kg)				
0-30	39	7.83	5.40	0.79	4.55	181	0.03	4197	876.30	0.95	3.16	1.56	0.66
0-30	46	7.71	7.56	1.65	17.75	245	0.08	2061	482.8	0.82	2.94	2.84	0.32

Araştırmanın yürütüldüğü Eskişehir iline ait uzun yıllar ortalamaları ile 2017 ve 2018 yılı vejetasyon dönemine ait sıcaklık (^{0}C), yağış (mm) ve oransal nem (%) değerleri Çizelge 2'de verilmiştir. Araştırmanın her iki yılında da toplam yağış uzun yıllar ortalamasından yüksek iken, ortalama sıcaklık ve nispi nem birinci yıl uzun yıllar ortalamasına yakındır. İkinci yıl ise ortalama sıcaklık ve nispi nem uzun yıllar ortalamasından yüksektir.

Çizelge 2. Araştırma yerine ilişkin iklim verileri

Aylar	Uzun yıllar			Deneme yılı (2017)			Deneme yılı (2018)		
	Sıcaklık (°C)	Yağış (mm)	Nem (%)	Sıcaklık (°C)	Yağış (mm)	Nem (%)	Sıcaklık (°C)	Yağış (mm)	Nem (%)
Mayıs	15.0	42.6	69.8	14.4	50.8	73.0	16.8	62.2	74.8
Haziran	19.4	34.7	66.9	19.1	44.8	73.4	19.9	46.6	69.5
Temmuz	22.4	5.2	62.1	23.1	13.4	59.5	22.3	46.0	65.5
Ağustos	22.4	17.7	64.1	22.0	31.4	67.3	22.9	12.6	63.5
Eylül	17.7	18.0	68.1	19.6	3.0	57.0	18.6	2.8	65.5
Toplam		118.2			143.4			170,2	
Ortalama	19.38		66.2	19.64		66.04	20,1		67.76

Meteoroloji İşleri Genel Müdürlüğü

Araştırma Eskişehir Osmangazi Üniversitesi Ziraat Fakültesi arazilerinde yürütülmüştür. Araştırmada azot bağlama ve fosfat çözücü özelliği olan beş farklı biyogübre [Bontera (*Bacillus amyloliquefociens, Bacillus pumilus, Bacillus subtilis, Bacillus licheniformis, Bacillus megaterium, Trichoderma harzianum, Trichoderma kanigi*), Bactoboost (*Bacillus subtilis, Bacillus magaterium, Loctococcus* spp.), Köklendirici (*Bacillus subtilis, Bacillus magaterium, Loctococcus* spp.) Lifebac NP (*Bacillus subtilis, Bacillus magaterium*) ve NSAH (% 15 organik madde, % 6 organik karbon, % 13 humik+ fulvik asit)], bir Rhizobia bakterisi (*Rhizobium leguminosorum*) ve kontrol olmak üzere yedi uygulama ile üç fosforlu gübre dozu (0, 3 ve 6 kg/da P_2O_5) üç tekerrürlü olarak uygulanmıştır.

Deneme tesadüf blokları faktöriyel deneme desenine göre üç tekerrürlü olarak kurulmuştur. Deneme materyali olarak Geçit Kuşağı Tarımsal Araştırma Enstitüsü'nden temin edilen Topçu fasulye çeşidi kullanılmıştır. Denemede kullanılan Rhizobia bakterisi Ankara Toprak ve Gübre Araştırma Enstitüsü'nden temin edilmiştir. Fosforlu gübre olarak %43-45 P_2O_5 içeren triple süper fosfat kullanılmıştır. Ekim ile birlikte tüm parsellere 2.5 kg/da N olacak şekilde %21'lik Amonyum sülfat gübresi uygulanmıştır. Ekim 45 cm sıra arası, 10 cm sıra üzeri, 4 sıra ve 4 m parsel boyu olacak şekilde, parsel büyüklüğü 7.2 m^2 olarak 4 Mayıs 2017 ve 4 Mayıs 2018 tarihlerinde yapılmıştır. Bakteri uygulaması nedeniyle yabancı ot kontrolü elle yapılmıştır. Haziran ayından itibaren yaklaşık on günlük aralıklarla deneme alanı sulanmıştır

Her parselden tesadüfi olarak 5 bitki seçilmiş ve bunlarda bitki boyu, ilk bakla yüksekliği, yaprak sayısı, ana dal sayısı, bakla uzunluğu tespit edilmiştir. Her parselin yanlarından birer sıra ve parsel başlarından 50 cm'lik kısımlar kenar tesiri olarak atılarak geri kalan kısım elle hasat edilerek tarlada kurutulmuş ve dekara tane verimi tespit edilmiştir (Akçin, 1974).

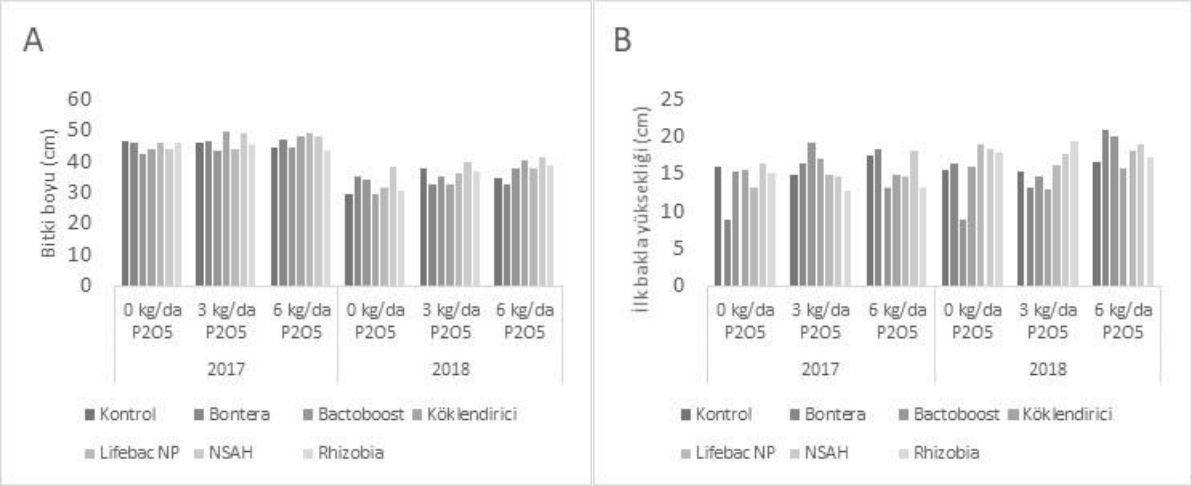
Araştırmadan elde edilen sonuçlar tesadüf blokları faktöriyel deneme desenine göre varyans analizi ile değerlendirilmiş, ortalamalar LSD testi ile karşılaştırılmıştır. Analizler için MSTATC paket programı kullanılmıştır.

BULGULAR ve TARTIŞMA

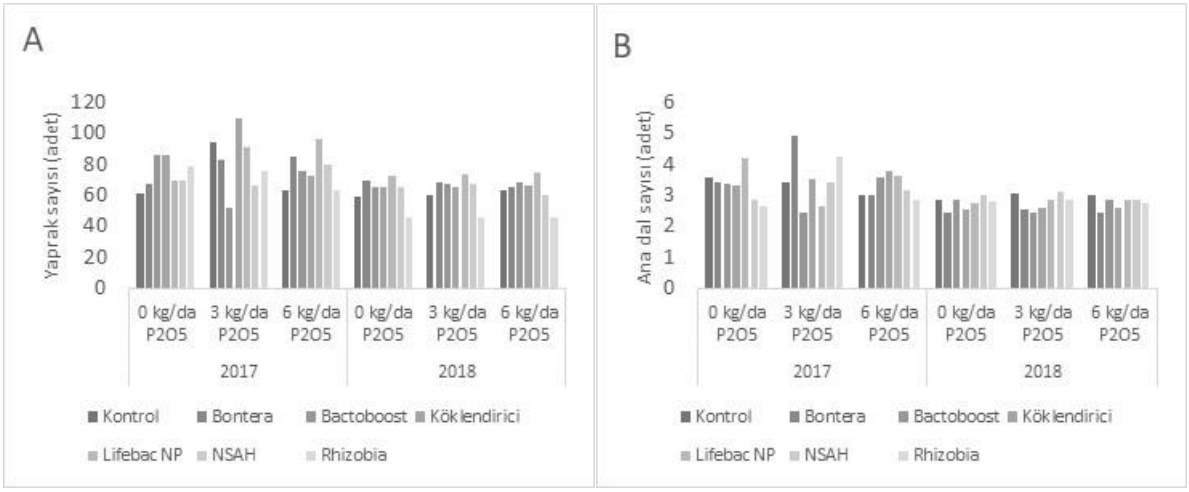
Farklı biyogübrelerin fosforlu gübre dozları ile etkileşimlerinin incelendiği araştırmada fasulye için incelenen tüm özelliklerde yıllar arasındaki farklılıklar istatistiki anlamda önemli bulunurken, fosfor dozları bakımından sadece bitki boyu, ilk bakla yüksekliği ve tane verimine ait değerler önemli çıkmış, bakteri uygulamaları arasındaki farklılıklar ise ana dal sayısı hariç incelenen tüm özelliklerde istatistiki anlamda önemli olmuştur (Çizelge 3). Bitki boyu bakımından ikinci yıl 0 kg/da P_2O_5 uygulanan kontrol parsellerinde en düşük değer gözlenirken, diğer parsellerde kontrol parselleri yüksek değerler göstermiştir (Grafik 1 A). İlk bakla yüksekliği ve bakla uzunluğu için birinci yıl 0 kg/da P_2O_5 uygulanan bontera parsellerinde düşük değer gözlenirken, diğer parsellerde bontera uygulaması yüksek değerler göstermiştir (Grafik 1 B; 3 A). İkinci yıl her üç fosfor dozunda da yaprak sayısı bakımından rhizobia parselleri yüksek değerler gösterirken, birinci yıl bu değerler yüksek olmuştur (Grafik 2 A). Ana dal sayısı için birinci yıl 3 kg/da P_2O_5 uygulanan bontera parsellerinde en yüksek değer gözlenirken, diğer parsellerde bontera uygulaması daha düşük değerler göstermiştir (Grafik 2 B). Tane verimi bakterilerin farklı fosfor dozlarına tepkileri farklı olmuştur (Grafik 3 B). Bu nedenle yıl x fosfor dozları x bakteri uygulamaları interaksiyonları önemli çıkmış olabilir.

Çizelge 3. Fasulye'de incelenen özelliklere ilişkin birleştirilmiş varyans analiz sonuçları ve ortalama değerler

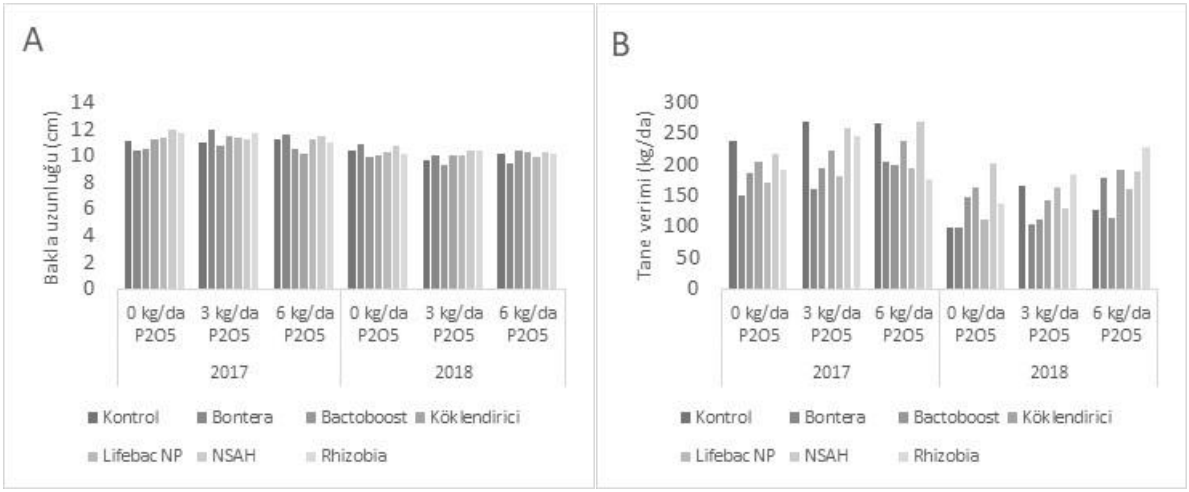
	Bitki Boyu (cm)	İlk Bakla Yüksekliği (cm)	Yaprak Sayısı (adet)	Ana Dal Sayısı (adet)	Bakla Uzunluğu (cm)	Tane Verimi (kg/da)
2017	45.92 A	15.22 B	77.33 A	3.38 A	11.16 A	211.21 A
2018	35.36 B	16.59 A	63.38 B	2.77 B	10.12 B	149.90 B
Ortalama	40.64	15.90	70.35	3.07	10.64	180.55
0 kg/da P_2O_5	38.79 C	15.15 C	68.51	3.04	10.73	165.15 C
3 kg/da P_2O_5	41.09 B	15.63 B	72.67	3.16	10.65	181.06 B
6 kg/da P_2O_5	42.03 A	16.94 A	69.89	3.02	10.54	195.46 A
Ortalama	40.64	15.90	70.35	3.07	10.64	180.55
Kontrol	39.82 B	15.89 B	66.74 CD	3.15	10.57 ABC	193.50 B
Bontera	39.95 B	15.65 B	72.90 ABC	3.13	10.70 ABC	149.80 D
Bactoboost	39.62 B	15.23 B	68.97 BC	2.93	10.21 C	158.72 C
Köklendirici	40.67 B	15.35 B	77.33 AB	3.06	10.50 BC	193.42 B
Lifebac NP	40.73 B	15.95 B	79.54 A	3.16	10.66 ABC	163.89 C
NSAH	43.42 A	17.33 A	67.94 CD	3.07	11.01 A	210.93 A
Rhizobia	40.24 B	15.95 B	59.08 D	3.02	10.82 AB	193.64 B
Ortalama	40.64	15.90	70.35	3.07	10.64	180.55
Genel Ort.	40.64	15.90	70.35	3.07	10.64	180.55
Yıl	**	**	**	**	**	**
Fosfor dozları	**	**	öd	öd	öd	**
Bakteri	**	**	**	öd	**	**
Yıl x Fos.	**	**	öd	öd	öd	**
Yıl x Bak.	**	**	**	**	öd	**
Fos. x Bak.	**	**	**	**	öd	**
Yıl x Fos x Bak.	**	**	**	**	**	**



Grafik 1. Farklı fosfor dozu ve bakteri uygulanan fasulyede bitki boyu (A) ve ilk bakla yüksekliğine (B) ilişkin interaksiyonlar [LSD % 1: 3.573 (A); LSD% 1:1.804(B)]



Grafik 2. Farklı fosfor dozu ve bakteri uygulanan fasulyede yaprak sayısı (A) ve ana dal sayısına (B) ilişkin interaksiyonlar [LSD % 1: 18.99 (A); LSD% 1:0.806 (B)]



Grafik 3. Farklı fosfor dozu ve bakteri uygulanan fasulyede bakla uzunluğu (A) ve tane verimine (B) ilişkin interaksiyonlar [LSD % 1: 1.055 (A); LSD% 1:14.15 (B)]

Araştırmamızda ilk bakla yüksekliği hariç incelenen tüm özelliklerde birinci yıl daha yüksek değerler görülmüştür (Çizelge 3). Bitki boyu ilk yıl yüksek iken ilk bakla yüksekliği ikinci yıl daha yüksektir. Pekşen (2005) ve Ülker (2008) bitki boyunun çevre şartlarından çok fazla etkilendiğini bildirmektedirler. Bitkide dal sayısı bakımından yıllar arasında önemli farklılıkların olduğu ve bu farklılıkların iklimsel faktörlerden kaynaklandığı diğer araştırıcılar tarafından da belirlenmiştir (Pekşen, 2005; Karakuş ve ark., 2005; Elkoca ve Çınar, 2015). Yüksek sıcaklıklar fasulye bitkisinde net asimilasyon miktarını azaltmakta ve tane veriminde düşüşlere neden olmaktadır (Rodríguez et al., 2005; Ashraf and Hafeez, 2004). Araştırmamızda ikinci yıl sıcaklıkları daha yüksektir. Bu yüksek sıcaklık ikinci yıl tane veriminin düşük olmasına neden olmuş olabilir.

Araştırmamızda fosfor dozları bitki boyu, ilk bakla yüksekliği ve tane verimi özelliklerini istatistiki anlamda etkilemiştir. En yüksek bitki boyu, ilk bakla yüksekliği ve tane

verimi 6 kg/da P_2O_5 uygulanan parsellerde belirlenmiştir (Çizelge 3). Fosfor dozu artışına bağlı olarak bu özelliklerde de artışlar görülmüştür. Ahmad (2001), Baydemir (2013) ve Mtua (2015) fasulyede artan fosfor dozlarının bitki boyunu artırdığını bildirmektedirler. Değişik araştırıcılar tarafından fasulyede artan fosfor dozlarının tane verimini olumlu yönde etkilediği bildirilmektedir (Baydemir 2013; Truko ve Mohammed 2014; Mtua 2015).

Bakteri uygulamaları ana dal sayısı hariç incelenen tüm özellikleri istatistiki anlamda etkilemiştir. Yaprak sayısı için en yüksek değer Lifebac NP uygulanan parsellerde belirlenirken, incelenen diğer tüm özelliklerde en yüksek değerler NSAH uygulanan parsellerden elde edilmiştir (Çizelge 3). Önder ve ark. (1999) fasulyede iki farklı mikrobiyal gübre ve 3 fosfor dozunu denemişler, ilk bakla yüksekliği ve bitki boyu, bakımından istatistiksel anlamda farklılıklar saptamışlardır. Talay (2019) biyogübre uygulamalarının arpada bitki boyunu artırdığını bildirmiştir. Zahir ve ark. (2007) *Azotobacter* bakterisinin mısır bitkisinde bitki boyunda artışa neden olduğunu saptamışlardır. Akhtar ve ark. (2013) *Rhizobium ve Bacillus sp*. bakterisini buğday tohumlarına aşılayarak etkilerini araştırmış, çalışma sonunda buğdayda bitki boyu ve başak uzunluğunda artış olduğunu bildirmişlerdir. PGPR bakterilerinin tane verimini artırdığı farklı araştırıcılar tarafından da saptanmıştır (Zahir ve ark. 2007; Akhtar ve ark. 2013; Fayetörbay ve ark. 2014; Talay 2019).

SONUÇ

Fasulyede incelenen morfolojik özellikler araştırmanın birinci yılında daha yüksektir. Bunun nedeni olarak ikinci yıl sıcaklıkların daha yüksek olması düşünülmektedir. Artan fosfor dozları bitki boyu, ilk bakla yüksekliği ve tane verimini olumlu yönde etkilemiştir. Araştırmamızda morfolojik özellikler bakımından etkili olan biyogübre NSAH olmuştur. Bitki gelişimini teşvik edici bakterilerin etkisi bakteri tür ve sayısı, bitki-bakteri kombinasyonu, bitki genotipi, gelişme dönemi, hasat tarihi, bitkisel parametreler, toprak tipi, toprak organik madde miktarı ve çevresel koşullara bağlı olarak değişmektedir. Bitki gelişimini teşvik edici bakteri uygulamaları laboratuar, sera ve tarla koşullarında yürütülmekte, ancak tarla denemelerinde önceden tahmin edilemeyen bazı koşullar bazen uygun sonuçların alınmasını zorlaştırmaktadır. Kullanılan mikrobiyal gübrelerin tarla koşullarında gelecek yıllarda denenmesi sonuçların daha kesinlik kazanması açısından önemli olacaktır.

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PROPAGATION AND CULTIVATION OF *Lavandula officinalis* SPECIES[2]

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ÖZET
Şiddetli kuraklık ve çölleşme tehdidi altındaki Ortadoğu ve Akdeniz havzasının bir parçası olan Türkiye topraklarının üçte ikisi kurak ve yarı kurak iklim kuşağında bulunmaktadır. Neredeyse yarısının yarı kurak olduğu Türkiye'de bozkır toprakları giderek genişlemektedir. Bu kurak ve yarı kurak koşullar altındaki şehirlerde, son zamanlarda kuraklığa dayanıklı peyzaj bitkilerine ihtiyaç giderek artmaktadır. Bu amaçla kullanılabilecek peyzaj bitkilerinden biri de *Lavandula officinalis* türüdür. Lavanta, koku, gıda, ilaç ile dolgu ve bordür bitkileri olarak bahçe tasarımı endüstrilerinde yaygın olarak kullanılan çok işlevli önemli bir aromatik bitkidir. Bu anlamda bu çalışma, ulusal ve uluslararası literatürü dikkate alarak bu türün fidan üretimi ve kültivasyonuna odaklanmaktadır. Bu çerçevede peyzaj çalışmalarında sıklıkla kullanılan bu lavanta türünün ilk olarak taksonomisi, botanik özellikleri, ekolojik istekleri, yayılış ve kullanım alanları tanıtılmıştır. Sonra türün fidanlık koşullarında generatif ve vejetatif üretimi son bilimsel araştırmaların sonuçlarına dayalı olarak ayrıntılı bir şekilde açıklanmıştır. Ayrıca türün kültivasyonu, bakımı ve hasadı hakkında bilgiler sunulmaktadır. Böylece türün fidanını üretmek ve türün kültivasyonunu yapmak isteyen üreticiler güncel bilgilere daha kolay ulaşabilecektir. Çünkü bilinçli üreticiler tarafından türün fidan üretimi ve kültivasyonu ne kadar iyi yapılırsa ülke ekonomisine de o kadar olumlu katkılar sağlanacaktır. Bu derleme makalesi ayrıca herhangi bir ileriki bilimsel araştırmaya başlamadan önce türün hangi yönlerinin incelenebileceği konusunda bir ön bilgi sağlayacaktır.

Anahtar Kelimeler: *Lavandula officinalis*, Üretim, Fidanlık, Kültivasyon, Aromatik bitki

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Lavandula officinalis TÜRÜNÜN ÜRETİMİ VE KÜLTİVASYONU

ABSTRACT

Türkiye, two-thirds of whose land are in the dry and semi-arid climate zone, is part of the Middle East and Mediterranean basin, which is threatened by severe drought and desertification. Steppe lands have been steadily expanding in Türkiye, virtually half of which is semi-arid. In cities under these arid and semi-arid conditions, the need for drought-resistant landscape plants has been increasing recently. One of the landscape plants that can be used for this purpose is *Lavandula officinalis*. It is a significant multifunctional aromatic plant that is widely used in the fragrance, food, medicinal, and garden design industries as fill and border plants. In this sense, this study focuses on the seedling production and cultivation of this species by considering national and international literature. In this framework, the species is firstly introduced in terms of taxonomy, botanical characteristics, ecological demands, distribution and usage fields. Then, the generative and vegetative production of the species under nursery conditions is elaborately explained based on the results of last current scientific researches. In addition, information on the cultivation, maintenance and harvesting of the species is presented. Thus, producers who want to produce seedlings of the species and cultivate the species will have easier access to up-to-date information. The better the seedling production and cultivation of the species is done by well-informed producers; the more positive contributions will be to the country's economy. This review article will also provide a preliminary information on which aspects of the species can be studied by any scientific further researches.

Keywords: *Lavandula officinalis*, Propagation, Nursery, Cultivation, Aromatic plant

INTRODUCTION

Urban and rural areas are the cradles of human civilization, as they have produced all practical advancements and feasible goods (Sheikhnejad and Yigitcanlar, 2020). They are regarded as the biggest contributors to the global economy, as well as to the environment, energy demand, social interaction, and greenhouse gas emissions (Arbolino et al., 2017). The continuity of human civilisation in an era of high population growth, urbanization, and industrialization depends on the sustainability of both urban and rural areas (Dizdaroglu, 2016; Ingrao et al., 2018; Kankanamge et al., 2020). On the other hand, the functions and forms of the rural landscape are impacted by flows of capital, people, goods, and information, changing its character (Kizos et al., 2010). Therefore, the notion of the circular economy must be applied to agricultural systems and environmental restoration, with special focus on the multi-purpose plant species (Allegrini et al., 2022). In recent years, people in rural areas have started to favor cultivating multi-purpose plant species.

Multi-purpose plant species can be harnessed in many different domains and for a variety of goals, depending on their own prerogative. They may be able to perform the standard agronomic and arboricultural tasks (Ceylan and Somuncu, 2021; Allegrini et al., 2022). *Lavandula officinalis* Chaix is a precious multi-purpose plant species due to its diverse uses such as beekeeping, agritourism, horticultural and industrial purposes. *L. officinalis*, one of the many plants that yield essential oils, is still among the most valuable. For this reason, the species is a subject of research due to its growing economic importance and predicted development in market demand nowadays.

In this review paper, the species is firstly described in terms of taxonomy, botanical characteristics, ecological demands, distribution and usage fields. Then, the generative and vegetative production of the species under nursery conditions is elaborately explained based on the results of last current scientific researches. In addition, information on the cultivation, maintenance and harvesting of the species is presented.

Description of *L. officinalis*

Among the *Lavandula* genus within the Lamiaceae family (Abdelsadek et al., 2022), the most commonly cultivated species are *L. officinalis*, also known as lavender or true lavender, *L. latifolia* Medik., commonly referred to as spike lavender, *L. stoechas* L., known as Spanish lavender, and *L. intermedia* Emeric ex Loisel., which is a hybrid known as lavandin (Crişan et

al., 2023). On the other hand, the *Lavandula* genus is represented by three taxa in Türkiye: *Lavandula angustifolia* Mill. subsp. *angustifolia*, *L. pedunculata* (Mill.) subsp. *cariensis* (Boiss.) and *L. stoechas* L. subsp. *cariensis* (Boiss.). *L. officinalis* is known locally as "Lavanta", *L. pedunculata* as "Karan" and *L. stoechas* as "Karabaş" (Küçük et al., 2018). Only *L. stoechas* is naturally grown in Türkiye, distributing especially in west and south regions (TAGEM, 2021).

L. officinalis, referred to as medical lavender, is perennial and evergreen shrub with multiple stems reaching 30 to 60 cm in height. It grows on hills and along the coasts and is natural to Asia, Europe, and the Mediterranean region. The thin, long, and finely haired evergreen leaves typically contain the essential oils. The teeth on the leaves are likewise pinnate. The plant blooms between April and June, and the violet-colored bracts support purple flowers. The plant is harsh tasting and has a powerful smell. Herbal medication is made from the flowers and leaves. Flowers and leaves are used as distillate to create lavender essential oil (Tahmineh et al., 2015). It is a significant multifunctional aromatic plant that is widely used in the fragrance, food, medicinal, and garden design industries as fill and border plants (Abdelsadek et al., 2022). One of its good cultivars is Munstead (Gangoo et al., 2017).

The cultivation of *L. officinalis* is possible outside of the Mediterranean region because of its ecological optimum, which is found in climates with cold winters and warm, sunny summers. In arid soils, the woody root system can expand up to 3-4 m deep, enhancing water absorption (Szekely-Varga et al., 2020). It requires a relatively high temperature, around 10-15°C, for successful germination and growth (Mason, 2014; Muntaen et al., 2016; Çetintaş, 2019).

Generative and vegetative propagation of *L. officinalis*

L. officinalis can be produced by seeding, cutting, plant dividing, tissue culture or layering (Platt, 2009; Mason, 2014; Singh Kakraliya et al., 2022; Crisan et al., 2023; El Saber Batiha et al., 2023). Although seed propagation is not significant in commercial lavender crops, it can still be utilized in certain cases, such as breeding programs (Mason, 2014; Singh Kakraliya et al., 2022). This method is also employed to propagate wild lavender genotypes found in France, which can be used to obtain essential oil that meets specific standards (ISO 3515, 2002). The average weight of a thousand lavender seeds is approximately 0.9 to 1 gram. To establish a lavender crop covering one hectare, seedlings can be obtained by sowing 0.3 kg of seeds in nursery beds, requiring an area of 100 to 150 square meters (Muntean et al., 2016). However,

it is crucial to keep in mind that seed germination varies and that growing plants are suitable for field crop establishment takes longer (Coltun, 2016; Crişan et al., 2023). Besides, in seed propagation, the small size of the seeds makes planting and germination challenging (Demirkaya et al., 2017). On the other hand, lavender seed germination rates and times were increased by GA_3. Biostimulants like gibberellic acid may help Lavandula seeds remove from dormancy (Szekely-Varga et al., 2021).

Cutting method, one of the vegetative propagations, is the most prevalent and extensively used technique for propagating lavender, applicable to both nursery cultivation and field cropping (Mason, 2014). This method enables the production of lavender plants that are genetically identical to the desired standards for crop cultivation, providing the necessary biological material for extracting essential oils (Karakaş and İzci, 2021; ISO 3515, 2002; Crisan, 2023). Cuttings are typically collected during autumn or spring, specifically in the months of September, October, March, or April, from healthy lavender plants that are 3 to 5 years old (Coltun, 2016). However, in propagation through cuttings, factors such as the cutting type, timing of cutting collection, and the hormone type and dosage need to be determined based on species and ecological conditions (Kara et al., 2011).

In this regard, some studies have indicated that the rooting rate varies depending on the cutting type and the rooting medium (Beatovic et al., 2012; Bona et al., 2012a; Özcan et al., 2013). The best cutting type is basal cutting, and the best IBA (indole-3-butyric acid) dose is 8000-10 000 mg/L (Çiçek, 2019). Additionally, hormone levels differ in the rooting of lavender cuttings of different origins (Bona et al., 2012b). The choice of rooting media for the cuttings was found to be significant in terms of rooting duration and the development of the root system architecture. The highest values of root length, the number of shoots and shoot length in different *L. officinalis* varieties were obtained from the growing medium with cocopeat (Karakaş and İzci, 2021). The highest (93%) and lowest (13%) rooting rate in *L. officinalis* were obtained from the perlite+peat (1:1) 2000 mg/L IBA and the peat control applications (Karakoyun et al., 2023). Depending on the temperature, rooted plants can be obtained within a few weeks. To promote branching, it is common to pinch the tips of the plants during transplantation. When the weather conditions are suitable, planting seedlings in the field can be done after 6 to 8 weeks (Mason, 2014).

Propagation through tissue culture is a viable method (Krimer et al.2017; Nabin et al., 2018), particularly suitable when there is limited availability of cuttings or a large number of plantlets is required (Mason, 2014). An optimized protocol for in vitro regeneration demonstrated that the use of Murashige and Skoog medium supplemented with 1.0 mg/L Benzylaminopurine (BAP) and 0.1 mg/L Naphthaleneacetic acid (NAA) resulted in the highest number of shoots through direct organogenesis in lavender. The plantlets obtained from this method exhibited excellent adaptation ex-vitro with a survival rate exceeding 80% (Nabin et al., 2018). Aydın (2021) also reported that the best growth and development of lavender explants were obtained from the usage of BAP hormone in an in vitro environment. However, it is important to further validate the quality of essential oil obtained from the in vitro multiplied plants through field evaluations. It is recommended to continue conducting biotechnological studies and agronomical field comparisons (Kirimer et al., 2017). In vitro-propagated lavender's growth and development were considerably enhanced by silver and gold nanoparticles (Jadczak et al., 2019). For in vitro cultivation of *L. angustifolia* in a media containing gibberellic acid, spermidine, or putrescine, a concentration of 0.5 mg/L is ideal (de Oliveira et al., 2019).
The diatomite and soil growing media are better for the plant development under ecological conditions of Niğde. 33% irrigation level has been recommended due to irrigation water savings (Noory, 2020; Ertekin, 2023). Growth characteristics had the highest values under 75% shaded areas (Aydemir Özcan, 2017).

At NaCl concentrations more than 50 mM, *L. officinalis* exhibited salt stress symptoms including chlorosis, followed by leaf and stem necrosis (Paraskevopoulou et al., 2020).

Cultivation of *L. officinalis*

Planting can be done at any time between spring and autumn (from the end of March to mid-May in Türkiye) but planting in autumn results in more flowers in the following year (Coltun, 2016; DİM, 2023). Commercial lavender plantations are typically established on slightly to moderately sloping land (Mason, 2014) with a slope angle not exceeding 15 degrees (Muntean et al., 2016). This helps ensure good drainage and prevents waterlogging. Soil ameliorants, such as gypsum for heavy sodic clay soil, can be used to break up clods (Mason, 2014).

Organic matter can be added to improve the texture of clay or sandy soils. In some cases, mulching with materials like gravel, wood chips, or other organic matter can be beneficial. Creating spoon drains or using sand slitting techniques, which involve narrow slits filled with

sand to enhance drainage, can help manage excess water. In persistent cases of waterlogging, subsurface drains may be necessary to address the issue (Mason, 2014). According to a recent study (Gök et al., 2022) in Tokat by using geographical information systems and analytical hierarchy process, lavender can be grown in 29% of the dry farming areas.

During crop establishment, adequate soil preparation is crucial (Coltun, 2016). Field preparation can be done in the spring by plowing. Additionally, harrowing can be done to further prepare the field. Planting is carried out by using a furrow opener plow to create furrows. The seedlings are then placed at the base of these furrows, approximately 2-3 times the length of the seedling, from the ground. In this case, watering the plants by applying water to the furrows becomes much easier. If an overhead irrigation system, such as sprinklers, is available, planting can also be done on a flat field without creating furrows. Generally, a planting dibble or plant trans-planter is used, and plants are immediately watered. In the first year, plant growth is usually slow, and short stems are formed. Flower spikes may develop, but they tend to be small. The main growth and yield start from the second year onwards. Lavender should be planted 50 cm in rows and 100-150 cm between rows, for easy mechanization and better growth (Coltun, 2016; CADA, 2017). One of the quality traits, the essential oil ratio was significantly impacted by nitrogen fertilizer at a planting space of 50 x 50 cm (Çelik Albayrak, 2022).

Maintenance of *L. officinalis* cultivation

Weed control is a crucial but relatively challenging task in lavender cultivation. Weeds compete with lavender plants for nutrients and can hinder their growth. As lavender is a perennial crop, over time the plants spread and cover the ground, making mechanical weed control difficult. The use of cultivators may not be the most suitable method as it carries the risk of damaging the plants (Mason, 2014). Manual hoeing can be employed in the spaces between rows (Varban et al., 2018). In certain plantations, weed mats or plastic film sheets are used; however, these can negatively impact the beneficial soil microorganisms and their activity (Mason, 2014).

Chemical herbicides are not commonly used in lavender cultivation due to the risk of plant wilting and lack of sufficient research on their effects on perennial aromatic plants like lavender. An experiment, conducted in Turkish Republic of Northern Cyprus, aimed to evaluate the effectiveness of seven chemical herbicides for weed control in lavender crops over a three-year period. Phytotoxicity symptoms were observed in the lavender plants a few weeks after herbicide application, although there was a significant decrease in weed biomass compared to

the control. Aclonifen caused leaf chlorosis and temporary stunting in lavender plants, potentially leading to crop failure, but the plants eventually survived with no significant impact on yield. Flurochloridone resulted in moderate to severe vein bleaching and a greater reduction in yield compared to Oxadiazon, Oxyfluorfen, and Dimethyl tetrachloroterephthalate. Linuron inhibited the growth of lavender plants and had more severe consequences on yield reduction than the other herbicides. Interestingly, some herbicides showed a slight increase in the essential oil content of lavender plants, although not significantly different from the control (Vouzounis et al., 2003)

Bioherbicides are gaining recognition as a potential alternative in weed management, although the concept itself is not entirely new. The underlying principle involves utilizing phytotoxic substances derived from specific plants, microorganisms, or arthropods to inhibit the growth of target weed species (Radhakrishnan, et al.,2018; Hasan et al., 2021). Allelopathic mechanisms can be employed to specifically target the most prevalent weed species in lavender crops within a particular area. For instance, a study conducted in the Transylvania region of Romania identified *Echinochloa crus-galli* (L.) P. Beauv. and *Sonchus arvensis* L. as the most commonly occurring weeds in a lavender crop (Vârban et al., 2018).

The literature suggests that a bioherbicide preparation based on *Carum carvi* L. could be used effectively against *Echinochloa crus-galli*. There are several other bioherbicide available that can be used to combat common weeds found in lavender crops. For example, *Brassica napus* L. has been effective against *Convolvulus arvensis* L., *Sinapis alba* L. against *Setaria viridis* (L.) P. Beauv., and the fungus *Ascochyta agropyrina* (Fairm.) Trotter has shown promise against *Chenopodium album* L., *Cirsium arvense* (L.) Scop., and *Sonchus oleraceus* L. Another bioherbicide, *Diaporthe gulyae* R.G. Shivas, S.M. Thomps. & A.J. Young, has demonstrated effectiveness against *Urtica dioica* L. (Hasan et al., 2021). Further studies are necessary to assess the specific effects of these bioherbicides on crop plants, allowing for dose adjustments and the selection of bioherbicides that do not negatively impact the agronomic parameters of the crop (Crişan et al., 2023).

Pruning plays a vital role in rejuvenating and promoting flowering in lavender plants. Regular pruning is a standard practice in lavender farms and contributes to the longevity of the plants (Mason, 2014). To encourage flowering, pruning is typically performed in spring, once the risk of frost has passed, by cutting the stems to approximately one-third of their original length.

During summer harvesting, the flowering tops (inflorescences) are trimmed. In autumn, a light pruning can be carried out a few weeks before the expected frost, where the shoots are trimmed about 2 cm above the woody part. Established plants can tolerate more severe pruning, which is often done in older plantations by cutting the plants closer to the ground to stimulate rejuvenation of the crop (Muntean et al., 2016).

While lavender plants can continue to live without fertilization, applying fertilizers can significantly improve their health and productivity (Mason, 2014; Westerveld, 2018). Lavender plants require essential nutrients such as nitrogen, phosphorus, zinc, boron, and magnesium for optimal growth (Coltun, 2016). It is recommended to fertilize the crop during establishment by incorporating 30-50 kg/da of manure into the soil (Muntean et al., 2016). The use of phosphorus-based fertilizers resulted in increasing the inflorescence yield per plant by almost double (Coltun, 2016). In autumn, it is recommended to apply fertilizers containing phosphorus and potassium, with suggested amounts of 7-8 kg/da of P_2O_5 and 4-6 kg/da of K_2O. Nitrogen-based fertilizers can be applied in spring, after the snow has melted, with recommended quantities of 60-80 kg/da (Muntean et al., 2016).

Using regular cattle fertilizer is more efficient in lavender cultivation if factors like stem diameter, number of main branches, and plant diameter are considered, while the usage of manure obtained from Sütaş dairy farm enhanced with microelements is more suitable for lavender production if factors like stem length, number of branches (flowers), and plant height are significant (Ertekin, 2023). For better vegetative growth and herb production, it is advised to fertilize lavender plants cultivated in sandy soils with sheep manure at the rate of 8 m^3/da + 6 g/L active dry yeast, along with 80 kg/da calcium super phosphate and 30 kg/da potassium sulphate. It can be advised to apply sheep manure at a rate of 4 m^3/da plus 6 g/L active dry yeast, along with 80 kg/da calcium super phosphate, 30 kg/da potassium sulphate, and ammonium sulphate at a rate of 40 kg/da, for the highest essential oil production (Sakr et al., 2015). The growth of lavender plants is positively impacted by the use of humic acid, and 3-6 kg/da of nitrogen fertilizer is an appropriate application rate (Aslan and Sarıhan, 2021). In terms of vegetative growth metrics, chemical compositions of the plant, and plant essential oil, the compost + *Azospirillum spp.* + *Azotobacter spp*. treatment performs better than the other treatments, followed by the compost + Active dry yeast treatment (Shoeip et al., 2022).
The primary developments in lavender cultivation rely on the employment of environmentally friendly methods to produce a high-quality raw material, such as organic fertilization and

microbial preparations (such as arbuscular mycorrhiza fungi) (Crişan et al., 2023). While 325 mg/L of K were more suitable for fresh and dry matter of lavender grown hydroponically, 300 mg/L of K were appropriate for production of its essential oils (Chrysargyris et al., 2017). Another study (Mihalașcu et al., 2020), exploring the effects of different organo-mineral fertilization levels on Sevstopolis, Vera, Hidcote, Buena Vista cultivars of *L. officinalis*, revealed that the cultivar Vera recorded the highest yields under organic fertilization (manure 30 t/ha).

Although there is shortage of water, full irrigation is the best irrigation subject because the irrigation program was established using the gravimetric approach and all of the irrigation water was used. The treatments that save 33% water can be applied to both the gravimetric method and the pan evaporation method when it comes to the requirement of imposing a constraint on the water source (Akçay et al., 2021). In August, irrigation and fertilization should be reduced or completely finished (CADA, 2017).

There are not many diseases and pests that impact on the species. It is susceptible to *Phytoptora* disease. Therefore, in particular, excessive irrigation and the very heavy soil texture on which the garden will be established should be avoided (CADA, 2017). *Rhizoctonia* and *Fusarium* fungal infections are important problems for organic lavender cultivation, and in the majority of cases, they lead to the demise of the culture. Biostimulators including amalgerol, millerplex and sugarXpress worked well, increasing the spike yield of the fungal infected culture compared to control (Giannoulis et al., 2020).

According to a study conducted in the conditions of the Southern Steppe of Ukraine (Manushkina et al., 2023), the treatment of plants with the growth regulator Stimpo from 137.30 up to 147.36 kg/ha, which is by 15.9-16.7% more than in the control, resulted in the biggest harvest of essential oil in all years of vegetation.

Harvesting of *L. officinalis*

Lavender harvesting commences during the crop's second year when it starts flowering, typically occurring in the months of June and July. This harvesting process repeats annually for a period of 12 to 15 years under conditions of optimal productivity. However, after this timeframe, the crop becomes less economically viable (Muntean et al., 2016) The crop reaches

its maximum productivity during the second and third years following its initial establishment (Giannoulis et al., 2020).

The lavender plant blooms in July, relying on the district. At the start of the flowering season, it is harvested with the stems since this is the time when essential oil rates are at maximum level. During the blossoming season, it is more convenient to harvest extremely early in the morning (IBB, 2023). A study (Balcı, 2019) carried out under ecological conditions of Karaisalı in Adana showed that although the harvesting after 15 July is suitable in terms of fresh branched flower yield and essential oil rate, it is not suitable in terms of dry flower and essential oil yield.

Weed blade with saw at the harvest of the plant is used. Harvesting is also done with gasoline lawn mowers in recent years. Harvest with machine saves labor and time. Harvested flowers are directly processed for essential oil or laid in a shaded environment to dry (DİM, 2023). However, many producers still harvest lavender by hand to avoid damaging the priceless flowers using automated harvesting techniques. More than 100 kg of lavender are required to produce 1 liter of lavender essence. To get 15 kilograms of essential oil, a whole hectare of lavender must be grown (Farr, 2022).

CONCLUSIONS

Lavender is a versatile agritourism plant. Although several studies on the growth and cultivation of the plant, especially fertilizer types and dosages, have been conducted recently, they are still limited. For this reason, in order to take advantage of this species efficiently, which makes a significant contribution to the local and national economies, more comprehensive research is unquestionably necessary. If research focuses more on organic fertilizers than chemical fertilizers, it will be better for the sustainable agriculture of *L. officinalis*.

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Lavandula TÜRLERİNİN PEYZAJ DÜZENLEMELERİNDE KULLANIMI[3]

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ÖZET
Günümüzde çevre düzenlemesi her zamankinden daha önemli hale gelmiştir. Peyzaj bitkileri peyzaj düzenlemelerinde iki şekilde hizmet sunmaktadır. Birincisi dış mekânları oluşturabilirler, ikincisi ise hâlihazırda mevcut olan binanın veya konutun mimarisini geliştirebilirler. Peyzaj bitkilerinin farklı form ve boyutları, insanların doğa ile etkileşimlerini ve doğaya olan özlemlerini gidermeye yardımcı olurlar. Ayrıca, bitkilerin doku, biçim, boyut ve renk gibi fiziksel özellikleri bir peyzaj düzenlemesine ilgi, çeşitlilik, estetik ve çekicilik sunar. Fiziksel özelliklerine bağlı olarak, bazı bitkiler mekânda görsel bir bileşen olarak daha değerli olabilir. Görsel değer, bitkinin gücünü veya mekân üzerine etkisini gösterir. Örneğin, dik formlar, canlı renkler ve kaba dokular çekicidir ve güçlü bir görsel etkiye sahiptir. Bu anlamda lavanta türleri, hem çiçeklerinin canlı rengi hem de güzel kokuları nedeniyle görsel değeri yüksek ve hastalığa karşı en dayanıklı peyzaj bitkilerinden biridir. Artan ekonomik önemi ve pazar talebinde beklenen büyüme nedeniyle, lavanta türleri aynı zamanda çok sayıda bilimsel araştırmanın odak noktası olan türlerden biridir. Bu derleme çalışması, öncelikle peyzaj düzenlemesinde lavanta türleri kullanımının önemini açıklamaktadır. İkinci olarak, türlerin peyzajda kullanımına yönelik bugüne kadar yapılan bilimsel çalışmaların bir özetini sunmaktadır. Üçüncü olarak, dünyada ve Türkiye'de lavanta yetiştiriciliğinin durumunu istatistiksel olarak ortaya koymaktadır. Çalışmada sunulan detaylı bilgiler sayesinde peyzaj bitkilerine ilgi duyan kişiler lavanta konusunda daha bilinçli hale gelecek ve lavantanın peyzaj düzenlemelerinde kullanımı artacaktır.

Anahtar Kelimeler: *Lavandula*, Kültivasyon Durumu, Peyzaj Düzenlemesi

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USE OF *Lavandula* SPECIES IN LANDSCAPING

ABSTRACT

Nowadays, landscaping is more crucial than ever. Landscape plants can serve in two ways in landscaping. They can make outdoor rooms and enhance the architecture of the building or residence already in place. Their different forms and sizes are of assistance as consistent reminders of people's enduring desire for interaction with nature. Furthermore, plants' physical traits, such as texture, form, size, and color, present interest, variety, and aesthetic appeal to a landscaping. Depending on their physical traits, some plants may be more valuable as a visual component in the environment. The visual value shows the plant's power or influence on its surroundings. For instance, erect forms, vivid colors, and coarse textures are seductive and have a strong visual effect. In this sense, *Lavandula* species is one of the landscape plants with high visual value due to both the vivid color of its blossoms and their fragrance and is most resistant to illness. Due to their growing economic significance and anticipated growth in market demand, *Lavandula* species is also one of the species that is currently the focus of numerous scientific investigations. This review paper firstly explains the importance of using *Lavandula* species in landscaping. Secondly, it presents a summary of the scientific studies conducted on the usage of the genus in landscaping to date. Thirdly, it statistically reveals the status of *Lavandula* species cultivation in the world and in Türkiye. Thanks to the detailed information presented in the study, people who are interested in landscape plants will become more conscious of *Lavandula* species. Thus, the use of *Lavandula* species in landscaping will be increased.

Keywords: *Lavandula*, Cultivation Status, Landscaping

INTRODUCTION

Plants, the basic unit of natural life, have been crucial to both nature and human existence since the beginning of time (Türker and Gül, 2018). In recent years, the demand of people for medicinal and aromatic plants has dramatically increased (Çiçek et al., 2023). They play a significant role in both the aesthetic and practical aspects of plant design due to their many leaf shapes, flowers and fruits in various colors and textures, the practical and aesthetic qualities of medicinal and aromatic plants make them useful in a variety of settings, including collection gardens, therapeutic gardens, healing gardens, botanical gardens, flower beds, roof gardens, sloped ground, and motorways (Arslan and Ekren, 2018).

Today, *Lavandula* species is one of the species that is frequently used for landscaping. One of the plants most suited for desert landscapes is *Lavandula* species. In their original environment, which runs from coastal to inland hillsides surrounding the Mediterranean, they thrive in rocky, gravelly, alkaline soils. Once planted, it merely requires infrequent watering and thrives in direct sunlight and high temperatures. (Murphy, 2007).

This review paper firstly explains the importance of using *Lavandula* species in landscaping. Secondly, it statistically reveals the status of *Lavandula* cultivation in the world and in Türkiye. Thirdly, it presents a summary of the scientific studies conducted on the usage of the *Lavandula* species in landscaping to date.

The Status of *Lavandula* Cultivation

According to the recent statistics, Türkiye produced 7722 tons of *Lavandula* in the area of 46479 da in 2022. Isparta accounted for 22% of total production in 2022. The highest yield (193 kg/da) of *Lavandula* was observed in 2022 (Table 1).

By 2010, it is known that Isparta was the only place where *Lavandula* was cultivated (BAKA, 2020). Afyonkarahisar was also registered as a province cultivating *Lavandula* in 2012. There is a continuous increase in the number of provinces cultivating *Lavandula*. As of 2022, *Lavandula* was cultivated in a total of 56 provinces in Türkiye (TUIK, 2023). The top five biggest cultivation areas in 2022 were ranked as Isparta (17%), Afyonkarahisar (10%), Denizli (9%), Burdur (7%) and Konya (6%) (TUIK, 2023).

The largest *Lavandula* garden (370 da) in terms of integrity in Türkiye and in terms of visual appeal in Europe is located in Akçaköy, Yeşilova-Burdur (Burdur Valiliği, 2018). The greatest *Lavandula* valley in Türkiye has been established in Kahramanmaraş, which had 1% of cultivation area as of 2022 (Web Tarım TV, 2022).

Table 1. Cultivation and harvesting areas, yield and production of *Lavandula* in Türkiye from 2012 to 2022 (TUIK, 2023)

	Cultivation Area (da)	**Harvesting Area (da)**	**Yield (kg/da)**	**Production (ton)**
2012	509	509	185	123
2013	709	709	135	105
2014	2189	2039	140	297
2015	3218	2858	135	400
2016	5700	5528	125	747
2017	6606	6361	151	845
2018	8684	8381	124	1040
2019	11903	11614	135	1462
2020	22188	21755	163	3499
2021	35810	35386	183	6108
2022	47176	46479	193	7722

400 tons *Lavandula* oil is produced and traded in the world, 170 tons of which are produced in Bulgaria. France, Türkiye, and Moldova are the other major producers of *Lavandula* oil on the world market. *Lavandula* oil that has been certified as organic can cost up to 90 euros per kg (Anonymous, 2023).

The Use of *Lavandula* in Landscaping

As an amenity plant for the contemporary garden, *Lavandula* has fast-growing, small in height, evergreen, and aromatic plant (Gangoo et al., 2017). There are numerous cultivars of the *Lavandula* species (Murphy, 2007), with pink, blue, lavender or white flowers (AUB, 2023) and different sizes (Detweiler, 2020).

Because of their adaptability, *Lavandula* is a precious plant at homes all around the world. It's a great alternative for gardeners because of its smell, contrast in leaf color, and water-saving characteristics (He et al., 2022; Kimbrough and Swift, 2023). Additionally, it can be utilized to create drought-tolerant green spaces as well as for pharmacological uses (Hasibi et al., 2022; Jigua et al., 2022).

The beautiful plant *Lavandula* is commonly cultivated; it is a neat, low-maintenance plant that works well as borders, knots, in rock gardens, and with roses (AUB, 2023). The following landscape uses of *Lavandula* are advised: mass planting, border edging, general garden use, and container planting (New Garden, 2023), hedging, topiary, spiral gardens, mazes, raised beds, potted plants, and baskets (Szekely-Varga and Cantor, 2019).

L. officinalis has primarily been grown in gardens in Romania as a beautiful and fragrant plant (Luncean et al., 2018). It also suits for green roof designs, which is a preferred sustainable alternative for modern structures in many places, due to its drought tolerance (Kotsiris et al., 2012; Figure 1). In vertical garden systems, *L. stoechas* L. can be planted as an alternative plant (Gür and Kahraman, 2021).



Figure 1. *Lavandula officinalis* in the planters box in the concept design of xeric landscape in Antalya Serdengeçti Park (Selim et al., 2021)

Use of *L. officinalis* in therapeutic gardens is appropriate (Yazici, 2019) because of its advantages as a plant, lavender smell, cut flowers, and landscape planting design, as well as its therapeutic properties (Szekely-Varga et al., 2017) and also stress reduction (Ghavami et al., 2022). Due to its fragrance plant, *L. officinalis* is advised in therapeutic plant landscapes for the hearing-disabled people (He et al., 2022).

L. officinalis with colorful blossom near tall and broad-leaved trees (sycamore and ash) in children's playgrounds is recommended (Kahveci et al., 2021). With its shape, evergreen foliage, summer-effective flowers, and unquestionably delightful scent, it can be utilized as a

border plant or in themed areas like stony rock gardens in outdoor landscape designs (Sarı and Karaşah, 2019).

CONCLUSIONS

Lavandula is becoming more and more essential to the economy of countries and rural regions as well as to landscape designs. In recent years, when global warming is experienced, the use of *Lavandula* species, which has low water consumption, in landscaping is more important. In landscape studies, especially in arid and semi-arid areas, *Lavandula* species should therefore be preferred more frequently. Additionally, it is crucial to conduct more studies on growing techniques of *Lavandula* species that can help plants grow more robustly in the face of potential salt and drought stresses in these areas.

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KENTLERDEKİ HAVA KİRLİLİĞİNİ AZALTMADA KENT YEŞİL ALANLARININ ROLÜ[4]

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ÖZET
Dünya nüfusunun yarısından fazlası artık kentsel alanlarda yaşamaktadır. 2050 yılına kadar bu oranın yaklaşık %70'e ulaşacağı tahmin edilmektedir. Günümüzde artan kentleşmenin getirdiği antropojenik etkiler nedeniyle şehirler artık daha yüksek hava kirliliği seviyelerine sahiptir. Hava kirliliği özellikle kent insanı ve ekosistem için ciddi tehlikeler oluşturmaktadır. Azalmış akciğer fonksiyonu, daha sık ve şiddetli solunum semptomları (nefes alma güçlüğü ve öksürme gibi), solunum yolu enfeksiyonlarına karşı artan hassasiyet, sinir sistemi üzerindeki etkiler (öğrenme, hafıza ve davranış üzerindeki etkiler gibi), kanser ve erken ölüm hava kirliliği kaynaklı bazı sağlık sorunlarıdır. Yaşlılar, çocuklar ve önceden hastalığı olanlar (kalp hastalığı, astım ve diyabet gibi) hava kirliliğinin sağlık üzerindeki olumsuz etkilerine karşı daha savunmasızdır. Bu çerçevede bu çalışma, öncelikle kentlerdeki hava kirliliği kavramını açıklamakta, ardından hava kirliliğinin dünyadaki ve Türkiye'deki durumunu istatistiksel olarak ortaya koymaktadır. Bir sonraki alt başlıkta ise hava kirliliğine karşı alınacak önlemler ele alınmıştır. Son olarak, kent yeşil alanlarının hava kirliliğini azaltmadaki rolü ayrıntılı literatür taramasıyla sunulmaktadır. Kent parkları, çatı bahçeleri, dikey bahçeler ve botanik bahçeleri gibi çeşitli yeşil alanların kirlilikle ilgili risklerin azaltılmasındaki önemi göz ardı edilmemesi gerekmektedir. Bu anlamda, hava kirliliğinin azaltılmasında en iyi peyzaj bitki türlerinin seçimi ve kullanımı önemli bir husustur. Sonuç olarak, hava kirliliğini azaltmak için kentsel yeşil alanlar artırılmalı, ekolojik koridorlar oluşturulmalı, uygun bitki türleri seçilmeli ve sayıları artırılmalıdır.

Anahtar Kelimeler: Bitki, Yeşil Alanlar, Hava Kirliliği, Peyzaj, Azaltma

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THE ROLE OF URBAN GREEN AREAS TO MITIGATE AIR POLLUTION IN CITIES

ABSTRACT

More than half of the world's population now lives in urban areas. It is estimated that this rate will reach approximately 70% by 2050. Today, cities now have higher air pollution levels due to anthropogenic effects resulting from the increasing urbanization. Air pollution poses serious dangers, especially for urban people and ecosystem. Reduced lung function, more frequent and severe respiratory symptoms (such as breathing difficulties and coughing), increased susceptibility to respiratory infections, effects on the nervous system (such as effects on learning, memory, and behavior), cancer, and premature death are just some of the air pollution-related health issues. Older persons, children, and those with pre-existing diseases (such as heart disease, asthma, and diabetes) are more vulnerable to the health impacts of air pollution. Within this framework, this study firstly explains the concept of air pollution, then statistically presents the situation of air pollution in the world and in Türkiye. Under the next sub-heading, measures against air pollution are elaborated. Finally, it presents the role of urban green areas in reducing air pollution with a detailed literature review. The importance of various green spaces, including urban parks, roof gardens, vertical gardens, and botanical gardens etc., cannot be overstated in mitigating pollution-related risks. In this case, the selection and use of the best landscape plant species in the reduction of air pollution is an important consideration. In conclusion, urban green spaces should be increased, ecological corridors should be established, suitable plant species should be selected and their numbers should be increased in order to reduce air pollution.

Keywords: Plant, Green Areas, Air Pollution, Landscape, Mitigation

INTRODUCTION

Urbanization has expanded both globally and in Türkiye in recent years, and as a result, so has the amount of traffic in the cities. Cities frequently experience higher amounts of air pollution than their surrounding areas due to the high traffic density. Air pollution is a crucial environmental issue because of its detrimental effects on human health (Vos et al., 2013; Johnson et al., 2018; Barwise and Kumar, 2020). It is globally the leading cause of environmental dangers that result in fatalities, albeit many efforts to reduce air pollution (Diener and Mudu, 2021). In this context, finding methods to lower health risks and increase chances for wellbeing in all urban areas is imperative (Zupancic et al., 2015).

It is well acknowledged that appropriate green infrastructure is one of the promising passive control techniques for air pollution (Barwise and Kumar, 2020). Vegetation in green spaces can help minimize air pollution by directly eliminating pollutants from the air as well as by lowering both air temperatures and building energy usage in and around green spaces (Nowak and Heisler, 2010). Green spaces have revealed a reduction in airborne pollution concentrations, particularly for particle matter (Diener and Mudu, 2021).

In this review paper, the concept of air pollution is explained, then the situation of air pollution in the world and in Türkiye is statistically presented and measures against air pollution are elaborated. Also, the role of urban green areas in mitigating air pollution is revealed with a detailed literature review.

Air Pollution

Air pollution can be described as the contamination of air because of the existence of substances in the atmosphere that lead to the damage to the health of humans and other living beings, or cause harm to the climate or to materials (WHO, 2022). These substances can include gases, particulate matter, and biological molecules. The most common air pollutants are carbon monoxide (CO), sulfur dioxide (SO_2), nitrous oxides (NO_x), methane (CH_4), chlorofluorocarbons (CCl_2F_2) and ammonia (NH_3) and particulate matters (PM) (Admassu and Wubeshet, 2006; EEA, 2017).

Air pollution can be categorized into two main types based on its origin: anthropogenic (caused by human activities) and non-anthropogenic (occurring naturally). Most air pollution stem from human-made sources (Pénard-Morand and Annesi-Maesano, 2004; Shaltami et al., 2020). Anthropogenic sources may be categorized as either mobile (cars, trucks, air planes, marine engines, etc.) or point source (factories, electric power plants, etc.). The other source is non-anthropogenic (natural sources) including dust from the earth's surface (crustal material), sea salt in coastal areas and biological material, in the form of pollen, spores or plant and animal debris (Delon, 1998).

Air pollution can lead to illnesses, allergies, and even fatalities in humans. It can also harm animals and crops, as well as damage the natural or built environment (Maesano et al., 2019; Shaltami et al., 2020). According to WHO (2022), increases in genetic damage that have been demonstrated to be predictive of human cancer are connected with the increasing exposures to outdoor air pollution or particulate matter in the air. Furthermore, exposure to outdoor air pollution can hasten the development of cancer through oxidative stress, reactions to oxidative stress, and persistent inflammation.

Particulate matter is one of the main pollutants in the atmosphere. Because of its small particle size, fine particulate matter (PM2.5) ($\mu g/m^3$) has the greatest potential to negatively impact human health. It typically causes problems for people's health, poor visibility, and poor air quality in urban areas since it is not only abundant in dangerous and harmful compounds, but also has a lengthy residence time in the atmosphere and may be transported over great distances (Li et al., 2020). Particulate matter air pollution is an increasing problem as more people move into urban areas across the world (Mandal et al., 2023).

According to World Health Organization's (WHO) Air Quality Guideline (2022), the annual average concentration of PM2.5 (5 $\mu g/m^3$) serves as a threshold or benchmark for assessing the potential health risks associated with air pollution. Accordingly, if the annual average concentration of PM2.5 exceeds 5 $\mu g/m^3$, individuals living in those areas are considered to be at higher risk. This means that prolonged exposure to levels above this threshold increases the likelihood of developing health issues, specifically related to cardiovascular and respiratory problems. In 2017, air pollution contributed to 4.9 million premature deaths worldwide, 3 million of which were attributable to ambient PM2.5 pollution (Pun et al., 2020). Paul et al. (2020) reported that the highest correlation was seen between diabetes mortality and NO_2

exposure among those with prevalent diabetes, while PM2.5, O_3, and O_x were all linked to an increased risk of developing diabetes and cardiovascular disease. A study (Maarraoui et al., 2022) conducted in the UK revealed that elevated NO_2, PM10, and PM2.5 levels dramatically reduced the likelihood of long-term happiness and immediate mental health. Another study (Çapraz, 2021) in İstanbul showed that increased hospital admissions for several of Türkiye's most prevalent and dangerous respiratory disorders were correlated with air pollution. PM2.5 had a significantly higher risk of causing acute bronchitis than PM10 and NO_2. Türkiye was identified as having one of Europe's highest rates of early mortality caused by air pollution. 28 924 people in Türkiye died prematurely as a result of exposure to ambient PM and ozone, according to current estimates in 2010 (HEAL, 2015).

Air Pollution Around The World and in Türkiye

According to PM2.5 threshold of WHO (2022), the countries, cities and regions in Africa and Central and South Asia was afflicted with the highest annual average PM2.5. Afghanistan was constantly rated among the top 15 polluted countries from 2018 to 2022. Yet, it is not present in the list because of the deficiency of available data as well as Oman. 20 new countries such as Burkino Faso, Rwanda, which were absent in the last year’s list, have been among the most polluted cities in the list of 2022.

The first and last ten countries and capital cities among 131 countries were illustrated based on their PM2.5 levels (µg/m³) in Figure 1-2. In 2022, 13 of the 131 countries and regions are at or under annual PM2.5 threshold of WHO (2022).

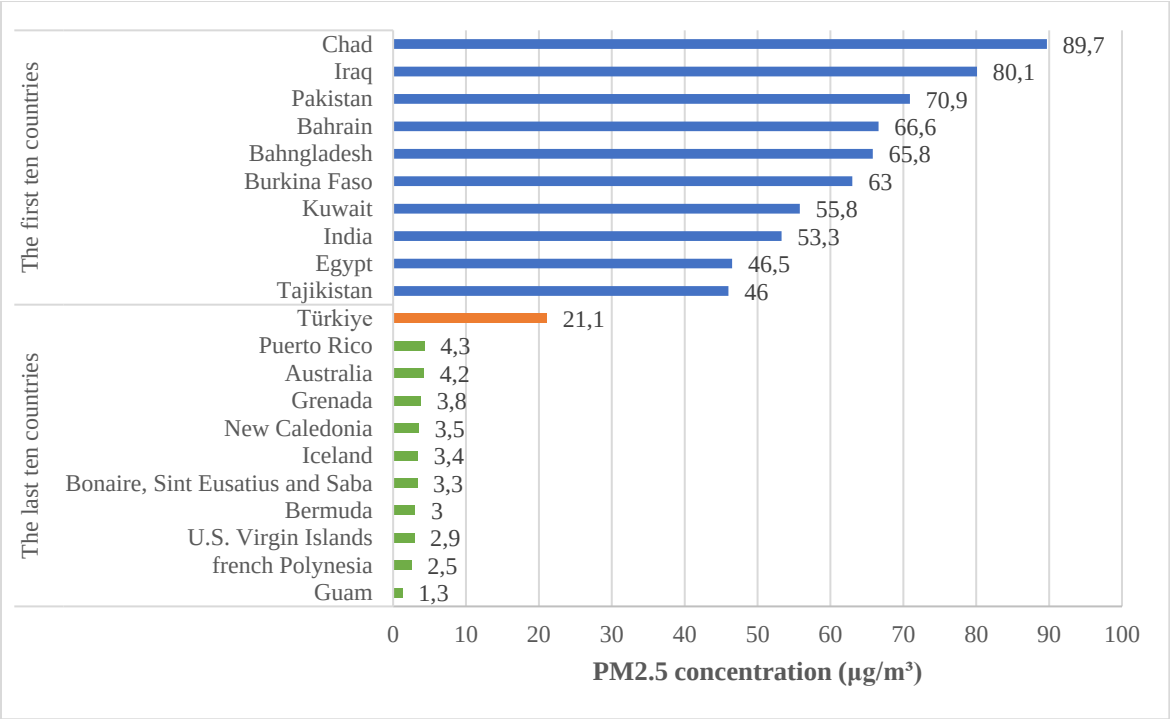

Figure 1. The first and last countries and Türkiye among 131 countries in terms of PM2.5 concentration (µg/m³) (WAQR, 2022)

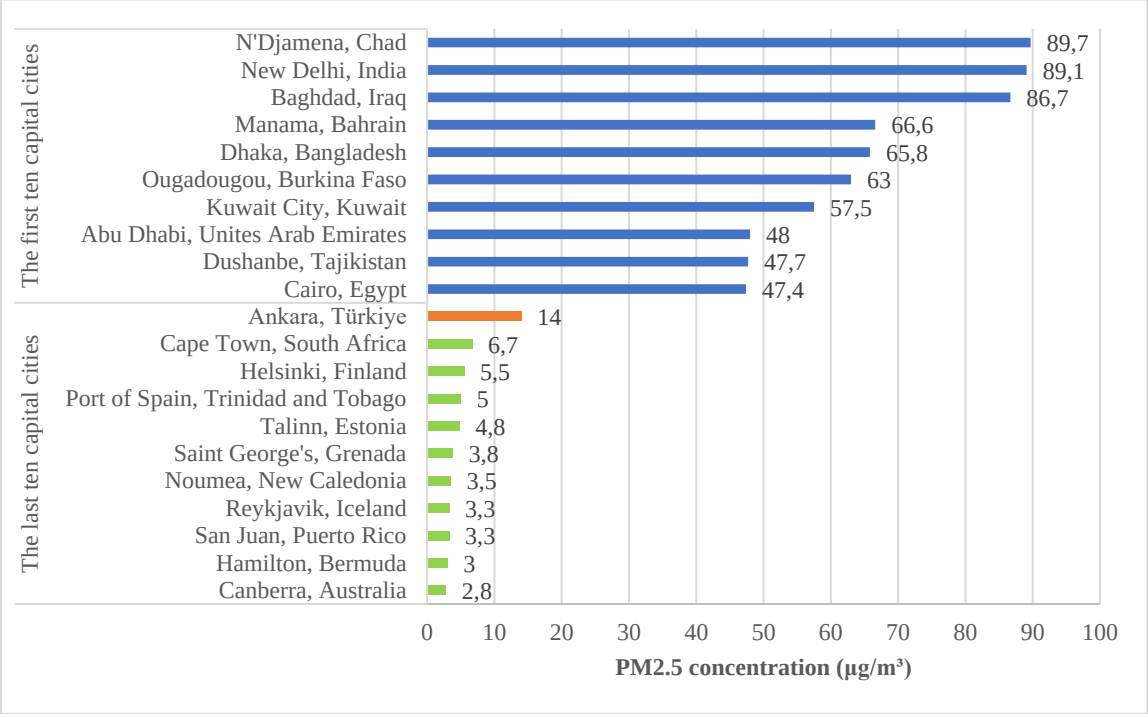

Figure 2. The first and last capital cities and Ankara, Türkiye among 116 capital cities in terms of PM2.5 concentration (µg/m³) (WAQR, 2022)

The first and last ten countries among 43 European countries with Türkiye and the worst and best 15 regional cities among 1713 cities in 43 European countries were presented in terms of

their PM2.5 levels (µg/m³) in Figure 3-4. Accordingly, only three European nations (Estonia, Finland, and Iceland) fulfilled the annual average PM2.5 standard of WHO (2022). 23 of the 43 countries had lower annual average PM2.5 in 2022 than that in 2021. The annual average PM2.5 in 4.6% of the 1,713 European cities was below the standard of WHO (2022). A mild winter in 2022 improved the quality of the air in Europe by reducing the demand for energy that causes pollution. According to the reporting data in 2022, five cities in Türkiye had high annual average PM2.5 (WAQR, 2022).

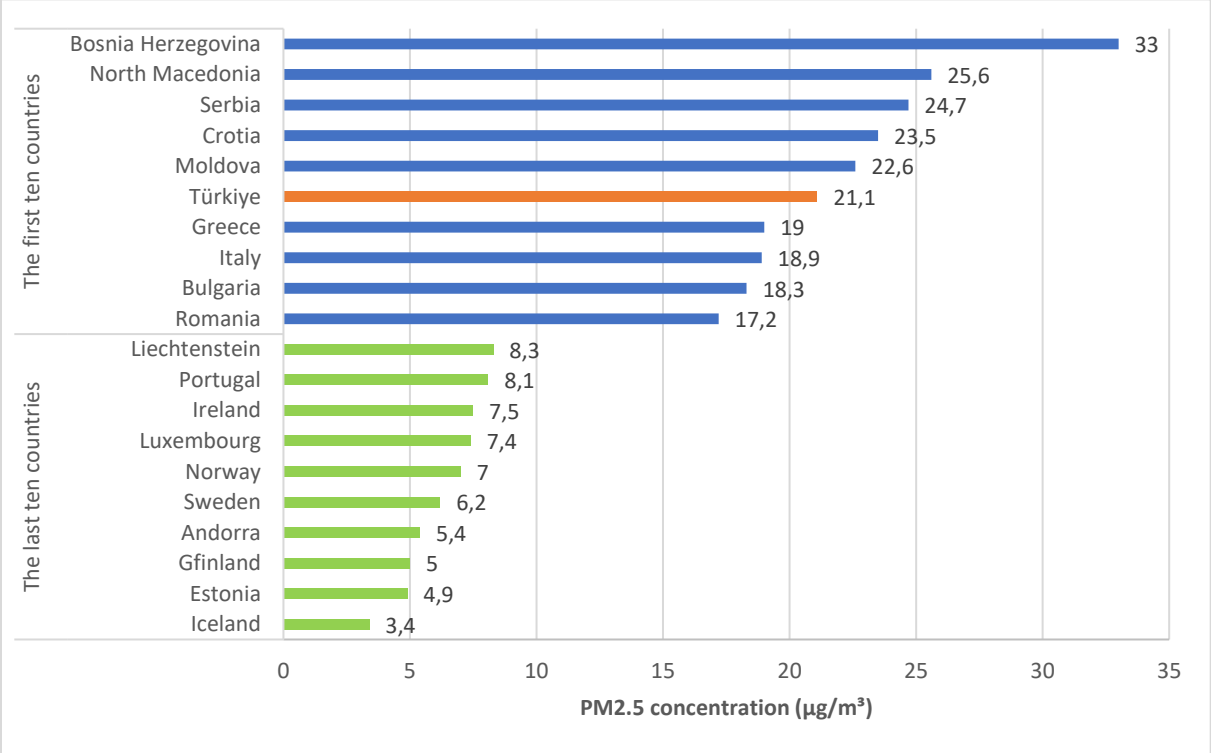

Figure 3. The first and last countries among 43 European countries in terms of PM2.5 concentration (µg/m³) (WAQR, 2022)

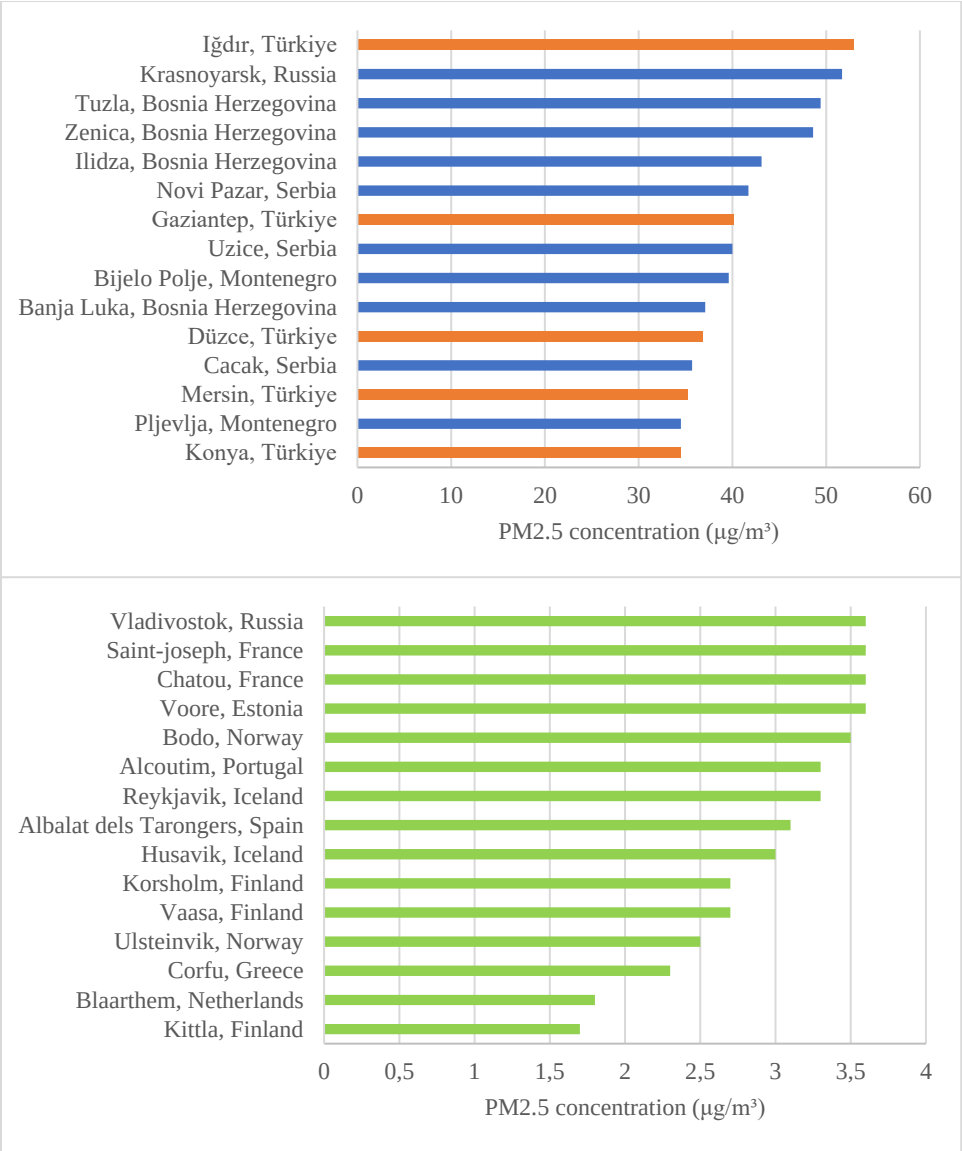

Figure 4. The worst and best 15 regional cities among 1713 cities in 43 Europe countries in terms of PM2.5 concentration (µg/m³) (WAQR, 2022)

The most polluted and unpolluted countries in the Africa are Chad (89.7 µg/m³) and Angola (8.8 µg/m³), respectively. The biggest problem with combating air pollution in Africa is still the lack of data on air quality. Africa is home to 70% of all wildfires worldwide. The majority of these fires produce a lot of ambient PM2.5. Chad's air quality declined in 2022. Dust storm that frequently hit Chad is a factor in the nation's increased PM2.5 concentrations (WAQR, 2022). On the other hand, the highest PM2.5 (25 µg/m^3) in Nairobi, Kenya was recorded during the cold and dry season while the lowest PM2.5 (8.9 µg/m^3) was observed during the short rainy season. PM2.5 in Nairobi originates from various sources, including traffic emissions, mineral dust, industrial activities, combustion processes, biomass burning, and sea salt (Mohammed et al., 2020).

The most polluted and unpolluted countries in the West Asia are Iraq (80.1 μg/m³) and Georgia (17.0 μg/m³), respectively. Increasing PM2.5 in Baghdad, Iraq are resulted from severe dust storms throughout the summer, that are significant natural pollution sources in this region. None of the annual average PM2.5 in any cities of West Asia is below the standard of WHO (WAQR, 2022).

The most polluted and unpolluted countries in the Central and South Asia are Pakistan (70.9 μg/m³) and Maldives (10.9 μg/m³), respectively. In this region, India and Pakistan typically have the poorest air quality. In Pakistan in 2022, house and woodland fires contributed to the country's poor air quality (WAQR, 2022). On the other hand, air pollution in India was responsible for approximately 1.67 million deaths (17.8% of the total deaths in country) in 2019. The majority of these fatalities were attributed to ambient particulate matter pollution. Household air pollution was also a significant contributor. Between 1990 and 2019, the death rate from ambient particle matter pollution increased significantly by 115.3% (Kaur and Pandey, 2021).

The most polluted and unpolluted countries in the East Asia are China (30.6 μg/m³) and Japan (9.1 μg/m³), respectively. China's air quality keeps becoming better each year. China's constant use of coal is a cause for concern. A significant share of the world's coal production and consumption is attributable to China. The sources of PM2.5 in China are industry, biomass burning, road dust, and road vehicles in addition to coal combustion as a major contributor (WAQR, 2022).

The most polluted and unpolluted countries in the Southeast Asia are Indonesia (30.4 μg/m³) and Cambodia (8.3 μg/m³), respectively. The polluted countries in this region are still striving to lower their PM2.5 levels to safe limits. In these countries, open burning, automobile emissions, industry, and power generation continue to be the leading sources of PM2.5. Air pollution in Indonesia is mainly caused by forest fires, peatland degradation and coal-fired power plants while automobile emissions affect especially big cities (WAQR, 2022). According to the data from the Environmental Agency of Jakarta Province, Jakarta has the highest annual average PM2.5 among all Indonesia's urban centers (Syuhada et al., 2023). Vehicle exhaust, non-vehicular emissions, including those with natural origins like sea salt, and secondary generation of particles (secondary aerosols) were the main primary sources of ambient PM2.5 pollution in Jakarta (Pun et al. 2020). Jakarta, a city on the island of Java, is notorious for its

high levels of pollution, and it has issues with the environment, overcrowding, and infrastructure. Although not everyone agrees that changing the capital to Borneo is a good idea, the Indonesian government is doing so in order to address the air pollution issue (Brown, 2023). According to a recent study (Syuhada et al., 2023), air pollution in Jakarta is responsible for about 7000 poor health outcomes in children, over 10,000 fatalities, and over 5000 hospitalizations annually. This study also showed that the annual overall cost of air pollution's negative effects on human health was at 2943.42 million dollars.

The most polluted and unpolluted countries in the Latin America and Caribbean are Peru (23.5 µg/m³) and U.S. Virgin Islands (2.9 µg/m³), respectively. In this region, the main causes of air pollution include vehicles, power plants, wildfires, landfills, and industrial activity. Only four countries in this region met the annual PM2.5 standard of WHO in 2022 (WAQR, 2022).

United States and Canada, the two in North America, have 8.9 µg/m³ and 7.4 µg/m³ PM2.5 concentrations, respectively. In 2022, both nations had lower annual average PM2.5 levels. The threat of wildfires in the US is expanding to include the entire year. The relatively mild wildfire season in 2022 considerably contributed to air advancements in US (WAQR, 2022). More than 400 wildfires, starting in March 2023, are currently burning in Canada, many of which are out of control. As the smoke moves south, it causes air quality alerts in the US. Surprisingly, more than 4.4 million hectares of land have been burned so far this year (Milman et al., 2023).

As for air quality of Türkiye, Arı et al. (2016) revealed that Bursa, Düzce, Şırnak and Afyonkarahisar were the most polluted cities while Adana, Rize and İzmir were the least polluted cities. According to EEA (2017), Ankara and İstanbul were the most polluted cities based on the average annual PM2.5 values. A study (Yener and Demirarslan, 2022) conducted in Marmara Region showed that the average annual PM2.5 was 25.5 µg/m³ and it was mostly impacted by spatial and meteorological factors. Aykaç et al. (2021) stated that from 2016 to 2020, there was not a dramatic improvement in Istanbul's air pollution, and traffic-related air pollution in İstanbul was not adequately measured. According to a study (Filiz, 2023) conducted using the AirQ+ program in Konya, fairly high air pollution, the death rate associated with air pollution in the population of people aged 30 and over was high.

Precautions Against Air Pollution

It has long been challenging to address air pollution issue using source control strategies because of the complexity and diversity of pollution sources. The government, authorities, and industry have been in the forefront of the fight against air pollution with the aid of legislative changes and technical innovation (Kumar and Katoria, 2013). Investigating alternate methods such as urban green areas for significantly mitigating air quality is urgently needed since urban trees may offer a number of ecological benefits (Mandal et al., 2023).

Priority is given to actions that reduce air pollution before it occurs (emission reduction) rather than after it has occurred (concentration reduction) or depend on avoiding existing pollution (exposure reduction) (Public Health England, 2019; Figure 5).

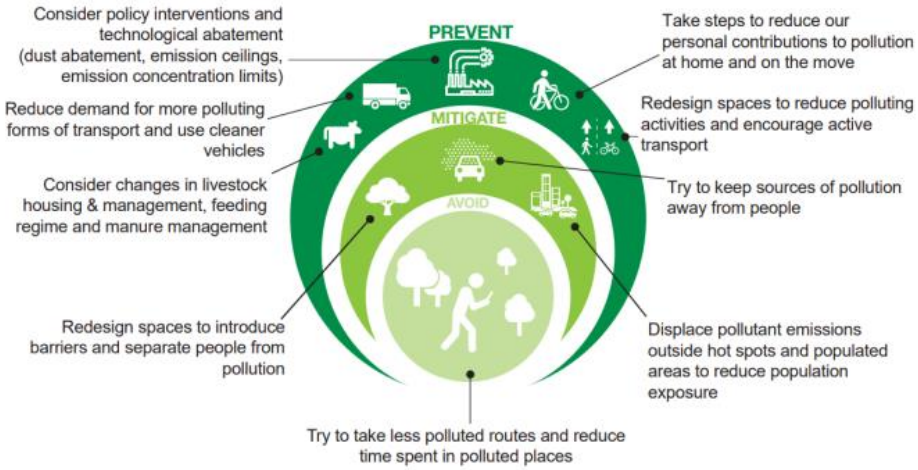

Figure 5. Air Pollution Hierarchy (Public Health England, 2019)

Local practitioners and policy makers should establish strategies for the future design and assessment of interventions in the five focus areas including vehicles and fuels, spatial planning, industry, agriculture, and people's behavior (Table 1).

Table 1. Interventions, key intervention types and types of intervention in the five focus areas (Public Health England, 2019)

Interventions		**Key Intervention types**	**Types of Intervention***
Vehicle/fuel		1. Reduce demand for more polluting forms of transport	P
		2. Reduce emissions from existing vehicles	P / M
		3. Promote vehicles with low emissions	P
		4. Displace pollutant sources outside hotspots and populated areas	M / P
		5. Operational interventions at airports and alternative fuels	P
		6. Lower emission marine fuels and operational interventions at ports	P
		7. electrification of the rail network and promotion of lower emissions from rolling stock	P
Planning/structural		1. Green infrastructure – urban vegetation	M
		2. Pollution reducing surfaces - titanium dioxide	M
		3. Encouraging cycling and walking	P
		4. Road pricing/ Congestion charge	P
		5. Driving restrictions	P
		6. Low emission zones	P
		7. Traffic calming and speed limits	P
		8. Traffic displacement through road alterations	P
		9. Co-implementation of various measures	Other
Industry	Policy Measures	1. Ambient air pollutant concentration limits	P
		2. National emissions ceilings	P
		3. Installation absolute emission caps	P
		4. Installation emission concentration limits: Best Available Technique based permitting	P
		5. Installation emission concentration limits: Cost-Benefit-Analysis based permitting	P
		6. Eco-design and product standards	P
		7. Elimination of plants	P

		8. Inspections and enforcement actions	P
		9. Monetary incentives	P
		10. Monetary penalties	P
		11. Trading schemes	P
	Technologies	12. Diffuse dust abatement	P
		13. Dust abatement (secondary)	P
		14. Primary NO_X/SO_2/PM measures	P
		15. NO_X abatement (secondary)	P
		16. SO_2 abatement (secondary)	P
		17. Primary VOC measures	P
		18. VOC abatement (secondary)	
Agriculture	Change in livestock housing design or management	Livestock building design	P
		Out-wintering pads	P
		Yard design	P
		Shorter housing periods for cattle	M
		Bio-filters	P
		Exhaust air scrubbing	P
		Electrostatic particle ionization and Particle separators	P
		In-house fogging	P
		Ozonation	P
		Choice of litter manure	P
		Poultry manure removal time	P
		Strategic tree-planting	M
	Change in diet or feeding regime	Cattle diet change	P
		Pig diet change	P
		Poultry diet change	P
		Feed scheduling (or phase feeding)	P
	Change in manure management/storage/ processing	Anaerobic digestion of manure and composting digestate	P
		Manure additives	P
		Manure composting	P
		Manure drying (poultry)	P
		Manure management system	P
		Manure treatment plant	P
		Manure/slurry storage methods	P
		Slurry acidification	P
	Low emission manure application to land	Rapid incorporation of solid manure	P
		Low emission slurry spreading	P
	Fertilizer application changes	Urease inhibitor	P
		Choice of N fertilizer	P
		Fertilizer management	P
		Nitrification/denitrification	P
	Change land use/consumption/productivity/ genetic selection/other	Change in consumption	P
		Change in land use or livestock species	P
		Local targeting of mitigation	P
		Genetic selection	P
		Other	P

People's Behaviors	Promotion of walking and cycling	P
	Public engagement	P / M / A
	Investment in public transport	M
	Eco-driver training	P
	No idling campaigns	P
	Eco-travel coordination programs	P
	Air quality messages/alerts/indices	A
	Personal exposure reduction programs	M / A
	Clean air days	P / M / A

**P: Prevention (reduce emissions), M: Mitigation (reduce environmental concentrations), A: Avoidance (reduce individual exposure)*

Role Of Urban Green Areas On The Mitigation Of Air Pollution

Landscape architecture is a science of open space that is naturally green, but it is also connected to the natural, human, and applied sciences, particularly since the 1970s (Ahern, 2005). It contributes to the development of a healthier environment by effectively filtering pollutants, decreasing the levels of particulate matter and gaseous pollutants in the atmosphere, and improving air quality (Kanu et al., 2018; Cai, 2020). In this vein, the methods that landscape architecture utilizes in order to mitigate the air pollution are (1) expanding urban green area, (2) building urban landscape green space ecological corridor, (3) optimizing the landscape plant structure, and (4) enhancing the targeting of landscape plant species (Bai, 2020).

The creation of major urban green spaces within landscaping is necessary to ensure adequate protection against air pollution. These green spaces play a crucial role in addressing air pollution by facilitating the circulation of rainwater and absorbing harmful substances present in the atmosphere. As a result, they contribute to a significant reduction in atmospheric pollution levels (Huo et al., 2017; Bai, 2020). They can also impact air quality by influencing particle deposition, dispersion, and modification (Diener and Mudu, 2021). Yilmaz et al. (2021) revealed that expanding the presence of large green spaces has positive effect on the mitigation of air pollution. The introduction of vegetation is particularly advantageous for the overall urban environment, especially in densely populated areas like neighborhoods. In large cities, this vertical arrangement also makes effective use of public space. To promote these, it is essential for the government to increase investments in expanding urban green spaces and provide support for the construction of landscape garden cities (Huo et al., 2017; Bai, 2020).

Wang et al. (2022) reported that the geographical distribution of urban green space was substantially correlated with PM2.5, NO_2, and SO_2 concentrations in 37 garden cities in subtropical monsoon China but not with the concentration of PM10. In a study conducted by using i-Tree Eco model by Selmi et al. (2016) in Strasbourg, France, it was found that the trees under the management of the city had the capacity to remove significant amounts of various air pollutants annually. Specifically, the reported pollutant removal figures were 5 tons of PM2.5, 12 tons of PM10, 14 tons of NO_2, 1 ton of CO (carbon monoxide), 56 tons of O_3, and 1 ton of SO_2. Of the total population of trees surrounding Bogor Botanical Garden in Indonesia, roadside trees had a physical function that was acceptable (very suitable and suitable) for absorbing gas air pollution (62.78%) and for adsorbing particle air pollution (80.5%) (Febrianti and Sulistyantara, 2020).

Within the context of air pollution control, the construction of green spaces in landscape garden layouts not only serves as conventional green areas but also assumes a critical role as ecological corridors. These corridors facilitate the movement of species, enhance biodiversity, and contribute to the mitigation of air pollution in urban areas. Different plant communities created through landscape architecture exhibit varying levels of effectiveness in adsorbing atmospheric pollutants. Among these communities, trees demonstrate the strongest adsorption effect, followed by shrubs, lawns, and pure coniferous forests (Bai, 2020). Vegetation has a significant role in eliminating air pollutants at the regional and national scales through the process of deposition to leaf surfaces. Vegetation can be utilized to control the flow and distribution of pollutants at smaller sizes, such the street level, by controlling their dispersion-the movement of pollutants by the wind away from the source and dilution with cleaner surrounding air. The first stage in determining the appropriate form of green infrastructure is to determine the type of urban road, such as a street canyon or open road (Mayor of London, 2019). Abhijith et al. (2017) emphasized that unlike high-level trees, low-level hedges improve the air quality in roadway canyons and green walls and rooftops can effectively minimize pollution on open roads and streets.

Plants offer a very effective, scalable, and cost-efficient way to lower urban air pollution levels (Moran, 2019). The principal sensors of PM pollution, plant leaves, can act as biological filters to significantly reduce the amounts of particles in the air in urban areas. Through canopy and leaf-level processes, vegetation could offer a viable green infrastructure for improving air quality, going beyond its conventional role as a passive target and sink for air pollutants

(Mandal et al., 2023). As a result, when designing and implementing landscape layouts and greening initiatives in urban areas, it is crucial to carefully select and combine these plants in a scientifically informed manner (Kremer et al., 2016). Pallawala et al. (2013) suggested *Terminalia arjuna* and *Cassia spp*. for roadside planting to reduce air pollution caused by dust particles based on their measured quantitative and qualitative morphological characteristics that contribute to a coarse texture and dense canopy.

Moreover, in a study (Rai, 2016) completed in Aizawl in India, it was determined that roadside plants such as *Ficus benghalensis, F. religiosa, Mangifera indica, Bougainvillea spectabilis, Psidium guajava, Hibiscus rosasinensis, Lantana camara, Delonix regia, Artocarpus heterophyllus, Cassia auriculata, Bauhinia variegate*, and *Lagerstroemia speciosa* had the impact on the control of PM pollutants. Another study (Greksa et al., 2019), carried out in Novi Sad, Serbia, showed that *Celtis occidentalis* L. can store Cu, *Quercus robur* L. plants can store primarily Zn, *Tilia argentea* L. plants can store Pb, and *Platanus x acerifolia* (Aiton) Willd. plants can store the least amount of the examined heavy metals.

Hopkins et al. (2021) developed a ranking system to identify 54 native tree species that best optimize climate, health, and environmental risk factors specifically for the Greater Houston area. From this ranking, 17 super trees were selected as the most optimal choices. The aim was to prioritize communities for large-scale plantings of these native trees based on their higher vulnerability to adverse health effects and environmental concerns, which are anticipated to worsen due to climate change. Thus, climate change actions can be optimized in addition to safeguarding vulnerable populations' health. According to the study completed by Anshori and Jayanti (2022), the concept of the vertical garden has emerged as one of the responses to reducing air pollution in public areas by utilizing plants like *Sansevieria* that absorb pollution.

It is essential to develop more precise methods to quantify pollution removal by plants, more effective modeling tools that would enable the inclusion of more complex geometries and larger computational domains, as well as decision support tools for optimal greenery arrangement, as implementing the most advantageous scenario for vegetation design is not always practical in practice (Badach et al. 2020). Urban authorities should shift from a purely technocratic way of thinking to thinking with nature by strategically greening urban spaces for long-term air pollution prevention and control measures (Chaudhuri and Kumar, 2022).

CONCLUSIONS

Human beings are exposed to a wide range of air pollutants because of the rise in city traffic in recent years. However, the majority of people are unaware of the dangers posed by traffic-related air pollution. In this sense, the importance of various green spaces, including urban parks, roof gardens, vertical gardens, and botanical gardens etc., cannot be overlooked in mitigating pollution-related risks. In this case, the selection and use of the best landscape plant species in the reduction of air pollution is an important consideration. But there haven't been numerous researches done yet on species selection as a means of reducing air pollution. As a result, more experimental research is required to identify plant species that are resistant to air pollution and more effective in reducing air pollution. As the quality of life is closely related to the air quality of the environment, understanding the significance of air pollution and adhering to the applied measures can end the threat or reduce the harm. A healthy society and globe will have been created in this manner.

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TRAFİK KAYNAKLI AĞIR METAL KİRLİLİĞİNİN ODUNSU PEYZAJ BİTKİLERİYLE BİYOİZLEMİ[5]

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ÖZET
Çarpık kentleşme ve teknolojideki hızlı gelişmeler hem özel hem de toplu ulaşımda artışa neden olmuştur. Bu artış, araç kaynaklı emisyonlar, aşınmış lastikler ve fren balatalarından kaynaklanan toz nedeniyle şehir içi ve şehirlerarası yollarda trafikle ilgili hava kirliliğine neden olmaktadır. Kentsel hava kirliliğinin başlıca nedenlerinden biri olan trafik kaynaklı hava kirliliği kent havasında ağır metal kirliliğine neden olmaktadır. Bu nedenle, kentsel hava kalitesinin etkin bir şekilde izlenmesine acilen ihtiyaç duyulmaktadır. Bu anlamda biyoizlem, ağır metal kirliliğini azaltmak için en etkili, ucuz, çevresel olarak avantajlı ve sürdürülebilir bir yöntemdir. Bu derleme çalışmasında öncelikle trafik kaynaklı kirlilik ve bunun insan, bitki, yaban hayatı ve toprak üzerindeki etkileri anlatılmaktadır. Daha sonra, trafikle ilgili ağır metal kirliliğinin biyoizlemi açıklanmaktadır. Son olarak, odunsu peyzaj bitkileri yardımıyla trafik kaynaklı ağır metal kirliliğinin biyoizlemi konusunda bugüne kadar yapılan çalışmalar detaylıca değerlendirilmiştir. Son yıllarda trafikten kaynaklanan ağır metal kirliliğinin biyoizlemi konusunda birçok çalışma yapılmıştır. Bu çalışmaların çoğu, bitkinin farklı organlarındaki ağır metal konsantrasyonlarına dayanmasına rağmen, aslında bitkilerin fotosentetik ve biyokimyasal değişimlerini dikkate alan çalışmalar da yapılmaktadır. Diğer taraftan, bitkilerin hava kirliliği tolerans indeksleri hesaplanarak bitkilerin tolerans seviyeleri belirlenmekte ve karşılaştırılmaktadır. Daha iyi bir kent planlaması ve tasarımı, etkili toplu taşıma ile caydırıcı araba kullanma önlemleri insanların araba ihtiyacını azaltabilir ve yürüme ile bisiklete binmeyi artırabilir. Emisyon azaltıcı teknolojik yöntemler, işlevsel bir trafik yönetim sistemi ve kentsel trafik kontrolünün kullanılması da trafikten kaynaklı hava kirliliğini azaltmada diğer önlemlerdir.

Anahtar Kelimeler: Peyzaj Bitkisi, Biyoizlem, Kirlilik, Araç

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BIOMONITORING OF TRAFFIC-RELATED HEAVY METAL POLLUTION THROUGH WOODY LANDSCAPE PLANTS

ABSTRACT

Unplanned urbanization and rapid developments in technology has caused an increase in both private and public transportation. This increase results in traffic-related air pollution (TRAP) around urban and intercity roadways owing to emissions from vehicles and dust from worn-out tyres and brake linings. TRAP, one of the principal causes of urban air pollution, resulted in heavy metal pollution in urban air. For this reason, an efficient monitoring urban air quality is urgently needed. In this sense, biomonitoring is the most effective, inexpensive, environmentally advantageous and long-lasting method to reduce heavy metal pollution. In this review article, primarily TRAP and its effects on human, plants, wild life and soils are explained. Then, biomonitoring of traffic-related heavy metal air pollution is elaborated. Finally, the studies conducted so far on biomonitoring of traffic-related heavy metal air pollution through woody landscape plants have been deeply evaluated. In recent years, many studies have been completed on the biomonitoring of heavy metal pollution from traffic. Although most of these studies are based on the existing of heavy metals in different parts of the plant, the number of studies that consider the photosynthetic and biochemical changes in plants are limited. On the other hand, the tolerance levels of plants are determined and compared by calculating the air pollution tolerance indexes of the plants. Better urban planning and design, effective public transportation, and deterrents to driving can reduce the need for cars and increase walking and bicycling. Emission-reducing technological methods, a functional traffic management system and the use of urban traffic control are other measures to reduce traffic-related air pollution.

Keywords: Landscape Plant, Biomonitoring, Pollution, Vehicle

INTRODUCTION

In recent years, the demand for technology has led to an increase in both private and public transportation. Due to emissions and the wear and tear on car parts, this generates traffic congestion and environmental pollution around urban and intercity roadways. One of the most significant environmental problems is heavy metal air pollution brought on by vehicle emissions (Acar and Özkul, 2020). Because of their prevalence, toxicity, durability, and bioaccumulation, heavy metals have the potential to harm both humans and ecosystems permanently (Men et al., 2018; Alexandrino et al., 2020; Al-Qahtani, 2020; Işık and Leblebici, 2023).

Cu, Fe, Ba, Sb, Cd, Pb, Zn, Cr, and Ni are among the heavy metals connected to vehicular traffic (Alexandrino et al., 2020; Skorbiłowicz et al., 2020; Liu et al., 2023). These metals can be found in a variety of matrices, including soil, vegetation, airborne particles, river sediments, and road dust etc. (Fujiwara et al., 2011). In this way, various plant species have served as biomonitors to help collect data on the state of the ecosystem (Alatou and Sahli, 2019; Lazo et al., 2019; Sevik et al., 2019) and even to measure the variation in chemical element concentration caused by the volume of traffic in vehicles (Cozea et al., 2019; Huang et al., 2019; Sevik et al., 2019; Turkyilmaz et al., 2018a; Turkyilmaz et al., 2018b).

The use of biomonitors, a low-cost alternative for analyzing air quality and gathering data on population exposure to air contaminants, enables the evaluation of numerous sampling locations at once (Giampaoli et al., 2016) as monitoring devices are few, expensive, and challenging to operate, local traffic and pollutants are frequently poorly assessed (Dasgupta et al., 2020). For this reason, a great technique for biomonitoring and environmental evaluation is the use of plants as bioindicators of environmental contamination brought on by vehicles along the roadside (Al-Qahtani, 2020). Consequently, plants are crucial research instruments for understanding heavy metal contamination from vehicles (Hosseini et al., 2020).

In this review paper, primarily TRAP and its effects on human, plants, wild life and soils are explained. Then, biomonitoring of traffic-related heavy metal air pollution is elaborated. Finally, the analysis of studies conducted so far on biomonitoring of traffic-related heavy metal air pollution through woody landscape plants are presented.

Traffic-Related Air Pollution (TRAP)

One of the main sources of air pollution in cities is traffic. The TRAP refers to air pollution that is caused by the use of motorized vehicles, such as passenger cars, buses, coaches, motorcycles, and heavy- and light-duty trucks (Khreis et al., 2020). The incidence and effects of TRAP depend on the geographic distribution of economic activity, habitations, and transportation links. The worst exposure occurs in places where heavily traveled roads are in the path of prevailing winds, especially during seasons when meteorological factors maximize pollution (Dasgupta et al., 2020).

TRAP is a significant contributor to outdoor air pollution in urban areas, producing sizeable amounts of elemental carbon, particulate matters (PM), carbon dioxide (CO_2), carbon monoxide (CO), nitrogen oxides (NO_x), nitrogen dioxide (NO_2), ozone (O_3), polycyclic aromatic hydrocarbons (PAHs), and volatile organic compounds (VOCs) (Zakaria et al., 2019; Khreis et al., 2020), notably carbonaceous particles, which contributed 28% to Black Carbon (as annual means for 2017) and about 11% to PM2.5 concentrations across Europe (EEA, 2023). The direct emission of these pollutants through the exhaust of moving cars is referred to as "tailpipe emissions". These emissions, which also include evaporative emissions, dust resuspension, tire and brake wear, and abrasion of road surfaces, are known as non-tailpipe emissions (Matz et al., 2019; Khreis, 2020). The accumulation of Ni, Cd, Pb, Zn, and other metals was found to be twice as high, 2.3 times higher, 3.3 times higher, 2.7 times higher, and 1.6 times higher in the park's high-pollution areas than in its low-pollution areas, respectively (Ayan et al., 2021).

The most significant sources of heavy metals come from the burning of fossil fuels, tire abrasion from vehicles, industrial operations and dust storms (Soleimani et al., 2018). They are significant part of the particulate matter (PM) in the atmosphere, and they have intricate pollution characteristics. Fine particulate matter (PM2.5), which has a higher surface area per unit mass than coarse particulate matter, can bind to heavy metals more efficiently. Additionally, due to its longer stay in the environment and deeper penetration into the lungs, PM2.5 is riskier than coarse PM (Li et al., 2013). Understanding the chemical makeup of airborne PMs in metropolitan environments is crucial due to their complexity, especially the amount of heavy metals in tiny particles that might negatively impact human respiratory systems (Soleimani et al., 2018).

TRAP exposure in humans can have a wide range of harmful health effects (Khreis et al., 2020; Figure 1). The risk of mortality and morbidity is increased by TRAP. Despite significant advancements in reducing vehicle emissions, there is an increasing threat to human health from TRAP that exists in many parts of the world (Thi, 2019). Each level of traffic-related air pollutants significantly correlated with air quality perception and respiratory health symptoms (Zakaria et al., 2019). Numerous respiratory conditions have been linked to nitrogen dioxide and particulate matter from traffic. Diesel exhaust pollutants encourage atherosclerotic plaque modifications, which can result in cardiovascular issues including heart disease or stroke. Both the pregnant women and the fetus may be affected by exposure to TRAP (Lockhart et al., 2015). Boogaard et al. (2022) reported that asthma onset in children and adults, lung cancer mortality, circulatory and ischemic heart disease and acute lower respiratory infections in kids are all linked to long-term exposure to TRAP. Children were more vulnerable than adults to the heavy metals' non-carcinogenic dangers. The heavy metals posed a minimal risk of cancer (Kumari et al., 2021). Furthermore, important biochemical processes regulating the growth and development of plants can be hampered by heavy metals (Rahul and Jain, 2016).



Figure 1. The complete sequence of TRAP-related health effects (CARTEEH, 2023)

Biomonitoring Of Traffic-Related Heavy Metal Air Pollution

Biomonitoring (bioindicators), also known as a biological monitor, is an organism that offers quantifiable data on the quality of the environment in which it lives. They also serve as indicators of the presence of pollutants and make an effort to provide further details regarding the type of pollution and the intensity of exposure. Additionally, it is a particular scientific method that evaluates environmental exposures to both natural and man-made substances based on tissue collection and analysis from each individual organism (Rashed, 2015; Figure 2). Biomonitoring, one of the most impressive passive techniques for tracking changes in atmospheric heavy metal concentrations (Isinkaralar, 2022), is not solely focused on the

concentration and effects of heavy metals and other contaminants in the environment, and particularly in the species living in the environment. It is promising way to distinguish between one place (such as an unpolluted site) and another (a polluted site) or to observe the impact of external forces on ecosystems and their development through time (Markert et al., 2003).

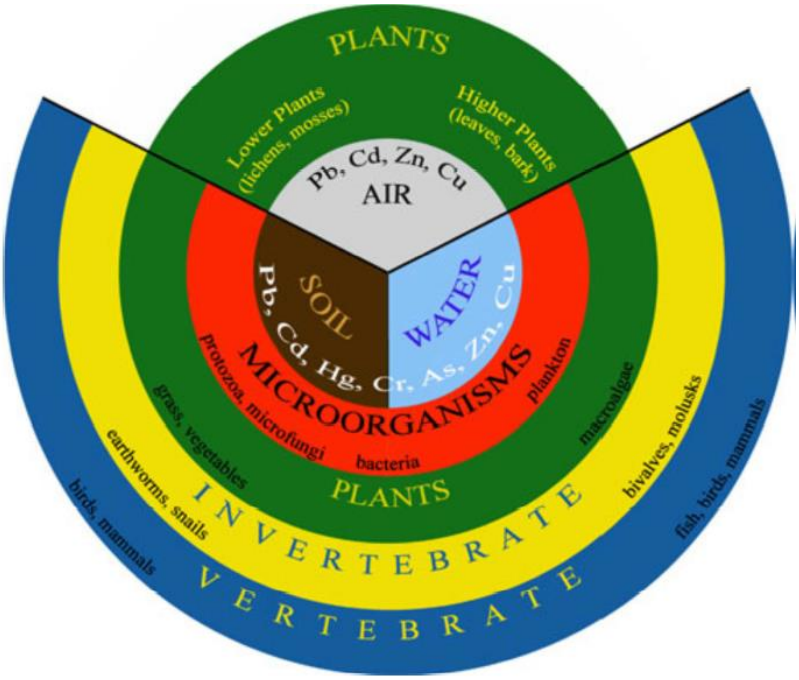

Figure 2. The most explored heavy metals in the biota of environmental compartments (Stankovic and Stankovic, 2013)

The advantages of biomonitoring compared to instrument monitoring are as follows (Cozea et al., 2019):

- Biomonitoring contains information about time variation, the accumulation or interaction of particular abiotic elements, and the response of a single living thing or a community of organisms to environmental changes.
- By monitoring populations and implicitly extrapolating from ecosystems exposed to pollution occurrences, the use of bioindicators can enable quick intervention to maintain the integrity of the environment and indirectly the health of the human population.

Although biomonitoring with plants is thought to be a suitable alternative method for gathering pollution data, there are still some unresolved difficulties that the scientific community needs to investigate. It is required to set up and apply novel, affordable, reliable, and adaptable instruments for monitoring air quality utilizing plants in addition to standard air monitoring systems (Giordano et al., 2021). It is well known that biomonitoring is effective, ecologically friendly strategy to identify and manage the kind, scope, and spread of harmful contaminants.

In this sense, plants' various organs can absorb and collect metal contaminants from the environment (Hosseini et al., 2020). The estimation of the accumulation of heavy metals in higher plants differs for deciduous and evergreen species. Higher deciduous plant species can count annual heavy metal accumulation, while evergreen plants can count long-term heavy metal accumulation (Işık and Leblebici, 2023).

Woody Landscape Plants As Biomonitoring For Traffic-Related Heavy Metal Air Pollution

The most exposed landscape plants are the best indicators of air pollution (Cetin et al. 2019). 79 studies, in which landscape plants are used as biomonitoring for heavy metal air pollution caused by traffic, were presented in Table 1. *Platanus orientalis* (14), *Aesculus hippocastanum* (8), *Ailanthus altissima* (7), *Cupressus sempervirens* (6), *Acer negundo* (4) and *Cedrus atlantica* (4) were studied in four or more research articles. 11 out of 14 studies on *Platanus orientalis* were conducted in different provinces of Türkiye. Traffic-related heavy metal air pollution studies were mostly carried out in Kastamonu (12) and Ankara (10), Türkiye.

Table 1. Woody landscape plant taxa used as biomonitoring for traffic-related heavy metal air pollution

Taxa	Location	Organ	Heavy Metal	Source
Elaeagnus angustifolia	Kayseri	Leaves	Cd, Pb and Zn	Aksoy and Şahin, 1999
Robinia pseudoacacia	Kayseri	Leaves	Cd, Cu, Pb and Zn	Aksoy et al. 2000
Fraxinus excelsior	Kayseri	Leaves	Cd, Cr, Cu, Ni, Pb and Zn	Aksoy and Demirezen, 2006
Corylus avellana	Ordu	Leaves	Cu, Fe and Zn	Huseyinova et al., 2009
Cercis siliquastrum subsp. *siliquastrum*	İstanbul	Leaves and bark	Cr, Fe and Ni	Yaşar et al., 2010
Pyracantha coccinea	Muğla	Leaves and branches	Cu, Fe, Mn and Ni	Akguc et al., 2010
Acacia cyanophylla *Eucalyptus camaldulensis* *Laurocerasus officinalis* *Ligustrum vulgare* *Magnolia grandiflora* *Olea europaea* var. *europaea*, *Phoenix dactylifera* *Picea abies* *Platanus orientalis*	Samsun	Leaves, needles and twigs	**As***, Cd, Cu, Pb and Zn	Demirayak et al., 2011, **2019**
Acer platanoides *Aesculus hippocastanum* *Betula pendula* *Tilia cordata*	Belgrade, Serbia	Leaves	Al, As, Ba, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb and Zn	Tomasevic et al., 2011

Pinus eldarica	Tehran, Iran	Barks	Cr, Cu, Ni, Pb and Zn	Kord and Kord, 2011
Pinus nigra *Platanus orientalis*	Salzburg, Belgrade and Thessaloniki	Leaves and bark	Cr, Cu, Fe and Pb	Sawidis et al., 2011
Aesculus hippocastanum	Plovdiv, Bulgaria	Leaves	Cd, Cr, Cu and Pb	Petrova et al., 2012
Dalbergia sissoo *Eucalyptus spp.* *Prosopis juliflora*	Sargodha, Pakistan	Leaves	Co, Fe, Mn, Ni and **Pb**	Naveed et al., 2012, **2020**
Elaeagnus angustifolia	Amasya	Leaves	Cu, Fe and Mn	Yıldırım et al., 2012
Laurus nobilis	Bartın	Leaves, bark and branches	Al, Cd, Cu, Ni and Pb	Yasar et al. 2012
Acer platanoides *Aesculus hippocastanum* *Betula pendula*	Plovdiv, Bulgaria	Leaves	Cd, Cr, Cu, Fe, Pb and Zn	Petrova et al., 2014
Aesculus hippocastanum *Platanus orientalis* *Populus alba*	Amasya	Leaves	Co, Cr, Cu, Ni and Pb	Karavin et al., 2014
Cupressus sempervirens *Euonymus japonicus* *Ligustrum ovalifolium*	Damascus, Syria	Needles	Cd, Co, Cr, Cu, Ni, Pb and Zn	Mansour, 2014
Juglans regia	Artvin	Leaves and bark	Cd, Cr, Cu, Fe, Mn, Ni, Pb and Zn	Dogan et al., 2014
Abies bornmülleriana *Acer campestre* *A. palmatum* *Aesculus hippocastanum* *Arbutus unedo* *Betula pendula* *Catalpa bignonioides* *Cupressus sempervirens* *Elaeagnus angustifolia* *Fraxinus excelsior* *Pinus nigra* *Platanus orientalis* *Prunus cerasifera* *P. cerasus* *Robinia pseudoacacia* *Salix babylonica* *Tilia rubra* *T. tomentosa*	Kastamonu	Leaves	Cd, Cu, Ni, Pb and Zn	Öztürk and Bozdoğan, 2015
Juniperus virginiana	Bishkek, Kyrgyzstan	Leaves and bark	Cd, Cr, Cu, Fe, Mn, Pb and Zn	Severoğlu et al., 2015
Platanus orientalis	Bartın	Leaves	Cd, Cr, Cu, Ni, Pb and Zn	Özel et al., 2015
Butea monospermae *Calotropis procera* *Saraca asoca*	Bilaspur, India	Leaves	Cd, Cr, Cu, Ni and Pb	Tiwari and Pandey, 2016
Cassia fistula	Chiang Mai, Thailand	Bark	Cr, Cu, Fe, Ni, Pb and Zn	Janta et al., 2016

Maclura pomifera	Amasya	Leaves	Co, Cr, Cu, Fe, Mn, Ni and Pb	Cansaran et al., 2016
Melia azedarach	Hatay	Leaves	Cd, Cu, Ni, Pb and Zn	Bozdogan, 2016
Robinia pseudoacacia	Poland	Leaves	Cd, Cu, Fe, Mn, Pb and Zn	Nadgorska-Socha et al., 2016
Pinus eldarica	Yazd, Iran	Needles	Cd, Cu, Fe, Pb and Zn	Miri et al., 2017
Abies bornmülleriana *Picea pungens* *Pinus nigra* *Pinus sylvestris*	Kastamonu	Needles	Cd, Co, Fe, Hg, Ni, Pb and Zn	Turkyilmaz et al., 2018a
Ailanthus altissima *Elaeagnus angustifolia* *Prunus* *Tilia tomentosa*	Ankara	Leaves	Cd, Cr, Cu, Fe, Mn, Ni, Pb and Zn	Turkyilmaz et al., 2018b
Celtis australis	İstanbul	Leaves, bark and branches	Cd, Cu, Pb and Zn	Ozturk et al., 2018
Chamaecyparis lawsoniana *Ligustrum japonicum*	Iran	Leaves	Al, As, Ba, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb and Zn	Kardel et al., 2018
Acer platanoides	Kastamonu	Leaves, branches and seeds	Al, Ba, Fe and Mn	Cetin et al., 2019
Ailanthus altissima *Platanus orientalis* *Pyracantha coccinea* *Thuja orientalis*	Ankara	Leaves, branches and seeds	Cd, Ni and Pb	Sevik et al., 2019
Fraxinus excelsior	Kastamonu	Leaves, branches and seed	Al, Ba, Fe and Mn	Akarsu et al., 2019
Pinus sylvestris	Ankara-İstanbul	Needles and branches	Cd, Cu and Pb	Arıcak et al., 2019
Platanus orientalis	İstanbul	Leaves and bark	Cd, Cr, Cu, Fe, Mn, Ni, Pb and Zn	Akbayır et al., 2019
Poincianella pluviosa	Rio de Janeiro, Brasil	Bark	Cd, Cu, Fe, Mn, Pb and Zn	de Souza et al., 2019
Rosmarinus officinalis	Hatay	Leaves and stems	Al, Cd, Cr, Cu, Fe, Mn, Ni, Pb, and Zn	Bozdogan Sert et al., 2019
Aesculus hippocastanum *Robinia pseudoacacia* *Salix babylonica* *Sophora japonica*	Ankara	Leaves	Cd, Cr, Cu, Fe, Mn, Ni, Pb and Zn	Turkyilmaz et al., 2020
Araucaria heterophylla	Quito, Ecuador,	Needles	Al, Ba, Co, Cr, Cu, Fe, Mn, Pb and Zn	Alexandrino et al., 2020
Berberis thunbergii *Buxus sempervirens* *Euonymus japonica*	Kastamonu	Leaves/needles and branches	Pb	Sevik et al., 2020

Juniperus sabina *Ligustrum vulgare* *Mahonia aquifolium* *Thuja orientalis*				
Casuarina equisetifolia *Cupressus arizonica* *C. italica Pinus halepensis* *Eucalyptus globulus* *Ficus nitida* *Pinus sylvestris* *Quercus ilex* *Quercus robur*	Baku, Azerbaijan	Leaves	Cd, Cr, Cu, Mn, Ni, Pb and Zn	Youssef, 2020
Cedrus sp.	Kastamonu	Annual rings	Co, Fe and Pb	Sevik et al., 2020
Cedrus sp. *Juniperus sp.* *Pinus sp.*	İstanbul	Leaves	Cd, Cr, Cu, Ni, Pb and Zn	Turan et al., 2020
Fraxinus rotundifolia *Ligustrum ovalifolium* *Thuja orientalis* *Ulmus umbraculifera*	Shahrekord, Iran	Leaves	Cd and Zn	Mostafavi et al., 2020
Abies nordmanniana subsp. *equi-trojani*	Kastamonu	Needles, bark and wood	Ba	Cetin et al., 2021
Acacia nilotica *Calotropis procera* *Ricinus communis* *Ziziphus mauritiana*	Pakistan	Leaves	Fe, Mn, Ni, Pb and Zn	Altaf et al., 2021
Acacia salicina *Casuarina equisetifolia* *Cupressus sempervirens* *Eucalyptus occidentalis* *Tamarix aphylla*	Gabès, Tunisia	Leaves and bark	Cd, Cu, Pb and Zn	Jeddi et al., 2021
Acer negundo *Ailanthus altissima* *Fraxinus excelsior* *Morus alba* *Morus nigra* *Platanus orientalis* *Pterocarya fraxinifolia* *Robinia pseudoacacia* *Salix alba* *Ulmus umbraculifera*	Isfahan, Iran	Leaves	Cd, Cr, Cu, Ni, Pb and Zn	Hatami-manesh et al., 2021
Acer negundo *Nerium oleander* *Platanus orientalis* *Robinia pseudoacacia* *Ulmus minor*	Samsun	Leaves, bark and wood	Cr and Mn	Karacocuk et al., 2021
Alstonia scholaris *Nerium oleander* *Tabernaemontana* *321ole321cose321* *Thevetia peruviana*	Punjab, India	Leaves	Cd, Cu, Pb, and Zn	Kaur et al., 2021

Betula pendula *Larix sibirica* *Picea abies* *Picea pungens* *Pinus sylvestris*	Kazakhstan	Leaves/needles	Cd, Co, Cr, Fe, Li, Ni, Pb and Zn	Ayan et al., 2021
Betula verrucosa	Erzurum	Leaves, bark and branches	As, Cd, Co, Cr, Mn, Ni, Pb and Zn	Çomaklı and Bingöl, 2021
Cedrus atlantica	Kastamonu	Annual rings	**Co**, Cr, Mn and **Ni**	Savas et al., 2021, **Koç, 2021**
Cinnamomum camphora *Osmanthus sp.* *Photinia × fraseri* *Platanus orientalis*	Hefei, China	Leaves and bark	Al, As, Cd, Cr, Cu, Mn, Ni, Pb and Zn	Fang et al., 2021
Cupressus arizonica	Kastamonu	Annual rings	Bi**, Cd, Cr, Fe, Li** and Ni	Cesur et al., 2021, **2022**
Ficus platyphylla *Mangifera indica* *Polyalthia longifolia* *Terminalia catappa*	Ghana	Leaves	Cd, Cu, Pb and Zn	Uka et al., 2021
Populus nigra	Cluj-Napoca, Romania	Leaves	Al, Cd, Co, Cu, Fe, Mn, Ni, Pb and Zn,	Levei et al. 2021
Robinia pseudoacacia cv. "Umbraculifera"	Şanlıurfa	Leaves	Cd, Cu, Ni, Pb and Zn	Karakeçi et al., 2021
Acer negundo *Aesculus hippocastanum* *Ailanthus altissima* *Prunus ceracifera* *Tilia platyphyllos*	Ankara	Leaves, branches and seeds	**Ba and** Cu	Işınkaralar and Pirinç Bayraktar, 2022, **Pirinç Bayraktar et al., 2022**
Acer hyrcanum *Chamaecyparis lawsoniana* *Cercis siliquastrum* *Citrus reticulata* *Cupressus sempervirens* *Eucalyptus camaldulensis* *Laurus nobilis* *Photinia serrulate* *Platanus orientalis* *Prunus cerasifera* *Pyracantha coccinea* *Schinus molle* *Thuja occidentalis*	Mersin	Leaves, bark and wood	**Cd, Cr,** Cu, Fe and **Zn**	Isinkaralar et al., 2022a, **2022b**
Ailanthus altissima *Broussonetia papyrifera* *Pinus tabuliformis* *Rhus typhina,*	Beijing, China	Leaves and bark	Cr, Cu, Mn, Pb and Zn	Liu et al., 2022
Ailanthus altissima *Cedrus atlantica* *Elaeagnus angustifolia* *Koelreuteria paniculate* *Platanus orientalis*	Ankara	Bark and wood	Cr, Mn and Zn	Yayla et al., 2022

Azadirechta indica *Conocarpus erectus* *Ficus bengalensis* *Ziziphus mauritiana*	Pakistan	Leaves and branches	Ba	Cetin and Jawed, 2022
Cedrus atlantica	Kastamonu	Annual rings	Cd and Pb	Isinkaralar, 2022
Cupressus sempervirens *Photinia serrulate* *Platanus orientalis* *Prunus cerasifera* *Thuja occidentalis*	Ankara	Leaves, bark and wood	Cd and Pb	Ahmida Saleha and Işınkaralar, 2022
Picea abies *Pinus sp.* *Thuja occidentalis*	Romania	Needles and bark	As, Cr and Hg	Andrei et al., 2022
Samanea saman	Jakarta, Indonesia	Bark	Cd, Cr, Cu, Mn, Pb and Zn	Rahman et al., 2022
Saraca asoca *Syzygium cumini*	Tamil Nadu, India	Leaves	Al, As, Cd, Cr, Cu, Fe, Mn, Zn, and Pb	Ramesh and Gopalsamy, 2022
Tilia cordata	Spain	Leaves	Al, Cr, Cu, Fe, Mn, Pb and Zn	Soba et al., 2022
Picea pungens	Ankara	Needles, bark and branches	Cr and Zn	Sulhan et al., 2023
Populus nigra *Salix babylonica* *Schinus molle* *Senna multiglandulosa*	Huancayo, Peru	Bark	Cd, Cr, Cu, Ni, Pb and Zn	Baltazar Sedano et al., 2023
Tilia tomentosa	Ankara	Leaves, branches and flower	As, Cd, Cr, Fe and Pb	Işık and Leblebici, 2023

** Heavy metals and their sources are also shown in bold*

Pb, Cu and Zn are the most explored heavy metals in studies. Leaves/needles are the most used plant part in heavy metal biomonitoring studies. The number of the study had a negative correlation with the number of explored heavy metal. Between 2011 and 2016 and between 2017 and 2023, studies primarily used 2-3 and 5–6 heavy metals, respectively (Figure 3-5).

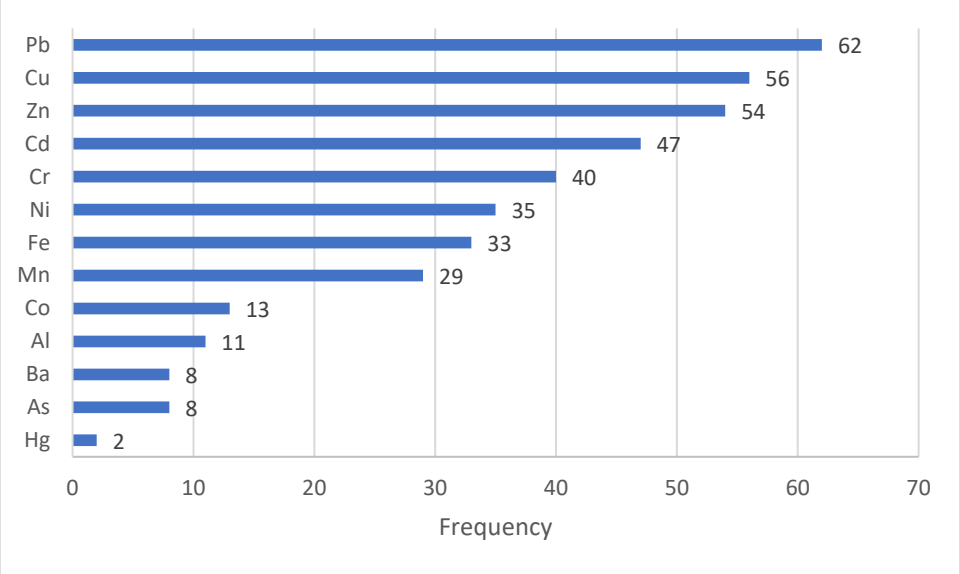

Figure 3. The number of the study based on the heavy metal

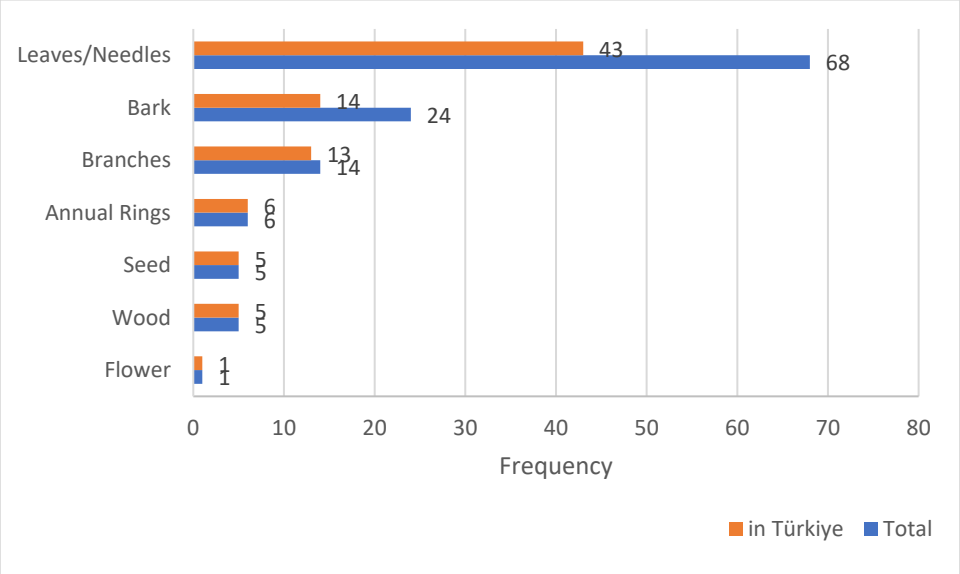

Figure 4. The number of the study based on the plant organ

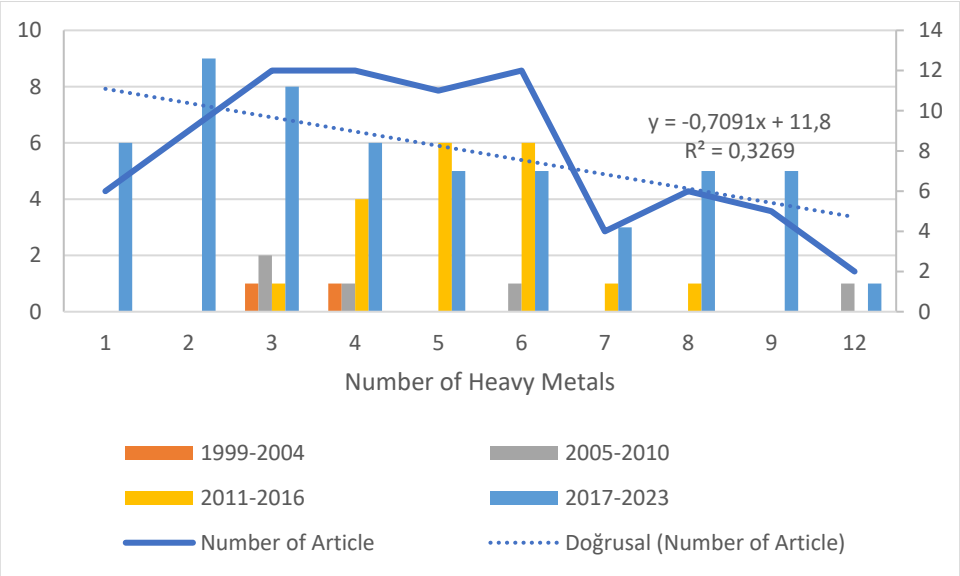

Figure 5. The number of the study based on the year and the number of explored heavy metal

CONCLUSIONS

Plants are suitable for monitoring the distributions of heavy metal pollution and their effects on living beings and ecosystems owing to their inherent traits and also allow us to predict environmental changes at both small and large scale. For monitoring air quality, biomonitoring with plants is regarded as a substitute method because it is affordable, reliable, and adaptable. The current study's analysis of 79 research showed that Türkiye had a significant interest in heavy metal biomonitoring investigations, and the number of studies decreased as both the year and the number of examined heavy metals increased. Techniques such as meta-analysis and bibliometric analysis should be used in future studies with more articles to evaluate more in-depth heavy metal biomonitoring investigations. As a result, various aspects of heavy metal biomonitoring can be understood better.

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ÖZET

Bu vaka sunumunu 1,5 yaşındaki Akkaraman ırkı dişi bir koyunda görülen miks paraziter enfeksiyon oluşturmaktadır. Selçuk Üniversitesi Veteriner Fakültesi Patoloji Anabilim Dalına sinirsel bulgular, çırpınma ve tek yöne meyilli dönme şikâyetleriyle getirilen ve nekropsisi yapılan koyunun beyin ve omentumunda paraziter şüpheli kistler görüldü. Nasal boşlukta sinek larvalarına rastlandı ve bağırsağında lezyonlar görüldü. Bunun üzerine Selçuk Üniversitesi Veteriner Fakültesi Parazitoloji Anabilim Dalına şüpheli örnekler gönderildi. Yapılan incelemelerde beyinden alınan şüpheli kistin *Taenia multiceps*'in larvası *Coenurus cerebralis* olduğu berrak sıvı ile dolu olan kist kesesi içinde beyaz renkli skoleks yapılarına bakılarak belirlendi. Omentumdan alınan şüpheli kistin yarı saydam ve ince çeperli olduğu, içinde beyazımsı renkte invagine olmuş tek bir skoleksin bulunduğu görüldü ve *Taenia hydatigena*'nın larvası olan *Cysticercus tenuicollis* olduğu tespit edildi. Nazal boşluktan toplanan sinek larvalarının posterior stigma levhalarında çok sayıda küçük deliklerin bulunduğu ve stigmalarının geniş bir D şeklinde olduğu, ön ucunda ağız çengelinin belirgin olarak görüldüğü ve segmentleri üzerinde birkaç sıralı küçük dikenlerin bulunmasından kaynaklı *Oestrus ovis*'in III. dönem larvası olduğu tespit edildi. Ayrıca bağırsak içerisindeki dışkıya yapılan natif muayene ve flotasyon metotu sonucunda *Eimeria* spp. ookistleri görüldü. Ayrıca beyin ve bağırsak dokularından alınan örnekler %10'luk formaldehit solüsyonunda fikse edildikten sonra rutin doku takibi işlemleri yapıldı. Parafine gömülen dokulardan 5 mikron kalınlığında kesitler alınarak rutin hematoksilen-eozin boyama prosedürü uygulandı ve ışık mikroskobunda incelendi. Beynin histopatolojik incelemesinde, kist zarının etrafında yabancı cisim dev hücreleri, hiperemi ve mononükleer hücre infiltrasyonları belirlendi. Bağırsağın histopatolojik incelemesinde parazitin gelişim dönemlerine rastlandı. Bu vaka sunumunun amacı, sürü olarak yetiştirilen hayvanlarda miks paraziter enfeksiyonların oluşturduğu kayıpların önemini vurgulamak ve sürüde bulunan köpeklerin bu enfeksiyonlar üzerindeki etkisi göz önünde tutularak alınacak önlemlerin daha sağlıklı olmasını sağlamaktır.

Anahtar Kelimeler: *Coccidiosis, Coenurus cerebralis, Cysticercus tenuicollis, Oestrus ovis*

A CASE OF COENURUS CEREBRALIS, OESTRUS OVIS, CYSTICERCUS TENUICOLLIS AND COCCIDOSIS IN A SHEEP

ABSTRACT

This case report consists of a mixed parasitic infection in a 1,5 year old Akkaraman female sheep. Suspected parasitic cysts were found in the brain and omentum of the sheep, which was brought to the Department of Pathology, Faculty of Veterinary Medicine, Selcuk University with complaints of nervous findings, fluttering and unidirectional turning and underwent necropsy. Fly larvae were found in the nasal cavity and lesions were observed in the intestine. Suspicious samples were sent to Selcuk University, Faculty of Veterinary Medicine, Parasitology Department. The examinations determined that the suspicious cyst taken from the brain was the larva of *Taenia multiceps*, *Coenurus cerebralis*, by looking at the white colored scolex structures in the cyst sac filled with clear fluid. It was observed that the suspicious cyst taken from the omentum was translucent and thin-walled, containing a single whitish invaginated scolex, and it was determined to be *Cysticercus tenuicollis*, the larva of *Taenia hydatigena*. The fly larvae collected from the nasal cavity were identified as stage III larvae of *Oestrus ovis* due to the presence of numerous small holes in the posterior stigma plates, a wide D-shaped stigma, a prominent mouth hook at the anterior end, and several rows of small spines on the segments. In addition, as a result of the native examination and flotation method of feces in the intestine, *Eimeria* spp. oocysts were seen. In addition, routine tissue follow-up procedures were performed after the samples taken from brain and intestinal tissues were fixed in 10% formaldehyde solution. Routine hematoxylin-eosin staining procedure was applied by taking 5 micron thick sections from paraffin-embedded tissues and examined under a light microscope. Histopathological examination of the brain revealed foreign body giant cells, hyperemia and mononuclear cell infiltrations around the cyst membrane. In the histopathological examination of the intestine, the developmental stages of the parasite were found. The aim of this case report is to emphasize the importance of losses caused by mixed parasitic infections in animals raised as herds and to ensure that the measures to be taken are healthier by considering the effects of dogs in the herd on these infections.

Keywords: *Coccidiosis, Coenurus cerebralis, Cysticercus tenuicollis, Oestrus ovis*

GİRİŞ

Taenia multiceps (*Multiceps multiceps*), köpek, tilki ve çakalların ince bağırsaklarında yerleşim gösteren bir sestoddur (Varcasia 2015). Bu sestodun larvası olan *Coenurus cerebralis* genellikle koyun, keçi gibi küçük geviş getiren hayvanlar ile bufalo, sığır, deve gibi büyük geviş getirenlerin sinir sistemlerinde yerleşim gösterir ve nörolojik anormalliklerle belirgin serebral coenurosise yol açar (Sharma 2006, Oryan 2015). Serebral olmayan coenurosis, etkilenen ara konakların kas dokuları ve viseral organları gibi vücudun diğer bölümlerinde de bildirilmiştir (Oryan 2010, Christodoulopoulos ve ark 2016). Enfeksiyon, *T. multiceps* yumurtaları ile kontamine gıda ve/veya suyu ile fekal-oral yolla gerçekleşir. Son konağın dışkısıyla atılan yumurtalar ara konaklar tarafından beslenme esnasında yutulduğunda, onkosferler ince bağırsakta açılır ve bağırsak duvarından geçerek kan dolaşımı yoluyla beyne ve diğer organlara yerleşip gelişmeye başlarlar (Schuster ve ark 2010, Amer ve ark 2017). Larvalar, ara konakta merkezi sinir sistemine özellikle beyin ve omuriliğe yerleşir. Beyin dokusunda 0,3-9,5 cm arasında değişen büyüklükte, içleri sıvı ve fazla sayıda skoleksten oluşan şeffaf keseler oluştururlar (Eckert ve ark 2005, Yılmaz ve ark 2014). Klinik bulgular kistin ebatına, yerleşim yerine ve beyin dokusuna yaptığı basınç miktarına göre değişir (Sharma ve Chauhan 2006, Gül ve ark 2007). *C. cerebralis* enfeksiyonun başlarında purulent meningoensefalitise sebep olurken enfeksiyonun ileri safhalarında genişlemeye devam eden kist ölümle sonuçlanabilen sinirsel semptomlara neden olabilir (Christodoulopoulos 2007). Küçük geviş getiren hayvanlarda *C. cerebralis* ile enfestasyon riski çok yüksektir (Amer ve ark 2017).

Oestrus ovis, larvaları koyun ve keçiler başta olmak üzere birçok hayvanda kavikol myiasise neden olan bir sinek türüdür. Yetiştiriciler için ekonomik açıdan büyük bir sorun olan *O.ovis,* larvalarını hayvanların burun mukozasına bırakır ve larvalar buradan yukarı hareket ederek nazal kavite ve sinüslerde yerleşim gösterir. Koyun ve keçilerde et, yün ve süt kaybına neden olmaktadır (Uslu ve Dik 2006, Arslan ve ark 2009). *O. ovis* larvalarının özellikle koyun ve keçileri enfekte ettiği bilinmesine rağmen, köpekler ve kediler gibi diğer hayvanlarda enfestasyonlar bildirilmiştir (Webb ve Grillo 2010, Zanzani ve ark 2016). Ayrıca insanlarda da *O. ovis* tarafından kazara enfestasyon vakaları bildirilmiştir. (Ahaduzzaman 2019, Brini ve ark 2019). *O. ovis*, kozmopolit bir parazittir. Yetişkin sinekler sıcak iklime sahip bölgelerde yaygındır ve yağışlı aylarda daha aktiftirler (Alcaide ve ark 2003, Gracia ve ark 2006). Parazit yaşam döngüsünün uzunluğu, mevsime ve iklim koşullarına bağlı olarak 4 hafta ila birkaç ay arasında değişmektedir (Zumpt 1965). İntrapuparyal metamorfoz 19-27 gün içinde meydana gelir (Cepeda-Palacios ve Scholl 2000) ve sineklerin yaşam süresi 2- 4 hafta arasında değişmektedir (Angulo-Valadez ve ark 2011). Koyunlarda *O. ovis* tarafından istila, dişi

sineklerin konakçılarının burun deliklerine küçük birinci evre larvaları (L1) bırakmasıyla başlar. Larvaların tüm gelişim evrelerinde (L1, L2 ve L3) vücut boyunca buccal kavisli kancalar ve diken sıraları vardır, bu da onların nazal geçişlere hareket etmelerini ve mukozal yüzeye tutunmalarını sağlar. Bu morfolojik yapılar, larvaların mukoza ve mukus salgısı ile beslenmesini kolaylaştırır ve ayrıca gelişimlerini tamamlamadan güçlü nefes veya hapşırma ile dışarı atılmalarını önler (Kamal ve ark 2021). Daha sonra olgun L3'ler tekrar nazal mukozaya göç eder ve hapşırma ile pupalar atılır ve toprakta gelişen pupadan erişkin sinek oluşur (Giannetto ve ark 1999). Larva istilası, kalın mukus ve mukopürülan burun akıntısı nedeniyle solunum güçlüklerine neden olabilir. Burun akıntılarında kan çizgileri gözlemlenebilir ve enfekte koyunlarda sık sık hapşırma, nefes darlığı ve öksürük gösterebilir (Dorchies ve Yilma 1996, Dorchies 1997).

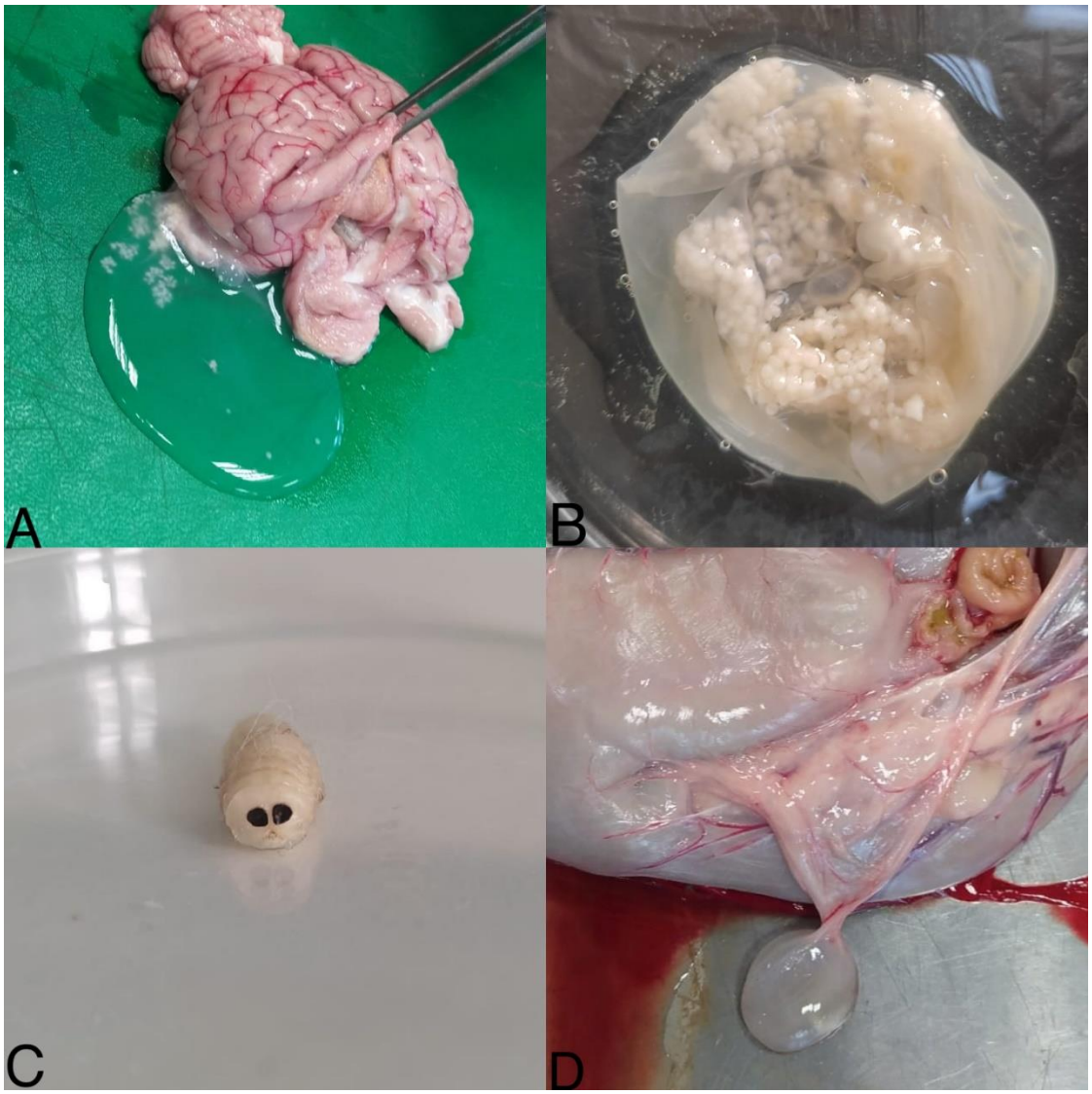
Cyticercus tenuicollis evcil ve vahşi köpekgillerin (köpek, kurt, tilki ve çakal) ince bağırsaklarında yaşayan *Taenia hydatigena*'nın larva formu olup koyun, manda, yak, sığır ve keçi gibi geviş getirenlerin omentum, mezenterium ve karaciğerinde yerleşir. (Samuel ve Zewde 2010, Saulawa ve ark 2011, Oryan ve ark 2012). Hemorajik ve fibrotik yollara ve serofibrinöz peritonite sebep olan hepatit sistiserkoza, bu sistiserklerin karaciğere hareketi nedeniyle ortaya çıkabilir (Fentahun ve ark 2012, Gholami 2018). Şiddetli enfeksiyonlar, ishal, anemi ve büyüme hızında düşüş ile ortaya çıkar ve bu da daha yüksek beslenme maliyetlerine yol açmaktadır (Blazek ve ark 1985). Koyunlarda yaygın olarak bulunan *C. tenuicollis*'in asıl patojen etkisi karaciğer üzerinde olmaktadır. Karaciğer parankiminde göç geçiren larvalar dokunun harabiyetine, travmaya, yangısal reaksiyonlara ve fibrozise neden olmakta ve hepatitis cysticercosa meydana gelmektedir. Karaciğerde oluşan doku harabiyeti sebebiyle anaerobik ortamda aktive olan *Clostridium novyi* toksinleri, kara hastalık (Black disease) olarak da bilinen Enfeksiyöz Nekrotik Hepatitise neden olabilmektedir (Soulsby 1986).

Coccidiosis (Eimeriosis), farklı hayvan türlerinin ince ve kalın bağırsaklarında gelişen ve özellikle genç yaştaki hayvanları etkileyen *Eimeria* cinsi koksidiyan protozoonların neden olduğu bir enfeksiyondur. Her yaştan ve ırktan küçük geviş getiren hayvanlar, *Eimeria* enfeksiyonuna karşı hassastır. Coccidiosis, klinik hastalığa (ishal) ve subklinik enfeksiyonlara bağlı kayıplar (özellikle zayıf kilo alımı) nedeniyle büyük ekonomik öneme sahiptir (Rehman ve ark 2011).

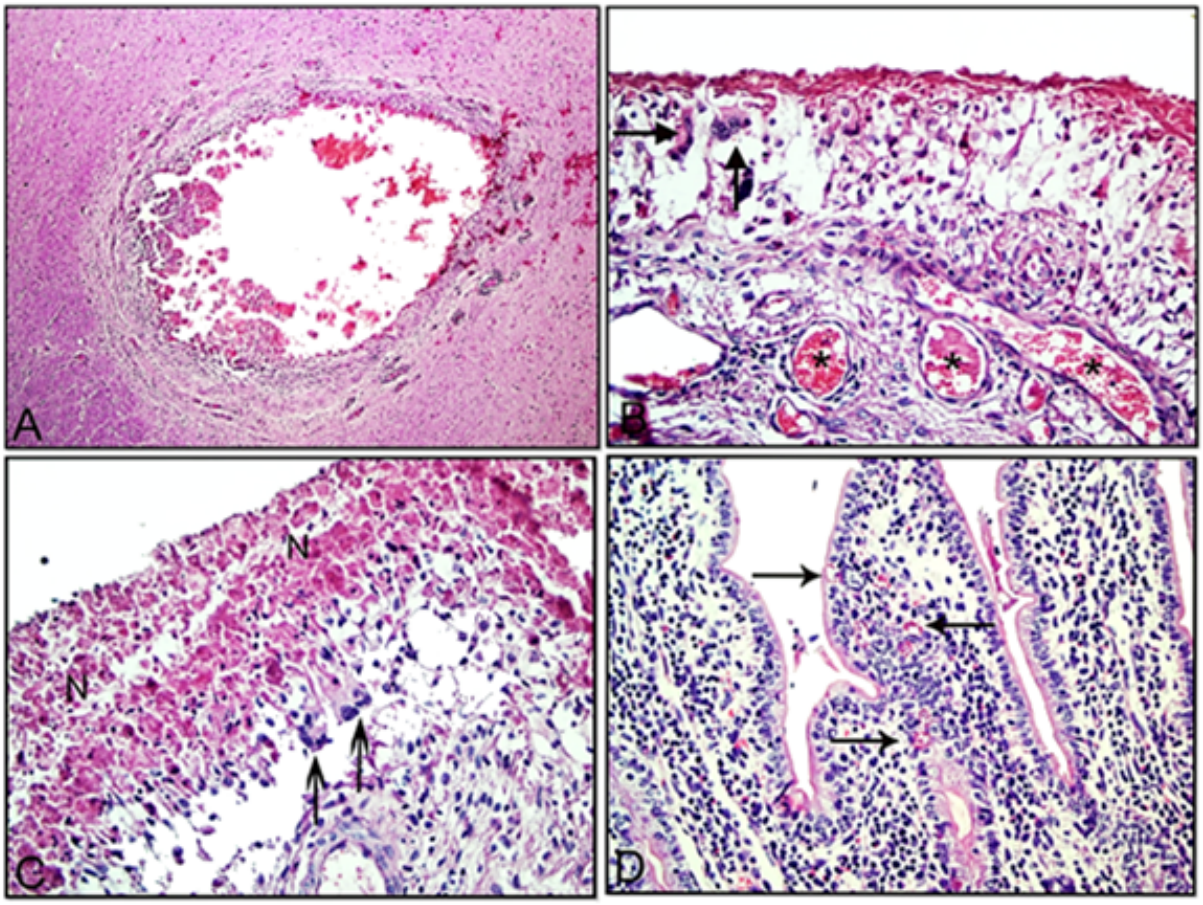
Olgu

Bu vakanın olgusunu, Selçuk Üniversitesi Veteriner Fakültesi Patoloji Anabilim Dalına nekropsisi yapılmak üzere getirilen 1,5 yaşında dişi Akkaraman koyunu oluşturmaktadır. Koyunun nekropsisi sonucu beyninde ve omentumunda şüpheli sıvı dolu keseler tespit edildi,

nasal boşluğunda sinek larvaları görüldü ve bağırsağında lezyonlara rastlanıldı. Patolojik muayenede, nekropside beynin sağ hemisferinin sol hemisferden daha büyük olduğu dikkati çekti. Beynin palpasyon ile muayenesinde sağ hemisferin fluktuan kıvamlı olduğu tespit edildi. Sağ hemisferin ön kısmından yapılan bir kesi sonucunda hemisferin iç kısmını tamamıyla dolduran kistik bir yapı ile karşılaşıldı. Kistin oluşturduğu basınç sonucu beyin dokusunda atrofi görüldü. Kesin teşhisi yapılması için Parazitoloji laboratuvarına gönderilen beyin dokusunun içindeki kist mikroskobik olarak incelendi ve içi berrak sıvı dolu olan kist kesesi içinde çok sayıda beyaz renkli skolekse rastlandı. Bu kistin *T. multiceps* larvası olan *C. cerebralis* olduğu tespit edildi (Resim 1A-1B). Histopatolojik inceleme için beyin dokusundan alınan örnek %10'luk formaldehit solüsyonunda fikse edildikten sonra Leica TP 1020 doku takip cihazı ile rutin doku takibi işlemleri yapıldı. Parafin blok haline getirilen dokudan 5 mikron kalınlığında kesitler alınarak rutin Hemotoxylen-Eosin (HxE) boyama prosedürü uygulandı (Luna 1964). Boyama işlemi sonrasında preperatlar Olympus BX51 ışık mikroskobunda incelendi. Histopatolojik incelemede kist duvarının etrafındaki damarlarda hiperemi gözlenirken aynı zamanda perivasküler mononükleer hücre infiltrasyonları belirlendi. Ayrıca, kist duvarının çevresinde yabancı cisim dev hücreleri ile mononükleer hücreler gözlendi. Beynin kistik bölge dışında kalan bölgelerinde nöronlarda dejenerasyon ve nekroz, gliozis ve damarlarda hiperemi görüldü. Gerek görülen kesitlerden fotoğraflar (Olympus EP50, Tokyo, Japan) çekildi (Resim 2 A,B,C). Omentumdan alınan şüpheli sıvı dolu kese mikroskobik olarak incelendi. Kistin yarı saydam ve ince çeperli olduğu, içinde beyazımsı renkte invagine olmuş tek bir skoleksin bulunduğu görüldü ve *T. hydatigena'*nın larvası olan *C. tenuicollis* olduğu tespit edildi (Resim 1D). Burun boşluğu ve sinüslerden toplanarak bir petri içerisinde getirilen sinek larvaları mikroskopta incelendi. Larvaların posterior stigma levhalarında çok sayıda küçük deliklerin bulunduğu ve stigmalarının geniş bir D şeklinde olduğu, ön ucunda ağız çengelinin belirgin olarak görüldüğü ve segmentleri üzerinde birkaç sıralı küçük dikenlerin bulunmasından kaynaklı *O. ovis*'in III. dönem larvası olduğu tespit edildi (Resim 1C). Ayrıca bağırsak içerisindeki dışkıya yapılan natif muayene ve flotasyon metotu sonucunda *Eimeria spp*. ookistlerine rastlandı. Histopatolojik incelemede bağırsak epitel hücrelerinin sitoplazmalarında koksidiyoz etkeninin gelişim formları saptandı, lamina propriya katmanında eozinofil granülosit ve mononükleer hücre infiltrasyonları görüldü (Resim 2D) ve bağırsak lezyonlarına coccidiosisin sebep olduğu sonucuna varıldı.



Resim 1. A. Beynin sağ hemisferinde *Coenurus cerebralis* kisti **B.** *Coenurus cerebralis* kist içerisinde bulunan skoleks yapıları, Orijinal **C.** *Oestrus ovis* larvası, Orijinal **D.** Omentum üzerinde *Cysticercus tenuicollis* kisti, Orijinal



Resim 2. A. *Coenurus cerebralis* kistinin genel görünümü X10, HXE. **B.** *Coenurus cerebralis* kist duvarındaki dev hücreleri (oklar), hiperemi (yıldızlar) ve perivasküler mononükleer hücre infiltrasyonları X40, HXE. **C.** *Coenurus cerebralis* kist duvarı etrafında nekrotik alan (N) ve yabancı cisim dev hücreleri (oklar), X40, HXE. **D.** *Eimeria'*nın bağırsak villuslarındaki gelişim formları (oklar) X40, HXE.

TARTIŞMA

Parazit enfeksiyonunun varlığı; hayvanların besin alımını, besin sindirimini ve çeşitli fizyolojik aktivitelerini olumsuz etkiler. Bu olaylar sonucunda erken ölüm, verim kaybı, canlı ağırlık artışının azalması, süt kalite ve miktarının azalması, doğurganlığın azalması gibi çeşitli olumsuz etkiler gözlemlenmiştir. Bütün bunlar hayvansal üretimin azalmasına neden olur ve insan beslenmesini olumsuz etkiler (Köroğlu ve Şimşek 2004).

T. multiceps'in sebep olduğu coenurosis koyunların önemli parazitleri arasında yer almakta olup dünyada ve ülkemizde büyük ekonomik kayıplara sebep olmaktadır (Sharma ve Chauhan 2006). Türkiye'de *C. cerebralis*'in prevalansının %1,3- 36,8 arasında olduğu bildirilmiştir (Akkaya ve Vuruşaner 1998, Kalkan 1978, Uslu ve Güçlü 2007). Hastalığın koyunlarda ciddi verim kayıpları oluşturduğu, sinirsel semptomlar ortaya çıkardığı, parietal kemiklerinde yumuşamaya sebep olduğu ve tüm bu belirtiler sonucu hayvanın ölüme sürüklendiği

bildirilmiştir (Karim 1979, Soulsby 1986, Akkaya ve Vuruşaner 1998). Beyinde yüzeysel yerleşimli kistlerin kafatasının deformasyonuna ve incelmesine sebep olduğu ayrıca kistlerin beyin atrofisi ve doku deformasyonu yaptığı bildirilmiştir. Kistler çoğunlukla hemisferlere yerleşmekle birlikte beynin parieto-oksipital, temporal, frontal bölgelerinde ve serebellumda da saptanmıştır (Uslu ve Güçlü 2007). Bu çalışmada kistin sağ hemisferin iç kısmını tamamıyla doldurduğu ve buna bağlı olarak beyin dokusunda atrofi olduğu tespit edildi. Bu sonuç literatür verileriyle benzerlik göstermektedir. Coenurosis'de yaş duyarlılığı olmadığı bilinse de 6-24 aylık koyunların daha duyarlı olduğu bilinmektedir. *C. cerebralis*'in gelişimi için uzun bir inkubasyon süreci gerekli olmakla birlikte hastalığa özgü klinik belirtilerin parazitle enfekte olunmasından yaklaşık olarak 3 ay sonra ortaya çıktığı bildirilmiştir (Gül ve ark 2007). Vakada 1,5 yaşında olan koyunun 5-6 aylıkken sinirsel belirti göstermeye başlaması bu durum ile örtüşmektedir.

O. ovis larvaları, koyun ve keçilerde nazal miyaz hastalığına neden olan *Oestridae* familyasından bir sinektir. Türkiye'de *O. ovis* prevalansının %22,50-%59 arasında değiştiği bildirilmiştir (Gökçen ve Sevgili 2004, Uslu ve Dik 2006, Arslan ve ark 2009, Karatepe ve ark 2014). Bu sineklerin larvaları, konakçılarının burun boşluklarında ve sinüslerinde gelişir. *O. ovis* 'li hayvanlarda gözlenen klinik belirtiler burun akıntısı, hapşırma, halsizlik, kendi ekseni etrafında dönme ve inkoordinasyon olarak özetlenebilmektedir (Yıldız 2016). Literatür verileriyle uyumlu olarak (Yıldız 2016), çalışmanın materyalini oluşturan koyunda kendi ekseni etrafında dönme, koordinasyon kaybı, iştahsızlık, başın nesnelere bastırılması, donukluk gibi çeşitli nörolojik semptomlar gözlenmiştir.

T. hydatigena'nın larvası olan *C. tenuicollis* ara konakların karaciğerinde, karın boşluğunda veya mezenterlere yapışık olarak bulunabildiği gibi tek başına veya kümeler şeklinde de bulunabilmektedirler (Dawn 1978). Türkiye'de *C. tenuicollis*'in prevalansının %49,2-%100 arasında olduğu bildirilmiştir (Kalkan 1978, Zeybek 1980, Sarımehmetoğlu 1993, Taş 1997, Değer ve ark 2001, Aydın 2003). Ara konaklarda hastalığın etkili bir tedavisi bulunmamakla birlikte, son konaklara uygun antelmintikler kullanılarak taeniasis tedavisi ile parazitlerin yayılmasının nispeten kontrol edilebileceği, ancak vahşi döngünün varlığı ve başıboş köpeklerin bunu zorlaştırdığı bildirilmiştir (Bamorovat ve ark 2014). Vakayı oluşturan koyunun bir sürüde bulunduğu ve sürüde bulunan çoban köpeklerine herhangi bir antiparaziter uygulama yapılmadığı hasta sahibinden alınan bilgilerle doğrulanmıştır.

Küçük geviş getiren hayvanlarda coccidiosis (Eimeriosis sensu stricto), *Eimeria* cinsinin çeşitli türlerinin neden olduğu, ince ve kalın bağırsakta gelişen, özellikle genç hayvanları etkileyen ve her konakçıya özgü olan bir protozoon enfeksiyonudur (Chartier ve

Paraud 2012). Özellikle genç hayvanlarda hemorajik diyare, depresyon, zayıflama ve ölümle sonuçlanabilen coccidiosis Türkiye'de koyunlarda yaygın olarak görülmektedir. Türkiye'de yapılan araştırmalarda koyunlarda Ege bölgesinde %37,6 (Sayın ve ark 1986) Elazığ'da %80,2 (Küçükerdan ve Dumanlı 1992), Bursa'da %97,7 (Demir 1995), Kars'ta %56 (Arslan ve ark 1999), Van'da %100 (Gül ve değer 2002), Bitlis'te %89.21 (Gül 2007) oranlarında enfeksiyon tespit edilmiştir.

SONUÇ ve ÖNERİLER

Vakayı oluşturan koyunun, 350 başlık bir sürüde bulunduğu ve sürüdeki yaklaşık olarak 40 hayvanda daha sinirsel belirtiler, çırpınma, bir tarafa meyilli olarak yürüme belirtileri olduğu ayrıca sürünün içerisinde 6 adet köpeğin çobanlık amacıyla bulundurulduğu hasta sahibinden alınan anamnezde öğrenilmiştir. Köpeklere herhangi bir antiparaziter uygulamanın yapılmadığı bilgisi alınmıştır. Vakada tespit edilen iki kistinde köpek sestod larvası olması anamnezle uyum göstermiştir. Bu nedenle önlem olarak, özellikle helmint enfeksiyonların kontrolü açısından köpeklerin belirli periyodlar ile dışkı muayenelerinin ve uygun bir antelmentik ile tedavilerinin yapılması ve en önemlisi de başta koyun olmak üzere ara konak hayvanların et veya sakatatlarının çiğ olarak köpeklere yedirilmemesi etkili olacaktır.

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TÜRKİYE'DE SON ON YILDA UN SANAYİİNDE ORTAYA ÇIKAN GELİŞMELER: SORUNLAR VE ÖNERİLER

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ÖZET

Gıda sanayiinin en önemli alt sektörlerinden biri olan ve çeşitli tahıl unları ile karışımlarını üreten un sanayii, küresel düzeyde stratejik bir öneme sahiptir. Özellikle Türkiye gibi tüketim yapısında ekmek başta olmak üzere tahıl grubu ürünlerin göreli öneminin yüksek olduğu gelişmekte olan ülkelerde, un sanayiinin önemi gıda güvencesi nedeniyle daha da artmaktadır. Un üretimi ve arzı savaş, salgın ve doğal afet gibi ani gelişen kriz dönemlerinde gıda güvencesi açısından daha da önemli hale gelmektedir. Türkiye iklim ve coğrafya bakımından tahıl (özellikle buğday) üretimine oldukça elverişli bir ülkedir. Hammadde üretim potansiyelinin yüksekliği ile un sanayii Türkiye'de oldukça gelişmiştir. Nitekim son on yılın verilerine göre Türkiye dünyanın en önemli un ihracatçısı ülkesidir. Bununla birlikte, son yıllarda un ithalatında artış eğilimi izlenmektedir. Ara malı olan unun kalitesi, üretiminde kullanılacağı ve ihraç edilecek unlu mamullerin kalitesini doğrudan etkilediğinden bu artışın kaliteli un ithalatına bağlı olduğu değerlendirilmektedir. Ayrıca kapasite kullanım oranının Dünya ortalamasının altında olması, un sanayiinin çözüm bekleyen bazı sorunları olduğunun göstergesidir. Bu çalışmanın amacı, Türkiye'de un sanayiinde son on yılda ortaya çıkan gelişmelerin incelenmesi ve konuya ilişkin sorunların ve çözüm önerilerinin tartışılmasıdır. Araştırmanın ürün kapsamını, buğday unu ve diğer tahıl unlarının üretimi ile bunların karışımları oluşturmaktadır. Çalışmada ele alınan son on yıl, 2022 yılı verilerine ulaşılması durumunda 2013-2022 yılları arasını, ulaşılamadığında ise 2012-2021 yılları arasındaki verileri kapsamaktadır. Elde edilen makro veriler çizelgeler ile gösterilmiş ve verilerin değerlendirilmesinde yüzde hesapları ile basit ve zincirleme indekslerden yararlanılmıştır.

Anahtar Kelimeler: Un Sanayii, Gıda Sanayii, Türkiye

DEVELOPMENTS IN THE GRAIN MILLING INDUSTRY IN TÜRKİYE IN THE LAST DECADE: PROBLEMS AND SUGGESTIONS

ABSTRACT

The grain milling industry, which is one of the most important sub-sectors of the food industry and produces various grain flours and their mixtures, has a strategic importance at the global level. Especially in developing countries like Türkiye, where the relative importance of grain group products, especially bread, is high in the consumption structure, the importance of the grain milling industry (the flour industry) is increasing due to food security. Flour production and supply become even more important in terms of food security in times of sudden crisis such as war, epidemic and natural disaster. Türkiye is a country that is very suitable for grain (especially wheat) production in terms of climate and geography. With the high raw material production potential, the flour industry is highly developed in Türkiye. As a matter of fact, according to the data of the last ten years, Türkiye is the most important flour exporting country in the world. However, an increasing trend has been observed in flour imports in recent years. Since the quality of the flour, which is an intermediate product, directly affects the quality of the bakery products to be used in its production and exported, it is considered that this increase is due to the import of quality flour. In addition, the fact that the capacity utilization rate is below the world average is an indication that the flour industry has some problems. The aim of this study is to examine the developments in the flour industry in Türkiye in the last ten years and to discuss the problems and solution proposals related to the subject. The product scope of the research consists of the production of wheat flour and other grain flours and their mixtures. The last ten years covered in the study are the years between 2013-2022 if the data for 2022 are available, and the data between 2012-2021 when it is not available. The obtained macro data were shown in the tables and percentage calculations and simple and chain indexes were used in the evaluation of the data.

Keywords: Flour Industry, Food Industry, Türkiye

GİRİŞ

Un sanayii, nüfusun zorunlu gıda madde gereksinimini karşılaması açısından gıda sanayii içinde özel ve oldukça önemli bir yere sahiptir. Gelişmiş ülkelerde olduğu gibi, gelişmekte olan ülkelerde de genellikle ilk kurulan gıda sanayii tesislerinden biri un fabrikalarıdır (Tor Kadıoğlu, 2019). Un, tahılların öğütülmesi ile elde edilen değerli bir ürün olup; modern insanın kullandığı ilk işlenmiş tarım ürünüdür. İnsan vücudunun ihtiyaç duyduğu günlük enerjinin %60'ı tahıl ürünlerinden sağlanmaktadır. Bu nedenle, un sanayii özellikle savaş, salgın ve doğal afet gibi kriz dönemlerinde nüfusun beslenmesi açısından son derece önemlidir. Besleme için en yaygın olarak tüketilen tahıl türü ise buğday ve ürünleridir (ekmek, bulgur, makarna, bisküvi, kek gibi). Türkiye iklim ve coğrafya bakımından buğday üretimine oldukça elverişlidir. Un üretiminde büyük paya sahip buğday ve diğer tahıllar uzun süre depolanabilen en önemli tarım ürünlerinden birisi olması nedeniyle un sanayii stratejik bir öneme sahiptir (TUSAF, Tarih Belirtilmemiş).

Türkiye'de, gıda güvencesinin en önemli bileşenlerinden biri olan un sanayii, oldukça aktif ve dinamik bir yapıda olup ileri ve geri bağlantılarıyla ülke ekonomisinde önemli bir yere sahiptir. Tarihteki ilk değirmenler Anadolu topraklarında kullanılmış ve bu köklü geçmiş, Türkiye'yi un üretimi ve ihracatında Dünyada ilk sıralara taşımıştır (Anonim, 2022). Bu çalışmanın amacı Türkiye un sanayiinde son on yılda meydana gelen gelişmelerin ortaya konulması amaçlanmaktadır. Araştırmanın kapsamını, gıda sanayiinin bir alt dalı olan un sanayiinde tahıldan un üretimi oluşturmaktadır. Ürün kapsamını oluşturan un grubu; buğday unu ve diğer tahıl unları olan arpa, çavdar, yulaf, mısır, pirinç unları ve karışımlardan oluşmaktadır. Çalışmada öncelikle dünya un ticaretinde Türkiye'nin yeri ortaya konmuştur. Türkiye'de son on yılda un sanayiinde ortaya çıkan gelişmeler ise, un sanayiindeki kuruluşlar, kapasite ve kullanımı, üretim, dış ticaret, istihdam ve yatırımlar açısından değerlendirilmiştir. Çalışmada ele alınan son on yıl, 2022 yılı verilerine ulaşılması durumunda 2013-2022 yılları arasını, ulaşılamadığında ise 2012-2021 yılları arasındaki verileri kapsamaktadır. Elde edilen makro veriler çizelgeler ile gösterilmiş ve verilerin değerlendirilmesinde yüzde hesapları ile basit ve zincirleme indekslerden yararlanılmıştır.

Un Sanayiinde Dünya Ticareti

Un, öğütülerek toz haline getirilmiş tahıl ve başka besin maddeleri olarak tanımlanmaktadır (TDK, 2023). Un çoğunlukla buğdaydan üretilmekte olup; Buğday Unu Tebliği'nde un; yabancı maddelerden temizlenmiş ve tavlanmış buğdayların tekniğine uygun olarak öğütülmesiyle elde edilen ürün olarak tanımlanmaktadır. Buğday unları ekmeklik, özel amaçlı

olmak üzere iki gruba ayrılmaktadır. Ekmeklik un; teknolojik özellikleri ekmek yapımına uygun buğdayların öğütülmesiyle elde edilen buğday unudur. Özel amaçlı un; baklava, börek, bisküvi, kek, pasta, yufka, pizza, hamburger, tahıllı ekmek gibi direkt tüketilen ürünlerin ve katkılı unlar, özel işlem görmüş unlar ve irmik altı unu gibi amaca yönelik mamullerin yapımına uygun buğday unlarıdır (GTHB, 2016).

Dünya un üretiminde önemli bir yere sahip olan buğday veya mahlut unu (un karışımları) ihracatı, 2022 yılında 5 704 645 bin US doları ile toplam un ihracat değerinde (6 957 844 bin US doları) %82.0'lik paya sahiptir. Dünya 2022 yılı un ihracat sıralamasında ilk sırada Türkiye yer alırken, bunu Almanya, Özbekistan ve İtalya takip etmektedir. Diğer tahıl unları ihracatı ise 2022'de 1 253 199 bin US dolar (toplam ihracatın %18.0'i) olup; ihracatta 155 936 bin US dolarla ilk sırada Tayland yer alırken, Türkiye 8 962 bin US doları ile Dünyada 26. sıradadır. 2022 Dünya un ihracatı 2013 yılına göre %12.8 oranında artmıştır (Tablo 1-2).

Tablo 1. Dünyada Un İhracatı Yapan Başlıca Ülkeler (Bin US $)

1101-Buğday veya mahlut unu											
	Dünya	Türkiye	Almanya	Özbekistan	İtalya	Hindistan	Arjantin	Kanada	ABD	Belçika	Kazakistan
2013	5.409.403	947.726	372.348	-	73.227	145.673	56.490	101.638	133.219	249.470	580.233
2014	5.144.329	935.162	359.804	-	82.381	136.411	130.776	140.558	126.493	206.085	561.601
2015	4.878.171	978.608	305.825	-	81.750	121.653	134.597	146.558	148.108	182.249	493.724
2016	4.767.893	1.078.489	300.298	-	93.152	90.454	178.353	137.491	161.335	157.411	504.592
2017	4.830.047	1.052.581	322.788	46.394	106.565	88.213	197.057	153.418	135.785	160.534	469.373
2018	4.907.472	1.006.290	344.887	70.085	126.120	100.405	193.228	147.231	131.531	139.688	445.998
2019	5.099.677	1.051.757	354.111	104.576	144.229	105.415	213.640	119.360	139.695	112.207	362.716
2020	4.877.786	951.074	345.579	218.610	153.320	138.978	194.069	120.318	145.938	121.892	489.385
2021	5.269.195	1.106.563	389.197	281.012	200.886	188.138	190.278	122.512	147.081	137.302	440.904
2022	5.704.645	1.497.903	494.581	268.530	251.904	209.495	196.729	169.301	163.213	155.522	145.762
1102- Tahıl unları (Buğday veya mahlut unu hariç)											
	Dünya	Tayland	Meksika	ABD	İtalya	Almanya	Zambiya	Belçika	El Salvador	Fransa	Türkiye
2013	759.675	135.682	44.306	88.150	41.824	42.936	1.079	5.432	39.218	31.725	1.557
2014	793.777	132.420	41.725	103.219	40.543	48.117	1.161	41.035	24.564	31.042	3.399
2015	727.659	123.816	51.239	88.916	37.952	45.564	671	35.462	26.129	27.907	4.148
2016	810.814	131.747	74.149	89.469	43.920	41.396	2.125	41.431	30.960	27.712	6.227
2017	885.704	130.157	109.283	91.381	57.521	41.780	675	42.342	25.789	28.633	9.763
2018	991.743	149.756	161.476	100.514	56.169	52.837	392	36.188	28.355	28.202	9.212
2019	938.001	163.181	109.479	91.529	59.358	55.653	471	33.516	32.399	28.060	4.590
2020	1.084.826	171.665	141.440	93.177	65.192	67.314	273	36.629	35.561	27.879	6.269
2021	1.133.955	167.555	126.622	95.209	74.688	73.157	428	44.798	34.638	34.061	6.497
2022	1.253.199	155.936	152.570	106.133	79.566	77.053	64.674	48.478	46.371	44.190	8.962

Kaynak: ITC Trade Map, 2023.

Tablo 2. Dünya Toplam Un İhracatı (Bin US $)

Yıl	Buğday veya mahlut unu	Tahıl unları (Buğday veya mahlut unu hariç)	Genel Toplam	2013=100
2013	5.409.403	759.675	6.169.078	100
2014	5.144.329	793.777	5.938.106	96,3
2015	4.878.171	727.659	5.605.830	90,9
2016	4.767.893	810.814	5.578.707	90,4
2017	4.830.047	885.704	5.715.751	92,7
2018	4.907.472	991.743	5.899.215	95,6
2019	5.099.677	938.001	6.037.678	97,9
2020	4.877.786	1.084.826	5.962.612	96,7
2021	5.269.195	1.133.955	6.403.150	103,8
2022	5.704.645	1.253.199	6.957.844	112,8

Kaynak: ITC Trade Map, 2023.

2022 yılı itibariyle Dünya buğday/mahlut unu ihracatının %26.3'ünü gerçekleştiren Türkiye'nin ihracatı 2018, 2020 yılları hariç diğer sekiz yılda bir önceki yıla göre artmıştır. Türkiye'nin en yakın rakibi 2021yılına kadar Kazakistan iken, 2022 yılında %8.7'lik payla en yakın rakibi Almanya olmuştur. Diğer en yakın rakipleri Özbekistan ve İtalya'dır (Tablo 3).

Tablo 3. Un İhracatı Yapan Başlıca Ülkelerin Karşılaştırılması (Buğday/mahlut unu-Bin US $)

Yıl	Dünya	Türkiye	%	Kazakistan	%	Almanya	%	Özbekistan	%	İtalya	%
2013	5.409.403	947.726	17,5	580.233	10,7	372.348	6,9	-	0,0	73.227	1,4
2014	5.144.329	935.162	18,2	561.601	10,9	359.804	7,0	-	0,0	82.381	1,6
2015	4.878.171	978.608	20,1	493.724	10,1	305.825	6,3	-	0,0	81.750	1,7
2016	4.767.893	1.078.489	22,6	504.592	10,6	300.298	6,3	-	0,0	93.152	2,0
2017	4.830.047	1.052.581	21,8	469.373	9,7	322.788	6,7	46.394	1,0	106.565	2,2
2018	4.907.472	1.006.290	20,5	445.998	9,1	344.887	7,0	70.085	1,4	126.120	2,6
2019	5.099.677	1.051.757	20,6	362.716	7,1	354.111	6,9	104.576	2,1	144.229	2,8
2020	4.877.786	951.074	19,5	489.385	10,0	345.579	7,1	218.610	4,5	153.320	3,1
2021	5.269.195	1.106.563	21,0	440.904	8,4	389.197	7,4	281.012	5,3	200.886	3,8
2022	5.704.645	1.497.903	26,3	145.762	2,6	494.581	8,7	268.530	4,7	251.904	4,4

Kaynak: ITC Trade Map, 2023 verilerinden yararlanılarak hazırlanmıştır.

Dünya un ithalat hacmi incelendiğinde; 2022 yılında toplam 6 936 035 bin US $ olup; buğday/mahlut unu 5 518 928 bin US dolar (%79.6) iken diğer tahıl unlarının ithalatı 1 417 10 bin US dolardır (%20.4). Buğday/mahlut unu ithalatında ilk üçte yer alan ülkeler; Irak, Hollanda ve ABD iken diğer tahıl unlarında ABD, Kongo ve Nijerya ilk üçte yer almaktadır (Tablo 4).

Tablo 4. Dünyada Un İthalatı Yapan Başlıca Ülkeler (Bin US $)

S. No	1101-Buğday veya mahlut unu										
	İthalatçı	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
	Dünya	5.390.778	4.890.894	4.888.630	4.960.871	5.217.074	5.194.106	5.124.046	4.843.338	5.157.347	5.518.928
1	Irak		2.027	452.762	501.532	663.640	578.973	482.266	453.833	489.496	612.636
2	Hollanda	300.009	253.572	225.490	207.739	220.174	220.329	195.246	206.526	238.621	294.525
3	ABD	130.880	160.770	178.939	182.022	187.716	207.352	192.682	202.087	213.446	294.098
4	Afganistan	268.972	523.145	468.469	664.062	746.573	764.475	563.618	562.266	587.942	281.688
5	Suriye	125.792	123.883	102.066	107.891	80.296	108.646	126.155	83.974	145.719	186.887
	1102- Tahıl unları (buğday veya mahlut unu hariç)										
	Dünya	893.964	934.864	845.945	955.558	1.078.004	1.111.825	1.097.151	1.272.052	1.274.383	1.417.107
1	ABD	88.113	79.625	86.315	112.465	129.043	135.576	157.549	201.437	197.560	251.961
2	Kongo	-	-	6.155	8.079	30.613	8.328	7.436	10.845	17.875	88.492
3	Nijerya	1.090	294	565	715	412	2.455	1.378	6.639	4.442	63.515
4	Kanada	39.040	36.943	36.483	37.453	40.495	46.028	42.172	49.025	52.135	58.134
5	İspanya	54.210	63.867	64.797	61.381	48.021	39.042	37.857	61.589	64.914	56.703

Kaynak: ITC Trade Map, 2023.

Türkiye'de Un Sanayiinin Mevcut Durumu

Un sanayii, ülkelerin tarım toplumundan sanayii toplumuna geçişinde genellikle öncelik verilen sanayii dallarından biridir (ASO, Tarih Belirtilememiş). Türkiye'nin ilk un fabrikası, 1924 yılında Ulu Önder Mustafa Kemal Atatürk'ün bizzat talimatıyla Aksaray'da kurulan Azmi Milli Un Fabrikasıdır. Türkiye'nin sanayileşme sürecinde en başından beri özel sektör tarafından geliştirilen sektör, uluslararası düzeyde teknolojik gelişim ve bilgi birikimi ile deneyime sahip bir sanayii olmuştur. Türkiye un sanayisi ülke tarım politikaları ile ve özelde buğday politikaları ile şekillenmiş olup; ucuz ekmek için devletin buğday tahsisi verdiği dönemlerden, aşırı rekabet ortamında ürün çeşitlenmesine, ihracata yönelen bir sektöre evrilmiştir. Tahsis dönemlerinde devlet eliyle aşırı kazançlar nedeniyle un fabrikaları sayısı ve kapasitelerinde patlama yaşanmış ve daha sonra da makine sanayiinin gelişimi ile kolaylaşan un fabrikası kurulumu sonucu bugünkü âtıl kapasitelere ulaşılmıştır. Türkiye'deki toplam un üretim kapasitesi yaklaşık 30.4 milyon ton, fiili üretim ise 2021 yılında yaklaşık 11.67 milyon ton (yaklaşık 3 milyon ton ihracat), mevcut üretim kapasitesi ülkenin toplam un tüketiminin yaklaşık 3 katıdır. Gelişmiş ülkelerde de benzer süreçler yaşanmış ve un fabrikaları önce sayı olarak artmış, daha sonra ise sayıları azalarak kapasiteleri büyümüştür. Belirli oranda kapasite fazlalığı rekabeti tüketici çıkarına düzenlerken, Türkiye'deki durumun, kaynakların atıl kalmasına yol açtığı belirtilmektedir (Yurdakul ve Aktaş, 2001). Türkiye'de 2022 yılı itibariyle 38 671 839 ton olan tahıl üretimi gerçekleşmiştir. Tahıl grubunda 19 750 bin ton ile buğday %51.1'lik oran ile birinci sıradadır (TÜİK, 2022a). Un sanayii işletmelerinin kuruluş yeri seçiminde, hammaddeye, pazara ve altyapıya yakınlık etkilidir. İşletmeler buğday alımını, her ay yaptıkları gibi sadece buğday hasadının yapıldığı dönemde de yapmaktadırlar. Alınan buğdaylar yoğun olarak piyasadan tedarik edilirken konjonktüre bağlı olarak da TMO'dan da alım

gerçekleştirilmektedir. Satın alınan buğday için pazara yakınlık birinci kriter olmakla birlikte, diğer bölgelerden alım veya ithalatta da seçenekler arasındadır (TUSAF, 2012).

Un Sanayiindeki Kuruluşlar

Türkiye Odalar ve Borsalar Birliği (TOBB) verilerine göre 71 ilde 710 un işletmesi bulunmaktadır. Mardin 58 (%8.2) işletme ile ilk sırada iken, bunu 46 (%6.5) işletme ile Konya, 44 işletme ile (%6.2) ile Gaziantep takip etmektedir (Tablo 5). Un fabrikalarının bölgelere dağılımında, %23.2'lik oranla İç Anadolu Bölgesi ilk sıradadır. Bunu %20.7 ile Güneydoğu Anadolu, %16.9 ile Marmara, %12.3 ile Karadeniz, %11.4 ile Ege, %10.6'lık payla Akdeniz ve %4.9 ile Doğu Anadolu Bölgesi izlemektedir (Tablo 6). Hammadde ve pazara yakınlık, tesisleşmeye elverişlilik bu bölgelerin öne çıkmasında önemli etkenlerdir (TUSAF, 2023).

Tablo 5. Un İşletmelerinin İllere Göre Dağılımı (2022 Yılı)

S. No	İl Adı	Makarnalık (durum) buğday unu	Ekmeklik ve kaplıca (kızıl) buğday unu	Diğer tahıl unları (buğday veya mahlut unu hariç)	Toplam Kayıtlı Üretici	(%)
		Kayıtlı Üretici	Kayıtlı Üretici	Kayıtlı Üretici		
1	Mardin	2	54	2	58	8,2
2	Konya	4	38	4	46	6,5
3	Gaziantep	3	38	3	44	6,2
4	Ankara	9	22	6	37	5,2
5	Samsun	1	27	-	28	3,9
	Diğer	31	430	36	497	70,0
	Toplam	**50**	**609**	**51**	**710**	**100,0**
	(%)	**7,0**	**85,8**	**7,2**	**100,0**	

Kaynak: TOBB, 2023 verilerinden yararlanılarak hazırlanmıştır.

Tablo 6. Un İşletmelerinin Bölgelere Göre Dağılımı (2022 Yılı)

Bölge	Kayıtlı Un Üreticisi Sayısı	(%)
İç Anadolu Bölgesi	165	23,2
Güneydoğu Anadolu Bölgesi	147	20,7
Marmara Bölgesi	120	16,9
Karadeniz Bölgesi	87	12,3
Ege Bölgesi	81	11,4
Akdeniz Bölgesi	75	10,6
Doğu Anadolu Bölgesi	35	4,9
Toplam	**710**	**100,0**

Kaynak: TOBB, 2023 verilerinden yararlanılarak hazırlanmıştır.

Un Sanayiinde Mevcut Kapasite ve Kullanımı

Türkiye un sanayii yaklaşık 30.39 milyon ton üretim kapasitesine sahiptir (Tablo 7). İller bazında ilk sırada yer alan Mardin ili bu kapasitenin %13.8'ini karşılarken %8.6 ile Konya ikinci sırada ve %7.6 ile Gaziantep üçüncü sırada yer almaktadır. Un üretim kapasitesinin bölgeler bazında dağılımda ise yaklaşık 8.2 milyon ton üretim kapasitesi ile Marmara Bölgesi birinci sırada yer almaktadır. İkinci sırada 7.9 milyon ton üretim kapasitesi ile Güneydoğu Anadolu Bölgesi yer alırken, bunu 4.7 milyon ton ile İç Anadolu Bölgesi takip etmektedir. 4.23

milyon ton üretim kapasitesi ile Karadeniz Bölgesi dördüncü, 2.2 milyon ton ile Akdeniz Bölgesi beşincidir. Bunu 2.03 milyon ton ile Ege Bölgesi ve 1.04 milyon ton ile Doğu Anadolu Bölgesi izlemektedir (Tablo 8). Dünyadaki un fabrikalarının ortalama kapasite kullanımı %65 iken, bu oran Türkiye'de yaklaşık olarak %50'dir (TUSAF, 2023). Toprak Mahsulleri Ofisi'nin 2018 yılı Hububat Sektörü Raporu'nda Türkiye'de faal un fabrika sayısı 659'dur. Bu 659 fabrikanın 37 870 416 ton/yıl olan kurulu kapasitesinin 19.606.901 ton/yılı kullanılmakta ve kapasite kullanım oranı %52'dir (TMO, 2018). Buna göre, son yıllarda işletme sayısı artarken, kapasite kullanım oranı %2 oranında azalmıştır.

Tablo 7. İllere Göre Un Üretim Kapasitesi (2022 Yılı)

S. No	İl Adı	Makarnalık (durum) buğday unu	Ekmeklik ve kaplıca (kızıl) buğday unu	Diğer tahıl unları (buğday veya mahlut unu hariç)	Toplam Üretim Kapasitesi kilogram	(%)
		Üretim Kapasitesi, kg	Üretim Kapasitesi, kg	Üretim Kapasitesi , kg		
1	Mardin	*	4.206.496.500	*	4.206.496.500	13,8
2	Konya	49.180.000	2.543.468.200	5.404.000	2.598.052.200	8,6
3	Gaziantep	*	2.313.132.222	*	2.313.132.222	7,6
4	Samsun	*	1.814.135.088	-	1.814.135.088	6,0
5	Tekirdağ	-	1.779.092.047	*	1.779.092.047	5,9
	Diğer	788.044.000	16.814.078.568	72.230.102	17.674.352.670	58,2
	Toplam	**837.224.000**	**29.470.402.625**	**77.634.102**	**30.385.260.727**	**100,0**
	(%)	**2,8**	**97,0**	**0,3**	**100,0**	

* Yararlanılan kaynakta, kayıtlı üretici sayısı 3 ve daha az ise üretim kapasitesi bilgileri verilmemektedir.
Kaynak: TOBB, 2023 verilerinden yararlanılarak hazırlanmıştır.

Tablo 8. Bölgelere Göre Un Üretim Kapasitesi (2022 Yılı)

Bölge	Üretim Kapasitesi Kilogram	%
Marmara Bölgesi	8.197.476.597	27,0
Güneydoğu Anadolu Bölgesi	7.902.984.902	26,0
İç Anadolu Bölgesi	4.740.090.067	15,6
Karadeniz Bölgesi	4.230.760.280	13,9
Akdeniz Bölgesi	2.235.153.404	7,4
Ege Bölgesi	2.031.663.360	6,7
Doğu Anadolu Bölgesi	1.047.132.117	3,4
Toplam	**30.385.260.727**	**100,0**

Kaynak: TOBB, 2023 verilerinden yararlanılarak hazırlanmıştır.

Un Sanayii Üretimi

Türkiye'nin 2021 yılı toplam un üretimi 11 673 369.2 tondur bunun %85.6'lık kısmını buğday/mahlut unu üretimi oluşturmaktadır. Toplam buğday unu üretiminde ise 2012 yılına göre 2021 yılında %45.4'lük bir artış olmuştur. Bir önceki yıla göre genel eğilim artış yönündedir (Tablo 9). 2021 yılı un toplam satış değeri ise 35.2 milyar TL'dir, 2012 yılına göre 2021 yılındaki artış %412.6 iken, bir önceki yıla göre en fazla artış 2021 yılında gerçekleşmiştir (Tablo 10).

Tablo 9. Yıllara Göre Un Üretimi (Ton)

Yıl	Buğday veya mahlut unu (ton)	%	Diğer tahıl unları (buğday/ mahlut unu hariç, kbu* dahil) (ton)	%	Toplam Un Üretimi (ton)	İndeks 2012= 100	Zincirleme İndeks
2012	7.700.983,6	96,0	324.858,5	4,0	8.025.842,1	100,0	-
2013	8.339.812,2	97,2	240.390,2	2,8	8.580.202,4	106,9	106,9
2014	8.491.874,5	92,8	654.729,1	7,2	9.146.603,6	114,0	106,6
2015	9.201.092,7	93,1	685.707,5	6,9	9.886.800,2	123,2	108,1
2016	9.377.515,3	89,9	1.058.537,8	10,1	10.436.053,1	130,0	105,6
2017	9.409.910,5	87,9	1.290.175,0	12,1	10.700.085,6	133,3	102,5
2018	9.260.962,0	86,5	1.444.904,1	13,5	10.705.866,1	133,4	100,1
2019	9.649.941,5	86,1	1.553.201,6	13,9	11.203.143,1	139,6	104,6
2020	10.066.668,2	86,9	1.523.978,2	13,1	11.590.646,4	144,4	103,5
2021	9.996.269,7	85,6	1.677.099,5	14,4	11.673.369,2	145,4	100,7

*kbu: kara buğday unu
Kaynak: TÜİK, 2022b.

Tablo 10. Yıllara Göre Un Satış Değerleri (1.000 TL)

Yıl	Buğday veya mahlut unu	Diğer tahıl unları (buğday/ mahlut unu hariç, kbu* dahil)	Toplam	2012=100	Zincirleme İndeks
2012	6.711.460	127.665	6.871.424	100	-
2013	8.120.492	71.205	8.226.780	119,7	119,7
2014	9.300.451	107.025	9.449.995	137,5	114,9
2015	10.381.155	174.385	10.592.455	154,2	112,1
2016	10.998.906	343.302	11.398.281	165,9	107,6
2017	12.265.813	454.842	12.780.844	186	112,1
2018	14.296.951	491.933	14.842.278	216	116,1
2019	18.595.383	594.302	19.297.249	280,8	130
2020	22.766.672	716.749	23.605.498	343,5	122,3
2021	33.743.868	1.260.117	35.221.186	512,6	149,2

Kaynak: TÜİK, 2022b.

Un Sanayii Dış Ticareti

Türkiye'nin 2022 yılı un ihracatı 1 484 611 056 dolar, ithalatı ise 3 495 712 dolardır. Türkiye dış ticaret dengesi açısından ihracatçı bir ülke konumundadır. Bununla birlikte yıllara göre ithalatın artış oranın ihracattan yüksek olduğu görülmektedir. 2016 yılından itibaren ithalatın arttığı ve özellikle 2016-2017 yıllarında bu artışın en yüksek seviyeye ulaştığı görülmektedir (Tablo 11). Türkiye'de yıllık un üretim ve stok miktarları yurtiçi tüketime yetecek düzeyde olmakla birlikte, mevsimsel dalgalanmalar ve kaliteli buğday arzında yaşanan sıkıntılardan dolayı özel sektörün ilave taleplerinin karşılanması amacıyla unun en önemli hammaddesi olan buğdayın ithalatı yapılmaktadır. Un ihracatında son yıllarda yaşanan olumlu gelişmeler de kaliteli buğday ithalatı ihtiyacını açıklar niteliktedir (ÇTSO, 2017).

Tablo 11. Türkiye'de Un Dış Ticareti (US Dolar)

Yıl	Buğday veya mahlut unu		Hububat unları (buğday/mahlut unu hariç)		Genel Toplam		Dış Ticaret Dengesi (İhracat-İthalat) Dolar	İhracat 2013=100	İthalat 2013=100
	İhracat	İthalat	İhracat	İthalat	İhracat	İthalat			
2013	946.604.888	146.432	1.538.966	107.349	948.143.854	253.781	947.890.073	100,0	100,0
2014	931.232.282	1.594.990	3.403.109	41.211	934.635.391	1.636.201	932.999.190	98,6	644,7
2015	978.591.054	1.415.035	4.148.121	116.615	982.739.175	1.531.650	981.207.525	103,6	603,5
2016	1.078.084.668	21.238.301	6.283.286	159.818	1.084.367.954	21.398.119	1.062.969.835	114,4	8.431,7
2017	1.052.581.273	33.217.921	9.762.701	119.630	1.062.343.974	33.337.551	1.029.006.423	112,0	13.136,3
2018	1.052.581.273	4.555.218	9.212.143	130.127	1.061.793.416	4.685.345	1.057.108.071	112,0	1.846,2
2019	1.006.196.951	3.752.515	4.742.806	109.118	1.010.939.757	3.861.633	1.007.078.124	106,6	1.521,6
2020	950.636.586	3.732.853	6.330.122	139.617	956.966.708	3.872.470	953.094.238	100,9	1.525,9
2021	1.107.653.147	4.314.570	6.556.453	194.222	1.114.209.600	4.508.792	1.109.700.808	117,5	1.776,6
2022	1.475.552.561	3.348.179	9.058.495	147.533	1.484.611.056	3.495.712	1.481.115.344	156,6	1.377,5

Kaynak: TÜİK, 2023 verilerinden yararlanılarak hazırlanmıştır.

Türkiye'nin buğday/mahlut unu ihraç ettiği ülkeler içinde 2022 yılı itibariyle %40.8 ile Irak ilk sırada yer almaktadır. Bunu sırasıyla Yemen (%10.2), Suriye (%10.1), Venezuela (%6.0) ve Sri Lanka (%4.3) takip etmektedir. Diğer tahıl ürünlerinde ise Angola %17.6 ile ilk sıradadır. Dolayısıyla Türkiye'nin un ihraç ettiği başlıca bölgelerin Orta Doğu, Asya, Güney Amerika ve Afrika Bölgelerine yoğunlaştığı ifade edilebilir (Tablo 12).

Tablo 12. Türkiye'nin Ülkeler İtibariyle Un İhracatı (Bin US Dolar)

1101-Buğday veya mahlut unu											2022
Yıl	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	%
Dünya	947.726	935.162	978.608	1.078.489	1.052.581	1.006.290	1.051.757	951.074	1.106.563	1.497.903	100
Irak	468.807	476.649	444.150	492.822	579.376	525.097	459.709	444.234	479.932	611.710	40,8
Yemen	3.049	2.994	28.458	19.661	12.127	53.611	142.116	85.180	106.680	152.748	10,2
Suriye	86.400	105.620	77.144	99.157	74.905	95.840	97.507	58.399	101.464	151.043	10,1
Venezuela	0	0	0	198	12.985	7.873	31.638	55.803	47.081	90.067	6,0
Sri Lanka	0	0	0	0	12	0	481	2.197		63.689	4,3
Diğer	389.470	349.899	428.856	466.651	373.176	323.869	320.306	305.261	371.406	428.646	28,6
1102- Tahıl unları (buğday veya mahlut unu hariç)											
Dünya	1.557	3.399	4.148	6.227	9.763	9.212	4.590	6.269	6.497	8.962	100
Angola	320	1.773	2.115	3.101	3.335	2.235	346	1.566	984	1.573	17,6
Irak	170	329	817	1.813	3.942	2.897	1.139	796	1.177	1.415	15,8
Filipinler	0	0	0	0	0	0	0	543	1.083	1.140	12,7
Suriye	221	218	152	82	1.009	606	498	494	608	1.009	11,3
Ürdün	2	0	103	220	227	275	316	317	306	758	8,5
Diğer	844	1.079	961	1.011	1.250	3.199	2.291	2.553	2.339	3.067	34,2

Kaynak: ITC Trade Map, 2023.

Türkiye'nin 2022 yılında buğday/mahlut unu ithal ettiği ülkeler içinde %86.5 ile Rusya ilk sıradadır. Bunu Yemen (%10.9) ve İtalya (%0.5) izlemektedir. Diğer tahıl unlarında ise %20.4'lük oran ile Almanya ilk sıradadır (Tablo 13).

Tablo 13. Türkiye'nin Yıllara Göre Ülkelere Un İthalatı (Bin US Dolar)

1101-Buğday veya mahlut unu											**2022**
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	**%**
Dünya	440	6.773	1.415	21.238	33.218	4.555	4.705	4.000	4.844	28.941	100
Rusya	0	0	0	0	5	0	281	6	49	25.048	86,5
Yemen	0	0	0	0	0	0	1.365	0	4.091	3.160	10,9
İtalya	94	161	126	80	124	113	87	59	78	146	0,5
Ukrayna	100	0	0	0	0	0	26	0		116	0,4
Irak	179	305	0	0	0	11	14	85	19	93	0,3
Diğer	67	6.307	1.289	21.158	33.089	4.431	2.932	3.850	607	378	1,3
1102- Tahıl unları (buğday veya mahlut unu hariç)											
Dünya	160	50	117	160	120	130	132	173	250	167	100
Almanya	1	4	4	6	5	17	2	22	25	34	20,4
İtalya	53	13	68	0	33	23	9	13	3	29	17,4
Ukrayna	0	0	0	0	0	0	13	27	55	28	16,8
Tayland	0	0	0	1	1	9	0	0	10	26	15,6
Fransa	10	4	15	19	15	23	28	22	22	17	10,2
Diğer	96	29	30	134	66	58	80	89	135	33	19,8

Kaynak: ITC Trade Map, 2023.

Un Sanayiinde İstihdam

Türkiye'de 2022 yılı itibariyle un sanayinde istihdam edilen kişi sayısı 20 235'tir. İllere göre dağılımda %10.2'lik payla Gaziantep ilk sıradadır. İşletme sayısı ve kapasite açısından ilk sırada yer alan Mardin'de ise çalışan sayısı 1325 kişi ve %6.5'lik oranla beşinci sıradadır. Kapasite ve işletme sayısı açısından üçüncü sırada yer alan Konya ili 456 çalışan sayısı ile 13. sıradadır (Tablo 14). Bölgelere göre istihdam oranları ise %27.1 ile Marmara Bölgesi'ni ilk sıraya taşımaktadır. Bunu Güneydoğu Anadolu (%20.1) ve ile İç Anadolu Bölgesi (%17.0) takip etmektedir (Tablo 15).

Tablo 14. İllere Göre Un Sanayinde Çalışan Sayısı (2022 Yılı)

Sıra No	**İl Adı**	**Makarnalık (durum) buğday unu**	**Ekmeklik ve kaplıca (kızıl) buğday unu**	**Diğer tahıl unları (buğday/ mahlut unu hariç)**	**Toplam Çalışan**	**(%)**
1	Gaziantep	206	1826	27	2.059	10,2
2	Mersin	630	530	635	1.795	8,9
3	Kocaeli	50	1365	179	1.594	7,9
4	Ankara	830	433	120	1.383	6,8
5	Mardin	126	1157	42	1.325	6,5
	Diğer	1291	10022	766	12.079	59,7
	Toplam	3.133	15.333	1.769	20.235	100,0

Kaynak: TOBB, 2023 verilerinden yararlanılarak hazırlanmıştır.

Tablo 15. Bölgelere Göre Un Sanayiinde Çalışan Sayısı (2022 Yılı)

Bölge	**Çalışan Sayısı**	**(%)**
Marmara Bölgesi	5.488	27,1
Güneydoğu Anadolu Bölgesi	4.065	20,1
İç Anadolu Bölgesi	3.441	17,0
Akdeniz Bölgesi	2.911	14,4
Karadeniz Bölgesi	2.310	11,4
Ege Bölgesi	1.360	6,7
Doğu Anadolu Bölgesi	660	3,3
Toplam	20.235	100

Kaynak: TOBB, 2023 verilerinden yararlanılarak hazırlanmıştır.

Un Sanayiinde Yatırımlar

Un sanayinin hammaddesi olan buğday üretiminin, ekolojik koşullara bağlı olması ve üretilen bölgenin iklim koşullarına göre değişiklik göstermesi Ar-Ge ve inovasyon çalışmalarının önemini arttırmaktadır. Türkiye'de un sanayi, teknolojik gelişmeler ve deneyime dayalı olarak ülke ihtiyacından daha fazla hacme ulaşarak uluslararası boyut kazanmıştır. Sektöre yeni kazandırılan ve yenilenen üretim tesisleri geleneksel un fabrikacılığını çok daha modern tesisler haline getirmiştir. Makineleşme oranı her yıl artarken, üretimi insan eli değmeden gerçekleştiren fabrikalar açılmaya başlamıştır. Daha güvenilir, hata oranının çok daha az olduğu işletmeler sektörde sayılarını her geçen yıl arttırmaktadır (TUSAF, 2023). Bununla birlikte gıda sektöründe; AB'ye uyum çerçevesinde 5996 sayılı "Veteriner Hizmetleri, Bitki Sağlığı, Gıda ve Yem Kanunu'nun kabulü ile gıda güvenliği ile ilgili yatırımlara ağırlık verilmiştir ve verilmeye devam etmektedir. Bunlar; Teknolojik iyileştirmeler, HACCP uygulamaları (laboratuvar, kontrol cihazları vb.), izlenebilirliğin sağlanması (kalite sistemleri, depolama, tedarikçi zinciri, perakende zincir vb.) şeklinde özetlenebilir (Demirbaş, 2020).

Yine sanayinin çevreye uyumlu yapılandırılması yanında üretim aşamasında oluşabilecek katı, sıvı atıklarla baca gazları (emisyon) kirliliklerini de kabul edilmiş standartlara çekmek için yatırımların düzenlemesi gerekmektedir. Bununla birlikte, sektörün hammaddelerini sağlayan tarımda, son yıllarda tohumculuk ve organik tarımdaki gelişmeler yatırım alanlarından biridir ki sürdürülebilir hammadde tedariki için önemlidir (SGM, 2022).

Yatırım niteliği açısından, TÜBİTAK (2011) tarafından hazırlanan Ulusal Gıda Ar-Ge ve Yenilik Stratejisi Raporunda Un ve Unlu Mamuller Sektörü 2023 Hedefleri değerlendirilebilir. Hedefler sırasıyla;

- Un sanayiinde inovasyonun arttırılması ve nanoteknolojiler uygulanarak, üretimde robot kullanım artışı.
- Ürünler bazında ülkelerin özelleşmesi, kalite ve marka bilincinin yaygınlaştırılması,

- Çevre bilincinin yaygınlaştırılması, doğal kaynaklar korunarak atıkları yeni ürünlere dönüştüren yöntemlerin geliştirilmesi,
- Yayım ve eğitim çalışmalarına hız verilmesi,
- Artan nüfusun beslenmesi için yoğun üretimin sürdürülmesi,
- Ürün çeşitliliği ile fonksiyonel gıdaların talep ve tüketimlerinin arttırılması,
- Gıda sanayiinde ısıl işlem gibi geleneksel teknolojilerin yerine besin elemanlarının daha az tahrip eden çevre dostu teknolojilerin kullanılması,
- Daha düşük hacimde daha yüksek besleyici değer içerek yeni ürünler geliştirilmesi ve
- Gıdaların hijyenik kalitesi, işlemesi, sınıflandırılması ve paketlenmesinde biyosensörler gibi teknolojilerin kullanılmasıdır (TÜBİTAK, 2011).

Un Sanayiinin Sorunları ve Çözüm Önerileri

Türkiye Un Sanayicileri Federasyonu tarafından yapılan SWOT analizinde sektörün zayıf yönleri olarak hammadde de kalite ve dışa bağımlılık, kalifiye personel sorunu, atıl kapasite ve pazarlama yöntemlerinin yetersizliği öne çıkmaktadır. Sektöre yönelik tehditler ise artan girdi maliyetleri, küresel ve politik sorunlar, gıda güvencesi ve tarımsal haksız rekabet koşulları ise tehditler olarak saptanmıştır (Tablo 16).

Tablo 16. Un Sanayii SWOT Analizi

Güçlü Yönler	**Zayıf Yönler**
-Geniş ticaret ağı -Hammaddeye erişim -Sürekli Talep -Yeni beslenme trendleri	- Hammadde de kalite ve dışa bağımlılık -Kalifiye personel yetersizliği -Atıl kapasite -Pazarlama yöntemlerinin yetersizliği
Fırsatlar	**Tehditler**
-Mevcut pazarlarda derinleşmek -Yeni pazarları ticaret ağına katmak -Değişen tüketim trendlerine uymak	-Artan girdi maliyetleri -Küresel ve politik sorunlar -Gıda Güvencesi -Tarımsal haksız rekabet koşulları

Kaynak: TUSAF, 2023.

Un sanayiinin sorunları ve bunlara ilişkin çözüm önerileri Tablo 17'de birlikte değerlendirilmiştir.

Tablo 17. Türkiye'de Un Sanayiinin Sorunları ve Çözüm Önerileri

Un Sanayi Sorunları	**Çözüm Önerileri**
Küresel ısınma ve iklim değişiklikleri nedeniyle beklenmeyen hava koşulları ve doğal afetlerin hammadde üretimini üzerindeki olumsuz etkisi.	Ulusal ve uluslararası düzeyde iklim değişikliği ile etkin olarak mücadele edilmesi gerekmektedir. Bu kapsamda, paydaşların katılımın sağlanarak sürdürülebilir hammadde tedariki için kuraklığa dayanaklı türlerin yetiştirilmesi, su tasarrufu önlemlerinin alınarak desteklenmesi ve bu konuda çiftçilerin eğitimi gerekmektedir.
Sektörün diğer en büyük sıkıntısı kaliteli, ucuz ve yeterli hammaddeye ulaşım zorluğu.	Hem yurtiçi talep, hem de ihracat için yerli üretim desteklenmelidir. Buğdayda dışa bağımlı bir ülke haline gelmeden çiftçinin buğday üretimini sürdürmesi için gerekli çalışmaların artırılarak devam etmesi gerekmektedir.
Atıl kapasite sorunu.	Milli sermayenin daha fazla ziyan edilmemesi için buğday unu üretiminin lisansa bağlanması gereklidir. Yeni tesislerin açılması bir plan dahilinde yapılmalıdır.
Kalifiye personel istihdamında yaşanan güçlük.	Kalifiye personel sorununu gidermek için uzman personelin yetiştirilmesi gerekmektedir. Bu konuda eğitimler devlet tarafından üniversiteler ile koordineli olarak desteklenmelidir.
Hammadde tedarik güvenliği riski; politik ve ekonomik riskler	Döviz kurlarındaki dalgalanma giderilmeli ve politik belirsizliklerin azaltılması gerekir.
Yetersiz ekmeklik buğdayın makarna sektörü ile paylaşılması.	Makarna sektörünün un sektörünün yaptığı gibi önce buğday ithalatı, sonra makarna ihracatı yapması gerekmektedir. Ayrıca, makarnalık buğday üretiminin artırılmasına yönelik politikaların uygulanması gereklidir. Örneğin, sözleşmeli tarım ve çiftçilerin üretimlerinde karşılaşacağı teknik ve ekonomik problemlerin desteklemesinin garanti edilmesi gibi selektif politikaların uygulanması sağlanabilir.
Pazar riski sorunu: İhracatın belli ülkelere yoğunlaşması.	Türkiye'nin un ihracatı yaptığı ülke sayısını artırması gereklidir. Pazar riskini azaltmak için, yeni pazarlara girişler hedeflenmelidir. Bunun için katma değeri artıracak inovasyon çalışmaları yapılarak ürün çeşitlendirilmesine ve markalaşmaya yönelik faaliyetler yapılabilir.

Kaynak: Özmermer, 2020; Tor Kadıoğlu, 2019.

SONUÇ

Un ülke nüfusunun zaruri besin maddesi olarak gıda güvencesi açısından stratejik bir öneme sahiptir. Un sanayinin Türkiye'deki son on yılının incelendiği bu çalışmada; Türkiye'nin dünya un ihracatında ilk sırada yer aldığı, işletmelerin daha çok İç Anadolu ve Güneydoğu Anadolu Bölgesi'nde yer aldığı belirlenmiştir. Türkiye'nin un üretiminde kendine yeterli olduğu ve un dış ticaret dengesi açısından ihracatçı konumunda bir ülke olduğu önemli sonuçlardan biridir. Un sanayiinde yeni ürünler ve teknolojilerin geliştirildiği, sanayide Ar-Ge ve inovasyon çalışmalarının yapıldığı, sektörde yeni ve yenilenen yatırımların geleneksel un fabrikacılığını çok daha modern tesisler haline dönüştüğü tespit edilmiştir.

Bu gelişmelerle birlikte sektörün önemli bazı sorunları da bulunmaktadır. Hammadde arz güvenliğinin kaliteli ve ucuz üretimle karşılanması, atıl kapasite, kalifiye personel istihdamında yaşanan sorunlar, yeni pazarlara erişim, politik risk ve döviz kurlarındaki dalgalanmalara bağlı

genel ekonomik durumdan kaynaklı riskler bunlardan bazılarıdır. Dünyada un üretiminde önemli bir konumda yer alan Türkiye'nin mevcut sorunların ve risklerin giderilerek rekabet gücünün artırılması için, sorunların kısa, orta ve uzun vadeli olarak ele alınması önerilmektedir. Kısa vadede etkin tarım politikası araçları kullanılarak yeterli kalite ve miktarda istikrarlı ve sürdürülebilir hammadde üretiminin sağlanabileceği ve katma değeri yüksek ürün geliştirme ve çeşitlendirilmesi için firmaların çeşitli proje desteklerinden yararlanabilecekleri değerlendirilmektedir.

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TÜRKİYE'DE BELLİ BAŞLI KRİTERLER İTİBARİYLE ORTA ÖLÇEKLİ BİR KARMA YEM İŞLETMESİ İÇİN KURULUŞ YERİ ÖNERİSİ

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ÖZET

Dünya nüfusunun artmasına paralel olarak, özellikle genç nüfusun sağlıklı beslenmesi için hayvansal kaynaklı kaliteli proteine olan talep atmaktadır. Türkiye'de de nüfus artış hızının yüksekliği hayvansal üretimin sürdürülebilirliğini zorunlu kılmaktadır. Üretim dalları itibariyle farklılık göstermekle birlikte, hayvansal üretim maliyetlerinin yaklaşık %50-70'ini yem maliyetleri oluşturmaktadır. Bu nedenle karma yem üretiminin yeterliliği ve sürdürülebilirliği oldukça önemlidir. Karma yem sanayii, hayvancılık işletmeleri için girdi üreten tipik bir tarıma bağlı sanayiidir. Hammadde açısından tarım sektörüne bağlı iken, ürettiği ürünleri de yine tarım işletmelerine pazarlamaktadır. Türkiye'de karma yem sanayii üretiminde en büyük pay büyükbaş ve küçükbaş hayvan yemlerine aittir. Bu yem gruplarının üretiminde kendine yeterlilik oranı %78 civarındadır. Kanatlı yem grubunda ise kendine yeterlilik sağlanmakla birlikte, hammadde tedariğinde ortaya çıkan sorunlar, kapasite kullanımını olumsuz etkileyebilmektedir. Hammadde tedariğinin yanı sıra, üretimi etkileyen diğer kriterler nedeniyle, yeni bir karma yem işletmesinin yatırım analizi stratejik öneme sahiptir. Bu çalışmanın amacı, orta ölçekli bir karma yem işletmesi için potansiyel iller kapsamında, belli başlı seçim kriterleri itibariyle en uygun kuruluş yerinin seçilmesidir. Çalışmada, orta ölçekli bir karma yem işletmesinin ele alınmasının nedeni, faal olmayan işletmelerin yaklaşık %84'ünün küçük işletmeler olmasıdır. İşletme küçükbaş ve büyükbaş hayvan yeminin yanı sıra, kanatlı ve evcil hayvan yemi de üretecektir. Çalışmada yararlanılan makro veriler 2018-2022 yılları arasını kapsamaktadır. Karşılaştırma kriterleri için ise yayınlanmış en son veriler alınmıştır. Kuruluş yerinin seçiminde, hammadde tedariği, karma yem sanayii ile hammadde ilişkisi olan sanayiler, pazara yakınlık (hayvan varlığı), illerin gelişmişlik düzeyi, iller arası rekabet endeksi (altyapı, ulaşım, dış ticaret, teknolojik altyapı) ve işgücü kriterleri dikkate alınmıştır. Seçim hiyerarşisi gözetilerek en uygun kuruluş yerinin Ege Bölgesi'nde olmasına ve bu bölgede ise İzmir ilinin seçilmesine karar verilmiştir.

Anahtar Kelimeler: Karma Yem, Kuruluş Yeri, Seçim Kriteri, Türkiye

ESTABLISHMENT LOCATION PROPOSAL FOR A MEDIUM-SCALE COMPOUND FEED BUSINESS IN TÜRKİYE ACCORDING TO CERTAIN CRITERIA

ABSTRACT

In parallel with the increase in the world population, the demand for quality protein of animal origin is increasing, especially for the healthy nutrition of the young population. The high population growth rate in Turkey necessitates the sustainability of animal production. Although it differs in terms of production branches, feed costs constitute approximately 50-70% of animal production costs. Therefore, the adequacy and sustainability of compound feed production are very important. The compound feed industry is a typical agro-industry that produces inputs for livestock enterprises. While it is dependent on the agricultural sector in terms of raw materials, it also markets the products it produces to agricultural enterprises. The largest share of the compound feed production in Turkey belongs to cattle, sheep and goat feeds. The self-sufficiency rate in the production of these feed groups is around 78%. In the poultry feed group, although self-sufficiency is ensured, the problems that arise in the supply of raw materials may adversely affect capacity utilization. Investment analysis of a new compound feed business is of strategic importance due to other criteria affecting production as well as raw material supply. This study aims to select the most suitable establishment location in terms of certain selection criteria within the scope of potential provinces for a medium-sized compound feed business. The reason for considering a medium-sized compound feed business in this study is that approximately 84% of inactive businesses are small businesses. In addition to sheep, goat and cattle feed, the enterprise will also produce poultry and pet feed. The macro data used in the study cover the years 2018-2022. For the comparison criteria, the latest published data were taken. In the selection of the establishment location, raw material supply, industries that have a raw material relationship with the compound feed industry, proximity to the market (animal numbers), the development level of the provinces, the inter-provincial competition index (infrastructure, transportation, foreign trade, technological infrastructure) and workforce criteria were taken into account. Considering the selection hierarchy, it was decided that the most suitable establishment location would be in the Aegean Region and that the city of Izmir would be selected in this region.

Keywords: Compound Feed, Place of Establishment, Selection Criteria, Türkiye

GİRİŞ

Dünya nüfusunun artmasına paralel olarak sağlıklı beslenme için hayvansal kaynaklı yüksek kaliteli proteine olan talep de artmaktadır. Hayvansal üretimdeki verimlilik, kalite ve yeterlilikte girdi maliyetlerinin %50-70'ini oluşturan karma yemlerin sürdürülebilir arzı ise kritik önemdedir (Bayraktar, 1999; Türkiyem-Bir, 2019). Karma yem sanayii, çeşitli hayvancılık işletmelerinin ihtiyaç duyduğu ve hayvansal verimin, genetik sınırların çizdiği azami düzeye en az masrafla çıkartılması için faaliyet gösteren tarıma bağlı bir sanayiidir (DPT, 1990). Karma yem sanayii insan gıdası olarak kullanılan veya kullanılmayan ürünleri değerlendirerek hayvansal proteine dönüştürmektedir. Türkiye'nin artan karma yem ihtiyacı göz önüne alındığında işletmelerin ana faaliyetlerini devam ettirdiği coğrafi yer olarak ifade edilen kuruluş yerinin, sürdürülebilir bir rekabet gücü doğrultusunda uygun bir şekilde seçilmesi çok önemlidir. Kuruluş yeri; işletmelerin tedarik, üretim, depolama ve dağıtım gibi temel işlevlerin ve bu işlevlere bağlı ekonomik amaçların gerçekleştirilebileceği en uygun yerdir (Demirbaş, 2023). Kuruluş yeri seçiminde alınacak kararın uzun süre işletmeyi aynı koşullar altında çalışma zorunda bırakacağından dolayı ekonomik ve çevresel tüm faktörlerin göz önünde bulundurulması gerekmektedir (Korkut ve ark., 2010).

Bu çalışmanın amacı, Türkiye'de olası "orta ölçekli" bir karma yem işletmesi yatırımı için en uygun kuruluş yerinin coğrafi bölge ve il düzeyinde belirlenmesidir. İşletme ölçeğinin belirlenmesinde talep miktarı, maliyetler, finansal imkanlar, teknik imkanlar, çalışma süresi, yönetim gibi birçok faktör etkilidir. Çalışmada, orta ölçekli bir karma yem işletmesi yatırımının ele alınmasının nedeni, faal olmayan işletmelerin yaklaşık %84'ünün küçük işletmelerden oluşmasıdır. Ayrıca, konu ile ilgili literatür incelendiğinde, dünyada artan nüfusa paralel hayvansal ürünlere olan talebin artması, Türkiye'de karma yem sanayiinde kapasite kullanım oranının %80-85 düzeyinde olması, büyükbaş ve küçükbaş hayvan yemlerinde kendine yeterlilik derecesinin %77.5 olması, mevcut hammadde arzının sanayiinin taleplerini karşılamada zorlanması, hammadde fiyatlarındaki ortalama artışın yem fiyat artışından daha yüksek olması gibi unsurlar göz önüne alınarak "orta ölçekli" bir karma yem işletmesi yatırım kararının rasyonel olacağı kabul edilmiştir. AB'ye uyum çerçevesinde belirlenen KOBİ tanımındaki yıllık çalışan istihdam miktarı ve yıllık net satış hasılatı veya mali bilançoya göre oluşturulan "orta büyüklükteki işletme" tanımı da dikkate alınmıştır (Resmi Gazete, 2005). Çalışmada yararlanılan makro veriler 2018-2022 yılları arasını kapsamaktadır. Karşılaştırma kriterleri için ise yayınlanmış en son veriler kullanılmıştır. Bu nedenle, 2022 yılı verilerinin henüz yayınlanmadığı iki veri setinde, yayınlanmış 2021 yılı verileri dikkate alınmıştır. Kuruluş yerinin seçiminde, hammadde tedariği, karma yem sanayii ile hammadde ilişkisi olan sanayiler,

pazara yakınlık (hayvan varlığı), illerin gelişmişlik düzeyi, iller arası rekabet endeksi (ana endeks, altyapı, ulaşım, dış ticaret ve sanayii, teknolojik altyapı) ve işgücü kriterleri birlikte değerlendirilmiştir.

Türkiye'de Karma Yem Sanayiinin Mevcut Durumu

Genelde en az iki yem hammaddesinin karışımıyla oluşan yemler olarak tarif edilen karma yemler; büyükbaş, küçükbaş ve kanatlı hayvanlar için üretilenlerde tahıllar, yağlı tohum küspeleri, hayvansal kökenli proteinler, enerji kaynakları, değirmen-bira fabrika atıkları, selektör altıbakliyat ile katkı maddeleri (vitaminler, melas vd.) kullanılmaktadır (ORAN, Tarih Belirtilmemiş). Üretimde büyükoneme sahip olan hammaddeler ise buğday, arpa, mısır ve soyadır (TAGEM, 2021). Türkiye'nin 2022 yılında karma yem üretimi 27 129 648 ton olup; üretimin yarısından fazlasını büyükbaş ve küçükbaş hayvan yemleri oluşturmaktadır. Tüm yem gruplarının üretimi yıllara göre artış göstermektedir (Tablo 1).

TAGEM 2021 raporunda; Türkiye'de büyükbaş ve küçükbaş hayvan yemlerinde kendine yeterlilik düzeyi %77.52 ve kanatlı yemlerinde ise %105.5'tir. Sektörde 2022 yılı itibariyle 912 kayıtlı üretici olup; 104 işletme ile Konya ili ilk sırada yer almaktadır. Bunu İzmir ve Afyon illeri takip etmektedir. İstihdam edilen personel sayısı 25 121 kişidir (TOBB, 2023). Karma yem sanayiinde üretilen yemlerin %98.4'ü iç pazarda tüketilmekle birlikte, dış ticaret dengesi açısından Türkiye ihracatçı konumundadır (Türkiyem-Bir, 2019). 2022 yılında yapılan toplam ihracat 394 526 Bin US $ iken, ithalat 194 301 bin US $'dir (ITC Trade Map, 2023). Sektörde, kapasite kullanım oranı %80-85 aralığındadır. Onaylı fabrikaların %54.2'si 10 ton/saat'in altında kapasiteye sahiptir (TAGEM, 2021). 2022 yılı toplam karma yem üretiminde Konya ili %9.51'lik (2 579 543 ton) oran ile ilk sıradadır. Bunu %9.46'lık oran ile İzmir, %8.67'lik oran ile Manisa ve %7.5'lik oran ile Balıkesir illeri izlemektedir (GKGM, 2023).

Tablo 1. Türkiye'de Karma Yem Üretimi (Ton)

Yıl	Büyük ve Küçükbaş	2018=100	Kanatlı Yemleri	2018=100	Diğer Yemler	2018=100
2018	13.741.988	100,0	9.766.923	100,0	635.578	100,0
2019	14.076.212	102,4	10.034.794	102,7	828.110	130,3
2020	15.115.019	110,0	10.033.796	102,7	1.123.451	176,8
2021	15.505.173	112,8	10.165.410	104,1	1.333.415	209,8
2022	15.036.046	109,4	10.565.469	108,2	1.528.133	240,4

Kaynak: GKGM, 2023.

Orta Ölçekli Bir Karma Yem İşletme Yatırımı İçin En Uygun Kuruluş Yerinin Seçimi

Kuruluş yeri bir yandan en uygun kalite, fiyat ve miktarda hammadde ile işgücü temin edilebilecek diğer yandan da en düşük maliyetle dağıtım yapılabilecek, dolayısıyla işletmenin kârını maksimize edecek bir coğrafi alan olmalıdır. Bu nedenle çok yönlü faktörlerin etkisi altında olan kuruluş yeri seçilirken objektif kararların verilmesi gerekmektedir (Korkut ve ark., 2010). Bu çalışmada, karma yem işletmesinin en uygun kuruluş yerinin seçimi için ekonomik ve çevresel faktörler birlikte değerlendirilmiştir. Sektörün en önemli sorunlarından biri olan yeterli hammadde açısından üretimde önemli payı olan buğday, mısır, arpa ve diğer ürünlerin üretim miktarı İç Anadolu Bölgesi'nde Konya ve Ankara illeri ilk iki sırada yer almaktadır. Güneydoğu Anadolu ve Akdeniz Bölgeleri ise ikinci ve üçüncü sıradadır (Tablo 2, Tablo 3). Karma yem üretiminde tahıllar dışında kullanılan ürünlerin yarısına yakın kısmını sanayii ürünleri veya farklı gıda maddeleri üretim artıkları oluşturduğundan (Bayraktar, 1999) ilişkili sanayilerin bölgesel dağılımı da incelenmiştir. Karma yem sanayii ile hammadde ilişkisi olan sanayiilerin dağılımında %22.6'lık oranla Ege Bölgesi ilk sıradır. Bunu Güneydoğu Anadolu ve Marmara Bölgeleri izlemektedir (Tablo 4). Ege Bölgesi karma yem üretiminde de %28.7'lik oranla ilk sırada iken, bunu Marmara ve İç Anadolu Bölgeleri takip etmektedir (Tablo 5).

Tablo 2. Karma Yem Hammaddesi Üretiminde Öncelikli İller (2022 Yılı, Ton)

İl	**Buğday**	**Mısır**	**Arpa**	**Çavdar**	**Yulaf**	**Darı**	**Soya Fasulyesi**
Konya	1.313.200	2.044.202	1.055.270	13.281	29.943	-	68
Ankara	822.387	62.816	718.078	834	59.402	-	55
Adana	537.941	888.348	28.911	214	44	-	87.915
Türkiye Toplamı	**16.000.000**	**8.500.000**	**8.100.000**	**273.000**	**365.000**	**4.168**	**155.000**

Kaynak: TÜİK, 2023a.

Tablo 3. Karma Yem Hammaddesi Üretiminde Bölgelerin Durumu (2022 Yılı, Ton)

Bölge	**Buğday***	**Mısır**	**Arpa**	**Çavdar**	**Yulaf**	**Darı**	**Soya Fasulyesi**
İç Anadolu	5.139.935	3.249.973	4.041.053	158.751	237.554	231	240
Güneydoğu Anadolu	1.855.836	1.798.952	709.126	-	71	333	2.050
Akdeniz	1.637.821	1.844.362	459.117	7.055	20.973	294	144.827
Marmara	2.841.961	600.834	438.277	27.147	50.172	2	204
Karadeniz	1.876.956	362.311	698.006	19.630	14.590	12	7.183
Ege	1.189.389	608.736	871.529	33.423	30.892	3.290	496
Doğu Anadolu	1.458.102	34.832	882.892	26.994	10.748	6	-
Toplam	**16.000.000**	**8.500.000**	**8.100.000**	**273.000**	**365.000**	**4.168**	**155.000**

Kaynak: TÜİK, 2023a verilerinden yararlanılarak hazırlanmıştır. *Durum buğdayı hariç

Tablo 4. Karma Yem Sanayii ile Hammadde İlişkisi olan Sanayiilerin Dağılımı (2022 Yılı)

Bölge	Un İmalatı	Et İşleme ve Saklama	Bira ve Malt	Küspe ve Diğer Katı Artıklar	Şeker İmalatı	Toplam	%
Ege Bölgesi	81	132	10	410	52	685	22,6
Güneydoğu Anadolu	147	25	-	363	57	592	19,6
Marmara	120	161	7	158	111	557	18,4
Akdeniz	75	60	7	261	65	468	15,5
İç Anadolu	165	109	3	12	93	382	12,6
Doğu Anadolu	35	25	1	13	92	166	5,5
Karadeniz	87	41	-	6	26	160	5,3
Toplam	**710**	**570**	**28**	**1223**	**496**	**3.027**	**100,0**

Kaynak: TOBB, 2023 verilerinden yararlanılarak hazırlanmıştır.

Tablo 5. Bölgelere Göre Karma Yem Üretimi (Ton, 2022 Yılı)

Bölge	Büyükbaş ve Küçükbaş Yemi	Kanatlı Yemi	Diğer Yemler
Ege	3.661.595,4	3.160.506,2	964.200,3
Marmara	2.854.534,4	2.668.681,5	287.104,2
İç Anadolu	4.023.733,0	1.204.216,3	138.670,5
Akdeniz	1.829.659,0	912.562,8	35.409,6
Karadeniz	809.224,2	1.810.212,6	55.832,0
Güneydoğu Anadolu	1.429.967,8	497.638,2	46.155,6
Doğu Anadolu	427.332,5	311.651,8	761,2
Toplam	15.036.046,2	10.565.469,3	1.528.133,3

Kaynak: Tarım ve Orman Bakanlığı, 2023.

Pazara yakınlık açısından yem tüketim merkezlerini belirleyen hayvan varlığıdır. Hayvan varlığında her grupta Ege Bölgesi birinci sıradadır. Büyükbaş ve küçükbaş hayvan varlığında; Doğu Anadolu, İç Anadolu ve Ege Bölgesi ilk sıralarda, kanatlı hayvan grubunda ise Marmara ve Ege Bölgesi ilk sıradadır. İl bazında; büyükbaş hayvan varlığında Konya,Erzurum ve İzmir; küçükbaş hayvan varlığında Van ve Konya; kanatlı hayvan varlığında ise Manisa ve Balıkesir illeri ilk sıralardadır (Tablo 6, Tablo 7).

Tablo 6. Bölgelere Göre Hayvan Varlığı (2021 Yılı)

Bölge	Büyükbaş (Baş)	%	Küçükbaş (Baş)	%	Kanatlı Hayvan (Adet)	%
Ege	2.886.770	16,0	5.952.814	10,3	112.797.991	28,3
İç Anadolu	3.820.041	21,2	11.965.944	20,8	40.067.426	10,1
Doğu Anadolu	3.687.079	20,4	13.824.567	24	18.083.505	4,5
Marmara	1.987.840	11,0	4.951.615	8,6	110.172.528	27,7
Karadeniz	2.652.204	14,7	2.857.412	5,0	68.299.813	17,2
Güneydoğu Anadolu	1.608.028	8,9	10.595.569	18,4	11.605.247	2,9
Akdeniz	1.394.155	7,7	7.371.283	12,8	37.088.650	9,3
Toplam	18.036.117	100,0	57.519.204	100,0	398.115.160	100,0

Kaynak: TÜİK, 2022 verilerinden yararlanılarak hazırlanmıştır.

Tablo 7. İllere Göre Hayvan Varlığı (2021 Yılı)

S. No	İl Adı	Büyükbaş Sayısı (Baş)		S. No	İl Adı	Küçükbaş Sayısı (Baş)		S. No		Kanatlı Hayvan Sayısı (Adet)	
		Sayı	%			Sayı	%			Sayı	%
1	Konya	957.748	5,3	1	Van	3.384.220	5,9	1	Manisa	51.923.526	13,0
2	Erzurum	860.404	4,8	2	Konya	3.058.681	5,3	2	Balıkesir	39.062.390	9,8
3	İzmir	781.070	4,3	3	Şanlıurfa	2.428.459	4,2	3	Sakarya	32.073.492	8,1
								6	İzmir	20.444.869	5,1
Türkiye Toplamı		**18.036.117**	**100,0**	**Türkiye Toplamı**		**57.519.204**	**100,0**	**Türkiye Toplamı**		**398.115.160**	**100,0**

Kaynak: TÜİK, 2022.

Yatırım için potansiyel illerin gelişmişlik durumunun belirlenmesinde Sanayi ve Teknoloji Bakanlığı'nın illerin ve bölgelerin Sosyo-Ekonomik Gelişmişlik Düzeyi Araştırması baz alınmıştır. Buna göre, İstanbul, Ankara, İzmir, Kocaeli ve Antalya illerinin gelişmişlik düzeyi açısından ilk sırada olduğu belirlenmiştir. En gelişmiş illeri kapsayan bölgeler; Marmara, İç Anadolu, Ege ve Akdeniz Bölgeleridir (STB, 2017). Bununla birlikte, Tablo 8'de gösterilen iller arası rekabet endeksine göre; İstanbul, Ankara ve İzmir rekabet indeksi en yüksek iller iken, altyapı açısından İstanbul, Ankara; ulaşım ile dış ticaret-sanayii indeksi açısından İstanbul ve İzmir illeri ilk sıradadır. İşgücü oranında ise Marmara, İç Anadolu ve Ege Bölgesi ilk sırayı paylaşmaktadır (Tablo 9).

Tablo 8. İller Arası Rekabet Endeksi (2018-2019 Yılı)

Ana Endeks			Altyapı Endeksi			Ulaşım Endeksi			Dış Ticaret ve Sanayii Endeksi			Teknolojik Altyapı Endeksi		
Sıra	İl	Skoru	Sıra	İl	Skoru	Sıra	İl	Skoru	Sıra	İl	Skoru	Sıra	İl	Skoru
1	İstanbul	77,00	1	İstanbul	84,35	1	İstanbul	94,65	1	İstanbul	87,03	1	İstanbul	93,82
2	Ankara	48,23	2	Ankara	80,31	2	İzmir	67,87	2	İzmir	31,23	2	Ankara	89,50
3	İzmir	44,17	3	Gaziantep	75,79	3	Balıkesir	63,54	3	Bursa	26,52	3	İzmir	87,11

Kaynak: Şeker ve ark., 2020.

Tablo 9. Bölgelere Göre İşgücü (2022 Yılı, 15-64 yaş, Bin)

Bölge	**İşgücü**	**%**
Marmara	12.016	36,1
İç Anadolu	4.840	14,5
Ege	4.563	13,7
Akdeniz	4.269	12,8
Karadeniz	2.926	8,8
Güneydoğu Anadolu	2.657	8,0
Doğu Anadolu	2.054	6,2
Toplam	**33.325**	**100,0**

Kaynak: TÜİK, 2023b.

Karma yem işletmelerinin bölgelere dağılımında; İç Anadolu, Ege ve Marmara Bölgeleri ilk sırayı paylaşmaktadır. İl bazında Konya 104 işletme ile ilk sırada iken, bunu İzmir ve Afyon illeri takip etmektedir (Tablo 10). Karma yem işletmesi yatırımı öncelikli yatırım alanları

kapsamında olmamakla birlikte, bölgelere göre değişen birçok devlet desteği bulunmakta olup; KDV İstisnası, Gümrük Vergisi Muafiyeti, Yatırım Yeri Tahsisi tüm bölgelere verilmektedir (ORAN, Tarih Belirtilmemiş). Çevresel faktörler açısından hayvancılığın yoğun olduğu yerler genel olarak karşılaştırıldığında; ulaşım, enerji, haberleşme, kalifiye işgücü ve organize sanayii bölgelerinin varlığı açısından Ege, Marmara ve İç Anadolu Bölgeleri daha avantajlı konumda iken, arazi fiyatlarının uygunluğu ve verilen devlet destekleri açısından Doğu ve Güneydoğu Anadolu Bölgeleri daha avantajlı olarak değerlendirilmektedir.

Tablo 10. İllere ve Bölgelere Göre Karma Yem İşletmelerinin Dağılımı (2022 Yılı)

No	İl Adı	Sayı	%		Bölge Adı	Sayı	%
1	Konya	104	11,4		İç Anadolu	263	28,8
2	İzmir	72	7,9		Ege	188	20,6
3	Afyon	54	5,9		Marmara	163	17,9
4	Ankara	52	5,7		Akdeniz	102	11,2
5	Gaziantep	45	4,9		Güneydoğu Anadolu	94	10,3
6	Balıkesir	42	4,6		Karadeniz	51	5,6
7	Diğer	543	59,5		Doğu Anadolu	51	5,6
	Toplam	**912**	**100,0**		**Toplam**	**912**	**100,0**

Kaynak: TOBB, 2023 verilerinden yararlanılarak hazırlanmıştır.

Yapılan analizler kapsamında orta ölçekli karma yem işletmesi kuruluş yeri için öne çıkan bölgeler Ege, İç Anadolu ve Marmara Bölgeleri iken; öne çıkan iller ise İzmir, Konya, Ankara ve Balıkesir olarak belirlenmiştir. Bu bölgeler ve illerden hammadde ilişkisi olan sanayiye yakınlık, pazara yakınlık, ulaşım (özellikle bir liman kenti olan İzmir'in denizyolu taşımacılığına da uygun olması), altyapı,dış ticaret-sanayi, teknolojik altyapı, işgücü, iller arası rekabetteki konumu göz önüne alınarak olası işletmenin amaçlarına hizmet edebilecek sürdürülebilir rekabet gücü sağlamada en uygun kuruluş yeri olarak Ege Bölgesi ve bu bölgede yer alan İzmir ili seçilmiştir.

SONUÇ

Türkiye'de yapılacak olası orta ölçekli bir karma yem işletmesi yatırımı için en uygun kuruluş yeri, ekonomik göstergelerden faydalanılarak yapılan karşılaştırmalı analizler sonucunda, Ege Bölgesi ve İzmir ili olarak belirlenmiştir. Öncelikle elde edilen veriler doğrultusunda seçim hiyerarşisi gözetilerek yatırım bölgesinin Ege Bölgesi olmasına karar verilmiştir. Nitekim, çalışmada ele alınan seçim kriterlerinden olan hammaddeye yakınlıkta ve ilişkili sanayiler açısından ilk sırada olması, toplam hayvan varlığı ve karma yem üretiminde en fazla paya sahip olması, mevcut işletme sayısında ikinci sırada olması ve sosyo-ekonomik gelişmişlik düzeyi açısından ilk üçte yer alması bölge seçiminde etkili olmuştur.

Ege Bölgesi'nde İzmir ilinin seçilmesinde ise karma yem işletme sayısı ve toplam yem üretiminde ikinci sırada yer alması, büyükbaş hayvan sayısında ikinci ve kanatlı hayvan sayısında altıncı sırada yer alması, ulaşım olanakları, altyapının yeterliliği, iller arası rekabet endeksinde ve sosyo-ekonomik gelişmişlik düzeyinde bölgedeki illere göre rekabetçi konumda olması, ana rekabet endeksinde de öne çıkan illerden Ankara'dan sonra üçüncü sırada, ulaşım ve dış ticaret-sanayi endeksinde ise daha iyi konumda olması etkili olmuştur.

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DEVELOPING BUSINESS OPERATIONS OF ENTERPRISES IN THE GREEN ECONOMY

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ABSTRACT
Green growth is becoming a development trend in the economy, aiming towards sustainable development goals. Businesses are increasingly seeking to demonstrate social responsibility and sustainable development, leading them to choose the path of green growth and sustainable development. Consequently, they have transitioned from traditional business models to green enterprises, responsible enterprises, and sustainable enterprises. This article proposes clean and green production models that integrate circularity deeply into the production chain, creating sustainable livelihoods for vulnerable communities through an overarching business model to convey the message of green growth. It also directs businesses to apply independent environmental business assessment indexes and environmentally friendly technologies to promote green investment activities, enhance efficiency, competitiveness, and foster the harmonious and sustainable development of enterprises.

Keywords: Green economy, circular economy, sustainable growth, green growth, competitive advantage.

JEL classification: O1, O3, O4, Q5, E6.

INTRODUCTION

In recent years, the term "green economy" has increasingly gained attention and emphasis on development in society. The green economy is an environmentally friendly economic approach that aims to enhance sustainable economic development, where business and production activities are conducted in a manner that is appropriate for the environment and society (Loiseau, Eleonore, et al., 2016). The green economy focuses on optimizing economic benefits while ensuring the protection of the environment, resources, and promoting social development. It concentrates on achieving a balance between economic development, environmental protection, and social equity (Iavicoli, Ivo, et al., 2014).

A green economy can be regarded as an economy with low carbon emissions, efficient resource utilization, and encompassing society as a whole (UNEP, 2011). The purpose of the green economy is to improve human welfare and social equality while significantly reducing environmental risks and natural resource scarcity (UNEP, 2011). The development of a green economy emphasizes sustainable resource use, protection, and restoration of the environment, while generating benefits for people and society. Green economy activities focus on reducing carbon emissions and other greenhouse gases into the environment. This often involves transitioning from fossil fuel energy to renewable energy and using cleaner and more efficient technologies (Mealy, P., & Teytelboym, A., 2022).

The green economy promotes efficient resource use and waste recycling to protect the environment in a sustainable development context. Production and consumption processes are optimized to reduce waste generation and encourage effective resource reuse, recycling, and utilization (Pan, Shu-Yuan, et al., 2018). The green economy encourages businesses to use renewable energy sources such as solar energy, wind energy, hydropower, and bioenergy. This helps reduce dependence on fossil fuels and greenhouse gas emissions. To develop a green economy, supportive policies and legal frameworks are necessary to encourage businesses and individuals to participate in green economic activities (Pan, Shu-Yuan, et al., 2018). This may include financial incentives, recommendations, and appropriate regulations.

Therefore, the green economy not only generates significant benefits to sustain the sustainable growth of the economy but also contributes to minimizing negative impacts on the environment and enhancing equitable social development. It has become an important trend in both business and government sectors worldwide (Sheldon, Roger A., 2016).

Challenges Arise When Implementing Green Economic Development In A Green Economy For Businesses

Digital economy and green economy are currently the most important topics in environmental policy and sustainable development agendas. The integration of digital and green economic development leads to new models and creates opportunities for sustainable growth and economic recovery in the context of economic crises caused by the pandemic. In reality, large corporations have more resources to develop green economies, but small and medium-sized enterprises (SMEs) face challenges in adopting green practices due to limited technological and financial resources. SMEs, in general, are currently under pressure from financial constraints, technical limitations, market dynamics, and competitive challenges. Many businesses that do not meet green standards struggle to access contracts or face rejections from foreign partners to purchase their products, while businesses that meet green standards often face an overwhelming demand. Throughout the process of developing a green economy, businesses encounter various difficult issues.

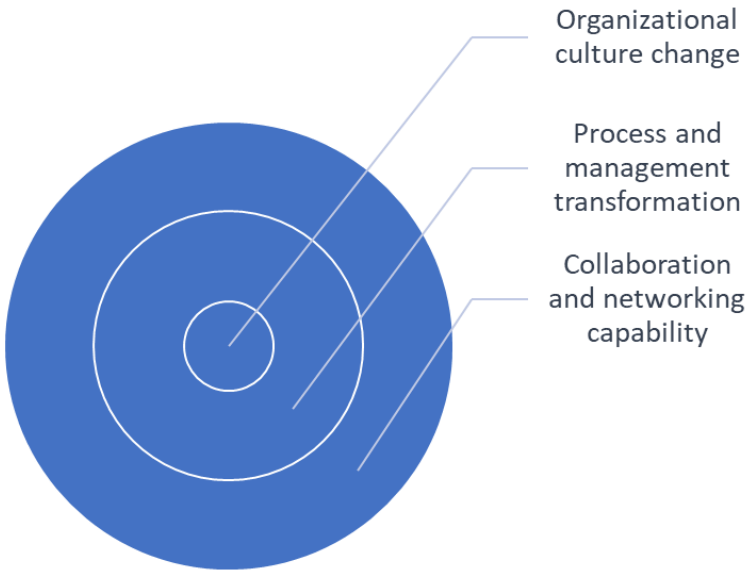

Figure 1. Iterative Challenges Faced by Businesses in Developing a Green Business Model

Transitioning to a green economic model requires businesses to undergo organizational culture change. Businesses need to reassess the values, attitudes, and behaviors of their employees and

management levels to drive positive environmental changes. This demands commitment from all levels of management and employees within the organization.

When developing a green business model, businesses face the need for significant initial investments, which can result in increased initial costs. For instance, investing in clean and advanced technologies, enhancing energy efficiency, and adopting environmentally friendly production processes may require substantial investments. Businesses need to carefully evaluate and optimize the use of financial resources and manage risks. Furthermore, developing a green business model entails process and management transformation. Green economic development necessitates changes in production processes and business management. This may involve adjusting production processes, incorporating recycling and waste management practices, modifying transportation and storage methods, and improving waste management processes. This requires investment of time and resources to facilitate change and adaptation.

Additionally, to implement green economic development, businesses need to seek collaboration and partnerships with suppliers of green goods and services, as well as non-governmental organizations. This necessitates the ability to build relationships and partnerships to achieve common goals and leverage shared benefits. To ensure the effectiveness of green economic development, businesses need to establish clear measurement indicators and objectives. This requires businesses to measure and monitor progress, providing necessary information for adjustment and improvement of operations.

In the current context, businesses that do not invest in green production will struggle to expand internationally and may face domestic market exclusion as consumers increasingly prefer green products. However, developing a green economy without proper institutional preparations, policies, and additional resources poses significant challenges. This presents a major issue for businesses participating in a green economy.

Proposed Green Business Model

Green businesses are enterprises that have minimal negative impact or the potential to have positive impacts on the environment, community, society, or the global/local economy. A green business model aims to develop businesses based on the triple bottom line of economic, social, and environmental aspects, with profitability being the ultimate goal. A green business integrates principles of sustainability into every business decision, offers environmentally friendly products or services as alternatives to non-green ones, and maintains a long-term commitment to environmental principles in its business operations.

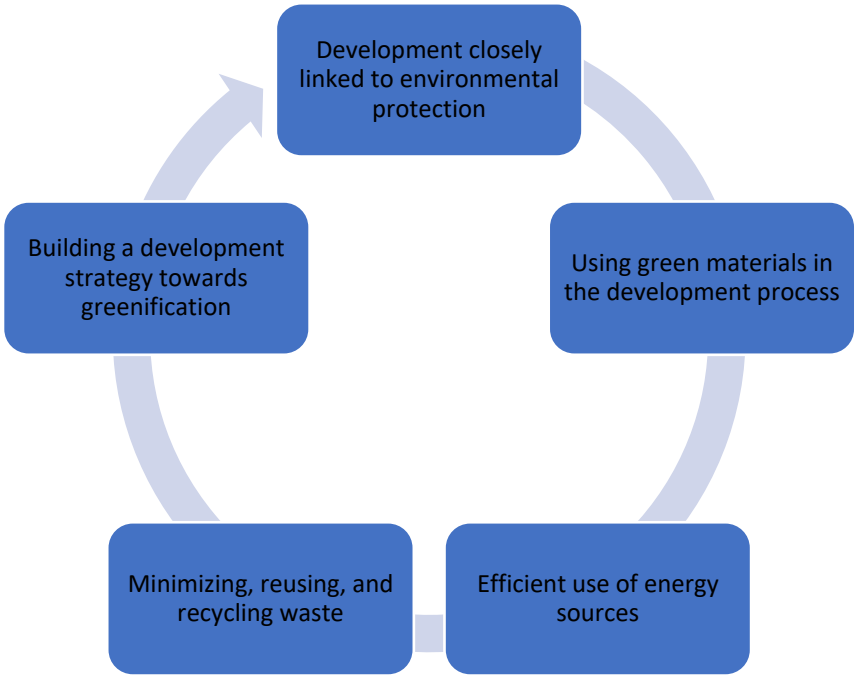

Figure 2. Proposed Green Business Model

The development of businesses in line with environmental protection aims to build an economy and society that harmonizes with the natural environment, creating long-term economic and social benefits without harming the environment and future generations. The perspective of development linked to environmental protection is a socio-economic development philosophy that emphasizes the protection of the environment throughout the development process. It is considered an essential and actively integrated element in decision-making and development activities. This requires ensuring that business activities and development do not cause harm or have negative impacts on the environment, natural resources, ecosystems, and human health. Developing businesses in line with environmental protection promotes a balance between the capacity for resource replenishment and protection, environmental resilience, and the needs of economic and social development. It involves implementing measures and policies to reduce pollution, protect biodiversity, manage natural resources sustainably, and address environmental issues such as climate change and environmental degradation.

To align business activities with environmental protection, businesses need to:

Develop products or services with minimal environmental impact. Prioritize the environment as a crucial factor in long-term business decision-making and development strategies.

Comply with relevant environmental regulations and standards in all business operations.

Green businesses effectively utilize energy sources throughout their development process. This means that businesses employ measures and strategies to optimize energy usage. Starting with

energy assessment and analysis, businesses need to evaluate and analyze energy consumption to identify areas of high energy usage and inefficiency in their operations. Analyzing energy usage patterns helps identify opportunities for improvement.

Next, businesses invest in energy-efficient equipment and machinery that have high energy performance ratings. This includes energy-efficient lighting systems, HVAC systems, and office equipment. Regular maintenance and optimization of these systems are essential to ensure their optimal performance.

Integrating renewable energy sources into business operations is crucial. This can involve installing solar panels, wind turbines, or utilizing geothermal energy to generate clean and sustainable energy. If on-site generation is not feasible, businesses should consider purchasing renewable energy from external sources.

Implementing an energy management system is important to monitor and control real-time energy consumption. Utilizing technologies and software enables businesses to track, measure, and adjust energy usage effectively.

Providing training to employees on efficient energy usage and raising awareness about the importance of energy conservation in daily business activities is essential.

Lastly, monitoring and evaluating energy usage according to set targets and objectives is crucial. Identifying ongoing improvement opportunities and implementing effective energy-saving measures are vital for continuous enhancement.

By effectively utilizing energy sources, green businesses not only reduce negative impacts on the environment but also create long-term economic and resource-saving benefits.

To pursue the development of a green business model, it is necessary to minimize, reuse, and recycle waste. Green businesses not only contribute to environmental protection but also reduce resource waste and production costs. Additionally, they create a positive image for the business and meet the increasing concern of customers and communities regarding environmental protection. To minimize, reuse, and recycle waste, green businesses should implement the following measures:

Firstly, businesses need to assess and classify waste. By conducting a detailed assessment of the type, volume, and origin of the waste generated by the business or implementing waste classification by type, businesses are effectively implementing recycling and waste classification solutions.

Secondly, businesses should minimize waste in the production process. This can be achieved by improving production processes, using sustainable materials and packaging, optimizing resource utilization, and reducing waste.

Thirdly, businesses should promote waste reuse. Encouraging the reuse of products, materials, or packaging to extend their lifespan is crucial. Developing policies and procedures for collecting, cleaning, and reusing materials within the production process and business operations is important.

Fourthly, businesses should implement waste recycling. Conducting recycling activities to convert waste into raw materials or new products is essential. Collaborating with recycling service providers or establishing internal recycling facilities to process waste and utilize resources is recommended.

Furthermore, it is important to educate and raise awareness. Training employees on waste reduction and recycling practices and implementing information and education programs to enhance awareness of the environmental and societal impacts of waste are vital.

Lastly, collaboration with partners and the community is crucial. Establishing connections with suppliers, customers, and the community to promote waste reuse and recycling is important. Collaborating with organizations and local authorities to create effective recycling and waste management opportunities is beneficial.

By implementing these measures, green businesses contribute to a sustainable and circular economy, reduce environmental impact, and promote resource efficiency.

CONCLUSIONS

In the current context of the digital economy, strengthening investment in digitization and gradually transitioning to digitalization significantly contributes to improving the utilization of resources in businesses. The development of the internet has greatly improved the efficiency of production businesses, increasing productivity by reducing transaction costs, eliminating inefficient resources, and fostering innovation. The impact of digital transformation on business behavior empowers organizations and its core mechanisms, representing a crucial characteristic of organizational change that enhances decentralized decision-making power.

Digitalization enables businesses to optimize resource utilization, enhance productivity, foster innovation, and enable decentralized decision-making. It involves leveraging digital technologies such as cloud computing, big data analytics, artificial intelligence, and the Internet of Things to streamline operations, automate processes, and make data-driven decisions. By embracing digital transformation, businesses can optimize resource allocation, reduce waste, and improve overall efficiency.

Moreover, digitalization facilitates better connectivity and collaboration between different stakeholders, including suppliers, customers, and partners. This enables businesses to foster

innovation, adapt quickly to market changes, and deliver products and services that meet evolving customer needs.

The digital transformation of businesses also empowers employees by providing access to information, tools, and platforms that enhance their productivity, collaboration, and decision-making capabilities. It enables decentralized decision-making, allowing employees at various levels to contribute their expertise and insights, leading to more agile and effective operations.

In summary, investing in digitization and leveraging digital technologies empowers businesses to optimize resource utilization, enhance productivity, foster innovation, and enable decentralized decision-making. Embracing digital transformation is vital for businesses to thrive in the digital economy and adapt to the changing landscape of the business environment.

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KEÇİ SÜTÜNDEN ÜRETİLEN YÖRESEL PEYNİRLER

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ÖZET

Dünyada tüketilen ve ticareti yapılan sütler inek, koyun, keçi ve manda olmak üzere dört çeşittir. Dünyada toplam sütün büyük bir kısmı peynire işlenmekte ve 4000 civarında peynir çeşidi bulunmaktadır. Türkiye'de en fazla tüketilen süt ve süt ürünleri inekten elde edilmekte olup bunu koyun ve keçi sütleri takip etmektedir. Her ülkenin kendi kültür ve gelişim düzeyine bağlı olarak yoğun bir şekilde tüketime sunduğu peynir çeşidi olduğu bilinmektedir. Ülkemizde Beyaz, Kaşar, Tulum, Otlu, Dil, Mihaliç, Çerkez, Çökelek, Civil ve Lor peynirleri gibi üretim miktarı açısından ekonomik değeri olan 50'ye yakın peynir çeşidi olduğu dile getirilmektedir. Yöresel üretimlerin de ilave edilmesi ile bu sayı 200 civarındadır. Diğer sütlere göre tadı ve aroması farklı olan keçi sütü, gelişmiş ve gelişmekte olan ülkelerde özel peynirlerin yapımında kullanılan bir süttür. Başta Fransa olmak üzere İspanya, İtalya, Portekiz ve Yunanistan gibi iklim koşulları bakımından Türkiye'ye benzeyen Akdeniz ülkelerinde süt keçisi yetiştiriciliği ve özel keçi peynirlerinin üretimi son derece gelişmiş olup ekonomik ve teknolojik açıdan önemli bir yere sahiptir. Ülkemizde 2010 yılında 6 293 233 baş keçi yetiştirilmekte iken; 2022 yılında bu sayının 12 324 928 başa yükseldiği görülmektedir. Türkiye'de bölgelere göre farklı ırklar ile keçi yetiştiriciliği yapılmakla beraber, en yaygın yetiştirilen yerli ırk Kıl keçisidir. Türkiye'de kıl keçisi yetiştiriciliği genellikle bitkisel üretime ve diğer hayvan türlerini yetiştirilmesine uygun olmayan engebeli, dağlık, ormanlık ya da çalılık alanlarda yapılmaktadır. Türkiye'nin her bölgesinde yetiştirilen Kıl keçisi sürülerinin özellikle Akdeniz ve Ege bölgelerinde yaygın olduğu bilinmektedir. Kıl keçisine dayalı üretimi yapılan keçi sütleri genellikle sade ve koyun veya inek sütü ile karıştırılarak peynire işlenmekte veya dondurma üretiminde kullanılmaktadır. Keçi peyniri çiğ keçi sütünden hazırlanan, kendine özgü lezzetti, dokusu ve karakteristik tadı olan bir peynirdir. Keçi sütünün fizikokimyasal özelliklerinin anne sütüne yakın olması çocuk, genç ve yaşlı beslenmesinde önemli bir yere sahip olmasını sağlamaktadır. Keçi sütünde, inek sütüne oranla laktoz miktarı daha düşüktür. Bu sebeple laktoz intoleransı gösteren kişilerin tercih edebileceği ve sindirilebilirliğinin yüksek olması nedeniyle sindirim konusunda sıkıntı çeken hastaların rahatça tüketebileceği bilinmektedir. Keçi sütü ve süt ürünlerinin son yıllarda gelişmiş ve gelişmekte olan ülkeler tarafından fazla talep görmesi; bu ürünlerin insan sağlığına olan faydaları, organik ürün çeşitliliğinin zenginliği ve ekonomik öneminden kaynaklanmaktadır. Göçebe topluluklarda en çok yapılan peynirlerden biri olan keçi peyniri Türk mutfağında da önemli bir yere sahiptir. Bu çalışmada, keçi sütünden üretilen peynir çeşitleri, yapım teknikleri ve bazı özellikleri yer almaktadır.

Anahtar Kelimeler: Keçi Sütü, Keçi Peyniri, Yöresel Peynirler

TRADITIONAL CHEESE PRODUCED FROM GOAT MILK

ABSTRACT

The types of milk consumed and traded in the world: cow, sheep, goat and buffalo. Most of the milk in the world is processed into cheese and cheese varieties are around 4000. The most consumed milk and dairy product in Turkey is obtained from cows, followed by sheep and goat milk. It is known that each country has a variety of cheese that it offers intensively depending on its own culture and development level. It is stated that there are nearly 50 cheese varieties in our country, such as Beyaz, Kashar, Tulum, Otlu, Dil, Mihaliç, Çerkez, Çökelek, Civil and Lor cheeses, which have economic value in terms of production amount. It is known that this number will be almost 200 with the addition of local productions. Goat milk, which has a different taste and aroma compared to other milks, is a milk used in the production of special cheeses in developed and developing countries. In Mediterranean countries, which are similar to Turkey in terms of climatic conditions, such as Spain, Italy, Portugal and Greece, especially France, dairy goat breeding and production of special goat cheeses are highly developed and have an important place in terms of economy and technology.While 6 293 233 goats were raised in our country in 2010; It is seen that this number has increased to 12 324 928 heads in 2022. Although goats are bred with different breeds according to the regions in Turkey, the most widely grown domestic breed is “Kıl Keçisi (hair goat)”. Hair goat breeding in Turkey is generally carried out in rugged, mountainous, forested or bush areas that are not suitable for plant production and raising other animal species. It is known that Hair goat herds raised in every region of Turkey are common especially in the Mediterranean and Aegean regions. Goat milk, which is produced based on hair goat, is generally plain and mixed with sheep or cow milk, processed into cheese or used in ice cream production. Goat cheese is a cheese prepared from raw goat milk, with its unique flavor, texture and characteristic taste. The fact that the physicochemical properties of goat milk are close to breast milk ensures that it has an important place in the nutrition of children, young and old. Goat milk has less lactose than cow milk. For this reason, it is known that people with lactose intolerance can prefer it and because of its high digestibility, patients who have problems with digestion can consume it comfortably. Goat milk and dairy products are in high demand by developed and developing countries in recent years; The benefits of these products to human health stem from the richness and economic importance of organic product diversity. Goat cheese, which is one of the most made cheeses in nomadic communities, also has an important place in Turkish cuisine. In this study, cheese types produced from goat's milk, production techniques and some properties are included.

Keywords: Goat Milk, Goat Cheese, Traditional Cheeses

GİRİŞ

Peynir; yağlı süt, krema, kısmen veya tamamen yağı alınmış süt, yayık-altı ya da bunların birkaçının veya tümünün karışımının peynir mayası denilen uygun proteolitik enzimlerle ve/veya zararsız organik asitlerle pıhtılaştırıldıktan sonra; peyniraltı suyunun ayrılması, pıhtının şekillendirilmesi ve tuzlanmasıyla elde edilen taze veya olgunlaştırıldıktan sonra tüketilen, besin değeri yüksek süt ürünü olarak tanımlanmaktadır (Yetişmeyen, 2013) ve Üçüncü, 2018). Dünyada toplam sütün büyük bir kısmının peynire işlendiği ve peynir çeşitlerinin 4000 civarında olduğu bildirilmiştir (Say, 2008). Peynir çeşitliğinin ortaya çıkmasında ham madde sütün cinsi (inek, koyu, keçi sütü peyniri), pıhtı oluşturma yöntemi (asit, maya peynirleri), sütün ısıl işlem görüp görmemesi (çiğ, pastörize peynir) yağ oranı (tam yağlı, yağlı, az yağlı, yağsız peynir), yapısı (çok sert, sert, yumuşak peynirler), tuz oranı (tuzlu, tuzsuz peynirler), katkı maddeleri (çeşitli ot ve baharatlar, eritici tuzlar, küf gelişimi desteklenerek yapılan peynirler), olgunlaşma süresi (taze, yarı olgun, olgun peynirler) gibi birçok faktör etkilidir (Üçüncü, 2004). Bu faktörlerin herhangi birinde veya bir grubunda meydana gelen küçük bir değişiklik, sonuçta farklı özelliklere sahip yeni bir peynir çeşidinin ortaya çıkarmasına vesile olmaktadır (Elmalı ve Uylaşer, 2012).

Enerji değeri yüksek ve protein, kalsiyum ve B2 vitamini yönünden zengin bir besin olan peynirin sağlıklı beslenmede önemli bir yere sahip olduğu dile getirilmiştir (Kırdar, 2001). Peynir yiyecek olarak çok eski zamanlardan beri kullanılmasına rağmen, peynirin ilk kimler tarafından nerede ve nasıl yapıldığı kesin olarak bilinmemektedir. Elde somut tarihsel bir kanıt olmasa da peynirin, MÖ 8000-6000 yıllarında koyun, keçi ve inek türlerinin evcilleştirilmesinden sonra Akdeniz kıyılarında, Mezopotamya'da ve bugünkü Güney-Batı Asya dediğimiz İndus vadisinde çobanlar tarafından yapıldığı sanılmaktadır. Yazılı olarak Kâşgarlı Mahmud'un Dîvânü Lugati't-Türk kitabında uyutmak, uyumuş süt ve peynir anlamlarında "udma veya udhıtma" olarak geçen peynir terimi için kurut, çökelek, bışlak, ağrımışık, kesük gibi ifadeler de kullanıldığı bilinmektedir. (Karaca, 2016).

Dünyada tüketilen ve ticareti yapılan süt çeşitleri inek, koyun, keçi ve manda sütüdür. Bu hayvanların süt ve süt ürünlerinin kokuları, tatları birbirinden farklı olmakta ve farklı damak zevklerine sahip tüketicilere hitap etmektedir (Akbay ve Boz, 2005). Türkiye'de en fazla tüketilen süt ve süt ürünü inekten elde edilmekte olup bunu koyun ve keçi sütü takip etmektedir. Her ülkenin kendi kültür ve gelişim düzeyine bağlı olarak yoğun bir şekilde tüketime sunduğu peynir çeşidi olduğu bilinmektedir (Durlu-Özkaya ve Gün, 2007). Ülkemizde Beyaz, Kaşar, Tulum, Otlu, Dil, Mihaliç, Çerkez, Çökelek, Civil ve Lor peynirleri gibi üretim miktarı açısından ekonomik değeri olan 50'ye yakın peynir çeşidi olduğu dile getirilmektedir

(Hayaloğlu ve ark., 2002; Kamber ve Şireli 2007). Yöresel üretimlerin de ilave edilmesi ile bu sayının 200'ü bulacağı bilinmektedir (Tekinşen ve Tekinşen, 2005; Tekinşen ve Elmalı, 2006; Kamber ve Terzi, 2008). Bu çalışmada Anadolu ile özdeşleşmiş Anadolu keçi peynirlerinin tanıtılması amaçlanmıştır. Bu amaç ile keçi sütü kullanılarak Anadolu'da üretimi yapılan peynir çeşitlerine değinilecektir.

Anadolu Keçi Peynirleri

Süt keçisi yetiştiriciliği ve özel keçi peynirlerinin üretiminin başta Fransa olmak üzere İspanya, İtalya, Portekiz ve Yunanistan gibi iklim koşulları bakımından Türkiye'ye benzeyen Akdeniz ülkelerinde gelişmiş olduğu ekonomik ve teknolojik açıdan önemli bir yere sahip olduğu bildirilmiştir. (İsleten ve Yüceer, 2005). Dünya genelinde keçi yetiştiriciliğine verilen önem son zamanlarda artmaktadır. Bu artış üzerine; keçi sütünün beslenme ve özellikle sağlık üzerine olumlu etkilere sahip olması, yağ globüllerinin çapının küçük olması nedeniyle kuvvetli asitler ile çok hızlı çözündüğünden sindirim problemi olan hastalar rahatlıkla tüketebilmesi, elde edilen ürünlerin karakteristik hoş bir tat ve aromaya sahip olması, diğer sütlere göre daha fazla miktarda esansiyel yağ asitleri, A ve B vitaminleri, riboflavin, niasin, kalsiyum, fosfor, klor, magnezyum, potasyum ve selenyum içerirken düşük oranda trans C18:1 yağ asidi içermesi.. vb. gibi olumlu özellikleri etkili olduğu dile getirilmiştir (Jandal, 1996; Kılıç ve ark.,2002; Haenlein, 2004; Metin, 2005; Park ve ark., 2007; Şatır ve Güzel-Seydim, 2010; Şentürklü ve Arslanbaş 2010; Akan ve Kınık, 2015). Keçi sütünün fizikokimyasal özelliklerinin anne sütüne yakın olması keçi sütünün çocuk, genç ve yaşlı beslenmesinde önemli bir yere sahip olduğu bildirilmiştir (Ribeiro ve Ribeiro, 2010).

Keçi sütünde, inek sütüne oranla laktoz miktarının daha düşük olduğundan alerji potansiyelinin düşük olduğu bilinmektedir (Song ve ark., 2020). Bu sebeple laktoz intoleransı gösteren kişilerin tercih edebileceği ve sindirilebilirliğinin yüksek olması nedeniyle sindirim konusunda sıkıntı çeken hastaların rahatça tüketebileceği vurgulanmıştır (Park ve ark., 2007; Sharma ve ark., 2021). Keçi sütü ve süt ürünlerinin tercih edilmesine bir diğer sebep ise inek sütüne oranla süt protein içeriğinin ve bağışıklık sistemini güçlendirici faktörlerinin yüksek olduğu dile getirilmiştir (Şentürklü ve Arslanbaş 2010). Ayrıca keçi sütünün, insan metabolizmasının düzgün bir şekilde çalışmasına yardımcı olan, kalbi koruyan biyoaktif bileşenler içerdiği bildirilmiştir (Çakır ve Tunalı-Akbay, 2021). Tüm bu olumlu özelliklerinden dolayı keçi sütü ürünleri bir çok diyet listesinde yer almaktadır (Nayik ve ark., 2021).

Keçi sütünün işlenmesi ve fermente edilmesiyle; peynir, yoğurt, dondurma, tereyağı gibi ürünlerin yanı sıra keçi sütüne probiyotik, prebiyotik ve vitaminlerin ilavesiyle fonksiyonel

gıdalar da üretilebileceği bilinmektedir (Pandya and Ghodke, 2007; Ranadheera ve ark.,2019). Hem dünyada hem Türkiye'de keçi sütü, süt ürünleri arasında en çok peynir üretiminde kullanılmaktadır. Keçi sütlerinden elde edilen peynirler taze ve olgunlaşmış olmak üzere iki farklı grupta sınıflandırılmaktadır. Keçi peynirleri nem oranına bağlı olarak yumuşak, yarı yumuşak, sıkı ve sert yapıda olabilmektedir (Coşkun ve Öndül, 2004). Ancak; keçi sütü pıhtısında sineresis olayının yavaş gelişmesinden kaynaklı olarak peynir suyu daha geç uzaklaştığı için keçi sütünün özellikle yumuşak peynir üretimine daha uygun olduğu düşünülmektedir.

Ülkemizde 2010 yılında 6 293 233 baş keçi yetiştirilmekte iken; 2022 yılında bu sayının 12 324 928 başa yükseldiği görülmektedir (TÜİK, 2023). Türkiye'de bölgelere göre farklı ırklar ile keçi yetiştiriciliği yapılmakla beraber, en yaygın yetiştirilen yerli ırk Kıl keçisidir. Türkiye'de kıl keçisi yetiştiriciliği genellikle bitkisel üretime ve diğer hayvan türlerini yetiştirilmesine uygun olmayan engebeli, dağlık, ormanlık ya da çalılık alanlarda yapılmaktadır. Türkiye'nin her bölgesinde yetiştirilen Kıl keçi sürülerinin özellikle Akdeniz ve Ege bölgelerinde yaygın olduğu bilinmektedir (Dellal, 2000; Keskin ve ark., 2017). Kıl keçilerine dayalı üretimi yapılan keçi sütleri genellikle sade ve koyun veya inek sütü ile karıştırılarak peynire işlenmekte veya dondurma üretiminde kullanılmaktadır (Sevran ve ark., 2011).

Tablo 1. Türkiye'de Üretilen Bazı Geleneksel Keçi Peynirleri

Antep Sıkma Peyniri	Civil Peyniri
Karaburun Keçi Sepet Peyniri	Diyarbakır Otlu Peyniri,
Burhaniye Sepet Peyniri	Küp Peyniri,
Gönen Yörük Peyniri	Çömlek Peyniri (Çankırı, Kırşehir, Nevşehir)
Konya Teneke Keçi Peyniri (Çepni)	Siirt Göçer Otlu Peyniri,
Denizli Taze Keçi Peyniri	Hakkari Dövme Peyniri
Yayladağı ve Çayır Peynirleri (Isparta),	Hatay Carra Peyniri
Ezine Keçi Peyniri (Edirne)	Armola Peyniri (İzmir, Seferihisar)
Eğirdir Keçi Peyniri	Kırk Tokmak
Akçakatık (Burdur) Peyniri	Kirlihanım Peynirleri (İzmir-Karaburun, Balıkesir)
Kelle Peyniri (Ayvalık)	Maraş Peyniri (Kahramanmaraş)
Çimi Peyniri (Antalya)	Abaza Peyniri
Tel Peyniri	Dolaz Peyniri

Kaynak: Kavas ve ark., 2005; Gelibolu, 2009; Kırdar ve Gün, 2010; İrkin ve ark, 2010; Tarakçı ark., 2015.

Ülkemizde üretilen bazı geleneksel keçi peynirleri Tablo 1'de verilmiştir. Bu kadar çeşitliliğe rağmen; yapılan birçok araştırma ülkemizde keçi sütü ve ürünlerine tüketicilerin gereken önemi vermediğini göstermektedir (Parkalay ve ark., 2010; Savran ve ark., 2011; Ocak ve Önder, 2014; Akbay ve ark., 2016; Engindeniz ve ark., 2017).

Antep Sıkma Peyniri (Antep Peyniri): Antep Peyniri Gaziantep ilinde üretilen ve yine aynı ilin adını taşıyan yöresel coğrafi işaretli bir peynirdir. Antep Peyniri geleneksel olarak Gaziantep ilinin meralarında otlatılan küçükbaş hayvanların sütlerinden yapılan bir peynir çeşididir. Yapı olarak Kaşar peynirini andıran salamura yapılarak oda sıcaklığında raf ömrü altı aya kadar uzatılabileceği bildirilmiştir (Albak Yalınız, 2019). Kamber ve Terzi (2008) bu peynirin Gaziantep'te "pişken" ya da "kelle" olarak da adlandırıldığını belirtmiştir. Telemesi haşlanan, yarı sert, taze (salamura yapılmadan) veya salamurada olgunlaştırılmış olarak üretilen ve tüketilen bir peynir olduğundan üretim teknolojisi açısından Beyaz peynir ile Kaşar peyniri arasında yer almaktadır. Üretimde sadece koyun veya sadece keçi sütü kullanılabildiği gibi, %50 koyun ve %50 keçi sütü karışımının kullanılabileceği bildirilmiştir (TÜRKPATENT, 2018).

Sepet Peyniri: Kınık ve arkadaşları (1999) sepet peynirinin Ege Bölgesinde özellikle Balıkesir, Burhaniye, Ayvalık, Foça, Karaburun ve Çeşme 'de yaygın olan yarı sert bir peynir türü olduğu dile getirmiştir. Bir bağ ve dere kenarlarındaki bitki saplarından örülmüş sepet içerisinde şekil verilen sepet peyniri keçi, koyun ve inek sütlerinin belirli oranda karıştırılması ile elde edildiği bilinmektedir (Karakaş ve Korukoğlu, 2006).

Tulum Peynirleri: Tulum peyniri; ham peynirin (teleme) ufalanıp, tuzlandıktan sonra tulumlara basılması ve belli bir süre olgunlaşması sonucu elde edilen peynir olarak tanımlanmakta, duyusal ve kimyasal özellikleri dikkate alınarak yapılan bir tanımda ise beyaz ve krem renkte, kuru madde ve yağ oranı yüksek, kolay dağılmayan (plastik özellikte), ağza alındığında eriyerek kendine has tereyağı aroması kolaylıkla hissedilen, yarı sert, homojen tekstürde ve belirgin asidik tat da olan bir peynir çeşidi olarak bilinmektedir (Dağdemir, 2000). Bu peynirin, Trakya dışında ülkenin birçok yöresinde tercihen keçi veya koyun sütü karışımlarıyla üretilen farklı ambalaj materyalleri içinde (ör. deri, laklı teneke kutu, bez, plastik bidon) olgunlaştırıldıktan sonra tüketime sunulduğu belirtilmiştir (Keleş ve Atasever, 1996). Büyük bir kısmı kuru tipte olan ve başlıca 20 kadar çeşidi bulunan mahalli tulum peynirleri yaygın olarak üretildiği yöre isimleriyle anıldığı bilinmektedir (Tekinşen ve Uçar, 2007).
Üçüncü (2004), kuru tulum peynirlerini Orta Anadolu, Doğu ve Güneydoğu Anadolu bölgelerinde yaygın üretilmekte; salamura tulum peynirleri ise başta İzmir, Aydın ve Manisa olmak üzere Ege Bölgesi'nde üretilmekte ve İzmir Tulum Peyniri olarak tanınmakta olduğunu dile getirmiştir. Tulum peynirleri sade olduğu gibi, çörekotlu ve cevizli olarak daha çok kahvaltılarda kullanılmaktadır.

Çörek Otlu Keçi Tulum Peynirinde Çörekotu aromatik (hoş kokulu) özelliklerinden dolayı lezzet vermek için kullanılmaktadır. Antibakteriyel, antiinflamatuar, antioksidant ve bağışıklık sistemini kuvvetlendirici etkiye sahip çörek otunun peynir çeşitlerinde öğütülmemiş halde kullanıldığı belirtilmiştir (Ramadan ve Mörsöl, 2002).

Cevizli Keçi Tulumu; Keçi tulum peynirinin cevizlisi olarak bilinmektedir. Cevizli keçi tulum peyniri eşsiz bir lezzete ve farklı bir aromaya sahip olup kahvaltılarda tek başına tüketilebildiği gibi şarapların yanında da sıklıkla tercih edilen bir peynirdir.

Akçabelen Tulum Peyniri (Çepni); tam yağlı akşam sağımı keçi sütünden ilkbaharda üretilen ismini Beyşehir'in Akçabelen Yaylası'ndan alan mahalli bir tulum peyniridir (Ünsal, 1997).

Yöresel peynir çeşitleri arasında yer alan Çimi peyniri, daha çok Antalya'nın Akseki ve Serik yaylalarında, Manavgat köylerinde genellikle çiğ keçi sütünden üretilen bir çeşit tulum peyniri olarak tanımlanmaktadır (Ünsal, 1997). Geleneksel adı "tuluk" olarak bilinen keçi tulumları içine peynir hava almayacak şekilde doldurulduktan sonra olgunlaştırılmak üzere, bu yaylalardaki doğal mahzen ya da "obruk" adı verilen çoğu zaman içi karlarla dolu mağaralara yerleştirilir ve buralarda 3-4 ay olgunlaşmaya bırakılmaktadır (Kılıç ve ark., 2002). Bu peynir keskin kokulu ve gözeneksiz bir yapıya sahip olup renginin deriye yakın bölgeler sarımtırak iken orta kısımları beyaz olduğu bilinmektedir (Kiraz, 2018).

Sarımsak Otlu Tulum Peyniri: Van otlu peynirinde kullanılan taze sarımsak otunun tulum peyniri üretiminde kullanılmasıyla üretilen peynirdir.

Dolaz (Tort) Peyniri: Dolaz (Tort) peyniri, ülkemizde Akdeniz Bölgesinde Isparta ve çevresinde üretilen koyun, keçi ve inek sütlerinden yapılan Beyaz peynirlerin peynir altı sularının uzun süre kaynatılıp, soğutulup bez torbalardan süzdürülmesiyle elde edilen koyu veya açık kahverengi renkte bir peynir olduğu bildirilmiştir (Şimşek ve Sağdıç, 2006).

Ezine (Edirne) Peyniri: Türkiye'de büyük ölçeklerde üretilen ve bol miktarda tüketilen popüler bir peynir olan Ezine peynirinin (Uymaz ve ark., 2019) en ayrıcalıklı özelliği; üretiminde keçi, koyun ve inek sütü karışımının kullanılması, starter kültür kullanılmaması ve üretiminin geleneksel yöntemle gerçekleştirilmesi olarak belirtilmiştir (Tuncel ve diğ., 2010). Sütlerin karışım oranı TÜRK PATENT (2006) tarafından; keçi sütü için en az % 40, koyun sütü için % 45–55 ve inek sütü için de en fazla %15 olarak belirtilmiştir.

Akçakatık (Burdur) Peyniri: Günümüzde birçok yörede geleneksel olarak üretilmekte olan Akçakatık peynirinin; Burdur ilinde tam yağlı sütten üretilen taze yoğurdun keçi ya da inek

karnı içerisinde karanfil ve tuz ile 3-6 ay olgunlaştırılması ile elde edilen bir peynir çeşidi olduğu dile getirilmiştir (Gün ve Şimşek, 2006; Memiş ve Ersoy, 2008).

Çanak Peyniri (Yozgat): Topraktan yapılmış çanak içerisine basıldıktan sonra kuma gömülerek olgunlaştırılan Yozgat Çanak peyniri, Yozgat merkez ve ilçelerinin doğal bitki örtüsü ve su kaynaklarıyla beslenen koyun, keçi ve ineklerden elde edilen sütlerden yapılan, kendine özgü tat ve aromaya sahip, az olgun ve yarım yağlı bir peynir olduğu bildirilmiştir (TÜRKPATENT, 2017).

Hatay Carra Peyniri: Geleneksel peynirlerimizden olan Carra peyniri Hatay ilinde en çok tüketilmekte olan genellikle keçi sütünden elde edilen bir peynir çeşidimizdir. Carra kelime anlamı olarak toprak kap anlamına gelmektedir. Bu peynire çörek otu ve kekik ilave edilmekte (Hayaloğlu ve Fox, 2008) ve sırlı testilere veya kavanozlara doldurulan Carra peyniri en az 4-5 ay olgunlaşmak için toprak altına (1.5 m derinlikte) gömüldüğü dile getirilmiştir (Güzeler ve Kılınçlı, 2018).

Tortu (Ekişimik): Isparta ili Sütçüler ilçesinde "tortu" veya "ekşimik" olarak bilinen çökelek, yayık artığı, koyun veya keçi sütünden yapılmış yoğurdun ayranına süt ilave edilerek kaynatılması sonucu elde edildiği bilinmektedir (Kırdar 2004a).

Maraş Parmak/Sıkma Peyniri: Maraş Parmak/Sıkma Peyniri, TÜRKPATENT (2021) tarafından pastörize edilmiş inek/keçi/koyun sütlerinden veya bunların karışımından üretilen, sıcak suda iki parmak (yaklaşık 2-3 cm) genişliğinde şekil verilen bir peynir olarak tanımlanmış ve üretimden sonra her hangi bir işlem yapılmadan yenilebildiği gibi her çeşit börek ve güveç yapımında ve tuzu alınmak suretiyle tatlı yapımında kullanılabileceği bildirilmiştir.

Keçi Füme Çerkez Peyniri: Çerkezlerin yoğun olduğu Sinop, Düzce, Adapazarı, Balıkesir, Bursa, Samsun, Sivas, Kayseri, Biga çevresinde ve daha az olarak diğer illerde aile işletmeleri ve küçük mandıralarda üretilen ve taze ya da olgun olarak tüketilen geleneksel Çerkez peyniri dumanlanarak üretildiğinde füme Çerkez peyniri olarak tanımlanmaktadır (Kamber,2008). Bu peynirin yapı olarak yumuşak bir peynir olduğu belirtilmiştir (Acar ve Karaosmanoğlu, 2019). Dumanlama yönteminin gıdaları dayanıklı hale getirmek ve duyusal kaliteyi de artırmak için kullanıldığı bilinmektedir. Ürüne kazandırdığı karakteristik renk, lezzet ve aroma nedeniyle

yeni ürünlerin geliştirilmesinde de dumanlama tekniğinin önemli olduğu dile getirilmiştir (Başak ve Şengör 2006, Özcan ve ark. 2008).

Keçi Mihalliç (Kelle) Peyniri: Mihalliç (Kelle) peynirinin Osmanlılar döneminde göçmen Arnavutların ön ayak olmasıyla Mihalıç yöresinde (bugünkü adı ile Karacabey ilçesi), yaklaşık 250 yıldır üretilen geleneksel bir peynir olduğu bilinmektedir (MEB, 2011).

Varto Keçi Peyniri: Varto keçi peyniri üretiminde süt ısıtılıp mayalanmakta, maya ilavesinden sonra oluşan pıhtı suyundan ayrılmak üzere bez torbalara boşaltılmaktadır. Daha sonra torbaların üzerine ağırlık konularak peynir suyunun tamamen ayrılması sağlanmaktadır. Sertleşen teleme, bir müddet sonra torbalardan çıkarılıp bıçak ile parçalanmaktadır. Muş Varto Keçi peyniri, taze olarak tüketilebildiği gibi, el ile ufalanarak bidonlara basılmakta ya da isteğe bağlı olarak salamura içinde saklanabildiği bildirilmiştir (Çetinkaya, 2005).

SONUÇ

Keçi peyniri üretiminde büyük öneme sahip kıl keçisi yetiştiriciliğine ve süt verimine daha fazla önem verilmelidir. Keçi sütü beslenme açısından değerli olduğundan dünya genelinde keçi yetiştiriciliğine verilen önem son zamanlarda artmaktadır. Beslenme açısından değerli olan keçi sütü ürünlerinin gerek üretim gerekse tüketim açısından ülkemizde de artması için; üreticilere daha çok destek verilmelidir. Peynirler ile ilgili yapılan çalıştay, sempozyum gibi bilimsel toplantılar, peynir tadım günleri, festivaller, kamu spotları gibi etkinlikler geleneksel gıdaya olan yönelimi artıracağından bu tür etkinliklere daha fazla önem verilmelidir. Bu bağlamda yöresel keçi peynirlerinin bilinirliğinin artması için ürünlere standart bir üretim metodu getirilerek coğrafi işaret çalışmalarının da artması ve Ezine peyniri dışında uluslararası tescil için çalışmaların yapılması gerekmektedir. Geleneksel peynirlerin gelecek nesillere aktarılması ve bilinirliğinin artması için; bu peynirlerin kayıt altına alınması, üretim teknolojilerinin geliştirilerek standardize edilmesi, daha fazla peynirin coğrafi işaret tescilinin alınması için çalışmalar yapılmalıdır. Coğrafi işaretli peynirlerimizde denetimlerin yapılması ve sürdürülebilirliğin sağlanması gereklidir. Ayrıca kültürel mirasımız içinde yaklaşık 200 çeşit geleneksel peynir olduğu bilinmektedir. Bu peynirlerin tamamının tanımlamaların yapılarak, geleneksel peynirler ait veri tabanının oluşturulması gerekmektedir.

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OZMOTİK KOŞULLANDIRMA VE HUMİDİFKASYON UYGULAMLARININ HAVUÇ TOHUMLARININ TOHUM ÇİMLENMESİ ÜZERİNE ETKİLERİ

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ÖZET

Çalışma çimlenmesi zor olan havuç (Daucus carota L.) tohumlarında çimlenmeyi kolaylaştırmak, hızlandırmak ve tohum performansını arttırmak için yapılmıştır. Ozmotik koşullandırma (OK) uygulamaları Polyethylene Glycol (PEG-6000) ile –1.0 MPa (273 g/L H2O) da 5 ve 7 gün süre ile yapılmıştır. Humidifikasyon uygulamaları ise 1,2 ve 3 gün süre ile yapılmıştır. En yüksek çimlenme oranı %69.5 ile 2 gün humidifikasyon uygulamasından elde edilmiş en düşük çimlenme oranı %52 ile kontrol grubu tohumlardan elde edilmiştir. En kısa ortalama çimlenme süresi 4.85 gün ile 7 gün PEG ile OK uygulamasından elde edilmiş, en yüksek ortalama çimlenme süresi 6.74 gün ile bir gün humidifikasyon uygulamasından elde edilmiş, kontrol grubu tohumları ise 6.27 gün olmuştur. En yüksek çimlenme indeksi 5.80 ile 7 gün PEG ile OK uygulamasından elde edilirken, en küçük çimlenme indeksi 4.04 ile kontrol grubu tohumlardan elde edilmiştir. Bu çalışmada tohum ekiminden önce PEG 6000, KH_2PO_4 gibi kimyasal maddelerle ile yapılan ozmotik koşullandırma uygulamalarına ilaveten humidifikasyon uygulamalarının, tohum çimlenmesi ve tohum gücüne olumlu katkılar yapabileceği ortaya konmuştur. PEG 6000 ve KH_2PO_4 birer kimyasaldır. Özellikle doz ve süre ayarlamasının üretici tarafından hazırlanması pratikte sorunlar çıkarabilir. Humidifikasyon uygulaması uygulama kolaylığı, organik bir materyal olan saf su ile yapılabilir olması, maliyeti vb konular dikkate alındığında, daha ön plana çıkabileceği öngörülmektedir. Günümüzde çevre sorunları nedeniyle, mümkünse hiç kimyasal kullanmadan tarımsal üretim yapılması desteklenmektedir. Veya en az kimyasal kullanarak üretim yapılması önerilmektedir. Tüm bu faktörleri dikkate aldığımızda humidifikasyon uygulamalarının çimlenmesinde sorun olan diğer sebze türlerinde etkilerinin araştırılması tohum teknolojisi açısından önem arz etmektedir. Bu konuda çalışmaların devam etmesi yerinde olacaktır.

Anahtar kelimeler: Havuç, PEG, humidifikasyon, çimlenme oranı, ortalama çimlenme süresi

THE EFFECTS OF OSMOTIC CONDITIONING AND HUMIDIFICATION TREATMENTS ON SEED GERMINATION OF CARROT SEEDS

ABSTRACT

The study was carried out to facilitate and accelerate germination of carrot (Daucus carota L.) seeds, which are difficult to germinate, and to increase seed performance. Osmotic conditioning (OC) applications were made with PEG-6000 at –1.0 MPa (273 g/L H_2O) for 5 and 7 days. Humidification applications were carried out for 1,2 and 3 days. The highest germination rate with 69.5% was obtained from the 2-day humidification application, and the lowest germination rate was obtained from the control group seeds with 52%. The shortest mean germination time was 4.85 days with 7 days of PEG and OC application, the highest mean germination time was 6.74 days and one day humidification application, and control group seeds were 6.27 days. While the highest germination index was obtained from the application of OC with PEG for 7 days with 5.80, the smallest germination index was obtained from the seeds of the control group with 4.04. In this study, it was revealed that in addition to osmotic conditioning applications with chemicals such as PEG 6000 and KH_2PO_4 before seed planting, humidification applications can make positive contributions to seed germination and seed vigor. PEG 6000 and KH_2PO_4 are chemicals. In particular, the preparation of dose and time adjustment by the producer may cause problems in practice. It is predicted that the humidification application will come to the fore when the ease of application, the fact that it can be done with pure water, which is an organic material, its cost, etc. are taken into consideration. Today, due to environmental problems, agricultural production is supported without using any chemicals if possible. Or it is recommended to produce using at least chemicals. When we consider all these factors, it is important to investigate the effects of humidification applications on other vegetable species that have problems in germination in terms of seed technology. It would be appropriate to continue to work on this issue.

Keywords: Carrot, PEG, humidifikation, germination rate, mean gerniation time

GİRİŞ

Bitkisel üretimde yetiştiriciliğin ilk aşaması, tohum ekilmesi ve bunların uygun koşullarda çimlendirilmesidir. Ancak, bu aşamada oluşan olumsuz ekolojik koşullar ve teknik hatalar (düşük toprak sıcaklığı, toprakta kaymak tabakasının oluşumu vs.) çimlenme ve fide çıkışını olumsuz yönde etkilemektedir. Uygunsuz koşullarda ekilen tohumların düzgün bir çimlenme ve çıkış sağlayabilmeleri için hasat sonrası ve ekim öncesi bazı uygulamalar yapılmaktadır. Bu uygulamalar arasında tohumların; iriliklerine göre sınıflandırılması, ekim öncesi ıslatma, büyümeyi düzenleyiciler, vitaminler, besin maddeleri veya ozmotik çözeltilerde tutulması, çimlendikten sonra jel halinde ekilmesi, kaplama ve bantlama sayılabilir (Heydecker ve Coolbear 1977, Hegarty 1986).

Son yıllarda kullanılan ekim öncesi uygulamalardan biri de tohumların ozmotik çözeltilerde tutulmasıdır. Bu uygulamalarda amaç, tohum içindeki su ile dışındaki çözeltinin ozmotik basınçları arasında fark yaratmak, böylece çimlenmeyi başlatacak kadar suyun girişini sağlamaktır. Teorik olarak çimlenmesi uyarılmış tohumlar hızlı ve yüksek oranda çıkış göstermektedir. Ozmotik çözelti olarak; KNO_3, $KHPO_4$, K_3PO_4, KH_2PO_4 gibi maddelerin yanında son yıllarda Polyethylene Glycol de kullanılmaktadır. Konu üzerinde yapılan araştırmalar, özellikle çimlenmesi geç olan veya ekonomik önemi fazla olan; domates, havuç, kereviz ve soğan gibi türlerde yoğunlaşmıştır (Yanmaz ve Özdil 1992).

Sebze türlerinde ozmotik çözeltiler yoluyla çimlenmenin uyarılabildiği ilk kez 1963 yılında domates tohumlarında Ells tarafından bulunmuştur. Bu çalışmada, KNO_3 + K_3PO_4 çözeltisinde belirli süreyle tutulan domates tohumlarında çıkış oranının arttığı belirlenmiştir. Ells'in yaptığı bu çalışmadan sonra o tarihe kadar daha çok tarla bitkileri tohumları üzerinde yoğunlaşan araştırmalar, sebze tohumları üzerinde de yapılmaya başlamıştır (Heydecker ve Coolbear 1977).

MATERYAL ve YÖNTEM

Çalışma 2022 ylında Kayseri üniversitesi Safiye Çıkrıkçıoğlu MYO okuluna ait labaratuvarda yürütülmüştür. Bitkisel materyal olarak "Nantes" havuç çeşidi tohumları kullanılmıştır. Tohumlara yapılan ön uygulamalar Şehirali (1997) ye göre aşağıdaki şekilde yapılmıştır. Tohumlara -1.0 MPa PEG-6000 (273 g/L) Sivritepe ve Demirkaya (2002) çözeltisi ile 5 ve 7 gün ozmotik koşullandırma uygulamaları yapılmıştır. Bir petri kabının altına ve üstüne filtre kâğıtları yerleştirilmiştir. Petri kabına 1 g tohum 0.01 g hassasiyetle tartılarak konmuştur. Tohumları yerleştirdikten sonra her petri kabına 10 ml PEG-6000 çözeltisi konmuştur.

Uygulamadan sonra tohumlar önce 5 dakika çeşme suyunda yıkanmış, sonra saf su ile durulanmıştır (Anonim 1985 a, b).

Humdidifikasyon uygulamaları, bir desikatör içine 1 litre saf su konulmuş ve suyun en üst seviyesinden yaklaşık 15 cm yukarısına metal bir ızgara yerleştirilmiştir. Bu metal ızgara üzerine bir higrometre konulmuş ve desikatörün kapağı sıkıca kapatılmıştır. Sonra 20 ± 1C'de çalışan bir inkübatör içine yerleştirilen desikatör içindeki havanın oransal neminin %100'e ulaşması beklenilmiştir. Daha sonra 0.01 g hassasiyetle tartımı yapılan 1 g tohum (her bir grup için) bir petri kabı içine konulmuş ve üstü açık kalacak şekilde desikatörün içindeki metal ızgaranın üzerine yerleştirilmiştir. Sonra desikatörün kapağı sıkıca kapatılarak humidifikasyon uygulamaları yapılmıştır (Sivritepe ve Demirkaya 2002)

Bu araştırmada; hidrasyon uygulamalarından, humidifikasyon ve PEG ile priming uygulamalarına başlamadan önce, uygulamada kullanılacak olan petriler ve filtre kâğıtları etüv içinde 170 ± C'de 1 saat tutularak sterilize edilmişlerdir. Çalışmaya başlamadan önce ortam ve petri kapları bir kez de %70'lik alkol ile dezenfekte edilmiştir. Sonra petri kapları saf su ile yıkanıp kağıt havlu ile kurulanmıştır. Böylece Rhizopus stolonifer, Alternaria sp. gibi funguslar ve saprofit bakterilerin muhtemel zararlı etkileri ortadan kaldırılmıştır.

Uygulamalarından sonra 4 tekerrürden oluşan (her tekerrürde 50 tohum) toplam 200 tohumla 25 ± 1°C'de ve ISTA kurallarına bağlı kalınarak yapılmıştır (Anonim 1985a, b). Her tekerrürde petri kaplarından kökçüğü ve başçığı tam oluşmuş genç fideler çimlenmiş olarak kabul edilip sayımları yapılmıştır. Radikula ve plumulası tam şeklini almayan tohumlar (anormal çimlenmiş tohumlar) ayrı bir grup olarak değerlendirilmiştir. Sayımlar tohumların ortamdan atılması suretiyle yapılmış ve sayımlara14. güne kadar devam edilmiştir. Tohum canlılığı 14 gün sonunda yüzde çimlenme (normal çimlenen tohumların yüzdesi) olarak belirlenmiştir. Anormal çimlenen tohumların nitelikleri: Bir temel organı (epikotil ya da hipokotil) eksik ya da kötü ve düzelmeyecek şekilde zarar görmüş, zayıf gelişmiş, fizyolojik olarak tahrip olmuş ya da temel yapıları deforme olmuş ya da kaybolmuş; temel yapılarından bir kısmı primer enfeksiyon sonucu hastalıklı ya da çürümüş ve normal gelişmesi önlenmiş çimler anormal çimlenen tohum olarak kabul edilmiştir (Bekendam ve Grob 1979). Ortalama çimlenme süresi Ellis ve Roberts (1981)'e göre hesaplanmıştır. Çimlenme indeksi ise (Copeland, L.O., Mc Donald 2001)'e göre hesaplanmıştır. Verilerin istatistiki olarak değerlendirilmesi "SSPS 13.0 for Windows" istatistik programında yapılmış, ortalamalar arasındaki farklılıklar 0.05 önemlilik seviyesinde LSD testine göre belirlenmiştir.

BULGULAR ve TARTIŞMA

PEG 6000 ve humidifkasyon yapılan istatistiki analizler sonucunda çimlenme yüzdelerini kontrole göre artırmıştır (P <0.05). Tohum gücünün bir göstergesi olan ortalama çimlenme süresi bakımından, PEG uygulamaları kontrole göre ortalama çimlenme süresini kısaltmış, humidifikasyon uygulamaları kontrolle aynı sonucu vermiştir. Tohum performansının bir göstergesi olan çimlenme indeksi bakımından PEG uygulamaları kontrole göre arttırmış, humidifikasyon uygulamaları kontrolle aynı sonucu vermiştir (Tablo-1). Daha önce yapılan çalışmalarda (Şeniz ve ark. 1993, 4 ve 8 gün PEG; Duman ve Eşiyok (1998) 10 gün süre ile PEG uygulamışlar ve tohum canlılığı üzerine etkilerini incelemişlerdir. Yaptığımız çalışma ile bu sonuçlar paralel olmuştur. Ayrıca humidifikasyon uygulamalarının daha ucuz ve kolay ve daha kısa sürede olumlu sonuçlar verdiği ortaya konmuştur. Uygulama süresi arttıkça maliyetlerin ve tohumların patojenlerle bulaşama riskinin arttığı unutulmamalıdır.

Tablo 1. Farklı sürelerde –1 MPa' PEG ve humidifkasyon uygulamalarının çimlenme, ortalama çimlenme süresi ve çimlenme indeksi üzerine etkileri

	Çimlenme (%)	Ortalama çimlenme süresi (gün)	Çimlenme İndeksi
Kontrol	52 b*	6.27 a	4.04 b
7 gün PEG	63 a	4.85 b	5.80 a
5 gün PEG	62.5 a	5.14 b	5.79 a
1 gün humidifikasyon	62.5 a	6.74 a	4.96 ab
2 gün humidifikasyon	69.5 a	6.69 a	4.34 b
3 gün humidifikasyon	66.5 a	6.55 a	4.84 ab

* Harfler 0.05 düzeyinde LSD testine göre ortalamalar arasındaki farklılıkları göstermektedir (P < 0.05)

Bu sonuçlara göre tohumlar ekim öncesinde PEG ile ozmotik koşullandırma uygulamalarına tabii tutuldukları zaman çimlenme yüzdelerini, çimlenme indeksini arttırmış, hem de tohum gücünün bir ifadesi olan ortalama çimlenme süresinin kısaldığını görmekteyiz. Humidifikasyon uygulamaları çimlenme oranları ve çimlenme indeksini arttırmıştır. Bu sebeple özellikle olumsuz koşullarda (uygun olmayan toprak koşulları vb.) tohum ekimi yapılacaksa ekim öncesi uygulama yapılması yerinde olacaktır.

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ENVIRONMENTAL AND HEALTH IMPACTS OF AIR POLLUTION: A REVIEW

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ABSTRACT
Air pollution is a major problem of recent decades, which has a serious toxicological impact on human health and the environment. The main consequences of air pollution are global warming, acid rain, smog, ozone depletion etc. According to W.H.O. report air pollution causes about 2 million premature deaths worldwide per year. In this paper, we aimed to discuss the toxicology of major air pollutants, causes, effects, sources of emission, and their impact on human health and the environment.

Keywords: Ecosystem, Global Warming, Human Health, Environment, Pollution, Smog

INTRODUCTION

Environmental pollutants are achieving demanding proportions globally. Urbanization and industrialization along with financial development have brought about an increase in electricity consumption and waste discharges. Global environmental pollutants, which includes greenhouse gas emissions and acid deposition, in addition to water pollution and waste control is considered as global public fitness problems, which should be investigated from more than one perspectives which include social, economic, legislative, and environmental engineering structures, as well as way of life conduct, supporting health promotion and strengthening environmental systems to resist infection. One of our era's greatest scourges is air pollution, on account not only of its impact on climate change but also its impact on public and individual health due to increasing morbidity and mortality. There are many pollutants that are major factors in disease in humans. (Manisalidis, I., Stavropoulou,2020) In 2014, the World Health Organization (WHO) estimated that 92% of the world population was living in places with less than optimum outdoor air quality. Furthermore, WHO reported that in 2012, outdoor air pollution caused around 3 million deaths worldwide and 6.5 million deaths (11.6% of all global deaths) were associated with indoor and outdoor air pollution together (Sweileh, W. M. 2018)

Review of Literature

Kumar, D.P (2021) Air pollution usually causes respiratory problems such as Chronic Obstructive Pulmonary Disease (COPD), asthma, bronchiolitis, lung cancer, cardiovascular events, central nervous system dysfunctions, and cutaneous diseases. Added to this, the climate change resulting from environmental pollution affects the geographical distribution of many infectious diseases like natural disasters as well as affects social and environmental determinants of health. Barua, S. (2020) among the regions studied, Europe excluding the EU and the UK sees the largest emissions reduction from increased indoor mobility. While short-run effects are limited, emissions in US-Canada respond to indoor and outdoor mobility changes both in the short and long run. My paper’s findings validate and qualify the on-going discussion and call for policies to curb unnecessary outdoor mobility to maintain air quality in the post-pandemic world. Miller, S., & Vela, M. (2013) In addition to the morbidity and mortality concerns of outdoor air pollution, studies have shown that air pollution also generates problems for children's cognitive performance and human capital formation. High concentrations of pollutants can affect children's learning process by exacerbating respiratory illnesses, fatigue, and absenteeism and attention problems. Igboekwe, M., & Eke, K. (2021) the effect of air pollution can be remedied by making a substitution of ozone layer depletion like

chlorofluorocarbon with hydrochlorofluorocarbon, carbon dioxide and water for fire extinguishing and others. The city of Port Harcourt has the highest sunburn unit of 14.1 mL in the month of March, and the cities of Ikeja and Calabar have their highest sunburn units of 14.5 mL in the month of December. These figures indicate the period of highest stratospheric ozone layer depletion. Hence, it is observed that air pollution can be hazardous, but if the rate of pollution is reduced drastically, the ozone layer can be restored. Ahmadvand, A., & Eghbali, H. (2020) In the past years, the increasing trend of air pollution in metropoles around the world has turned this into a serious challenge, and its negative impacts have developed in different social, environmental and economic fields. Undoubtedly, one of the negative and serious impacts is the increasing number of patients due to air pollution.

Methods

This paper is theatrical nature. This paper is purely based on secondary data referring to various sources such as newspaper articles, research papers from Scopus, and web science and Report.

Objectives of The Study

- To study the impact of air pollution regarding the human health
- To study the impact of air pollution regarding the environment

Effects of Air Pollution on Environment

Air pollution has significant and wide-ranging effects on the environment. It poses a threat to various ecosystems, biodiversity, and human health. Here are some of the key effects of air pollution on the environment:

Climate Change: Air pollution contributes to climate change through the release of greenhouse gases, such as carbon dioxide (CO2) and methane (CH4). These gases trap heat in the atmosphere, leading to global warming and subsequent environmental impacts like rising temperatures, melting ice caps, and altered weather patterns.

Smog Formation: Certain air pollutants, including nitrogen oxides (NOx) and volatile organic compounds (VOCs), combine with sunlight to form ground-level ozone, commonly known as smog. Smog is harmful to both human health and vegetation. It can damage plant tissues, reduce crop yields, and contribute to respiratory issues in humans.

Acid Rain: Air pollution, particularly sulfur dioxide (SO2) and nitrogen oxides (NOx) emissions from industrial activities and power plants, can lead to acid rain. Acid rain occurs when these pollutants react with moisture in the atmosphere, forming acidic compounds that

fall to the ground. Acid rain can harm forests, lakes, and aquatic ecosystems, leading to the decline of fish populations and degradation of soil quality.

Biodiversity Loss: Air pollution can have detrimental effects on biodiversity. Pollutants can directly damage plants and animals, disrupt ecosystems, and alter natural habitats. It can impair photosynthesis in plants, leading to reduced growth and decreased productivity. Airborne pollutants can also settle on water bodies, affecting aquatic life and disrupting delicate ecological balances.

Ozone Depletion: Certain man-made chemicals, such as chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs), contribute to the depletion of the ozone layer in the upper atmosphere. The thinning of the ozone layer allows harmful ultraviolet (UV) radiation to reach the Earth's surface, increasing the risk of skin cancer, cataracts, and other health problems in humans, as well as impacting marine and terrestrial ecosystems.

Soil and Water Contamination: Airborne pollutants can settle on land and water surfaces, contaminating soils and water bodies. This contamination can harm plants, reduce soil fertility, and disrupt the balance of aquatic ecosystems. Toxic pollutants, such as heavy metals and persistent organic pollutants, can enter the food chain, posing risks to both wildlife and human health.

Disruption of Ecosystem Services: Air pollution can disrupt the provision of ecosystem services, which are essential for human well-being. For example, pollution-related damage to pollinators like bees can have significant impacts on agricultural productivity and food security. Similarly, the decline of forest ecosystems due to air pollution can reduce their ability to purify air and water, regulate climate, and provide habitat for wildlife. Addressing air pollution requires concerted efforts to reduce emissions, improve industrial practices, promote sustainable energy sources, and adopt cleaner technologies. By mitigating air pollution, we can protect the environment, safeguard human health, and preserve the delicate balance of ecosystems.

Effects of Air Pollution on Human Health

Air pollution has severe effects on human health, both in the short term and long term. Exposure to polluted air can lead to various health problems, including:

Respiratory Issues: Air pollution can cause or exacerbate respiratory diseases such as asthma, bronchitis, and chronic obstructive pulmonary disease (COPD). The fine particles and toxic gases present in polluted air can irritate the respiratory system, leading to inflammation, coughing, wheezing, and difficulty breathing.

Cardiovascular Problems: Long-term exposure to air pollution is linked to an increased risk of cardiovascular diseases. Fine particulate matter (PM2.5) and other pollutants can enter the bloodstream, causing inflammation, oxidative stress, and damage to blood vessels. This can lead to conditions like heart attacks, strokes, and high blood pressure.

Increased Mortality: Prolonged exposure to high levels of air pollution has been associated with increased mortality rates. The elderly, young children, and individuals with pre-existing respiratory or cardiovascular conditions are particularly vulnerable. Air pollution-related deaths can result from respiratory and cardiovascular diseases, as well as lung cancer.

Impaired Lung Development: Children exposed to air pollution may experience impaired lung development, which can have long-term consequences for their respiratory health. It can lead to reduced lung function, increased susceptibility to respiratory infections, and higher chances of developing chronic respiratory conditions later in life.

Cancer: Certain air pollutants, such as benzene, formaldehyde, and polycyclic aromatic hydrocarbons (PAHs), are classified as carcinogens. Prolonged exposure to these pollutants increases the risk of developing lung cancer and other types of cancer, including bladder, liver, and skin cancer.

Allergies and Irritation: Air pollution can trigger allergies and cause irritation of the eyes, nose, and throat. Pollutants like ozone and nitrogen dioxide can worsen symptoms in individuals with existing allergies or respiratory conditions.

Neurological Effects: Emerging research suggests that air pollution can have adverse effects on the brain and nervous system. Exposure to pollutants has been associated with cognitive impairments, decreased cognitive function in children, and an increased risk of neurodevelopmental disorders, such as autism and attention deficit hyperactivity disorder (ADHD). It is important to note that the health effects of air pollution can vary depending on the type and concentration of pollutants, duration of exposure, and individual susceptibility. Efforts to reduce air pollution, promote clean energy sources, and improve air quality standards are crucial for protecting human health and well-being. Additionally, individuals can take measures to reduce personal exposure, such as staying indoors on days with high pollution levels, using air purifiers, and wearing masks in highly polluted areas.

Air Pollution Causes

I. Natural Causes

- **Volcanic activities**

Volcanic eruptions emit a series of toxic gases (consisting of sulfur and chlorine) as well as particulate count (ash particles) however is typically limited to localized areas;

- **Winds and air currents**

Can mobilize pollution from the ground and delivery them over huge areas;

- **Wildfires**

Add carbon monoxide, in addition to particulate rely on, to the ecosystem (containing natural contaminants consisting of PAHs); could affect great areas, even though in trendy they are confined and can be contained;

- **Microbial decaying processes**

microorganisms which can be present in any surroundings have a chief position in herbal decaying strategies of dwelling organisms as well as environmental contaminants; this hobby effects within the natural launch of gases especially methane fuel;

- **Radioactive decay approaches**

For example, radon gasoline is emitted due to natural decay approaches of Earth's crust which has the capacity to accumulate in enclosed areas consisting of basements;

- **Increasing temperatures**

Make contributions to a growth inside the quantities of contaminants volatilizing from polluted soil and water into the air.

II. Anthropogenic Causes

- **Mining and smelting**

Emit into the air a spread of metals adsorbed on particulate remember that is suspended inside the air due to crushing & processing of mineralogical deposits;

- **Mine tailing disposal**

because of their high-quality particulate nature (resulting after crushing and processing mineral ores) constitute a source of metals to ambient air which might be spread by the wind over large regions;

- **Foundry activities**

Emit into the air a diffusion of metals absorbed on particulate remember that is suspended within the air due to processing of steel uncooked substances (along with using furnaces);

- **Transportation**
- Emits a series of air pollution (gases – such as carbon monoxide, sulfur oxides, and nitrogen oxides - and particulate count) via the tailpipe gases due to internal combustion of diverse fuels (generally gasses such as oxides of carbons, of sulfur, of nitrogen, in addition to natural chemical substances as PAHs)
- **Coal Power Plants**

Whilst burning coal this could emit a chain of gases as well as particulate matter with metals (consisting of As, Pb, Hg) and natural compounds (especially PAHs);

- **Agriculture**

Pollute the air generally thru emissions of ammonia gas and the software of pesticides/herbicides/pesticides which comprise poisonous volatile natural compounds;

- **Smoking**

Emits a series of toxic chemical substances which includes a chain of organic and inorganic chemical substances, a number of that are carcinogenic;

- **Dry Cleaned Clothes**

may additionally hold and emit inside the surroundings small quantities of chlorinated solvents (including PCE) or petroleum solvents which have been used by the dry cleaners; this may in the end create a health risk if the clothes returned from the dry cleaners are stored in enclosed indoor spaces.

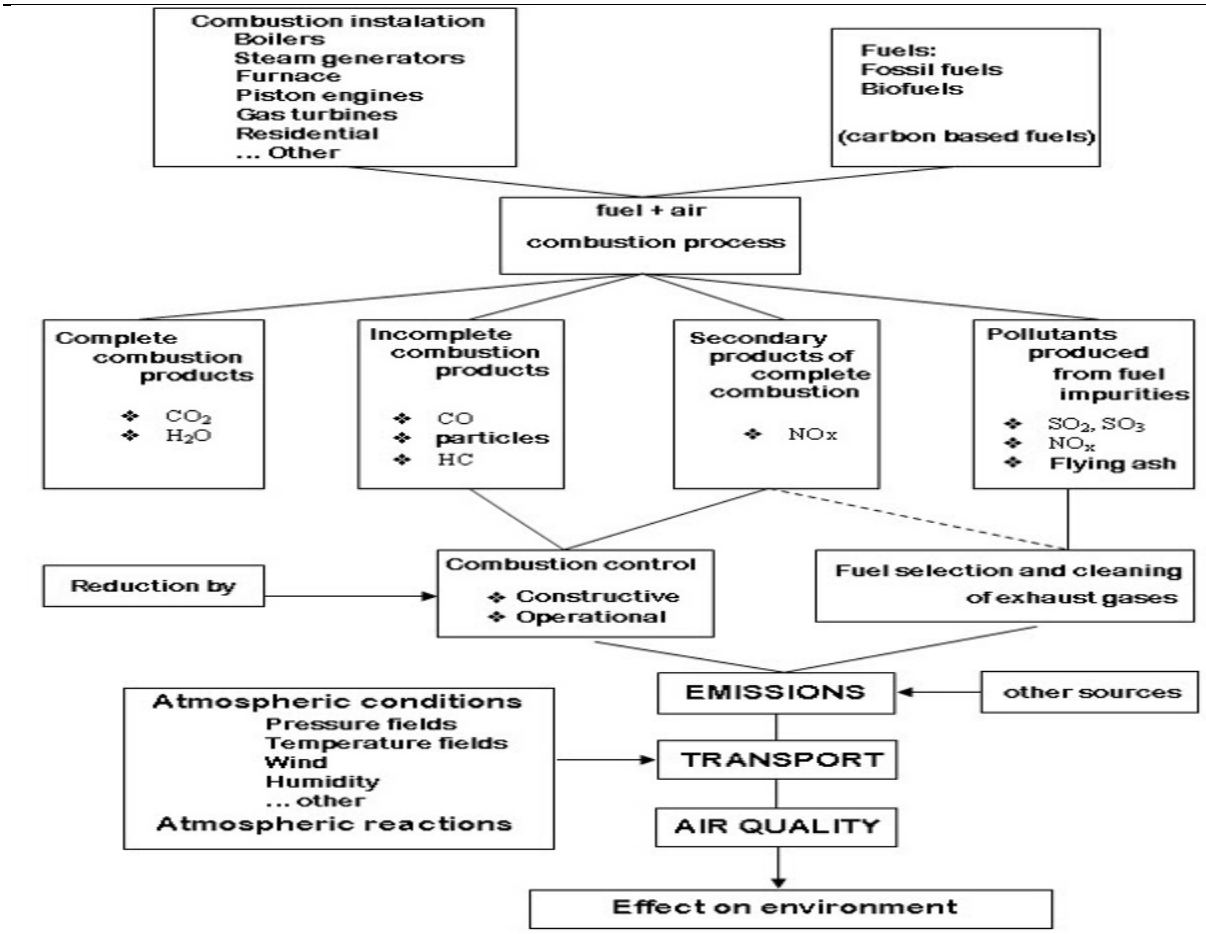

Figure1: Sources and Products of Anthropogenic Pollution
Source: www.researchgate.net/figure/Sources-and-products-of-anthropogenic-pollution

Table 2: Criteria air pollutants

Pollutant	Common Sources	Maximum Acceptable Concentration In The Atmosphere	Environmental Risks	Human Health Risks
carbon monoxide (CO)	automobile emissions, fires, industrial processes	35 ppm (1-hour period); 9 ppm (8-hour period)	contributes to smog formation	exacerbates symptoms of heart disease, such as chest pain; may cause vision problems and reduce physical and mental capabilities in healthy people
nitrogen oxides (NO and NO2)	automobile emissions, electricity generation, industrial processes	0.053 ppm (1-year period)	damage to foliage; contributes to smog formation	inflammation and irritation of breathing passages
sulfur dioxide (SO2)	electricity generation, fossil-fuel combustion,	0.03 ppm (1-year period); 0.14 ppm (24-hour period)	major cause of haze; contributes to acid rain formation, which subsequently	breathing difficulties, particularly for

	industrial processes, automobile emissions		damages foliage, buildings, and monuments; reacts to form particulate matter	people with asthma and heart disease
ozone (O3)	nitrogen oxides (NOx) and volatile organic compounds (VOCs) from industrial and automobile emissions, gasoline vapours, chemical solvents, and electrical utilities	0.075 ppm (8-hour period)	interferes with the ability of certain plants to respire, leading to increased susceptibility to other environmental stressors (e.g., disease, harsh weather)	reduced lung function; irritation and inflammation of breathing passages
particulate matter	sources of primary particles include fires, smokestacks, construction sites, and unpaved roads; sources of secondary particles include reactions between gaseous chemicals emitted by power plants and automobiles	150 µg/m3 (24-hour period for particles <10 µm); 35 µg/m3 (24-hour period for particles <2.5 µm)	contributes to formation of haze as well as acid rain, which changes the pH balance of waterways and damages foliage, buildings, and monuments	irritation of breathing passages, aggravation of asthma, irregular heartbeat
lead (Pb)	metal processing, waste incineration, fossil-fuel combustion	0.15 µg/m3 (rolling three-month average); 1.5 µg/m3 (quarterly average)	loss of biodiversity, decreased reproduction, neurological problems in vertebrates	adverse effects upon multiple bodily systems; may contribute to learning disabilities when young children are exposed; cardiovascular effects in adults
Source: U.S. Environmental Protection Agency				

CONCLUSION

Air pollutions have major effects on human health, triggering, and inducing many illnesses main to excessive morbidities and mortalities, mainly in developing countries. Therefore, air pollutions manage is essential and must be on the top of the priority listing of the governments. The policymakers and legislators in these international locations have to update all legal guidelines and rules associated with air pollutions. Coordination among one-of-a-kind

departments regarding in air pollutions have to be led by a effective environmental protection agency. A powerful environmental protection organization should have enough budgets for administration, research, improvement, tracking, and complete manipulation of the environment which includes air pollutants.

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ÖZET
Sumak, son yıllarda içerdiği faydalı bileşenler nedeniyle hayvan beslenmesinde üzerinde durulan tıbbi ve aromatik bitkilerden birisidir. Sumak, antimikrobiyal, antienflamatuar, antioksidan ve iştah açıcı özellikleri nedeniyle hayvanların sağlığını korumaya ve performanslarını artırmaya yardımcı olabilir. Tavukların genel sağlığına yardımcı olarak etki gösterdiği gibi yumurta üretimini artırarak üretimi ve yumurta kalitesi üzerinde olumlu etkiler yapmaktadır. Antimikrobiyal ve antienflamatuar özellikleri enfeksiyonları ve iltihaplanmayı önlerken, antioksidan özellikleri tavukların bağışıklık sistemini güçlendirebilir. Sumak bitkisi ruminant rasyonlarına eklenerek hayvanların sindirim sistemi sağlığını destekleyebilir, metan üretimini azaltabilir ve çeşitli sağlık faydaları sağlayabilir. Ancak dikkatli kullanılmalı ve aşırı miktarda verilmemelidir. Bu derleme ile sumak bitkisinin hayvan beslemede önemi vurgulanmaya çalışılmıştır.

Anahtar Kelimeler: Sumak, Broiler, Yumurtacı Tavuk, Bıldırcın, Hayvan Besleme

POSSIBILITIES OF USING SUMAC IN ANIMAL NUTRITION

ABSTRACT

Sumac is one of the medicinal and aromatic plants that have been emphasized in animal nutrition in recent years due to its beneficial components. Due to its antimicrobial, anti-inflammatory, antioxidant, and appetizing properties, sumac can help maintain the health of animals and increase their performance. It not only helps the general health of chickens, but also increases egg production and has positive effects on egg production and egg quality. Its antimicrobial and anti-inflammatory properties prevent infections and inflammation, while its antioxidant properties can boost chickens' immune systems. Sumac plants can be added to ruminant diets to support the digestive health of animals, reduce methane production, and provide various health benefits. However, it should be used with caution and should not be given in excessive amounts. In this review, the importance of the sumac plant in animal nutrition has been tried to be emphasized.

Keywords: Sumac, Broilers, Laying hen, Quail, Animal nutrition

GİRİŞ

Sumak bitkisi, bilimsel adıyla Rhus türleri, Anacardiaceae familyasına ait bir bitki türüdür. Sumak bitkisi, özellikle Akdeniz bölgesi ve Orta Doğu'da yaygın olarak bulunur (Adalı ve ark., 2023). Birçok farklı Rhus türü vardır, ancak genel olarak sumak bitkileri, çalı veya ağaç şeklinde büyüyebilen, sert ve odunsu gövdelere sahip bitkilerdir (Perone ve ark., 2022). Sumak bitkisinin en tanınmış türlerinden biri, Rhus coriaria'dır. Bu bitkinin kırmızı renkli meyveleri, öğütülerek baharat olarak kullanılır. Sumak baharatı, genellikle Türk mutfağında ve Orta Doğu mutfağında kullanılan bir tatlandırıcıdır. Meyveler, ekşi ve hafif acı bir tat profiliyle karakterize olup; salatalar, mezeler, et yemekleri ve çeşitli soslar için lezzet verici olarak kullanılır. Sumak bitkisi ayrıca tıbbi ve aromatik özellikleri nedeniyle de değerlidir. Yaprakları ve gövdeleri bazı durumlarda ilaç yapımında kullanılır. Ancak, sumak bitkisinin türlerine bağlı olarak, bazılarının temas dermatiti gibi cilt reaksiyonlarına neden olabilecek yağlar içerdiği bilinmektedir (Ünver ve Özcan, 2006; Rayne ve Mazza, 2007).

Sumak (Rhus coriaria), güçlü antimikrobiyal, antioksidan, antifungal ve antienflamatuar özelliklere sahip yüksek oranda biyoaktif bileşikler içeren potansiyel bir yem takviyesidir. Sumak meyveleri, kümes hayvanlarının performansı üzerinde çok çeşitli yararlı etkilere sahiptir (Shariatmadari ve Shariatmadari, 2020; Batiha ve ark., 2023; Osmólska ve ark., 2023).

Sumak, içerdiği birçok bileşik nedeniyle sağlık açısından faydalı olabilecek besleyici bir baharattır. İçeriğindeki organik asitler, özellikle sitrik asit, malik asit ve tartarik asit, sumak baharatına ekşi lezzetini verir. Ayrıca, sumakta bulunan fenolik bileşikler, antioksidan özellikleri nedeniyle sağlık açısından faydalıdır (Shahrajabian ve Wenli, 2022). Bunlar arasında flavonoidler, antosiyaninler ve tanenler yer alır. Sumak ayrıca C vitamini, A vitamini, E vitamini ve K vitamini gibi vitaminler ile demir, kalsiyum, magnezyum, potasyum ve fosfor gibi mineraller açısından zengindir. Bu nedenle, sumak tüketimi, bağışıklık sistemi sağlığı, kemik sağlığı ve enerji üretimi gibi çeşitli sağlık yararları sağlayabilir. Uçucu yağlar da, sumak bitkisinde bulunur ve baharatın aroma ve lezzetinde önemli bir rol oynar. Bunlar arasında limonen, pineen, kariofilen ve tümeng gibi bileşikler yer alır. Ancak, sumak bitkisindeki bileşiklerin miktarı, bitkinin türüne, yetiştiği bölgeye ve toprağın özelliklerine bağlı olarak değişebilir (Karadaş ve ark.,2020; Rad, Khaleghi ve Javadi, 2020; Sakhr ve Khatib, 2020).

Sumak bitkisi sağlığa pek çok faydası olan biyolojik bileşikler içermektedir. Önemli biyolojik etkilerini:

- Antioksidan özellikler: Sumak, içerdiği yüksek miktarda antioksidan bileşikler nedeniyle serbest radikallerin neden olduğu oksidatif stresi azaltabilir. Antioksidanlar, hücrelerin hasar görmesini önleyebilir ve yaşlanma sürecini yavaşlatabilir.
- Anti-enflamatuar özellikler: Sumak, antosiyaninler ve diğer fenolik bileşikler gibi anti-enflamatuar özelliklere sahip bileşikler içerir. Bu nedenle, sumak, iltihaplı durumların tedavisinde yardımcı olabilir.
- Anti-mikrobiyal özellikler: Sumağın, antifungal, antibakteriyel ve antiviral özelliklere sahip olduğu bilinmektedir. Bazı çalışmalar, sumak ekstraktının E. coli, Salmonella ve Staphylococcus aureus gibi zararlı bakterilerin büyümesini engelleyebileceğini göstermiştir.
- Sindirim sistemi sağlığı: Sumak, içerdiği organik asitler sayesinde sindirim sistemi sağlığına faydalı olabilir. Özellikle sumak, yemeklerin hazmını kolaylaştırmaya yardımcı olabilir ve gaz sorunlarına iyi gelebilir.
- Anti-kanser özellikler: Bazı araştırmalar, sumak ekstraktlarının bazı kanser hücrelerinin büyümesini engelleyebileceğini göstermiştir. Sumak, kanser önleyici özellikleri nedeniyle de önemli bir bitkidir.

Tablo 1. Sumak meyvesinin kuru ve taze şeklinin besin madde kompozisyonu (Bahita ve ark., 2022).

Besin Madde Kompozisyonu	**Taze**	**Kurutulmuş**
Nem, %	10.60	2.43
Yağ, %	7.40	18.74
Protein, %	2.60	4.69
Ham selüloz, %	14.60	-
Karbonhidrat, %	-	71.21
Kül, %	1.80	2.93
Suda çözülebilir ekstrakt	63.80	-
Asitlik, %	4.60	-
pH	3.70	3.02

Yapılan bir araştırmada, yemdeki sumak düzeyi arttıkça yemdeki nem ve yağ düzeyinin azaldığı, buna karşılık protein ve kül içeriğinde artış olduğu tespit edilmiştir (Ibraheem ve ark., 2022). Sumak bitkisinde bulunan yağ asitleri, vitamin ve mineral içerikleri Tablo 2'de verilmiştir (Ozcan ve Hacıseferogulları, 2004).

Tablo 2. Sumaktaki temel besinler (Ozcan ve Hacıseferogulları, 2004)

Besinler	Oran
Oleik asit, %	37.70
Linoleik asit, %	27.40
Palmitik asit, %	21.10
Stearik asit, %	4.70
Diğer yağ asitleri, %	9.10
Vitamin B6, ppm	69.83
Vitamin C ppm	38.91
Vitamin B1, ppm	30.65
Vitamin B2, ppm	24.68
Nikotinamid, ppm	17.95
Potasyum, ppm	7963,35
Kalsiyum, ppm	3661,57
Fosfor, ppm	1238,74
Magnezyum, ppm	855,95
Demir, ppm	144,53

Alsamri ve Athamneh (2021), sumak bitkisinin önemli miktarda kalsiyum, magnezyum, fosfor, demir, sodyum, manganez ve bakır içerdiğini bildirirken; mineral içeriklerinin çevresel faktörler ve bölgesel koşullardan etkilendiğini açıklamışlardır.

Hayvan Beslemede Kullanımı

Sumak bitkisi, hayvan beslemede kullanılan birçok bitki türünden biridir. Sumak, içerdiği yararlı bileşikler nedeniyle hayvanların sağlığını korumaya yardımcı olabilir ve performanslarını artırabilir. İşte sumak bitkisinin hayvan beslemedeki kullanımlarından bazıları aşağıdadır:

- Yem katkısı: Sumak, yemlere baharat olarak katılarak hayvanların iştahını artırabilir. Ayrıca, sumak bitkisi, sindirim sistemini düzenleyerek yemlerin daha iyi emilmesine yardımcı olabilir.
- Antibakteriyel etki: Sumak bitkisi, içerdiği antimikrobiyal bileşikler sayesinde hayvanlarda enfeksiyon riskini azaltabilir. Sumak, özellikle hayvanlarda sık görülen bağırsak enfeksiyonlarına karşı etkilidir.

- Anti-inflamatuar etki: Sumak bitkisi, anti-enflamatuar özellikleri sayesinde hayvanlarda inflamasyonu azaltabilir. Bu nedenle, sumak bitkisi, hayvanlarda artrit, osteoartrit ve diğer inflamatuar hastalıkların tedavisinde kullanılabilir.
- Antioksidan etki: Sumak, içerdiği antioksidanlar nedeniyle hayvanların sağlığını koruyabilir. Sumak, hücre hasarını önleyebilir ve hayvanların bağışıklık sistemini güçlendirebilir.
- Tatlandırıcı: Sumak, hayvan yemlerine doğal bir tatlandırıcı olarak eklenerek hayvanların yemleri daha iştah açıcı hale getirilebilir.

Kanatlı Hayvan Beslemede Kullanımı

Cinnamaldehyde ve eugenol, sumak bitkisinde bulunan doğal bileşiklerdir ve antimikrobiyal, antioksidan ve anti-enflamatuar özellikleri vardır. Tavuklar üzerinde yapılan bazı araştırmalar, bu bileşiklerin kullanımının tavukların sağlığını olumlu etkileyebileceğini göstermiştir. Cinnamaldehyde ve eugenol, tavukların sindirim sisteminin düzenlenmesine ve enfeksiyonlara karşı korunmasına yardımcı olur. Bu bileşikler, tavukların bağırsaklarında bulunan zararlı bakterilerin büyümesini engelleyebilir ve bu nedenle tavukların bağırsak sağlığını korur. Bu da tavukların besinlerini daha iyi değerlendirmelerine ve daha fazla canlı ağırlık kazanmalarına yardımcı olur. Ayrıca, cinnamaldehyde ve eugenol'un anti-enflamatuar etkileri, tavukların inflamasyonlu hastalıklardan daha az etkilenmelerine yardımcı olmakla birlikte tavukların daha sağlıklı büyümelerine ve daha fazla verimli olmalarına yardımcı olmaktadır (Langhout, 2000; Mazloom, 2011; Ghasemi ve ark., 2014).

Sumak bitkisi, içeriğindeki doğal bileşikler nedeniyle kanatlı et kalitesini olumlu etkileyebilir. Sumak bitkisi, antioksidan, antimikrobiyal ve anti-inflamatuar özellikleriyle bilinir. Bu özellikleri sayesinde, sumak bitkisi kanatlı hayvanların sağlığını koruyabilir ve et kalitesini artırabilir. Özellikle, sumak bitkisinin antioksidan özellikleri, etteki lipidlerin oksidasyonunu önleyerek etin tazeliğinin korumasına yardımcı olabilir. Ayrıca, sumak bitkisi, etteki lipid peroksidasyonunu da azaltarak etin daha sağlıklı olmasını sağlayabilir. Sumak bitkisi ayrıca antimikrobiyal etkileri sayesinde, kanatlı hayvanlarda enfeksiyonların önlenmesine yardımcı olabilir. Bu da etin kalitesini artırarak, daha taze ve sağlıklı bir et üretimi demektir (Mansoub, 2012; Hoseeini Sayar ve Farahavar, 2017).

Sumak bitkisi, yumurta tavuğu üretimi ve yumurta kalitesi üzerinde olumlu etkilere sahiptir. Sumak bitkisi, içeriğindeki doğal bileşikler sayesinde tavukların sağlıklı olmasına ve yumurta üretimlerinin artmasına yardımcı olmaktadır. Bunun yanı sıra, sumak bitkisi, yumurta sarısında bulunan doymamış yağ asidi miktarını artırmaktadır. Doymamış yağ asitleri, insan sağlığı açısından önemli olup; kalp hastalığı, diyabet ve obezite gibi hastalıkların önlenmesine

yardımcı olabilir. Araştırmalar, sumak bitkisinin tavuk yemlerine ilave edilmesinin, tavukların yumurta sarısında bulunan oleik asit ve linoleik asit miktarını artırdığını göstermiştir. Bu iki yağ asidi, doymamış yağ asitlerinin önemli bir parçasıdır ve yumurta sarısının besleyici değerini artırır. Yapılan çalışmalar ayrıca, sumak bitkisinin tavukların karaciğerinde omega-3 yağ asidi miktarını artırdığını da göstermiştir. Omega-3 yağ asitleri, kalp sağlığı için faydalı olup; tavuk yumurtasında bulunurlar (Gálik ve ark., 2014; Gurbuz ve Salih, 2017; Shariatmadari ve Shariatmadari, 2020).

Yapılan bir araştırmada, yumurtacı tavukların yemlerine sumak katkısının performans ve kalite üzerine herhangi bir olumsuz etkisinin olmadığı saptanmıştır (Daş ve ark., 2022).

Sumağın etlik civciv ve piliçlerin yemlerine katkısının özellikle performans ve yemden yararlanma oranı üzerinde olumlu etki yaptığına dair bildirişler bulunmaktadır. Bu konuda yapılan bir araştırmada etlik piliçlere sumak tozunun 2 farklı düzeyde (2.5 ve 5.0 g/k yeme) verilmesinin canlı ağırlık kazancı ile yem etkinliğini iyileştirdiği bildirilirken (Kheiri ve ark., 2015); Golzadeh ve ark., (2012), bu bulguya zıt olarak yeme 7 g/kg düzeyinde sumak tozu katkısının yemden yararlanma oranını olumsuz bir şekilde etkilediğini ifade etmiştir. Al-Jaf ve ark., (2022), etlik piliç yemlerine sumak, soğan ve maya katkısının etkilerini araştırdıkları çalışmalarında, uygulamaların performans parametreleri üzerine olumlu etki yaptığını tespit etmişlerdir.

Sumak ve hibiskus infüzyonu ile kekik ve karanfil hidrodistilatlarının tavuk etlerinde dekontaminant ve raf ömrünü uzatıcı doğal ajan olarak mevcut kimyasal ajanlara alternatif olarak kullanılabileceği bildirilmiştir (Aksoy ve ark., 2011). Valiollahi ve ark., (2014), sumak ve ayva kullanımının etlik civcivlerde vücut performansı, kolesterol profili ve antikor titresi üzerinde hemen hemen benzer yararlı etkilere sahip olduğu sonucuna varmıştır. Sharbati ve ark., (2015)'nin yaptığı bir çalışmada, sumak ilaveli yemin sıcaklık stresi altındaki piliçlerde tiobarbitürik asit reaktif madde değerlerini ve pH'ı iyileştirdiği ve but et yağını azalttığı sonucuna varmışlardır. Shata (2017), Japon bıldırcınlarının yemlerine sumak katkısının AST ve ALT düzeylerini azalttığını ifade etmiştir. Moringa, kekik, sumak tozları ve karışımlarının kullanıldığı piliç rasyonlarında, bu karışımın piliçlerde büyüme performansına etkisini önemli derecede artırdığı bildirilmiştir (Söğüt ve Mohammad, 2018). Yapılan bir çalışmada bıldırcın rasyonlarına sumak ilavesinin herhangi bir olumsuz etkisinin olmadığı, sıcak yaz şartlarında, kanda toplam antioksidan durum ve oksidatif stres indeksi değerleri üzerine olumlu etkisinden dolayı yem katkı maddesi olarak kullanılabileceği belirlenmiştir (Kırar ve ark.,2020).

Cakmak ve ark., (2017), etlik piliçlerin yemlerine sumak katkısının serum AST, ALT, alkalin fosfat düzeyi üzerine olan etkisinin istatistiki olarak önemsiz olduğunu bildirirken; Rasheed ve ark., (2023) sumak katkısının etlik piliçlerin serumundaki lipid içeriğini, bilhassa kolesterolü düşürmede etkili olmadığını, piliçlerin NDV ve IBV aşısına karşı antikor üretiminin az da olsa geliştiğini, IBV'ye karşı antikor titresinin, inhalasyon uygulamasıyla önemli ölçüde olumlu bir gelişme gösterdiğini açıklamışlardır.

Ruminant Beslemede Kullanımı

Sumak bitkisi, ruminantlar için yararlı bir yem katkı maddesi olabilir. Sumak bitkisi, hayvanlar için birçok faydalı bileşen içermektedir. İçerdiği faydalı bileşenler antimikrobiyal, antioksidan ve antiinflamatuar özellikler gösterir. Bu nedenle, sumak bitkisi, ruminantların sindirim sistemindeki mikroorganizmaların büyümesini kontrol etmek, bağışıklık sistemini desteklemek ve inflamasyonu azaltmak için kullanılabilir. Sumak bitkisi, ruminant rasyonlarında farklı şekillerde kullanılabilir. Örneğin, sumak bitkisi tozu, yemlerin üstüne serpilebilir veya yemlerle birlikte karıştırılabilir. Ayrıca, sumak bitkisi özütü, yemlere doğrudan eklenerek veya hayvanların içeceği suya karıştırılarak verilebilir. Ancak, sumak bitkisinin kullanımıyla ilgili dikkat edilmesi gereken bazı faktörler de vardır. Örneğin, sumak bitkisi fazla miktarda kullanıldığında, hayvanların sindirim sistemine zarar verebilir. Bu nedenle, sumak bitkisi, ruminant rasyonlarına sadece belirli miktarda eklenmelidir. Sumak bitkisi, özellikle kaba yemlerin düşük enerji yoğunluğu nedeniyle sindirilememesi durumunda ruminantların performansını artırmak için kullanılabilir. Ayrıca, sumak bitkisi, ruminantların bağırsak sağlığını korumaya yardımcı olan tanenler içerir. Tanenler, bağırsaklardaki zararlı bakterilerin büyümesini önler ve sağlıklı bağırsak bakterilerinin büyümesini destekler. Sumak bitkisi gibi tanen içeren bitkiler, ruminantların sindirim sistemine girdiğinde metan üretimini azaltmaya yardımcı olur. Tanenler, ruminantların sindirim sistemlerindeki metan üreten mikroorganizmaların faaliyetlerini inhibe edebilir ve böylece metan üretimini azaltabilir (Menke ve ark., 1979; Kamalak ve Ozkan, 2021).

Sumak bitkisi, anti bakteriyel, anti ishal, anti spazm çözücü, anti viral olması nedeniyle hayati ve tedavi edici bir role sahiptir ve karaciğer fonksiyonlarını iyileştirmede, mideyi korumada, ve yaraların ve cilt mantarlarının tedavisinde kullanılmaktadır (Panico ve ark., 2009; Hashem ve Alamri, 2010).

Ruminantlar, özellikle sığır ve koyunlar, doğal olarak bitki bazlı bir yeme sahiptirler ve doğal otlaklarda sumak bitkisi de dahil olmak üzere çeşitli bitkileri tüketirler. Sumak bitkisinin ruminant rasyonlarında kullanımı, bu bitkinin besleyici özellikleri nedeniyle giderek popüler

hale gelmektedir. Sumak bitkisi, yemlerin lezzetini artırabilir ve hayvanların yem tüketimini teşvik edebilir. Bununla birlikte, sumak bitkisi aşırı miktarda verildiğinde veya diğer yemlerle dengesiz kullanıldığında, hayvanların sindirim sistemi sağlığını olumsuz etkileyebilir. Bu nedenle, sumak bitkisinin ruminant rasyonlarına eklenmesi dikkatli bir şekilde yapılmalıdır.

Yapılan bir çalışmada, koyun rasyonlarına mısır silajı yerine artan dozlarda sumak yaprağı ikamesinin gaz ve metan üretimini azalttığı bildirilmiştir (Kaya ve ark.,2022). Hussein ve ark., (2022), İvesi kuzu rasyonlarına farklı seviyelerde ilave edilen sumak tozunun kuzu işkembe sıvısının pH değerlerini, amonyak konsantrasyonu, protozoa sayıları ve bakteri sayılarını etkilemediğini tespit etmişlerdir.

SONUÇ

Sumak bitkisi, hayvan beslemede çeşitli şekillerde kullanılabilir ve hayvanların sağlığını korumaya yardımcı olabilir. Sumak bitkisinin hayvan beslemedeki kullanımlarından arasında;

- Yem katkısı: Sumak, yemlere baharat olarak katılarak hayvanların iştahını artırması. Ayrıca, sumak bitkisi, sindirim sisteminin düzenlenmesine yardımcı olarak yemlerin daha iyi emilmesini sağlar,
- Antibakteriyel etki: Sumak bitkisi, antimikrobiyal bileşikler içerdiği için hayvanlarda enfeksiyon riskini azaltır. Özellikle bağırsak enfeksiyonlarına karşı etkili olur,
- Anti-enflamatuar etki: Sumak, anti-enflamatuar özellikleri sayesinde hayvanlarda inflamasyonu azalır. Bu özellik, artrit, osteoartrit ve diğer inflamatuar hastalıkların tedavisinde kullanılabilir,
- Antioksidan etki: Sumak bitkisi, antioksidanlar açısından zengindir ve hayvanların sağlığını korur. Antioksidanlar, hücre hasarını önleyerek bağışıklık sistemini güçlendirir,
- Tatlandırıcı: Sumak, hayvan yemlerine doğal bir tatlandırıcı olarak eklenerek hayvanların yemleri daha iştah açıcı hale getirmesi sayılabilir.

Bu derleme ile sumak bitkisinin hayvan beslemede önemi vurgulanmaya çalışılmıştır.

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KÜÇÜKBAŞ HAYVANCILIK İŞLETMELERİNDE HAYVAN REFAHININ DEĞERLENDİRİLMESİNDE KULLANILAN PARAMETRELER

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ÖZET

Küçükbaş hayvan yetiştiriciliği dünyanın birçok bölgesinde yaygın olarak yapılmaktadır. Koyun ve keçiler olumsuz çevre şartlarına ve hastalıklara dayanıklı, idaresi kolay, masrafı az ve üretim yönünden güvencelidir. Ayrıca insanların sağlıklı beslenmesi için gerekli olan et ve süt kaynaklarının önemli birer kaynağıdır. Hayvan yetiştiriciliği farklı amaçlar için yapılıyor olsa da yetiştiriciliğin temelini, sağlıklı hayvanlar ve kârlı bir hayvansal üretim oluşturmaktadır. Hayvansal üretimde son yıllarda meydana gelen değişiklikler, nüfus artışına paralel olarak artan gıda talebi, üretim sistemlerinde değişikliklere ve entegre üretim faaliyetlerinin artmasına neden olmaktadır. Üretimde meydana gelen artışın yanı sıra mevcut barınma, sürü yönetimi, beslenme ve çevre koşullarında da değişmeler kaçınılmaz olmuştur. Meydana gelen bu değişimlerde hayvanlar pek çok stres faktörlerine maruz kalmaktadır. Hayvanlar çeşitli tepkilerle karşılaştıkları zorluklarla başa çıkmaya çalışır. Bu değişikliklerin izlenmesi, ölçülmesi ve değerlendirilmesi hayvanlarda meydana gelecek üretkenliğin devamlılığın sağlanabilmesi için gerekmektedir. Çiftlik hayvanlarında refah, hayvanın çevresiyle uyum içerisinde olması, içinde yaşadığı çevreye zihinsel ve fiziksel acıya maruz kalmadan uyum gösterebilmesi ve sağlıklı olabilme halidir. Hayvan refahı "iyilik hali ve hayvan sağlığı" kavramları ile yakından ilişkili olup bu iki durumun değerlendirilmesi pratikte hayvan refahının değerlendirilmesi anlamına gelmektedir. Hayvan refahı konusunda duyarlılığın artması, çeşitli türlerden çiftlik hayvanları için mevcut refah düzeyinin ortaya konulması ihtiyacını meydana getirmiştir. Çalışmalar koyun ve keçiler de dahil olmak üzere çiftlik hayvanlarında refahını değerlendirilmesi için çiftlik içi protokollerin uygulanması gerektiğini ortaya koymaktadır. Uygulanacak çiftlik içi refah değerlendirme protokolleri hem hayvan sağlığı hem de üretim süreçlerinin kalite standartlarının iyileştirilmesine katkıda bulunabilir. Ayrıca bu uygulamalar, yetiştiricilerin kötü refah koşullarını belirlemelerine yardımcı olabilir ve hayvan refahının iyileştirilmesine teşvik edebilir. Yüksek kaliteli gıda talep eden tüketiciler, hayvansal ürünlerin, hayvanların refahına daha fazla özen gösterilerek elde edilmesini ve işlenmesini de beklemektedir. Bu çalışmada küçükbaş hayvanlarda işletmelerinde hayvan refahının değerlendirilmesinde kullanılan parametreler ve öneminin ortaya konulması amaçlanmıştır.

Anahtar Kelimeler: Koyun, keçi, hayvan refahı, hayvan sağlığı

PARAMETERS USED IN THE EVALUATION OF ANIMAL WELFARE IN SHEEP AND GOAT FARMS

ABSTRACT

Sheep and goats breeding is common in many parts of the world. Sheep and goats are resistant to adverse environmental conditions and diseases, easy to manage, low in cost and safe in terms of production. Although animal breeding is done for different purposes, the basis of breeding is healthy animals and profitable animal production. Changes in animal production in recent years, increasing food demand in parallel with population growth, cause changes in production systems and an increase in integrated production activities. In addition to the increase in production, changes in the existing housing, herd management, nutrition and environmental conditions were inevitable. In these changes, animals are exposed to many stress factors. Animals try to cope with the difficulties they encounter with a variety of reactions. Monitoring, measuring and evaluating these changes is necessary to ensure the continuity of productivity in animals. Animal welfare is closely related to the concepts of "well-being and animal health", and the evaluation of these two situations means the evaluation of animal welfare in practice. The increased awareness on animal welfare has created the need to reveal the current welfare level for farm animals of various species. Studies suggest that on-farm protocols should be applied to assess the welfare of livestock, including sheep and goats. The on-farm welfare assessment protocols to be implemented can contribute to the improvement of both animal health and quality standards of production processes. In addition, these practices can help breeders identify poor welfare conditions and encourage improved animal welfare. Consumers who demand high quality food also expect animal products to be obtained and processed with greater attention to animal welfare. In this study, it is aimed to reveal the parameters used in the evaluation of animal welfare in sheep and goat farms and their importance.

Keywords: Sheep, goat, animal welfare, animal health

GİRİŞ

Hayvan refahını olumsuz etkileyen stres faktörleri aynı zamanda hayvanlarda meydana gelecek biyolojik fonksiyonlardaki değişiklikler ile beraber stresin maliyetini oluşturmaktadır. Pek çok stres faktörü için maliyet stres kısa süreli olduğunda göz ardı edilebilirken, stresin uzun sürdüğü veya ciddi olduğu durumlarda maliyet önemli ölçüde artmaktadır. Biyolojik fonksiyonlardaki değişiklik hayvanlarda üretkenliğin ve devamlılığın temelini oluşturan bağışıklık, büyüme ve üreme özelliklerini baskılar (Altınçekiç ve Koyuncu, 2012). Ayrıca çiftlik hayvanlarında refahının iyileştirilmesi, sürü yönetim uygulamalarında ve sonraki pazar aşamalarında (örneğin, nakliye, kesim) önemli maliyetlere de neden olabileceğinden, çiftlik hayvanları refahının sağlanmasının ekonomik olmasının bir zorunluluktur (Grethe, 2017). Yapılan çalışmalarda hayvan refahı endişelerinin sınıflandırması, ilgili türler, hayvan refahı boyutu (sağlık, davranış, duygular) ve derece dahil olmak üzere çeşitli boyutlara dayalı olabileceği ifade edilmektedir (Spiller ve ark., 2015).

Çiftlik hayvanlarında refah, genel olarak "hayvanların insanlar tarafından oluşturulan çevreye herhangi bir acı veya rahatsızlık duymaksızın uyum gösterebilmesi" şeklinde tanımlanmaktadır (Fraser ve ark., 1997, Broom 1991). Refah, genelde beş temel kavram üstüne oturtulmuştur. Bunlar;

1. Hayvanlar aç, susuz ve kötü beslenmeye maruz bırakılmamalıdır. Bunun için hayvanlara taze su ve yiyecek her zaman sağlanmalıdır.
2. Hayvanlar hiçbir şekilde rahatsız edilmemelidir. Bunun için barınak ve rahat bir dinlenme alanı da dahil olmak üzere uygun bir çevre sağlanmalıdır.
3.Hayvanlar ağrı, yara ve hastalıklardan korunmalıdır. Bunun için koruyucu tedbirler alınmalı, erken teşhis yapılmalı, hastalıklar tedavi edilmelidir.
4.Hayvanlar normal davranışlarını gösterebilmelidir. Bunun için, yeterli alan ve diğer kolaylaştırıcı tedbirler alınmalı, aynı türden hayvanlar gruplar halinde tutulmalıdır.
5. Hayvanlar, korku ve stres yaratan ortamlarda bulundurulmamalıdır. Bunun için zihinsel (mental) acı çekmeye neden olan uygulamalar ve koşullar ortadan kaldırılmalıdır.

Hayvan refahının değerlendirilmesi, üretken, verimli ve sürdürülebilir bir çiftlik hayvanı üretim sistemlerinin önemli bir parçası olarak kabul edilir. Bu durum çiftlik düzeyinde hayvanların refahının değerlendirilmesini, türe özgü protokollerin geliştirilmesini gerektirir (Blokhuis ve ark., 2010) Hayvan refahının değerlendirilmesi ve belirlenmesi çok kriterli ve çok boyutlu bir yaklaşımdır (EFSA, 2012; Tiezzi ve ark., 2019). Çiftlik hayvanlarının refahını etkileyen temel faktörler, fiziksel çevre, hayvanların kullanabileceği kaynaklar ve yönetim uygulamalarıdır.

Hayvanlar davranışsal ve fizyolojik özellikleriyle bu girdilere uyum sağlar (AWIN, 2021). Bu uygulamalar yetiştiricilerin olumsuz refah koşullarını belirlemelerine yardımcı olabilir ve hayvan refahının iyileştirilmesine teşvik edebilir. Bu çalışmada küçükbaş hayvanlarda işletmelerinde hayvan refahının değerlendirilmesinde kullanılan parametreler ve öneminin ortaya konulması amaçlanmıştır.

İşletmelerinde Hayvan Refahinin Değerlendirilmesi

Çiftlik hayvanları strese bireysel ve türe özgü davranışlarla cevap verirler. Hayvanlar önceki deneyimleri ve genetik yapılarına bağlı olarak aynı uyarana farklı tepkiler verebilir. Ayrıca fizyolojik durum ve pek çok faktör de hayvanların vereceği stres tepkilerini etkileyebilmektedir. Refahın izlenmesinde, hayvanların sağlık durumları, hareketlilik seviyeleri, yem ve su alımı, dinlenme düzeni, duruşu, çıkardıkları sesler, davranışsal tepkiler vb birçok durum gözlemlenir. Elde edilecek veriler ile hayvanların mevcut durumunun barınma sistemlerinin, yem ve çevresel faktörlerin uygunluğu test edilmiş olur. Yani hayvanın maruz kaldığı belirli bir durumdan olumsuz etkilenip etkilenmediğini test edilebilir (Squires, 2003).

Geçmişte, çiftlik hayvanlarının refahına duyulan ilgi, esas olarak olumsuz deneyimlerin en aza indirilmesine odaklanmıştı (Yeates ve Main, 2008). Ancak günümüzde araştırmacılar arasında bu yaklaşımın eksik olduğu, tüketicilerin endişelerini tam olarak yansıtmadığı ve olumlu deneyimlerin hayvan refahının da önemli bir parçası olduğu konusunda artan bir farkındalık vardır (Vigors, 2019; Yeates ve Main, 2008). Hayvanların iyi ya da mutlu bir yaşama ya da iyi bir yaşam kalitesine sahip olmaları için, bir hayvanın yaşamı boyunca iyi hayvan refahının olumlu deneyimlerin sıklığının, hayvanlarda refahın sağlanamadığı olayların deneyimlerin sıklığından daha fazla olması gerektiği öne sürülmüştür (FAWC, 2009; Green ve Mellor, 2011; Webb ve ark., 2019). Bununla birlikte, bu alanda pek çok çalışma yapılmasına rağmen, hayvanlarda refahın olumlu yönlerine yönelik araştırmalar sınırlı düzeyde kalmakta, olumsuz hayvan refahını ortaya koyan araştırmalar kadar çalışma literatürde mevcut değildir. Dolayısı ile hayvan refahını olumlu etkileyen (güvenilir, hızlı) göstergeler eksiktir. Bu nedenle, çiftlik hayvanlarında pozitif duyguların geçerli göstergelerinin geliştirilmesine ve bunların çiftlik içi değerlendirme protokollerine entegre edilmesine ihtiyaç vardır (Boissy ve ark., 2007; Lawrence ve ark., 2019; Webb ve ark., 2019; Laurijs ve ark., 2021).

Zufferey ve ark. (2021) koyunlarda çiftlik içi refah değerlendirmesi için hayvan temelli göstergeler üzerine yaptıkları çalışmada, refahı değerlendirmek için geçerli ve uygulanabilir göstergelere dayalı kapsamlı protokollere ihtiyaç olduğunu bildirmişlerdir. Topallık veya vücut kondisyon skoru gibi umut verici protokoller, iyi bilinen ve yerleşik göstergelerin yanı sıra,

kaşıntılı davranış veya dinlenme süresi gibi değerlendirilmesi gereken yeni göstergeler de belirlemişlerdir.

Napolitano ve ark. (2009) yaptıkları çalışmada; geleneksel yetiştiricilik yapan ve organik yetiştiricilik yapan koyunculuk işletmelerinde refahın değerlendirmesi için ANI (Animal Needs Index) 35 L sisteminden geliştirilen protokolü kullanmışlardır. Elde edilen sonuçlarda ANI puanları barınma özellikleri ve hayvan temelli parametreler açısında organik ve geleneksel çiftlikler arasında önemli farklılığın olmadığını belirtmişlerdir, bu da her iki sistemde de yeterli hayvan refahının sağlandığını göstermektedir.

Meşe ve Karakuş (2019) yaptıkları çalışmada; Van ili Edremit ilçesi küçükbaş hayvancılık işletmelerinin refah açısından değerlendirilmişlerdir. Koyun ve keçilerde refah değerlendirmesi amacıyla ANI (Animal Needs Index) 35 L sisteminden geliştirilen protokolü kullanarak küçükbaş hayvancılık işletmelerinin hayvan refah kriterlerine uygunluğunu araştırılmıştır. Çalışma sonucunda ilçedeki küçükbaş hayvancılık işletmelerinin, barınma koşulları parametrelerinden birim hayvan başına düşen yüzey alanı ve yemlik boyutu dışındaki parametreler bakımından düşük-orta; yapı ve ekipman durumu parametreleri açısından düşük-orta ve hayvan sağlığı parametreleri bakımından da orta-yüksek puan refah kategorilerinde yer aldığı belirlenmiştir.

Öziş Altınçekiç (2014) Marmara Bölgesi'nde tarımsal üretim faaliyetleri açısından öne çıkan Bursa ilinde koyunculuk işletmelerinin yapısal durumu, yetiştiricilik özellikleri ve ele alınan bu özelliklerin hayvan refahı kapsamında incelenmesine yönelik çalışma yapmıştır. Çalışmada; yetiştiricilerin yaşları, meradan yararlanma süreleri, bakım yönetim işlerinden olan kuzuların ayrılması, koç katım yöntemi, koç katım zamanı, göbek kordonu bakımı, yavru zarları ile ilgilenme, damızlıktan çıkarma kriterleri, yapağı ve gübrenin değerlendirilme şekli, çoban kullanımı, merada farklı türlerle otlama, barınak duvar malzemesi, tarım örgütüne üyelik ve işletmede kayıt tutulması gibi koyunculuğun yapısal ve donanımsal özelliklerini ortaya koyan kriterler bakımından işletmeler arasında görülen farklılıklar önemli bulunmuştur. İşletmelerin yapısal ve yönetsel bazı özelliklerinin hayvan refahı noktasında değerlendirildiğinde; yetiştirme, bakım-yönetim uygulamaları, sağlık koruma ve yapısal özellikler bakımından yetersiz ancak iyileştirmeye açık olduğu belirlenmiştir.

Anzuino ve ark. (2010) 24 ticari süt keçisi çiftliğinde keçilerin sağlık ve refahına yönelik yaptıkları çalışmada; belirlenen ana refah sorunları, topallık ve aşırı tırnak büyümesi, meme ve meme başı lezyonları, cilt lezyonları ve kaşıntı şeklinde ifade etmişlerdir.

Martini ve ark. (2015) farklı üretim sistemlerinde süt keçisi çiftliklerinde refahının değerlendirilmesi için yaptıkları çalışmada; ANI (Animal Needs Index) yöntemini kullanmış ve değerlendirmişlerdir. Sonuç olarak, iller ve yetiştirilen ırklar arasında barınak, yapı ve donanım durumu ve hayvan sağlığı açısından önemli farklılıklar tespit edilirken, üretim sistemleri arasında çok az fark bulunduğunu ifade etmişlerdir.

Öziş Altınçekiç ve Koyuncu (2015) yaptıkları çalışmada; küçükbaş hayvancılık işletmelerinde biyogüvenlik uygulamalarının direkt veya endirekt yolla hayvanlarda hastalığa neden olabilecek etkenlere karşı bir koruma sağladığını ifade etmişlerdir. İşletmelerde etkili bir biyogüvenlik sisteminin uygulanması hastalıkların yayılmasını sağlayan biyolojik organizmaların işletmelere giriş ve hareket serbestliğini minimuma indirerek, bu noktada, sağlıklı bir yetiştiricilik yapmak ve hayvanlardan daha yüksek verim elde etmenin yanında güvenli gıda üretimi için hayvancılık işletmelerinde de biyogüvenlik konusunda gerekli önlemlerin alınmasının kaçınılmaz olduğunu belirtmişlerdir.

Sonuç ve Öneriler

Yetiştiricilerin, çiftlik hayvanları üzerinde refahı olumsuz etkileyen ve stres oluşturan çevresel faktörleri ve yönetim uygulamalarını belirleyememeleri veya zamanında müdahalelerin yapılamaması, hayvanların performansının düşmesine, üreme özelliklerinin düşmesine ve dolayısı ile hayvansal ürün tedariğinde azalmalara yol açabilir. Çiftlik hayvanlarında refahın kötü olması patojenlere karşı hayvanların hassasiyetinde bir artışa yol açar. Yapılan çalışmalarda olumsuz barınma, beslenme ve sürü yönetimi uygulamalarında hayvan hastalıkları; doğrudan kayıplara, ölümler, döl veriminde azalma ve dolaylı kayıplara ilaçlar ve veterinerlik hizmetleri için ek maliyetler, ek işçilik süreleri ve maliyetlere neden olabileceği bildirilmektedir.

Çalışmalar koyun ve keçiler de dahil olmak üzere çiftlik hayvanlarında refahını değerlendirilmesi için çiftlik içi protokollerin uygulanması gerektiğini ortaya koymaktadır. Uygulanacak çiftlik içi refah değerlendirme protokolleri hem hayvan sağlığı hem de üretim süreçlerinin kalite standartlarının iyileştirilmesine katkıda bulunabilir. Ayrıca bu uygulamalar, yetiştiricilerin kötü refah koşullarını belirlemelerine yardımcı olabilir ve hayvan refahının iyileştirilmesine teşvik edebilir.

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KÜÇÜKBAŞ HAYVANLARDA ERKEN DAMIZLIKTA KULLANMADA VE BESİN YETERSİZLİKLERİNİN TESPİTİNDE VÜCUT KONDİSYON PUANLAMASI UYGULANMASI

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ÖZET

Hayvan yetiştiriciliği uygulamalarında çevresel faktörlerin neden olduğu olumsuz etkileri en aza indirmeye yönelik pratik uygulamalara önem verilmektedir. Vücut kondisyon puanlaması, bir hayvanın kas ve yağ gelişiminin subjektif olarak tahminidir. Sırt ve pelvik bölgelerdeki vücut yağ rezervlerinin görsel ve dokunsal olarak değerlendirilmesi ile yapılan vücut kondisyon puanlaması genellikle belirli bir puan aralığında puanlanır. Hayvanlarda vücut enerji rezervlerini ve beslenme durumunu değerlendirmek için yararlı bir yöntem olmakla birlikte yaygın olarak kullanılmaktadır. Besleme, genotip, yaş, cinsiyet, fizyolojik dönem ve çevre koşulları gibi birçok faktör vücut kondisyon puanını etkilemektedir. Son zamanlarda küçükbaş hayvan yetiştiriciliğinde sürü yönetiminde pratik, kolay ve ekonomik uygulamalar üzerine birçok çalışma yapılmaktadır. Koyun ve keçilerde vücut durumunun puanlanması ve vücut durumundaki değişikliklerin değerlendirilmesi hem sürü yönetiminde hem de araştırmalarda stratejik araçlar haline gelmiştir. Ayrıca bu puanlama hayvanın metabolik durumunu yansıtarak hastalıklara karşı daha az duyarlı, daha iyi döl verimine sahip ve daha fazla karkas ve süt verimine sahip bireylerin belirlenmesini sağlar. Dolayısı ile hayvanlarda rutin olarak vücut kondisyon puanlamasının değerlendirilmesi potansiyel problemlerin kontrol altına alınarak karlılığın önemli ölçüde artmasına katkıda bulunacaktır. Bu çalışmada küçükbaş hayvanlarda erken dönemde damızlıkta kullanma ve besin yetersizliklerinin tespitinde vücut kondisyon puanlaması uygulanması ve öneminin ortaya konulması amaçlanmıştır.

Anahtar Kelimeler: Koyun, keçi, vücut kondisyon puanlaması, damızlıkta kullanma

EARLY BREEDING USE AND APPLICATION OF BODY CONDITION SCORING IN DETECTION OF NUTRITIONAL DEFICIENCIES IN SMALL RUMINANTS

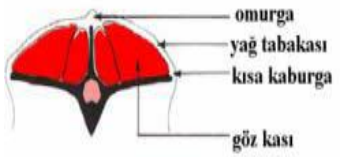
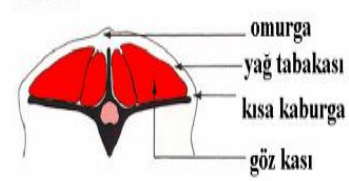
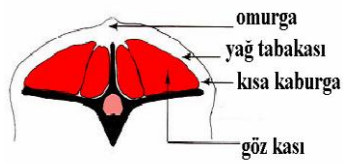
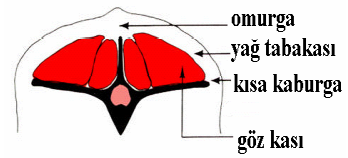
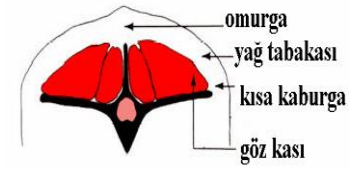
ABSTRACT

In animal husbandry practices, practical applications to minimize the negative effects caused by environmental factors are important. Body condition scoring is a subjective estimate of an animal's muscle and fat development. Body condition scoring, which is done by visual and tactile assessment of body fat reserves in the back and pelvic regions, is usually scored within a certain point range. It is a useful and widely used method to assess the body's energy reserves and nutritional status in animals. Many factors, such as feeding, genotype, age, sex, physiological period, and environmental conditions affect the body condition score. Recently, many studies have been carried out on practical, easy, and economical applications in flock management in small ruminant breeding. Scoring of body condition and evaluation of changes in body condition in sheep and goats have become strategic tools in both flock management and research. In addition, this scoring reflects the metabolic status of the animal, enabling the identification of individuals that are less susceptible to diseases, have better fertility, and have higher carcass and milk yields. Therefore, routine evaluation of body condition scoring in animals will contribute to a significant increase in profitability by controlling potential problems. In this study, it was aimed to demonstrate the application and importance of body condition scoring in the detection of nutritional deficiencies and early breeding utilization in small ruminants.

Keywords: Sheep, goats, body condition scoring, use in breeding

GİRİŞ

Küçükbaş hayvan yetiştiriciliği, küresel ısınmanın tüm dünyada etkisinin görülmeye başlaması ile daha da önemli hale gelmiştir. Koyun ve keçi, diğer türlere göre ekstansif koşullarda yetiştirme ve bu hayvanlardan ürün elde etme imkânı veren türlerdir. Bu yönüyle küçükbaş hayvan yetiştiriciliği, insan beslenmesinde hayvansal protein kaynağı ve ekonomik gelir sağlar. Koyun ve keçi yetiştiriciliğinde erken damızlıkta kullanmayı sağlamak, besin yetersizliklerinin tespiti, hayvan kayıplarını ve elde edilen ürün kayıplarını önlemek için kolay uygulanabilen yöntemler kullanılmalıdır. Bu yöntemlerden biri vücut kondisyon puanlamasıdır. Vücut kondisyon puanı (VKP) sığır, koyun ve keçilerde vücudun değerlendirilmesinde kullanılan önemli bir pratik uygulamadır. Ayrıca hayvanlarda yüksek enerji ihtiyacının arttığı dönemlerde ve stres durumunda vücut rezervlerinin yeterli olması hayvanın yaşamasını ve verimini olumlu yönde etkiler. Yetersiz beslenme dönemlerinin en basit göstergesi mevcut yağ rezervlerinde meydana gelen değişimdir ve VKP ile kolaylıkla belirlenebilir (Villaquiran ve ark., 2004; Ghosh ve ark., 2019). Koyun ve keçilerde VKP değerlendirmesi, yıl boyunca çeşitli üretim aşamalarında vücut rezervlerindeki değişimi izlemek için faydalıdır. Vücut kondisyon puanlaması hayvanlarda üreme, gebelik, laktasyon gibi kritik dönemlerde, sağım sırasında otlatma ve konsantre yem takviyesine dayalı hayvancılık sistemlerinde, ya da ekstansif yetiştiricilikte VKP'i düşük olan hayvanlarda besleme yönetiminin takibini ve değiştirilmesini kolaylaştıran bir yöntemdir (Molina ve ark., 1991; Nawito ve ark., 2015; Koyuncu ve ark., 2018). Vücut kondisyon puanının ölçümünün kolay uygulanması yetiştirici tarafından kullanılmasını sağlayacaktır (Türkyılmaz ve ark., 2017). Koyun ve keçi verimli türler olarak kabul edilir. Her iki türün de çoğu ırkı yıllık bir üreme döngüsü gösterir. Bununla birlikte, bu türlerdeki üreme özellikleri pek çok faktör tarafından da kontrol edilir. Döl verim ölçütleri ve üreme verimliliği ile vücut kondisyon puanı arasında anlamlı etki bulunmaktadır. Yapılan çalışmalarda vücut kondisyon puanının düşük olması durumunda gebelik oranı ve doğan kuzu sayısında azalma görülmüştür (Atti ve ark., 2001; Vin˜oles ve ark., 2002; Ucar ve ark., 2005; Vin˜oles ve ark., 2005; Abdel-Mageed, 2009; Sejian ve ark., 2015; Yılmaz ve ark., 2011). Vücut kondisyon puanı, bir hayvanın kas ve yağ gelişimi hakkında tahmini bilgi veren uygulamadır (Russel ve ark., 1969; Sanson ve ark., 1993; Russel ve ark. 1981). Bir hayvanın vücut kondisyon puanını incelemek için bel bölgesinde omurga çevresinde, son kaburganın hemen arkasında ve böbreklerin üstünde palpasyonla puanlama yapılır (Jefferies, 1961; Russel ve ark., 1969). Küçükbaş hayvanlarda vücut kondisyon puanlamasında 5 tanesi uygulamada kullanılmaktadır (Şekil 1) (Russel ve ark., 1969).

Puan 0	Deri ve kemik arası boştur. Hayvan ölebilir. Yetersiz bakım ve besleme koşullarında görülebilir.
Puan 1 (Zayıf kondisyon) 	Yağ birikimi çok azdır.
Puan 2 (Orta kondisyon) 	Sırt kemiği belirgindir. Çok az miktarda yağ doku vardır.
Puan 3 (İyi kondisyon) 	Sırt kemiği belirgin değildir.
Puan 4 (Yağlı kondisyon) 	Yağ tabakası kalındır.
Puan 5 (Orta yağlı kondisyon) 	Yağ tabakası çok kalındır. İstenmeyen bir durumdur. Güç doğumlara neden olur.

Şekil 1.Vücut kondisyon puanlaması

Bu çalışmada vücut kondisyon puanlaması ile koyun ve keçilerde verimli dönemin uzun olmasını sağlamak için erken damızlıkta kullanma yaşının belirlenmesinde ve döl veriminin arttırılmasında kullanılması üzerinde durulmuştur.

Vücut Kondisyon Puanı, Damızlıkta Kullanma Yaşı ve Döl Verimi

Döl verimi, sürünün devamlılığını sağlaması, et, süt ve yapağının elde edilmesi için kaynak oluşturması bakımından önemlidir. Döl verimi, kalıtsal yapı ile besleme, canlı ağırlık, yaş, kuzulama mevsimi, bireysel ayrım, bakım ve yönetim gibi unsurların ortaklaşa oluşturduğu

çevresel etmenlerin etkisinde belirlenir (Sönmez ve Kaymakçı, 1987). Koyunların kuzulama döneminde sahip oldukları kondisyon, süt verimine ve kuzu gelişimine önemli etki etmektedir (Robinson, 1990). Keçi yetiştiren bir işletmenin verimliliği ve kârlılığı genotiple bağlantılı her hayvandan her yıl en az bir adet yavru alınması ile yakından ilişkilidir. Bu nedenle sürü yönetiminde çiftleşme sezonunda yapılması gereken bakım besleme ve aşım uygulamaları büyük önem arz etmektedir (Tüney, 2015).

Damızlıkta kullanma yaşı, hayvanların gelişmelerinde, verimlerinde önemli bir gerilemeye yol açmadan üreme için kullanılabilecekleri en erken yaş olarak tanımlanabilir. Damızlıkta ilk kullanma yaşı, işletmenin verimliliğini etkiler. Damızlığa ayrılan genç hayvanların büyüme ve gelişme dönemi verimin olmadığı ancak masraflı bir dönemdir. Bu dönemin kısa tutulması verimin artırılması ve masrafın azaltılmasında etkili olur. Erken yaşta damızlıkta kullanmanın daha sonraki üretim sezonlarında üretkenliği düşürebileceği ve bu olumsuzluğa yetersiz bakım besleme koşullarından ortaya çıkan depresyon etkili olabilir. Erken damızlıkta kullanmada, iyi bakım ve besleme koşullarında üreme etkinliğini arttırır (Drymundsson, 1973). Tüfekci ve Olfaz (2016)'ın Saanen x Kıl keçi melezi (G1) keçi ve çebiç grupları üzerine yaptıkları çalışmada, çebiçlerin doğdukları yıl damızlıkta kullanılmasının döl veriminde ve oğlakların büyüme özelliklerinde etkileri bakımından elde edilen sonuçlar çebiçlerde keçilere göre daha düşük olmuştur. Ancak çebiçlerin erken yaşta damızlıkta kullanılması hayvanların verimli ömür süresini uzatmıştır. Bu yönüyle erken yaşta damızlıkta kullanma bakım besleme koşullarına dikkat edildiğinde yetiştiriciye faydalı olacaktır. Özellikle büyüme döneminde üreme organlarının ve endokrin bezlerin gelişiminde yeterli enerji alımı ön plana çıkmaktadır (Esenbuğa ve ark., 2001; Rottray, 1977). Bazı çalışmalarda erken yaşta damızlıkta kullanılan keçilerin analık kabiliyetlerinin daha iyi olduğu bildirilmiştir (Dyrmundsson, 1973; Everett ve ark., 1971; Hulet, 1969). Kuzu ve çepiçlerin erken yaşta damızlıkta kullanılması ile generasyonlar arası süre kısaltacaktır. Bu açıdan genetik ıslah etkinliği yükselerek küçükbaş hayvan yetiştiriciliğine olumlu etki yapacaktır (Düzgüneş, 1976; Ocak, 2011).

Küçükbaş hayvan yetiştiriciliğinde erken yaşta damızlıkta kullanma, işletmeye katma değer sağlayacaktır. Erken damızlıkta kullanılmada çepiç ve kuzuların ergin canlı ağırlığın %60-70'ine ulaşmış olmasına dikkat edilmelidir (Ocak, 2011; Demir ve ark., 2018). Türk Saanen keçilerinde ilk yılda damızlıkta kullanılmaları için ergin canlı ağırlığın (ortalama 62 kg) yarısına ulaşmaları gerektiği üzerinde durulmuştur (Tölü ve ark., 2009). Akkeçi ırkının erken damızlıkta kullanılmasının belirlenmesi üzerine yapılan çalışmada ilkine damızlıkta kullanma çağında Akkeci dişi oğlakların 30-35 kg gelmesi ve ergin ağırlığın %65-70'ine ulaşması gerektiği

bildirilmiştir. Ayrıca Akkeçi ırkında erken damızlıkta kullanma döl verim parametrelerini ve yavru doğum ağırlığını olumsuz etkilememiştir (Coşkun ve Ertuğrul, 2022).

Mendizabal ve ark. (2011) keçi sahiplerinin vücut kondisyon puanını bilmeleri sürü yönetiminde etkili ve kullanılabilir bir ölçüm olduğunu bildirmişlerdir. Dinler (2005) keçilerde yaptığı çalışmada, hayvanlarda VKP'ının bazı özellikler üzerine etkisini araştırmıştır. Çalışmada iki gözlemci tarafından belirlenen dört fizyolojik dönemdeki (teke katımı, gebelik ortası, doğum, sütten kesim) vücut kondisyon puanı ortalamaları sırasıyla 2,65, 2,83, 2,06 ve 2,63; 2,72, 2,92, 2,11 ve 2,63 olarak bildirilmiştir. Teke katımı ve gebelik döneminde kondisyon puanının canlı ağırlığa etkisi her iki gözlemci bakımından önemli olduğu bildirilmiştir. Ayrıca, vücut kondisyon puanı gruplarından 3,5 kondisyona sahip keçilerde döl veriminin en yüksek düzeyde olduğu bildirilmiştir. De Santiago-Miramontes ve ark. (2009) Meksika keçi ırkların da bazı üreme özellikleri üzerine vücut kondisyonunun etkisini belirlemek için yapılan çalışmada vücut kondisyon puanı yüksek olan grupta östrus oluşması ve ovulasyonun diğer gruplara göre göre daha erken meydana geldiği bildirilmiştir. Ayrıca düşük kondisyon puanlı dişi keçilerin daha kısa üreme sezonuna, daha fazla anormal kızgınlık döngüsüne ve daha az ovulasyona sahip olduğu bildirilmiştir. Thompson ve Meyer (1994), keçilerde yüksek oranda döl verimi elde etmek için optimum vücut kondisyon puanının teke katımında 3-4 arasında, gebelikte 2,5-4, doğuran keçilerde 3-4 ve sütten kesimde 2 puan ve üzerinde olması istenmektedir.

Türkyılmaz ve ark. (2017) farklı koyun ırkları ile yaptıkları çalışmada koç katım döneminde VKP'ın koç altı koyun başına ve doğuran koyun başına düşen döl verim ölçütleri üzerine istatistiki bir etkisi tespit edilmemiş ancak en yüksek döl veriminin 4 vücut kondisyon puanına sahip koyunlarda elde edildiği bildirilmiştir. Sarı ve ark., (2013) Tuj koyunlarında yatıkları araştırmada vücut kondisyon puanının, ana yaşı ve doğum tipinin yavruda bazı büyüme özelliklerine ve yaşama gücüne etkisinin olduğunu bildirmişlerdir. Kandemir ve ark., (2013) yaptıkları çalışmada yarı entansif sistemde yetiştirilen farklı ırk koyunlarda vücut kondisyon puanlamasının döl verimi, gelişme ve ana canlı ağırlığı gibi özellikler üzerine etkilerini incelemiştir. Sonuç olarak Menemen ve Ile de France x Akkaraman melezi koyunlarında vücut kondisyon puanı ortalamaları sırasıyla; 2,79 ve 2,75 olup, aşım ve doğum dönemlerine göre bu değerler sırasıyla; 2,83 ve 2,70 olarak bildirilmiştir. Çam ve ark., (2018) Karayaka koyunlarında vücut kondisyonu ile döl verimi özellikleri arasında ilişkiyi değerlendirdikleri araştırmada, orta ve yağlı vücut kondisyon puanına (2,5-4,0) sahip koyunların, daha iyi performans gösterdiğini bildirmişlerdir. Koçlar üzerinde yapılan araştırmada vücut kondisyon puanlamasına göre düşük VKP grubu (VKP:2-2.5; n=5), orta VKP grubu (VKP:3-3.5; n=5) ve daha yüksek VKP grubu

(VKP:4-4,5; n=5) olarak belirlenmiştir. Çalışma sonucunda vücut kondisyon puanının hem testiküler hemodinamik hem de antioksidan madde ile ilişkili olduğu bildirilmiştir. Yüksek vücut yağ oranı metabolik ve hormonal homeostazı olumsuz yönde etkileyebilmektedir (El-Sherbiny ve ark., 2023). Bu çalışmalar koyunların aşırı ve düzensiz beslenmesinin üreme ve döl veriminde düşmelere neden olabileceğini göstermektedir. Bu nedenle düzenli VKP kontrolleri ile döl veriminde meydana gelebilecek kayıplar önlenebilir. Kacang keçilerinde zayıf vücut kondisyon puanına sahip olanlarda kanda demir seviyesinde düşüklük, yumurtalık fonksiyon bozukluğu görülmüştür (Widiyono ve ark., 2020). Erken damızlıkta kullanma belirteçler Tablo 1'de verilmiştir.

Tablo 1. Erken damızlıkta kullanma belirteçleri

Özellikler	
Canlı ağırlık	Coşkun ve Ertuğrul (2022); Demir ve ark. (2018)
Yavru doğum ağırlığı	Coşkun ve Ertuğrul (2022)
Kısırlık oranı	Coşkun ve Ertuğrul (2022)
Gebelik başına aşım sayısı	Coşkun ve Ertuğrul (2022)
Doğuran keçi başına doğan oğlak sayısı	Coşkun ve Ertuğrul (2022)
Tekealtı keçi başına doğan oğlak sayısı	Coşkun ve Ertuğrul (2022)
Gebelik oranı	Coşkun ve Ertuğrul (2022)
Oğlaklama oranı	Coşkun ve Ertuğrul (2022); Okere ve ark. (2022)

Küçükbaş hayvan yetiştiriciliğinde doğumdan sonra ilk haftalarda yavru ölümleri sıkça görülebilmektedir. Çoğuz doğumlarda ananın sütünün yeterli olmaması, kolostrumu her yavrunun yeterli düzeyde alamamasından kaynaklı hastalıklara karşı bağışıklığın gelişememesi, yavrunun beslenememesi ve yetiştirici uygulamaları yavru ölümlerinin artmasında etkili olmaktadır (Koyuncu ve Akgün, 2018). Ana besin rezervlerinin yeterli olması doğum sonrası yavru gelişimine etki etmektedir. Karayaka koyunları üzerinde yapılan araştırmada gebeliğin 50. gününde vücut kondisyon puanının en az 2,50 en fazla 5,00 olduğu tespit edilmiştir. Yapılan ölçümlerde gebeliğin 50. gününde anaların ortalama vücut kondisyon puanı arttıkça yavruların doğum ağırlığının da artığı bildirilmiştir (Tozlu Çelik ve ark., 2019). Vücut kondisyon puanı oğlaklama oranı üzerinde etkili olmuştur. Et keçisi dişilerinde daha düşük VKP (VKP<3) ve canlı ağırlığa (40-60 kg) sahip olanlarda teke katım dönemi öncesi flushing uygulaması önerilmiştir. Bu uygulamanın et verimine yönelik yetiştiricilik yapan işletmelerde üreme verimliliğinde ve karlılığında önemli gelişmeler sağlayabileceği bildirilmiştir (Okere ve ark., 2022).

Vücut Kondisyon Puanı ve Canlı Ağırlık

Hayvancılıkta canlı ağırlık ve vücut kondisyonu hayvanların verimli dönemini etkileyen önemli faktörlerdir (Robinson, 1990). Koyunların besleme seviyesinin göstergesi canlı ağırlık ve vücut kondisyon puanı ile ifade edilir (Kenyon ve ark., 2014). Vücut kondisyon puanı 2,9 ile 3,6 arasındaki olan koyunlarda öncelikle yağın çoğunlukla deri altında biriktiği bildirilmiştir (Lourencon ve ark., 2023). Hayvanlar, verim dönemlerinde hatta tüm yaşamlarında olumsuz çevre koşullarına karşı vücutlarında bulunan yağ ve protein rezervlerini kullanarak tepki verirler (Butler-Hogg, 1984; Fattet ve ark., 1984). Hayvanların aşım, gebelik ve doğum gibi fizyolojik dönemlere ulaşmadan yeterli canlı ağırlık ve vücut kondisyonuna sahip olmalıdırlar (Özder ve ark., 1997).

Vücut ağırlığının düzenli olarak kontrol edilmesi ile vücut rezervlerinin tespiti, büyüme, üreme performansı ve süt üretimi hedeflenen düzeye getirilebilir. Ancak küçükbaş hayvan yetiştiriciliğinde canlı ağırlık kontrollerinde işgücü ve zaman ihtiyacı fazladır. Vücut ağırlığı veya göğüs çevresi genellikle hayvanın durumunu ölçmek için izlenir, ancak bu tekniklerin birtakım dezavantajları vardır. Birincisi, tartı terazileri kullanışsızdır, pahalıdır ve taşınması zordur. İkincisi, ağırlık kendi başına bir hayvanın durumunu yansıtmaz, büyük bir çerçeveye sahip hayvan, vücut rezervleri düşük seviyedeyken, küçük bir çerçeveye sahip ancak rezervleri bol olan diğer hayvanlara göre daha yüksek bir vücut ağırlığına sahip olabilir. Bu nedenle hayvanın mevsimsel ağırlık değişimini kaydetmek için bireysel olarak tanımlama yapılmalıdır. Üçüncüsü, bağırsak ve mesane dolumu, gebelik ve doğumun bir sonucu olarak canlı ağırlıkta büyük farklılıklar meydana gelebilir. Ayrıca ağırlık değişiklikleri, protein veya yağ içeriğindeki önemli değişikliklerden ziyade doku hidrasyonunu yansıtır. Göğüs çevresinin ölçülmesi, hayvanların ayrı ayrı tutulmasını gerektirir ve sonuçlar, ölçüm bandının duruşuna, konumuna ve gerginliğine, yapağı kalınlığına ve bağırsak dolgusuna göre değişebilir (Ghosh ve ark., 2019). Tozlu Çelik ve Olfaz (2017) yaptıkları çalışmada Kıl keçi, Saanen x Kıl F1, Saanen x Kıl G1 ve Saanen x Kıl G2 genotipleri için 6. ay göğüs çevresi ölçülerini sırasıyla; 70.85 cm, 73.07 cm, 70.72 cm ve 67.00 cm olarak belirlemişlerdir. Göğüs çevresi üzerine genotip ve doğum tipinin önemli ($P<0.01$) etkisi olduğu bildirilmiştir. Aynı araştırmada Saanen x Kıl G1 melezleri ile Kıl keçi oğlaklarının benzer değerlerde göğüs çevresine sahip olduğu görülmektedir. Göğüs bölgesinin iyi gelişmesinin genotip, besleme ve bakım şartlarının iyi olmasından kaynaklandığı bildirilmektedir (Tozlu Çelik ve Olfaz, 2017). Göğüs çevresi de besin madde eksikliklerinin belirlenmesinde değerlendirilen bir parametredir. Vücut kondisyon puanı hayvanın enerji dengesinin veya vücut rezervlerinin bir göstergesidir. Küçükbaş hayvan

yetiştiricileri tarafından VKP'ının düzenli ölçümü ile çevre veya hastalıkla ilişkili stres faktörleri azaltılarak sürü refahı iyileştirilebilir (Curnow ve ark., 2011). Vücut kondisyon puanı, üreticilerin üretimi ve üremeyi optimize etmek için ihtiyaç duyulan yemin kalitesi ve miktarına ilişkin yönetim kararları almasına yardımcı olabilen basit ama kullanışlı bir prosedürdür ve bu nedenle koyun ve keçi pazarlamasında önemli bir rol oynayabilir (Ghosh ve ark., 2019). Besin madde yetersizlikleri belirteçleri Tablo 2'de verilmiştir.

Tablo 2. Besin madde yetersizlikleri belirteçleri

Özellikler	
Vücut kondisyon puanlaması	Ghosh ve ark. (2019); Lourencon ve ark. (2023)
Canlı ağırlık	Ghosh ve ark. (2019); Kenyon ve ark. (2014)
Kan parametreleri	Lourencon ve ark. (2023)
Göğüs çevresi	Tozlu Çelik ve Olfaz (2017)
Beden kitle indeksi	Lourencon ve ark. (2023)

SONUÇ ve ÖNERİLER

Sonuç olarak koyunlarda ve keçilerde vücut kondisyon puanlaması, yetiştiricilerin hayvanların farklı fizyolojik dönemlerinde vücut rezervlerini değerlendirmek için kullandıkları basit, etkili ve ucuz bir yönetim aracıdır. Damızlık yaşının erken döneme çekilmesinde ve dönemsel besin yetersizliklerin tespitinde canlı ağırlık ile vücut kondisyon puanlamasının birlikte değerlendirilmesinin döl verimi ve birim hayvandan daha uzun süre fayda sağlamada etkili olacağı düşünülmektedir. Koyun ve keçilerde damızlık yaşının erkene çekilmesinde vücut kondisyon puanlaması ile diğer değerlendirilen faktörlerin birlikte inceleneceği çalışmalar yapılmalıdır.

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İÇ ANADOLU EKOLOJİK KOŞULLARINDA KETENCİK (*Camelina* sp.) İLE ARA ÜRÜN SİSTEMLERİ GELİŞTİRİLEREK FAYDALI VE ZARARLI BÖCEK İLİŞKİSİNİN İNCELENMESİ

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ÖZET

1. Ürün çeşitlendirmesinin toprak ve ekosistem üzerindeki faydalarına dair çok sayıda araştırma bulunmaktadır. Karışık ekim sistemleri; doğal ekosistem ve türleri korumanın yanında, toprak besin maddeleri ile taban suyunun efektif kullanımını da sağlamaktadır. Bu sistem hastalık, zararlı ve yabancı otlara karşı doğal rekabeti güçlendirmektedir. Ekosistemi, tarımsal arazi bütünlüğünü, biyolojik çeşitliliği ve gıda güvenliğini korumayı amaçlayan, yenilikçi ve çeşitlendirilmiş ara ürün sistemleri günümüzde daha çok organic tarımda tercih edilmeye başlayan farklı bir yöntemdir. Ketencik, ılıman iklimlerde yetişen Brassicaceae familyasına ait tek yıllık geniş yapraklı yağlı tohumlu bir bitkidir. Ketencik ile karışık ekim çalışmasında ara ürün kullanımı toprak erozyonunun önlenmesi, yabancı otlar, bitki hastalıkları, bitki zararlılarıyla yüksek rekabet sağlaması, üretilen mahsullerin tohum kalite özelliklerinin arttırılması, yeni pazar fırsatları ile "Biyoçeşitlilik stratejisi 2030"a göre biyolojik çeşitlilik kaybını önlemek ve bozulmuş ekosistemleri eski haline getirmek, gibi amaçlarla planlanmıştır. 2022-2023 yılları arasında yürütülmekte olan bu çalışmada ketencik (*Camelina sativa* L.); kuraklığa ve soğuğa karşı oldukça toleranslı, hızlı çimlenme gücüne sahip bir bitki olması, yazlık-kışlık ekim yapılabilmesi, yüksek yağ ve protein oranına sahip olması, organik tarım sistemlerinde başarılı olarak yer alabilecek olması nedeniyle ana bitki olarak seçilmiştir. Karışık ekimde ise baklagil olarak çemen, baharat olarak kişniş ve tahılımsılardan karabuğday kullanılmıştır. Sürveyler; olasılıklı örnekleme yöntemlerinden basit tesadüfi örnekleme yöntemi kullanılarak yapılmıştır. Ketencik ekiliş alanını temsil edecek şekilde zararlılar toplanarak takibi yapılmıştır. Çalışmada Coleoptera takımından *Phylotreta nigripes* (Fabricius), *Phyllotreta corrugata* Reiche & Saulcy, *Phyllotreta cruciferae* (Goeze), *Smaragdina biornata angorensis* (Lopatin), *Blaps* sp., *Meligethes flavipes* Sturm ve *Aphis fabae* Scopoli, *Brevicoryne brassicae* (L.), *Myzus (Nectarasiphon) persicae* (Sulzer) (Hemiptera) türleri belirlenmiştir. Ketencik ile karışık ekim çalışması "ERA-NET CORE Organic Cofund Third Call program. Agreement No. CORE Organic/III/87/SCOOP/2022" proje çalışmasının bir bölümüdür.

Anahtar Kelimeler: *Camelina* sp., zararlı böcek, İç Anadolu

INVESTIGATION OF BENEFICIAL AND HARMFUL INSECT RELATIONSHIP BY DEVELOPING INTERCROPPING SYSTEMS WITH CAMELINA IN CENTRAL ANATOLIA ECOLOGICAL CONDITIONS

ABSTRACT

There is a great deal of research on the benefits of crop diversification on soil and ecosystems. Mixed cultivation systems; In addition to protecting natural ecosystems and species, it also provides effective use of soil nutrients and ground water. This system strengthens natural competition against disease, pests and weeds. Innovative and diversified intermediate product systems that aim to protect the ecosystem, agricultural land integrity, biodiversity and food security are a different method that is becoming more preferred in organic agriculture today. Innovative and diversified intermediate product systems that aim to protect the ecosystem, agricultural land integrity, biodiversity and food security are a different method that is becoming more preferred in organic agriculture today. *Camelina* is an annual broadleaf oilseed plant belonging to the Brassicaceae family, which grows in temperate climates. The use of intermediate products in the mixed cultivation study with camelina is planned for purposes such as preventing soil erosion, ensuring high competition with weeds, plant diseases, plant pests, increasing the seed quality characteristics of the produced crops, preventing biodiversity loss according to the "Biodiversity strategy 2030" with new market opportunities and restoring degraded ecosystems. In this study, which is being conducted between 2022-2023, flax (Camelina sativa L.); It has been chosen as the main plant because it is a plant that is very tolerant to drought and cold, has rapid germination power, can be planted summer-winter, has a high fat and protein ratio, and can be successfully included in organic agriculture systems. In mixed cultivation, fenugreek was used as legumes, coriander as spices and buckwheat from grains. Surveys; It was made using simple random sampling method from probabilistic sampling methods. *Phylotreta nigripes* (Fabricius), *Phyllotreta corrugata* Reiche & Saulcy, *Phyllotreta cruciferae* (Goeze), *Smaragdina biornata angorensis* (Lopatin), *Blaps* sp., *Meligethes flavipes* Sturm (Coleoptera) and *Aphis fabae* Scopoli, *Brevicoryne brassicae* (L.), *Myzus (Nectarasiphon) persicae* (Sulzer) (Hemiptera) species were identified in the study. Mixed planting work with *Camelina* "ERA-NET CORE Organic Cofund Third Call program. Agreement No. CORE Organic/III/87/SCOOP/2022" is part of the project work.

Keywords: Agricultural Biodiversity, Yield, Organic Agriculture, Ecosystem, Agricultural Practices

GİRİŞ

Biyolojik zenginlik ya da biyoçeşitlilik, canlıların farklılığını ve değişkenliğini, birbirleriyle ve çevreleriyle karşılıklı etkileşimlerini ifade etmektedir. Doğal ekosistemler, artan nüfus ve doğal kaynak tüketim hızının etkisiyle zarar görmekte ve genetik çeşitlilik çok büyük bir hızla azalmaktadır. Biyolojik çeşitliliğin küresel ölçüde azalması, günümüzde insanlığın karşı karşıya bulunduğu en ciddi çevresel sorunlardan biri olarak görülmektedir. Biyoçeşitliliğin azalmasının küresel ölçüde etkileri olduğunun kabul edilmesi, uluslararası toplumu 'Birleşmiş Milletler Biyolojik Çeşitlilik Sözleşmesi' ile ilgili görüşmeler yapma konusunda harekete geçirmiştir. Rio de Janerio'da 1992 yılında gerçekleştirilen Yeryüzü Zirvesi'nde Biyolojik Çeşitlilik Sözleşmesinde Türkiye'nin de aralarında bulunduğu 156 devlet, kendi sınırları içerisindeki bitkilerin, hayvanların ve mikrobiyolojik yaşamın çeşitliliğinin tam olarak korunması sorumluluğunu üstleneceklerine, ayrıca biyolojik kaynakları sürdürülebilir kullanacaklarına ve biyolojik çeşitlilikten sağlanan faydaları eşit olarak paylaşmanın yollarını arayacaklarına dair taahhütlerde bulunmuşlardır. Türkiye sözleşmeyi 1994 yılında Paris'te imzalamıştır. Türkiye halihazırda biyolojik çeşitliliğin korunması ile ilgili pek çok uluslararası sözleşmeye (Biyolojik Çeşitlilik, Paris, Ramsar, Bern, CITES, Çölleşmeyle Mücadele gibi) taraftır ve Tarım ve Orman Bakanlığının da onay verdiği bir ulusal biyolojik çeşitlilik stratejisi ve eylem planı geliştirmek dahil olmak üzere, sözleşme şartlarına uymakla yükümlüdür.

Avrupa ile Asya arasında, üç tarafı, nitelikleri birbirinden oldukça farklı olan denizlerle çevrili, üç kıta arasında köprü görevi yapan, 779.000 km^2'lik alana sahip Türkiye, topografik özellikleri, nedeniyle, kısa mesafelerde değişik iklim kuşaklarını bünyesinde bulundurmaktadır. Çok farklı iklim özelliklerini bir arada barındırmasının yanında, geçirdiği jeolojik, paleontolojik, iklimsel süreçler, farklı biyotik yapıları ile karakterize edilen üç farklı biyocoğrafik bölgenin çakışma noktasında yer alması nedeniyle, olağanüstü bir biyolojik çeşitliliğe ve ekosistem çeşitliliğine sahip ender ülkelerden biridir. Buna rağmen ülkemizde böcek faunasının tespiti konusundaki araştırmalar kısıtlı kalmıştır. Özellikle birçok bitki türünün gen kaynağı olan Anadolu'da sayısız endemik bitki türünün bulunduğu bilinmektedir. Ankara ili araştırma alanı fitocoğrafik açıdan ve iklim, flora, vejetasyon yönünden belirgin karekterlere sahip olup, ağaçsı olmayan kserofitler bakımından doğu Holarktik alemin en zengin bölgesi kabul edilmektedir. Ankara, Orta Anadolu bölgesinde kuzeyde Çubuk, güneyde Mogan, batıda Mürted ve Engürü ovalarının kesiştiği, engebeli, fakat yerleşmeye uygun özellikler taşıyan bir konumdadır (Arslan ve Çelem 2001).

Doğal bitki türleri ile oldukça zengin bir envantere sahip olan Ankara'nın sadece şehir yerleşim alanı içinde, park kenarında, durak yanında, bahçe kenarında, duvar dibinde, boş alanlarda kendi kendine yetişen 1115 adet doğal bitki türü bulunmaktadır. Şehir içinde yetişen bu bitkilerin %18 kadarı endemik yani Ülkemize özgüdür (Erik vd 1998). Bu bitki varlığının 5 tanesini Eğreltiler, 3 tanesini Kozalaklılar ve geri kalanını da çiçekli bitkiler oluşturmaktadır. Tür sayısı bakımından en zengin başlıca familyalar sırası ile Asteraceae (Papatyagiller), Fabaceae (Baklagiller), Poaceae (Buğdaygiller), Brassicaceae (Tupgiller) ve Lamiaceae (Ballıbabagiller) familyalarıdır (Yıldırım, 2001). Şehirde yetişen 175 bitki türünün endemik olması yani sadece ülke sınırları içinde yetişiyor olması ile jeolojik yapı ve tersiyer yapı önem kazanmaktadır.

Bölgedeki bitki çeşitliliği ile canlıların bulunmasının doğru orantılı olarak artış göstermesini göz önüne alırsak, Ankara'nın gerek bitki örtüsü gerekse canlıların bulunma çeşitliliğinin sebepleri de ortaya çıkmaktadır. Yabancı ot ve yabani otsu bitkilerin besin, baharat ve ilaç olarak da kullanıldığı bilinmektedir. Günümüzde tıbbi ve baharat bitkilerine karşı ilgi gittikçe artmaktadır. Bu konuda tarımcıların, botanikçilerin, biyologların, farmakologların ve doktorların bitkilerin kullanılmasında, sistematik bilgilerin oluşturulmasında, ilaç ve faydalı bitki olarak içeriklerinin araştırılmasında ve üretiminde birlikte çalışma zorunluluğu vardır (Özer vd 2001). Tıbbi ve Aromatik bitkilerin yalnız ülkemizde değil, Avrupa hatta dünyada ticaretinin son yıllarda gittikçe artması nedeniyle, Nesli Tehlike Altındaki Doğal Bitki ve Hayvanların Uluslararası Ticaretini Düzenleyen Anlaşma listelerine alınması için çalışmalar başlatılmış ve devam etmektedir (Ekim 2001).

Son yıllarda tarımsal üretimde kullanılan birçok kimyasal ilaç, gübre ve hormonlar çevreyi ve insan sağlığını tehdit eder boyutlara ulaşmış ve doğal denge bozulmuştur. Verimi arttırıcı yapay girdilerin bilinçsiz ve kontrolsüz olarak kullanılması sonucu insan ve çevre sağlığında olumsuz etkilerin son derece fazla olduğu bir ortamda ara ekim olarak adlandırılan tarım şekli alternatif olarak ortaya atılmıştır.

Turpgiller

Turpgiller yani Brassicaceae ailesi bünyesinde, endüstriyel ve yemeklik yağ bitkileri, sebze türleri, yem bitkileri ve baharat bitkileri gibi ekonomik değere sahip olan çok sayıda türü içermektedir. Brassicaceae familyasında yer alan baharat bitkileri arasında *Brassica juncea* (hint hardalı), *Erysimum* ssp. (duvar çiçeği) ve *Sinapis alba* (beyaz hardal) türleri kullanılmaktadır. Çin lahanası, karnabahar, yaprak lahana, brokoli, brüksel lahanası, gibi *Brassica oleracea* çeşitlerinin yanı sıra bahçe teresi, turp, şalgam ve roka gibi türler de sebzeler

arasında sık bir şekilde kullanılmaktadır. *Brassica carinata* (Ethopya hardalı), *Camelina sativa* (ketencik), *Eruca vesicaria* (roka) gibi türler ise yemeklik yağ, biyodizel yakıt bitkileri olmaları açısından ve moleküler tarım bakımından ciddi bir imkana sahiptir (Gugel ve Falk, 2006; Warwick vd., 2007; Sıralı vd., 2013). Yeni Dünya bitkileriyle önemini yitiren ketencik, son dönemlerde petrolden türetilmiş yakıtlara ilave edilebilecek yenilenebilir kaynak olarak tekrardan önem kazanmıştır. Tüm dünyada olduğu gibi ülkemizde de artan nüfusa paralel olarak başta gıda olmak üzere endüstriyel ürünler ve enerjiye olan insani ihtiyaçlar giderek artmaktadır.

Karışık ekim sistemi; doğal ekosistem ve faydalı ve zararlı türleri korumanın yanında, toprak besin maddeleri ve taban suyunun efektif kullanımını sağlamaya çalışan, hastalık zararlı ve yabancı otlara karşı doğal rekabeti iyileştiren bir yöntemdir. Ayrıca ekosistemi ve tarımsal arazi bütünlüğünü, biyolojik çeşitliliği ile gıda/yem güvenliğini korumayı amaçlayan yenilikçi ve çeşitlendirilmiş organik ara ürün sistemlerine odaklanmıştır.

Ketencik [*Camelina sativa* L. Crantz], Brassicaceae ailesinde bulunan ve genel olarak bilinen 7 *Camelina* türünden biridir. Bu türler arasında *Camelina* cinsi ekonomik olarak değerli olan tek türdür. Ketencik, ülkemiz koşullarında hem yaz hem de kış aylarında yetişebilen, kısa vejetasyon zamanına sahip olan önemli bir yağ bitkisidir (Şekil 1).



Şekil 1. Ketencik [*Camelina sativa* L. Crantz], Brassicaceae

Ketencik ile karışık ekim çalışmasında ara ürün kullanımı toprak erozyonunun önlenmesi, yabancı otlar, bitki hastalıkları, bitki zararlılarıyla yüksek rekabet sağlaması, üretilen mahsullerin tohum kalite özelliklerinin arttırılması, yeni pazar fırsatları ile "Biyoçeşitlilik stratejisi 2030"a göre biyolojik çeşitlilik kaybını önlemek ve bozulmuş ekosistemleri eski haline getirmek, gibi amaçlarla planlanmıştır.

Son yıllarda tarımsal üretimde kullanılan birçok kimyasal ilaç, gübre ve hormonlar çevreyi ve insan sağlığını tehdit eder boyutlara ulaşmış ve doğal denge bozulmuştur. Verimi arttırıcı yapay girdilerin bilinçsiz ve kontrolsüz olarak kullanılması sonucu insan ve çevre sağlığında olumsuz etkilerin son derece fazla olduğu bir ortamda ara ekim/karışık ekim olarak adlandırılan tarım şekli alternatif olarak ortaya atılmıştır.

MATERYAL ve METOT

2022-2023 yılları arasında yürütülmekte olan bu çalışmada ketencik (*Camelina sativa* L.); kuraklığa ve soğuğa karşı oldukça toleranslı, hızlı çimlenme gücüne sahip olması, yazlık-kışlık ekim yapılabilmesi, yüksek yağ ve protein oranına sahip olması, organik tarım sistemlerinde başarılı olarak yer alabilecek olması nedeniyle ana bitki olarak seçilmiştir.

Örnekler toplanırken bitkiler gözle kontrol edilmiştir (Şekil 2) ve atrap kullanılmıştır. Atrap içerisinden toplanan örnekler etil asetatlı öldürme şişelerine alınarak öldürülmüştür. Etil asetatlı şişelerde öldürülen örnekler preparasyonu yapılmak için boş şişelere aktarılmış ve şişelerin içine yer numaraları verilerek arazi defterine kaydedilmiştir.



Şekil 2. Deneme alanında örneklerin toplanması

Karışık ekimde ise baklagil olarak çemen (*Trigonella foenum-graceum* L.), baharat olarak kişniş (*Coriandrum sativum* L.) ve tahılımsılardan karabuğday (*Fagopyrum esculentum* Moench) kullanılmıştır. Sürveyler; olasılıklı örnekleme yöntemlerinden basit tesadüfi örnekleme yöntemi kullanılarak yapılmıştır. Ketencik ekiliş alanını temsil edecek şekilde zararlılar toplanarak takibi yapılmıştır.

SONUÇLAR ve TARTIŞMA

Çalışmada Coleoptera takımından *Phyllotreta nigripes* (Fabricius) (Şekil 3a), *Phyllotreta corrugata* Reiche & Saulcy (Şekil 3b), *Phyllotreta cruciferae* (Goeze), *Smaragdina biornata angorensis* (Lopatin) (Şekil 4 a), *Blaps* sp. (Şekil 4 b), *Meligethes flavipes* Sturm ve Hemiptera takımından *Aphis fabae* Scopoli, *Brevicoryne brassicae* (L.), *Myzus (Nectarasiphon) persicae*

(Sulzer) türleri belirlenmiştir. Coleoptera takımına ait türlerin teşhisleri Dr. Öğr. Üyesi Neslihan BAL (Gazi Üniversitesi Fen Fakültesi Biyoloji Bölümü, Ankara) ve Dr. Didem CORAL (Zirai Mücadele Merkez Araştırma Enstitüsü, Ankara) tarafından yapılmıştır.



Şekil 3. a) *Phyllotreta nigripes* b) *Phyllotreta corrugata*



Şekil 4. a) *Smaragdina biornata angorensis*, b) *Blaps* sp.

Ketencik üzerinde ülkemizde ilk defa kaydedilen Hemiptera takımı Aphididae familyasından *Aphis fabae* koloniler halinde konukçularının genç sürgün uçlarına, çiçekler üzerine ve belirgin olarak kıvırdığı yapraklar üzerine yerleşir, yoğun populasyonda bitkinin tüm yapraklarında bulunmaktadır. Otuzdan fazla bitki virus hastalığının vektörü olarak bilinmektedir (Blackman ve Eastop, 1984). Vektörü olduğu ve nonpersistent yolla nakletme durumunda olduğu virüslere örnek olarak fasulye sarı mozaik, şeker pancarı mozaik, Dahlia mozaik, hıyar mozaik virüsleri, persistent yolla naklettiği virüslere örnek olarak da pancar sarı ağ virüsü, patates yaprak kıvırcıklığı virüsleri verilmektedir. Yine aynı takımdan *Brevicoryne brassicae* Ülkemizde önceki araştırıcılar tarafından lahana çeşitleri üzerinde saptanmıştır (Giray, 1974; Düzgüneş ve ark., 1982). Konukçularının yaprak altlarında yoğun koloniler oluşturmakta, ayrıca çiçek tomurcukları ve tohum taslakları üzerine yerleşip tohum oluşumunu engellemektedir. Lahana yetiştiriciliğinde önemli bir zararlı olup ülkemizde yaygındır. Birçok bitki virüs hastalığının vektörüdür. Bunlardan nonpersistent yolla naklettikleri pancar mozaik, kabak siyah halka leke, kabak halka nekrosis, karnabahar mozaik, hıyar mozaik, turp mozaik virüsleri örnek olarak verilebilir. Son olarak Ketencik üzerinde tespit edilen ve polifag oluşu ile birçok virüslerin de etkili birer vektörü olan *Myzus (N.) persicae*, primer konukçu olarak seçtiği *Prunus persica* ve diğer *Prunus* türleri ile sayısız sekonder konukçusu üzerinde heteroecious holosiklik yaşam göstermekte, ılıman bölgelerde ve sera koşullarında parthenogenetik olarak canlı doğurma ile

yıl boyu devam etmektedir. Konukçularının yeni gelişen dokularında, yaprakların altlarında ve yaşlı yapraklarda yoğun koloniler oluşturarak kıvrılmalar meydana getirmektedir. 100'den fazla virüsü nonpersistent ve persistent yolla nakledebilmektedir. Bunlardan özellikle ekonomik zarar ortaya koyan patates ve tütün virüslerini nakletmesi önemlidir. Patates acuba mozaik, patates A ve patates Y virüsü ile tütün solgunluk virüsünü nonpersistent, patates yaprak kıvırcıklığı, tütün yaprak bükülme ve domates sarı ağ virüslerini de persistent yolla taşımaktadır (Kennedy ve ark., 1962; Blackman ve Eastop 2023).

İyot sayısı (144) bakımından kuruyan yağ sınıfında yer alan ketencik yağı, bu özelliğinden dolayı makine yağı sanayisinde ve vernik sanayisinde tercih edilmektedir. Geçmiş dönemlerde yoğun bir şekilde yetiştiriciliği yapılmış olan ketencik, gıda ve hayvan yemi kaynağı olarak kullanılmaktadır (Göre ve Ayaşan 2021). Ketencik yağının aromatik tadını hafifletmek amacıyla diğer bitkisel yağlarla, özellikle kolza yağı ile, karıştırılarak mayonez, salata sosu vb gibi bazı gıda ürünlerinin yapımına da katkı sağlamaktadır. Tarımsal ilaçların kullanımında dolgu maddesi olarak ve pestisit yapımında kullanılan petrol yağının yerine de konabilen ketencik yağı az kalıntı bırakmasıyla yeni bir kaynak olmaktadır. Yeşil gübre bitkisi olarak yetiştirilmesi, organik gübrelemeye katkı sağlarken toprak zenginliği açısından da destek olmaktadır. Ayrıca süs bitkisi olarak çevre düzenlemesi yapılan alanlarda da kullanılmaktadır (Göre ve Ayaşan, 2021). Ketencik bitkisi ile ara ekim çalışması ve bununla ilgili olabilecek diğer karışık ekim çalışmaları hastalık, zararlı ve yabancı ot kontrolünde entegre ürün yönetimini sağlamaktadır. Organik tarım yapılan alanlarda sürdürülebilirliğin sağlanması açısından karışık ekimin kullanılması avantajlı görünmektedir. Bu konuda daha detaylı ve farklı ürünlerle yapılacak çalışmalarla desteklenmesinin konunun önemini öne çıkaracağı düşünülmektedir.

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EMERGING TRENDS IN AGRICULTURE: BENEFITS AND CHALLENGES

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ABSTRACT
The agricultural sector is experiencing a transformative shift driven by emerging trends that are reshaping the way food is produced, distributed, and consumed. This abstract provides an overview of the key emerging trends in agriculture and their potential implications for sustainable food production. Precision agriculture, characterized by the integration of advanced technologies such as remote sensing, GIS, and GPS, enables farmers to optimize resource allocation and enhance productivity. This trend promotes efficient crop monitoring, precise irrigation, targeted fertilization, and effective pest control, resulting in improved yields and resource management. Finally, the formation of Farmer Producer Organizations (FPOs) empowers small-scale farmers by enabling collective marketing, better price negotiation, and improved access to credit and government schemes. FPOs facilitate knowledge exchange, adoption of best practices, and farmer-centric approaches, strengthening the position of farmers in the agricultural value chain.

Keywords: Precision agriculture, Organic farming, Sustainable agriculture, Farm mechanization, Digital agriculture, Agri-entrepreneurship, Agricultural, High-value crops, Diversification, Farmer Producer Organizations (FPOs)

INTRODUCTION

Organic farming is gaining traction as consumers demand pesticide-free and environmentally friendly produce. Farmers are increasingly adopting organic farming methods and sustainable agricultural practices to cater to this growing market. Government initiatives and certification programs have further propelled the expansion of organic farming, contributing to soil health and biodiversity conservation. The adoption of sustainable agricultural practices is another noteworthy trend in the sector. Conservation agriculture, agroforestry, and integrated pest management techniques are being embraced to minimize the use of chemical inputs, reduce soil erosion, and enhance ecosystem resilience. This shift towards sustainable practices ensures the long-term viability of agriculture while mitigating environmental impacts. Farm mechanization is revolutionizing agricultural operations, reducing labor dependency, and enhancing productivity. Modern machinery and equipment are being employed for plowing, sowing, harvesting, and post-harvest processing. Mechanization enables efficient farm management, timely operations, and increased efficiency in resource utilization.

Digital agriculture, powered by mobile apps, sensors, and IoT devices, is transforming the way farmers collect and analyse data. Real-time information on weather, soil conditions, crop health, and market prices helps farmers make informed decisions, optimize resource allocation, and improve overall productivity. This trend fosters precision farming, enhances decision-making capabilities, and facilitates market connectivity. Agri-entrepreneurship and the rise of agricultural startups are driving innovation and creating new opportunities in the sector. These startups leverage technology to address challenges in the agricultural ecosystem, such as supply chain management, market access, and financial inclusion. The emergence of agri-entrepreneurs contributes to the development of sustainable and market-oriented agriculture. Diversification into high-value crops is becoming a popular strategy for farmers, offering economic prospects and risk diversification. Cultivation of fruits, vegetables, spices, floriculture, and medicinal plants taps into lucrative markets while reducing vulnerability to climate variability and market fluctuations.

Review of Literature

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challenges, and policy implications of FPOs in promoting collective marketing, access to credit, and improved market linkages.

OBJECTIVES OF EMERGING TRENDS IN AGRICULTURE

The objectives of emerging trends in agriculture are focused on transforming and improving various aspects of the agricultural sector. These objectives aim to address the challenges faced by farmers, enhance productivity, promote sustainability, and ensure food security. Here are the key objectives of emerging trends in agriculture:

Enhance Productivity: One of the primary objectives is to increase agricultural productivity through the adoption of advanced technologies, precision farming techniques, and improved farming practices. This includes optimizing resource utilization, enhancing crop yields, and improving overall efficiency in agricultural production systems.

Promote Sustainability: Emerging trends aim to promote sustainable agricultural practices that minimize negative environmental impacts, conserve natural resources, and preserve biodiversity. This involves reducing chemical inputs, adopting organic farming methods, implementing conservation agriculture, and practicing responsible land and water management.

Improve Food Safety and Quality: Another objective is to ensure the production of safe, nutritious, and high-quality food. This includes promoting good agricultural practices, reducing the use of harmful chemicals, and adhering to quality standards and certifications to meet consumer expectations for safe and healthy food products.

Foster Innovation and Technological Advancement: Emerging trends aim to foster innovation and the adoption of advanced technologies in agriculture. This involves promoting digital agriculture, precision farming, automation, remote sensing, and data-driven decision-making to improve efficiency, optimize resource management, and enhance farm operations.

Encourage Market Connectivity and Value Addition: The objective is to enhance market connectivity for farmers, enabling them to access fair prices and expand market opportunities. This involves promoting direct marketing channels, e-commerce platforms, and value addition activities to increase farmers' income and create additional value along the agricultural value chain.

Ensure Climate Resilience: With the increasing challenges posed by climate change, the objective is to enhance the resilience of agricultural systems. This includes adopting climate-smart agricultural practices, developing climate-resilient crop varieties, implementing water management strategies, and promoting adaptive farming techniques to mitigate climate-related risks.

Empower Farmers and Rural Communities: Emerging trends aim to empower farmers, especially small-scale farmers, and rural communities. This involves promoting farmer collectives, supporting farmer producer organizations (FPOs), providing access to credit, training, and extension services, and creating opportunities for agri-entrepreneurship to improve the socio-economic conditions of farmers and rural livelihoods.

Foster Sustainable Resource Management: The objective is to promote efficient and sustainable management of natural resources in agriculture. This includes water conservation, soil health management, sustainable use of fertilizers and pesticides, and responsible waste management to minimize environmental pollution and degradation.

Enhance Knowledge Sharing and Collaboration: Emerging trends focus on promoting knowledge sharing, collaboration, and capacity building among farmers, researchers, policymakers, and other stakeholders. This involves creating platforms for information exchange, encouraging research and innovation partnerships, and fostering multi-stakeholder collaboration to drive sustainable agricultural development.

Achieve Food Security and Sustainable Development Goals: The overarching objective is to contribute to global food security and achieve the United Nations Sustainable Development Goals (SDGs) related to agriculture, poverty alleviation, environmental sustainability, and rural development. Emerging trends in agriculture play a crucial role in ensuring the availability, accessibility, and affordability of food while safeguarding the environment and improving livelihoods.

IMPORTANCE OF EMERGING TRENDS IN AGRICULTURE

Emerging trends in agriculture hold significant importance in transforming the agricultural sector and addressing various challenges faced by farmers, consumers, and the environment. Here are the key reasons highlighting the importance of these trends:

Sustainable Food Production: Emerging trends in agriculture promote sustainable practices that minimize environmental impacts, conserve natural resources, and prioritize ecosystem health. This is crucial for ensuring long-term food production while safeguarding the environment for future generations.

Increased Productivity and Efficiency: By adopting precision agriculture, farm mechanization, and digital technologies, farmers can optimize resource allocation, enhance productivity, and improve efficiency. This is essential for meeting the increasing global demand for food and ensuring food security.

Economic Development and Livelihoods: The adoption of emerging trends in agriculture, such as agri-entrepreneurship, agricultural startups, and market-oriented practices, creates economic opportunities, generates employment, and enhances income for farmers. This contributes to rural development, poverty alleviation, and improved livelihoods.

Improved Food Quality and Safety: Organic farming practices and sustainable agricultural methods prioritize the production of high-quality, safe, and nutritious food. These trends address consumer concerns regarding pesticide residues, chemical inputs, and the overall healthfulness of agricultural produce.

Climate Resilience and Adaptation: With the challenges of climate change and increasing climate variability, emerging trends in agriculture promote resilient farming practices. These trends enable farmers to adapt to changing climatic conditions, mitigate production risks, and build resilience against extreme weather events.

Technological Advancement: The adoption of digital agriculture, precision farming, and advanced technologies in agriculture fosters innovation, knowledge sharing, and technology transfer. It enables farmers to access real-time information, data-driven decision-making tools, and advisory services, empowering them to make informed choices and improve agricultural practices.

Market Connectivity and Fair Trade: Emerging trends facilitate better market connectivity, reducing the dependency on intermediaries and enabling farmers to access fair prices for their produce. Direct market linkages, e-commerce platforms, and improved supply chain management contribute to transparent and efficient agricultural markets.

Environmental Conservation and Biodiversity Preservation: Sustainable agricultural practices promoted by emerging trends help preserve biodiversity, reduce soil erosion, protect water resources, and conserve natural habitats. This contributes to the preservation of ecosystems, wildlife, and overall environmental health.

Food Safety and Security: By adopting sustainable practices, reducing chemical inputs, and promoting responsible agricultural methods, emerging trends play a crucial role in ensuring food safety and security. They enhance the availability and accessibility of safe and nutritious food for growing populations.

Empowering Farmers: Farmer Producer Organizations (FPOs), collective marketing initiatives, and capacity building efforts empower farmers by providing them with a stronger voice in the agricultural value chain. These trends enable farmers to negotiate better prices,

access credit, and avail themselves of government schemes, strengthening their socio-economic status.

Overall, emerging trends in agriculture are vital for achieving sustainable, efficient, and inclusive agricultural systems. By addressing environmental, economic, and social challenges, these trends pave the way for a resilient, productive, and sustainable agricultural sector that meets the evolving needs of a growing population.

EMERGING TRENDS IN AGRICULTURE

In recent years, Indian agriculture has witnessed several emerging trends that are shaping the sector and driving its growth. Here are some of the notable trends:

Precision Agriculture: Precision agriculture involves the use of advanced technologies such as remote sensing, geographic information systems (GIS), and global positioning systems (GPS) to optimize agricultural practices. Farmers are adopting precision farming techniques to monitor and manage crop health, irrigation, fertilization, and pest control, leading to improved yields and resource efficiency.

Organic Farming: There is a growing demand for organic and pesticide-free produce both domestically and globally. Indian farmers are increasingly adopting organic farming methods to cater to this demand. The government has also introduced certification programs and provided incentives to promote organic agriculture, resulting in an expansion of organic farming practices.

Sustainable Agriculture: With the increasing focus on environmental sustainability, there is a shift towards sustainable agricultural practices in India. Farmers are adopting practices like conservation agriculture, agroforestry, and integrated pest management to minimize the use of chemical inputs, reduce soil erosion, and promote biodiversity conservation.

Farm Mechanization: Mechanization is playing a vital role in transforming Indian agriculture. Farmers are adopting mechanized equipment and machinery for various farming operations, including plowing, sowing, harvesting, and post-harvest processing. Mechanization helps in reducing labor dependency, increasing productivity, and improving overall efficiency.

Digital Agriculture: Digital technologies are rapidly transforming Indian agriculture. Mobile apps, sensors, and Internet of Things (IoT) devices are being used to collect and analyze data related to weather, soil moisture, crop health, market prices, and more. This information enables farmers to make data-driven decisions, optimize resource allocation, and enhance productivity.

Agri-Entrepreneurship and Startups: The agriculture sector in India is witnessing a rise in agri-entrepreneurship and the emergence of innovative startups. These startups are leveraging

technology to address various challenges in agriculture, such as farm-to-market connectivity, supply chain management, financial inclusion, and access to information and advisory services. This trend is fostering innovation and creating new opportunities in the agricultural ecosystem.

Diversification and High-Value Crops: There is an increasing trend of diversification from traditional crops to high-value crops in Indian agriculture. Farmers are shifting towards cultivation of fruits, vegetables, spices, floriculture, and medicinal plants to tap into lucrative markets. This diversification not only offers better economic prospects but also helps in reducing risks associated with climate variability and market fluctuations.

Farmer Producer Organizations (FPOs): Farmer Producer Organizations are gaining prominence in India to empower farmers and improve their market access. FPOs enable small and marginal farmers to collectively market their produce, negotiate better prices, access credit, and avail of various government schemes. They also facilitate the adoption of best practices and promote farmer-centric approaches. These emerging trends in Indian agriculture reflect a growing emphasis on sustainability, technology adoption, value addition, and market orientation. They hold the potential to transform the sector, enhance farmers' livelihoods, and contribute to the overall development of agriculture in India.

BENEFITS ON EMERGING TRENDS IN AGRICULTURE

Emerging trends in agriculture bring forth several benefits that positively impact farmers, consumers, and the environment. Here are some key benefits associated with these trends:

Increased Productivity: Precision agriculture, farm mechanization, and digital technologies optimize resource allocation, improve farming practices, and enhance overall productivity. Farmers can monitor crop health, water usage, and nutrient application more precisely, resulting in higher yields and efficient resource management.

Improved Sustainability: Sustainable agricultural practices, including organic farming, conservation agriculture, and agroforestry, promote environmental stewardship. These practices reduce soil erosion, minimize chemical inputs, preserve biodiversity, and promote soil health, ensuring the long-term sustainability of agricultural systems.

Enhanced Resource Efficiency: Precision agriculture and digital technologies enable farmers to optimize resource utilization, such as water, fertilizers, and energy. By precisely applying inputs based on real-time data, farmers can reduce wastage, improve efficiency, and minimize environmental impacts.

Quality and Safety of Produce: Organic farming practices prioritize the use of natural inputs and minimize the presence of chemical residues in crops. This results in the production of high-

quality and safe agricultural produce, meeting the increasing consumer demand for pesticide-free and healthier food options.

Economic Opportunities: The emergence of agri-entrepreneurship and agricultural startups creates new economic opportunities in the sector. These ventures introduce innovative solutions, improve market access, and create employment opportunities in rural areas. It also fosters value addition, diversification, and higher-value crop cultivation, leading to increased income for farmers.

Market Connectivity: Digital agriculture and market-oriented practices enable farmers to access real-time market information, connect with buyers, and make informed decisions. This reduces dependency on intermediaries, promotes fair pricing, and enhances market transparency, benefiting both farmers and consumers.

Climate Resilience: Sustainable agricultural practices help build climate resilience by reducing vulnerability to extreme weather events and climate change impacts. Diversification into high-value crops and adoption of resilient farming techniques enable farmers to adapt to changing climatic conditions and mitigate production risks.

Farmer Empowerment: Farmer Producer Organizations (FPOs) and collective marketing initiatives empower small-scale farmers by providing them with a unified platform to negotiate better prices, access credit facilities, and avail themselves of government schemes. This enhances the socio-economic status of farmers and strengthens their bargaining power in the market.

Technology Adoption: The adoption of advanced technologies in agriculture improves farm operations, data-driven decision-making, and overall efficiency. It helps bridge the information gap, provides access to advisory services, and enables farmers to adopt best practices, leading to improved productivity and profitability.

Environmental Conservation: Sustainable agricultural practices contribute to environmental conservation by reducing soil erosion, minimizing water pollution, and preserving natural habitats. By promoting biodiversity and ecosystem health, emerging trends in agriculture support ecological balance and long-term sustainability. These benefits highlight the transformative potential of emerging trends in agriculture, paving the way for a more sustainable, efficient, and resilient agricultural sector.

CHALLENGES ON EMERGING TRENDS IN AGRICULTURE

While emerging trends in agriculture offer numerous benefits, they also come with certain challenges that need to be addressed. Here are some key challenges associated with these trends:

High Initial Investment: Adoption of emerging trends in agriculture often requires significant initial investment in technology, equipment, and infrastructure. Small-scale farmers may face financial constraints in acquiring these resources, limiting their ability to embrace these trends fully.

Technological Barriers: Farmers, particularly those in remote or resource-limited areas, may lack access to the necessary technological infrastructure and digital literacy. Limited internet connectivity, lack of technical knowledge, and inadequate training can hinder the widespread adoption of digital agriculture and other technology-driven trends.

Education and Awareness: Familiarity with emerging trends and their benefits is crucial for farmers to embrace and implement them effectively. Providing education, training, and awareness programs to farmers regarding sustainable practices, precision agriculture, and new technologies is essential for their successful adoption.

Resistance to Change: Traditional farming practices are deeply ingrained in many farming communities. Resistance to change and skepticism about new methods and technologies can pose challenges in adopting emerging trends. Addressing misconceptions, demonstrating the benefits, and promoting knowledge sharing are important to overcome resistance and encourage adoption.

Fragmented Land Holdings: In many regions, small and fragmented land holdings make it difficult to implement mechanization and precision agriculture techniques. Limited access to machinery and the inability to implement large-scale technological interventions can hinder the adoption of emerging trends in such areas.

Market Access and Infrastructure: While emerging trends promote market orientation, inadequate market infrastructure and limited access to markets can pose challenges. Farmers need reliable transportation, storage facilities, and market linkages to effectively connect with buyers and access fair prices for their produce.

Policy and Regulatory Support: The absence of supportive policies, regulations, and incentives can impede the adoption of emerging trends. Governments need to provide a conducive policy environment, financial support, and incentives to encourage farmers to embrace sustainable practices, invest in technology, and adopt innovative approaches.

Data Privacy and Security: The increasing use of digital technologies and data collection in agriculture raises concerns about data privacy and security. Safeguarding farmers' data, ensuring its confidentiality, and protecting against cyber threats are important considerations that need to be addressed to maintain trust in these emerging trends.

Capacity Building and Extension Services: Strengthening agricultural extension services and providing adequate capacity building support to farmers are crucial for the successful implementation of emerging trends. Extension services should provide technical assistance, training, and advisory support to farmers to ensure effective adoption and utilization of new practices and technologies.

Environmental Impact: While sustainable practices are promoted through emerging trends, it is essential to continually monitor and mitigate any unintended environmental consequences. Balancing productivity with ecological sustainability, minimizing chemical inputs, and monitoring potential ecological impacts are important considerations for sustainable agriculture. Addressing these challenges requires a multi-stakeholder approach involving farmers, governments, technology providers, research institutions, and civil society organizations. Collaboration, policy reforms, infrastructure development, and capacity building efforts are key to overcoming these challenges and maximizing the potential benefits of emerging trends in agriculture.

CONCLUSION

In conclusion, these emerging trends in agriculture reflect a transition towards sustainability, technology adoption, market orientation, and farmer empowerment. Embracing these trends has the potential to transform the agricultural sector, enhance food production, and contribute to a more sustainable and resilient future.

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TÜRK DÜNYASININ TARIM, HAYVANCILIK VE KIRSAL KALKINMA PROJESİ VE 4. SANAYİ DEVRİMİNİN BİLEŞENLERİ

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ÖZET

Küreselleşme olgusunun gittikce tüm sahalarda adım adım gerçekleştiği bir dünyada, Türk Dünyasının bölgesel ve kıtasal bütünlüyü önem taşımaktadır. Türk Devletlerinin Avrasiya kıtasında birleşik devlet olan TURAN devletini kurma çabası da küreselleşmenin bölgesel ve kıtasal kalkınma projesinin bir parçası olarak Kuzey Kıprız ve Balkanlardakı Türk yerləşimini də içinə almaktadır. Türk Devletler Teşkilatının yaptığı Devlet Başkanlığı Zirveler Toplantısının amacı da, küresel kalkınmada yeni gelişim yollarını aramak olmuştur. Bu çalışmanın temel amacı küresel kalkınmada Türk Dünyasının tarım, hayvancılık ve kırsalın bölgesel, aynı zamanda kıtasal kalkınmasının çözüm yollarını ve potansiyelini belirlemek ve robotlaşmış sistemlər ile geliştirme yollarını tetkik etmektir. Çalışmada analitik və ampirik yöntemler (*sistematik yaklaşım, modelleme karşılaştırma, mantıksal genelleme)* kullanılmıştır. Araştırmada, Türk Dünyasına ait coğrafi alandakı tarım, hayvancılık ve kırsalın bütünlüyünün yaranmasının zeruret olduğu ve qomşu devletlerin de bu kalkınma projesinin içinde bulunmasının mühim olduğu ortaya çıkmıştır. Teknoloji dünyasının, otomasyon sistemlerin, yapay zekanın, robot ve kobotların bu kalkınma projesinin en önemli unsurları olacağı sonucuna varılmıştır. Siyasi gücün çözemedeği bölgesel savaşların bitməsinin vacib olduğu sonucuna gəlinmişdir. Teknoloji gelişim ile ortak üretilen ürün bolluğunun bu savaşları durduracağı sonuç değerlendermesi olarak verilmiştir. Küreselleşmenin olgu ve kaçınılmaz olduğu, bölgesel ve kıtasal kalkınma için barışın olmasının mühüm olduğu, teknoloji ile gelişimin de anahtarı olduğu kanaatına gəlinmiştir.

Anahtar Kelimeler: Türk Dünyası, tarım, hayvancılık ve kırsal, kalkınma, robot ve cobot

AGRICULTURE, LIVESTOCK AND RURAL DEVELOPMENT PROJECT OF THE TURKIC WORLD AND COMPONENTS OF THE 4TH INDUSTRIAL REVOLUTION

ABSTRACT

In a world where globalization is gradually occurring in all fields, the regional and continental integrity of the Turkic world holds significance. The endeavour to establish the TURAN state as a united state for Turkic countries in the Asian continent includes the Turkic settlements in Northern Cyprus and the Balkans as the part of the regional and continental development project of globalization. The objective of the Presidential Summit Meetings determined by the Turkic States Organization was to explore new ways of development in global development. The primary aim of this study is to determine the solutions and potential for the agricultural, livestock, and rural development of the Turkic world in global development, as well as on a continental scale, and to investigate the development paths using robotized systems. The research employed analytical and empirical methods, such as a systematic approach, modelling comparison, and logical generalization. The study revealed that it is important to establish the unity of agriculture stockbreedig and rural areas within the geographical scope of the Turkic world, and the involvement of neighbouring countries in this development project is crucial. It is widely accepted that the world of technology, automation systems, artificial intelligence, robots, and cobots will constitute the most significant elements of this development project. It is recognized that the cessation of regional wars, unresolved by political power, can be achieved. Consequently, it is inferred that the abundance of products resulting from technological advancements will put an end to these wars. The inevitability and fact of globalization, the importance of peace for regional and continental development, and the role of technology as a key to development are reached as conclusions.

Keywords: Turkic World, agriculture, livestock and rural areas, development, robots and cobots

GİRİŞ

Teknolojinin gelişimi sanayi devrimleri ile bir gelişim yoluna girmiştir. Devrimlerin ana koşulları hareket biçimlendiren enerjinin içatı, makine içatı, teknoloji çeşitliliğinin artması olmuş ve günümüze kadar da devam etmektedir. Bu bakımdan "enerji" kavramı tüm gelişim süreçlerinin özü olarak bir arayış konusu olmuştur. Genellikle tüm devrimler enerji nevinin değişimiyle ilişkilidır. Endüstri 1.0. devriminde "bio enerji", Endüstri 2.0. devriminde "elektrik enerjisi", Endüstri 3.0. devriminde elektrik enerjisinin yenilenemez kaynakları ile birlikde yenilenebilir kaynaklardan alınması, sanayeləşməni gəliştiren özel değerin elektrik enerjisi olduğunu ortaya koymuştur. Elektrik enerjinin sürekliliği üretimi otomosyon, otomotik sistemler hesabına seri, çevik hale getirmişdir. Bu sanayeleşme devri elektroniğin gelişimi, sayısallaşma veya djitallaşma icatı, proqramlana bilen lojistik controller-PLC, bilgisayar, otomotik sistemler, otomasyon sistemlerin gelişim süreçlerini içine alan devr olarak, hızlı endüstri devri niteliği kazanmıştır. Endüstri 3.0 devrimi elektronik cihazların ve bilişim teknolojilerinin çevik üretim otomosyonuna enteqre devri olarak değer kazanmaktadır.

Endüstri 4.0. devrimi enerji kaynaklarının daha yeni üretilme teknolojisini ortaya koyan, vizyonuna göre 3. Sanayeye benzese de, bileşenleri ile farklı biçim sergileğen bir devri başlatmaktadır. Endüstri 4.0. devrimi esnek, 3D ve 4D printerlerde eklemeli üretim devri olarak değer kazanıyor. Djital teknoloji gelişim ile gelen Endüstri 4.0. devrimi tüm alanlarda yeni donanım sistemi, yeni üretim sistemi, yeni işçi sistemi veb. sistemler oluşturmaktadır. Aynı zamanda 4.Sanaye bileşenlerinin sanaye sektörüna tatbik edildiyi gibi, sanaye sektörü olmayan alanlara da tatbik edilmesi, zıt sistemleri birlik haline getirecek durum da sergilemektedir.

Endüstride olan bu gelişim süreçleri tüm alanları etkilediyi gibi tarım, hayvancılık ve kırsal kalkınma için donanım sisteminin ve ürün yetiştirme, hasat, satış, kırsal alanların tarıma hazırlanması ved. bu gibi süreclerin hayata geçmesine de etki etmektedir.

Endüstrüel devrimler toplumsal yaşamın gelişim süreçlerini de içine almaktadır. Toplumların kontrol edilmesi ve devletlerin hegemen siyasi duruşunun ekonomiye bağlı olan sanayeleşmenin(*endüstrileşmenin*) başladığı ülkelere ait olduğu bilinmektedir. İngiltere, Almaniya, Fransa, ABŞ, Yaponiya, İsviçre gibi ülkelerin ilk sanayeci ve hegemenci, ve siyasetci oldukları ve günümüze kadar bu duruşu sergilemekde oldukları da bilinmektedir. Aslında "siyaset" teriminin iktisadiyatın(*ekonomin*) gücü olarak oluştuğunu, ilk sanayeleşen Avrupa devletlerinin doğal kaynaklara çökmesiyle sömürgeçi konuma geldikleri de tarihten biliniyor.

Eski toplumlardan biri olan Türk toplumu genellikle hayvancılığa önem veren bir toplum olsa da, sanat eserleri M.Ö. 6-5.binyıllara ait kurgan çalışmalarından bulunan halı, kilim, çizme, giysi, bezek eşyaları, boyak, kablar ve s. gibi buluntulardan bu milletin çok gelişmiş sanat texnolojisinin olduğunu gösteriyor. Toplum ruhundaki hürlük, eşitlik Türkleri zorunlu işci çalıştırma çabasından uzak tutmuş ve sanayeleşme Avrupadan gec başlamıştır. Türk toplumunun teknoloji gelişimin içinde olduğu, eski çağdan bu yana bir çok icatlara imza atdığı tarihi araştırmalardan bellidir. Doğu ilm adamlarının bilgi kitaplarının, içatlarının hegemencilerin eline geçmesi, Doğu'da sanayeleşmenin geç başlaması sebeplerinden biri olmuştur. Genellikle sanayeleşmenin temel funksiyonu olan enerji konusunun kollektif üretim sistemini oluşturan temel faktör olduğu dikkata alınarsa, toplumsal gelişimde Doğu'nu Batı'dan geri koyan faktörün de elektrik enerjisi olduğunu değerlendirmiş oluruz.

Böğleçe teknoloji çeşitliliği değil, enerji güc kaynağının kollektiv iş, seri üretim, çevik, esnek otomasyon sistemi geliştirerek sanayeleşme ile birge devlet ve toplumsal hegemenlik gücü olduğunun farkına varılır. Bu bakımdan sanayeleşme, zaman geçtikce genel şartlar altında tüm dünya devletlerinde önem taşımaya başlamıştır.Türk milletinin her zaman devlet geleneği ve "kızıl elma" ideoloji yolu olduğu yine tarih sayfalarında yazılmış, araştırmacılar tarafından tatkik edilmiştir. Eski gelenekleri yenilemek adına Türk milletinin kurduğu devletlerin bütünleşme çabası zaman-zaman hegemen devletler tarafından istenmese de, günümüzde küreselleşme olgusunun getirdiği kurallar ve şartlar bu talebi ortya koymaktadır.

Küreselleşme olgusu teknoloji gelişim, enerji kaynak değişimi, djitalleşme, 4. Sanaye devrim bileşenleri, yapay zeka gibi yenilikler ile beşer toplumunun yaşam seviyesini yükseltmek adına tüm doğa kaynaklarının adaletli bölgü sistemini ortaya koymaktadır. Aynı zamanda 4. Sanaye toplumsal gelişimi akıl ve zeka(*sonuç sıkarma, yararlanma, yeni durumlara uyabilme yeteneği)* kapasitesi ile ayıracağı, bilgi alış-verişinde ve uygulamada geçiken toplum bilincinin yaşam durumunda engeller ortaya çıkacağı akıllı ortamı oluşturacaktır.

Endüstri 4.0. devrimin dokuz bileşenleriyle değişen üretim biçimleri yalnız sanayede yok, aynı zamanda hammal sektöründe de, tatbikini bulmuşdur. 4.Sanaye bileşenlerinin gida hammal alanına tatbiki kesintisiz hammal tedarük sistemini oluşturup, bölgesel gida üretim zincirini yaratmak çabasını artırmıştır. Gida üretim zincirini yaratmak için devletlerin deniz ürünleri, tarım, hayvancılık ve kırsal kalkınma projelerinin ortaklaşa hayata geçirmesi temel şartlardan biridir.

Bölgesel hegemenlik güçünün iki kutuplu dünyada Sovyetlerin varlığına kadar SSRB ait olduğinu ve o zamanlar küreselleşme olgusunun başlamadığı devr olduğunu dikkata

almalıyız. Artık son devirlerde Avrasiyanın bölgesel gücünün Türkiye ve Türk devletler birliğinin birlikde kuracağı federasyonun bu görevi ala bileceyi ve Gida üretim zincirini yaratacağı ihtimal edilmektedir.

Bu bakımdan makalede Türk Dünyasının ve komşu devletlerin federasyon birliği sayesinde kurulacak devletin hayata geçirebileceği kalkınma projesi araştırma konusu olacaktır. Projede klassik yöntem, makine ve mekanizmalardan oluşan donanımdan ve üründen farklı Endüstri 4.0. devrimin yeni biçimli tarım, hayvancılık ve kırsal kalkınma konuları tatkik edilecektir.

Literatür Özeti

Bilim ve teknoloji küreselleşmenin taşıyıcılarıdır. Egemenlik arzusu ve ekonomi, küreselleşmenin motorudur. Baş döndürücü bir hıza ulaşan "değişim", küreselleşmenin ne olduğunun düşünülmesine fırsat vermeden etkin olmasını sağlamaktadır. Değişim, doğal olarak çözülme ve yeniden yapılanmaları beraberinde getirmektedir. Küreselleşme, yerel olanın evrenselleşmesine, evrensel olanın da yerelleşmesine yol açmaktadır (Robertson, 1992; aktaran Onat, 2002).

IoT kavramı gelişmesini büyük ölçüde algılayıcı cihazlardaki bu teknolojilere borçludur. Çok sayıda, küçük boyutlu, kablosuz teknoloji kullanan algılayıcı cihazlar ile çevremizdeki hemen hemen bütün olayları izlemek mümkün olmaktadır. Ancak bu cihazlar tarafından üretilen veriyi (big data) saklayabilmek için büyük kapasiteli depolama platformlarına, veriyi analiz edebilen yazılımlara (Big Data Analytics) ve kullanıcı ile arayüz görevini yerine getirecek kolay kullanımlı web servislerine ihtiyaç vardır. Bu nedenle IoT genel kullanıma açık bulut servislerine ihtiyaç duymaktadır (Ercan& Kutay, 2016).

5G teknolojisinin önünü açacağı ikinci ve asıl gelişme ise makine öğrenmesi için öğrenme kanalları ve altyapıdır. Her yerden veri toplayan bir ağ, aynı zamanda bu veriden çıkarımlar yapıp bu çıkarımlara yaslanan müdahaleler üzerinden varsayımlarını test edebildiği oranda gerçek bir öğrenme sürecine girecektir(Bilim ve Aydınlanma Akademisi , 2021).

OECD'nin üçlü (triadic) patent verileri; Avrupa Patent Ofisi, ABD Patent ve Marka Tescili Ofisi ve Japon Patent Ofisi olmak üzere 3 büyük patent ofisinin verilerini kapsamasından dolayı, ülkeler arasında karşılaştırma yaparken sıklıkla kullanılmaktadır. Türkiye 49.6 triadic patent sayısı ile 54 ülke arasında 29. sırada bulunmaktadır(OECD, 2018c; aktaran Bilgin& Işık, 2018).

Yöntem

Bu çalışma bilimsel teorik araştırma olarak, sistemli yaklaşım, karşılaştırılmalı yöntem, yapısalçılık yöntemi zeka ve mantıksal genellemeden yararlanılmıştır.

Türk Dünyasının Bölgesel ve Kıtasal Bütünlüğünün Önemi

Küreselleşme olgusunun gittikce tüm sahalarda adım adım gerçekleştiği bir dünyada, Türk Dünyası'nın bölgesel ve kıtasal bütünlüyü önem taşımaktadır. Türkiye devleti cöğrafi yerleşim yerine, siyasi duruşuna, tarım ve endüstrideki yerine bağlı olarak küreselleşmenin zeruret saydığı bölgesel bütünlüyü sağlayacak tek devlet pozisiyonundadır. Türkiye'nin liderlik ederek kurabileceği bölgesel bütünlük, Türk Dünyası'nın bütünlüyünü zorunlu kılacaktır. Türk Devletleri'nin Avrasiya kıtasında birleşik devlet olan TURAN devletini kurma çabası da küreselleşmenin bölgesel ve kıtasal kalkınma projesinin bir parçası olarak Kuzey Kıprız ve Balkanlar'dakı Türk yerleşimini de içinə almaktadır. Küresel kalkınmada Türk Devletler Teşkilatı'nın yaptığı Devlet Başkanlığı Zirveler Toplantısı'nın işi de, yeni gelişim yollarını aramak olmuşur. Bölgesel ve kıtasal kalkınma projesinin tüm alanlarda bir biriyle ilişkili biçimde hayata geçirilmesi, bütünlükde bölgedeki yaşam biçimini iyi yönde etkileyecektir. Bu projenin hayata geçmesinde Türkiye devletinin dünyadaki konumuna bağlı olarak öncüllük etmesi normal sayılır.

Türkiye'nin tekstil, otomobil, savunma ve gida sanayelerinde, tarım vəd. gelişmiş alanlarda hızlı adımları ilə kazandığı öncüllüğü diger Türk devlet ve toplumların Türkiye çevresinde birleşmesine yol açmaktadır. Endüstri 4.0. bileşenleriyle çalışan bütün bir üretim ve hammal sisteminin kurulması çabası Türkiye devletinin kendi içindeki kalkınma projesine dayalı olsa da, bu projeyi bölgesel kalkınmaya dönüşdürmek Türk devletlerinin birge çabası ile olacaktır. "Devrimin Türkiye ekonomisinde meydana getireceği etkilerinin şekillenmesinde önemli unsurlardan biri de Türk Ulusal Yenilik Sistemi (UYS) olacaktır. Farklı ülkeler tarafından geliştirilen teknolojilerin transfer edilmesinde, tersine mühendislikte, yeni bilgilerin ve teknolojilerin geliştirilmesinde, yeniliklerin etkilerinin topluma yayılması gibi süreçlerde UYS'nin bileşenleri aktif rol oynamaktadır"(Bilgin& Işık, 2018).

Türkiye'de Ulusal Yenilik Sistemine(UYS) bağlı beş yıllık kalkınma planları ile başlamış, bilim ve teknoloji gelişimde, TUBİTAK(1963), teknoloji yenilik politikalarını belirten BTYK(1983), finansal destek veren KOSGEV(2017) gibi kurumlar sayesinde universiteler çokalmış, Teknoloji Geliştirme Bölgeleri(teknopark) kurulmuş, AR-GE faaliyyetleri geliştirilmiştir.

Bu faaliyyetler Djital Dönüşüm İndeksi hızla artan Türkiye'nin kısa zamanda Endüstri 4.0. devrim yeniliklerine de tam sahibleneceğini gösteriyor. Son devrlerde yapay zeka ve robotik gelişimin örneği olan elektrikli Toog T10X otomobili, insansı robot fabrikasının üretime başlaması, KUKA ved. robot entegratorlarının artması ile endüstrüel kol tasarımlama, ROKETSAN-ın projesiyle üretilmiş drone, İHA, SİHA, Bayraktar TB 2 SİHA, SUNGUR HSS, MAM ailesi ve son aşamada olan yeni modeller Türkiye'nin bir öncül olarak Avrasiya'da yeni bir devlet federasyonu kuracağına da hazır olduğunu göstreriyor.

Sanayede olan bu gelişmelerin yalnız hammaldan ürün almak için kullanmanın zamanı geçtiğini de fark eden Türkiye devletinde hammal üretiminde veya hammal kaynakların aşkarlanıb üretime hazırlık aşamalarının yapılmasında da adımlar atmıştır.

Bildiyimiz gibi dünya bir çalkanma içerisinde ve artan insan sayı gida ve içmeli suya bağlı problem yaratmaktadır. Yanı hanki sanayenin gelişmesinden çok çok önemli olan gida ve su tüketim sisteminin gelişmesini sağlamaktır ki, teknoloji gelişimin gida ve su kaynaklarına, hammal ihtiyatlarına yönelik bir sanayeni kurulması önemlidir.

Sanaye şimdiye kadar donatım sistemi, makina, mekanizmler oluşturmakla görevliydiyse, günümüzde tüm alanlarda tatbik edilen Endüstri 4.0. bileşenleri vardır ve yalnız kontrolcu otomasyon sistemleri değil, alınan ürünler de esneklik kazanmaktadır. Bu bakımdan gida ve içki ürünlerinin hammaldan yapılması gibi, gida hammalının üretilmesi veya yenilenebilir kaynaklarının bulunması da bu bileşenlerin tatbiqi ile mümkündür. Gida hammal kaynakları veya üretme alanı tarım, hayvancılık, çöl ve kırsal alanların verimliliyine bağlıdır.

Sanayeni değiştiren enerji nevleri olduğu gibi, gida hammal kaynakların bulunması ve üretim de klasik yöntemden gelişmiş yönteme geçmekte çevik, yalın, esnek olarak 4. Sanaye bileşenleri ile farklılaşmıştır.

Avrupa, ABŞ, Yaponiya, Çin ved. ülkeler Sanaye 4.0. bileşenlerinin tatbikinin öncülleri olduğu için, gida hammal kaynakları veya üretilme alanında başarıları çoktur.

"- HTT en fazla ABD'de kullanlmakta olup, dier önemli ülkeler arasnda Arjantin, Brezilya, Avustralya, Almanya ve Danimarka yer almaktadr. - HTT'nin kullanm oranı yllara göre artış göstermektedir. En yaygın kullanlan teknolojiler arasnda; Verim görüntüleme, Otomatik dümenleme, Uydu esaslı konum belirleme sistemleri (GNSS), Toprak haritalama ve Deişken düzeyli gübre uygulama teknolojileri yer almaktadır" (Keskin, 2013).

Gida konusu hassas konu olduğu için özellikle Çin'in yapay gida üretimi sağlık için tartışmalı bir konu olarak dikkata alınması gerekmektedir. Son devrlerde Avrupa tarım, hayvancılığın gelişmesine üstünlük vermektedir.

"Hassas Tarm teknolojileri Avrupa'da beklenenden daha az uygulanma durumunda olup bunun başlıca sebebi olarak teknolojilerin yüksek maliyeti ve sistemlerin karmaşıklı sebebiyle konunun öreniminin ve kavranmasının zor ve masraflı olması gösterilmektedir" (Kutter ve ark., 2011; aktaran Keskin, 2013).

Türkiye sivil toplum iş adamları Avrupa HİBE -lerinden yararlanmakta Avrupa Birliyinin aday olan veya aday ihtimalı olan ülkelere Katılım Öncesi Mali Yardım Aracı'yla destek olma planı hazırlamıştır. İPARD Programı Katılım Öncesi Mali Yardım Aracı'nın Kırsal Kalkınma bileşenidir. Avrupa Komisyonu ve Tükiye Cumhuriyeti'nin finansal destek verdiyi "Kırsal Kalkınma Programı"nın 2014-2020-ci yıllarda uygulandığı projeler kırsal alanların gelişimine etki göstermiştir.

Tarım ve Kırsal Kalkınmayı Destekleme Kurumu(TKDK) İPARD Programı kapsamında tarım, hayvancılıkda modern teknolojinin tatbiki ve kullanılması için faaliyyet göstermektedir. Yani, Türkiye 4.Sanaye bileşenleriyle çalışan "hassas tarım", hassas hayvancılık ve kırsal kalkınma projesinde doğal ürün üretim ve hammal sisteminin kurulmasının djital bir sistemini oluşturma çabası göstermektedir. Türkiye Türk devletleri içerisinde nisbeten konuya hakim olandır. Bu bakımdan bölgesel kalkınmada Türkiye'nin tecrübesinden yararlanmak zorunlu gözüküyor.

Türk Dünyası'nın Tarım, Hayvancılık Ve Kırsal Kalkınmasının Çözüm Yolları Ve 4. Sanaye Bileşenlerinin Etkisi

Gida hammalının çokaltılması ve su kaynaklarının bulunması beşer toplumunun varlığını sürdürmek için önemlidir. Tarım, hayvancılık ve kırsal kalkınma yeni dünya düzeninde beşer toplumunun yaşamını sürdürmesinin temel garantisidir. Tüm dünya için geçerli olan bu durum Avrasiya halkının varlığı için de çok önemlidir.

Kıtasal kalkınma bölgesel kalkınmalardan oluşan, bölgesel kalkınmalar devletlerin bütünleşerek federasyon haline gelmesi ile oluşarak ortaya çıkmakta, hiyerarşi yönetim sistemi oluşturmaktadır. Hiyerarşi yönetim sistemi aynı zamanda hiyerarşi üretim sistemi ile oluşmaktadır. Tarım, hayvancılık ve kırsal kalkınma piramit kalkınma sistemi, yani bölgesel kalkınma olarak ulusal, uluslararası üretim bağları kurarsa, günümüzde zincir marketing sistemine benzer, zincir hammal ve ürün üretim sistemini almak mümkün olur. Bu konuyu analiz ederken eski Sovetler Birliyi'ni unutmamakta fayda vardır. 15 ülkeyi birleştiren bir yapısı olan dünyadakı kutuplardan biri olan Sovyetler'in GOELRO devlet kalkınma planı ülkeyi elektrikleştirmeden ve sanayeleştirmeden başlamıştır. Burda en önemli hüsus ilçelerin ve 15 ülkenin bir-birine ihtiyacı olan halde bağlanması idi. Bir ülkede kurulan fabrika ve

zavotların hammal ihtiyatının diger ülkeden gelmesi gibi. O sabepten de, Sovyetler'den sonra hürriyetine kavuşan bütün ülkelerin sanayesinde çöküş olmuşdur. Bu örnekden birlikde savaşsız yaşamın yol haritasını çizmek mümkündür. Bu da hammal ve ürünlerden ortaklaşa yararlana bilen 4. Sanaye bileşenleri oluşan hammal ve ürünün akıllı üretim sisteminin kurulması ile bölgesel bütünlüye yol açmaktır.

Tabii ki, qomşu devletlerin bu bölgesel bütünleşmeden geride kalması onların tek başına var olma tehlikesini artıracağı için bölgesel hammal ve ürünün akıllı üretim sisteminin kalkınma projesinden kenar kalmaları imkansız gibi gözüküyor. Özellikle tarihi topraklarımız üzerinde Sovyet'ler tarafından kurulan Ermenistan ve Gürcüstan ve İran adlanan devletin içine aldığı 11ostan(*vilayet*) olan Güney Azerbaycan bu konuda hassas bir durumdadır. Avrasiya'da bölgesel güc olacağı bir devletin toplumunun rifahını iyileşdirmek ve küresel şartlar altında beşer insanlarının taleyine de dokunmak önemli vazife olarak karşıya çıkmaktadır.

Avrasiya kitasında bölgesel kalkınma ile toplumların gida probleminin çözümünün de, Türk Dünyası'nın ve komşu devletlerin federasyon birliği sayesinde hayata geçmesinde teknoloji gelişim önem taşımaktadır. Toplumların yeni dünya düzeninde yerini belirlemesi ilk olarak muhafıza, su ve gida hammal problemlerinin çözümüne bağlıdır. Avrasiya'da bölgesel su ve gida hammal kalkınma projesinin ortaya koyulması, teknoloji kalkınma projesi ile iç içe hayata geçirilerse, gölgesel rifah yükselmesi, propogandacı eylem ve savaşlara da son verecek ve dost, barış olan bir ortamda yaşam devam edecekdir. Yani, siyasetin çözemediği problemlerin yaşam tarzının değişmesiyle değiştirileceğinin, insanların maddi ve manevi hallarının iyileşdirilmesi olacaktır. İdeolojisi değişen bir toplum olarak Avrsiya kıtasında kurulacak yeni federasyon devletin gida hammalı deniz ürünleri de dahil, tarım, hayvancılık ve kırsal kalkınma projelerinin ortaklaşa hayata geçirilmesine yol alacaktır. Bu projeler klasik değil, Endüstri 4.0. bileşenleriyle "hassas tarım", "hassas hayvancılık" ve kırsal kalkınmayla başlayıp, akıllı tarım, hayvancılık ve kırsal kalkınmayla "hammal-ürün üretim ve tedarik zinciri"ni oluşturarak bütünleşme sistemini sağlayacaktır. Akıllı bölgesel, hatta küresel kalkınma projesinin hayata geçmesinde Türkiye öncü olacaktır. "Bu tezi destekleyen bir araştırma The Boston Consulting Group (BCG) tarafından yapılmıştır. Hazırlanan raporda; "..Türkiye'nin üretim üssü statüsünü sağlama alması da, şirketlerin, Sanayi 4.0'ın getirdiği teknolojik avantajları ne kadar kapsamlı ve hızlı uygulayacaklarına bağlı olacak. Üretim üssü olma konusunda yarışan Türkiye için bu devrimin öncülerinden olmak bir tercih değil zorunluluk olmalı ve bu yolda adımlar hızlı atılmalı" diye belirtilmiştir(Ege Bölgesi Sanayi Odası, Ekim 2015).

"Hammal-ürün üretim ve tedarik zinciri"ni oluşturan bütünleşme sistemi, aslında akıllı fabrik-tarım, akıllı fabrik-hayvancılık ve akıllı kırsal alan sistemini oluşturmaktadır. Bölgesel ürün taşıma sistemlerinin kurulması ise ayrıca bir kalkınma projesi olarak ortaya çıkmaktadır. Kalkınma projelerinin hayata geçmesi için Endüstri 4.0. ile Endüstri 3.0. özelliklerine ait farklığı bilmek gerekir. Endüstri 4.0. devrimin üretim model ve özelliklerini Endüstri 3.0. devrimin özellikleri ile karşılaştırılmalı analiz yaparken, 4. Sanayenin farklı özellikleri olduğunu aşağıdakı biçimde göre biliriz. Çeviklikten esnekliğe, kapalı otomosyondan açık otomosyona, klasik fabrikalardan akıllı fabrikalara, klasik üretim sistemlerinden akıllı üretim sistemlerine, akıllı üretim modeline, siber-fiziksel üretim sistemine, kendi kendini optimazisiyon eden robotik sistemler ile üretime, yeni ve eski sistemlerin integrasyon ile çalışmasına, güclü siber kontrola, yapay ve düzey inteqrasyon zincir hegemon üretim ve satış alanına, 3D eklemeli üretim ve hibrit üretim sistemine, bulut tabanlı işleme, 4D esnek üretim sistemine, 5G teknolojisiyle üretime, cobotlar, yapay zekalı robotlar ve teknoloji ile akıllı fabrikalarda insansız üretime ved. sistemlere rastlana bileriz. 3.Sanaye ve 4.Sanaye bileşenlerinin bütünleştiği nokta djitalleşmedir. Sanaye hazır üretim sistemi ile hammal üretim sisteminin bütünleşmesi, djitalleşme vasıtasıyla "üretim ve tedarik zincir sistemi"ni oluşturmaktadır. Ortaya çıkan gerçeklik; sanaye ve hammal kaynaklarının bir-biriyle ilişkili, kendi kendini optimazisiyon ederek devamlı çalışabilen bir sistemin yapılandırılmasıdır. 4-cü Sanaye bileşenlerinin hepsinin aynı zamanda tatbiki ve üretimden yararlanma zaman alacak ve aşamalar sonucu ortaya çıkacak bir durumdur. Bu bakımdan gida hammalıyla bağlı kalkınma projelerinin tatabikinin de aşamalı olması zeruridir. Bu aşamaların birincisinin djitalleşme, ikincisinin "hassas" ortamın oluşturulması, üçüncüsü ise "akıllı" ortamın oluşturması, dördüncüsünün bölgesel kalkınmayla "akıllı hammal-ürün üretim ve tedarik zinciri"ni oluşturmak olarak sıralaya biliriz.

Endüstri 4.0. Bileşenleri İle "Hassas Tarım", "Hassas Hayvancılık" Ve Kırsal Kalkınma

Gida hammal kaynakları deniz ürünleri, tarımsal ürünler, hayvansal ürünler çöl ve kırsal alanların sahip olduğu kaynaklardır. "Hammal-ürün üretim ve tedarik zinciri" sistem bütünlüğü teknoloji bulguların sanaye ile kırsal alan sistemini oluşturmaya başlamıştır. Önceden de sanaye makina, mekanizm ve cihazlardan her zaman yararlanılmıştır. Ama, Endüstri 4.0. bileşenlerinin tatbiki yalnız donanım sistemini değil, direk hammalın ve ürünün kendisine katkı sağlama gücüne sahip olmakla önceki sanaye bileşenlerinden farklılık sağlamaktadır.

Bu bakımdan Endüstri 4.0. devriminde hammal üretimi veya bulunması, sanayedeki üretimin bir bölüümü olarak "hammal-ürün bütünleşme sistemi" oluşturmaktadır. Bu da bir

ürünün varolma süreçlerini, yani hammal kaynaklarının yapılandırılmasından başlayarak, sanaye üretim hattına ve ürün satışına kadar tüm süreçleri içine alan bir sistemin sürekli mevcutluğunu sağlamaktır. Bu bakımdan Endüstri 4.0. devriminde deniz ürünleri, tarım, hayvancılık ve kırsal kalkınma projeleri dokuz endüstri bileşenlerinden etkilenmiş bir sistemi içine alacak şekilde qurulması esas konu olarak ortaya çıkmıştır. 4. Sanaye bileşenleri "üretim ve tedarik zincir sistemi"ninin bütünlüyü ile ürün üretime başlanmışdır. "Çevreye dost yöntemlerle tarımın sürdürülebilirliğini sağlamak için "precision agriculture" olarak adlandırılan ve türkceye "hassas tarım" olarak çevrilen yeni tarım yöntemi ortaya çıkmıştır....Hassas tarım tam anlamıyla tarımsal faaliyetleri kontrol ve optimize etmek için dijital teknolojileri kullanan modern bir tarım yönetimi konseptidir. Hassas tarımda esas amaç optimizasyondur"(Kocaoğlu ved., 2021). Hassas tarım teknolojileri(HTT) aslında djitalleşme ile elektronik cihazlar vasıtasıyla oluşan teknolojilerdir. Bu teknolojide sensörlerin önemi çok büyüktür. Tarım kalkınma projesi için "hassas tarım" projesi ve hayvancılıkta "hassas hayvancılık" projeleri dünyada ve son devirlerde Türkiye'de başlatılmış finansal destek alan konuları içermektedir. "Hassas tarım" ve "hassas hayvancılık" projeleri bir birine bağlı olan projelerdir, çünki hayvancılığın gelişiminde tarımın gelişimi çok önem taşımaktadır. Genellikle "Hassas" projelerde djitalleşme ve elektronik cihaz uyğulamaları önem taşımaktadır. Yakından ve uzaktan algılama için sensör teknoloji uygyulamaları(Mobil Platformalar), çeşitli(*reng,koku, alan, konum tespiti, görme, eşitme veb.)* sensörlerden, hassas tarımda inavasyon uygulamaları Navigasyon, GPR(*küresel konumlama sistemi*) ile üç boyutlu konum tespiti, coğrafi bilgi sistemi(GİS), İnternet haberleşme sistemleri, gelişmiş bilgi sistemiyle veri almak, paylamak ve veri göndermek gibi Veri iletişim ve yönetimi Isebus, Wireless, konuları, işlemek için elektronik manitor sistemi, Ürün izlenebilirliği-RFİD ve ilgili memari, Remote moritoring(Uzaktan Problem Çözme Robot Uygulamaları), John Deere Makineleri ve d. ile mümkündür.

Hassas tarım teknolojileri ve hassas hayvancılık genellikle Endüstri 4.0. devriminde oluşan 9 bileşenlerin uygulanmasıyla akıllı tarım ve akıllı hayvancılık projelerine dönüşmüş oluyor.

Endüstri 4.0. Bileşenleri ve Üretim Modelleri İle "Hassas"Tan "Akıllı" Kalkınmaya Keçit

Araştırma sonucu Endüstri 4.0. devrimin getirdiyi yenilikleri aşağıdakı gibi sıralaya bileriz:

1. Büyük veri(Big Data)
2. Nesnelerin İnterneti
3. Bulut bilişim
4. Yapay Zeka
5. Siber fizik sistemler

6. Robot teknolojisi ve otonom sistemler
7. Otomasyon
8. Similasyon
9. Ağ güvenliği

Bileşenlerin tatbik edilmesiyle oluşan üretim modellerini ve özellikleri tatkik ederek aşağıdakı gibi göstermek olur:

1. Akıllı üretim modeli-siber-fizik üretim sistemi
2. Yatay ve dikey sistem enteqrasyonu
3. Eklemeli üretim
4. Siber güvenlik
5. Eski ve Yeni sistemlerin entegrasyonu
6. Kendi kendine optimizasyon
7. Açık otomasyon
8. 5G teknoloji
9. Üretimde artırılmış gerçeklik(Augmented Reality) ve sanal gerçeklik(Virtual Reality
10. Yeşil üretim(geri dönüşüm enerjisi)
11. Dağıtılmış üretim süreci
12. İnsan robot iş birliyi ve iş birliyine dayalı robotlar(Cobotlar)
13. Akıllı tutucular
14. Bütünleşme tak ve çalıştır kolaylığı
15. Proqramlama kolaylığı
16. Akıllı fabrika
17. Endüstri 4.0. eğitimi

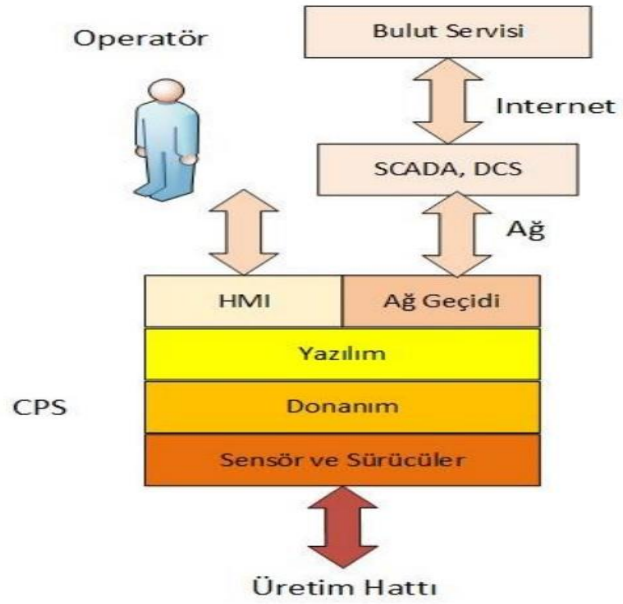
Endüstri 4.0. siber-fiziksel sistemlerin gelişmesi devri olarak nitelik kazanmaktadır. Siber-fiziksel sistemler fiziki ortamı virtual ortama taşıyabilen bir sistem olarak, şebeke, internet ağ ünvanı, fiziki nesne, veri ve virtual ortamı ifade eder. Siber-fiziksel sistemler nesnelerin interneti ve hizmetlerin interneti olarak gerçek zamanlı fiziki hareketleri kontrol eden sistemlerdir.

Siber-fiziksel sistemler tarım, hayvancılık ve kırsal kalkınma projesinde klasik modelden “hassas” modele, “hassas” modelden “akıllı” modele keçitle kuruluyor. Bu iki model djital model olsalar da, akıllı model bütünleşmiş model değerini almaktadır. Yani, “hassas tarım”, “hassas hayvancılık” ve kırsal kalkınma modellerini “akıllı” modellerin ilk aşaması kabul etmek doğru olardı. Her iki model veri toplanmasına, veri analizine, veri paylanmasına ve veri depolanmasına bağlıdır. Verilerin toplanması GPS, GİS, çeşitli sensörler, mobil bilişim ve diger teknolojilerle yapılır. “Hassas” tarımda yukarıda bahsettiğimiz teknolojiler kullanılarak çok miktarda veri toplanır. “Big data” ya da “büyük veri” dediğimiz bu yapılandırılmamış veri setleri kendi başına bir anlam ifade etmez. Toplanan verileri işlemenin yani çıktı yönetiminin hassas tarım konseptiyle birleşmesi “smart farming” olarak adlandırılan “akıllı tarım” teknolojilerini doğurmuştur. Akıllı tarımın amacı, tarladan toplanan bilginin “akıllıca” kullanılmasıdır”(Kocaoğlu, 2021). Hassas tarım (Precising farming) kontrolçu ve

optimize edicidir. Akıllı tarım toplanmış veriden yapay zeka ile kullanılması mümkün olan sistem olduğu için, verilerin bilgi kaynaklı olması önem taşımaktadır. "Akıllı tarım, tarımsal üretime yönelik verileri ve uygulamaları optimize etmek için, güncellenebilen bilgilerin hızla analiz edildiği, kaynaklardan maksimum düzeyde faydalanılan, kullanıcılar tarafından eyleme geçirilebilir kararların uygulandığı gelişmiş üretim yönetim yaklaşımıdır"(ÇAKIR ved., 2022). Nesnelerin interneti IoT, büyük veri ve yapay zekanın birlikte oluşturduğu akıllı üretim, otomasyon sistelmer ile süreçlerden geçiyor. Genellikle şebeke, internet ve nesneler gibi 3 temel dayanıklığı olan sistem nesnelerin interneti(İoT) denir. Bu projede Endüstri 4.0. bileşenlerinden olan büyük veri, nesnelerin interneti, insanların interneti, hizmet interneti entegre edilerek akıllı tarım, hayvancılık, kırsal için bir sistem oluşturmaktadır.

İoT- İİoT Nesnelerin İnterneti

Moor İnsights ve Patrik Moorhead nesnelerin internetinin insanların nesnelerinin interneti(İoT) ve endüstri interneti(İİoT) olarak ikiye ayırmıştır. Nesnelerin virtual kimlik ve kodlaşma ile şebeke sistemi ile haberleşmesi, veri alış-verişi kimlik doğrultusunda belirlenerek uygun verini alması sağlanmaktadır. IoT kavramıyla ortaya çıkan uygulamalar "bilgi ve analiz" ile "otomasyon ve kontrol" olmak üzere iki temel açıdan incelenebilir. Bilgi ve analiz, daha doğru karar vermeyi sağlayacak şekilde verilerin ilişkilendirilmesi ve analiz edilmesini ifade ederken otomasyon ve kontrol ise verilerin otomatik bir şekilde işlenmesini, karmaşık durumlara hızlı çözümler ortaya koyulmasını ve insan müdahalesi olmaksızın süreçlerin işlemesini ifade etmektedir (Öğünç, 2018). "IoT ve endüstriyel otomasyon sistemlerinin bütünleşik uygulaması IIoT (Industrial Internet of Things) olarak adlandırılmaktadır" (Lin et al. 2015; aktaran Kutay, 2018). Tuncay Ercan ve Mahir Kutay(2016) İİoT–endüstrüel nesnelerin internetinın özelliklerini; dağıtk zeka, hızlı haberleşme, açık sistemler ve standartlar, gerçek zamanlı üretim ve veri aktarımı gibi gruplaştırmışlar.



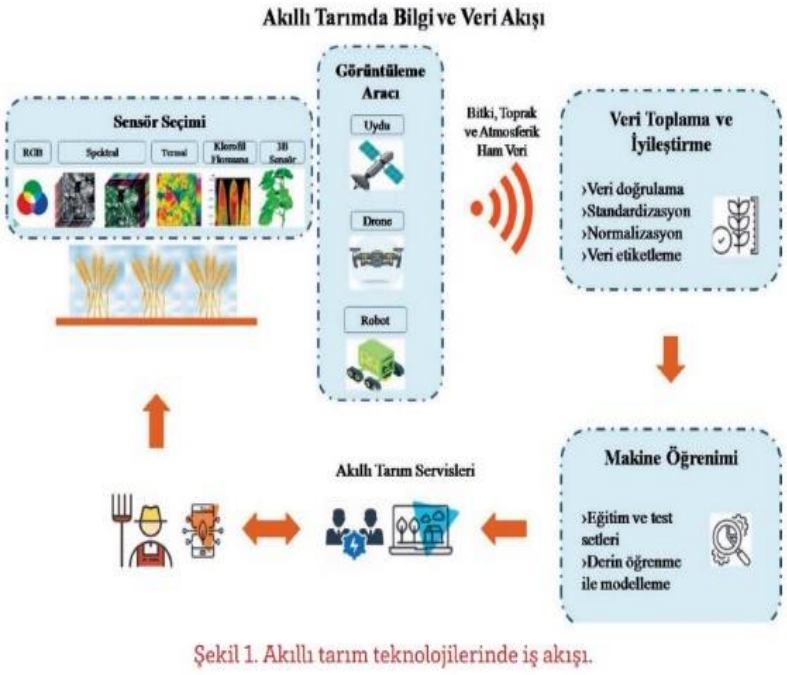
Şekil 2. IIoT mimarisi.

Şekil 1. Endüstri nesnelerinin interneti(Ercan ve Kutay)

Endüstri 4.0. bileşenlerinin farklı alanlara tatbiqi farklı ağ bağlantıları, böyük veriden kusursuz ve kesintisiz yararlanma, nesnelerin haberleşme ve karar alma yetenklerinden düzgün istifade, siber kontrolun sağlanması, siber alandakı verilerden fiziksel alanda yararlanıldığı gibi, fiziksel alan verilerinden de siber alanda kullanımı sağlanıyor olmalıdır. CASAGRAS ile fiziksel ve sanal nesnelerin ag bağlantılarını, veri depolamanın küresel alt yapısını oluşturuyor. SAP fiziksel nesnelerin ağ bağlantılarını, akıllı nesneler üzerinden karar alma ortamını sağlayan, ETOS siver ve fiziksel nesneler arasında bağlantıları oluşturan ortak ağ gibi bir birinden farklı fonksiyonları yerine yetiren sistem olduğu bilinmektedir.

Bu sistem küresel bağlantılı, fiziksel dünyanı bir birine bağlayan ve sanal dünya ile fiziksel dünyanı bağlayan İnternet ve bağları içine almaktadır. Nesnelerin interneti fiziksel ve sanal nesneler olarak ikiye ayrıldığı için onlar arasında veri bağlantıları kurmak, veri üretimi, veri paylaşımı, karar verme, bilgi transferi bir biriyle bağlantılı bir ağ sistemi oluşturmaktadır. Ama bu sistem bir merkezden kontrol edilmesi tehlike yaratdığı için, İoT-ların bağlantılarının ayrı ayrılıkta kontol edilmesi gerekir. Tarım alanında toprağı yumşaltma, tohum sepme, ekim, biçim, hasat, ağaç ve bitkilerin ilaçlanması, alak otlardan temizleme, denli bitkileri, domates, biber, patlıcan, karpuz, yemiş, çilek, meyve(alma, partakal ve b.) yığma, hayvancılıkta yem hazırlama, süt sağımı ve süt ürünleri hazırlama, gibi bir cok süreçlerin hayata keçmesinde insanın bir bilgisayar veya mobil telefonla kontrolcu olması gerekiyor. Tarım uygulamaları: Özellikle seralar gibi kapalı ve ortam bilgilerinin nispeten kontrol edilebileceği ve farklı tarım

ürünlerinin yetiştirilmesinde en uygun şartların sağlanmasına yönelik fonksiyonların çift yönlü olarak çalıştırılması iyi bir Nesnelerin İnterneti uygulamasıdır. Bir serada kontrol edilmesi gereken kritik sıcaklık, nem ve toprak değerleri, IoT sisteminin bir parçası olan makineler arası iletimi müteakip merkezi bir bilgisayarda veya internet ortamında yapılandırılarak saklanır, değerlendirilir ve mobil kullanıcıların kendi telefon uygulamaları veya web erişimleri üzerinden kontrol edilebilir (Zhao et al, 2010; aktaran Ercan & Kutay, 2016).



Şekil 1. Akıllı tarım teknolojilerinde iş akışı.

Şekil 2. Akıllı tarım teknolojilerinde iş akışı

Süt Toplama Merkezlerinin Belirlenmesi Toplama merkezlerinin kurulmasına yönelik, yürütülecek çalışmalarda yol haritasının tespit edilmesi amacıyla yapılan toplantılarda, süt potansiyeli yüksek ve aynı zamanda ulaşım imkanları iyi olan yerler ele alınmış ve nasıl yol izlenilmesi gerektiği değerlendirilmiştir. Toplantılarda ve saha çalışmalarında, Süt Toplama Merkezlerinin ilçe merkezi veya merkezi büyük bir köyde kurulmasının hem kısa hem de orta ve uzun vadede önemli getirileri olacağı ve sistemin işlerliliği açısından oldukça önemli olduğu sonucu ortaya çıkmıştır(Yavuz ve d., 2016).

Süt için kurulan bu merkezlerin tarım ürnleri içinde kurulması ve gelecekte bölgesel stasionlara çevrilmesi bölgesel kalkınma projesinin bir parçası olur.

Çoğu kez "köy kalkınması" ile eş anlamlı kullanılan "kırsal gelişme ya da kalkınma", kırsal alanlarda yaşayan insan topluluklarının toplumsal, ekonomik, ekinsel açılardan yapısını değiştirecek biçimde üretim, gelir ve gönenç (refah) düzeylerinin geliştirilmesini, insan-toprak

ilişkilerindeki dengesizliklerin giderilmesini, kentsel alanlardaki fiziksel ve toplumsal altyapının yaratılmasını, tarımsal ürünlerin daha iyi değerlendirilmesini amaçlayan çok yönlü süreçleri, etkinlikleri ve örgütlenmeleri anlatmaktadır(Geray, 2011: 43; aktaran İlter, Eylül 2019).

Bu kalkınmanın akıllı sistemler ile yapılması toplumsal bilincin yükselmesine bağlı olduğu için djital ve Endüstri 4.0. bileşenleri teknolojileri eğitimi almaq gerekir.

Akıllı kalkınma robot, kobot ve nesnelerin interneti dünyasıdır. İnsan emeyinin yerine geçen robot dünyası ürünlerin bioloji yapısını ve malzemesini bilerek, insan ile ürünü ayırma gibi bir yapay zeka sahibi olmaktadırlar. Bu insanlarla bir ortamda zarersiz işlemesi ve canlılarla temasda daha doğal ortam kurmaya yol açıyor. Robot tutucularının yeniden yapılandırılması ve yapacağı işe göre kendi kendi deyişe bilmesi de bu yenilikler içerisindedir.

Akıllı üretim büyük veri, bulut depolama, nesnelerin interneti, siber-fiziksel sistemler, yapay zeka, akıllı robot ve kobotlardan oluşmuş bir sistem ile hayata geçirilir. Nesnelerin ve hizmetlerin interneti büyük veri, bulut depolama ile bilgi alış-verişini sağlaya bildiyi ortamın hazırlanması önemli konulardan biridir. Bu ortam tarım üçün seçilmiş çografi alan olar ki, bu alanın toprak verimliliyinin insansız arac ve GPR(*Global Positioning Sistem*), uydu sistemi ile 3 boyutlu nesne tespitleri yapılarak seçilmesi gerekir.

“Tarımsal üretimde, 5G teknolojisi, tarımsal IoT ile mahsul büyüme bilgilerinin toplanmasını ve büyüme ortamının izlenmesini sağlamakta ve bilgileri kesin bir tarımsal üretim planı oluşturmak için işleyebilmektedir.”(Çakır, 2022).

Üretimde Artıtılmış Gerçeklik ve Sanal Gerçeklik

Hibritleşme konusunda artırılmış gerçeklikden fiziksel olarak yararlandıysak, onu sanal sisteme aktarıb, büyük veri olarak sonrakı aşamalarda kullanmak mümkün olur. Bu da Metaverse için yol açmaktadır. Sanal alem bir deneyim labaratuvarı olarak kullanılıp, sonuçları fiziksel ortama taşımak akıllı tarım, hayvancılık ve kırsal alanda yeni keşflere yol açacaktır**.**

Geleşekde koku ve tad sensörlerin yardımıyla sanal veri olarakda kullanıla bilecek bir ortamın olacağı çokta gec bir zamanda olmayacak. O zaman sanal parakende pazarlar bile kurulacak, hammallar deyişim yolu ile para mübadilesi olmadan da satıla bilecek. Sanal satış fiziksel satışa eş zamanlı yansıyacak. Sanal tarım alanında ürünlere dokunarak pazarlık yapmak mümkün olacak.

SONUÇ

Sanaye bileşenlerinden tam olarak yararlanmak ortaya akıllı üretim modelinin oluşumunu, siber-fiziksel üretim sistemini, kendi kendini optimazisiyon eden robotik sistemleri

ve insanlarla birge çalışabilen akıllı cobotlarla üretimi, eski sistemlerin üzerinde yeni sistemleri kurmayı, yani integrasyonla çalışmayı, güclü siber kontrolü, yapay ve düzey inteqrasyon zincirli hegemen üretim ve satış alanını, 3D eklemeli üretim ve hibrit üretim sistemini, 4D esnek üretim sistemini, bulut tabanlı işleme sistemini (CBM), yapay zeka ile "akıllı üretim ve tedarik zincir sistemi"ni, yapay zeka ile insansız kırsal alanda akıllı fabrikaların kurulması ve 5G teknolojisi ile davamlı veri aktarımını sağlayan yapay zekalı yeni bir sistemde çalışmak ved. yeniliyi getirir.

Araştırmada, Türk Dünyasına ait coğrafi alandakı tarım, hayvancılık ve kırsalın bütünlüyünün yaranmasının zeruret olduğu ve qomşu devletlerin de bu kalkınma projesinin içinde bulunmasının mühim olduğu ortaya çıkmıştır.

Türkiyede gelişmekte olan bu akıllı sistemin bölgesel ve kıtasal kalkınma için önemi büyükdür. Bölgesel ve Avrasiya için Türk Dünyasının ekonomi, teknoloji, hammal ve üretimde birleşmiş bir sisteme gecmesi çok önem taşımaktadır. Bu yeni teknolojiler ile daha tez kalkınmanın bölgesel olarak hızlı irelilemesini yapılandırmaktır.

Bölgesel akıllı kalkınma projesinde diger Türk devletlerinin yakından ilgilenmesi ve ekonomi destek vermesi önemli konudur. Son günlerde Türkiyenin NATO Zirvesindeki konumu da, küresel kalkınmada bölgesel gücün Türk Dünyası olacağı müjdesini de vermektedir.

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SOIL PARENT MATERIAL AND PLANT NUTRIENTS: EXPLORING THE LINKAGES

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ABSTRACT
Soil is a vital component of the Earth's ecosystem as it directly affects agricultural productivity, ecosystem sustainability, nutrient cycling and water resources. Soil is a dynamic and complex ecosystem influenced by a variety of factors, including soil parent material and geological characteristics. Soil parent material provides the initial mineral and organic matter composition of the soil, affecting its fertility and nutrient retention capacity. Geological features such as tectonic activity, volcanic eruptions, sedimentary deposits and glacial processes contribute to the formation of different soil types and influence nutrient availability. Plants need various nutrients for their growth and development. These nutrients are named as macro- and micronutrients according to the amounts required by plants. The availability of these nutrients in the soil is very important for plant uptake and health. Nutrients are closely related to the soil parent material and weathering processes. Biological processes such as the activities of microorganisms and plant roots also contribute to weathering and soil development. Depending on the soil parent material and soil formation events, soil properties vary. These variations affect the amount of nutrients and their uptake mechanisms. For example, phosphorus availability in soil is affected by various soil properties such as pH, texture, organic matter content, lime level and microbial activities. In short, soil parent material directly affects plant communities and their nutrient composition.

Keywords: Parent material, plant nutrition, soil

INTRODUCTION

Soil is a dynamic and complex ecosystem influenced by various factors, including soil parent material and geological features. The composition of soil parent material and the geological processes and features in a given area play a crucial role in determining the fertility and nutrient content of the soil. The formation and characteristics of soil are influenced by various factors, including climate, topography, organisms, and parent material (Buol et al., 2011). Among these factors, the relationship between soil parent material, geological features, and plant nutrients has garnered significant attention due to its profound impact on soil fertility, agricultural productivity, and ecosystem dynamics. Understanding the relationship between soil parent material, geological features, and plant nutrients is essential for effective soil management and sustainable agricultural practices. The composition of soil parent material provides the mineral and organic matter composition of the soil, influencing its fertility and nutrient-holding capacity (Brady & Weil, 2016). Geological features, such as tectonic activity, volcanic eruptions, sedimentary deposits, and glacial processes, contribute to the formation of different soil types and impact nutrient availability (Chesworth, 2013). This article aims to explore the linkages between soil parent material, geological features, and plant nutrients, shedding light on their interdependencies and implications for soil fertility. By understanding these linkages, we can gain valuable insights into soil formation, nutrient cycling, and sustainable agricultural practices.

SOIL PARENT MATERIAL: THE FOUNDATION OF SOIL FORMATION

Definition and Types of Parent Material

Soil parent material refers to the material from which soils develop. It can include weathered rock, sediments, volcanic deposits, and organic matter. Different parent materials have distinct compositions and characteristics that influence soil properties (Brady & Weil, 2016). For example, limestone parent material tends to result in alkaline soils with high calcium content, while granite-derived parent material may lead to acidic soils with lower nutrient availability. The classification of soil parent material is given in Figure 1.

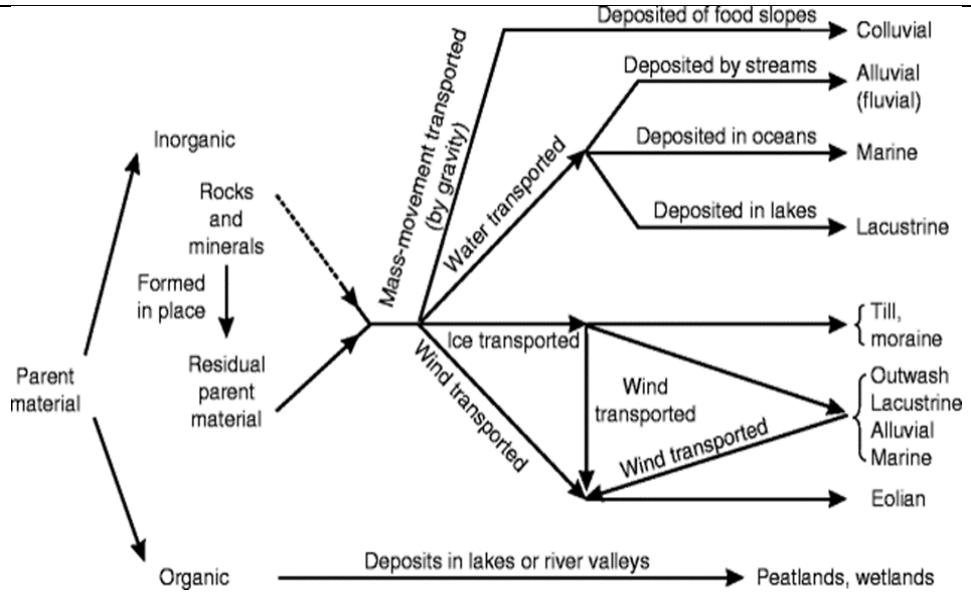

Figure1. Classification of parent materials in relation to their kinds, development, transport, and deposition (Mocek and Owczarzak, 2011)

İnfluence of Parent Material on Soil Properties

The composition of parent material significantly impacts soil properties, including texture, structure, and nutrient content. Parent material provides the initial mineral and organic matter composition of the soil, influencing its fertility and nutrient-holding capacity (Brady & Weil, 2016). Soils derived from basaltic parent material, for instance, often have higher cation exchange capacity and nutrient availability compared to soils derived from quartz-rich sandstone. Soil formation diagram given in Figure 2.

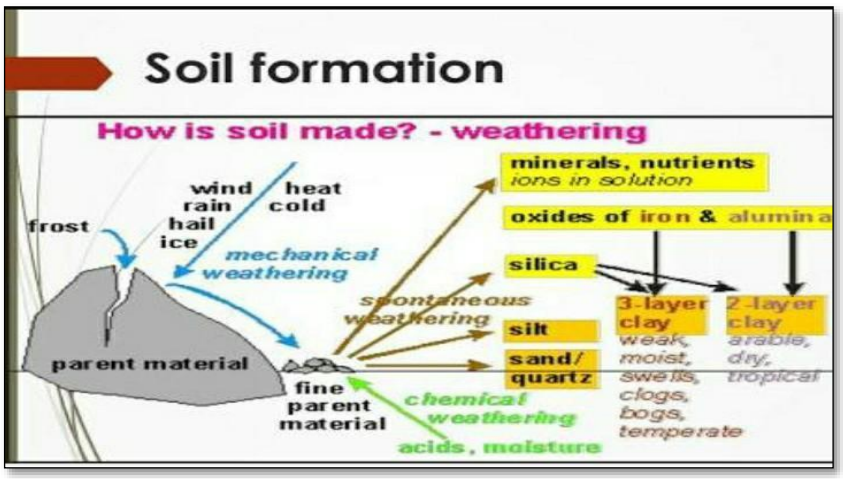

Figure 2. Soil formation diagram (https://boom-pics.click/soil-formation-diagram)

Weathering Processes and Soil Development

Weathering processes, including physical, chemical, and biological weathering, transform parent material into soil. Physical weathering involves the breakdown of rocks into smaller particles, while chemical weathering alters the mineral composition and releases nutrients (Buol et al., 2011). Biological processes, such as the activity of microorganisms and plant roots, also contribute to weathering and soil development. These processes collectively determine soil characteristics, including nutrient content and availability. Chemical weathering is one of the most important sources of inorganic nutrients in mineral soils under natural conditions (Anderson, 1988).

GEOLOGICAL FEATURES AND THEIR IMPACT ON SOIL FORMATION

Tectonic activity, such as uplift, subsidence, and plate movements, influences soil formation through changes in topography and exposure of new parent materials. Uplift and erosion expose fresh parent material, initiating soil development, while subsidence can lead to the deposition of sediments and the formation of new soil layers (Chesworth, 2013). The uplift of mountain ranges, for example, can result in the formation of young, nutrient-rich soils due to the weathering of newly exposed rock. Volcanic eruptions contribute to the formation of volcanic soils, known as andisols, which are rich in organic matter and possess unique mineralogical properties (Brevik et al., 2015). Volcanic ash deposits provide a source of readily available nutrients, including phosphorus and potassium, due to their fine texture and high weathering rates. The presence of volcanic parent material often leads to highly fertile soils, making volcanic regions agriculturally productive. Sedimentary deposits, such as river alluvium and marine deposits, have significant impacts on soil fertility. River alluvium, consisting of fine sediments deposited by rivers, is often rich in organic matter and nutrients (Grossman & Reinsch, 2002). These deposits contribute to the development of fertile soils that are highly suitable for agriculture. Marine deposits, such as coastal plains and deltas, also play a vital role in soil formation, providing mineral-rich sediments that enhance soil fertility.

NUTRIENTS IN SOIL: AVAILABILITY AND DYNAMICS

Essential Plant Nutrients

Plants require various nutrients for their growth and development. These nutrients are named as macro- and micronutrients according to the amounts required by plants. These include macronutrients such as nitrogen (N), phosphorus (P), and potassium (K), as well as micronutrients like iron (Fe), manganese (Mn), and zinc (Zn). The availability of these nutrients

in the soil is crucial for plant uptake and health. Essential nutrients required by the plant give in Figure 3.

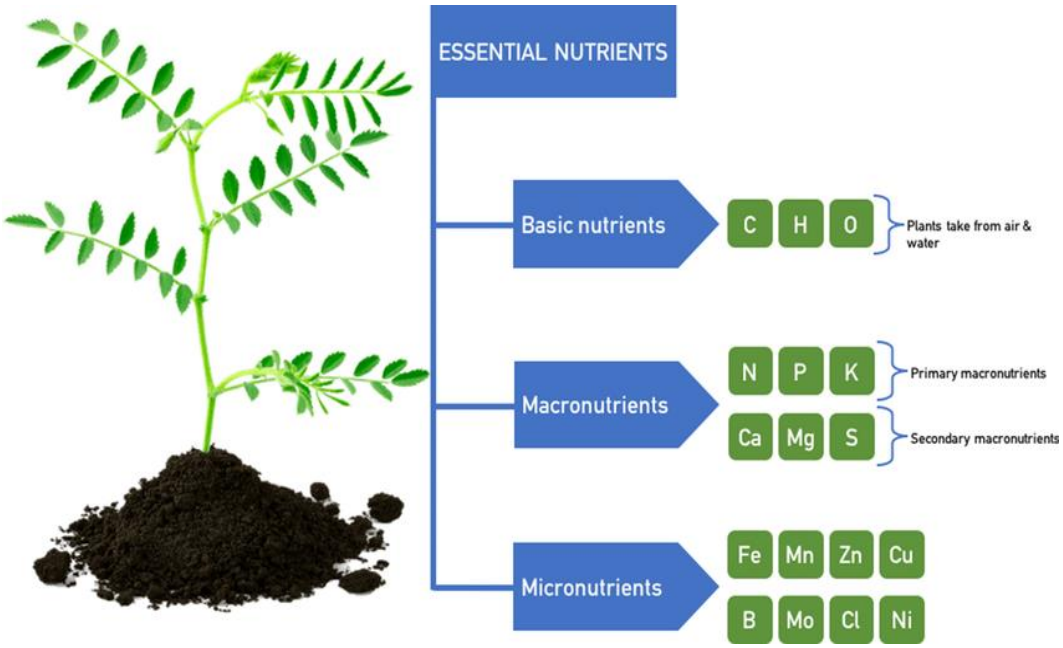

Figure3. Essential nutrients required by the plant for their growth (Patil et al. 2020)

Nutrient Cycling in Soils

The cycling of nutrients, especially nitrogen and phosphorus, is one of the services of agricultural soils in the ecosystem (Schröder et al., 2016). Nutrients in the soil are subject to cycling processes that involve both biological and chemical transformations. These processes include mineralization, immobilization, nitrification, denitrification, and nutrient uptake by plants (Vitousek et al., 2013). The nutrient cycle is shown in Figure 4. Soil microorganisms play a vital role in these cycles by decomposing organic matter and converting nutrients into forms accessible to plants. As plants utilize mineral nutrients in inorganic form, they are dependent upon the rate at which mineralization occurs in the soil. It has often been assumed that nutrient mineralization is mainly a result of the activity of the soil microflora, while the soil fauna is considered to have only an insignificant direct influence. The occurrence of soil fauna populations increases nutrient release by fragmentation of parent material (Reichle 1977).

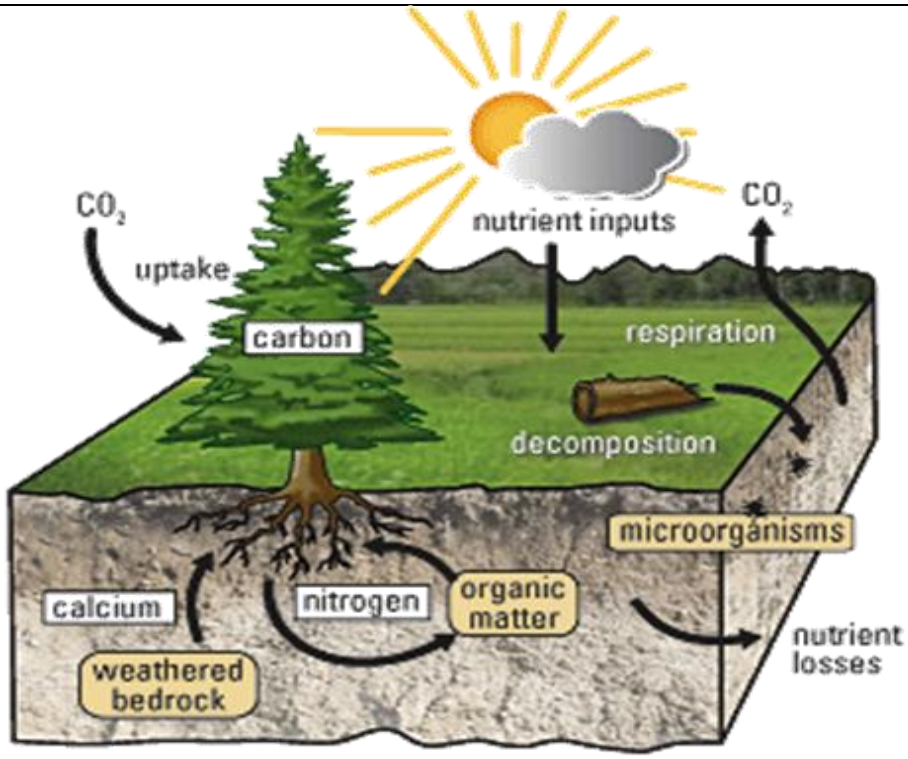

Figure 4. Nnutrient cycle (https://mdocs.skidmore.edu/crandallparktrees/ecosystem/nutrient-cycling/)

Role of Soil Parent Material in Nutrient Content

Soil parent material significantly influences the initial nutrient content of the soil. Different parent materials possess varying nutrient compositions, which can influence nutrient availability in the soil. For example, soils derived from basaltic parent material often have higher levels of essential nutrients such as potassium and phosphorus (Renneson et al., 2010). With the chemical weathering of the parent material, important nutrients such as calcium, magnesium, potassium, sodium, iron, silicon, aluminum and phosphorus take place in the soil. In research on plant nutrients, climate and, more recently, soils and landforms are largely considered as explanatory factors, while soil parent materials are rarely taken into account. Knowledge of soil parent materials may help in the simulation of crop production for the future (Augusto et al. 2017).

İnteractions Between Clay Minerals and Nutrient Availability

Soil minerals, such as clay minerals and iron/aluminum oxides, play a crucial role in nutrient availability. They can adsorb and release nutrients, affecting their mobility and availability to plants (Weil &Brady, 2010). Clay minerals, with their high surface area and negative charge, have a strong ability to retain cations such as potassium and calcium. Iron and aluminum oxides, on the other hand, can retain phosphorus, making it less accessible to plants.

EXAMINING SOIL-PARENT MATERIAL-NUTRIENT RELATIONSHIPS

Chemical weathering is one of the most important sources of inorganic nutrients in mineral soils under natural conditions. Calcium, magnesium, potassium, sodium, iron, silicon, aluminum and phosphorus in the soil by chemical weathering are important in plant nutrition and soil development. Among the microelements released by chemical weathering are manganese, copper, zinc, molybdenum, boron, chlorine and cobalt. Sulfur can be obtained from both mineral and atmospheric sources (Anderson, 1988)

Numerous studies have explored the relationships between soil parent material, geology, and nutrient availability in various regions. For instance, research conducted in the Van lake basin revealed that soils derived from different parent materials exhibited variations in nutrient content and fertility (Karaca et al., 2018).

Geological factors, such as the presence of specific rock types or mineral deposits, can significantly impact nutrient availability in agricultural soils. For example, research conducted in South Africa demonstrated that soils developed on tillite parent material had higher calcium content (Bühmann et al., 2006). Excess calcium affects soil pH and nutrient uptake.

Soil is a vital component of the Earth's ecosystem as it directly affects agricultural productivity, ecosystem sustainability, nutrient cycling, and water resources. Moreover, the phosphorus availability in soil is affected by various soil properties such as pH, texture, organic matter content, moisture level and microbial activities. Parent materials had a significant influence on P forms and on P, Al, Fe and Ca contents in both surface and deep horizons. soil properties are very important and vary from one soil type to another. Soil differences can generate different P behavior. In light textural soils like sandy and silty soils, P is more readily available for plants and for lateral transfers (Renneson et al., 2010).

MANAGEMENT IMPLICATIONS AND FUTURE DIRECTIONS

Understanding the relationship between soil parent material, geological features, and plant nutrients has practical implications for soil management. Farmers and land managers can tailor soil management strategies based on the geological characteristics of their specific region. This includes selecting appropriate nutrient amendments, optimizing irrigation practices, and adopting conservation techniques that account for nutrient availability and potential limitations.

While significant progress has been made in understanding the relationship between soil parent material, geological features, and plant nutrients, several research gaps remain. Further investigations are needed to unravel the mechanisms underlying nutrient release, retention, and cycling in different geological contexts. Long-term studies assessing the impacts of geologic

factors on soil fertility and plant productivity will contribute to sustainable soil management practices. Additionally, interdisciplinary collaborations between soil scientists, geologists, and agronomists are crucial for a comprehensive understanding of these relationships.

CONCLUSION

The relationship between soil parent material, geological features, and plant nutrients is complex and multifaceted. Soil parent material provides the initial composition and influences soil properties, while geological features shape soil formation processes. These factors, in turn, impact nutrient availability and cycling. Understanding these linkages is essential for optimizing soil management practices, enhancing agricultural productivity, and ensuring long-term sustainability.

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THE EFFECT OF DIFFERENT IRRIGATION PRACTICES ON STOMATAL CONDUCTIVITY IN SILAGE MAIZE GROWN IN SOIL AMENDED WITH STABILIZED WASTEWATER SLUDGE

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ABSTRACT
The utilization of domestic stabilized wastewater sludge in agricultural fields to enhance soil fertility is considered an appropriate practice as it encompasses waste management and environmental protection. Stabilized wastewater sludge serves as a potential source of organic matter and nutrients, particularly nitrogen and phosphorus. Therefore, the application of wastewater sludge in silage maize cultivation, which actively utilizes nitrogen, can be a cost-effective means of achieving high yields. Additionally, the application of sludge can improve soil water holding capacity, thereby reducing water stress in plants and positively affecting stomatal conductivity. Nitrogen, especially, directly affects plant growth and productivity under drought stress conditions. Stomata play a crucial role in plant adaptation to changing environmental conditions as they regulate both water loss and CO2 uptake. Considering the influence of soil moisture on organic matter mineralization, nitrogen release, and uptake, this study investigated the effect of three different irrigation practices (based on real-time water consumption and effective rainfall differences of 25, 50, and 75 mm) in soil amended with four different doses (0, 30, 60, and 90 t/ha) of wastewater sludge on stomatal conductivity throughout the season through pre-irrigation measurements. The results indicate that the stomatal conductivity values of silage maize decreased with increased pre-irrigation soil moisture stress but increased with an increase in sludge dosage. The increased stomatal conductivity values positively influenced silage yield.

Keywords: Irrigation, Stabilized wastewater sludge, Silage maize, Stomatal conductivity

INTRODUCTION

With the increase in urbanization and industrialization worldwide and in our country, the number of wastewater treatment plants has rapidly increased, leading to an increase in the amount of solid waste known as wastewater sludge. The disposal of wastewater sludge is considered a technical, economic, and environmental necessity (Altun and Sahin, 2021). The controlled and appropriate use of wastewater sludge in agricultural production areas is among the simplest disposal options (Mondal et al., 2015; Cakır and Cimrin, 2018; Poggere et al., 2019). Stabilized sewage sludge not only has the potential to be an organic matter source but also serves as an important ready nutrient source. Therefore, the application of sewage sludge enriches the soil with essential N, P, K, and micronutrients for plant nutrition, and it also contributes to sustainable organic matter addition, enhancing soil fertility (Szymańska et al., 2013; Zuo et al., 2019; Ravi et al., 2020). The improvement of soil structural properties through the influence of organic matter can also contribute to additional benefits in plant productivity (Ors et al., 2015; Sabtow, 2019; Abdallh and Sahin, 2020; Sahin et al., 2020; Badaou and Sahin, 2021). Silage maize, which has high yield and feed energy, is among the valuable crops in the world. Due to its efficient nitrogen utilization, sewage sludge can be used in the cultivation of silage maize. Silage maize produced under conditions where sewage sludge is applied has provided a 19-25% higher yield compared to the control group (Černý, 2012). Fresh and dry matter yield of silage maize fertilized with sewage sludge has been found to be higher than mineral-fertilized silage maize (Szymańska et al., 2013). Wieczorek et al. (2017) also stated that fertilizing maize with sewage sludge positively affects maize yield. Stomata play a crucial role in enabling plant adaptation to changing environmental conditions by controlling both water loss and the uptake of O_2 and CO_2. It is known that stomata have important functions in regulating water loss through transpiration and controlling CO_2 uptake to enhance photosynthetic efficiency (Damour et al., 2010). In general, it can be stated that the assimilation of CO_2 is not necessarily reduced in proportion to stomatal conductance due to the effects of soil moisture content on photosynthesis. Chlorophyll is one of the main components of chloroplasts, essential for photosynthesis, and its content is positively correlated with photosynthetic rate. Application of sewage sludge to the soil leads to an accumulation of nitrogen in the leaves, thus enhancing the greenness, or photosynthetic activity, of maize leaves (Szymańska et al., 2016). Therefore, nitrogen acquisition is highly important for the growth and productivity of plants under drought stress. Nitrogen not only influences carbon partitioning in plants but also enhances the accumulation of soluble sugars and starch, which promote leaf

development (Küçük Kaya, S., 2021). Soil moisture is one of the main factors affecting microbial activity, and it plays a crucial role in carbon and nitrogen mineralization processes (Bellitürk et al., 2009; Cenkseven et al., 2017; Yun et al., 2019). Therefore, it can be stated that soil moisture content, together with increasing soil organic carbon mineralization and nitrogen emissions, enhances plant uptake in response to decreasing soil moisture stress. C4 plants like silage maize can exhibit good growth and development with appropriate water and nutrient support due to their efficient photosynthetic mechanisms. In this study, the effects of different doses of stabilized wastewater sludge application were investigated on stomatal conductivity in silage maize plants under different soil moisture regimes created by drip irrigation. The wetting-drying cycle of the soil was managed, and possible changes in stomatal conductivity due to organic matter mineralization and nitrogen release were addressed and related to silage yield.

MATERIAL and METHOD

The research was conducted in a field located at coordinates 39.9340° N, 41.2350° E and an elevation of 1780 m in Erzurum province in the year 2021. Four different doses of stabilized wastewater sludge and three different irrigation regimes were tested in the study, following a completely randomized factorial design with 3 replications, resulting in a 4x3 factorial arrangement.

Stabilized Wastewater Sludge Application and Planting

The stabilized sewage sludge was obtained from the Erzurum province municipal biological wastewater treatment plant. The sludge mainly consists of municipal waste, with a small amount of industrial waste from meat and dairy processing facilities (Abdallh and Sahin, 2020; Badaou and Sahin, 2021). The applied sludge has a nitrogen content of 4.13% and an organic matter content of 38.6%.

In the experiment, considering the planned doses (D0: 0 t/ha, D1: 30 t/ha, D2: 60 t/ha, D3: 90 t/ha), the sludge was manually spread on the surface of the plots and mixed with the top 15 cm layer using a hoeing machine. Prior to planting, the plots were tilled to a depth of 15 cm using a vertical rotavator, and then DKC6777 silage maize seeds were sown in the plots at a spacing of 15x70 cm using a pneumatic seeder.

Irrigation Applications

Irrigations were conducted using a surface drip irrigation system, with one lateral per plant row. Rested groundwater (C2S1) from the reservoir was taken from the hydrant, filtered, and its pressure adjusted before being measured with a meter and applied to the plots. The amount of water applied to each plot was determined based on the moisture reduction at the effective root

depth needed to reach field capacity. Soil moisture measurements were carried out using the gravimetric method. From the planting date until the planned irrigation period, all plots were irrigated with equal amounts of water. During this period, irrigation was performed with a 0.30 irrigation rate, using enough water to replenish the moisture deficit in the top 30 cm of soil to field capacity when the difference between real-time crop water consumption (ETc) and effective precipitation (Peff) was approximately 25 mm. In the planned irrigation period, considering a root depth of 90 cm and an irrigation rate of 0.65, irrigation was performed when the difference between ETc and Peff was 25 mm (S1), 50 mm (S2), and 75 mm (S3), for different irrigation regimes. ETc values were calculated using the ETc = ETo x Kc approach, where Kc values were obtained from the "Crop Water Consumption Guide for Irrigated Crops in Turkey" (TAGEM, 2017). ETo values were calculated using the Penman-Monteith (FAO) equation in the CROPWAT (Ver. 8.0) software, using daily climate data from the Erzurum Airport climate station. Rainfall was measured using a rain gauge located in the experimental field."

Other Cultural Applications

A fertilization program was implemented in the control plots (D0) based on pre-planting analysis to address the deficient levels of nitrogen (N) and phosphorus (P). For weed control, the first cultivation operation was carried out when the plant height reached 15-20 cm, while the second cultivation operation took place when the plant height reached 40-50 cm (4-6 leaves). Planned irrigation practices were conducted from this stage until harvest.

Stomatal conductivity

During the planned irrigation period, measurements were carried out on the middle leaves of three selected plants in all plots using a portable leaf porometer device (Decagon Devices, Inc. SC-1 Leaf Porometer) between 10:00 AM and 2:00 PM (Fischer et al., 1998; Pietragalla and Pask, 2012). These measurements were conducted prior to each irrigation event. The porometer device allowed for the assessment of stomatal conductivity, providing valuable information about the plants' physiological response to water availability. The selected time frame of 10:00 AM to 2:00 PM was chosen as it represents a period of high solar radiation and optimal stomatal activity.

Statistical Analyses

The experimental parameters were subjected to variance analysis using the SPSS statistical analysis program, and significant means were classified at a 5% significance level using the

Duncan multiple comparison test (Duncan 1955; Açıkgöz 1993). Additionally, the regression analysis approach was employed to investigate pairwise relationships.

RESULTS and DISCUSSION

The highest stomatal conductance values were determined in the D3 and S1 treatments (Figure 1). As the soil drying period increased from S1 to S3, a significant decrease ($p < 0.01$) in stomatal conductance was observed (Figure 2). Sabagh et al. (2017) found that fully irrigated maize plants exhibited higher stomatal conductivity compared to stressed plants. Han et al. (2016) also observed a decrease in leaf stomatal conductivity parallel to increasing water stress. The increasing stress in the soil is considered the main cause of the decrease in stomatal conductivity. The significance of stomata in plant physiology stems from their role in facilitating gas exchange and water vapor escape between the intercellular space of leaves and the atmosphere (Ödemis et al., 2022). When plants experience water stress, stomata tend to partially or completely close as a defense mechanism to reduce water loss. At the cellular level, drought signals promote stomatal closure to conserve water (Liu and Qin, 2021). This closure restricts the movement of gases, including CO2, into the leaf, thereby limiting photosynthesis.

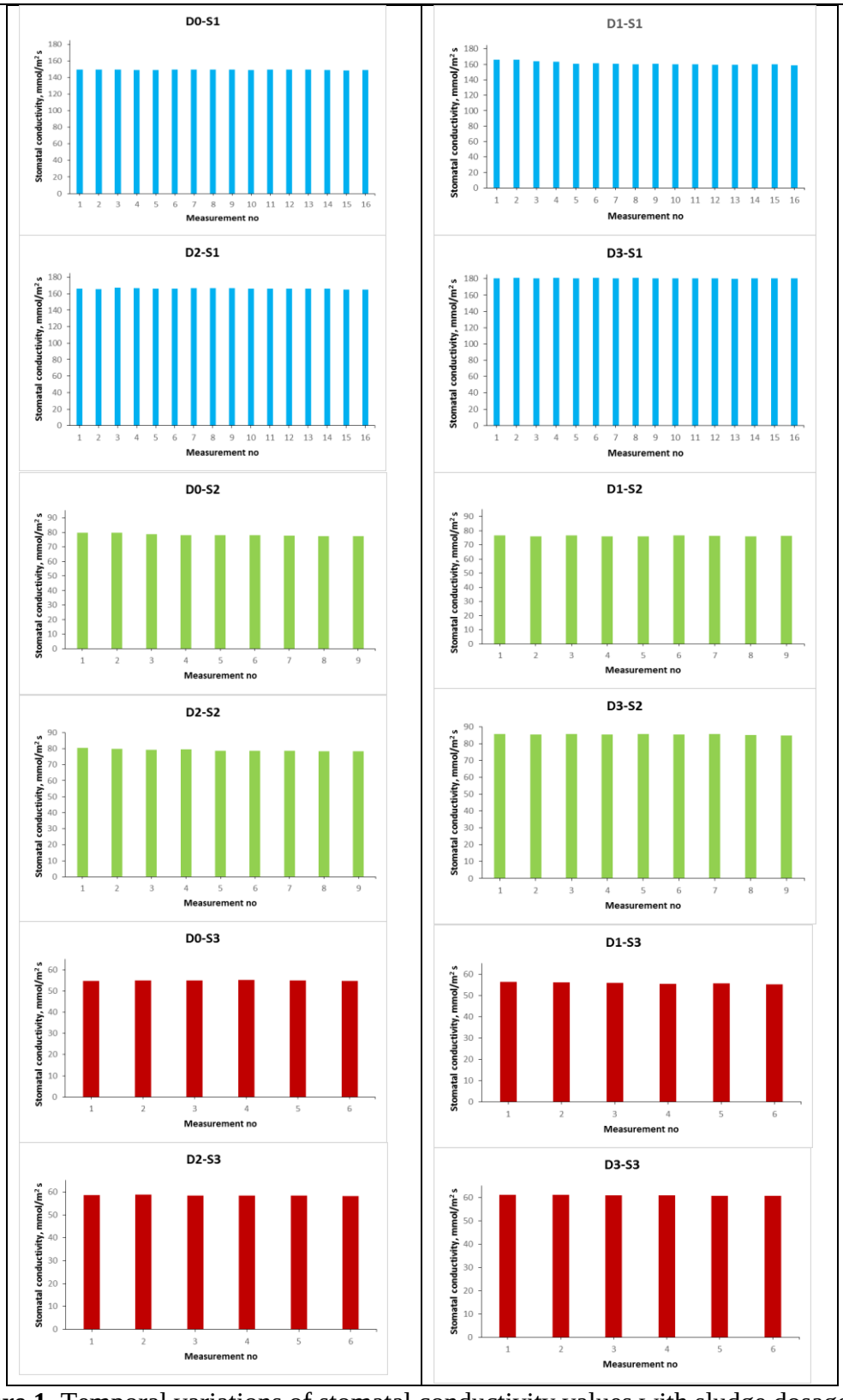

Figure 1. Temporal variations of stomatal conductivity values with sludge dosage and irrigation application

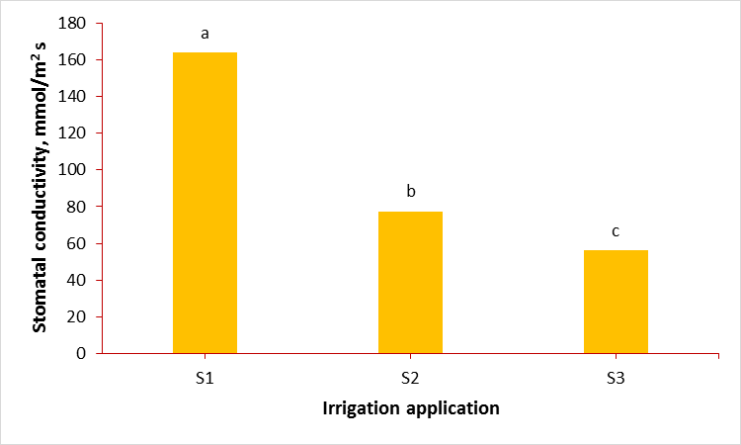

Figure 2. Changes in stomatal conductivity with irrigation applications

The application of treated sludge has shown a positive effect on stomatal conductivity, as indicated by Figure 3, with a significant increase ($p<0.01$) observed under arid conditions. This increase in stomatal conductivity is attributed to the abundance of nutrients in the environment (Elloumi et al., 2016). The addition of treated sludge to the soil contributes organic matter, enhancing soil structure, nutrient retention capacity, and microbial activity. Consequently, the increment in organic matter content can have a beneficial impact on stomatal conductivity by promoting overall plant health and vigor. Specifically, the nitrogen derived from the treated sludge is believed to play a crucial role in enhancing photosynthetic activity. Furthermore, the enhanced water-holding capacity in soil amended with treated sludge may alleviate water stress during prolonged drought periods, leading to a positive influence on stomatal conductivity. It should be noted that nitrogen supplementation can stimulate stomatal development and help mitigate drought-induced damage in plant tissues (Liao et al., 2022).

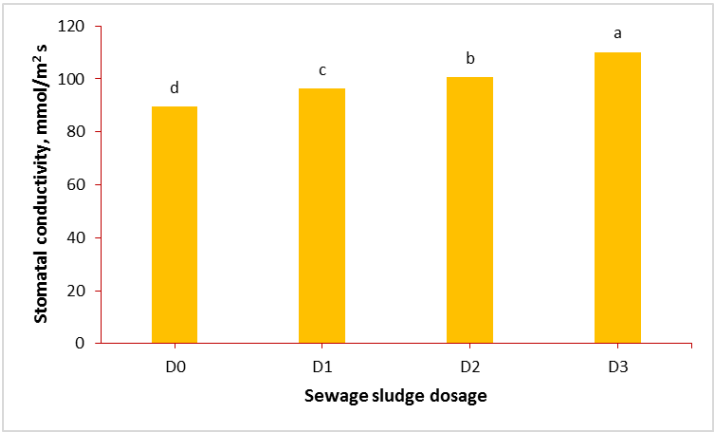

Figure 3. Variation of stomatal conductivity with treated sludge dosage

The improvement in stomatal conductivity has positively influenced the yield of silage, as supported by a significant ($p<0.01$) positive linear relationship between silage yield and

stomatal conductivity, as shown in Figure 4. It is suggested that the plant's ability to undergo better photosynthesis under conditions of high stomatal conductivity may lead to this outcome. Sabagh et al. (2017) found a close and negative relationship between grain yield and stomatal conductivity in maize. Therefore, limited nitrogen availability and drought have been identified as the main causes of yield reduction (Liao et al., 2022).

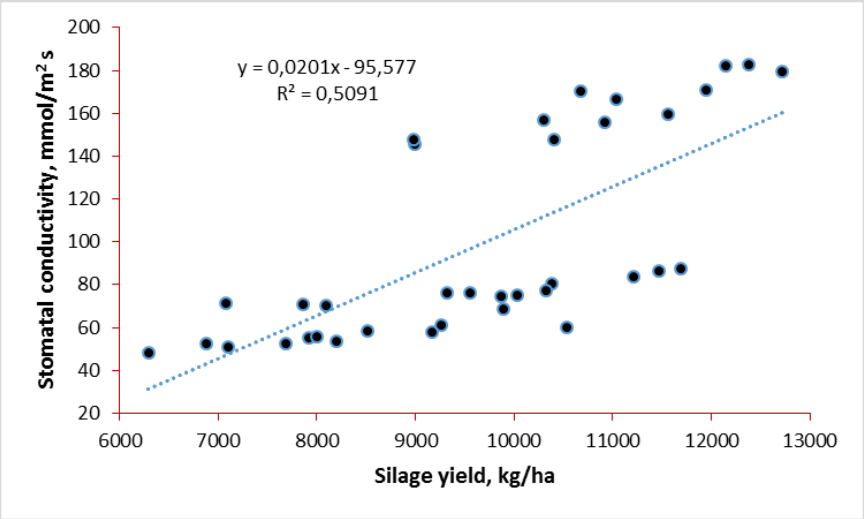

Figure 4. The relationship between stomatal conductivity and silage yield

CONCLUSION

It has been determined that the increase in the duration of soil dryness during the cultivation of silage maize leads to a decrease in stomatal conductivity in the plants. However, the addition of domestic stabilized sewage sludge to the soil has been found to improve stomatal conductivity. It has also been observed that the increase in stomatal conductivity values has a positive linear effect on silage yield. Therefore, it has been suggested that under cultivation conditions where sewage sludge is present, the differentiation in stomatal conductivity can be considered in managing soil moisture stress and contributing to physiological processes in silage maize.

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Statement of Conflict of Interest

The authors declare that they are no conflict of interest.

Authors' Contributions

Authors designed, analyzed and arranged the research, worked together on the preparation of figures. The authors contributed to the writing of the article and took part in the process of publication of the article and read and approved it.

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ZORUNLU İNEK TRAFİĞİ OLAN SAĞIM ROBOTLARINDA ÇALIŞMA PARAMETRELERİ[1]

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ÖZET

Robotik sağım sistemlerinin geliştirilmesinde mühendislik araştırmalarının rolü büyüktür. Ancak robotik teknolojilerin çiftliklere entegrasyonunun gözden geçirilmesi şarttır. 1996 yılı sonunda Hollanda'da ilk ticari otomatik sağım sisteminden itibaren hayvanlar sağlıklı ve kendi istekleri ile robota gelerek sağım işlemi için gönüllü olmaları sağlanmaya çalışılmaktadır. Diğer sektörlerden teknoloji transfer eden süt sağım sistemleri canlı hayvan ile çalışmanın getirdiği hassasiyetle kendini yenilemektedir. Bir işletme için iyi gibi gözüken uygulamalar bir diğerine uymamaktadır. Bu sebepten sahada yapılan ve yapılacak olan her çalışma çok değerlidir ve sistemin eksiklerini görerek kendini yenilemesini ve hızla gelişen ve değişen yeni teknolojiyi halihazırdaki sisteme dahil edilmesini sağlayacaktır. Bu çalışmada, robotik sağım sistemlerinin çalışmalarının takip edilerek robot etkinliğinin arttırılmasına yönelik sağımla ilişkili parametrelerin belirlenmesi amaçlanmıştır. Araştırma, 'zorunlu inek trafiği' tipine göre planlanmış ve Holstein Friesian ırkı 500 adet sağmal ineklerin olduğu ticari bir çiftlikte yürütülmüştür. Çiftlikte sağmal ineklerin bulunduğu ana bina, aynı çatı altında birbirinden bağımsız bölünmüş dört ahırdan meydana gelmiş ve her ahır bölümünde 2'şer adet olmak üzere toplamda 8 adet robotik sağım ünitesi vardır. Araştırmada çiftliğin bir ahır bölümündeki sağım robotlarının dört yıllık performansları incelenmiştir. Ahırdaki iki robotun karşılaştırıldığı dört yıllık denemelerde inek başına günlük sağım sıklığı ilk üç yıl ortalama 2,82 adet/gün iken, dördüncü yıl 3,06 adet/gün değerine yükselmiştir. Denemelerde ilk yıl ineklerin günlük süt verimi, sağım başına verimi ve robotta geçen süre sırasıyla 26,1 kg, 9,1 kg ve 7,2 dakika iken, dördüncü yıl bu değerler 46,6 kg, 15,3 kg ve 7,7 dakika belirlenmiştir. Robotlardaki ret sayıları ve süreleri ilk üç yıl artan seviyelerde iken (2,6-5,5 adet ve 2,2-4,9 dakika), dördüncü yıl bu değerler 2,0 adet ve 1,9 dakikaya düşmüştür. Ahırdaki robotların günlük sağım sayıları ilk yıl 145,6 adet iken, ikinci yıl bu sayı 161,3 adet ile en üst seviyeye yükselmiş, ancak üçüncü ve dördüncü yılda azalarak 157,1'den 153,0'e düşmüştür. İneklerin günlük sağım süresi aralıklarında ise 8,14 ila 8,30 dakika gibi çok az değişiklik olmuştur. Ayrıca robotların sağımdaki yüklenme oranı birinci yıl %72,3 iken, bu oran artarak dördüncü yıl %82,2'ye yükselmiştir. Bu sayede robotların boşta geçen süreleri %22,4'ten %10,8'e düşüş göstermiştir. Ahırdaki ilk yıl verilerinin düşük saptanmasına, birinci yılın işletme ve hayvanlar için daha

[1] Bu çalışma Hasan Kuraloğlu'nun Doktora tezinin bir bölümünden üretilmiştir. / This study was produced from a part of Hasan Kuraloğlu's PhD thesis.

başlangıç yılı olması sebep gösterilebilir. Dördüncü yıl verilerinin yüksek olmasına ise, çiftlik bütünündeki yüksek süt verimine sahip hayvanların bu ahır bölümüne toplanması, hayvanların çevreye uyum sağlayarak robotik sistemi tanıması sebep gösterilebilir.

Anahtar Kelimeler: Robotlu Sağım, İnek Trafiği, Sağım Sıklığı, Robot Yüklenmesi, Sağım aralığı

OPERATING PARAMETERS IN MILKING ROBOTS WITH FORCED COW TRAFFIC

ABSTRACT

Engineering research has a great role in the development of robotic milking systems. However, it is essential to review the integration of robotic technologies into farms. Since the first commercial automatic milking system in the Netherlands at the end of 1996, it has been tried to ensure that the animals are healthy and volunteer for the milking process by coming to the robot on their own free will. Milking systems, which transfer technology from other sectors, renew themselves with the sensitivity of working with live animals. Practices that seem good for one business do not fit another. For this reason, every work done or to be done in the field is very valuable and will enable the system to renew itself by seeing the deficiencies and include the rapidly developing and changing new technology into the current system. In this study, it was aimed to determine the parameters related to milking to increase robot efficiency by following the work of robotic milking systems. The study was planned according to the type of "guided cow traffic"" and was carried out on a commercial farm with 500 Holstein Friesian dairy cows. The main building, where the milking cows are located, consists of four independent barns under the same roof and there are 8 robotic milking units, 2 in each barn section. In the study, four-year performances of milking robots in a barn section of the farm were examined. In the four-year trials comparing the two robots in the barn, the average number of milking per cow per day was 2.82 milking/day in the first three years, while it increased to 3.06 milking/day in the fourth year. In the first year of the trials, the daily milk yield of the cows, the yield per milking and the time spent on the robot were 26.1 kg, 9.1 kg and 7.2 minutes, respectively, while in the fourth year these values were 46.6 kg, 15.3 kg and 7.7 minutes. determined. While the number of rejections and the duration of the robots were increasing in the first three years (2.6-5.5 and 2.2-4.9 minutes), these values decreased to 2.0 and 1.9 minutes in the fourth year. While the daily milking numbers of the robots in the barn were 145.6 in the first year, this number increased to 161.3 in the second year, but decreased from 157.1 to 153.0 in the third and fourth years. There was little change in the daily milking time intervals of the cows, such as 8.14 to 8.30 minutes. In addition, while the loading rate of robots in milking was 72.3% in the first year, this rate increased to 82.2% in the fourth year. In this way, the idle time of the robots decreased from 22.4% to 10.8%. The reason for the low data for the first year in the barn may be that the first year is the beginning year for the farm and animals. The high data for the fourth year can be attributed to the fact that cows with high milk yield in the whole farm are collected in this barn section, cows adapt to the environment and recognize the robotic system.

Keywords: Robotic Milking, Cow Traffic, Milking Frequency, Robot Loading, Milking Interval

INTRODUCTION

Today, it is more difficult to ensure sustainability by incorporating advanced technology into the agricultural sector than in other sectors. Especially as the investments in livestock enterprises increase, the suppliers serving this sector are also improving their service function not only to sell the product but also to ensure the sustainability of the complex technology This not only controls the operation of the sold product, but also provides incentives for upgrading and re-acquiring new products by introducing them to the business.Thus, technology will be more accessible and usable, especially in the dairy sector (Kuraloğlu, 2014).

Using the resources more effectively on dairy farms, it is necessary to explore the full potential of each individual dairy cow. While herd management is applied in traditional milking farms, the basic logic in precision dairy farms is that each cow should be evaluated as an individual and each cow should be managed individually. The most interesting of the precision dairy farming technologies is milking robots. The use of milking robots has increased in the United States, Canada and Australia, especially in European countries. In our country, the use of this technology is new; Since the pros and cons of milking robots compared to traditional milking systems are not fully known by the operators, they are adopted slowly. However, the increase in the need for qualified labor will increase the preference of the robotic milking system (Örs ve Oğuz, 2016).

While robotic milking systems (AMS-Automatic milking systems, VMS- Voluntary Milking Systems, RMS- Robotic Milking Systems), one of the precision livestock developments, control the process, there have also been many changes in the way the entire farm system is managed. Milking is no longer performed in certain sessions; instead, the cow can now choose when to milk on the robot and allow milking to be distributed over a 24-hour period (John et al., 2016).

There are three types of traffic regulations proposed by robotic system manufacturers in farms. The first is free cow traffic. When the cow gets up from the stall, it is free to go to the robot or the feed table. There are no sorting, gates or routing. The cow can go wherever it wants, of its own free will. Secondly, milk-first forced cow traffic. In this traffic, the feeding area and the resting areas are separated from each other. When the cow gets up from the stall, it makes the transition to the feed table through the smart gates located close to the robot. If the cow's milking

time has not come, the smart gate directs the cow to the feed table. If there is a milking permit, the cow is directed to the waiting area in front of the robot to be milked. After milking, it proceeds to the feed table. The animal can pass from the feed table to the rest area through one-way gates. The third type of traffic is the feed-first forced cow traffic. In this traffic, cows have free reach to the ration feed table with one-way gates. When cows return from the feeding area, they are controlled by a selection gate and directed to the robot if there is milking permission, and to the resting area if there is no permission (Hobbis, 2013; Rodriguez, 2012; Rodriguez, 2014).

There are many international studies on robotic milking systems. However, in Turkey, there are mostly survey-based studies that reveal the statistical figures in the enterprises, and compilation-weighted publications that examine the economic situation and reveal the differences of the system with the existing milking systems (Gonulol, 2016; Örs and Oğuz, 2016; Akar Çıkrıkçı, 2019). There are almost no studies that reveal the situation of commercial enterprises in the field and contribute to the performance of robotic systems. In this study, it was aimed to determine the 4-year performance of milking-related parameters to increase robot efficiency by following the work of robotic milking systems in a commercial farm.

MATERIAL and METHODS

Material

This research was conducted in a commercial farm established in Balıkesir province, which was planned according to the 'milk-first forced cow traffic' type. The main building, where the milking cows are located, consists of four independent barns under the same roof. There are 8 robotic milking units in total, two in each barn. In this study, four-year performances of 2 milking robots in a barn of the farm were examined.

The layout of a barn on the farm and the animal movements in the barn are given in Figure 1 (Kuraloğlu, 2022). Accordingly, when the cows want to pass from the resting area (A) to the feeding area (C), they are sorte at a pre-selection gate (5) and if there are milking permits, with the guidance of the sorting gate, the robot located in the milking room (B) (1) enters the waiting area (E) to be milked. Otherwise, it is sent to the feed area where PMR is given. The animal that is milked in the robot is left in the exit area (F). Then, with another smart separator gate combination (5), it is directed to the separation area (G) if a special treatment or treatment is required, and to the feed area if it is not. The passage from the feed area to the rest area where

the beds are located is provided by three one-way gates (6). The plans of the four barns in the enterprise are the same and they are positioned in a mirror symmetry manner.

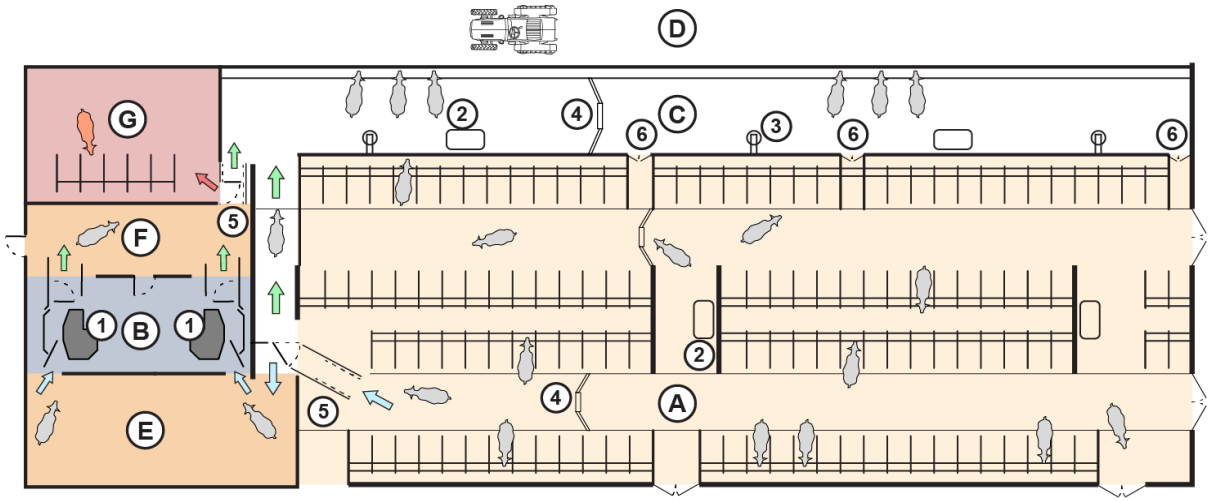

Figure 1. Layout plan and animal movements in the barn

A-Resting area, B-Milking room, C-Feeding area, D-Feeding line, E-Waiting area, F-Exit area, G-Separation area, 1-Robotic Milking System (AMS), 2- Trough, 3-Brush, 4-Manure scraper, 5-Smart gate, 6- One way gate

The barn where the research was conducted is the barn where the cows with proper udder shape and high milk yield are located. Since the barn is the easiest to observe in the farm main building, it is close to the milk room and the IT room, the robots here were chosen for research. There are an average of 102 cows in the barn. A partial mixed ration (PMR) is distributed on the farm twice a day, at 08:30 in the morning and at 17:00 in the evening. In addition to PMR, concentrated feed is given from the feed station in the robotic system according to the individual needs of the animal. The ration feed in the feed line is pushed 3 times a day. Ration feed distributed 33 kg per animal; It consists of 2 kg of straw, 3.5 kg of alfalfa, 18 kg of corn silage, 0.35 kg of vitamin and mineral mixture, 3 kg of corn flake, 0.15 kg of soda and 6 kg of concentrated feed. The total length of the feed table is 53 m. In the milk room, there is a main milk cooling tank and a buffer tank that serves during the washing and milk transfer process to tanker. Robots are automatically washed three times a day (at 03:00, 12:00 and 21:00) with alkaline detergent 3 times and acid detergent once, respectively. A washing time of a robot takes an average of 20 minutes. Imported product robotic milking systems are used in the research farm. The general view of the robotic system and some elements are given in Figure 2 (Anonymous, 2013).

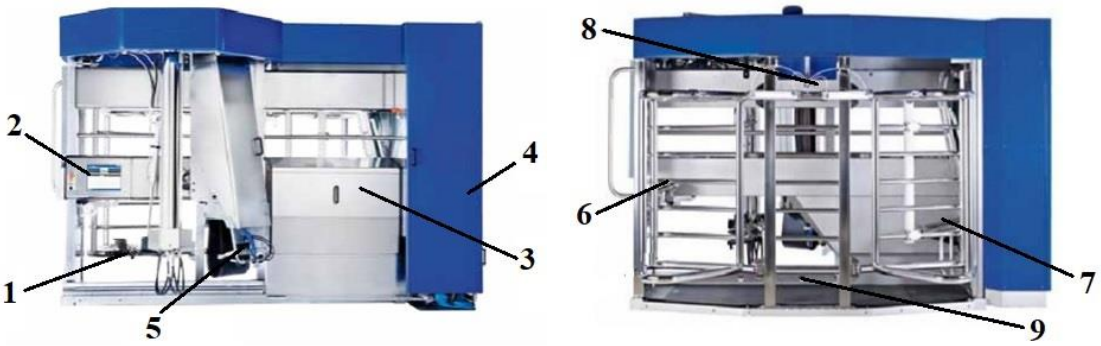

Figure 2. General view of the robotic milking system

1- Robot arm; 2- Screen; 3- Milking unit; 4- Washing system; 5- Disinfectant spray nozzle; 6- Manure gutter; 7- Bait station; 8- Electrically controlled gates; 9- Automatic foor washing

Herd management program (DelPro 4.5) is used in the robotic milking system. The software presents the information coming from all units in the farm (robotic system, automatic concentration feed station, smart gates, electronic tags, activity meters, etc.) in the form of a report on the computer. Necessary reports in the herd program are based on feeding, milking, device, activity, cow and herd monitoring etc. on the "Design Tree" selective time levels. headers can be created by the user. In this research, the report named “Group Milking” presented under the “Animal” tab of the herd management program was used. In this report, group-based data were selected between certain dates with the “User Defined” tab, and the start date and time of the visit of each animal, its group, the number of the robot on which it was milked, the name of the operation (milking, feed only, rejection, exit without milking), the total milk yield of the cow in one visit, milking time (min:h), number of milkings per day, unfinished operations, amount of milk, average milk flow amount (kg/min) were recorded. The research data were transferred daily from the herd program and analyzed in MS Excel program and analyzed in Minitab 17 program. The comparison of barns on the farm was analyzed using ANOVA and compared using the LSD test ($P<0.05$). The mean and standard deviation of the data were calculated.

Methods

The 4-year performance of two robotic systems in the barn with high milk yielding cows, which can represent the full capacity loading of the milking robots, was investigated. In order for the robot data to represent homogeneous results in the trials, 20 February-20 April of each year was taken as a basis and 60-day data were used. The milking system performance results are not individual for each robot, but are given as the average of two robots in the barn. The reason for averaging; is that the waiting area of the two robots is common. The trial period could have

been kept longer, but there has been a lot of animal movement in the barns. In addition, drying, sending to the infirmary due to illness, slaughtering, etc. For reasons, it becomes difficult to work with the same animals in the same barn.

The following basic parameters were examined in the barn (Kuraloğlu, 2022):

- Number of cows milked per robotic system (unit/robot),
- Daily milking frequency per cow (pieces/day, cows),
- Distribution of the number of milkings per cow per day (%),
- Hourly milking number distribution of the two robots during the day (unit/h),
- Daily milk yield per cow (kg/day, cow),
- Cow milk yield per milking (kg/milking, cow),
- Milk flow per cow (kg/min, cow),
- The cow's daily milking time interval (h/cow, day),
- Percent distribution of cow's daily milking time interval (%),
- Time spent on the robot during milking (min),
- Number of rejections per day,
- Daily rejection time (min/day),
- Number of milkings per day per robot (pcs/day, robot),
- Loading rates of the robot in milking, washing, idle and non-milking processes (%),
- Daily labor requirement per cow (man hour/cow, day),

While the basic parameters above can be directly obtained from the herd management program, some of them are calculated with linked equations (Castro et al., 2012; Priekulis and Laurs, 2012; Ünal and Kuraloğlu, 2016).

RESULTS and DISCUSSION

The milking characteristics obtained from two robots belonging to 4 years in the working barn are given in Table 1. As seen in the table, the number of cows milked in the barn varies between approximately 100-117, and 50-59 animals are milked per robot. It can be expected that the number of animals per robot is higher (around 65) in farms where milk compulsory cow traffic is applied first. Therefore, it can be said that the optimum herd number has not been reached.

Table 1. Milking characteristics for four years in the barn

Parameter	Unit	1st year	2nd year	3rd year	4th year
Number of milked cows	pcs/2 robots	101.8±0.43c	116.8±0.39a	110.9±0.79b	100.3±0.74c
Number of days in milk	piece	144.9±0.18	154.8±0.76	153.4±0.96	195.1±1.41
Number of lactations	piece	1±0.00	1.6±0.00	2.2±0.01	2.8±0.01
Daily milking frequency	pcs/day	2.87±0.02b	2.76±0.01c	2.84±0.02b	3.06±0.03a
Daily milk yield	kg/ day	26.1±0.17d	32.3±0.09c	33.6±0.28b	46.6±0.43a
Milk yield per milking	kg/milking	9.1±0.05c	11.7±0.04b	11.8±0.07b	15.3±0.09a
Average milk flow rate	kg/min	1.3±0.01d	1.7±0.01c	1.7±0.01b	2.0±0.01a
Time spent on the robot during milking	min	7.2±0.04b	7.1±0.02b	7.0±0.03b	7.7±0.03a
Number of rejections per day	piece	2.6±0.34b	2.7±0.34b	5.5±0.44a	2.0±0.22b
Daily rejection duration	min/ day	2.2±0.36b	1.9±0.30b	4.9±0.57a	1.9±0.29b
Number of milkings per day of the robot	pcs / day	145.6±0.92d	161.3±0.70a	157.1±0.75b	153.0±0.85c
Daily milking interval	h/ day	8.2±0.02	8.1±0.02	8.2±0.02	8.3±0.02
Daily labor requirement	worker h/ day cow	0.012	0.012	0.011	0.011

*Average values shown with lowercase letters (a,b,c,d) on the same line show the differences between years ($p<0.05$)

Daily milking frequency per animal varied between 2.76 and 3.06 (Table 1). Low milking frequency in the second year; The reason may be the feeding strategies applied and the commuting strategies of delayed animals. The fourth year value was above the limit values (2.5-2.9) for farms with first milk driven cow traffic in the literature (Ipema, 1997; Laurs et al., 2009; Castro et al., 2012, Sitkowska et al., 2015). The animals were not grouped according to their yield in the first three years across the farm. The fact that high-yielding animals were collected in the barn after grouping provided a good value of 3.06 for milking frequency.

While the daily milk yield was 26.1 kg in the first year, which is the first lactation period of the cows, it increased to 32.3 kg with an increase of 24% in the second year and to 33.6 kg with an increase of 28% in the third year. The reason for the low milk yield in the first year may be the fact that the cows are in the first lactation and the period of getting used to the robotic system of the cows and workers. It can be said that the increase in the number of herd lactations and be familiar with the robot system in the second and third years have a positive effect on milk yield. Despite the fact that the number of animals in the barn was at the lowest level (100.3 units) in the fourth year, the daily milk yield increased by 78% compared to the first year and reached

the highest level with 46.6 kg. This amount has been reached to the fact that cows with high milk yield throughout the farm are taken to this barn in the fourth year. It is an important issue to know how much extra milk will be given by animals that are milked more than twice a day. Compared to 3x milking and 2x milking, the amount of milk can increase by 20% on average. Milking 4x times can provide an extra increase of 5-10%. The additional increase in milk yield provided by stimulation of milk producing cells is associated with better feeding and better management on the farm where 3x milking is performed (Hobbis, 2013). With the grouping strategy carried out in the fourth year in the farm, feeding was done according to the expected yields of the high-yielding cows and the highest milk yield was obtained.

The increase in the daily milk yield of the cows by years has similarly increased the milk yield per milking. Accordingly, the milking yield, which was 9.1 kg in the first year, increased by 28% on average in the second and third years to 11.8 kg, and increased by 79% to 15.3 kg in the fourth year (Table 1). Milk yield increases showed that the cows were accustomed to the robot system. Controlling the robot operation from the manager to the workers in the barn, increasing the milking efficiency of the cows with increasing lactation age and adapting to the environment and knowing the system, and herd grouping have provided this improvement. Another factor affecting the yield per milking is the milk flow rate (milking flow). This value, which is related to the genetics of the animal, is also affected by environmental conditions, the care and settings of the milking system and the training of the animals. Stress is low in every animal that is well fed, welfare conditions are created, and if milking is done at the right time with the right conditions and equipment, the milking flow will increase. In the measurements made, the milk flow rate increased significantly each year (1.28, 1.66, 1.68 and 1.97 kg/min) (Table 1).

Despite the increase in the productivity of the cows in the farm, which was not grouped in the first three years, the time spent on the robot was found to be close to each other (average 7.1 minutes). The increase in milk flow of animals during milking can be shown as a reason for this. On the other hand, the significant daily milking frequency (3.1) and daily milk yield increase (46.6 kg) in the fourth year increased to 7.7 minutes, increasing the time spent on the robot by only 8%. The fact that this period does not increase is a desired situation for the entire herd to use the robot effectively. The fact that this period does not increase much in the fourth year can be shown to increase the milk flow rate from 1.3 kg/min to 2.0 kg/min at milking.

Results obtained after the first year in this study were similar to that of Castro et al. (2012) (1.44 kg/min) and Heringstad and Kjøren Bugten (2014) (1.5 kg/min) were found to be higher than the results of their research (Table 1).

The daily number of rejections and the duration of the cows in the robot are examined, the third year was the highest year with 5.5 and 4.9 minutes. In the fourth year of grouping, the least results were obtained with 2.0 units and 1.9 minutes (Table 1). The target value should be zero in the number and duration of refusals in farms that apply milk-first forced cow traffic first. In a farm with a pre-selection gate, it is impossible for a cow without a milking permit to enter the waiting area. However, sometimes manual intervention may be made by the worker due to faults of robots. On the other hand, although the cows collected from the barn are sent directly to the waiting area and leaving the milking selection to the robot, it seems like a temporary solution, it affects the robot performance negatively. However, since the intervention to delayed milking is a priority, it has been seen that the concern of robot performance can be put into the background. In addition, after the operations carried out in the separation area (special needs area) after the robots, the cows are left back to the robot waiting area instead of the feeding area. In this case, the cow without milking permit can occupy the robot.

The maximum number of milkings performed by a robot during the day was obtained with 161.3 units in the second year data. The lowest number of milkings was realized in the first year with 145.6 units. This situation can be primarily associated with the number of animals in the barn in those years (102 cows in the first year, 117 cows in the second year). On the other hand, in the fourth year with the lowest number of animals (100 cows), the robot's milking rate was expected to be the lowest, but on the contrary, it ranked third with 153.0 milkings. The grouping of high-yielding animals on the farm in this barn for the fourth year has increased the loading rate of the robots.

When the daily milking intervals in the barn were examined, values close to each other were found between 8.1 and 8.3 hours. Less commuting in only the fourth year increased the milking interval slightly (8.3 hours). While the daily labor requirement per cow was 0.012 worker hours in the first two years, it decreased slightly to 0.011 worker hours in the next two years. It can be said that cows have adapted to robotic systems over the years, reducing the labor. The ratios of the time spent by the two robots in the barn in milking, idle, washing and non-milking operations are given in Figure 3. As seen in Figure 3, the highest percentage of loading of robots

in milking belongs to the fourth year with 82.2%, and the lowest percentage belongs to the first year with 72.3%. The second and third years were found to be close to each other with 79% and 78%. The fact that the first year in the farm is the beginning of the robot operation and the animal can be shown to be low, while the fourth year's milking routine in the barn is completely left to the robot, and the time (percentage) of milking time (percentage) of high productive cows being taken to this barn may be shown to be high.

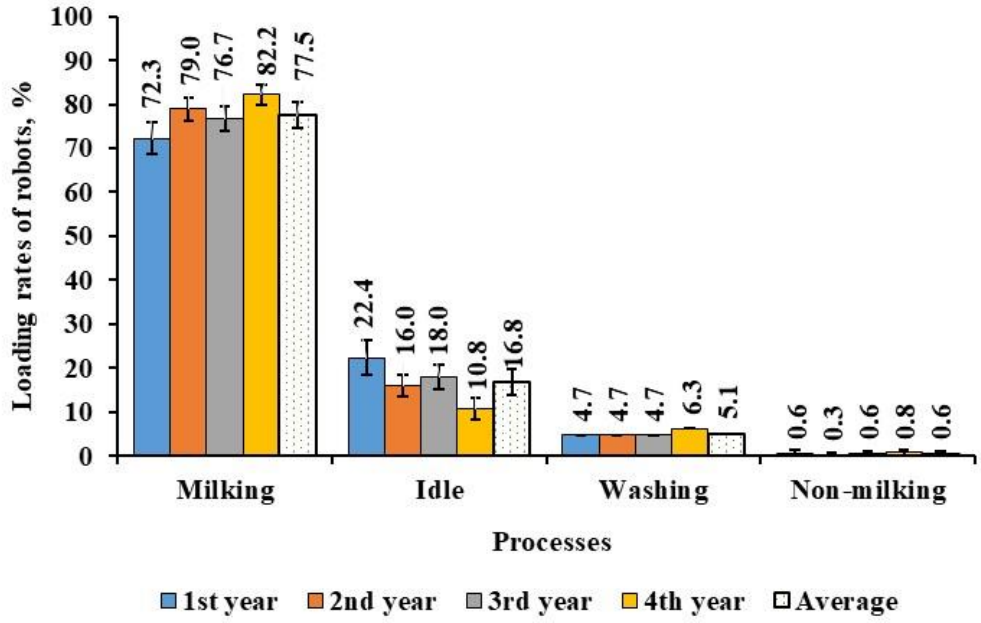

Figure 3. Rates of time spent by robots in milking, idle, washing and non-milking operations

When the idle time ratios of the robot are examined, the highest with 22.4% in the first year and the lowest with 10.8% in the fourth year. The most effective factor on idle time is the number of cows. In the barn, there are 102 cows in the first year and 100 cows in the fourth year, and the number is close to each other. However, the percentages of idle time are far from each other. This can be attributed to the wrong strategies in cow traffic, the feeding not supporting the traffic, and the animals not being trained. In the fourth year, the loading of high-yielding animals in the barn increased and the idle time percentage decreased. Laurs et al. (2009) found the rate of idle time as 19% in a study they conducted with 88 animals in a compulsory type barn. Although the number of animals in the first year of this study was 14 more than the number in the authors' study, the rate of idle time was higher than the rate given by the authors. This surplus can be attributed to the new establishment of the farm, the cows in the first lactation and the lack of training of the working staff. In general, increasing the number of cows in the barn can reduce idle time. However, increasing the number of cows is not the only factor that

will increase the performance of the robot. Cow traffic management is also important. In other words, in order to reduce the idle time in robots, animals that have not been milked should be trained instead of being held (Devir et al., 1999).

The times spent in the washing process' were the same (one wash was 20 minutes). However, when the idle time of the robot exceeds 30 minutes, the system performs a short rinse. Cleaning processes such as washing and rinsing can be changed in the system. If the number of cows that are not milked on maintenance-repair days increases, the washing process can be canceled. In the fourth year, detergent washing has been reduced to two this year, as highly productive cows keep the robots busy. When the non milking processes are examined, the fourth year is different from the values in other years with a rate of 0.8%. Because, apart from rejection, without milking and manual milking under this title, heifers are trained to the robot before calving by using the "only feed" function in the third and fourth years. This feature was not used for the first two years.

The milking rates of the cows according to the number of milkings per day are given in Figure 4. When the figure is analyzed, the distribution of milking numbers per cow is concentrated at 2x, 3x and 4x in all years. Cow milking rates, which were 1.1% and 2.2% in the first year and second year at 1x milking, decreased significantly (0.5% and 0.3%) in the third and fourth years. In the fourth year with high yielding animals, 4x milking increased significantly and reached 20.8%. Again in the same year, the rate of milking 5x times increased to 2.8%, increasing the number of milking per animal per day of the group. The daily milking frequency of 3.06 in the fourth year can explain the result of this improvement. In the fourth year, the number of milking has been increased by the barn structure created according to the yield throughout the farm. It can be suggested that barns with low robot performance improve the robot visits, with cow feeding strategy, training, and routine introduction of unmilked cows.

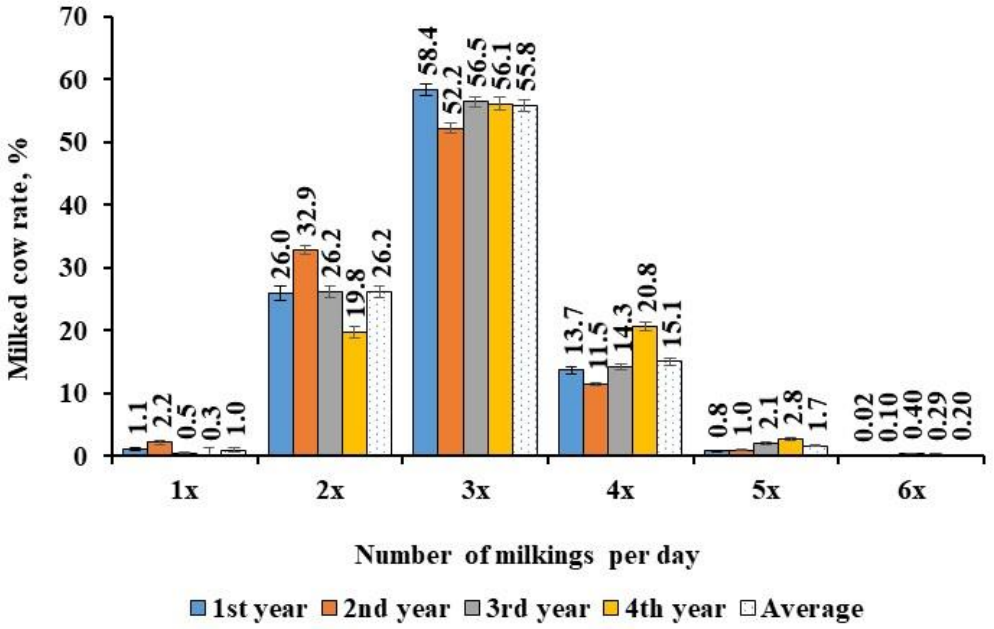

Figure 4. Distribution rates of cows according to daily milking numbers

When the distribution of hourly milking numbers of the two robots in the barn is examined in a 24-hour period, it is seen that the lowest milking number is 12,2 in the range of 00:00-08:00 hours in the average of four years, and the highest number of milking is between 16:00-24:00. It was seen that it was reached at :00 hours (Figure 5 and Table 2). The main cleaning times of the robots in the barn were changed every year. In the first year, washing was done at 03:00, 12:00 and 21:00 hours, however, the lowest number of milkings (5.8 in the range of 03:00-04:00) was determined this year. In the second year, the washing process was programmed at 00:00, 06:00 and 12:00, in the third year it was changed to 04:00, 12:00 and 20:00. In the fourth year, the washing process was reduced to two times a day and was carried out at 04:00 and 20:00. In the second and third years of the study, it was observed that the number of robot milking reached peak values (15.7 and 15.2/2 robots). However, considering that the number of animals in the barn was high in these years, it cannot be said that it was very successful. Because after the yield grouping in the fourth year, although the number of cows was the lowest in four years (100).

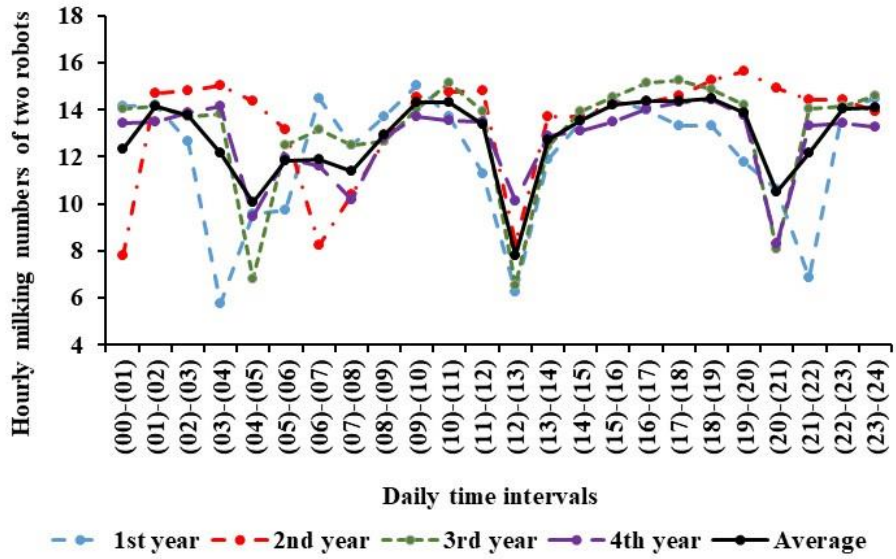

Figure 5. Distribution of hourly robot milking during a day (total of two robots)

Table 2. Summary of the distribution of the milking number of the two robots during the day

Clock-Parameter	1st year	2nd year	3rd year	4th year	Average
00:00-08:00	11.6	12.3	12.6	12.3	12.2
08:00-16:00	12.5	13.3	12.9	12.9	12.9
16:00-24:00	12.3	14.7	13.8	13.1	13.5
Smallest	5.8	7.8	6.6	8.3	7.1
The biggest	15.0	15.7	15.2	14.4	15.1
Average	12.1	13.4	13.1	12.8	12.9

It was stated in Table 1 that there was no significant difference between the visit times of the cows to the milking robot during 4 years in the barn. The milking time intervals given in the table vary between 8.1 and 8.3 hours. As it is known, one of the features of robotic milking is that cows can visit the milking robot voluntarily. This causes a large variation in the frequency of visits to the milking robot and thus milking intervals can result in high variation. For this reason, the milking time intervals of the cows in the robot visit were examined proportionally (Figure 6). As seen in the figure, approximately 92% of milkings in the first and second years were detected at the highest rates between 4-12 hours of milking. In the fourth year, this time interval was found to be the lowest with 88.8%. In the third year, the milking interval of 4-12 hours increased by 89.4%, close to the fourth year. On the other hand, the fact that 7.5% of milkings are detected on average over 12 hours in the third and fourth years may pose a problem for animal health. Since milking routines are largely left to the robot in the third and fourth years, it makes it difficult to follow up cows that are delayed in milking. In this case, human labor and initiative cause delays in the transportation of the animal. On the other hand, milking

visits under 4 hours is another problem that reduces robot performance. Because arrivals to the robot under 4 hours cause rejections. Hogeveen et al. (2001) investigated the relationship between the milking interval of the milking robot, milk production and milk flow rate on 66 cows. They found that 9.7% of milkings were shorter than 6 hours and 17.6% were longer than 12 hours. The researchers reported that the average daily milking frequency of 6% of all cows was less than two, and this was due to the cow factor and the time of the day affecting the change in the milking interval. In addition to the cow factor, the authors found that milking interval length also had a significant effect on milk production and milk flow rate. They found that the effect of milking interval on milk production per hour was greater in high-yielding cows than in low-yielding cows. It can be said that the findings of the researchers are similar to the results of this study.

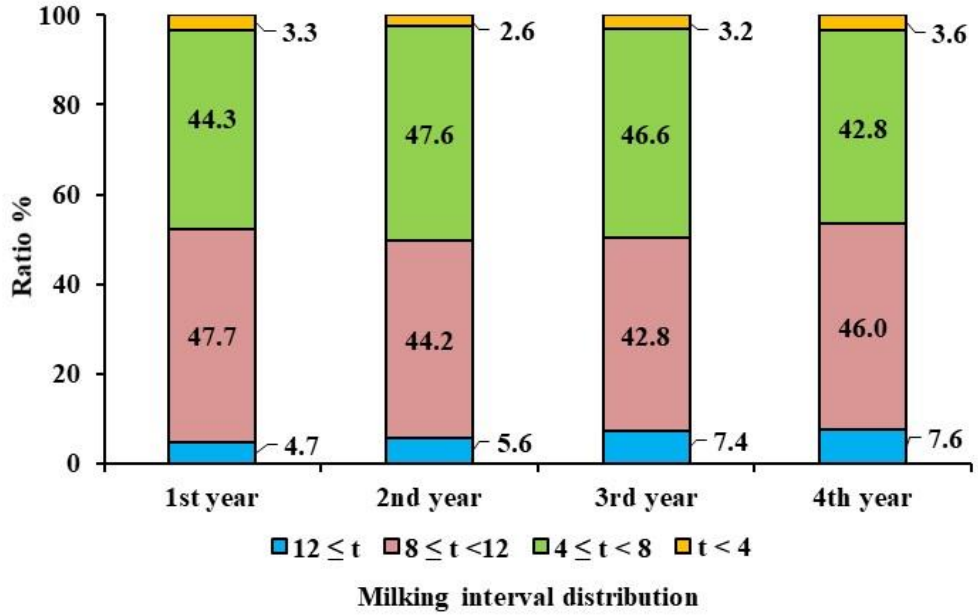

Figure 6. Distribution rates of cows in the milking interval

CONCLUSION and SUGGESTIONS

The priority of the study was to determine the effects of the processes in the first years of establishment of the commercial farm, on the robot performance. The results obtained from this study are as follows.

- Daily milking frequency, which varied between 2.76-2.87 in the first three years in the barn, reached 3.06 in the fourth year because of the grouping made throughout the farm. This showed that it is beneficial to grouping animals according to yield for more effective use of robot performance.

- Since the first year of the research was the first lactation period of the cows, the daily milk yield, milking yield and milk flow rates were found to be 26.1 kg/day, 9.1 kg/milking and 1.3 kg/min, respectively. In the second and third years, these data increased to an average of 25%, and in the fourth year, the yield increased by 78% on average thanks to the grouping. Over the years, the employees' mastery of the use of robots, the increase in the lactation age of the cows and their understanding of the system by adapting to the environment have increased the milking efficiency. The yield grouping of the herd also provided this improvement.
- While the loading percentage of robots in milking was 72.3% in the first year, increasing it to 82.2% in the fourth year is a significant improvement. This increase in rate significantly reduced the idle time of the robot (from 22.4% to 10.8%). The biggest reason for potential improvement seems to be using milking management strategies to increase the percentage of time each robot milks cows. By leaving the milking routine completely to the robot in farm management, especially the length of time spent in milking of high-yielding cows can be shown as a reason for this improvement.
- Although the number of cows milked by the two robots in the barn during the day was 13.2 in average in the second and third years, this number was reached with an average of 114 animals. Although the number of cows in the barn decreased to 100 in the fourth year, the two robots milked an average of 12.8 cows. With this year's yield grouping, milking frequency of cows, milk yield etc. It has been observed that the robot performance can be maximized due to the improvement of the robots.
- Grouping can be done in enterprises that do not have capacity problems and have more than one robotic system barn. When creating groups, milking numbers suitable for robot loading and the number of animals equivalent to them should be calculated.
- Robots must have idle time. Thus, less dominant animals are not rejected during robot visits and the desired daily milking numbers can be achieved.
- Capacity can be affected not only by the number of animals and milking, but also by milking efficiency and duration.
- Animals with bad teats and not suitable for milking should be removed from the herd. Reverse alternative solutions (such as manual tooling) should not be applied to the operation of the system.
- Animal traffic in the barn should be set up correctly, and interventions that will affect robot performance should be avoided.

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FACTORS INFLUENCING FARMER-HERDER CONFLICT IN ARDO-KOLA AND LAU LOCAL GOVERNMENT AREAS OF TARABA STATE, NIGERIA

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ABSTRACT
The study assessed factors influencing farmer- Herder conflict in Ardo-kola and Lau local government areas of Taraba State. Specifically the study describes socio-economic characteristics of the arable crop farmers; and identified factors influencing farmers-herders conflict. Multi-Stage sampling techniques were used to select one hundred and fifty arable crop farmers. Frequency, percentage, mean and standard deviation were used in the analysis of the data. Reveals arable crop farmers had a mean age of 41 years. Majority (62.6% and 85.7%) was male, married with no formal education (55.7%). 43% were arable crop farmers by occupation. Majority (63.3% and 78.9%) belongs to a cooperative society, had no access to extension services. with a mean household size of seven persons and average annual income of ₦270, 406.1 respectively. Land and water bodies$\overline{X} = 3.6$), Unemployment$\overline{X} = 3.5$), religion($\overline{X} = 3.2$) and land tenure system $\overline{X} = 3.1$) were among major factors influencing farmers - herder conflict. The study concluded that farmers- herder conflict have influence on the livelihood of crop farmers. The study therefore recommended among others that extension agency in the state should liaise with stakeholders to engage both farmers and herder on how to curtail the future occurrence of the crises in the study area.

Keywords: Farmer-Herder, Crop, Nigeria

INTRODUCTION

Agricultural production provides the means of livelihood and economic sustenance for the majority of Sub-Saharan African regions (Kugbegaand Aboagye, 2021). Farmers and herders make significant contributions in meeting the nutritional needs of the country and thus contributing to food security of households (Yakubu *et al.*,2021). The nomadic herdsmen are mainly the Fulani people who have their settlement located in the northern part of Nigeria. The Fulani people known to be territorial in nature also speak the Fulfulde language. A significant number of them are nomads, herding cattle, goats and sheep across the vast dry grass lands of their environment, keeping isolate from the local communities, making them the world's largest pastoral nomadic group (Soomiyo and Fadairo, 2020) Farmer-Herder conflicts have been a common feature of economic livelihood in West Africa (Ijirshar, Ker and Terlumun, 2015).

In the period before the beginning of the 20th century, the problem was mainly restricted to the savanna belts of West Africa. Cattle rearing were mainly prevalent in the Guinea, Sudan and Sahel savanna belts where crop production was carried out only during the short rainy season on a small scale. This gave the cattle herders access to a vast area of grass land. As time went on, and with the introduction of irrigated farming in the Savanna belt of Nigeria, and the increased withering of pasture during the dry season, less pasture was available to cattle herders (Akerjiir, 2018). The herdsmen had to move southward to the coastal zone where the rainy season is longer and the soil retains moisture for long, in search of pasture and water–a movement called transhumance (Ijirshar*et al.* 2015). This gave rise to an increased pressure on natural resources and a stiff competition for available resources between farmers and herders (Adebayo, 2017). Today those cattle pathways do not exist particularly those around urban area are been taken over by people for different purpose. Cattle are now using the same road with people. There are many other predominant causes. Blockage of waterholes by farmers and fishermen, crop damage by pastoralist livestock and reprisal attacks on pastoralist by sedentary farmers when ethnic or religious disputes occur somewhere else (Audu, 2014). Also, allocation of grazing lands as government layouts without compensating the pastoralist, breakdown of law and order and taking side by local rulers or Judges responsible for dispute resolution (Rasak, 2011). It is therefore become imperative to assess factors influencing farmer-Herder conflict in Ardo-kola and Lau local government areas of Taraba State.

Specifically the study describes

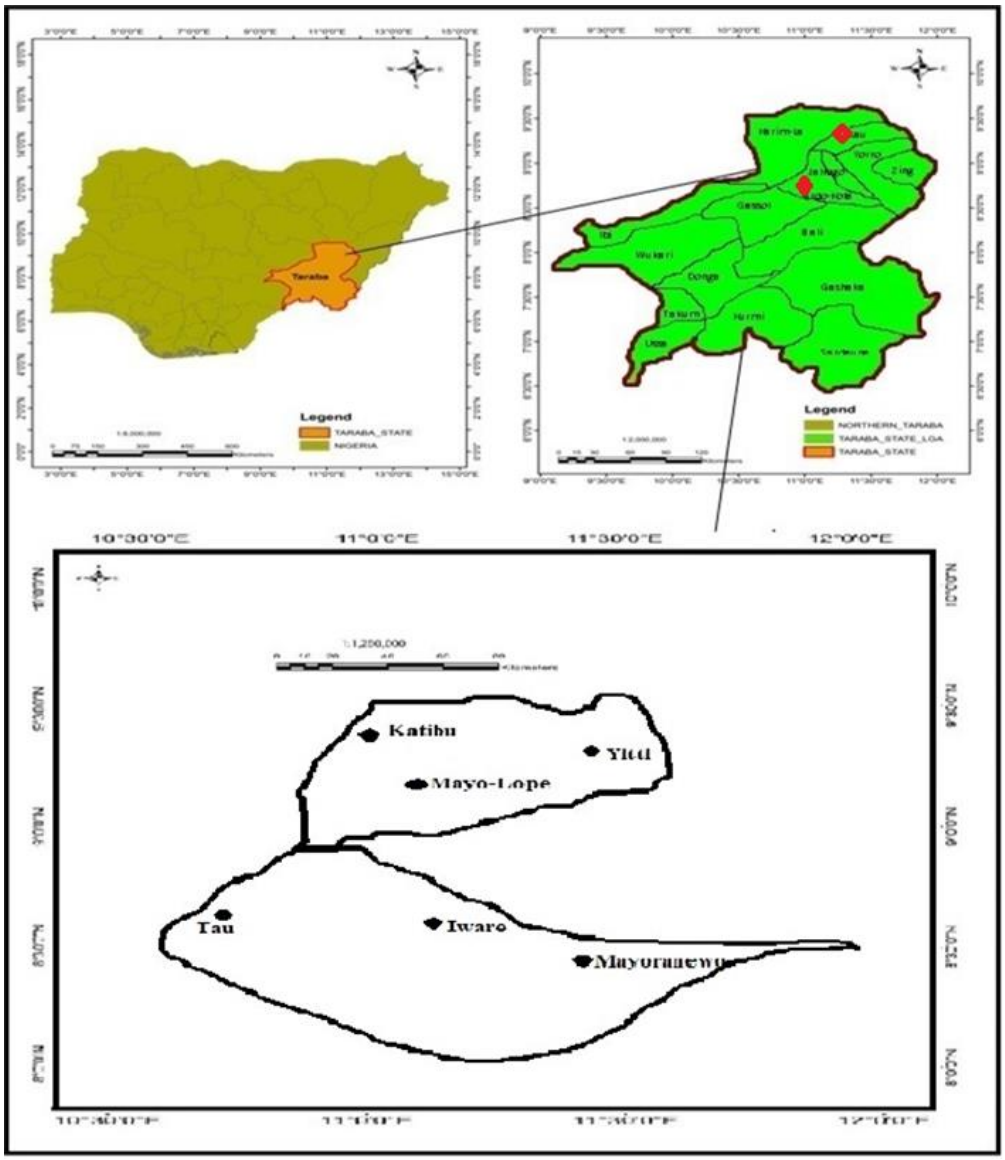
i. socio-economic characteristics of the arable crop farmers; and
ii. identified factors influencing farmers-herders conflict.

Methodology

The study was conducted in Ardo-Kola and Lau Local Government Area of Taraba State, Nigeria

Ardo Kola is also one of the Local governments out of the sixteen (16) local government areas of Taraba State and has an estimated population of about 86,921 (NPC 2006) and 125,964 is estimated to be the population as at 2021. It has a total land area of about 2,262km^2 and located between latitudes 8º34' and 9 º 10' and longitudes 10 º 58' and 11 º 30' East of the Greenwich meridian. The Local government headquarters is 24kms away from Jalingo the State capital. It's bordered to the east by Jalingo, Gassol to the West and Karim-Lamido to the North and Bali local government area to the South.The climate of the local government area is marked by dry season between (November-March) and rainy season between (April-October).It has an average annual rainfall ofbetween 800mm to 1,525 mm and temperature variation between 150 to 380. The agrarian nature and rich alluvial track of soil found in most part of the local government makes the local government area conducive for growing of various food crops like rice, maize, Cassava, sorghum, yam among others with majority of inhabitants of the local government area are engage in farming as an occupation. The basic amenities available are schools, hospitals, electricity and communication services among others. Some of the economic activities in the local government area are; fishing, pottery, cloth weaving among others. It also has various ethnic groups which include; Jukun-Kona, Mumuye, Fulani among others.

Lau Local Government Area is one of the 16 Local Government Areas in Taraba State which is located between latitude 8o 56'N to 9o 40'N of the equator and longitude 11o 15'E to 11o 40'E of the Green witch meridian. Lau LGA has a land mass of 1660km2 with the population of 95,190 (NPC, 2006). It has a projected population of about 143,833 by 2017. LGA is bounded to the northeast by Demsa LGA of Adamawa state, to the north and west by Karim Lamido LGA, and to the south by Ardo Kola, Jalingo and Yorro LGAs. Lau is a lowland area located on the flood plains of the River Benue. It is drained by river Mayodunga and several others which empty into river Benue. Most of the tributary rivers are silted. Sand deposits have almost leveled the river valleys in most places. Lau LGA has a tropical continental climate and Sudan savanna type vegetation which consists of grasses and scattered tall trees. The dominant vegetation consists of acacia plants and a type of palm called giginya in Hausa language. The palm is seen dotting the landscape on the flood plain of River Benue. The soil consists of alluvial soil rich in alluvial deposits and mostly of clay loamy soil and sandy loamy in some places (Oruonye 2015).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Method of Data Collection

The data for this study were obtained mainly from primary sources. This was obtained by the use of structured questionnaire which were administered to arable crop farmers in the study area.

Sample Size and Sampling Techniques

Multi-stage sampling procedures were used for the study.

Stage I: It involve the purposive selection of two local government areas, Ardo- Kola and Lau Local Government Areas in Taraba state recently exposed to incidences of farmer-herder conflicts.

Stage II: It involved a purposive selection of 3 villages, from each of the 2 selected LGAs who have experience farmer-herder clashes recently to give a total of 6 village/towns.

Stage III: Finally A total of one hundred and fifty arable crop farmers were randomly selected from the six selected villages for the study.

Table1: Sample size selection plan

Local governments	Towns/Villages Selected	No. of
Ardo-Kola	Tau	25
	Iware	28
	Mayo ranewo	22
Lau	Mayo-Lope	35
	Katibu	18
	Yitti	22
2	6	150

Source: Field Survey, 2021

Method of Data Analysis

Data for this study were analysed using descriptive statistics in the form of frequency, percentage distribution, mean , ranking scale and standard deviations.

RESULTS and DISCUSSION

Socio-Economic Characteristics of Arable Crop Farmers

The result of the study in Table 2 reveals 45.8% of the arable crop farmers were between the age less than 21 – 40 years with a mean age of 41 years, this implies that farmers-herders clashes have seen a wide range of agile arable crop farmers who are in their productive years suffer in their livelihood pursuit. This is similar to the findings of Ukamaka**,** Danjuma, Mbolle and Innocent (2017) who reported that majority of the respondents were between the age bracket of 21 to 60 years. Majority (62.6%) of the arable crop farmers were male. This implies that more male participates in arable crop farming as a means of livelihood, and were more vulnerable to

react to the influences of farmers-herders conflicts. This is similar to the results of Chigozie (2019) and Hussein (2020) who found out that male formed majority of arable crop farmers. More than haif (55.7%) of the arable crop farmers had acquired no formal education. This implies that there is still a low level of educational attainment among arable crop farmers and thus could not be flexible to ideas, perceptions and understanding of farmers-herders conflict. This is similar to the findings of Dimelu*et al.* (2017), who reported that low level of education could negatively affect the farmers' perception of conflict situation and subsequently their behavior and attitude to conflict and as such might be one of the reasons why farmer-herders' conflict has remained unabated and a regular phenomenon in the study area. Results in Table 2 further indicates that 43% of the arable crop farmers had farming as primary occupation. This implies that some arable crop farmers go into civil service while those already in the service go into farming to avoid the traps of hunger and poverty that accompany the ever-increasing cost of living. In the same way, the proportion of arable crop farmers involved in artisan/business can be attributed to the availability of more business opportunities in the area. This is similar to the finding of Dimelu*et al.* (2017) who reported farmers involved in other livelihood activities for income generation and households food supply. Majority (63.3%) of the arable crop farmers belong to a cooperative society. Membership of cooperative is a veritable tool for enhancing production through economy of scale, and more importantly, an instrument for conflict resolution and sustainable peace. This is similar to the findings of Dimelu et al. (2017) who also found out that a significant proportion of the arable crop farmers belonged to organizations.

Moreover, result in table2 shows that 42.9% had a household size of eight to eleven with a mean household size of seven and standard deviation of five respectively. This implies that arable crop farmers had a large household size that could see them respond to the influence of farmers-herders clashes by diversifying or shifting patterns of cultivation to earn a better livelihood. Majority (78.9%) indicates had no access to extension services amidst the clashes. Access to extension services will serve as a veritable tool that could aid the arable crop farmer react to farmers-herders conflict from ideas and innovations generated from research institutions. Ideas and interventions from extension agents could see arable crop farmers and herders live in peace, thus could also be a means to settle peace among farmers and herders. Majority (77.5%) had an annual income between ₦101,000 – 600,00 with an annual mean income of ₦270, 406. This implies that at an average farmers make a r revenue of ₦270, 406 from arable crop production. Thus, attacks on the farmlands could attract serious dispute with opponents, being the major

means of livelihood. Hence, farmer-herders' conflict are often a consequence of struggle for survival in the study area.

Table 2: Socio-economic characteristics of arable crop farmers

Socio-economic characteristics	Frequency	Percentage	$\bar{x}$	STD
Age				
<20	13	8.8	41	19
21 – 40	55	37.4		
41 – 60	52	35.4		
61 and above	27	18.4		
Gender				
Male	92	62.6		
Female	55	37.4		
Marital status				
Single	21	14.3		
Married	72	49.0		
Divorced/Divorcee	19	12.9		
Widow/Widower	35	23.8		
Educational attainment				
Non formal education	82	55.7		
Primary education	37	25.3		
Secondary education	18	12.2		
Tertiary education	10	6.8		
Primary occupation				
Farming	63	43		
Artisan/Business	47	31.9		
Membership of cooperative				
Yes	93	63.3		
No	54	36.7		
Household size				
1 – 3	21	14.2	7	5
4 – 7	40	27.2		
8 – 11	63	42.9		
>12	23	15.6		
Access to extension services				
Access	31	20.1		
No access	116	78.9		
Annual income				
<100,000	19	13	270,406,1	249,376,3
101, 000 – 300, 000	54	36.7		
301,000 – 600,000	60	40.8		
>601, 000	14	9.5		
Total	**147**	**100**		

Source: Field Survey, 2022

Factors Influencing Farmer-Herders Clashes

Table.3 shows the distribution of factors influencing farmer-herder conflict. The result shows that land and water bodies was ranked first with a mean score ($\overline{X} = 3.6$) and standard deviation of 1.3, as the main factor that influence farmer-herder conflict, subsequently followed by unemployment ($\overline{X} = 3.5$) and standard deviation of 1.0, politics ($\overline{X} = 2.9$) and standard deviation of 0.9, religion ($\overline{X} = 3.2$) and standard deviation of 0.8, land tenure system ($\overline{X} = 3.1$ and standard deviation of 0.8, poverty ($\overline{X} = 3.3$) and standard deviation of 0.8, culture ($\overline{X} = 3.1$) and standard deviation of 0.6, were ranked as 3rd, 4th, 5th and 6th factors influencing farmer-herder conflict. This shows that a wide range of factors influence farmer-herder conflicts, to include land and water bodies on which the farmers cultivates crops while herders graze with their cattle, competing for this scarce resources will no doubt cause upset among these actors. Similarly, Tanko (2021) reported that Scarcity of land, water and foliage which stems from unfavorable weather and climatic condition reduces the availability of these resources and usually changes the pattern of grazing by herders and their social relations with farmers.

Table 3: Distribution of arable crop farmers based on factors influencing farmer-herder clashes

Factors influencing farmer-herders clashes	SA	A	D	SD	$\bar{X}$	STD
Religion	63(1.7)	65(1.3)	14(0.2)	5(0)	3.2	0.8
Culture and traditions	42(1.4)	47(1.0)	41(0.6)	17(0.1)	3.1	0.6
Land tenure system	57(1.6)	68(1.4)	8(0.1)	0(0)	3.1	0.8
Politics	74(2.0)	21(0.4)	30(0.4)	22(0.1)	2.9	0.9
Land and water bodies	98(2.7)	41(0.8)	8(0.1)	0(0)	3.6	1.3
Leadership	54(1.5)	62(1.3)	18(0.2)	13(0.1)	3.1	0.7
Inheritance	12(0.3)	29(0.6)	62(0.8)	44(0.3)	2	0.2
Unemployment	69(1.9)	78(1.6)	0(0)	0(0)	3.5	1.0
Poverty	68(1.9)	45(1.1)	20(0.2)	14(0.1)	3.3	0.8

Source: Field Survey, 2022

CONCLUSION and RECOMMENDATION

In conclusion, the findings of this study have shown that, conflict between farmers and herders in Lau and Ardo-Kola communities largely revolves around livelihood issues. Herdsmen and farmers conflicts have influence on the livelihood of arable crop farmers. Many have died, many displaced and properties in form of crops, animals, houses among others destroyed. Farmer-herder conflicts have drastically reduced the availability of food supply as well as the income of arable crop farmers. Therefore, it is recommended that

i. Extension agency in the state should liaise with stakeholders to engage both farmers and herder on how to curtail the future occurrence of the crises in the study area.

ii. Farmers should acquire adult education as it would bring about enlightenment, tolerance and productive farming.

iii. Policies regarding farming on cattle routes should be well-designed and adequately adhered to by farmers, to avoid clashes. Policies on herders encroaching farmlands should also be redesigned in order to avoid reprisal attacks and the conflict entirely.

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VARIATION IN STOMATAL DENSITY AND DISTRIBUTION ON LEAVES OF DIFFERENT RADISH CULTIVARS

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ABSTRACT

The objective of the study was to investigate the changes in stomata characteristics of different radish cultivars with different root sizes. In the study, stomata density, width, length, size, index, and lower-to-upper epidermis ratio were measured in six radish cultivars (Alçin, Cherry Belle, Kırmızı İnci, Beyaz İnci, Siyah İnci, and Toros Beyazı). An impression technique using clear nail varnish was performed to investigate the stomata characteristics. The study revealed that radishes had amphistomatic leaves with stomata distributed over both surfaces. There were significant differences in the stomata characteristics of the radish cultivars studied. The stomata densities of the radish cultivars varied from 136 to 326 number mm^{-2} on the lower epidermis, and 62 to 149 number mm^{-2} on the upper epidermis. The length of the stomata was 18-26 µm and 21.5-25.6 µm on the lower and upper epidermis, respectively. The ratio of the number of stomata on the lower/upper epidermis was higher in Kırmızı İnci and Beyaz İnci, and the other cultivars also had a higher number of stomata on the lower epidermis. The negative and significant correlation between stomata density and stomata length (r=-0.657**) and size (r=-0.575**) on lower epidermis. The results suggest that the ratio of the number of stomata on the lower to the upper epidermis should be advised to determine the genetic differences in radish. It was concluded that the characteristics of stomata depend on genotypic factors and that cultivars with small roots have fewer stomata and larger stomata than the other cultivars.

Keywords: *Raphanus sativus* L., stomata frequency, stomata size, cultivar

INTRODUCTION

Radish (*Raphanus sativus* L.) is a member of the family Brassicaceae and is an important root vegetable that adapts to temperate zones in the world. It is a popular vegetable worldwide and is generally consumed in salads and aperitifs in Türkiye. It contains secondary metabolites such as anthocyanins and glucosinolates (Jing et al. 2012) along with carotene, ascorbic acid, tocopherol, and quercetin (Chen et al. 2014). There are a lot of registered radish cultivars with different root shapes, colors, and sizes, and their vegetation periods are generally between 35 and 50 days (Gunay 2005).

Stomata are the microscopic pores located on one or both sides of the lamina in plants. They regulate carbon dioxide uptake and water loss (Kacar et al. 2006) and are responsible for about 95% of total water transpiration (Hedrich & Shabala 2018). The density of stomata per unit area and the size of stomata can directly influence photosynthesis and transpiration (Fu et al. 2010). Stomata characteristics can determine plant tolerance levels to abiotic stresses such as drought, salinity, and heat. Hughes et al. (2017) reported that reduced stomata density resulted in improved drought tolerance in barley, while stomata density increased in peanut under water stress (Çınar et al. 2016). Kuşvuran et al. (2010) found a strong negative relationship between stomata density and drought tolerance in melon. Moreover, stomata density was correlated with salt tolerance in strawberry (Orsini et al. 2012), barley (Kiani-Pouya et al. 2020), and rocket (Kaya 2021a). On the other hand, stomata number depends on genotypic factors and has been used for the segregation of hazelnut cultivars (Avcı & Aygün 2014) and apple rootstocks (Mert et al. 2009). It is used for determining ploidy levels in pepper (Shrestha & Khang 2016), and larger stomata, more chloroplasts per guard cell, and lower stomata density were selected as putative tetraploids in radish (Limera et al. 2016; Pei et al. 2019). Stomata density has also been identified as a useful trait to distinguish radish mutants (Whang et al. 2015). This study was conducted to determine the stomata characteristics of radish cultivars with different root sizes and to show variation among radish genotypes.

MATERIALS and METHODS

The six radish cultivars (Alçin, Cherry Belle, Kırmızı İnci, Beyaz İnci, Toros Beyazı, and Siyah İnci) with different root sizes were used in the study. The seeds of the radish cultivars were sown in plastic pots filled with a mixture of peat, perlite, and vermiculite (3:1:1), and they were transferred in a growth chamber at temperatures of 22°C and 16°C day/night and relative humidity between 60 and 70%. Twenty-one days after sowing, the stomata on the third leaf from the top of each plant were observed. For this purpose, an impression of the leaf surface

was made with a layer of transparent nail polish. The middle section of the upper (adaxial) and lower (abaxial) epidermal surfaces of the leaf was used. The impressions were peeled off and monitored with a light microscope Zeiss Axio Scope A.1 at Department of Field Crops, Eskişehir Osmangazi University. Stomata properties were observed at three different locations of each leaf impression at 400× magnification. Stomata density was calculated by counting the number of stomata per leaf area (number mm^{-2}) on both leaf surfaces (adaxial and abaxial). Stomata length and width were measured on the images captured by the digitalization program AxioVision 4.3.

Stoma size (μm^2) = [(Stomata width / 2) × (Stoma length / 2)] × π

The stomata index was equal to the stomata length divided by the stomata width. The experiment was analyzed using the statistical program JMP 13.0 in a completely randomized experimental design with three replicates, and the mean values were compared with the LSD test at the $p<0.05$ level.

RESULTS and DISCUSSION

Radish cultivars had different stomata densities on both the lower and upper epidermis (Table 1). The average number of stomata on the lower epidermis was higher than on the upper epidermis of all radish cultivars (Figure 1). The highest stomata density on the lower epidermis was obtained in Siyah İnci with 326 number mm^{-2}, while the lowest stomata density was counted in Alçin with 136 number mm^{-2}, and in Cherry Belle with 139 number mm^{-2}. A similar trend was observed on the upper epidermis, where Toros Beyazı had the highest number of stomata with 149 number mm^{-2}, followed by Siyah İnci with 135 number mm^{-2} and Beyaz İnci with 110 number mm^{-2}. Since the radish cultivars had different stomata densities on both sides of the leaf surfaces, they have amphistomatic leaves. On the other hand, it can be easily deduced that the stomata density is low in the small-sized radish cultivar Cherry Belle, followed by Alçin. Similar results were reported by Kaya et al. (2021b) in pepper, who found significant differences in stomata density among pepper cultivars with different fruit sizes. This was also confirmed by Chen et al. (2014) and Wang et al. (2015), who showed that the number of stomata changed according to radish genotypes.

Table 1. Stomata length, width, and size of the lower and upper epidermis of the investigated radish cultivars.

Cultivars	Stomata length (µm)		Stomata width (µm)		Stomata size (µm^2)	
	Lower	Upper	Lower	Upper	Lower	Upper
Alçin	22.5^b	21.1^c	15.5^b	14.2	273^c	237^b*
Cherry Belle	26.1^a	25.6^a	15.1^b	14.4	310^b	290^a
Kırmızı İnci	25.6^a	23.8^b	17.5^a	15.1	352^a	282^a
Beyaz İnci	21.6^b	21.2^c	15.1^b	13.8	257^c	230^b
Siyah İnci	18.3^c	23.9^b	15.5^c	14.4	195^d	271^a
Toros Beyazı	22.0^b	21.5^c	15.2^b	14.0	264^c	237^b
Mean	**27.2**	**27.4**	**18.8**	**17.1**	**330**	**309**

*: Letters connected with means in each column show significance levels at %5

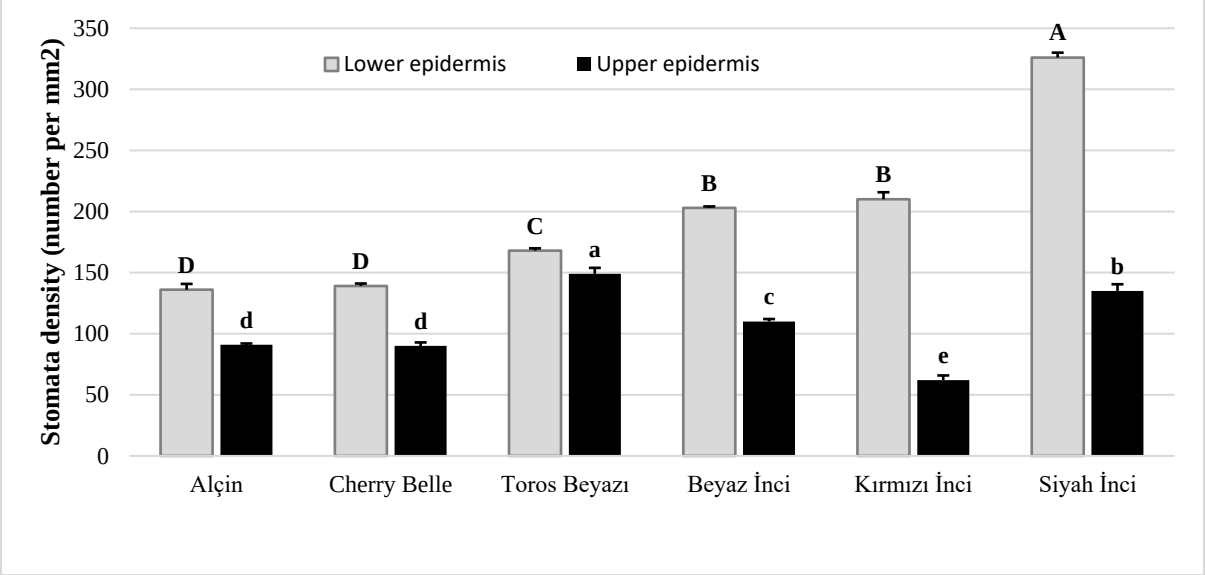

Figure 1. The stomata density (number mm^{-2}) of the lower and upper epidermis of radish cultivars. Bars and letters on each column show standard error and significance level at 5%, respectively

There were significant differences ($p<0.05$) in stomata length, width, and size among radish cultivars, and the mean values are shown in Table 1. In addition, the images of the stomata of the radish cultivars were shown in Figure 2 and Figure 3. As can be seen in the Figures, the guard cells are kidney-shaped. The length of stomata on the lower and upper epidermis of the radish cultivars was similar, but in Siyah İnci, the length of stomata on the lower epidermis was shorter than on the upper epidermis. The longest stomata on both sides of the leaf were measured in Cherry Belle. The widest stomata on the lower epidermis were measured in Kırmızı İnci, while radish cultivars had similar stomata width on the upper epidermis with no difference between them. Chen et al. (2014) reported significant differences in stomata length among radish cultivars, and Pei et al. (2019) detected higher stomata length and width in a tetraploid

cultivar than in a diploid one. Regarding the size of stomata, the largest stomata was found in Kırmızı İnci with 352 μm^2, while Siyah İnci had the smallest stomata size on the lower epidermis.

Table 2. Stomata index, and lower/upper number ratio of the lower and upper epidermis of the investigated radish cultivars.

Cultivars	Stomata index		Lower/upper stomata number ratio
	Lower	Upper	
Alçin	1.45	1.48^{c}	1.52^{cd}*
Cherry Belle	1.72	1.78^{a}	1.51^{cd}
Kırmızı İnci	1.47	1.58^{bc}	3.43^{a}
Beyaz İnci	1.43	1.54^{c}	1.84^{c}
Siyah İnci	1.35	1.66^{b}	2.44^{b}
Toros Beyazı	1.45	1.54^{c}	1.13^{d}
Mean	**1.77**	**1.92**	**2.37**

*: Letters connected with means in each column show significance levels at %5

The index of stomata did not significantly change with the lower epidermis of the radish cultivars while Cherry Belle had the highest index of 1.72 (Table 2). On the other hand, a significant difference in the stomata index was observed on the upper epidermis of the radish cultivars, and the highest index was obtained in Cherry Belle with 1.78. The ratio between the number of stomata on the lower and upper epidermis changed significantly with radish cultivars. The highest ratio was obtained in Kırmızı İnci with 3.43, followed by Siyah İnci with 2.44 (Figure 2). The other cultivars had similar values ranging from 1.13 to 1.84. This ratio suggests that the number of stomata on the lower and upper epidermis is controlled by genetic factors and could be a reliable trait for identifying radish cultivars. The relationship between the characteristics of stomata was shown in Table 3. The number of stomata on the lower epidermis (StN Lo) was negatively and significantly correlated with stomata length (r=-0.657**) and stomata index (r=-0.575**) on the lower epidermis. The highest correlation coefficients were calculated between stomata length and stomata size (r=-0.948**) on the lower epidermis.

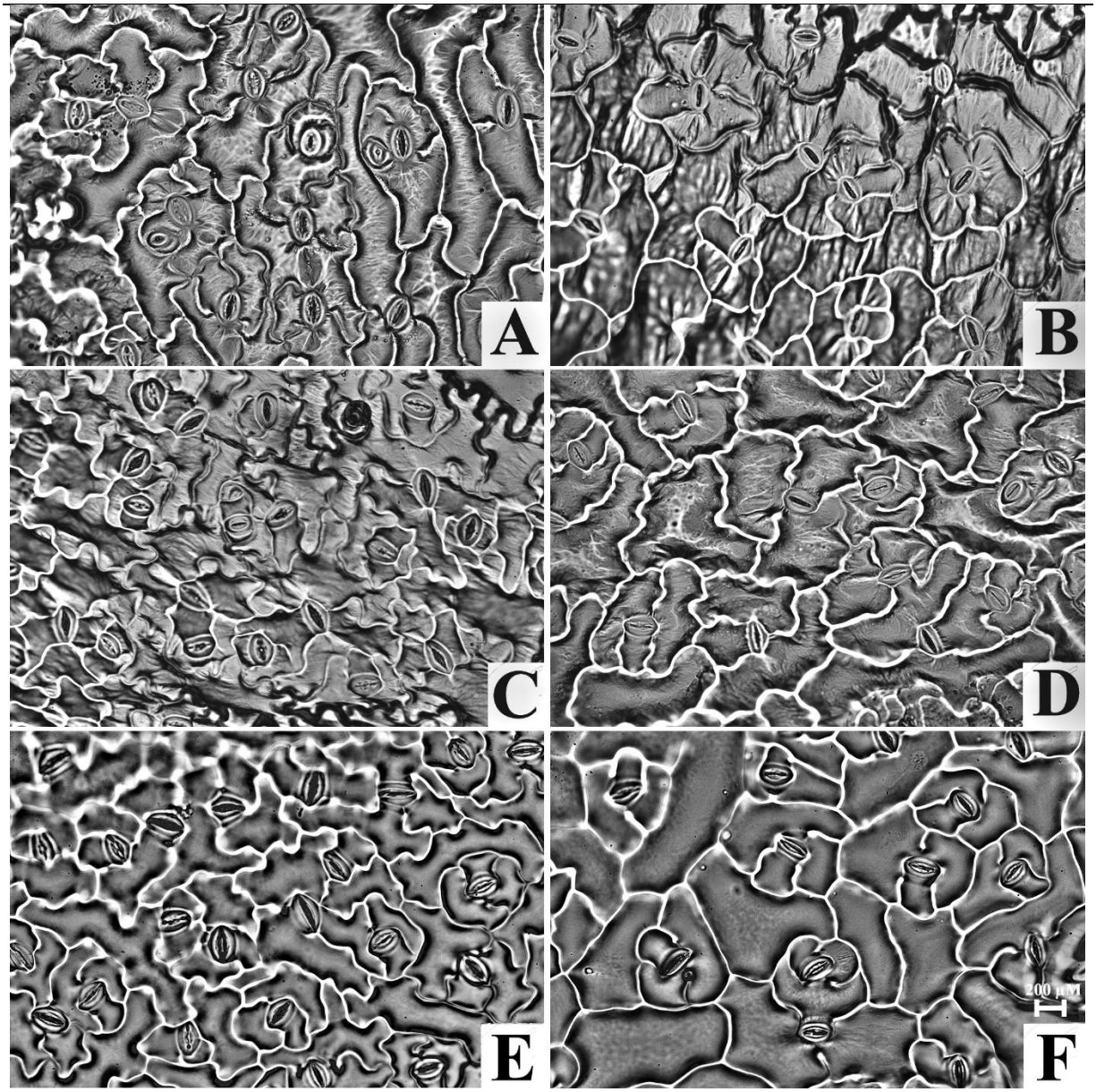

Figure 2. Leaf stomata morphology of lower (A, C, and E) and upper (B, D, and F) epidermis of Alçin, Beyaz İnci, and Cherry Belle.

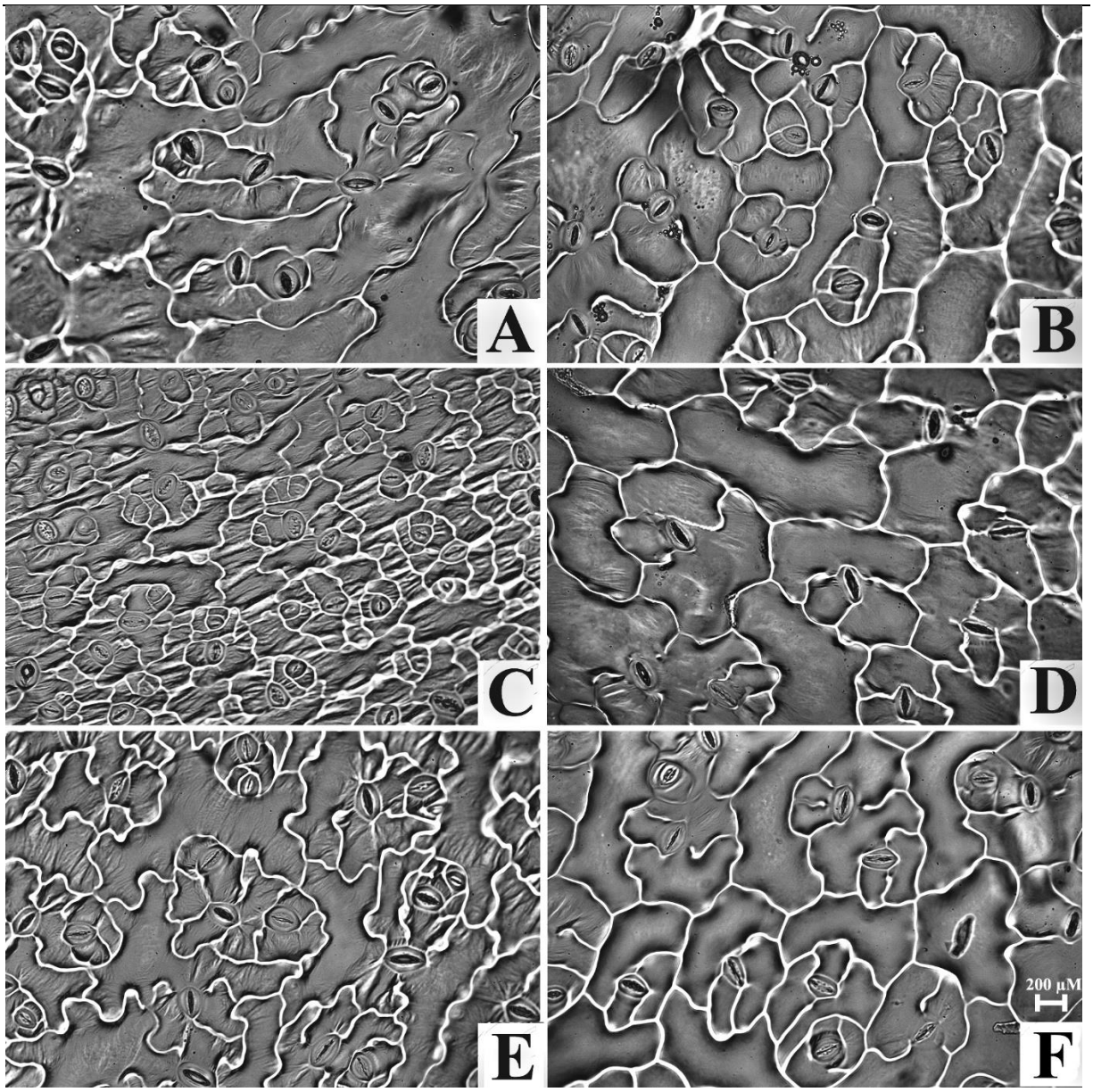

Figure 3. Leaf stomata morphology of lower (A, C, and E) and upper (B, D, and F) epidermis of Kırmızı İnci, Siyah İnci, and Toros Beyazı, respectively.

Table 3. The correlation coefficients between the stomata properties of radish cultivars.

	StN Lo	StN Up	StW Lo	StW Up	StL Lo	StL Up	StS Lo	StS Up	StL Lo	StL Up
StN Upper	0.316	-								
StW Lower	-0.423*	-	-							
		0.670**								
StW Upper	0.154	-0.453*	0.247	-						
StL Lower	-	-	0.713**	0.211	-					
	0.657**	0.692**								
StL Upper	0.158	-0.311	-0.009	0.479*	0.383	-				
StS Lower	-	-	0.897**	0.267	0.948**	0.265	-			
	0.568**	0.746**								
StS Upper	0.177	-0.418	0.101	0.765**	0.369	0.931**	0.308	-		
StI Lower	-	-0.379	0.123	0.062	0.782**	0.529**	0.544	0.410*	-	
	0.575**									
StI Upper	0.080	-0.070	-0.169	-0.095	0.305	0.828**	0.133	0.567**	0.569**	-
StN Lo/StN Up	0.530**	- 0.561**	0.406*	0.568**	0.117	0.338	0.291	0.482*	-0.215	0.020

*:p<0.05, **: p<0.01. StN= stomata number, StW= stomata width, StL= stomata length, StS= stomata size, StI= stomata index, Lo= lower, Up= upper

CONCLUSION

Identification of the characteristics and distribution of stomata on leaves can help in classifying radish species, cultivars, and types. In addition to the number of stomata per unit area, stomata length, width, and size can be used to characterize genotype and adaptation to environmental conditions. This study found that significant differences in stomata characteristics were observed among the radish cultivars studied with different root sizes. These differences may be useful for the genotypic identification of radishes. The ratio of stomata number of the lower-to-upper epidermis also proved to be a valuable criterion for distinguishing genotypic variations. In this study, small-rooted radish cultivars were found to have lower stomatal density, but this observation needs to be confirmed by further studies with the high number of genotypes to make a final decision. The results suggest that stomata characteristics are useful in determining genotypic variation and explaining differences in plant growth and yield performance of radish cultivars under different environmental conditions.

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DENİZ HIYARININ BESİNSEL ÖZELLİKLERİ VE SAĞLIK ÜZERİNE POTANSİYEL ETKİLERİ

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ÖZET

Deniz hıyarı, besin değeri yüksek, geleneksel olarak yüzyıllar boyunca tıbbi amaçlar için kullanılmış ve tropikal ve subtropikal kıyı bölgelerinde yaygın olarak bulunan bir bentik organizmadır. Deniz hıyarı "trepang" (Malezya), "beche de-mer" (Fransız), "namako" (Japonya), "plingkao" (Tayland), "haishen" (Çin) ve "teripang" (Endonezya) olarak bilinmektedir. Uluslararası pazarda ise kum balığı (sandfish) olarak adlandırılmaktadır. Sadece Çin'de çeşitli kıyı bölgelerinde 140'tan fazla deniz hıyarı türünün tespit edildiği ve bunların yaklaşık 20'sinin ekonomik değeri olan yenilebilir türlerden olduğu belirlenmiştir. Yeryüzünde ise yaklaşık 1400 deniz hıyarı türünün bulunduğu ortaya konulmuştur. Bunların arasında yer alan 30 - 40 türün ekonomik değeri yüksektir. Bu türlerden başı çekenler *Apostichopus japonicus* (Japon deniz hıyarı), *Actinopyga mauritiana*, *Holothuria scabra*, *Parastichopus californicus*, *Cucumaria frondosa*, ve *Thelenota ananas* olarak sıralanabilir. Sri Lanka, Endonezya ve Kore başta olmak üzere Asya ülkelerinde ve son zamanlarda Amerika ve Afrika ülkelerinde deniz hıyarı üretimi yoğun olarak gerçekleştirilmektedir. Ülkemiz denizlerinde ise Holothuria familyasına ait 22 deniz hıyarı türünün varlığı belirlenmiştir. Bunlar arasında ekonomik değeri olan türler *Holothuria mammata*, *Holothuria tubulosa* ve *Holothuria polii*'dir. Deniz hıyarı yetiştiriciliği ülkemizde gerçekleştirilmemekle birlikte avcılığı ise toplama yöntemiyle 1 Haziran – 31 Ekim tarihleri dışında yapılabilmektedir. Yasal üretim alanları İzmir-Çeşme Karaabdullah Burnu ile Balıkesir-Ayvalık Eğribucak Burnu arasında ve Mersin Anamur Burnu ile Seyhan Nehri'nin denize döküldüğü yer arasıdır. Toplanan deniz hıyarları su ürünleri işleme fabrikalarında kaynatılıp kurutulmakta ya da dondurulmaktadır. Elde edilen ürünler ise genellikle Güney Kore, Çin, Japonya ve bazı Avrupa ülkelerine ihraç edilmektedir. Deniz hıyarı, düşük yağ miktarı ile yüksek protein ve mineral madde içeriğinin yanı sıra polisakkaritler, saponinler, karotenoidler ve fenolik bileşikler gibi biyoaktif maddeleri içeren, etkileyici bir besin profiline sahip ve farmasötik değeri olan popüler bir deniz ürünüdür. Yapısındaki bu bileşenler sayesinde deniz hıyarı, anti-pıhtılaşma, hipolipidemik, hipoglisemik, antioksidan, anti-kanser ve bağırsak sağlığını iyileştirme gibi çeşitli biyolojik aktivitelere sahiptir. Bu çalışmada yeni fonksiyonel ürünlerin geliştirilmesine öncülük edebilecek ürünlerden biri olan deniz hıyarı hakkında bilgi vermek ve deniz hıyarının besleyici özellikleri ve sağlık etkilerinden bahsetmek hedeflenmiştir.

Anahtar Kelimeler: Deniz hıyarı, Hipolipidemik aktivite, Holothuroidea, Kum balığı

NUTRITIONAL PROPERTIES OF SEA CUCUMBER AND ITS POTENTIAL EFFECTS ON HUMAN HEALTH

ABSTRACT

The sea cucumber is a benthic organism with high nutritional value that has traditionally been used for medicinal purposes for centuries and is common in tropical and subtropical coastal regions. The sea cucumber is known as “trepang” (Malaysia), “beche de-mer” (French), “namako” (Japan), “plingkao” (Thailand), “haishen” (China) and “teripang” (Indonesia). In the international market, it is called “sandfish”. It has been determined that more than 140 species of sea cucumbers have been detected in various coastal regions in only China, and about 20 of them are edible species with economic value. It has been revealed that there are about 1400 sea cucumber species on Earth. Among them, 30-40 species have high economic value. Chiefs among these species are *Apostichopus japonicus* (Japanese sea cucumber), *Actinopyga mauritiana*, *Holothuria scabra*, *Parastichopus californicus*, *Cucumaria frondosa*, and *Thelenota pineapple*. The production of sea cucumber is carried out intensively in Asian countries, especially in Sri Lanka, Indonesia, and Korea, and recently in America and African countries. In the seas of our country, the presence of 22 sea cucumber species belonging to the Holothuria family has been determined. Among them, species with economic value are *Holothuria mammata*, *Holothuria tubulosa,* and *Holothuria polii*. Although sea cucumber farming is not carried out in our country, it can be harvested by collecting method except between 1 June and 31 October. Legal production areas of sea cucumber are between İzmir-Çeşme Karaabdullah Cape and Balıkesir-Ayvalık Eğribucak Cape and between Mersin Anamur Cape and the place where the Seyhan River empties into the sea. The collected sea cucumbers are boiled and dried or frozen in aquaculture processing plants. The products obtained are generally exported to South Korea, China, Japan, and some European countries. Sea cucumber is a popular seafood product with an impressive nutritional profile and pharmaceutical value, containing bioactive substances such as polysaccharides, saponins, carotenoids, and phenolic compounds, as well as low-fat content and high protein and mineral contents. Thanks to these components in its structure, sea cucumber has various biological activities such as anti-clotting, hypolipidemic, hypoglycemic, antioxidant, anti-cancer and improving intestinal health etc. In this study, it is aimed to give information about sea cucumber, which is one of the products that can lead to the development of new functional products, and to explain the nutritional properties and health effects of sea cucumber.

Keywords: Sea cucumber, Hypolipidemic activity, Holothuroidea, Sandfish

GİRİŞ

Son yıllarda, doğal kaynaklardan elde edilen fonksiyonel bileşenler ile bazı kronik hastalıkları ilişkilendiren artan sayıda bilimsel makale, ilaçların yanısıra fonksiyonel gıdaların ve nutrasötiklerin temel beslenme gereksinimlerini karşılamanın ötesinde insan sağlığını desteklemek ve hatta iyileştirmek için olağanüstü olasılıklara sahip olduğunu göstermektedir. Tüketicilerin sağlıklı beslenme ve hastalıkları önleme arasındaki ilişkiye olan ilgisi dünya çapında günden güne artmaktadır. Fonksiyonel gıdaların, nutrasötiklerin ve biyomedikal ürünlerin birçok kaynağı vardır. Bunlar karada ve denizde bulunabilirler. Meyveler, sebzeler, tahıllar, probiyotikler ve mantarlar gibi karasal kaynaklar, denizde yer alan kaynaklardan daha fazla keşfedilmişlerdir. Piyasadaki bu tarz ürünlerin büyük çoğunluğu karasal kökenli olsa da deniz organizmaları, karasal kaynaklarda bulunmayan benzersiz özelliklere sahiptir ve bunlardan elde edilen ürünler oldukça dikkat çekmektedir. Deniz organizmalarından biri olan deniz hıyarı, gıda ve biyomedikal endüstrilerinde kullanılabilecek biyolojik aktivitelere sahip yeni fonksiyonel materyallerin doğal bir kaynağıdır (Pangestuti and Arifin, 2018). Holothuroidea veya deniz hıyarları, solucan benzeri yapıdadır ve genellikle yumuşak gövdeli derisi dikenliler grubunun bir üyesidir (Haider et al., 2015). Deniz hıyarı, ağız, anüs ve tüp ayaklardan oluşmaktadır. Tam bir sindirim sistemi, merkezi sinir sistemi ve basit üreme sistemleri bulunmaktadır. Üremeleri ise sperm ve yumurtaların su ortamına salınarak döllenmesi sonucunda yani dış döllenme yoluyla meydana gelmektedir (Künili, 2017). Hemen hemen her deniz ortamında bulunmaktadırlar (Haider et al., 2015). Deniz hıyarları, 0 ile 100 m arasında değişen derinliklerde, kayalıkların altlarında, yumuşak sedimentlerde ve deniz çayırı yataklarında yaşarlar. Deniz çayırı (*Posidonia oceanica*) kenarları ve boşlukları da bu türler için oldukça uygun alanlardır. Deniz hıyarları, besin olarak ise organik maddeleri (protozoa, diatom, detritus vb.) tüketirler (Aydın et al., 2011). Çeşitli formlarda yaklaşık 1400 deniz hıyarı türü bulunmaktadır. Bunlardan bazıları yaklaşık 20 cm uzunluğundadır. Ancak bazı küçük türlerin yetişkinlerinin boyları 1 cm'yi bile geçmeyebilirken, büyük türlerden birinin (*Synapta maculata*) uzunluğu ise 5 m'ye ulaşabilmektedir. Şu anda dünya çapında 66 farklı deniz hıyarı türü, ticari olarak kullanılmaktadır (Haider et al., 2015). Deniz hıyarı avcılığı, Güney Pasifik'teki ticari balıkçılığın en eski faaliyetlerinden biridir. Deniz hıyarı en az 1000 yıl öncesinden beri ticari olarak hasat edilmektedir (Özer et al., 2004). Asya ve Pasifik bölgelerinde toplam avlanan deniz hıyarı miktarı yaklaşık 20.000–40.000 ton/yıl civarındadır (Wen et al., 2010). Holothurians (deniz hıyarları) birçok tropikal ve subtropikal ülkede geleneksel olarak çiğ, kurutulmuş ve haşlanmış olarak tüketilmektedir. Deniz hıyarının gıda olarak tüketiminin

olduğu başlıca ülkeler Çin, Hong Kong, Güney Kore, Singapur ve Japonya'dır (Özer et al., 2004). Deniz hıyarının işleme adımları genellikle temizleme, ayıklama, kaynatma, soğutma, güneşte kurutma, paketleme ve depolamadır. Pazarlaması ise donmuş, pişmiş-kurutulmuş, pişmiş-tuzlanmış ve pişmiş-tuzlanmış-kurutulmuş ürünler olarak yapılmaktadır (Aydın et al., 2011). Ayrıca deniz hıyarı sabun, tonik, krem, ekstrakt veya gıda takviyesi olarak da piyasalarda yer almaktadır (Künili, 2017). Kurutulmuş deniz hıyarı Fransızca'da "beche-de-mer", Çince'de "hai-som" ve Endonezce'de ise "trepang" olarak adlandırılmaktadır. Deniz hıyarı boyutu, görünümü, kokusu, rengi, nem ve yabancı madde içeriğine göre ticari olarak derecelendirilmektedir. Alıcılar, şekli tek düze ve boyutu ekstra büyük olan ürünleri tercih etmektedirler (Özer et al., 2004). Akdeniz'de yaklaşık 37 deniz hıyarı türünün varolduğu belirlenmiştir. Türkiye'de Ege, Akdeniz ve Marmara denizlerinde ticari deniz hıyarı türleri bulunmaktadır. Fakat deniz hıyarı ülkemizde gıda maddesi olarak tüketilmediğinden dolayı tamamı ihraç edilmektedir. Türkiye'de bulunan ticari deniz hıyarı türleri arasındaki en çok ihraç edilen türler *Holothuria tubulosa, Holothuria polii* ve *Holothuria mammata* olarak sıralanabilir. Bu türler Akdeniz'de yaz ve sonbahar aylarında (Temmuz-Eylül arası), özellikle kıyı bölgelerde üremektedirler (Aydın et al., 2011).

Deniz Hıyarının Besinsel İçeriği ve Sağlık Etkileri

Deniz hıyarları, hipertansiyon, astım, romatizma, iktidarsızlık, kabızlık, kesikler ve yanıklara karşı etkinlikleri nedeniyle Çin ve Malezya literatüründe tonik ve geleneksel bir ürün olarak tanınmaktadır. Anti-anjiyojenik, antikanser, antikoagülan, anti-hipertansiyon, anti-enflamatuar, antimikrobiyal, antioksidan, antitrombotik ve yara iyileşmesi gibi birçok benzersiz biyolojik ve farmakolojik aktiviteye sahip olmasının nedeninin deniz hıyarı türlerinin yapısındaki kimyasal bileşikler olduğu belirtilmektedir. Deniz hıyarlarının bu tıbbi yararları ve sağlık işlevleri, özellikle triterpen glikozitler (saponinler), kondroitin sülfatlar, glikozaminoglikan, sülfatlanmış polisakkaritler, steroller (glikozidler ve sülfatlar), fenolik bileşikler, peptidler, serberositler ve lektinler gibi önemli miktarlarda biyoaktif bileşiklerin varlığına bağlanmaktadır (Bordbar et al., 2011). Deniz hıyarı birçok balık türü gibi protein açısından zengin olduğundan dolayı besin değeri yüksek, ideal bir gıda materyalidir. Yapılan çalışmalarca amino asitler ve eser elementler açısından zengin olduğunu doğrulanmıştır. Ayrıca deniz hıyarı polisakkaritler ve kollajen gibi çeşitli biyoaktif maddeleri de içermektedir (Gao et al., 2016). Deniz hıyarları ortalama % 70 – 90 nem, % 7-15 protein, % 2 – 3 yağ ve %7-9 ise kül içermektedir. Deniz hıyarı proteini, günlük ihtiyaç duyulan aminoasitlerin hemen hemen hepsini yapısında bulundurmaktadır (Künili, 2017). 100 g deniz hıyarı 6-12 g aralığında aminoasit içeriğine sahip olup yapısında en yüksek

oranda glisin, glutamik asit ve aspartik asit bulunmaktadır (Siculo et al., 2012; Zaenuri et al., 2016) (Çizelge 1). Deniz hıyarı düşük yağ içeriğinde hem doymuş hem de doymamış yağ asitlerini bir arada bulundurmaktadır. Deniz hıyarı yağ asitlerinin % 14 – 17'si doymuş yağ asitleri ve % 66 - 76 ise doymamış yağ asitleridir. Doymuş yağ asitleri arasında palmitik asit (% 3 - 8), stearik asit (% 3 - 9), miristik asit (% 1 - 3) ve behenik asit (% 1 - 3) baskın olarak yer alırken; doymamış yağ asitlerinden ise linolenik asit (%8-10), araşidonik asit (% 12 - 20) eikopentaenoik asit (% 6 - 15) ve dokosaheksaenoik asit (%5 -12) oransal olarak en yüksek miktarda bulunun yağ asitleridir. Deniz hıyarlarının mineral madde içerikleri ise oldukça yüksektir. Yapılarında bulunan major mineral maddeler sodyum (25 - 153 g/kg), klor (36 - 251 g/kg), kalsiyum (15 – 68 g/kg), magnezyum (4 - 8,6 g/kg) ve potasyum (1,1 - 5,2 g/kg) iken, minör mineral maddeler ise demir (41 - 660 mg/kg), çinko (11 - 100 mg/kg), bakır (3 - 74 g/kg), manganez (1 - 16 mg/kg), selenyum (1 - 4 mg/kg), krom (1-10 mg/kg) ve nikel (0,3 – 5 mg/kg) olarak sıralanabilir. Ayrıca toksik elementlerden olan arsenik, kurşun ve kadmiyumun da deniz hıyarlarında bulunabileceği, hatta arsenik miktarının oldukça yüksek seviyelere ulaşabildiği yapılan çalışmaların sonucunda gözlemlenmiştir (Künili, 2017).

Çizelge 1. Bazı deniz hıyarı türlerinin amino asit kompozisyonları (%) (Siculo et al., 2012; Zaenuri et al., 2016)

Amino asitler	*Holothuria tubulosa*	*Holothuria polii*	*Paracaudina australis*
Esansiyel amino asitler			
Lösin	1.55	1.37	0.42
Histidin	0.82	0.88	0.11
Lisin	1.11	0.77	0.43
Arginin	4.14	3.58	0.54
Valin	1.23	1.37	0.28
İzolösin	0.88	0.72	0.26
Treonin	2.74	1.87	0.39
Fenilalanin	0.48	0.72	0.21
Metionin	0.62	0.62	-
Toplam	11.90	13.60	2.63
Esansiyel olmayan amino asitler			
Tirozin	0.63	1.03	0.20
Aspartik asit	5.60	4.49	0.60
Alanin	4.69	3.71	0.50
Prolin	4.53	4.90	0.44
Glisin	10.36	7.42	0.85
Glutamik asit	8.03	6.18	1.06
Serin	1.81	1.46	0.32
Sistein	0.22	0.46	-
Toplam	29.88	36.68	3.68

Orijini farklı olan ve farklı mevsimlerde avlanan deniz hıyarlarının besinsel bileşimlerindeki farklılıkların (özellikle lipid, protein ve nem içeriği), işleme özelliklerini ve besin değerlerini etkileyebildiği göz önünde bulundurulmalıdır. Özellikle mevsimler arasındaki bileşim

değişimi, (yağ asitleri ve amino asitler bakımından) orijin değişiminden çok daha belirgindir (Feng et al., 2021).

SONUÇ

Deniz hıyarı, deniz otu çayırları, mercan resifleri, mangrovlar ve çamur düzlükleri gibi çeşitli deniz ekosistemerinde bulunabilen bir deniz bentik organizmasıdır. Deniz hıyarlarının çoğu yüksek besin değerine sahiptir. Çeşitli deniz hıyarları uzun zamandır geleneksel gıda olarak, ilaç sanayinde ve fonksiyonel gıda üretiminde ingredient olarak kullanımı mevcuttur. Deniz hıyarı türlerinin hemen hemen hepsinin zengin yağ asidi profiline (özellikle PUFA bakımından), esansiyel olan ve esansiyel olmayan amino asit profiline ve mineral madde içeriğine sahip olduğu belirlenmiştir. Deniz hıyarları ile ilgili yapılan araştırmalar, bu organizmanın anti-kanser, anti-inflamatuar, antikoagülan, anti-hipertansiyon gibi farmakolojik aktiviteler gösterdiğini ortaya koymuştur. Fakat ekonomik gelişmeler ile birlikte, son on yılda deniz hıyarı pazar talebi kademeli olarak artmış ve bu da yabani deniz hıyarı kaynaklarının ciddi şekilde azalmasına neden olmuştur. Bu nedenle, deniz hıyarlarının yapay olarak yetiştirilmesi gündemdedir. Böylece üretimi artırılabilecek ve doğal stokların yeniden inşası sağlanacaktır. Yeni gıda tasarımlarında ingredient olarak kullanımı artırılabilecek ve yeni fonksiyonel gıdaların geliştirilmesiyle hem pazara katkı sağlanacak hem de daha çok tüketiciye ulaşması sağlanabilecektir.

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ESTIMATION OF GENOTOXIC EFFECT OF HERBICID RANDAP 480 EC AT GOLDFISH (*Carassius auratus*) THROUGH MICRONUCLEUS TEST AND NUCLEOPLASMIC BRIDGES AFTER 10 DAY TREATMENT

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ABSTRACT
Several herbicides have already been found to be toxic to aquatic organisms. The herbicide randap 480 ec, is one of the most widely herbicides used in weed control. This study aims to evaluate the genotoxic potential of the randap herbicide on the **Goldfish (*Carassius auratus*)** using the micronucleus test and nucleoplasmic bridge. Our findings also confirmed that the micronucleus test and nuclear bridge on fish erythrocytes in vivo are useful tools in determining the potential genotoxicity of commercial herbicides. Obtained results show significant increase of number of micronuclei in erythrocytes of goldfish.

Keywords: Micronucleus assay, genotoxicity, herbicid, Randap

INTRODUCTION

The presence of herbicides in water is a consequence of weed control in terrestrial ecosystems and water reservoirs. Since there is growing concern over the presence of genotoxins in the aquatic environment, it is important to develop methods for detection of genotoxic effects in aquatic organisms. MN are formed in the process of cell division and their expression can occur at different times after the DNA damage event, depending on the cell cycle kinetics and the mechanism of induction. The MN assay, originally developed with mammalian species (Jha, 2000), is today widely applied in fish and other aquatic organisms, including sea urchin, mussels, oysters, crabs and worms, and in wild and transplanted animals. The large majority of studies or programmes on the genotoxic effect of the polluted environment have been carried out with the use of bivalves and fish.

The micronucleus (MN) test, due to its simplicity, is one of the most applicable techniques to identify genomic alterations in environmental animals. This procedure is technically easier and more rapid than the microscopic analysis of chromosomal aberrations in metaphase, considering also that many aquatic organisms have small chromosomes difficult to be analysed. A large number of pollutants in this complex mixture are responsible for multiple effects at the organisms, including human beings, and ecosystem levels, affecting organ function, reproductive status, species survival, population size and ultimately biodiversity (Dixon , 2002). Among these, carcinogenic and mutagenic compounds are the most problematic as their effect may exert a damage beyond that of individual and may be active through following generations. Epizootic neoplasms have been found in a variety of ectothermic species, such as shellfish, echinoderms, jawless fish and bony fish (Bickham, 2000).

MATERIAL and METHODS

We used the species of fish goldfish (Carassius auratus). The fish were collected in the lake Stublina nearby city Gjilan, south- east part of Kosovo. After the capture, they were placed in aquariums with aerated tap water and taken to the laboratory. After acclimation to reduce the stress of capture and transport, fish were treated in aquarium with fungicide for 96 hours. Slides were stained with Giemsa. The frequency of micronuclei and nuclear abnormalities were estimated by counting 1000 cells in extensions. Fish goldfish (Carassius auratus) was chosen for this study because it is very adapt for investigation, also due to proven sensivity to genotoxic chemicals. In each aquarium put ten (10) fish, total number of fish is 50 fish.

Concentrations of herbicid Randap 480 EC , it was in first aquarium 6 ml herbicid Randap 480 EC / 40 liter water, in second aquarium 4 ml herbicid Randap 480 EC / 40 liter water, in third

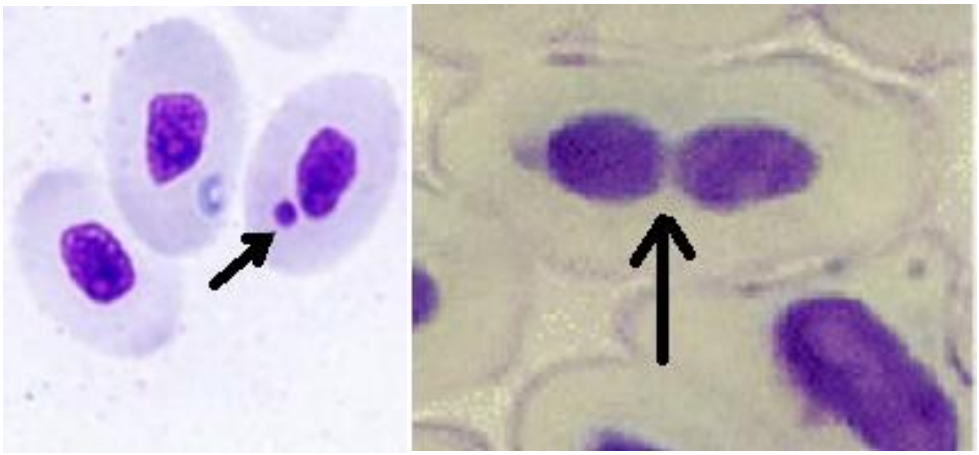
aquarium 2 ml herbicid Randap 480 EC / 40 liter water, in fourth aquarium 1 ml herbicid Randap 480 EC / 40 liter water. Fifth aquarium uses as control, without herbicid Randap 480 EC, contain only drinking water. Experimental design Fish goldfish (Carassius auratus) were placed in five different aquaria, each one containing tap water (negative control) and four different aquaria containing different dilution of herbicid Randap 480 EC. The fish was cut in caudal region and smears of peripheral blood were made on free clean slides. Slide preparation and staining For each fish prepare three slides. Slides were coded, for each fish. The smears are air-dried and fixed in absolute ethanol for 25 minute. After fixation, the slides were stained in aqueous Giemsa (diluted in destiled water ratio 1:5) for 50 minute. For each fish prepare 4 slides, and 500 cells were scored from each slide, while for each fish scored 2000 erythrocytes.

RESULTS and DISCUSSION

The biomonitoring genotoxicity in aquatic organisms is very important for several reason: protection of genetic diversity in natural populations for maintain of population survival, detection of carcinogenic effects in aquatic organisms to assess the health of aquatic organisms, as well as to prevent carcinogens from entering the food chain to humans (Jha et al. 2000). The frequencies of MN in peripheral blood erythrocytes after exposure to the herbicid Randap 480 EC treated for 10 days, are summarized in table 1, Fig. 1. At first aquaria we registered the 71 micronuclei (MN) and 27 Nucleoplasmic bridge (NB), which is higher compared with other aquaria and with control group. At second aquaria we registered 58 MN and 21 Nucleoplasmic bridge, while at the third aquaria has 41 MN and and 10 Nucleoplasmic bridge. At fourth aquaria has 24 MN, and 8 Nucleoplasmic bridge at 2000 erythrocyte. At control group we determine 6 MN / 2000 erythrocytes, and 4 Nucleoplasmic bridges. The present study brings together information based on in vivo systems to evaluate herbicide randap induced genotoxicity in golden fish Carassius auratus. The average numbers of MN at all groups treated with herbicide are 48.5 MN and 16 Nucleoplasmic bridges, statistically are significantly higher compared with control group.

Table 1: Average number (per aquarium) of micronuclei (MN) and nucleoplasmic bridge in 2000 erythrocytes of peripheral blood of fish goldfish (Carassius auratus) after 10 days treatment in different concentration of herbicid Randap 480 EC. And Statistical processing of MN and Nucleoplasmic bridge, between aquariums 1,2,3,4 and aquarium controle

Aquarium/ treated for 10 days	Average number of micronuclei (MN) and Nucleoplasmic bridge in erythrocytes per aquarium		Statistical processing of MN	Statistical processing of Nucleoplasmic bridge
	MN	Nucleoplasmic bridge	Significancy - P	Significancy -P
Aquarium 1(6 ml herbicid /40 l water): Aquarium controll	71	27	S , P = <0.001	S , P = <0.001
Aquarium 2 (4 ml herbicid /40 l water): Aquarium controll	58	19	S , P = <0.001	S , P = <0.001
Aquarium 3(2 ml herbicid /40 l water) : Aquarium controll	41	10	S , P = <0.001	S , P = <0.001
Aquarium 4 (1 ml herbicid /40 l water) : Aquarium controll	24	8	S , P = <0.001	S , P = <0.001
Aquarium control	6	4		
Average number of MN and Nucleoplasmic bridge ,at treated fish , without control group	194 : 4= 48.5	64 : 4= 16		



1 2

Figure 1. Erythrocytes with micronuclei (1), and with nucleoplasmic bridge (2)

At table 2, are presented statistical processing of micronucleus (MN) and nucleoplasmic bridge (NB), between aquarium 1 and other aquariums, with different concentrations of herbicide randap, where the statistical differences between aquarium 1 (with 71 micronucleuses) and aquarium 2 (with 58 micronucleuses, P = 0.030), aquarium 3 (with 41 micronuclei, P = 0.003) and aquarium 4 (with 24 micronuclei, 0.003), are on a significant scale (see Table 2). Also the differences between aquarium 2 (with 58 micronuclei) with aquarium 3 (with 41 micronuclei, 0.012) and aquarium 4 (with 24 micronuclei, P = 0.008), are to a significant degree. There are also significant differences (P = 0.003) between aquarium 3 (with 41 micronuclei) and aquarium 4 (with 24 micronucleus).

Table 2. Statistical processing of MN and Nucleoplasmic bridge (NB), between aquarium 1 and other aquariums, with different concentrations of herbicide randap

	Statistical processing of MN		Statistical processing of Nucleoplasmic bridge	
Aquarium 1(6 ml herbicid /40 l water): Aquarium 2(4 ml herbicid /40 l water)	71 : 58	NS, P = 0.294	27:19	S, P = 0.030
Aquarium 1(6 ml herbicid /40 l water): Aquarium 3(2 ml herbicid /40 l water)	71:41	NS, P = 0.080	27:10	S, P = 0.003
Aquarium 1(6 ml herbicid /40 l water): Aquarium 4(1 ml herbicid /40 l water)	71:24	S, P = 0.041	27:8	S, P = 0.003
Aquarium 2(4 ml herbicid /40 l water) : Aquarium 3(2 ml herbicid /40 l water)	58 : 41	S, P = 0.017	19 :10	S, P = 0.012
Aquarium 2(4 ml herbicid /40 l water) : Aquarium 4(1 ml herbicid /40 l water)	58: 24	S, P = 0.003	19:8	S, P = 0.008
Aquarium 3(2 ml herbicid /40 l water) : Aquarium 4(1 ml herbicid /40 l water)	41:24		10:8	S, P = 0.003

The effects of genotoxicity of herbicide are reported to be several folds more than control group. Our results are in accordance with investigation by some other authors (Dixon, 2002; Bickham,

2000), which showed that the micronucleus with erythrocytes of fishes seems to be efficient to detect the genotoxicity of chemicals. The increasing use of pesticides in contemporary agriculture is considered a major problem worldwide. Although the application of these agrochemicals is concentrated in terrestrial areas, they can reach the aquatic environment by drift, runoff, drainage and leaching (Cerejeira, 2003), raising a number of environmental concerns especially in systems of shallow waters. Among pesticides, organophosphates constitute the predominant class.

CONCLUSIONS

The obtained results clearly demonstrate the genotoxic properties of Randap expressed as DNA damage (measured by the micronuclei and nucleplasmic bridge) in erythrocytes of fish C. auratus exposed to different concentrations of this herbicide. This result is indicative of a risk to fish populations resulting from the occurrence of this agrochemical in natural water bodies. We have ascertained significant differences between the treated aquariums with herbicide and the control aquarium ($P = <0.001$).

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NAVIGATING THE EVOLVING LANDSCAPE: EXPLORING EMERGING TRENDS AND CHALLENGES IN DATA CENTER SECURITY

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ABSTRACT
Data centers are integral to the storage, processing, and transmission of vast quantities of sensitive information, necessitating robust data center security measures. This comprehensive review investigates the emerging trends and challenges within data center security. By analyzing recent developments and potential threats, this study aims to deepen our understanding and guide effective security practices within data center environments. Through an extensive examination of pertinent literature and industry reports, this paper identifies significant trends, explores associated challenges, and provides insights into risk mitigation and the enhancement of data center security. The findings of this review contribute to the existing knowledge base on data center security and offer valuable guidance to practitioners and organizations striving to safeguard their data assets in an ever-evolving digital landscape.

Keywords: Data center security, Advanced Persistent Threats (APTs) Insider threats, Cloud security

INTRODUCTION

In today's digital era, data centers play a critical role in storing, processing, and managing vast amounts of sensitive information across industries (Smith & Anderson, 2023). With organizations increasingly relying on data centers for their essential operations, ensuring the security of these facilities becomes of utmost importance. However, data center security faces numerous emerging trends and challenges that demand continuous attention and adaptation.

This comprehensive review aims to explore the emerging trends and challenges in data center security, offering valuable insights for organizations and security practitioners (Johnson & Thompson, 2023). By examining recent research, industry reports, and expert opinions, this study provides an in-depth overview of the current state of data center security and highlights areas that require further focus (Brown & Lee, 2023).

The review delves into various aspects of data center security, including physical security measures, network security protocols, access controls, threat detection and prevention systems, and incident response strategies (Williams et al., 2023). It takes into account the evolving landscape of data center security, considering advancements such as cloud computing, virtualization, and the Internet of Things (IoT), which introduce new complexities and potential vulnerabilities.

To ensure reliable and accurate findings, a systematic literature review methodology will be employed (Davis et al., 2023). This methodology involves identifying and analyzing relevant academic research articles, industry reports, and case studies that shed light on emerging trends and challenges in data center security. Through synthesis and evaluation of the selected literature, key themes, trends, and challenges will be identified and presented.

Moreover, the review will discuss the implications of emerging technologies and regulatory frameworks on data center security practices (Wilson & Roberts, 2023). It will explore the potential impact of concepts like artificial intelligence, machine learning, and blockchain on enhancing data center security measures and addressing emerging threats.

By consolidating and analyzing current research, the findings of this comprehensive review will contribute to the existing body of knowledge on data center security (Johnson et al., 2023). Organizations and security professionals can leverage these insights to gain a better understanding of the evolving data center security landscape and identify areas for improvement. Ultimately, this review will serve as a valuable resource for developing robust security strategies and countermeasures to mitigate risks and protect sensitive data within data center environments.

LITERATURE REVIEW

Emerging Trends in Data Center Security

Data center security is constantly evolving to adapt to emerging trends and technological advancements. One significant trend is the increasing adoption of cloud computing, which has resulted in a shift from traditional on-premises data centers to cloud-based environments (Smith et al., 2018). This transition introduces new security challenges related to data privacy, access control, and vulnerabilities in shared infrastructure (Kandukuri et al., 2009). Furthermore, the proliferation of Internet of Things (IoT) devices has expanded the attack surface, necessitating robust security measures to protect data center assets from potential breaches (Gubbi et al., 2013).

Threat Landscape and Security Risks

Data centers face a multitude of security threats that can compromise sensitive information and disrupt business operations. Cyberattacks, including Distributed Denial of Service (DDoS) attacks, malware infections, and insider threats, pose significant risks to data center security (Sood et al., 2016). Advanced Persistent Threats (APTs) are also a growing concern, with sophisticated attackers targeting data centers with stealthy and prolonged attacks to gain unauthorized access (Gupta et al., 2016). Understanding the evolving threat landscape is crucial for developing effective security strategies.

Security Frameworks and Best Practices

Various security frameworks and best practices have been developed to address the challenges in data center security. The National Institute of Standards and Technology (NIST) provides a comprehensive framework that outlines security controls and risk management processes for

data centers (Scarfone et al., 2013). Additionally, compliance with regulations such as the General Data Protection Regulation (GDPR) and the Payment Card Industry Data Security Standard (PCI DSS) helps organizations establish robust security measures and protect sensitive data (Sicari et al., 2018). Implementing these frameworks and adopting best practices can significantly enhance data center security posture.

Technologies for Data Center Security

Data center security relies on a combination of physical and logical controls. Physical security measures, such as access controls, surveillance systems, and environmental monitoring, safeguard the data center infrastructure from unauthorized access and physical threats (Alcaraz Calero et al., 2014). On the other hand, logical security measures include network segmentation, encryption, intrusion detection and prevention systems (IDPS), and security information and event management (SIEM) solutions to detect and mitigate cyber threats (Krutz & Vines, 2010). Advancements in artificial intelligence and machine learning have also enabled the development of intelligent security systems capable of real-time anomaly detection and response (Kumar et al., 2020).

Challenges and Future Directions

Despite advancements in data center security, several challenges persist. Balancing security measures with operational efficiency is a challenge, as stringent controls can impact performance and flexibility (Sobers et al., 2018). Additionally, the rapid pace of technological evolution introduces complexities, requiring continuous monitoring and updating of security solutions to address emerging threats (Grobauer et al., 2014). Future research directions include exploring the potential of blockchain technology for enhancing data center security, improving incident response capabilities, and addressing the human factor through user awareness and training (Dhillon & Backhouse, 2001).

Data center security is a critical concern in today's digital landscape. This literature review highlights the emerging trends, potential threats, security frameworks, technologies, and challenges associated with data center security. By synthesizing the current body of knowledge, this review provides valuable insights and guidance for practitioners and organizations striving to protect their data assets. Understanding the evolving landscape of data center security and

implementing effective security measures is crucial for ensuring the confidentiality, integrity, and availability of sensitive data.

Methodology

Literature Search: A systematic search will be conducted to identify relevant academic research articles, industry reports, and case studies focusing on data center security. Databases such as IEEE Xplore, ACM Digital Library, and Scopus will be utilized to gather a comprehensive collection of scholarly resources. Specific keywords, including "data center security," "emerging trends," "challenges," and "best practices," will be used to refine the search and ensure the inclusion of relevant publications. Selection Criteria: The gathered literature will undergo a screening process based on predefined inclusion and exclusion criteria. Only peer-reviewed articles, conference papers, and reputable industry reports published within the last five years will be considered. The selected sources will primarily address emerging trends, challenges, and best practices in data center security.

Data Extraction and Analysis: Relevant data and information from the selected sources will be systematically extracted and organized. Key themes, trends, and challenges in data center security will be identified and analyzed. The extracted data will include details such as authors' names, publication dates, research methodologies employed, and main findings related to emerging trends and challenges in data center security. Synthesis and Interpretation: The extracted data will be synthesized and interpreted to provide a comprehensive overview of emerging trends and challenges in data center security. Connections, patterns, and relationships among different sources will be explored to identify common themes and variations in the literature. The findings will be presented in a coherent and structured manner, highlighting key insights and implications for data center security practices.

Limitations: It is important to acknowledge the limitations of this methodology. The review will focus solely on published literature, potentially excluding unpublished research or proprietary industry information. Additionally, the inclusion of recent publications may introduce a bias towards current trends, potentially overlooking relevant older studies. However, efforts will be made to ensure a comprehensive and balanced analysis by considering both contemporary and foundational works in the field of data center security. Ethical Considerations: This review is based on the analysis of existing literature and does not involve

human subjects or confidential data. Therefore, ethical approval is not required for this study. The outlined methodology will guide the systematic collection, analysis, and interpretation of literature to explore emerging trends and challenges in data center security. By employing a rigorous and structured approach, this study aims to provide valuable insights and recommendations for practitioners and organizations seeking to enhance their data center security practices.

The findings of this comprehensive review highlight the emerging trends and challenges in data center security. The analysis underscores the need for organizations to stay vigilant and adapt their security practices to address evolving threats. By implementing proactive measures, such as leveraging advanced threat detection technologies, adopting best practices, and staying updated on emerging trends, organizations can enhance their data center security posture. Some key findings and recommendations from the analysis include: Advanced Persistent Threats (APTs) pose a significant risk to data center security. Organizations should prioritize robust security measures, including intrusion detection and prevention systems, threat intelligence sharing, and employee training, to mitigate the impact of APTs. Cloud security is crucial in the context of data center environments. Organizations should focus on implementing encryption, access controls, and secure data transmission protocols to protect data stored and processed in cloud-based services. The proliferation of IoT devices introduces new security challenges. Organizations should prioritize securing IoT devices, implementing strong authentication mechanisms, and regularly updating firmware to prevent unauthorized access and potential vulnerabilities.

Insider threats are a significant challenge in data center security. Organizations should implement strict access controls, monitor user activities, and provide comprehensive training to employees to mitigate the risks associated with malicious insiders. Data privacy and compliance regulations, such as GDPR and CCPA, require organizations to implement appropriate security measures. Data centers should ensure compliance with relevant regulations, implement data protection strategies, and conduct regular audits to protect personal and sensitive data. Supply chain security is crucial for data centers. Organizations should evaluate and ensure the security posture of third-party vendors and service providers, implement vendor risk management practices, and establish clear security requirements in contracts to mitigate supply chain risks.

Network segmentation is a recommended security best practice. By dividing the data center network into distinct segments, organizations can isolate critical assets and limit the impact of a security breach or unauthorized access. Collaboration and threat intelligence sharing within the data center community can enhance early threat detection and mitigation. Organizations should actively participate in information sharing initiatives and stay updated on emerging threats and attack techniques. Continuous monitoring, along with robust incident response plans, is essential for effective data center security. Organizations should implement real-time monitoring tools, SIEM systems, and conduct regular security audits to detect and respond to security incidents promptly. By incorporating these findings and recommendations into their security strategies, organizations can strengthen their data center security practices and better protect their sensitive information and critical operations. To conclude, this comprehensive review has explored the emerging trends and challenges in data center security. Through an in-depth analysis of relevant literature and industry reports, we have identified key trends and discussed the associated challenges that organizations face in securing their data centers.

The analysis highlights the importance of adapting security measures to address evolving threats, such as advanced persistent threats (APTs), insider threats, and vulnerabilities introduced by cloud computing and the Internet of Things (IoT). Organizations need to implement robust security practices to protect their sensitive information and maintain the integrity of their operations. A multi-layered approach to data center security is crucial, encompassing strong access controls, regular vulnerability assessments, advanced threat detection and prevention systems, and effective incident response protocols. Employee training and awareness programs are also essential to mitigate the risks of insider threats and social engineering attacks. Looking ahead, organizations must stay informed about emerging technologies and industry best practices. Artificial intelligence (AI), machine learning, and blockchain technology can enhance data center security by improving efficiency, integrity, and trust in data management. It is important to recognize that data center security is an ongoing process. As technology advances and new threats emerge, organizations must continually adapt their security strategies. Regular security audits, risk assessments, and staying up-to-date with industry developments are critical to maintaining a strong security posture.

The findings of this review contribute to the existing knowledge on data center security by providing valuable insights into emerging trends and challenges. The identified mitigation strategies and best practices offer guidance to practitioners and organizations seeking to enhance their data center security and protect their valuable data assets. In conclusion, safeguarding data centers and ensuring robust security is paramount for organizations to protect sensitive information and maintain trust in their operations. By proactively addressing the emerging trends and challenges discussed in this review, organizations can establish a solid security foundation and effectively mitigate risks in today's complex digital landscape.

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MANAGEMENT PRACTICES OF CATTLE DISEASES AND PARASITES AMONG PASTORALISTS IN NORTH-EAST, NIGERIA

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ABSTRACT
Adequate management practices of cattle diseases and parasites are of paramount importance for the development of the livestock sub-sector of the Nigerian economy. There are limited access to knowledge on the traditionalmanagement practices of cattle diseases and parasites by the Pastoralists in North-Eastern Nigeria. Therefore, this study assessed management practices of cattle diseases and parasites among Pastoralists in North East, Nigeria. The study described the socio-economic characteristic of the respondents and analysed cattle diseases and parasites management practice. Multi stage sampling techniques was adopted in selecting 420 respondents for the study. The respondents comprise of 126, 105, 84 and 105 from Adamawa, Bauchi, Gombe and Taraba States respectively. Percentage, frequency, means, rating scale and logit regression were used in analyzingthe data. Result shows thatthe mean age of the pastoralists was 35 years, majority (99.5% and 88.6%) were male and acquired Koranic education. Married pastoralists constituted 52.8% with an average household size of nine persons. Vaccination ($\bar{x}$ =2.9), use of herbs ($\bar{x}$ =2.77) and deworming ($\bar{x}$ =2.72) were thepastoralists commonly used management practices in curtailing cattle diseases and parasites. Coefficient of age (0.0224), friends (0.0042), sex (0.0865),were significant in management practice of cattle diseases and parasites.With this therefore, this study recommends that need for extending the knowledge and adoption of modern management practices of cattle diseases and parasites to the rural pastoralists so as to increase productivity and higher efficiency in the cattle industry.

Keywords: Management Practices, CattleDiseases and Parasites, Pastoralists, North-East, Nigeria

INTRODUCTION

The important of the basic management practices of cattle diseases and parasites in the development and growth of the livestock subsector of the Nigerian economy is paramount There are limited access to knowledge on the traditional management practices of cattle diseases and parasites among the Pastoralists in North-Eastern Nigeria. Improper management of cattle diseases and parasites results in poor reduction growth performance, lower market value and loss of animal due to death. Diseases such as Tuberculosis, Anthrax, Brucellosis, foot and mouth disease which are zoonotic in nature have the tendency of affecting the pastoralists and their family if not properly manage.

Several studied abound on the common management practices employed by pastoralists. Cresswell*et al.* (2014), reported that vaccination is among the common management practice for prevention of BVD, with nearly 80% of surveyed cattle farmers in the British communities saying they administer BVD vaccines to some of their cattle. According to Epu(2010), on his study provide a unified approach to consumer resource modeling and reported that, the use of improved breeding stock and local concoctions were among the practices used to control pests and diseases among herdsmen in Rijau Local Government Area of Niger State. Worms in animals are treated using some herbs with specific measurement known by the farmers.

It has been reported that pastoralist locally treat cases of diarrhea in goats using a mixture of boiled cowpea leaves and salt. Similarly, potato leaves were also reported to be used in treating cases of diarrhea in goats. However, fresh mashed cannabis leaves and salt dissolve in water are used in treating coughing, poor appetite and diarrhea in goats. To increase milk production, Olaniyi, and Adewale (2013) reported the use boiled guava leaves and salt. On livestock welfare farmers regularly make fire in the kraals to get rid of pests and make the animalscomfortable. They also use “fallow” system (leaving the area without making use of it for at least 3 years) the kraals to reduce pest infestation especially by ticks and lice (Andrew, 2017).

Adelakun*et al.* (2015), report the socioeconomic effects of farmer-herders conflict on agricultural extension service delivery in a State in Southwest Nigeria; Anonguku*et al*. (2008) also report on the socio economic analysis of livestock pilferage in rural and urban areas of Benue State Nigeria, Usman*et al.* (2017) carryout a study on the native methods of controlling parasites among herders’ communities in Adamawa State, Nigeria. However, despite the several efforts by researchers, it could be argued that, there was not much empirical study conducted on management practices of cattle diseases and parasitesin North-East, Nigeria.

Hence, this research assessed pastoralists' management practices of cattle diseases and parasites in North East, Nigeria. Specifically, the study seeks to:

i. describe the socio-economic characteristics of the pastoralists in the study area; and
ii. identify cattle diseases and parasites management practices adopted by the pastoralists in the study area.

The hypothesis for the study was stated below:

H_{01}: There was no significant relationship between pastoralists' socio-economic characteristics and their management practices of cattle diseases and parasites

METHODOLOGY

The study was carried out in North East Nigeria. The region comprises of Adamawa, Bauchi, Borno, Gombe, Taraba and Yobe States. It lies between latitude $6^0 26^1$ and $13^0 45^1$N and Longitude $8^0 42^1$ and $14^0 39^1$E (Usman, 2010). North East Nigeria was created from the Northern region on the 27th of May 1967 and covers close to one third (280,419km^2) of Nigeria's land area (909,890km^2) with a population of 18,984,299 people that is 13.5% of the country's population (NPC, 2006). The National Population Commission projected an annual growth rate of 13.6% which brought the population figure to 32,137,094 as at 2020. The region shares international border with the Republic of Cameroon to the East, Republic of Chad to the North East and Republic of Niger to the North (Yurco, 2011). This area is largely located in the Sudan and Northern Guinea Savannah zones which are characterized by relatively high temperature throughout the year with an annual average temperature varying from 23.2^{o}C to 32.5^{0}C while rainfall ranges between 467 mm to 1091 mm (Usman, 2010).

A multi stage sampling procedure was adopted in selection of the pastoralists. Primary data was used in the study which was sourced by administering questionnaires to the pastoralists.

Stage 1: Involved a purposive selection of Four (4) states of Adamawa, Bauchi, Gombe and Taraba. This is for the fact that the researcher could not go into Borno and Yobe states on account of security threats in the states.

Stage 2: It involved purposive selection of six, five, four and five local government areas from Adamawa, Bauchi, Gombe and Taraba states respectively. In all 20 local government areas with supportive vegetation for cattle rearing were selected for the study.

Stage 3: It involved the purposive selection of one community each that pastoralists mostly reside from the 20 local government areas selected for the study that is 20 communities were selected.

Stage 4: Snow ball technique was employed to select pastoralists for the study as the exact population of the pastoralists in the communities was unknown.

State 5**:** Finally, selection of 21 pastoralists were selected per community using a snow ball technique, in all 420 pastoralists were involved in the study. However only 417 questionnaires were finally analysed as three questionnaires could not be accounted for.

Table 1: Sample size selection plan

Names of States selected	Local Government Areas	Names of communities selected	Number of pastoralists interviewed
Adamawa	Toungo	Toungo	21
	Yola-South	Ngorore	21
	Jada	Kojoli	21
	Ganye	Ganye	21
	Mayo-Belwa	Mayo-Belwa	21
	Mubi	Mubi	21
Bauchi	Alkaleri	Alkaleri	21
	Soro	Soro	21
	Darazo	Darazau	21
	Katagum	Azare	21
	Gamawa	Gamawa	21
Gombe	Gombe	Gombe	21
	Balanga	Cham	21
	Funakaye	Bajoga	21
	Akko	Tumu	21
Taraba	Wukari	Bantaje	21
	Gassol	Tella	21
	Ardo-Kola	Iware	21
	Bali	Garbachede	21
	Gashaka	Karamti	21
Total	**20**	**20**	**420**

Source: field survey, 2020

Method of Data Analysis

The data obtained was analyzed using frequency, percentage, mean, and rating scale while logit regression was used to test the hypothesis of the study.

Mean

$$3 + 2 + 1 = \frac{6}{3} = 2$$

$$\bar{x} = \frac{\sum Fx}{n}$$

Where: $\bar{x}$ = mean rating scale
$\sum$ = Summation
F = Frequency of the Pastoralists
x = Number of pastoralists to the item
n= Total number of pastoralists

The logit regression model is explicitly specified as:

$$P = \exp \frac{(b_0 + b_1X_1 + b_2X_2 \ldots\ldots + b_pX_p)}{1 + \exp(b_0 + b_1X_1 + b_2X_2 + \cdots + b_pX_p)}$$

The hypotheses generated for the study were tested as follow:

Hypothesis

There was no significant relationship between pastoralists'socio-economic characteristics andmanagementof cattle diseases and parasites.

P = management practices of cattle diseases and parasites (Dependent variable)
X_1 to X_8 = Independent variables
X_1= Age (in years)
X2 = Sex (male=1, female=0)
X3 = Marital Status (married = 1, single = 0)
X4 = Household size (Numbers of people in the household)
X5 = Educational level (number of years in formal schooling)
X6 = Management experience (number of years in cattle disease management)
X7 = Herd size (number of cattle under one's care)
X_8= Access to extension services
b_1-b_8= Regression coefficients

RESULTS and DISCUSSION

Pastoralists' Socio-Economic Characteristics

Age is an important factor in assessing pastoralist management practices of livestock diseases and parasites in North East, Nigeria. It reveals the physical strength and agility of the pastoralist. Ageing has an adverse effect on agricultural productivity in general. Moreover, Usman*et al.* (2017), Mohammed (2019) and Adelakun*et al.* (2020) are of the opinion that, age is not a factor to deny involving pastoralists' youths who were below the age of 40 years in pastoralism since young adults have to experience part of activities in the pastoralists' societies. Result in table 2 showed that majority (57.8 %) of the pastoralists were between the age of 21 – 40 years. With

a mean age of 35 years, the findings implies that, pastoralist in the study area is been carried out by individuals who are active, vibrant and physically able to move around with their animals.

This may be in contrast to the older pastoralists who would not possibly be able to move around with cattle due to advancement in age. This result agreed with the findings of Ofuoku and Isife (2009), Sale *et al.* (2016), Dimelu*et al.* (2019) and Onah*et al.* (2020) all reported that pastoralists are often young with a lot of energy possessed to carry their animals to scavenge. This gives more advantage to the younger pastoralists knowing that nomadic life requires a lot of movement that demanded a lot of stamina.

Male and female have different roles, responsibilities, access to resources and decision making processes in the society at large. Male and female both have vital roles and contributions toward continuation and adaptation of pastoral systems. Results in table 2 showed that majority (99.5%) of the pastoralists were male. This implies that male dominated pastoralism because of their natural flexibility as it is energy demanding to move from place to place, thus limits the number of women participating.

This is in agreement with the findings of Olaleye*et al*. (2010); Ijirshar*et al.* (2015); Cediel (2012); Tesfaye*et al.* (2013); Mangesho*et al.* (2017) and Usman*et al.* (2017), who reported in their various studies that majority of pastoralists were male. Therefore in packaging extension messages and technologies for the pastoralists, the fact that most of them are male should be borne in mind.

Marriage is considered a respected and revered institutions in both rural and urban societies, marriage is a respected institution. Marriage bestows on individuals social status, recognition and makes persons to be considered responsible (Ndaghu, 2011). Result in table 2 below shows that majority (52.8%) of the pastoalists were married. This findings implies that pastoralism in the study area is seen as a means of livelihood, been carried out mostly by married individuals for households sustainability. Marriage is a crucial aspect of the Fulani culture, for a pastoralists' to get married and raise his family, is perceived to confer respect on individuals and reinforces individuals' ties.

This corroborates the findings of several scholars, Ofuoku and Isife (2009); Cediel (2012); Sunday (2013); Ibrahim *et al.* (2015); Ijirsha*et al.* (2015); Mangesho*et al.* (2017); Hussaini, (2018) and Dimelu*et al.* (2019), who also reported that majority of the pastoralist are married. Therefore in packaging extension message for the pastoralists, it is important to consider the fact that marriage is a most cherished institution among them.

The size of a household underscores the rate at which pastoralism is practice in such household, especially in the Northern Nigeria where pastoralism is high. The result in table 2 below shows that majority (50.1%) of the pastoralists were from household of 7 – 13 persons, 29.4% had between 14 – 20 persons while 6.7% had 21 persons or more. With a mean household size of 12 persons, this findings reveals that majority of the pastoralists were from large households. This implies that large household size could help the pastoralists with more members to convey the cattle for grazing and also aid easy diffusion of knowledge knowing that more individuals from a single household will participate in pastoralism. The result similar with the findings of Ijirshar *et al.* (2015); Ismaila (2017); Mangesho*et al*. (2017) and Hussaini (2018); who all reported an average of household size of nine persons among pastoralist households. Education is a variable that broadens the mental horizon, influences the totality of the mind and predisposes farmers to new ideas (Ndaghu, 2011). High level of education could enhance pastoralists understanding of cattle diseases and parasites management. Result in table 2below shows that majority (86.1%) of the pastoralists acquired no formal education, 6.9% attained primary education, 4.5% attained secondary while 2.3% had attained tertiary education. This findings implies that majority of the pastoralist had acquire no formal education yet could manage cattle, moreover, attaining some level of education could help the pastoralist in acquiring more knowledge through reading and contact with extension services regarding the management practices of cattle diseases and parasites pastoralism. Low level of education could only mean those pastoralists are limited to traditional knowledge and practices of cattle diseases and parasite management.

This is in agreement with Mohammed *et al.* (2015); Scasta (2016); Adua and Hassan (2016); Omonona (2018); Kwagge (2018) and Yugud*aet al.* (2018) who reported low level of education among pastoralist in Nigeria.

Number of cattle owned elaborates the quantity and size of herds under the pastoralists care. In this regards, majority (46.1%) of the pastoralists as revealed in table 2below had a herd size of 101 – 200 cattle, 40% had <100 cattle, 11.3% had 201-300 herd size, while 2.2% of the pastoralist had >300 herd size. The number of cattle owned by the pastoralist could hamper his desire to acquire more knowledge on the various management practices. This implies that pastoralists with small herd's size could be eager to multiply the herds size with reliable knowledge acquired. With a mean herd's size of 152 cattle, according to ICBF (2008), herds were categories into small herds (average of 37 cattle), medium (average of 54 cattle) and large

herds (average of 87 cattle); the result indicates that pastoralism is practiced in a large scale within the North-East, Nigeria.

This is in disagreement with Timothy (2012); Idowu (2017); Pinilla*et al*. (2019) and Chowdhury (2019) who all reported that pastoralists have small herds.

Pastoralists' years of experience in management of cattle disease and parasites elaborates number of years in which the pastoralist had been in cattle management and the experiences gained per duration. Result of the finding in table 2 presents that 31.4% of the pastoralists had been engaged in cattle management for 31 - 40 years. By implication, years of management experience could increase pastoralists' knowledge on management of cattle diseases as a result of its frequent occurrences among the herds.

With a mean age of eight years, the finding is in line with Ducrotoy *et al.* (2016); Yasine*et al.* (2016); Umoh, (2017); Usman*et al.* (2017); Amran*et al.* (2018); Yahaya (2018) and Aliyu (2018) they all reported a mean of less than 10 years in management experience among pastoralists.

Membership of pastoralists' organization reveals whether the respondent was a member of cooperative society, or organizations that promote pastoralism. Result from table 2 below shows that almost all (97.1%) of pastoralists were members of Miyetti Allah Cattle Breeders Association (MACBAS) and only 2.9% belong to no cooperative organizations. This finding implies that pastoralists are active in their organizations, which could be said to have benefited them in one way or the other.

This is in agreement with the findings of La'azar (2016); Lawal (2017); Yahaya (2018) and Lawal-Adebowale*et al.* (2018) who separately reported that majority of pastoralists belongs to the Miyetti Allah cattle breeders association.

Benefits derived from MACBAS elaborately, is seen as the advantage gained by pastoralists from the immediate environment which could be social, financial, educational or psychological. Result of the finding in table 2 shows that 46.3% of the pastoralists admitted that 'security' is the major benefits derived from the association, 19.4% admits to benefits of acquiring loan, while 10.0% derived other benefits such as livelihood sustainability like obtaining cattle feeds, medications and feeders. This implies that MACBAS benefits the pastoralists in terms of security and provision of knowledge on cattle diseases and parasites management.

This finding is in agreement with Okello*et al*. (2014); Rahim (2015); Umoh (2017); Amran*et al.* (2018) and Buno (2018) who reported that Cattle Breeders Association provides security and infor[p0o9i8u7589 mation on knowledge and management of cattle diseases and parasites.

The number of visits by extension agents in the study area has to do with the number of times extension agents had direct contacts with the pastoralists in the local communities to share with them the required information and resources if possible to enable the pastoralists efficiently execute the cattle production enterprise. Results in table 2revealed that 0.9% had weekly contacts with extension agents, 1.3% were been visited on monthly basis, 32.7% had contacts once in a management year while majority (65.1%) of the pastoralists admitted that they had no contact with extension agents.

This finding implies that extension visits could improve the pastoralists' knowledge of cattle diseases and parasites management as they provide information that could enhance cattle production. It is evident that poor access to extension services could be a reason why majority of the pastoralists lacked modern knowledge of cattle diseases and parasites management.

Table 2: Socio-economic characteristics of the pastoralists

Age	Frequency	Percentage	Mean ($\bar{X}$)
≤ 20	48	11.5	35
21 – 30	108	25.9	
31 – 40	133	31.9	
41 – 50	86	20.7	
51 and above	42	10.0	
Sex			
Male	415	99.5	
Female	2	0.5	
Marital Status			
Single	177	42.4	
Married	220	52.8	
Widow/Widower	2	0.5	
Divorce	18	4.3	
Household size			
<6	58	13.8	12
7 – 13	209	50.1	
14 – 20	123	29.4	
21 and above	28	6.7	
Educational Attainment			
No formal education	359	86.1	
Primary education	29	7.0	
Secondary education	10	2.3	
Tertiary education	19	4.6	
Number of cattle			
<100	167	40	152
101 – 200	192	46.1	
201 – 300	47	11.3	
Years of management experience			
<20	80	19.2	8
21 – 30	131	31.4	
31 – 40	113	27.1	
Membership of pastoralist organisation			
Yes	405	97.1	
No	12	2.9	
Benefits from pastoralist organization			
Cattle diseases and parasite information	101	24.0	
Loan	81	19.4	
Security	193	46.3	
Others	42	10.0	
Frequency of visit by extension agents			
Daily	0	0.0	
Weekly	4	0.9	
Monthly	5	1.3	
Once in a management year	136	32.7	
Not at all	271	65.1	
Total	**417**	**100**	

Source: Field Survey, 2021

Cattle Diseases and Parasites Management Practices Adopted by the Pastoralists

Modern Practices

The result in Table 3showed the various management practices in cattle diseases and parasites. The results based on the sub-ranking showed that vaccination with a mean score of 2.0 was ranked 1st as the modern practices of management of cattle disease, followed by deworming with a mean score of 1.97, while dipping and spraying was sub-ranked 3rd with a mean score of 1.96 respectively. This implies that the pastoralists have a good knowledge on vaccination and deworming which is seen as a modern practice of cattle diseases and parasites management in the study area. This is in line with the findings of Singh *et al.*(2016) and Abiola*et al.*(2016) who reported vaccination and deworming as a measure in management of cattle diseases and parasites.

Traditional Methods

The result in table 3 based on sub-ranking reveals that use of herbs was ranked as 1stwith a mean score of 1.86 as the cultural practices of cattle diseases and parasite management, while smoked and manual ticks removal were ranked 2nd and 3rd with a mean score of 1.78 and 1.75 as the traditional practices involved in management of cattle diseases and parasites. This implies that the pastoralists also engaged in traditional methods and could be evident that they have traditional knowledge of cattle diseases and parasites management in the study area. This is in agreement with the findings of Farrah, (2009) and Usman*et al.*(2017) who reported that manual ticks removal is a basic parasite management practice by pastoralist in the study area.

Modern/Traditional Practices

Based on the general ranking of the results in Table 3, among both modern and traditional methods adopted by pastoralist in cattle diseases and parasite management, vaccination was ranked 1st with a mean score of 2.0, followed by deworming with a mean score of 1.97, dipping and spraying and dusting with a mean score of 1.96 and 1.95 which were rank 3rd and 4th respectively. The traditional method commonly practiced by the Pastoralists were use of herbs, smoked and manual ticks removal with a mean score of 1.86, 1.78, and 1.75 were ranked in 7th, 9th and 10th respectively. This is implies that Pastoralists in the study still hold on to some traditional practices of cattle diseases and parasite management which they found it effective despite the availability and ease in the use of modern management practices. It could be deduced that pastoralist in the study area highly uses modern practices of cattle diseases and parasites management such as vaccination, deworming, quarantine, dipping and dusting more than the traditional methods like the use of herbs, use of smoke and manual ticks removal.

Table 3: Distribution of Pastoralists based on management practices of cattle diseases and parasites

S/No.	Practices	Yes Freq/%	Effective Freq/$\bar{X}$)	Not Effective Freq/$\bar{X}$)	Mean ($\bar{X}$)	Sub-Rank	General Rank
Modern practices							
i.	Dipping and spraying	321(76.9)	308 (1.92)	13(0.04)	1.96	3rd	3rd
ii.	Dietary supplementation	395(94.7)	344(1.74)	51(0.13)	1.87	6th	6th
iii.	Vaccination	413(99.0)	398(1.96)	15(0.04)	2.0	1st	1st
iv.	Docking/tailing	362(86.8)	290(1.60)	70(0.19)	1.79	7th	8th
v.	Dusting	395(94.7)	373(1.89)	22(0.06)	1.95	4th	4th
vi.	Deworming	409(98.0)	399(1.95)	10(0.02)	1.97	2nd	2nd
vii.	Quarantine	310(74.3)	288(1.86)	22(0.07)	1.93	5th	5th
Traditional practices							
viii.	Bush Burning	312(74.8)	174(1.12)	138(0.44)	1.56	6th	13th
ix.	Use of Holy Books	398(95.4)	211(1.06)	187(0.47)	1.53	7th	14th
x.	Movement away	346(82.9)	157(0.91)	189(0.55)	1.46	8th	15th
xi.	Manual ticks removal	319(76.5)	241(1.51)	78(0.24)	1.75	3rd	10th
xii.	Use of herbs	415(99.5)	359(1.73)	56(0.13)	1.86	1st	7th
xiii.	Smoked	402(96.4)	311(1.55)	91(0.23)	1.78	2nd	9th
xiv.	Incantation (Spiritual)	402(96.4)	242(1.20)	160(0.39)	1.59	5th	12th
xv.	Breeding	412(98.8)	270(1.31)	142(0.34)	1.65	4th	11th

Source: Field Survey, 2021

Testing of Hypotheses of the Study

The result of the analysis in Table 4 showed that, age (0.0224), household size (0.0311) and access to extension service (0.0440) were found to be negatively and statistically significant at 5%. This implies that an increase in these socio-economic variables will definitely increase their use of management practice of cattle diseases and parasites in the study area. Therefore the null hypothesis (H_0) of this study which stated that there was no significant relationship between Pastoralists' socio-economic characteristics and use of management practices was rejected and the alternative hypotheses (H_1) accepted which states that there is statistical and significant relationship between Pastoralists' socio-economic characteristics and use of management practices of cattle diseases and parasites.

This result implies that as the pastoralists gets older, years of management practices increases with more knowledge and experienced gained likewise household increases overtime, which also play a significant role in the management of cattle diseases and parasites. The higher the number of pastoralists in a household the more the tendency to acquire and get acquainted with different management practice of cattle diseases and parasite, access to agricultural extension services could also increase, and could result to adequate increase in management practices of cattle diseases and parasites such as vaccination, deworming, manual ticks removal among

others. This findings is similar to Usman*et al.* (2017) who reported that age had a positive relationship with the pastoralists' knowledge of cattle parasite and disease management.

Table 4: Logit regression analysis of relationship betweensocio-economic characteristics and management practices of cattle diseases and parasites

Variables	Regression Coefficient	Standard error	Z-statistics	Prob.
X_1(Age)	0.893326	0.02739	1.544584	0.0224*
X_2(Sex)	0.878446	.955044	-1.714365	0.0865^{NS}
X_3 (Marital status)	0.884474	0.499834	0.116330	0.9074^{NS}
X_4 (Household size)	0.893659	0.046209	-2.156024	0.0311*
X_5(Educational Level)	0.894574	0.387962	-0.794731	0.4268^{NS}
X_6 (Experience)	0.895439	0.027424	-1.312767	0.0893^{NS}
X_7 (Herd size)	0.893261	0.001064	0.895454	0.3705^{NS}
X_8 (Access to Extension services)	0.879783	0.204410	-2.014239	0.0440*
C	5.686781	2.008176	2.831815	0.0046
R-square	0.140059			
Adjusted R-square	0.930456			
5% level of significance *				
NS - Not significant				

Source: Field Survey, 2021

CONCLUSION

Based on findings of the study, the following conclusions were drawn. The pastoralists were mostly young male adults who were married with a large household size, with less or no formal education; they practiced small scale cattle production with the years of management experiences only. This has contributed to limited or no access to modern sources of information on cattle diseases and parasite management with the majority of the pastoralist in North-East Nigeria belonging to Miyetti Allah Cattle Breeders Association. It could be noted the mobility engulfing pastoralism in general limits or even disconnects the pastoralist from extension services entirely for a longer duration resulting to haphazardly accessing information on cattle management as well. This has deprived pastoralists from benefiting from other extension services such as access to cattle management equipments and tools provided by the government on low and affordable prices for cattle production.

RECOMMENDATIONS

Based on the findings of the study, the following recommendations were made.

i. Majority of the pastoralists have low level of education and majorly speak only their native languages (*Fulfulde*), for effective extension service delivery messages meant for the pastoralists should be packaged, using both audio-visuals translated to local

languages, as it is evidencedthat most of the pastoralist rarely communicate effectively in Hausathe perceived common language of the people.

ii. Pastoralism a gesture of instability with both the cattle and herder, which ensures that the cattle breeders moves from one place to another in search of quality grazing field, various mobility measures and devices as applicable to extension services should be provided to ensure that majority of pastoralists get access to various extension services provided at different places and time.

iii. It is clearly indicated that majority if not all of the pastoralists belongs to the Miyyeti Allah Cattle Breeders Association, by this, the organization should solely be the target audience for dissemination of extension services instead of face to face or individual contact methods, also a need to promote and support the organization in all round knowing that diffusion of extension services will be at ease thereby securing the cattle industry in Nigeria at large.

iv. With the finding that pastoralists acquires more experiences on management practices of cattle diseases and parasite as they grow older, extension services as well should target the teenage pastoralist so as to aid them grow and practice modern pastoralism with a higher level of knowledge on the cattle diseases and parasites management overtime.

v. Pastoralists should try to embark on other forms of cattle diseases and parasites management other than the default vaccination, deworming and the traditional measures of smoked and manual ticks' removals so as to aid them curtail the dangers attached to the prevalence of these diseases and parasites.

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POSSIBILITIES FOR CONTROLLED STORAGE AND PROPAGATION IN MEDICINAL PLANT SPECIES

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ABSTRACT
A small part of the herbs exported from Bulgaria are cultivated. They are mainly collected from habitats. The richness of the Bulgarian flora is due to the favorable relief and soil-climatic conditions. The study, conservation and preservation of medicinal plants is an opportunity to preserve biological diversity. Chemical compounds isolated from medicinal plants often serve as a guide and model for synthesizing similar or even more effective drugs. In recent years, a successful interaction between traditional and folk medicine has been observed. This gives good results in the treatment of various diseases. People's interest in herbal medicines is increasing. The species Calendula officinalis L., Pelargonium roseum L., Ruta graveolis L., Hiperricum perforatum L. and Asclepias tuberosa L. were studied. The methods by which the genotype realizes the maximum of its potential in in vitro conditions are studied. Cultivation of plant species under controlled conditions requires the study of factors and conditions allowing stimulation of root and stem development, with a high reproduction coefficient. In the experiment, two main environments were tested - Quorin & Lepoivre (1977) and Murashige & Skoog (1962). The differences between the basic food media included in the experiment are mainly in the type of salts and the amount with which they participate in the composition of each one of them.

Keywords: micropropagation, proliferation, medical type, in vitro storage

INTRODUCTION

The Bulgarian flora is a source of plant species, rich in a large set of chemical components, which are in limited populations. Biodiversity loss has been increasing in the last years of our century. This necessitates the collection and preservation of plant species. Their preservation is a priority task on a global scale. The methods of growing tissue cultures are one of the rapidly developing areas with a significant economic effect. They provide an opportunity for rapid cloning and maintenance of the genetic structure of plants. The species Calendula officinalis L. is an annual, herbaceous plant of the Asteraceae family. It is grown as an ornamental plant throughout Europe (Evstatieva, 2001; Atanasova, 2004). Calendula extract has antiviral and anti-inflammatory properties (Imenez-Mediana et. al, 2006). Applying in vitro methods to Calendula officinalis makes it possible to realize a large number of explants in a short period of time. The author Victorio (2008) found that the Murashige & Skoog nutrient medium without added hormones hindered the maximum development of the species.

The homeland of Pelargonium roseum is South Africa. In Bulgaria, the plant is grown as a garden flower. For medicinal purposes, the aerial part of the plant is collected. The herb has an anti-dermatitis and blood pressure-lowering effect. The application of the conventional propagation method of the species is limited due to the difficult germination of the seeds. The introduction of plant biotechnology, including the in vitro method, creates a prerequisite for accelerated production of authentic planting material (Xu et al., 2003; MacRae, 2007).

The species Ruta graveolens is used for medicinal purposes, but as the species is protected, its collection from natural deposits is not allowed. The top branches with leaves and flowers, which are collected during flowering, are used for the herb. Factors influencing the growth of Ruta graveolens under controlled conditions and storage were studied by Massot et al (2000). A protocol for micropropagation of the species was developed by John Steal, (1997) and Castro and Barros, (1997) shoot tip, between nodal and leaf segments and evaluated different culture media for optimal micropropagation. The growth regulators necessary for the maximum rapid multiplication for the purpose of practical targeting of the species Ruta graveolens have been established (Bohidar et al., 2008; et al., Diwan et al., 2008; Mohamed et al., 2011).

St. John's wort (Hypericum perforatum L.) is one of the most widely used herbs in Bulgaria (Tsytlag, 2003, Vasilev, 2009). There are data on successful introduction in vitro of Hypericum perforatum of Bulgarian origin (Evstatieva 2007, Dimitrova et al., 2007). The resulting in vitro cultures are a great opportunity for maximum storage and propagation and its adaptation to the natural environment (Ali et al., 2015).

The herb is Asclepias tuberosa is a perennial species found in rocky forests and is known as buttercup or milkweed. It is used in medicine as an anti-inflammatory, antispasmodic and estrogenic effect. The maximum micropropagation of the Asclepias tuberosa species in controlled conditions is achieved by determining optimal conditions of the nutrient medium Murashige & Skoog (1962) with added plant hormones (Stimart, 1985, Zimmerman 1986, Wyatt 2004, Rajech 2010).

The aim is to study the storage of Calendula officinalis L., Pelargonium roseum L., Ruta graveolis L., Hiperricum perforatum L. and Asclepias tuberosa L in controlled conditions by optimizing the factors affecting micropropagation.

MATERIALS and METHODS

When seeds of the species Calendula officinalis, Pelargonium roseum, Ruta graveolis, Hiperricum perforatum and Asclepias tuberosa were introduced into controlled conditions, the effectiveness of different sterilizing solutions was tested. The method used to obtain pure plant material is based on ethyl alcohol and bleach in different concentrations and exposures:

1. 96% C2H5OH for 5 minutes;
2. 70% C2H5OH for 1 min; 40% bleach (containing 5% active chlorine) for 5 min;
3. 60% C2H5OH for 1 min; 30% bleach (containing 5% active chlorine) for 10 min;
4. 50% C2H5OH for 3 min; 20% bleach (containing 5% active chlorine) for 15min

Murashige-Skoog (1962) without addition of vitamins, kinetin and FeNaEDTA was applied as the basic culture medium. In the experiment, 2 main environments were tested - Quorin & Lepoivre (1977) and Murashige & Skoog (1962) (Table 1). Nutrient media are used to grow plants under controlled conditions. The different level of these nutrients induces the growth of micro-plants. The differences between the basic food media included in the experiment are mainly in the type of salts and the amount with which they participate in the composition of each one of them.

Table 1. Composition of nutrient media for introduction into in vitro culture

	Murashige & Skoog (1962)		**Quorin & Lepoivre** (1977)
macronutrients	mg/L	**macronutrients**	mg/L
MgSO4. 7 H2O	370	MgSO4	175
CaCl2. 2 H2O	440	CaCl2. 2 H2O	578
KNO3	1900	KNO3	1800
NH4NO3	1650	NH4NO3	400
KH2PO4	170	KH2PO4	270
micronutrients		**micronutrients**	
Mn SO4. 4H2O	22.3	Mn SO4 H2O	0.78
KJ	0.83	KJ	0.08
CoCL2. 7 H2O	0.025	CoCL2. 6 H2O	0.025
ZnSO4. 7H2O	8.60	ZnSO4. 7H2O	8.60
CuSO4. 5H2O	0.025	CuSO4. 5H2O	0.025
H3BO3	6.2	H3BO3	6.2
NaMoO4. 2H2O	0.25	NaMoO4. 2H2O	0.25
		FeNaEDTA	36.7
vitamins		**vitamins**	
Thiamine vit. B1	2.0	Thiamine vit. B1	0.4
Pyridoxine HCl vit. B6	0.5	Myo-inositol	100
Nicotinic Acid	0.5		
Kinetin	0.4		
Fe хелат			
Fe NaEDTA	36.7		

Sucrose (30 g/l) was used as a carbohydrate source, and agar (7.0 g/l) with a medium pH of 5.6 was used as a hardener, and its adjustment was made with 1N KOH before autoclaving. Sterilization is carried out for 20 min at 120º C and a pressure of 0.9 atm.

Explants were grown in 50 ml glass tubes, sealed sterile to prevent secondary infection. The cultivation of the initial plant material was continued in a phytostatic room at a temperature of 22 -25 º C, a photoperiod of 16 hours day and 8 hours night and illumination 2000-3000 lx, provided by fluorescent lamps, with white light. The original plants were periodically transferred to fresh nutrient medium at 30-day intervals.

RESULTS and DISCUSSION

Sterilization is the initial stage of microplant development, obtaining pure plant material growing on artificial nutrient media. The results of the study on the influence of sterilizing

agents in the species Calendula officinalis show that the highest percentage of pure culture is obtained in option 2 (Fig.1). No bacterial or viral disease was observed during the development of the explants. The resulting pure seed culture is maximally multiplied.

The efforts made to introduce in vitro conditions the species Pelargonium roseum led to a positive result in option 1. In this species, a large number of contaminated seeds were observed applying the sterilization procedure. This may be due to an endogenous infection involving a greater number of microorganisms, which in turn leads to greater difficulties in the selection and determination of the duration of use of the detergent.

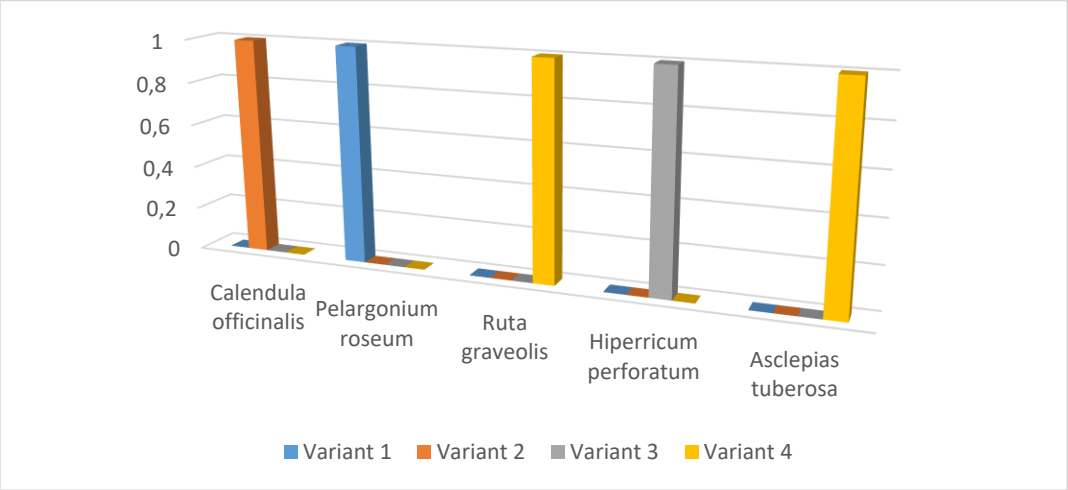

Figure 1. Influence of sterilizing agents in obtaining a pure culture

Maximum number of pure Ruta graveolis microplants were obtained in variant 4 (Fig. 1). Sterilization of this medicinal species requires a longer time, and the study of the sterilization process requires the presence of a larger amount of plant material. Data analysis showed that no bacterial contamination was observed during in vitro cultivation of the explants of the Hypericum perforatum species, which was due to the successful sterilization in variant 3. During two subcultivations, very weak signs of development were observed. After this stage, the in vitro adaptation ends, the explants resume their growth and development, with no signs of unwanted deviations. As a result of the experiments to introduce in vitro culture of Asclepias tuberosa seeds, a stably multiplying culture was obtained in option 4 with the participation of 50% C2H5OH for 3 min and 20% bleach (containing 5% active chlorine) for 15 min. Since the sterilization of species collected from their natural habitats proves to be a difficult task, obtaining single healthy explants is considered a success.

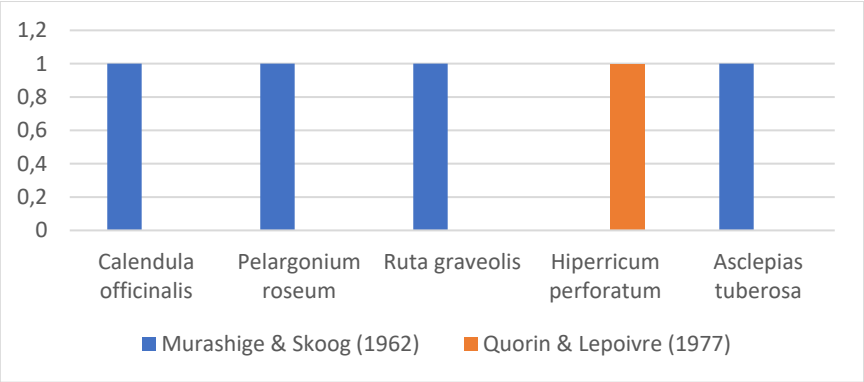

Figure 2. Influence of the studied nutritional environments on the studied plant species

Analysis of the data shows that the species Calendula officinalis high multiplication factor in the nutrient medium Murashige & Skoog (1962). The microplants are well leafed with root system development on the 20th day of planting the experiment. The choice of an appropriate composition of vitamins during the proliferation phase is important not only for reaching a high multiplication factor, but also for the formation of buds with intensive development, without physiological deviations. The studied two nutrient environments have a favorable development of the Pelargonium roseum species. After the 20th day of establishment of the experiment, the number of leaves and the number and length of the root system of the species were recorded in nutrient medium Murashige & Skoog (1962). After the second subculturing, a large number of microexplants are reported, which are about to be adapted and returned to their natural environment of development. Very good response of the species Ruta graveolis regarding the maximum realization of the potential in a nutrient medium Murashige & Skoog (1962). Up to the 13th day of starting the experiment, no significant differences in the development of the species were observed in the two food environments. After this period, in the comparison of the two nutrient media in Murashige & Skoog (1962), slightly higher indicators in the development of the explants were observed compared to Quorin & Lepoivre (1977). Repeated subcultivation is one way to obtain new plants. In the present study, the rate of micropropagation was reported to increase with the observation period (Photo 1).

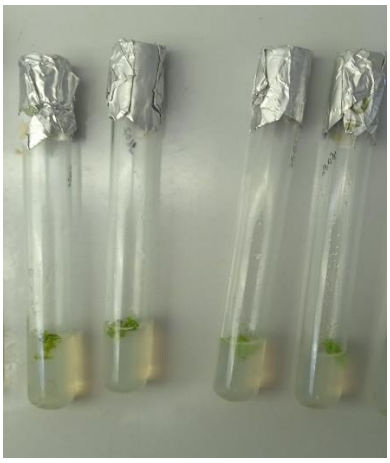

Photo 1. Ruta graveolis in nutrient medium Murashige & Skoog (1962)

When taking into account the biometric indicators, the measurement of the effect of the action of the nutrient media on the multiplication process in the species Hypericum perforatum was observed after 10 days of placing the plants on the nutrient medium Quorin & Lepoivre (1977). The composition of the nutrient medium for plant tissues provides everything necessary for the growth of explants. The induced root system was star-shaped, observed after 10 days of planting the trial (Photo 2).



Photo 2. Hypericum perforatum in the nutrient medium Quorin & Lepoivre (1977)

In the multiplication stage, the best proliferation was achieved when growing Asclepias tuberosa microplants in Murashige and Skoog (1962). The development of microplants in the nutrient medium, the presence of a root system and roots, is recorded on the 8th day of the experiment. The formed root system is white in color, branched, and the roots are firmly attached to the base of the plants. Maximum stem and leaf growth was observed up to the 15th day of planting the experiment.

CONCLUSIONS

The production of clean, sterile plant material in plant species depends on the sterilizing agent and the period of exposure. An effective in vitro protocol for mass micropropagation related to the normal morphological development and good vital status of the explants was developed in the species Calendula officinalis, Pelargonium roseum, Ruta graveolis, Hiperricum perforatum and Asclepias tuberosa.

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FOOD SAFETY AND HACCP APPLICATIONS IN ICE CREAM PRODUCTION

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ABSTRACT
Ice cream is a dairy product obtained by blending and freezing various ingredients. Ice cream is particularly enjoyed and consumed by all age groups, especially children, during the summer months. It is frequently preferred due to its nutritional content and easy digestibility. However, ice cream is susceptible to contamination due to pre-production, production, and post-production processes. The containers used for milk storage, personnel hygiene, the operating environment, and sales areas directly influence the microbiological quality of ice cream. The contamination of milk used in ice cream production, particularly by pathogenic microorganisms, not only leads to a decrease in the quality of the ice cream but also poses a risk of foodborne illnesses due to the introduction of certain microorganisms. Children, especially those who consume ice cream, are more susceptible to illnesses and have weaker immune systems compared to children who do not consume ice cream. The consumption of ice cream can lead to various illnesses in children, including pneumonia, gastroenteritis, sepsis, typhoid fever, dysentery, vomiting, meningitis, fever, and cough. The detection of microorganisms such as *Escherichia coli*, *Enterobacteriaceae*, *Listeria* spp., *Salmonella* spp., and *Staphylococcus aureus* in ice cream samples is considered an indication of inadequate hygiene conditions. It has been observed that ice cream samples sold without packaging are more susceptible to such microbial hazards compared to samples sold with packaging. In order to ensure food safety, identify potential hazards, and eliminate any associated risks in ice cream production, HACCP (Hazard Analysis and Critical Control Points) practices have been developed. HACCP applications provide a number of advantages such as obtaining safe products in ice cream production, ensuring the safety of the supply chain, eliminating risk factors, effectively controlling processes, preventing economic losses, and identifying investment areas. In traditional and industrial ice cream production, it is recommended that hygiene and sanitation rules should be followed and personnel should be adequately informed about these issues in order to avoid both a decrease in food quality and health problems.

Keywords: Ice cream, food safety, microbiological quality, HACCP system

INTRODUCTION

Ice cream is defined as a product obtained by processing and freezing a mixture that includes milk and other dairy products as raw materials, along with specific proportions of water and sugar. Depending on demand, it may also contain ingredients such as salep, emulsifiers/eggs, and flavorings. After undergoing pasteurization or similar heat treatment, the mixture is processed and frozen using appropriate techniques to produce the final ice cream product (Anonymous, 2022). Ice cream has been consumed since ancient times and is enjoyed by consumers due to several reasons. It contains higher levels of protein, fat, calcium, vitamin A, vitamin D, and vitamin B2 compared to milk. It is also easily digestible and can incorporate a variety of additives. These qualities contribute to its popularity as a delightful food item among consumers. It has been reported that ice cream, which is primarily consumed by children (Rahman et al., 2016), can be susceptible to microbial contamination during either the production process or post-production stages due to various factors (Samaržija et al., 2012). Several factors affect the microbiological quality in ice cream production. These factors can be listed as follows: high microbial load in raw materials, air quality in the production facility, cleanliness of equipment and utensils, personnel hygiene, absence of chlorine in the water used, and lack of hygiene in sales areas (Derelioğlu and Tugay, 2019). Furthermore, the water, fat, sugar, emulsifiers, sweeteners, coloring agents, and thickeners used during production are considered significant sources of contamination. (Mokbul et al., 2016). Contaminations occurring particularly during post-pasteurization processes are of great importance in terms of both ice cream quality and consumer health (Derelioğlu and Tugay, 2019).

Analysis of ice cream samples has shown that microbiologically, packaged and unpackaged products are not of the same quality. It has been observed that ice cream samples produced by large-scale establishments are manufactured under more hygienic conditions compared to locally produced ice creams in the domestic market (Derelioğlu and Tugay, 2019). Due to the presence of proteins, ice cream provides a conducive environment for the growth of certain pathogenic microorganisms. As a result, it has been determined that ice cream can potentially cause foodborne illnesses due to the presence of pathogenic microorganisms capable of producing enterotoxins (Abdünnur, 2016). *Aeromonas* species, which are of food origin and capable of multiplying in ice cream even at refrigerator temperatures, are recognized as pathogens that can cause infections in terms of public health (Romero et al., 2012). In addition, *Campylobacter jejuni* species, which is considered a pathogenic strain, is known worldwide as a factor in gastroenteritis and can potentially develop in ice cream (Anonymous, 2017). It has

been reported that *Staphylococcus aureus* is at the forefront of microorganisms causing food poisoning worldwide (Ansari et al., 2023).

FOOD SAFETY AND MICROBIOLOGICAL QUALITY IN ICE CREAM PRODUCTION

Traditional ice creams are considered to be one of the dairy products that need to be controlled for *S. aureus* contamination in some countries worldwide (Ansari et al., 2023). It has been determined that individuals of various age groups, especially children, who consume ice cream may experience health problems such as cholera, tuberculosis, typhoid bacillus, septicemia, meningitis, fever, cough, dysentery, vomiting, diarrhea, stomach pain, and weakness. In ice cream production technology, it is necessary to pay greater attention to hygiene and sanitation rules, as well as implement strict microbiological quality control measures to ensure the safety of ice creams (Alsagher et al., 2021).

Abdünnur (2016) investigated the presence of *Listeria monocytogenes* and *Enterobacteriaceae* in a total of 70 ice cream samples, including 33 packaged and 37 unpackaged ones, offered for sale in Istanbul. According to the *Enterobacteriaceae* counts, it was determined that a total of 20 of the ice cream samples, 5 of the packaged ones, and 15 of the unpackaged ones, contained 300-66000 cfu/g *Enterobacteriaceae* group and did not comply with the codex. İşleyici et al. (2016) conducted a study to investigate the microbiological quality of packaged and unpackaged ice creams sold in Van province. Within the scope of the study, a total of 50 ice cream samples were collected, including fruit-flavored, plain, chocolate, and pistachio-flavored ice creams. According to the study findings, in the packaged ice cream samples, the total aerobic mesophilic microorganism count was determined as 2.46 log cfu/g, the *S. aureus* count was 0.27 log cfu/g, the yeast-mold count was 0.25 log cfu/g, and the total psychrophilic microorganism count was 1.28 log cfu/g. In the packaged ice cream samples, they were unable to detect *E. coli*, *Salmonella* spp., and *L. monocytogenes*. In the unpackaged ice cream samples, they determined the total aerobic mesophilic microorganism count as 4.70 log cfu/g, the coliform count as 2.29 log cfu/g, the *E. coli* count as 0.11 log cfu/g, the *S. aureus* count as 2.18 log cfu/g, the yeast-mold count as 2.06 log cfu/g, and the total psychrophilic microorganism count as 1.62 log cfu/g. In the unpackaged ice cream samples, they did not detect *Salmonella* spp., but they isolated *L. monocytogenes* in 5 samples. According to the obtained data, they emphasized that some of the identified strains, due to their pathogenic characteristics, could pose serious risks in terms of public health. They stated that this risk is higher in ice cream samples sold without packaging in the market.

Abo El-Makarem (2017) investigated the microbiological quality of 50 packaged and 50 unpackaged ice cream samples available for sale in the city of Alexandria, Egypt. The study found that the number of *S. aureus* in ice cream samples collected from the market was determined to be $9.1x10^2$ cfu/mL in unpackaged ice cream and $0.8x10^4$ cfu/mL in packaged ice cream. Çubukçu and Aydemir-Atasever (2018) conducted a study to investigate the microbiological quality of 75 ice cream samples, including 25 vanilla, 25 chocolate, and 25 cherry flavors, available in the Erzurum market. They reported that no *L. monocytogenes*, *Salmonella* spp., and *E. coli* were detected in the analysis of the 75 ice cream samples. The study reported that *S. aureus* was detected at a level of 3.85 log cfu/g in one sample of chocolate ice cream, while it was not detected in the samples of vanilla and cherry ice cream. They found that total aerobic mesophilic bacteria counts ranged from 3 to 7.55 log cfu/g in vanilla ice cream, from 3 to 8 log cfu/g in chocolate ice cream, and from 2 to 8 log cfu/g in cherry ice cream. *Enterobacteriaceae* counts ranged from 1.5 to 6.76 log cfu/g in vanilla ice cream, from 1.5 to 5.46 log cfu/g in chocolate ice cream, and from 1.5 to 6.48 log cfu/g in cherry ice cream. *Enterococcus* counts ranged from 2 to 5 log cfu/g in vanilla ice cream, from 2 to 7 log cfu/g in chocolate ice cream, and from 2 to 6 log cfu/g in cherry ice cream. They emphasized that considering the levels of these detected microorganism species, there may be a hygiene-related risk. Badayman (2018) conducted a study in Aydın province to determine the hygiene and chemical quality of plain Roma ice creams sold in open-air markets. In this study, they obtained 50 samples of ice cream from various establishments. In the analyzed ice cream samples, the average counts of mesophilic aerobic bacteria, total psychrophilic bacteria, *Enterobacteriaceae*, coliform group, and *S. aureus* were determined as 5.16 log cfu/g, 4.27 log cfu/g, 3.56 log cfu/g, 3.42 log cfu/g, and 0.56 log cfu/g, respectively. Furthermore, they isolated *S. aureus* from 10 out of 50 ice cream samples and *L. ivanovii* from 7 samples.

Derelioğlu and Tugay (2019) conducted a study to investigate the presence of gastroenteritis-causing microorganisms in Maraş ice cream. They collected a total of 60 ice cream samples from various establishments and patisseries. They investigated the presence of *Aeromonas* spp., *Campylobacter* spp., and *E. coli* in these ice cream samples. According to the study findings, they did not detect any *Campylobacter* species in the 60 ice cream samples. They found the presence of *Aeromonas* species in 11 samples and *E. coli* in 5 samples. Additionally, within the scope of the study, they performed strain identification of these microorganisms. They reported that among the 11 samples of plain ice cream contaminated with *Aeromonas* species, the most frequently identified species was *A. hydrophila*, followed by *A. sobria* and *A. caviae*. Akar (2020) examined the microbiological characteristics of 10 samples of ice cream sourced from

local companies in Erzurum, as well as 10 samples of ice cream available nationwide. According to the study data, coliform group microorganisms were not detected in the samples of ice cream available nationwide. However, in all samples of ice cream sourced from the local market, coliform group microorganisms were detected. Additionally, high levels of yeast and mold were detected in the samples of ice cream available in the local market. They emphasized that the observed microbiological differences in ice cream samples available in the local and national markets may be related to insufficient heat treatment, non-compliance with hygiene rules by personnel, and inadequate sterilization of equipment and utensils used in the production process.

Sohel et al. (2022) conducted a study to investigate the microbiological loads of ice cream samples collected from shops located near schools in the Tangail district of Bangladesh, as well as the infection levels of children consuming ice cream. They identified a total of 26 pathogenic strains in the analyzed ice cream samples. Furthermore, within the scope of the study, they found that among the 232 students, individuals who consumed ice cream had higher infection levels compared to those who did not consume ice cream. Acaröz et al. (2023) conducted a study to investigate the microbiological quality parameters of 40 packaged and 40 unpackaged ice cream samples available for consumption in Afyonkarahisar. According to the study findings, the highest values determined for coagulase-positive staphylococci were 5.53 log cfu/g in unpackaged ice cream and 2.60 log cfu/g in packaged ice cream. The total yeast and mold counts were 3.60 log cfu/g in unpackaged ice cream and 3.78 log cfu/g in packaged ice cream. The *Enterobacteriaceae* counts were 6.20 log cfu/g in unpackaged ice cream and 3.42 log cfu/g in packaged ice cream. Lastly, the coliform bacteria counts were 5.68 log cfu/g in unpackaged ice cream and 2.48 log cfu/g in packaged ice cream.

HACCP APPLICATIONS IN ICE CREAM PRODUCTION

An internationally recognized food safety system called Hazard Analysis and Critical Control Points (HACCP) has emerged with the aim of ensuring the production of safe foods that do not pose a risk to human health. This system focuses on identifying and controlling existing hazards throughout the entire process from production to consumption and aims to minimize the potential risks to the lowest possible level (Altun, 2011; Dzwolak, 2019). To ensure the establishment of a food safety system, seven different principles have been established in the implementation of HACCP (Okçu, 2007). These mentioned principles are shown in Figure 1.

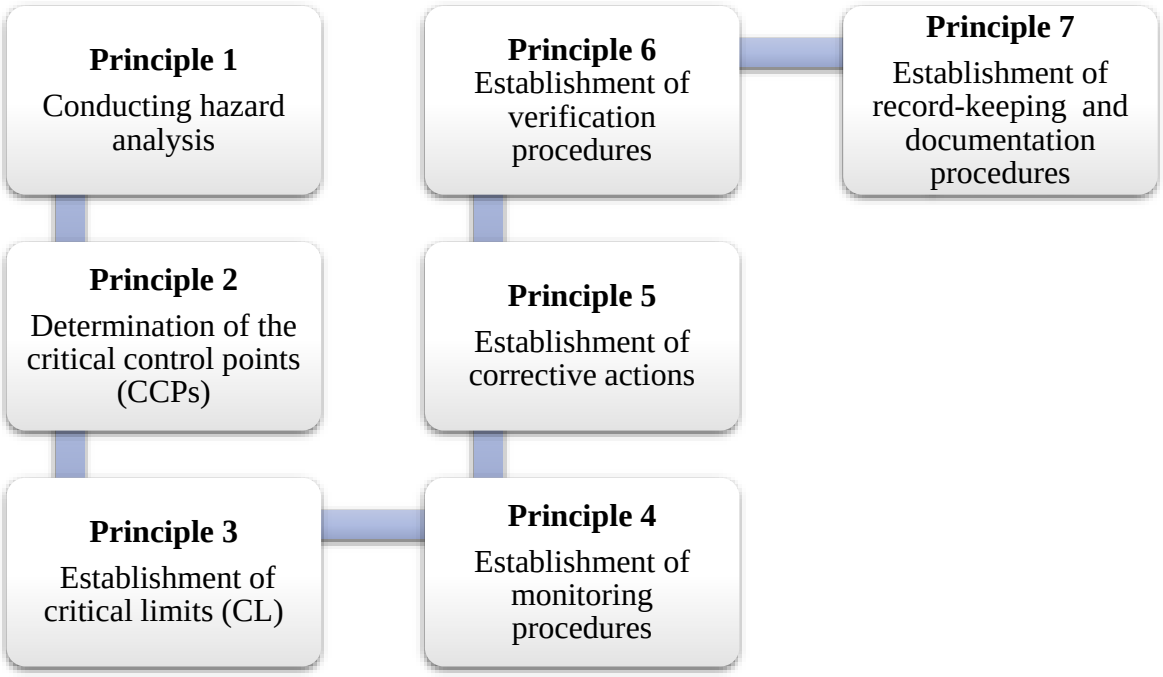

Figure 1. HACCP principles (Okçu, 2007)

When starting a HACCP study, there are different preliminary preparation stages to be considered, such as forming the HACCP team, identifying the product or products, determining the consumption pattern and target group of the products, and creating and approving the flow chart (Surak, 2003). The HACCP system, which is an important method in ensuring food safety, can be applied industrially before, during, and after the production stages of ice cream. This implementation allows for:

- Obtaining safe products that are free from biological, chemical, and physical hazards,
- Ensuring the overall safety of the supply chain,
- Identifying hazards and eliminating risk factors,
- Developing self-control systems for effective process control,
- Preventing economic loss and facilitating export opportunities,
- Identifying necessary areas for investment and exploring new markets (Tokuç and Görker, 2000).

CONCLUSION and RECOMMENDATIONS

Ice cream, especially preferred by children, is a dairy product that is commonly consumed in our daily lives. Due to various reasons, production parameters, or post-production processes, ice cream is highly susceptible to contamination. Among the reasons for contamination, personnel, equipment, production areas, and areas where ice cream is sold afterwards are identified. Studies conducted in the literature have shown that ice cream samples, particularly

those sold without packaging, are more susceptible to contamination. As a result, microbiologically contaminated ice cream samples can potentially cause various illnesses. To ensure the safe consumption of ice cream, it is essential to establish and maintain sufficient hygiene and sanitation conditions. It is concluded that in order to meet these requirements, staff should have the necessary knowledge and skills, comply with the requirements of the HACCP system, and ensure that sales take place under appropriate conditions.

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DIOXIN IN MILK AND DAIRY PRODUCTS

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ABSTRACT
Milk and dairy products, which are an important source of nutrition, can sometimes be contaminated with harmful compounds such as heavy metals, pesticides, veterinary drugs, and dioxins. Dioxins, which pose significant risks to human and animal health by being included in the food chain, are formed as a result of exposure of substances containing chlorine or bromine to high temperatures. Dioxins, which are poorly soluble in water, are soluble in lipids and non-polar organic solvents and can be degraded in the absence or presence of oxygen. Dioxins, which are highly resistant to metabolic degradation in the body, have a long half-life under natural environmental conditions. As a source of dioxin; exhaust gases from vehicles using leaded fuel, paper packaging in contact with food, preparations used in cosmetics, dentistry and medicine, chemical factories, wood and waste incineration processes, machinery, and engine oils can be given as examples. Dioxins can enter the human body, primarily through the respiratory tract, from meat and milk from animals fed with dioxin-contaminated feed and from fish and other aquaculture products grown in contaminated waters. Dioxins, which are mostly taken into the body with fatty foods, show different accumulation and toxicity depending on metabolism. Dioxins, which inhibit protein synthesis in the cell by forming a complex with DNA in the cytoplasm, bind to Arh receptors and cause DNA mutation. To protect against dioxin toxicity, it is necessary to classify waste and apply appropriate waste disposal processes for each category, to use unbleached or chlorine-free paper products, to minimize the use of low-quality plastic packaging, to prevent food contact, to choose low-fat products instead of full-fat ones, to construct industrial facilities away from agricultural areas, and to utilize effective filters in vehicles and factories. This review study provides detailed information about the components of dioxins, sources and contamination reasons of dioxins, the impact of dioxins on human health, and measures that can be taken to protect against dioxin toxicity.

Keywords: Milk, dairy products, dioxin

INTRODUCTION

Milk holds a significant place in nutrition for people in many parts of the world, assuming complementary and supportive roles in terms of human health with its beneficial components such as vitamins, minerals, essential amino acids, and fatty acids (Lin et al., 2021). Studies have shown that the components of milk and dairy products play an important role in preventing diseases such as Type 2 diabetes, bone diseases, and obesity (Ratajczak et al., 2021; Awwad et al., 2022). Milk and dairy products can pose risks to human health due to the presence of harmful compounds such as heavy metals, pesticides, veterinary drugs, and dioxins. These agricultural or industrially derived substances have been reported by numerous institutions and organizations, including the World Health Organization (WHO), as factors that adversely affect human health. Dioxins, first entering our lives with the Seveso Disaster in 1976 (Italy), are known as highly toxic environmental pollutants that pose a threat to the environment and living organisms, and can be encountered almost everywhere. As a result of the combustion of substances containing chlorine or bromine at high temperatures, dioxins, which are referred to as unwanted by-products, are formed. Due to their high toxicity, dioxins are considered a potential hazard, negatively affecting human health and the environment (Güneş, 2007). Dioxins accumulate in animal fat tissues, playing an active role in the food chain and posing a risk to human health. Since 1980, these compounds have been closely monitored, and high doses of exposure to them can lead to acute poisoning, skin lesions, developmental disorders in children, and even cancer (Tuomisto, 2019).

GENERAL PROPERTIES OF DIOXINS

Polychlorinated biphenyls (PCBs), polychlorinated dibenzofurans (PCDFs), polychlorinated dibenzodioxins (PCDDs), or polybrominated dibenzofurans (PBDFs) and polybrominated dibenzo-*p*-dioxins (PBDDs) have gained attention in recent years as persistent organic pollutants due to their wide distribution, high potential toxicity, and extreme stability. Dioxins are formed through the combustion of chlorine-containing compounds in an environment with low oxygen content. Dioxins, which cause adverse effects on human and animal health as well as the environment, can persist in nature without significant degradation for a relatively long period of time (Ishida et al., 2005; Aoudeh et al., 2022). These pollutants are characterized by low solubility in water, making them resistant to metabolic and environmental breakdown. They have a wide distribution range and exhibit high levels of toxicity. These substances, called dioxins or dioxin-like compounds, have similar chemical structures and similar effects on living organisms. A total of 75 PCDD compounds and 135 PCDF compounds have been identified

based on their degree of chlorination (1-8) (Salahov and Ayvaz, 2000; Karademir, 2004; Lavric et al., 2005; Erol, 2007). In nature, there are 210 different PCDD/F compounds (75 PCDDs and 135 PCDFs) and 209 different PCB (Polychlorinated Biphenyl) compounds, among which 17 (dioxin derivatives containing 4 or more chlorine atoms) exhibit higher levels of toxicity compared to others (Güneş, 2007). The toxicities of other dioxin derivatives are determined relative to the most toxic compound, 2,3,7,8-Tetrachlorodibenzo-*p*-dioxin (TCDD), and the World Health Organization (WHO) defines a Toxicity Equivalence Factor (TEF) for each compound (Çiftçi, 2008a; Rathna et al., 2018). The TEF value of TCDD is reported to be 1, while the average TEF value for PCBs is 0.1. The total toxicity in products is determined by multiplying each dioxin compound's TEF value and summing them all, which is expressed as the Total Equivalent Toxicity (TEQ). PCDD and PCDF compounds have been classified by the World Health Organization (WHO) as Group 1 carcinogens, and it has been reported that the daily tolerable intake for humans is 1-4 pg TEQ/kg (WHO, 1998).

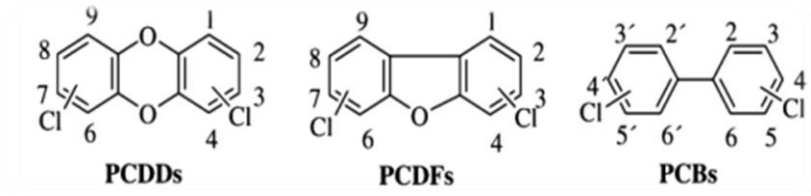

Figure 1. Chemical structures of dioxins (Baytok and Bingöl, 2013)

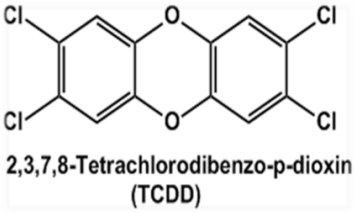

Figure 2. Tetrachlorodibenzo-*p*-dioxin (TCDD) (Baytok and Bingöl, 2013)

Dioxins, soluble in lipids and nonpolar organic solvents, have low solubility in water. Additionally, dioxins can undergo degradation under both aerobic and anaerobic conditions (Erol, 2007). It is reported that the half-lives of dioxins, which are taken into the body mostly with fatty foods (meat, milk, butter, eggs, etc.) and show lipophilic properties, vary between 12-30 days in mice, 16-17 weeks in cattle and 7-8 years in humans (Baytok and Bingöl, 2013; Domingo, 2023). Dioxins stored in the fatty tissues of humans and animals pass into the blood as a result of stress, lactation, and starvation and can continue their toxic effects for a long time. It has been determined that even very low levels of dioxins exhibit highly toxic effects in living organisms (Arıkan et al., 2009).

DIOXIN SOURCES AND CAUSES OF CONTAMINATION

Dioxins occur as a by-product of chlorophenols produced as bactericides and fungicides. As a source of dioxin;

- The exhaust gases from vehicles that use leaded fuel are known as a source of dioxins.
- Lignin, a component found in the structure of wood, can be converted into dioxins during paper production, making this process one of the significant sources of dioxins.
- Paper packaging in contact with food has been identified as a source of contamination.
- The production of minerals, lime, cement, glass, and ceramics is listed among the effective sources.
- Preparations used in cosmetics, dental and medical are reported as sources of dioxins.
- Chemical production factories, wood, and waste incineration processes are known as the most common source of dioxin.
- Biomass burning and drying are shown as sources of dioxins
- Machine and engine oils are also sources of dioxins (Anonymous, 2000; Baytok and Bingöl, 2013).

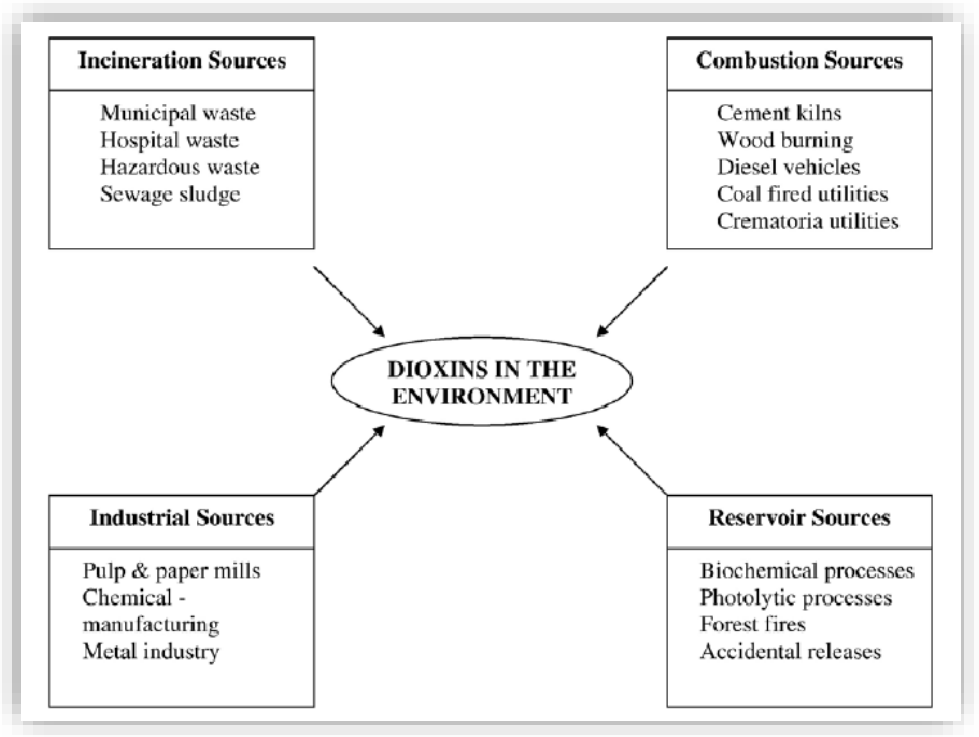

Figure 3. Sources of dioxins in the environment (Kulkarni et al., 2008)

Dioxins, which we encounter almost everywhere, can be taken into the human body directly from the air through the respiratory tract. However, dioxins can also enter the human body through the consumption of fish that grow in contaminated waters, as well as through the

consumption of feed contaminated with dioxins and milk and meat products from animals fed with contaminated plants (Paumgartten et al., 2000; Domingo, 2023). Dioxins taken into the human body by milk, fish, and meat products show different accumulation and toxicity depending on the metabolism of these products. A person who consumes a certain amount of dairy products daily (about 30 g) can take TCDD at 6 pg levels into the body (Davy, 2004). It has been reported that dioxin content was determined in decreasing amounts in chicken, pork and beef, respectively, in studies on different animal species (Charnley and Doull, 2005). A study conducted in Kocaeli province has also determined that the milk, meat, and eggs of animals fed in the vicinity of an incineration facility contain high levels of dioxins (Aslan et al., 2007). The amount of dioxins and similar compounds accumulated in fatty components vary depending on the fat content of milk and dairy products, resulting in differences in the amount of intake into the body. Studies have shown that approximately 25-45% of the total dioxin intake is derived from milk and dairy product (Marcotrigiano and Storelli, 2003).

Çiftçi (2008b) reported that the average dioxin values in butter samples obtained from local farms in Elazığ and its surroundings were 4.92 pg TEQ/kg. In a study conducted on breast milk, it was found that the average dioxin level in samples obtained from mothers living in Brazil was 1.7 pg TEQ/kg. It was determined that this value falls within the acceptable daily intake limits, and furthermore, it is significantly lower compared to individuals living in industrial areas (Paumgartten et al., 2000). In a study conducted in Italy, dioxin was detected in 85% of the purchased raw milk samples and 100% of the Mozzarella cheese samples (Cirillo et al., 2009).

Bertocchi et al. (2015) revealed in their study conducted in the Brescia region of Italy that the average PCDF/PCDD ratio in milk samples obtained from 14 local dairy farms ranged from 1.17 to 2.08 pg TEQ/kg. Luo et al. (2021) reported a twofold difference in dioxin levels between breast milk samples obtained from mothers living near recycling areas and those obtained from the reference group in their study conducted in China, Taiwan, and Hong Kong. Moreover, through the comparison of sample specimens taken from infants, it was determined that infants residing in the region had dioxin values that were twice as high as those in the reference group. It has been observed that the levels of dioxins in UHT milk obtained from supermarkets in Switzerland (0.51 ng TEQ/kg) are higher than those in milk obtained from rural areas (0.36 ng TEQ/kg). It is estimated that the source of these dioxins is contamination in animal feed due to industrial activities (Unkila et al., 1995). Battisti et al. (2022) examined samples from various food groups in Italy between 2011 and 2017 in their study and found that PCDDs were present

in almost every product. In the same study, the highest PCDD levels were found to be 94% in cream, 89% in baby food, 79% in goat milk, and 58% in sheep milk.

EFFECTS OF DIOXINS ON HUMAN HEALTH

Cancer, respiratory difficulties, asthma, high blood pressure, kidney diseases, reproductive disorders, wasting syndrome, hepatotoxicity, and developmental disorders are some of the diseases caused by dioxins (Güneş, 2007; Arıkan et al., 2009). They bind to receptor proteins in the cytoplasm and form complexes with DNA, thereby inhibiting protein synthesis in the cell. Moreover, they bind to aryl hydrocarbon (Ah) receptors, which are DNA transcription factors and have a steroid structure, causing DNA mutations. It has been reported that in the absence of Ah receptors, the acute toxicity caused by dioxins decreases (Pohjanvirta and Tuomisto, 1994). Dioxins not only cause DNA mutation but also increase the rate of lipid peroxidation, thus accelerating not only the formation of cancer but also its progression (Yoshida and Ogawa, 2000).

WAYS TO PREVENT DIOXIN TOXICITY

- Creating an efficient incineration process by burning and reducing to ash at approximately 600°C,
- Classifying the waste and establishing a waste disposal process suitable for each class of waste,
- Using unbleached or chlorine-free paper products,
- Avoiding low-quality plastic packaging as much as possible and preventing food contact with such packaging,
- Not heating food and beverages in plastic packaging in the microwave,
- Choosing low-fat products over full-fat ones,
- Constructing industrial facilities in areas far away from agricultural lands
- Using efficient filters in factory chimneys can be listed as a measure (Güneş, 2009; Baytok and Bingöl, 2013; Rathna et al., 2018).

CONCLUSION and RECOMMENDATIONS

Dioxins present significant health risks to humans and animals, primarily due to their characteristics as air pollutants and their ability to contaminate various environmental elements such as soil, water, rivers, streams, and plants through the transport of polluted air by wind. All living organisms, including plants, animals, and humans, are initially exposed to the harmful effects of dioxins. It is widely recognized that the main source of human exposure to PCDD/Fs is through dietary intake. In order to reduce the contamination caused by environmental

pollution, it is essential to develop appropriate environmental policies and to take the necessary measures. These efforts can help to minimize the toxicity of dioxins. It is important to avoid the consumption of dioxin-contaminated food as much as possible. It is also recommended that effective and rapid analytical methods be researched to ensure proper monitoring and control of consumer products.

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ECONOMICS OF OIL PRICES AND DYNAMIC RELATIONSHIP WIT EXCHANGE RATES AND STOCK MARKETS UNDER UNCERTAINTY: A LITERATURE REVIEW

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ABSTRACT
The role of crude oil in economic development of a country need not be overemphasized. The interrelationship of crude oil price with exchange rate and stock market under uncertainty is highlighted. Most of the literature concerning uncertainty and oil price, Oil price and exchange rates, and oil price and stock markets have been reviewed. An attempt shall be made to predict the dynamic relationship between these three variables through this paper.

Keywords: Crude oil, Exchange Rates, Stock Markets, Uncertainty, Oil price

INTRODUCTION

Crude Oil pricing have important bearing on the functioning of global economy. Like other commodities, the oil price is determined by supply and demand factor. Major fluctuation in price of oil exerts significant economic impact. A 10 percent increase in crude oil price will lead to increase in Wholesale Price Index (WPI) in India by 0.9 percent. Also a 10 percent increase in oil prices lead to increase of India's Current Account Deficit(CAD) by nearly $15 billion or 0.4 percent of GDP. Rising crude oil prices will also have a positive impact on Indian Economy because higher crude oil prices will bring higher revenue for the states under unchanged excise duty condition.

Oil specific demand shocks impact all exchange rates. Oil supply shocks lead to significant depreciation in real exchange rates of oil exporters. Oil specific demand shock can lead to a significant appreciation in the real exchange rates in both oil importers and oil exporters. In countries with large oil imports, a small increase in the real oil prices can result in a rise in the prices of tradeable good and ultimately resulting in depreciation of domestic currency. Increase in real exchange rates are associated with decrease (increase) in real oil prices of oil –importing (oil-exporting) countries.

An increase in oil prices usually lowers the expected growth and increases inflation expectations over short run. Decreasing economic growth prospects, in turn, lower companies earning expectation, resulting in dampening effect on stock prices. Increase in oil price tends to compress corporate profit. In addition, during periods of high oil prices, investors usually become more uncertain about the outlook for corporate earnings which eventually lead to higher equity risk premia demanded by investors resulting into additional downward pressure on stock prices.

The dynamic relationship between oil prices, exchange rates and stock markets is further complicated by uncertainty. Uncertainty arising due to factors like geo political events, natural disasters, changes in government policies, or unexpected shift in market sentiment bring about difficulty in ascertaining relationship between these three factors.

One approach to analyzing the dynamic relationship between oil prices, exchange rates and stock market under uncertainty is to use statistical models that incorporates uncertainty in to their prediction. For example, Monte Carlo simulation techniques can be used to generate a range of possible outcomes based on a set of probabilistic assumptions about the future values of three factors. By simulating thousands of or even millions of scenarios, analysts can identify patterns and trends that may not be apparent from a single deterministic model.

Another approach to predict the relationship between these three variables is to apply Regression Analysis. Multiple Regression analysis will enable prediction of dependent variable from independent variable.

Additionally qualitative analysis through reviewing news articles, government reports and such other published sources shall identify potential sources of uncertainty and assess their likely impact on market dynamics.

The Study

"Economics of Oil Prices, and dynamic relationship with Exchange Rates and Stock Markets under Uncertainty".

Need of the Study

Oil price has dominant role to play in the macroeconomic environment.It influences both exchange rates and stock market indices.Oil price ,exchange rates and stock markets are interrelated with one another.This interrelation need to be studied under uncertainty.Though there have been several research on dynamic relationship between oil prices and exchange rates ,limited research have been done on the interrelationship aspect among oil prices,exchange rates and stock markets under uncertainty.So researcher have undertaken the study"Economics of Oil Prices and dynamic relationship with Exchange Rates and Stock Markets under Uncertainty"

Objectives of the Study

The present study titled "Economics of Oil Prices and dynamic relationship with Exchange Rates and Stock Markets under Uncertainty" have following objectives:

1.To analyze the economic relationship between oil prices, exchange rates and stock market indices

2.To investigate the impact of exchange rates on the relationship between oil prices and stock market indices.

3.To compare the impact of oil prices on the stock market indices across different countries.

4.To identify any asymmetries or non-linearities in the relationship between oil prices, exchange rates, and stock market indices.

Literature Review

Uncertainty and Oil Price

Economic policy uncertainty had a significant negative impact on oil prices.

A study found that oil prices are more sensitive to uncertainty during periods of high oil prices compared to low oil prices.

A research conducted to analyze the dynamic relation between oil price returns,exchange rates,stock returns and uncertainty shocks using daily data employing a structural Vector

Autoregression economic technique finds that COVID 19 induced uncertainty dampened the oil and stock market.It also further suggests that COVID 19 induced uncertainty distorted the dynamics between oil and stock prices in the initial periods due to cautionary approach followed by investors.[Aloui (2019),Chen(2019) Prabhesh and Kumar(2021)Sakaki(2017);Alam and Uddin,(2014);Bonga (2017);Kumar and Singh (2020);Al-Faris and Al-Titi(2021)

Oil Price and Exchange Rates

Most of study on the topic have suggested that, there is a significant and dynamic relationship between these variables. The findings suggest that the spillover effects between these markets are bidirectional and the impact of stocks can be asymmetric.[Basher and Sadorsky,P,(2016);Edwing.,Malik,andAlgahtani,F.(2018);Menshi,Beljid,Boubaxin,andManagi ,(2015); Salisu and Fasanya.(2017).]

Using data of oil price and exchange rates of 14 countries for the period January 1999 to November 2014,another study examines the dynamic correlation between oil prices and exchange rates by DCC-GARCH model. The results show the significant negative correlation between oil prices and exchange rates over the period. These results imply that the increase of oil price is coinciding with U.S. dollar depreciation and vice versa. This correlation strengthen in negative direction during financial crisis period,while it shifts to an upward trend after financial crisis period.

In one study on five oil exporting countries using bound testing approach to cointegration finds long run relationship between oil prices and exchange rates in all five countries.[Basher and Sadorsky (2016);Oskoee and Saha (2016)]

In another study researcher indicated that exchange rate is highly affected by changes in other variables. However stock market has fewer roles in affecting the exchange rate.[Sujit and Kumar, (2017)]

There have been strong linkages between rates and oil prices observed in the long run.Either exchange rates or oil prices are potentially useful predictor of the other variable in the short run, but the effects are strongly time varying.

The reaction of oil price to an appreciation of US Effective Exchange rate is negative and different over time,which may generate different adverse effects on investment.

Long run relationship between oil prices and exchange rates depend on country-specific circumstances. For countries adopting free floating system,oil importers reveal a significantly bidirectional correlation,while oil exporters show no correlation between oil prices and exchange rates.[Beckmonn,Czudaj and Arora (2017) ;Castro and Rodriguez (2020);Chi,Lee, and Lee (2021)]

Another study explores the nonlinear relationship between crude oil prices and exchange rates of major currencies from quantitative and structural perspectives, by utilizing bivariate normal mixture model.The correlation coefficient between oil prices and exchange rates demonstrate that their dependence typically start from 2004,then dynamically change overtime.The Researchers investigate whether business cycle and oil price shocks as two possible exogenous factors affect the dependence structure of oil-Ex linkage.Researchers found significant structural heterogeneity during economic expansion while little evidence of heterogeneity in recession.This finding provides alternative interpretations for the enhanced dependency between oil prices and exchange rates and generates implications of financialization in commodity market. The application of normal mixture model not only provide us knowledge of non-linear relationship between oil prices and exchange rates but also guidance for investors in risk management and portfolio diversification complementary to the traditional portfolio theory based on Normal distribution.[Xu;Zian;Li;Libo (2019).]

Oil Price and Stock Market

Impact of oil prices on the stock market is inversely proportional.A shoot in oil price leads to a nosedive in the stock market.And a decrease in oil price on an average leads to higher stock market return.So the effect of oil prices becomes predictable in the stock market.The effect is profound when the oil price increase in the magnitude of 50% to 100% annually.[Kapur and Baweja(2011)]

Several studies have been done on the impacts of oil markets on stock markets,where as little research in the reverse direction exists.One study reveals that the causal effects between oil and stock markets depend heavily on whether research is performed using aggregate stock market indices, sectoral indices, or firm level data or stock market operate in net oil importing or net oil exporting countries.

Investigating the dynamic relationship between oil prices and stock markets for 18 countries over the period 1997-2014 by administering VAR model, it is evidenced that there exists a significant and positive relationship between oil prices and stock markets in most countries. Conclusions vary depending on whether studies use,symmetric or asymmetric changes in the price of oil, or whether they focus on unexpected changes in oil prices.The study shows oil price volatility transmits to to stock market volatility and that including measures of stock market performance improves forecast of oil prices and Price Volatility.There have been extensive study on dynamic relationship between oil prices,exchange rates and emerging Stock Markets under uncertainty using VAR model.The results show that oil prices and exchange rates have a significant impact on emerging stock markets[Degiannakis.,Filis., and Arrora, (2018)]

Another study conducted in China by applying DCC-GARCH model revealed that there exist significant volatility spill overs between oil well as prices and stock markets as between exchange rates and stock markets. The result suggest that oil price and exchange rates have a significant impact on stock market volatility in China.

On investigation of the dynamic relationship between oil price, exchange rates and stock markets in the Gulf Cooperation Council (GCC) countries by applying multivariate GARCH model, the study evidences a significant volatility spill overs between oil prices and exchange rates as well as oil prices and stock markets. The result suggests that oil prices have a significant impact on exchange rates and stock market volatility in the GCC countries.[Aloui (2017);Ji and Zhang (2017).]

Research Methodology

Research methods to be applied are both quantitative analysis and review of existing research study available on the topic at international and national level. Time Series econometric analysis shall be conducted to investigate the dynamic relationship of oil price with exchange rate and stock market under uncertainty. Multiple Regression analysis shall be applied to ascertain the interrelationship among oil price, exchange rates and stock markets. Bibliometric analysis shall be used for peer review of literature. For test of hypotheses t statistics and Chi Square test shall be used.

Research Hypotheses

1. H0:There is no dynamic relationship between oil prices, exchange rates and stock market indices.

H1:There is a dynamic relationship between oil prices, exchange rates and stock market indices

2. H0:Exchange rates have no impact on the relationship between oil prices and stock market indices.

H1:Exchange rates have an impact on the relationship between oil prices and stock market indices.

3. H0: The impact of oil prices on the stock market indices is the same across different countries.

H1:The impact of oil prices on the stock market indices differs across different countries.

Research Analysis

The analysis of oil prices reveals several key factors that influence their movements. Besides interaction of supply and demand, factors such as geopolitical tensions, production levels, OPEC decisions, and macroeconomic conditions play an important role in shaping oil price

fluctuation. Higher demand for oil, driven by economic growth and industrial activities, tends to push oil prices up, while increased oil supply can lead to price declines.

Exchange rates reflect the relative value of one currency compared to another. Various factors such as interest rate differentials, trade balances, inflation rates, and capital flows impact exchange rate movements. An increase in oil prices affects exchange rates through multiple channels. Higher oil prices increase production cost leading to imported inflation, which may result in Central banks increasing interest rates to stabilize prices. Higher interest rates attract foreign capital which strengthens the domestic currency. On the other hand, a decrease in oil price leads to currency depreciation.

Stock markets are influenced by a wide range of factors. hThese are economic indicators, corporate earnings, investor sentiment, corporate earnings, and global market conditions. The relationship between oil prices and stock markets is multifaceted. For oil importing countries, higher oil prices negatively impact corporate profitability, increase production cost, and decrease consumer spending power, potentially leading to stock market declines. Conversely, oil exporting countries may experience stock market gains when oil prices rise, as higher oil revenues can stimulate economic growth and boost corporate earnings.

Uncertainty can have a significant impact on oil prices. Heightened uncertainty can lead to increased price volatility.

CONCLUSION

The dynamic relationship between oil prices, exchange rates, and stock markets is complex and multifaceted and can become even more complicated under conditions of uncertainty. Uncertainty can have a significant impact on the relationship between oil prices, exchange rates and stock markets. Specifically, uncertainty can increase market volatility, make it difficult to predict market movements, and create new risks and opportunities for investors and businesses. To manage these risks and take advantage of opportunities, it is important for policy makers, investors, and businesses to have a deep understanding of the complex and dynamic relationship between oil prices, exchange rates and stock markets. This requires ongoing research and analysis, as well as a willingness to adapt to changing market conditions and adjust strategies accordingly.

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KOYUN VE KEÇİLERDE ÖSTRUS SENKRONİZASYONU METOTLARI VE GÜNCEL İLERLEMELER

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ÖZET

Koyun ve keçiler, et, süt ve yapağı üretimi için ekonomik olarak büyük değer taşıyan hayvanlardır. Koyun ve keçilerde döl verimi, en önemli ve diğer verimleri etkileyen bir verimdir. Son yıllarda döl veriminin arttırılması için östrus senkronizasyonu metotları ve güncel ilerlemeler üzerine odaklanılmıştır. Koyun ve keçiler doğaları gereği mevsime bağlı poliöstrik hayvanlar olduklarından, üreme sezonu sınırlı bir zaman dilimiyle kısıtlanmaktadır. Aynı zamanda anöstrüs sezonda hayvanlar kızgınlık göstermemekte ve çiftleşme gerçekleşmemektedir. Bunun sonucu olarak üreme veriminde kayıplara yol açmaktadır. Bu nedenle, östrus senkronizasyonu metotları, yetiştiricilere üreme döngüsünü optimize etme ve üreme verimliliğini artırma konusunda fayda sağlamaktadır. Östrus senkronizasyonu, küçükbaş hayvanlarda kullanılan bir dizi yöntemdir ve üreme yönetimi açısından büyük avantajlar sağlayabilir. Hormonal metotlar, progestagen implantları ve progesteron ile döllemeye hazırlık protokolleri gibi yöntemleri içermektedir. Biyoteknolojik ilerlemeler, yeni protokollerin geliştirilmesi ve multidisipliner çalışmaların yapılmasıyla koyun ve keçilerde östrus senkronizasyonu başarısını arttırmaktadır. Bunun yanı sıra, GnRH analogları gibi hormonlar da senkronizasyonu sağlamak için kullanılmaktadır. Östrus senkronizasyonunda hormonal metotların yanı sıra, non-hormonal metotlar da etkili olabilir. Bu metotlar arasında, ışık uygulamaları önemli bir rol oynar ve uzun gün veya kısa gün protokollerini içerir. Ayrıca, beslenme faktörleri de senkronizasyon sürecini etkileyebilir ve hayvanların beslenme rejimi üzerinde yapılan optimize edilmiş düzenlemeler, başarılı senkronizasyonu destekleyebilir. Son zamanlarda, koyun ve keçilerde östrus senkronizasyonu alanında önemli ilerlemeler kaydedilmiştir. Yeni progestagenler ve dozlama protokolleri üzerinde çalışmalar yapılmıştır ve daha etkili GnRH analogları geliştirme çabaları sürmektedir. Ayrıca, ışık uygulamaları ve beslenme yöntemleri konusunda da iyileştirmeler yapılmaktadır. Bu derleme yazısı, koyun ve keçi yetiştiricilerine, östrus senkronizasyonu metotlarına ve güncel ilerlemelere dair kapsamlı bir bakış sunmaktadır. Bu bilgiler, yetiştiricilere üreme verimliliğini artırmak için değerli bilgiler ve yöntemler sunmaktadır.

Anahtar Kelimeler: Koyun ve Keçi, Östrus senkronizasyonu, Hormonal ve Non-hormonal metotlar, Döllemeye hazırlık protokolleri, Güncel ilerlemeler

METHODS AND CURRENT ADVANCES IN ESTRUS SYNCHRONIZATION OF SHEEP AND GOATS

ABSTRACT

Sheep and goats are economically valuable animals for meat, milk, and fleece production. In sheep and goats, reproductive efficiency is the most important and influences other efficiency. In recent years, the focus has been on estrus synchronization methods and current advances to increase reproductive efficiency. Since sheep and goats are polyestrous animals by nature, the breeding season is restricted to a limited period. At the same time, during the anoestrous season, animals do not come into heat, and mating does not occur. As a result, this leads to losses in reproductive efficiency. Therefore, estrus synchronization methods are useful for breeders to optimize the reproductive cycle and increase reproductive efficiency. Estrous synchronization is a set of methods used in ovine animals and can provide great advantages in terms of reproductive management. Hormonal methods include progestagen implants and progesterone insemination preparation protocols. Biotechnological advances, the development of new protocols, and multidisciplinary studies are improving the success of estrus synchronization in sheep and goats. In addition, hormones such as GnRH analogs are also used to achieve synchronization. In addition to hormonal methods, non-hormonal methods can also be effective in estrus synchronization. Among these methods, light treatments play an important role and include long-day or short-day protocols. Furthermore, nutritional factors can also influence the synchronization process, and optimized adjustments to the animals' feeding regime can support successful synchronization. Recently, significant progress has been made in the field of estrus synchronization in sheep and goats. New progestagens and dosing protocols have been studied, and efforts are underway to develop more effective GnRH analogs. Improvements are also being made in light treatments and feeding methods. This review provides sheep and goat breeders with a comprehensive overview of estrus synchronization methods and current advances. This information provides breeders with valuable insights and methods to improve reproductive efficiency.

Keywords: Sheep and Goats, Estrus synchronization, Hormonal and Non-hormonal methods, Fertility preparation protocols, Recent advancements

GİRİŞ

2021 yılında Türkiye'nin koyun ve keçi varlığı ile ilgili TÜİK verilerine göre Koyun sayısı 45 milyon 178 bin baş, keçi sayısı 12 milyon 342 bin baş olarak kaydedilmiştir (TÜİK, 2021). Bu rakamlar, bir önceki yıla göre koyun sayısında %7,2 artış, keçi sayısında ise %3 artış olduğunu göstermektedir (TÜİK, 2021) . Küçükbaş hayvan varlığı açısından Türkiye, dünyada 10'uncu, Avrupa'da ise birinci sırada yer almaktadır.

Koyun ve keçiler, dünya genelinde önemli bir ekonomik değere sahip olan küçükbaş hayvan türleridir. Bu hayvanlar, et, süt, yün ve deri üretimiyle tarım sektöründe büyük bir rol oynamaktadır. Ancak, üreme verimliliği bu türlerde sürdürülebilirlik ve karlılık açısından kritik bir faktördür. Bu nedenle, koyun ve keçi yetiştiricileri, üreme süreçlerini optimize etmek ve sürü verimliliğini artırmak için çeşitli yöntemlere başvurmaktadır.

Koyun ve keçi yetiştiriciliğinde iki temel hedef bulunmaktadır. Öncelikli olarak, maliyetleri artırmadan veya az masrafla daha iyi bir verimlilik elde etmek amaçlanır. Bu amaçla, işletmelerin karlılığını artırmak ve kaynaklarını daha etkin bir şekilde kullanmak için önem kazanmaktadır. İkinci olarak, üreme performansını üst seviyelere çıkarmak hedeflenir. Bu, sağlıklı yavru sayısını artırmak, üreme döngüsünü iyileştirmek ve genetik potansiyeli en üst düzeye çıkarmak anlamına gelir. Bu amaçlar doğrultusunda, yetiştiriciler genellikle besleme programlarını optimize eder, sağlık kontrollerini düzenli olarak yapar, uygun ırkları seçer ve üreme yönetimini etkin bir şekilde gerçekleştirir. Böylece, koyun ve keçi yetiştiriciliği faaliyetleri daha verimli hale getirerek işletmeler daha karlı hale getirmiş olurlar (Lindsay, 1991).

Üreme verimliliği, küçükbaş hayvan yetiştiriciliğinin ekonomik sürdürülebilirliği için hayati bir faktördür. Bununla birlikte, birçok üretici, operasyonlarının ekonomik sürdürülebilirliği için hayati olan mevcut hormonal etkileşimle ilgili üreme teknolojilerini kullanmamaktadır (AL-Jaryan et al. 2023). Bu nedenle, bu derleme, hormonal ve hormanal olmayan yöntemler ile üreme değişikliklerinin ve hormon etkileşimlerinin potansiyel etkilerini araştırmayı ve koyun üremesi için ileri teknolojileri belirlemeyi amaçlamaktadır.

Küçükbaş hayvanlarda üretim verimliliğini artırmak için üreme yönetimi programlarının uygulanması önemlidir. İyi bir üreme yönetimi, östrus başlangıç zamanlamasının manipüle edilmesini içerir (Reyes-Ramirez et al., 2021). Üreme mevsiminde, koyunların 15-20 gün (ortalama 17 gün) süren bir östrus döngüsü vardır ve östrus 16-59 saat (ortalama 29 saat) sürer. Östrus genellikle ovülasyonun başlangıcını işaret eder ve genellikle östrusun bitiminden bir saat sonra başlar (Doğan and Nur., 2006). Östrus süreleri uzadığında, ovülasyon genellikle östrusun sonundan önce gerçekleşir, östrus süreleri kısalınca ovülasyon östrustan sonra gerçekleşir.

Çiftlik hayvanlarının fizyolojik yapı ve mekanizmalarının değişim sürecinde kazandıkları özellikler, birçok faktörün etkisi altında bulunmaktadır. Mevsime bağlı üreme döngüleri üzerindeki etkili faktörler arasında, gün ışığının değişimi olan fotoperiyot, havanın sıcaklığı, nem miktarı, düşen yağış miktarı, beslenme durumu, kuzulama zamanları ve laktasyon periyodu önemli rol oynamaktadır (Kaymakçı, 2012; Rosa and Bryant, 2003; Yıldız et al., 2002). Koyunlar, tropikal bölgelerde yıl boyunca östrus dönemine sahiplerken, ülkemiz gibi kuzey yarımkürede bulunan bölgelerde mevsime bağlı poliöstrik hayvanlar olarak kabul edilir ve genellikle yaz sonu veya sonbahar başlangıcında üreme sezonuna girerler (Yılmaz, 1999).

Falcon et al. (1997) tarafından belirtildiği gibi, yaz döneminde günlerin uzun ve gecelerin kısa olması, melatonin salınım süresinin kısalacağını gösterir. Bu nedenle, melatonin bir mevsim habercisi gibi davranır. Koyunlarda, Gökdal ve Baş (1996) tarafından yapılan çalışmalara göre, günlük olarak 3-4 mg melatonin hormonunun yaklaşık 45 gün boyunca yemlere eklenmesi, mevsimsel çiftleşme aktivitesine müdahale edebilir. Bu işlem genellikle deri altına yerleştirilen kulak implantlarıyla kolaylıkla uygulanır. Melatonin, koyunlarda üreme fizyolojisi üzerinde etkili olmasının yanı sıra, progesteronun yıllık ritmini ve luteal fonksiyonunu da düzenler. Alfonso et al. (2003) tarafından yapılan araştırmalar, melatonin hormonunun dişide gebeliğin oluşumunu, embriyo gelişimindeki değişiklikleri ve fertilite oranını etkilediğini düşündürmektedir.

Östrus sikluslarının senkronizasyonu, östrusun başlangıcında ve yapay tohumlama (AI) zamanında gruplandırmaya olanak tanır. Ovülasyon sürecinin uyarılmasıyla, doğurganlık artırılabilir ve erken laktasyon döneminde östrus gösteren dişilerde doğum arası süre yani generasyonlar arası süre azaltılabilir. Doğumdan sonra, birçok koyun ve keçi cinsinde bir geri dönem oluşur ve cinsel uyarının aşaması sadece günlük ışık süresinin kısalmasıyla birlikte sonbaharda başlar (Dardente et al., 2016; Đuričić et al., 2019; Luo and Sun, 2018; Ungerfeld, 2019).

Genel olarak, koyunlarda östrus senkronizasyonunda sentetik öncül hormonlar kullanılmakta olup, bu hormonların etkileri farklılık gösterebilir (Gül ve Erdoğan, 2021; Öztürkler, 2015 Kutluca, 2009; Gökçek et al., 2022). Bu nedenle, koyunlarda doğal hormon içeren uygulamalara verdikleri yanıtın belirlenmesi, östrus senkronizasyon uygulamalarının üreme performansı üzerindeki etkilerini değerlendirmek için son derece önemlidir.

Östrus senkronizasyonu, koyun ve keçi yetiştiricilerinin üreme yönetiminde kullandıkları önemli bir stratejidir. Bu yöntem, sürüdeki dişi hayvanların kızgınlık dönemlerini aynı zamana denk getirmeyi amaçlar. Östrus senkronizasyonu, yetiştiricilere bir dizi avantaj sağlar. Bunlar arasında hayvanların toplu olarak doğumlarını gerçekleştirmesi, üreme sezonunun kısaltılması,

suni tohumlama ve embriyo transferi gibi üreme tekniklerinin daha etkin bir şekilde uygulanabilmesi ve genetik ilerlemeyi hızlandırabilmesi sayılabilir. Döl verimi, hayvancılığın sürdürülmesinde önemli payı olan bir verimdir. Döl veriminin iyileştirilmesi için ıslah çalışmalarına ilave olarak farklı östrus senkronizasyonu metotları uygulanmaktadır. Koyun ve keçi yetiştiriciliğinin en önemli gelir kaynağı kuzu ve oğlak satışıdır. Döl verimini iyileştirme yönünde yapılacak uygulamalar giderek önemli hale gelmiştir.

Koyun yetiştiriciliğinde, döl veriminin arttırılması ve kızgınlıkların düzenleyen fotoperiyodik bir siklus düzeninden dolayı, ışık uygulamaları, besleme takviyeleri ve normal siklus döngüsünde farklı hormonların (Progestagenler, PMSG, GnRH, PGF2α) uygulanması ile kızgınlığın senkronize edilmesi sağlanabilir (Akdağ ve Akal, 2018). Pratikte kullanılan hormonlar şunlardır:

1. Progesteronlar (P4): Koyun ve keçilerde progesteron hormonu kullanılarak kızgınlık dönemi düzenlenebilir ve döl verimi artırılabilir. Progesteronlar genellikle oral yolla yemlere katılarak veya rumende eriyebilir cam kapsüller şeklinde verilebilir.
2. Östrojenler: Östrojen hormonları da kızgınlık dönemi düzenlemek ve döl verimini artırmak için kullanılabilir. Östrojenler genellikle enjeksiyon yoluyla uygulanır.
3. Prostaglandin F2α ve analogları: Prostaglandin hormonları, kızgınlık dönemini tetiklemek ve senkronize etmek için kullanılır. Enjeksiyon yoluyla uygulanabilirler.
4. PMSG (Pregnant Mare Serum Gonadotropin): PMSG veya eCG (Equine Chorionic Gonadotropin), yumurtlama ve döl verimini artırmak için kullanılan bir gonadotropin hormonudur. Enjeksiyon yoluyla uygulanır.
5. GnRH (Gonadotropin Releasing Hormon): GnRH, yumurtlama ve kızgınlık dönemi düzenlemek için kullanılan bir hormondur. Enjeksiyon yoluyla uygulanabilir.
6. hCG (Human Chorionic Gonadotropin): hCG, yumurtlama sürecini desteklemek ve döl verimini artırmak için kullanılan bir hormondur. Enjeksiyon yoluyla uygulanır.

Ayrıca, koyun ve keçi yetiştiriciliğinde melatonin gibi diğer hormonlar veya bu hormonların kombinasyonları da kullanılabilir. Hormonlar genellikle yemlere oral yolla katılarak, enjeksiyon yoluyla, deri altı implantasyon veya vajinal sünger veya CIDR (progesteron emdirilmiş silikon bir elastomerden yapılmış aygıt) kullanılarak verilebilir (Skliarov et al., 2021; Öztürkler, 2015; Hamra et al., 1989; Yu et al., 2022).

Çoğu koyun üreme yönetimi teknolojisi, östrus ve ovülasyonu indüklemeyi ve senkronize etmeyi hedefler, böylece mevsim dışı kuzulama mümkün olur (Gonzalez-Bulnes et al. 2020). İndüklenen östrus ve senkronize üreme, kuzuların ve koyunların aynı düzeyde süt üretmesine,

işçilik maliyetlerini azaltmasına ve yavrulama ve doğurma zamanlarını kontrol etmesine olanak sağlar ki; bu da koyunlarda progestojenler, prostaglandin (PGF2α) ve Equine Chorionic Gonadotropin (eCG) gibi hormonlarla gerçekleştirilir (Habeeb and Kutzler, 2021, Reyes-Ramirez et al. 2021). Gonadotropin salgılatıcı hormon (GnRH) veya Human Chorionic Gonadotropin (hCG) enjeksiyonları, çiftleşme sırasında veya hemen sonra embriyo ve fetüs kaybını önlemek veya koyun üreme özelliklerini artırmak için uygulanır (Rostami et al., 2017). Ek bir çalışma, bir progesteron yüklü CIDR cihazı ile birlikte uygulanan tek doz GnRH'nin, folikül dalga çıkışını senkronize etmek için kısa süreli bir protokol altında koyun üreme teknolojilerinde yumurtalık yanıtını iyileştirdiğini göstermiştir (Año-Perello et al., 2020).

Kızgınlık senkronizasyon uygulamalarında kısa ve uzun süreli uygulamalar yapılmaktadır. Kızgınlık senkronizasyon metotlarında östrus oranları yüksek olmasına rağmen gebelik oranı ırk, mevsim, iklim, çevresel etkiler ve tohumlama yöntemlerine göre değişebilmektedir. Genellikle koyunlarda kısa süreli kızgınlık senkronizasyonunun daha iyi sonuçlar verdiği bildirilmektedir (Öztürkler, 2015). Kıl keçisi yetiştiriciliğinde, oğlak satışı en önemli gelir kaynaklarından biridir. Döl verimini artırmak için yapılan uygulamaların yanı sıra saha çalışmaları da önemli bir etkiye sahip olacaktır (Şirin et al., 2020). Koyun ve keçi eti ve sütü ile diğer yan ürünleri, hayvansal protein kaynağı olarak insan beslenmesinde önemli bir yere sahiptir. Bu nedenle, döl verimini artırmak amacıyla farklı yöntemlerin kullanımı gündeme gelmiştir.

KIZGINLIK SENKRONİZASYONUNDA HORMONAL METOTLAR

Sentetik progestagenler (megestrol asetat, dimol, amol, vb.) oral veya intravajinal olarak uygulanabilir. Oral yol en az işgücü gerektiren yöntemdir. İlaç tuzla karıştırılır ve daha sonra yemle karıştırılır veya etil alkolle çözündürülerek toz haline getirilip yeme karıştırılır. Bu tedavi günlük olacak şekilde, 8-10 gün boyunca uygulanmalıdır, ancak bu uygulama yoluyla tedavi edilen tüm hayvanlarda gereken dozun tam tüketimini garanti etmez (Skliarov, 2021).

Küçükbaş ruminantlarda progestagen takviyesi için intravajinal cihazlar daha sık kullanılmaktadır. Progestagenik preparasyonun alkol veya propilen glikol çözeltisi ile emdirilmiş ince gözenekli bir sünger ile yaklaşık 10-14 gün boyunca uygulanabilir. Bu yöntemde, süngerler progestagen (100-500 mg), megestrol asetat (30 mg), kronolon (30 mg), dimol (10-15 mg) ve diğerleri gibi belli oranlarda emdirilerek kullanılır. Bir ipek ip, süngere 15-20 cm uzunluğunda dikilir ve vulvadan 2-3 cm dışarıda kalacak şekilde bırakılır, böylece süngeri kolayca vajinadan çıkarabilirsiniz. Sünger çıkarıldığında, 700-1200 IU eCG deri altına enjekte edilir. 48 saat sonra, dişiler östrüs belirtileri gösterir ve suni tohumlama yapılabilir. İlk eCG enjeksiyonundan sonra kızgınlık belirtisi göstermeyen dişiler 16 gün sonra tekrar tedavi

edilebilir, ancak hayvanların bir grup olarak yönetilmesi, bireysel veya küçük gruplar için tedavinin tekrarlanmasını zorlaştırmakta ve pratik olmamaktadır. Küçükbaş ruminantlarda üreme mevsiminin başında hormon stimülasyonunun etkinliği, mevsimin sonunda olduğundan çok daha düşüktür. Laktasyondaki dişilerde, östrüs stimülasyonunun ve doğurganlığın, laktasyon olmayan hayvanlara göre daha düşük olduğu gözlemlenmiştir. Doğumdan bir ay önce küçükbaş ruminantlarda östrüs indüklenmesi önerilmez, çünkü uterusun yetersiz involüsyonu sonucunda doğurganlık çok düşük olur (%10-35).

Günümüzde, progestagen uygulaması için poliüretan süngerler veya belirli miktarda progesteron veya sentetik analoglarının emdirildiği silikon elastik cihazlar kullanılarak ileri yöntemler geliştirilmiştir. Genellikle bu amaçlarla fluorogeston asetat veya medroksiprogesteron asetat kullanılır ve bu intravajinal cihazlar için farklı ticari isimler kullanılır (süngerler veya spiraller): "Chronogest", "Veramix", "Ovakron", "Syncrite", "CIDR–G" (Powell et al., 1996; Skliarov et al., 2021; Romano, 1998). Bu intravajinal cihazlar genellikle eCG ile birlikte 9 ila 19 gün boyunca kullanılır ve genellikle cihazların çıkarılmasından önce veya 48 saat içinde uygulanır. Östrüs senkronizasyonu, süngerlerin veya spirallerin çıkarılmasından sonra 24-48 saat içinde hayvanların %90'ında östrüs gerçekleşir (Skliarov et al., 2021).

Koyunlar mevsimsel olarak çiftleşen hayvanlardır ve kısa gün ışığında aktif olarak üreme yaparlar (Carvajal-Serna et al., 2018). Bu nedenle, östrus senkronizasyonu gibi yardımcı üreme biyoteknolojileri, östrus ve anöstrus dönemlerinde genetik kaybı önlemek ve üreme verimliliğini artırmak amacıyla kullanılabilir (Kasimanickam et al., 2021). Progestagen-gonadotropin, melatonin ve norgestomet implantları, Kontrol Intravajinal İlaç Salımı (CIDR) tabanlı protokol (Martinez-Ros and Gonzalez-Bulnes, 2019) gibi birçok senkronizasyon yöntemi küçükbaş hayvan üretiminde kullanılmaktadır. Bu östrus senkronizasyon yöntemleri kısa süreli (6 - 11 gün) ve/veya uzun süreli teknikler (12 - 19 gün) ile uygulanır (Boscos et al., 2002; Ramukhithi et al., 2012; Uslu et al., 2012).

Küçükbaş hayvanlarda üreme dönemi dışında kızgınlık senkronizasyonunda en etkin uygulamalardan biri fotoperiyodik uygulamalardır. Fotoperiyodik uygulamalar ile melatonin hormonu ve Progestagen kullanımı söz konusudur. Üreme döneminde ise Progesteron, Progesteron + PMSG, Melatonin, Melatonin + Progesteron, Melatonin + Progesteron + PMSG yöntemleri uygulanmaktadır. Irklara yönelik farklı senkronizasyon protokolleri uygulanması yönünde araştırmalar devam etmektedir. Bu protokollerin tespit edilerek uygulanması döl verimine olumlu katkı yapacağı bildirilmektedir (Akdağ ve Akal, 2018). Küçükbaş hayvanlarda kısa süreli hormon uygulamaları ile kombinasyonları son yıllarda daha fazla kullanılmaktadır.

Döl verimini arttırmak için kızgınlık senkronizasyonunda özellikle progesteron ve progestagen sünger veya implantlarına ilave olarak PGF2α ve PMSG, eCG ve GnRH gibi hormon kombinasyonları uygulanmaktadır (Öztürkler, 2015; Gül ve Erdoğan, 2021).

Melatonin hormonu, koyun ve keçide üremeyi etkileyen bir hormondur. Bu etki ticari formlarının kullanımını artırmıştır. Genellikle melatonin hormonu implantları yaygın kullanılmaktadır. Bu hormon, küçükbaş hayvanlarda kızgınlık dönemini erkene çekerek, ovülasyon ve ikizlik oranını ve embriyo yaşamını olumlu etkilemektedir (Akdağ ve Akal, 2018). Özmen (2021) tarafından yapılan çalışmada İvesi koyunlarında koç katım dönemi dışında progesteron ve PMSG uygulaması ile kızgınlık uyarılmıştır. Çalışmada kızgınlığı tespit edilen koyunlara suni tohumlama yapılmıştır. İntraservikal tohumlamaların süresi gebelik oranında fark oluşturmamıştır. Fakat kızgınlık belirlendikten sonra 21-24 saat sonra suni tohumlama yapılması önerilmiştir (Özmen, 2021).

Kilis keçilerinde östrus senkronizasyonu uygulanan bir çalışmada, 13-15 aylık çebiçe, üreme sezonu dışında 11 gün süreyle progesteron emdirilmiş süngerler (20 mg flugestone acetate) kullanılarak ve süngerin çıkarılmasından 2 gün önce PGF2α (125 mcg cloprostenol) uygulanarak çalışma gerçekleştirilmiştir. Bu çalışmada, iki farklı zamanda eCG (500 IU) uygulaması yapılmıştır. Sünger çıkarılmasından 48 saat önce eCG (500 IU) uygulamasının gebelik oranını artırabileceği ve ekonomik verimlilik süresini uzatabileceği belirtilmiştir (Özmen ve ark., 2021).

Kıvırcık koyunlarında yapılan 5 gruplu bir çalışmada, I. grupta 18 mg melatonin içeren Regülin implantı kulak arkası deri altına uygulanmıştır. II. grupta CIDR (Controlled Internal Drug Release) aparatı intravajinal olarak 12 gün boyunca kullanılmış ve çıkarıldığı gün koyunlara 500 IU PMSG (Pregnant Mare Serum Gonadotropin) kas içi olarak uygulanmıştır. III. grupta ise 20 mg flugeston asetat emdirilmiş süngerler intravajinal olarak 14 gün süreyle yerleştirilmiş ve çıkarıldığı gün koyunlara 500 IU PMSG kas içi olarak uygulanmıştır. IV. grupta ise 11 gün arayla iki doz halinde deri altına PGF2α (Prostaglandin F2α) (3 cc) enjeksiyonu yapılmıştır. V. grup ise herhangi bir uygulama yapılmayan kontrol grubu olarak değerlendirilmiştir. Bu çalışmada, kuzulama oranı sırasıyla %80, %95, %88, %92 ve %76 olarak belirlenmiştir. Ayrıca çoğuz doğum oranı, KKBDKS (Koçaltı Koyun Başına Doğan Kuzu Sayısı), DKBDKS (Doğuran Koyun Başına Doğan Kuzu Sayısı) ve yaşama gücü de değerlendirilmiştir (Duymaz ve Koyuncu, 2021). Üreme sezonu dışında östrüsleri uyarılan koyunlarda, kısa süreli intravaginal progestagen ve PMSG kombinasyonuna ek olarak non-spesifik immunmodülatörün etkisi incelenmiştir. Bu çalışmada, immunmodülatör ilavesinin gebelik

oranında artışa neden olduğu ve östrüs oranı ile vaginal akıntı skoruna etkisi olduğu bulunmuştur (Doğan ve Kutlu, 2022).

2022 yılında Gökçek ve arkadaşları tarafından gerçekleştirilen bir araştırma, Akkaraman koyunlarında progestin kaynağının üreme performansı, kuzu doğum ağırlığı ve kuzu ölüm oranı üzerindeki etkisini incelemek amacıyla yapılmıştır. Araştırmada, 51.3 ± 1.5 kg vücut ağırlığına sahip ve en az iki doğum yapmış 40 adet Akkaraman koyunu deneme hayvanı olarak kullanılmıştır. Tüm koyunlara, östrus senkronizasyonundan 96 saat önce korpus luteum regresyonu elde etmek için intramusküler PGF2α (2.5 mg) enjeksiyonu yapılmıştır. Koyunlar, vücut ağırlığı ve yaşlarına göre rastgele olarak iki gruba ayrılmıştır. İlk gruptaki koyunların (n=20) östrüsleri, 0.30 g doğal progesteron içeren intra-vajinal CIDR cihazı ile senkronize edilmiştir. İkinci gruptaki koyunların (n=20) östrüsleri ise, 30 mg flugestone asetat içeren intra-vajinal sünger ile senkronize edilmiştir. CIDR ve sünger, 12 gün sonra çıkarılmış ve intramusküler olarak 600 IU PMSG enjekte edilmiştir. Enjeksiyonlardan 24 saat sonra, tüm koyunlar Akkaraman koçlarıyla bir araya getirilmiş ve östrüste olan koyunlar kaydedilmiştir. Araştırma sonucunda, Akkaraman koyunlarında doğal ve sentetik progesteron uygulamaları arasında östrüs oranı, gebelik oranı ve gebelik süresi açısından anlamlı bir farklılık tespit edilmemiştir. Ancak, CIDR uygulaması Akkaraman koyunlarında toplam ve çoklu kuzu doğum oranlarını artırmıştır ($P<0.05$). Bu sonuçlar, CIDR cihazının PMSG ile birlikte kullanılmasının Akkaraman koyunlarında kuzu üretiminde başarı oranını artırabileceğini göstermiştir.

Fransa'da, koyun ve keçilerde östrusu senkronize etmek için en yaygın yöntem, 11 gün süreyle 45 mg fluorogestone asetat içeren intravajinal süngerlerin kullanılmasıdır. Ardından, süngerin çıkarılmasından 48 saat önce hayvanlara 400-600 IU eCG ve bir kez uygulanan 50 µg cloprostenol (Prostaglandin F2α'nın sentetik bir analoğu) verilmiştir. Bunun ardından, östrüs belirtileri göstermeksizin sünger çıkarıldıktan 43-45 saat sonra soğutulmuş veya dondurulmuş spermlerle bir kez suni tohumlama yapılmıştır. İkinci tedaviden sonra dondurulmuş-çözünmüş spermlerle iki kez suni tohumlama yapılan keçiler (n=6970), ilk tedaviden sonra aynı koşullarda suni tohumlama yapılan keçilere (n=6240) göre daha verimli oldukları: sırasıyla %61.1 ve %56.7; ($P<0.01$). İkinci tedavinin uygulanmasından sonra, indüklenen östrus sırasında bir kez suni tohumlama yapılan keçiler (n=10,621), aynı dondurulmuş-çözünmüş spermlerle iki kez suni tohumlama yapılan keçilere (n=6970) göre daha verimli: sırasıyla %63.0 ve %61.1; ($P<0.01$) bulunmuştur. Alp keçilerinde, tedavilerin 10:00-14:00 saatleri arasında sonlandığı durumlarda doğurganlık oranı, 15:00-21:00 saatleri arasında sonlandığı durumlardan daha yüksek gerçekleşmiştir: sırasıyla %65.7 (n=4338) ve %60.7 (n=2671); ($P<0.01$) (Corteel et al., 1988).

Amerika Birleşik Devletleri'nde küçükbaş hayvanlarda kullanılan yaygın sistemler, sığırlar için geliştirilen Syncro-mate-B (SMB; Rhone-Merieux, Athens, GA) sistemi ile temin edilen norgestomet kulak implantına dayanır. Sığırlar için kullanılan implant, sentetik progestagen olan norgestometin (17α-acetoxy-11β-methyl-19-pregn-4-ene-3,20-dione) 6 mg içerir, ancak koyun ve keçilerde kullanıldığında genellikle yarısı veya üçte biri kadar kullanılır. Bu implant, koyunlara 9-14 gün süreyle yerleştirilir ve implantın çıkarılmasından 2 gün önce veya çıkarma sırasında eCG veya prostaglandin ek olarak uygulanır. Bu tedaviden sonra östrus başlangıcı, mevsim, ırk ve doza bağlı olarak hayvanların %62 ila %100'ünde kızgınlık gözlemlenmiştir (Gonzales-Reyna et al., 1999; Mellado and Valdez 1997).

Cardwell et al. (1998)'de yaptıkları bir araştırmada Norgestomet implantı (6 mg) uygulanmış Dorset ve Rambouillet × Dorset koyunlarda östrusun ve ovülasyonun zamanlaması bir telemetrik HeatWatch östrus tespit sistemi ve transrektal ultrasonografi kullanılarak değerlendirmişlerdir. Çalışmada koyunların %84'ünde östrus tespit edilmiştir. Mevsim (ilkbahar ve sonbahar), olayların zamanlaması üzerinde bir etkiye sahip olmadığı; ancak, PMSG (500 IU) ile birlikte tedavi, sadece implant uygulanan koyunlara göre ovülasyonu 79.8'den 68.6 saate ve östrus başlangıcını 46.0'dan 32.6 saate kadar ($P<0.01$) öne çekmiştir. Norgestomet implantasyonunu takiben LH pikinin meydana geldiği zamanlama (11 gün boyunca 3 mg norgestomet, 400 IU PMSG ve implant çıkarılmasından 48 saat önce 50 µg cloprostenol ile) implantasyonun 9. gününde iki veya daha fazla Corpus Luteum varlığında (46.9 saat) 0 ve bir Corpus Luteum (sırasıyla 42.5 ve 42.2 saat) olan duruma göre gecikmiştir ($P<0.05$), ancak tedavinin başlangıcında Corpus Luteum sayısı üzerinde etkisinin olmadığı tespit edilmiştir (Freitas et al., 1996). Tedavinin başlangıcındaki Corpus Luteum sayısı östrusun başlangıcını etkilememiş, her iki gündeki folikül populasyonları da östrusun zamanlaması ve LH salınımı üzerinde etkili olmamıştır.

Motlomelo et al. (2002) tarafından yapılan bir çalışmada ise keçilerde doğal çiftleşme mevsimi sırasında östrus senkronizasyonu için medroksiprogesteron asetat, fluorogeston asetat süngerleri ve kontrollü içerik salım (CIDR) cihazlarının etkinliği değerlendirmişlerdir. Üç progestojen tedavisi arasında östrus yanıtında (yaklaşık %97) ve indüklenen östrus süresinde (33.3±13.4 saat) anlamlı farklılık gözlenmemiştir. Östrus başlangıç süresi CIDR grubunda (27.2±0.4 saat) fluorogeston asetat (30.9±0.4 saat) ve medroksiprogesteron asetat (32.2±0.5 saat) gruplarına kıyasla anlamlı olarak daha kısa bulunmuştur. CIDR grubunda tedavi günlerinin 4. ile 16. günleri arasındaki serum progesteron konsantrasyonları, medroksiprogesteron asetat ve fluorogeston asetat gruplarına kıyasla daha yüksek olarak belirlenmiştir ($P<0.05$). Suni tohumlama (AI) sonrası 40 gün içinde gebelik oranında (sırasıyla

CIDR, medroksiprogesteron asetat ve fluorogeston asetat grupları için %52, %60 ve %47) anlamlı farklılık gözlenmemiştir. Sonuçlar, keçilerde östrus senkronizasyonu için medroksiprogesteron asetat, fluorogeston asetat ve CIDR intravajinal progestojen tedavilerinin eşit derecede etkili olduğunu göstermiştir.

Naimi koyunlarında ikiz doğum ve cinsiyet önseçimi için CIDR veya Sünger ile hormon enjeksiyonu arasındaki karşılaştırmasının yapıldığı çalışmada Naimi koyunlarında östrus senkronizasyonu, doğum oranı, ikiz doğum ve cinsiyet önseçimi oranını indüklemek için CIDR veya süngerlerin, sırasıyla PMSG ve GnRH enjeksiyonlarıyla karşılaştırılmasını amaçlamışlardır. Bu çalışmada, 86 Naimi koyunu dişi ve doğurganlığı kanıtlanmış altı erkek koç kullanılmıştır. Sonuçlar, ilk CIDR grubundaki koyunların en yüksek doğurganlık oranına sahip olduğunu göstermiştir, 26/28 (%92.59). Yavruların cinsiyet oranı 22/35 erkek (%62.85) ve 13/35 dişi kuzulardır (%37.14). İkizlik oranları 9/22 (%34.4) olup, 14 erkek (%77.77) ve 13 dişi (%37.14) kuzu üretmiştir. İkinci sünger grubundaki koyunların doğurganlık oranı 16/26 (%61.53) olarak belirlenmiştir. Bu grup, toplam kuzuların en düşük oranını 20/92 (%21.73) üretmiş ve cinsiyet oranları 11/20 erkek (55.0%) ve 9/20 (45.0%) dişi kuzulardan oluşmuştur. İkizlik oranları 4/22 (%25) olup, iki erkek ve iki dişi ikiz içermektedir. İkizlik cinsiyet oranları altı erkek (%77.77) ve iki dişi (%22.34) kuzulardır. Sonuç olarak, CIDR kullanımı, hormon enjeksiyonuyla birlikte üreme yönetimi, erkek doğum oranı ve cinsiyet önseçimi oranı için daha iyi olduğu belirlenmiştir (Alhimaidi et al., 2023).

Hu koyunlarında östrus senkronizasyonunun beş farklı protokolünü karşılaştırarak en etkili ve ekonomik protokolü belirlemek ve avantajlı düzenlemeyi büyük ölçekli koyun yetiştiriciliğinde uygulamak için yaptıkları bir araştırmada. Sağlıklı çok doğurgan Hu koyunları (n = 150) rastgele beş gruba ayrılmış ve tüm koyunlara fluorogestone asetat (FGA, 45 mg) vajinal sünger uygulanmıştır. İlk üç grup (Grup I, II ve III) süngerler on birinci gün çıkarılmış ve dokuzuncu günde intramüsküler olarak 0.1 mg PGF2a enjekte edilmiştir. Grup I, sünger çıkarılmasından 36 saat sonra 6 µg gonadotropin salgılatıcı hormon (GnRH) intramüsküler enjeksiyon yapılmıştır. Grup II, dokuzuncu günde 330 IU gebe kısrak serum gonadotropin (PMSG) enjekte edilmiştir. Grup III'de, 6 µg GnRH ve 330 IU PMSG kombinasyonu, Grup I ve Grup II ile aynı anda uygulanmıştır. Son iki grubun (Grup IV ve V) süngerleri on üçüncü gün çıkarılmış ve 330 IU PMSG intramüsküler olarak aynı anda enjekte edilmiştir. Grup IV'de 12. günde 0.1 mg PGF2a uygulanmıştır. Tüm koyunlar sünger çıkarılmasından 24, 36, 48, 60 ve 72 saat sonra östrusa girdikleri tespit edilmiştir. Sünger kaybı ve vajinitis süngeri çıkarılırken kaydedilmiştir. Dorper koçlarının taze semeni ile servikal suni tohumlama (AI) yapılmıştır. Tohumlamadan 30 gün sonra, gebelik veteriner B-ultrason cihazı ile tespit edilmiştir. Tüm koyunların doğum

durumu ve her grupta östrus senkronizasyonu için ilaç maliyeti kaydedilmiştir. Sonuçlar: Genel olarak, sünger çıkarıldıktan sonra 24-36 saat ve 36-48 saat arasındaki östruslu koyunların ortalaması diğer üç dönemden önemli ölçüde yüksek bulunurken, 60-72 saatlik dönemin oranı ilk üç dönemden önemli ölçüde düşük bulunmuştur. Beş zaman dilimindeki östruslu koyunların yüzdelik oranlarında, sünger kaybı oranında, vajinitis oranında, toplam östruslu koyun yüzdesinde, gebe kalma oranında, tek doğum oranında, ikiz doğum oranında ve çoklu doğum oranında herhangi bir anlamlı farklılık bulunmamıştır. Toplam östruslu koyun yüzdesi ve gebe kalma oranı Grup II ve III'de %80 daha fazla bulunmuştur ve Grup II protokolünde ikizlik doğum oranı %70'tir. Koyunların doğum oranında Grup II, III, IV ve V arasında fark bulunmamıştır. Grup III'ün ilaç maliyeti en yüksek bulunmuştur (22.5 CNY). Sonuç olarak, doğum oranı, ikiz doğum oranı ve östrus senkronizasyonu için ilaç maliyeti göz önüne alındığında, Grup II, bu beş protokol arasında büyük ölçekli koyun çiftliklerinde uygulanması ve yaygınlaştırılması için en uygun olduğunu belirlemişlerdir (Yu et al. 2022).

Koyunlarda progesteron cihazlarının yeniden kullanılması ve eCG ile östrus senkronizasyonu gerçekleştiren bir araştırmada ise yeniden kullanılan progesteron cihazlarına (kontrollü iç ilaç salımı (CIDR)) dayalı uzun senkronizasyon protokollerinin farklı dozlarda equine chorionic gonadotropin (eCG) ile ilişkilendirilerek melez koyunlarda (Suffolk × Kathadin × Dorset) üreme değişkenleri üzerindeki etkisini belirlemişlerdir. CIDR, aynı sürüden gelen koyunlarda bir önceki çalışmada 11 gün boyunca kullanıldıktan sonra yıkanıp dezenfekte edilmiş ve yeniden kullanılmıştır. Üreme mevsimindeki 64 koyun dört deney grubuna (n=16) rastgele olarak atanmıştır. Tedaviler, 10 günlük CIDR ve 300 IU eCG ile bir grup; 10 günlük CIDR ve 400 IU eCG ile bir grup; 12 günlük CIDR ve 300 IU eCG ile bir grup; ve 12 günlük CIDR ve 400 IU eCG ile bir grup olarak yapılmıştır. Tamamen rastgele bir tasarım kullanılmıştır. Tüm tedavilerde östrus gösterme oranı %100 olarak tespit edilmiştir. Östrusun başlangıcı, gebelik oranı, doğurganlık oranı, doğurma şekli ve üreme indeksi gruplar arasında eşit olarak bulunmuştur. Progesteron serum konsantrasyonu, 10 günlük CIDR gruplarındaki koyunlarda daha yüksek. İkinci kez kullanılan CIDR'ler, koyunlarda östrus senkronizasyonu için 300 veya 400 IU eCG ile birlikte iyi gebelik oranları elde etmek ve daha yüksek üreme oranları sağladığını bildirilmiştir (López-García et al., 2021).

Koyunlarda östrus indüksiyonu ve senkronizasyon protokollerine maruz kalanlarda tükürük kristalleşmesinin incelendiği bir çalışmada. Bedensel sıvıların, özellikle tükürüğün kristalleşmesi, birçok türde incelenen bir konu olmuştur ve östrusu tespit etmek için basit bir alternatiftir çünkü bu inceleme için önemli bir mali yatırım veya uzman kişilere ihtiyaç duyulmaz. Papatya desenli kristalleşme, servikal ve burun mukusu, tükürük ve gözyaşı salgısı

ile kolostrumda tanımlanmıştır. Üreme döngüsü sırasında tükürük kristalleşmesindeki değişiklikler, bu dönemdeki farklı hormon konsantrasyonlarıyla ilişkilendirilmiştir. Bu nedenle, yapılan bir çalışma östrus indüksiyonu ve senkronizasyon protokollerine maruz kalan koyunlarda tükürük kristalleşme desenlerini değerlendirmiştir. Deneme, 11 melez Corriedale koyundan oluşturulmuş ve iki deneme döneminde (ilkbahar ve sonbahar) değerlendirilmiş ve östrus indüksiyonu ve senkronizasyon protokollerine tabi tutulmuştur. Rastgele bir östrus döngüsü evresinde (gün 0), her bir koyun 7 gün boyunca 0.36 g progesteron içeren bir intravajinal cihaz (Primer®) ile implant edilmiştir. Bu cihaz, üreticinin talimatlarına göre ve özel bir aplikatörün yardımıyla yerleştirilmiştir. Cihazın çıkarılma gününde (gün 7), hayvanlara 0.0375 mg D-Kloprostenol (Prolise®) ve domuz hipofizinden (Folltropin-V'nin NIH-FSH-P1'i) elde edilen 10 mg Folltropin® intramüsküler olarak uygulanmıştır. Tükürük, deneme dönemleri boyunca altı noktada toplanmış: gün 1 (implant yerleştirilmesinden 3 gün önce); gün 4 (implantın yerleştirildiği gün); gün 9 (implantın yerleştirilmesinden 5 gün sonra); gün 11 (implantın çıkarıldığı ve hormonların uygulandığı gün); gün 12 (implantın çıkarılmasından 24 saat sonra [muhtemel östrus]); ve gün 13 (implantın çıkarılmasından 48 saat sonra). 10 µL tükürük içeren yaymalar, tükürük kristalleşmesinin değerlendirilmesi için bir optik ışık mikroskobu altında (x200) incelenmiştir. Tükürük kristalleşmesi, slaytta gözlenen kristalleşmenin yayılımına göre 0 ile 3 arasında puanlanarak sınıflandırılmıştır. Ayrıca, gözlem alanının (x200) doluluğu ve gözlenen ağaçlandırma deseninin türü de dikkate alınmıştır. Değerlendirme şu şekilde yapılmış: 0= kristalleşme yok; 1= çok az kristalleşme; 2= düşük kristalleşme ve 3= yoğun kristalleşme. Koyunlarda bulunan kristalleşme desenleri, östrus dönemine yaklaştıkça levhaların miktarında, çeşitliliğinde, tanımında ve boyutunda bir artış olduğunu ve literatürde tipik olarak tanımlananlardan farklı olduklarını göstermiştir. Tükürük kristalleşmesi desenleri, östrus indüksiyonu ve senkronizasyon protokolü tarafından tanımlanan östrus döngüsü evrelerini takip etmiştir (Gonçalves et al., 2020).

Üreme mevsimindeki kıl keçileri üzerinde gerçekleştirilen bir çalışmada, iki farklı progestagen olan flugeston asetat ve norgestomet uygulamalarıyla östrüs senkronizasyonu ve farklı zamanlarda yapılan servikal tohumlamanın başarısı değerlendirilmiştir. Çalışma, 2-5 yaş arasındaki 80 kıl keçisi üzerinde yürütülmüştür. Keçiler, tesadüfi örnekleme yöntemiyle iki eşit gruba ayrılmıştır. Vajinal sünger (FGA, n=40) veya kulak implantı (Nİ, n=40) ile 8 gün süreyle tedavi uygulanmıştır. Progestogen gereçlerinin çıkarılmasından 24 saat önce keçilere 200 IU PMSG ve 0.150 mg PGF2α kas içi enjeksiyon yapılmıştır. Östrüs gösteren keçiler FGA (n=36) ve Nİ (n=30) gruplarına göre alt gruplara ayrılmıştır. FGA1 (n=18) ve Nİ1 (n=15) gruplarına östrüslerin belirlenmesinden 12 saat sonra, FGA2 (n=18) ve Nİ2 (n=15) gruplarına ise östrüs

tespitinden 18 saat sonra intra servikal olarak tohumlama yapılmıştır. FGA1 (%77.8) ve FGA2 (%66.7) gruplarındaki keçilerde elde edilen gebelik oranı, kulak implantı grubu (Nİ1; %60.0, Nİ2; %53.3) keçilere göre daha yüksek bulunmuştur, ancak bu farklılık istatistiksel olarak önemsizdir. Sonuç olarak, üreme mevsimindeki kıl keçilerinde, vajinal sünger uygulamalarının östrüs senkronizasyonu ile birlikte gerçekleştirilecek sabit zamanlı suni tohumlamalar için kullanılabileceği sonucuna varılmıştır (Erarslan ve Karaca, 2017).

Koyunlarda suni tohumlama zamanının, östrusun başlangıç saati, östrus süresi, ovülasyonun gerçekleşme süresi ve spermatozoonların fertil yaşam süresi gibi faktörleri dikkate alarak gebelik oranını etkileyebileceği belirtilmiştir. Yapılan çalışmada, üreme mevsimi dışında progesteron içeren intravajinal sünger ve PMSG ile kızgınlığı uyarılan ivesi ırkı koyunlar için uygun suni tohumlama zamanının belirlenmesi amaçlanmıştır. Östrus tespit edilen koyunlar üç gruba ayrılmıştır. Östrus tespit edilen koyunlara sırasıyla 1. grup (n=30) 10-15 saat sonra, 2. grup (n=33) 16-20 saat sonra ve 3. grup (n=35) 21-24 saat sonra intraservikal yolla suni tohumlama yapılmıştır. Gebelik muayenesi, suni tohumlamadan 30-35 gün sonra ultrason ile gerçekleştirilmiştir. Elde edilen sonuçlara göre, ultrason muayenesi sonrası gebelik oranları sırasıyla %26.7, %39.4 ve %45.7 olarak bulunmuştur. Çalışma sonucunda, mevsim dışında östrus senkronizasyonu yapılan ivesi koyunlarda, östrus tespitinden 10-15 saat, 16-20 saat ve 21-24 saat sonra intraservikal suni tohumlamanın gebelik oranı üzerinde istatistiksel olarak anlamlı bir fark oluşturmadığı bulunmuştur (P>0.05). Ancak, gebeliğin ekonomik değeri ve çalışmadan elde edilen veriler göz önüne alındığında, kızgınlık tespitinden 21-24 saat sonra intraservikal suni tohumlamanın faydalı olabileceği sonucuna varılmıştır (Özmen, 2021).

Kaya ve arkadaşlarının (2003) yaptığı bir çalışmada, Kıvırcık koyunlarda melatonin ve progestagen süngerlerinin ayrı ayrı veya birlikte kullanımının üreme performansı üzerindeki etkileri araştırılmıştır. Çalışma, östrus dönemi ve laktasyon dönemi olmayan 40 koyun üzerinde gerçekleştirilmiştir. Haziran ayında, koyunlara melatonin (Regulin) implantları uygulanmıştır. Bu koyunlardan 20'sine ve başka 20 koyuna temmuz ayında progestagen (Synchron) süngerleri uygulanmıştır. Süngerler 14 gün sonra çıkarılmış ve koyunlara 600 IU pregnant mare serum gonadotropin (PMSG) verilmiştir. Kontrol grubu olarak bırakılan 20 koyun bulunmaktadır. Temmuz ayında tüm koyunlara koç katılmıştır. Melatonin, progestagen + PMSG, melatonin + progestagen + PMSG ve kontrol gruplarında doğum oranları sırasıyla %85, %90, %95 ve %75 olarak bulunmuştur. İkizlik oranları ise sırasıyla %52.9, %73.7, %61.1 ve %43.6 olarak tespit edilmiştir. Doğumlar koç katılımından sonraki 156 ± 6.24, 153 ± 6.07, 155 ± 7.33 ve 164 ± 12.03 günlerde gerçekleşmiştir ve doğumlar tedavi gruplarında 17.66 ± 3.51 gün, kontrol grubunda ise 33.07 ± 2.25 günlerde yoğunlaşmıştır. Koyun başına düşen canlı yavru sayısı

sırasıyla 1.47 ± 0.51, 1.44 ± 0.51, 1.47 ± 0.61 ve 1.43 ± 0.50 olarak belirlenmiştir. Sonuç olarak, üreme mevsimi başlangıcında, östrus dönemindeki koyunlarda, melatonin ve progestagen tedavilerinin ayrı ayrı veya birlikte kullanılması doğum oranını artırmakta ve doğumları toplulaştırmaktadır, böylece üreme mevsimi kontrol altına alınabilmektedir. Ayrıca, melatonin ve melatonin + progestagen + PMSG uygulamaları, klasik progestagen + PMSG uygulamalarına bir alternatif olarak düşünülebilir (Kaya ve ark., 2003).

Uyar ve Alan (2008) tarafından yapılan bir araştırmada, koyunlarda erken anöstrüs döneminde melatonin uygulamalarının ovülasyon ve gebelik üzerindeki etkisi araştırılmıştır. Çalışma, Van bölgesindeki 2-3 yaş arası 38 sağlıklı Akkaraman ırkı koyun üzerinde gerçekleştirilmiştir. İki sağlıklı fertil koç, doğal aşım yapmak için kullanılmıştır. Yirmi sekiz koyuna 18 mg melatonin içeren implantlar kulak derisi altına yerleştirilmiştir. On koyun ise kontrol grubu olarak seçilmiş ve herhangi bir uygulama yapılmamıştır. İki koça da aynı şekilde üçer adet (toplamda 54 mg melatonin) bu implantlardan yerleştirilmiştir. Implantlar yerleştirildikten sonra, sabah ve akşam olmak üzere günde iki kez koç taraması ile östrüs takibi yapılmış ve östrüste olan koyunlara aşılanmıştır. Aşılamalar tamamlandıktan 45 gün sonra gerçek zamanlı ultrasonografi ile gebelik muayeneleri yapılmış ve doğum kayıtları tutulmuştur. Melatonin ve kontrol gruplarındaki tüm koyunlardan, implant uygulama gününden itibaren haftada bir kez kan alınarak plazma progesteron seviyeleri ölçülmüştür. Plazma progesteron konsantrasyonları, EIA yöntemiyle belirlenmiştir. Sonuç olarak, erken anöstrüs döneminde melatonin ile östrüslerin uyarılması ve aşımların yapılması sonucunda %82.14 oranında gebelik elde edilirken, kontrol grubundaki koyunlarda normal üreme mevsimi gelene kadar herhangi bir siklik aktivite veya gebelik sağlanamamıştır. İmplant uygulamasının başlangıcından ilk östrüs başlangıcına kadar geçen süre, melatonin grubunda 60.8±0.42 gün olarak bulunurken, kontrol grubunda ise 138.0±1.56 gün olarak saptanmıştır. Doğu Anadolu Bölgesi'nde yer alan Van bölgesinde Akkaraman ırkı koyunlara Mayıs ayı ortalarında melatonin implant uygulamasının, östrüs ve ovülasyonları normal üreme sezonuna göre 2-2.5 ay öne çekebileceği ve yüksek oranda gebelik elde edilebileceği sonucuna varılmıştır (Uyar ve Alan, 2008).

Ungerfeld (2003) yaptığı bir çalışmada, koyunlarda koç katımından 3 veya 5 gün önce tek doz 2,5 mg MAP (Medroksiprogesteron) uygulamasının, 17-25 günler arasında östrus gözlemlenmesine neden olduğu ve diğer MAP dozlarıyla benzer etkilere sahip olduğu tespit edilmiştir.

Prostaglandin tabanlı östrüs senkronizasyonu sistemleri, CL'nin regresyonu aracılığıyla luteal fazı sonlandırarak östrus döngüsünü kontrol eder. Bu yaklaşım sadece döngüsel dişilerde uygulanabilir olup bu nedenle prostaglandin tabanlı sistemler koyun ve keçilerde üreme

mevsiminde kullanılmaktadır. İki yaygın olarak kullanılan ürün PGF2α (Lutalyse; Pharmacia & Upjohn) ve prostaglandin analogu olan cloprostenol (Estrumate; Bayer, Shawnee Mission, KS) bulunmaktadır. Östrus döngüsünün tüm evreleri benzer şekilde tedaviye duyarlı olmadığından, keçi ve koyunlarda genellikle aralarında 11 gün olan çift enjeksiyon sistemi en yaygın olarak kullanılan yaklaşımdır (Wildeus, 2000).

KIZGINLIK SENKRONİZASYONUNDA NON-HORMONAL METOTLAR

Kızgınlık Senkronizasyonunda Işık Etkisi

Koyun ve keçide foto periyodik etki ve melatonin üremenin mevsime bağlı olmasını sağlar. Bu etki, laktasyondaki ananın süt veriminin ve yavrusunun hayatta kalması için doğumun çevre sıcaklığının arttığı ilkbahar döneminde gerçekleşmesini sağlar. Aynı zamanda ilkbaharda yem temini kolaylaşır. Yeni uygulamalar ile kısa ve uzun gün ışık uygulamaları ile üremenin foto periyodik olarak kontrolü sağlanabilir. Ancak yapay ışık uygulamalarında, küçükbaş hayvanların kapalı ortamda tutulmalarından kaynaklı problemler bu uygulamaları sınırlı tutmaktadır. Işık uygulamaları, genotipik değeri yüksek koçlardan her mevsim semen toplamak amacıyla yapay tohumlama merkezlerinde kullanılmaktadır.

Aydınlatma

Gün uzunluğu, yani aydınlanma süresi, koyun ve koçların üreme davranışlarını etkiler. Bu konuda yapılan çalışmalar, gün uzunluğunun çiftleşme mevsimini ve koyunlardaki kızgınlık döngüsünü belirlemede önemli bir faktör olduğunu göstermiştir (Rosa and Byront, 2003). Koyunlar genellikle günlerin kısaldığı dönemlerde çiftleşme mevsimine girerler. Bu dönem genellikle sonbahar ve kış aylarına denk gelir. Günlerin kısalması ve gece süresinin artması, koyunlarda hormonal değişikliklere neden olur ve kızgınlık göstermelerine yol açar. Koyunlar, bu dönemde belirli bir mevsimde birbirini takip eden seriler halinde kızgınlık gösterirler. Bu doğal kızgınlık döngüsü, koyun yetiştiriciliğinde üreme yönetiminde dikkate alınır. Örneğin, çiftleşme mevsiminden önce, yapay ışıklandırma teknikleri kullanılarak gün uzunluğu suni olarak uzatılabilir. Bu, koyunlarda çiftleşme mevsimini öne çekmek ve üreme performansını artırmak için kullanılan bir yöntemdir.

Rosa and Byront (2003) tarafından yapılan çalışmalar, gün uzunluğunun koyunların üreme davranışları üzerinde önemli bir etkisi olduğunu ve çiftleşme mevsiminin gün uzunluğuyla ilişkili olduğunu göstermektedir. Bu nedenle, koyun yetiştiriciliğinde aydınlatma süresinin kontrolü ve yönetimi, üreme performansını etkileyen önemli bir faktördür. Aygün ve Gökdal (1996) tarafından yapılan çalışmalar, koyunlarda gün uzunluğunun mevsimsel üreme döngüsünün düzenlenmesinde önemli bir faktör olduğunu göstermektedir. Bu nedenle, koyun

yetiştiriciliğinde aydınlatma süresinin kontrol edilmesi ve gün uzunluğunun yönetimi, çiftleşme mevsimini ve üreme performansını etkilemek için kullanılan yaygın bir yöntemdir.

Kontrol edildiğinde, mevsimsel üreme döngüsüne sahip türlerde yumurtalık aktivitesinin erken başlatılması için aydınlatma kullanılabilir. Örneğin, koyun gibi günlerin kısalmasıyla çiftleşme mevsimine giren türlerde, bir barınak içinde ışıklandırma kontrol edilebilir. Yaklaşık 8-12 hafta süresince ışık miktarı azaltıldığında, bu hayvanların üreme döngüleri kontrol altına alınabilir. Bu yöntem, elit koyunlar veya süt keçilerinin üremesi için uygun olan işletmelerde uygulanabilir, ancak ticari ölçekte, özellikle yetiştirici sürülerinde uygulanması oldukça zordur. Ancak, geleneksel barınaklarda kış aylarında normal doğal aydınlatma ile birlikte yapay bir ışıklandırma kullanarak, yaklaşık 20 saatlik bir ışıklandırmaya maruz bırakılabilir ve daha sonra aniden yapay ışıklandırmayı keserek kısa ışıklandırmaya geçilebilir. Gün uzunluğunu yapay olarak azaltmak, koçların normal aşım mevsimi dışında üreme aktivitelerini artırabilir. Örneğin, Suffolk koçlarında gün uzunluğunda yapılan 18 saat ışık/6 saat karanlık oranından 9 saat ışık/15 saat karanlık oranına kadar bir azalma, testis aktivitelerinin artmasına katkıda bulunabileceği bildirilmiştir (Williams et al., 1992). Ayrıca, koyun ve koçlarda 3 veya 4 aylık süren sabit bir 16 saat ışık/8 saat karanlık ve 8 saat aydınlık, 16 saat karanlık uygulaması, eşeysel aktiviteyi etkileyebilir (Rosa ve Bryant, 2003). Bu şekilde yapay olarak gün uzunluğunu değiştirerek, koyun ve koçlarda üreme aktivitelerini düzenlemek mümkün olabilir.

Kızgınlık Senkronizasyonunda Koç ve Teke Etkisi

Koçların deriden ve göz çevresinden salgıladığı feromonlarla, uzun süre koçlardan izole edilen koyun sürüsü üzerinde etkili olduğu bildirilmiştir. Bu feromonlar, diğer türlerde olduğu gibi koyunlarda da vajinal salgı veya idrarda üretildiği belirtilen bazı feromonlar gibi benzer şekilde koçlar üzerinde etkili olabilir (Martin, 2001). Koyunlarda sosyo-seksüel iletişim açısından erkek-erkek, dişi-dişi ve erkek-dişi grup ilişkileri bulunur. Koçların, koyunlardan belirli bir süre ayrılma döneminden sonra sürüye yeniden katılması, ovülasyon üzerinde feromonal etkiler gösterebilir (Rosa ve Bryant, 2002).

Koç etkisi, koyunların anöstrus döneminde koç ile temas etmelerinden yaklaşık 18-25 gün sonra senkronize bir kızgınlık göstermelerini sağlayan feromonal ve davranışsal bir uyarımdır. Bu etki ilk olarak Avustralya'da Underwood ve arkadaşları (1944) tarafından uygulanmış ve koç etkisi olarak adlandırılmıştır. Ekonomik ve kolay bir yöntem olarak kabul edilen koç etkisi, anöstrus sezonu boyunca kullanılabilir (Gordon, 1997; Ungerfeld, 2003). Koç etkisinden yararlanmak için, koçların koyunlardan en az 6 hafta boyunca ayrı tutulması gerekmektedir. Koçlar, koyunlar tarafından görülmemeli ve kokuları alınmamalıdır. Bazı kaynaklar, koçların

koyunlardan ayrı bölmelerde tutulmasının yeterli olduğunu belirtirken, diğer kaynaklar ise 100-200 metre uzaklıkta olmalarının yeterli olduğunu söylemektedir (Gökdal, 1996).

Koyunlarda mevsimsel anöstrus döneminde, koç etkisiyle ovülasyon oranı %60 ile %90 arasında artırılabilir. Uyarıya tepki veren koyunların bir bölümü daha sonra anöstrusa geri dönebilir. Merinos koyunlarında yapılan bir çalışmada, koç etkisi kullanılarak ovülasyon oranı %80 ila %90 olarak artırılmıştır. Ancak, anöstrus dönemine geri dönen koyunların takip eden normal çiftleşme mevsiminde tekrar doğal olarak ovülasyon gösterdikleri gözlemlenmiştir (Oldham et al., 1985). Koç etkisini etkileyen faktörler arasında ırk, sürüdeki koç yüzdesi, doğum sonrası dönem, östrusta bulunan koyun yüzdesi ve anöstrus derinliği önemlidir (Yardımcı ve Şahin, 2003). Koç etkisiyle senkronizasyonun sağlanması ve yüksek düzeyde gebelik elde edilmesi için kullanılan koçların döllenme yeteneği de kritik öneme sahiptir (Kaymakçı ve Taşkın, 1995). Koçlar açısından, çiftleşme performansı çevresel faktörlere bağlı olarak önemli ölçüde değişebilir. Uygulamada, aşımın serin saatlerde gerçekleştirilmesi ve koçların yaz kısırlığından korunması, performansı olumlu yönde etkileyebilir.

KIZGINLIK SENKRONİZASYONUNDA YEM KATKISI VE VİTAMİN UYGULAMALARI

Hayvanlarda besin yetersizlikleri nedeniyle vitamin eksiklikleri görülebilmektedir. Küçükbaş hayvanlarda özellikle üreme dönemi, gebelik ve süt verim dönemleri beslemeye dikkat edilmelidir. Koyun ve keçilerde beklenen verimi elde etmek ve arttırmak için vitamin takviyeleri yapılması önemlidir.

Melengestrol Asetat (MGA) yem takviyesi, bu ürün, östrusu baskılamak için geliştirilen ve yemlik sığır hayvanlarında kullanılan oral olarak etkili bir sentetik progestagen olup aynı zamanda mevsimsel anövüler koyunlarda doğurgan bir östrusu indüklemek için de kullanılmıştır. Bu ürünün kullanımı, MGA içeren bir takviyenin günlük bir veya iki kez beslenmesini gerektirir ve süre genellikle 8 ila 14 gündür. MGA ile östrüs senkronizasyonu protokolleri genellikle PG-600 (PMSG/hCG; Invervet, Millsboro, DE) ve/veya Ralgro (zeranol; Pittman-Moore, Terre Haute, IN) ile birlikte yapılan eş zamanlı tedavileri içermiştir (Wildeus, 2000). Zeranol, sığırlar ve koyunlar için ticari olarak mevcut olan, LH ve FSH konsantrasyonları üzerinde östrojen benzeri etkileri olan bir büyüme uyarıcısıdır ve hem MGA beslenmesinin başlangıcında (Jabbar et al., 1994) hem de sonunda (Powell et al., 1996) uygulanmıştır.

MGA beslemesi kullanılarak yapılan östrüs senkronizasyonu deneylerinden elde edilen sonuçlar, mevsimsel anöstrusta, östrus yanıtı %13 ila %96 arasında değişmiş ve genellikle PMSG veya zeranol ile birlikte uygulandığında daha yüksek olmuştur. Benzer şekilde, MGA

beslemesinden sonra doğurganlık değişkenlik göstermiştir (%10 ila %75), bu da eş zamanlı tedavi ve erkek etkisine bağlıdır (Umberger et al., 1994). Zeranol, MGA besleme süresinin sonunda uygulandığında daha yüksek dozlarda senkronize östrus yanıtını artırmaya eğilim gösterse de, doğurganlık bu yüksek doz seviyelerinde (5 mg) düşmüştür ($P<0.05$) (Powell ve ark., 1996). Bu doğurganlık düşüşü, zeranol'ün MGA beslemenin başlangıcında uygulandığında gözlenmemiştir (Jabbar ve ark., 1994).

Küçükbaş hayvanlarda döl veriminin iyileştirilmesinde D vitamini uygulaması için yemlerin vitamin içeriği ve kanda D vitamini seviyesinin belirlenmesi kızgınlık senkronizasyonda olumlu etkilemiştir (Kaya ve Koçak, 2022). Doğum yapmış 80 Pırlak ırkı koyunun kullanıldığı bir çalışmada, Temmuz ayında kızgınlık senkronizasyonu üzerine vitamin A, D3 ve E'nin etkileri incelenmiştir. Koyunların östrüs senkronizasyonu için 20 mg kronolon içeren vagina içi sünger (Chronogest CR®) ve sünger çıkarılma anında 480 IU kas içi eCG (ChronoGest/PMSG® 6000 IU/25 ml) uygulanmıştır. Koç katımında, Grup 1'e (n=40) vitamin A (300.000 IU), D3 (100.000 IU) ve E (50 mg) kombinasyonu (Vigantol-E®, 1ml) kas içine enjekte edilirken, Grup 2'ye (n=40) herhangi bir uygulama yapılmamıştır. Östrüs, gebe kalma ve gebelik başına düşen yavru sayıları sırasıyla Grup 1'de %92,5, %87,5, 1,54; Grup 2'de ise %90, %75 ve 1,37 olarak belirlenmiş ve gruplar arasında istatistiksel olarak anlamlı bir fark bulunmamıştır ($P>0.05$). Yapılan çalışma sonucunda, Temmuz ayında Pırlak ırkı koyunlarda 11 gün süreli progesteron+eCG senkronizasyon yöntemi ile beklenen döl verim etkisi, elde edilmiştir (Birdane ve Avdatek, 2020).

Diğer bir çalışmada ise, CIDR (Controlled Internal Drug Release) içeren vitamin A, E + Se uygulamasının anöstrus dönemindeki Kıvırcık koyunlarda doğurganlık ve kuzu performansı üzerindeki etkilerini değerlendirmek amacıyla yapılmıştır. Koyunlar rastgele 5 gruba ayrılmıştır. Grup 1'deki hayvanlara, vajinaya 0.33 g progesteron içeren CIDR cihazı yerleştirilmiş ve ardından 14 gün sonra çıkarılmıştır. Vajinal aparatların çıkarılmasından sonra ve PGF2α enjeksiyonundan 20 koyuna kas içine 500 IU Pregnant Mare Serum Gonadotropin (PMSG) enjekte edilmiştir. Grup 2'deki hayvanlara CIDR + Vitamin A + Vitamin E uygulanmıştır. Grup 3'teki hayvanlara Vitamin A (2 ml/baş) uygulanmıştır. Grup 4'teki hayvanlara Vitamin E + Se (2 ml/baş) uygulanmıştır. Kontrol grubu olarak belirlenen grup 5 ise 18 koyundan oluşmuştur. Uygulamadan 24 saat sonra koçlar sürüye eklenmiştir. CIDR, CIDR + Vitamin A, E + Se, Vitamin A, Vitamin E + Se uygulanan koyunlar ve kontrol grupları için sırasıyla gebelik oranı (%95.0, %100.0, %100.0, %100.0, %83.3), kuzulama oranı (%95.0, %100.0, %100.0, %100.0, %83.3) ve doğurma oranı (%21.1, %30.0, %5.0, %10.0, %0.0) bulunmuştur. Sonuç olarak, CIDR, Vitamin A ve E + Se uygulamasının tek başına veya

kombinasyon halinde Kıvırcık koyunlarda üreme performansını iyileştirdiği sonucuna varılmıştır (Koyuncu et al., 2019).

Kaya ve Koçak (2022) tarafından gerçekleştirilen bir çalışmada, Romanov koyunlarında üreme mevsiminde senkronizasyon protokolüne başlandığı gün D vitamini enjeksiyonunun kuzulama performansı ve bazı fertilite parametreleri üzerindeki etkisi araştırılmıştır. Çalışma, 2-4 yaş arası 40 adet Romanov ırkı koyunda yapılmıştır. Senkronizasyon protokolüne başlandığı gün, birinci gruptaki koyunlara (n=23) D vitamini enjeksiyonu (1 ml, Provet-D3®, Provet, Türkiye) yapılırken, ikinci gruptaki koyunlara (n=17, kontrol grubu) 1 mL serum fizyolojik kas içine enjekte edilmiştir. Kızgınlıkları senkronize etmek amacıyla tüm koyunlara 14 gün süreyle vagina içine sünger (20 mg flugestone asetat, Chronogest®, Fransa) uygulanmış ve sünger çıkarıldıktan hemen sonra 300 IU gebe kısrak serum gonadotropini (eCG; Chrono-Gest/PMSG®, Almanya) kas içine uygulanmıştır. Her iki grupta da östrus (%100), gebelik (%100) ve kuzulama oranı (%100) benzer olarak belirlenmiştir. Ancak, D vitamini uygulanan grupta çoğul kuzulama oranının (%91,3) daha yüksek olduğu saptanmıştır. Ayrıca, D vitamini uygulanan grupta fekundite ve verimlilik oranının daha yüksek olduğu gözlemlenmiştir. Sonuç olarak, D vitamini uygulamasının senkronizasyon protokolü ile elde edilecek yavru veriminde artış sağlamaya yardımcı olabileceği düşünülmektedir. D vitamini enjeksiyonlarının fertilite parametreleri üzerindeki etkilerini daha iyi anlamak için daha kapsamlı çalışmalara ihtiyaç duyulduğu sonucuna varılmıştır (Kaya ve Koçak, 2022).

YENİ İLERLEMELER

Ovsynch

Günümüzde, sığırların senkronizasyonu için kolay, ekonomik ve etkili yöntemler geliştirilmiştir. Bu yöntemlerden biriside Ovsynch'tir. Bu program koyunlar ve keçiler içinde kullanılmaya başlanmıştır, Küçükbaş hayvanların ovülasyonlarını belirli bir zamanda toplamak amacıyla kullanılan bir yöntemdir. Bu yöntemde, GnRH (Gonadotropin Releasing Hormon) ve PGF2α (Prostaglandin F2α) kombinasyonları kullanılarak ovülasyonlar senkronize edilir ve sabit zamanlı suni tohumlama uygulaması gerçekleştirilir.

Bir çalışmada, bu yöntemlerden biri olan Ovsynch protokolünün koyunlara uyarlanması amaçlanmıştır. Çalışmada, 150 Tahirova koyunu ve 6 adet koç kullanılmıştır. Üreme mevsimindeki koyunlar rastgele 3 gruba ayrılmıştır. Her bir koyuna 0. gün GnRH ve 6. gün PGF2a+PMSG uygulanmıştır. İkinci gruptaki koyunlara 8. gün hCG, üçüncü gruptakilere ise 7,5. gün östradiol propionat (EP) ve 8. gün hCG enjekte edilmiştir. Aşımlar, birinci grupta ilk gün %68, ikinci gün %32 oranında; ikinci grupta ilk gün %80, ikinci gün %8, üçüncü gün %12 oranında; üçüncü grupta ise ilk gün %72, ikinci gün %6, üçüncü gün %6 oranında

gerçekleştirilmiştir. Sonuç olarak, birinci grupta 48 doğumun 9'undan ikiz (%18,7), 39'undan tek; ikinci grupta 49 doğumun 11'inden ikiz (%22,4), 38'inden tek; üçüncü grupta 48 doğumun 5'inden ikiz (%10,4), 43'ünden tek kuzu elde edilmiştir. Bu çalışmada, Tahirova koyunlarında modifiye Ovsynch protokolünün kullanımının üreme performansı üzerindeki etkileri belirlenmiştir. Sığırlarda etkili olan Ovsynch protokolü koyunlara uyarlanmış ve EWESYNCH olarak adlandırılmıştır (Alkan et al., 2012).

Hindistan'da kullanımını artırmak için ekonomik ve etkili hormonal müdahalelerin, üreme mevsiminde koyunlarda verimliliği artırmak için hala gerekli olduğu bildirililmiş ve bu amaçla, modifiye senkronizasyon protokollerinin (Ovsynch; GnRH, 4.0 µg buserelin asetat–PGF2α, 125µg kloprostenol–GnRH, 4.0 µg buserelin asetat; MSD Animal Health, Hindistan) etkinliğini değerlendirmek için bir çalışma yapılmıştır. Kısa süreli (0–5, 7. gün; grup-I), orta süreli (0–8, 9. gün; grup-II) veya uzun süreli (0–12, 13. gün; grup-III) progesteron (P4) tedavisi ile birlikte üreme performansını artırmak için kullanılmıştır. Çalışmada çiftleştirilmiş (Nali×Rambuillet) melez koyunlara ait AVIKESIL-S® intravajinal süngerler (her bir süngerde 350 mg doğal P4, Hindistan Merkezi Koyun ve Yün Araştırma Enstitüsü tarafından sağlanmıştır) kullanılmıştır. Grup-I, -II ve -III'de sırasıyla 5 gün (0-5), 8 gün (0-8) veya 12 gün (0-12) süreyle P4 tedavisi uygulanmıştır. Çalışma Hindistan'da üreme mevsimi (Kasım-Ocak ayları, sonbahar mevsimi) sırasında gerçekleştirilmiştir. Her bir grup 50 adet rastgele seçilmiş (doğum sırasına göre) koyundan oluşturulmuş ve bir grup (grup-IV) kontrol grubu olarak belirlenmiştir. Östrus sergileyen koyunlarla çiftleşme için her grupta beş fertil üreme koçu kullanılmıştır. Östrus aktivitesi ve verimlilik değişkenleri üzerindeki veriler tek yönlü ANOVA ve Ki-kare testi kullanılarak analiz edilmiştir. Sonuçlar, östrus senkronizasyon oranının grup-II'deki koyunlarda (%82) grup-III'teki koyunlara (%56) göre daha yüksek olduğunu ($P<0.01$) göstermiştir. Bununla birlikte, grup-II'deki koyunların östrus süresi grup-III'e göre önemli ölçüde ($P<0.05$) daha uzun bulunmuştur (35.5±3.2 saat'e karşı 26.8±2 saat). Gebelik oranı (sırasıyla grup-II, -IV, -I ve -III'te %70, %66, %66 ve %32), doğurma oranı ve doğurganlık grup-III'teki koyunlarda diğer üç gruba göre önemli ölçüde daha düşük ve diğer üç grupta benzer oranlar belirlenmiştir. Doğurganlık ve ikizlik oranı tüm gruplar arasında benzer bulunmuştur ($P>0.05$). Sonuç olarak, modifiye Ovsynch protokolü (günler; 0-12, 13) ve 12 günlük progesteron tedavisi, östrus indüksiyonu ve verimlilik sonuçlarında azalmaya neden olmuş ve kontrol grubu koyunlarla (grup-IV) karşılaştırıldığında bile daha düşük sonuçlar elde edilmiştir. Bu nedenle, Hindistan'da üreme mevsiminde koyunlarda verimliliği artırmak için foliküler dinamiklerle birlikte endokrinolojik ilişkileri içeren bu tür protokollerde daha ileri çalışmalara ve alternatif yaklaşımlara ihtiyaç duyulduğu bildirilmiştir (Om et al., 2021).

On beş adet çoğuz doğuran keçi, ortak Ovsynch protokolünü (GPG: intramusküler, IM, olarak 50 mg gonadorelin enjeksiyonu, ardından 7 gün sonra 125 µg kloprostenol IM enjeksiyonu ve daha sonra 2 gün sonra 50 mg gonadorelin IM enjeksiyonu) veya aynı dozlarda nanoüretim hormonları kullanılan Ovsynch protokolünü (NGPG) veya her bir hormonun yarım dozajını kullanan Ovsynch protokolünü (HNGPG) eşit olarak modifiye etmişlerdir. Ovsynch protokolü uygulaması sonrası, B-mode, renkli ve spektral Doppler tarama kullanılarak yumurtalık yapısı ve yumurtalık ve luteal arter hemodinamik indeksleri izlemişlerdir. Kan serumu progesteron (P4), östradiol (E2) ve nitrik oksit (NO) düzeyleri belirlenmiştir. İlk gonadotropin salınım hormonu (GnRH) enjeksiyonundan sonra, büyük folikül sayısı NGPG ve HNGPG'de GPG'ye kıyasla azalmış (P=0.02). HNGPG, daha büyük korpus luteum (CL) çaplarına (P=0.001) ve gelişmiş yumurtalık ve luteal kan akımına sahip olmuştur ve GPG ve NGPG ile karşılaştırıldığında daha iyi sonuçlar vermiştir. Hem NGPG hem de HNGPG, GPG'ye kıyasla E2 ve NO düzeylerini önemli ölçüde artırmıştır. HNGPG, GPG'ye kıyasla P4 düzeylerini artırdığı bildirilmiştir (P<0.001), NGPG ise orta bir değer vermiştir. Prostaglandin F2α (PGF2α) enjeksiyonundan sonra, HNGPG CL'lerin en büyük çapına (P=0.001) ve GPG ve NGPG'ye kıyasla yumurtalık kan akımını önemli ölçüde artırmıştır. Hem NGPG hem de HNGPG, GPG'ye kıyasla NO düzeylerini artırdığı bildirilmiştir (P=0.007). E2 düzeyi, GPG'ye kıyasla HNGPG'de arttırmış (P=0.028), NGPG ise orta bir değer vermiştir. Foliküler fazda, HNGPG, orta folikül sayısını artırmış (P=0.043), ovülasyon aralığını kısaltmış (P=0.04) ve yumurtalık arter kan akımını (P<0.001) ile birlikte P4, E2 ve NO düzeylerini artırmıştır (P <0.001) ve GPG ve NGPG ile karşılaştırıldığında. Luteal fazda, farklı deney grupları arasında CL sayıları benzerken, CL çapı, luteal kan akımı ve kan serumu P4 ve NO düzeyleri HNGPG'de (P<0.001) GPG ve NGPG ile karşılaştırıldığında arttırmıştır. Sonuç olarak, Ovsynch protokolü için nanotoksikasyon sistemi, keçilerin östrus senkronizasyonu sonuçlarını iyileştirmek için daha düşük hormon dozu uygulamasına olanak sağlayarak yeni bir strateji olarak önerilebildiği bildirilmiştir (Hashem et al.., 2022).

Panjaitan ve arkadaşları (2020), Kacang keçilerinin üzerine yaptıkları bir çalışmada ise östrus döngüsü sırasında PGF2α ve ovsynch protokolü ile tetiklenen östrus performansını ve progesteron konsantrasyonunu karşılaştırmışlardır. Araştırmada altı dişi Kacang keçi kullanılmıştır ve keçiler K1 ve K2 olmak üzere iki gruba ayrılmıştır. K1 grubuna 10 günlük aralıklarla intramusküler olarak 7.5 mg PGF2α enjekte edilmiştir. K2 grubu ise ovsynch yöntemi kullanılarak tetiklenmiştir. K2 grubu için protokol şu şekildedir: 1. günde keçilere 7.5 mg PGF2α enjekte edilmiş, 8. günde 50 µg GnRH enjekte edilmiş, 15. günde 7.5 mg PGF2α enjekte edilmiş ve 18. günde ise 50 µg GnRH enjekte edilmiştir. Östrus, erkek keçi kullanılarak

ve görsel gözlemle tespit edilmiştir. Kan örnekleri, östrusun 7., 14. ve 21. günlerinde alınmış ve progesteron konsantrasyonu enzim bağlı immünosorbent analiz (ELISA) tekniğiyle ölçülmüştür. K1 ve K2 gruplarında östrusun yoğunluğu, başlangıcı ve süresi sırasıyla 8.33±2.08 vs 7.00±1.00; 56.00±34.12 vs 36.00±20.78 saat; ve 24.00±26.15 vs 24.00±20.78 saat olarak bulunmuştur (P>0.05). K1 ve K2 için 7., 14. ve 21. günlerde progesteron hormonunun düzeyi sırasıyla 0.812±0.710 vs 2.369±3.351; 5.051±7.754 vs 3.091±4.385 ng/ml; ve 4.173±6.692 vs 3.562±4.113 ng/ml olarak bulunmuştur (P>0.05). Bu sonuçlar, PGF2α ve ovsynch protokollerinin Kacang keçilerinin östrus performansı ve progesteron konsantrasyonu üzerinde anlamlı bir etkisinin olmadığını göstermiştir.

Melez koyunlar üzerine yapılan bir çalışmada ise Ovsynch östrus senkronizasyon protokollerinin iki farklı dönemde, yani sezon içi ve sezon dışı mevsimde karşılaştırmalı etkinliğini test etmek için tasarlanmıştır. Her iki dönemde toplam 60 dişi koyun rastgele dört gruba (her grupta n=15) ayrılmıştır: Grup I (Üreme mevsim dışı kontrol), II (Üreme mevsim dışı tedavi), III (Üreme mevsimi kontrol) ve IV (Üreme mevsimi tedavi). Ovsynch protokolü (Grup II ve IV), 0. günde buserelin asetat, 5. günde kloprostenol sodyum ve 7. gününde buserelin asetat intramüsküler olarak (im) uygulanmıştır. Çalışma sürecinde plazma progesteron konsantrasyonunun belirlenmesi için kan örneklemesi yapılmıştır. Erken gebelik teşhisi için transrektal gerçek zamanlı B-mod ultrasonografi (USG) 25. gününde yapılıp 45. gününde teyit edilmiştir. Çalışmanın sonuçları, Ovsynch protokolünün östrus indüksiyonunda neredeyse eşit derecede etkili olduğunu ve her iki mevsimde de daha iyi gebelik oranı ve sonraki verimlilik sağladığını göstermiştir. Progesteron konsantrasyonu 14, 25 ve 45. günde tüm gruplar arasında anlamlı bir farklılık göstermemiştir (P<0.05). Bu nedenle, Ovsynch protokolü, yıl boyunca melez koyunlarda üreme verimliliğinin iyileştirilmesi için hem üreme mevsimi hem de üreme dışı mevsimde önerildiği bildirilmiştir (Yadav et al., 2020).

Ovsynch protokolünün verimliliğini değerlendirmek için 26 adet Santa Inês koyunu üç farklı gruba ayrılmıştır. Kontrol grubunda (n=8) östrus senkronizasyonu, 14 gün boyunca 60 mg MAP içeren süngerlerle gerçekleştirilmiştir(T1). D14'te 300 IU eCG uygulanmıştır. İkinci grupta (n=9) Ovsynch protokolü uygulanmış(T2): D0'da 25 µg GnRH, D7'de 37.5 µg PGF2α ve D9'da 25 µg GnRH enjekte edilmiştir. Üçüncü grupta (n=9) ise modifiye edilmiş Ovsynch protokolü kullanılmıştır(T3): PGF2α ve ikinci GnRH enjeksiyonları iki gün önce gerçekleştirilmiştir. Östrus tespiti arama koçları kullanılarak yapılmıştır. Tüm koyunlar iki kez 12 saat arayla çiftleştirilmiştir. Gebelik oranı (PR), çiftleşme sonrası 30 gün sonra ultrasonografi ile değerlendirilmiştir. Ortalama östrus tepkisi %88.46 ve gruplar arasında farklılık gözlenmemiştir (P>0.05). Östrus başlangıcı için süre T1'de diğer gruplara göre daha uzun tespit

edilmiştir (P<0.05) (sırasıyla 41.31±7.2, 13.37±8.42 ve 6.75±5.2 saat). Kabul etme süresi, T1 ve T3 dişilerinde (sırasıyla 40.5±6.49 saat ve 53.68±10.27 saat) T2 dişilerine göre daha uzun (34.56±7.2 saat) (P<0.05). İndüklenen östrus süresi gruplar arasında anlamlı fark göstermemiştir (P>0.05). Gebelik oranı Ovsynch protokolü ile senkronize edilen koyunlarda anlamlı derecede yüksek bulunmuştur (P<0.05) (sırasıyla %37.5, %62.5 ve %25, T1, T2 ve T3 için). Sonuçlar, deneysel koşullar altında Ovsynch protokolünün üstün verimliliğini göstermiştir (Oliveira et al., 2009).

Üreme mevsiminde keçilerde sabit zamanlı suni tohumlama elde etmek için yapılan bir çalışmada ise Ovsynch protokolünün (klasik kronolon içeren vajinal sünger+eCG tedavisiyle karşılaştırıldığında) etkinliğini değerlendirmiştir. Her grup, 24 Boer keçiye uygulanmıştır. Östrusun başlangıcı ve süresi bir penisi örtülü erkek keçi kullanılarak belirlenmiş ve foliküler gelişme ultrasonografi ile izlenmiştir. Ovülasyon ve corpus luteum kalitesi progesteron konsantrasyonlarından belirlenmiştir. Her iki grupta da (GnRH enjeksiyonunun ikinci enjeksiyonundan 16 saat sonra ve sünger çıkarılmasından 43 saat sonra) belirlenen zamanlarda suni tohumlama yapılmıştır. Östrus, Ovsynch tedavisi uygulanan keçilerin %96'sında (prostaglandin enjeksiyonundan 49 saat sonra) ve süngerle senkronize edilen keçilerin %100'ünde (sünger çıkarılmasından 37 saat sonra) belirlenmiştir. Suni tohumlama yapıldığı sırada düşük progesteron konsantrasyonları Ovsynch ile senkronize edilen keçilerin 21/24'ünde ve süngerlerle senkronize edilen keçilerin ise 24/24'ünde gözlenmiştir. LH konsantrasyonları, her iki grupta da ovülasyon öncesi dönem boyunca belirlenmiştir (her grup için 10-11 keçi). LH salınımının senkronizasyonu, Ovsynch tedavisi ile sünger tedavisine kıyasla daha sıkı olduğu bildirilmiştir. Doğum oranları (Ovsynch ve sünger gruplarında sırasıyla %58 ve %46) ve ikizlik (Ovsynch ve sünger tedavisi gören keçilerde sırasıyla 1,86 ve 1,83) her iki grupta da benzerdir, aynı şekilde ovülasyon sayısı (sırasıyla 2,9 ve 3,3) ve corpus luteumun prematür regresyonu olan keçilerin oranı (sırasıyla %29 ve %17). Prematür luteal regresyonu olan ve prostaglandin alırken düşük progesteron seviyeleri olan keçiler hariç tutulduğunda, Ovsynch tedavisinden sonra doğum oranı %87,5'e (14/16) ulaşmıştır. Üreme mevsiminde, Ovsynch protokolü sünger-eCG tedavisine alternatif bir seçenek olabileceği bildirilmiştir (Holtz et al., 2008).

Yağlı-kuyruklu koyunlarda yapılan bir çalışmada, farklı senkronizasyon protokollerinin reprodüktif parametreler üzerindeki etkileri araştırılmıştır. Toplam 71 baş birden fazla doğum yapmış yağlı-kuyruklu koyun, rasgele olarak 4 deneme grubuna ayrılmıştır. Birinci gruptaki koyunlara (n=20, uzun süreli FGA), 20 mg FGA içeren süngerler intravajinal olarak yerleştirildikten sonra 14. günde çıkarılarak, 400 IU PMSG intramusküler olarak enjekte edilmiştir. İkinci gruptaki koyunlara (n=18, kısa süreli FGA), 20 mg FGA içeren süngerler

intravajinal olarak yerleştirildikten sonra 8. günde çıkarılarak, 400 IU PMSG intramusküler olarak enjekte edilmiştir. Üçüncü gruptaki koyunlara (n=17, Ovsynch grubu), Ovsynch protokolü (0. günde 0.004 mg GnRH, 7. günde 125 µg PGF2α ve 9. günde 0.004 mg GnRH) uygulanmıştır. Dördüncü gruptaki koyunlara (n=16, kısa süreli FGA + Ovsynch) ise, 20 mg FGA içeren süngerlerin intravajinal olarak yerleştirilmesiyle birlikte 0.004 mg GnRH enjekte edilmiştir. Süngerlerin 7 gün sonra çıkarılmasının ardından 125 µg PGF2α ve 9. günde 0.004 mg GnRH uygulanmıştır. Senkronizasyon grupları arasında son uygulama-östrus aralığı ($P<0.001$), östrus süresi ($P<0.05$), gebelik ($P<0.01$) ve doğum oranları ($P\leq0.001$) açısından önemli farklar gözlenmiştir. Çalışma sonucunda, standart Ovsynch protokolünün, üreme sezonundaki yağlı-kuyruklu koyunlarda klasik kısa ve uzun süreli FGA içeren vajinal sünger uygulamalarına göre gebelik ve doğum oranlarında önemli ölçüde azalmaya yol açtığı belirlenmiştir (Kulaksız et al., 2013).

Üreme mevsimi boyunca keçilerde sabit zamanlı suni tohumlama sonrası östrus senkronizasyonu, foliküler gelişim ve doğurganlık üzerine Chronogest destekli Ovsynch ve Co-synch protokollerinin etkisi incelenmiştir. 30 kg'dan fazla vücut ağırlığına sahip doğurmamış dişi keçilere Co-synch (n=24) ve Ovsynch (n=25) protokolleri uygulanmıştır. Östrusun başlangıcı ve süresi arama koçu ile belirlenmiştir. Keçilere laparoskopik olarak Co-synch için ikinci gonadotropin salıcı hormon (GnRH) enjeksiyonunda 11.5×10^6 hareketli spermatozoa/ampul ve Ovsynch için ikinci GnRH enjeksiyonundan 8 saat sonra tohumlama yapılmıştır. Keçilerde sergilenen östrus oranları sırasıyla %92 ve %84 olup, sünger çıkartılmasından östrus başlangıcına kadar geçen süreler Co-synch için 31.1 saat, Ovsynch için 30.9 saat; östrus süreleri ise sırasıyla 34.4 saat ve 29.4 saat olarak tespit edilmiştir ($P> 0.05$). İkinci GnRH enjeksiyonunda folikül çapları sırasıyla 0.72 cm ve 0.68 cm olup, ovülasyon sayıları Co-synch için 2.6, Ovsynch için 2.8 olarak belirlenmiştir. Co-synch ve Ovsynch grupları arasında 30 gün içinde geri dönüş oranı (NRR30) (%62 ve %40) ve 30. günde belirlenen gebelik oranları (%38 ve %24) açısından anlamlı farklılık bulunmamıştır. Doğum ve doğurganlık oranları, Co-synch uygulanan keçilerde sırasıyla %38 ve 1.4, Ovsynch uygulanan keçilerde ise %24 ve 1.2 olarak belirlenmiştir ($P>0.05$). Sonuç olarak, Co-synch protokolü, ergenlik başlangıcı ve üreme mevsiminde ovülasyon zamanındaki değişkenlikle ilişkili olan Ovsynch protokolüne göre daha iyi sonuçlar verebilir. Keçilerde zamanlanmış suni tohumlama sonrası doğurganlık sonuçlarını iyileştirmek için sabit zamanlı suni tohumlama için en iyi zamanı ve kabul edilebilir tohumlama dozunu belirlemek için daha fazla çalışma yapılması gerektiği bildirilmiştir (Nur et al. 2013).

SONUÇ ve ÖNERİLER

Koyun ve keçiler zor iklim şartlarına uyum sağlayan ve farklı ürünler üretme imkânı ile gelir sağlayan hayvanlardır. Küçükbaş hayvan yetiştiriciliği tarımsal faaliyet yapılamayan dağlık alanlarda geçim kaynağı olmaktadır. Bu yönüyle birim hayvandan elde edilecek sağlıklı yavru sayısını artırmak oldukça önemlidir. Bir yılda elde edilecek yavru sayısını arttırmak için bilinen uygulamaların yanı sıra yeni uygulamaları gündeme getirmektedir. Döl verimini arttırmak için farklı tekniklerin uygulanması amacıyla yetiştiricilere eğitim verilmesi ve farkındalık oluşturulması gereklidir. Aynı zamanda bölgesel olarak ırklara yönelik uygulanabilecek kızgınlık senkronizasyon teknikleri ile ilgili daha fazla çalışma yapılmalıdır.

Yüksek değerli hayvanların genetik kaynaklarının kullanım verimliliğini artırmak ve koyun ve keçilerin üreme sürecine daha fazla katılımını sağlamak için üreme biyolojisi hakkındaki detaylı bilgilere dayalı mevcut biyoteknolojik yöntemler ve teknikler bulunmaktadır. Östrus senkronizasyonu, koyun ve keçilerde üreme verimliliğini artırmak için etkili bir yöntemdir. Hormonal metotlar (progestagen implantları, progesteron ile döllemeye hazırlık protokolleri ve GnRH analogları) östrus senkronizasyonunda yaygın olarak kullanılmaktadır. Non-hormonal metotlar ışık uygulamaları, beslenme faktörleri ve koç-teke etkisi de östrus senkronizasyonunda etkili olabilir. Biyoteknolojik ilerlemeler, yeni protokollerin geliştirilmesi ve multidisipliner çalışmalar, koyun ve keçilerde östrus senkronizasyonu başarısını artırmaktadır.

Araştırmalar, daha etkili progestagenlerin ve dozlama protokollerinin geliştirilmesine odaklanmalıdır. GnRH analogları gibi hormonlar üzerinde yapılan çalışmalar, östrus senkronizasyonunu daha da iyileştirmek için devam etmelidir. Hormonların kullanılmadığı çalışmalarda ise Işık uygulamaları ve beslenme yöntemleri aynı zamanda koç ve teke etkisi üzerinde yapılan çalışmaların devam etmesi, senkronizasyon sürecini destekleyebilir. Koyun ve keçilerde östrus senkronizasyonuyla ilgili daha fazla saha çalışması ve uygulama deneyleri yapılmalıdır. Bu öneriler, östrus senkronizasyonu alanında daha fazla bilgi ve uygulama geliştirmeye yardımcı olabilir. Araştırmaların devam etmesi, koyun ve keçi yetiştiricilerinin üreme verimliliğini artırmak için daha etkili ve uygulanabilir yöntemlere erişmelerine yardımcı olacaktır.

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DOĞU KARADENİZ BÖLGESİNDE YAYILIŞ GÖSTEREN *Alchemilla sericata* Rchb. TÜRÜNÜN ANATOMİK ÖZELLİKLERİ

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ÖZET

Bu çalışma ile Giresun ilinden toplanan *Alchemilla sericata* Rchb. türüne ait bazı anatomik özelliklerinin belirlenmesi amaçlanmıştır. *A. sericata* türü *Alchemilla* L. cinsine aittir. Cinsin Türkiye'de 82 türü bulunmaktadır. Tür Anadolu'da 'ipek keltatı' olarak bilinmektedir. *Alchemilla* türleri yara iyileştirici, yatıştırıcı, idrar söktürücü ve öksürük kesici olarak kullanılır. *A. sericata* türünün toprak üstü kısımları yağ asitleri bakımından zengindir. Ayrıca antioksidan ve antimikrobiyal aktiviteye sahiptir. Büyükbaş ve küçükbaş hayvanlar için önemli besin kaynağı olan *Alchemilla* türleri çayır ve meralarda geniş yayılış gösterirler. Anatomik çalışmalar %70'lik alkolde fikse edilen örnekler üzerinde gerçekleştirilmiştir. Türün kök, rizom, gövde, petiol ve yaprak enine ve yüzeysel kesitleri el yardımı ile alınmıştır. Anatomik ölçüm ve gözlemler Nikon FDX-35 mikroskop programı kullanılarak yapılmıştır. Türün kökünde korteks ve öz parankima hücreleri bol miktarda nişasta ile doludur. Endoderma ve perisikl hücreleri oldukça belirgindir. Kökte öz bölgesi parankima hücreleri ile doludur. Rizomda en dışta 4 sıralı periderm hücreleri yer almaktadır. İletim demetleri üzerinde çok hücreli ve dikdörtgen şekilli meristematik hücreler bulunmaktadır. Korteks ve öz bölgesindeki parankima hücrelerinde nişasta taneleri ve druz kristalleri yer almaktadır. Druz kristalleri ortalama 59.94 ± 7.5 µm çapındadır. Gövde de iletim demetleri üzerinde parçalı bir yapıya sahip sklerankimatik halka gözlemlenmektedir. Petiyolün üzeri çok sayıda uzun örtü tüyü ile kaplıdır. Epidermis tabakasının altında 3-4 sıralı kollenkima hücreleri bulunmaktadır. Biri diğerlerinden daha büyük olmak üzere hadrosentrik tipte 3 iletim demeti yer almaktadır. Yaprak dorsiventral tiptedir. Mezofil 2 sıralı palizat parankiması ile 3-4 sıralı sünger parankiması içermektedir. Yaprağın üst yüzeyindeki stomalar anomositik ve aktinositik tiptedir. Yaprağın alt yüzeyinde üst yüzeye göre daha fazla örtü tüyü bulunmaktadır. Yaprak üst yüzeyindeki stoma indeksi 14 iken alt yüzeydeki stoma indeksi 11.51 dir.

Anahtar Kelimeler: *Alchemilla, Alchemilla sericata,* Anatomi

ANATOMICAL CHARACTERISTICS OF *Alchemilla sericata* Rchb., SPECIES, DISTRIBUTED IN THE EASTERN BLACK SEA REGION

ABSTRACT

The aim of this study was to determine some anatomical features of *Alchemilla* sericata Rchb. species collected from Giresun province. *A. sericata* species belongs to the genus *Alchemilla* L. The genus has 82 species in Turkey. The species is known as 'ipek keltatı' in Anatolia. *Alchemilla* species are used as wound healers, sedatives, diuretics, and cough suppressants. The aerial parts of *A. sericata* are rich in fatty acids. It also has antioxidant and antimicrobial activity. *Alchemilla* species, which are an important food source for cattle and sheep, are widely distributed in meadows and pastures. Anatomical studies were carried out on specimens fixed in 70% alcohol. Cross and surface sections of roots, rhizomes, stems, petioles, and leaves were taken by hand. Anatomical measurements and observations were made using Nikon FDX-35 microscope program. In the root of the species, the cortex and pith parenchyma cells are abundantly filled with starch. Endoderma and pericycle cells are quite prominent. The root pith region is filled with parenchyma cells. The rhizome has 4 layers of periderm cells at the outermost. There are multicellular and rectangular meristematic cells on the vascular bundles. In the cortex and pith region, parenchyma cells contain starch grains and druse crystals. The druse crystals have an average diameter of 59.94 ± 7.5 µm. A fragmented sclerenchymatic ring is observed on the vascular bundles in the stem. The petiole is covered with numerous long eglandular hairs. Below the epidermis layer there are 3-4 layers of collenchyma cells. There are 3 vascular bundles of the hadrocentric type, one of which is larger than the others. The leaf is dorsiventral type. The mesophyll contains 2 layers of palisade parenchyma and 3-4 layers of spongy parenchyma. Stomata on upper surfaces of the leaf are anomocytic and actinocytic. There are more eglandular hairs on the lower surface of the leaf than on the upper surface. The stomatal index on the upper surface of the leaf is 14, while the stomatal index on the lower surface is 11.51.

Keywords: *Alchemilla*, *Alchemilla sericata*, Anatomy

GİRİŞ

Alchemilla sericata Rchb. türü Rosaceae familyasına aittir. Otsu ve odunsu formda bitkilere sahip olana familya ~3.000 türden oluşan büyük bir angiosperm familyasıdır (Xiang ve ark., 2017). *Alchemilla* cinsi dünyada 1000'den fazla, Türkiye de ise 82 türe sahiptir (İlgün ve ark. 2014; Ayaz, 2012). Cinsin türleri Anadolu da 'fındık otu, aslan ayağı, dokuztepe, yeditepe' olarak bilinir (Baytop, 1994). *Alchemilla sericata* türü ise 'İpek keltatı' olarak bilinmektedir (Ayaz, 2012). Türkiye'de *Alchemilla* cinsine ait türler genel olarak kuzey Anadolu bölgesinde yayılış göstermektedir (Davis, 1972; Samancı, 1998). *Alchemilla* cinsine ait türler içerdikleri zengin sekonder metabolitler ile tıbbi öneme sahip bitkilerdir. Bu bileşikler antimikrobiyal, antienflematuar, antioksidan, antiproliferatif, yara iyileştirici ve antimutajenik gibi pekçok biyokimyasal aktiviteye sahiptir (İlgün ve ark. 2014). *A. sericata* türünün toprak üstü kısımlarından elde edile ekstraktta yüksek miktarda doymuş yağ asitleri ve daha düşük miktarlarda diğer bazı terpenoid bileşikler tespit edilmiştir. Bu bileşikler yüksek düzeyde antioksidan ve orta düzeyde antimikrobiyal etkilere sahiptir (Shafaghat ve ark., 2017). *Alchemilla* cinsine ait pek çok türler ilgili anatomik çalışmalar bulunmaktadır. Araştırıcılar bitkilerin kök, rizom, gövde, yaprak sapı ve yaprak organların önemli yapılar olduğuna ve bu yapılardaki druz krsitallerinin varlığı, sayısı ve büyüklüğüne dikkat çekmişlerdir (Zhu ve ark 2015; İlgün ve ark. 2016; Grytsyk ve ark., 2019). İncelediğimiz türünde dahil olduğu pek çok *Alchemilla* türü morfolojik özellikler yönü ile doğada benzerlik göstermektedir. Türlerin ayırt edilmesine morfolojik karakterlerin yanı sıra anatomik, mikromorfolojik, sitolojik ve biyokimyasal gibi pek çok bilim alandan yararlanılması katkı sağlayacaktır (Ayaz ve Beyazoğlu, 2002). Tıbbi değeri olan bu bitkilerin doğru teşhis edilmesi son derece önemlidir.

Bu çalışma ile daha önce Türkiye örnekleri incelenmemiş olan ve Doğu Karadeniz Bölgesinde yayılış gösteren *A. sericata* türünün vejetatif organlarının anatomik yapılarının ele alınması amaçlanmıştır.

MATERYAL ve METOD

A. sericata türü 2020 yılında Türkiye'nin Giresun ili Tamdere yaylasından toplanmıştır. Araziden alınan örnekler Flora of Turkey'e (Pawlowski ve Walters 1972) göre belirlenmiştir. Numuneler anatomik çalışmalar için %70'lik etil alkol çözeltisinde muhafaza edilmiştir. Bitkinin kök, rizom, gövde, petiyol ve yaprak enine ve yüzeysel kesitleri el yardımı ile alınmıştır. Kesitler gliserin-jelatin ile kaplanarak daimî hale getirilmiştir (Vardar 1987). Yüzeysel kesitler safranin/fast green (1/9) karışımı ile boyanmıştır (Bozdağ ve ark. 2016). Anatomik fotoğraflar Nikon FDX-35 mikroskobu ile çekilmiştir. Tüm ölçümler ve gözlemler görüntüleme yazılımı (NIS-Elements, Version 3.00 SP5) kullanılarak yapılmıştır. Stoma

indeksi ve stoma oranı bitkinin yaprak yüzeyinden hesaplanmıştır (Meidner ve Mansfield 1968).

BULGULAR

Kök

Bitkinin kökünde en dışta tek sıralı epidermis ve yer yerde periderm oluşumu gözlemlenmektedir. Korteks parankimatik hücreleri çok sıralı olup, geniş bir alan kaplamaktadır. Merkezi silindirde yer alan endodermis ve perisikl tabakası oldukça belirgindir. Endodermis hücreleri ortalama14.73 ± 3.45 µm çapındadır. İletim demeti ksilem kollarına göre poliarktır. Ksilem hücreleri ortalama 16.21 ± 3.23 µm çapındadır. Kökün öz bölgesi parankimatik hücreler ile doludur. Korteks ve öz bölgesindeki parankima hücrelerinde bol miktarda nişasta taneleri göze çarpmaktadır (Tablo 1, Şekil1A-C).

Rizom

Rizomda en dışta 1-2 sıralı periderm hücreleri yer almaktadır. Korteks parankima hücreleri ortalama 62.4 ± 16.2 x 25.55 ± 4.12 µm ebatlarındadır. Korteks tabakasının altında dikdörtgen şekilli çok sıralı parankimatik hücreler yer almaktadır. Rizom öz bölgesi bol nişasta içeren parankimatik hücrelerden oluşmaktadır. Korteks ve öz bölgesi parankimatik hücreleri arasında tekli ya da gruplar halinde druz kristalleri bulunmaktadır (Tablo 1, Şekil1D-E).

Gövde

Gövdenin en dışında 1 sıralı epidermis hücreleri bulunmaktadır. Ayrıca gövdenin dış kısmında bazı yerlerde periderm oluşumu gözlenmektedir. İletim demeti halka şeklindedir. İletim demeti etrafında parçalanmış sklerankimatik kın oluşumu bulunmaktadır. Ksilem hücreleri ortalama 18.34 ± 3.36 µm çapındadır. Gövdenin öz bölgesi parankimatik hücreler ile doludur (Tablo 1, Şekil1F-H).

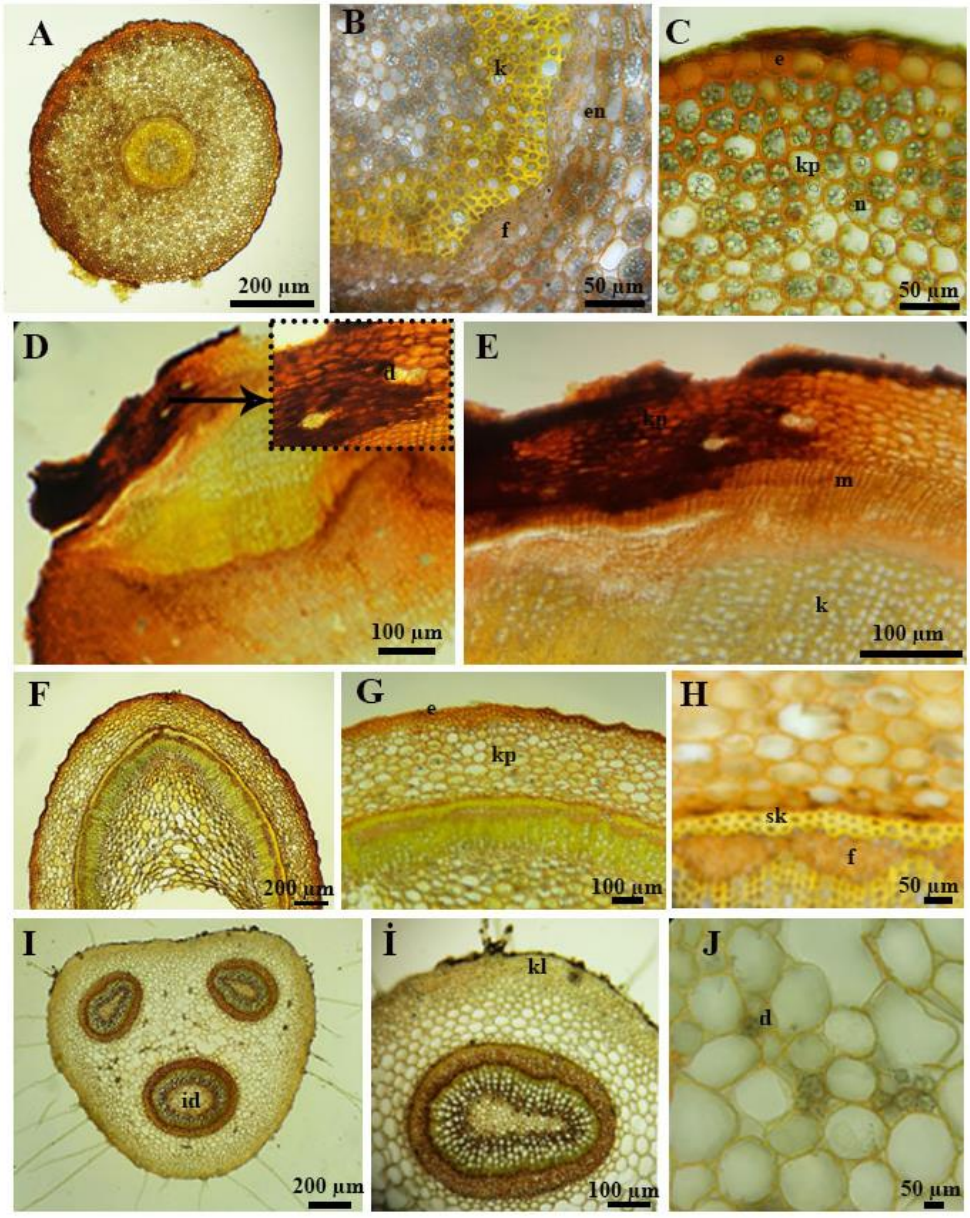
Petiyol

Petiyol üçgen şekillidir. Petiyolün etrafı çok sayıda uzun örtü tüyü ile çevrilidir. Köşelerde epidermis tabakası altında 1-3 sıralı kollenkima hücreleri yer almaktadır. Kollekima hücreleri ortalama 23.83 ± 3.35 µm çapındadır. Biri diğerlerinden büyük olmak üzere hadrosentrik tipte 3 iletim demeti mevcuttur. İletim demetlerinin üzerinde köşelere doğru sklerenkimatik kın bulunmaktadır. Parankimatik hücreler arasında çok sayıda tekli ya da kümeler halinde dizilmiş druz kristalleri yer almaktadır (Tablo 1, Şekil1I-J).

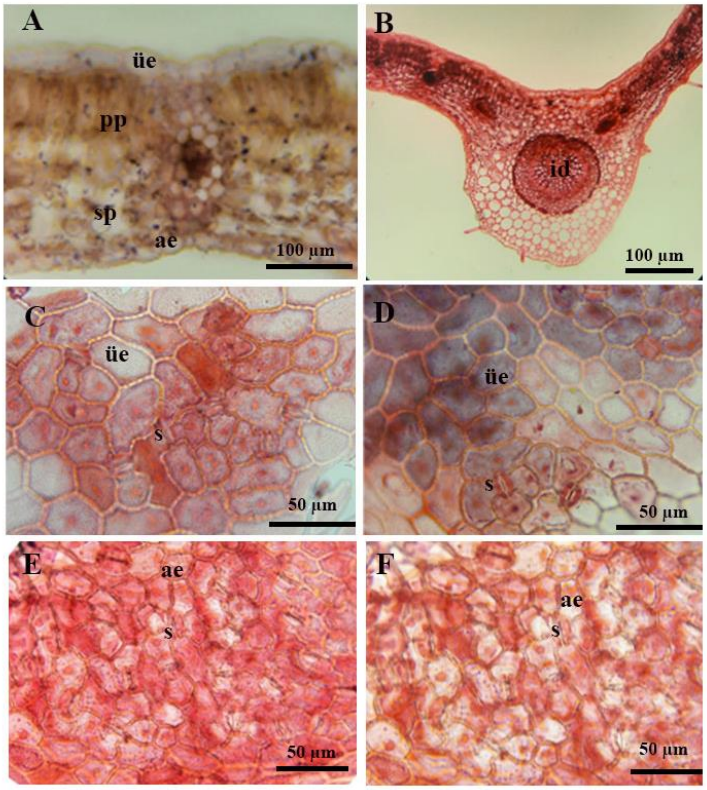
Yaprak

Yaprak dorsiventral tiptedir. Mezofil 2 sıralı palizat parankiması ile 3-4 sıralı sünger parankiması içermektedir. Palizat parankima hücreleri ortalama 11.63 ± 2.84 x 42.45 ± 4.75 µm ebatlarındadır. Yaprak iletim demetleri etrafındaki demet kını oldukça belirgindir (Tablo 1,

Şekil 2 A-B). Yaprağın üst yüzeyindeki stomalar anomositik ve aktinositik tiptedir (Şekil 2 C-D). Stoma ortalama 21 ± 1.29 x 26.24 ± 2.06 µm ebatlarındadır. Yaprak alt yüzeyindeki stomalar anomostik tiptedir (Şekil 2 E-F). Stomalar ortalama 22.4 ± 1.92 x 26.10 ± 2.41µm ebatlarındadır. Yaprağın alt yüzeyinde üst yüzeye göre daha fazla örtü tüyü bulunmaktadır. Yaprak üst yüzeyindeki stoma indeksi birim alanda 14 iken alt yüzeydeki stoma indeksi 11.51 dir. Yaprağın hem enine kesitlerinde hem de yüzeysel kesitlerinde druz kristallerine rastlanılmıştır.



Şekil 1. *A. sericata* türünün anatomik özellikleri. A-C: kök, B-D: rizom, F-H: gövde, I-J petiyol. d: druz kristali, e:epidermis, en: endeodermis, f:floem, id:iletim demeti, k:ksilem, kl:kollenkima, kp.korteks parankiması, m:meristemastik parankima, sk:sklerankima.



Şekil 2. *A. sericata* türünün yaprak anatomik özellikleri. A-B: yaprak enine kesiti, C-D yaprak üst yüzey, E-F: yaprak alt yüzey. ae:alt epidermis, id:iletim demeti, s:stoma, sp:sünger parankima, pp:palizat parankima, üe:üst epidermis.

Tablo 1. *A. sericata* türünün anatomik ölçümleri

		En/çap (µm) Ortalama±SH	Boy (µm) Ortalama±SH
Kök	Periderm	29.55 ± 5.11	22.83 ± 6.19
	Korteks parankima	32.76 ± 4.46	-
	Endodermis	14.73 ± 3.45	11.27 ± 2.42
	Ksilem	16.21 ± 3.23	-
Rizom	Periderm	33.51 ± 5.66	19.00 ± 4.22
	Korteks parankima	62.40 ±16.27	25.55 ± 4.12
	Druz kristal	59.94 ± 7.57	-
Gövde	Epidermis	19.55 ± 3.59	14.59 ± 2.27
	Korteks parankima	62.26 ± 10.0	-
	Endodermis	15.10 ± 2.25	10.65 ± 2.39
	Sklerankima	16.63 ± 3.28	-
	Ksilem	18.34 ± 3.36	-
	Öz parankima	65.94 ± 19.42	-
Petiyol	Epidermis	18.08 ± 2.88	14.95 ± 2.44
	Kollenkima	23.83 ± 3.35	-
	Korteks parankima	65.02 ± 9.94	-
	Sklerankima	13.93 ± 1.61	-
	Ksilem	22.98 ± 2.98	-
	Druz kristal	22.15 ± 3.15	-
Yaprak	Üst epidermis	25.13 ± 5.08	21.17 ± 4.35
	Alt epidermis	21.68 ± 5.58	15.46 ± 2.30
	Palizat parankima	11.63 ± 2.84	42.45 ± 4.75
	Sünger parankima	23.51 ± 4.06	-
	Ksilem	16.72 ± 2.30	-

TARTIŞMA ve SONUÇ

Bu çalışmada mera bitkisi olarak geniş yayılış gösteren *Alchemilla sericata* türünün vejetatif organlarının anatomik özellikleri belirlenmiştir. *Alchemilla* cinsi türleri alpin bölgelerde yetişen mera bitkileri olduğu için yetiştiği çayırlık alanda herbivorlar tarafından sıklıkla tüketilir. Tüketildiğinde hayvanların bağırsak florasında değişikliğe neden olduğu için hayvanlar tarafından üretilen sütün içeriğini ve tadını değiştirdiği ile ilgili çeşitli çalışmalar da bulunmaktadır. Bu duruma bitkinin içerdiği sekonder bileşiklerin etkili olduğu düşünülmektedir (Falchero ve ark., 2010; İlgün ve ark., 2014). Ayrıca *Alchemilla* cinsine ait birçok tür tıbbı öneme sahiptir. Morfolojik açıdan taksonomik sıkıntıları olan bu cinse ait türlerin ayırt edilmesinde anatomi, biyokimya ve sitoloji gibi alanlardan yararlanılmaktadır (Ayaz ve Beyazoğlu, 2002).

İncelediğimiz türün kökünde 3-4 sıralı parankimatik hücreler yer almakta olup, kök özü poliarktır. *Alchemilla japonica* Nakai et Hara türünün kök yapısında endodermis üzerinde düzgün sıralı dikdörtgen şekilli 5-6 sıralı parankimatik hücreler bulunmaktadır. Ayrıca kökün merkezi ksilem kollarına göre tetrarktır (Zhu ve ark., 2015). Albornoz ve ark. (2007) Rosaceae familyasına ait üç türün kökünde protoksilem kollarının sayısının türlerin tanımlanmasında önemli karakterler olduğunu ortaya koymuştur.

Türün toprak altı gövdesi rizom şeklindedir. Korteks tabakasının altında dikdörtgen şekilli çok sıralı parankimatik hücreler yer almaktadır. Boruz (2010) *A. connives* Buser ve *A. crinite* Buser türlerinin rizom yapısında çok sıralı endodermis tabakası bulunduğunu belirtmiştir. Ayrıca incelediğimiz türde tekli ya da gruplar halinde druz kristallerinin varlığı da dikkat çekmektedir. Türün gövdesinde endodermis tabakası altında belirli aralıklarla sıralanmış sklerankimatik halka yer almaktadır. *Alchemilla mollis* (Buser) Rothm. türünde de benzer şekilde 3-4 sıralı sklerenkimatik yapı bulunmaktadır (İlgün ve ark., 2016). *A. japonica* türünün gövdesinde küçük ve düz hücrelerden oluşan endodermis tabakası mevcuttur (Zhu ve ark.2015). İncelediğimiz türün gövde özü boş olup, kenarlarda ergastik madde içeren parankimatik hücreler bulunmaktadır. *Alchemilla sericata* türünün petiyol yapısında çok sayıda örtü tüylerine rastlanılmıştır. *Alchemilla* türleri ile yapılan çalışmalarda petiyol anatomisinin önemli karakterlere sahip olduğu belirtilmiştir (Faghir ve ark., 2016, Grytsyk 2019). Faghir ve ark. (2016) yapmış oldukları çalışmada İran da yetişen incelediğimiz *A. sericata* türünün de dahil olduğu birçok *Alchemilla* türünün petiyol anatomisini araştırmışlardır. Bizim incelediğimiz ve İran da yetişen *A. sericata* türünün petiyol anatomileri karşılaştırıldığında İran da yetişen örneklerin daha az tüy ve druz kristali içerdiği belirlenmiştir. İlgün ve ark. (2016) *Alchemilla mollis* türünün petiyolünde endodermis tabakası üzerindeki parankima hücrelerinde nişasta

tanelerine rastlamıştır. İncelediğimiz türde ise nişasta tanelerine rastlanılmamıştır. İncelediğimiz türün yaprak tipi bifasiyaldir. Yaprak mezofili 2 sıralı palizat ve 3-4 sıralı sünger parankimasından oluşmaktadır. *Alchemilla* cinsine ait türlerle yapılan pek çok çalışmada yaprak mezofil tipi bifasiyal olup, palizat ve sünger parankima hücrelerinin tabaka sayısı farklılık göstermektedir (Zhu ve ark., 2015, İlgün ve ark., 2016). Bu durum bitkilerin yaşadıkları habitatlardan kaynaklanabilir. Rosaceae L. familyasının ait bitkilerin stoma tipi anomositiktir (Watson ve Dalwitz, 1991). *A. sericata* türünün üst yüzeyindeki stomalar anomositik ve aktinositik tiptedir. Türün yaprak altındaki stomalar ise anomositik tiptedir. *Alchemilla mollis* türünün hem üst hem de alt yüzeyinde stomalar anomositik tiptedir (İlgün ve ark., 2016).

Sonuç olarak, tıbbi bitki ve mera bitkisi olarak bilinen *Alchemilla sericata* türünün anatomik yapısı ayrıntılı olarak incelenmiştir. Bitkinin yapraklarında stoma tiplerinin, druz kristallerinin varlığı ve bulunduğu yerlerin, rizom ve kök de endoderma tabakasında çok katlı meristematik yapının varlığı ve gövdede sklerenkimatik halkanın varlığı ve bulunma şekli önemli taksonomik karakterler olarak belirlenmiştir.

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FARKLI SİLAJLIK SORGUM GENOTİPLERİNİN OT VERİM, VERİM ÖZELLİKLERİ VE SİLAJ KALİTESİNİN BELİRLENMESİ

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ÖZET
Sorgum, diğer tahıllara göre biyotik ve abiyotik stres koşullarına nispeten daha dayanıklıdır. Bu nedenle sorgum, düşük girdili tarıma kolayca adapte edilebilir. Ayrıca sorgumun yüksek ot verimi ve kaliteli yem üretimi gibi bazı üstün özellikleri vardır. Bu çalışmanın amacı, bazı sorgum genotiplerinin ot verimini, verim parametrelerini ve silajlık özelliklerini belirlemektir. Deneme 2014 yılı yetiştirme sezonunda Kayseri ilinde yapılmıştır. Bitki materyali olarak 16 farklı sorgum genotipi kullanılmıştır. Deneme tesadüf blokları deneme deseninde üç tekrarlamalı olarak yürütülmüştür. Sorgum bitkileri süt-hamur olum döneminde morfolojik gözlemler yapılmış ve gözlemlerin hemen ardından hasat gerçekleştirilmiştir. Sorgum bitkileri yaklaşık 2.5-3 cm'lik parçalar halinde doğranmış ve 2 kg'lık vakum torbalarına doldurulup havası alınarak kapatılmıştır. Daha sonra tüm örnekler karanlıkta 60 gün süreyle bekletilmiştir. İncelenen tüm özellikler yönünden genotipler arasındaki fark istatistiksel olarak önemli bulunmuştur ($P<0.01$). Araştırma sonuçlarına göre bitki boyu 114.66 cm - 303.00 cm, bitki çapı 9.63 mm - 28.67 mm, yaprak oranı %12.54 - %24.18, salkım oranı %9.62 - %48.25, gövde oranı %37.47 - %70.97 ve yeşil ot verimi 1015.1 - 8651.2 kg/da arasında değişmiştir. Sorgum genotiplerinden elde edilen silajların pH değerleri 3.88 - 4.66, kuru madde oranı %23.70 - %42.59, ham protein oranı %4.50 - %8.35, asit deterjanda çözünmeyen lif (ADF) oranı 37.69 - %50.95, nötr deterjanda çözünmeyen lif (NDF) oranı %56.54 - %72.84, ham yağ oranı %0.72 - %1.93 ve ham kül oranı %7.19 - %12.37 arasında değişim göstermiştir. Yeşil ot verimi yönünden Rox çeşidinin, ham protein miktarı yönünden 117/B genotipinin ve düşük ADF ve NDF içeriği yönünden Sugar Graze çeşidinin öne çıktığı tespit edilmiştir.

Anahtar Kelimeler: sorgum, genotip, verim, yem özellikleri

DETERMINATION OF HERBAGE YIELD, YIELD CHARACTERISTICS AND SILAGE QUALITY OF DIFFERENT SILAGE SORGHUM GENOTYPES

ABSTRACT

Sorghum is relatively more resistant to biotic and abiotic stress conditions than the other cereals, so, sorghum can easily be adapted to low-input agriculture. Sorghum has some superior characteristics like herbage yield and animal feed quality. The objective of the present study was to determine herbage yield, yield parameters and silage characteristics of some sorghum genotypes. Experiment was conducted in Kayseri Province of Turkey during the growing seasons of 2014. Different 16 sorghum genotypes were used as the plant material. Experiment was conducted in randomized blocks experimental design with three replications. Morphologic observations were performed at milk-dough stage of the sorghum plants and harvest was performed right after observations. The sorghum plants were chopped about 2.5-3 cm pieces, filled and sealed in 2 kg deflated vacuum bags. Then the all samples were preserved in dark for 60 days. Effects of genotypes on all parameters were found to be highly significant ($P<0.01$). Considering the results plant high varied between 114.66 - 303.00 cm, plant diameter varied between 9.63 - 28.67 mm, leaf ratio varied between 12.54% - 24.18%, panicle ratio varied between 9.62% - 48.25%, stem ratio varied between 37.47% - 70.97% and green herbage yield varied between 1015.1 - 8651.2 kg/da. pH varied between 3.88 - 4.66, dry matter ratio varied between %23.70 - %42.59, crude protein content varied between 4.50% - 8.35%, ADF content varied between 37.69% - 50.95%, NDF content varied between 56.54% - 72.84%, crude oil content varied between 0.72% - 1.93%, crude ash content varied between 7.19% - 12.37% of silage of sorghum genotypes. The Rox cultivar was found to be prominent with green herbage yield, 117/B was found to be prominent with crude protein and Sugar Graze was found to be prominent with low ADF and NDF.

Keywords: Sorghum, genotype, herbage yield, forage parameters

GİRİŞ

Diğer tahıllara göre farklı çevresel streslere karşı daha dayanıklı ve üretimi daha düşük girdili olan sorgum bitkisi dünyanın beşinci önemli tahılıdır (Awika ve Rooney, 2004). Sorgum kuraga, tuzluluğa dayanıklı bölgelere kolaylıkla yetiştirilebilmektedir (Li vd. 2010). Bu üstün özelliklerinden dolayı dünyanın birçok bölgesinde marjinal alanlarda hayvan besleme için yaygın bir şekilde kullanılmaktadır (Barile vd. 2007). Sorgum, mısır yetiştiriciliği için çok fazla sıcak ve kurak alanlarda, mısır bitkisine alternatif olabilmektedir. Sorgum bitki besin maddeleri yönünden fakir ve tuzlu topraklara, uzun süreli su basmalarına mısıra göre daha fazla dayanıklıdır (Anonim, 1995). Sorgumun hayvan beslemede en yaygın kullanım şekillerinden birisi silajdır. Silajın besleme değerinin yüksek oluşu, kolaylıkla uzun süre muhafaza edilmesi, sindiriminin diğer kaba yemlere göre kolay olması, kış döneminde de hayvanların suca zengin yemler ile beslenmesine olanak sağlaması gibi üstün özellikleri ile tüm dünyada hayvan beslemede yaygın şekilde kullanılmaktadır (Tükel ve Hatipoğlu, 1997).

Hayvan beslemede yemlerin, rasyonlarda kullanım öncesi kimyasal bileşimi ile besin maddelerinin saptanması büyük önem taşımaktadır (Kaplan vd. 2019). Hayvanların yem tüketimi, yemin sindirilmesi ve yemlerin hayvansal ürüne dönüştürülmesi yemin kalitesine bağlı olarak değişmektedir. Yemin potansiyel besleme değeri; fiziksel ve biyokimyasal değerlerinin ölçülmesi ile saptanan yaygın, hızlı, kolay ve ucuz bir yöntemdir (Kaplan et al. 2014). Bu çalışmanın amacı farklı silajlık sorgum genotiplerinin verim, verim özellikleri ile bu genotiplerden elde edilen silaj örneklerinin yem özelliklerinin belirlenmesidir.

MATERYAL ve YÖNTEM

Araştırmada, 16 adet silajlık sorgum genotipi bitkisel materyal olarak kullanılmıştır. Tarla denemesi, tesadüf blokları deneme deseninde üç tekrarlamalı olarak kurulmuştur. Denemede parsel boyutları 1.6 m x 5 m= 8 m^2 olacak şekilde belirlenmiştir. Deneme, el markörü yardımıyla 40 cm ara ile açılan 5 m uzunluğundaki sıralara 4 sıra halinde ekilmiştir. Ekimde dekara 4 kg olacak şekilde tohumluk kullanılmıştır. Denemeye ekim öncesi dekara saf madde üzerinden 10 kg azot (N), 10 kg fosfor (P_2O_5) ve daha sonra üst gübresi olarak da 10 kg/da N gübresi verilmiştir. Ekimden sonra, deneme parsellerindeki bitkilerin çıkışını sağlamak için yağmurlama sulama yapılmıştır. Parsellerde yetişme sezonu boyunca çapa ile yabancı ot mücadelesi yapılmıştır. Bitkiler süt-hamur olum döneminde morfolojik gözlemler alınarak biçilmiştir.

Denemenin yürütüldüğü 5 aylık (Mayıs-Eylül) yetiştirme sezonundaki aylık ortalaması sıcaklık 22.7 °C olmuştur. Vejetasyon devresi içinde yeterli yağış olmağı için bitkilerin su ihtiyacı sulama suyuyla karşılanmıştır. Araştırma alanından alınan toprak numunelerinin analiz

sonucuna göre; pH'sı hafif alkali, tuz içeriği bakımından tuzsuz, organik madde içeriği az, P_2O_5 yeterli düzeyde, K_2O içeriği iyi, kireç içeriği de az olarak tespit edilmiştir.

Hasatta tüm bitkiler yaklaşık 2.5-3 cm uzunluğunda parçalanarak 2 kg'lık vakum poşetlerine doldurulmuş havası alınarak ağzı kapatılmıştır. Örnekler karanlık bir yerde (24±2°C) 60 gün muhafaza edilmiştir. Açılan silajlardan karıştırılarak alınan 30 g örnek ile 270 ml su karıştırılarak pH ölçümü yapılmıştır. Yine taze silaj örneklerinden alınan 250 g örnek 70 °C'de 48 saat etüvde kurutulmuş ve kuru madde oranı belirlenmiştir. Kurutma tamamlandıktan sonra yem örnekleri 1 mm'lik elekleri olan değirmende öğütülerek kimyasal analizlere hazır hale getirilmiştir. Kuru madde, ham protein, ham yağ ve ham kül analizleri AOAC (1990)'da belirtilen yöntemlerle yapılmıştır. Hücre duvarını oluşturan NDF ve ADF gibi unsurların analizi sırasıyla Van Soest and Wine (1967) ve Van Soest (1963)'de belirtilen yöntemle ANKOM 200 Fiber Analyzer (ANKOM Technology Corp. Fairport, NY, USA) cihazı kullanılarak yapılmıştır. Araştırma sonucu elde edilen bulgular, SAS (SAS Inst. 1999) programından yararlanılarak tesadüf blokları deneme desenine göre varyans analizine tabi tutulmuştur. Bulunan ortalamalar arasındaki farkın önemli olup olmadığı Duncan testi ile belirlenmiştir.

BULGULAR ve TARTIŞMA

Sorgum genotiplerinin bitkisel özellikleri ve yeşil ot verimi değerleri Çizelge 1'de verilmiştir. İncelen bitkisel özellikler ve verim üzerine genotipin etkisi istatistiksel çok önemli bulunmuştur ($p \leq 0.01$). Sorgum genotiplerinin bitki boyu 114.66-303.00 cm, bitki çapı 9.63-28.67 mm, yaprak oranı %12.54-24.18, salkım oranı %9.62-48.25, gövde oranı %37.47-70.97 ve yeşil ot verimi 1015.1-8651.2 kg/da arasında değişmiştir. En yüksek bitki boyu, bitki çapı ve yaprak oranı PI17676601 genotipinden, salkım oranı A.N genotipinden, gövde oranı 183 nolu genotipten ve yeşil ot verimi Rox çeşidinden elde edilmiştir.

Sorgum genotiplerinden elde edilen silajların biyokimyasal özellikleri Çizelge 2'de verilmiştir. Silajın biyokimyasal özellikleri üzerine genotipin etkisi etkisi istatistiksel çok önemli bulunmuştur ($p \leq 0.01$). Sorgum genotiplerinin pH 3.88-4.66, kuru madde oranı %23.70-%42.59, ham protein oranı %4.50-%8.35, ADF oranı 37.69-%50.95, NDF oranı %56.54-%72.84, ham yağ oranı %0.72-%1.93 ve ham kül oranı %7.19-%12.37 arasında değişim göstermiştir. En yüksek ham protein oranı 117/B genotipinden, en yüksek ADF oranı 226/B genotipinden, en yüksek NDF oranı PI17676601, 226/B ve A.N genotiplerinden, en yüksek ham yağ oranı IS12859 genotipinden ve en yüksek ham kül oranı 271 nolu genotipten elde edilmiştir.

Çizelge 1. Silajlık sorgum türlerinin bitkisel özellikleri ve yeşil ot verimi değerleri

Genotipler	Bitki Boyu (cm)	Bitki Çapı (mm)	Yaprak Oranı (%)	Salkım Oranı (%)	Gövde Oranı (%)	Yeşil Ot Verimi (kg/da)
Sugar Graze	228.66^{d}	22.23^{de}	16.84^{gh}	12.97^{ı}	70.17^{a}	7594.1^{b}
ROX	163.33^{h}	22.91^{cd}	19.43^{ef}	9.62^{j}	70.94^{a}	8651.2^{a}
271	149.66^{j}	10.17^{j}	22.51^{bc}	18.61^{h}	58.87^{cd}	2444.3^{g}
270	197.66^{f}	13.38^{g}	21.57^{cd}	17.96^{h}	60.46^{c}	2820.0^{f}
269	140.33^{k}	11.78^{hı}	20.01^{de}	33.24^{e}	46.74^{f}	3102.5^{e}
253	156.00^{ı}	23.65^{c}	20.91^{de}	45.15^{b}	33.93^{ı}	3321.1^{e}
183	220.33^{e}	17.15^{f}	15.51^{hıj}	13.51^{ı}	70.97^{a}	5682.3^{c}
242	200.33^{f}	17.46^{f}	12.54^{k}	27.64^{f}	59.81^{cd}	4504.9^{d}
PI17676601	303.00^{a}	28.67^{a}	24.18^{a}	11.32^{ıj}	64.49^{b}	3343.2^{e}
226/B	268.33^{b}	25.54^{b}	23.55^{ab}	23.47^{g}	52.98^{e}	4449.2^{d}
185	266.66^{b}	22.65^{cd}	15.06^{ıj}	18.84^{h}	66.09^{b}	2810.4^{f}
IS12859	114.66^{l}	9.63^{j}	17.99^{fg}	38.72^{c}	43.28^{g}	1795.9^{h}
66	181.00^{g}	12.40^{gh}	16.68^{gh}	35.70^{d}	47.61^{f}	1391.4^{ı}
144	269.33^{b}	21.20^{e}	16.51^{gh}	22.78^{g}	60.70^{c}	1797.1^{h}
A.N.	151.33^{j}	10.65^{ıj}	14.27^{j}	48.25^{a}	37.47^{h}	1015.1^{j}
117/B	256.66^{c}	18.07^{f}	23.49^{ab}	19.45^{h}	57.05^{d}	2428.3^{g}
ÖD	**	**	**	**	**	**
KO	96.17	110.84	400.05	438.10	408.68	139.45

ÖD: önem derecesi, KO: kareler ortalaması, **: P≤0.01

Çizelge 2. Silajlık sorgum türlerinin silajlarının biyokimyasal özellikleri

Genotipler	pH	Kuru Madde (%)	Ham Protein (%)	ADF (%)	NDF (%)	Ham Yağ (%)	Ham Kül (%)
Sugar Graze	3.99^{cde}	27.14^{g}	6.23^{cde}	37.69^{f}	56.54^{f}	1.42^{bc}	9.18^{cdef}
ROX	3.97^{de}	23.70^{h}	5.72^{def}	44.92^{cd}	67.30^{bcd}	1.25^{bcd}	8.97^{cdef}
271	3.99^{cde}	27.39^{g}	5.22^{fgh}	49.59^{ab}	67.46^{bc}	1.15^{bcde}	12.37^{a}
270	4.11^{bcde}	36.95^{c}	6.17^{cde}	39.45^{ef}	68.14^{bc}	1.56^{ab}	9.10^{cdef}
269	3.94^{de}	27.69^{fg}	4.88^{gh}	42.67^{de}	65.85^{cd}	1.09^{cde}	8.66^{defg}
253	4.66^{a}	32.63^{de}	6.49^{cd}	41.00^{ef}	64.92^{cd}	1.46^{bc}	8.72^{cdefg}
183	4.11^{bcde}	27.74^{fg}	4.50^{h}	45.23^{cd}	67.96^{bc}	0.81^{de}	10.04^{bcd}
242	3.88^{e}	36.16^{c}	5.79^{def}	45.75^{cd}	64.74^{cd}	0.94^{de}	8.27^{efg}
PI17676601	4.08^{bcde}	26.35^{gh}	6.40^{cd}	47.55^{abc}	70.75^{ab}	0.89^{de}	8.88^{cdef}
226/B	4.20^{bcd}	30.76^{ef}	6.25^{cd}	50.95^{a}	71.84^{a}	0.72^{e}	7.97^{fg}
185	4.16^{bcde}	31.89^{e}	5.03^{fgh}	45.60^{cd}	67.38^{bcd}	0.81^{de}	8.03^{fg}
IS12859	4.32^{b}	37.74^{bc}	7.33^{b}	47.81^{abc}	60.93^{e}	1.93^{a}	10.30^{bc}
66	4.33^{b}	40.56^{ab}	5.47^{efg}	45.93^{cd}	65.72^{cd}	1.57^{ab}	11.38^{ab}
144	4.18^{bcde}	35.06^{cd}	5.12^{fgh}	47.87^{abc}	72.84^{a}	0.88^{de}	7.19^{g}
A.N	4.30^{bc}	42.59^{a}	6.58^{c}	46.97^{bc}	66.21^{cd}	1.38^{bc}	10.23^{bcd}
117/B	4.01^{bcde}	26.39^{gh}	8.35^{a}	44.94^{cd}	63.77^{de}	0.73^{e}	9.85^{bcde}
ÖD	**	**	**	**	**	**	**
KO	0,08	647.17	287.46	252.66	317.56	0.26	351.87

*ÖD: önem derecesi, KO: kareler ortalaması, **: P≤0.01*

Ball vd. (2001) kuru madde ve protein oranlarının genotipler arasında farklı olması bitkinin genetik yapısından kaynaklandığı gibi yaprak, başak ve gövde oranlarına, olgunlaşma dönemine, sıcaklığa ve gübrelemeye göre değiştiğini ifade etmişlerdir. Hayvan beslemede kullanılan kaba yemlerin ADF ve NDF oranlarının düşük olması istenmektedir. Yüksek miktardaki ADF ve NDF içerikleri sindirimi zorlaştırmakta ve kaliteyi düşürmektedir (Kaplan vd. 2014). Silajda düşük pH seviyesi çözünebilir şekerlerin fermantasyonu ile asitlenmiş bir ortamın varlığını işaret eder (Islam vd. 2012). Kuru madde miktarının artması ve suda çözünen şeker miktarının azalması ile pH'nın yüksek olması ve laktik asit ve asetik asit miktarının azalmasına neden olmaktadır (Filya, 2003).

Bu araştırmada kullandığımız genotiplerin morofolojik özellikleri ile biyokimyasal sonuçları birçok araştırmanın çalışması ile benzerlik göstermektedir (Kaplan ve Kara, 2014; Kaplan vd. 2019; Ciftci vd. 2023).

SONUÇ ve ÖNERİLER

Kayseri ilinde söz konusu denemenin birkaç yıl daha yapılması gerektiği kanaatine varılmıştır. Tek yıllık araştırma sonuçlarına göre; yeşil ot verimi yönünden Rox çeşidinin, ham protein miktarı yönünden 117/B genotipinin ve düşük ADF ve NDF içeriği yönünden Sugar Graze çeşidinin öne çıktığı tespit edilmiştir.

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FARKLI SULAMA SEVIYELERINDE YETIŞTIRILEN YONCA ÇEŞITLERINDE FENOLIK VE ANTIOKSIDAN AKTIVITEDEKI DEĞIŞIMLER

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ÖZET
Bu çalışma, su stresinin yonca çeşitlerinde toplam fenolik, toplam flavonoid, DPPH, hidrolize tanen ve kondanse tanen içerikleri üzerine etkilerini ortaya koymak, amacıyla 2021 yılında yürütülmüştür. Çalışmada tam sulama koşullarında tüketilen suyun %100, %75 ve %50'si (I_{50}, I_{75} ve I_{100}) 3 farklı yonca çeşidine (Şahin 42, Minerva ve Magna 601) damla sulama sistemiyle uygulanmıştır. Tesadüf blokları deneme desenine göre 3 tekrarlı şekilde yürütülen denemede toprak nemi takip edilerek etkili kök bölgesinde tüketilen su saptanarak sulama uygulamaları yapılmıştır. Toplam flavonoid içeriği hariç incelenen tüm özellikler üzerinde sulama uygulamaları istatistiksel olarak önemli değişimlere neden olmuştur.

Anahtar Kelimeler: Yonca, fenolik bileşik, antioksidan

CHANGES IN PHENOLIC AND ANTIOXIDANT ACTIVITY IN ALFALFA CULTIVARS GROWN UNDER DIFFERENT IRRIGATION LEVELS

ABSTRACT

This study was carried out in 2021 to reveal the effects of water stress on total phenolic, total flavonoid, DPPH, hydrolyzed tannin and condensed tannin contents in alfalfa cultivars. In the study, 100%, 75% and 50% of the water consumed under full irrigation conditions (I50, I75 and I100) was applied to 3 different clover varieties (Şahin 42, Minerva and Magna 601) with drip irrigation system. In the experiment, which was carried out in 3 repetitions according to the random blocks trial design, the water consumed in the effective root zone was determined by monitoring the soil moisture and irrigation applications were made. Irrigation applications caused statistically significant changes on all the examined properties except for the total flavonoid content.

Keywords: Alfalfa, phenolic compound, antioxidant

GİRİŞ

Günümüzde sera gazlarının salınımının artarak devam etmesi ve buna bağlı oluşan küresel ısınma sorunu giderek daha fazla hissedilir hale gelmiştir (Yoro ve Daramola, 2020). Küresel tarım alanlarının yarıdan fazlası kuraklık sorunuyla karşı karşıyadır (Geng vd. 2016). Sulama, tarımsal üretim faaliyetlerinde verim ve kaliteyi etkileyen en önemli faktörlerden biridir (Kang vd. 2017; Kaplan vd.2019; Hu vd. 2021). Su kıtlığı, yonca yetiştiriciliğinde en büyük problemlerin başında geldiğinden (Putnam vd. 2021), bu koşullar altında yoncanın verimliliğini ve kalıcılığını artırmak gerekmektedir. Sulama sularının miktarında henüz çok ciddi sorunlar ortaya çıkmamışken, kısıtlı sulama şartlarında da tatminkâr seviyede ürün üretebilen çeşitlerin tespiti, su kısıtlılığına tepkilerinin araştırılmasına öncelik verilmesi (Zhang vd. 2015) ve uygun sulama programının oluşturulması son derece kritiktir (Kamran vd. 2022). Yonca (*Medicago sativa* L.), sadece hayvan beslenmesinde iyi bir baklagil yem bitkisi değil aynı zamanda toprak kalitesini de artırabilen iyi bir münavebe bitkisidir (Benabderrahim vd. 2015). Birçok ülkede yaygın olarak yetiştirilmekte olan yonca bu ülkelerin çoğunda en fazla yetiştirilen yem bitkisi konumundadır (Li and Huang, 2008; Singer vd. 2018). Yonca, toprakta bulunan su miktarına uyum sağlamada geniş spektrumlar gösterir ve aşırı kurak koşullarda bile hayatta kalıp ürün verebilir (Capstaff and Miller, 2018). Ancak su kıtlığı, kurak alanlarda yem verimi ve kalitesi için önemli bir sınırlayıcı faktördür (Liu vd. 2021). Yonca hayvan besleme açısından oldukça önemli bir bitkidir. Yüksek miktarda protein ve mineral içeriğine sahip olması yoncayı diğer yem bitkilerine göre öne çıkarmaktadır. Aynı zamanda sağlık açısından faydalı ve pek çok hastalığa karşı koruyucu etkileri olan fitokimyasalları da içermektedir. Bu çalışmanın amacı yonca çeşitlerinde yapılan farklı sulama stratejilerinin yoncanın antioksidan enzim aktivitesi ve fenolik içeriğine olan etkileri araştırmaktır.

MATERYAL ve METOT

Araştırma, 2021 yılında Erciyes Üniversitesi Tarımsal Araştırma Merkezi'nde yürütülmüştür. Materyal olarak 3 farklı yonca çeşidi (Şahin 42, Minerva, Magna 601) kullanılmıştır. Çalışmada sulama seviyeleri (Tarla kapasitesinine göre I_{100}: 100, I_{75}: 75 ve I_{50}: 50%) ana parsel, çeşitler alt parsel olacak şekilde 1 Mayıs 2019 tarihinde bölünmüş parseller deneme desenine göre üç tekrarlamalı olarak dekara 2.5 kg tohumluk olacak şekilde elle ekilmiştir. Ekimle birlikte 3 kg/da azot (N), 10 kg/da fosfor (P_2O_5) verilmiştir. Her bir parsel 1.6×5 m boyutlarında (8 m^2) olup 20 cm arayla 8 sıra içermektedir. Parsel aralarında 50 cm ve blok aralarında 2 m boşluk bırakılmıştır. Yetişme süresince herhangi bir hastalık veya zararlı görülmemiştir. Parsel ve blok aralarında yabancı ot kontrolü sağlanmıştır. Yetiştirme sezonu boyunca 4 biçim alınmış ve biçimler %10 çiçeklenme döneminde yapılmıştır (Çaçan vd. 2018).

Kayseri ili yıllık ortalama sıcaklık 10.6 °C olup, en soğuk ay olan Ocak ayında ortalama sıcaklık -1.7°C ve bu ayda ortalama maksimum ve minimum sıcaklık farkı 11.0°C'dir. En sıcak ay ise ortalama 22.2°C sıcaklık ile Temmuz ayıdır. Ortalama toplam yıllık yağış 389 mm, nisbi nem ise %66.6 olarak kaydedilmiştir (Tablo 1).

Tablo 1. 2021 yılına ait iklim verileri

	Nisan	Mayıs	Haziran	Temmuz	Ağustos	Eylül	Ekim
Tort (ºC)	10.7	15.9	18.8	23.8	21.9	16.9	11.8
Tmaks(ºC)	16.8	23.6	25.8	31.8	30.7	24.2	20.4
Tmin(ºC)	4.5	7.4	12.1	14.6	13.5	10.4	4.0
RHort, %	63.5	56.4	53.1	44.7	41.5	49.4	53.0
Rüzgar, m/s	2.2	2.2	2.0	2.4	1.1	1.7	1.4
Yağış, mm	22.7	21.3	37.2	0.0	17.1	16.7	0.2
ET, mm	3.59	5.04	5.65	6.75	5.37	3.91	2.56

Deneme alanı toprağının kumlu-tınlı, kireç ve tuz oranları düşük, pH hafif alkali ve organik maddece fakir olduğu belirlenmiştir (Tablo 2).

Tablo 2. Deneme alanına ait toprak özellikleri

Toprak Özellikleri	**Derinlik (cm)**		
	0-30	**30-60**	**60-90**
Tekstür	Tınlı	Tınlı	Killi-Tınlı
EC_s (dS/m)	0.23	0.171	0.260
pH	8.10	8.18	8.15
Tarla Kapasitesi, P_w (%)	20.08	22.18	21.31
Solma Noktası, P_w (%)	12.39	13.21	11.89
Hacim Ağırlığı (gr/cm^3)	1.27	1.24	1.22
Organik Madde (%)	1.27	1.15	0.72
Kireç (%)	2.50	5.73	3.24
N (kg/da)	2.14	1.06	0.41
P_2O_5 (kg/da)	2.08	1.14	0.61
K_2SO_4 (kg/da)	27.14	37.71	30.91

Sulama suyunun elektriksel iletkenliği 242 µS/cm ve pH derecesi 7.60 olarak saptanmıştır (Tablo 3). Yoncanın sulanmasında damla sulama sistemi kullanılmıştır. Her iki bitki sırasına bir adet, 16 mm dış çaplı, 4 atm işletme basınçlı polietilen (PE) damla sulama lateral boru hattı döşenmiştir. Yıldırım (2003)'de verilen ilkelerden yararlanarak, %100'e yakın ıslatılan alan oranı elde edecek damlatıcı debisi (2 lt/h) ve damlatıcı aralığı (25 cm) kullanılmıştır. Her bir bloğun başına bir adet su sayacı yerleştirilerek sulamalar takip edilmiştir.

Tablo 3. Deneme alınında kullanılan sulama suyu özellikleri

pH	EC_w (µS/cm)	Na^+ (mg/L)	K^+ (mg/L)	Ca^{+2} (mg/L)	Mg^{+2} (mg/L)	HCO_3^- (mg/L)	CO_3^{-2} (mg/L)	SAR
7.60	242	11.64	4.59	26.36	6.68	12.21	< 1.00	2.91

Yonca örnekleri 65 °C'de etüvde kurutma işleminden sonra öğütücü yardımı ile toz haline getirilmiştir. Öğütülen örnekler 1 g örnek için 50 ml %40'lık etanol ile soxhlet ekstraktöründe yaklaşık olarak 6 saat süreyle 60 ℃'de özütleme işlemiş gerçekleştirilmiştir. Elde edilen özütler daha sonra basınç altında rotary evaporatörle 40 ℃'de yoğunlaştırılıp, +4 ℃'de deney yapılacak hale getirilmiştir. Toplam fenolik içerik küçük değişiklikler ile Folin-Ciocalteu yöntemine göre belirlenmiştir. Toplam flavonoid içeriği Arvout-Grand vd. 1994'e göre spektrofotometrik olarak belirlenmiştir. Yonca örneklerinin DPPH serbest radikal süpürme aktiviteleri Shimada ve ark. (1992), kullanmış oldukları method ile belirlenmiştir. Analizler 3 tekerrürlü olarak yapılmıştır.

İstatistik Analiz

İncelen tüm özelliklere ait sonuçlar öncelikle bölünmüş parseller deneme desenine göre varyans analizine tabi tutulmuştur. F testine göre istatistiksel olarak önemli olan özelliklere ait ortalamaların karşılaştırılmasında çoklu karşılaştırma testi (Duncan) kullanılmıştır. İstatistiksel analizler için SAS İstatistik Paket programı kullanılmıştır (SAS Inst., 1999).

Bulgular

Yonca çeşitlerinde yapılan analizlerde toplam fenolik içerik üzerine sulama suyu seviyelerinin etkisi istatistiksel olarak $p<0.01$ seviyesinde önemli farklılıklar oluşturmuştur. Sulama * Çeşit interaksiyonu da aynı seviyede önemlidir. En yüksek toplam fenolik içerik %25 su kısıtı olan U75 konusunda ve Magna 601 çeşidinde 725,19 mg/100g olarak bulunmuştur. En düşük GAE ise %50 su kısıtı olan uygulamada Minerva çeşidinde 431,85 mg/100g olarak hesaplanmıştır.

Tablo 4. Toplam fenolik, DPPH, toplam flavonoid, hidrolize tanen ve kondanse tanen

U50	Toplam Fenolik mg 100g-1	DPPH %İNH.	TOF mg/kg	HET mg/kg	KOT mg/kg
Minerva	431,85f	15,33c	20,77c	30,75d	36,96g
ŞAHİN 42	541,04d	18,61b	14,97c	7,50d	60,80f
MAGNA 601	648,02b	21,81a	20,24c	567,00cd	104,73e
U75	**Toplam Fenolik mg 100g-1**	**DPPH %İNH.**	**TOF mg/kg**	**HET mg/kg**	**KOT mg/kg**
MİNERVA	602,07c	18,42b	19,29c	861,00cd	100,50e
ŞAHİN 42	610,05bc	14,20cd	36,22a	3144,00a	213,05a
MAGNA 601	725,19a	19,32b	30,27ab	708,00cd	124,61d
U100	**Toplam Fenolik mg 100g-1**	**DPPH %İNH.**	**TOF mg/kg**	**HET mg/kg**	**KOT mg/kg**
MİNERVA	487,71e	8,80f	18,52c	2435,25ab	181,93b
ŞAHİN 42	490,00e	12,06de	17,38c	3067,50a	136,02c
MAGNA 601	576,76cd	10,28ef	28,14b	1396,50bc	139,61c

Sulama suyu seviyesindeki değişimin yonca çeşitlerinde DPPH içeriği üzerine etkileri ve interaksiyonları istatistiksel olarak çok önemli (%1) bulunmuştur. En yüksek DPPH içeriği U50 konusunda Magna 601 çeşidinde %21.81 olarak bulunurken 3n düşük DPPH Minerva çeşidinde U100 konusunda % 8.80 olarak belirlenmiştir. Toplam flavonoid sulama uygulamalarından istatistiksel olarak önemli bir seviyede etkilenmemiştir. Yonca çeşitlerinin flavonoid içeriği 17.38 – 145.41 mg/kg aralığında değişim göstermiştir. Hidrolize tanen (HET) ve kondanse tanen (KOT) sulama uygulamalarından ve su x çeşit interaksiyonlarından $p<0.01$ düzeyinde etkilenmiştir. En yüksek hidrolize tanen U50 ve U100 uygulamalarında aynı çeşitte elde edilirken (Şahin 42) en düşük hidrolize tanen Şahin42 çeşidinde 7.50 mg/kg olarak elde edilmiştir. Kondanse tanen U75 konusunda 213.05 mg/kg ile en yüksek değere ulaşırken, Minerva çeşidinde U50 konusunda 36.96 mg/kg değerlerine kadar gerilemiştir.

SONUÇ

Araştırma sonuçlarına göre yoncada toplam fenolik, DPPH, toplam flavonoid, kondanse tanen ve hidrolize tanen içerikleri üzerine çeşidin ve sulamanın etkisi oldukça önemli çıkmıştır. Toplam fenolik içeriği ve DPPH içeriği Magna 601 çeşidinde en yüksek seviyeye ulaşmıştır. Toplam flavonoid, hidrolize tanen ve kondanse tanen içerikleri ise en yüksek Şahin 42 çeşidinde tespit edilmiştir. En yüksek içerikler %25 su kısıtı uygulanan U75 konusunda olduğu tespit edilmiştir. Sulama suyunda meydana gelen azalmanın düzenli bir azalışa neden olmadığı ancak içeriği önemli seviyelerde değiştirdiği görülmektedir.

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KLİMAKTERİK MEYVELERDE HASAT SONRASINDA SOLUNUMUN ÖNEMİ

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ÖZET
Klimakterik meyveler, hasat sonrası olgunlaşma sürecinde önemli fizyolojik değişimler yaşayan meyvelerdir. Bu değişimler, meyvelerin aroma, tat, tekstür ve diğer duyusal özelliklerinde belirgin gelişmelere yol açar. Solunum, klimakterik olgunlaşma sürecinde biyokimyasal ve moleküler düzeyde önemli bir rol oynar. Solunum, canlı organizmaların hücrelerinde enerji üretmek için gerçekleşen bir biyokimyasal süreçtir. Bitkilerde solunum, fotosentez yoluyla elde edilen organik bileşiklerin metabolizması ve enerji üretimi için önemlidir. Solunum sırasında, besin maddeleri oksijen kullanılarak parçalanır ve enerji açığa çıkar. Bu enerji, hücre içindeki işlevlerin sürdürülmesi, metabolik reaksiyonlar, hücre bölünmesi, hareket gibi birçok yaşamsal süreci desteklemek için kullanılır. Klimakterik meyvelerde, hasat sonrası dönemde solunum önemli ölçüde artar. Bu artış, meyvelerin metabolik aktivitelerinin hızlanmasına ve enerji üretiminin artmasına yol açar. Solunumdaki bu artış, besin maddelerinin parçalanması ve glikozun enerjiye dönüştürülmesiyle gerçekleşir. Solunum, meyvelerin hücresel düzeydeki enerji gereksinimini karşılar ve olgunlaşma sürecinin ilerlemesini destekler. Verilen makale, hasat sonrası klimakterik meyvelerde solunumun önemine ilişkin ilgili bilgileri sağlamaktadır.

Anahtar Kelimeler: Solunum, Muhafaza, Etilen, Klimakterik

THE IMPORTANCE OF RESPIRATORY AFTER HARVEST IN CLIMATERIC FRUIT

ABSTRACT

Climacteric fruits are fruits that undergo significant physiological changes during post-harvest ripening. These changes lead to notable improvements in the fruits' aroma, taste, texture, and other organoleptic properties. Respiration plays a crucial role in the climacteric ripening process at both biochemical and molecular levels. Respiration is a biochemical process that generates energy in living organisms' cells. In plants, respiration is essential for the metabolism and energy production of organic compounds obtained through photosynthesis. During respiration, nutrients are broken down using oxygen, and energy is released. This energy is utilized to sustain cellular functions, metabolic reactions, cell division, movement, and other vital processes within the cell. In climacteric fruits, respiration significantly increases during the post-harvest period. This increase accelerates the fruits' metabolic activities and enhances energy production. The rise in respiration rate is driven by the breakdown of nutrients and the conversion of glucose into energy. Respiration fulfills the cellular energy requirements of the fruits and supports the progression of the ripening process. The given article provides relevant information on the importance of respiration in post-harvest climacteric fruits.

Keywords: Respiration, Storage, Ethylene, Climacteric

GİRİŞ

Klimakterik meyveler, hasat sonrası olgunlaşma sürecinde önemli fizyolojik değişimler gösteren meyvelerdir. Bu değişimler, meyvelerin aroma, tat, tekstür ve diğer organoleptik özelliklerinde belirgin iyileşmelere yol açar (Aydınlıoğlu ve ark., 2023). Klimakterik olgunlaşma sürecinde solunum, biyokimyasal ve moleküler düzeyde önemli bir rol oynar. Solunum, canlı organizmaların hücrelerinde enerji üretimi için gereken bir biyokimyasal süreçtir. Bitkilerde solunum, fotosentezle elde edilen organik bileşiklerin metabolizması ve enerji üretimi için önemlidir (Seymour ve ark.,2013). Solunum sürecinde besin maddeleri, oksijen kullanılarak parçalanır ve enerji açığa çıkarılır. Bu enerji, hücre içerisindeki işlevlerin sürdürülmesi, metabolik reaksiyonlar, hücre bölünmesi, hareket gibi birçok yaşamsal süreci desteklemek için kullanılır. Klimakterik meyvelerde solunum, hasat sonrası dönemde belirgin bir şekilde artar. Bu artış, meyvelerin metabolik aktivitelerinin hızlanmasına ve enerji üretiminin artmasına yol açar. Solunum hızındaki artış, besin maddelerinin parçalanması ve glikozun enerjiye dönüştürülmesiyle gerçekleşir. Solunum, meyvelerin hücresel düzeyde enerji gereksinimini karşılar ve olgunlaşma sürecinin ilerlemesini destekler (Erbaş ve ark., 2022). Klimakterik meyvelerdeki solunum hızındaki artış, etilen hormonu ile yakından ilişkilidir. Etilen hormonu, olgunlaşma sürecinin düzenlenmesinde önemli bir role sahiptir ve solunumu etkileyerek olgunlaşma sürecini hızlandırır. Etilen hormonunun salınımı, solunumu uyarır ve artan solunum hızı da etilen üretimini daha da artırır. Bu etkileşim, klimakterik meyvelerin hızlı olgunlaşma sürecinin bir parçasıdır (Prusky ve ark.,2023). Klimakterik meyvelerde hasat sonrası solunum, olgunlaşma sürecinin önemli bir bileşenidir. Solunum hızındaki artış, enerji üretimini sağlar ve olgunlaşma sürecini destekler. Etilen hormonunun etkisiyle birlikte, solunum klimakterik meyvelerin olgunlaşma ve depolama süreçlerinde kritik bir rol oynar. Bu nedenle, klimakterik meyvelerin hasat sonrası solunumunu anlamak, üretim, depolama ve pazarlama süreçlerinde önemli bir faktördür (Zein ve ark., 2023).

Solunumun Tanımı ve Mekanizması

Solunum, canlı organizmaların hücrelerinde enerji üretimi için gerekli olan bir biyokimyasal süreçtir. Bu süreçte, besin maddeleri oksijen kullanılarak parçalanır ve enerji açığa çıkarılır. Bitkilerde solunum, fotosentezle elde edilen organik bileşiklerin metabolizması ve enerji üretimi için önemlidir (Ribeiro ve ark., 2023). Solunum, hücre içerisinde gerçekleşen bir dizi biyokimyasal reaksiyondan oluşur. İlk adım, glikozun glikoliz adı verilen bir süreçle parçalanmasıdır. Glikolizde, glikoz molekülü, sitoplazmada çeşitli enzimatik reaksiyonlarla pirüvat moleküllerine ayrışır. Bu aşamada, bir miktar enerji açığa çıkar ve NADH gibi elektron taşıma molekülleri üretilir. Pirüvat molekülleri daha sonra mitokondriye taşınır ve Krebs

döngüsü olarak da bilinen bir dizi reaksiyona girer. Krebs döngüsü, pirüvatın daha fazla parçalanması ve elektron taşıma molekülleri olan NADH ve FADH2'nin üretilmesiyle sonuçlanır. Bu moleküller daha sonra elektron taşıma zincirine taşınır. Elektron taşıma zinciri, mitokondri içindeki zar yapısı boyunca bulunan proteinlerden oluşur (Lelievre ve ark.,2008). Elektron taşıma zinciri, NADH ve FADH2'den gelen elektronları alır ve bu elektronları bir dizi reaksiyonla oksijenle birleştirir. Bu süreçte, serbest enerji açığa çıkar ve ATP (adenozin trifosfat) adı verilen enerji taşıyıcı moleküller üretilir. Solunum, bitkilerde enerji üretimi ve metabolizma için gerekli olan bir süreçtir. Solunum, meyvelerin hücresel düzeyde enerji üretimi, besinlerin parçalanması ve metabolik aktivitelerin sürdürülmesi için oksijenin tüketilmesi ve karbondioksitin salınması anlamına gelir. Klimakterik meyvelerde, solunum hızı hasat sonrası dönemde önemli ölçüde artar. Sonuç olarak, solunum sürecinde glikoz ve diğer besin maddeleri, oksijen kullanılarak parçalanır ve enerji üretimi gerçekleştirilir. Bu enerji, hücresel işlevlerin sürdürülmesi, metabolik reaksiyonlar, hücre bölünmesi, hareket gibi birçok yaşamsal süreci desteklemek için kullanılır. Solunum aynı zamanda bitkilerde fotosentez sürecinin tamamlayıcısı olarak da işlev görür, çünkü fotosentezle üretilen organik bileşikler solunumda kullanılır ve enerji açığa çıkarılır (Zein ve ark.,2023).

Klimakterik Olgunlaşma ve Solunum İlişkisi

Klimakterik olgunlaşma, bazı meyvelerde hasat sonrası olgunlaşma sürecinin gerçekleştiği bir fenomendir. Bu süreçte, meyveler belirli bir noktada olgunlaşmaya başlarlar ve etilen hormonunun salınımıyla hızla olgunlaşırlar. Klimakterik meyvelerde solunum hızı da belirgin bir şekilde artar ve olgunlaşma sürecinin bir parçası olarak önemli bir rol oynar. Klimakterik meyvelerin hasat sonrası döneminde solunum hızında artış, meyvelerdeki metabolik aktivitelerin hızlanmasına ve enerji üretiminin artmasına yol açar. Bu artış, besin maddelerinin parçalanması ve glikozun enerjiye dönüştürülmesiyle sonuçlanır (Giovannoni ve ar.,2004). Solunum, meyvelerdeki hücresel enerji gereksinimini karşılar ve olgunlaşma sürecinin ilerlemesini destekler. Klimakterik meyvelerdeki solunum hızındaki artış, etilen hormonu ile ilişkilidir. Etilen, olgunlaşma sürecinin düzenlenmesinde önemli bir role sahiptir ve solunumu etkileyerek olgunlaşma sürecini hızlandırır. Etilen hormonunun salınımı, solunumun uyarılmasıyla başlar ve artan solunum hızı etilen üretimini daha da artırır. Bu etkileşim, klimakterik meyvelerdeki hızlı olgunlaşma sürecinin bir parçasıdır. Solunum ve etilen arasındaki ilişki, klimakterik meyvelerin depolama sürecinde de önemlidir. Depolama sırasında meyvelerin solunum hızı ve etilen salınımı kontrol edilerek olgunlaşma süreci yönetilebilir. Örneğin, bazı depolama koşulları, solunumu düşürerek meyvelerin raf ömrünü uzatabilir. Ayrıca, etilen inhibitörleri veya etileni absorbe eden malzemeler kullanarak etilen

salınımı kontrol edilebilir ve olgunlaşma süreci geciktirilebilir. Klimakterik meyvelerde hasat sonrası solunum, olgunlaşma sürecinin önemli bir bileşenidir. Solunum hızındaki artış, enerji üretimini sağlar ve olgunlaşma sürecini destekler. Etilen hormonunun etkisiyle birlikte, solunum klimakterik meyvelerin olgunlaşma ve depolama süreçlerinde kritik bir rol oynar. Bu nedenle, klimakterik meyvelerin hasat sonrası solunumunu anlamak, üretim, depolama ve pazarlama süreçlerinde önemli bir faktördür (Zulpan ve ark.,2023).

Zhang ve ark 2019 da yaptıkları çalışmada domates meyvesinin olgunlaşmasını engellmeye yardımcı olan 1-MCP gazının etilene maruz kaldıktan sonra etilene tepkinin minimuma indirildiğini ve domates meyvelerinin olgunlaşmasındaki karmaşık etilen ve 1-MCP etkileşimini anlamada önemli bilgiler sunabileceğini bildirmiştir.

Solunum Kontrol Mekanizmaları

Klimakterik meyvelerde solunum hızı, bir dizi kontrol mekanizması tarafından düzenlenir. Bu kontrol mekanizmaları, bitkisel hormonlar, genetik düzenlemeler ve çevresel faktörler aracılığıyla etkilenir.

Etilen

Etilen, klimakterik meyvelerin olgunlaşmasında ve solunum hızının artmasında önemli bir rol oynar. Etilen hormonu, olgunlaşma sürecini tetikler ve solunumu uyarır. Etilen, olgunlaşma sırasında meyvelerde enzimatik yollarla üretilir ve etkilerini hücrelere ileterek solunum hızını artırır. Li ve ark 2016 da yaptıkları bir derleme çalışmasında MCP (Metilsiklopropen), klimakterik olmayan meyveler için bir etilen antagonistidi olduğunu ve hasat sonrası depolama süresini uzatmak ve meyve kalitesini korumak için yaygın olarak kullanıldığını açıklamış daha sonrasında 1-MCP'nin narda perikarp esmerleşmesi gibi fizyolojik bozuklukların gelişimini inhibe ettiğini, 'Shatangju' mandalinalarında ekti yaprakların yaşlanmasını inhibe etiğini ve çilek meyvesinde ise derecelenme ve renk değişiminin engellenmesine yardımcı olduğunu tespit etmişlerdir.

Oksijen ve Karbondioksit Seviyeleri

Solunum hızı, meyvelerdeki oksijen ve karbondioksit seviyelerine bağlı olarak düzenlenir. Oksijen seviyeleri düşük olduğunda, solunum hızı azalır ve enerji üretimi sınırlanır. Bununla birlikte, yüksek karbondioksit seviyeleri de solunumu inhibe edebilir. Bu nedenle, depolama koşullarında oksijen ve karbondioksit düzeyleri kontrol edilerek solunum hızı yönetilebilir. Sampaio ve ark., (2007) yaptıkları bir çalışmada sarı mombin meyvesininolgunlaşma sürecinde klimakterik bir özellik gösterdiğini tespit etmişlerdir. olgunlaşma sırasında solunumun arttığını, karbonhidratların oksidasyonunun maksimuma ulaştığı sonucuna varmışlardır.

Sıcaklık

Meyvelerin solunumu, sıcaklıkla da ilişkilidir. Genellikle, artan sıcaklık solunum hızını artırırken, düşük sıcaklıklar solunumu yavaşlatır. Sıcaklık, enzimatik reaksiyonların hızını etkilediği için solunum üzerinde doğrudan bir etkiye sahiptir.

Besin Maddeleri

Solunum, besin maddelerinin parçalanması ve metabolizması için gerekli olduğundan, besin maddelerinin mevcudiyeti de solunumu etkiler. Özellikle karbonhidratlar, solunum hızını artıran ana enerji kaynağıdır. Karbonhidratlar mevcut olduğunda, solunum hızı artar ve enerji üretimi artar.

Genetik Düzenlemeler

Solunum hızı, genetik düzenlemeler aracılığıyla da kontrol edilir. Birçok gen, solunumu düzenleyen enzimlerin üretimini etkiler. Bu genetik düzenlemeler, meyve olgunlaşması ve solunum süreçlerinin senkronizasyonunu sağlar.

Bu kontrol mekanizmaları, klimakterik meyvelerde solunum hızının düzenlenmesine yardımcı olur. Bu mekanizmaların anlaşılması, klimakterik meyvelerin depolama, işleme ve pazarlama süreçlerinde solunum hızının yönetilmesine ve ürün kalitesinin korunmasına yardımcı olur. Klimakterik meyvelerin hasat sonrası olgunlaşma süreci, solunumun yanı sıra birçok başka fizyolojik değişikliği de içerir. İşte klimakterik meyvelerin hasat sonrası olgunlaşma sürecinde diğer önemli faktörler:

Etteyken Depolanan Besin Maddeleri

Klimakterik meyveler, hasat sırasında çeşitli besin maddelerini depolarlar. Bu besin maddeleri, olgunlaşma sürecinde solunum ve enerji üretimi için kullanılır. Özellikle karbonhidratlar, meyvelerin enerji kaynağıdır ve solunum sürecinde parçalanarak enerji üretimine katkıda bulunurlar.

Enzimatik Aktiviteler

Klimakterik meyvelerde, olgunlaşma sürecinde enzimatik aktivitelerde artış görülür. Bu enzimler, meyvelerin dokularının yumuşamasını sağlar ve aroma, tat ve diğer organoleptik özelliklerin gelişmesine katkıda bulunur. Örneğin, pektinaz enzimi, meyvelerin hücre duvarlarındaki pektini parçalayarak dokunun yumuşamasını sağlar.

Aroma bileşikleri ve Tat

Klimakterik meyvelerde olgunlaşma sürecinde aroma bileşikleri ve tat daha belirgin hale gelir. Bu bileşikler, meyvelerin aromasını ve lezzetini oluşturan organik bileşiklerdir. Olgunlaşma sürecinde artan enzimatik aktiviteler ve metabolik değişiklikler, aroma bileşiklerinin oluşumunu ve birikimini etkiler.

Renk Değişiklikleri

Klimakterik meyvelerin olgunlaşma sürecinde renkleri de değişir. Bu renk değişiklikleri, klorofilin azalması ve karotenoidlerin birikmesiyle gerçekleşir. Olgunlaşma sürecinde, yeşil olan meyveler genellikle daha parlak ve canlı renklere dönüşür.

Tekstür Değişiklikleri

Klimakterik meyvelerin olgunlaşma sürecinde dokuları da değişir. Dokulardaki pektin parçalanması ve hücre duvarlarının yumuşaması, meyvelerin daha yumuşak ve sulu bir yapıya sahip olmasını sağlar. Bu dokusal değişiklikler, meyvelerin yenilebilirlik ve tüketici tercihleri açısından önemlidir. Koşumcu 2019 da yaptığı çalışmada domates (Solanum lycopersicum L.) meyvesine hasattan sonra uyguladığı Ultrases uygulamasının meyvelerde çözünebilir kuru madde, asit miktarı ve şeker içeriğin etkilemediğini ancak ağırlık kaybını arttırdığını ve enfeksiyonu baskıladığını tespit etmiştir. Ayrıca ultrases uygulamasının olgunlaşmayı geciktirme gibi olumlu bir sonuç doğurduğu bildirmiştir. Bu faktörler, klimakterik meyvelerin hasat sonrası olgunlaşma sürecindeki fizyolojik değişiklikleri açıklamaktadır. Solunum, enerji üretimi ve etilen hormonunun salınımı, bu değişikliklerin anahtar belirleyicileri arasındadır. Meyvelerin olgunlaşma sürecini anlamak, hasat sonrası yönetim ve depolama süreçlerinin optimize edilmesi ve tüketicilere en iyi kalitede ürün sunulması için önemlidir.

SONUÇ

Sonuç olarak, klimakterik meyveler, hasat sonrası olgunlaşma sürecinde önemli fizyolojik değişimler gösterir. Bu süreçte, solunum hızında belirgin bir artış görülür ve solunumun klimakterik meyvelerin olgunlaşma sürecindeki önemli bir bileşen olduğu anlaşılmıştır. Solunum, bitkilerde enerji üretimi ve metabolik aktiviteler için gereklidir. Klimakterik meyvelerde solunum hızındaki artış, besin maddelerinin parçalanması ve enerji üretiminin artmasıyla sonuçlanır. Etilen hormonu, solunumu etkileyerek olgunlaşma sürecini hızlandırır. Solunum hızı, çeşitli kontrol mekanizmaları aracılığıyla düzenlenir, bunlar arasında etilen, oksijen ve karbondioksit seviyeleri, sıcaklık, besin maddeleri ve genetik düzenlemeler bulunur. Bu kontrol mekanizmalarının anlaşılması, klimakterik meyvelerin depolama, işleme ve pazarlama süreçlerinde solunum hızının yönetilmesine yardımcı olur. Klimakterik meyvelerin hasat sonrası solunumunu anlamak, ürün kalitesinin korunmasına ve tüketiciye sağlıklı ve lezzetli meyveler sunmaya yönelik stratejilerin geliştirilmesinde önemli bir faktördür. Klimakterik meyveler hasat sonrası olgunlaşma sürecine girerler. Bu süreçte solunum, enzimatik aktiviteler, aroma bileşikleri ve tat, renk değişiklikleri ve tekstür değişiklikleri gibi birçok fizyolojik değişiklik meydana gelir. Olgunlaşma sürecini anlamak, meyvelerin doğru zamanda hasat edilmesi, depolanması ve tüketiciye sunulması için önemlidir.

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BAZI MİNİMAL İŞLENMİŞ SEBZE TÜRLERİNİN MUHAFAZASINDA ETKİLİ UYGULAMALAR VE DEPOLAMA PERFORMANSI

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ÖZET
Yaşam koşulları ve yaşam tarzlarında meydana gelen değişimler beraberinde gıda tüketiminde kalitesi yüksek olan hazır gıdalara talebi artırmıştır. İnsanların hazır ve doğal ürünlere duydukları talep ve yaşam tarzlarındaki değişiklikler nedeniyle, tüketiciler daha az işlenmiş ancak daha uzun raf ömrüne sahip ve depolama sırasında besleyici ve duyusal özelliklerini koruyan gıda ürünleri aramaktadır. Bu gereksinimler, meyve ve sebzeler gibi çabuk bozulabilen minimal işlem görmüş gıda ürünlerinde söz konusu olduğunda birçok zorluk ile karşılaşılmaktadır. Bu nedenle, son yıllarda yenilebilir kaplamalar, işlenmiş ürünlerin kalitesini, raf ömrünü, güvenliğini ve işlevselliğini artırma kapasiteleri nedeniyle yoğun bir şekilde geliştirilmiş ve incelenmiştir. Ayrıca, bazı fonksiyonel bileşenler yenilebilir bir matrise dahil edilebilir ve gıdaların yüzeyine uygulanabilir, böylece güvenlik ve hatta besinsel ve duyusal nitelikler arttırılabilir. Kaplanmış meyve ve sebzeler söz konusu olduğunda, renk, meyve eti sertliği, mikrobiyal yük, çürüme oranı, ağırlık kaybı, duyusal özellikler ve beslenme parametreleri gibi ürünlerin türüne ve depolama koşullarına çok özel olan kalite parametreleri dikkatle izlenmelidir.

Anahtar Kelimeler: Depolama, meyve, sebze, yenilebilir kaplama

EFFECTIVE PRACTICES AND STORAGE PERFORMANCE IN THE PRESERVATION OF SOME MINIMALLY PROCESSED VEGETABLE TYPES

ABSTRACT

Changes in living conditions and lifestyles have increased the demand for ready-to-eat foods with high quality in food consumption. Due to people's demand for ready-to-eat and natural products and changes in lifestyles, consumers are looking for food products that are less processed but have a longer shelf life and retain their nutritional and sensory properties during storage. These requirements pose many challenges when it comes to minimally processed food products that are perishable, such as fruit and vegetables. Therefore, in recent years, edible coatings have been intensively developed and studied for their capacity to improve the quality, shelf life, safety and functionality of processed products. Furthermore, some functional ingredients can be incorporated into an edible matrix and applied to the surface of foods, thus enhancing safety and even nutritional and sensory qualities. In the case of coated fruits and vegetables, quality parameters that are very specific to the type of products and storage conditions, such as colour, firmness, microbial load, decay rate, weight loss, sensory properties and nutritional parameters, should be carefully monitored.

Keywords: Edible coating, fruit, storage, vegetable

GİRİŞ

Meyve ve sebzeler hasattan sonra bozulmaya karşı oldukça hassastır. Hasat sonrası meyve ve sebzeler solunum yapmaya, başka bir deyişle oksijen kullanmaya ve karbondioksit üretmeye devam eder. Ayrıca, hasat sonrası su kaybı meyve ve sebzelerin kalitesini etkilemekte ve bozulmaya neden olmaktadır. Solma, pörsüme, aşırı olgunlaşma, üşüme zararı ve doku kaybı, aşırı su kaybından kaynaklanan hasat sonrası çürümenin bazı belirtileridir. Hasattan sonra, meyve ve sebzelerin olgunlaşma ve yaşlanma süreci, klimakterik veya non-klimakterik olmalarına bağlı olarak farklılık gösterir. Klimakterik meyveler, belirli bir olgunluk seviyesinde bitkiden ayrıldıktan sonra, depolama süresince etilen biyosentezi sayesinde tam fizyolojik olgunluğa ulaşabilir. Bu nedenle, klimakterik meyveler hasattan sonra maksimum yeme kalitesine ulaşabilir.

Klimakterik meyveler, olgunlaşma sürecini ve buna bağlı biyokimyasal ve enzimatik reaksiyonları kolaylaştıran etileni kendi kendilerine üretirler. Etilen üretimi solunum hızını tetikler ve klimakterik meyvelerin raf ömrünü azaltır. Öte yandan, klimakterik olmayan meyveler hasattan sonra maksimum yeme kalitesine ulaşmaya veya olgunlaşmaya devam edemezler; sadece yaşlanma ve su kaybı nedeniyle bozulurlar ve etilene karşı duyarsızdırlar. Genel olarak, meyve ve sebzelerin hasat sonrası ömrü çok sınırlıdır ve bu durum ciddi ekonomik kayıplara neden olabilmektedir.

Depolama esnasında, ürünlerin kalitesinde bozulmalara meydana gelmekte, bu durum gıda üreticilerinin karşılaştığı önemli bir sorun olmakta ve ürün kayıplarına önemli ölçüde neden olmaktadır. Son yıllarda, yeni ve akıllı gıda işleme teknolojileri (UHP-Ultra High Pressure, PEF-Pulsed Electric Field, MAP-Modified Atmosphere Packaging, RF-Radio Frequency, Active Packaging vb.) gıda muhafazasının uzatılmasına, raf ömrünün uzatılmasına ve ürün kayıplarının azaltılmasına katkıda bulunmak amacıyla geliştirilmiştir (Stan ve ark., 2019; Chitrakar ve ark., 2021).

Tüketiciler daha az işlenmiş ürünler ya da uygun muhafaza süresine sahip, sağlıklı ve yüksek besin değeri sunan minimal işlenmiş ürünler aramaktadır. Bu gereksinimler, meyve ve sebzeler gibi bozulabilirliği yüksek gıda ürünleri söz konusu olduğunda daha önemli bir hal almaktadır. Bu artan talep, uygun ve sürdürülebilir muhafaza tekniklerinin geliştirilmesine neden olmakta ve gün geçtikçe önem arz etmektedir (Nair ve ark., 2020).

Günümüzde tüketiciler daha az işlenmiş ve daha sağlıklı gıda ürünlerini tercih etmektedir ve bu nedenle yenilebilir ambalaj sistemleri üzerine araştırma faaliyetleri her geçen yıl artmaktadır. Yenilebilir filmler ve kaplamalar, yenilebilir bileşenlere sahip gıda maddeleri için birincil ambalaj malzemesi olarak aroma, tat ve görünüm gibi duyusal özelliklerin

korunmasına yardımcı olacak şekilde tasarlanmıştır. Yenilebilir filmlerle kaplanan meyve ve sebzeler daha uzun raf ömrüne sahip olur ve olgunlaşma süreçleri gecikir (Hassan ve ark., 2018; Ulusoy ve ark., 2018).

Yenilebilir kaplamalar ve filmler farklı gıda ürünlerinin raf ömrünü uzatmada etkili olsalar da gıda endüstrisi yeni işleme tekniklerine yönelik tüketici kabulü sorunuyla karşı karşıyadır (Vital ve ark., 2018). Tüketicilerin yeni teknolojiler ve ürünlerle ilgili tutumlarını nasıl oluşturduklarını ve algıladıklarını anlamak gıda zinciri inovasyonu için önemlidir, çünkü tüketici kabulü başarılı gıda ürünlerinin geliştirilmesi için çok önemlidir (Stan ve ark., 2019; Siegrist ve Hartmann, 2020), Nanoteknoloji (Peters ve ark., 2016), radyo frekansı (Stefanoiu ce ark., 2018), gıda ışınlama (MacRitchie ve ark., 2014) ve yenilebilir filmler ve kaplamalar (Wan ve ark., 2007; Deliza ve ark., 2003) gibi yeni işleme teknolojileri ve tekniklerine yönelik tüketici kabulüne ilişkin çeşitli çalışmalar yapılmıştır.

Bu çalışmada, kaplama bileşenleri ve formülasyonu, uygulama yöntemleri ve besin kalitesi de dahil olmak üzere gıda raf ömrü ve kalitesi üzerindeki etkisi gibi teknolojik yönleri vurgulayarak, farklı minimal işlenmiş meyve ve sebzelere uygulanan yenilebilir formülasyon üzerine yapılan en son araştırmalara odaklanmaktadır. Yenilebilir filmler ve kaplamalar, bunların bileşimi ve uygulama yöntemlerinin yanı sıra minimal işlenmiş meyve ve sebzeler için yenilebilir kaplamalardaki fonksiyonel katkı maddeleri sunulmaktadır.

Yenilebilir Kaplamaların Bileşimi ve Uygulama Yöntemleri

Yenilebilir kaplama genel olarak, gaz alışverişini önlemek ve böylece olgunlaşma sürecini geciktirmek amacıyla ürün yüzeyine ince bir tabaka veya tabakalar halinde uygulanan kimyasal veya biyolojik malzemelerden yapılmış bir kaplama tabakası olarak tanımlanmaktadır. Meyve ile çevre arasında bir bariyer oluşturmak amacıyla meyve yüzeyine uygulanabilen ince yenilebilir bir tabaka olarak da tanımlanmaktadır. Yenilebilir kaplamaların su hareketine kısmi bir bariyer sağlamakta, böylece nem kaybını azaltmakta ve aynı zamanda gaz değişimine bir bariyer görevi görerek meyvenin etrafındaki atmosferi değiştirebilmektedir.

Yenilebilir kaplamalar ve filmler için kullanılan ana bileşenler lipidler, polisakkaritler ve proteinlerdir, ancak yenilebilir kaplamalarda farklı özellikler elde etmek için reçineler, çözücüler ve plastikleştiriciler gibi diğer malzemelerin de kullanılması gerekir. Yenilebilir kaplamaların esnekliği ve geçirgenliği plastikleştiricilerin kullanımıyla, gerilme mukavemeti çözücülerin kullanımıyla ve su buharı geçirgenliğinin önlenmesi reçinelerin yardımıyla elde edilir (Ulusoy ve ark., 2018; Galus, 2019). Yenilebilir bir kaplama, adından da anlaşılacağı gibi, içerdiği gıda ile birlikte tüketilebilir ve biyolojik olarak bozulabilir yapıdadır. Meyve ve sebzeler üzerindeki yenilebilir kaplamalar, sentetik muadillerine göre uygun, çevre dostu

alternatifler olarak kabul edilmiştir. Nem, buhar, gazlar ve çözünen maddelere karşı yarı geçirgen bariyerler. Oksijen ve karbondioksit gibi gazların ve su buharının sınırlı hareketi, solunum hızının azalmasına ve taze ürünlerde ağırlık kaybına yol açar. Yenilebilir bir kaplamanın bu özellikleri, daha uzun raf ömrüne sahip daha taze ürünlerle sonuçlanır. Yenilebilir kaplamalar bariyer görevi görmenin yanı sıra antimikrobiyal, antioksidan ve kararma karşıtı aktiviteler de sağlamaktadır (Yousuf ve ark., 2018).

Minimal işlem görmüş sebze ve meyvelerde pazar değerini belirleyen kalite, ürünlerin dilimlenmesinden hemen sonra azalmaya başlamaktadır. Minimal işlemle üründe oluşan fiziksel hasarlar nedeniyle oksijen ile etkileşim başlamaktadır. Fiziksel hasar gören hücrelerde solunumun artmasına bağlı olarak etilen salınımında artış meydana gelmekte böylelikle üründe hızlıca yumuşamalar gerçekleşmektedir (Aguilar ve ark., 2004).

Yenilebilir film ve kaplamalar, minimal işlem görmüş sebze ve meyvelerde kısmen geçirgen bir yapı oluşturmaktadır. Ürünün oksijen, karbondioksit ve nem geçirgenliğini kontrol altında tutup ağırlık kaybı, oksidatif reaksiyon, solunum hızı ve etilen salınımını sınırlamakta hasat sonrası ömrünü uzatmaktadır (Park, 1999; Mastromatteo ve ark., 2010). Ürün bileşenleri arasında veya yüzeyinde oluşmuş protein, polisakkarit ya da lipit kökenli 3 mm'den kalın bir yapıya sahip olmayan tabaka film ve kaplama olarak tanımlanmaktadır (Yılmaz ve ark., 2007). Yenilebilir film ve kaplama malzemeleri, üretiminin basit ve ucuz olması, doğal bileşiklerden elde edilmesi, ürünün tazeliğini koruması ve kalitesini artırması gibi etkilerinden dolayı kullanımı artış gösteren ambalaj malzemesi olmuştur (Appendini ve Hotchkiss, 2002; Wan ve ark., 2006).

Sebzelerde Yenilebilir Kaplama Malzemeleri ile Ilgili Yapılan Çalışmalar

Martiñon ve ark. (2014), yaptıkları bir araştırmada 4 °C'de depolanan dilimlenmiş kantalop kavunlarına hasat sonrası depo ömrünün uzatılması amacıyla farklı dozlarda pektin, kitosan ve kapsüllenmiş trans-sinnamaldehitin uygulamışlardır. Araştırmacılar kontrol grubuna göre uygulamaların antimikrobiyal etki gösterdiğini, hasat sonrası kalite parametrelerinde olan L^* parlaklık değerinin uygulamalar ile korunduğunu, depo ömrünün kontrol grubuna kıyasla 4 gün uzatıldığını ve kavunların 9 gün depolanabileceğini tespit etmişlerdir. Dilimlenmiş karpuzların muhafaza ömrünü uzatmak amacıyla yapılan bir çalışmada sodyum aljinat, pektin ve kalsiyum çözeltilerinden farklı oranlarda (%0.5, %1, %2) oluşturdukları yenilebilir kapmalar daldırma yöntemi ile dilimlenmiş meyvelere uygulanmış ve 4°C'de depolanmıştır. Çalışma sonucunda uygulama yapılmayan meyvelerde depolama süresi 7 gün sürerken uygulama yapılan meyvelerde depolama süresi 15 güne kadar uzatılabildiği vurgulanmıştır (Sipahi ve ark., 2013).

Dilimlenmiş armut meyvelerine glutatyon ve N-asetil-sistein içeren pektin, sodyum aljinat ve jellan yenilebilir kaplama uygulaması yapıldığı bir çalışmada, 14 gün boyunca 4°C'de depolanan armutların solunum hızı, mikrobiyal bozulma, antioksidan kapasitesi ve duyusal kaliteleri incelenmiştir. Depolama sonunda kaplamaların dilimlenmiş meyvelerin etilen salınımını azalttığı, duyusal özelliklerini ve sertliğini koruduğu, mikrobiyal bozulmayı ve enzimatik kararmayı engellediği, antioksidan kapasitesini ve toplam fenolik içeriğini koruduğu tespit edilmiştir. Ayrıca pektin ve sodyum aljinat bazlı yenilebilir kaplama uygulamalarının dilimlenmiş armutların kalitesini kaybetmeden 14 gün boyunca başarılı bir şekilde koruyabileceği gösterilmiştir (Oms-Oliu ve ark., 2008).

Dilimlenmiş elmalara protein bazlı antioksidan içeren yenilebilir kapmalarının uygulandığı bir araştırmada, kaplama uygulanan meyvelerde kararma indeksi ve ağırlık kaybı kontrol (uygulama yapılmayan) grubuna kıyasla daha az olduğu, pH ve sertliğin korunduğunu bildirilmiştir. Ayrıca kaplamalar arasında ferulik asit içerikli kaplama uygulaması dilimlenmiş elmaların muhafaza süresini uzatmada etkili uygulama olarak önerilmiştir (Alves ve ark., 2017).

Dilimlenmiş kivi meyvelerine uygulanan farklı dozlarda (%0.05, %0.10, %0.15) poly-ε-lysine ilaveli sodyum aljinat bazlı yenilebilir kaplamanın etkisinin incelendiği bir çalışmada, dilimlenmiş kivi meyveleri 14 gün boyunca 4°C sıcaklıkta depolanmış olup belli aralıklar ile ölçüm ve analizler yapılmıştır. Çalışma sonucunda %0.05 ve %0.10 poly-ε-lysine ilaveli sodyum aljinat bazlı yenilebilir kaplama yapılan meyvelerin daha düşük solunum hızı oranına sahip olduğu, %0.05 poly-ε-lysine ilaveli sodyum aljinat bazlı yenilebilir kaplama yapılan meyvelerde ise askorbik asit, renk, toplam klorofil içeriği, toplam antioksidan kapasitesinin korunduğu ayrıca MDA (malonaldehit) birikiminin azaldığı bildirilmiştir (Li ve ark., 2017). Gonzales ve ark., (2019), hasat sonrası uygulanan farklı kaplama malzemelerinin (sodyum aljinat, pektin, CMC ve mısır nişaştası) patlıcan meyvelerinde etkisini ortaya koyabilmek için bazı fiziko-kimyasal, biyo-kimyasal ve fizyolojik analizler yürütmüşlerdir. Sonuç olarak, uygulanan polisakkarit malzemelerinin 12 günlük depolama süresince meyvelerde ağırlık kaybını, meyve etinde büzüşmeleri, solunum hızını ve mikrobiyal aktiviteyi azaltırken, pH, SÇKM, titre edilebilir asitlik ve C vitamini gibi kalite kriterlerini meyvelerde koruduğunu bildirmişlerdir. Yenilebilir aljinat ve zein film kaplamalarının domates kalite parametreleri üzerine etkisinin incelendiği bir çalışmada, uygulama yapılan kaplamaların solunum hızı ve etilen hızını azaltıp olgunlaşmayı ertelediği, tekstür ve renk özelliklerini muhafaza ettiği tespit edilmiştir. Ayrıca, her iki kaplamanın domateste askorbik asit içeriğini koruduğu görülmüştür. (Zapata ve ark., 2008).

Kitosan (% 2), sodyum aljinat (% 1.5) ve kitosan (% 3) + sodyum aljinat (% 2)

uygulamalarının taze kesilmiş nektarinlerde etkileri araştırılmıştır. Sonuç olarak, sodyum aljinat uygulanan örneklerde diğer uygulamalara kıyasla daha düşük SÇKM, sertlik ve parlaklık tespit edilmiştir. Öte yandan kitosan uygulanan örneklerde ise daha düşük ağırlık kaybı meydana gelmesinin yanı sıra daha yükse SÇKM, sertlik ve parklaklık tespit edilmiştir (Chiabrando ve Giacalone, 2016).

Hasat sonrası *Pholiota nameko* mantarlara uygulanan sodyum aljinatın kekik yağı, L-sistein ve nisin ile kombinasyonu ile elde edilen yenilebilir kaplama malzemesinin mantarlarda hasat sonu fizyolojisi üzerine olan etkisi incelenmiştir. Sonuç olarak, uygulama yapılan mantarlarda ağırlık kaybının, şapka açılmasının, kararmanın, malondialdehit ve polifenol oksidaz ve peroksidaz aktivetesinin önemli derecde inhibe edildiği bildirilmiştir. Ayrıca, kaplama malzemesinin çözünür şeker, askorbik asit ve protein içeriğinin mantarlarda depolama süresince korunduğu bildirilmiştir (Zhu ve ark., 2019).

Polietilen glikol veya sodyum aljinat içeren karnauba kaplama malzemesinin 22-24 °C'de depolanan patlıcanların raf ömrü üzerine olan etkileri incelenmiştir. Sonuç olarak, elde edilen kombinasyon uygulamalarının patlıcanlarda etkin bir şekilde raf ömrünü uzattığı ve kalite özelliklerini koruduğu belirtilmiştir (Singh ve ark., 2019).

Hidroksietil selüloz ve sodyum aljinat ile kuşkonmaz atıklarının kominasyonu ile elde kaplama malzemesinin çileklerde *Penicillium italicum*'a karşı anti-fungal aktivite gösterdiği tespit edilmiştir. Ayrıca, uygulamanın hasat sonrası meyvelerde ağırlık kaybını azalttığını, renk değişimlerini geciktirdiğini ve toplam fenolik madde içeriğini koruduğu bildirilmiştir (Liu ve ark., 2021). Hasat sonrası meyvelerinin kalitesinin korumak ve hasat sonrası raf ömrünün uzatmak amacıyla pektin bazlı kaplama malzemesi (pektin + balmumu + sorbitol + su + emülsifiye ajan olarak ADM, Decatur, IL) hıyarlara uygulanmıştır. Kaplama malzemesi uygulanana meyveler 23 °C % 40 oransal nemde ve 12 °C % 85 oransal nemde muhafaza edilmiştir. Her iki depolama sıcaklığında muhafaza edilen meyvelerde kaplama malzemesinin ağırlık kaybını ve solunum hızını düşürdüğü tespit edilmiştir. Ayrıca kaplama malzemesinin meyvelerde sertlik, renk, SÇKM ve klorofil içeriğini koruyarak meyvelerin depolama ömrünü 14 gün uzattığı bildirilmiştir (Moalemiyan ve ark., 2012). Pektin, mısır unu ve pancar tozu ile hazırlanan kaplama malzemesinin, domateslerin raf ömrü ve kalitesi üzerine etkilerini belirlemek için yürütülen bir çalışmada, uygulanan kaplama malzemesinin domateslerde ağırlık kaybı, meyvelerdeki çürüme oranını, olgunlaşma indeksi, solunum hızı, renk değişimleri ve antioksidan kapasite üzerine olumlu etkileri olduğu belirtilmiştir. Sonuç olarak, kaplama uygulamasının domateslerde raf ömrünün uzamasına ve kalitesinin korunmasında eklili olduğu bildirilmiştir (Chaturvedi ve ark., 2019).

SONUÇ

Meyve ve sebzelerin hasat sonrası kayıplarının azaltılması dünya genelinde bir sorun olmaya devam etmektedir. Taze ürünlere yenilebilir kaplamaların uygulanması, hasat sonrası kayıp sorununa potansiyel bir çözüm olabilir niteliktedir. Üstün antimikrobiyal veya antifungal aktivitelere sahip doğal maddeler, sentetik ambalajların yerine popülerlik kazanmaktadır. Yenilebilir film ve kaplama malzemeleri depolanan meyve ve sebzelerin biyolojik ve fonksiyonel özelliklerini korurken, mikrobiyal yükleri azaltmaktadır. Solunum gibi fizyolojik süreçler üzerindeki etkisi, metabolik tepkiler, metabolitlerin üretimi vb. depolama sırasında işlenmiş ürünler de dikkate alınmalıdır.

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USE OF PHYTOBIOTICS TO IMPROVE REPRODUCTIVE PERFORMANCE OF POULTRY

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ABSTRACT
For reasons such as the prohibition of antibiotics in animal nutrition and the controversial use of some synthetic additives, feed additives that can replace them are being researched. Phytogenic feed additives are one of them. Phytogenics or phytobiotics, defined as plant-derived products, are of great interest in animal nutrition because they are natural. Many plants have important effects such as antioxidant, antibacterial, antiviral, antifungal, anti-inflammatory, and anti-cancer with the secondary metabolites they contain. For this reason, studies are carried out to investigate the possibilities of using phytobiotics in poultry nutrition, as in the nutrition of other farm animals. Although there are extensive studies investigating the effects of these substances on growth performance, product quality, and animal health in poultry, there are limited studies investigating the effects on reproductive performance. Recently, there has been increasing interest in using natural substances to improve reproductive performance in poultry. This review aims to give general information about phytobiotics and summarize studies investigating their effects on reproductive performance in poultry.

Keywords: Phytobiotics, plant additive, poultry nutrition, reproductive performance

INTRODUCTION

In animal nutrition, feed additives are used for various purposes such as increasing growth performance (Arif et al., 2019) and reproductive performance (Mihaylova et al., 2020), improving product quality (Placha et al., 2022), and protecting animal health (Chuang et al., 2020). The use of synthetic antioxidants is controversial because of their potentially harmful effects (Lorenzo et al., 2018). The use of antibiotics in animal nutrition is prohibited due to the development of bacterial resistance and residues in the products (Barton, 2000). For these reasons, natural additives that can be alternatives to antibiotics are being investigated (Salim et al., 2018). One of these alternative sources is phytogenic feed additives (Vidanarachchi et al., 2005). Phytogenics (phytobiotics) are briefly defined as products of plant origin (Abbas, 2012). Phytogenics are categorized into four different groups herbs (not including the woody parts of the plant), botanicals (whole plant or any part such as root, bark, leaves), extracts, and essential oils (Hashemi and Davoodi, 2011). Plants contain various secondary metabolites (Tiwari and Rana, 2015). These substances are produced in plants in response to various stress factors (Chandran et al., 2020). The secondary metabolites of plants are given in Figure 1 (Twaij and Hasan, 2022).

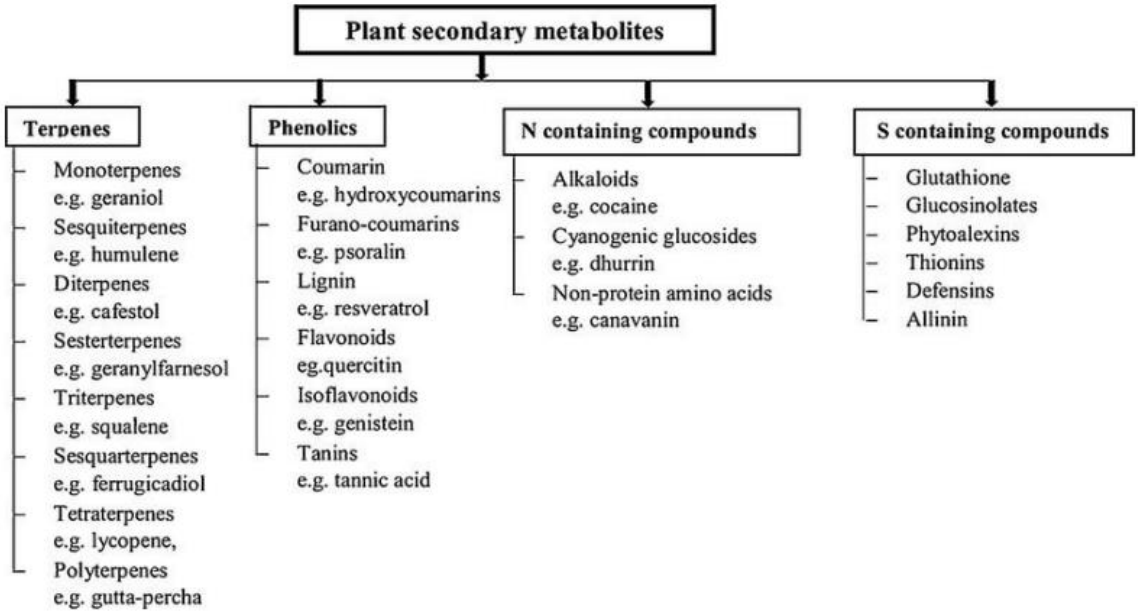

Figure 1. Secondary metabolits of plants (Twaij and Hasan, 2022)

Secondary metabolites are important bioactive components of plants (Bernhoft, 2010). With these bioactive components, plants show various effects such as antioxidant, antibacterial, antiviral, anti-inflammatory, antifungal, and anticancer (Ram et al., 2015; Shakya, 2016). The main bioactive components and effects of some medicinal plants are given in Table 1 (Parham et al., 2020).

Table 1. Main compound and effects of some plants (Parham et al., 2020)

Plant	Main Compounds	Effects	References
Cinnamon	- Cinnamaldehyde - Eugenol	- Antioxidant - Antimicrobial - Anti-inflammatory - Anti-allergic - Anti-cancer - Hypocholesterolemic	Friedman et al. (2002) Willis et al. (2019)
Clove	- Eugenol - Eugenyl acetate - α-humulene - 2-heptanone - β-caryophyllene	- Antioxidant - Antimicrobial - Anti-inflammatory - Anti-allergic - Anti-cancer	Anwer et al. (2014) Diego and Wanderley (2014)
Garlic	- Allicin - Phenolic Compounds	- Antioxidant -Antimicrobial - Antidiabetic - Anti-cancer -Cardioprotective	Martins et al. (2016) Toledano Medina et al. (2019)
Ginger	- Phenolic acids - Gingerols - Shogaols - Paradols	- Antioxidant - Antimicrobial - Anti-diabetic - Anti-inflammatory - Anti-cancer - Analgesic	Singh et al. (2018) Idris et al. (2019)
Fennel	- Phenolic compounds	- Antioxidant - Antimicrobial - Anti-inflammatory	Rajić et al. (2018)
Mint	- Phenolic compounds	- Antioxidant - Antimicrobial - Anticancer - Anti-inflammator	Mimica and Bozin (2008)
Thyme	- Carvacrol - Thymol - Phenols	- Antioxidant - Antimicrobial - Expectorant - Spasmolytic	Oliviero et al. (2016) Tzima et al. (2015)
Turmeric	- Vitamin-C - Cineole - Tumerone - Borneol - Zingiberene - d-sabinene - d-phellandrene	- Antioxidant - Antimicrobial - Anti-inflammatory - Anticancer - Anticoagulant - Hypoglycemia	Panpatil et al. (2013) Sharma et al. (2019)

There are different studies conducted on the use of some phytobiotics such as thyme (Al-Mashhadani et al. 2011; Cimrin, 2019; Yalçın et al., 2020), wild leek (Kılınç et al., 2023), anise (Al-Mashhadani et al., 2011; Yu et al., 2018)), ashwagandha (Kılınç, 2023), jujube (Kılınç et al., 2020), lavender (Torki et al., 2021), sage (Galamatis et al., 2021; Farhadi et al., 2020; Assi Husain et al., 2023), rosemary (Mathlouthi et al. 2012; Cimrin, 2019), black cumin (Toghyani

et al., 2010; Ghosh et al., 2020), ginger (Nasiroleslami and Torki, 2010; Kairalla et al., 2022), cinnamon (Abo-Ghanima et al., 2020), Meligy et al., 2023) and mentha (Torki et al., 2021). In this review, phytobiotics and studies investigated of their effects on reproductive performance in poultry are summarized.

Effects of Phytobiotics on Reproductive Performance in Poultry

Reproductive performance is very important for the sustainability of livestock breeding (Mihaylova et al., 2020). It is known that some phytobiotics improve reproductive performance in poultry (Yitbarek, 2015). There are the studies investigating the possibilities of using phytobiotics to improve reproductive performance in poultry nutrition. Some of these are summarized in Table 2.

Table 2. Effects of phytobiotics on reproductive performance in poultry

Phytobiotics	Poultry	Dose	Treatment Effects	Referances
Oregano Thyme Rosemary Turmeric	Laying hens	0, 0.5, and 1%	-Increased the percentages of fertility (1% oregano, 1% rosemary, 0.5% turmeric) - Increased the percentages of hatchability of fresh eggs (1.0% thyme and 0.5-1.0% turmeric)	Radwan-Nadia (2008)
Satavari Ashwagandha	Quail	0, 0.5, 1, and 1.5%	- The best age at sexual maturity, hatchability, fertility in treatment groups	Bhardwaj (2009)
Ginger	Broiler (Breeder male)	0, 5, and 10% (in drinking water)	- Increased in the weight of the testis - Increased ejaculate volume, sperm counts, concentration - Decreased motility and abnormality	Saeid et al. (2011)
Cinnamon Rosemary	Quail	0, 200 ppm cinnamon, rosemary and mix (100 ppm)	- Significant effects on the fertility - No effects on hatchability traits and sex ratios	Şimşek et al. (2015)
Dried fruit-vegetable-herb	Broiler	0, 1.5, and 3%	- Higher fertilisation and hatchability rates (dried fruit-vegetable-herb supplemented groups)	Tarasewicz and Aniśko (2015)
Yucca schidigera (YS)	Quail (Exposed to lead in the	0, 100 200 mg/kg YS and (100 mg/kg lead + 100 mg/kg	- Decreased fertility (%), hatchability (%), hatchability of fertile eggs (%) in lead-exposed group - Decreased this negative effects on reproductive performance with supplementation of YS (especially 200 mg/kg YS)	Alagawany et al. (2018)

	diet)	YS, 100 mg/kg lead + 200 mg/kg YS)	- Potential modulatory role against the lead-induced inhibitory effects on reproductive performance (YS supplementation)	
Cinnamon Ginger	Broiler (Breeder male)	0, 500, and 1000 mg/L of drinking water	- Increased ejaculate volume (ml) and sperm concentration and movements - Decreased abnormal sperm (%)	Mohammed and Amin (2019)
Thyme Oregano	Quail	0, 1 g/kg thyme, oregano and mix (0.5 g/kg)	- Increased fertility percentages oregano-supplemented group) - Increased egg number and egg mass in all experimental periods (thyme-supplemented group)	El-Hindawy et al. (2021)
Garlic Ginger Thyme Euphorbia Moringa	Hen	0.5, and 1% (garlic, ginger, thyme) 0.75, and 1.5% (euphorbia) 2.5, and 5% (moringa)	- No effect on hatchability (%) and fertility (%) - No effect embryonic mortality was high increasing levels of additives. Increased chick body weight at hatching (1% thyme-supplemented group)	Ndzi et al. (2022)

CONCLUSION

With the prohibition of antibiotics in animal nutrition, research on additives that can be an alternative to antibiotics has also gained momentum. Researchers and manufacturers have turned to natural resources in particular. One of the most important of these additives has been phytobiotics. The studies have been conducted on the production performance of various phytobiotics in poultry. However, studies investigating the effects of phytobiotics on reproductive performance are more limited. As in all farm animals, reproductive performance is important for sustainability in poultry farming. Therefore, more studies are needed on this subject.

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BİLECİK İLİ DOĞAL FLORASINDAN TOPLANAN SARI TAŞ YONCASI GENOTİPLERİNİN (*Melilotus officinalis* (L) Lamb.) YEM KALİTESİ

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ÖZET
Bilecik, Marmara, Karadeniz, İç Anadolu ve Ege Bölgelerinin kesişim noktasında yeralan ve dört coğrafi bölgede toprakları olan Türkiye'deki tek ildir. Küçük yüzölçümüne karşın, coğrafi konumu sayesinde sahip olduğu iklim özellikleri ve biyolojik zenginliği ile Türkiye'nin önemli bir kısmını temsil etmektedir. Bu çalışmada, Bilecik doğal florasında bulunan sarı taş yoncası (*Melilotus officinalis* (L) Lamb.) bitkilerinin toplanarak yem kalitesinin belirlenmesi amaçlanmıştır. Bitkiler çiçeklenme döneminde iken, aralarındaki mesafe 8 km'den az olmayan ve 5 dekarı aşmayan 34 lokasyondan toplanmıştır. Toplanan bitkiler kese kâğıdına konularak Bilecik Şeyh Edebali Üniversitesi Ziraat ve Doğa Bilimleri Fakültesi Tarla Bitkileri Bölümü Laboratuvarına getirilmiştir. Bitki örnekleri etüve konularak 60°C'de sabit ağırlığa gelene kadar kurutulmuş, sonrasında 1 mm elek çapındaki değirmende öğütülerek analize hazır hale getirilmiştir. Bitkilerde ham protein (HPO), asit deterjanda çözünmeyen lif (ADF), nötr deterjanda çözünmeyen lif (NDF), potasyum (K), fosfor (P), kalsiyum (Ca), magnezyum (Mg), kondanse tanen (KT), toplam fenolik (TFN), toplam flavonoid (TFL) ve radikal kovucu aktiviteleri (DPPH) içerikleri belirlenmiştir. Genotiplerin ortalama HPO, ADF, NDF, K, P, Ca, Mg, KT, TFN, TFL ve DPPH içerikleri sırasıyla %19.12, %34.37, %46.62, %2.66, %0.30, %1.42, %0.27, %1.16, 154.23 mg GA g-1, 10.00 mg QE g-1 ve %44.05 olmuştur. Elde edilen sonuçlar Bilecik doğal florasında bulunan sarı taş yoncalarının kalite özellikleri bakımından geniş varyasyon gösterdiğini yem bitkisi olarak önemi bir potansiyel taşıdığını göstermiştir. Bu itibarla mevcut çalışmanın sonuçları ısla çalışmaları için ümitverici ve ıslahçılara ışık tutacak niteliktedir.

Anahtar Kelimeler: Doğal flora, sarı taş yoncası, genotip, kaba yem, kalite

FORAGE QUALITY OF YELLOW SWEET CLOVER (*Melilotus officinalis* (L.) Lamb.) GENOTYPES IN THE NATURAL FLORA OF BİLECİK PROVINCE

ABSTRACT

Bilecik Bilecik is one of the richest provinces in Turkey in terms of biological diversity. Bilecik, which is located at the intersection of different regions, represents a very large part of Turkey with its climatic characteristics and biological diversity, although it has a small area. This study was carried out to determine the quality traits of yellow sweet clover (Melilotus officinalis (L.) Lamb.) from the natural flora of Bilecik province. Plant collection was carried out at 34 locations, with distances of at least 8 km and not exceeding 5 deca, when the plants were in flowering satage. The collected plants were placed in a paper bag and were brought to Bilecik Şeyh Edebali University, Faculty of Agriculture and Natural Sciences, Department of Field Crops Laboratory. After the samples were dried in an oven at 60°C until they reached a constant weight, they were ground in a mill with a sieve diameter of 1 mm and made ready for analysis. The contents of crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), potassium (K), phosphorus (P), calcium (Ca), magnesium (Mg), condensed tannin (CT), total phenolic (TP), total flavonoid (TF) and radical repellent activities (DPPH) in samples of plants were be determined. The CP, ADF, NDF, K, P, Ca, Mg, CT, TP, TF and DPPH contents were ranged between 19.12%, 34.37%, 46.62%, 2.66%, 0.30%, 1.42%, 0.27%, 1.16%, 154.23 mg GA g^{-1}, 10.00 mg QE g^{-1} and 44.05%, respectively. The results showed that the yellow sweet clover found in Bilecik natural flora shows wide variation in terms of quality characteristics and has an important potential as a fodder plant. In this respect, the results of the present study are promising for breeding studies and shed light on breeders.

Keywords: Natural flora, genotype, sweet yellow clover, roughage, quality

GİRİŞ

Türkiye'de 19 milyon büyük baş hayvan birimi (BBHB) bulunmaktadır. Ülkede çayır meralardan ve tarla tarımı içerisinde yeralan yem bitkileri ekim alanlarından elde edilen kaliteli kaba yem miktarı ise 31 milyon tondur. Hayvan varlılığın yıllık yem ihtiyacı 86 milyon ton, açık ise 55 milyon tondur (Acar ve ark., 2020). Bu durum hayvanların kaliteli kaba yem ile beslenememesine ve dolayısıyla da verimlerinin düşmesine neden olmaktadır. Kaliteli kaba yem açığının kapatılması ve hayvansal verimin iyileştirilmesi ülke tarımı içerisinde yeralan yem bitkileri üretimin arttırılması ve çayır-mara alanalarının iyileştirilemesinin yanında doğal florada yeralan alternatif yem kaynaklarının da rasyonlara dâhil edilmesi ile mümkün olabilecektir.

İnsan yaşamının vazgeçilmez bir öğesi olan biyolojik çeşitlilik, nüfus ve sanayileşmenin artması ile tehlike altındadır. Uzmanlar 2030 yılına kadar biyolojik çeşitliliğin %20'sinin yok olacağını, bu tehdidin ise sanayileşmenin yoğun olduğu bölgelerde daha da ciddi boyutta olacağını öngeörnektedirler (Karagöz ve ark., 2016). Diğer taraftan farklı görüşler doğal florada bulunan genotiplerin; hastalıklara, pestisitlere ve stres şartlarına dayanım için potansiyel bir kaynak olduğunu göstermektedir (Frankel ve Hawkes, 1975; Hawkes, 1983; Holden ve Williams, 1984). Nitekim kültür çeşitlerinin geliştirilmesi ve eksikliklerinin giderilmesinde günümüzdeki ve gelecekteki muhtemel ihtiyaçlar için bu kaynaklar önem ihtiva etmektedir (Astley, 1987). Ayrıca bitkise üretimde devamlık bu kaynakların var olmasına bağldır. Bu nedenele hem bitkisel üretimde devamlılık doğal flora bulunan tür/türlerin korunmasına bağlıdır. Biyolojik çeşitliliğin korunması ve değerlendirilmesi ülke yararına yönelik en önemli yatırımların başında gelmektedir (Akgün ve ark, 1998).

İç Anadolu, Kardeniz, Marmara ve Ege Bölgelerinin kesim noktaları üzerinde bulunan Bilecik, taşıdığı özellikler ile minyatür bir Türkiye'dir. İlin deniz seviyesinden yüksekliği 500 metredir. En yüksek noktası Bozüyük ilçesinin batı ve güneybatısında yeralan 1906 m ile Kala Dağı'dır. Sakarya Irmağı boyunca uzanan çok geniş olmayan düzlükler şeklinde ovalar il topraklarının %7'lik bir bölümünü kaplar. Pazaryeri, Osmaneli, Bozüyük ve Gölpazarı Ovaları başlıca düzlük alanlardır. Yayla olarak adlandırılabilecek düzlükler yok denecek kadar azdır. İlin yüzölçümünün %47'sinin ormanlık alanlar oluşturmaktadır. Bu durum yağışının fazla olduğu anlamına gelmektedir. Ayrıca hem bitki hem de hayvan bakımından zenginleşmesine de katkı sağlamaktadır. Bu nedenlerden dolayı Bilecik'te bitkisel çeşitlilik oldukça fazla olup, bu çeşitlilik içerisinde ise endemizm oranının da yüksektir.

Baklagiller familyasına ait olan sarı taş yoncası (*Melilotus officinalis* (L) Lamb.) iki yıllık bir türdür. Bitkinin ilk yıl lezzetliliği ve besleme değeri ikinci yıla gore daha yüksektir. Bitkinin

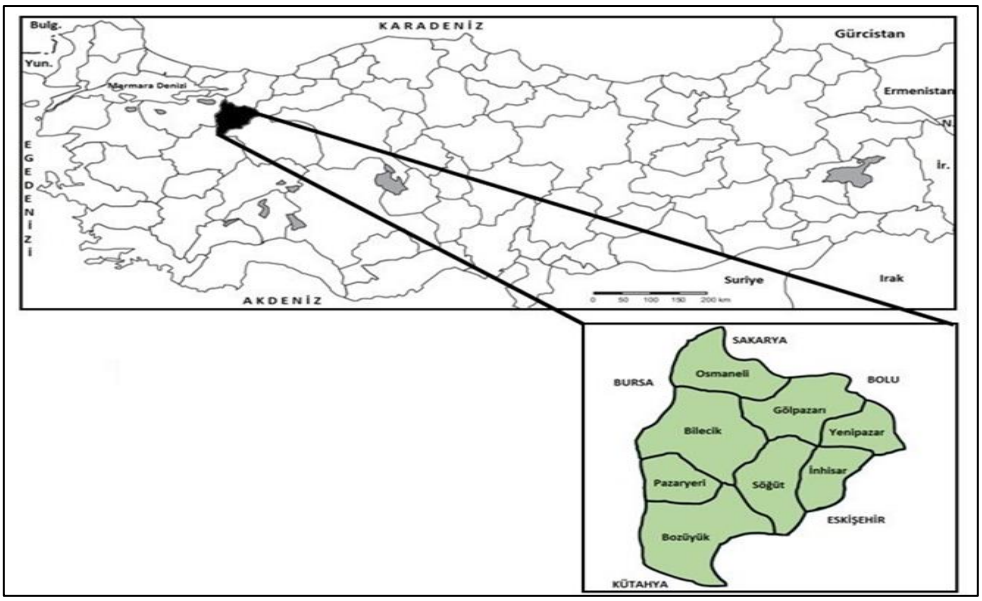
diğer yona türlerine gore şişme problemi daha azdır. Bitki ayrıca arılar için nektar kaynağıdır (Manga ve ark., 2003; Gülümser ve ark., 2021). Bitkide en büyük sorun kumarin içerimesidir. Kumarin özelliklle kötü kurutma koşullarında fungal aktivite sonucu toksik bir bileşik olan dikumorala (Dicoumarol) dönüşerek hayvanlarda ölüme kadar yol açabilecek hastalıklara sebep olabilmektedir (Smith, 1962). Bu toksik etki kötü koşullarda kurtulmuş ot veya zarar görmüş bitkiler yoğun tüketildiğinde ortaya çıkamaktadır. Bu nedenle önlem alınması kolaydır. Kumarin içeriği bitkilerde genellikle %2.0-2.5 aasında değişmektedir. Bu bağlamda kumarin içermeyen ya da az miktarda içeren yeni sarı taş yoncası çeşitlerin ıslahı önem taşımaktadır. Yapılan çalışmalarda dünyada tarımı yapılan Norgold ve Polara adında verim ve kumarin içeriği bakımından düşük 2 adet çeşit bulunmaktadır (Şılbır, 2009). Bu çalışmada Bilecik ili doğal florasında bulunan sarı taş yoncası genotiplerinin yem kalitesinin belirlenmesi amaçlanmıştır.

MATERYAL ve YÖNTEM

Bu çalışmada materyal olarak Bilecik ilinin doğal florasından toplanan sarı taş yoncası (*Melilotus officinalis* (L) Lamb.) genotipleri kullanılmıştır. Genotoplerin toplandığı yerlere ait coğrafi bilgiler Tablo 1'de, Bilecik ilinin ilçelerine ait harita ise Şekil 1'de, genotiplerin genel görünüşleri ise Şekil 2'de verilmiştir.

Tablo 1. Genotiplerinin toplandığı yerlere ait coğrafi bilgiler

Genotipler	İlçe	Köy	Lokalite		Yükseklik (m)
			Kuzey	Doğu	
1	Merkez	Gülümbe	40° 11' 752	29° 58' 18"	522
2	Merkez	Çukurören	40° 13' 832"	29° 56' 971"	328
3	Merkez	Beyce	40° 15' 820"	29° 54' 407"	685
4	Merkez	Dere sakarı 1	40° 10' 06"	30° 05' 71"	222
5	Merkez	PMY okulu	40° 08' 104"	29° 57' 442"	673
6	Merkez	Pelitözü	40° 09' 879"	29° 56' 401"	662
7	Merkez	Kampüs	40° 11' 557"	29° 57' 918"	557
8	Merkez	Deresakarı 2	40° 12' 06"	30° 04' 71"	299
9	Merkez	Deresakarı 3	40° 11' 6"	30° 9' 46"	180
10	Merkez	Merkez 1	40° 5' 1"	30° 7' 16"	477
11	Osmaneli	Balçıkhisar 1	40° 19' 562"	29° 58' 140"	630
12	Osmaneli	Balçıkhisar 2	40° 20' 939"	29° 58' 230"	573
13	Osmaneli	Büyükyenice	40° 20' 872"	30° 03' 163"	107
14	Osmaneli	Kazancı	40° 19' 531"	30° 05' 345"	109
15	Gölpazarı	Üyük	40° 14' 898"	30° 06' 614"	140
16	Gölpazarı	Kurşunlu	40° 14' 823"	30° 10' 880"	350
17	Gölpazarı	Merkez 1	40° 16' 607"	30° 17' 481"	529
18	Gölpazarı	Merkez 2	40° 15' 200"	30° 18' 204"	508
19	Gölpazarı	Gemici	40° 10' 685"	30° 09' 263"	129
20	Gölpazarı	Gökçeler	40° 12' 22'	30° 19' 5"	706
21	Gölpazarı	Kümbet	40° 13' 9"	30° 23' 1"	696
22	Pazaryeri	Karadede	40° 03' 266"	29° 50' 471"	825
23	Pazaryeri	Merkez	39° 59' 619"	29° 55' 805"	758
24	Pazaryeri	Aşağı armutlu	39° 53' 757"	29° 53' 073"	788
25	Pazaryeri	Demirkale	40° 11' 4"	30° 13' 32"	520
26	Bozüyük	Ormangüzle	39° 52' 562"	29° 54' 812"	1007
27	Bozüyük	Dodurga	39° 47' 701"	29° 55' 777"	1130
28	Bozüyük	Darıdere	39° 49' 614"	29° 59' 722"	980
29	Bozüyük	Merkez	39° 55' 464"	30° 02' 302"	893
30	Bozüyük	Günyarık	39° 57' 850"	30° 07' 092"	1052
31	Yenipazar	Harmankaya	40° 9' 4"	30° 26' 50"	527
32	Yenipazar	Yenipazar gölet	40° 9' 47"	30° 31' 19"	749
33	Yenipazar	Kuşça	40° 7' 29"	30° 28' 0"	1078
34	İnhisar	Merkez	40° 3' 39"	30° 21' 50"	293



Şekil 1. Bilecik ili ve ilçeleri



Şekil 2. Sarı taş yoncası genotiplerinin genel görünümü

Genotipler 2022 yılında ve Tan (1992)'ın belirttiği esaslar dikkate alınarak toplanmıştır. Buna göre, toplama çalışması iki durak arasında 8 km'den az olmayacak şekilde mesafe bırakılmak üzere 5 dekarlık bir alan içerisinde ve bitkilerin çiçeklenme döneminde gerçekleştirilmiştir. Toplanan bitkiler kese kâğıdına konulduktan sonra Bilecik Şeyh Edebali Üniversitesi Ziraat ve Doğa Bilimleri Fakültesi Tarla Bitkileri Bölümü Laboratuvarına getirilmiştir. Daha sonra bu örnekler etüve konularak 60°C'de sabit ağırlığa gelene kadar kurutulmuş ve 1 mm çapındaki değirmende öğütülerek analizler için hazır hale getirilmiştir. Örernkerde belirlenen kalite analizleri aşağıda verilmiştir.

Ham Protein, Asit Deterjanda Çözünmeyen Lif (ADF), Nötr Deterjanda Çözünmeyen Lif (NDF) ve Mineral Madde Analizi (%): Örnekler 60 °C'de sabit ağırlığa ulaşıncaya kadar etüvde kurutulmuş ve 1 mm elek çapına sahip değirmende öğütülerek analize hazır hale getirilmiştir. Daha sonra bu örneklerin ham protein, ADF, NDF, potasyum (K), kalsiyum (Ca), magnezyum (Mg) ve fosfor (P) içerikleri içerikleri Yozgat Bozok üniversitesi Ziraat Fakültesi

Tarla Bitkilerin Bölümünde yer alan Near Infrared Reflectance Spectroscopy (Foss 6500) cihazıyla IC-0904FE paket programı kullanılarak belirlenmiştir.

Kondanse Tanen Analizi (%): 0.01 gr örnek tartılarak üzerine 6 ml tanen çözeltisi eklenmiş ve bir tüpe konularak vortex yardımı ile karıştırılmıştır. 1 saat kaynar suda bekletilen örnekler kaynar sudan çıkarılıp 1 saat 100 °C de tutulacak, soğutulduktan sonra spektrofotometrede 550 nm'de absorbans değerinde okunmuştur (Bate-Smith,1975). Kondanse tanen aşağıdaki formül aracılığıyla hesaplanmıştır

Absorbans (550 nm x 156.5 x seyreltme faktörü)/ Kuru ağırlık (%).

Toplam Flavonoid İçeriği Analizi (mg QE g^{-1}): Quercetin stok çözeltisi 200 mg/L konsantrasyonda hazırlanmış ve bu konsantrasyondan seyreltme ile beş farklı konsantrasyon elde edilmiştir. Bitkilerin ekstraktları (1 ml) aynı miktarda % 2'lik AlCl3 ile karıştırılarak oda koşullarında 10 dk bekletilmiş ve numuneler 415 nm'de absorbans değerinde okunmuştur. Aynı işlemler standart Quercetin için de yapınış ve örneklerin flavonoid içerikleri Quercetin eşdeğeri (mg QE/g) olarak hesaplanmıştır (Arvouet-Grand ve ark., 1994).

Toplam Fenolik İçeriği Analizi (mg GA g^{-1}): Ekstraktların toplam fenolik içeriği Singleton ve ark. (1999)'nın metoduna göre uyarlanmıştır. Çalışma için örnek çözeltilerinden 0.2 ml alınmış ve üzerine 9 ml distile su ilave edildikten sonra 0.2 ml Folin-Ciocalteu eklenerek 3 dk beklemeye bırakılmıştır. Son olarak 10 ml'ye ayarlanacak şekilde 0.6 ml sodyum karbonat (Na_2CO_3, %20) eklenmiştir. 2 saat karanlıkta (oda sıcaklığında) bekletilen örnekler spektorfotometrede ve 760 nm'de absorbans değerinde okunmuştur. Saf suda çözülmüş gallik asit standart kalibrasyon eğrisi oluşturmada kullanılmıştır. Gallik asitten 0.1 mg/ml ana stok olarak hazırlanmış ve seyreltme ile yedi farklı konsantrasyon elde edilmiştir. Kontrol için örnek çözeltisi kadar (0.2 ml) saf su ilave edilmiştir. Gallik asit standart grafiğine göre tüm bitki ekstrakttlarındaki toplam fenolik madde miktarı mg gallik asit eşdeğeri (GAE) g^{-1} ekstrakt olarak hesaplanmıştır.

Radikal Kovucu Aktivite Analizi (DPPH) (%): Serbest radikal aktiviteleri bilinen bir radikal olan 2.2-difenil-1-pikrilhidrazil (DPPH) serbest radikali kullanılarak belirlenmiştir (Gezer ve ark., 2006). DPPH radikali süpürücü aktivite tayini için 4 mg DPPH, 100 ml metanol içerisinde çözülerek derişim hazırlanmıştır. Ekstraklardan ana stoktan farklı konsantrasyonlarda seyreltmeler yapılmıştır. Her bir örnek için 2 ml DPPH radikali ve farklı konsantrasyonlardaki ekstrakt çözeltilerinden 200 µl ilave edilmiştir. Oda sıcaklığında 30 dk karanlıkta inkübe edildikten sonra spetrofotometre cihazında 517 nm'de absorbans değerinde okuma yapılmıştır. Standart olarak askorbik asit ve bütillenmiş hidroksi toluen (BHT) kullanılmıştır. Kontrol için deney tüpüne ekstrakt çözelti miktarı kadar örnek çözücüsü ilave edilmiş ve her bir deneme 3

tekerrürlü olarak yapılmıştır. DPPH radikali süpürücü %'sinin belirlenmesinde aşağıdaki formül kullanılmıştır.

% DPPH radikal süpürücü aktivitesi= [(Akontrol–Aekstrak)/Akontrol] x 100.

Verilerin Değerlendirilmesi: Elde edilen sonuçlar SAS paket programı kullanılarak iki yönlü varyans analizine tabi tutulmuştur.

BULGULAR ve TARTIŞMA

Bilecik doğal florasından toplanan sarı taş yoncası genotiplerinin ham protein (HPO), asit deterjanda çözünmeyen lif (ADF), nötr deterjanda çözünmeyen lif (NDF), potasyum (K), fosfor (P), kalsiyum (Ca), magnezyum (Mg), kondanse tanen (KT), toplam fenolik (TFN), toplam flavonoid (TFL) ve radikal kovucu aktivite (DPPH) içerikleri Tablo 2'de verilmiştir.

Genotiplere ait en yüksek HPO %23.58 (Osmaneli /Büyükyenice), en düşük ise %13.61 (Merkez/Dere sakarı 1), ortalama ise %19.12 olmuştur. Doğal floradan toplama çalışmalarında varyasyon katsayısı değeri (%VK) yüksek olması istenir Çalışmada genotiplerin ham protein oranına ait VK değeri %13.39 olmuştur. Gülümser ve ark. (2020) Bilecik ilinin farklı lokasyonlarından topladıkları aktaş yoncası genotiplerinin ortalama ham protein oranını %16.26, VK'nın ise %15.55 olduğunu bildirmişlerdir.

ADF ve NDF oranları %25.52-45.14, %29.00-61.28 arasında değişim göstermiş, ortalama ADF ve NDF oranları ise sırasıyla %34.37 ve %46.62 olmuştur (Tablo 2). Yisehak (2008) yaptığı çalışmada aktaş yoncasının ortalama ADF oranını %33.10, NDF oranının ise %37.20 olduğunu bildirmiştir. belirtmişlerdir. Farklılıklar genotip ve ekolojiden kaynaklanmış olabilir.

Genotiplere ait K, P, Ca ve Mg içerikleri sırasıyla %1.35-3.55, %0.19-0.37, %0.94-2.71 ve %0.13-0.57 arasında değişmiştir (Tablo 2). Aşçı ve Acar (2018) makro besin elementini; hayvanların daha fazla alması gereken elementler olarak tanımlamışlardır. Makro besin elementlerinin hayvanların bünyelerinde fazla ya da az olması hayvanlarda farklı hastalıklara neden olabilmeketedir. Kalsiyum ve fosforun az olması hayvanlarda raşitizm hastalığına sebep olurken, fazla alınan fosfor böbrekte taş oluşumuna sebep olmaktadır (Khan ve ark., 2017; Thomson, 2018). Bu nedenle hayvanların ihtiyacı olan makro besin elementlerinden K % 0.3-0.8, Mg % 0.1-0.2 ve Ca ise % 0.1-0.2 arasında, P ise % 0.2 olması gerekmektedir (Mayland ve Hankins, 2001). Çalışmada tüm genotiplerin belirtilen mineral madde değerleri istenilen aralıkta veya bir miktar üzerindeolmuştur (Tablo 2).

En yüksek KT içeriği %2.87 ile Gölpazarı/Kurşunlu, en düşük ise %0.39 ile Gölpazarı/Gemici genotibinde belirlenmiştir (Tablo 2). KT ruminantlardan açığa çıkan ve küresel ısınmaya neden olan metan gazı salınımın azaltılması için önem teşkil etmektedir. Bu nedenle KT bakımından zengin olan yem bitkilerinin rasyonalarda yer alması hayvanların verim ve kalitesini artırırken,

amonyak ve azot oksit salınımını düşürerek karbon tutumunu artırmaktadır (Undi ve ark., 2016). Kumar ve Singh (1984) ile Barry (1987) bitkilerde düşük KT seviyesinin (%2.0-3.0) rumendeki protein bozulmasını azalttığını, yüksek miktardaki KT ise (<%3.0) protein sindirimi ile birlikte mikrobiyal ve enzim faaliyetlerini olumsuz şekilde etkilediğini bildirmişlerdir. Çalışma tüm genotiplerin kondanse tanen içeriği %3.0'dan düşük olmuştur (Tablo 2).

Genotiplerin sırasıyla, TFN, TFL ve DPPH içerikleri sırasyıla 64.84-273.58 mg GA g^{-1}, 4.74-14.91 mg QE g^{-1} ve %10.12-63.75 arasında değişmiştir. Söz konusu özelliklerin VK değerleri ise sırasıyla %42.04, %4.74 ve %44.58 olmuştur (Tablo 2). Bitkilerde bulunan sekonder bileşikler (TFN, TFL, DPPH, vb.) bitkilerin hayatlarını devam ettirmelerini sağlayan enerji kaynağıdır. Bitkiler stres koşullarında bu maddeleri sentezleyerek gelişimlerine devam ederler. Diğer taraftan bitki bünyesinde bulunan sekonder bileşikleri içeren yem bitkileri fitoterapik özellik göstermektedirler. Bu sayede hayvanlar daha sağlıklı olurken, hayvansal ürünlerin verim ve kalitesi de artmaktadır (Kuhnen ve ark., 2014).

Tablo 2. Sarı taş yoncası genotiplerinin yem kalitesi özellikleri

Gen.	HPO	ADF	NDF	K	P	Ca	Mg	KT	TFN	TFL	DPPH
1	17.57	41.71	55.14	3.02	0.31	1.14	0.16	1.14	183.00	12.46	33.39
2	21.57	25.52	29.00	1.71	0.19	2.71	0.57	1.77	158.84	11.41	28.39
3	20.23	32.25	44.82	2.75	0.32	1.48	0.26	0.83	193.29	10.81	36.96
4	13.61	39.40	54.88	2.66	0.24	1.35	0.29	1.34	195.32	14.26	50.31
5	22.27	34.21	44.77	3.00	0.35	1.18	0.18	1.08	187.04	12.75	43.53
6	18.69	32.78	45.38	2.58	0.28	1.58	0.33	1.69	186.82	13.43	61.85
7	20.85	31.47	41.28	2.43	0.29	1.60	0.28	1.06	218.94	13.84	60.52
8	23.34	26.78	39.40	3.02	0.34	1.43	0.29	0.72	70.99	4.10	45.15
9	21.68	28.85	40.34	2.63	0.32	1.64	0.38	0.83	65.73	2.36	45.15
10	14.24	43.22	57.95	2.23	0.36	0.94	0.23	0.86	84.02	2.31	63.57
11	18.55	32.21	42.64	1.62	0.25	2.06	0.42	1.89	246.88	13.99	43.11
12	20.28	35.11	46.00	2.92	0.32	1.24	0.27	1.16	163.86	13.74	41.54
13	23.58	34.76	41.88	2.51	0.37	1.19	0.13	1.09	201.98	13.59	46.78
14	14.48	44.96	60.04	3.09	0.28	0.97	0.14	2.39	182.37	13.01	48.64
15	17.92	38.37	53.27	2.99	0.30	1.30	0.25	1.42	188.22	14.08	46.68
16	19.34	31.26	45.59	2.50	0.28	1.69	0.32	2.87	203.80	13.80	50.94
17	19.36	39.55	52.11	3.10	0.33	1.08	0.16	0.98	172.27	13.97	41.99
18	19.45	37.54	49.04	2.66	0.31	1.28	0.18	0.74	193.69	13.50	39.23
19	15.00	42.43	55.03	2.13	0.25	1.31	0.27	0.39	185.61	13.05	35.28
20	17.80	33.56	42.91	2.63	0.27	1.38	0.27	0.85	60.89	2.63	30.21
21	21.59	30.30	43.88	3.14	0.33	1.51	0.32	1.12	68.43	3.31	37.24
22	18.40	35.85	47.83	3.02	0.30	1.44	0.27	0.98	200.36	13.31	33.57
23	18.46	34.45	49.79	3.04	0.31	1.32	0.23	1.62	214.30	12.90	39.76
24	20.20	33.29	46.09	2.98	0.30	1.57	0.31	1.54	168.23	12.46	33.71
25	19.33	35.27	46.64	2.49	0.28	1.43	0.28	0.73	62.51	4.38	36.59
26	19.57	34.87	47.76	3.20	0.30	1.46	0.24	0.81	169.61	12.46	37.76
27	19.83	33.48	47.76	3.55	0.33	1.30	0.19	0.90	184.03	13.62	48.08
28	19.89	33.95	46.93	3.00	0.30	1.53	0.25	0.96	191.24	12.45	44.51
29	22.26	26.50	37.38	2.48	0.30	1.70	0.29	1.35	171.86	13.03	36.47
30	20.26	30.77	45.01	3.27	0.32	1.50	0.29	0.83	232.03	12.92	39.90
31	20.96	28.34	40.70	3.08	0.32	1.38	0.31	0.95	63.25	2.90	41.68
32	19.35	29.33	40.91	2.79	0.29	1.45	0.29	1.48	77.54	4.43	48.79
33	17.54	32.78	45.58	2.56	0.34	1.29	0.33	0.68	90.28	3.34	54.80
34	14.20	45.14	58.54	1.35	0.33	1.03	0.26	0.96	70.72	2.14	60.71
Ort.	19.12	34.37	60.04	2.80	0.30	1.42	0.27	1.16	246.88	14.08	44.05
EA	13.61	25.52	29.00	1.35	0.19	0.94	0.13	0.39	60.89	2.14	28.39
EÜ	23.58	45.14	61.28	3.55	0.37	2.71	0.57	2.87	273.58	14.91	63.57
SS	2.56	5.34	6.81	0.63	0.04	0.32	0.08	0.53	64.84	4.74	10.12
VK	13.39	15.53	14.61	22.50	13.33	22.53	29.63	19.83	42.04	4.74	44.58

HPO: Ham protein oranı (%); ADF: Asit deterjanda çözünmeyen lif (%); NDF: Nötr deterjanda çözünmeyen lif (%); K: Potasyum; (%); P: Fosfor (%); Ca: Kalsiyum (%); Mg: Magnezyum (%); KT: Kondanse tanen (%); TFN: Toplam fenolik (mg GA g^{-1}); TFL: Toplam flavonoid (mg QE g^{-1}); DPPH: Radikal kovucu aktivite (%); Ort: Ortalama; EA: En az; EÜ: En üst; SS: Standart sapma; VK: Varyasyon katsayısı (%).

SONUÇLAR ve ÖNERİLER

Bilecik doğal florasında bulunan sarı taş yoncaları kalite özellikleri bakımından geniş varyasyona sahip olduğu ve dolayısıyla da yem bitkisi olarak önemli bir potansiyel taşıdığını

göstermiştir. Buna göre, mevcut çalışmanın sonuçları ıslah çalışmaları için ümit verici ve ıslahçılara ışık tutacak niteliktedir.

TEŞEKKÜR

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BİLECİK İLİ DOĞAL FLORASINDAN TOPLANAN HİNDİBA GENOTİPLERİNİN (*Cichorium intybus* L.) YEM KALİTESİ

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ÖZET

Bilecik, Marmara, Karadeniz, İç Anadolu ve Ege Bölgelerinin kesişim noktasında yer alan ve dört coğrafi bölgede toprakları olan Türkiye'deki tek ildir. Küçük yüzölçümüne karşın, coğrafi konumu sayesinde sahip olduğu iklim özellikleri ve biyolojik zenginliği ile Türkiye'nin önemli bir kısmını temsil etmektedir. Bu çalışmada, Bilecik ili doğal florasında bulunan yabani hindiba (Cichorium intybus L.) bitkilerinin toplanarak yem kalitesinin belirlenmesi amaçlanmıştır. Bitkiler çiçeklenme döneminde iken, aralarındaki mesafe 8 km'den az olmayan ve 5 dekarı aşmayan 35 lokasyondan toplanmıştır. Toplanan bitkiler kese kâğıdına konularak Bilecik Şeyh Edebali Üniversitesi Ziraat ve Doğa Bilimleri Fakültesi Tarla Bitkileri Bölümü Laboratuvarına getirilmiştir. Bitki örnekleri etüve konularak 60°C'de sabit ağırlığa gelene kadar kurutulmuş, sonrasında 1 mm elek çapındaki değirmende öğütülerek analize hazır hale getirilmiştir. Bitkilerde ham protein (HPO), asit deterjanda çözünmeyen lif (ADF), nötr deterjanda çözünmeyen lif (NDF), potasyum (K), fosfor (P), kalsiyum (Ca), magnezyum (Mg), kondanse tanen (KT), toplam fenolik (TFN), toplam flavonoid (TFL) ve radikal kovucu aktiviteleri (DPPH) içerikleri belirlenmiştir. Genotiplerin ortalama HPO, ADF, NDF, K, P, Ca, Mg, KT, TFN, TFL ve DPPH içerikleri sırasıyla %15.55, %42.32, %55.42, %2.65, %0.36, %1.01, %0.20, %0.66, 130.58 mg GA g^{-1}, 3.82 mg QE g^{-1} ve %78.45 olmuştur. Bilecik doğal florasından toplanan yabani hindiba genotipleri arasında kalite özellikleri bakımından geniş varyasyon olduğu tespit edilmiştir. Bu sonuçlar ileride yapılacak ıslah çalışmalarına ışık tutacak niteliktedir. İncelenen yabani hindiba genotiplerinin yem kalitesi ile hayvan sağlığı ve verimi bakımından ümit var bulunmuş, dolayısıyla hayvan beslenmesinde kaba yem olarak önemli bir potansiyel taşıdıkları belirlenmiştir.

Anahtar Kelimeler: Doğal flora, hindiba, genotip, kaba yem, kalite

FORAGE QUALITY OF CHICORY (*Cichorium intybus* L.) GENOTYPES IN THE NATURAL FLORA OF BİLECİK PROVINCE

ABSTRACT

Bilecik is the only province in Turkey that is located at the intersection of the Marmara, Black Sea, Central Anatolia and Aegean Regions and has lands in four geographical regions. Despite its small area, it represents an important part of Turkey with its climatic characteristics and biological richness thanks to its geographical location. In this study, it was aimed to determine the quality traits of chicory (*Cichorium intybus* L.) found in the natural flora of Bilecik province. Plants at the flowering stage were collected from 35 locations with a distance at least 8 km and not exceeding 5 decare. The collected plants were placed in a paper bag then were brought to Bilecik Şeyh Edebali University, Faculty of Agriculture and Natural Sciences, Department of Field Crops Laboratory. Plant samples were put in an oven and dried at 60°C until they reached a constant weight, then they were ground in a mill with a sieve diameter of 1 mm and made ready for analysis. The contents of crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), potassium (K), phosphorus (P), calcium (Ca), magnesium (Mg), condensed tannin (CT), total phenolic (TP), total flavonoid (TF) and radical repellent activities (DPPH) in samples were determined. The CP, ADF, NDF, K, P, Ca, Mg, CT, TP, TF and DPPH contents were ranged between 15.55%, 42.32%, 55.42%, 2.65%, 0.36%, 1.01%, 0.20%, 0.66%, 130.58 mg GA g^{-1}, 3.82 mg QE g^{-1} and 78.45%, respectively. It has been determined that there is a wide variation in terms of quality characteristics among wild chicory genotypes collected from the natural flora of Bilecik. These results shed light on breeding studies. The wild chicory genotypes examined were found to be promising in terms of feed quality, animal health and yield, therefore it was determined that they had an important potential as roughage in animal nutrition.

Keywords: Natural flora, genotype, chicory, roughage, quality

GİRİŞ

Türkiye'de 19 milyon büyük baş hayvan birimi (BBHB) bulunmaktadır. Ülkede çayır meralardan ve tarla tarımı içerisinde yeralan yem bitkileri ekim alanlarından elde edilen kaliteli kaba yem miktarı ise 31 milyon tondur. Hayvan varlılığın yıllık yem ihtiyacı 86 milyon ton, açık ise 55 milyon tondur (Acar ve ark., 2020). Bu durum hayvanların kaliteli kaba yem ile beslenememesine ve dolayısıyla da verimlerinin düşmesine neden olmaktadır. Kaliteli kaba yem açığının kapatılması ve hayvansal verimin iyileştirilmesi ülke tarımı içerisinde yeralan yem bitkileri üretimin arttırılması ve çayır-mara alanalarının iyileştirilemesinin yanında doğal florada yeralan alternatif yem kaynaklarının da rasyonlara dâhil edilmesi ile mümkün olabilecektir. İnsan yaşamının vazgeçilmez bir öğesi olan biyolojik çeşitlilik, nüfus ve sanayileşmenin artması ile tehlike altındadır. Uzmanlar 2030 yılına kadar biyolojik çeşitliliğin %20'sinin yok olacağını, bu tehdidin ise sanayileşmenin yoğun olduğu bölgelerde daha da ciddi boyutta olacağını öngörnektedirler (Karagöz ve ark., 2016). Diğer taraftan farklı görüşler doğal florada bulunan genotiplerin; hastalıklara, pestisitlere ve stres şartlarına dayanım için potansiyel bir kaynak olduğunu göstermektedir (Frankel ve Hawkes, 1975; Hawkes, 1983; Holden ve Williams, 1984). Nitekim kültür çeşitlerinin geliştirilmesi ve eksikliklerinin giderilmesinde günümüzdeki ve gelecekteki muhtemel ihtiyaçlar için bu kaynaklar önem ihtiva etmektedir (Astley, 1987). Ayrıca bitkise üretimde devamlık bu kaynakların var olmasına bağldır. Bu nedenele hem bitkisel üretimde devamlılık ancak ve ancak doğal flora bulunan tür/türlerin korunmasına bağlıdır. Biyolojik çeşitliliğin korunması ve değerlendirilmesi ülke yararına yönelik en önemli yatırımların başında gelmektedir (Akgün ve ark, 1998). İç Anadolu, Kardeniz, Marmara ve Ege Bölgelerinin kesim noktaları üzerinde bulunan Bilecik taşıdığı özellikler ile minyatür bir Türkiye'dir. İlin deniz seviyesinden yüksekliği 500 metredir. En yüksek noktası Bozüyük ilçesinin batı ve güneybatısında yeralan 1906 m ile Kala Dağı'dır. Sakarya Irmağı boyunca uzanan çok geniş olmayan düzlükler şeklinde ovalar il topraklarının % 7'lik bir bölümünü kaplar. Pazaryeri, Osmaneli, Bozüyük ve Gölpazarı Ovaları başlıca düzlük alanlardır. Yayla olarak adlandırılabilecek düzlükler yok denecek kadar azdır. İlin yüzölçümünün %47'sinin ormanlık alanlar oluşturmaktadır. Bu durum yağışının fazla olduğu anlamına gelmektedir. Ayrıca hem bitki hem de hayvan bakımından zenginleşmesine de katkı sağlamaktadır. Bu nedenlerden dolayı Bilecik'te bitkisel çeşitlilik oldukça fazla olup, bu çeşitlilik içerisinde ise endemizm oranının da yüksektir. Hindiba asteraceae (*Cichorium intybus* L.) familyasında yeralan, hem tek hem de çok yıllık bir bitkidir. Bitki güçlü kök yapısına sahip olup, sıcaklıklara toleranslıdır oldukça yüksektir. Bu özelliği sayesinde diğer tüerlerin kuruduğu dönemde yeşil kalabilmektedir (Kiers ve ark., 1999) ve dolayısyla da bu durum

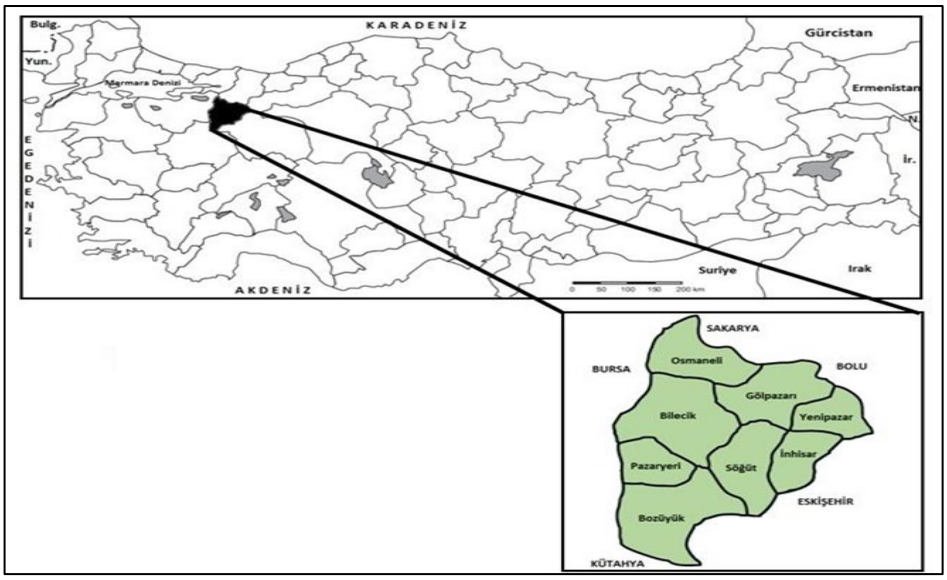
hayvanlar için yeşil yem zincirinin devamlılığı anlamına gelmektedir. Diğer taraftan hindibanın hayvan besleme bakımından buğdaygiller ile kıyaslandığında daha yüksek besin içeriğe sahip olduğu, bazı yonca türleri ile kıyaslandığında ise benzer olduğu bilinemketedir (Scales ve ark., 1994). Yapılan çalışmalar hindibanın selüloz ve hemiselüloz içeriğinin düşük, protein içeriğinin ise yüksek olduğunu göstermiştir (Athanasiadou ve ark., 2007; Başaran ve ark., 2019). Bu çalışmada Bilecik ili doğal florasında bulunan hindiba genotiplerinin yem kalitesinin belirlenmesi amaçlanmıştır.

MATERYAL ve YÖNTEM

Bu çalışmada materyal olarak Bilecik ilinin doğal florasından toplanan hindiba (*Cichorium intybus* L.) genotipleri kullanılmıştır. Genotoplerin toplandığı yerlere ait coğrafi bilgiler Tablo 1'de, Bilecik ilinin ilçelerine ait harita ise Şekil 1'de, genotiplerin genel görünüşleri ise Şekil 2'de verilmiştir.

Tablo 1. Genotiplerinin toplandığı yerlere ait coğrafi bilgiler

Genotipler	İlçe	Köy	Lokalite		Yükseklik (m)
			Kuzey	Doğu	
1	Merkez	Gülümbe	40° 11' 752	29° 58' 18"	522
2	Merkez	Çukurören	40° 13' 832"	29° 56' 971"	328
3	Merkez	Beyce	40° 15' 820"	29° 54' 407"	685
4	Merkez	Dere sakarı 1	40° 10' 06"	30° 05' 71"	222
5	Merkez	PMY okulu	40° 08' 104"	29° 57' 442"	673
6	Merkez	Ulupınar	40° 07' 097"	29° 53' 073"	877
7	Merkez	Pelitözü	40° 09' 879"	29° 56' 401"	662
8	Merkez	Kampüs	40° 11' 557"	29° 57' 918"	557
9	Merkez	Deresakarı 2	40° 12' 06"	30° 04' 71"	299
10	Merkez	Deresakarı 3	40° 11' 6"	30° 9' 46"	180
11	Merkez	Merkez 1	40° 5' 1"	30° 7' 16"	477
12	Osmaneli	Balçıkhisar 1	40° 19' 562"	29° 58' 140"	630
13	Osmaneli	Büyükyenice	40° 20' 872"	30° 03' 163"	107
14	Osmaneli	Kazancı	40° 19' 531"	30° 05' 345"	109
15	Gölpazarı	Üyük	40° 14' 898"	30° 06' 614"	140
16	Gölpazarı	Kurşunlu	40° 14' 823"	30° 10' 880"	350
17	Gölpazarı	Merkez 1	40° 16' 607"	30° 17' 481"	529
18	Gölpazarı	Merkez 2	40° 15' 200"	30° 18' 204"	508
19	Gölpazarı	Gemici	40° 10' 685"	30° 09' 263"	129
20	Gölpazarı	Gökçeler	40° 12' 22'	30° 19' 5"	706
21	Gölpazarı	Kümbet	40° 13' 9"	30° 23' 1"	696
22	Pazaryeri	Karadede	40° 03' 266"	29° 50' 471"	825
23	Pazaryeri	Merkez	39° 59' 619"	29° 55' 805"	758
24	Pazaryeri	Aşağı armutlu	39° 53' 757"	29° 53' 073"	788
25	Pazaryeri	Demirkale	40° 11' 4"	30° 13' 32"	520
26	Bozüyük	Ormangüzle	39° 52' 562"	29° 54' 812"	1007
27	Bozüyük	Dodurga	39° 47' 701"	29° 55' 777"	1130
28	Bozüyük	Darıdere	39° 49' 614"	29° 59' 722"	980
29	Bozüyük	Merkez	39° 55' 464"	30° 02' 302"	893
30	Bozüyük	Günyarık	39° 57' 850"	30° 07' 092"	1052
31	Yenipazar	Harmankaya	40° 9' 4"	30° 26' 50"	527
32	Yenipazar	Yenipazar gölet	40° 9' 47"	30° 31' 19"	749
33	Yenipazar	Kuşça	40° 7' 29"	30° 28' 0"	1078
34	Söğüt	Küre	40° 04' 678"	30° 08' 156"	513
35	İnhisar	Merkez	40° 3' 39"	30° 21' 50"	293



Şekil 1. Bilecik ili ve ilçeleri



Şekil 2. Hindiba genotiplerinin genel görünümü

Genotipler 2022 yılında ve Tan (1992)'ın belirttiği esaslar dikkate alınarak toplanmıştır. Buna göre, toplama çalışması iki durak arasında 8 km'den az olmayacak şekilde mesafe bırakılmak üzere 5 dekarlık bir alan içerisinde ve bitkilerin çiçeklenme döneminde gerçekleştirilmiştir. Toplanan bitkiler kese kâğıdına konulduktan sonra Bilecik Şeyh Edebali Üniversitesi Ziraat ve Doğa Bilimleri Fakültesi Tarla Bitkileri Bölümü Laboratuvarına getirilmiştir. Daha sonra bu örnekler etüve konularak 60°C'de sabit ağırlığa gelene kadar kurutulmuş ve 1 mm çapındaki değirmende öğütülerek analizler için hazır hale getirilmiştir. Örneklerde yapılan kalite analizleri aşğıda verilmiştir.

Ham Protein, Asit Deterjanda Çözünmeyen Lif (ADF), Nötr Deterjanda Çözünmeyen Lif (NDF) ve Mineral Madde Analizi (%): Örnekler 60 °C'de sabit ağırlığa ulaşıncaya kadar etüvde kurutulmuş ve 1 mm elek çapına sahip değirmende öğütülerek analize hazır hale getirilmiştir. Daha sonra bu örneklerin ham protein, ADF, NDF, potasyum (K), kalsiyum (Ca), magnezyum (Mg) ve fosfor (P) içerikleri içerikleri Yozgat Bozok üniversitesi Ziraat Fakültesi Tarla Bitkilerin Bölümünde yer alan Near Infrared Reflectance Spectroscopy (Foss 6500) cihazıyla IC-0904FE paket programı kullanılarak belirlenmiştir.

Kondanse Tanen Analizi (%): 0.01 gr örnek tartılarak üzerine 6 ml tanen çözeltisi eklenmiş ve bir tüpe konularak vortex yardımı ile karıştırılmıştır. 1 saat kaynar suda bekletilen örnekler kaynar sudan çıkarılıp 1 saat 100 °C de tutulacak, soğutulduktan sonra spektrofotometrede 550 nm'de absorbans değerinde okunmuştur (Bate-Smith,1975). Kondanse tanen aşağıdaki formül aracılığıyla hesaplanmıştır

Absorbans (550 nm x 156.5 x seyreltme faktörü)/ Kuru ağırlık (%).

Toplam Flavonoid İçeriği Analizi (mg QE g^{-1}): Quercetin stok çözeltisi 200 mg/L konsantrasyonda hazırlanmış ve bu konsantrasyondan seyreltme ile beş farklı konsantrasyon elde edilmiştir. Bitkilerin ekstraktları (1 ml) aynı miktarda % 2'lik AlCl3 ile karıştırılarak oda koşullarında 10 dk bekletilmiş ve numuneler 415 nm'de absorbans değerinde okunmuştur. Aynı işlemler standart Quercetin için de yapınış ve örneklerin flavonoid içerikleri Quercetin eşdeğeri (mg QE/g) olarak hesaplanmıştır (Arvouet-Grand ve ark., 1994).

Toplam Fenolik İçeriği Analizi (mg GA g^{-1}): Ekstraktların toplam fenolik içeriği Singleton ve ark. (1999)'nın metoduna göre uyarlanmıştır. Çalışma için örnek çözeltilerinden 0.2 ml alınmış ve üzerine 9 ml distile su ilave edildikten sonra 0.2 ml Folin-Ciocalteu eklenerek 3 dk beklemeye bırakılmıştır. Son olarak 10 ml'ye ayarlanacak şekilde 0.6 ml sodyum karbonat (Na_2CO_3, %20) eklenmiştir. 2 saat karanlıkta (oda sıcaklığında) bekletilen örnekler spektorfotometrede ve 760 nm'de absorbans değerinde okunmuştur. Saf suda çözülmüş gallik asit standart kalibrasyon eğrisi oluşturmada kullanılmıştır. Gallik asitten 0.1 mg/ml ana stok olarak hazırlanmış ve seyreltme ile yedi farklı konsantrasyon elde edilmiştir. Kontrol için örnek çözeltisi kadar (0.2 ml) saf su ilave edilmiştir. Gallik asit standart grafiğine göre tüm bitki ekstrakttlarındaki toplam fenolik madde miktarı mg gallik asit eşdeğeri (GAE) g^{-1} ekstrakt olarak hesaplanmıştır.

Radikal Kovucu Aktivite Analizi (DPPH) (%): Serbest radikal aktiviteleri bilinen bir radikal olan 2.2-difenil-1-pikrilhidrazil (DPPH) serbest radikali kullanılarak belirlenmiştir (Gezer ve ark., 2006). DPPH radikali süpürücü aktivite tayini için 4 mg DPPH, 100 ml metanol içerisinde çözülerek derişim hazırlanmıştır. Ekstraklardan ana stoktan farklı konsantrasyonlarda seyreltmeler yapılmıştır. Her bir örnek için 2 ml DPPH radikali ve farklı konsantrasyonlardaki ekstrakt çözeltilerinden 200 µl ilave edilmiştir. Oda sıcaklığında 30 dk karanlıkta inkübe edildikten sonra spetrofotometre cihazında 517 nm'de absorbans değerinde okuma yapılmıştır. Standart olarak askorbik asit ve bütillenmiş hidroksi toluen (BHT) kullanılmıştır. Kontrol için deney tüpüne ekstrakt çözelti miktarı kadar örnek çözücüsü ilave edilmiş ve her bir deneme 3 tekerrürlü olarak yapılmıştır. DPPH radikali süpürücü %'sinin belirlenmesinde aşağıdaki formül kullanılmıştır.

% DPPH radikal süpürücü aktivitesi= [(Akontrol–Aekstrak)/Akontrol] x 100.

Verilerin Değerlendirilmesi: Elde edilen sonuçlar SAS paket programı kullanılarak iki yönlü varyans analizine tabi tutulmuştur.

BULGULAR ve TARTIŞMA

Bilecik doğal florasından toplanan hindina genotiplerinin ham protein (HPO), asit deterjanda çözünmeyen lif (ADF), nötr deterjanda çözünmeyen lif (NDF), potasyum (K), fosfor (P), kalsiyum (Ca), magnezyum (Mg), kondanse tanen (KT), toplam fenolik (TFN), toplam flavonoid (TFL) ve radikal kovucu aktivite (DPPH) içerikleri Tablo 2'de verilmiştir.

Genotiplere ait en yüksek HPO %20.35 (Merkez/Beyce), en düşük ise %11.66 (Osmaeli/Büyükyenice), ortalama ise %15.55 olmuştur. Başaran ve ark. (2019) Yozgat, Samsun, Amasya, Antalya, Nevşehir, Konya ve Kırşehir illerinden topladıkları hindiba genotiplerinin ortalama ham protein oranını %14.07 olmuştur. Doğal floradan toplama çalışmalarında varyasyon katsayısı değeri (%VK) yüksek olması istenir Çalışmada genotiplerin ham protein oranına ait VK değeri %13.24 olmuştur.

ADF ve NDF oranları %35.24-54.57 ve %44.80-69.73 arasında değişim göstermiş, ortalama ADF ve NDF oranları ise sırasıyla %42.32 ve %55.42 olmuştur (Tablo 2). Sulas (2004) hinidabanın ADF oranının %25.8-49.9, Labreveux ve ark. (2006) ise NDF oranının %25.5-39.9 arasında değiştiğini belirtmişlerdir. Farklılıklar genotip ve ekolojiden kaynaklanmış olabilir.

Genotiplere ait K, P, Ca ve Mg içerikleri sırasıyla %1.35-3.32, %0.28-0.44, %0.55-1.49 ve 0.10-0.49 arasında değişmiştir (Tablo 2). Aşçı ve Acar (2018) makro besin elementini; hayvanların daha fazla ihtiyaç duyduğu elementler olarak tanımlamışlardır. Makro besin elementlerinin hayvanların bünyelerinde fazla ya da az olması hayvanlarda farklı hsatalıklara neden olabilmketedir. Kalsiyum ve fosforun az olması hayvanlarda raşitizm hastalığına sebep olurken, fazla alınan fosfor böbrekte taş oluşumuna sebep olmaktadır (Khan ve ark., 2017; Thomson, 2018). Bu nedenle hayvanların ihtiyacı olan makro besin elementlerinden K % 0.3-0.8, Mg % 0.1-0.2 ve Ca ise % 0.1-0.2 arasında, P ise % 0.2 olması gerekmektedir (Mayland ve Hankins, 2001). Çalışmada tüm genotiplerin mineral madde içerikleri belirtilen değerler arasında ya da üzerinde olmuştur (Tablo 2).

En yüksek KT içeriği %1.75 ile Gölpazarı/Merkez, en düşük ise %0.35 ile Osmaneli/Büyükyenice genotibinde belirlenmiştir (Tablo 2). KT ruminantlardan açığa çıkan ve küresel ısınmaya neden olan metan gazı salınımın azaltılması için önem teşkil etmektedir. Bu nedenle KT bakımından zengin olan yem bitkilerinin rasyonalarda yer alması hayvanların verim ve kalitesini artırırken, amonyak ve azot oksit salınımını düşürerek karbon tutumunu artırmaktadır (Undi ve ark., 2016). Kumar ve Singh (1984) ile Barry (1987) bitkilerde düşük

KT seviyesinin (%2.0-3.0) rumendeki protein bozulmasını azalttığını, yüksek miktardaki KT ise (<%3.0) protein sindirimi ile birlikte mikrobiyal ve enzim faaliyetlerini olumsuz şekilde etkilediğini bildirmişlerdir. Çalışma tüm genotiplerin kondanse tanen içeriği %3.0'dan düşük olmuştur (Tablo 2).

Genotiplerin sırasıyla, TFN, TFL ve DPPH içerikleri sırasyıla 35.96-353.19 mg GA g^{-1}, 1.87-5.04 mg QE g^{-1} ve %41.53-88.95 arasında değişmiştir. Söz konusu özelliklerin VK değerleri ise sırasıyla %52.65, %26.70 ve %15.13 olmuştur (Tablo 2). Bitkilerde bulunan sekonder bileşikler (TFN, TFL, DPPH, vb.) bitkilerin hayatlarını devam ettirmelerini sağlayan enerji kaynağıdır. Bitkiler stres koşullarında bu maddeleri sentezleyerek gelişimlerine devam ederler. Diğer taraftan bitki bünyesinde bulunan sekonder bileşikleri içeren yem bitkileri fitoterapik özellik göstermektedirler. Bu sayede hayvanlar daha sağlıklı olurken, hayvansal ürünlerin verim ve kalitesi de artmaktadır (Kuhnen ve ark., 2014).

Tablo 2. Hindiba genotiplerinin yem kalitesi özellikleri

Gen.	HPO	ADF	NDF	K	P	Ca	Mg	KT	TFN	TFL	DPPH
1	13.75	47.00	61.88	2.47	0.35	0.86	0.12	0.49	136.16	3.72	87.54
2	14.49	45.64	60.47	3.02	0.37	0.85	0.16	0.58	60.02	3.52	86.34
3	20.35	37.67	50.55	2.88	0.44	1.05	0.24	0.69	85.45	4.17	84.96
4	16.19	43.72	58.26	2.96	0.36	0.91	0.22	0.50	151.30	4.12	75.10
5	17.96	37.77	49.02	2.62	0.38	1.21	0.20	0.58	166.37	4.88	81.88
6	15.55	41.29	52.27	2.76	0.36	1.06	0.19	0.48	219.41	5.04	88.39
7	16.48	35.24	50.03	2.54	0.33	1.28	0.25	1.15	237.17	4.44	88.65
8	18.28	35.92	44.80	2.99	0.37	1.16	0.18	0.73	188.22	4.61	88.72
9	15.40	41.94	53.94	2.78	0.38	0.84	0.18	0.81	78.12	3.04	62.85
10	11.89	48.46	61.61	1.93	0.31	1.03	0.23	0.73	69.51	1.87	60.84
11	14.24	43.22	57.95	2.23	0.36	0.94	0.23	0.86	84.02	2.31	63.57
12	19.13	38.46	50.48	2.94	0.41	1.10	0.23	0.65	129.58	4.78	86.41
13	11.66	54.57	69.73	1.85	0.28	0.64	0.13	0.35	103.85	2.44	74.36
14	13.39	46.21	58.95	2.63	0.32	0.93	0.13	0.39	182.33	3.54	87.43
15	17.61	39.43	54.16	3.34	0.39	1.28	0.30	0.60	71.03	2.38	79.88
16	13.20	43.63	57.07	2.38	0.34	1.22	0.35	0.46	119.20	3.76	85.51
17	15.05	45.35	59.13	2.38	0.36	0.91	0.11	0.44	152.77	4.49	84.78
18	18.11	39.24	52.86	2.73	0.38	1.49	0.49	1.75	125.23	3.72	82.53
19	17.87	39.29	53.38	3.32	0.40	1.24	0.33	0.84	89.68	3.73	75.11
20	15.04	45.35	58.59	2.35	0.35	0.63	0.12	0.64	64.92	3.75	60.37
21	14.35	43.82	55.25	2.56	0.34	0.88	0.18	0.72	84.21	4.02	70.29
22	16.74	42.82	54.16	2.51	0.38	0.91	0.12	0.55	229.72	4.89	86.14
23	15.65	40.33	52.78	2.56	0.37	1.04	0.16	0.73	353.19	4.96	86.21
24	16.30	40.53	54.32	3.18	0.38	1.09	0.16	0.56	213.30	4.61	86.89
25	15.27	43.73	55.72	2.25	0.34	0.93	0.23	0.57	59.99	4.13	60.73
26	17.02	38.55	48.53	3.12	0.37	1.12	0.19	0.46	260.09	4.86	87.77
27	14.42	40.71	54.85	3.02	0.35	1.00	0.10	0.37	115.28	4.46	86.30
28	13.31	46.28	62.13	2.87	0.32	0.86	0.10	0.38	113.27	3.84	87.65
29	15.98	38.62	52.81	2.93	0.36	0.93	0.12	0.80	146.84	3.97	88.12
30	18.20	41.83	52.61	2.87	0.44	0.93	0.15	0.67	94.04	3.09	87.61
31	14.02	47.17	58.70	2.23	0.35	0.64	0.16	0.67	35.96	2.22	41.53
32	12.53	42.93	56.17	2.72	0.32	1.03	0.22	0.65	81.05	4.54	69.36
33	15.79	39.82	54.82	2.58	0.36	0.99	0.30	0.66	86.92	3.86	72.72
34	14.82	39.40	53.36	3.01	0.34	1.32	0.28	0.68	111.57	3.75	88.50
35	14.20	45.14	58.54	1.35	0.33	1.03	0.26	0.96	70.72	2.14	60.71
Ort.	15.55	42.32	55.42	2.65	0.36	1.01	0.20	0.66	130.58	3.82	78.45
EA	11.66	35.24	44.80	1.35	0.28	0.55	0.10	0.35	35.96	1.87	41.53
EÜ	20.35	54.57	69.73	3.32	0.44	1.49	0.49	1.75	353.19	5.04	88.95
SS	2.06	4.02	4.75	0.42	0.03	0.19	0.09	0.27	68.76	1.02	11.87
VK	13.24	9.50	8.57	15.85	8.33	18.81	45.00	40.90	52.65	26.70	15.13

HPO: Ham protein oranı (%); ADF: Asit deterjanda çözünmeyen lif (%); NDF: Nötr deterjanda çözünmeyen lif (%); K: Potasyum (%); P: Fosfor (%); Ca: Kalsiyum (%); Mg: Magnezyum (%); KT: Kondanse tanen (%); TFN: Toplam fenolik (mg GA g^{-1}); TFL: Toplam flavonoid (mg QE g^{-1}); DPPH: Radikal kovucu aktivite (%); Ort: Ortalama; EA: En az; EÜ: En üst; SS: Standart sapma; VK: Varyasyon katsayısı (%).

SONUÇLAR ve ÖNERİLER

Bilecik doğal florasından toplanan yabani hindiba genotipleri arasında kalite özellikleri bakımından geniş varyasyon olduğu tespit edilmiştir. Bu sonuçlar ileride yapılacak ıslah çalışmalarına ışık tutacak niteliktedir. İncelenen yabani hindiba genotiplerinin yem kalitesi ile hayvan sağlığı ve verimi bakımından ümit var bulunmuş, dolayısıyla hayvan beslenmesinde kaba yem olarak önemli bir potansiyel taşıdıkları belirlenmiştir.

TEŞEKKÜR

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KLOROJENİK ASİT AÇISINDAN ZENGİN YEŞİL KAHVE EKSTRAKTININ ANTİOKSİDAN ve ANTİMİKROBİYAL AKTİVİTESİNİN BELİRLENMESİ

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ÖZET

Yeşil kahve, başlıca klorojenik asit (KJA) olmak üzere antioksidanların önemli bir kaynağıdır ve bilinen sağlığa faydaları nedeniyle tüketimi son yıllarda popüler hale gelmiştir. Mevcut çalışma kapsamında, KJA açısından zengin yeşil kahve ekstraktının (YKE) antioksidan ve antimikrobiyal aktiviteleri araştırılmıştır. YKE'nin yüksek toplam fenolik içeriğe (84.63 mg GAE/ml) ve DPPH radikal giderici aktiviteye (202.86 µg TE/ml) sahip olduğu tespit edilmiştir. YKE'nin Gram-negatif (*E. coli, Y. enterocolitica, P. aeruginosa,* ve *K. pneumoniae*) ve Gram-pozitif (*L. monocytogenes, S. aureus, B. subtilis, M. luteus* ve *E. faecalis*) bakterilere karşı antimikrobiyal aktivitesi disk difüzyon ve minimum inhibisyon konsantrasyon (MİK) yöntemleri ile değerlendirilmiştir. YKE, *E. coli* hariç test edilen tüm Gram-pozitif ve Gram-negatif bakteriler üzerine antimikrobiyal aktivite göstermiştir. İnhibisyon zonları ve MİK değerlerine göre, *E. faecalis* ve *K. pneumoniae* YKE'ye en hassas bakteriler olarak belirlenmiştir. Bu sonuçlar, YKE'nin doğal antioksidan ve antimikrobiyal ajan olarak gıdalarda kullanım için umut verici bir potansiyele sahip olduğunu göstermiştir.

Anahtar Kelimeler: Yeşil Kahve, Klorojenik Asit, Antioksidan, Antimikrobiyal, Minimum Inhibisyon Konsantrasyon

DETERMINATION OF ANTIOXIDANT AND ANTIMICROBIAL ACTIVITY OF GREEN COFFEE EXTRACT RICH IN CHLOROGENIC ACID

ABSTRACT

Green coffee is an important source of antioxidants, mainly chlorogenic acid (CGA), and its consumption has become popular in recent years due to its known health benefits. In the present study, the antioxidant and antimicrobial activities of green coffee extract (GCE) rich in CGA were investigated. GCE was found to have high total phenolic content (84.63 mg GAE/ml) and DPPH radical scavenging activity (202.86 µg TE/ml). The antimicrobial activity of GCE against Gram-negative (*E. coli*, *Y. enterocolitica*, *P. aeruginosa*, and *K. pneumoniae*) and Gram-positive (*L. monocytogenes*, *S. aureus*, *B. subtilis*, *M. luteus*, and *E. faecalis*) bacteria was evaluated by disk diffusion and minimum inhibition concentration (MIC) assays. GCE showed antimicrobial activity against all Gram-positive and Gram-negative bacteria tested, except *E. coli*. According to the zones of inhibition and MIC values, *E. faecalis* and *K. pneumoniae* were found to be the most sensitive bacteria to GCE. These results showed that GCE has a promising potential for use in foods as a natural antioxidant and antimicrobial agent.

Keywords: Green Coffee, Chlorogenic Acid, Antioxidant, Antimicrobial, Minimum Inhibition Concentration

GİRİŞ

Kahve, dünya genelinde sudan sonra en popüler içecek olup tüketiminin yüksek olması nedeniyle diyet ve sağlıkta önemli bir bileşendir (Bosso ve ark., 2023). Kahvenin popülaritesi, keyif verici tadı, psiko-uyarıcı etkileri ve dikkat çekici sağlığa faydalarından kaynaklanmaktadır (Antonio ve ark., 2010; Canci ve ark., 2022; Zhu ve ark., 2021; Bosso ve ark., 2023).

Kahve bitkisi yaklaşık 80 tür içermesine karşılık yalnızca iki türü ticari olarak değerlidir. Kahve üretiminin %75'ini *Coffea arabica* (Arabica) %25'ini ise *Coffea canephora* (Robusta) oluşturmaktadır. Arabica kahvesi, duyusal özellikler bakımından Robusta'dan daha üstün sayılır ve uluslararası piyasada daha yüksek ticari değere sahiptir (Mussatto ve ark., 2011; Garg, 2016). Robusta kahvesi, zayıf aromalı ve belirgin bir acılık ile karakterize edilirken, Arabica kahvesi ise daha hafif, meyvemsi ve asidik özelliktedir (Alonso-Salces ve ark., 2009; Gałan ve ark., 2015).

Kahve, çeşitli fenolik bileşenler dizisi tarafından sağlanan potansiyel sağlık yararları nedeniyle fonksiyonel bir içecek olarak kabul edilir (Cheong ve ark., 2013). Epidemiyolojik araştırmalar, ölçülü kahve tüketiminin diyabet ve kardiyovasküler hastalıklar gibi çeşitli kronik hastalıkları önlemenin yanı sıra kolon kanseri, Parkinson ve Alzheimer hastalığı riskini azaltmada önemli bir rolü olduğunu göstermiştir (Getachew ve Chun, 2016; Zhu ve ark., 2021). Bu faydalı etkiler, özellikle klorojenik asit (KJA) olmak üzere fenolik asitlerin varlığı ile ilişkilendirilmiştir (Narita ve Inouye, 2015; Getachew ve Chun, 2016; Garg, 2016). Bitkilerde baskın olan fenolik asit türü KJA'dır ve kahve çekirdeklerindeki içeriği oldukça önemlidir. KJA, kafeik, ferulik ve p-kumarik gibi hidroksisinnamik asitlerin kinik asit ile esterleşmesi sonucu oluşur ve kahvede en bol bulunan KJA formu 5-O-kafeoilkinik asittir (Bosso ve ark., 2023; Mills ve ark., 2013). Birçok çalışmada, KJA'nın antienflamatuar, antitümör, diyabet ve obezite önleyici, karaciğer, böbrek ve sinir sistemi koruyucu gibi biyolojik aktiviteleri içeren sağlığa faydalarının yanı sıra yüksek antioksidan ve antimikrobiyal etkiye sahip olduğu bildirilmiştir (Naveed ve ark., 2018; Wang ve ark., 2022; Getachew ve Chun, 2016; Babova ve ark., 2016; Bharath ve ark., 2015).

Kahvenin sahip olduğu fizyolojik etkilerin sorumlusu olan fitokimyasalların içeriği kavurma, öğütme ve demleme gibi birçok faktörden etkilenir. Kavurma, biyoaktif bileşik seviyelerini düşürürken tipik kahve aromasını ve rengini oluşturan başta dehidrasyon, Maillard reaksiyonu ve Strecker bozunması olmak üzere birçok kimyasal reaksiyona neden olan ana kahve işleme adımlarından biridir (Mills ve ark., 2013; Montenegro ve ark., 2021). Kafein

içeriği kavurma işlemi ile çok fazla değişmezken, trigonellin kısmen parçalanarak B_3 vitamini ve uçucu bileşiklere dönüştürülür (Montenegro ve ark., 2021). Öte yandan, yüksek sıcaklıklarda kararsız olduğu bilinen KJA'nın içeriği kavurma işlemi ile önemli ölçüde azalmaktadır (Mills ve ark., 2013; Narita ve Inouye, 2015; Awwad ve ark., 2021). Kahvenin kavrulması, her %1 kuru madde kaybı için %8-10 KJA bozunması/dönüşümü ve %11 ila %45 polifenol bozunması ile sonuçlanır (Budryn ve ark., 2015; Zain ve ark., 2018). Kahve çeşidine ve kavurma derecesine bağlı olarak toplam KJA içerikte 6 kata kadar kayıp olabileceği bildirilmiştir (Narita ve Inouye, 2015; Awwad ve ark., 2021). Ayrıca, kavurma sırasında asparajin ve indirgen şekerlerin kondenzasyonu ile kanserojen özellikteki akrilamid oluşumu da söz konusudur (Montenegro ve ark., 2021). Kavurma işlemi sırasında özellikle KJA içeriğindeki yüksek kayıptan dolayı, kahvenin değerli biyoaktif bileşiklerinin korunduğu alternatif yöntemlere ihtiyaç vardır (Getachew ve Chun, 2016).

Yeşil kahve çekirdeği, kavrulmamış olgun veya olgunlaşmamış kahve çekirdeğini ifade eder. Kahve meyvesi hasat edildiğinde, çekirdekler kuru veya ıslak işleme tabi tutulabilir. Orta Amerika ve Afrika'nın bazı bölgelerinde uygulanan yaş işlemede, meyve eti çekirdeklerinden ayrıldıktan sonra çekirdekler fermente edilir ve yaklaşık iki gün suda bekletilir. Yıkanmamış veya doğal kahve olarak da bilinen kuru işleme, hasattan sonra bütün haldeki meyvenin önce temizlendiği ve daha sonra kuruması için beton veya tuğla bir zemin veya masalar üzerine yayılarak 2-3 hafta boyunca güneşe maruz bırakıldığı ve eşit kuruma için düzenli olarak döndürüldüğü eski bir işleme yöntemidir. Kuru işleme, ucuz ve uygulaması kolay bir yöntem olup Robusta kahvesinin neredeyse tamamında, Brezilya'da üretilen Arabica kahvesinin ise yaklaşık %90'ında bu yöntem kullanılmaktadır. Bahsedilen bu iki işlemin dışında, Endonezya ve Brezilya'da "ıslak-kabuklu", "yarı-yıkanmış" veya "Gilling Basah" olarak da adlandırılan yarı-kuru işleme yöntemi de kullanılmaktadır. Bu işlemler sonucunda kabuk, müsilaj, posa ve parşömen çıkarıldıktan sonra elde edilen yeşil kahve çekirdekleri, uluslararası pazarda işlem görmektedir (Mussatto ve ark., 2011; Garg, 2016; Bosso ve ark., 2023).

Yeşil kahveyi diğer kahvelerden ayıran en büyük özellik diğer kahveler gibi ısıl işlem görmemesidir. Tüketiciler genellikle sadece kavrulmuş kahve kullandıkları için yeşil kahve yeni bir gıda ürünü olarak kabul edilebilir (Bosso ve ark., 2023). Yeşil kahvenin temel bileşenleri, çözünmeyen polisakkaritler (%34-53), çözünebilir karbonhidratlar (%6-12.5), lipitler (%8-15), azot içeren bileşikler (%11-15), KJA'lar (%6.7-12.1), kafein (%0.8-4.0), trigonellin (%0.3-1.2) ve minerallerdir (%3.0-5.4) (Mussatto ve ark., 2011; Bosso ve ark., 2023). Yeşil kahvenin ana biyoaktif bileşikleri ise KJA'lar, kafein, trigonellin, kafestol ve

kahweol'dür. Yeşil kahve, bu biyoaktif bileşenlerden kaynaklanan antioksidan, antimikrobiyal, antienflamatuar, hepatoprotektif, kardiyoprotektif, kemopreventif, anti-diyabetik, anti-obezite, antikanser, anti-nörodejeneratif etkilerin yanı sıra uyanıklık ve konsantrasyonda artış, yorgunlukta azalma, ağrı algısında azalma gibi sağlık etkilerine sahiptir (Wang ve ark., 2022; Bosso ve ark., 2023). Öte yandan, aşırı kahve tüketimi toplam kolesterol seviyesinin yükselmesi ve HDL-c (yüksek yoğunluklu lipoprotein) seviyesinin düşmesi, taşikardi, kan basıncında artış, bilişsel faaliyetlerde bozulma, baş ağrısı, anksiyete, uykusuzluk ve uyku kalitesinde bozulma gibi istenmeyen etkilere de yol açabilir (Bosso ve ark., 2023).

Yeşil kahve KJA'nın doğada önemli bir kaynağıdır. Başlıca 5-kafeoilkinik asit olmak üzere 80'den fazla KJA çeşidi yeşil kahve çekirdeklerinde tespit edilmiştir. Bazı kahve türlerinin KJA içerikleri %1'den düşük olmasına rağmen, başlıca iki kahve türü olan *Coffea arabica* ve *Coffea canephora*'nın KJA içerikleri kuru madde bazında sırasıyla %3.40-7.24 ve %5.17-14.4 aralığındadır (Narita ve Inouye, 2015). Yeşil kahve çekirdeklerinde on üç KJA sınıfı tanımlanmıştır ve ana alt sınıfları kafeoilkinik asitler, dikafeoilkinik asitler ve grup başına birkaç izomeri olan feruloilkinik asitlerdir (Alonso-Salces ve ark., 2009; Bosso ve ark., 2023).

Sağlığa faydaları, antioksidan kapasiteye katkı sunan radikal süpürücü faaliyetleri ve zengin biyoaktif bileşen içeriği nedeniyle yeşil kahve çekirdeklerinin nutrasötik ve farmasötik endüstrisinde kullanımına karşı artan bir ilgi bulunmaktadır (Babova ve ark., 2016). Yeşil kahve, çeşitli yöntemlerle elde edilen ekstraktlarının yanı sıra granül, kapsül, toz, sakız ve yağ formunda kozmetik, gıda ve ilaç endüstrisi gibi birçok alanda kullanılmaktadır (Bosso ve ark., 2023). Özellikle son yıllarda, yeşil kahve ekstraktlarının (YKE) gıda uygulamalarına yönelik çalışmalar giderek artmaktadır. Bu bağlamda, YKE'nin fındık ezmesi (Şimşek ve ark., 2023), sığır köftesi (Mostafa ve El Azab, 2022), burger (Bergamaschi ve ark., 2023), yoğurt (Pimpley ve ark., 2022), kek (Gomes ve ark., 2022), ekmek (Zain ve ark., 2018; Ibrahim ve ark., 2020) ve içecek (Tamer, 2018; Indiarto ve ark., 2022) gibi çeşitli gıdalar üzerine etkileri araştırılmıştır. Yeşil kahve diğer ürünlere dahil edildiğinde, polifenollerin, antioksidanların ve fenoliklerin konsantrasyonunu artırır, bu sayede çoklu doymamış yağ asitlerinin kaybını, akrilamid oluşumunu ve sineresis oranını azaltır. Ayrıca, duyusal özelliklerin gelişimine katkı sağlar ve yüksek biyoerişilebilirlik sunar (Gomes ve ark., 2022).

Yeşil kahvenin KJA içeriği dahil olmak üzere antioksidan ve antimikrobiyal özellikleri ekstraksiyon yönteminden önemli ölçüde etkilenmektedir (Gałan ve ark., 2015; Getachew ve Chun, 2016; Lin ve ark., 2022; Gligor ve ark., 2023; Rai ve ark., 2018; Montenegro ve ark., 2021; Faria ve ark., 2021). Özellikle yeşil kahveye atfedilen biyoaktif özelliklerin başlıca

sorumlusu olarak kabul edilen KJA'nın etkili bir şekilde ekstraksiyonu önem arz etmektedir. Öte yandan, kahve içeceğinin kalitesiyle yakından ilişkili olan kafeinin içeriği, kavurma işlemi uygulanmadığı için diğer kahvelere göre daha düşük olsa da yeşil kahve çekirdekleri için önemli bir alkaloiddir (Alonso-Salces ve ark., 2009; Yeşilyaprak, 2017). Ancak, kafeinin sinir sistemi üzerindeki bilinen etkileri yeşil kahveden elde edilen ekstraktların antioksidan olarak besin takviyelerinde uygulanabilirliğini azaltmaktadır. Bu yüzden, yeşil kahve özlerinde klorojenik asit/kafein oranının yüksek olması istenen bir durumdur (Babova ve ark., 2016).

Bu bilgiler doğrultusunda planlanan bu araştırmada, KJA açısından zengin YKE'nin antioksidan ve antimikrobiyal aktivitelerinin belirlenmesi amaçlanmıştır.

MATERYAL ve YÖNTEM

Materyal

Araştırmada kullanılan *Coffee arabica* (Brazilya) cinsi yeşil kahve Ordu piyasasından temin edilmiş ve işletme bünyesinde öğütülmüştür.

Yöntem

Yeşil Kahve Ekstraktının Eldesi

Yeşil kahve ekstraktı (YKE), W02015189857 A1 nolu patentte tarif edilen ve Şimşek ve ark. (2023) tarafından bildirilen yöntem izlenerek elde edilmiştir. Öğütülmüş yeşil kahvenin yağı Soxhlet cihazında hekzan ile muamele edilerek uzaklaştırılmıştır. Yağı uzaklaştırılmış ve kurutulmuş yeşil kahveden 30 gr tartılarak su: etanol karışımı (%20:80) ile 120 ml'ye tamamlanmış ve manyetik karıştırıcıda 750 rpm'de 4 saat ekstraksiyona tabi tutulduktan sonra filtre edilmiştir. Bu işlem üç kez tekrarlanmış ve elde edilen süzüntünün dörtte biri kalacak şekilde rotary evaporatör yardımıyla 45°C'de koyulaştırılmıştır. Evaporatörden alınan çözelti üzerine kafeinin uzaklaşması için 45 ml kloroform ilave edilmiş ve santrifüjden sonra ayırma hunisi ile kloroform uzaklaştırılmıştır. Kloroform uzaklaştırılan çözelti 45 ml aseton ile muamele edilmiş ve suda çözünür kurumadde seviyesi %70 oluncaya kadar evaporatörde 45°C'de koyulaştırılmıştır. Elde edilen KJA açısından zengin YKE kullanılıncaya kadar 4°C'de muhafaza edilmiştir.

Toplam Fenolik İçerik ve Antioksidan Aktivite Analizleri

KJA açısından zenginleştirilmiş YKE'nin toplam fenolik içeriği Folin-Ciocalteu yöntemine (Singleton ve Rossi, 1965) göre gallik asit eşdeğer (GAE) cinsinden belirlenirken, antioksidan aktivite ise DPPH* serbest radikal giderme yöntemine (Brand-Williams ve ark., 1995) dayanarak troloks eşdeğer (TE) olarak tespit edilmiştir.

Antimikrobiyal Aktivitenin Belirlenmesi

Antimikrobiyal aktivite, agar-disk difüzyon (Anwar ve ark., 2015) ve minimum inhibisyon konsantrasyon (MIK) (Demirdoven ve ark., 2015) yöntemleri izlenerek belirlenmiştir. Antimikrobiyal aktivite analizlerinin öncesinde, YKE 0.45 µm gözenek çapında şırınga ucu filtreden geçirilerek steril hale getirilmiştir. Çalışmada kullanılan mikroorganizma suşları 37°C'de 24 saat inkübe edilerek aktifleştirilmiştir. Test edilecek bakterilerin aktifleştirilmesinde Brain Heart İnfision (BHI) Broth (Merck, Darmstadt, Almanya) kullanılmıştır. Hazırlanan bir gecelik genç kültürler antimikrobiyal aktivite denemelerinde kullanılmıştır.

Disk Difüzyon Yöntemi

YKE'nin test edilen mikroorganizmalara karşı inhibisyon zon çaplarının belirlenmesi, Mueller Hinton Agar (MHA) (Merck, Darmstadt, Almanya) üzerinde gerçekleştirilmiştir. Bakteri inokulumları densitometre cihazı kullanılarak McFarland 0.5 hücre yoğunluğuna ayarlanmış ve içerisinde 25 ml uygun steril besiyeri bulunan petri plaklarına 100 µl aktarılarak steril pamuklu eküvyon yardımıyla besiyeri yüzeyine yayılmıştır. Daha sonra, petri plaklarına uygun şekilde yerleştirilen steril diskler (6 mm çapında) üzerine 15'er µl YKE emridilmiştir. Pozitif kontrol olarak ampisilin (10 µg/disk) ve gentamisin (10 µg/disk) antibiyotik diskler kullanılmıştır. Hazırlanan petriler 37°C'de 24 saat inkübe edildikten sonra dijital kumpas yardımıyla inhibisyon zonları ölçülmüştür.

Minimum İnhibisyon Konsantrasyon (MİK) Yöntemi

MİK testi için öncelikle, steril 96-kuyulu U-tabanlı plakalardaki kuyucuklara 2. sıradan 10. sıraya kadar 100 µl BHI broth aktarılmıştır. Plakanın ilk 10 sırası YKE'nin seri dilüsyonları için kullanılmıştır. YKE'nin seri dilüsyonlarını (50-0.10 mg/ml) hazırlamak için 1. sıradan başlayarak 10. sıraya kadar kuyucuklar arası karışım transferi gerçekleştirilmiştir. Ardından, her kuyucuğa (12. sıra hariç) 0.5 Mcfarland'a ayarlanmış test inokulumu eklenmiştir. YKE içermeyen 11. sıra mikroorganizma gelişimi için pozitif kontrol, yalnızca BHI broth içeren 12. sıra ise kültür ortamının sterilite kontrolü için negatif kontrol olarak kabul edilmiştir. Bu şekilde hazırlanan plakalar 37 ˚C'de 18-24 saat inkübe edilmiştir. İnkübasyon sonunda, bakteriyel büyüme indikatörü olarak her bir hücreye tiyazolil mavi tetrazolyum bromür (MTT) (0.2 mg/ml) solüsyonundan aktarılmış ve 37°C'de 30 dakika inkübasyonun ardından kuyucuklarda gerçekleşen renk değişimleri izlenmiştir.

BULGULAR ve TARTIŞMA

Yeşil Kahve Ekstraktının Antioksidan Kapasite Özellikleri

Tablo 1'de görüldüğü üzere KJA açısından zengin YKE'nin yüksek toplam fenolik içeriğe ve DPPH radikal giderici aktiviteye sahip olduğu tespit edilmiştir. Bulgularımız, literatürde farklı çözgenler ve yöntemler kullanılarak elde edilen yeşil kahve özleri için bildirilen toplam fenolik içerik ve DPPH radikal giderici aktiviteden oldukça yüksektir (Jeszka-Skowron ve ark., 2016; Lin ve ark., 2022; Ali ve ark., 2022; Gligor ve ark., 2023). Bu durum, yeşil kahve çekirdeklerinde ortalama %12 aralığında olan KJA içeriğin (Bosso ve ark., 2023), mevcut çalışmada izlenen ekstraksiyon yöntemi ile yüksek seviyelere çıkarılmasına atfedilebilir.

Tablo 1. YKE'nin Toplam Fenolik İçeriği ve Antioksidan Aktivitesi

	Toplam Fenolik İçerik (mg GAE/ml)	**DPPH Radikal Giderici Aktivite (µg TE/ml)**
YKE	84.63±1.82	202.86±16.49

Yeşil kahvenin KJA içeriği ile antioksidan aktivitesi arasında doğrusal bir ilişki olduğu bildirilmiştir (Babova ve ark., 2016; Ali ve ark., 2022; Awwad ve ark., 2021). Jeszka-Skowron ve ark. (2016) yeşil kahve ekstraktlarının ortalama KJA ve toplam fenolik içeriklerini sırasıyla 166 mg/L ve 1043 mg GAE/L olarak bulmuştur. Gligor ve ark. (2023) yeşil kahve çekirdeklerinden klasik (maserasyon, Soxhlet ekstraksiyonu) ve yenilikçi (turbo ekstraksiyon, ultrason destekli ekstraksiyon ve bu yöntemin bir kombinasyonu) yöntemlerle elde edilen yirmi ekstraktın toplam fenolik içerik ve DPPH radikal giderici aktivitelerini sırasıyla 0.44-2.69 mg GAE/ml ve 2.61-9.16 mg TE/ml aralığında belirlemiştir.

Yeşil Kahve Ekstraktının Antimikrobiyal Aktivite Özellikleri

YKE'nin Gram-negatif (*Escherichia coli*, *Yersinia enterocolitica*, *Pseudomonas aeruginosa* ve *Klebsiella pneumoniae*) ve Gram-pozitif (*Listeria monocytogenes*, *Staphylococcus aureus*, *Bacillus subtilis*, *Micrococcus luteus* ve *Enterococcus faecalis*) bakterilere karşı antimikrobiyal aktivitesi disk difüzyon ve minimum inhibisyon konsantrasyon (MİK) yöntemleri ile değerlendirilmiştir. Buna göre, antimikrobiyal analiz sonucu belirlenen inhibisyon zonları (mm) ve MİK değerleri (µg/ml) Tablo 2'de verilmiştir. Ayrıca, mikroseyreltme plağında YKE'nin farklı konsantrasyonlarının mikroorganizmalar üzerine inhibisyon etkisi Şekil 1'de görülmektedir.

Tablo 2. YKE'nin Antimikrobiyal Aktivitesini Gösteren İnhibisyon Zonları ve MİK Değerleri

Mikroorganizma	İnhibisyon Zon Çapı (mm)			MİK (µg/ml)
	YKE	Ampisilin	Gentamisin	
K. pneumoniae ATCC®13883	15.1±0.8	TE	24.6±0.3	≥ 6.25
E. feacalis ATCC®29121	16.8±0.3	26.5±0.7	23.3±0.2	≥ 12.50
M. luteus NRRL B-1018	11.6±0.2	46.0±1.2	27.1±0.7	≥ 25
Y. enterocolitica ATCC®27729	14.9±0.5	9.1±0.8	21.5±0.3	≥ 25
P. aeruginosa ATCC®27853	11.3±0.7	TE	21.9±0.3	≥ 25
L. monocytogenes ATCC®7644	7.1±0.1	12.6±0.4	22.3±0.1	≥ 50
S. aureus ATCC®6538	7.6±0.2	21.2±0.9	25.8±0.8	≥ 50
B. subtilis NRRL B-209	7.4±0.2	22.8±0.6	28.4±0.5	> 50
E. coli ATCC®25922	TE	13.4±0.3	23.6±0.3	-

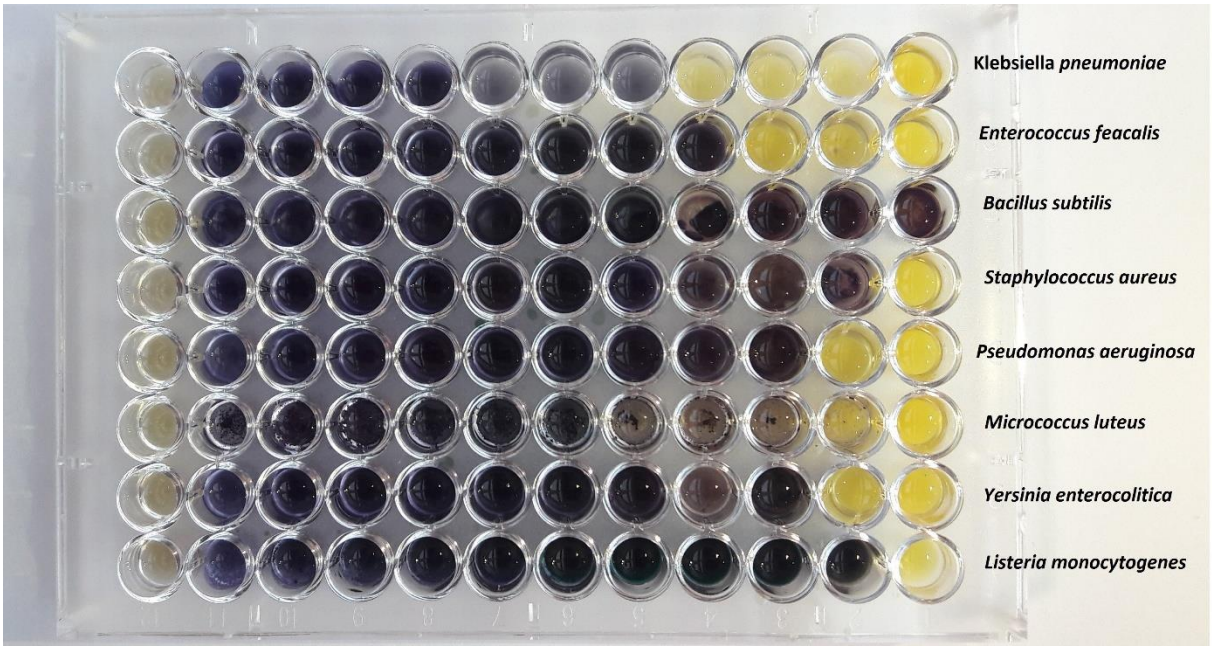
TE: Tespit edilemedi; "-": Uygulanmadı; YKE: Yeşil kahve ekstraktı

Disk difüzyon sonuçlarına göre, YKE *E. coli* hariç test edilen tüm mikroorganizmalar üzerine antimikrobiyal aktivite göstermiştir. En geniş inhibisyon zonları Gram (+) bakterilerden *E. feacalis* (16.8 mm), Gram (-) bakterilerden ise *K. pneumoniae* (15.1 mm) üzerine belirlenmiştir. En düşük antibakteriyel etki ise sırasıyla 7.1 mm, 7. 6 mm ve 7.4 mm inhibisyon zonları ile *L. monocytogenes, S. aureus ve B. subtilis* için tespit edilmiştir. Standart antibiyotikler ile karşılaştırıldığında, YKE'nin antibakteriyel potansiyelinin genel olarak gentamisine göre daha düşük, Gram (-) bakterilere karşı (*E.coli* hariç) ise ampisilinden daha etkili olduğu tespit edilmiştir.

Şekil 1'de görüleceği üzere mikrodilüsyon yöntemi sonuçları, test edilen bakteriler arasında YKE'ye en dirençli suşun >50 µg/ml MİK değeri ile *B.subtilis* olduğunu göstermiştir. Öte yandan, en düşük MİK değerleri (6.25 µg/ml) *K. pneumoniae* için belirlenmiştir. *M. luteus, Y. enterocolitica ve P. aeruginosa*'nın inhibisyonu için 25 µg/ml YKE yeterli olurken, *L. monocytogenes* ve *S. aureus* bakterilerinin inhibisyonu ancak 50 µg/ml YKE konsantrasyonu ile mümkün olmuştur. İnhibisyon zonları ve MİK değerlerine göre, *E. faecalis* ve *K. pneumoniae* YKE'ye en hassas bakteriler olarak belirlenmiştir.

Benzer şekilde, birçok çalışma yeşil kahveden elde edilen ekstraktların çözücü, konsantrasyon ve yönteme bağlı olarak değişmekle birlikte *Streptococcus mutans*, *S. aureus*, *P. aeruginosa*, Salmonella typhimurium, Salmonella enterica, *Listeria innocua*, *B. subtilis*, *Bacillus cereus*, *K. pneumoniae*, *Aspergillus* türleri ve *Candida albicans* üzerine antibakteriyel ve antifungal aktiviteye sahip olduğunu bildirmiştir (Antonio ve ark., 2010; Yeşilyaprak, 2017; Suárez-Quiroz ve ark., 2013;Getachew ve Chun, 2016; Canci ve ark., 2022; Díaz-Hernández ve ark., 2022; Lin ve ark., 2022).

Coffea arabica (Arabica) ve *Coffea canephora* (Robusta) türlerine ait beş yeşil kahveden elde edilen ekstraktların antimikrobiyal etkisininin değerlendirildiği bir çalışmada, ekstrakta en dirençli (*E.coli*) ve en hassas (*S. aureus*) bakteriler için MİK değerleri sırasıyla 30 mg/ml ve 5 mg/ml olarak belirlenmiştir (Getachew ve Chun, 2016). Díaz-Hernández ve ark. (2022) yeşil kahvenin su ve etanol ekstraktlarının *E.coli*, *Enterobacter cloacae*, *E. faecalis, S. aureus* ve *Staphylococcus hominis* dahil bazı bakterilerin inhibisyonunu için minimum konsantrasyonun 8 mg/ml'den fazla olması gerektiğini bildirmiştir. Bir diğer çalışmada, yeşil kahvenin su, etilasetat, aseton ve kloroform ekstraktlarının test edilen tüm mikroorganizmalara (*S. epidermidis, Bacillus pumilus, E. faecalis, E. coli, Enterobacter aerogenes, Legionella* spp., *Candida albicans, Aspergillus fumigatus*) karşı iyi ve orta derece antimikrobiyal aktiviteye sahip olduğu gözlenmiştir (Yeşilyaprak, 2017). Bharath ve ark. (2015) ise %50 KJA içeren saf YKE'nin bazı periodontal patojenik bakterilerin (*Porphyromonas gingivalis, Prevotella intermedia, Fusobacterium nucleatum* ve *Aggregatibacter actinomycetemcomitans)* inhibisyonu üzerine çok düşük konsantrasyonlarda (0.2-3.125 µg/ml) etkili olduğunu tespit etmiştir.



Şekil 1. YKE'nin farklı konsantrasyonlarının test edilen bakteriler üzerine inhibisyon etkisi

Polifenoller, KJA, kafein, kafeik asitler, melanoidinler, proantosiyanidinler, kinik asit ve ferulik asit gibi biyoaktif bileşenler kahvenin antibakteriyel aktivitesinden sorumludur (Antonio ve ark., 2010; Nayeem ve ark., 2011; Gałan ve ark., 2015; Bharath ve ark., 2015; Canci ve ark., 2022). Mevcut çalışmada YKE'nin test edilen bakteriler için tespit edilen düşük MİK değerleri KJA'nın yüksek konsantrasyonuna bağlanabilir. Nitekim, saf KJA'nın birçok

mikroorganizmaya karşı antibakteriyel ve antifungal etkisi önceki çalışmalarda bildirilmiştir (Lou ve ark., 2011; Kabir ve ark., 2014; Li ve ark., 2014; Suárez-Quiroz ve ark., 2013).

Fenolik bileşiklerin antimikrobiyal etki mekanizması karmaşık olmakla birlikte, KJA'nın antimikrobiyal etki mekanizması şu şekilde özetlenebilir: (1) Hücre zarlarının yapısını tahrip ederek ve zar geçirgenliğini önemli ölçüde artırarak hücre içi metabolitlerin sızmasına neden olur. Hücre inaktivasyonunu tetikler; (2) Normal hücre döngüsü ilerlemesine müdahale ederek mikroorganizmaların büyümesini engeller; (3) Bakteri hücrelerinin normal metabolik aktivitelerini bozarak hücrelerde metabolik bozukluklara yol açar (Garg, 2016; Wang ve ark., 2022).

SONUÇ ve ÖNERİLER

Mevcut çalışmada izlenen ekstraksiyon yöntemi ile elde edilen KJA içeriği yüksek YKE'nin dikkate değer antioksidan kapasiteye ve antimikrobiyal aktiviteye sahip olduğu belirlenmiştir. Elde edilen bulgular, YKE'nin doğal antioksidan ve antimikrobiyal ajan olarak gıdalarda kullanım için umut verici bir potansiyele sahip olduğunu göstermiştir. Tüketicilerin doğal gıda katkı maddeleri için artan talebi göz önüne alındığında, YKE sentetik katkıların yerine doğal bir alternatif olarak kullanılabilir. Ayrıca, gelecekte çözücünün etkin şekilde uzaklaştırıldığı KJA ekstraktları elde etmek ve yeşil kahveden KJA ekstraksiyonu için daha pratik ve etkili yöntemler geliştirmek için daha fazla çalışmalara ihtiyaç vardır.

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BAZI YEREL ÜZÜM ÇEŞİTLERİNİN İKİ FARKLI YÖNTEMLE ANTİOKSİDAN KAPASİTELERİNİN BELİRLENMESİ

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ÖZET

Üzüm içerdiği vitaminler, mineraller, aminoasitler ve antioksidan özellik gösteren fenolik bileşikler nedeniyle sağlıklı ve dengeli beslenmede mutlaka tüketilmesi gereken gıdalardan birisidir. Antioksidanlar genellikle küçük miktarlarda bile lipitler, proteinler ve nükleik asitler gibi biyolojik olarak önemli bileşiklerin oksidatif yıkımını önleyebilen veya azaltabilen bileşiklerdir. Son yıllarda, antioksidan aktiviteye sahip bireysel bileşikler belirlenmiş olmakla birlikte, doğal materyallerin antioksidan aktivitesinin bir bütün olarak değerlendirilmesine yönelik yaklaşımlar kullanılmaya başlanmıştır. Üzümlerin antioksidan aktivitesinin değerlendirilmesi için, çoğu zaman radikallerin elemine edilmesine veya maddelerin redoks özelliklerinin ölçülmesine dayanan TEAC-ABTS, ORAC, FRAP ve DPPH gibi çeşitli yöntemler kullanılmaktadır. Bu çalışmada, Batman ili Gercüş ilçesinde bir üretici bağında yetiştirilen Benitaht, Hasani, Kerküş, Mazrona, Sinceri ve Zeyti yerel beyaz üzüm çeşitlerinin, DPPH ve FRAP yöntemleri kullanılarak antioksidan kapasiteleri belirlenmiştir. Çeşitlerin 2022 vejetasyonunda teknolojik olgunluğa ulaşmış salkımlarının omuz (3 adet), orta (2 adet) ve uç (1 adet) kısımlarından alınan tanelerinde spektrofotometre ile analizler gerçekleştirilmiştir. Her iki yönteme göre de ölçülen antioksidan kapasitesi bakımından çeşitler arası farkı karşılaştırmada Kruskal-Wallis testi kullanılmıştır. Ayrıca çeşitlerin antioksidan kapasitelerini belirlemek üzere, FRAP ve DPPH yöntemleri ile yapılan ölçümler arası uyumu değerlendirmek için Bland-Altman grafiği çizilmiştir. Antioksidan kapasiteleri çeşit özelliği olarak farklılık göstermiştir. Çalışma sonucunda çeşitlerin DPPH yöntemi ile belirlenen antioksidan kapasiteleri en yüksek kapasiteden en düşük kapasiteye doğru; 6.225 mg/g (Mazrona), 5.415 mg/g (Hasani), 5.090 mg/g (Zeyti), 4.920 mg/g (Benitaht) 4.535 mg/g (Sinceri), ve 4.365 mg/g (Kerküş) olarak belirlenmiştir. Çeşitlerin FRAP yöntemi ile belirlenen antioksidan kapasiteleri ise en yüksek kapasiteden en düşük kapasiteye doğru; 1.285 mg/g (Mazrona), 1.200 mg/g (Hasani), 1.050 mg/g (Benitaht), 1.005 mg/g (Zeyti), 0.955 (Kerküş) ve 0.920 mg/g (Sinceri) olarak kaydedilmiştir. Bland-Altman grafiğine göre yöntemlerin birbiriyle uyumlu olduğu ve birbirinin alternatifi olarak kullanılabileceği gözlenmiştir.

Anahtar Kelimeler: *Vitis vinifera* L., beyaz üzüm çeşitleri, antioksidan kapasite, spektrofotometri

DETERMINATION OF ANTIOXIDANT CAPACITY OF SOME NATIVE GRAPE VARIETIES WITH TWO DIFFERENT METHODS

ABSTRACT

Grape is one of the foods that must be consumed in a healthy and balanced diet due to its vitamins, minerals, amino acids and phenolic compounds with antioxidant properties. Antioxidants are generally compounds that can prevent or reduce the oxidative destruction of biologically important compounds such as lipids, proteins and nucleic acids even in small amounts. In recent years, although individual compounds with antioxidant activity have been identified, approaches to evaluate the antioxidant activity of natural materials as a whole have started to be used. For the evaluation of the antioxidant activity of grapes, various methods such as TEAC-ABTS, ORAC, FRAP and DPPH are used, which are mostly based on the elimination of radicals or measurement of the redox properties of substances. In this study, the antioxidant capacities of native white grape varieties 'Benitaht', 'Hasani', 'Kerküş', 'Mazrona', 'Sinceri' and 'Zeyti' grown in a producer vineyard in Gercüş district of Batman province were determined DPPH and FRAP methods. Analyses were carried out by spectrophotometer on the berry taken from the shoulder (3 pieces), middle (2 pieces) and tip (1 piece) parts of the technologically mature clusters of the varieties in the 2022 vegetation. Kruskal-Wallis test was used to compare the differences between varieties in terms of antioxidant capacity measured by both methods. In addition, Bland-Altman graph was drawn to evaluate the agreement between FRAP and DPPH methods for the measurements of antioxidant capacity of the varieties. The antioxidant capacities of the varieties differed as a variety feature. As a result of the study, by DPPH method, the antioxidant capacities of the varieties were observed from the highest to the lowest as follows; 6.225 mg/g (Mazrona), 5.415 mg/g (Hasani), 5.090 mg/g (Zeyti), 4.920 mg/g (Benitaht), 4.535 mg/g (Sinceri), and 4.365 mg/g (Kerküş) capacity. By the FRAP method, these values were recorded from the highest to the lowest as follows; 1.285 mg/g (Mazrona), 1.200 mg/g (Hasani), 1.050 mg/g (Benitaht), 1.005 mg/g (Zeyti), 0.955 (Kerküş) and 0.920 mg/g (Sinceri). According to the Bland-Altman graph, it has been observed both methods are agreement with each other and can be used as alternatives.

Keywords: *Vitis vinifera* L., white grape varieties, antioxidant capacity, spectrophotometry

GİRİŞ

Bir organizmada moleküler hasar ve redoks sinyalinin kesilmesine neden olan oksidanlar ve antioksidanlar arasındaki dengesizlik durumu olarak ifade edilen oksidatif stress, antioksidan alımının uygun şekilde artırılmasıyla azaltılabilmektedir. Antioksidanlar, nispeten küçük konsantrasyonda bile oksidasyon sürecinde inhibitör olarak kullanılır ve böylece vücutta fizyolojik olarak çeşitli rollerde yer alır. Hem bitkilerde hem de hayvanlarda hastalıkların önlenmesi ve vücut savunma sisteminde önemli bir role sahiptir (Çiçek, 2022).

Bugünün sosyal yaşamında dengesiz beslenme, tütün ve alkol kullanımı ve çevre kirliliğinin artması kronik oksidatif strese neden olmaktadır. Antioksidanlar, serbest radikalleri süpürme ve *in vivo* oksidasyon zincirlerini durdurma özelliğine sahip olduklarından çevresel ve fizyolojik stres, yaşlanma ve kansere karşı kullanılırlar (Głód vd. 2015; Apak, 2019; Çiçek, 2022). Gıda antioksidanları, oksidatif stresin önlenmesinde önemli bir rol oynadıklarından toplam antioksidan aktivite ve toplam antioksidan kapasite gibi ölçüm yöntemleri geliştirilmiştir.

Genel olarak toplam antioksidan kapasite analizleri elektron transferi ve hidrojen atomu transferi esaslı olmak üzere sınıflandırılmakta olup, peroksil radikalinin süpürmesi (ORAC, TRAP), metal iyonun indirgenmesi (FRAP, CUPRAC) ve organik radikal süpürmesi (ABTS, DPPH) esaslı yöntemler bulunmaktadır (Karadağ vd. 2009; Jiang vd. 2021; Çiçek, 2022).

Üzüm dünyada meyve türleri içerisinde önemli bir antioksidan kaynağı olarak kabul edilmektedir (Ames vd.,1993). Farklı üzüm çeşitleri, belirgin şekilde farklı antioksidan aktiviteler sergileyebilmektedir (Liu vd., 2018). Bu çalışmada Batman ili Gercüş ilçesinde bir üretici bağında yetiştirilen bazı yerel üzüm çeşitlerinin antioksidan kapasitesi iki farklı yöntemle belirlenmiştir.

MATERYAL ve YÖNTEM

Materyal

Araştırma materyalini Batman ili Gercüş ilçesinde bir üretici bağında yetiştirilen Benitaht, Hasani, Kerküş, Mazrona, Sinceri ve Zeyti yerel beyaz üzüm çeşitleri oluşturmaktadır. Olgunlaşma, 2022 yılı vejetasyonunda bağda kuru madde miktarının dijital refraktometre yardımıyla ölçülmesiyle belirlenmiştir. Kuru madde değeri %17-%18'e ulaştığında salkımlar kesilmiş ve salkımların omuz (3 adet), orta (2 adet) ve uç (1adet) kısımlarından alınan tane örnekleri homojenizatörde homojen hale getirilip, 50 ml'lik falkon tüplerinde analizler yapılıncaya kadar -20 C' de muhafaza edilmiştir.

Yöntem

Toplam Antioksidan Kapasitesinin Belirlenmesi

Antioksidan kapasitesini belirlemek amacıyla, en yaygın kullanılan iki reaktifin radikal süpürme yeteneklerinin belirlenmesine dayalı olarak kullanılan reaktiflerden biri olan DPPH (2,2-diphenyl-1picrylhydrazyl) ile üzümlerde antioksidan kapasitesini belirlemek için kullanılan güvenilir, basit ve hızlı bir kolorimetrik yöntem olan FRAP kullanılmıştır.

DPPH Yöntemi

Etanol ile seyreltilerek elde edilen 0.2, 0.4, 0.6, 0.8, 1 (mg/ml) konsantrasyonlarındaki tane örneğinden 1 ml alınarak, 2.9 ml 0.1 mM DPPH solüsyonuna eklenmiş ve 15 dk sonra, karışımın absorbans değeri spektrofotometrede 517 nm'de ölçülmüştür. Her bir uygulamaya ait örneğin serbest radikali indirgeme kapasitesi;

DPPH inhibasyonu (%) = [(Ac-As)/Ac x 100]

eşitliğinden yararlanarak saptanmış, ardından her bir uygulamaya ait IC 50 (mg/g) değeri hesaplanmıştır (Blois, 1958).

FRAP Yöntemi

Asetat buffer, 2,3,5-Trifeniltetrazolyum klorit (TPTZ) ve Ferrik klorürden oluşan FRAP'tan 2850 µl, tane örneğinden ise 150 µl alınarak 10 ml'lik cam tüplere aktarılmıştır. Karanlık oda koşullarında 30 dk bekletildikten sonra, örnekler spektrofotometrede 593 nm dalga boyunda okunmuş ve hesaplamalarda Trolox eşdeğeri (TE) kullanılmıştır (Benzie ve Strain, 1996).

İstatistik Analiz

DPPH ve FRAP yöntemleri ile ölçülen antioksidan kapasitesi bakımından çeşitlere göre tanımlayıcı istatistikler; ortalama, standart hata, minimum ve maksimum değer olarak verilmiştir. Her iki yönteme göre de ölçülen antioksidan kapasitesi bakımından çeşitler arası farkı karşılaştırmada Kruskal-Wallis testi kullanılmıştır. Ayrıca çeşitlerin antioksidan kapasitelerini belirlemek üzere, iki yöntemle yapılan ölçümler arası uyumu değerlendirmek için Bland-Altman grafiği çizilmiştir. Hesaplamalarda istatistik önemlilik (anlamlılık) düzeyi %5 olarak alınmış ve hesaplamalar için SPSS (ver: 22) istatistik paket programlarından yararlanılmıştır.

BULGULAR ve TARTIŞMA

Çalışmada, her iki yönteme göre de yapılan ölçümler için çeşitlere göre tanımlayıcı istatistikler ve karşılaştırma sonuçları Çizelge 1'de verilmiştir. Çizelge 1'de görüldüğü üzere DPPH yöntemine göre en yüksek antioksidan kapasite 6.225 mg TE/g ile Mazrona çeşidinde gözlenirken, aralarındaki fark istatistik olarak önemli olmamakla birlikte, bunu 5.415 mg TE/g

ile Hasani ve 5.090 mg TE/g ile Zeyti çeşitleri izlemiştir. En düşük ortalama ise 4.365 mg TE/g ile Kerküş çeşidinde gözlenmiştir.

FRAP yöntemine göre Hasani çeşidinden olan farkı istatistik olarak önemli olmamakla birlikte, yine en yüksek antioksidan kapasite 1.285 mg TE/g ile Mazrona çeşidinde gözlenirken, Kerkük çeşidinden olan farkı önemli olmamakla birlikte, en düşük antioksidan kapasite 0.920 mg TE/g ile Sinceri çeşidinde gözlenmiştir.

Çizelge 1. Çeşitlere göre tanımlayıcı istatistikler ve karşılaştırma sonuçları

	Çeşitler	Ort.	St. Hata	Min.	Max	p
DPPH (mg TE/g)	Mazrona	6.225 a	0.075	6.15	6.30	0.001
	Zeyti	5.090 bc	0.060	5.03	5.15	
	Sinceri	4.535 d	0.115	4.42	4.65	
	Benitaht	4.920 c	0.040	4.88	4.96	
	Kerküş	4.365 d	0.015	4.35	4.38	
	Hasani	5.415 b	0.185	5.23	5.60	
	Genel	5.091	0.187	4.35	6.30	
FRAP (mg TE/g)	Mazrona	1.285 a	0.005	1.28	1.29	0.001
	Zeyti	1.005 bc	0.025	0.98	1.03	
	Sinceri	0.920 c	0.010	0.91	0.93	
	Benitaht	1.050 b	0.060	0.99	1.11	
	Kerküş	0.955 bc	0.005	0.95	0.96	
	Hasani	1.200 a	0.050	1.15	1.25	
	Total	1.069	0.040	0.91	1.29	

a, b, c,… ↓ : Farklı küçük harfi alan çeşitler arası fark önemlidir.

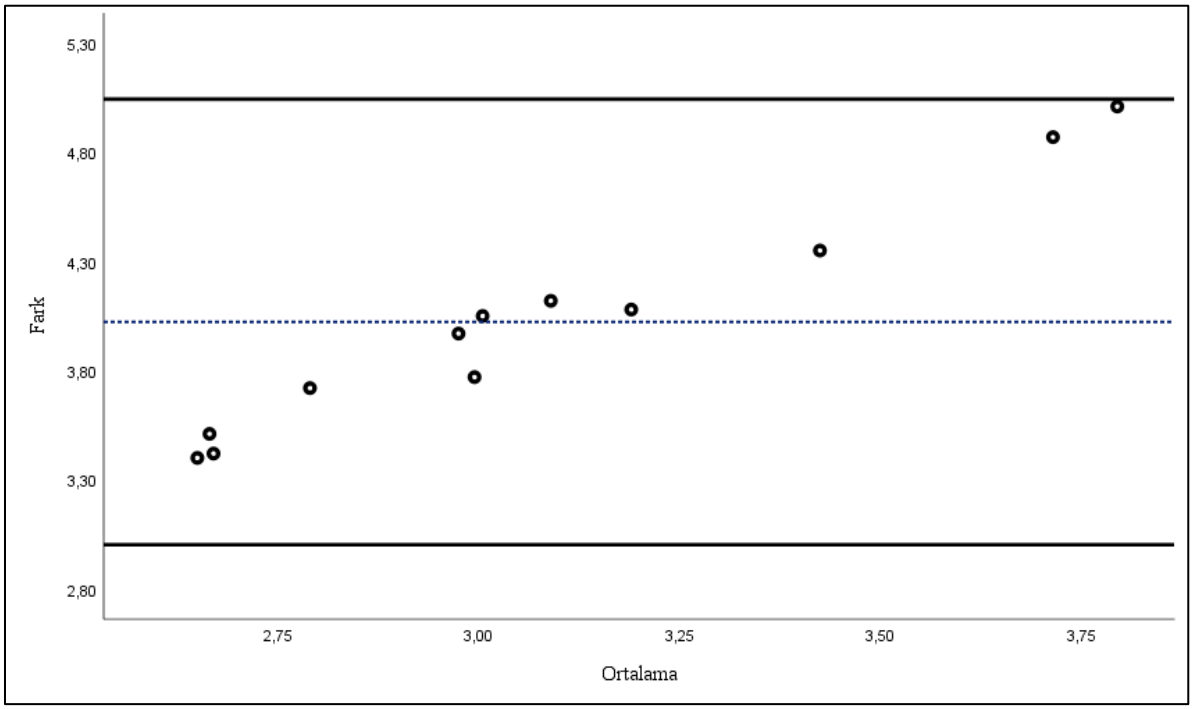
Çekya ekolojisinde yetiştirilen üç beyaz üzüm çeşidinin DPPH ve FRAP yöntemleri kullanılarak belirlenen antioksidan kapasiteleri sırasıyla 4.66 mg/g; 0.96 mg/g (Chardonnay), 6.10 mg/g; 1.09 mg/g (Welschriesling) ve 5.3 mg/g; 1.25 mg/g (Pinot gris) olarak kaydedilmiştir (Balík vd., 2009). Sonuçlarımız literatürle uyumludur. Antioksidan kapasitesi için DPPH ve FRAP yöntemleri ile yapılan ölçümlere ait tanımlayıcı istatistikler Çizelge 2' de verilmiştir.

Çizelge 2. Antioksidan kapasitesi için yöntemlere göre tanımlayıcı istatistikler

	Ort.	St. Sap	Min.	Mak.	Farklar				%95 Güven Aralığı	
					Ort.	St. Sap	Min.	Mak.	Alt Sınır	Üst Sınır
DPPH	5.092	0.649	4.35	6.30	4.023	0.521	3.40	5.01	4.023 – (0.521x1.96)	4.023 – (0.521x1.96)
FRAP	1.069	0.142	0.91	1.29						
Ortalama	3.080	0.391	2.65	3.80					3.002	5.044

Çizelge 2'deki farklara ait ortalama ve güven aralığına dayalı hesaplanan Bland-Altman grafiği Şekil 1' de verilmiştir. Şekil 1'de görüldüğü üzere, Bland-Altman grafiğindeki antioksidan kapasitesi için iki yöntemle yapılan ölçüm değerlerinin farkları ve ortalamalarına ait noktalar,

uyum sınırları içerisinde olduğundan, bu değerlere ait farklar ve ortalamalar arasında ilişki olmadığı söylenebilir. Diğer bir ifade iki ölçüm yöntemi arasında uyum olduğu ve birbirinin alternatifi olarak kullanılabileceği söylenebilir.



Şekil 1. DPPH ve FRAP yöntemleri ile ölçülen antioksidan kapasitesi için Bland-Altman grafiği

İki yöntem arasındaki uyumu belirlemede genellikle korelasyon ve regresyon analizleri kullanılsa da bu doğru bir yaklaşım değildir. Zira, yöntemler arası uyumu, korelasyon katsayısı ile değerlendirmek yanıltıcı sonuçlar verir.

Bland-Altman grafiği, iki yöntem arasındaki uyumu değerlendirmek üzere yöntemler arasındaki farkın ortalaması ve bu farkın kabul edilebilir sınırları hakkında bilgi verir. Ayrıca Bland-Altman grafiği ile yanlılık (bias veya farkların sistematik olarak 0'dan farklı olup olmadığını) ve hatanın (farkların) yaygınlığı da incelenebilir. Bland-Altman grafiği ile aynı zamanda cihazların güvenilirliği de değerlendirilebilir.

SONUÇ

Bu çalışmada Batman ili Gercüş ilçesinde yetiştirilen altı beyaz üzüm çeşidinin iki farklı spektrofotometrik yöntemle antioksidan kapasitesi belirlenmiştir. Çalışma sonucunda her iki özellik bakımından da üzüm çeşitleri arasında önemli farklılıklar bulunurken, yöntemlerin birbiriyle uyumlu olduğu ve birbirinin alternatifi olarak kullanılabileceği gözlenmiştir.

Diğer yandan, son yıllarda dünyada üzüm çeşitlerinin bölgesel olarak antioksidan

kapasitelerinin incelendiği birçok çalışma yapılmasına rağmen, Türkiye'de bu konu ile ilgili yapılan çalışmaların sınırlı olduğu söylenebilir. Bu nedenle, farklı ekolojilerde yürütülecek çalışmalar ile sofralık, kurutmalık, şaraplık ve şıralık olarak değerlendirilen yerli üzüm çeşitlerinin yabancı üzüm çeşitleri ile karşılaştırmalı olarak antioksidan kapasiteleri belirlenmeli, böylece yerli üzüm çeşitlerine kalite anlamında farklı bakış açıları geliştirilmelidir. Bu bağlamda, yerli üzüm çeşitleri ile ilgili kapsamlı çalışmalara ihtiyaç duyulduğu düşünülmektedir.

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BATMAN (GERCÜŞ) YEREL ÜZÜM ÇEŞİTLERİNİN TOPLAM FENOLİK BİLEŞİK VE FLAVONOİD İÇERİĞİ

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ÖZET

Yerli üzüm çeşitlerinin fenolik bileşik içeriklerinin belirlenmesi, bu çeşitlere kalite anlamında farklı bakış açısı geliştirilmesi bakımından değerlidir. Bu çalışmada, Batman ili Gercüş ilçesinde bir üretici bağında yetiştirilen Benitaht, Hasani, Kerküş, Mazrona, Sinceri ve Zeyti yerel beyaz üzüm çeşitlerinin, toplam fenolik bileşik ve toplam flavonoid içerikleri belirlenmiştir. Çeşitlerin 2022 vejetasyonunda teknolojik olgunluğa ulaşmış salkımlarının omuz (3 adet), orta (2 adet) ve uç (1 adet) kısımlarından alınan tanelerinde spektrofotometre ile analizler gerçekleştirilmiştir. İlgilenilen özellikler bakımından çeşitleri karşılaştırmada Kruskal-Wallis testi kullanılırken, bu özellikler bakımından çeşitler arası benzerlik düzeyini belirlemede Kümeleme analizi yapılmıştır. Toplam fenolik bileşik ve toplam flavonoid içeriği çeşit özelliği olarak farklılık göstermiştir. Çalışma sonucunda çeşitlerin toplam fenolik bileşik içeriği; en yüksek içerikten en düşük içeriğe doğru 346.395 mg GAE 100 g^{-1} (Mazrona), 313.100 mg GAE 100 g^{-1} (Hasani), 277.830 mg GAE 100 g^{-1} (Sinceri) 221.065 mg GAE 100 g^{-1} (Benitaht), 244.110 mg GAE 100 g^{-1} (Zeyti) ve 214.055 mg GAE 100 g^{-1} (Kerküş) olarak belirlenmiştir. Çeşitlerin toplam flavonoid içeriği ise en yüksek içerikten en düşük içeriğe doğru; 27.200 mg KE g^{-1} (Mazrona), 25.955 mg KE g^{-1} (Hasani), 25.340 mg KE g^{-1} (Sinceri), 24.860 mg KE g^{-1} (Benitaht), 25.105 mg KE g^{-1} (Zeyti) ve 24.705 mg KE g^{-1} (Kerküş) olarak kaydedilmiştir. Yapılan kümeleme analizi sonucunda; en yüksek benzerlik oranı %94.702 ile Benitaht ve Kerküş çeşitleri arasında gözlenmiştir. Bu iki çeşidin oluşturduğu kümeye, Zeyti çeşidi katılması ile benzerlik oranı %77.291 olmuştur. Mazrona ve Hasani çeşitleri arasındaki benzerlik oranı ise %74.828 olarak bulunmuştur. Kerküş, Benitaht ve Zeyti çeşitlerinin oluşturduğu kümeye, Sinceri çeşidinin katılması ile benzerlik oranı %51.815 olarak gözlenmiştir.

Anahtar Kelimeler: *Vitis vinifera* L., beyaz üzüm çeşitleri, polifenoller, spektrofotometri

TOTAL PHENOLIC COMPOUND AND FLAVONOID CONTENT OF BATMAN (GERCÜŞ) NATIVE GRAPE VARIETIES

ABSTRACT

Determination of phenolic compound contents of local grape varieties is valuable in terms of developing different perspectives on the quality of these varieties. In this study, total phenolic compound and total flavonoid contents of 'Benitaht', 'Hasani', 'Kerküş', 'Mazrona', 'Sinceri' and 'Zeyti' native white grape varieties grown in a producer vineyard in Gercüş district of Batman province were determined. Spectrophotometer analyses were carried out on the berries taken from the shoulder (3 pieces), middle (2 pieces) and tip (1 piece) parts of the clusters that reached technological maturity in the 2022 vegetation. While Kruskal-Wallis test was performed to compare varieties in terms of considered characteristics, Cluster analysis was carried out to determine similarity level of varieties. The total phenolic compound and total flavonoid content of the cultivars differed as varieties feature. As a result of the study, the total phenolic compound contents of the varieties from the highest to the lowest content were determined as follows; 346.395 mg GAE 100 g^{-1} (Mazrona), 313.100 mg GAE 100 g^{-1} (Hasani), 277.830 mg GAE 100 g^{-1} (Sinceri), 221.065 mg GAE 100 g^{-1} (Benitaht), 244.110 mg GAE 100 g^{-1} (Zeyti) and 214.055 mg GAE 100 g^{-1} (Kerküş). Total flavonoid content of the varieties was also recorded from the highest to the lowest as follows; 27.200 mg KE g^{-1} (Mazrona), 25.955 mg KE g^{-1} (Hasani), 25.340 mg KE g^{-1} (Sinceri), 24.860 mg KE g^{-1} (Benitaht), 25.105 mg KE g^{-1} (Zeyti) and 24.705 mg KE g^{-1} (Kerküş). As a result of the cluster analysis, the highest similarity level was observed between Benitaht and Kerküş varieties with 94.702%. With joining Zeyti variety to this cluster, similarity level was 77.291%. The similarity level between Mazrona and Hasani varieties was found 74.828%. With the joining of Sinceri variety to the cluster formed Kirkoush, Benitaht and Zeyti varieties, the similarity level was observed as 51.815%.

Keywords: *Vitis vinifera* L., white grape varieties, polyphenols, spectrophotometry

GİRİŞ

Üzüm, iyi nutrasötik potansiyele sahip önemli bir fenolik bileşik kaynağıdır (Maxcheix vd., 1990). Üzüm tanelerindeki fenoliklerin konsantrasyonu, genetik, çevresel ve kültürel faktörlere bağlı olarak değişkenlik göstermektedir (Ribereau-Gayon vd., 1999; Haselgrove vd., 2000). Fenolik bileşikler, farklı şekillerde sınıflandırılabilmekle birlikte, genel anlamda flavonoidler ve flavonoid olmayanlar olmak üzere iki gruba ayrılmaktadır. Flavonoidler, flavan-3-oller (tanenler), flavonoller ve antosiyaninleri içermektedir. Flavonoid olmayanlar ise fenolik asitler ve stilbenlerden oluşmaktadır (Gökçen vd. 2017). Üzümlerde miktar anlamında öne çıkan grup flavonoidlerdir.

Flavonoidler asmanın büyüme ve gelişiminde abiyotik (özellikle UV) ve biyotik stress faktörlerine karşı sentezlenen önemli sekonder metabolitler olup üzümün tane rengi, tat ve besin değeri üzerine etkili bileşiklerdir (Gouot vd. 2019). Antosiyaninler, flavonoller ve flavan-3-oller, üzüm tanelerinde biriken ana flavonoidlerdir (Zhang ve Hao, 2020). Çeşitli faktörlerin yanı sıra, flavonoid profili ve içeriği, üzümlerde flavonoid metabolizmasını düzenlemek için birbiriyle etkileşime giren iklim koşulları ve yetiştirme tekniklerinden etkilenir (Gouot vd., 2019; Rienth vd., 2021). Aynı çeşide ait flavonoid profili ve içeriği üzerinde bile iklim ve hava koşulları önemli rol oynamaktadır (Cheng vd., 2014; Keller, 2020). Işığın yoğunluğu, kalitesi ve fotoperiyodu flavonoid metabolizmasını etkileyen en önemli iklimsel faktördür (Cheng vd., 2023). Genel olarak ışık, flavonoidlerin, özellikle antosiyaninlerin ve flavonollerin seviyelerini artırmaktadır (Torres vd. 2020). Sıcaklık, flavonoid sentezini etkileyen bir diğer önemli çevresel faktör olup, genel olarak düşük sıcaklık, flavonoid sentezi ile ilgili genlerin ekspresyonunu indükleyebilmekte ve birikimini artırabilmektedir (Shinomiya vd., 2015). Bununla birlikte, yüksek sıcaklıklar flavonoidlerin sentezini önemli düzeyde engellemektedir (Gouot vd. 2019). Su durumu, flavonoid sentezini etkileyen üçüncü önemli çevresel faktördür. Ilımlı su eksikliği, antosiyaninlerin ve proantosiyanidinlerin birikimini artırmakta, tane hacmini azaltarak taneyi iyileştirmekte ve flavonoid sentez yollağı ile ilgili genlerin ekspresyonunu doğrudan düzenlemektedir (Rienth vd., 2021). Bu çalışmada Batman ili Gercüş ilçesine ait yerel üzüm çeşitlerinin toplam fenolik bileşik ve flavonoid içeriği belirlenmiştir.

MATERYAL ve YÖNTEM

Materyal

Araştırma materyalini Batman ili Gercüş ilçesinde bir üretici bağında yetiştirilen Benitaht, Hasani, Kerküş, Mazrona, Sinceri ve Zeyti yerel beyaz üzüm çeşitleri oluşturmaktadır. Olgunlaşma, 2022 yılı vejetasyonunda bağda kuru madde miktarının dijital refraktometre

yardımıyla ölçülmesiyle belirlenmiştir. Kuru madde değeri %17-%18'e ulaştığında salkımlar kesilmiş ve salkımların omuz (3 adet), orta (2 adet) ve uç (1adet) kısımlarından alınan tane örnekleri homojenizatörde homojen hale getirilip, 50 ml'lik falkon tüplerinde analizler yapılıncaya kadar -20 C' de muhafaza edilmiştir.

Yöntem

Toplam Fenolik Bileşik ve Flavonoid İçeriğinin Belirlenmesi

Toplam fenolik bileşik içeriği Folin-Ciocaltaeu kalorimetrik yöntem ile saptanmıştır (Swain ve Hillis, 1959). Çözeltilerin spektrofotometrede 725 nm dalga boyunda absorbansları okunmuş, toplam fenolik bileşik içeriği gallik asit eşdeğeri (GAE) mg 100 g^{-1} yaş ağırlık (YA) olarak verilmiştir. Toplam flavonoid içeriği Ivanova vd. (2011)'e göre belirlenmiştir. Çözeltilerin spektrofotometrede 510 nm dalga boyunda absorbansları okunmuş, toplam flavonoid içeriği mg kateşin (KE) eşdeğeri g^{-1} YA olarak ifade edilmiştir.

İstatistik Analiz

Çalışmada ele alınan özellikler için tanımlayıcı istatistikler; ortalama, standart hata, minimum ve maksimum değer olarak verilmiştir. Çeşitleri karşılaştırmada Kruskal-Wallis testi kullanılmıştır. Ayrıca ele alınan özellikler bakımından çeşitler arası benzerlikleri belirlemek üzere Kümeleme analizi yapılmıştır. Kümeleme analizinde, bağlantı yöntemi olarak tam bağlantı yöntemi, uzaklık ölçüsü olarak Öklit uzaklığı kullanılmıştır. Hesaplamalarda istatistik önemlilik (anlamlılık) düzeyi %5 olarak alınmış ve hesaplamalar için SPSS (ver: 22) ve MINITAB (ver: 14) istatistik paket programlarından yararlanılmıştır.

BULGULAR ve TARTIŞMA

Toplam fenolik bileşik içeriği bakımından tanımlayıcı istatistikler ve karşılaştırma sonuçları Çizelge 1'de verilmiştir.

Çizelge 1. Toplam fenolik bileşik içeriği bakımından tanımlayıcı istatistikler ve karşılaştırma sonuçları

	Çeşitler	Ort.	St. Hata	Min.	Mak.	p
Toplam Fenolik Bileşik (mg GAE 100 g^{-1})	Benitaht	221.065 e	1.315	219.75	222.38	0.001
	Hasani	313.100 b	5.360	307.74	318.46	
	Kerküş	214.055 e	5.195	208.86	219.25	
	Mazrona	346.395 a	3.775	342.62	350.17	
	Sinceri	277.830 c	2.870	274.96	280.70	
	Zeyti	244.110 d	2.570	241.54	246.68	
	Total	269.426	14.582	208.86	350.17	

a, b, c,… ↓ : Farklı küçük harfi alan çeşitler arası fark önemlidir

Çizelge 1'de görüldüğü üzere, toplam fenolik bileşik içeriği bakımından en yüksek ortalama 346.395 mg GAE 100 g^{-1} ile Mazrona çeşidinde gözlenirken, bunu 313.100 mg GAE 100 g^{-1}

ile Hasani ve 277.830 mg GAE 100 g^{-1} ile Sinceri çeşitleri izlemiştir. En düşük ortalama ise Benitaht çeşidinden (221.065 mg GAE 100 g^{-1}) olan farkı istatistik olarak önemli olmamakla birlikte, 214.055 mg GAE 100 g^{-1} ile Kerküş çeşidinde gözlenmiştir. Isparta ekolojisinde yetişen dört beyaz üzüm çeşidinin toplam fenolik bileşik içeriği en yüksek içerikten en düşük içeriğe doğru 275.8 mg GAE 100 g^{-1} (Italia), 231.7 mg GAE 100 g^{-1} (Çavuş), 209.3 mg GAE 100 g^{-1} (Hafızali) ve 195.7 mg GAE 100 g^{-1} (Kozak beyazı) olarak belirlenmiştir (Göktürk-Baydar vd., 2005). Çalışma sonuçları literatürle uyumlu bulunmuştur. Toplam flavonoid içeriği bakımından tanımlayıcı istatistikler ve karşılaştırma sonuçları Çizelge 2'de sunulmuştur. Flavonoid içeriği bakımından en yüksek ortalama 27.200 mg KE g^{-1} ile Mazrona çeşidinde gözlenirken, bunu 25.955 mg KE g^{-1} ile Hasani ve 25.340 mg KE g^{-1} ile Sinceri çeşitleri izlemiştir. En düşük ortalama ise Benitaht (24.860 mg KE g^{-1}) ve Zeyti (25.105 mg KE g^{-1}) çeşitlerinden olan farkı istatistik olarak önemli olmamakla birlikte, 24.705 mg KE g^{-1} ile Kerküş çeşidinde gözlenmiştir.

Çizelge 2. Toplam flavonoid içeriği bakımından tanımlayıcı istatistikler ve karşılaştırma sonuçları

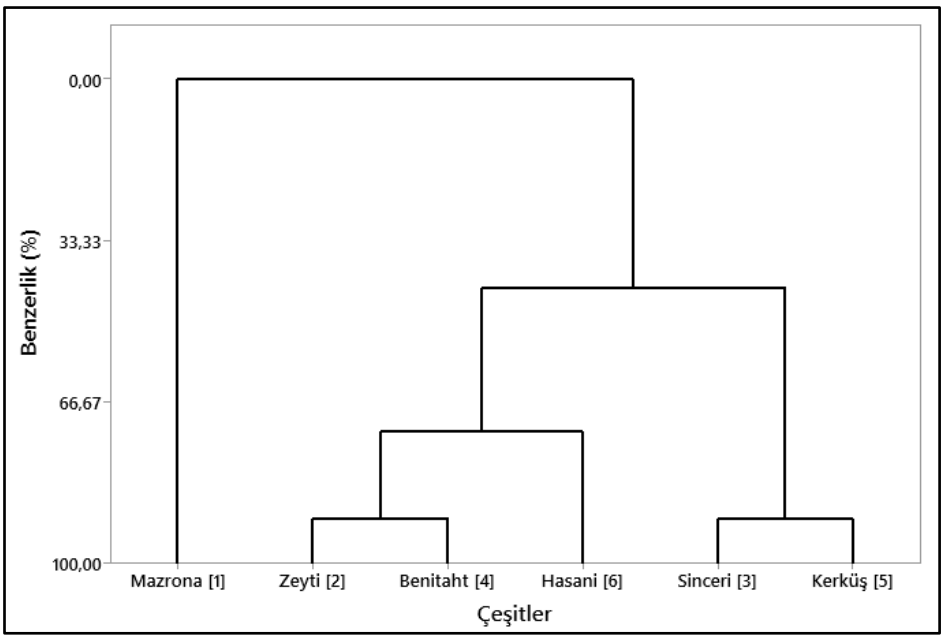
	Çeşitler	Ort.	St. Hata	Min.	Mak.	p
Toplam Flavonoid (mg KE g^{-1})	Benitaht	24.860 d	0.060	24.80	24.92	0.001
	Hasani	25.955 b	0.095	25.86	26.05	
	Kerküş	24.705 d	0.125	24.58	24.83	
	Mazrona	27.200 a	0.020	27.18	27.22	
	Sinceri	25.340 c	0.190	25.15	25.53	
	Zeyti	25.105 cd	0.165	24.94	25.27	
	Total	25.527	0.258	24.58	27.22	

a, b, c,… ↓ : Farklı küçük harfi alan çeşitler arası fark önemlidir

Makedonya (Üsküp) ekolojisinde yetişen iki beyaz üzüm çeşidinin tane eti, kabuk ve çekirdeklerinin toplam flavonoid içerikleri sırasıyla; Smederevka çeşidinde 0.18, 10.8 ve 49.4 mg KE g^{-1} olarak belirlenirken Chardonnay çeşidinde 0.23, 3.12, 69.6 mg KE g^{-1} olarak belirlenmiştir (Ivanova vd. 2011). Literatür verileri sonuçlarımızı destekler niteliktedir. Ele alınan özellikler bakımından çeşitler arasındaki benzerlik düzeyini belirlemek üzere yapılan Kümeleme analizi özet sonuçları Çizelge 3'te dendogram ise Şekil 1'de verilmiştir. Yapılan analiz sonucunda; en yüksek benzerlik oranı %94.702 ile Benitaht ve Kerküş çeşitleri arasında gözlenirken, bu iki çeşidin oluşturduğu kümeye Zeyti çeşidinin katılması ile benzerlik oranı %77.91 olmuştur. Mazrona ve Hasani çeşitleri arasındaki benzerlik oranı ise %74.828 olarak bulunmuştur. Kerküş, Benitaht ve Zeyti çeşitlerinin oluşturduğu kümeye, Sinceri çeşidinin katılması ile benzerlik oranı %51.815 olarak gözlenmiştir.

Çizelge 3. Kümeleme analizi özet sonuçları

Adım	Küme sayısı	Benzerlik oranı	Birleşen çeşitler		Yeni küme	Yeni kümedeki çeşit sayısı
1	5	94.702	4	5	4	2
2	4	77.291	2	4	2	3
3	3	74.828	1	6	1	2
4	2	51.815	2	3	2	4
5	1	0.000	1	2	1	6



Şekil 1. Dendogram

SONUÇ

Günümüzde üzüm çeşitlerinin fenolik bileşik içeriği üzerine yapılan çalışmalar, ülkelerin asma gen kaynakları söz konusu olduğunda, bağcılık potansiyelinin ifadesinde bir itibar unsuru olarak öne çıkmaktadır. Bu nedenle, yerli üzüm çeşitlerinin fenolik bileşik içeriklerinin belirlenmesi, bu çeşitlere kalite anlamında farklı bakış açıları geliştirilmesi bakımından değerlidir. Bu çalışmada, Batman/Gercüş ekolojisinde yetiştirilen altı (6) beyaz üzüm çeşidinin toplam fenolik bileşik ve toplam flavonoid içerikleri belirlenmiştir. Toplam fenolik bileşik bakımından en yüksek içerikten en düşük içeriğe doğru üzüm çeşitlerinin sıralaması Mazrona > Hasani > Sinceri > Zeyti > Benitaht > Kerküş şeklinde gerçekleşmiştir. Toplam flavonoid içeriği bakımından ise üç çeşit toplam fenolik bileşik sıralamasında olduğu gibi öne çıkmış ve en yüksek içerikten en düşük içeriğe doğru çeşitler Mazrona > Hasani > Sinceri > Benitaht > Kerküş > Zeyti olarak sıralanmıştır.

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HASAT SONRASI 1-MCP UYGULANMIŞ DOMATESTE KATEGORİK TEMEL BİLEŞENLER ANALİZİ I: MUHAFAZA İLE BAZI KALİTE ÖZELLİKLERİ ARASINDAKİ İLİŞKİLER

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ÖZET

Domatesin uygun olgunluk döneminde hasat edilmesi ve uygun depolama süresinde depolanması optimum faydanın sağlanabilmesi açısından önemlidir. Bunun için de kalite özellikleri ile depolama özellikleri arasındaki ilişki yapısının doğru olarak belirlenmesi gerekmektedir. Kategorik temel bileşenler analizi (KATBA), sürekli, kategorik ve sıralı değişkenleri içeren veri setlerinde; değişkenler ve değişkenlerin kategorileri arasındaki ilişki yapısını, daha düşük boyutta (genellikle iki boyutlu uzayda), görsel olarak sunan ve böylece yorumlama kolaylığı sağlayan çok değişkenli analiz yöntemlerinden birisidir. Çalışmada domateste; uygulama faktörünün 3 seviyesi depolama süresi faktörünün 6 (0, 7, 12, 17, 28 ve 39. gün) seviyesi, depolama özellikleri (Ağırlık kaybı, Etilen ve Solunum) ve kalite özellikleri (L*, a*, DELTA E, SÇKM, pH ve TEA) arasındaki ilişki incelenmiştir. Ele alınan sürekli değişkenler "düşük" ve "yüksek" olmak üzere iki kategoriye ayrılmıştır ve tüm değişkenler (toplam 11 değişken) birlikte ele alınarak Kategorik temel bileşenler analizi yapılmıştır. Analiz sonucunda, 11 değişken için ilk iki boyuta ait özdeğerler 1' den büyük bulunmuş ve iki boyuta indirgeme yapılmıştır. Bu boyutlardan birinci boyut, varyansın %58.7'sini açıklarken, ikinci boyut %21'ini açıklamıştır. İlk 2 boyutun birlikte varyans açıklama oranı %79.7 olarak bulunmuştur. Uygulama ile Depolama süresi, birbiri ile negatif ilişkili olarak, birinci boyuta göre sırası ile sol ve sağ tarafta yer almıştır. Özelliklerden; a*, pH, Ağırlık kaybı, SÇKM ve DELTA-E özellikleri birbirleriyle yüksek pozitif ilişkili olarak birinci boyuta göre pozitif bölge olan sağ alt bölgede yer alırken, bunlarla negatif ilişkili olan; L*, Etilen, Solunum ve TEA, birinci boyuta göre negatif olan sol alt bölgede yer almıştır. Sonuç olarak, 11 değişken arasındaki ilişki yapısı, yaklaşık %79 varyans açıklama oranı ile 2 boyuta indirgenerek, görsel olarak daha kolay anlaşılabilir ve yorumlanabilir şekilde sunulmuş ve aralarında doğrusal veya doğrusal olmayan ilişkilerin bulunduğu, fazla sayıda ve farklı türde değişken içeren veri setlerinde Kategorik temel bileşenler analizinin kullanılabilir olduğu gözlenmiştir.

Anahtar Kelimeler: Domates, depolama, 1-MCP uygulama, boyut indirgeme, konfigürasyon

CATEGORICAL PRINCIPAL COMPONENTS ANALYSIS IN POST-HARVEST 1-MCP TREATED TOMATOES I: RELATIONSHIPS BETWEEN STORAGE AND SOME QUALITY TRAITS

ABSTRACT

Harvesting of tomatoes at the properly maturity period and storing them at the properly storage period are important for optimum benefit. For this purpose, the relationship structure between quality characteristics and storage characteristics should be determined accurately. Categorical principal component analysis (CATPCA) is one of the multivariate analysis methods that visually presents the relationship structure between variables as well as that of categories in a lower dimension (usually in two-dimensional space) in the data sets containing continuous, categorical and ordinal variables and provides easy interpretation. In this study, the relationships between 3 levels of treatment factor, 6 levels of storage duration factor (0, 7, 12, 17, 28 and 39 days), storage characteristics (Weight loss, Ethylene and Respiration) and quality characteristics (L*, a*, DELTA E, TSS, pH and TEA) were examined in tomato. The continuous variables were categorized into two categories as "low" and "high" and all variables (11 variables in total) were considered together and Categorical principal components analysis was performed. As a result of the analysis, the eigenvalues of the first two dimensions for 11 variables were found greater than 1 and were reduced to two dimensions. While the first dimension accounted for 58.7% of the variance, the second dimension accounted for 21%. Two dimensions together accounted for 79.7% of the total variation. Treatment and Storage time were negatively correlated with each other and located on the left and right sides of the first dimension, respectively. Among the traits; a*, pH, Weight loss, TSS and DELTA-E were highly positively correlated with each other and located in the right sub-region, which is the positive region according to the first dimension, while L*, Ethylene, Respiration and TEA, which are negatively correlated with each other, were located in the left sub-region, which is negative according to the first dimension. As a result, the relationship structure between 11 variables was reduced to 2 dimensions with accounting for approximately 79% of variation and presented in a visually more easily understandable and interpretable way, and it was observed that Categorical principal component analysis can be used in data sets containing a large number and different types of variables with linear or non-linear relationships between them.

Keywords: Tomatoes, storage, 1-MCP treatment, dimension reduction, configuration

GİRİŞ

Domateste renk, irilik, şekil, görünüş bozuklukları ve kusurları gibi dış kalite özellikleri ile birlikte, tat ve lezzet, sertlik, dayanım, olgunluk, aroma maddeleri, SÇKM ve pH gibi iç kalite özellikler de önemli olup, bu özellikler, çeşit özellikleri, ortam faktörleri ve yetiştirme dönemi ile yakından ilişkilidir (Sağlam ve Taşova, 2017). Domatesin olgunluğu ve raf ömrü tüketici beklentisi ile yüksek kalite ve lezzetin sağlanabilmesi açısından önemlidir (Şen ve ark., 2004). Kırmızı olum döneminde hasat edilen kırmızı domateslerin raf ömrü sınırlı olup, bekleme süresine bağlı olarak sertlik ve titre edilebilir asitlik miktarı azalmakta, küf kokusu ve istenmeyen tatlar oluşmaktadır (Janse, 1995). Domateste çeşit ve olgunluk dönemi ile birlikte, depolama koşullarına ve süresine bağlı olarak, suda çözünür kuru madde (SKM), titre edilebilir asitlik (TA) ve C vitamini miktarı değişmektedir (Özbay ve Ateş, 2015).

Domatesin uygun olgunluk döneminde hasat edilmesi ve uygun depolama süresinde depolanması optimum faydanın sağlanabilmesi açısından önemlidir. Bunun için de kalite özellikleri ile depolama özellikleri arasındaki ilişki yapısının doğru olarak belirlenmesi gerekmektedir. Kategorik temel bileşenler analizi (KATBA), sürekli değişkenlerin yanı sıra; kategorik ve sıralı değişkenleri de içeren veri setlerinde; değişkenler ve değişkenlerin kategorileri arasındaki ilişki yapısını, daha düşük boyutta (genellikle iki boyutlu uzayda), görsel olarak sunan ve böylece yorumlama kolaylığı sağlayan çok değişkenli analiz yöntemlerinden birisidir. Çalışmada, aralarındaki ilişki yapısı incelenmek istenen değişkenler (özellikler), farklı değişken tipindedir. Bu nedenle çalışmada, farklı uygulama koşullarında ve farklı depolama süresinde, depolama özellikleri ile kalite özellikleri arasındaki ilişkileri belirlemek üzere, Kategorik temel bileşenler analizi yöntemi kullanılmıştır.

MATERYAL ve YÖNTEM

Çalışmada domateste; uygulama faktörünün 3 seviyesi depolama süresi faktörünün 6 (0, 7, 12, 17, 28 ve 39. gün) seviyesi, depolama özellikleri (Ağırlık kaybı, Etilen ve Solunum) ve kalite özellikleri (L*, a*, DELTA E, SÇKM, pH ve TEA) arasındaki ilişki incelenmiştir. Ele alınan özelliklerden uygulama faktörü kategorik değişken iken, depolama süresi sıralı (ordinal) değişken, diğer özellikler ise sürekli değişken olarak alınmıştır. Çalışmada ele alınan özelliklere ait tanımlayıcı istatistikler Tablo 1'de verilmiştir.

Tablo 1. Özellikler için tanımlayıcı istatistikler

n = 54	Ort.	St. Sap.	Min.	Mak.
Ağırlık kaybı	2.294	2.084	0.01	8.51
Etilen	3.194	2.334	0.76	8.82
Solunum	22.634	5.026	14.42	33.69
L*	38.590	1.006	36.25	40.14
a*	22.568	1.685	18.77	25.62
DELTA-E	3.337	2.004	0.01	7.53
SÇKM	6.449	0.316	5.90	6.94
pH	4.345	0.180	3.36	4.68
TEA	0.618	0.110	0.43	0.97

Ele alınan sürekli değişkenler "düşük" ve "yüksek" olmak üzere iki kategoriye ayrılmıştır ve tüm değişkenler (toplam 11 değişken) birlikte ele alınarak Kategorik temel bileşenler analizi yapılmıştır. Standart temel bileşenler analizi gibi Kategorik temel bileşenler analizi de bir boyut indirgeme yöntemidir. Hem değişkenler arasındaki, hem de değişkenlerin kategorileri arasındaki doğrusal ve doğrusal olmayan ilişkileri iki boyutlu uzayda görsel olarak sunabilme imkanı sağlamaktadır (Abou-Senna ve vd., 2021).

n: Gözlem veya denek sayısı ve m: değişken (özellik) sayısı olmak üzere;
H: nxm boyutlu veri matrisi olsun. **H** matrisinin her bir sütunundaki değişken nx1 boyutlu h*j* vektörü ile gösterilebilir (j = 1, 2,…,m). Herhangi bir h*j* değişkeni sürekli bir değişken değilse; büyük bir olasılıkla aralarındaki ilişki de doğrusal değildir. Bu nedenle doğrusal olmayan bir dönüşüm veya transformasyon uygulamak gerekir. Her kategorinin dönüşümü (transformasyonu) bir optimal ölçeklenmiş değer içerir. Böylece **H** matrisi $\mathbf{Q}_{ij}$ matrisi ile yer değiştirir. **Q** matrisi, gözlenen puanlarının yerine, kategorik değişkenler için ölçeklenmiş değerleri içerir (Torres-Cárdenas vd., 2021).

KATBA, standart veya klasik Temel bileşenler analizi (TBA) ile aynıdır. Dönüşüm yapılan değişkenler arasındaki ilişki yapısını bulmayı amaçlar. Bu amaçla KATBA'da, kayıp fonksiyonu (loss function) minimize edilmeye çalışılır. Kayıp fonksiyonu, çoklu nominal transformasyonlara göre ağırlıklandırılmış değerleri içerir. Elde edilen temel bileşenlerdeki nesneler veya bireylere ait skor değerleri, Kategorik temel bileşenler analizinde de nesne skorları veya skor değerleri olarak adlandırılır. Optimal ağırlıklar seti ile çarpılan bu bileşenler, bileşen saturasyonu olarak belirlenir ve orijinal veri setine mümkün olduğu kadar yakınsamaya çalışılır (Torres-Cárdenas vd., 2021).

p; bileşen sayısı olmak üzere, **X**; nxp boyutlu bileşen skorları matrisi ve **A**'da mxp boyutlu bileşen satürasyonları (component saturations) matrisi olarak tanımlandığında ve bu matrisin *j*. satırı a_j olarak ifade edildiğinde, Kayıp fonksiyonunda orijinal verilerle temel bileşenler arasındaki fark minimize edilir. Böylece kayıp fonksiyonu;

$$L\,(Q,A,X) = n^{-1}\sum_{j=1}^{m} tr(q_j\,a'_j - X)'(q_j a'_j - X)$$

olarak yazılır (Torres-Cárdenas vd., 2021).

Bu kayıp fonksiyonu aşağıdaki sınırlamalara tabii tutulur.

Transforme edilmiş değişkenler standardize edilir. Böylece $q'_j q_j$ = n olur.

Bu kısıtlama, $q_j\,a'_j$ çarpımında; q_j ile a'_j arasındaki belirsizliği çözmek için gereklidir.

Bu normalizasyonla; q_j z skorlarını içerir ve böylece a_j'deki bileşen saturasyonları ile değişkenler ve bileşenler arasındaki korelasyonu sağlamış olur.

Önemsiz çözümden kaçınmak için;
A = 0, **X** = 0 ve **X′X** = n**I** (I, birim matris) koşulları ile birlikte nesne skorlarının merkezileştirilmesi gerekir. Böylece 1′**X** = 0 (1, birim vektör) olur (Torres-Cárdenas vd., 2021). İstatistik analizler için SPSS (ver: 22) istatistik paket programı kullanılmıştır.

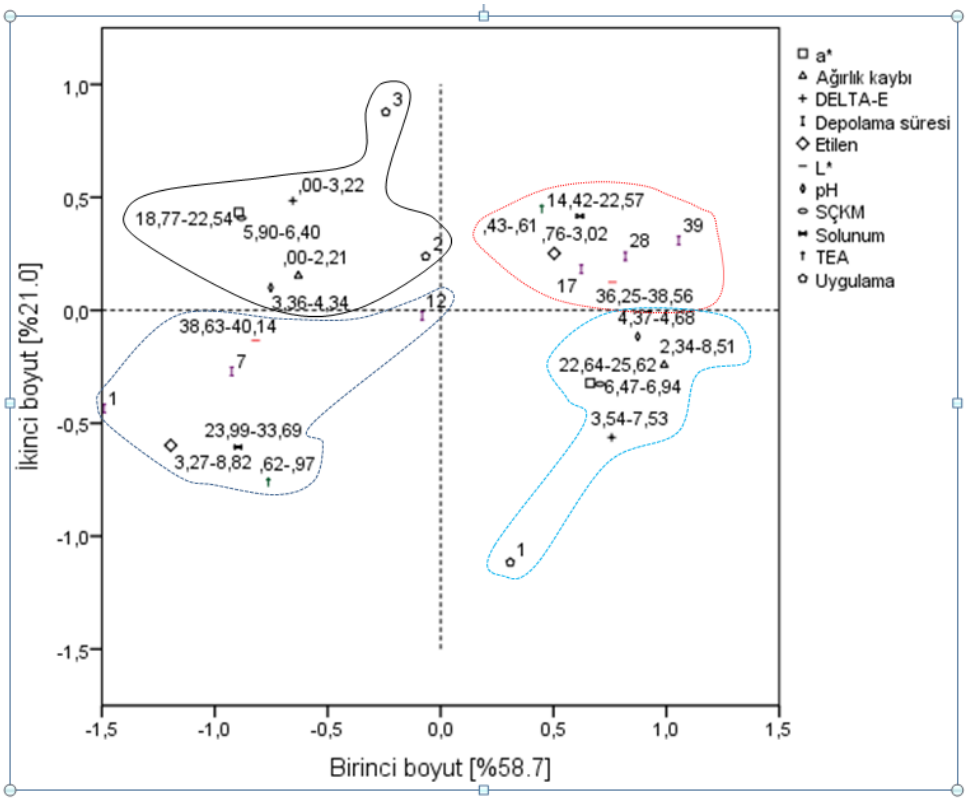
BULGULAR ve TARTIŞMA

Çok değişkenli analiz yöntemlerinden birisi olan Standart temel bileşenler analizi, sürekli değişken olarak ifade edilen özellikler arasındaki doğrusal ilişkilere dayalı bir boyut indirgeme yöntemi olarak kullanılmaktadır. Bu yöntem, orijinal değişkenler arasındaki varyasyonu (farklılığı veya değişimi) maksimum yapacak şekilde, orijinal değişkenlerin doğrusal kombinasyonlarından oluşan ve temel bileşen olarak adlandırılan yeni değişkenler bulmayı amaçlar. Standart temel bileşenler analizine benzer şekilde, Kategorik temel bileşenler analizi de bir boyut indirgeme yöntemidir. Yapılan analiz sonucunda, 11 değişken için transforme edilmiş değerler arasındaki korelasyonlar ve boyutlara ait özdeğerler Tablo 2'de verilmiştir.

Tablo 2. Değişkenler için transforme edilmiş değerler arasındaki korelasyonlar ve boyutlara ait özdeğerler

	Uygulama	Depolama süresi	Ağırlık kaybı	Etilen	Solunum	L*	a*	DELTA-E	SÇKM	pH	TEA
Uygulama	1										
Depolama süresi	0.000	1									
Ağırlık kaybı	-0.364	0.701	1								
Etilen	-0.085	-0.829	-0.518	1							
Solunum	-0.203	-0.856	-0.430	0.783	1						
L*	0.078	-0.738	-0.693	0.511	0.559	1					
a*	-0.409	0.579	0.610	-0.507	-0.429	-0.444	1				
DELTA-E	-0.528	0.484	0.478	-0.358	-0.241	-0.449	0.725	1			
SÇKM	-0.357	0.638	0.637	-0.399	-.0396	-0.555	0.737	0.756	1		
pH	-0.256	0.700	0.631	-0.521	-0.543	-0.597	0.574	0.628	0.606	1	
TEA	-0.258	-0.625	-0.297	0.594	0.613	0.566	-0.192	-0.174	-0.240	-0.404	1
Boyut	1	2	3	4	5	6	7	8	9	10	11
Özdeğer	6.460	2.310	0.655	0.531	0.448	0.387	0.250	0.226	0.218	0.099	0.051

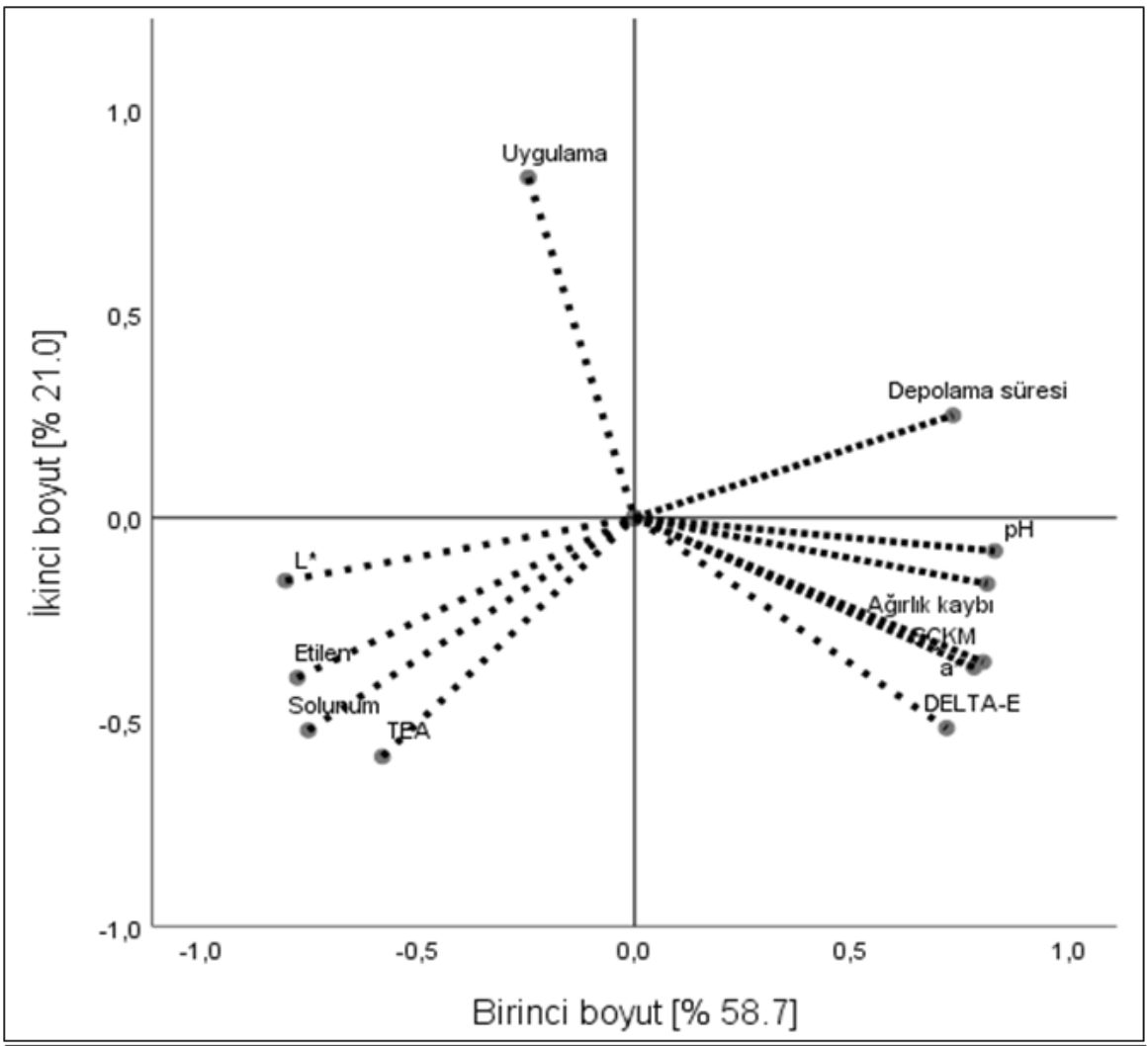
Tablo 2'de görüldüğü üzere, ilk iki boyuta veya bileşene ait özdeğerler 1' den büyük bulunmuş ve iki boyuta indirgeme yapılmıştır. Bu boyutlardan birinci boyut, varyansın %58.7'sini açıklarken, ikinci boyut %21'ini açıklamıştır. İlk 2 boyutun birlikte varyans açıklama oranı %79.7 olarak bulunmuştur. Diğer bir ifade ile yaklaşık %20.3'lük kayıpla, 11 değişken arasındaki ilişki yapısı 2 boyutta özetlenebilmiştir.



Şekil 1. Özelliklerin kategorileri arasındaki ilişkilerin iki boyutlu uzaydaki konfigürasyonu

Çalışmada ele alınan özelliklerin kategorileri arasındaki ilişkilerin iki boyutlu uzaydaki konfigürasyonu Şekil 1' de verilmiştir. Şekil 1'de görüldüğü üzere, her iki boyuta göre de pozitif bölge olan sağ üst bölgede TEA, Solunum, L* ve Etilen düşük değerleri ile depolama süresinin 17. 29. ve 39. gün kategorileri yer almıştır. Buna göre depolama süresinin 17. 28. ve 39. günlerinde; TEA, Solunum, L* ve Etilenin düşük değerli olduğu gözlenmektedir. Birinci uygulama ile birlikte, DELTA-E, a*, SÇKM ve Ağırlık kaybı özelliklerinin "yüksek" kategorileri, birinci boyuta göre pozitif, ikinci boyuta göre negatif olan sağ alt bölgede yer almıştır. Buna göre birinci uygulamada adı geçen özelliklerin yüksek değerli olma eğiliminde oldukları gözlenmiştir. Böylece bu özelliklerin yüksek olması tercih edildiğinde veya istendiğinde, birinci uygulamanın yapılmasının önerilebileceği söylenebilir.

Depolama süresinin; 0, 7 ve 12. günleri ile birlikte; L*, Etilen, TEA ve Solunumun "yüksek" kategorileri, her iki boyuta göre de negatif olan sol alt bölgede yer almıştır. Buna göre depolama süresinin 0, 7 ve 12. günlerinde adı geçen özelliklerin yüksek değerli oldukları veya bu depolama sürelerinde yüksek değerlerini koruyabildikleri söylenebilir. İkinci ve üçüncü uygulamalarla birlikte, DELTA-E'nin, Ağırlık kaybının a*'nın ve SÇKM'nin düşük değerleri, birinci boyuta göre negatif, ikinci boyuta göre pozitif bölge olan sol üst bölgede yer almıştır. Buna göre ikinci ve üçüncü uygulamalarda, adı geçen özelliklerin düşük değerli olma eğiliminde oldukları gözlenmektedir. Böylece bu özelliklerin düşük olmasının tercih edildiği durumlarda, ikinci ve üçüncü uygulamaların yapılabileceği önerilebilir.



Boyut	Uygulama	Depolama süresi	Ağırlık kaybı	Etilen	Solunum	L*	a*	DELTA-E	SÇKM	pH	TEA
1	-0,245	0,734	0,812	-0,777	-0,752	-0,804	0,782	0,719	0,803	0,830	-0,581
2	0,833	0,251	-0,162	-0,392	-0,520	-0,154	-0,367	-0,515	-0,353	-0,081	-0,585

Şekil 2. Değişkenler arasındaki ilişkinin iki boyutlu uzaydaki konfigürasyonu

Değişkenlerin kategorileri arasındaki ilişkilerin verilmiş olduğu Şekil 1'e ilaveten, değişkenler arasındaki ilişkilerin 2 boyutlu uzaydaki konfigürasyonu da Şekil 2'de verilmiştir. Şekil 2'de görüldüğü üzere; Uygulama ve Depolama süresi, birbiri ile negatif ilişkili olarak, varyansın yaklaşık %59'unu açıklayan birinci boyuta göre sırası ile sol ve sağ tarafta yer almıştır. Benzer şekilde, özelliklerden; a*, pH, Ağırlık kaybı, SÇKM ve DELTA-E özellikleri birbirleriyle yüksek pozitif ilişkili olarak birinci boyuta göre pozitif bölge olan sağ alt bölgede yer alırken, bunlarla negatif ilişkili olan; L*, Etilen, Solunum ve TEA, birinci boyuta göre negatif olan sol alt bölgede yer almıştır.

Bilimsel çalışmalarda ele alınan özellikler, kategorik veya sürekli değişken yapısında olabileceği gibi aralarındaki ilişkiler de doğrusal olmayabilir. Bu durumda, Standart temel

bileşenler analizinin varsayımları sağlanmamaktadır. Bu gibi durumlarda, bu varsayımlara karşı daha esnek bir yöntem olan Kategorik temel bileşenler analizi (KATBA) veya Doğrusal olmayan temel bileşenler analizi yöntemi kullanılabilir.

Standart temel bileşenler analizi gibi Kategorik temel bileşenler analizi de bir boyut indirgeme yöntemidir. Analiz yöntemi sürekli, kategorik (veya nominal) ve sıralı değişkenleri içeren veri setlerinde kullanılabilmekte ve Standart temel bileşenler analizine göre daha genel bir yaklaşım sunmaktadır. Ayrıca, Standart temel bileşenler analizinin varsayımlarına gerek duymamaktadır. Bununla birlikte, hem değişkenler arasındaki hem de değişkenlerin kategorileri arasındaki doğrusal ve doğrusal olmayan ilişkileri iki boyutlu uzayda görsel olarak sunabilme imkânı sağlamaktadır.

SONUÇ

Sonuç olarak, çalışmada 3 farklı uygulamada ve 6 farklı depolama süresinde domateste depolama ve kalite özellikleri arasındaki ilişkiler, Kategorik temel bileşenler analizi ile incelenmiştir. 11 değişken arasındaki ilişki yapısı, yaklaşık %79 varyans açıklama oranı ile 2 boyuta indirgenerek, görsel olarak daha kolay anlaşılabilir ve yorumlanabilir şekilde sunulmuştur. Böylece aralarında doğrusal veya doğrusal olmayan ilişkilerin bulunduğu, fazla sayıda ve farklı türde değişkenleri içeren veri setlerinin analizinde Kategorik temel bileşenler analizinin kullanılabileceği gözlenmiştir.

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HASAT SONRASI 1-MCP UYGULANMIŞ DOMATESTE KATEGORİK TEMEL BİLEŞENLER ANALİZİ II: MUHAFAZA İLE TOPLAM FENOLİK BİLEŞİK, ANTİOKSİDAN KAPASİTE VE ENZİM ARASINDAKİ İLİŞKİLER

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ÖZET

Domateste toplam fenolik bileşikler, antioksidan kapasitesi ve enzimler, olgunluk dönemi ve depolama süresi ile yakından ilişkilidir. Bunun için de ilişki yapısının doğru olarak belirlenmesi gerekmektedir. Kategorik temel bileşenler analizi (KATBA), sürekli, kategorik ve sıralı değişkenleri içeren veri setlerinde; değişkenler ve değişkenlerin kategorileri arasındaki ilişki yapısını, daha düşük boyutta (genellikle iki boyutlu uzayda), görsel olarak sunan ve böylece yorumlama kolaylığı sağlayan çok değişkenli analiz yöntemlerinden birisidir. Çalışmada domateste; uygulama faktörünün 3 seviyesi, depolama süresi faktörünün 6 (0, 7, 12, 17, 28 ve 39. gün) seviyesi ve depolama özellikleri (ağırlık kaybı, etilen ve solunum) ile birlikte; APX, CAT, SOD, MDA toplam fenolik bileşik ve antioksidan aktivite arasındaki ilişkiler incelenmiştir. Ele alınan sürekli değişkenler "düşük" ve "yüksek" olmak üzere iki kategoriye ayrılmıştır ve tüm değişkenler (toplam 11 değişken) birlikte ele alınarak Kategorik temel bileşenler analizi yapılmıştır. Analiz sonucunda, 11 değişken için ilk iki boyuta ait özdeğerler 1' den büyük bulunmuş ve iki boyuta indirgeme yapılmıştır. Bu boyutlardan birinci boyut, varyansın %43.1'ini açıklarken, ikinci boyut %34.2'sini açıklamıştır. İlk 2 boyutun birlikte varyans açıklama oranı %77.3 olarak bulunmuştur. Uygulama, SOD, antioksidan aktivite ve CAT birbirleri ile yüksek ilişkili olarak, birinci boyuta göre pozitif bölgede (sağ tarafta) yer almıştır. Benzer şekilde, MDA, ağırlık kaybı ve depolama süresi de kendi arasında yüksek pozitif ilişkili olarak birinci boyuta göre negatif bölgede yer almıştır. Etilen ile solunum yüksek pozitif ilişkili bulunurken, toplam fenolik bileşik ile APX yüksek negatif ilişkili bulunmuştur. Sonuç olarak, 11 değişken arasındaki ilişki yapısı, yaklaşık %77 varyans açıklama oranı ile 2 boyuta indirgenerek, görsel olarak daha kolay anlaşılabilir ve yorumlanabilir şekilde sunulmuş ve aralarında doğrusal veya doğrusal olmayan ilişkilerin bulunduğu, fazla sayıda ve farklı türde değişken içeren veri setlerinde Kategorik temel bileşenler analizinin kullanılabilir olduğu gözlenmiştir.

Anahtar Kelimeler: Domates, depolama, 1-MCP uygulama, boyut indirgeme, konfigürasyon

CATEGORICAL PRINCIPAL COMPONENTS ANALYSIS IN POST-HARVEST 1-MCP TREATED TOMATOES II: RELATIONSHIPS BETWEEN STORAGE AND TOTAL PHENOLIC COMPOUND, ANTIOXIDANT CAPACITY, AND ENZYME

ABSTRACT

Total phenolic compounds, antioxidant capacity and enzymes in tomato are closely related to ripeness and storage period. For this, it is necessary to determine the relationship structure correctly. Categorical principal component analysis (CATPCA) is one of the multivariate analysis methods that visually presents the relationship between variables as well as that of categories in a lower dimension (usually in two-dimensional space) in the data sets containing continuous, categorical and ordinal variables and provides easy interpretation. In this study, the relationships between 3 levels of treatment factor, 6 levels of storage duration factor (0, 7, 12, 17, 28 and 39 days), Storage traits, Total phenolic compounds, antioxidant activity, APX, CAT, SOD and MDA were examined in tomato. The continuous variables were categorized into two categories as "low" and "high" and all variables (11 variables in total) were considered together and Categorical principal components analysis was performed. As a result of the analysis, the eigenvalues of the first two dimensions for 11 variables were found greater than 1 and were reduced to two dimensions. While the first dimension accounted for 43.1% of the variance, the second dimension accounted for 34.2%. Two dimensions together accounted for 77.3% of the total variation. Treatment, SOD, antioxidant activity and CAT were highly correlated with each other and were located in the positive region (right side) according to the first dimension. Similarly, MDA, weight loss and storage duration were also highly positively correlated with each other and located in the negative region according to the first dimension. Ethylene and respiration were highly positively correlated, while total phenolic compounds and APX were highly negatively correlated. As a result, the relationship structure between 11 variables was reduced to 2 dimensions with accounting for approximately 77% of variation and presented in a visually more easily understandable and interpretable way, and it was observed that Categorical principal component analysis can be used in data sets containing a large number and different types of variables with linear or non-linear relationships between them.

Keywords: Tomatoes, storage, 1-MCP treatment, dimension reduction, configuration

GİRİŞ

Dünya genelinde yetiştirilen, ekonomik değeri yüksek bir sebze olan Domates (*Lycopersicon esculentum* Mill), yüksek likopen seviyesi nedeniyle kırmızı dönemde hasat edildiğinde kısa bir raf ömrüne sahiptir. Bununla birlikte, kırmızı aşamada ise yüksek düzeyde tat ve aromayı etkileyen aroma maddeleri içermektedir. Bu nedenle tüketiciler genellikle kırmızı domatesi tercih etmektedir. Ancak kırmızı olgun meyveler, hızlı yumuşamaları, asit içeriklerinin değişmesi, hastalık ve zararlılara yatkınlıkları nedeniyle daha fazla hasat sonrası kayıp gösterir (Bahar ve ark., 2022). Depo edilen domateslerde belirli dozlarda 1-MCP uygulamasının, muhafazası yapılan diğer meyve ve sebzelerde olduğu gibi depo süresini uzatmada etkili olduğu bildirilmiştir (Bower ve Mitcham, 2001).

Domates olgunlaşmasında, enzimatik ve enzimatik olmayan sistemler kritik öneme sahiptir (Jimenez ve ark., 2002). Gerek yaşlanma, gerekse savunma mekanizmasıyla ile ilişkili olan antioksidatif enzimler, oksidatif stresin baskılanmasında önemli bir rol oynamaktadır. APX, CAT ve SOD gibi enzimler serbest oksijen radikallerini süpürerek hücreleri oksidatif hasardan koruyan enzimlerdir (Sun ve ark., 2011).

Kategorik temel bileşenler analizi (KATBA), sürekli değişkenlerin yanı sıra; kategorik ve sıralı değişkenleri de içeren veri setlerinde; değişkenler ve değişkenlerin kategorileri arasındaki ilişki yapısını, daha düşük boyutta (genellikle iki boyutlu uzayda), görsel olarak sunan ve böylece yorumlama kolaylığı sağlayan çok değişkenli analiz yöntemlerinden birisidir.

Çalışmada, aralarındaki ilişki yapısı incelenmek istenen değişkenler (özellikler), farklı değişken tipinde olduğundan; farklı uygulama koşullarında ve farklı depolama süresinde, depolama özellikleri, toplam fenolik ve antioksidan kapasitesi arasındaki ilişkileri belirlemek üzere Kategorik temel bileşenler analizi yapılmıştır.

MATERYAL ve YÖNTEM

Çalışmada domateste; uygulama faktörünün 3 seviyesi, depolama süresi faktörünün 6 (0, 7, 12, 17, 28 ve 39. gün) seviyesi ve depolama özellikleri (ağırlık kaybı, etilen ve solunum) ile birlikte; APX, CAT, SOD, MDA, Toplam fenolik bileşik ve antioksidan aktivite arasındaki ilişkiler incelenmiştir. Ele alınan özelliklerden; uygulama faktörü kategorik değişken iken, depolama süresi sıralı (ordinal) değişken, diğer özellikler ise sürekli değişken olarak alınmıştır. Çalışmada ele alınan özelliklere ait tanımlayıcı istatistikler Tablo 1'de verilmiştir.

Tablo 1. Özellikler için tanımlayıcı istatistikler

n = 54	Ort.	St. Sap.	Min.	Mak.
Ağırlık kaybı	2.294	2.084	0.01	8.51
Etilen	3.194	2.334	0.76	8.82
Solunum	22.634	5.026	14.42	33.69
APX	0,266	0,053	0,14	0,37
CAT	0,023	0,012	0,00	0,05
SOD	18,014	7,951	1,31	42,16
MDA	1,668	0,656	0,92	3,87
Toplam fenolik bileşik	30,510	5,827	17,83	42,84
Antioksidan aktivite	8,001	1,921	4,76	13,17

Ele alınan sürekli değişkenler "düşük" ve "yüksek" olmak üzere iki kategoriye ayrılmıştır ve tüm değişkenler (toplam 11 değişken) birlikte ele alınarak Kategorik temel bileşenler analizi yapılmıştır.

Standart temel bileşenler analizi gibi Kategorik temel bileşenler analizi de bir boyut indirgeme yöntemidir. Hem değişkenler arasındaki, hem de değişkenlerin kategorileri arasındaki doğrusal ve doğrusal olmayan ilişkileri iki boyutlu uzayda görsel olarak sunabilme imkanı sağlamaktadır (Abou-Senna ve vd., 2021).

n: Gözlem veya denek sayısı ve m: değişken (özellik) sayısı olmak üzere;
H: nxm boyutlu veri matrisi olsun. **H** matrisinin her bir sütunundaki değişken nx1 boyutlu h*j* vektörü ile gösterilebilir (j = 1, 2,…,m). Herhangi bir h*j* değişkeni sürekli bir değişken değilse; büyük bir olasılıkla aralarındaki ilişki de doğrusal değildir. Bu nedenle doğrusal olmayan bir dönüşüm veya transformasyon uygulamak gerekir. Her kategorinin dönüşümü (transformasyonu) bir optimal ölçeklenmiş değer içerir. Böylece **H** matrisi $\mathbf{Q}_{ij}$ matrisi ile yer değiştirir. **Q** matrisi, gözlenen puanlarının yerine, kategorik değişkenler için ölçeklenmiş değerleri içerir (Torres-Cárdenas vd., 2021).

KATBA, standart veya klasik Temel bileşenler analizi (TBA) ile aynıdır. Dönüşüm yapılan değişkenler arasındaki ilişki yapısını bulmayı amaçlar. Bu amaçla KATBA'da, kayıp fonksiyonu (loss function) minimize edilmeye çalışılır. Kayıp fonksiyonu, çoklu nominal transformasyonlara göre ağırlıklandırılmış değerleri içerir. Elde edilen temel bileşenlerdeki nesneler veya bireylere ait skor değerleri, kategorik temel bileşenler analizinde de nesne skorları veya skor değerleri olarak adlandırılır. Optimal ağırlıklar seti ile çarpılan bu bileşenler, bileşen saturasyonu olarak belirlenir ve orijinal veri setine mümkün olduğu kadar yakınsamaya çalışılır (Torres-Cárdenas vd., 2021).

p; bileşen sayısı olmak üzere, **X**; nxp boyutlu bileşen skorları matrisi ve **A**'da mxp boyutlu bileşen satürasyonları (component saturations) matrisi olarak tanımlandığında ve bu matrisin *j*. satırı a_j olarak ifade edildiğinde, Kayıp fonksiyonunda orijinal verilerle temel bileşenler arasındaki fark minimize edilir. Böylece kayıp fonksiyonu;

$$L\,(Q,A,X) = n^{-1}\sum_{j=1}^{m} tr(q_j\,a'_j - X)'(q_j a'_j - X)$$

olarak yazılır (Torres-Cárdenas vd., 2021).

Bu kayıp fonksiyonu aşağıdaki sınırlamalara tabii tutulur.

Transforme edilmiş değişkenler standardize edilir. Böylece $q'_j q_j$ = n olur.

Bu kısıtlama, q_j a'_j çarpımında; q_j ile a'_j arasındaki belirsizliği çözmek için gereklidir.

Bu normalizasyonla; q_j z skorlarını içerir ve böylece a_j'deki bileşen saturasyonları ile değişkenler ve bileşenler arasındaki korelasyonu sağlamış olur.

Önemsiz çözümden kaçınmak için;
A = 0, **X** = 0 ve **X′X** = n**I** (I, birim matris) koşulları ile birlikte nesne skorlarının merkezileştirilmesi gerekir. Böylece 1′**X** = 0 (1, birim vektör) olur (Torres-Cárdenas vd., 2021). İstatistik analizler için SPSS (ver: 22) istatistik paket programı kullanılmıştır.

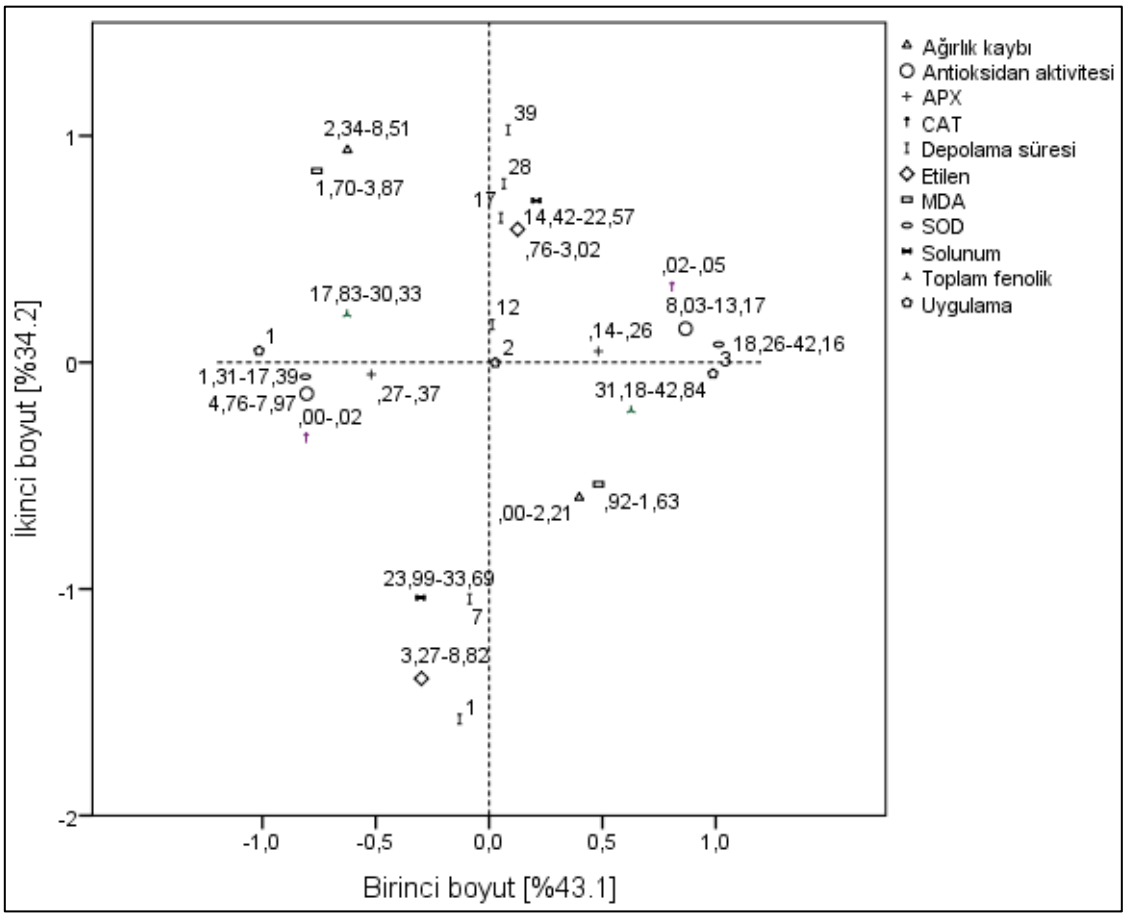
BULGULAR ve TARTIŞMA

Çok değişkenli analiz yöntemlerinden birisi olan Standart temel bileşenler analizi, sürekli değişken olarak ifade edilen özellikler arasındaki doğrusal ilişkilere dayalı bir boyut indirgeme yöntemi olarak kullanılmaktadır. Bu yöntem, orijinal değişkenler arasındaki varyasyonu (farklılığı veya değişimi) maksimum yapacak şekilde, orijinal değişkenlerin doğrusal kombinasyonlarından oluşan ve temel bileşen olarak adlandırılan yeni değişkenler bulmayı amaçlar. Standart temel bileşenler analizine benzer şekilde, Kategorik temel bileşenler analizi de bir boyut indirgeme yöntemidir. Yapılan analiz sonucunda, 11 değişken için transforme edilmiş değerler arasındaki korelasyonlar ve boyutlara ait özdeğerler Tablo 2'de verilmiştir.

Tablo 2. Değişkenler için transforme edilmiş değerler arasındaki korelasyonlar ve boyutlara ait özdeğerler

	Uygulama	Depolama süresi	Ağırlık kaybı	Etilen	Solunum	APX	CAT	SOD	MDA	Toplam fenolik	Antioksidan aktivitesi
Uygulama	1										
Depolama süresi	0.000	1									
Ağırlık kaybı	-0.372	0.696	1								
Etilen	-0.097	-0.855	-0.518	1							
Solunum	-0.188	-0.864	-0.430	0.783	1						
APX	-0.215	-0.011	0.144	0.105	0.106	1					
CAT	0.688	0.297	-0.114	-0.406	-0.452	-0.296	1				
SOD	0.639	0.066	-0.408	-0.254	-0.287	-0.489	0.671	1			
MDA	-0.552	0.601	0.766	-0.518	-0.352	0.296	-0.266	-0.484	1		
Toplam fenolik	0.411	-0.217	-0.570	-0.081	0.075	-0.148	0.333	0.596	-0.342	1	
Antioksidan aktivitesi	0.639	0.109	-0.237	-0.219	-0.271	-0.409	0.741	0.704	-0.389	0.371	1
Dimension	1	2	3	4	5	6	7	8	9	10	11
Eigenvalue	4.741	3.770	0.919	0.789	0.407	0.291	0.214	0.184	0.127	0.119	0.062

Tablo 2'de görüldüğü üzere, ilk iki boyuta veya bileşene ait özdeğer 1'den büyük bulunmuş ve iki boyuta indirgeme yapılmıştır. Bu boyutlardan birinci boyut varyansın %43.1'ini açıklarken, ikinci boyut %34.2'sini açıklamıştır. İlk 2 boyut birlikte toplam varyansın %77.3'ünü açıklamıştır.



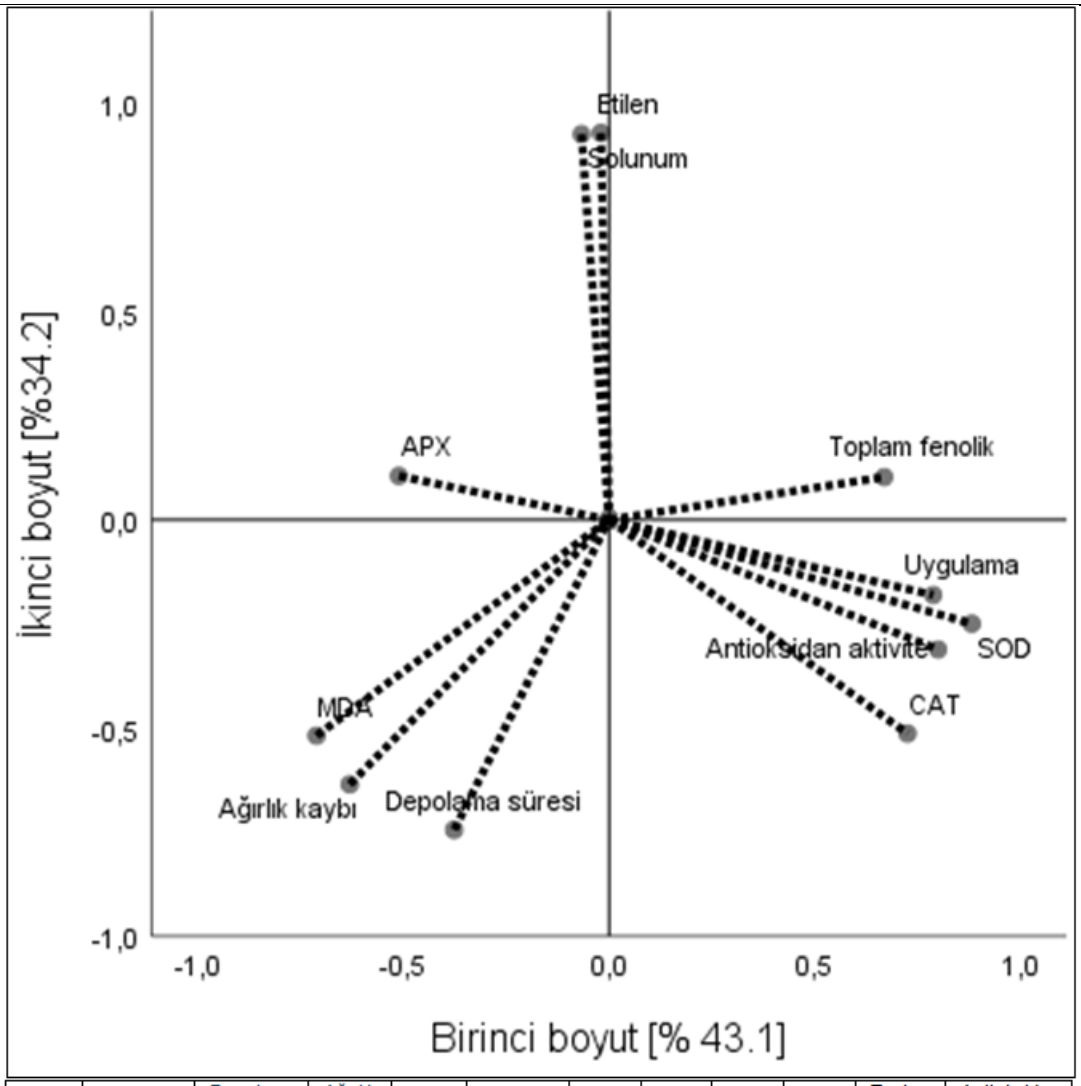
Şekil 1. Özelliklerin kategorileri arasındaki ilişkilerin iki boyutlu uzaydaki konfigürasyonu

Çalışmada ele alınan özelliklerin kategorileri arasındaki ilişkilerin iki boyutlu uzaydaki konfigürasyonu Şekil 1' de verilmiştir. Şekil 1'de görüldüğü üzere, her iki boyuta göre de pozitif bölge olan sağ üst bölgede depolama süresinin 12., 28. ve 39. günleri ile birlikte; solunum ve etilenin düşük kategorisi, CAT, antioksidan aktivite, APX ve SOD'un ise yüksek kategorileri yer almıştır. Buna göre depolama süresinin; 12., 28. ve 39. günlerinde solunum ve etilen düzeyinin azalma, CAT, antioksidan aktivite, APX ve SOD'un ise artma eğiliminde olduğu söylenebilir.

Birinci boyuta göre pozitif, ikinci boyuta göre negatif bölge olan sağ alt bölgede üçüncü uygulama ile birlikte; Toplam fenolik bileşiğin yüksek, MDA ve ağırlık kaybının ise düşük kategorileri yer almıştır. Buna göre üçünü uygulamada, Toplam fenolik bileşik düzeyinin yükselme, MDA ve ağırlık kaybının ise düşme eğiliminde olabileceği söylenebilir.

Her iki boyuta göre de negatif bölge olan sol alt bölgede, depolama süresinin 0. ve 7. günleri ile birlikte; solunumun yüksek, etilen, CAT, APX, antioksidan aktivite ve SOD'un ise düşük kategorilerinin yer aldığı görülmektedir. Buna göre 0. ve 7. gün depolama süresinde; solunum yüksek değerini korurken veya yüksek değerli olma eğilimi gösterirken, etilen, CAD, APX, antioksidan aktivites ve SOD değerleri ise düşük olma eğilimi göstermektedir.

Her iki boyuta göre de negatif bölge olan sol üst bölgede ise birinci uygulama ile birlikte toplam fenolik bileşiğin düşük, MDA ve ağırlık kaybının ise yüksek kategorileri yer almıştır. Buna göre birinci uygulamada toplam fenolik bileşiğin azalma, MDA ve ağırlık kaybının ise yükselme eğiliminde olması beklenmektedir.



Boyut	Uygulama	Depolama süresi	Ağırlık kaybı	Etilen	Solunum	APX	CAT	SOD	MDA	Toplam fenolik	Antioksidan aktivitesi
1	,787	-,376	-,630	-,019	-,067	-,510	,725	,881	-,710	,668	,799
2	-,181	-,745	-,636	,929	,926	,105	-,513	-,250	-,519	,103	-,312

Şekil 2. Değişkenler arasındaki ilişkinin iki boyutlu uzaydaki konfigürasyonu

Değişkenlerin kategorileri arasındaki ilişkilerin verilmiş olduğu Şekil 1'e ilaveten, değişkenler arasındaki ilişkilerin iki boyutlu uzaydaki konfigürasyonu da Şekil 2'de verilmiştir. Şekil 2'de görüldüğü üzere; Uygulama SOD, antioksidan aktivite ve CAT birbirleri ile yüksek ilişkili olarak, varyansın yaklaşık %43ünü açıklayan birinci boyuta göre pozitif bölgede (sağ tarafta) yer almıştır. Benzer şekilde, MDA, ağırlık kaybı ve depolama süresi de kendi arasında yüksek pozitif ilişkili olarak birinci boyuta göre negatif bölgede yer almıştır. Etilen ile solunum yüksek pozitif ilişkili bulunurken, toplam fenolik bileşik ile APX yüksek negatif ilişkili bulunmuştur. Birçok alandaki çalışmalarda, çalışmaya konu olan özellikler, farklı değişken türünde olabileceği gibi aralarındaki ilişkiler de doğrusal veya doğrusal olmayabilir. Bu durumda, yaygın kullanılan Standart temel bileşenler analizinin varsayımları sağlanamamaktadır. Bu gibi

durumlarda, bu varsayımlara karşı daha esnek bir yöntem olan Kategorik temel bileşenler analizi (KATBA) veya Doğrusal olmayan temel bileşenler analizi kullanılabilir.

Standart temel bileşenler analizine benzer şekilde Kategorik temel bileşenler analizi de bir boyut indirgeme yöntemidir. Yöntem, sürekli, kategorik (veya nominal) ve sıralı değişkenleri içeren veri setlerinde kullanılabilmekte ve Standart temel bileşenler analizine göre daha genel bir yaklaşım sunmaktadır. Ayrıca, Standart temel bileşenler analizinin varsayımlarına gerek duymamaktadır. Bununla birlikte, hem değişkenler arasındaki hem de değişkenlerin kategorileri arasındaki doğrusal ve doğrusal olmayan ilişkiler, iki boyutlu uzayda görsel olarak sunabilmektedir.

SONUÇ

Sonuç olarak, çalışmada 3 farklı uygulamada ve 6 farklı depolama süresinde domateste depolama, toplam fenolik bileşik, antioksidan aktivite ve enzim özellikleri arasındaki ilişkiler, Kategorik temel bileşenler analizi ile incelenmiştir. 11 değişken arasındaki ilişki yapısı, yaklaşık %77 varyans açıklama oranı ile 2 boyuta indirgenerek, görsel olarak daha kolay anlaşılabilir ve yorumlanabilir şekilde sunulmuştur. Böylece aralarında doğrusal veya doğrusal olmayan ilişkilerin bulunduğu, fazla sayıda ve farklı türde değişkenleri içeren veri setlerinin analizinde Kategorik temel bileşenler analizinin kullanılabileceği gözlenmiştir.

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BAZI MÜRDÜMÜK (*Lathyrus sativus* L.) GENOTİPLERİNİN TANELERİN YEM ÖZELLİKLERİNİN BELİRLENMESİ

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ÖZET

Mürdümük (*Lathyrus sativus* L.) çok eski tarihlerden beri hayvan beslemede yaygın bir şekilde kullanılan baklagil yem bitkisidir. Ancak genotiplerin besinsel içerikleri oldukça farklılık göstermektedir. Bu çalışmanın amacı farklı mürdümük genotiplerine ait tanelerin yem özelliklerinin belirlenmesidir. Bu amaçla farklı 31 mürdümük genotipi tohumları materyal olarak kullanılmıştır. Deneme tesadüf blokları deneme desenine göre üç tekerrürlü olarak 2015 yılında yazlık yetiştirme sezonunda Elazığ koşullarında yürütülmüştür. Mürdümük tohumları fizyolojik olgunluk döneminde hasat edilmiş ve biyokimyasal analizler için 1 mm elek çapına sahip değirmende öğütülmüş ve analizlerin yapılması süresince +4 °C'de saklanmıştır. Çalışmada mürdümük genotiplerinde ham protein, ham kül, ham yağ, nötr deterjanda çözünmeyen lif (NDF) ve asit deterjanda çözünmeyen lif (ADF) içerikleri incelenmiştir. Araştırma sonuçları GT (genotip özellik) - Biplot analizi ile değerlendirilmiş böylece mürdümük genotiplerinin yem kalite özellikleri yönünden değerlendirilmesi ve özellikler arası ilişkilerin belirlenmesi daha açıkça ortaya konmuştur. Genotipin yem özellikleri üzerine etkisi istatistiksel olarak önemli bulunmuştur ($P \leq 0.01$). Çalışma sonucunda elde edilen bulgulara göre mürdümük genotiplerinin ham protein içeriği %25.75 ile %29.31 arasında, ham kül içeriği %2.49 ile %5.34 arasında, ham yağ içeriği %0.50 ile %1.55 arasında, NDF içeri %16.10 ile %21.40 arasında ve ADF içeriği %6.79 ile %10.89 değişim göstermiştir. GT - Biplot analizi genotiplerin karşılaştırılmasında kolaylık sağlamaktadır. GT - Biplot varyasyonun %57.4 açıklamıştır. Mürdümük genotiplerin yem kalite özellikleri yönünden gruplandırılmasında ve seçiminde GT biplot analizinin kullanılabileceği ve kolaylık sağladığı sonucuna varılmıştır. Mürdümük genotipleri hayvanlar için önemli bir besin kaynağıdır. Araştırma sonuçlarına göre, çalışmada kullanılan genotipler içerisinde Ela ve Leu genotiplerinin yanında Elazığ popülasyonu ile 481 nolu hat yüksek ham protein içeriği ile ön plana çıkmıştır.

Anahtar Kelimeler: mürdümük, genotip, yem özellikleri, GT-Biplot

DETERMINATION OF FEED QUALITY PARAMETERS OF GRAINS OF SOME GRASS PEA (*Lathyrus sativus* L.) GYNOTYPES

ABSTRACT

Grass pea (*Lathyrus sativus* L.) is a legume fodder plant that has been widely used in animal feeding since ancient times. However, the feed parameters of the genotypes vary considerably. The objective of the present study was to determine nutritional compound of grains of some grass pea. A total of 31 different grass pea genotypes were used as the plant material of this study. Experiment was carried out in randomized blocks design with 3 replications during spring of 2015 year. The seeds were harvested during the physiological maturity period and ground by using 1 mm sieve experimental mill for biochemical analysis and stored at +4 °C during the analysis. The current experiment was examined the crude protein, crude ash, crude oil, neutral detergent fiber (NDF) and acid detergent fiber (ADF) in grass pea genotypes. Experimental results were assessed through GT (genotype trait) - Biplot analysis and the relationships between feed quality parameters were put forth clearly. Effects of genotypes on grain feed parameters were found to be highly significant ($P<0.01$). Considering the results crude protein content varied between 25.75% - 29.31%, crude ash varied between 2.49% - 5.34%, crude oil varied between 0.50% - 1.55%, NDF varied between 16.10% - 21.40% and ADF varied between 6.79% - 10.89%. GT - Biplot analysis facilitates the comparison of genotypes. GT - Biplot explained 57.4% of variation. GT - Biplot analysis revealed ideal grass pea genotypes for feed quality parameters. Ela and Leu genotypes, Elazığ population and line 481 were prominent with high crude protein content in plant materials.

Keywords: grass pea, genotypes, feed parameters, GT-Biplot

GİRİŞ

Dünya genelinde yeşil ot, kuru ot ve tane yemi olarak hayvan beslenmesinde yaygın bir şekilde kullanılan mürdümük bitkisi (*Lathyrus sativus* L.) ülkemizin hemen hemen her bölgesinde doğal olarak yetişmektedir (Özdemir vd. 2020). Mürdümük kuraklığa ve tuzluluğa dayanıklı, hastalık ve zararlılara karşı toleranslı, daha kısa yetişme süresine sahip ve yetiştirilmesinde düşük girdiye ihtiyaç duyulması gibi üstün özelliklere sahip bir baklagil bitkisidir (Seydoşoğlu vd. 2015; Özyazici ve Açikbaş 2019; Sönmez ve Türki 2022). Mürdümük ayrıca soğuğa da orta derecede dayanıklıdır (Talukdar, 2011). Bu nedenle ılıman bölgelerde kışlık ekilirken, soğuk bölgelerde yazlık ekilmektedir. Tohumunun ve otunun yüksek protein içeriğine sahip olması nedeniyle ot ve tane için yetiştirilmektedir (Özyazici ve Açikbaş 2019). Ayrıca mürdümük baklagil olması nedeniyle yeşil gübre olarak kullanıma sahip olup, önemli bir ekim nöbeti bitkisidir. Kuraklığa dayanıklı olan bitki, sel baskınından kaynaklı kök havasızlığına da dayanıklıdır (Campbell vd. 1994).

Yemler arasında görülen farklılıkların ortaya konulmasında, yemlerin kimyasal kompozisyonu belirlenmesi (ADF, NDF, protein, kül, yağ) oldukça önemlidir (Kaplan vd. 2014). Biplot analizi, verilerin görsel olarak değerlendirilmesi amacıyla yaygın bir şekilde kullanılmaktadır. Biplot iki yönlü bir tablo tasarımı olup, satır ve sütun faktörlerini grafiksel olarak göstermektedir (Yan ve Tinker, 2006). Bu analiz yönteminde genotiplerin birden fazla özelliğinin grafiksel olarak gösterilebilmesi, gerek çok sayıda genotip ve çok sayıda özellikler arasındaki ilişkileri görsel olarak karşılaştırmaya olanak sağlamaktadır (Yan, 2001). Bu çalışmanın amacı farklı mürdümük genotiplerinin tanelerinin yem özelliklerinin belirlenmesidir.

MATERYAL ve YÖNTEM

Bu çalışma, 2015 yılında Elazığ ilinde yazlık ekim yapılarak yürütülmüştür. Araştırmada çeşit, hat ve popülasyonlardan oluşan toplam 31 adet mürdümük genotipi materyal olarak kullanılmıştır (Çizelge 1). Deneme, tesadüf blokları deneme desenine göre üç tekerrürlü olarak kurulmuştur. Ekim 05.04. 2015 tarihinde, parsel uzunluğu 5 m, sıra arası 30 cm olan parsellere 4 sıra halinde yapılmıştır. Ekimde her sıraya 100 adet tohum atılmıştır. Denemeye ekimden hemen önce dekara saf madde üzerinden 3.6 kg saf azot (N) ve 9.2 kg saf fosfor (P_2O_5) olacak şekilde DAP gübresi verilmiştir. Ekilen parsellerde özellikler her parseldeki bitkilerin altındaki 3-4 baklanın tümüyle sarardığı ve tanelerin sertleştiği dönemde hasat yapılmıştır.

Çalışmanın yapıldığı 2014 yılında (12 ortalama sıcaklık 15.1 °C, toplam yağış 398.1 mm ve ortalama nispi nem %51.1 olmuştur. Toprak bünyesi tınlı, tuzluluk sorununun olmadığı ve

toprak pH'sının ise hafif alkali olduğu görülmüştür. Organik madde içeriği çok az düzeyde olup, kireç ve fosfor içeriğinin orta düzeyde, potasyum içeriğinin ise yetersiz olduğu görülmüştür.

Çizelge 1. Çalışmada kullanılan genotipler ve kısaltmaları

Kısaltma	Genotip	Kısaltma	Genotip
G1	452	G17	HAT-19
G2	481	G18	ADIYAMAN
G3	504	G19	ALBUS
G4	508	G20	AZUREUS
G5	520	G21	BİFLOR
G6	522	G22	COLORCTUS
G7	528	G23	ELA
G8	531	G24	ELAZIĞ POP
G9	553	G25	EREN
G10	563	G26	GÜRBÜZ
G11	HAT-1	G27	İFLS 491
G12	HAT-6	G28	İPTAŞ
G13	HAT-12	G29	KARACADAĞ
G14	HAT-15	G30	LEU
G15	HAT-17	G31	MARDİN POP
G16	HAT-18		

Mürdümük tanelerinin ham kül içeriği 550 ^{o}C'de 8 saat kül fırınında yakılarak, ham yağ analizi eter ekstraksiyonu yöntemi ile Soxhlet collector kullanılarak belirlenmiştir (AOAC, 1990). Ökse otunun azot (N) miktarının belirlenmesinde Kjeldahl metodu kullanılmıştır. Ham protein oranı ise Nx6.25 formülü ile hesaplanmıştır (AOAC, 1990). ADF ve NDF analizleri ANKOM cihazı kullanılarak yapılmıştır (ANKOM Tech methods, 2017). Araştırmadan elde ettiğimiz veriler, SAS istatistik programı kullanılarak tesadüf blokları deneme desenine analiz edilmiş ve ortalamalar arası farklılıklar LSD yöntemiyle karşılaştırılmıştır.

BULGULAR ve TARTIŞMA

Mürdümük genotiplerinin biyokimyasal özellikleri Çizelge 2'de verilmiştir. Genotipin ADF, NDF ve ham yağ içeriği üzerine etkisi istatistiksel olarak % seviyesinde önemli olurken ham kül ve ham protein üzerine etkisi istatistiksel olarak %5 seviyesinde önemli olmuştur. Mürdümük genotiplerinin ADF içeriği %6.77-%10.89, NDF içeriği %16.10-%21.40, ham kül içeriği %2.49-%5.34, ham protein içeriği %25.75-%29.31 ve ham yağ içeriği %0.50-%1.55 arasında değişmiştir.

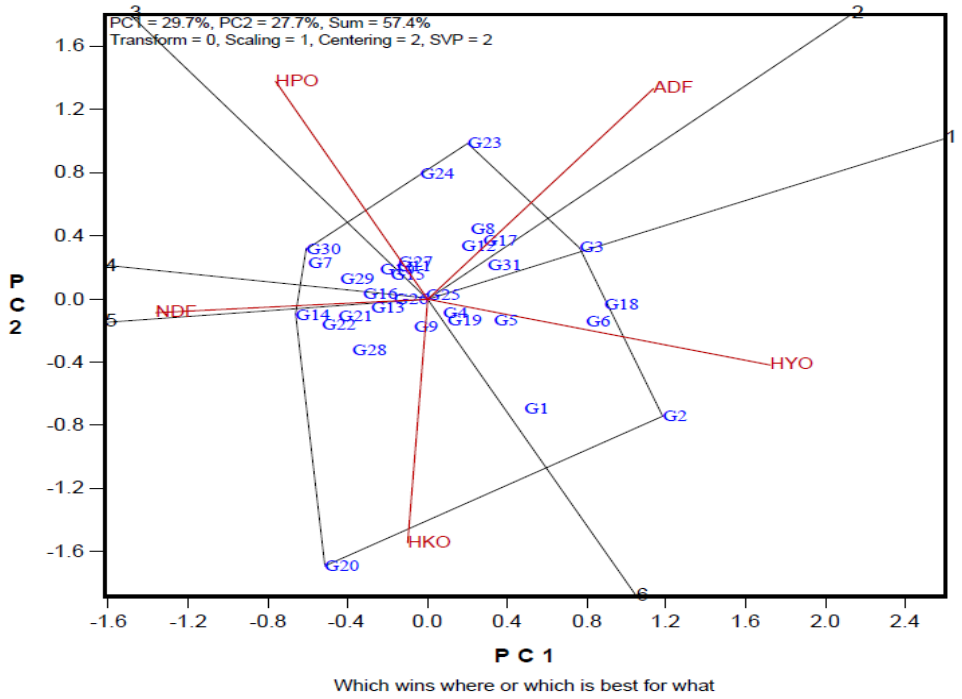
Çizelge 2. Mürdümük genotiplerinin biyokimyasal özellikleri

Genotipler	ADF	NDF	Kül	Protein	Yağ
452	8.44	18.94	3.09	25.75	1.18
481	9.14	17.32	3.24	26.47	1.48
504	10.14	17.36	2.84	27.68	1.17
508	8.25	17.82	2.85	27.37	0.83
520	9.03	20.10	2.79	26.90	1.23
522	9.31	17.50	3.00	26.98	1.28
528	9.25	21.27	2.84	27.56	0.50
531	9.69	17.67	2.84	28.14	0.80
553	9.10	20.15	3.14	26.99	0.83
563	8.78	19.43	2.84	27.96	0.73
HAT-1	9.45	21.40	2.49	26.95	0.85
HAT-6	9.67	17.60	2.59	27.02	0.58
HAT-12	8.04	18.70	2.74	27.30	0.62
HAT-15	7.97	20.92	2.79	27.33	0.58
HAT-17	8.85	19.33	2.64	27.28	0.66
HAT-18	8.00	19.77	2.89	28.28	0.88
HAT-19	9.06	17.31	2.84	28.61	0.98
ADIYAMAN	8.85	17.54	2.79	27.67	1.55
ALBUS	7.58	16.72	2.74	27.50	0.82
AZUREUS	6.82	18.29	5.34	27.17	0.60
BİFLOR	7.38	18.78	2.74	27.67	0.63
COLORCTUS	6.93	19.15	2.89	28.33	0.77
ELA	10.89	17.34	2.89	29.24	0.66
ELAZIĞ POP	9.69	18.06	2.70	29.21	0.73
EREN	8.67	18.65	2.64	26.98	0.73
GÜRBÜZ	8.84	19.28	2.74	26.86	0.62
İFLS 491	8.78	18.83	2.80	28.04	0.75
İPTAŞ	6.77	19.25	2.54	27.16	0.80
KARACADAĞ	8.60	20.96	2.74	27.78	0.76
LEU	7.63	20.04	2.69	29.31	0.83
MARDİN POP	8.88	16.10	2.69	27.52	0.70
LSD	0.02**	2.29**	1.28*	2.04*	0.33**

Genotiplerde kuru madde, ADF, NDF, yağ ve protein oranlarının farklı olması bitkinin genetik yapısından kaynaklandığı tarımsal uygulamalara ve ekolojik faktörlere göre değiştiğini ifade edilmektedir. Yemlerin yapısında yer alan ve sindirimi olumsuz etkileyen hücre duvarı bileşenleri (NDF ve ADF) seviyelerinin artması, hayvanların yem tüketimini sınırlamaktadır. Bu değerlerin olumsuz etkisinden dolayı değerlerin düşük olması istenmektedir (Kaplan vd. 2015). Kaya ve Yalçın (1999) mürdümükte yağ oranının % 1-2 düzeyinde, NDF oranının %27

ve ham kül içeriğinin %3.1 olduğunu bildirmiştir. Ham protein sonuçlarımız Deniz (2020) ve Yıldırım vd. (2023), ham yağ ve ADF içeriğimiz Vakit (2008) ile benzerlik göstermiştir.

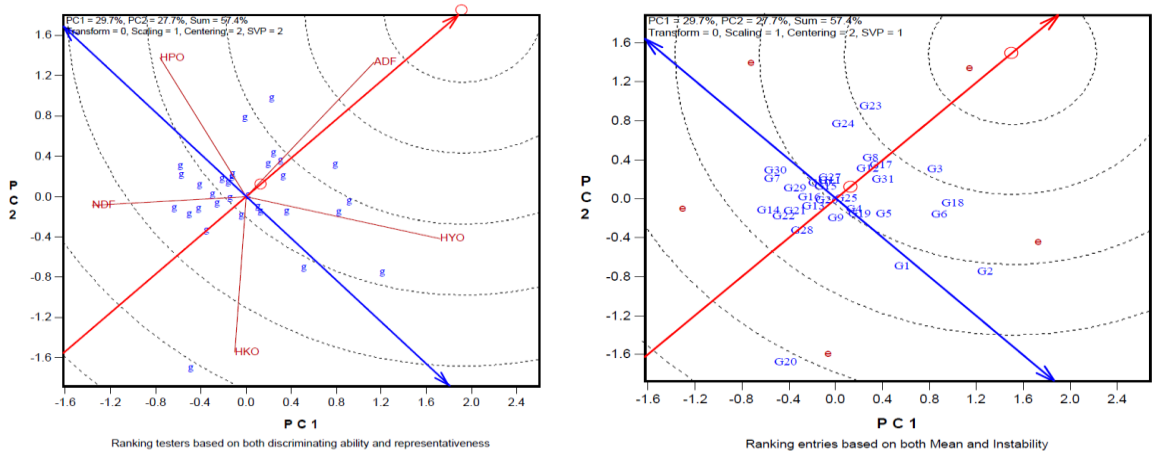
Mürdümük genotiplerinin genotip-özellik biplot grafiği Şekil 1'de verilmiştir. Şekil 1'de görüleceği gibi Ela (G23), Elazığ popülasyonu (G24) ve Leu (G30) ham protein içeriği yönünden, Hat 15 (G14) NDF içeriği yönünden Azureus (G20) ham kül içeriği yönünden, 481 nolu hat (G2) ve Adıyaman (G18) ham yağ içeriği bakımından, 504 nolu hat (G3) ve Ela (G23) çeşidi ise ADF içeriği yönünden ön plana çıkmıştır.



Şekil 1. Mürdümük genotiplerinin biyokimyasal özellik biplot grafiği

Mürdümük genotiplerinde ideal genotip ve ideal özelliğin belirlenmesi amacıyla yapılan GT biplot grafikleri Şekil 2'de verilmiştir. Buna göre mürdümük genotiplerinde ideal özellik ADF içeriği olurken ideal genotipleri ise 504 ve Ela genotipleri olmuştur.

Biplot analizi, genotip-özellik gibi çift yönlü veri girişi yapılarak tüm genotiplere eşit olarak uygulanabilmektedir (Akçura vd. 2011). Biplot analizi ile genotipler farklı özellikler açısından taranabilmekte (Yan ve Tinker, 2006) ve incelenen özellikler için ideal genotipler belirlenebilmektedir (Yan ve Kang, 2003). İdeal genotip, merkez çembere en yakın olanın merkez çemberinde yer alan genotiptir (Kaya vd. 2006).



Şekil 2. Mürdümük genotiplerinde ideal özellik ve ideal genotipi belirlemek için oluşturulan biplot grafiği

SONUÇ ve ÖNERİLER

Araştırma sonuçlarına göre mürdümük genotipleri hayvanlar için önemli bir besin kaynağıdır. Çalışmada kullanılan genotipler içerisinde Ela ve Leu çeşitlerinin yanında Elazığ popülasyonu yüksek ham protein içeriği ile ön plana çıkmıştır. GT Biplot proğramı ile yapılan değerlendirmede Ela, Elazığ popülasyonu ve 504 genotipleri ön plana çıkmıştır.

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MAHLEP (*Prunus mahaleb* L.)'İN BİLEŞİMİ VE KULLANIM ALANLARI

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ÖZET
Mahlep (*Prunus mahaleb* L.) bitkisi ülkemizde Kuzey, Doğu ve Güneydoğu Anadolu'nun birçok yöresinde doğal olarak yetişmektedir. Gıda endüstrisi açısından mahlep meyvesinin etli kısmı ve çekirdeği (tohum) önemlidir. Mahlepten üretilen ürünler mahlep püresi, mahlep şarabı, mahlep unu ve mahlep yağıdır. Gıda endüstrisi dışında parfümeri sanayi (parfüm, losyon gibi kozmetik ürünlerinde), boya sanayi (vernik, cila yapımında), mobilyacılık, ilaç sanayi ve anaç olarak bahçecilikte kullanılmaktadır. Mahlep çekirdeği önemli bir protein ve yağ kaynağıdır. Ayrıca fenolik bileşikler, tokoferoller, mineral madde içeriği ve aroma bileşenleri ile de dikkat çekmektedir. Mahlep sağlığa yararlı bileşenleri nedeniyle geleneksel tedavi yöntemlerinde sıklıkla kullanılmaktadır. Bu çalışmada, ekonomik değeri ve ihracat potansiyeli oldukça yüksek olan beyaz mahlebin (*Prunus mahaleb* L.) bileşimi, elde edilen ürünleri, kullanım alanları ve sağlık üzerine etkisi hakkında bilgi verilmiştir.

Anahtar kelimeler: *Prunus mahaleb* L., İdris, kumarin, mahlep ürünleri.

THE COMPOSITION AND USES OF MAHALEB (*Prunus mahaleb* L.)

ABSTRACT

Mahaleb (*Prunus mahaleb* L.) plant grows naturally in many regions of North, East and Southeast Anatolia in our country. The pulp and seed (seed) of mahaleb fruit are important for the food industry. The products produced from mahaleb are mahaleb puree, mahaleb wine, mahaleb flour and mahaleb oil. Apart from the food industry, it is used in the perfumery industry (in cosmetic products such as perfume, lotion), paint industry (in the production of varnish, lacquer), furniture, pharmaceutical industry and gardening as rootstock. Mahaleb seed is an important source of protein and fat. It also draws attention with its phenolic compounds, tocopherols, mineral substance content and aroma components. Mahaleb is frequently used in traditional treatment methods due to its beneficial components. In this study, information is given about the composition of white mahaleb (*Prunus mahaleb* L.), which has a very high economic value and export potential, its products, usage areas and its effect on health.

Keyword: *Prunus mahaleb* L., İdris, kumarin, mahaleb products

GİRİŞ

Mahlep arapça kökenli bir kelime olup "tatlı kokulu" veya "parfüm kralı" anlamlarına gelmekte, mahlebin kirazın yabani türü olan beyaz ve siyah olmak üzere iki türüne sahip olmaktadır (Mariod ve ark., 2009; Mariod ve ark., 2010).

Siyah mahlep (*Monechma ciliatum* (Jacq.) Milne-Redh) *Acanthaceae* (Ayıpençesigiller) familyasına mensup olup 30-65 cm yüksekliğe ulaşabilen bir bitki türüdür. Sudan'da tıbbi amaçlı olarak yetiştiriciliği yapılmaktadır (Uguru ve ark., 1995). Siyah mahlep çekirdekleri tatlı ve hoş kokuya sahip olmakta, bitkinin sabit yağ içeriğinden dolayı kozmetik sanayinde deodorant ve losyonların üretiminde kullanıldığı bilinmekte ayrıca ağrı kesici ve diyareyi azaltma gibi önemli rollere sahip olduğu yapılan çalışmalarla ifade edilmektedir (Hedberg ve Stangard, 1989; Mariod ve ark., 2009).

Beyaz mahlep (*Prunus mahaleb* L.) gülgiller (*Rosaceae*) familyasının *Prunus* cinsine ait, kısa boylu çalımsı, dağınık ve geniş tepeli, meyve ve dalları özel kokuya sahip olan, beyaz çiçekli, kışın yaprağını döken küçük bir ağaçtır (Hedberg ve Stangard, 1989; Mariod ve ark., 2009). Beyaz mahlebin anavatanı, Avrupa ve Batı Asya olmasına rağmen Güney Avrupa, Fransa, Güney Almanya, Kuzey Asya, Kafkasya ve Türkistan içlerine kadar uzanan oldukça geniş bir alanda doğal olarak yayılma göstermiştir. Türkiye'de ise Tokat, Mardin, Çorum, Amasya, Ordu, Erzurum, Uşak ve Van gibi birçok ilde kendiliğinden yetişmektedir (Mataracı, 1997; Ağaoğlu ve Ergül, 2001; Meraler, 2010). Mahlep bitkisinin yerli isimleri bölgelere göre değişmektedir. Amasya'da İdris veya Pis Ağaç, Tokat ve Amasya'da Mahlep veya Melhem, Tokat'ta Endülüs olarak adlandırılsa da, bazı bölgelerde Yabani Kiraz, Taş Kirazı, Endirez, Keniro, Kokulu Kiraz, Meltem'' gibi isimlerle de anılmaktadır (Darıcı ve ark., 2016). Geçmişte mahlep Kuzey Anadolu Bölgesinde yalnızca sınır bitkisi olarak yetiştirilirken son zamanlarda gerek iç tüketimin gerekse ihracatın artmasından dolayı ve özellikle kapama bahçelerin kurulması ile beyaz mahlep yetiştiriciliği hızla artmıştır (Mataracı, 1997; Ağaoğlu ve Ergül, 2001; Meraler, 2010). Ülkemizde yetiştiriciliği yapılan mahlep büyük oranda ihraç edilmektedir (Darıcı ve ark., 2016). Kalyolcu ve ark. (2008), mahlep ağaçların ihracatında Amasya ve Tokat illerimizin iki önemli merkez konumunda olduğu ifade edilmektedir. Ülkemizde yıllara göre iç mahlep ticareti çizelge 1'de gösterilmektedir (TÜİK, 2016).

Çizelge1. Mahlep bitkisinin ülkemiz ihracat, ithalat miktar ve bedellerinin yıllara göre dağılımı (TÜİK, 2016).

Mahlep	2012		2013		2014		2015		2016	
İhracat	Miktar (kg)	Bedel ($)	Miktar (kg)	Bedel ($)	Miktar (kg)	Bedel ($)	Miktar (kg)	Bedel ($)	Miktar (kg)	Bedel ($)
	144.240	1.745.584	101.711	1.716.151	71.165	1.457.354	213.952	4.673.812	100.484	1.830.783
İthalat	0	0	0	0	13.000	56.130	0	0	6.400	20.115

Mahlep meyvesinin gıda endüstrisinde etli kısmı ve çekirdeği kullanılmaktadır. Mahlebin kullanım alanı yönünden başta sağlık, gıda ve ilaç sanayisi olmak üzere birçok alanda ihtiyaca göre bitkinin çeşitli aksamları kullanılarak tüketilmektedir (Ieri ve ark., 2012; Öztürk ve ark., 2014). Bitkinin meyveleri çok küçük olup, küresel ve yüzeyi düz bir yapıya sahip olmaktadır. Olgunlaşması tamamlanan meyveler koyu kırmızı veya siyah renkli olmaktadır. Kokulu olan meyvenin tadı ekşi ve buruk olup, nohut iriliğinde ve sulu bir yapıya sahip olmaktadır. Mahlep çekirdeği tek olup yumurta şeklinde, sivri uçlu, yumuşak yapılı acı ve aromatiktir bir tada sahiptir (Resim 1,2) (Aydın ve ark., 2002; Öner ve Uysal, 2006; Jerković ve ark., 2011).



Resim 1. Mahlep bitkisinin meyvesi



Resim 2. Mahlep bitkisinin tohumu

Mahlep tohumunun içeriğinde önemli protein ve yağ asitleri ihtiva etmektedir. Çekirdeği ve tozu, geleneksel tıpta diüretik, antidiyabetik, tonik, afrodizyak ve balgam sökücü olarak kullanılmaktadır. Ülkemizde kandil simidi, kurabiye, poğaça, kek, kap kek ve turta gibi pastacılık mamullerinde, tat verici olarak değerlendirilmektedir (Öztürk ve ark. 2014). Mahlep çekirdeğinin içeriğindeki protein oranı yetiştiriciliği yapılan bölgeye göre değişmekle birlikte %28-31 aralığında, yağ oranı ise %4,7-40,0 aralığında değişim göstermektedir (Johansson ve ark., 1997; Aydin ve ark., 2002; Yücel, 2005; Kalyoncu ve ark., 2008; Güzel, 2011; Majid ve ark., 2011). Ayrıca, içeriğinde %27-40 oranında sabit yağ ve kumarin ihtiva etmektedir. İçeriğindeki kumarin serbest yapıda veya glikozla birleşmiş olarak bulunmaktadır. Yağlarda

nadir olarak gliserit asidi bulurken, mahlep yağında %35 oranına kadar eleostarin asidi bulunmaktadır. Eleostarin asidinin gliseridi taşıyan yağların filmleri elastikiyet ve suya karşı dayanıklılık yönünden diğer kuruyan yağlardan daha üstün özellikli olduğundan buda mahlep bitkisini bu yünüyle diğer bitkilerden üstün kılmaktadır. Ayrıca yağında doymamış yağ asitlerinden olan %33-34 oranında linoleik asit ve %33 oranında oleik asit bulunmaktadır (Meraler, 2010).

Mahlep tohumunun aroma bileşeninin en önemlisi kumarinlerdir. Bileşiminde kumarin türevlerinden kumarin, dihidrokumorin ve herniarin (7-methoksikumarin) içermektedir. Ayrıca, içeriğinde glikosidik olarak bağlı olan 4-metoksietil-sinnamat bulundurmakta ve çok düşük düzeyde amigdalin (mandelonitrile-β-gentiobioside) bileşimini ihtiva etmektedir (Alsaid ve Hifnawy, 1986; Aydın ve ark., 2002).

Mariod ve ark. (2009), yapmış oldukları çalışmada mahlep çekirdeğinin içeriğindeki oranların; %28 protein ve %30 yağ, %18 lif, %14 karbonhidrat, %2 kül içerdiğini, tohum yağının asit değeri 1,21-7,86 mg KOH/g, peroksit değeri ise 1,021- 2,54 meq O2/kg olduğunu bildirmişlerdir.

Ülkemizde yörelere göre değişmekle birlikte mahlep bitkisinin çeşitli kısımları, geçmişten günümüze halk ilacı özelliğini korumuş ve son zamanlarda yoğun bir şekilde tohum ve meyveleri kullanılmaktadır. Çiçek, yaprak, meyve sapı ve resin kısmı da çeşitli hastalıkların tedavisinde halk ilacı yaygın olarak kullanılmaktadır (Meraler, 2010). Tohumu yöresel ilaçlarda tonik ya da azot içeriği yönünden zengin olmasına karşın nişasta oranının az olmasından dolayı antidiyabetik (şeker hastalığı) olarak kullanılmaktadır. Meyveleri böbrek sancısı ve karın ağrısını gidermede etkili olup, zamkı (resin) ise öksürük ve bağırsak iltihaplarının iyileştirilmesinde etkili olarak kullanılmaktadır. Ayrıca kuvvet verici, idrar arttırıcı, diyareyi önleyici/azaltıcı, balgam söktürücü olarak kullanılırken nefes darlığı ve astım gibi hastalıklara karşı etkili olduğu bilinmektedir (Anonim, 2017a).

Meyve ve tohumları ayrı ayrı değerlendirilen mahlep ağacının tüketimi ve kullanım alanları oldukça geniş olmaktadır. Meyve etinden mahlep ezmesi veya püresi, mahlep şarabı üretilirken çekirdeğinden ise mahlep tanesi, mahlep unu ve mahlep yağı elde edilmektedir (Mariod ve ark., 2010).

Tohumlarından elde edilen yağın içeriğindeki önemli kimyasal özelliklerinden dolayı boya sanayinde geniş kullanım alanına sahip olmaktadır. Bu yağ, suya dayanıklı olmasından dolayı gemi boyaları ve vernik imalatında önemli bir paya sahip olmaktadır. Ayrıca, tohumları ince toz haline getirilerek kozmetik sanayinde renklendirme amacıyla değerlendirilmekte ve

kına haline getirilen mahlep, ter kokusunu giderme özelliği nedeniyle parfüm, losyon gibi kozmetik ürünlerinde kullanılmaktadır (Anonim, 2017b).

Mahlep unundan, pasta ve çörek yapılmakta, içeriğindeki kumarinden dolayı aromasının vanilya kokusu taşıması nedeniyle tatlandırmada kullanılmaktadır. Çekirdeği Ürdün'de üretilen Nabulsi peynirine tat ve aroma vermesi için salamuraya eklenmektedir (Öner ve Uysal, 2006; Anonim, 2011).

Kabukları hoş kokulu ve kumarin içermesinden dolayı dalları geçmişte tütün çubuğu ve pipo yapımında kullanılmaktaydı. Ayrıca, ağacının odun kısmı sert ve damarlı yapıya sahip olduğu için oymacılık, kerestecilik ve mobilyacılıkta yaygın olarak değerlendirilmektedir (Anonim, 2017a).

Tohumları, krem ve ilaç sanayiinde de değerlendirilen mahlep, protein ve yağ asitleri kaynağı olup çekirdeklerinden elde edilen yağ vernik hazırlamada oldukça kıymetlidir (Kalyoncu ve ark. 2008). Ayrıca dal ve sürgünleri, ağızlık ve baston üretiminde değerlendirilmektedir. Birçok farklı alanda değerlendirilen mahlep meyvelerinin jölesi, pestili ve şekerlemesi de yapılmaktadır (Öner ve ark 2006).

Mahlebin diğer bir önemli kullanım alanlarından biri de anaçlık özelliğine sahip olmasıdır. Kiraz ve vişne yetiştiriciliğinde kullanılan anaçların büyük bir kısmını tohum anaçları oluşturmakta ve her iki tür için de orta kuvvette bir anaç olan mahlebin, ülkemizdeki kullanımı gün geçtikçe yaygınlaşmaktadır (Çelik, 1983). Türkiye'de yetiştiriciliği yapılan kiraz ağaçlarının %75-80'i *Prunus mahaleb* L. anacı üzerine aşılıdır. Eroğul ve Hepaksoy (2013), yürüttükleri çalışmada sulama problemi olan veya az su verilebilen arazilere mahlep anacının uyumunun iyi olduğunu belirtmişlerdir. Mahlebin bu özelliğinde dolayı hava drenajı açısından, yamaç ve eğimli alanlarda kiraz bahçesi tesisinde en iyi şekilde kullanılabilecek bir anaçtır. Ayrıca son zamanlarda Orta Anadolu'da kurak yerlerin ağaçlandırılmasında iyi sonuç alındığından dolayı öncü ağaç olarak tercih edilmektedir (Anonim, 2017a).

Mahlep bitkisi çok çeşitli kullanım alanlarına sahip olmasına rağmen gıda olarak tüketimi maalesef Türkiye ve birkaç ülke ile sınırlı kalmıştır. Ayrıca, mahlep bileşimi üzerine yapılan sınırlı sayıdaki çalışmalar, mahlebin kimyasal ve fonksiyonel olarak önemli bir bitki olduğu ifade edilmektedir. Bu alanda yapılacak çalışmaların artması ile mahlebin kullanım alanlarının artacağı da öngörülmektedir (Özbey ve ark., 2011).

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ÜLKEMİZ İÇİN YENİ İKİ FARKLI ELMA GENOTİPİNİN ISPARTA EKOLOJİK KOŞULLARINA ADAPTASYONU

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ÖZET

Meyve yetiştiriciliğinde üretici ve tüketici istekleri oldukça dinamik olup, ıslahçıların değişen talepler ve ekolojik faktörler altında talepleri karşılaması gerekmektedir. Bu sebeple, yeni genotiplerin geliştirilmesinde, ebeveyn olabilme potansiyeli bulunan genetik kaynakların zenginleştirilmesi son derece önemlidir. Bu çalışma kapsamında, taze tüketiminin yanı sıra sanayinin birçok koluna entegre olmuş elma türünde, Kazakistan ve Türkmenistan kökenli iki elma genotipinin Isparta ekolojik koşullarına adaptasyonu araştırılmıştır. Türkmenistan orjinli genotipte meyve eni, meyve boyu ve meyve ağırlığı özellikleri sırası ile 6.25 - 7.5 mm, 57.52 - 65.32 mm ve 125.11–165.11g aralıklarında tespit edilmiştir. Aynı sıralama Kazakistan orjinli genotipte ise 6.25 - 7.80 mm, 51.23 - 70.40 mm ve 102.20 - 178.20 g şeklinde ölçülmüştür. Meyve boyutlarını oluşturan en ve boy özellikleri kendi aralarında yüksek düzeyde pozitif ilişki içerisinde tespit edilmiştir. Ayrıca hacmi arttıran bu özellikler, meyve ağırlığı ile de kuvvetli pozitif ilişki içerisinde tespit edilmiştir. Elde edilen sonuçların genetik havuza katkı sağlayacağı düşünülmektedir.

Anahtar Kelimeler: Sürdürülebilir tarım, adaptasyon, genotip, pomoloji

ADAPTATION OF TWO DIFFERENT APPLE GENOTYPES TO ISPARTA ECOLOGICAL CONDITIONS FOR OUR COUNTRY

ABSTRACT

Producer and consumer demands are very dynamic in fruit growing and breeders have to meet the demands under changing demands and ecological factors. For this reason, it is extremely important to enrich the genetic resources that have the potential to become parental as a variety in the development of new genotypes. Within the scope of this study, the adaptation of two genotypes originating from Kazakhstan and Turkmenistan to the ecological conditions of Isparta was investigated in apple species that have been integrated into many branches of industry as well as its fresh consumption. In the Turkmenistan origin genotype, fruit width, fruit length and fruit weight characteristics were determined in the range of 6.25 - 7.5 mm, 57.52 - 65.32 mm and 125.11-165.11 g, respectively. The same order was measured as 6.25 - 7.80 mm, 51.23 - 70.40 mm and 102.20 - 178.20 g in the Kazakhstan origin genotype. Width and length characteristics constituting fruit sizes were found to be highly positively correlated with each other. In addition, these properties that increase the volume were determined in a strong positive relationship with fruit weight. It is thought that the results obtained will contribute to the genetic pool.

Keywords: Sustainable agriculture, adaptation, genotype, pomology

GİRİŞ

Elma, dünyada en çok tüketilen ve ticarete konu olan yumuşak çekirdekli meyve türleri arasında yer almaktadır (Tangüler ve ark., 2021). Türkiye'de 2020 yılında 4.3 milyon ton elma üretilmiş, bunun %21.7'sini tek başına Isparta ili karşılamıştır (TÜİK, 2022). Elma, taze tüketiminin yanı sıra farklı şekillerde işlenerek çeşitli ürünlere dönüştürülebilen fonksiyonel meyve türlerindendir. Meyve suyu, reçel-marmelat, şarap ve sirke gibi ürünler, elmanın kullanım çeşitliliğini gösteren örneklerdir. Bu ürünler, C vitamini, lif ve antioksidanlar gibi besin maddeleri açısından zengindir (Baytekin ve Akça, 2011).

Meyve yetiştiriciliğinde üretici ve tüketici istekleri oldukça dinamik olup, ıslahçıların değişen talepler ve ekolojik faktörler altında talepleri karşılaması gerekmektedir. Bu değişen talepleri karşılayabilmek ve ekolojik faktörler altında verimli genotipler geliştirebilmek için ıslahçıların önemli bir rolü vardır (Özçağıran ve ark., 2005). Özellikle elma gibi önemli bir meyve türünde, üretici ve tüketici beklentilerini karşılayacak yeni genotiplerin geliştirilmesi büyük bir önem taşımaktadır. Bunun için ise genetik kaynakların zenginleştirilmesi ve adaptasyon yeteneği olan ebeveyn genotiplerin kullanılması gerekmektedir. Bu sebeple, yeni genotiplerin geliştirilmesinde, ebeveyn olabilme potansiyeli bulunan genetik kaynakların zenginleştirilmesi son derece önemlidir (Eskimez ve ark., 2020).

Tarım alanlarının azalması ve nüfusun sürekli olarak artması, mevcut alanların daha etkin bir şekilde kullanılmasını gerektirir (Nielsen, 2016). Bu nedenle, ekolojik olarak uygun tür ve çeşitlerin doğru bir şekilde seçilmesi son derece önemlidir. Verimlilik ve ürün niteliği açısından üstün özelliklere sahip olmak için, ekolojik olarak uygun tür ve çeşit seçimi kritik bir rol oynamaktadır (Taysı ve Çelik, 2017). Tarımsal üretimde, ışık, nem, sıcaklık, toprak yapısı ve faunası gibi ekolojik faktörlerin ürünün nihai şekli ve kompozisyonu üzerinde kümülatif bir etkisi vardır. Türler ve çeşitler arasında bu faktörlere farklı tepkiler görülebilir (Li ve ark., 2012; Tiwari ve Cummins, 2013).

Elma, düşük ekolojik seçicilik ve yüksek adaptasyon yeteneği gösteren bir meyve türüdür ve Türkiye genelinde yazlık, güzlük ve kışlık olmak üzere çeşitli genotiplere sahiptir. Ancak, bu çeşitlilik arasında sadece birkaç tanesi, verim, kalite, yetiştiricilik ve muhafaza açısından önem kazanmıştır (Kaşka, 1997; Özçağıran ve ark., 2005). Elma yetiştiriciliği, ülkemizde büyük bir ekonomik değere sahip olup, tüketici talepleri çeşitlilik göstermektedir (Eskimez ve ark., 2020). Bu talepler zaman içinde değişebilir ve ıslahçıların bu değişen taleplere uygun genotipler geliştirmesi gerekmektedir. Aynı zamanda, elma yetiştiriciliği ekolojik faktörlerin büyük bir etkisi altında gerçekleşmektedir. Isparta gibi belirli bir bölgede elma yetiştiriciliği yapılıyorsa,

o bölgenin iklim ve toprak özellikleri göz önünde bulundurularak adaptasyon yeteneği yüksek genotipler seçilmelidir.

Genetik çeşitlilik, genotiplerin adaptasyon yeteneklerini artırır ve değişen taleplere cevap verebilmelerini sağlar. Elma genetik kaynaklarının zenginleştirilmesi, farklı özelliklere sahip ebeveyn genotiplerin kullanılmasıyla gerçekleştirilebilir (Mertoğlu ve Evrenesoğlu, 2019). Bu şekilde, Isparta gibi özel bir bölgede yetiştiricilik için uygun genotipler geliştirilebilir ve bölgenin ekonomisine katkı sağlayabilir. İlgili literatürdeki çalışmalar ve araştırmalar, genetik kaynakların zenginleşmesi ve adaptasyon yeteneği yüksek ebeveyn genotiplerin kullanımı gibi konular üzerine yoğunlaşmaktadır. Literatürde yeni genotiplerin geliştirilmesi için genetik kaynakların zenginleştirilmesinin büyük bir önem taşıdığı bildirilmektedir (Ünüvar ve Pırlak, 2014; Taysı ve Çelik, 2017). Bu bağlamda, Isparta gibi belirli bir bölgede elma yetiştiriciliği yapılıyorsa, adaptasyon yeteneği yüksek genotiplerin seçilmesi ve ekolojik koşullara uygun çeşitlerin kullanılması önemlidir. Bu sayede, Isparta'nın iklim ve toprak özelliklerine en iyi adapte olan ve verimlilik, kalite ve muhafaza özellikleri açısından avantajlar sunan yeni elma genotipleri geliştirilebiecektir.

Bu çalışmanın amacı, Isparta'nın iklim, toprak ve diğer ekolojik faktörleri göz önünde bulundurarak, yeni iki elma genotipinin Isparta bölgesinde başarılı bir şekilde yetiştirilebilme potansiyelini değerlendirmektir. Ayrıca, bu çalışma, yerel elma üreticilerine, daha verimli ve dayanıklı elma çeşitlerini kullanma potansiyeli sağlayarak, tarımsal üretimlerini iyileştirme ve sürdürülebilirliklerini artırma konusunda yardımcı olmayı hedeflemektedir. Bu sebeple, çalışmada, bu genotiplerin pomolojik özellikleri ve genotipler arasındaki farklılıklar, olası sebepleri ile birlikte açıklanmaya çalışılacaktır.

YÖNTEM

Çalışma, 2022 yılında Isparta Uygulamalı Bilimler Üniversitesi, Ziraat Fakültesi, Bahçe Bitkileri bölümüne ait elma koleksiyon parselinde yürütülmüştür. Materyal olarak, 2004 yılında, 3.5 m x 1 m sıra arası ve sıra üzeri mesafe olacak şekilde dikilen Kazakistan ve Türkmenistan kökenli iki genotip kullanılmıştır. Araştırma alanının rakımı 1009 m olup, karasal iklim özellikleri göstermektedir.

Pomolojik Özellikler

Hasat edilen meyveler, zaman kaybetmeden laboratuvar ortamına aktarılmıştır. Meyve ağırlığı, 0.001 g'a duyarlı elektronik terazi (Vibra, AJH-42OCE), meyve eni, boyu, sap uzunluğu ve eni ise 0.01 mm'ye duyarlı dijital kumpas aracılığı ile ölçülmüştür. Meyve eti sertliği dijital el

penetrometresi (FT-327) ve kabuk üst renk değerleri ise renk ölçer (Minolta CR-400) vasıtası ile belirlenmiştir (Karaçalı, 2012).

İstatiksel Analiz

Araştırma, tesadüf parselleri deneme desenine göre tasarlanmıştır. Pomolojik özelliklerde, her ağacın dört tarafından toplanan yirmişer meyve üzerinde ölçümler yapılmıştır. İncelenen özelliklerin genotipler arasında istatistiksel olarak önemli farklılıklar gösterip göstermediği Minitab-17 paket programında, one-way ANOVA prosedürü kullanılarak tespit edilmiştir. Çeşitler arası farklılıkların ortaya çıkarılmasında, Tukey çoklu karşılaştırma testi kullanılmıştır (Zar, 2013).

BULGULAR ve TARTIŞMA

Tüketici talepleri doğrultusunda, adaptasyon çalışmalarında meyve boyu, eni ve tane ağırlığı gibi özelliklerin belirlenmesi ve karakterizasyonu büyük önem taşır. Bu çalışmalar, tüketici taleplerine uygun yeni ürünlerin piyasaya arz edilmesi bakımından önemlidir. Bu şekilde, tüketicilerin beklentilerini karşılayan, görsel olarak çekici ve lezzetli meyveler elde etmek mümkün olmaktadır. Böylelikle, piyasaya değer katan ve pazar taleplerini karşılayabilen yeni çeşit yada genotipler elde edilebilmektedir. Bu bağlamda, çalışmada, meyve eni (73,02 mm), meyve boyu (58,41 mm) ve tane ağırlığı (147,9 g^{-1}) açısından üstün olan genotipin Kazakistan genotipine ait olduğu tespit edilmiştir (Çizelge 1).

Malatya yöresinde elma klon seleksiyonunu amaçlayan bir çalışma gerçekleştirilmiştir. Meyve eni 74.73-90.72 mm arasında, meyve boyu 65.75-88.43 mm arasında, meyve ağırlığı 163.20-275.00 g arasında ve meyve eti sertliği 3.8-5.22 kg/cm² arasında değişim göstermektedir (Çöçen ve ark., 2018). Karaman ekolojisinde Fuji çeşidinde meyve eni 78.74 mm, meyve boyu 59.59 mm, meyve ağırlığı 197.33 g ve meyve eti sertliği 7.0 kg/cm² olarak belirtilmiştir (Ünüvar ve Pırlak, 2014). Aynı şekilde, Osmaniye ekolojisinde meyve eni 79.3 mm, meyve boyu 65.4 mm, meyve ağırlığı 212.8 g ve meyve eti sertliği 8.2 kg/cm² olarak bildirilmiştir (Bolat ve ark., 2019. Tokat ekolojisinde yine Juji elma çeşidinde yapılan bir çalışmada ise meyve eni 86.2 mm, meyve boyu 71.1 mm ve meyve ağırlığı 280.2 g olarak rapor edilmiştir (Baytekin ve Akça, 2011). Sonuç olarak, farklı elma çeşitlerinin meyve özellikleri, yetiştirildikleri ekolojik koşullara bağlı olarak değişebilmektedir. Özellikle sıcak iklim bölgelerinde yetiştirilen meyvelerde, oksin hormonunun sıcaklıkla birlikte artması ve meyvelerde yuvarlak yapı oluşumuna neden olması nedeniyle meyveler daha basık ve şişkin olmaktadır. Tam tersi durumda ise sitokinin ve giberellik asidin etkinliği artar ve meyveler daha uzun olur (Sherman ve Beckman, 2002). Meyve eni, meyve boyu, meyve ağırlığı gibi özellikler genotipe yada

çeşide bağlı olmaksızın farklılık göstermektedir. Bu bilgiler, elma çeşitlerinin adaptasyon yeteneklerinin ve meyve özelliklerinin belirlenmesinde önemli bir referans sağlamaktadır. Çalışma sonuçlarımız, literatürle büyük ölçüde uyumlu olmasına rağmen, yetiştiricilik sistemi, kültürel uygulamalar ve ekolojik faktörlerin incelenen özellikler üzerindeki etkilerinin göz ardı edilmemesi gerektiğini göstermektedir.

Meyve ağırlığını etkileyen en önemli faktörlerden biri meyve tutumu olarak bilinir ve seyreltme işleminin artmasıyla birlikte meyve büyüklüğünde artış gözlemlenir. Ayrıca yetiştirme sisteminin sık dikime doğru kayması, toplam verimliliği artırsa da bitki başına verimi düşürebilir. Serin iklimlerde tamamlanan bitkilerde, gelişim süresi uzadıkça hücreler arası boşluk azalır ve daha sert meyvelerin üretimine olanak sağlar. Ayrıca bu durumun meyve ağırlığını artırdığı bildirilir (Bostan ve Çelikel-Çubukçu, 2018). Bu nedenlerle, meyve yetiştiriciliğinde yetiştirme sistemleri, kültürel uygulamalar ve ekolojik faktörler dikkate alınmalıdır. Bu bağlamda, çalışmaların daha geniş bir perspektifte yapılması ve farklı ekolojik koşulları da içermesi önemlidir.

Çizelge 1. Genotiplerin, meyve eni, boyu ve tane ağırlık değerleri bakımından karşılaştırılması

Genotip	En (mm)**	Boy (mm)**	Tane ağırlık (g^{-1})**
Kazakistan	73,02[a]	58,41[a]	147,9[a]
Türkmenistan	65,13[b]	52,51[b]	116,9[b]

**Aynı sütunda farklı harflerle gösterilen ortalamalar arasındaki farklar önemlidir ($p<0.01$)

Meyve kabuk ve meyve eti renk değerleri, genellikle Lab* renk uzayı kullanılarak değerlendirilir. L* değeri, ışık yoğunluğunu temsil eder ve 0 ile 100 arasında bir ölçekte ifade edilir. Daha yüksek L* değeri, daha açık bir renk tonunu temsil ederken, daha düşük L* değeri daha koyu bir renk tonunu göstermektedir (Uğurlu ve Saraç, 2021). Buna göre Çizelge 2'de genotipler meyve kabuk ve meyve eti rengi bakımından karşılaştırılmış ve meyve kabuk ve meyve eti renk değerleri bakımından, genotipler arasında istatistiksel olarak anlamlı bir fark gözlemlenmemiştir.

Çizelge 2. Genotiplerin meyve kabuk ve meyve et renk değerleri açısından karşılaştırılması

Genotip	Meyve kabuk [öd]			Meyve eti [öd]		
	L	a	b	L	a	b
Kazakistan	52,12	10,21	45,2	70,23	-6,83	23,93
Türkmenistan	48,15	9,20	24,63	191,0	-9,44	23,58

öd: önemli değil

Meyve sapı, meyvenin ağaç üzerindeki tutunma noktasıdır ve meyve gelişimi sırasında besinlerin taşınması ve su alımı için önemli bir rol oynar. Meyve sapının uzunluğu, kalınlığı ve sağlamlığı, meyvenin ağaç üzerinde dengeli bir şekilde tutunmasını sağlar. Aynı zamanda, sapın kalitesi ve sağlamlığı hasat sürecinde meyvenin zarar görmesini ve depolama süresince bozulmasını önleyebilmektedir (Akçay ve ark., 2019). Meyve eti sertliği, meyvenin dokusal özelliği olarak bilinir ve tüketici tercihleri ve muhafaza süresi açısından önemlidir. Sert meyveler genellikle daha uzun bir raf ömrüne sahip olabilirken, yumuşak meyveler daha kısa bir muhafaza süresine sahip olabilir (Polat ve ark., 2020). Verim ise meyve yetiştiriciliğinde önemli bir hedef olarak kabul edilir. Verim, ağaç başına veya arazi alanına düşen meyve miktarını ifade eder. Yüksek verimli genotipler veya yetiştirme sistemleri, daha fazla meyve üretimi sağlar ve ekonomik açıdan daha karlı olabilir. Verim, meyve gelişimi, çiçeklenme, tozlaşma, meyve tutumu ve beslenme gibi faktörlerden etkilenebilmektedir. Verim, genellikle meyve ağacının büyüklüğü, çiçeklenme yoğunluğu, meyve tutumu ve meyve büyüklüğü gibi faktörlerle yakından ilişkilidir. Bu nedenlerle, meyve sapı özellikleri, meyve eti sertliği ve verim, meyve fizyolojisi ve kalite açısından önemli parametrelerdir (Bolat ve İkinci, 2019) Bu özellikler, genotipler arasındaki farklılıkları ve yetiştirme koşullarının etkisini anlamak için araştırmalarda dikkate alınmalıdır. Çizelge 3'e göre sap uzunluğu ve sap eni ve verim bakımından genotipler arasında istatistik bakımından önemli bir fark tespit eidlmemiştir. Sertlik değeri bakımından ise Türkmenistan ön plana çıkmaktadır (7,94 libre). Bu sonuç, Türkmenistan genotipinin daha sert meyvelere sahip olduğunu ve bu özelliğiyle diğer genotiplerden ayrıldığını göstermektedir. Bu durum, Türkmenistan genotipinin muhtemelen daha uzun bir raf ömrüne ve daha iyi bir muhafaza potansiyeline sahip olabileceğini düşündürmektedir. Bu bulgular, adaptasyon çalışmaları ve yeni çeşit geliştirme süreçlerinde genotiplerin özelliklerinin dikkate alınmasının önemini vurgulamaktadır.

Çizelge 3. Genotiplerin meyve sapı özellikleri, meyve eti sertliği ve verim açısından karşılaştırılması

Genotip	Sap uzunluğu (mm)^{öd}	Sap eni (mm) ^{öd}	Sertlik (libre)**	Verim (ağaç/ kg^{-1}) ^{öd}
Kazakistan	21,71	2,97	7,26^{b}	1,9
Türkmenistan	21,12	2,40	7,94^{a}	2,7

**Aynı sütunda farklı harflerle gösterilen ortalamalar arasındaki farklar önemlidir ($p<0.01$), öd: önemli değil.

SONUÇ

Bu çalışma, meyve boyu, eni ve tane ağırlığı açısından üstün olan genotipin Kazakistan genotipine ait olduğunu ortaya koymuştur. Ayrıca, sertlik özelliği bakımından Türkmenistan genotipinin diğer genotiplere kıyasla daha üstün olduğu bulunmuştur. Diğer özellikler (meyve kabuk ve meyve eti renk değerleri, meyve sapı özellikleri ve verim) bakımından ise genotipler arasında önemli bir farklılık tespit edilmemiştir. Bu sonuçlar, tüketici talepleri doğrultusunda yeni çeşit ve genotipler geliştirilmesi için adaptasyon çalışmalarının önemini vurgulamaktadır. Sürdürülebilir tarım ve ıslah çalışmaları, tarımın çevresel, ekonomik ve sosyal sürdürülebilirlik ilkelerine uygun olarak yürütülmesini hedeflemektedir. Bu çalışmalar, verimliliği artırmak, doğal kaynakları korumak, çevresel etkileri azaltmak ve çiftçilerin yaşam kalitesini iyileştirmek amacıyla tarım uygulamalarını geliştirmeyi amaçlamaktadır. Araştırmalar, gelecekteki tarımsal üretimi güvence altına almak ve gıda güvenliğini sağlamak açısından büyük öneme sahiptir. Bu bağlamda her yöreye uygun çeşit ve genotiple ilgili çalışmaların devam etmesi gerekmektedir Sonuç olarak, meyve yetiştiriciliğinde üretici ve tüketici taleplerinin değişkenliği ve ekolojik faktörler altında adaptasyon yeteneği önemlidir. Isparta gibi belirli bir bölgede elma yetiştiriciliği yapılıyorsa, bu faktörleri dikkate alarak yeni genotiplerin geliştirilmesi gerekmektedir. Bu çalışma, Isparta'nın elma yetiştiriciliği sektöründe sürdürülebilirlik ve verimlilik açısından önemli bir katkı sağlayacaktır.

Açıklama: Yazarlardan İlknur ESKİMEZ 100/2000 Sürdülebilir Tematik alanında doktora yapmaktadır. Öğrencimize maddi desteğini esirgemeyen Yükseköğretim Kuruluna teşekkür ederiz.

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MİNÖR MEYVELER VE MEYVE YETİŞTİRİCİLİĞİNDE ÖNEMİ

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ÖZET
Minör meyveler az miktarda yetiştirilen, tanınırlığı az olan meyvelerdir. Genellikle doğada kendiliğinden yetişmekte olan bitkilerden toplanmaktadır. Bu meyve türlerinden bazıları zaman içinde kültüre alınarak sınırlı alanda tarımı başlamıştır. Bir kısmının da hem süs bitkisi olarak kullanımı hem de meyvelerinden yararlanıldığı görülmektedir. Ekolojik bakımdan son derece zengin çeşitliliğe sahip ülkemizde dört mevsim minör meyveleri toplama ve bunlardan yararlanma olanağı bulunmaktadır. Anadolu topraklarında yerel halkın gerek beslenme gerekse ufak da olsa gelir açısından vazgeçilmezleri arasında yer almaktadırlar. Zengin besin içeriği, C vitamini kaynağı ve antioksidan değeri bakımından son derece önemli gıda alternatifleridir. Son yıllarda salgın hastalıkların artmasıyla birlikte bu meyvelerin günlük beslenme diyetinde önemi oldukça değer kazanmıştır. Zengin bir mineral ve vitamin kaynağıdırlar. İnsan vücudunun ihtiyacı olan ek besinleri, desteği sağlamakta faydaları sayılamayacak kadar çoktur. Kalp-damar sağlığının korunması, kolesterolün dengelenmesi, kas sisteminin güçlü olması ve sağlıklı çalışması, diyabete karşı destekleyici etkileri en önemli yararları arasında yer almaktadır. Ekolojik açıdan ele alındığında, iklim değişikliğinin her geçen gün etkilerini daha fazla hissettirdiği göz önüne alındığında, değişen ekolojik koşullarda yaşamını sürdürebilecek meyveler daha da değerli olmaktadır. Tuzluluk, kuraklık, aşırı yağışlar vb. koşullarda hayatta kalabilecek meyvelerin belirlenip, bir an önce yetiştiriciliğinin artması önemlidir. Bir kısmı değerli bir endüstriyel hammadde kaynağıdır. Farklı şekillerde, kurutarak, dondurarak, işlenmiş olarak değerlendirilmeleri olanaklar dahilindedir. Bu da besinlerin uzak noktalara taşınmasını kolaylaştıracaktır. Bu meyvelerinin yetiştiriciliğinin artması tanınırlığının artması ile gelişebilecektir. Ancak bu şekilde daha geniş kitlelere ulaşması mümkün olabilir. Minör meyvelere talebin artması arzını da artıracaktır. Bu nedenle bu derleme makalede önemli minör meyvelere ve özelliklerine yer verilmiş, tanınırlığının artması için öneriler değerlendirilmiştir.

Anahtar Kelimeler: Minör meyveler, aronya, gojiberi, bal meyvesi, Bektaşi üzümü

MINOR FRUITS AND THEIR IMPORTANCE IN FRUIT CULTURE

ABSTRACT

Minor fruits are grown in small quantities and they have little recognition. It is usually collected from natural growing plants in nature. Some of these fruit species have cultivated and their production have began in limited areas. It is seen that some of them are used both as ornamental plants and their fruits are used. In our country, which has an extremely rich ecological diversity, there is the opportunity to collect and benefit from minor fruits in all seasons. They are among the indispensables of the local people in Anatolian lands in terms of both nutrition and income, even if it is small. They are extremely important food alternatives in terms of rich nutritional content, vitamin C source and antioxidant value. With the increase in epidemic diseases in recent years, the importance of these fruits in daily nutrition diet has gained a lot of value. They are a rich source of minerals and vitamins. The additional nutrients needed by the human body are innumerable in providing support. Among the most important benefits are the protection of cardiovascular health, the balancing of cholesterol, the strong and healthy functioning of the muscle system, and its supportive effects against diabetes. From an ecological point of view, considering that the effects of climate change are felt more and more every day, fruits that can survive in changing ecological conditions become even more valuable. Salinity, drought, heavy rains etc. It is important to determine the fruits that can survive in these conditions and to increase their cultivation as soon as possible. Part of it is a valuable source of industrial raw materials. It is possible for them to be evaluated in different ways, by drying, freezing, and processed. This will make it easier to transport food to distant places. The increase in the cultivation of these fruits will be able to develop with the increase in recognition. In this way, it may be possible to reach wider audiences. The increase in demand for minor fruits will also increase the supply. For this reason, in this review article, important minor fruits and their characteristics are included, and suggestions for increasing their recognition are evaluated.

Keywords: Minor fruits, chokeberry, goji berry, honey fruit, gooseberry

GİRİŞ

Minör meyveler az bilinen, sınırlı üretimi bulunan meyve türleri olarak tanımlanabilir. Yerel halk arasında yüzyıllardır gerek besin değerleri gerekse halk ilaçları olarak değer görmüşler; birçok etnobotanik çalışmaya konu olmuşlardır (Sülüşoğlu Durul and Polat, 2022). Türkiye önemli meyve üreticisi ülkelerden biridir. Geniş alanlarda ekonomik olarak yetiştiriciliği yapılan birçok meyve türünün yanı sıra, az bilinen ve yetiştiriciliği sınırlı olan meyve türlerinin de anavatanı veya doğal olarak yetiştiği bir bölgedir. Yüksek besin değerine sahip, tıbbi ve aromatik değeri önemli bu meyveler arasında iğde, muşmula, hünnap, karayemiş, bektaşi üzümü, gojiberi, kocayemiş gibi türler sayılabilir. Minimum maliyetlerle, aşırı sıcak ve kurak koşullarda, farklı toprak yapılarına sahip bölgelerde başarılı bir şekilde yetiştirilebilen bu meyveler gelecekte önemi artacak türler olarak değerlendirilmelidir. Genellikle küçük meyveleriyle yüksek emek gücü ile doğadan toplanarak tüketiciye sunulan minör meyveler vitamin ve mineraller açısından besin değerleri, biyoaktif bileşenleri, çeşitli serbest radikallere karşı antioksidan etkileriyle öne çıkarlar (Ashok et al., 2020). Az bilinen meyveler kırsal kesimde geleneksel yemeklerin vazgeçilmezi olup, yöresel pazarlarda satışa sunulmaktadır. Bu avantajlarına karşın, tüketim miktarı sınırlıdır, ticareti çok azdır ya da henüz yapılmamaktadır.

MİNÖR MEYVELERİN ÖNEMİ VE MEVCUT DURUM

Son yıllarda etkisini iyiden iyiye hissettiren küresel ısınma ve sonucunda ortaya çıkan iklim değişikliği gıda güvenliği ve artan nüfusun beslenmesi sorunlarını da beraberinde getirmiştir. Kırsal nüfusun yoksullukla başa çıkmasında yeterince kullanılmayan meyvelerin gizli açlığa karşı savaşmak için alternatif kaynaklar olarak kullanılabileceği her geçen gün daha fazla vurgulanmaktadır. Yine biyolojik çeşitliliğin de önemli ürünleri arasında yer alan bu meyveler yaban hayvanlarının beslenmesinde de ana zincirin bir parçasıdır. Yerel halk arasında yüzyıllardır gerek besin değerleri gerekse halk ilaçları olarak değer görmüşler; birçok etnobotanik çalışmaya konu olmuşlardır (Sharma et al., 2019).

Günümüzde uygun dikim materyallerinin yeterince üretilememesi gerek üretim alanlarının artmasını gerekse ticarete konu olacak miktarlarda üretimi önemli ölçüde engellemektedir. Acil entegrasyon gerektiren bu sorunların üstesinden gelmek meyve ağacının iyileştirilmesi için bitki biyoteknolojisi yaklaşımları çözümler sağlamaktadır. Bu meyve türlerinin daha verimli çeşitlerinin yetiştiricilikleri için uygun ekolojiler göz önünde bulundurularak ıslahı ve seleksiyonu mutlak gereklidir. Çalışmaların hız kazanması bakımından teknolojik yenilikler önemlidir. Minör meyve türlerinin üretiminde en önemli avantajı sağlayabilecek tekniklerin başında doku kültüründe üretim yer almaktadır. Uzun bir hayat döngüsüne sahip olan, gençlik

kısırlığı bulunan minör meyvelerde, biyotik ve abiyotik stres koşulları, verim çalışmaları için doku kültürü teknikleri süreci hızlandıran bir tekniktir. Bazı minör meyvelerin kademeli toplanması gerekmektedir. Yine toplama bitki yapısı ve meyve yapısından kaynaklı zorluklar oluşturabilmektedir. Kültürel koşulların iyileştirilmesi ve hasadının kolaylaştırılması ele alınması gereken konulardır.

TÜRKİYE'DE YETİŞTİRİCİLİĞİ ARTAN MİNÖR MEYVELER

Aronya (*Aronia melanocarpa*): *Rosaceae* familyasında yer alan, Doğu Amerika orjinli bir bitkidir. Uzun ömürlü, çalı formunda gelişen bir meyvedir. Yarı gölge bitkisidir. Çekici meyve türlerindendir. Meyveleri kurutularak bitki çayı şeklinde değerlendirilebilir. Yoğurtlarda ve içeceklerde renklendirici, tatlandırıcı olarak kullanılabilir. Sağlık açısından antioksidan özellikleriyle bilinmektedir. Bitki kök yapısını oluşturduktan sonra dip sürgünleri ile rahatlıkla yayılabilir. Rüzgar perdesinde alt örtü bitkisi olarak yer verilebilmektedir (Anonim 2023c). Hastalık ve zararlılara dayanıklıdır. 2.5X2.5 m aralıklara dikilebilir. Türkiye'de yetiştiriciliği artan, popüler minör meyvelerdendir (Anonim 2023a, Anonim 2023b).

Bektaşi Üzümü (***Ribes uva-crispa***): Çelikleri ve daldırma ile çoğaltılabilmektedir. Anavatanı Avrupa ve Kuzey Afrika'dır (Anonim 2023c). İlk olarak İngiltere'de kültüre alınan bu meyve, günümüzde en fazla Almanya'da üretilmektedir. İngiltere, Almanya ve Polonya'da ıslah çalışmaları ağırlıklı olarak yürütülmektedir (Stanislaw et al., 2022). Rusya, Polonya, Almanya ve İskandinav ülkelerinde yetiştiriciliği yaygındır (Baker, 1999). Yabani türleri soğuklara dayanıklıdır. Kültür formları aşırı sıcak ve soğuğa karşı hassas olabilmektedir. Orta ağır topraklarda gelişimi iyidir. Organik maddece zengin topraklarda verimi artar (Anonim 2023d). Çalı formunda gelişir ve 1.5 m kadar boylanabilir (Baker, 1999). Bir bitkiden 4-5 kg ürün alınabilmektedir.

Gojiberi (*Lycium barbarium* L.) Gojiberi meyveleri ilk olarak Çin yemeklerinde ve Çin geleneksel tıbbında karşımıza çıkmıştır. Taze, dondurulmuş, kurutulmuş ve şarap, meyve suyu, çay gibi çok farklı şekillerde tüketilebilen bir meyvedir. C vitamini, polisakkaritler, fenolik bileşikler, lif bakımından zengindir. 21. yy'da Avrupa'nın birçok ülkesine yayılmıştır (Vidovi´c et al., 2022). Günümüzde en büyük üretici ülke Çin'de süper meyve olarak tanınmaktadır (Chen et al., 2018). Çalı formunda gelişmekte ve çok uzun yıllar verim vermektedir.

İğde (***Eleagnus angustifolia***): Anavatanı Güney Avrupa, Asya ve Amerikadır. Güneşli yerleri seven ağaçları soğuğa dayanıklı olarak bilinmektedir. Ekolojik değeri yüksek bir türdür. Rüzgâr kıran ve erozyon kontrolü için süs bitkisi olarak geniş çapta yetiştirilmektedir. İğde yaban hayatı habitatı için de geniş alanlarda dikimi yapılan ağaçlar arasındadır. Yas güvercini ve kuzey

bülbülü burada yuva yapar ve diğer yaban hayatı da barınak olarak kullanır. Bal arıları için iyi bir besin kaynağıdır. Kunduzlar baraj inşası malzemesi olarak genellikle iğde dallarını kullanır (Anonim 2023e). Bozulmuş taşkın yatakları ve nehir kıyılarının ilk ağaç türlerinden olup, bir defa yerleşince varlığını her koşulda sürdürebilmektedir. Hatta istilacı tür olabilmektedir. Kireçli toprakları değerlendirilebilmesi diğer bir avantajıdır. Ağaçlarının kuraklığa dayanıklı olması nedeniyle iklim değişikliğinde değerlendirilebilecek türlerdendir. Meyvelerinin su içeriğinin düşük olması, uzun süre saklanmasına ve tüketimine olanak tanımaktadır (Anonim 2023f).

Bal Yemişi (*Lonicera ceaerulea*): 1-3 m boylanabilen çalıdır. Soğuklara ve kireçli topraklara dayanıklıdır; yaz sıcak rüzgarlarına hassastır. Odunsu/yarı odunsu çeliklerle çoğaltılır. Ekonomik ömrü 30 yıldır. İlk defa Rusya'da kültüre alınan meyve antioksidan değerleri ile tıbbi açıdan da öne çıkmaktadır. Kalp koruyucu etkileri, sinir dejenerasyonunu koruyucu faydaları bulunmaktadır; ayrıca iyi bir diyet meyvesidir (Polat et al., 2022). Fidan üretimi yapılmaktadır ve tarımı başlamıştır.

Hünnap (*Zizyphus jujube* Mill.): Kalorisi düşük, C vitamini açısından zengin bir meyvedir. Ayrıca, fenolik maddeler, flavanoidler, triterpenik asitler ve polisakkaritlerce zengindir (Gao ve ark. 2013). Afrika'dan Asya'ya, Güney Avrupa'ya ve Anadolu'ya geniş bir yayılım alanı vardır (Kemeç Hürkan, 2019). 10 m'ye kadar boylanmaktadır. Kansere karşı etkileri bilinmektedir. Diyabete karşı etkilidir. Kök ekstraktlarının antifungal etkileri vardır (Sarfaraz ve ark., 2002). Diyabete karşı etkileri vardır (Gülay, 2013). Ağaçları 7-8 yaşında verime başlamaktadır, ekonomik ömrü 40-50 yıl olup, 400 yaşına kadar yaşayabildiklerinden bahsedilmektedir (Gündoğmuş and Taşçı, 2019).

SONUÇ ve ÖNERİLER

Sunulan minör meyvelerin önemine değinilerek, Türkiye'de yetiştiriciliği artan bazı ılıman iklim minör meyvelerinden örnekler verilmiştir. Bu meyvelerin gen kaynaklarının kısıtlı olması ya da yeterince tanınmaması, ekonomik değerlerinin yeterince bilinmemesi, yetiştiricilikleri konusunda bilgilerin ve gerekli teknolojilerin kısıtlı olması yetiştiriciliklerinin yaygınlaşmasının önündeki önemli kısıtlardır. Yetiştiriciliklerinin geliştirilebilmesi için fidan üretimlerinin ve bahçe tesisinin ulusal projelerle desteklenmesi atılması gereken en önemli adımdır. Pazarlama ağının güçlendirilmesi, istenen fiyat değerlerine çıkılabilmesi için meyve verim ve kalitesinin artırılması önemlidir. Değerlendirme şekilleri konusunda tüketicinin yeterli bilince sahip olması için iyi bir tanıtım çalışmasının yapılması ve ayrıca değerlendirme teknolojilerinin geliştirilmesi önem taşımaktadır.

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SHORT-TERM EFFECTS OF ORGANIC FERTILIZER SUPPORTED WITH DIFFERENT DOSES COMBINATION OF MICROBIAL AND INORGANIC FERTILIZERS ON SOME SOIL PROPERTIES

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ABSTRACT
The application of fertilizers is crucial for enhancing soil fertility and promoting crop growth in agricultural systems. However, traditional methods heavily relying on inorganic fertilizers can have negative impacts on soil health and the environment. To address these concerns, alternative fertilization approaches incorporating organic and microbial fertilizers have gained interest for improving soil quality and minimizing environmental risks. In this study, the short-term effects of organic fertilizer supported with different doses and combinations of microbial and inorganic fertilizers were investigated on selected soil properties at a 0-10 and 10-20 cm depth. Soil parameters including pH, electrical conductivity (EC), organic matter (OM), $CaCO_3$, phosphorus (P_2O_5), water-stable aggregates (WSA), bulk density (BD), porosity, and mean weight diameter (MWD) were analyzed. 100% cattle manure treatment with microbial fertilizer application exhibited higher pH, OM, $CaCO_3$, and P_2O_5 content compared to other treatments. 100% organic cattle manure treatment supported by chemical fertilizers, resulted in increased EC, WSA, and MWD. Notably, 75% cattle manure treatment with microbial fertilizer application and 50% sheep manure treatment with 50% organic sheep manure and 50% chemical fertilizer showed lower values for some soil properties such as OM and P_2O_5.

Keywords: organic fertilizer, inorganic fertilizer, soil properties, short-term effects

INTRODUCTION

The application of fertilizers is an essential practice in agricultural systems to enhance soil fertility and promote crop growth (Zhou et al. 2022; Yousaf et al. 2017). Traditional methods of fertilizer application often rely heavily on the use of inorganic fertilizers, which can have negative impacts on soil health and the environment (Agbede 2010). In recent years, there has been a growing interest in alternative fertilization approaches that incorporate organic and microbial fertilizers to improve soil quality and minimize environmental risks (Li et al. 2020). Understanding the interactions between organic, microbial, and inorganic fertilizers and their effects on soil properties is crucial for sustainable agricultural practices. By evaluating key soil parameters such as nutrient content, pH, organic matter content, and microbial activity, the potential of these fertilizer combinations to enhance soil health can be assesed and support crop productivity. Moreover, studying the short-term effects allows us to evaluate the immediate impacts of these treatments on soil properties, providing valuable insights.

Soils can be exposed to various factors, and this can lead to the deterioration of their physical, chemical, and biological properties (Mulugeta et al. 2019). In Turkey, the most significant problems arising from the destruction of soil cover and its improper use include agricultural land degradation, desertification, and salinization.

The present study aims to investigate the short-term effects of organic fertilizer supported with different doses and combinations of microbial and inorganic fertilizers on selected soil properties. Organic fertilizers, derived from natural sources such as animal manure, compost, or plant residues, offer several advantages over synthetic fertilizers. They contribute to long-term soil fertility, enhance soil structure and water-holding capacity, and promote the activity of beneficial soil microorganisms. Microbial fertilizers, on the other hand, consist of beneficial microorganisms such as bacteria, fungi, or mycorrhizal species that can improve nutrient availability and plant growth.

The findings of this study will contribute to our knowledge of the efficacy of organic fertilizer supported with microbial and inorganic fertilizers in improving soil properties. This information can guide farmers in making informed decisions regarding fertilizer management practices, promoting sustainable agriculture, and minimizing the negative environmental impacts associated with conventional fertilization methods.

MATERIALS and METHOD

Experimental set-up

The experiment was conducted at Erciyes University Agricultural Research and Application Center (ERÜTAM) using the randomized complete block design. Soil analyses were carried out in the laboratories of the Soil Science and Plant Nutrition Department at Erciyes University. According to the analysis results, the soil in the experimental area has a sandy-loam texture. The lime content is low, and in terms of salinity classification, the soil in the study area is non-saline and slightly alkaline. The organic matter content of the study area soils is relatively low (Soil Survey Staff, 1993).

Table 1. Amount and the source of tratments

Treatments
100% cattle manure (2000 kg/ha)
75% cattle manure (1500 kg/ha) + 25% chemical fertilizer (8 kg/ha P_2O_5+ 5 kg/ha N)
50% cattle manure (1000 kg/ha) + 50% chemical fertilizer (8 kg/ha P_2O_5+ 10 kg/ha N)
Full dose of control chemical fertilizer (8 kg/ha P_2O_5, 20 kg/ha N)
100% sheep manure (800 kg/ha)
75% sheep manure (600 kg/ha) + 25% chemical fertilizer (8 kg/ha P_2O_5+ 5 kg/ha N)
50% sheep manure (400 kg/ha) + 50% chemical fertilizer (8 kg/ha P_2O_5+ 10 kg/ha N)

The nitrogen-based chemical fertilizers were split, with half applied at the time of seeding and the remaining portion applied during the hoeing operation when the plants reached a height of 40-45 cm. In the study, the row length of the plots was 5 m, and inter-row spacing was 15 cm, resulting in each plot consisting of 5 rows (5 m x 3.5 m = 17.5 m^2 plot area). To ensure isolation between treatments, a 2 m gap was left between blocks and a 1 m gap between plots.



Figure 1. Experimental site

Soil Sampling and Analysis

Approximately 500 grams of soil samples were collected from each plot at depths of 0-10 cm and 10-20 cm, representing both disturbed and undisturbed areas. The collected samples were kept at room temperature until they reached an air-dried and then sieved through a 2 mm mesh to prepare them for analysis. Soil pH and Electrical Conductivity (Anonymous 1954) analyses were conducted. Organic matter content was determined using the Walkey Black wet oxidation method described by Nelson and Sommers (1982). % CaCO3 content was determined according to the method by Çağlar (1958). Soil bulk density (Richards 1954) and texture (Bouyoucos 1951) analyses were also performed. Mean weight diameter (Demiralay 1993) was calculated. Aggregate stability analysis was conducted following the method by Kemper and Rosenau (1986). The porosity of the soils was determined using the dry bulk density and particle density of soil.

Statistical Analysis

The research findings were subjected to variance analysis using the randomized complete block design in the SAS program (SAS Inst. 1999). The significance of differences between means was determined using the Duncan test.

RESULTS and DISCUSSION

The analysis of soil properties at the 0-10 and 10-20 cm depth revealed significant variations among the different treatments (Table 2 and 3). Soil pH values ranged from 7.52 to 7.76, with 50% sheep manure treatment (wb) having the lowest pH and 100% cattle manure treatment (wb) having the highest pH. Electrical conductivity (EC) values ranged from 0.24 to 0.46 dS m^{-}, with 50% sheep manure treatment having the lowest EC and 75% sheep manure treatment having the highest EC. Organic matter (OM) content exhibited significant differences among the treatments,

with values ranging from 1.10 to 2.23. 100% cattle manure treatment (wb) had the highest OM content, while 50% cattle manure treatment (wb) had the lowest. The application of organic and microbial fertilizers seemed to have a positive effect on increasing the OM content compared to the control treatment. Calcium carbonate ($CaCO_3$) content varied from 0.73 to 1.91%, with 100% sheep manure treatment having the highest $CaCO_3$ content and 75% sheep manure treatment (wb) having the lowest. 100% sheep manure treatment showed the highest $CaCO_3$ content, indicating the influence of the fertilizer type on the soil's $CaCO_3$ content. Phosphorus content ranged from 12.19 to 23.37 kg da^{-}, with 100% sheep manure treatment having the highest phosphorus content and 50% sheep manure treatment (wb) having the lowest. The application of organic fertilizers, especially 100% sheep manure treatment resulted in higher phosphorus levels compared to other treatments. Water-stable aggregates (WSA) ranged from 0.29 to 0.65, with 50% sheep manure treatment having the lowest WSA and 100% sheep manure treatment having the highest. The incorporation of organic and microbial fertilizers seemed to improve soil aggregation, as higher WSA values were observed in treatments with organic amendments. Bulk density (BD) values ranged from 1.15 to 1.36 g cm^{-3}, with 50% sheep manure treatment having the lowest BD and 75% sheep manure treatment (wb) having the highest. The addition of organic and microbial fertilizers appeared to have a positive effect on reducing soil compaction. Porosity and MWD results showed minor variations among the treatments, with values ranging from 0.45 to 0.57. The treatments did not significantly influence these soil properties.

Table 2. Soil properties for the 0-10 cm soil depth

	Treatments	pH	EC	OM	$CaCO_3$ (%)	P_2O_5 (kg da^{-})	WSA	BD (g cm^{-3})	Porosity	MWD
wb	100% cattle manure (wb)	7.76	0.33	**2.23^{a}**	1.60^{bc}	19.32^{bc}	0.50^{cd}	1.23^{de}	0.54^{bc}	0.52^{bc}
	75% cattle manure (wb)	7.73	0.34	1.78^{d}	1.61^{cb}	18.17^{c}	0.35^{f}	1.33^{ab}	0.50^{ef}	0.49^{d}
	50% cattle manure (wb)	7.54	0.28	**1.10^{f}**	0.91^{gh}	17.53^{cd}	0.31^{gh}	1.23^{de}	0.53^{bc}	**0.56^{a}**
	Full dose chemical (wb)	7.61	0.29	1.15^{f}	1.68^{b}	15.38^{de}	**0.29^{h}**	1.19^{ef}	0.55^{ab}	0.55^{ab}
	100% sheep manure (wb)	7.64	0.30	1.80^{bcd}	0.85^{gh}	21.34^{ab}	0.57^{b}	1.23^{de}	0.54^{bc}	0.56^{a}
	75% sheep manure (wb)	7.66	0.33	1.77^{d}	1.35d^{ef}	18.43^{c}	0.51^{c}	1.22^{ed}	0.54^{bc}	0.54^{ab}
	50% sheep manure (wb)	7.72	0.34	1.39^{e}	1.28^{ef}	13.50^{ef}	0.48^{de}	1.25^{d}	0.53^{bc}	**0.45^{f}**
nb	100% cattle manure	7.68	0.26	2.00^{b}	1.24^{f}	18.70^{bc}	0.59^{b}	1.27^{cd}	0.52^{cde}	0.50^{cd}
	75% cattle manure	7.72	0.31	1.71^{d}	1.53^{bcd}	16.74^{cd}	0.57^{b}	**1.15^{f}**	**0.57^{a}**	**0.45^{f}**
	50% cattle manure	7.69	0.28	1.66^{d}	1.47^{cde}	**12.19^{f}**	0.45^{e}	1.23^{de}	0.53^{c}	0.50^{cd}
	Full dose chemical	7.52	0.30	1.15^{f}	0.98^{g}	13.29^{ef}	0.34^{fg}	1.22^{de}	0.54^{bc}	0.49^{de}
	100% sheep manure	7.70	0.34	1.98^{bc}	**1.91^{a}**	**23.37^{a}**	**0.65^{a}**	1.28^{bcd}	0.52^{cde}	0.46^{ef}
	75% sheep manure	7.63	0.46	1.79^{cd}	**0.73^{h}**	17.87^{cd}	0.32^{gh}	1.31^{abc}	0.50^{def}	0.52^{bc}
	50% sheep manure	7.67	0.24	1.27^{ef}	1.64^{bc}	12.84^{ef}	0.29^{h}	**1.36^{a}**	**0.49^{f}**	0.51^{cd}

Wb: with bacteria treatment, nb: no bacteria treatmant, EC: electrical conductivity, OM: organic matter content, WSA: water stabil aggregate, BD: bulk density, MWD: mean weight diameter

Table 3. Soil properties for the 10-20 cm soil depth

	Treatments	pH	EC	OM	$CaCO_3$ (%)	P_2O_5 (kg da^{-})	WSA	MWD
wb	100% cattle manure (wb)	7.74	0.27	**1.87^{a}**	1.67^{ab}	9.84^{cde}	0.56^{d}	0.58^{a}
	75% cattle manure (wb)	7.84	0.29	1.74^{abc}	**1.78^{a}**	11.01^{abc}	0.45^{e}	0.50^{def}
	50% cattle manure (wb)	7.84	0.24	1.41^{ef}	1.48^{bcd}	5.98^{g}	**0.32^{f}**	0.57^{a}
	Full dose chemical (wb)	7.66	0.22	1.33^{efg}	1.29^{de}	5.71^{g}	0.34^{f}	0.56^{ab}
	100% sheep manure (wb)	7.61	0.22	1.68^{bc}	1.50^{bcd}	**12.40^{a}**	0.64^{bc}	0.52^{cde}
	75% sheep manure (wb)	7.67	0.29	1.45^{de}	**0.79^{f}**	8.48^{ef}	0.48^{e}	0.58^{a}
	50% sheep manure (wb)	7.72	0.19	1.35^{efg}	1.18^{e}	**5.40^{g}**	0.45^{e}	0.49^{ef}
nb	100% cattle manure	7.74	0.24	1.79^{ab}	1.36^{cde}	8.95^{ef}	**0.78^{a}**	0.56^{ab}
	75% cattle manure	7.73	0.24	1.62^{c}	1.54^{a-d}	11.41^{ab}	0.55^{d}	0.50^{def}
	50% cattle manure	7.69	0.22	1.39^{ef}	1.62^{ab}	9.39^{def}	0.61^{c}	0.49^{ef}
	Full dose chemical	7.61	0.16	1.26^{fg}	1.48^{bcd}	6.31^{g}	0.47^{e}	**0.47^{f}**
	100% sheep manure	7.69	0.24	1.58^{cd}	1.56^{abc}	10.72^{bcd}	0.66^{b}	0.53^{bcd}
	75% sheep manure	7.71	0.23	1.38e^{f}	1.67^{ab}	7.99^{f}	0.54^{d}	0.54^{abc}
	50% sheep manure	7.53	0.19	**1.20^{g}**	1.33^{cde}	8.11^{f}	0.47^{e}	0.51^{c-f}

Wb: with bacteria treatment, nb: no bacteria treatmant, EC: electrical conductivity, OM: organic matter content, WSA: water stabil aggregate, BD: bulk density, MWD: mean weight diameter

The properties of soil samples taken from the 10-20 cm depth are presented in Table 2. The pH values ranged from 7.53 to 7.84. Electrical conductivity (EC) values ranged from 0.16 to 0.29 dS m^{-}. Organic matter content varied among the treatments, with values ranging from 1.20 to 1.87%. 100% cattle manure treatment (wb) had the highest OM content where the 50% sheep manure treatment had the lowest. The $CaCO_3$ content ranged from 0.79 to 1.78%, indicating a moderate lime presence in the soil. Phosphorus content for 10-20 soil depth varied among the treatments, with values ranging from 5.40 to 12.40 kg da^{-}. 100% sheep manure treatment (wb) had the highest P_2O_5, significantly higher than other treatments. Overall, the application of different combinations of organic, microbial, and inorganic fertilizers had notable effects on various soil properties. The results highlight the potential of organic fertilizers in improving soil quality and nutrient availability. Further analysis and interpretation of these results will provide valuable insights into the short-term effects of these fertilizer combinations on soil properties and their implications for sustainable agricultural practices.

CONCLUSION

In conclusion, the findings of this study highlight the potential of different fertilizer combinations to influence selected soil properties in the short term. The incorporation of organic

and microbial fertilizers, along with inorganic fertilizers, demonstrated varying effects on soil pH, electircal conductivity, organic matter content, lime content, phosphorus availability, water-stable aggregates, bulk density, porosity, and mean weight diameter. The findings of this study contribute to our understanding of the short-term effects of different fertilizer combinations on soil properties. However, further research is warranted to assess the long-term impacts, crop performance, and environmental implications associated with these fertilizer treatments. Additionally, considering the site-specific conditions and crop requirements is crucial for the successful implementation of fertilizer management strategies in agricultural systems. In summary, incorporating organic and microbial fertilizers, alongside appropriate doses of inorganic fertilizers, can offer promising opportunities for improving soil health and sustaining agricultural productivity. By adopting sustainable fertilizer practices, farmers and land managers can enhance soil fertility, minimize environmental risks, and ensure the long-term sustainability of agricultural systems.

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KONYA KAPALI HAVZASI'NIN TARIM VE SU POTANSİYELİ

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ÖZET
Bu çalışmada, Türkiye'deki 25 hidrolojik havzadan biri olan Konya Kapalı Havzası'nın toprak ve su kaynakları ile tarımsal potansiyeli değerlendirilmiştir. Havzanın toplam yüz ölçümü 49 786 km^2 olup, başta Konya, Niğde, Aksaray, Karaman olmak üzere Ankara, Isparta ve Nevşehir illerinin toprakları bulunmaktadır. Havzanın yıllık ortalama yağış miktarı, 380-400 mm arasında değişmektedir. Beyşehir Gölü başlıca yer üstü su (YÜS) kaynağı olmakla birlikte, havza sınırları içerisinde içme-kullanma ve sulama amaçları ile inşa edilmiş birçok baraj bulunmaktadır. Havzada yer altı suyu (YAS) kullanımı, son yıllarda artarak devam etmiştir. Bu durum, havzadaki yer altı su seviyesinin giderek düşmesine sebep olmaktadır. Havzanın yaklaşık yarısını (%45,77) tarım alanları, %26'sını ise orman ve meralar oluşturmaktadır. Havzada 2 655 040 ha'lık alan (%53,31) yarı kurak sınıfına ait olup, bu sınıfa sahip tarım arazi varlığının yüksek olması, havzada yetiştirilen birçok bitki türü için sulamanın yapılmasını zorunlu kılmaktadır. Havzadaki sulama alanına ilişkin olarak muhtelif kaynaklarda farklı değerler verilmekle birlikte, bu değerler 1 070 108 ha ile 904 467 ha arasındadır. Bu hususta YÜS sulamaları, 220 242 ha ile 461 364 ha arasında değişirken, YAS sulamaları 575 903 ha ile 698 485 ha değerleri arasında bir sulama alanını teşkil etmektedir. Havzanın toplam su potansiyeli 5,07 milyar m^3/yıl kadardır. Havzanın yıllık kullanılabilir su potansiyeli ise, akarsulardan 1,25 milyar m^3/yıl ve YAS kaynaklarından 2,023 milyar m^3/yıl olmak üzere toplam 3,27 milyar m^3/yıl olarak tahmin edilmektedir. Havza, bitkisel üretim anlamında Türkiye'nin önde gelen bölgelerinden birini oluşturmaktadır. TÜİK verilerine göre, havzada üretim miktarı bakımından önde gelen bitkiler, şeker pancarı, mısır, yonca, patates, elma ve buğday olarak belirlenmiştir. Kısaca ifade etmek gerekirse Konya Kapalı Havzası, zengin tarımsal arazi varlığı ve üretim potansiyeline rağmen, yıllık yağış miktarı ve sulamada kullanılan su kaynakları kısıtlı bir bölgedir.

Anahtar Kelimeler: Konya Kapalı Havzası, Su Kaynakları, Arazi Varlığı, Sulama Alanı, Bitkisel Üretim

AGRICULTURE AND WATER POTENTIAL OF KONYA CLOSED BASIN

ABSTRACT

In this study, soil and water resources and agricultural potential of Konya Closed Basin, which is one of the 25 hydrological basins in Turkey, were evaluated. The total surface area of the basin is 49 786 km^2 and includes the lands of Ankara, Isparta and Nevşehir provinces, especially Konya, Niğde, Aksaray, Karaman. The annual average rainfall of the basin varies between 380-400 mm. Although Beyşehir Lake is the main source of surface water (SW), there are many dams built for drinking-use and irrigation purposes within the borders of the basin. Groundwater use (GW) in the basin has continued to increase in recent years. This situation causes the groundwater level in the basin to decrease gradually. Approximately half (45.77%) of the basin is composed of agricultural areas, and 26% is forest and pastures. An area of 2 655 040 ha (53.31%) in the basin belongs to the semi-arid class, and the high amount of agricultural land in this class necessitates irrigation for many plant species grown in the basin. Although different values are given in various sources regarding the irrigation area in the basin, these values are between 1 070 108 ha and 904 467 ha. In this regard, SW irrigations vary between 220 242 ha and 461 364 ha, while GW irrigations constitute an irrigation area between 575 903 ha and 698 485 ha. The total water potential of the basin is 5.07 billion m^3/year. The annual usable water potential of the basin is estimated to be 3.27 billion m^3/year, 1.25 billion m^3/year from rivers and 2.023 billion m^3/year from groundwater resources. The basin is one of the leading regions of Turkey in terms of crop production. According to TUIK data, the leading crops in terms of production amount in the basin are sugar beet, corn, clover, potato, apple and wheat. In short, Konya Closed Basin is a region with limited annual precipitation and water resources used for irrigation, despite its rich agricultural land and production potential.

Keywords: Konya Closed Basin, Water Resources, Land Resource, Irrigation Area, Crop Production

INTRODUCTION

The basin is the geographical term that forms the entire area within this area by collecting the part of the precipitation waters that are stored and transferred to the surface flow in a water collection area. Konya Closed Basin is one of the 25 hydrological basins in Turkey. As there is no outflow of water to the seas as in river basins, the waters collect and form a closed area and the basin creates its own water resources (Yazıcı et al., 2019). In this study, soil and water resources and agricultural potential of Konya Closed Basin were evaluated. For this purpose, previously published articles and reports about the basin were used.

Konya Closed Basin is located in the Central Anatolia Region and between 36°51' and 39°29' north latitudes and 31°36' and 34°52' east longitudes (TUBITAK, 2010). It is surrounded by Sakarya and Kızılırmak from the north, Kızılırmak and Seyhan from the east, the Eastern Mediterranean from the south, and Antalya and Akarçay Basins from the west. The total area of the basin, which covers approximately 6.4% of Turkey's surface area, is 49 786 km^2 (Anonymous, 2018). The lands of the provinces of Konya, Niğde, Aksaray, Karaman, Ankara, Isparta and Nevşehir are located in the basin. A small part of Antalya and Mersin without a settlement is also in the basin area. The map of the basin is given in Figure 1.

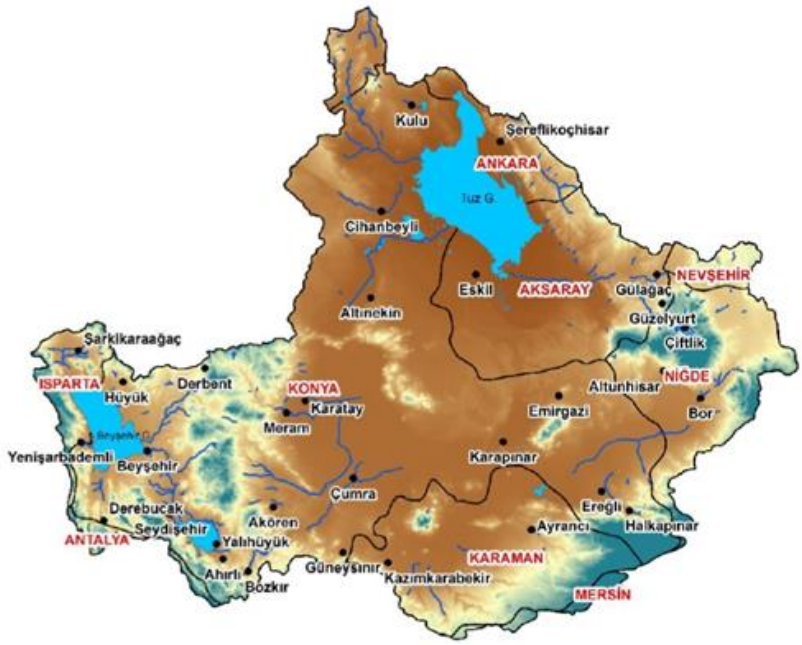

Figure 1. Konya Closed Basin provinces and districts (Anonymous, 2020)

Konya Closed Basin was formed due to the air movements of an old river bed rising in the middle of Anatolia. As a result of insufficient drainage, its soils are often alluvial and saline.

The plain is covered with limestone and volcanic mountain ranges (up to 3534 meters high). The same mountains also prevent drainage to the sea and effectively form Turkey's largest basin. Since it can only empty its waters into lakes, swamps or semi-swamps, it has the characteristics of a closed basin (TUBITAK, 2010).

KONYA CLOSED BASIN

Climate

Konya Closed Basin is a basin where different climates can be experienced due to its large area. In the south, there is a Mediterranean climate with warm and rainy winters and hot and dry summers, a continental climate in the middle and northern parts, and a desert climate in and around Karapınar (T.R. Ministry of Agriculture and Forestry, 2015).

Semi-arid climate is dominant in a large part of Konya Closed Basin, and 70% of the precipitation occurs outside the crop growing period (İnan et al., 2006). The annual average rainfall of the basin varies between 380-400 mm (Anonymous, 2020). The recent decrease in the total amount of precipitation indicates that the basin has begun to transition from a semi-arid climate to an arid climate (Şen and Başaran, 2007).

Due to the different climate types seen in the Konya Closed Basin, the temperature distribution differs. Although the monthly average temperature varies between 0.3^{o}C and 23°C, July and August are the hottest months, and January and February are the coldest months. Looking at the monthly temperature averages for many years, it is seen that the temperature drops to zero or below only in January. The average temperatures of January and February, measured at the meteorological observation stations of Karaman and Hasan Mountain, can fall below zero. In Aksaray, Yalıhüyük, Emirgazi and Seydişehir observation stations, it was not observed that the average temperatures fell below zero. In summer, the average temperature of the basin is above 18°C. In July, the average temperature is 22°C and the precipitation amount is 6.6 mm, while the temperature is almost the same in August, the precipitation is slightly higher and reaches 13 mm. (T.R. Ministry of Agriculture and Forestry, 2022).

Water Resources and Sub-Basıns

The regimes of the current streams in the Konya Closed Basin, where precipitation is irregular and low, are irregular. Streams located mostly in the east, west and south of the basin are not in

a position to meet the water requirement of the basin, and many streams and streams dry up in the dry summer months or their flow rates decrease significantly. Beyşehir Lake, Turkey's third largest lake and the largest natural lake in terms of usable fresh water reserves, is one of the most important surface water resources of the basin. It is a 656 km² wide tectonic depression lake and is still the largest potable water source in Turkey. Due to the indiscriminate withdrawal of water from the lake for various purposes, it is facing the danger of gradual extinction, pollution and deterioration (T.R. Ministry of Agriculture and Forestry, 2020).

Due to the insufficient surface water supply in the region, the use of groundwater has continued to increase since the 1960s. It is a fact that there have been problems in the use of groundwater in recent years in the basin, which has a significant amount of groundwater. In recent years, the demand for groundwater has increased even more due to the decrease in precipitation, especially in April and May, which is required by grains (DSI, 2009). In the Konya Plain, the underground flow is towards Aksaray Plain in the northeast and Altınekin Plain in the north (Göçmez and İşçioğlu, 2004). State Hydraulic Works (DSI) IV. The Regional Directorate has determined 9 different sub-basins in the Konya Closed Basin, taking into account the characteristics such as surface precipitation area, groundwater recharge area, geological, hydrogeological and aquifer structure in terms of underground water resources (Tunçok and Bozkurt, 2015). Figure 2 shows the map showing the sub-basins of the Konya Closed Basin, and Table 1 includes information on the sub-basins' groundwater operating reserve, allocation amounts and consumption. As can be seen here, the amount of water withdrawn in some sub-basins is considerably higher than the allocated amount.

Table 1. Information on Konya Closed Basin Sub-basins and water amount (DSI, 2020)

Sub-Basins	**Groundwater Reserve (hm^3/year)**	**Groundwater Allocation (hm^3/year)**	**Actual Consumption (hm^3/year)**
Beyşehir	130	70,81	112,59
Çumra-Karapınar	456	914,06	1371,39
Karaman-Ayrancı	244	384,32	477,67
Ereğli-Bor	435	283,92	569,02
Sultanhanı-Obruk	440	572,21	877,65
Altınekin	71	48,17	86,2
Cihanbeyli-Kulu	68	71,84	144,78
Şereflikoçhisar	32	2,87	3,65
Misli	147	45,58	132,58
Total	**2479,26**	**2811,31**	**3775,53**



Figure 2. Konya Closed Basin Sub-Basins

Irrigation Organizations

In order to ensure the proper management and sustainability of existing water resources, some policies are implemented and the structures that will ensure that these policies are transferred to the field in the most effective way are irrigation organizations. These organizations have a say in the use of water in agriculture. The main irrigation organizations in the basin are irrigation associations, irrigation cooperatives, municipality, provincial special administration, village legal entity and public irrigations.

Information on the irrigation areas of the irrigation associations in the basin is given in Table 2. In 2020, the total irrigation area of the irrigation associations is 188 496 ha. Looking at the irrigation areas of the associations on a provincial basis, Aksaray has 21 022 ha, Karaman 31 862 ha, Konya 131 712 ha, Isparta 2490 ha and Ankara 1410 ha. Located in Konya - Çumra district, Çumra Irrigation Association and Ova Irrigation Association together cover a total area of 74 098 ha (DSI, 2022a).

Table 2. Konya Closed Basin Irrigation Associations (DSI, 2022a)

Province	District	Irrigation Association	Irrigation Area (ha)
Aksaray	Merkez	Uluırmak	20 122
	Ortaköy	Ekecik Bozkır	900
Karaman	Merkez	Karaman Ovası	31 862
Konya	Çumra	Çumra	74 098
	Çumra	Ova	
	Ereğli	İvriz	36 108
	Ereğli	İvriz Sol Sahil ve Yıldızlı	
	Seydişehir	Seydişehir	21 506
Isparta	Yenişarbademli	Yenişarbademli	2490
Ankara	Şereflikoçhisar	Şereflikoçhisar Ovası	1410
Total			**188 496**

Apart from irrigation associations in the basin, the irrigation areas of other irrigation organizations and public irrigation originating from surface water (SW) in 2020 are given in Table 3. In 2020, irrigation cooperatives carried out their activities on a total area of 9 508 ha, municipal irrigation on 22 328 ha, village legal entity and agricultural development cooperatives irrigation on 3 891 ha, provincial special administrations on 17 959 ha and public irrigation on 13 928 ha (DSI, 2017 and DSI, 2022b).

Table 3. Irrigation areas of other irrigation organizations and public irrigation originating from surface water

Irrigation Organizations	Irrigation Area (ha)
Irrigation Cooperatives	9508*
Municipal Irrigation	22 328*
Village Legal Entity + Agricultural Development Cooperative	3891*
Provincial Special Administration	17 959**
Public İrrigation	13 928**
Total	**67 614**

* DSI (2022b); ** DSI (2017)

Information on the number of GW (Groundwater) irrigation cooperatives and irrigation areas in the basin are given in Table 4. The total number of irrigation cooperatives is 286, and the total irrigation area is 211 280 ha (DSI, 2022b and DSI, 2017). Konya province constitutes a large part of the basin in terms of the number of irrigation cooperatives and irrigation area.

Table 4. Number of GW irrigation cooperatives and irrigation areas in the basin

Province	Irrigation Cooperative*	Irrigation Area (ha)**
Aksaray	26	15 251
Karaman	33	34 631
Niğde	54	24 194
Konya	166	136 510
Nevşehir	4	-
Isparta	3	694
Total	**286**	**211 280**

*DSI (2022b); **DSI (2017)

There are plenty of certified and uncertified wells within the borders of the basin. The total number of certified wells in the basin is 18 913. Since the safe underground water reserve of the basin was exceeded by the allocations, new wells were not allowed to be drilled and as a result, many uncertified wells were drilled. The total number of uncertified wells was 55 708 (DSI, 2009 and DSI, 2017).

Land Existence and The Area Opened To Irrigation

Information on the land classes of the Konya Closed Basin is given in Table 5. Accordingly, approximately half of the basin (45.77%) is agricultural areas and 26% is forests and pastures (Ateşoğlu et al., 2019).

Table 5. Distribution of Konya Closed Basin by land classes (Ateşoğlu et al., 2019).

Land Class	Land Area (ha)	Share in the Basin (%)
Settlements	122 493	2,46
Agricultural Areas	2 279 480	45,77
Forests	258 043	5,18
Pastures	1 039 010	20,86
Water Surfaces	200 838	4,03
Other Areas	1 080 668	21,70
Total	**4 980 532**	**100**

The size of the unirrigated agricultural land in the basin is 1 435 090 ha and it constitutes approximately 63% of the basin's agricultural areas. While the orchards and greenhouses have a total area of 24 250 ha, the size of the remaining irrigated agricultural areas is 820 141 ha. In the Konya Closed Basin, an area of 2 655 040 ha (53.31%) belongs to the semi-arid class, and the largest land use class in this class belongs to agriculture with 1 240 000 ha (Ateşoğlu et al., 2019). The high availability of semi-arid agricultural land necessitates irrigation for many plant species grown in the basin. In Figure 3, the land use map of the Konya Closed Basin is given.

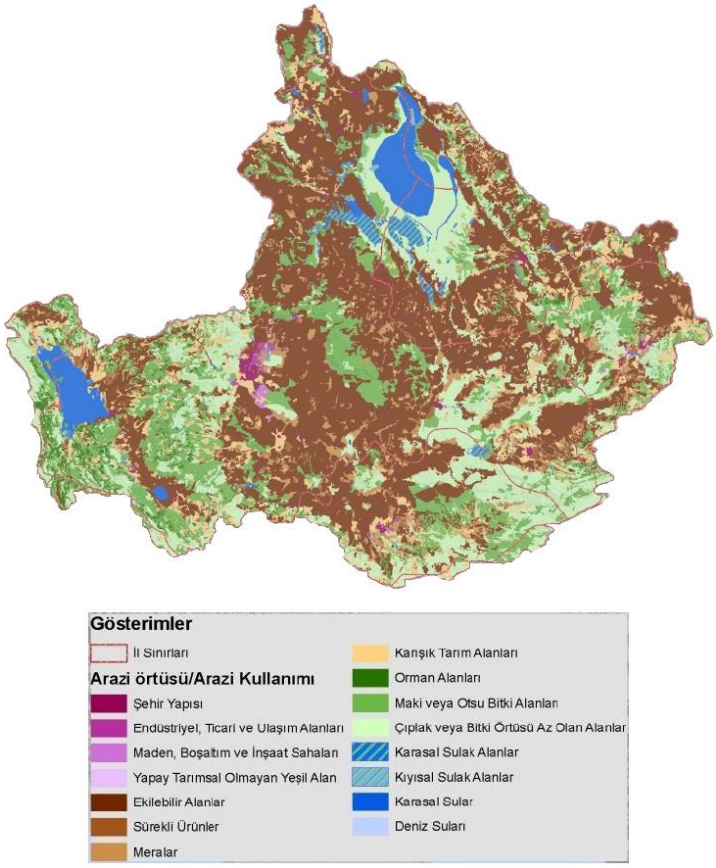

Figure 3. Land use of Konya Closed Basin

Different values are given in various sources regarding the size of the basin irrigation area. For example, according to Anonymous (2018) data, it was determined that 792 388 ha of the area irrigated under productive conditions in the basin in 2012 and 620 570 ha of this area were irrigated with groundwater. The main districts that come first in terms of the size of the irrigated area in the basin are Çumra, Altınekin, Ereğli, Karapınar, Karatay, Karaman Merkez, Aksaray Merkez, Niğde Merkez. The data shown in some sources about basin irrigation are as given in Table 6.

Table 6. Data from different sources related to the area opened for irrigation in the basin

Water Source	Organizations	DSI (2009)	DSI (2022a)	DSI (2023)	Anonymous (2022)
Surface Water (SW)	DSI	220 242	224 189	225 482	232 125
	PSA+PI	147 920	-	65 829+94 508	229 239
Ground-water (GW)	Cooperatives	198 814	180 607	207 783	180 607*
	Certified Wells	174 891	174 891*	368 120 (OI)	428 137 (PI)
	Uncertified Wells	324 780	324 780*		
Total		**1 066 647**	**904 467**	**961 722**	**1 070 108**

PSA: Provincial Special Administration; PI:Public Irrigation; OI: Other Irrigation
*DSI (2009)

According to DSI (2017) data, more detailed information on the agricultural areas opened for irrigation in the basin is given in Table 7. According to this table, a total of 890 352 hectares of land, 264 013 ha from SW resources and 626 339 ha from GW resources, has been opened to irrigation in the basin.

Table 7. The agricultural area opened to irrigation in the basin and its distribution to the provinces (DSI, 2017)

Water Source	Organizations	Distribution of irrigation areas by provinces (ha)							
		Basin	**Konya**	**Karaman**	**Aksaray**	**Niğde**	**Isparta**	**Ankara**	**Nevşehir**
SW	DSI	232 125	157 406	21 518	24 280	7556	19 955	1410	0
	PSA	17 959	11 133	538	2352	2868	1069	0	0
	PI	13 928	7565	3323	1980	679	381	0	0
	Total	264 013	176 104	25 379	28 612	11 103	21 405	1410	0
GW	IC	212 130	137 360	34 631	15 251	24 194	694	0	0
	PI	414 209	250 205	35 999	72 572	49 183	0	0	6251
	Total	626 339	387 565	70 630	87 823	73 377	694	0	6251
Total		**890 352**	**563 668**	**96 009**	**116 435**	**84 480**	**22 099**	**1410**	**6251**

PSA: Provincial Special Administration; PI:Public Irrigation; IC: Irrigation Cooparetives

Irrıgation Area Crop Pattern and Production Amount

The distribution of irrigated crops in the basin for the year 2020 has been compiled according to the provinces according to TUIK (2020) and is given in Table 8. According to the table, the main crops with the highest production area in the basin are wheat, maize, barley, sugar beet and sunflower. The total production area of these five plants constitutes 73% of the total irrigated land. Konya province has reached the highest cultivation area values for all plants except dry beans, potatoes, watermelon, pepper and apple. In Aksaray, sunflower, barley and sugar beet, in Karaman, apple, sugar beet and sunflower are prominent plants. Potato, dry bean and applesin Niğde, silage maize in Isparta, onion in Ankara and potato in Nevşehir draw attention.

Table 8. Distribution of irrigated crop production area in the basin by provinces and plants (TUIK, 2020)

Crop	The size of the planted area (ha)							
	Aksaray	**Karaman**	**Konya**	**Niğde**	**Isparta**	**Ankara**	**Nevşehir**	**Total**
Wheat	22 349,8	9584,9	152384,4	23583,8	157,8	552,5	1 030,1	209 643,3
Barley	11 892,5	5 689,9	70 166,1	3 895,3	25	1 576	187,2	93 432
Dry Bean	655	8 177	14 842,6	15 725	38,3	12,5	5 300	44 750,4
Chickpea	36,9	1 433,3	3 636,3	-	-	-	-	5 106,5
Safflower	100	3,3	255,8	-	-	-	-	359,1
Canola	70	-	324,7	-	-	-	-	394,7
Oat	-	145,8	634,1	-	-	-	584,9	1 364,8
Triticale	-	49	1 019,4	360	-	-	-	1 428,4
Lentil	-	-	191,6	-	-	-	-	191,6
Potato	5 000	1 734	13 086,1	17 892	0,6	250	2 150	40 112,7
Sugar Beer	11 337,7	7 302,4	69 882,8	1 424,4	774,7	1 638,9	-	92 360,9
Maize	8 318,2	28 961	89 681,8	57,2	109,8	290,1	-	127 418,1
Silage Maize	8 871	5 562,5	35 343	6 020	1 351,9	550	367,7	58 066,1
Sunflower	12 034,1	8 559,7	55 590,6	50	-	160	-	76 394,4
Clover	16 517	4 288	32 587	6 016	318	500	400	60 626
Watermelon	607	1 924	1 396	484	50,2	100	-	4 561,2
Melon	525	1 277,5	2 799,5	677	42	750	-	6 071
Pepper	130,7	990,3	471,8	253,7	71,6	-	0,4	1 918,5
Tomato	2 363,5	2 349,7	7 820,4	2 509,6	209,9	80	3,2	15 336,3
Onion	141,5	734	1 916,7	542	403,3	3 500	7	7 244,5
Apple	1 575,6	18 373,7	9 547,8	14 707	1 018,3	11,6	37,8	45 271,8
Grape	716	3 497,7	4 170,3	2 565	412,2	115,5	102,8	11 579,5
Cherry	71,5	663,1	1 580,1	217	250,5	-	0,6	2 782,8
Total Irrigated Land	**103 313**	**111 300,8**	**569 328,9**	**96 979**	**5 234,1**	**10 087,1**	**10 171,7**	**906 414,6**
Total Agricultural Land	**321 390**	**306 557,8**	**1 423 443,5**	**192 001,5**	**34 252,3**	**92 715,8**	**23 954,5**	**2 394 315,4**

The annual product amounts of the crops cultivated in irrigated water in the basin for the year 2020 have been compiled according to TUIK (2020) on the basis of provinces and are given in Table 9. The leading plants in terms of production amount in basin irrigation were determined as sugar beet, corn, clover, potato, apple and wheat. The total production amount of these six plants constituted approximately 87% of the total production in irrigated conditions in the basin. Konya province has reached the highest production values in all plants except dry beans, potatoes, watermelon, pepper and apple. Clover and sugar beet production in Aksaray, sugar beet and apple in Karaman, potato production in Niğde, silage maize and sugar beet in Isparta, onion in Ankara and potato production in Nevşehir came to the fore.

Table 9. Distribution of irrigated plant production amount in the basin by provinces and crops (TUIK, 2020)

Crop	Production Amount (ton)							
	Aksaray	**Karaman**	**Konya**	**Niğde**	**Isparta**	**Ankara**	**Nevşehir**	**Total**
Wheat	108 693	39 754	672 638	118590	447	2161	3386	945 669
Barley	64 988	29 226	402 971	22 023	80	8677	687	528 652
Dry Bean	1963	26 869	48 808	54 785	70	28	15 900	148 423
Chickpea	109	4301	9311	-	-	-	-	13 721
Safflower	232	7	353	-	-	-	-	592
Canola	280	-	1263	-	-	-	-	1543
Oat	-	534	2317	-	-	-	1462	4313
Triticale	-	162	4463	1800	-	-	-	6425
Lentil	-	-	399	-	-	-	-	399
Potato	215 910	63 718	558 925	675 507	13	9439	91 319	1 614 831
Sugar Beer	864 433	632 093	5 447 746	100 657	49 886	119 426	-	7 214 241
Maize	76 246	274 577	914 271	506	4004	2783	-	1 272 387
Silage Maize	582 990	330 115	2 202 051	372 560	60 331	34 500	20 224	3 602 771
Sunflower	36 211	26 703	234 079	69	-	331	-	297 393
Clover	1 123 930	277 756	1 583 110	295 915	10 300	7500	10 000	3 308 511
Watermelon	26 695	78 754	65 345	22 778	1609	3000	-	198 181
Melon	15 738	37 615	128 447	25 418	1004	6750	-	214 972
Pepper	1191	31 456	11 003	4189	856	-	5	48 700
Tomato	92 093	157 505	535 268	186 148	7762	2600	144	981 520
Onion	2450	14 771	85 570	29 613	4154	182 494	76	319 128
Apple	8574	462 262	211 249	352 622	22 194	318	852	1 058 071
Grape	6455	19 158	30 827	9673	5194	391	411	72 109
Cherry	608	7145	21 152	2820	1936	75	2	33 738
Total Irrigated Land	**3 229 789**	**2 514 481**	**13 171 566**	**2 275 673**	**169 840**	**380 473**	**144 468**	**21 886 290**
Total Agricultural Land	**3 570 087**	**3 209 413**	**15 433 754**	**2 528 963**	**254 764**	**544 823**	**166 545**	**25 708 349**

Agricultural Water Use

The total precipitation area of the Konya basin is 4.99 million ha and it constitutes approximately 7% of Turkey. The basin is Turkey's 4th largest basin in terms of precipitation area. The annual river potential of the Konya Basin, in the 2013-2021 period; The average annual average for the 3 years covering 2013-2015 is 4.52 billion m^3 and the average for the six years covering the 2016 - 2021 period is determined as 2.47 billion m^3 per year. The usable part of this is estimated to be approximately 1.25 billion m^3/year. The groundwater potential of the Konya basin is estimated to be around 2.597 billion m^3/year, and the operating reserve is determined as 2.023 billion m^3 (DSI, 2022a). Considering the 2.47 billion m^3/year stream and 2.597 billion m^3/year groundwater potential of the basin, the total water potential is around 5.07 billion m^3/year. The annual usable water potential of the basin is estimated as 3.27 billion m^3/year in total, 1.25 billion m^3/year from rivers and 2.023 billion m^3/year from groundwater resources.

The amount of land irrigated from surface and underground water resources in the Basin and the amount of irrigation water reported to be used for irrigation of these areas are given in Table 10. Accordingly, 4.72 billion m^3 of water is consumed annually for irrigation purposes in the basin. While 1.352 billion m^3 of water, which is approximately 29% of this amount, is obtained from surface resources, the remaining 71% is drawn from groundwater resources (DSI, 2017).

Table 10. Agricultural water use throughout the basin (DSI, 2017)

Water Source	Organizations	Irrigation Area		Water Use	
		Amount (ha)	Proportion (%)	Amount (m^3/yıl)	Proportion (%)
SW	DSI	232125	26	1 182 810 000	
	PSA	17959	2	96 770 000	
	Public Irrigation	13928	1.65	72 740 000	
	Toplam	264012	29.65	1 352 320 000	28,62
GW	DSI + PSA	211280	23.7	1 233 330 000	
	Public Irrigation	414209	46.5	2 134 850 000	
	Total	626340	70.35	3 372 090 000	71,38
Total		**890352**	**100**	**4 724 410 000**	**100**

PSA: Provincial Special Administration

CONCLUSIONS and RECOMMENDATIONS

Konya Closed Basin is one of the most important agricultural production points of Turkey, where many field crops, fruit and vegetables are produced. It is one of the leading regions in the cultivation of sugar beet, corn, clover and wheat. However, the annual precipitation amount (380-400 mm) is below Turkey's average and the majority of precipitation occurs outside of crop production, making irrigation necessary.

Total water potential of Konya Closed Basin is estimated as 5.07 billion m^3/year and usable water potential as 3.27 billion m^3/year. Of this usable part, 1.25 billion m^3/year is surface water and 2.023 billion m^3/year is groundwater resources. However, the surface water used for irrigation is 1.35 billion m^3/year and the groundwater is 3.37 billion m^3/year. It is seen that water is drawn for irrigation purposes, especially above the usable part of the underground.

Groundwater levels are gradually decreasing throughout the basin. While this situation creates problems in terms of water supply, it causes an increase in environmental formations such as sinkholes and causes serious damage to the environment. In the Konya Closed Basin, the number of sinkhole formations has increased significantly in recent years. The decrease in groundwater levels also causes more energy use in order to deliver the water to the crops. In

the wells where electricity is used for irrigation in the basin, the decrease in water level increases the bill amounts along with more electricity consumption.

For the sustainable use of water resources in the basin, an irrigation program should be implemented. Crops should not be given more water than they need, and limited watering should be done when necessary. Performance measurements of the irrigation networks or facilities in the basin should be made, and it should be ensured that the water is supplied to the network as much as the irrigation water needs. There is no regional-scale data unity regarding the potential, sectoral use and measurement of water resources in the basin. The common data of the relevant institutions sometimes do not match with each other. In order to avoid confusion in this regard, a database should be developed and made accessible.

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KARAMAN OVASI SULAMA BİRLİĞİ'NDE SULAMA SUYU İHTİYACI VE KARŞILANMA ORANI

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ÖZET

Su kaynakları ve yıllık düşen yağış miktarının kısıtlı olduğu bölgelerde, suyun etkin kullanımı büyük önem arz etmektedir. Bu hususta sulama suyu ihtiyacının karşılanma oranı, önemli göstergelerden birini oluşturmaktadır. Bu çalışmada, Karaman Merkez ilçesinde yer alan Karaman Ovası Sulama Birliği'nde 2010, 2015 ve 2020 yıllarına ait sulama suyu ihtiyaçlarının karşılanma oranları belirlenmiştir. Karaman Ovası Sulama Birliği, toplam 31 862 ha sulama alanına sahip olup, birlik sahasında mısır ve hububat, ön plana çıkan bitkilerdir. Sulama birliğinde sulama suyu temin oranlarının hesaplanabilmesi için, belirtilen yıllara ait sulanan alandaki bitki deseni ile şebekeye alınan su miktarı (m^3/yıl) verileri, Devlet Su İşleri Genel Müdürlüğü'nden temin edilmiştir. Sulama sahasındaki bitkilerin yıllara göre sulama suyu ihtiyaçları (m^3/yıl), FAO tarafından geliştirilen CropWat yazılımı ile hesaplanmış ve şebekeye alınan su miktarları doğrultusunda sulama suyu temin oranları belirlenmiştir. Sulama birliğinin toplam sulanan alan büyüklüğü, 2010 yılında 8 282 ha, 2015 yılında 7 883 ha iken, Ayrancı ve İbrala sulamalarının sulama birliğine devredilmesi ile 2020 yılında toplam sulanan alan 24 560.5 ha'a çıkmıştır. Sulama birliği sahasındaki bitkilerin net sulama suyu ihtiyaçları 2010, 2015 ve 2020 yılları için sırasıyla, 41 248 583.82, 40 750 459.03 ve 125 189 325.20 m^3/yıl olarak hesaplanmıştır. Sulama şebekesine alınan su miktarları ise, sırasıyla 41 196 868, 50 454 043 ve 165 480 000 m^3/yıl olmuştur. Sulama suyu temin oranları, 2010 yılı için 1.00, 2015 yılı için 1.24 ve 2020 yılı için 1.32 olarak belirlenmiş ve sulama birliği ortalaması 1.19 olarak hesaplanmıştır. Karaman Ovası Sulama Birliği için belirlenen azami sulama suyu temin oranı 1.37 değeri baz alındığında, sulama suyu ihtiyacının 2020 yılında büyük oranda karşılandığı görülmüştür.

Anahtar Kelimeler: Sulama Suyu Temin Oranı, Karaman Ovası Sulama Birliği, Sulama Suyu İhtiyacı, CropWat

IRRIGATION WATER REQUIREMENT AND SUPPLY RATIO IN KARAMAN PLAIN IRRIGATION ASSOCIATION

ABSTRACT

Effective use of water is of great importance in regions where water resources and annual precipitation are limited. In this regard, the irrigation water requirement supply ratio is one of the important indicators.In this study, the irrigation water requirement supply ratios for the years 2010, 2015 and 2020 in the Karaman Plain Irrigation Association located in the central district of Karaman was determined.Karaman Plain Irrigation Association has a total irrigation area of 31 862 ha, and corn and cereals are the prominent crops in the irrigation association area.In order to calculate the relative water supplies in the irrigation association, the crop pattern in the irrigated area and the amount of water taken into the network (m^3/year) data for the specified years were obtained from the General Directorate of State Hydraulic Works.The irrigation water requirements (m^3/year) of the crops in the irrigation area were calculated with the CropWat software developed by FAO, and relative water supplies were determined in line with the amount of water taken into the network.While the total irrigated area size of the irrigation association was 8 282 ha in 2010 and 7 883 ha in 2015, the total irrigated area increased to 24 560.5 ha in 2020 with the transfer of Ayrancı and İbrala irrigations to the irrigation association.The net irrigation water requirements of the crops in the irrigation association area were calculated as 41 248 583.82, 40 750 459.03 and 125 189 325.20 m^3/year for the years 2010, 2015 and 2020, respectively. The amount of water taken into the irrigation network was 41 196 868, 50 454 043 and 165 480 000 m^3/year, respectively. Relative water supplies were determined as 1.00 for 2010, 1.24 for 2015 and 1.32 for 2020, and the irrigation association average was calculated as 1.19. Based on the maximum relative water supply determined for the Karaman Plain Irrigation Association as 1.37, it has been seen that the irrigation water requirement is largely met in 2020.

Keywords: Relative Water Supply, Karaman Plain Irrigation Association, Irrigation water requirement, CropWat

INTRODUCTION

In regions with relatively low annual precipitation in Turkey, agricultural irrigation has become a very important practice. Irrigation is done for the purposes such as getting sufficient yield from the grown products, washing the harmful salts accumulated in the soil, and ensuring the application of some fertilizers and pesticides (Kara, 2005). 6.96 million hectares of 24 million hectares of agricultural land in Turkey has been opened for irrigation. However, it is predicted that 8.5 million ha of land has irrigable potential (DSI, 2022a).

The efficient and economical use of water in irrigation facilities is important for the sustainability of water resources. In this regard, water resources should not be used more than the required amount. In some conditions, it is also possible that the sufficient amount of water cannot be diverted to the irrigation network, which is not desirable. The relative water supply indicator is used to determine whether the amount of irrigation water needed is met or not. It is reported that if the relative water supply is equal to 1, the irrigation system is given as much water as needed, if it is greater than 1, more than the need, and when it is less than 1, less irrigation water is given (Beyribey, 1997).

One of the irrigation organizations responsible for the proper use and operation of irrigation facilities in Turkey is irrigation associations. As of 2022, there are 181 irrigation associations in Turkey (Bostancı, 2023). Karaman Plain Irrigation Association, which is the subject of the study, is the only irrigation association of Karaman province. The annual precipitation amount in Karaman is below the Turkey average and the majority of precipitation falls in winter months. This requires irrigation for most crops. For this reason, Karaman Plain Irrigation Association is the most important irrigation organization in Karaman province, where irrigation is carried out using surface water resources. Therefore, in this study, in order to determine the effective use of water in the irrigation association, relative water supplies were calculated and it was evaluated whether the irrigation water requirement was met.

MATERIALS and METHODS

The study was based on the Karaman Plain Irrigation Association, and the association area is located in the Merkez district of Karaman province. Karaman Merkez district has a total surface area of 370 900 ha and an altitude of 1063 m above sea level. It is one of the leading districts

of the province in terms of agriculture, trade and culture (Anonymous, 2023). Figure 1 shows the location of the district in Karaman.



Figure 1. Location of Karaman Merkez district in the Karaman Province

The main rivers used for energy production, drinking-use and irrigation purposes in Karaman province are Göksu River, Gödet Stream, Göktepe Stream, Kışla Stream, İbrala Stream and Ermenek Stream. Along with these, Ayrancı, Ermenek, İbrala and Gödet Dams constitute the surface water resources of the province. The groundwater potential in Karaman province is 244 million m^3, and it is used for drinking and agricultural purposes (Anonymous, 2016).

The long-term average values of the climatic elements of Karaman province are given in Table 1. The average annual precipitation in Karaman is 337.8 mm, and an arid climate is dominant. Precipitation falls mostly in winter and spring seasons. Irrigation is a very important agricultural activity in Karaman, as the total rainfall is low in the summer months when the need for plant water is usually highest.

Table 1. Some long-term (1951 - 2022) climate elements in Karaman province (MGM, 2022)

KARAMAN	1	2	3	4	5	6	7	8	9	10	11	12	Annual Total
Temperature (°C)	0.6	2.0	6.3	11.6	16.2	20.2	23.4	23.0	18.8	13.1	7.0	2.7	**12.1**
Highest Temperature (°C)	5.5	7.4	12.4	18.2	23.3	27.7	31.1	31.0	27.2	20.7	13.7	7.7	**18.8**
Lowest Temperature (°C)	-3.7	-2.6	0.5	5.0	8.9	12.5	15.2	14.7	10.4	5.8	1.2	-1.6	**5.5**
Hours of Sunshine (hour)	3.5	4.6	6.2	7.8	9.8	11.6	12.6	11.9	10.2	7.4	5.4	3.5	**7.9**
Rainfall (mm)	43.4	34.7	36.6	35.8	34.2	24.6	5.3	6.5	8.7	28.2	33.1	46.7	**337.8**

The total agricultural area of the Merkez district of Karaman is 212 451 ha, and it constitutes 63% of the total agricultural area of the province of Karaman. Within the total agricultural area of the district, field crops have a share of 76%, fruits 15%, vegetables 5% and fallow land 4%. The main products in terms of production amount in the district are; mazie, apples, sugar beets, clover and tomatoes. Wheat, mazie and barley are products with high cultivation area (TUIK, 2022). Data on the main plants grown in Karaman Center are given in Table 2.

Tablo 2. The main crops and cultivation areas in Karaman Merkez District (TUIK, 2022)

	Crop	Production Amount (tonnes)	Cultivation Area (ha)
1	Maize	666 095	34 500
2	Apple	609 509	21 645
3	Sugar Beet	373 169	4814,7
4	Clover	264 000	4000
5	Tomato	121 638	1791,3
6	Wheat	100 445	45 271,8
7	Barley	97 799	33 350
8	Vetch	83 100	4800
9	Potato	57 878	1500
10	Watermelon	45 200	1130

Karaman Plain Irrigation Association has a total irrigation area of 31 862 ha as of 2022. The irrigation association is responsible for the operation of Karaman, Ayrancı and İbrala irrigations (DSI, 2022b). In 2020, the area of responsibility of the Karaman Plain Irrigation Association has increased with the inclusion of Ayrancı and İbrala irrigations in the association area, and the irrigation association has reached the position of the only irrigation association in the province of Karaman.

The number of water users in the irrigation association is 3970, of which 85% are members of the association. While there are a total of 1068 certified groundwater wells in the irrigation area, it is estimated that there are around 4000 uncertified groundwater wells. In the association area, 8100 hectares of conventional irrigation network is irrigated, 15040 hectares are irrigated with canalette and 8700 hectares are piped irrigation network (Bostancı, 2023).

In this study, it was aimed to determine the rate of meeting the crop irrigation water need of Karaman Plain Irrigation Association in 2010, 2015 and 2020. The crop pattern of the association area, the amount of water taken into the network (m^3) and the gross irrigation water need (m^3) data for the relevant years were obtained from the General Directorate of State Hydraulic Works.

The net irrigation water requirements (mm) of the crops grown in the association area were calculated using the Cropwat software developed by FAO. The total irrigation water requirement (m^3) of the irrigation area was determined by multiplying the net irrigation water requirement (mm) of each plant with the irrigated area size (ha). Relative irrigation supply was obtained by dividing the amount of water (m^3) taken into the network by the total irrigation water requirement, and this value was calculated for the years 2010, 2015 and 2020. In addition, the irrigation rate values were determined by dividing the actually irrigated area in the irrigation area by the total irrigation area.

RESULTS

The data regarding the irrigation of Karaman Plain Irrigation Association are given in Table 3. The irrigation area, which was 15 040 ha in 2010 and 2015, increased to 31 840 ha in 2020. Likewise, while the irrigation ratio was quite close to each other in 2010 and 2015, it increased in 2020. The actual irrigated area values were 8282 ha, 7883 ha and 24 560.5 ha in 2010, 2015

and 2020, respectively. The inclusion of İbrala and Ayrancı irrigations in the irrigation union in 2020 has increased the size of the actually irrigated area.

Table 3. Data on the irrigation of the Karaman Plain Irrigation Association

Karaman Plain Irrigation Association	**Years**		
	2010	**2015**	**2020**
Actually Irrigated Area (ha)*	8282	7883	24 560,5
Irrigation Area (ha)*	15 040	15 040	31 840
Irrigation Ratio (%)	55,0	52,4	77,1

* DSI, 2022c

The crop pattern for the years 2010, 2015 and 2020 in the irrigation association area is given in Table 4. Maize was the crop with the highest production area. After maize, grain and fruits are the products with high production area. These three products made up approximately 70-84% of the total production area. Due to the increase in the size of the irrigated area in 2020, the production areas of all products reached their highest values.

Table 4. Production areas of Karaman Plain Irrigation Union area by years and plants (ha) (DSI, 2022c)

Crops	**Production Area (ha)**		
	2010	**2015**	**2020**
Grain	3312,8	2049,58	6905,6
Sugar Beet	662,56	315,32	1257,9
Fruit	745,38	1182,45	2584,3
Sunflower	828,2	157,66	1821,8
Legume	579,74	630,64	739,8
Maize	1739,22	3389,69	10594,4
Vegetable	82,82	78,83	114
Forage Crops	165,64	78,83	540,6
Water-Melon	165,64	-	-
Potato	-	-	2,1
Total	**8282**	**7883**	**24560,5**

The net irrigation water requirements (mm) of the crops in the irrigation association area were calculated with the Cropwat software. The crop irrigation water requirement values calculated for the year 2010 by the irrigation association are given in Table 5. The total irrigation water requirement in 2010 was determined as 41 248 583.82 m^3. The average net crop irrigation water requirement was calculated as 498.1 mm. Since the irrigated area value of grain is high, the total irrigation water requirement was higher than that of other crops.

The values calculated for the year 2015 in the irrigation association are given in Table 6. A total of 40 750 459.03 m^3 plant irrigation water needs have been calculated. The average net crop irrigation water requirement increased slightly to 516.9 mm compared to 2010. The irrigation water requirement of the corn plant constituted 44% of the total irrigation water requirement.

The crop irrigation water requirement values calculated for the year 2020 in the irrigation association are given in Table 7. Total irrigation water requirement was determined as 125 189 325.20 m^3. The average net crop irrigation water requirement was 509.7 mm, close to the values in 2010 and 2015. The irrigation water requirement of maize, grain and fruit crops constituted 79% of the total irrigation water requirement. Considering the total irrigation water requirements (m^3) in the determined years, there has been an increase of approximately 200% in 2020 compared to 2010 and 2015.

Tablo 5. Crop irrigation water requirement for 2010 in Karaman Plain Irrigation Association irrigation area

Crops	**Irrigation Area (ha)***	**Net Crop Irrigation Water Requirement (mm)**	**Irrigation Water Requirement (m^3)**
Grain	3312,8	368,8	12 217 606,40
Sugar Beet	662,56	772,9	5 120 926,24
Fruit	745,38	648,4	4 833 043,92
Sunflower	828,2	583,7	4 834 203,40
Legume	579,74	548,4	3 179 294,16
Maize	1739,22	532,1	9 254 389,62
Vegetable	82,82	572,8	474 392,96
Forage Crops	165,64	280	463 792,00
Water-Melon	165,64	525,8	870 935,12
Total	**8282**	**498,1**	**41 248 583,82**

* DSI (2022c)

Table 6. Crop irrigation water requirement for 2015 in Karaman Plain Irrigation Association irrigation area

Crops	**Irrigation Area (ha)***	**Net Crop Irrigation Water Requirement (mm)**	**Irrigation Water Requirement (m^3)**
Grain	2049,58	368,8	7 558 851,04
Sugar Beet	315,32	772,9	2 437 108,28
Fruit	1182,45	648,4	7 667 005,80
Sunflower	157,66	583,7	920 261,42
Legume	630,64	548,4	3 458 429,76
Maize	3389,69	532,1	18 036 540,49
Vegetable	78,83	572,8	451 538,24
Forage Crops	78,83	280	220 724,00
Total	**7883**	**516,9**	**40 750 459,03**

* DSI (2022c)

Table 7. Crop irrigation water requirement for 2020 in Karaman Plain Irrigation Association irrigation area

Crops	**Irrigation Area (ha)***	**Net Crop Irrigation Water Requirement (mm)**	**Irrigation Water Requirement (m^3)**
Grain	6905,6	368,8	25 467 852,80
Sugar Beet	1257,9	772,9	9 722 309,10
Fruit	2584,3	648,4	16 756 601,20
Sunflower	1821,8	583,7	10 633 846,60
Legume	739,8	548,4	4 057 063,20
Maize	10594,4	532,1	56 372 802,40
Vegetable	114	572,8	652 992,00
Forage Crops	540,6	280	1 513 680,00
Potato	2,1	579,9	12 177,90
Total	**24560,5**	**509,7**	**125 189 325,20**

* DSI (2022)

By using the amount of water taken into the irrigation network (m^3) and the irrigation water requirement values determined for the irrigation area, relative irrigation supplies of the Karaman Plain Irrigation Association for the years 2010, 2015 and 2020 are calculated and are given in Table 8. In the irrigation association, the relative irrigation supplies for 2010, 2015 and 2020 were determined as 1.00, 1.24 and 1.32, respectively, and the average relative irrigation supply was 1.19.

Table 8. Karaman Plain Irrigation Association relative irrigation supplies by years

Years	Amount of Water Taken into the Irrigation Network (m^3/yıl)*	Irrigation Water Requirement (m^3/yıl)	Relative Irrigation Supply
2010	41 196 868	41 248 583,82	1,00
2015	50 454 043	40 750 459,03	1,24
2020	165 480 000	125 189 325,20	1,32
Average	**85 710 303,67**	**69 062 789,35**	**1,19**

* DSI (2022c)

Based on the gross irrigation water requirement values of the Karaman Plain Irrigation Association, the average irrigation efficiency of the irrigation association was determined as 73%. Considering this value, it was calculated that the relative irrigation supply should be 1.37 (1/0.73=1.37). All of the relative irrigation supply calculated for the irrigation association were below 1.37 and the needed irrigation water could not be taken into the network. Despite this, the desired value was quite close to the desired value in 2020, and 73% of the irrigation water needed in 2010 was given to the irrigation network. Therefore, although it is seen that the irrigation water requirement in the irrigation association cannot be fully met, it can be said that the ideal result has been reached to a large extent.

Regarding the relative irrigation supply; Turhan (2019) calculated the relative irrigation supply as 2.03-3.42 in the Develi Plain Right Bank Irrigation Association, Kızıloğlu et al. (2018) 2.23-4.54 in Lower Pasinler Plain irrigation network, Tavman (2019) 1.18-2.28 in Konya-Çumra Irrigation, Çolpak (2019) 0.41 in Serik Deniztepesi Pump Irrigation Association, Gençoğlu (2018) 0.70-1.85 in Kırıkhan Irrigation Association and Cin (2017) 1.98 in Ankara Beypazarı Başören Irrigation Cooperative. When these studies are examined, it is seen that the irrigation water requirements of the Karaman Plain Irrigation Association can be met at a very good rate.

CONCLUSIONS and RECOMMENDATIONS

Karaman Plain Irrigation Association is the only irrigation association in Karaman province and has an important position in terms of agricultural production. With an irrigation area of 31 862 ha in 2022, it constitutes 15% of the total agricultural area of the Merkez district of Karaman. Karaman, Ayrancı and İbrala irrigations, which are under the responsibility of the irrigation association, are one of the important surface water resources of the province.

At the point where the ideal relative irrigation supply for the Karaman Plain Irrigation Association is 1.37, the calculated relative irrigation supply are between 1.00-1.32, which shows that the rate of meeting the irrigation water requirement is quite close to the desired level. Obtaining near-ideal results in the irrigation association, which is of great importance in the irrigation of Karaman province, has revealed a positive picture in terms of effective and economical use of water. Because, while the use of groundwater and surface water resources in agriculture is gradually increasing in the Central Anatolia Region, where the province of Karaman is located, the amount of precipitation cannot adequately feed these water resources. This situation requires more careful and conscious use of water resources.

Performance evaluations should be made in other irrigation organizations and irrigation facilities, together with irrigation associations, and the current situation should be determined and solutions to problems should be put forward. At points where irrigation water needs cannot be met, it should be ensured that the rate of use of pressurized irrigation systems with high irrigation efficiency is increased, water transmission losses are reduced, irrigation programs are implemented, limited irrigation is applied when necessary, and the cultivating of crops with lower crop water consumption should be expanded. The use of water above the requirement causes the rapid decrease of water resources and the emergence of salinity problem. As a result, irrigation water requirements for irrigation facilities and organizations should be determined and water allocation should be made accordingly.

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QUALITY CHANGES IN SHELF LIFE CONDITIONS OF PURPLE PASSION FRUIT HARVESTED AT DIFFERENT MATURITY STAGES

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ABSTRACT
Possum Purple passion fruit, grown in Antalya/Turkey conditions, were harvested in four different maturity stages according to skin color (green, 25-50%, 50-75% and 75-100% purple). After harvest, the fruit were stored under room conditions for 12 days at 20±1°C and 65±5% relative humidity. Weight loss, total soluble solids (TSS), titratable acidity (TA), skin color, pulp yield and respiration rate were measured at certain intervals during shelf life. The lowest weight loss occurred in fruits with 75-100% coloration. It was determined that as the coloration increased, there was a decrease in TA and respiration rate, and an increase in TTS and pulp yield. At the end of the shelf life, less quality loss occurred in fruits with 75-100% purple compared to other groups.

Keywords: *Passiflora edulis*, maturity, quality, shelf life

INTRODUCTION

In recent years, the demand for tropical fruit varieties has increased in the world and especially in the European market due to their high attractiveness in terms of appearance and color, as well as their health effects and biochemical contents. The limited growing areas of these products, which are mostly grown in developing countries, and the distance to the markets where there is demand cause the prices of tropical fruit to be higher than other fruit (Gübbük vd., 2017).

Tropical fruit species can be grown in some microclimatic areas in the Mediterranean Region of Turkey. In addition, the proximity of the region to the European market provides an important advantage. Therefore, in recent years, the production of tropical fruit species has increased in the region in terms of providing labor and high income. Passion fruit is one of the tropical fruit whose production is increasing in this region. The passion fruit industry and market is continuously developing worldwide due to the health effects of the active ingredients in the fruit (Rizwan et al., 2021). The *Passiflora* genus, which can be grown in tropical and subtropical climates, has about 500 species. The most common and well-known among those with edible fruits is *Passiflora edulis* Sims (Dal and Biner, 2019). *Passiflora edulis* has two forms, purple (*Passiflora edulis* Sims. f. *Edulis*) and yellow fruit (*Passiflora edulis* f. *Flavicarpa*), of which the purple fruit is better adapted to subtropical conditions and accounts for most of the trade in Europe (Gübbük et al., 2017; Dal and Biner, 2019). Purple passion fruit, which are more popular in the trade, are less acidic, have a better aroma-flavor and higher juice content (Joy and Divya, 2006). With increasing demand for both fresh fruit and processed juice, purple passion is a fruit with great potential for trade (Sang and Hai, 2020).

It is only possible to reduce postharvest quality losses and to provide sufficient quantity and quality of product for both domestic and foreign markets by harvesting the products at the appropriate harvest time and storage under the most suitable conditions specific to the product. The ability of crops to be stored successfully and to pass through marketing chains with minimum loss depends on their physiology at harvest. Harvest time, which differs depending on the ecological conditions of growing the crop, is important for yield, quality and especially post-harvest durability (Elgar et al., 1998; Echeverria et al., 2002). Harvest maturity is a critical parameter affecting flavor development, post-harvest ripening and fruit processing (Kovač et al., 2010). Several different criteria can be used to determine the harvest maturity of passion fruit, mainly time after flowering and skin color. The skin color is the most obvious indicator

of fruit maturity. As the fruit ripens the skin color changes from green to purple (Joy and Divya, 2016).

Passion fruit is a climacteric fruit species and quality losses occur after harvest due to shell shrinkage, color darkening, microbial contamination, etc. caused by high respiration and water loss. The quality of climacteric fruit after harvest is closely related to preharvest factors, and the most important of these factors is the maturity of the fruit at harvest (Kader, 1999b; Kviklienė et al., 2011; Bertone et al., 2012). The postharvest quality of passion fruit is significantly dependent on harvest time and storage conditions (Chen et al., 2018). Harvest maturity is an important factor that can lead to changes in the sensory and nutritional qualities of passiflora fruit (Baraza et al., 2013).

In this study, it was aimed to determine the quality changes of Possum Purple passion fruit harvested at different maturity stages grown in Antalya conditions during shelf life.

MATERIAL and METHOD

Possum Purple passion fruit cultivar was used as a material in the study. The fruit were obtained from the orchard located on the Bati Akdeniz Agricultural Research Institute (Serik, Antalya/Turkiye). Fruits were harvested in four different periods: green, 25-50% purple, 50-75% purple and 75-100% purple according to the peel color determined by the visual expression. After harvest, the fruit were stored at 20±1°C and 65±5% relative humidity (shelf life) for 12 days. During the storage period, weight loss and peel color measurements were performed at 2-day intervals, and TA, TSS, pulp yield and respiration rate measurements were carried out at 3-day intervals.

Weight loss

Weight losses of fruit were expressed as the percentage of loss of weight with respect to the initial weight. Weight loss was determined by the formula: [(First weight - Last weight) / First weight] × 100.

TSS and TA

TSS was measured using a refractometer and expressed as percentage (%). After filtering the juice obtained from the fruit samples, 1 mL sample was taken from the filtrate, made up to 20 mL and titrated with 0.1 N NaOH solutions until the pH reached 8.1. TA is calculated as g citric acid/100 mL juice.

Fruit skin color

The change in the skin color of the fruit was measured with a Minolta CR-400 (Minolta Camera Co. LTD Ramsey. NJ) brand chromometer (color measuring device). Hue angle (h°) and

chroma (C*) values calculated according to Commission Internationale I'Eclairage (CIE) L*, a* and b* values were used in the evaluation of the results obtained from the measurements made from the equatorial region of the fruits (Crisosto et al., 2004). L* value indicates brightness, C* value indicates the vitality of the fruit peel. Hue angle represents the angle between the x-axis and the line passing through the intersection of a* and b* values. It is known that the angle corresponds to red when it is 0°, yellow when 90°, green when it is 180° and blue when it is 270°. Calculations of C* value and h° were made according to the following formulas.

$h° = \tan^{-1} (b^*/a^*)$ $C^* = [(a^*)^2 + (b^*)^2]^{1/2}$

Respiration rate

The respiration rate of fruit was measured with a gas chromatography (Agilent 6840) Chemstation A.09.03 [1417]. Measurements were made in split/splitless (S/SL) of inlet in split mode with gas sampling valve with 1 mL gas sample by using fused silica capilar column (GS-GASPRO, 30 m × 0.32 mm I.D., U.S.A), with thermal conductivity detector (TCD). Fruits were weighed and enclosed for 3 h in a 2 L airtight jars at 20°C. A gas sample was withdrawn from the headspace for determination of respiration rate. The temperature of the oven and TCD detector were 40°C (isothermal), and 250°C respectively. Respiration rate (measured as CO_2 production) was expressed as mL CO_2 $kg^{-1}h^{-1}$.

Pulp yield

Whole fruit and the pulp which manually scooped out were weighed. The pulp yield was expressed as a percentage (%) of total fruit weight at the time of measurement.

Statistical analysis

The experiment was organized with 3 replicates and 20 fruits in each replicate. Data were subjected to analysis of variance (ANOVA, JMP7), means were separated by means of LSD test (P<0.05, 0.01, 0.001).

RESULTS and DISCUSSION

The weight loss of fruits at all maturity stages was increased during the shelf life (Figure 1). The average weight loss was 2.91 % at the beginning of the storage period and reached to 14.40% at the end of 12 days. Maturity stage was significantly affected the weight loss. At the end of the shelf life period, the lowest weight loss (7.60%) was observed in the 75-100% purple group, while the other three groups showed statistically similar results. The respiration rate of the fruit initially decreased and then increased during the shelf life (Figure 1). At the beginning of storage, the highest respiration rate was observed in the green stage fruit. The respiration rate

of the fruit in the green stage increased after the 6th day and the other groups increased after the 9th day. The highest average respiration rate (155.74 mL CO_2 $kg^{-1}h^{-1}$) was obtained from green stage fruits, while the lowest (87.49 mL CO_2 $kg^{-1}h^{-1}$) was observed in 75-100% purple fruit. The other two groups (25-50% purple, 50-75% purple) showed similar results. Water loss, which is one of the most important causes of postharvest losses, leads to weight loss in fruit, increases spoilage and shriveling by triggering ethylene production (Siddiqui and Dhua, 2009). The differences weight loss of fruits at different maturity stages are caused by the accumulation of sugars and the respiration rate of fruit. Passion fruit that are more highly colored contain higher sugar content and have a lower respiration rate (Lagat Cyrus et al., 2018). Sugars are osmotically active and increase their weight by absorbing water across the semipermeable membrane (Ahmad and Siddiqui, 2015). Moreover, immature fruit tissues have a higher respiration rate than mature fruit tissues. The higher respiration rate of fruit, the higher weight loss (Lagat Cyrus et al., 2018). The increased respiration rate with increasing shelf life is related to the increased metabolic activity associated with fruit ripening (Pongener et al., 2014).

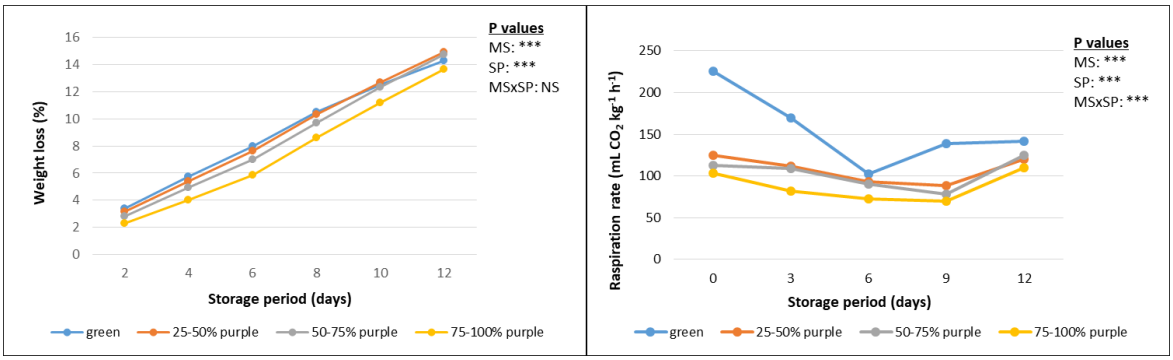

Figure 1. Weight loss and respiration rate changes during shelf life of Possum Purple passion fruits harvested at different maturity stages
SP: Storage period, MS: Maturity stage: NS: Non-significant, ***: *P*< 0.001.

Maturity stage and storage period significantly influenced pulp yield (Table 1). Pulp yield increased during the shelf life period. After harvest, the average pulp yield was 46.15% and increased to 53.15% at the end of the shelf life period. Fruits at green stage and 25-50% purple colored fruit were statistically in the same group in terms of pulp yield and gave lower values than the other group. The highest mean pulp yield values were obtained from fruits with 75-100% purple (51.91%) and 50-75% purple (51.33%) coloration. Similar findings to this study, other studies reported that pulp weight was higher in passion fruits with more colored peel than those with less colored peel due to the accumulation of more biomass (Pongener et al., 2014; Lagat Cyrus et al., 2018).

TSS and TA values obtained during shelf life were examined and it was determined that these properties were significantly affected by maturity stage and storage period factors. While TSS values fluctuated during this period, TA values decreased compared to the beginning. The increase in TSS values during ripening is associated with the breakdown of stored carbohydrates into simple sugars during respiration (Siddiqui and Dhua, 2010). The decrease in TA values is attributed to the utilization of organic acids as respiratory substrates (Yumbya et al., 2014). The highest TSS content (15.39%-15.36%) was obtained from 50-75% and 75-100% colored fruit during shelf life. In terms of TA, it was observed that the acidity decreased as the coloration of the fruit increased. Fruit in the green stage showed the highest TA value (5.68 g citric acid/100 mL), while 75-100% purple group fruit showed the lowest TA value (3.54 g citric acid/100 mL). The increase in TSS values and decrease in TA values in passion fruit with increasing number of days after full flowering or percentage of coloration have been similarly shown in other studies (Diaz et al., 2012; Baraza et al., 2013; Shahbani et al., 2021).

Table 1. Effect of different maturity stages on pulp yield, TSS and TA changes in Possum Purple passion fruit during shelf life

	Maturity stage (MS)	Storage period (SP)					Mean
		0	3	6	9	12	
Pulp yield (%)	Green stage	43.80	47.95	45.53	49.31	48.68	47.05 b
	25-50% purple	46.49	47.46	50.15	49.25	50.93	48.86 b
	50-75% purple	47.94	50.61	49.58	52.40	56.12	51.33 a
	75-100% purple	46.36	51.33	51.91	53.07	56.87	51.91 a
	Mean	46.15 c	49.34 b	49.29 b	51.01 b	53.15 a	
	P values	MS ***	SP ***	MS × SP ^{NS}			
TSS (%)	Green stage	11.87	11.69	12.27	14.33	12.80	12.59 c
	25-50% purple	13.87	14.00	14.40	14.73	15.00	14.40 b
	50-75% purple	15.33	14.40	15.73	15.60	15.87	15.39 a
	75-100% purple	15.40	15.40	15.73	14.67	15.60	15.36 a
	Mean	14.12 bc	13.87 c	14.53 abc	14.83 a	14.82	
	P values	MS ***	SP *	MS × SP ^{NS}			
TA (g citric acid/100 mL)	Green stage	5.25	5.86	5.97	5.56	5.77	5.68 a
	25-50% purple	4.82	5.48	5.58	5.20	4.52	5.12 b
	50-75% purple	4.77	4.94	4.65	3.86	2.95	4.23 c
	75-100% purple	4.40	3.88	4.27	3.24	1.93	3.54 d
	Mean	4.81 b	5.04 ab	5.12 a	4.47 c	3.79 d	
	P values	MS ***	SP ***	MS × SP ***			

P values: NS:>0.05, *:<0.05, **: <0.01, ***:<0.0001, NS: nonsignificant
Means followed by different letters with in the same row and column are significantly different.

The color change in fruits during storage under shelf conditions was significantly affected by harvest maturity and storage period (Table 2). At the end of the shelf life period, L* and hº values decreased and C* value increased compared to the initial values. These results indicate that the darkening and dulling of the color increased as the fruit turned from green to purple. In previous studies, it was reported that darkening and dulling of the peel color of passion fruits increased with the progression of ripeness during storage and this change may vary depending on the ripeness stage of the fruit (Ambuko et al., 2014; Pongener et al., 2014; Shahbani et al., 2021). Fruit in the green stage showed the highest L* value (53.52), while the lowest L* value (41.09) was obtained from 75-100% colored fruit.

Table 2. Color changes in Possum Purple passion fruit harvested at different ripeness stages during shelf life

	Maturity stage	Storage period (SP)							Mean
	(MS)	0	2	4	6	8	10	12	
L*	Green stage	53.31	53.52	53.63	53.53	53.61	53.90	53.13	53.52 a
	25-50% purple	50.09	49.89	49.40	51.34	50.76	50.49	48.70	50.10 b
	50-75% purple	46.69	47.90	47.44	47.87	45.97	43.09	38.92	45.41 c
	75-100%	43.69	43.74	43.42	44.03	40.31	37.35	35.08	41.09 d
	Mean	48.45 ab	48.76 a	48.47	49.19 a	47.66 b	46.21 c	43.96 d	
	P values	MS*** SP *** MS × SP ***							
C*	Green stage	30.93	31.41	31.48	31.19	31.47	31.15	30.55	31.17 a
	25-50% purple	22.16	22.07	21.98	22.05	21.43	19.79	19.53	21.29 b
	50-75% purple	15.53	15.10	15.68	14.45	14.41	16.91	18.99	15.87 c
	75-100%	10.31	10.02	10.08	10.66	13.58	16.25	17.86	12.68 d
	Mean	19.73 c	19.65 c	19.81	19.59 c	20.22	21.03 ab	21.73 a	
	P values	MS*** SP ** MS × SP ***							
h°	Green stage	120.80	120.72	120.89	120.70	119.51	117.81	111.73	118.88
	25-50% purple	109.76	108.14	108.58	108.57	104.85	92.50	72.07	100.64
	50-75% purple	93.39	92.88	93.53	87.70	74.22	44.15	28.72	73.51 c
	75-100%	66.88	67.90	70.11	66.85	42.50	24.14	16.03	50.63 d
	Mean	97.71 a	97.41 a	98.28 a	95.95 a	85.27 b	69.65 c	57.14 d	
	P values	MS*** SP *** MS × SP ***							

P values: NS:>0.05, *:<0.05, **: <0.01, ***:<0.0001, NS: nonsignificant
Means followed by different letters with in the same row and column are significantly different.

During the shelf life, the highest C* (31.17) and hº values (118.88) were measured in green stage fruits and the lowest C* (12.68) and hº values (50.63) were measured in 75-100% purple fruits. Fruit harvested at the green stage did not develop purple color and ripening did not progress after harvest. Although passion fruit is a climacteric fruit species, the failure to develop purple color when harvested at the green stage was also reported by Pongener et al. (2014) and Diaz et al. (2012). As ripening progresses in passion fruit, chlorophyll breaks down in the peel and anthocyanin pigments are synthesized to increase coloration (Pongener et al., (2014).

The results of the study showed that different ripeness stages significantly affected the fruit quality of Possum Purple variety passion fruits during harvest and shelf life. The fruits harvested at green and 25-50% purple stages did not develop the purple skin color and taste specific to the variety during the shelf period. However, quality losses in these two groups of fruits were higher than the other groups. This result shows that Possum Purple variety fruits should not be harvested before at least 50% skin coloration. In the study, the best results were obtained from fruits with 75-100% skin coloration in terms of quality criteria examined at harvest and during the shelf life period.

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BİTKİSEL ÜRETİMDE DENİZ YOSUNUNUN ORGANİK GÜBRE OLARAK DEĞERLENDİRİLMESİ

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ÖZET
Bitkisel üretimde organik materyal kullanımının toprağın fiziksel özelliklerini olumlu yönde iyileştirdiği ve ürün kalitesi ile verimi önemli miktarda artırdığı bilinmektedir. Çeşitli organik kökenli materyaller uzun yıllardır bitkisel üretimde gübre ve toprak ıslah materyali olarak kullanılmaktadır. Bu bağlamda son yıllarda gerek daha ekonomik ve gerekse çevre dostu bir bitkisel üretim yapmak için organik materyallere ve gübrelere karşı ilgi artmaktadır. Deniz yosunu, denize kıyısı olan çeşitli ülkelerde ve özellikle Doğu Asya'nın bütün ülkelerinde yıllardır yiyecek ve bazı ürünlerde ham madde olarak farklı şekillerde değerlendirilmektedir. Fakat topraklarında organik maddeye ve bitkisel üretimde gübreye ihtiyacı olan bazı ülkelerde deniz yosununun gübre olarak kullanılmasına yönelinmiştir. Toprakta kolay parçalanan deniz yosunu gübresi azot (N) ve kalsiyum (Ca) bakımından oldukça zengindir. Ayrıca, bünyesinde magnezyum (Mg), demir (Fe), bakır (Cu), çinko (Zn), mangan (Mn), bor (B), ve kobalt (Co) gibi mikro elementler ve çeşitli büyüme düzenleyicileri içermektedir. Deniz yosunu gübresi bitkisel üretimde kullanıldığında, çimlenmeyi artırır, kök gelişimini güçlendirir, daha koyu renkli ve büyük çiçek ve yaprak oluşumunu teşvik eder, hastalık ve zararlılara; don, kuraklık, tuzluluk gibi biyotik ve abiyotik stres faktörlerine ve olumsuz toprak şartlarına dayanımı artırır, topraktaki besin elementlerinin bitkiler tarafından alımını kolaylaştırır, bitkilerin daha sağlıklı kalmalarını sağlar. Bu çalışma toprak ıslahı, kalitesi ve bitkisel üretimde çeşitli ve önemli olumlu etkilere sahip olan deniz yosunu gübresinin Türkiye'de tanınması ve daha yaygın kullanımı için hazırlanmıştır. Çalışmada yosun çeşitleri, deniz yosunu gübresinin üretimi, içeriği, Türkiye'de ve dünyada kullanımı ve önemi açıklanmıştır. Deniz yosunu gübresi üzerine yapılan çalışmalar incelenerek bitkisel üretimde uygulanması hakkında öneriler getirilmiştir. Türkiye gibi denize kıyısı olan ve kültürel faktörler nedeni ile gıda sanayinde kullanım olanağı olmayan ülkelerde deniz yosununun gübre olarak kullanımının ülke ekonomisine önemli katkılar sağlayacağı ön görülmektedir.

Anahtar Kelimeler: Deniz Yosunu Gübresi, Organik Madde, Toprak İyileştirici, Bitkisel Üretim

EVALUATION OF SEAWEED AS ORGANIC FERTILIZER IN PLANT PRODUCTION

ABSTRACT

It is well known that the use of organic materials in plant production improves the physical properties of the soil in a positive way and significantly increases the product quality and yield. Various organic-based materials have been used as fertilizer and soil improvement material in plant production for many years. In this context, interest in organic materials and fertilizers has been increasing in recent years in order to make a more economical and environmentally friendly plant production. Seaweed have been used in different ways as a raw material in food and some products in various coastal countries and especially in the all the countries of Eastern Asia for years. However, in some countries that need organic matter in their soils and fertilizer in plant production, seaweed is used as fertilizer. Seaweed fertilizer, which is easily broken down in the soil, is very rich in nitrogen (N) and calcium (Ca). In addition, it contains micro elements such as magnesium (Mg), iron (Fe), copper (Cu), zinc (Zn), manganese (Mn), boron (B), and cobalt (Co) and various growth regulators. When seaweed fertilizer is used in plant production, it increases germination, strengthens root development, encourages the formation of darker and larger flowers and leaves, increases resistance to diseases and pests, biotic and abiotic stress factors such as frost, drought, salinity and adverse soil conditions, facilitates the uptake of nutrients in the soil by plants and ensures plants to stay healthier. This study was prepared for the recognition and more widespread use of seaweed fertilizer, which has various and important positive effects on soil improvement, and plant quality and production. In the study, algae varieties, the production of seaweed fertilizer, its content, its use and importance in Turkey and in the world were elaborately explained. Studies on seaweed fertilizer were reviewed, and recommendations for its use in plant production were made. It is anticipated that the use of seaweed as fertilizer in countries like Turkey, which has a seacoast but cannot use seaweed in the food business owing to cultural factors, will significantly contribute the economy of the nation.

Keywords: Seaweed Fertilizer, Organic Material, Soil Improving, Plant Production

GİRİŞ

Nüfus artışı dünyada bir çok sorunu beraberinde getirirken özellikle toprak gibi doğal kaynakların bilinçli kullanımı üzerinde ki baskıyı her geçen gün arttırmaktadır. Bu nedenle bitkisel üretime yönelik sürdürülebilir faaliyetlerin planlanması ve uygulanması çevre ile uyumlu olmalıdır. Toprakların daha verimli olması ve birim alandan daha fazla ürün elde etmek üretericiler için önemlidir. Bu bağlamda Türkiye gibi toprakları organik madde bakımından yoksun ülkelerin sürdürülebilir bir bitkisel üretim kapsamında organik gübrelere gereksinimleri vardır. Doğal olarak mevcut olan, üretilen ya da organik kökenli atık materyallerin yetiştirme ortamı ya da gübre olarak kullanılması tarımsal üretime ve çevreye olduğu kadar ülkelerin ekonomisine de büyük fayda sağlamaktadır (Çiçek 2021).

Organik materyallerin bitkisel üretimde kullanıldığında toprakların fiziksel özelliklerini iyi yönde geliştirdiği bazı araştırmacılar tarafından da belirtilmiştir (Canbolat 1992; Özbek vd. 1993; Alagöz vd. 2006; Özyazıcı vd. 2011; Madakbaş et al. 2014; Oluwadare and Osakwe 2014; Çiçek Atikmen ve Kütük 2015; Çiçek Atikmen vd. 2018; Demir ve Doğan Demir 2019; Er vd. 2020; Çiçek 2021; Çiçek ve Yücedağ 2021; Çiçek vd. 2021; Korkmaz 2022). Toprağa organik materyallerin uygulanması, toprak ıslahında en çok tercih edilen yöntemlerden biridir (Demiralay 1977; Canbolat 1992; Çepel 1996; Er 2020; Çiçek ve Yücedağ 2021; Çiçek 2021; Çiçek vd. 2021). Organik maddeler; toprak erozyonuna karşı toprak taneleri birbirine bağlayarak koruyan, topraktaki su hareketini düzenleyen, su tutma ve havalanma kapasitesini arttıran ve diğer taraftan da, toprak verimliğini organik azot ve diğer bitki besin elementlerini toprağa sağlayarak artıran son derece elzem bir toprak bileşenidir (Soil Management Guide 2008; Er vd. 2020; Çiçek 2021; Çiçek ve Yücedağ 2021; Çiçek vd. 2021).

Deniz yosunu, denize kıyısı olan çeşitli ülkelerde ve özellikle Doğu Asya'nın bütün ülkelerinde yıllardır yiyecek ve bazı ürünlerde ham madde olarak farklı şekillerde değerlendirilmektedir (Şekil 1). Fakat topraklarında organik maddeye ve bitkisel üretimde gübreye ihtiyacı olan çeşitli ülkelerde deniz yosununun gübre olarak kullanılmasına yönelinmiştir.



Şekil 1. Serada gıda taksiyesi ve hayvan yemi amaçlı deniz yosunu üretemi (Muğla/Seydikemer)

BİTKİSEL ÜRETİMDE DENİZ YOSUNUNUN KULLANIM OLANAKLARI

Deniz yosunları, deniz ve okyanus dışında tatlı sularda da yetişen makroalglerdir (White and Keleshian 1994). Tatlı sularda yaşayan deniz yosunları yeşil okyanus ve denizlerde yaşayanlar ise kırmızı veya kahverengidir (Şekil 2).



Şekil 2. Kahverengi ve yeşil yosun

Deniz yosunlarının gübre olarak en eski ve en çok kullanımı Uzak Doğu ülkelerinde olduğu belirtilmiştir. Diğer taraftan Avrupa da denize geniş kıyısı olan Fransa, İngiltere ve İrlanda gibi ülkelerde bu tür kullanımlar mevcuttu. Fırtınaların koparıp kıyıya sürüklediği yosunlar sahil kenarlarında büyük yığınlar olusturmakta ve bu bölgelerde yerel halk tarafından sadece az bir miktarı gübre olarak kullanılmaktaydı (Duran 2019; Abetz 1980). Fransa, 17. yüzyılda deniz

yosunlarından yararlanmıştır. İngiltere□de 18. yüzyıldan itibaren yosun toplanmaya başlanmıştır. Yine 18. yüzyılın sonralarında İskoçya da yıllık yosun üretimi 20,000 ton kuru alg miktarına (400,000 yaş ağırlık) ulaşmıştır (Abetz 1980). Deniz yosunundan elde edilen sıvı ya da katı ekstraktlarının bitkisel üretimde kullanılması, kuvvetli kök gelişimini destekleyerek bitkilerin topraktan daha fazla ve daha kolay besin maddesi ve su almalarını sağlar. Diğer taraftan bitkilerde klorofil oluşumunu hızlandırarak vejetatif aksamın artmasını teşvik eder. Bitkilerin hastalık ve zararlılara karşı daha dirençli olmalarına sebep olur. Deniz yosunu bitkileri kuraklık, su stresi, ışık ve sıcaklık stresi ve don gibi çeşitli abiyotik stres faktörlerine dayanımını artırır (Duran 2019; Korkmaz 2023). Deniz yosunu, topraktan bitki tarafından alınımında sorunlar yaşanan mikro elementlerin daha kolay alınabilmesini sağlar (Duran 2019). Diğer taraftan doğal şartlarda toprakta kolayca parçalanarak bol miktarda azot (N) ve kalsiyum (Ca) sağlar. Ayrıca, bünyesinde magnezyum (Mg), demir (Fe), bakır (Cu), çinko (Zn), mangan (Mn), bor (B), ve kobalt (Co) gibi mikro elementler ve çeşitli büyüme düzenleyicileri (oksinler, sitokininler, gibberellinler, absisik asit) ile betainler gibi bileşikler içermektedir (Duran 2019; Korkmaz 2023). Katı ya da sıvı formlarda bulunan deniz yosununun kullanımı, meyve ağaçlarında dallanmayı ve meyve tutumunu arttırarak çiçek ve meyve dökümünü azaltır. Bitkilerde %30'a kadar verim artışı sağlarken ürünlerin raf ömrünü uzatır. Nematod ve virüs kaynaklı zararları azaltır (Duran 2019). Deniz yosunu günümüzde birçok ülkede özellikle serada sebze (domates, biber) yetiştiriciliğinde, meyve (turunçgil, asma, elma, armut vb.) ve süs bitkileri (lavanta, orkide vb.) üretiminde gübre olarak kullanılmaktadır (Yazıcı ve Kaynak 2001, Korkmaz 2023).

SONUÇ

Kimyasal gübrelerin bitkisel üretimde yoğun olarak kullanılması sonucunda toprak kalitesinin giderek bozulması ve yeraltı su kaynaklarının kirlenmesi nedeni ile sürdürülebilir ve çevreci tarımsal yöntemler daha fazla önem kazanmıştır. Bu bağlamda tarımsal üretimde farklı organik materyallerin gübre olarak kullanımı üzerine daha fazla çalışma yapılmaktadır. Organik materyallerin çevreci, ekonomik, geri dönüşümlü, bol miktarda ve kolay bulunur olması aranan özelliklerdendir. Deniz yosunu istenilen bu özellikleri fazlası ile karşılayan ve değerli bir organik maddedir. Dünyada hızla artan gıda ihtiyaçlarını karşılayabilmek için kimyasal gübre kullanımının yanında organik gübrelerin de kullanımını artırarak mevcut üretimi azaltmadan daha sağlıklı ve sürdürülebilir bir tarımsal üretim için özellikle deniz yosunu gibi doğal olarak

üretilen ya da organik kökenli atık materyallerin gübre kullanımının artırılması çevre ve insan sağlığı için önemlidir.

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ÖZET

Hem ülke ekonomisi hem de insanların hayatlarını devam ettirebilmeleri için ihtiyaç duyulan tarımsal gıda maddelerine yıl içerisinde sağlıklı ve güvenli bir şekilde erişim gün geçtikçe daha da önem kazanmaktadır. Kaynakların sınırlı ve dünya nüfusunun giderek kalabalıklaşması nedeniyle eldeki kısıtlı kaynaklarla üretilen tarımsal ürünlerin hasattan tüketime kadar kayba uğramadan ya da çok az bir kayıpla tüketime kadar uygun koşullarda muhafaza edilmesi konusunu gündeme getirmektedir. Ancak taze meyve ve sebze gibi ürünler çok çabuk bozulabileceği için hasat edildiği dönemde çok kısa bir süre içerisinde tüketilmesi gerekmektedir ve bu ürünlerde uzun süreli bir depolama yapmak mümkün değildir. Tarımsal ürünlerin bir kısmı ise yıl boyunca tüketimi karşılayabilmek için uzun süreli olarak depolanmaya uygun olup, insanların gıda ihtiyaçlarının karşılanmasında en temel gıda maddelerini ihtiva etmektedirler. Hasattan sonra kötü depolama koşullarında veya yanlış depolama uygulamaları nedeniyle, tarımsal ürünlerde yıllık %30 oranında bir kayıp meydana gelmektedir. Hasat sonrası ürün kayıplarını azaltabilmek, tüketimin yıl içerisinde dengeli bir şekilde dağılımına imkân sağlamak ve ürünlerin yıl içerisinde ihtiyaç oranında satışa çıkarılmasıyla çiftçilerin ekonomik olarak kalkınmasına katkı sağlamak amacıyla oluşturulan lisanslı depoculuk uygulamaları, Türkiye'de 17 Şubat 2005 tarihinde, 5300 sayılı Tarım Ürünleri Lisanlı Depoculuk Kanunu ile başlamıştır. Türkiye'de, 8.931.223 tonu hububat, 96.500 tonu pamuk, 13.500 tonu zeytin, 11.600 tonu fındık, 5.000 tonu kuru kayısı ve 4.000 tonu Antep Fıstığı olmak üzere toplam lisanlı depo kapasitesi 9.061.823 tona ulaşmıştır. Konya ili, hem ülkenin tarımsal üretim potansiyeline katkıları hem de toplam lisanslı depo kapasitesinin yaklaşık %20'sini oluşturması nedeniyle, tarımsal üretim ve depolamada oldukça önemli bir konumdadır. Bu çalışmada, tarımsal ürün depolarının tipleri, özellikleri ve ürünlerin depolanma koşulları ile ilgili genel bilgiler verilerek, Konya ilinin tarımsal üretim ve lisanslı depolamadaki önemi hakkında genel bir değerlendirme yapılmıştır.

Anahtar Kelimeler: Lisanslı Depoculuk, Tarımsal Ürün Depoları, Depolama Koşulları, Yapı Tipleri

AGRICULTURAL PRODUCT WAREHOUSES AND LICENSED WAREHOUSING: THE CASE OF KONYA

ABSTRACT

A healthy and safe access to agricultural foodstuffs, which are needed for both the country's economy and people to continue their lives, is gaining more and more importance day by day. Due to the limited resources and the gradual increase in the world population, it raises the issue of preserving the agricultural products produced with the limited resources available from harvest to consumption under appropriate conditions until consumption without loss or with very little loss. However, since products such as fresh fruits and vegetables can deteriorate very quickly, they must be consumed in a very short time during the harvest period and it is not possible to make a long-term storage in these products. Some of the agricultural products are suitable for long-term storage to meet the consumption throughout the year, and they contain the most basic foodstuffs to meet the food needs of people. Post harvesting, there is occurs an annual loss of 30% in agricultural products due to poor storage conditions or improper storage practices. Licensed warehousing practices, which were created to reduce post-harvest product losses, to allow for a balanced distribution of consumption throughout the year, and to contribute to the economic development of farmers by putting the products on sale during the year at the rate of need, started in Turkey on February 17, 2005 with the Licensed Warehousing in Agricultural Products Law No. 5300. In Turkey, the total licensed warehouse capacity has reached 9.061.823 tons, of which 8.931.223 tons of cereals, 96.500 tons of cotton, 13.500 tons of olives, 11.600 tons of hazelnuts, 5.000 tons of dried apricots and 4.000 tons of pistachios. Konya province has a very important position in agricultural production and storage, both because of its contributions to the agricultural production potential of the country and because it constitutes approximately 20% of the total licensed warehouse capacity. In this study, a general evaluation was made about the importance of Konya province in agricultural production and licensed storage by giving general information about the types, characteristics and storage conditions of agricultural product warehouses.

Keywords: Licensed Warehousing, Agricultural Product Warehouses, Storage Conditions, Building Types

INTRODUCTION

Agricultural storing which is defined as the preservation and protection of agricultural products without losing their qualitative and quantitative characteristics until they are consumed after harvesting, has become a more important branch of activity today with technological developments. The production of agricultural products has an important position both to meet the nutritional needs of people and to contribute to the producer and the country's economy, and therefore it is very important to store the products in suitable conditions until consumption. In addition to climate change, due to the increasing world population, limited resources, decreasing or not being used effectively, it has become increasingly important to preserve agricultural products, which have an important share in human nutrition, from harvest to consumption without loss or with very little loss. The purpose of storage is to preserve the quality of the harvested or produced products at the highest possible level and to keep the negative effects that cause them to lose their qualitative and quantitative characteristics at the lowest level (Dizlek, 2012). According to Sargın and Okudum (2014), agricultural products can be stored for a longer period of time with proper storage activities, it is possible to find all kinds of fruits and vegetables throughout the year, and quality losses due to mistakes made in storage are also reduced.

perishable fruits and vegetables must be consumed within a short time after harvest and are not suitable for long-term storage. According to the results of the studies conducted by McGregor (1987), Cantwell (1999) and Sargent et al. (2000) tomatoes can be stored for 7 days at 90-95% humidity and 8-10 ^{o}C, 8-10 days and eggplant at 90-95% humidity, 8-12 ^{o}C temperature, while melon can be stored for 12-21 days at 90-95% humidity and 7-10 ^{o}C temperature and watermelon can be stored for 14-21 days at 90% humidity and 10-12 ^{o}C temperature. Agricultural products with low grain moisture content, such as cereals, can be stored for more than a year depending on the need.

Nowadays, structures for storing products can be planned in the system of bench (Bunker) type warehouses, silos (steel and reinforced concrete) and controlled atmosphere warehouses (Kibar and Öztürk, 2010). Silos are generally built with vertical walls, flat bottoms or conical bottoms. For a certain volume to be stored, the height of the flat-bottomed silos is less than the cone bottomed silos. While flat bottomed silos are preferred in cases where the storage period is long and there is no need for a high discharge flow, a steeper funnel should be designed to reach a high discharge flow (Özel, 2007).

Silos are cylindrical, suitable for mechanization and high initial construction costs (Anonymous, 2015). Although silos can be built as wood, steel, reinforced concrete and prestressed concrete, wooden silo construction is not preferred today. Although steel is commonly used in the construction of small volume silos, medium and large volume silos are built with reinforced concrete (Noberhaus, 1965; Ciesielski et al. 1967; Durmuş, 2007).

Due to the low wall thickness, steel silos are faced with the problem of buckling due to compressive stresses, and circular sectioned silos with less bending effect are generally used (Rotter, 2001). Although circular, rectangular, square or polygonal cross-sections are used in the construction of reinforced concrete silos, the most appropriate cross-section is circle, and since the side walls of the silos are only forced by tensile force in circular-section silos, they can be built with a smaller body thickness compared to square and rectangular silos. However, the manufacturing difficulty and high cost of the curvilinear formwork required in the construction of circular reinforced concrete silos should also be considered (Özel, 2007).

DEFINITION, IMPORTANCE AND SCOPE OF LICENSED WAREHOUSING

Licensed warehousing practices, which have been applied for many years in the USA, have started to be implemented in many countries in recent years, as they bring structural solutions to the storage of agricultural products. Due to improper storage practices after harvest, an annual average loss of 30% occurs in agricultural products. For this reason, storing agricultural products in suitable conditions after harvesting until consumption, prolonging the marketing period of the products produced in a short production season and offering them for sale at more affordable prices throughout the year, prevents excessively low or excessively high prices as it allows agricultural products to be sold continuously throughout the year. Licensed warehousing practices, which facilitate the trade of products by preserving their class and quality, for the purposes of creating a price balance between the producer and the consumer, started in Turkey on February 17, 2005, with the Agricultural Products Licensed Warehousing Law No. 5300. Licensed warehousing system, which determines the quality and class of agricultural products to be taken into warehouses by authorized classification laboratories, creates important opportunities in the marketing of agricultural products, provides the opportunity to deliver the desired quantity and quality of agricultural products at any time without any limitation, ensures that the products are kept in healthy warehouses equipped with modern systems. It is defined as a system that contributes to the prevention of informal shopping in the economy by preventing price fluctuations in the market of products and provides

financing to farmers with electronic product certificates given in exchange for the delivery of products to warehouses (Anonymous, 2015; Ergun et al., 2022).

Minimum qualifications to be provided in licensed warehouses; 1. Planning the warehouse floor, interior and exterior warehouse surfaces and roof in a quality and manner that will protect the product from all kinds of internal and external damages, prevent moisture-proof and prevent foreign matter from mixing with the product inside the warehouse, 2. Planning it as a closed structure and there are free spaces and passageways around the warehouse where the vehicles and equipment can move freely during both taking the products into the warehouse and removing them, 3. Planning of storage structures in size and quality that will prevent the mixing of products and deterioration of their qualitative and quantitative characteristics in the storage of products of different product types, classes and grades, 4. Licensed the closed storage capacity of the warehouses included in the license is 20,000 tons, especially for grains and oilseed products stored in bulk, and the closed storage capacity of each branch is at least 2,000 tons, 5. It has adequate ventilation and fire extinguishing systems, 6. It has a dust extraction system. Also, the presence of this system in transport and transfer equipment that has the risk of dust collection, 7. If necessary, drying, sieving, etc., according to the quality of the product to be stored. In order to provide services, it is necessary either to have units and facilities of the appropriate capacity and type, where these operations can be carried out within the enterprise or in the vicinity, or these services must be provided by the licensed warehouse operation by making an agreement with other enterprises (Tutar, 2010; Ünal, 2011; Anonymous, 2013). In licensed warehousing, firstly, the product information brought to the warehouse by the vehicle is processed into the computer system and then weighed and analyzed by taking samples from various points of the vehicle. The results of the analysis are reported to the product owner and if there is no objection, the products of quality and quality suitable for storage are directed to the product receiving point to be stored in accordance with the quality class. While the product is poured, the dust and foreign materials in the product are collected and removed from the product with the dust collection system and if the moisture content is suitable for storage, it is transferred to the silo where it will be stored. Products with high moisture content are transferred to silos suitable for their quality and class after they are dried and cooled to a certain level. After the products are filled into the warehouses, the electronic product receipt is issued and the product is delivered to the owner. The necessary controls are made to remove the product from the licensed warehouses, the product is unloaded from the warehouses by issuing the exit document, and finally the electronic product certificate is cancelled. In addition, in order

for agricultural products such as cereals to be stored in licensed warehouses with steel or reinforced concrete construction, their moisture content must be 14% or less (Kaleta and Górnicki, 2013). According to the analyzes made, the temperature fluctuations in the silo of the products that are suitable for storage are monitored by heat sensors located at certain distances within the ropes attached to the roof beams of the warehouse, and the excess heat is tried to be thrown out by operating the ventilation systems in the silos where there is heating. The storage times of the products in licensed warehouses vary according to the quality and type of the product (Abdullah et al., 2019; Dal-uyen et al., 2019), and the moisture content of wheat and barley, which is desired to be stored for more than six months, is maximum 13% (Hoseney, 1986; McKenzie, 2010).

CURRENT STATUS OF LICENSED WAREHOUSING IN TURKEY

Licensed warehousing activities in Turkey started with the Agricultural Products Licensed Warehousing Law No. 5300 enacted in 2005 and the licensed warehouse regulation issued in 2013. Although licensed storage activities were carried out in only 8 product groups (cereals, legumes, oilseeds, hazelnuts, dried apricots, cotton, olives, olive oil) from 2013 to 2016, the communiqués issued in 2016, 2017 and 2019 also allowed the storage of pistachios, raisins and dairy products. Licensed storage capacity in Turkey is 9 135 723 tons, 99% of which is cereals and 1% of other products (cotton, olive-olive oil, hazelnut, dried apricot, pistachio) are stored. If the total capacity of the companies that have received a license and started to operate is included in the license, a capacity of 13 761 116 tons will be reached. The total capacity of the companies that have received the establishment permit is 6 176 000 tons and the total storage capacity will be 19 937 116 tons with the license of all of them. The number of licensed warehouse enterprises which is 170 operating in our country, will reach 330 as of 2023 with the operation of all enterprises that have been granted establishment permission (Table1), (Anonymous, 2023).

Table 1. Current status of licensed warehousing in Turkey (Anonymous, 2023)

Licensed warehouse business granted establishment permit (units)	330
Licensed warehouse business in operation (units)	170
Authorized classifier (laboratory services) (units)	28
Reference authoritative classifier (units)	4
Current (active) total licensed warehouse capacity (tons)	9 135 723
Total capacity of licensed warehouses if all of their capacity is included in the license (tons)	13 761 116
Total capacity of enterprises that have received establishment permission (tons)	6 176 000
Projected total capacity of 330 companies (tons)	19 937 116

Although the number of enterprises that obtained establishment permits in Turkey in 2011, when licensed warehousing activities began, was 7 and the number of enterprises in operation was 1, In 2023, 170 of the 330 enterprises that received establishment permits are in operation (Figure 1; Figure 2), (Anonymous, 2020; Anonymous 2021a; Anonymous 2022a; Anonymous 2022b).

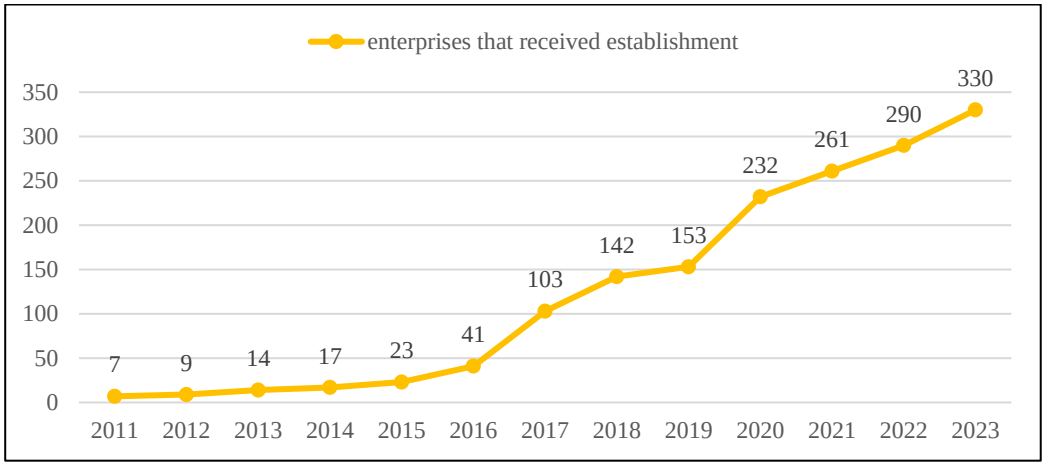


Figure 1. Change of licensed warehouse enterprises that received establishment permission between 2011-2023 in Turkey

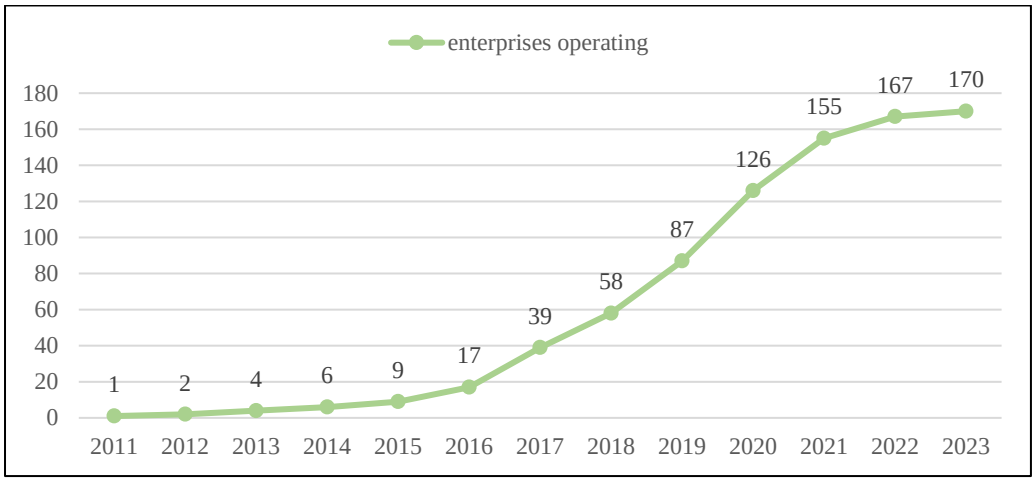


Figure 2. Change of licensed warehouse enterprises operating in Turkey between 2011-2023

Although the active licensed warehouse capacity in Turkey was 40 thousand tons and the total licensed warehouse capacity was 397 thousand tons in 2011, the active licensed warehouse capacity reached approximately 9 million 136 thousand tons and the total licensed warehouse capacity reached approximately 19 million 937 thousand tons in 2023 (Figure 3; Figure 4), (Anonymous, 2020; Anonymous 2021a; Anonymous 2022a; Anonymous 2022b).

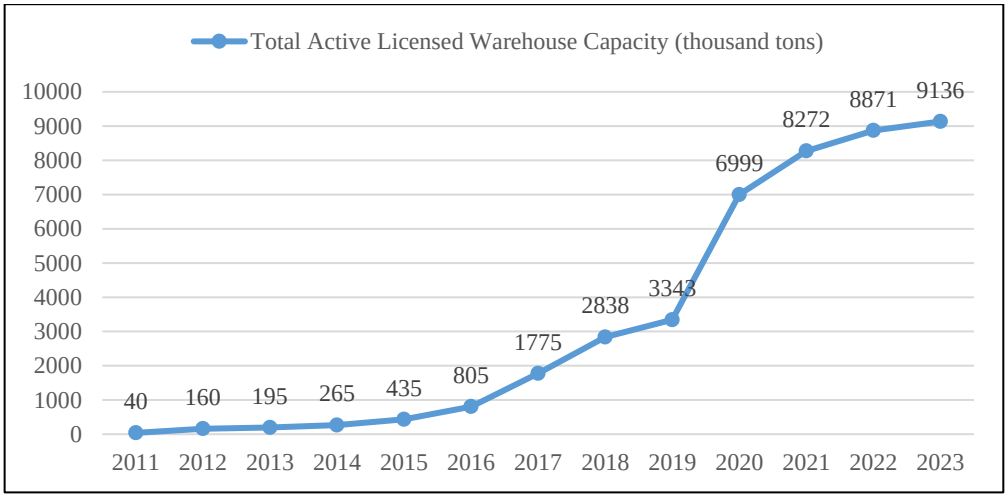


Figure 3. Active licensed warehouse capacities in Turkey between 2011-2023

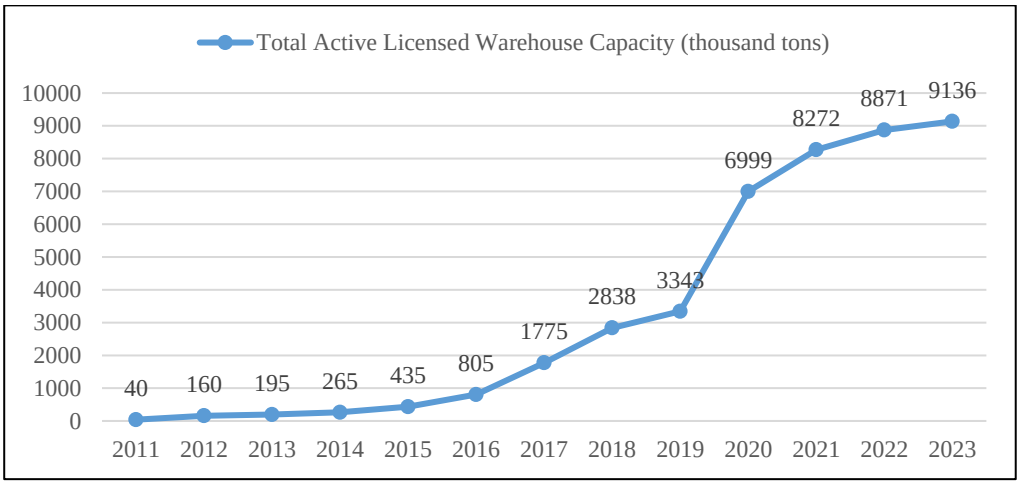


Figure 4. Total licensed warehouse capacities projected in Turkey between 2011-2023

THE PLACE AND IMPORTANCE OF KONYA PROVINCE IN AGRICULTURAL PRODUCTION AND LICENSED STORAGE

The province of Konya, which has approximately 5% of Turkey's surface area (4 083 800 ha) and approximately 8% (1,859.079 ha) of agricultural land, also accounts for approximately 12% of the total grain production. 13 (Anonymous, 2021b; TUIK, 2023) (Table 2; Table 3; Table 4). Grain is stored in 99% of licensed warehouses, and the fact that agricultural production is intensively made and that almost half of the licensed warehouses in the Central Anatolian region constitutes the province of Konya, which is described as a grain warehouse, makes it more important in terms of storage activities.

Table 2. The share of Konya province in total land assets (Anonymous, 2021b)

Year	Turkey/Konya	Area (ha)	Agricultural Area (ha)	Forest Area (ha)	Meadow Area (ha)	Other Areas (ha)
2021	Turkey	78.004.300	23.136.584	21.678.134	14.616.617	18.572.965
	Konya	4.083.800	1.859.079	492.857	812.414	919.450
Konya's Share (%)		5,24	8,4	2,27	5,56	4,95

Table 3. Usage status of agricultural lands in Turkey and Konya and the share of Konya in agricultural production (Anonymous, 2021b)

Year	Turkey/Konya	Total Agricultural Area (ha)	Farm plants (ha)	Fallow Area (ha)	Vegetable Area (ha)	Fruits (ha)	Ornamental Plants (ha)
2021	Turkey	23.136.584	15.614.972	3.173.252	779.246	3.563.707	5.407
	Konya	1.859.079	1.473.258	307.158	30.881	47.698	84
Konya's Share (%)		8,04	9,43	9,68	3,96	1,34	1,55

A total of 35801 thousand tons of cereals were produced in Turkey in 2022, of which approximately 55% is wheat, 19% is corn, 23.7% is barley, 0.8% oats, 0.6% rye and 0.9% other cereals. (sorghum, millet and triticale). In Konya, which constitutes an important part of the total grain production with a rate of 12.52 percent, 43% of the total production of 4484 thousand tons is wheat, 28% corn, 28% barley, 0.3% oat, 1.3% rye and 1% rye. 0.2 of them consists of other grains (Table 4).

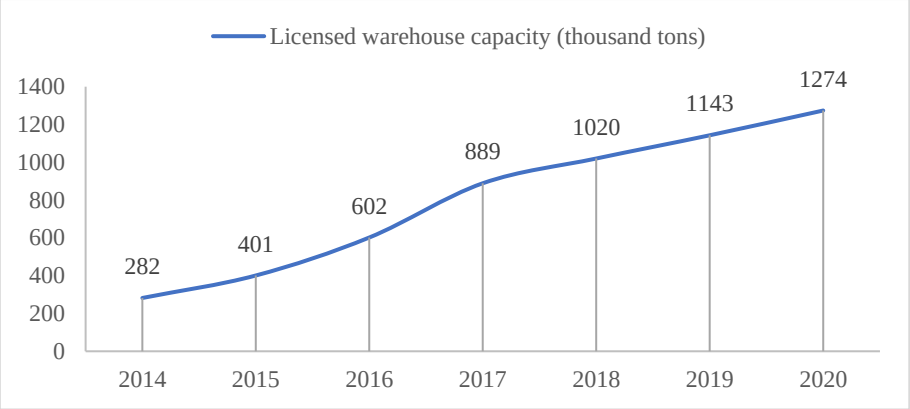
Table 4. Total grain production in Turkey and Konya and the place of Konya in production according to grain type (TUIK, 2023)

Year	Turkey/Konya	Total Grain Production (1000 tons)	Wheat (1000 tons)	Corn (1000 tons)	Barley (1000 tons)	Oats (1000 tons)	Rye (1000 tons)	Other (1000 tons)
2022	Turkey	35801,54	19751,36	6750	8500	276	200	324,18
	Konya	4484,06	1929,54	1261,47	1264,82	14,83	5,85	7,55
Konya's Share (%)		12,52	9,77	18,69	14,88	5,37	2,93	2,33

46% in Central Anatolia, 22.5% in Southeast Anatolia, 14% in Marmara, 13% in Mediterranean, 2% in Black Sea, 1.5% in the Aegean and 1% in the Eastern Anatolia region locate of licensed warehouses in Turkey. Konya is the province with the highest licensed

warehousing capacity in Turkey and it constitutes approximately 20% (1 822 731 tons) of the total capacity of 9 135 723 tons. It is expected that the total licensed warehousing capacity in the province of Konya will reach approximately 2 million tons, with the license for the entire capacity of the enterprises that have obtained the establishment permit. Licensed warehousing capacity in Konya Province increased by 350% from 2014 to 2020, reaching 1,273,820 tons from 282,200 tons (Figure 5). Licensed warehouse capacity in the province has reached 1 822 731 tons with an increase of approximately 43% from 2020 to 2023 (Anonymous, 2023).

Figure 5. Konya province licensed warehouse capacity (thousand tons)



CONCLUSION

Agricultural production is a field of activity that both affects and is affected by global drought and climate change, and has a very important place in meeting the nutritional needs of people. For this reason, it is important that agricultural products produced in a limited area and with limited resources are delivered to the consumer with the least possible loss. Although the production amounts and yields of agricultural products in the world tend to increase in recent years, due to rapid population growth and nutritional habits, the amount of consumption increases more than production, so it is important to store agricultural products after harvest as well as production. With the spread of licensed warehousing activities, the harvested products will be kept in healthy conditions with less loss and the continuity of the quality of the products in terms of both quality and quantity will be ensured. With licensed warehousing, the welfare level of farmers will also increase as agricultural products will be offered for sale not only during the harvest period but also throughout the year. The nutritional values of agricultural products stored in appropriate storage structures and storage conditions will be preserved at the highest level possible, and more and better-quality products will be delivered to people by reducing rate of wastage. Increasing licensed storage activities in Konya, where agricultural

production is intensive, and raising awareness of farmers about storing their products in these warehouses will be useful in terms of reducing product losses.

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TUZ STRESİNİN BAZI ŞEKER SORGUM [*Sorghum bicolor var. saccharatum* (L.) Mohlenbr.] ÇEŞİTLERİNİN ÇİMLENME ÖZELLİKLERİ ÜZERİNE ETKİSİ

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ÖZET

Bu çalışma, bazı şeker sorgum çeşitlerinin çimlenme döneminde tuz stresine tepkilerini belirlemek amacıyla yürütülmüştür. Denemede bitki materyali olarak Erdurmuş, Gülşeker ve Sweet Betty çeşitleri kullanılmıştır. Çalışmada sekiz farklı tuz stresi seviyesi (0, 50, 100, 150, 200, 250, 300 ve 350 mM) ele alınmıştır. Deneme, Bursa Uludağ Üniversitesi Ziraat Fakültesi Tarla Bitkileri Bölümü Bitki Fizyolojisi Laboratuvarı'nda tesadüf parselleri deneme deseninde dört tekerrürlü olarak yürütülmüştür. Çalışmada tohumlarda 12. ve 24. saatlerdeki su alım oranları, çimlenme yüzdesi, çimlenme indeksi, kökçük uzunluğu, sapçık uzunluğu, kökçük yaş ağırlığı, sapçık yaş ağırlığı kökçük kuru ağırlığı ve sapçık kuru ağırlığı gibi özellikler incelenmiştir. Araştırma sonucunda; şeker sorgum çeşitlerinin tuz stresi seviyelerine farklı tepki verdikleri ve bu tepkinin de istatistiksel olarak kökçük kuru ağırlık hariç diğer incelenen özelliklerde önemli olduğu belirlenmiştir. Tuz stresi seviyelerinin incelenen tüm özellikler üzerine etkisi olumsuz olmuştur. Şeker sorgum çeşitlerinde 150 mM tuz stres seviyesi uygulaması çimlenme yüzdesi, kökçük uzunluğu, sapçık uzunluğu, kökçük yağ ağırlığı, sapçık yaş ağırlığı, kökçük kuru ağırlığı ve sapçık kuru ağırlığı özelliklerinde önemli derece azalmaya neden olmuştur. Erdurmuş çeşidinin artan tuz stres seviyeleri altında diğer iki çeşide göre çimlenme yüzdesi başta olmak üzere incelenen tüm özelliklerde ön plana çıktığı belirlenmiştir.

Anahtar Kelimeler: Çimlenme yüzdesi, Şeker sorgum, Tuz stresi

THE EFFECT of SALT STRESS in SOME SWEET SORGHUM [*Sorghum bicolor var. saccharatum* (L.) Mohlenbr.] VARIETIES on GERMINATION CHARACTERS

ABSTRACT

This study was carried out to determine the response of some sweet sorghum cultivars to salt stress levels during the germination period. Erdurmus, Gulseker and Sweet Betty varieties were used as plant material in the experiment. Eight different salt stress levels (0, 50, 100, 150, 200, 250, 300 and 350 mM) were considered in the study. The experiment was carried out in a randomized plot design with four replications in Bursa Uludag University, Faculty of Agriculture, Department of Field Crops, Plant Physiology Laboratory. In the study were determined water intake rate of seeds at twelfth and twenty-fourth hours, germination percentage, germination index, root length, shoot length, root fresh weight, shoot fresh weight, root dry weight and shoot dry weight. As a result of the research; it was determined that sweet sorghum cultivars reacted differently to salt stress levels and this response was statistically significant in other investigated properties except root dry weight. Salt stress levels had a negative effect on all the traits studied.150 mM salt stress level application in sweet sorghum cultivars caused a significant decrease in germination percentage, root and shoot length, root and shoot fresh weight and root and shoot dry weight properties. It was determined that Erdurmus cultivar came to the fore in all the examined characteristics, especially germination percentage, under increasing salt stress levels compared to the other two cultivars.

Keywords: Germination percentage, Salt stress, Sweet sorghum

GİRİŞ

Şeker sorgum, anavatanı Kuzey ve Orta Afrika olarak bilinen buğdaygiller (Graminae) familyasına ait, tek yıllık ve kendine döllenen bir bitkidir (Dilmenler, 2021). Bitkinin toplam kütlesinin % 70-75'i saptan, % 10-15'i yapraktan, % 7'si taneden ve % 10'u kökten oluşmaktadır (Bayram ve Turgut, 2005). Güçlü kök yapısı sebebiyle her türlü iklim koşullarında yetiştirilebilmektedir (Dilmenler, 2021). C4 fotosentezi grubunda bulunan ve bir enerji bitkisi olan şeker sorgum uygun koşullarda 4-5 ay gibi yetiştirme süresinde 4.5 m' ye kadar boylanmakta ve dekara 4500-11000 kg yaş ot verimi alınabilmektedir (Dweikat, 2014). Birçok bitkiye göre daha az su ve gübreye ihtiyaç duymaktadır. Kurak koşullarda da gelişimini sürdürebilen, geçici kuraklıklara dayanabilme özelliği ile bitkiler aleminin devesi olarak anılmaktadır (Küçüksemerci ve Baytekin, 2017). Şeker sorgumun mısıra kıyasla kuraklığa daha dayanıklı ve toprak seçiciliği daha az ve ayrıca tuz stresine, yüksek sıcaklığa, düzensiz yağış değişimi koşullarına daha toleranslı bir bitkidir (Dilmenler 2021). Hastalık ve zararlılara karşı şeker sorgumun dayanımı yüksek olup tarımsal üretimin devamlılığını sağlayacak önemli bir bitkidir (Çakır, 2004).

Bitkilerin yaşamlarını sürdürdükleri alanlarda büyüme, gelişme ve metabolizmayı etkileyen ya da kısıtlayan durumlara stres adı verilmektedir. Stres, abiyotik stres faktörleri (soğuk, sıcak, kuraklık, tuzluluk, su fazlalığı, radyasyon, çeşitli kimyasallar, oksidatif stres, rüzgar ve toprakta besin yetersizliği) ve biyotik stres faktörleri (virüs, bakteri ve fungusları içeren patojenler, böcekler ve herbivor) olmak üzere iki grupta incelenmektedir (Yılmaz ve ark., 2011). Tuzluluk dünyada olduğu gibi ülkemizde de bitki çeşitliliğini ve tarımsal üretkenliği azaltarak tarım topraklarında olumsuz etkiye neden olacak sorunlardan biridir (Tiryaki, 2018). Tuz stresi, toprakta NaCl ve diğer çözülebilir tuz miktarının artışına neden olduğu için bitkinin büyümesi ve gelişimi olumsuz etkilenmektedir. Toprak da tuz yoğunluğunun artması ve su potansiyelinin azalmasından dolayı bitkiler bu duruma karşı tepki oluşturmaktadır. Tuz stresinin yoğunluğuna ve süresine bağlı olarak bitkilerde çimlenme, büyüme, gelişme, fotosentez ve hücre bölünmesi gibi biyolojik olaylar olumsuz etkilemektedir (Yılmaz ve ark., 2011). Bitkilerin tuzlu ortamlara verdiği tepkiler genotipik farklılıklara göre değişmekte ve tuz stresinin bitkiler üzerindeki etkisi tuzun ve bitkinin çeşidinde ayrıca tuzun miktarına bağlı olarak değişim göstermektedir (Çulha ve Çakırlar, 2011). Dehnavi ve ark. (2020), şeker sorgum çeşitlerinde yürüttükleri çalışmada tuz stres seviyesi arttıkça çeşitlerin çimlenme yüzdesi, çimlenme indeksi, kökçük ve sapçık yaş ağırlığının olumsuz etkilendiğini tespit etmişlerdir. Dilmenler (2021), şeker sorgum çeşitlerinin tuz stres seviyesini incelediği bir çalışmada çimlenme oranının %58.86-94.76, kökçük

uzunluğunun 22.85-33.01 cm ve sapçık uzunluğunun 5.22-69.24 cm arasında değişim gösterdiğini bildirmiştir. Özyağcı ve Açıkbaş (2021), tuz stresi altında şeker sorgum çeşitlerine ait çimlenme yüzdesinin % 17.3 -75.0, çimlenme indeksinin 1.14-8.35,kökçük yaş ağırlığının 3.5-22.6 mg, sapçık yaş ağırlığının 10.234.3 mg, kökçük kuru ağırlığının 0.29-2.15 mg ve sapçık kuru ağırlığının 0.54-3.45 mg arasında değişim gösterdiğini rapor etmişlerdir.

Bu çalışmada, bazı şeker sorgum çeşitlerinin çimlenme döneminde tuz stresine tepkilerinin belirlenmesi amaçlanmıştır.

MATARYEL ve YÖNTEM

Bu çalışma, Bursa Uludağ Üniversitesi Ziraat Fakültesi Tarla Bitkileri Bölümü Bitki Fizyolojisi Laboratuvarı'nda tesadüf parselleri deneme deseninde dört tekerrürlü olarak yürütülmüştür. Denemede bitki materyali olarak Erdurmuş, Gülşeker ve Sweet Betty çeşitleri kullanılmıştır. Çalışmada sekiz farklı tuz stresi seviyesi (0, 50, 100, 150, 200, 250, 300 ve 350 mM) ele alınmıştır. Çimlendirme öncesinde tohumlar %2'lik sodyum hipoklorit ile yüzey sterilizasyonuna tabi tutulmuştur. Tohumlar 10 dakika sodyum hipoklorit ile çalkalanmış ve ardından önce çeşme suyu ile daha sonra saf su ile iyice yıkanma işlemi yapılmıştır. Yüzey sterilizasyonu yapıldıktan sonra tohumlar başlangıç nem içeriklerine dönünceye kadar (24 saat) oda şartlarında bekletilmiştir (Rezende ve ark. 2017). Çimlendirmeler için 15 cm'lik petri kapları kullanılmıştır. Yüzey sterilizasyonuna tabi tutulan tohumlar tek katlı çimlendirme kâğıdı bulunan petri kaplarına 50 adet tohum olacak yerleştirilmiştir. Tek katlı çimlendirme kâğıtlarına yerleştirilen tohumların üzerine 0 mM, 50 mM, 100 mM, 150 mM, 200 mM, 250 mM, 300 mM ve 350 mM tuz stres seviyelerinin her bir solüsyondan her bir petriye 10 ml verilmiştir. Bu işlemden hemen sonra buharlaşmayı engellemek amacıyla petri kaplarının etrafı parafilm ile sarılmış ve petri kapları 25±1 ^{0}C sıcaklığa ayarlı iklimlendirme dolabına konulmuştur (Avcı ve ark., 2016). Petriler iklimlendirme dolabına konulduktan sonra ilk 12. saat ve 24. saatlerde tohumların ağırlıkları tartılarak belirlenmiş ve aşağıdaki formül yardımıyla su alım oranları (%) hesaplanmıştır.

% Su Alım Oranı=(A2 –A1/A1)100 (Akbarimoghaddam ve ark., 2011).

A1 = Tohumun ilk ağırlığı

A2 = 12. veya 24. saatteki tohum ağırlığı

Denemede 10 gün boyunca gözlemler yapılmış ve kökçük uzunluğu 2 mm uzamışsa tohum çimlenmiş sayılmıştır (Rezende ve ark. 2017). 10 gün sonra petri kaplarında çimlenme yüzdesi (ÇY-%), çimlenme indeksi (ÇI), kökçük uzunluğu (KU-cm) sapçık uzunluğu (SU-cm), kökçük

yaş ağırlığı (KYA-mg/fide) sapçık yaş ağırlığı (SYA-mg/fide), kökçük kuru ağırlığı (KKA-mg/fide) ve sapçık kuru ağırlığı (SKA-mg/fide) gibi özellikler incelenmiştir. Çimlenme yüzdesi (%), 10. gün sonunda çimlenen tohumlar sayılarak, (çimlenen tohum sayısı/toplam tohum sayısı) x 100 formülü ile çimlenme yüzdesi % olarak hesaplanmıştır. Çimlenme indeksi (Çİ), Dehnavi ve ark. (2020)'na göre hesaplanmıştır. Kökçük ve sapçık uzunluğunu belirlemek için her bir petriden rastgele seçilen 15 bitki alınmış, sapçık ve kökçük kısımlarına ayrıldıktan sonra cetvelle uzunluk ölçümleri yapılmıştır ve ardından kökçük ve sapçık yaş ağırlığını için hassas terazide tartım yapılarak ortalama sapçık ve kökçük yaş ağırlıkları (mg/fide) hesaplanmıştır. Yaş ağırlık belirlenen kökçük ve sapçıklar, 65 ^{0}C hava dolaşımlı kurutma fırında 48 saat kurutulduktan sonra hassas terazide tartılarak ortalama kuru ağırlıkları (mg/fide) belirlenmiştir. Araştırmadan elde edilen veriler, tesadüf parselleri deneme deseninde faktöriyel düzene göre 4 tekerrürlü olarak varyans analizine tabi tutulmuştur (Turan, 1995). Bütün hesaplamalar bilgisayarda JMP paket programından yararlanılarak yapılmıştır. Önemlilik testlerinde % 1 ve % 5, farklı grupların belirlenmesinde ise % 5 olasılık düzeyi kullanılmıştır. Farklı grupların belirlenmesinde LSD testinden yararlanılmıştır.

BULGULAR ve TARTIŞMA

Bazı şeker sorgum çeşitlerinin farklı tuz seviyelerinde12. saatteki su alım oranı, 24. saatteki su alım oranı, çimlenme yüzdesi, çimlenme indeksi, kökçük uzunluğu, sapçık uzunluğu, kökçük yaş ağırlığı, sapçık yaş ağırlığı, kökçük kuru ağırlığı ve sapçık kuru ağırlığı özelliklerine ilişkin varyans analiz sonuçları Çizelge 1'de verilmiştir. Şeker sorgum çeşitleri arasında kökçük kuru ağırlığı hariç incelenen tüm özellikler bakımından %1 olasılık düzeyinde farklılıklar ortaya çıkmıştır. Tuz stres seviyeleri açısından kökçük kuru ağırlığı % 5, çimlenme yüzdesi, çimlenme indeksi, kökçük uzunluğu, sapçık uzunluğu, kökçük yaş ağırlığı, sapçık yaş ağırlığı ve sapçık kuru ağırlığı özellikleri ise %1 olasılık düzeyinde farklılıklar göstermiştir. Çeşit x tuz stresi interaksiyonu bakımından ise 12. saatteki su alım oranı, 24. saatteki su alım oranı ve kökçük kuru ağırlık özellikleri hariç incelenen diğer özelliklerde % 1 olasılık düzeyinde önemli farklılıklar tespit edilmiştir (Çizelge 1).

Şeker sorgum çeşitlerinin 12. saatteki su alım oranları % 30.86-38.09 arasında değişim göstermiştir (Çizelge 2). 12. saatteki en yüksek su alım % 38.09 ile Erdurmuş çeşidinde, en düşük ise 30.86 ile Gülşeker çeşidinden elde edilmiştir. Tuz stres seviyelerinin 12. saatteki su alım oranları % 30.88-38.31 arasında değişmiştir. Artan tuz stres seviyeleri 12. saatteki su alım oranını olumsuz etkilemiş ve en düşük su alım oranları 300 mM, 250 mM, 200 mM ve 350 mM tuz stresi seviyelerinde belirlenmiştir (Çizelge 2). 12. saatteki su alım oranı üzerine çeşit x tuz

interaksiyonunun etkisi önemsiz olmuş ve genel olarak 12. saatteki su alım oranları % 27.54-42.26 arasında değişim göstermiştir (Çizelge 1 ve Çizelge 2).

Çizelge 1. Şeker sorgum çeşitlerinin farklı tuz stresi seviyelerinden elde edilen 12. saatteki su alım oranı, 24. saatteki su alım oranı, çimlenme yüzdesi, çimlenme indeksi, kökçük uzunluğu, sapçık uzunluğu, kökçük yaş ağırlığı, sapçık yaş ağırlığı kökçük kuru ağırlığı ve sapçık kuru ağırlığı üzerine etkilerine ilişkin varyans analiz sonuçları (Kareler ortalaması)

V.K	SD	12. saatteki SAO	24. saatteki SAO	ÇY	ÇI	KU	SU
Tuz	7	69.40**	250.65**	1988.93**	6875.77**	139.39**	378.28**
Çeşit	2	453.30**	793.33**	43373.79**	63480.58**	79.10**	186.85**
Ç X K	14	1.94	53.36	278.98**	644.03**	13.25**	19.06**
Hata	72	13.81	41.13	32.61	21.90	2.30	1.05

SD: Serbestlik Derecesi, SAO: Su alım oranı, ÇY: Çimlenme yüzdesi, ÇI: Çimlenme indeksi KU: Kökçük uzunluğu, SU: Sapçık uzunluğu
**, *: :Sırasıyla % 1 ve % 5 düzeyinde önemlidir.

Çizelge 1'in devamı

V.K	SD	KYA	SYA	KKA	SKA
Tuz	7	189.38**	8735.1**	3.71*	30.62**
Çeşit	2	93.51**	3211.91**	1.62	19.02**
Ç X K	14	79.67**	1260.11**	2.42	10.57**
Hata	72	4.37	41.72	1.51	0.35

SD: Serbestlik Derecesi, KYA: Kökçük yaş ağırlığı, SYA: Sapçık yaş ağırlığı, KKA: Kökçük kuru ağırlığı, SKA: Sapçık kuru ağırlığı
**, *: :Sırasıyla % 1 ve % 5 düzeyinde önemlidir.

Şeker sorgum çeşitleri bakımından 24. saatteki su alım oranlarına ait ortalama değerler incelendiğinde; %38.82-47.69 arasında değişim gösterdiği belirlenmiştir. Şeker sorgum çeşitlerinden en yüksek 24. saatteki su alım oranına sahip çeşit %47.69 ile Erdurmuş, en düşük ise % 38.82 ile Gülşeker olmuştur. Tuz stres seviyelerinin 24. saatteki su alım oranları üzerine etkisi incelendiğinde; % 36.41-51.18 değerleri arasında değişim göstermiştir. Artan tuz stres seviyelerinin ortamın osmotik basıncını arttırdığı için tohumların su alım oranının azalmasına neden olmuştur. 24. saatteki su alım oranı bakımından çeşit x tuz interaksiyonunun önemsiz olduğu tespit edilmiş ve genel olarak bu saatteki alım oranları % 32.12-60.72 değerleri arasında değişim gösterdiği tespit edilmiştir (Çizelge 2). Şeker sorgum çeşitlerinin çimlenme yüzdesi değerleri incelendiğinde; %18.62-89.56 arasında değişim gösterdiği belirlenmiştir (Çizelge 3).

En yüksek çimlenme yüzdesi % 89.56 ile Erdurmuş, en düşük ise % 18.62 ile Gülşeker çeşidinde gerçekleşmiştir. Avcı ve ark. (2016), Özyağcı ve Açıkbaş (2021) ve Dilmenler (2021), şeker sorgum çeşitlerinin tuz stresi altında çimlenme yüzdesi bakımından farklı tepki verdiklerini belirlemişlerdir. Tuz stres seviyeleri açısından çimlenme yüzdeleri incelendiğinde, % 40.67-78.17 aralığında değişim göstermiştir. Tuz stres seviyeleri arttıkça çimlenme yüzdesinde azalmaya neden olmuştur. Çeşit x tuz interaksiyonu bakımından çimlenme yüzdeleri % 0.00-97.0 arasında değişim göstermiştir. En yüksek çimlenme yüzdesi Erdurmuş çeşidinin kontrol grubunda gerçekleşmiştir. Bunu aynı grupta yer alan Erdurmuş çeşidinin 50 mM tuz stres seviyesi takip etmiştir. En düşük çimlenme yüzdeleri ise Gülşeker çeşidinin 350 mM, 300 mM ve 250 mM tuz stres seviyelerinde tespit edilmiştir (Çizelge 3).

Çizelge 2. Şeker sorgum çeşitlerinin farklı tuz stresi seviyelerinden elde edilen 12 saatteki su alım oranları (%) ve 24 saatteki su alım oranlarına (%) ait ortalama değerler

Çeşitler	NaCl (mM)								Ort.
	0	50	100	150	200	250	300	350	
12. Saatteki Su Alım Oranı (%)									
Sweet Betty	37.86	34.06	34.23	31.80	31.29	31.40	29.56	30.95	32.64^{b}
Erdurmuş	42.26	39.82	39.26	38.99	36.42	36.91	35.55	35.50	38.09^{a}
Gülşeker	34.82	32.45	31.45	31.84	31.10	29.73	27.54	27.98	30.86^{b}
Ort.	38.31^{a}	35.44^{ab}	34.98^{ab}	34.21^{ab}	32.94^{b}	32.68^{b}	30.88^{b}	31.47^{b}	
24. Saatteki Su Alım Oranı (%)									
Sweet Betty	46.26	40.45	39.94	36.62	47.60	36.84	32.12	34.77	39.32^{b}
Erdurmuş	60.72	54.97	50.72	47.47	43.66	43.23	41.45	39.30	47.69^{a}
Gülşeker	43.56	39.65	40.59	38.98	38.32	36.61	35.67	37.25	38.82^{b}
Ort.	51.18^{a}	45.02^{ab}	43.75^{a-c}	41.02^{bc}	43.20^{a-c}	38.89^{bc}	36.41^{c}	37.11^{bc}	

Çizelge 3. Şeker sorgum çeşitlerinin farklı tuz stresi seviyelerinden elde edilen çimlenme yüzdesi (%) ve çimlenme indeksine ait ortalama değerler

Çeşitler	NaCl (mM)								Ort.
	O	50	100	150	200	250	300	350	
Çimlenme Yüzdesi (%)									
SweetBetty	85.00^{a-c}	82.50^{a-c}	76.00^{cd}	79.50^{b-d}	77.00^{cd}	66.50^{de}	56.00^{ef}	47.00^{f}	71.19^{b}
Erdurmuş	97.00^{a}	96.50^{a}	94.50^{ab}	93.50^{ab}	92.50^{ab}	85.50^{a-c}	82.00^{a-c}	75.00^{cd}	89.56^{a}
Gülşeker	52.00^{ef}	44.00^{f}	24.00^{g}	11.00^{gf}	9.50^{gf}	4.50^{h}	3.50^{h}	0.00^{h}	18.62^{c}
Ort.	78.17^{a}	74.33^{a}	64.83^{b}	61.33^{b}	59.67^{b}	52.17^{c}	47.17^{cd}	40.67^{d}	
Çimlenme İndeksi									
SweetBetty	110.81^{b}	94.92^{c}	85.01^{de}	75.01^{ef}	64.43^{fg}	48.21^{hı}	37.03^{ij}	27.83^{j}	67.40^{b}
Erdurmuş	134.89^{a}	135.45^{a}	131.07^{a}	100.36^{bc}	90.04^{cd}	77.51^{e}	62.55^{fg}	54.17^{gh}	98.26^{a}
Gülşeker	32.76^{j}	24.66^{jk}	12.25^{kl}	5.45^{l}	4.29^{l}	2.65^{l}	1.62^{l}	0.00^{l}	10.46^{c}
Ort.	92.82^{a}	85.01^{b}	74.78^{c}	60.27^{d}	52.92^{e}	42.79^{f}	33.73^{g}	27.33^{h}	

Çeşitlerin çimlenme indeksine ait ortalama değerleri incelendiğinde, çimlenme indeksinin 10.46-98.26 arasında değişim gösterdiği belirlenmiştir. En yüksek çimlenme indeksi değeri 98.26 ile Erdurmuş çeşidi, en düşük ise 18.62 ile Gülşeker çeşidinde gerçekleşmiştir. Çimlenme indeksinin iyi ve hızlı bir çıkış oluşturabilme potansiyeli olan çeşitlerin belirlenmesinde önemli bir kriter olduğunu belirtilmektedir (Özkurt ve ark., 2019). Özyağcı ve Açıkbaş (2021), şeker sorgum çeşitlerinde yürüttükleri çalışmada, çimlenme indeksinin 1.14-8.46 arasında değişim gösterdiğini bildirmişlerdir. Tuz stres seviyeleri açısından çimlenme indeksi değerleri 27.33-92.82 aralığında değişim göstermiştir. Artan tuz stres seviyelerinin çimlenme indeksi değerlerinin azalmasına neden olduğu tespit edilmiştir. Çimlenme indeksi tohumların çimlenmesindeki düzeni gösterdiği ve en yüksek çimlenme indeksi tohumların hepsi birinci günde çimlenirse elde edildiği belirlenmiştir. Bu durum ayrıca çimlenme yeteneğinin büyüklüğünü de göstermektedir (Gürbüz ve ark., 2009). Çeşit x tuz interaksiyonu bakımından çimlenme indeksleri 0.00-135.45 arasında değişmiştir. En yüksek çimlenme indeksi değerleri Erdurmuş çeşidinin 0 mM, 50 mM ve 100 mM tuz stres seviyelerinden elde edilmiştir (Çizelge 3). Şeker sorgum çeşitlerine ait kökçük uzunluğu değerleri 3.46-6.21 cm aralığında değişim göstermiş ve en yüksek kökçük uzunluğu 6.21cm ile Sweet Betty çeşidinden elde edilmiştir (Çizelge 4). Dilmenler (2021), tuz stresi altında şeker sorgum çeşitlerinin kökçük uzunluğunun 22.85-33.01mm aralığında değişim gösterdiğini bildirmiştir. Artan tuz stres seviyelerinin kökçük uzunluğu üzerine etkileri incelendiğinde, kökçük uzunluğunun 0.52-10.15 cm

aralığında değişim gösterdiği belirlenmiştir. En yüksek kökçük uzunluğu 10.15 cm ile kontrol grubundan elde edilmiştir. Bunu sırasıyla 7.95 cm ile 50 mM ve 6.15 cm ile 100 mM tuz stres seviyeleri takip etmiştir. En düşük kökçük uzunluğu 300 mM ve 350 mM tuz stres seviyelerinde gerçekleşmiştir. Çeşit x tuz interaksiyonu bakımından kökçük uzunluğu değerlerinin 0.00-11.95 cm arasında değişim gösterdiği tespit edilmiştir. En yüksek kökçük uzunluğunun Gülşeker ve Sweet Betty çeşitlerinin 0 mM tuz stres seviyesinde olduğu belirlenmiştir (Çizelge 4).

Çizelge 4. Şeker sorgum çeşitlerinin farklı tuz stresi seviyelerinden elde edilen kökçük uzunluğu (cm) ve sapçık uzunluğuma (cm) ait ortalama değerler

Çeşitler	NaCI (mM)								Ort.
	O	50	100	150	200	250	300	350	
Kökçük Uzunluğu (cm)									
Sweet Betty	11.94^{a}	9.09^{a-c}	9.98^{ab}	6.10^{b-f}	6.40^{b-e}	3.19$^{d-ı}$	2.21$^{f-ı}$	0.80^{hı}	6.21^{a}
Erdurmuş	6.56^{b-d}	5.26^{c-g}	4.51^{d-h}	3.97$^{d-ı}$	3.10$^{d-ı}$	2.36$^{e-ı}$	1.20$^{g-ı}$	0.75^{hı}	3.46^{b}
Gülşeker	11.95^{a}	9.50^{ab}	3.97$^{d-ı}$	1.15^{hı}	1.08^{hı}	0.39^{ı}	0.09^{ı}	0.00^{ı}	3.52^{b}
Ort.	10.15^{a}	7.95^{b}	6.15^{b}	3.74^{c}	3.53^{c}	1.98^{cd}	1.17^{d}	0.52^{d}	
Sapçık Uzunluğu (cm)									
Sweet Betty	20.39^{a}	16.43^{b}	12.08^{c}	8.50^{de}	7.60^{d-f}	4.47^{gh}	1.75^{h-k}	0.48^{k}	8.96^{a}
Erdurmuş	14.95^{b}	8.58^{d}	5.06^{fg}	4.60^{g}	5.80^{e-g}	5.20^{fg}	3.41^{g-j}	0.73^{jk}	6.04^{b}
Gülşeker	17.62^{b}	8.54^{d}	3.56$^{g-ı}$	1.71$^{ı-k}$	1.18$^{ı-k}$	0.72^{jk}	0.00^{k}	0.00^{k}	4.17^{c}
Ort.	17.65^{a}	11.18^{b}	6.90^{c}	4.94^{d}	4.86^{d}	3.46^{e}	1.72^{f}	0.40^{g}	

Çeşitlerin sapçık uzunluğuna ait ortalama değerleri incelendiğinde, 4.17-8.96 cm aralığında değişim gösterdiği belirlenmiştir. En yüksek sapçık uzunluğu 8.96 cm ile Sweet Betty, en düşük sapçık uzunluğu ise 4.17 cm ile Gülşeker çeşidinden elde edilmiştir. Dilmenler (2021), tuz stresi altında şeker sorgum çeşitlerinde yürüttüğü çalışmada sapçık uzunluğunun 15.24-26.97 mm aralığında değişim gösterdiğini bildirmiştir. Tuz stres seviyeleri açısından sapçık uzunluğu 0.40-17.65 cm arasında değişmiştir. Tuz stres seviyesi artıkça sapçık uzunluğu azalmıştır. Çeşit × tuz interaksiyonunun sapçık uzunluğu değerleri incelendiğinde; 0.00-20.39 cm arasında değişim göstermiştir. En yüksek sapçık uzunluğu Sweet Betty çeşidinin 0 mM tuz stres seviyesinde gerçekleşmiştir. Şeker sorgum çeşitleri kökçük yaş ağırlığı incelendiğinde; 4.14-7.18 mg/fide arasında değişim göstermiştir (Çizelge 5). En yüksek kökçük yaş ağırlığı Sweet Betty, en düşük kökçük yaş ağırlığı ise Erdurmuş çeşidinden elde edilmiştir. Özyağcı ve

Açıkbaş (2021), tuz stresi altında şeker sorgum çeşitlerinin kökçük yaş ağırlığının 3.5-22.6 mg aralığında değişim gösterdiğini rapor etmişlerdir. Tuz stres seviyesi bakımından kökçük yaş ağırlığı incelendiğinde; kökçük yaş ağırlığının 1.45- 11.76 mg/fide arasında değişim gösterdiği belirlenmiştir. En yüksek kökçük yaş ağırlığı 11.76 mg/fide ile 50 mM tuz stres seviyesinde tespit edilmiştir. Bunu sırasıyla aynı istatistiki grupta yer alan 11.62 mg/fide ile 0 mM tuz stres seviyesi takip etmiştir. Çeşit × tuz interaksiyonu bakımından kökçük yaş ağırlığı değerleri incelendiğinde; kökçük yaş ağırlığının 0.00-22.35 mg/fide aralığında değişim gösterdiği belirlenmiştir. En yüksek kökçük yaş ağırlığı Gülşeker çeşidinde 50 mM ve 0 mM tuz stres seviyelerinden elde edilmiştir (Çizelge 5).

Çizelge 5. Şeker sorgum çeşitlerinin farklı tuz stresi seviyelerinden elde edilen kökçük yaş ağırlığı (mg/fide), sapçık yaş ağırlığı (mg/fide), kökçük kuru ağırlığı (mg/fide) ve sapçık kuru ağırlığına (mg/fide) ait ortalama değerler

Çeşitler	NaCl (mM)								Ort.
	0	50	100	150	200	250	300	350	
Kökçük Yaş Ağırlığı (mg/fide)									
Sweet Betty	10.35^{b}	9.50^{bc}	10.18^{bc}	7.63^{b-e}	7.30^{b-e}	5.68^{b-g}	4.73^{c-h}	2.05^{e-h}	7.18^{a}
Erdurmuş	6.03^{b-f}	5.60^{b-g}	3.43^{d-h}	5.28^{b-h}	3.85^{d-h}	3.55^{d-h}	3.10^{d-h}	2.30^{e-h}	4.14^{b}
Gülşeker	18.50^{a}	22.35^{a}	8.68^{b-d}	3.25^{d-h}	2.10^{e-h}	1.03^{f-h}	0.28^{gh}	0.00^{h}	7.02^{a}
Ort.	11.62^{a}	11.76^{a}	8.15^{b}	5.38^{c}	4.42^{cd}	3.42^{c-e}	2.70^{de}	1.45^{e}	
Sapçık Yaş Ağırlığı (mg/fide)									
Sweet Betty	84.60^{b}	70.05^{bc}	64.25^{cd}	47.00^{d-f}	41.63^{e-g}	29.68$^{g-ı}$	16.20$^{ı-m}$	5.00^{lm}	44.80^{a}
Erdurmuş	58.83^{c-e}	34.58^{f-h}	23.00^{h-j}	22.73^{h-k}	27.50$^{g-ı}$	27.70$^{g-ı}$	21.75^{h-l}	5.35^{lm}	27.68^{b}
Gülşeker	122.78^{a}	55.98^{c-e}	21.95^{h-k}	6.22^{j-m}	5.53^{k-m}	5.00^{lm}	0.00^{m}	0.00^{m}	27.22^{b}
Ort.	88.73^{a}	53.53^{b}	36.40^{c}	25.32^{d}	24.89^{d}	20.79^{de}	12.77^{e}	3.45^{f}	
Kökçük Kuru Ağırlığı (mg/fide)									
Sweet Betty	0.78	0.95	0.88	0.50	0.70	0.58	0.75	0.18	0.66
Erdurmuş	0.65	0.38	0.60	0.60	0.60	0.35	0.25	0.08	0.44
Gülşeker	4.10	1.70	0.85	0.30	0.15	0.00	0.00	0.00	0.89
Ort.	1.84^{a}	1.01^{ab}	0.78^{ab}	0.46^{ab}	0.48^{ab}	0.31^{ab}	0.33^{ab}	0.08^{b}	
Sapçık Kuru Ağırlığı (mg/fide)									
Sweet Betty	6.40^{ab}	0.54^{jk}	5.70^{bc}	4.38^{c-e}	4.73^{cd}	3.63^{d-g}	2.50$^{g-ı}$	0.65^{jk}	3.56^{a}
Erdurmuş	4.10^{d-f}	2.40$^{g-ı}$	2.00^{h-j}	2.10^{g-j}	2.88^{e-h}	3.15^{e-h}	2.55$^{f-ı}$	0.70^{jk}	2.48^{b}
Gülşeker	7.52^{a}	4.35^{c-e}	2.75$^{f-ı}$	1.20$^{ı-k}$	0.41^{k}	0.35^{k}	0.00 ^{k}	0.00 ^{k}	2.07^{c}
Ort.	6.01^{a}	2.43^{cd}	3.48^{b}	2.56^{c}	2.67^{c}	2.37^{cd}	1.68^{d}	0.42^{e}	

Çeşitlerin sapçık yaş ağırlığına ait ortalama değerler incelendiğinde 27.22-44.80 mg/fide aralığında değişim gösterdiği belirlenmiştir (Çizelge 5). En yüksek sapçık yaş ağırlığının 44.80 mg/fide ile Sweet Betty çeşidi, en düşük ise 27.22 mg/fide ile Gülşeker çeşidinin sahip olduğu tespit edilmiştir. Şeker sorgum çeşitlerinin tuz stresi altında sapçık yaş ağırlığı üzerine farklı tepki verdiği bazı araştırıcılar tarafından da bildirilmiştir (Dilmenler, 2021; Özyağcı ve Açıkbaş, 2021).Tuz stres seviyeleri bakımından sapçık yaş ağırlığının 3.45-88.73 mg/fide arasında değiştiği belirlenmiştir. En yüksek sapçık yaş ağırlığı 88.73 ile 0 mM tuz stres seviyesinden elde edilirken bunu sırasıyla 53.53mg/fide ile 50 mM tuz stres seviyesi takip etmiştir. Çeşit × tuz interaksiyonu açısından sapçık yaş ağırlığına ait ortalama değerler 0.00-122.78 mg/fide arasında değişim göstermiştir. En yüksek sapçık yaş ağırlığı Gülşeker çeşidinin 0 mM tuz stres seviyesinden elde edilmiş ve bunu Sweet Betty çeşidinin 0 mM tuz stres seviyesi takip etmiştir (Çizelge 5). Şeker sorgum çeşitlerinin kökçük kuru ağırlığına ait ortalama değerleri incelendiğinde 0.44-0.89 mg/fide arasında değişim gösterdiği belirlenmiş olup çeşitlere ait kökçük kuru ağırlıkları bakımından istatistiki bir farklılık tespit edilmemiştir (Çizelge 5). Tuz stres seviyelerinin kökçük kuru ağırlığına ait ortalama değerleri incelendiğinde; 0.08-1.84 mg/fide aralığında değişim gösterdiği belirlenmiştir. En yüksek kökçük kuru ağırlığı 1.84 mg/fide ile 0 mM tuz stres seviyesinde olmuştur. En düşük kökçük kuru ağırlığı ise 0.08 mg/fide ile 350 mM tuz stres seviyesinden elde edilmiştir (Çizelge 5). Şeker sorgum çeşitlerinin sapçık kuru ağırlığına ait ortalama değer incelendiğinde; 2.07-3.56 mg/fide arasında değişim gösterdiği belirlenmiştir (Çizelge 5). En yüksek sapçık kuru ağırlığı 3.56 mg/fide ile Sweet Betty çeşidi, en düşük ise 2.07 mg/fide ile Gülşeker çeşidinin sahip olduğu tespit edilmiştir. Tuz stres seviyeleri bakımından sapçık kuru ağırlıkları 0.42-6.01 mg/fide aralığında değişim göstermiştir. Çeşit × tuz interaksiyonu açısından sapçık kuru ağırlığına ait ortalama değerler incelendiğinde; 0.00-7.52 mg/fide aralığında değişim gösterdiği belirlenmiştir. En yüksek sapçık kuru ağırlığı Gülşeker çeşidinin 0 mM tuz stres seviyesinden elde edilmiştir (Çizelge 5).

SONUÇ

Bu çalışma, şeker sorgum çeşitlerinin çimlenme döneminde tuz stres seviyelerine tepkilerini belirlemek amacıyla yürütülmüştür. Şeker sorgum çeşitlerinin tuz stres seviyeleri arttıkça 12. ve 24. saatlerdeki su alım oranları, çimlenme yüzdesi, çimlenme indeksi, kökçük uzunluğu, sapçık uzunluğu, kökçük yaş ağırlığı, sapçık yaş ağırlığı kökçük kuru ağırlığı ve sapçık kuru ağırlığı özelliklerini olumsuz etkilediği belilenmiştir. Şeker sorgum çeşitlerinde 150 mM tuz stres seviyesinin çimlenme yüzdesi, kökçük uzunluğu, sapçık uzunluğu, kökçük yaş ağırlığı,

sapçık yaş ağırlığı, kökçük kuru ağırlığı ve sapçık kuru ağırlığı özelliklerinde önemli derece azalmalara neden olduğu tespit edilmiştir. Erdurmuş çeşidinin artan tuz stres seviyeleri altında diğer iki çeşide göre çimlenme yüzdesi başta olmak üzere incelenen tüm özelliklerde ön plana çıktığı belirlenmiştir. Ancak bu çalışmanın fide döneminde de yapılması çeşitlerin tuza dayanımının belirlenmesi açısından daha sağlıklı bilgiler vereceğinden fide dönemine yönelik çalışmalarda yürütülmelidir.

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FARKLI PRİMİNG UYGULAMALARI VE ARITILMIŞ ATIK SU KONSANTRASYONLARININ HÜNNAP (*Ziziphus jujuba* Mill.) TOHUMLARININ ÇİMLENMESİ ÜZERİNE ETKİSİ*

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ÖZET

Sert çekirdekli meyve türleri içerisinde yer alan hünnap (*Ziziphus jujuba* Mill.) tohumlarının doğrudan çimlendirilmesinde başarılı sonuçlar alınamadığı bilinmekte ve bu sebeple çimlenme öncesi farklı ön uygulamaların yapılması gerekmektedir. Bu çalışma, hünnap tohumlarının çimlendirilmesi için farklı ön işlemlerle (Katlama + H_2SO_4+ suda bekletme) katlama süresini kısaltarak arıtılmış atık su uygulamasının çimlenme üzerine etkilerini belirlemek amacıyla gerçekleştirilmiştir. Çalışma, Bilecik Şeyh Edebali Üniversitesi Tarımsal Uygulama ve Araştırma Merkezinde bulunan hızlı ıslah ve iklim büyütme odasında gerçekleştirilmiştir. Hünnap tohumları, yüzey sterilizasyonu sonrası +4 ºC de 30 gün katlamaya alınmış ve katlama sonrası 30 dk H_2SO_4 (Konsantre %97) bekletilerek son ön işlem olarak, iki gün suda bekletme uygulanmıştır. Çalışma, 4 farklı atık su dozu (25, 50, 75, 100%) ve kontrol olmak üzere 5 konudan oluşmuştur. Deneme tesadüf parselleri deneme desenine göre 3 tekerrürlü ve her tekerrürde 20 tohum olacak şekilde kurulmuştur. Deneme kurulduktan sonra her 7 günde bir ölçüm alınarak çimlenme oranı (%), çimlenme süresi (gün), kökçük uzunluğu (cm), kökçük ağırlığı (g), hipokotil uzunluğu (cm), hipokotil ağırlığı (g), kökçük kuru ağırlığı (g), hipokotil kuru ağırlığı (g) parametrelerinin belirlenmesi hedeflenmiştir ancak çimlenme gerçekleşmediği için veriler alınamamıştır. Çimlenme gerçekleşmemesi yapılan incelemeler sonucunda bir ay katlama süresinin yeterli olmadığı, uygulanan 30 dakikalık H_2SO_4'in sert kabuk içerisine geçerek tohuma zarar verdiği ya da H_2SO_4 uygulama süresinin az geldiği düşüncesi diğer çalışmalarla desteklenmektedir.

Anahtar Kelimeler: atık su, H_2SO_4, hünnap, katlama, tohum

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THE EFFECT OF DIFFERENT PRIMINING APPLICATIONS AND TREATED WASTE WATER CONCENTRATIONS ON THE GERMANY OF JUJUBA (*Ziziphus jujuba* Mill.) SEEDS

ABSTRACT

Direct germination of jujube (*Ziziphus jujuba*) seeds, which are among the stone fruit species, cannot yield successful results. Various pre-applications are required to achieve successful seed germination results. This study was carried out to determine the effects of treated waste water application on germination by shortening the folding time with different pre-treatments (Folding + H_2SO_4 + soaking in water) for the germination of jujube seeds. The study was carried out in the rapid breeding and climate growth room of Bilecik Şeyh Edebali University Agricultural Application and Research Center. Jujube seeds were folded for 30 days at +4 ºC after surface sterilization and kept in H_2SO_4 (Concentrated 97%) for 30 minutes after folding and soaked in water for two days as the final pre-treatment. The study consisted of 4 different wastewater doses (25, 50, 75, 100%) and 5 subjects as control. The experiment was established in a randomized plot design with 3 replications and 20 seeds in each replication. The following parameters were targeted to be determined: germination rate (%), germination time (day), rootlet length (cm), rootlet weight (g), hypocotyl length (cm), hypocotyl weight (g), root dry weight (g), hypocotyl dry weight (g), but data could not be acquired because germination did not occur. As a result of the examinations, the fact that germination did not occur is supported by other studies, that the one month doubling time is not enough, that the applied 30-minute H_2SO_4 penetrates into the hard shell and damages the seed, or that the H_2SO_4 application time is short.

Keywords: folding, H_2SO_4, jujube, seed, waste water

GİRİŞ

Hünnap, *Rhamnaceae* ailesi, *Ziziphus* cinsinin *Ziziphus jujuba Mill* türü içerisinde yer alan sert çekirdekli meyve türlerinden biridir (Liu ve ark., 2003). Hünnap meyvesinin doğal yayılım alanı içerisinde Çin dışında, Güney Avrupa, Kuzey Afrika, Hindistan, Suriye, Rusya, Ortadoğu ve Anadolu ülkeleri yer almaktadır (Ecevit ve ark., 2002). Bitki morfolojik olarak dik ya da tırmanıcı, 5-10 m uzunluğunda, çalı ya da ağaç formunda bir bitkidir (Kemeç Hürkan, 2019).

Ülkemizde yeni tanınmaya başlayan hünnap meyvesi, zengin besin içeriği, taze tüketimin yanında, ekmek, hoşaf, şeker ve reçel yapımında özellikle kurutulmuş olarak tüketime uygun olan tıbbi meyvelerden biridir. Kurutulmuş olan meyveler aynı zamanda çerez ve çay içeriğinde, ekmek, kek gibi gıda endüstrilerinde aktif bir bileşen olarak kullanılmaktadır (Krška ve Mrshra, 2009). Hünnap meyvesi sağlığımız açısından da oldukça faydalıdır. A ve C vitaminlerini içermesiyle beraber vücudun ihtiyacı olan çinko, fosfor, magnezyum, demir, riboflavin ve niasin gibi maddeleri de içermektedir. İnsan bedeninde, metabolizma ürünleri sonrası ortaya çıkan, serbest radikaller diye adlandırılan kısa ömürlü fakat olumsuz etkisi fazla olan molekülleri etkisiz hale getiren çok önemli antioksidanları da içerdiğinden son yıllarda hünnap tercih edilen bir meyve haline gelmiştir (Özgen ve ark., 2006; Gerçekcioğlu ve Aslan Uygun, 2021).

Hünnap meyvesinin fidanları doğrudan tohumla, dip sürgünleri, aşı ve çelikle çoğaltılmaktadır. Ticari yetiştiricilikte aşı ile çoğaltım daha yaygın yapılmaktadır. Geleneksel hünnap yetiştiriciliğinde ise bölgelerde en pratik ve yaygın olarak kök sürgünleri ile çoğaltım yöntemidir. Hünnap meyvesi için yeni üretim alanlarında çöğür bitkilerinin aşılanarak yetiştiriciliği yapılmış olup kök sürgünler doğrudan dikim için değil anaç olarak kullanılmaya başlanmıştır (Liu, 2006).

Anaç olarak da kendi tohumlarının kullanılmasının yanı sıra Karaçalı ya da Çatlı (*Paliurus aculeatus*) diye bilinen bitkinin tohumu kullanılmaktadır (Deligöz ve ark., 2007). Kuzey Çin'de, Çin hünnabı anacı yerine yabani hünnap ağaç tohumları (*Z. acidojujuba*) kullanılır (Liu, 2006). Başka bir hünnap türü olan Yabani (ekşi) hünnap anacı Avustralya'da olmadığından, Batı Avustralya'da *Z.jujuba Mill* kültür çeşidi olan *Jinsixiaozao* anaç olarak kullanılmaktadır.

Başarılı bir tohum çimlenmesi için öncelikle meyve etinden ayrılan tohumların temizlenip kurutularak uygun depolama koşullarında saklanması gerekmektedir. Hünnap sert çekirdekli meyve türleri içerisinde olduğundan doğruda tohum çimlendirme de başarılı sonuçlar alınamamaktadır. Tohum ekiminden önce yüksek çimlenme oranı elde etmek için çimlenme engelinin ortadan kaldırılması amacıyla tohuma farklı uygulamalar yapılarak çimlendirme

ortamına alınmalıdır (Yahyaoğlu ve Ölmez, 2005). Hünnap tohumlarının çimlendirilmesi konusunda yapılmış olan çalışmalar çok azdır.

Yapılan çimlendirme çalışmalarında meyve tohumların dormansisinin kırılması için kullanılan metotlardan katlama yöntemi başta olmak üzere zımpara, sıcak veya soğuk suda bekletme, asit ve kimyasal uygulama gibi bazı ön işlemlerin kullanılması sonucu çimlenmenin istenilen düzeyde geliştiği görülmüştür. Bu konuda yapılan araştırmalar incelendiğinde, Deligöz ve ark., (2007)'ın Karaçalı ve Hünnap tohumlarının çimlendirilmesi üzerine GA_3, çıtlatma ve ekim zamanının etkilerini araştırdıkları çalışmalarında en iyi sonucu, ekimden önce hünnap tohumlarını 400 ppm GA_3'te 24 saat, Karaçalı tohumlarını ise 100 ppm GA3 çözeltisi içinde 12 saat bekletme uygulamasından elde ettikleri, QI (2008) ise *Zizyphus jujuba* tohumlarında yaptıkları çimlendirme çalışmasında, farklı (0, 200, 500, 800 mg/L) GA_3 konsantrasyonları kullanmışlardır. En iyi sonucu yabani hünnap tohumlarına yapılan 800 mg/L GA_3 uygulamasından elde ettiklerini bildirmişlerdir. Polat, (2019) Hünnap tohumlarının çimlenme engelinin ortadan kaldırılması için tohumları H_2SO_4 ile bekletme, tohum kabuğu çatlatma ve tohum embriyosu çıkartma gibi bazı ön işlemlere tabi tutarak hünnap tohumlarının ekimini yapmış ve sonuç olarak embriyosu çıkartılan tohum ve H_2SO_4 kullanılmasının hünnap tohumlarının çimlenme oranını artırdığını bildirmiştir.

Temiz su kaynakları yarı kuraklık ve kuraklık gözlenen iklime sahip ülkelerde, giderek kalabalıklaşan nüfusun içme ve kullanma su ihtiyaçlarını karşılamak için yetersiz kalmaya başlamaktadır. Bu ülkeler arasında olan Türkiye yapılan araştırmalar ile su sorunu yaşamaya aday olarak değerlendirilebilir. Kent nüfusunun artışı ile birlikte su kullanımının artmasına bağlı olarak atık su oluşumunda da bir artış yaşanmaktadır (Kukul ve ark.,2007).

Tarımda arıtılmış atık suların değerlendirilmesinin pek çok avantajı vardır. İlk olarak toprak verimliliği ile mahsul üretiminin arttırmasına katkıda bulunurken aynı zamanda tarımsal sulamalar içinde bir kaynak olmasının yanı sıra atık sular, bitkinin besin maddesi olan nütrientleri içerir. Bu nütrientler, Potasyum (K), Fosfor (P), Azot (N) olmak ile birlikte bunun yanında Çinko (Zn), Bakır (Cu) ve Manganez (Mn) gibi mikro besin elementlerini içermesidir. Arıtılmış atık suların nütrient bakımından zengin olması zirai amaçlı geri kullanımda bir artışa neden olmaktadır (Büyükkamacı, 2009).

Arıtılmış atık suların kullanılmasıyla iyi ve kaliteli suların sulama dışında kullanımının artması dışında, yapay gübre gereksinimleri azalır ve atık sular doğaya zarar vermeden olabilecek en faydalı şekilde uzaklaştırılması sağlanmış olur (Kukul ve ark., 2007).

Arıtılmış atık suların kullanımı ile ilgili yapılan uluslararası bazı düzenlemeler sonucunda atık suların araziye verilmesinden ya da sulama için uygun olup olmadığını belirlenmeden önce incelenmesi gerekli olan parametreler belirtilmelidir. Bu parametrelere bakıldıktan sonra arıtılmış atık suların, tarımda kullanımı uygun olmaktadır. Arıtılmış atık suların tarımsal amaçlı çimlenme ve fide gelişimini olumlu etkilediğini gösteren çalışmalar yapılmış olup bu çalışmalardan mısır çeşitlerinde kullanılan atık suyun %25 konsantrasyonda çimlenme yüzdesini arttırdığını, %75 konsantrasyonda fide gelişim üzerinde teşvik edici bir etki göstermesiyle birlikte kullanılan atık suyun ürünlerin büyümesini arttırırken, kimyasal maliyetten tasarruf etmeyi aynı zamanda yeraltı sularına yönelik kirlilik riskinin de azalabileceğini belirtilmiştir (Kardeş ve ark., 2020).

Bu çalışmada kullanılacak materyal, sert bir çekirdek yapısına sahip olan hünnap tohumlarının çimlendirilmesi için farklı ön işlemlerle katlama süresini kısaltarak, arıtılmış atık su uygulamasının çimlenme üzerine etkilerinin araştırılması hedeflenmiştir.

GELİŞME

Hünnap tohumları özel bir tohum firmasından temin edilmiş ve çalışma Bilecik Şeyh Edebali Üniversitesi Tarımsal Uygulama ve Araştırma Merkezinde bulunan hızlı ıslah ve iklim büyütme odasında gerçekleştirilmiştir. Çalışmada kullanılan atık su, Bilecik Şeyh Edebali Üniversitesi atık su arıtma tesisinden alınan sular kullanılmıştır. Atık su numunesinin analiz sonuçları Tablo 1' de verilmiştir.

Tablo 1. Atık su numunesinin analiz sonuçlar

Parametreler(1)	**Analiz Tarihi**	**Analiz Metodu**	**Analiz Sonucu**	**Sınır Değer**(2)
pH	21.10.2021	SM4500H$^+$B	8,42	6-9
Askıda Katı Madde (AKM)	21.10.2021	SM 2540-D	20,350 mg/l	70
Kimyasal Oksijen İhtiyacı (KOİ)	22.10.2021	SM 5220 B	58,835 mg/l	180
Biyokimyasal Oksijen İhtiyacı (BOİ)	22-27.10.2021	SM 5210 D	34 mg/l	50

(1): Çevre ve Şehircilik Bakanlığı Yeterlik Belgesi ve TÜRKAK Akreditasyon Belgesi kapsamında yapılmıştır.
(2): Sınır değerler, Su Kirliliği Kontrolü Yönetmeliği

Deneme için 4 farklı atık su dozu (25, 50, 75, 100%) ve kontrol olmak üzere 5 konudan oluşmuştur. Çimlenme denemesi 3 tekerrürlü ve her tekerrürde 20 tohum olacak şekilde kurulmuştur.

Hünnap tohumlarında çimlenmeyi kolaylaştırmak için katlama ve H_2SO_4 (Konsantre %97) bekletme ön işlemleri uygulanmıştır. Bu işlemlerin uygulanması sırasıyla;

Yüzey sterilizasyonu için % 3'lük Sodyum hipoklorit çözeltisinde 10 dakika bekletilmiş ve ardından saf suyla birkaç defa yıkanmıştır, 300 adet hünnap tohumu plastik kaplardaki perlit içerisinde 18.08.2022 tarihinde +4 ºC de 30 gün katlamaya alınmış olup 1 aylık katlama boyunca perlit ve tohumlar belirli aralıklarla sulanmıştır. 18.09.2022 tarihinde tohumlar katlamadan çıkartılmıştır. Katlamadan çıkartılan tohumlar 30dk H_2SO_4 (Konsantre %97) bekletilmiş ve son ön işlem olarak, İki gün suda bekletme uygulanmıştır.

20.09.2022 tarihinde 3/2 oranında torf ve 3/1 oranında perlit karıştırılarak her bir tekerrürde 20 tohum olacak şekilde 3 tekerrür viyollere ekim yapılmıştır. Ekim derinliği tohum büyüklüğünün 2 katı olarak belirlenmiştir. Viyoller büyütme odasına alınmıştır ve büyütme odasının sıcaklığı 24 °C'ye ayarlanmıştır. Ekimleri yapıldıktan sonra ilk kontrol 7. günde yapılmış ve 7 gün arayla kontroller yapılarak tohumların su ihtiyacına göre günlük sulama yapılmıştır.

Deneme kurulduktan sonra her 7 günde bir ölçüm alınarak çimlenme oranı (%), çimlenme süresi (gün), kökçük uzunluğu (cm), kökçük ağırlığı (g), hipokotik uzunluğu (cm), hipokotil ağırlığı (g), kökçük kuru ağırlığı (g), hipokotil kuru ağırlığı (g) parametrelerinin belirlenmesi hedeflenmişti ancak çimlenme gerçekleşmediği için veriler alınamamıştır.

Hünnap tohumlarının çimlendirilmesi için farklı ön işlemlerle katlama süresini kısaltarak arıtılmış atık su uygulamasının çimlenme üzerine etkilerinin araştırıldığı çalışmamız 18.08.2022 tarihinde katlama ile başlayan çalışmamızda kontrol grubu da dahil olmak üzere tohumlarda çimlenme meydana gelmediği için çalışma 26.12.2022 tarihinde sonlandırılmıştır (Tablo 2).

Çimlenme gerçekleşmemesi yapılan incelemeler sonucunda bir ay katlama süresinin yeterli olmadığı, uygulanan 30 dakikalık H_2SO_4'in sert kabuk içerisine geçerek tohuma zarar verdiği ya da H_2SO_4 uygulama üresinin az geldiği düşüncesi aşağıda verilen çalışmalarla desteklenmektedir.

Lopez ve Aviles (1988) *Prosopis alba, P. chilansis, P. flexuosa* ve *P. Tamaruqo* türlerinin tohumlarında denemeler yapmışlar ve dormansinin giderilmesi için uygulanacak en iyi metodu belirlemeyi amaçlamışlardır. Kaynar su, sülfirik asit ve kuru buharda bekletilen tohumlar içerisinde en iyi çimlenmenin 24 saat sülfirik asitte bekletme işlemine ait olduğunu, Göktürk ve ark., (2006) karaçalı tohumlarının çimlenme engellerini giderecek uygun yöntemlerin belirlenmesi çalışmasında soğuk katlama ile konsantre (%98) sülfürik asitte (H_2SO_4) bekletme işlemlerinde en iyi çimlenme yüzdesini 40-80 dk H_2SO_4ve sera koşullarında elde ettiklerini bildirmişlerdir. Polat (2019) hünnapta yaptığı çimlenme çalışmasında H_2SO_4, çıtlatma ve

embriyo ekimini denemiş ve farklı H_2SO_4 bekletme sürelerinde (60-90-120 dakika) çimlenme oranlarını %30,4 ve %31,1 olarak belirlemiştir. Bu çalışmalar çalışmamızda çimlenme elde edilememesini H_2SO_4'ün süresinin az olabileceğinin düşüncesini desteklemektedir.

Yumuşak çekirdekli meyve türlerinden olan "*Crataegus orientalis* (Pallas Ex. Bieb) (doğu alıcı) ve *Crataegus pontica* (k. koch.) (doğu karadeniz alıcı) tohumlarının çimlenmesi üzerine yapılan çalışma da katlama, küllü suda bekletme ve sülfürik asitte zedeleme ön işlemlerinin farklı sürelerde birleştirilmiştir. Çimlenme durumuna göre soğuk katlama yapılan alıç çeşitlerin de 17 hafta soğuk katlamaya ilave sıcak katlama ve kül uygulamaları yapılan deneme tekerrürlerin de çimlenme gözlenmemiştir. Uygulana sülfürik asidin çimlenme engellerinin ortadan kaldırılmasında etkili olmadığını bildirmiştir (Baba, 2017). Başka bir çalışmada ise, nitrik asit ve sülfürik asit uygulamalarının kayısının çimlenmesi üzerine katlama + nitrik asit ve doğrudan ekimde sülfürik asit uygulamasında çimlenmenin elde edilemediği bunun da asidin tohum kabuğundan sızarak tohuma zarar verdiği ifade edilmiştir (Ernim, 2018). Çimlenme elde edilememesi katlama sonrası yumuşayan tohum kabuğundan sülfürik asidin içeriye sızarak tohuma zarar verdiği başka bir teori olarak düşünülmektedir.

Çimlenme üzerine katlama süresi ve sıcaklığı göz önüne alındığında, vişnede yapılan farklı süre ve sıcaklık uygulamalarının (20-25 ºC' de 2 hafta, + 3 ºC'de 2 hafta, 20-25 ºC' de 2 hafta, + 3 ºC sıcaklıkta 12 hafta) çimlenme üzerine etkilerinin araştırıldığı çalışmada uygulamaların dormansinin kırılmasında herhangi bir etki göstermediği ve tohumda kararsızlığa neden olduğu belirtilmiştir (Celepaksoy, 2011). Erkmen (2009), ülkemizdeki ormanlarda yetişen taksonlardan olan Tatar Akçaağacında soğuk katlama ön işlemlerinin tohum çimlenmesi üzerine etkilerinin araştırıldığı çalışmada; kontrol (katlamaya alınmayan), 15, 30, 45, 60, 75, 90, 105 ve 120 gün olmak üzere 15 günlük ara ile 8 kez farklı zamanlarda katlama denemesi yapılmıştır ve çalışmanın sonucuna göre kontrol, 15 gün ve 30 günlük katlama sürelerinde tohumlarda çimlenme belirtisi olmadığı ve uygulanan ön işlemlerin yeterli olmadığı bildirilmiştir. Bazı üvez (*Sorbus* spp) türleri tohumlarının çimlendirilmesinde katlama ve fitohormonların etkileri isimli çalıma da 90 gün katlama, GA, BA ve kinetin uygulanmış Kuş Üvezi (Karabük) tohumlarında çimlenme olmadığı, 45 ve 120 gün katlamaya alınmış tohumlarda ise bazı hormonlar ile sadece % 3'lük çimlenme olduğu saptanmıştır (Can, 2012). Üvez (*Sorbus aucuparia*), kızılcık (*Cornus mas*) ve yabani kiraz (*Prunus avium*) tohumlarının çimlenmesi üzerine bazı ön işlemlerin etkilerinin belirlenmesi çalışmasında kızılcıkta soğuk ve sıcak katlama ile H_2SO_4 önişlemlerinde çimlenme gerçekleşmemiştir. Kuş üvezi tohumlarında uygulanan farklı sürelerde soğuk katlama (30, 45, 60, 75, 90 ve 120 gün) ile H_2SO_4 (5, 10 ve

15 dakika) ön işlemlerinin çimlenme engelini giderme üzerine etkili olmadığı bildirilmiştir (Hocoğlu, 2013).

SONUÇ

Hünnap *Ziziphus jujuba* dünya üzerinde Doğu Akdeniz'den başlayıp Japonya ve Kore'ye, Güney ve Doğu Asya'ya kadar uzanan geniş bir alanda yayılma yapan, en çok 10 m civarında boy yapabilen kısa boylu, kışları ise yaprakları dökülen ağaç türüdür.

Başarılı bir tohum çimlenme için öncelikle meyve etinden ayrılan tohumlar temizlenip kurutularak uygun depolama koşullarında saklanması gerekmektedir. Hünnap sert çekirdekli meyve türleri içerisinde olduğundan doğruda tohum çimlendirme de başarılı sonuçlar alınamamaktadır. Tohum ekiminden önce yüksek çimlenme başarı elde etmek için çimlenme engelinin ortadan kaldırılması amacıyla tohuma farklı uygulamalar yaparak çimlendirme ortamına alınmalıdır (Yahyaoğlu ve Ölmez, 2005).

Su varlığı konusunda yapılan bir çalışmada ülkeler arasında kişi başına düşen su mevcudiyeti sınıflandırmasında ülkemiz su kıtlığı çeken ülke konumunda olmakla birlikte DSİ verilerine göre gelecekte su fakiri ülke sınıfına gireceğimiz düşünülmektedir. Bu durum bizi su kullanımı ve tüketiminde en önemli pay olan tarımsal faaliyetlerde kullanılacak suyu daha dikkatli kullanmaya yöneltmektedir. Yetersiz temiz su kaynaklarına alternatif olarak, tarımda evsel atık suların çeşitli yöntemler kullanılarak arıtılması akılcı bir çözüm olarak görülmektedir. Gelişmekte olan ülkelerde atık su uygulamaları, tarımsal sulamada diğer su kaynaklarına göre daha ekonomik, makro ve mikro elementler bakımından zengin olması gibi nedenlerle tarımda yaygın olarak kullanılmaktadır (Zambi, 2022).

Bu çalışmada hünnap tohumlarının çimlendirilmesi için sert çekirdekli tohumlar için önerilen 3 aylık katlama süresinin farklı ön işlemlerle kısaltılarak arıtılmış atık su uygulamasının çimlenme üzerine etkilerinin araştırılması hedeflenmiştir. Ancak çalışma sonucunda 30 gün katlama süresinin az ve H_2SO_4'ün yeterli gelmediği ya da asit uygulamasının tohuma zarar verdiği düşünülerek daha önceki çalışmalarla desteklenmiştir. Bu sebeple bundan sonraki çalışmalarda katlama süresi ile birlikte H_2SO_4 uygulama doz ve süreleri değiştirilerek atık suyun etkisi incelenmesi önerilmektedir.

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KARABUĞDAY (*Fagopyrum esculentum* Moench.) ÇEŞİTLERİNDE TOHUMA ÖN UYGULAMANIN ÇİMLENME VE İLK GELİŞME DÖNEMİ ÜZERİNE ETKİLERİ

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ÖZET

Bu araştırma; Başkent Üniversitesi, Kahramankazan Meslek Yüksekokulu ile Transplantasyon ve Gen Bilimleri Enstitüsü, laboratuvarlarında yürütülmüştür. Araştırmada; karabuğday (*Fagopyrum esculentum* Moench.)'in Aktaş ve Güneş çeşitlerinde farklı ön uygulama ortamları ve dozlarının; çimlenme oranı ve ilk gelişme dönemi üzerindeki etkilerinin belirlenmesi amaçlanmıştır. Materyal olarak, Aktaş ve Güneş karabuğday tohumları kullanılmıştır. Uygulama ortamları; kontrol ve iki ön uygulama ortamı; Mannitol (%4, %6) ve Sorbitol (%4, %6) olarak hazırlanmıştır. Tohumlar 24 saat bu sıvılarda bekletildikten sonra 24 saat süre ile havlu kağıtlar üzerinde kurutulup, deneme için kullanılmıştır. Denemelerden elde edilen veriler; tesadüf parselleri faktöriyel deneme desenine göre değerlendirilmiştir. Araştırma sonuçlarına göre; çimlendirmeye konulan tohumların birinci günde yapılan sayımlarında; her iki çeşitte de kontrolde çimlenme görülmez iken, diğer uygulamalarda %13-23 oranında çimlenme tespit edilmiştir. Ayrıca çimlenme hızı ve çimlenme gücünde kontrole göre ön uygulama (priming) yapılan tohumlarda önemli derecede artış görülmüştür. Çeşitlerde sapçık ve kökçük uzunluğu, sapçık ve kökçük yaş ve kuru ağırlıkları yönünden kontrolde en düşük değerler elde edilirken, mannitol ve sorbitol uygulamalarında daha yüksek değerler tespit edilmiştir. Çeşitler arasında en yüksek sapçık uzunluğu 5.8 cm Aktaş çeşidinde mannitol %4 ile ön uygulama yapılmış tohumlarda görülmüştür. Kökçük uzunluğu en yüksek 14.8 cm olarak mannitol %6 ile ön uygulama(priming) yapılmış tohumlarda elde edilmiştir, sapçık ve kökçük yaş ağırlık ile sapçık kuru ağırlıklarında en yüksek değerler tohumlara mannitol %4 uygulaması ile Aktaş çeşidinde elde edilmiştir. Sonuçlara göre mannitol ve sorbitol farklı dozları ile ön uygulama (priming) Aktaş ve Güneş karabuğday çeşitlerinde kontrole göre hızlı bir çimlenme sağlamıştır ayrıca çimlenme hızı ve çimlenme gücü, sapçık ve kökçük yaş ve kuru ağırlıklarında da kontrole göre artış tespit edilmiştir.

Anahtar Kelimeler: Karabuğday, Ön Uygulama, Mannitol, Sorbitol, Çimlenme, İlk Gelişme

EFFECTS OF SEED PRIMING ON GERMİNATİON AND SEEDLING GROWTH OF BUCKWHEAT (*Fagopyrum esculentum* Moench.) CULTIVARS

ABSTRACT

This study was conducted at laboratories of Başkent University Kahramankazan Vocational School and Institute of Transplantation and Gene Sciences. The study aimed to find the effects of different priming pretreatments and doses on germination and initial growth of buckwheat (*Fagopyrum esculentum* Moench.) cv. Aktaş and Güneş. The priming treatments consisted of no chemical treatment (control), priming with %4 and %6 mannitol, 4% and 6 sorbitol for 24 hours priming. Thereafter, the seeds were rubbed with drying paper and allowed to dry for 24 hours. The experiment was established according to the "Factorial Experiment Pattern in Random Plots". According to the results germination rate (%) was recorded in the study. First day of counting results showed that no germination was recorded in control; whereas, other priming pretreatments showed germination rate of 13-23%. Significant increase in the seed vigor and germination rate compared to control seeds was also observed in the study. In terms of seedling shoot and seedling root length, seedling shoot and root fresh and dry weights the lowest values were obtained in control and higher values were obtained in seed priming with mannitol and sorbitol. Between cultivars, the highest seedling shoot length was obtained 5.8 cm in Aktaş cultivar that primed with 4% mannitol. The highest seedling root length was 14.8 cm was obtained after priming with %6 mannitol, The highest values of seedling shoot and seedling root fresh weight and seedling shoot dry weight were obtained after seed priming at Aktaş cultivar with 4% mannitol. It is concluded that, priming the seeds of Aktaş and Güneş cultivars of buckwheat with different doses of mannitol and sorbitol provided faster germination in Aktaş and Güneş buckwheat cultivars than control and also increased the initial growth and seedling shoot and seedling root fresh and dry weights of buckwheat.

Keywords: Buckwheat, Seed priming, Mannitol, Sorbitol, Germination, initial growth

GİRİŞ

Karabuğday bitkisi (*Fagopyrum esculentum*) Polygoneaceae familyasına ait tek yıllık bitkidir. Karabuğday Güçlü bir ekolojik uyum kabiliyetine sahiptir, bu nedenle her türlü olumsuz ortama adaptasyon sağlayabilmektedir. (Li ve Zhang, 2001). Bu bitkinin tahılla ile akrabalığı bulunmamaktadır (Acar, 2009; Debnath ve ark., 2008). Karabuğday; başta antioksidan maddeler içermesinin yanında protein, diyet lif, B ve E vitamini yönünden zengin olma özelliği ile glutensiz ürünlerde kullanılan ve arana bir tarla bitkisidir (Takahama ve ark., 2010; Fessas ve ark., 2008; Sakac ve ark., 2011). İklim ve toprak isteği yönünden seçici değildir ve vejetasyon süresi kısa olan yazlık bu bitkinin diğer bitkilerle kolayca ekim nöbetine alınması önemli özelliklerinden biridir. Beyaz ve pembe çiçekleri ile arıları cezbeden ve uzun süre çiçekli kalan karabuğday arıcılık ve bal üretimi içinde önemli bir tarla bitkisidir. Bitkisel ve hayvansal üretimin sürdürülebilirliğinde önemli katkı sağlayabilecektir. Hızla artan dünya nüfusunun ve tarımsal üretim yapılan alanların son sınırlarına ulaşmış olduğu, birim alandan daha fazla ürün elde etme gerekliliğini ortaya koymuştur (Geçit, 1995).

Yüksek verimli yeni çeşitlerin geliştirilmesinin yanı sıra, bitki yetiştirme tekniklerinin iyileştirilmesi, girdilerin uygun zamanda ve uygun dozda kullanılması önemlidir. Son yıllarda bazı büyüme düzenleyici maddelerin; verim ve kalite üzerine etkileri konusunda pek çok araştırmalar yapılmaktadır. Tohum'da ön uygulamanın (priming) etkisi, su alımı sırasında hücrelerin metabolik aktivasyonu hücrelerin osmotik olarak ayarlanması ve bir seri fizyolojik ve biyokimyasal olaylar dolaysıyla tohumların daha iyi bir çimlenme potansiyeli kazanmasına bağlanmaktadır (Burgass ve Powell, 1984). Bu araştırmada; farklı ön uygulama (priming) ortamlarının ve dozlarının karabuğdayda; çimlenme ve ilk gelişme dönemi üzerindeki etkilerinin belirlenmesi amaçlanmıştır.

MATERYAL ve YÖNTEM

Deneme, 2022 yılında Başkent Üniversitesi Kahramankazan Meslek Yüksekokulu ile Transplantasyon ve Gen Bilimleri Enstitüsü, laboratuvarlarında yürütülmüştür. Bu çalışmada bitki materyali olarak; Aktaş ve Güneş karabuğday tohumları kullanılmıştır. Denemede kullanılan tohumlar Tarla Bitkileri Merkez Araştırma Enstitüsünden temin ettirilmiştir. Ön uygulama (priming) ortamı olarak; mannitol ve sorbitol (Alkollü şekerler) kullanılmıştır. Kontrol ve iki ön uygulama (priming) dozları olarak; mannitol (% 4 , % 6) ve sorbitol (%4, %6) hazırlanmıştır. Tohumlar 24 saat süre ile bu sıvılarda bekletildikten sonra saf su ile üç kez yıkanmıştır daha sonra 24 saat süresi ile normal oda sıcaklığında havlu kağıtlar üzerinde

kurutulmuştur. Daha sonra kurutulmuş olan tohumlar deneme ortamlarına alınmıştır. Uygun dozları belirlemek için ön deneme yapılmıştır. Bu denemede laboratuvar koşullarında iyi sonuç veren dozlar belirlendikten sonra bu dozlarla ön uygulama (priming) yapılan tohumlar laboratuvar denemelerinde kullanılmıştır.

Laboratuvar denemeleri

Uygulama sonrası tohumların çimlenme yüzdelerinin belirlenmesi için denemeler 4x50 tohum şeklinde kurutma kağıtları arasında çimlenmeye bırakılmıştır. Her bir kurutma kağıdına nem kaybını önlemek için 5 ml saf su eklenmiştir ve daha sonra ağzı kilitli torbalar içerisinde yerleştirildikten sonra sıcaklığı ±1 ^{o}C hassasiyetinde çalışan ve tohum çimlendirmeye uygun % 70 nem içeren çimlendirme kabinine yerleştirilmiştir, standart çimlenme sıcaklığı olarak 25 ^{o}C ‘ye ayarlanıp, çimlenmeye bırakılmıştır. 6 gün boyunca sürdürülmüş ve 2 mm’lik kökçük çıkışı çimlenme kriteri olarak kabul edilmiştir. Çimlenme testlerinde ISTA kuralları esas alınmıştır.

Çimlendirmeye konulan tohumlarda her gün sayım yapılmıştır, ISTA kurallarına göre çimlenme hızının belirlenmesi için 3.günde yapılan sayımda, elde edilen değer % çimlenme hızı olarak belirlenmiştir. Çimlenme hızı belirlendikten sonra tohumlar çimlendirme kabininde tutulmaya devam edilmiş ve 6. günde yapılan sayımda elde edilen değer, çimlenme gücü olarak belirlenmiştir. Çimlendirmenin 6. gününde her tekerrürden alınan 10 adet bitkiciğin sapçık ve kökçük uzunlukları, yaş ve kuru ağırlıkları belirlenmiştir.

Verilerin değerlendirilmesi

Denemelerden elde edilen veriler; tesadüf parselleri faktöriyel deneme desenine göre değerlendirilmiştir. Elde edilen verilerle varyans analizi yapılmış, F testine göre önemlilik düzeyi belirlenmiş ve farklılık gruplandırılması, Duncan testine göre yapılmıştır.

SONUÇ ve TARTIŞMA

Bu araştırma; Aktaş ve Güneş karabuğday çeşitlerinde, laboratuvar koşullarında yürütülmüş ve farklı tohum ön uygulamaları (priming)’nın, çimlenme ve ilk gelişme dönemine etkileri araştırılmıştır. Ele alınan özelliklere ilişkin veriler ve bu verilerin değerlendirilmesi aşağıda açıklanmıştır. Laboratuvardan elde edilen sonuçların ortalamasına göre; karabuğday Aktaş ve Güneş tohumlarının çimlenme oranı, çimlenme hızı ve çimlenme gücü incelendiğinde, tohuma ön uygulama (seed priming) kontrole göre bariz bir artış göstermiştir. Çizelge 1.’de Çimlenme

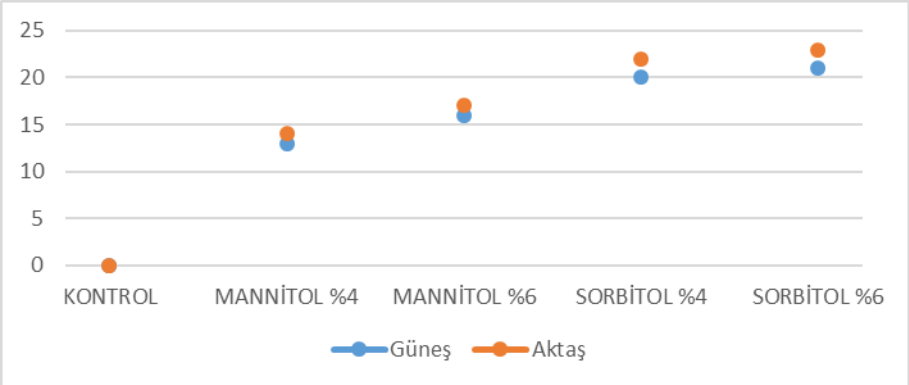
oranı incelendiğinde tohumlar çimlenme ortamına konulduktan 24 saat sonrası yapılan sayımlarda her iki çeşitte de kontrolde çimlenme gözükmez iken mannitol ve sorbitol ile ön uygulama (priming) yapılan tohumlarda %13 ile %23 oranlarında çimlenme görülmüştür.

Çizelge 1. Farklı Ön uygulamaların yapıldığı karabuğday çeşitlerinde çimlenme oranı ortalamaları (%)

Uygulamalar	**Güneş**	
	24 Saat sonrası çimlenme oranı (%)	**24 Saat sonrası çimlenme oranı (%)**
Kontrol	0	0
Mannitol %4	13	14
Mannitol %6	16	17
Sorbitol %4	20	22
Sorbitol %6	21	23

(*) harfler 0.01, rakamlar 0.05 düzeyinde farklı grupları göstermektedir.

Çimlenme oranına ilişkin elde edilen sonuçlar; ön uygulamanın (priming) pek çok bitki türünde, çimlenme-çıkış oranını artırdığını bildirmiştir. Jeya Chandra ve ark. (2022), Vinga muıngo üzerine yaptıkları bir çalışmada mannitol ile ön uygulama (priming) yapılan tohumlarda kontrole göre çimlenme oranı ve çimlenme gücünün arttırdığını belirtmişlerdir, Papastylianou ve Karamanos (2012), pamuk tohumlarını mannitol ile ön uygulama (priming) yaptıklarında; çimlenmenin arttığını bildirmişler. Şekil 1 de görüldüğü gibi, uygulamadan 24 saat sonra en az çimlenme oranı kontrol uygulamasında %0 iken mannitol ve sorbitol dozları ile ön uygulama (priming) yapılan tohumlarda kontrole göre belirgin artış göstermiştir.



Şekil 1. Birinci gün çimlenme oranı (%)

Çimlenme hızı ve çimlenme gücü verileri incelendiğinde kontrole göre artış görülmektedir. Çizelge 2' ye göre, Aktaş ve güneş karabuğday çeşitlerinde çimlenme hızında ön uygulama dozları arası farklılık saptanmıştır. En az çimlenme hızı kontrol uygulamalarında iken sorbitol %4, sorbitol %6, mannitol %4 ve mannitol %6 ile yapılmış olan ön uygulamalarda (priming) maksimum çimlenme hızı belirlenmiştir.

Çizelge 2. Farklı ön uygulamaların yapıldığı karabuğday çeşitlerinde çimlenme hızı ortalamaları (%)

Uygulamalar	Çimlenme hızı Ön uygulama dozları (%)
Kontrol	14.16 b
Mannitol %4	50.85 a
Mannitol %6	47.5 a
Sorbitol %4	60.00 a
Sorbitol %6	51.65 a

(*) harfler 0.01, rakamlar 0.05 düzeyinde farklı grupları göstermektedir

Çimlenme gücü verileri incelendiğinde mannitol ve sorbitol uygulamalarında kontrole göre belirgin bir artış saptanmıştır (Çizelge 3). En az çimlenme gücü Güneş çeşidi kontrolünde %55 iken Aktaş çeşidinde sorbitol %4, sorbitol %6, mannitol %4 ve mannitol %6 ile yapılmış olan ön uygulamalarda (priming) maksimum çimlenme gücü %93.35 ve %91.65 olarak belirlenmiştir.

Çizelge 3. Farklı ön uygulamaların yapıldığı Aktaş ve Güneş çeşitlerinde çimlenme gücü ortalamaları (%)

Uygulamalar	Çimlenme gücü (%)
Güneş Kontrol	55.00 bc
Güneş Mannitol %4	63,35 b
Güneş Mannitol %6	63.35 b
Güneş Sorbitol %4	85.00 a
Güneş Sorbitol %6	86.65 a
Aktaş Kontrol	35.00 c
Aktaş Mannitol %4	91.65 a
Aktaş Mannitol %6	91.65 a
Aktaş Sorbitol %4	93.35 a
Aktaş Sorbitol %6	93.35 a

(*) harfler 0.01, rakamlar 0.05 düzeyinde farklı grupları göstermektedir

Bu araştırmada çimlenme hızına ilişkin elde edilen sonuçlar; Tavili ve ark. (2012)'de kılçıklı brom üzerine yaptıkları bir araştırmanın hidro primimg ve osmo priming 'in kılçıklı brom tohumlarda kontrole göre çimlenme hızının arttığını gösteren ve Thapaa ve ark. (2022) mannitol ile hardal tohumlarına ön uygulamanın çimlenme yüzdesi çimlenme hızı ve gücü üzerine olumlu etkiler olduğunu bildiren çalışmalar ile uyum göstermektedir.

Sapçık ve kökçük uzunluğu yönünden ortalamaları incelendiğinde en yüksek sapçık uzunluğu, 14.83 cm olarak karabuğday Aktaş çeşidi tohumlarına ön uygulama yapıldığında ve en az ise Güneş çeşidi kontrolde 2.66 cm olarak ölçülmüştür. Karabuğdayda kökçük uzunluğundan elde edilen ortalama verileri incelendiğinde en yüksek kökçük uzunluğu Aktaş çeşidi tohumlarına mannitol %6 ile ön uygulama yapıldığında görülmüştür, en düşük kökçük uzunluğu ise Güneş çeşidinin kontrol uygulamasında saptanmıştır. Değerler çizelge 4 de verilmiştir.

Çizelge 4. Farklı ön uygulamaların yapıldığı karabuğday çeşitlerinde sapçık ve kökçük uzunluğu ortalamaları (cm)

Uygulamalar	**Sap uzunluk(cm)**	**kökçük uzunluk (cm)**
Güneş Kontrol	2,66 e	4,667 e
Güneş Mannitol %4	3,167 de	7,667 c
Güneş Mannitol %6	2,833 de	5,667 de
Güneş Sorbitol %4	4,333 b	5,833 d
Güneş Sorbitol %6	3,333 cde	8,500 c
Aktaş Kontrol	2,167 de	7,500 c
Aktaş Mannitol %4	5,833 a	12,83 b
Aktaş Mannitol %6	4,333 b	14,83 a
Aktaş Sorbitol %4	4,100 bc	12,10 b
Aktaş Sorbitol %6	3,667 bcd	8,167 c

(*) harfler 0.01, rakamlar 0.05 düzeyinde farklı grupları göstermektedir

Sapçık ve kökçük uzunluğuna ilişkin elde edilen sonuçlar; Khazaie ve ark., (2013)'de osmoprimingin çavdar (*Secale Montanum*)tohumları üzerine etkileri incelendiği araştırma sonucunda, ön uygulama (priming) yapılan tohumların sapçık ve kökçük uzunlukları hiç bir ön muamele yapılmayan tohumlara göre daha uzun olduğunu belirtmektedir ve bu çalışma sonuçları ile uyum göstermektedir. Sapçık ve kökçük yaş ağırlıkları değerlerini incelediğimizde kontrole göre artış görülmektedir. Çizelge 5'de görüldüğü gibi, en yüksek sapçık ve kökçük yaş ağırlıkları Aktaş çeşidinde mannitol %4 uygulamasında görülmüş iken en düşük ise Güneş çeşidi kontrol uygulamasında saptanmıştır.

Çizelge 5. Farklı ön uygulamaların yapıldığı karabuğday çeşitlerinde sapçık ve kökçük yaş ağırlığı ortalamaları (g)

Uygulamalar	Sapçık yaş ağırlık (g)	Kökçük yaş ağırlık ağırlık(g)
GÜNEŞ KONTROL	0,05553 e	0,01170 d
GÜNEŞ MANNİTOL %4	0,08517 b	0,02083 bc
GÜNEŞ MANNİTOL %6	0,06157 cde	0,02113 bc
GÜNEŞ SORBİTOL %4	0,06837 c	0,01763 cd
GÜNEŞ SORBİTOL %6	0,06530 c	0,01807 cd
AKTAŞ KONTROL	0,06390 cd	0,01123 d
AKTAŞ MANNİTOL %4	0,1064 a	0,03737 a
AKTAŞ MANNİTOL %6	0,1053 a	0,02787 b
AKTAŞ SORBİTOL %4	0,05670 de	0,01910 cd
AKTAŞ SORBİTOL %6	0,08983 b	0,01657 cd

(*) harfler 0.01, rakamlar 0.05 düzeyinde farklı grupları göstermektedir.

Sapçık ve kökçük kuru ağırlıkları incelendiğinde en yüksek sapçık kuru ağırlığı Güneş çeşidinde mannitol %4 ve Aktaş mannitol %4 uygulamalarında görülmüştür, kökçük kuru ağırlığı incelendiğinde ise en yüksek kökçük kuru ağırlığına Aktaş çeşidinde mannitol %4 uygulamasında saptanmıştır. En düşük sapçık ve kökçük kuru ağırlığı güneş çeşidi kontrol uygulamasında görülmüştür. Değerler çizelge 6'da verilmiştir.

Çizelge 6. Farklı ön uygulamaların yapıldığı karabuğday çeşitlerinde sapçık ve kökçük kuru ağırlığı ortalamaları (g)

Uygulamalar	Sapçık kuru ağırlık (g)	kökçük kuru ağırlık (g)
GÜNEŞ KONTROL	0,009067 ab	0,001 b
GÜNEŞ MANNİTOL %4	0.01403 a	0,001 b
GÜNEŞ MANNİTOL %6	0.01260 a	0,002 ab
GÜNEŞ SORBİTOL %4	0,01390 a	0,001 b
GÜNEŞ SORBİTOL %6	0,006567 ab	0,001 b
AKTAŞ KONTROL	0,003400 b	0,002 ab
AKTAŞ MANNİTOL %4	0,01173 a	0,003 a
AKTAŞ MANNİTOL %6	0,01127ab	0,002 ab
AKTAŞ SORBİTOL %4	0,008800 ab	0,002 ab
AKTAŞ SORBİTOL %6	0.006833 ab	0,002 ab

(*) harfler 0.01, rakamlar 0.05 düzeyinde farklı grupları göstermektedir.

Sapçık ve kökçük yaş ve kuru ağırlıklarına ilişkin elde edilen sonuçlar; Khazaie ve ark., (2013) ve Moradi ve Yunesi (2009) osmoprimingin çavdar (*Secale Montanum*) ve sorgum (*Sorghum bicolor* L.) tohumlarının çimlenme ve ilk gelişmesi üzerine etkilerini araştırmaları ile uyum göstermektedir. Araştırma sonuçları karabuğday çeşitleri için ön uygulamanın (priming) kontrole göre daha iyi sonuçlar verdiğini göstermiş, mannitol ve sorbitol uygulamalarının iyi bir çimlenme çıkış sağladığı, sapçık ve kökçük uzunluğu, yaş ve kuru ağırlıkları yönünden kontrole göre belirgin bir artış göstermiştir.

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ÖZET

Gastronomi son yılların en popüler alanlarından biri haline gelmiştir. Bunda kuşkusuz görsel ve yazılı medyanın etkisinin yanında artan turizm faaliyetlerininde payı vardır. Ziyaretçiler destinasyonun tarihi, kültürel ve doğal güzelliklerinin yanında mutfak kültürünede ilgi duymaktadırlar. Destinasyondaki yerel halkın mutfak kültürünü ön plana çıkarması ziyaretçilerin yoğun ilgisi ile karşılanmakta bu da yerel kalkınmaya destek olmaktadır. Özellikle son zamanlarda yerel yemeklere olan ilginin artması kaybolmaya yüz tutmuş yerel yemeklerin tekrar gün yüzüne çıkması çalışmalarını hızlandırmaktadır. Yöresel mutfak kültürü, turistlerin turizm faaliyetleri olarak ziyaret ettikleri destinasyonlarda o yerin kültürünü ve mirasını temel bir şekilde anlamasına yardımcı olacaktır. Buna ek olarak bu bilinci nesilden nesile aktarılarak yerel gastronomik unsurları korumak ve devamlılığını sürdürmesine yardımcı olacaktır. Bu çalışmada, Karadeniz Bölgesi'nde yer alan Ordu'nun İkizce ilçesinin mutfak kültürü, kültürel analiz ve kırsal kalkınma açısından incelenmiştir. Bu kapsamda araştırma temel olarak iki bölümden oluşmaktadır. İlk bölümde kavramsal çerçeve oluşturulmuş ve bu kavramsal çerçeve içinde yerel gastronomi ve Ordu mutfak kültüründe İkizce detaylı olarak ele alınmıştır. Çalışmanın ikinci bölümde ise araştırmanın yöntemine, bulgu ile analizlerine ve sonuç ile önerilerine yer verilmiştir. Araştırmada Ordu İli İkizce İlçesi mutfak kültürünü ortaya koymak için uzun yıllar bölgede yaşayan bölge mutfak kültürüne hakim kişilerle görüşmeler yapılmıştır. Katılımcılara sofra adabı, yeme içme ile ilgili gelenek ve görenekler, günlük öğünler, yiyecek içecekler, yiyecek saklama ve kış hazırlıkları, doğum, ölüm, düğün bayram gibi önemli günlerde yiyecek içecek ritüelleri gibi konularda bilgi almak üzere yarı-yapılandırılmış görüşme formları oluşturulmuştur. Bu çalışmada, Karadeniz Bölgesi'nde yer alan Ordu'nun İkizce ilçesine ait yerel yemek kültürü incelenmiştir. Yerel halk tarafından geçmişte tüketilen yemeklerinin hazırlanışı ile ilgili veriler toplanarak yemek kültürü tespit edilecektir. Bu sayede İkizce ilçesinin yerel mutfak kültürünün tanıtımı amaçlanmaktadır. Bu kapsamda araştırma temel olarak iki bölümden oluşmaktadır. İlk bölümde kavramsal çerçeve oluşturulmuş ve bu kavramsal çerçeve içinde yerel gastronomi ve Ordu mutfak kültüründe İkizce detaylı olarak ele alınmıştır. Çalışmanın ikinci bölümde ise araştırmanın yöntemine, bulgu ile analizlerine ve sonuç ile önerilerine yer verilmiştir. Araştırmada bölgeye ait geçmişten günümüze mutfak mirası olarak bırakılan ürünlerin tespit edilerek belirlenmesi

amaçlanmıştır. Verilerin toplanmasında ve analiz sürecinde nitel araştırma yöntemlerinde en sık kullanılan yarı-yapılandırılmış görüşme tekniği kullanılmıştır. Katılımcılara sofra adabı, gelenek ve görenekler, günlük öğünler, kutsal günler ve eğlence amaçlı etkinlikler hakkında bilgi almak üzere yarı-yapılandırılmış görüşme formları oluşturulmuştur. Araştırma sonucunda elde edilen bilgiler doğrultusunda ilçeye ait ritüeller ve yemek kültürü belirlenmiştir. Yapılan görüşmeler MAXQDA progmanında analiz edilmiştir. Araştırma sonucunda elde edilen bilgiler doğrultusunda Ordu İli İkizce İlçesinin mutfak kültürü gastronomi turizmi, kültürel analiz ve kırsal kalkınma açısından belirlenmiştir.

Anahtar Kelimeler: Yerel mutfak, Gastronomi, Ordu, Kültür analizi, İkizce

LOCAL GASTRONOMY CULTURAL ANALYSIS: THE CASE OF IKIZCE

ABSTRACT

Gastronomy has become one of the most popular fields in recent years. Undoubtedly, besides the effect of visual and written media, increasing tourism activities have a share in this. Visitors are also interested in the culinary culture as well as the historical, cultural and natural beauties of the destination. The local people's culinary culture in the destination is met with intense interest from the visitors, which supports local development. Especially recently, the increase in interest in local food accelerates the efforts of local dishes, which are on the verge of disappearing, to come to light again. Local culinary culture will help tourists to have a basic understanding of the culture and heritage of that place in the destinations they visit as tourism activities. In addition, this awareness will be transferred from generation to generation and will help preserve and maintain local gastronomic elements. In this study, the culinary culture of İkizce district of Ordu, located in the Black Sea Region, was examined in terms of cultural analysis and rural development. In this context, the research basically consists of two parts. In the first part, a conceptual framework was created and within this conceptual framework, İkizce in local gastronomy and Ordu culinary culture was discussed in detail. In the second part of the study, the research method, findings and analyzes, results and suggestions are given. In the research, interviews were conducted with people who have lived in the region for many years and who have mastered the culinary culture of the İkizce District of Ordu Province. Semi-structured interview forms were created for the participants to get information about table manners, traditions and customs related to eating and drinking, daily meals, food and beverages, food storage and winter preparations, food and beverage rituals on important days such as birth, death, wedding and holiday. The interviews were analyzed in the MAXQDA program. In line with the information obtained as a result of the research, the culinary culture of the İkizce District of Ordu Province was determined in terms of gastronomic tourism, cultural analysis and rural development.

Keywords: Local cuisine, Gastronomy, Ordu, Cultural analysis, İkizce

GİRİŞ

Gastronomi kavramı son yıllarda oldukça ses getirmiştir. Aslında gastronominin kökü daha eskiye dayansa da popülerliğini sonradan kazanmıştır. İnsanoğlunun hayatta yaşamını devam ettirebilmesi için temel ihtiyaçlarının giderilmesi gerekmektedir. Bu ihtiyaçlardan en başta yer alanlardan biri gastronomi olmaktadır. Çünkü insan ırkı fizyolojik yapısı gereği yeme içme eylemine bağlı yaşamaktadır. Bu noktada gastronominin insanların yaşamları için önemi vurgulanmaktadır.

Turizmin gelişmesiyle birlikte gastronomi turizmi de gelişmiştir. Farklı destinasyonları ziyaret eden kişiler ziyaretleri esnasında bölgeye ait olan yöresel gastronomik ürünlerini tercih etmektedirler (Sarıışık ve Özbay, 2015, s.266). Bölgeler de bu sayede gastronomik kimlik kazanmış olmaktadır. Bir bölgeye ait olan mutfak kültürü o bölgenin değerleri hakkında bilgi vermektedir. Bu sebeple gastronomi turizmi ve mutfak kültürü kavramları önem kazanmaktadır. Bir yöreye ait mutfak kültürünün olması o yörenin aynı zamanda diğer destinasyonlardan ayrılarak, kişisel kimlik kazanarak fark yaratması anlamına gelmketedir.

Gastronomi turizmi, destinasyon ziyarteçilerine sunduğu yeme içme deneyimi yanında o yörenin gelenek ve görenekleri, değer yargıları ve mutfak kültürü hakkında da bilgi vermektedir. Bundan dolayı gastronomi, turizm hareketliliğini canlandıran, destekleyen veya tamamlayan niteliklere sahiptir. Ayrıca gastronomi turizminin varlığı bölgenin sürdürülebilirliği açısından da büyük önem arz etmekedir. Bazı insanlar bazı bölgeleri sadece gastronomik ürünleri sebebiyle ziyaret etmek isteyebilir. Örneğin Erzurum'da yenilen bir cağ kebabının tadı veya sunumu farklı bir ilde görüldüğünde aynı heyecanı ve hevesi vermeyebilir. Çünkü bu üründe yöreye özgü bir kimlik bulunmaktadır. Bu kimlik bölgenin mutfak kültürünü oluşturmaktadır.

Bir bölgenin mutfak kültürüne sahip olması bölgenin ziyaretçi oranının artmasına ek olarak yöreye özgü ürünlerin de tanıtımında önemli rol oynamaktadır. Özellikle son zamanlarda yöresel yemek anlayışına olan ilginin artması mutfak kültürünün önemli bir husus olduğunu bir kez daha vurgulamaktadır. Mutfak kültürüne sahip olunması iyi bir analiz ile mümkündür. Bundan dolayı çalışmanın amacı İkizce ilçesinin mutfak kültürünü belirlemektir.

Literatür Taraması

Yerel Gastronomi

Gastronomi kelimesi kavramsal olarak incelediğinde Yunanca kelime olup "gastro" ve "nomos" sözcüklerinin bir araya gelmesiyle oluşmaktadır (Küçükkömürler, Şirvan ve Sezgin,

2018, s.79). Bu kavrama göre neyi, nerede ve ne zaman hangi kurallarla yeniliği içtildiğiyle doğrudan alakalı tavsiyelerden oluşan, yeme içme konusunda yeteneğe sahip olma becerisi gerektiren sanattır (Santich, 2004, s.15). Türk Dil Kurumu'nda gastronomi "iyi yemek sanatı veya sağlığa uygun hoş, lezzeti ve güzel görünen yiyecekleri tüketme" anlamına gelmektedir (Türk Dil Kurumu, 2023). Bu bağlamda gastronomi kavramının en temelinde yeme içme hareketliliği vardır. İnsan ırkının yaşamını sürdürmesi açısından da büyük role sahip olan gastronomi kavramı tarihsel geçmişine bakıldığında da aynı değeri görmek mümkündür. Özellikle ateşin bulunmasıyla birlikte yeni ekipmanlar elde edilerek bir kültür şeklini almıştır (Özdemir ve Altıner, 2019, s.2).

Gastronomi turizmi, bölgeyi ziyaret eden turistlere o bölgenin kültürü ve tarihsel geçmişi hakkında bilgi sunmasının yanı sıra daha önce tadılmamış yöreye özgü yiyecek ve içeceklerin deneyimlenmesine olanak sağlayan bir turizm çeşididir (Akbaba ve Kendirci, 2016, s. 115-116). Turistler bu gibi deneyimler yaşadıklarında seyahatlerinin davranışlarına olumlu yansıdıklarını, motivasyon yaratıcı etkisi olduğunu ve bölgeyi tekrar ziyaret etme isteği uyandırdıklarını ifade etmektedirler (Erciyas ve Yılmaz, 2021, s.97). Dolayısıyla gastronominin turizm için katkısı yok sayılamaz. Özellikle son on yılda ilgi duyulan turizm çeşidi olan gastronomi turizminin her bir bölgeye sağladığı canlılık da yadsınamaz. Bir bölgenin gelişmesine olanak sağlayan etkenlerden biri olan gastronomi turizmi, bölge için varsa anlamı olan tarihlerde yiyecek ve içecek festivalleri yapılarak yöreye yoğun turist çekmektedir (Büyükşalvarcı ve Akkaya, 2018, s. 455). Turistler bölgeye ait yerel gastronomik unsurları deneyimledikçe o bölgeyi tanımaya ve anlamaya başlayacaktır.

Yerel gastronomik ürünlerin kendileri has oluşumları, özgün yapı ve kültürel birer yansıtma olarak değerlendirilmektedir (İflazoğlu ve Yaman, 2020, s.1945). Bir yörenin mutfak kültürünü tanımak için o bölgeye yapılan seyahat esnasında yerel ürünlerden tadılması işleri kolaylaştıracaktır. Aynı zamanda yerel gastronomik ürünler bölgenin çekiciliğine ve daha rahat pazarlanabilmesine de imkân tanımaktadır (Seçilmiş ve Soydan, 2021, s.1). Yöresel yemek kavramı bu noktada anlamını kazanmaktadır. Bu anlayışa göre yöresel yemek kültürü, turistlerin turizm faaliyetleri olarak ziyaret ettikleri destinasyonlarda o yerin kültürünü ve mirasını temel bir şekilde anlamasına yardımcı olacaktır. Buna ek olarak bu bilinci nesilden nesile aktarılarak yerel gastronomik unsurları korumak ve devamlılığını sürdürmesine yardımcı olacaktır (Küçük ve Saatçi, 2022, s.189).

Ordu Mutfak Kültüründe İkizce

Kültür, insanların dünyaya geldiği ve yetiştiği, aynı zamanda etkisinde kaldığı bir toplumda sahip olduğu değerlerdir (Deniz ve Kalem 2018, s. 81). Bu değerler sabit kalmak zorunda değildir. Yineleyip geliştirmek kişilere bağlıdır. Dil, din, giyim, yemek, konuşma şekli, davranışlar gibi unsurlar kültürü oluşturmaktadır. Bu yüzden kültür kavramı, 'gelişme' kavramından soyutlanmaması gerekmektedir. Kültürün asıl amacı şudur; doğduğunda sadece doğal bir tepki ve yetenek şeklinde olan insan aklını sürekli geliştirmektir. İnsan tarafından değiştirilen ve geliştirilen kültür, insana doğanın verdiği akıldan çok daha farklı ve değişik bir unsurdur. Kültür, insanın temel yeteneğini, kültür tarihinin oluşumunu sağlayan kendiliğinden gelişimi temsil etmektedir (Uzunaslan ve Çifci, s.217).

Kültür, doğası gereği klasikleşmiş araçlar ile ölçülemez. Ölçülebilmesi için kültürün öncelikle yaşanması ve hissedilmesi gerekir. Kültür analizi yapan bir araştırmacının araştırdığı kültürü anlayabilmesi için o kültür içinde bulunması, o insanlarla zaman geçirmesi gerekmektedir (Nar, 2019, s.72). Analiz etmek istediği toplumun yemek kültüründen giyecek kültürüne kadar iyi bir gözlem yapmalıdır. Aynı zamanda doğru bir kültür analizi için birden fazla kültürel ortamda bulunulması ve ona göre analiz edilmesi gerekmektedir (Güney, 2023, s.69). Kültür analizi yaparken ihtiyaç duyulan ana faktörlerden biri o yöreye ait gastronomik ürünlerdir. Yörenin gastronomi kültürü bölge halkının kültürü hakkında bilgi vermektedir. Özellikle insanoğlunun temel yaşam kaynağı olan yeme içme faaliyeti gastronomik kültür için önemli rol oynamaktadır.

Mutfak kültürü kavram olarak, beslenmeyi sağlayan yiyecek ve içecek çeşitleri ve hazırlanması, pişirilmesi, saklanması ve tüketilmesi sürecinin yanı sıra olarak, ekipmanları ve yemek geleneğiyle toplumun sosyo-kültürel, ekonomik durumuna, tarihsel kimliğine, yeme-içme alışkanlıklarına, tarım üretimine göre şekillenmiş mutfağını içine alan kendine özgü kültürel bir yapıyı ifade etmektedir (Uzel, 2018,s.39). Bireylerin tarih öncesi dönemlerde bu yana beslenmek durumunda kaldıklarında birtakım kurallar ortaya çıkmıştır. Bu kurallar zaman geçtikçe toplumların kendilerine özgü kimlikleri, değerleri ve yargıları etkileyerek kendilerine özgü mutfak kültürlerini ortaya çıkarmıştır (Solmaz ve Altıner, 2018, s.113).

Mutfak kültürü, kültürün en önemli parçasıdır. Sadece yediğimiz ürünler değil, aynı zamanda bu kültürün içinde yeme içmeye dair her unsur bulunur. Mekân olarak mutfağın yanında her türlü yiyecek ve içecek, araç ve gereçler, bir bütün olarak mutfak kültürünü oluşturur (Başaran, 2021, s.644). Bundan dolayı mutfak kültürüne göre yemeğin hazırlanış ve sunuş biçimi o bölge

hakkında genel bir bilgi vermektedir. Aynı zamanda mutfak kültürü zamanla bölgeyle birlikte bütün hale gelerek diğer bölgelerden veya toplumlardan ayrışmış hale gelecektir.

Ordu Kültür ve Turizm Bakanlığı'na göre Ordu mutfak kültürü şu şekildedir (2023):

Ordu mutfağı, yörenin coğrafi özelliklerine göre şekillenmiştir. Ordu'nun balık, sebze, meyve yönünden zengin Karadeniz kıyısında, dağ - yayla ve deniz kültürünün iç içe olduğu bir yörede bulunması mutfağını zenginleştirmiştir. Balıkçılık, fındık, mısır tarımına, arıcılık ve yaylacılığa bağlı ekonomi Ordu mutfağının oluşmasında önemli etkendir. İl içerisinde kıyı kuşağı ve kıyı ardı (yüksek kesimler) gibi alt yörelerde coğrafi koşullardaki değişikliğe bağlı olarak halkın yiyecek ve içeceklerinde farklılıklar görülmektedir. Kıyı kuşağı yağışlı ve ılıman iklime sahip olduğundan bitkisel ve hayvansal (özellikle balık) temelli beslenmektedir. Buna bağlı olarak hamsi, levrek ve somon balığı günümüzde sofralarda çok sık görülmektedir. Yükseklere çıkıldıkça iklimin nispeten sertleştiği (kar daha fazla yağmakta, daha uzun yerde kalmakta vs.) yayla kültürüne geçilmektedir. Mesudiye, Kabadüz, Kumru, Gölköy, Korgan, Gürgentepe, Aybastı, Kabataş, Akkuş yörelerinde yaylalara bağlı olarak yapılan hayvancılık uzun yıllardır temel geçim kaynaklarından biridir. Bu nedenle etli hamurlu, mısır, patates ve buğday ürünlerinin bu yörelerde sofraya gelme sıklığı fazladır. Kıyı kuşağında sığır eti, yükseklerde özellikle yaylalarında ise koyun eti tüketimi daha fazladır. Kapalı toplum yapısına sahip yüksek rakımlı coğrafyalarda yakın zamana kadar geleneksel mutfak kültürünün korunduğu görülmektedir. Ordu mutfağı, tarihsel gelişim süreci içerisinde aldığı göçlerle zenginlik ve çeşitlilik kazanmıştır. Yörede yaşayanların örf ve adetleri, gelenek ve görenekleri ile şekillenmektedir. Özellikle gürcü yemekleri ile Ordu mutfağı zenginleşmiştir. Ordu mutfağına, balık ve sebze yemekleri, turşu kavurmaları, doğada kendiliğinden yetişen yöreye özgü bitkilerden yapılan yemekler, hamur işleri ve evde açılan özellikle fındıkla yapılan tatlılar hakimdir.

1990 yılında kurulan ve Ordu iline bağlı İkizce ilçesinin nüfusu 20.332'dir. Coğrafi yüz ölçümü olarak 118 km2'lik alana sahiptir. İkizce'ye ait toplam beş tane belediye ve altı tane köy bulunmaktadır. İlçenin tarihine bakıldığında ise İkizce'nin Anadolu Selçuklu Beylikleri döneminde merkezi Niksar'da bulunan Taceddinoğulları Beyliği'nin eline geçtiği rivayet edilmektedir. Yörenin tamamen Türkleşmesi Fatih Sultan Mehmet'in Rum Pontus Devleti'ni ortadan kaldırması ile gerçekleşmiştir (Kültür ve Turizm Bakanlığı, 2023). Ordu şehir merkezine olan uzaklığı 92 km ve Ünye ilçesine olan uzaklığı ise 30 km'dir.

Yöntem

Araştırmanın amacı İkizce ilçesine özgü yerel yemek kültürünü incelemektir. Bu sebeple araştırma soruları oluşturulmuştur. Verilerin toplanmasında ve analiz sürecinde nitel araştırma yöntemleri kullanılmıştır. Araştırmada eğitim ve sosyal bilimler alanındaki nitel araştırmacıların en sık kullandığı veri toplama tekniklerinden biri olan yarı-yapılandırılmış görüşme tekniği kullanılmıştır (Çelik vd., 2020). Yapılan görüşmeler için hazırlanan sorular, konu ile ilgili literatür incelenerek ve gastronomi alanında uzman kişilerin görüşleri alınarak oluşturulmuştur (Bucak ve Ateş, 2014). Görüşmeler telefon aracılığıyla yapılmıştır. İlçeye ait mutfak kültürünü belirlemek için beş katılımcıyla görüşülmüştür. Katılımcılarda 3 erkek ve 2 kadın bulunmaktadır. Yaş aralıkları en az 30 ve en fazla 52'dir. Aynı zamanda bu katılımcılardan dördü çalışmakta biri çalışmamaktadır. Gelir düzeyleri olarak en az olan katılımcının geliri asgari ücret düzeyindedir. Eğitim durumları olarak en az lise mezunu en fazla yüksekokulu mezunu bulunmaktadır. Katılımcıların uygun olduğu saatler belirlenmiş ve izinleri alınarak kaydedildikten sonra deşifre edilmiştir. Görüşme öncesi katılımcılardan gönüllü olduklarının beyanı sözlü olarak alınmıştır. Bilgiler beş farklı kategori içerisinde çeşitli sorular ile edinilmiştir. Kategori başlıkları şu şekildedir:

Eğlence Amaçlı Etkinlikler Bağlamında Mutfak Kültürü

- Günlük Öğünler Bağlamında Mutfak Kültürü
- Sofra Adabı ve Servis Usulleri Bağlamında Mutfak Kültürü
- Eğlence Amaçlı Etkinlikler Bağlamında Mutfak Kültürü

İkizce ilçesinin yerel yemek kültürü ile ilgili bilgilere ulaşmak için 30 yaş üstü katılımcılar tercih edilmiştir. Görüşmelerde tekrar yaşanmaması adına beş kişi ile yapılması uygun görülmüştür. Veriler içerik analizi kullanılarak yorumlanmıştır. İçerik analizi sürecinde kodlama ve haritalama özellikleri bulunan MAXQDA programından yararlanılmıştır. Görüşmeler sonucunda elde edilen veriler, MAXQDA programında hiyerarşik-alt kod modeli, kod teori modeli, belge portresi ve kelime bulutu analizi yapılmıştır. Kodlama sistemi ana ve alt tema belirlenerek gerçekleştirilmiştir. Belirlenen temalarda katılımcıların vermiş oldukları cevaplar dikkate alınmıştır.

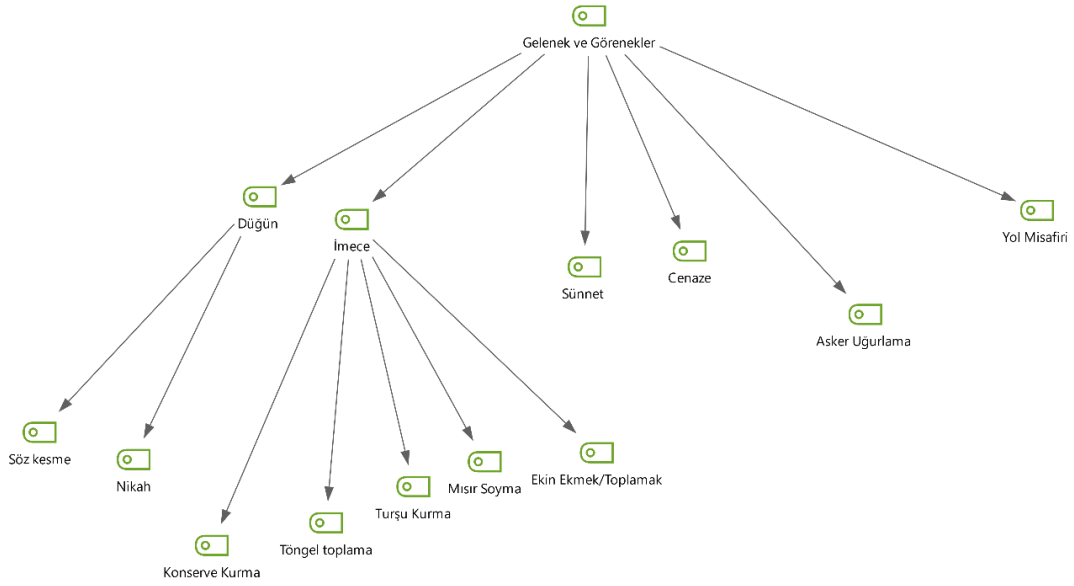
Bulgular

Katılımcılardan elde edilen veriler MAXQDA nitel araştırma analiz programında kodlanmıştır. Yapılan araştırmaya yönelik oluşturulan ana temaya kod sistemi şekil 1'de gösterilmiştir.



Şekil 1. Ana Temaya Yönelik Kod Sistemi

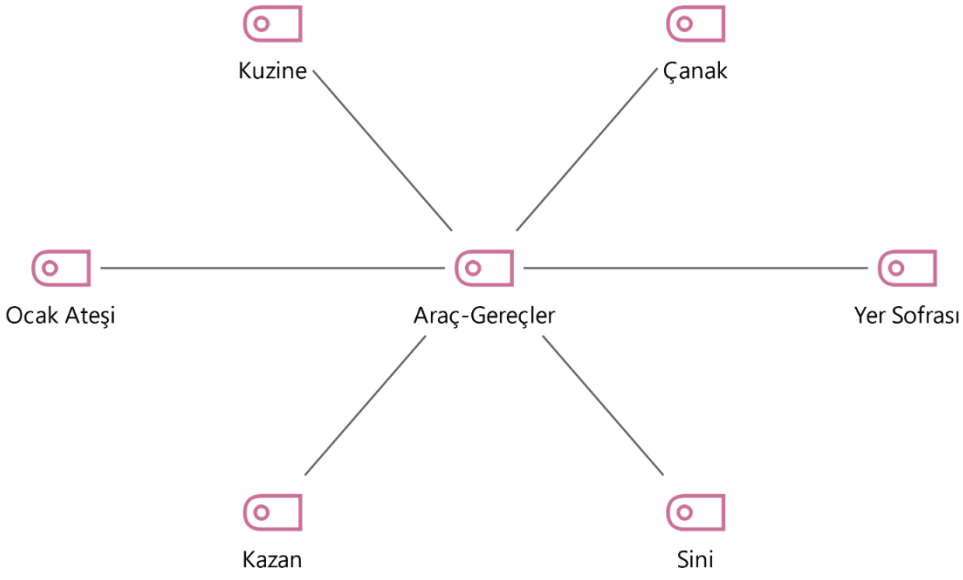
Araştırma kapsamında ana tema olarak yedi kategori kullanılmıştır. Her bir tema farklı renklerde kodlanarak alt temalara ayrıştırılmıştır. İlk tema gelenek ve göreneklerin yer aldığı temadır. Sırasıyla diğer temaları 'araç-gereçler, sofra adabı, eğlence amaçlı etkinlikler, kutsal günler, öğünler ve demografik bilgiler' oluşturmaktadır. Her temanın alt temalarını gösterebilmek için MAXQDA analiz programında Hiyerarşik Kod-Alt Modeli yapılmıştır.



Şekil 2. Gelenek ve Görenekler Hiyerarşik Kod-Alt Modeli

Şekil 2'de gelenek ve görenekler başlığı altında altı alt tema bulunmaktadır. Bu temalar: Düğün, imece sünnet, cenaze, asker uğurlama ve yol misafiridir. İlçede imcece olarak mısır sıyma, fındık toplama ve konserve yapma gibi etkinlikler vardır. Ancak katılımcılardan elde edilen bilgiler doğrultusunda imecelerin çocukluk dönemlerinde daha çok yapıldığı, günümüzde çeşitli sebeplerden dolayı önemini yitirdiği sonucuna varılmıştır. Diğer alt bir tema olan düğün teması nişan, söz, kız isteme ve nikah ile birleştirilmiştir. Bunun sebebi günümüzde bu temalardan bazılarının aynı tema altında yapılabiliyor olmasından kaynaklanmaktadır. Bazı

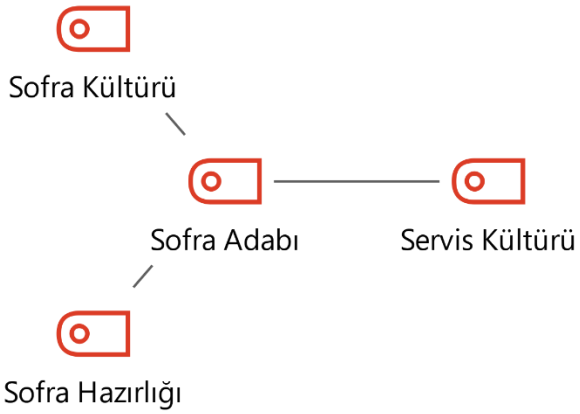
katılımcılara göre düğünde keşkek, pilav, ayran ve sarmanın verildiği söylenirken diğer katılımcılar da aynı yemeklerin kına günü verildiği söylenmektedir. Katılımcılardan gelen cevaplara göre söz ve nişan ayrı olarak yapılmamaktadır. Aynı zamanda nikah ile düğün genellikle aynı gün tercih edilmektedir. İlçede asker uğurlamaları kişilerin bütçeleriyle orantılı olmakla birlikte genellikle evlerinin önlerinde davul ve zurna eşliğinde küçük eğlence yaparak olduğunu söylemektedirler. Asker uğurlamada çoğu katılımcı yemek verildiğini ifade etmektedir. Özellikle pilav, keşkek, tavuk döner ve ayran en çok tercih edilen asker eğlencesi yemekleridir. İlçede sünnetlerin ev ortamlarında yapıldığı ve kısa bir araba konvoyundan sonra yemek ikram ediliği ifade edilmketedir. Bu yemekler arasında asker uğurlamadaki gibi pilav, keşkek, tavuk döner, sarma ve ayran bulunmaktadır. Analiz sonucuna göre ilçede tanımadık misafire bir şey istemediği sürece herhangi bir ikramda bulunulmamaktadır. Ancak yoldan geçen tanıdık misafirlere çay ve aparatif (kahvaltılık türü, börek kızartması, turşu kavurması) ürünler ikram edilmektedir. İlçede cenaze etkinliklerinin ölen kişinin evlerinde toplanarak yapıldığı ifade edilmektedir. Cenaze sahibinin herhangi bir yemek ikramında bulunmadığını, tamamnını komşuların veya akrabalarının yaptığını ve dağıtıldığını söylemektedirler. Özellikle cenaze un helvasının tereyağ ile kavrularak ölen kişinin ruhuna gitmesi inancıyla ikram edildiği söylenmektedir. Yine cenaze yemekleri arasında tavuk döner, pilav, ayran veya pide ikram edildiği ifade edilmektedir.



Şekil 3. Araç ve Gereçler Kod- Teori

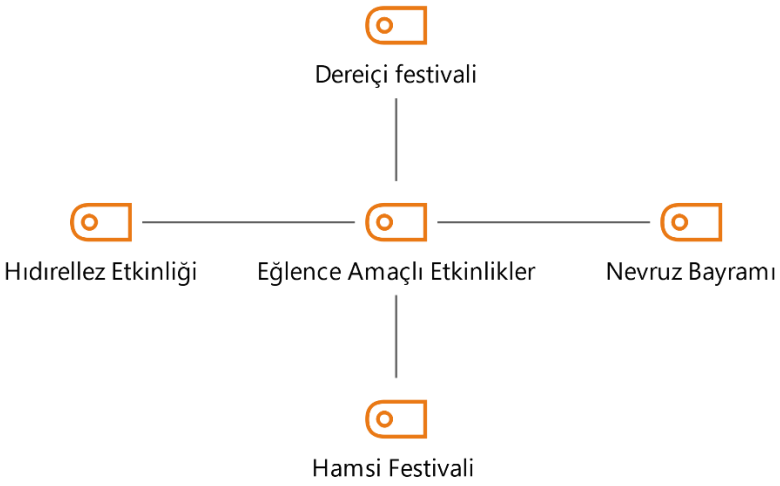
Şekil 3'e göre araç ve gereçler temasında altı ayrı alt tema kodlanmıştır. Bunlar; kuzine, ocak ateşi, kazan, sini, çanak ve yer sofrasıdır. Katılımcılardan elde edilen bilgiler ışığında çocukluk dönemlerinde bu araç ve gereçlerden en çok kullanılanın kazan ve yer sofrasıdır. Diğer dört alt

temaların günümüzde halen tercih edildiğini ancak eskiye nazaran önemini yitirdiği sonucuna ulaşılmaktadır.



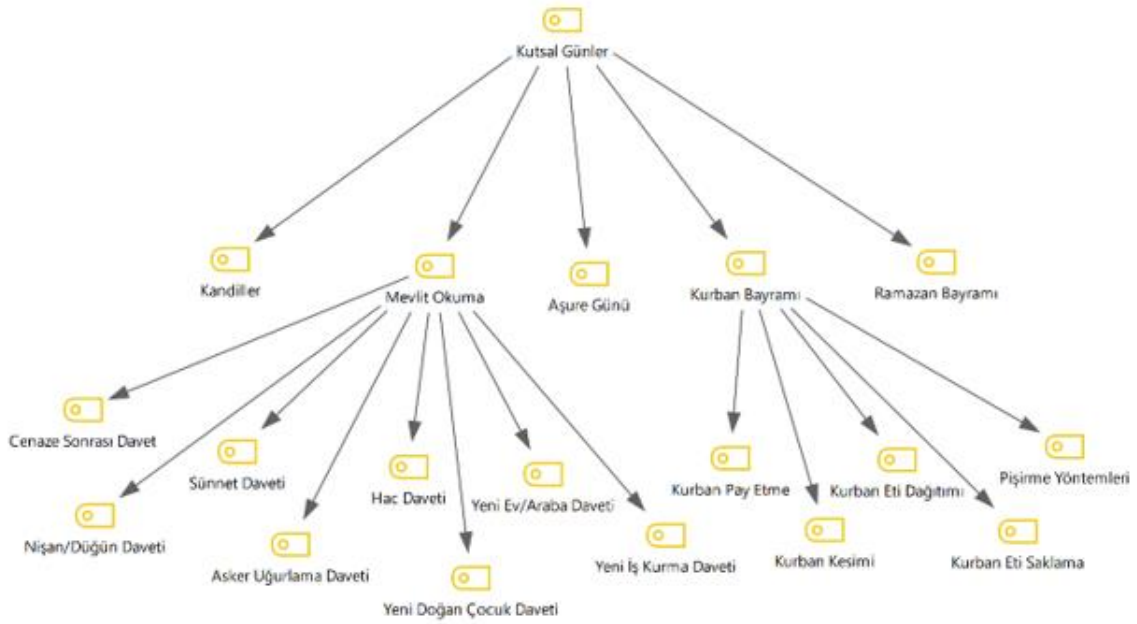
Şekil 4. Araç ve Gereçler Kod- Teori

Şekil 4'e bakıldığında sofra adabı teması altında üç alt başlık bulunmaktadır. Bunlar; sofra kültürü, sofra hazırlığı ve servis kültürüdür. Katılımcılara göre yaşadıkları ilçede bu kategoriye hem geçmişte hem günümüzde oldukça önem verilmektedir. Özellikle akşam yemeklerinde herkesin bir arada olduğu, misafir geldiğinde daha özenli sofraların hazırlandığı, yemeklerin sofraya geliş sıralarının bulunduğu, yemek yeme esnasında kimsenin konuşmaması gibi kurallara dikkat ettikleri sonucuna varılmıştır. Sofra hazırlığı olarak misafir için daha nadir kullanılan örtülerin serildiği ve daha az kullanılan genellikle desenli tabaklar kullanılmaktadır. Sofra hazırlığını genellikle annelerinin veya kız kardeşlerinin yanı sıra yengelerinin de yaptıklarını söylemektedirler. Çocukluk dönemlerinde yemeklerin sırayla sofraya geldiğini ancak günümüzde bütün yemeklerin aynı anda sofraya konulduğunu ifade etnektedirler.



Şekil 5. Eğlence Amaçlı Etkinlikler Kod- Teori

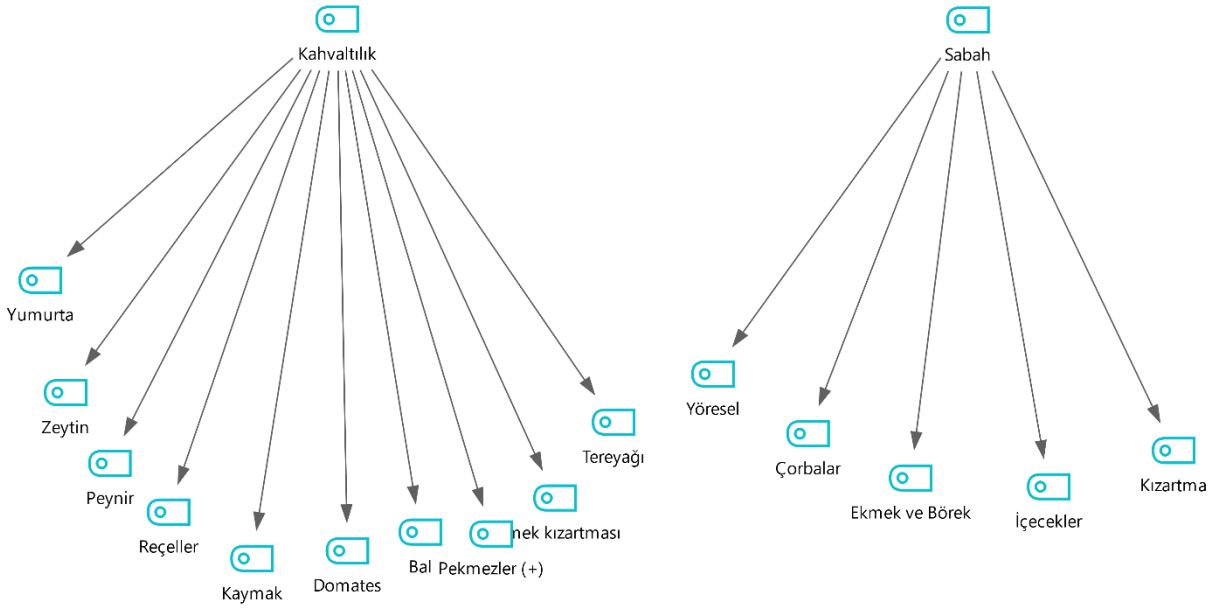
Şekil 5'te bulunan eğlence amaçlı etkinlikler temasında dört alt başlık birleşmektedir. Bunlar ; hıdırellez etkinliği, hamsi festivali, nevruz bayramı ve dereiçi festivalidir. Katılımcılardan gelen cevaplara istinaden eğlence amaçlı etkinliklerin geçmiş yıllarda festival düzeyinde yapıldığı ve yılda birkaç kez düzenlendiği belirlenmiştir. Özellikle İkizce ilçesinde önceki yıllarda dereiçi festivalinin bulunduğu ancak günümüzde bu festivalin yapılmadığı anlaşılmıştır. Aynı zamanda ilçede hıdırellez etkinliğinin kutlanmadığı ancak baharın gelişi adı altında nevruz bayramının ve 7-20 Mayıs tarihlerinde 'mayıs yedisi' kutlanıldığı belirlenmiştir. Bu etkinlikte belirli yerlere stantların kurulduğu, tekstil ürünlerinin normal fiyatlardan daha ucuza satıldığı, uçurtma uçurma gibi etkinliklerin yapıldığı sonucuna varılmıştır. Daha önce yapılan ama artık yapılmayan ilçeye özgü olan festivalin adı ise dereiçi festivali. Yapıldığı dönemlerde bahar aylarında olduğunu ve nevruzdaki gibi etkinliklerin yanı sıra konserlerin de yoğun olduğu bir festival olduğu söylenmektedir.



Şekil 6. Kutsal Günler Kod- Teori

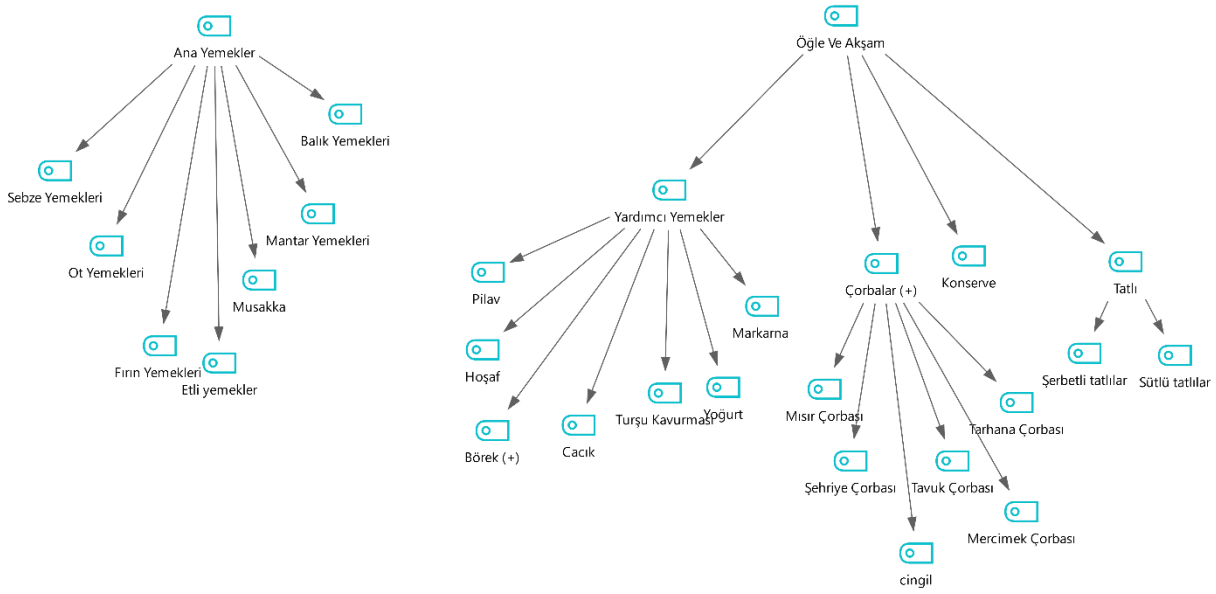
Şekil 6'ya göre kutsal günler temasında beş alt tema bulunmaktadır. Bu temaları kandiller, mevlit okuma, aşure günü, kurban bayramı ve ramazan bayramı oluşturmaktadır. Katılımcılardan elde edilen bilgilere göre kandillere özgü herhangi bir yemek veya sofra hazırlığı yapılmamaktadır. Mevlüt okuma ise farklı sebeplere dayanarak yapılmkatadır. Bunların arasında sünnet sonrası, cenaze sonrası, yeni ev/araba alma sonrası, yeni iş kurma, nişan/düğün, asker uğurlama, yeni doğan çocuk veya hac daveti gibi mevlüt türleri yer almaktadır. İkizce ilçesi bu mevlüt türleri arasında en çok cenaze sonrası mevlütü tercih ettikleri sonucuna varılmıştır. İlçede aşure günü komşular arasında yapılmaktadır. Özellikle aynı

apartmanda oturan komşular birbirlerine aşure yapıp dağıtmaktadır. Genellikle aşurede kullandıkları malzemeler ise; nar taneleri, tarçın, badem, fıstık, kuru siyah üzüm, nohut ve fasulyedir. İlçede kutlanan dini bayramlardan bir tanesi kurban bayramıdır. Katılımcılardan gelen bilgilere göre kurban bayramı için hazırlıklar bayram gününden bir hafta öncesinden başlamaktadır. Kurban pazarlarından en az bir hafta önce giderek kurbanlarını seçmektedirler. Bayram sabahı namazdan sonra dualarla birlikte erkeklerin kurbanı gözlerini bağlayarak kestiklerini ve pay sahiplerine dağıtıldıklarını ifade etmektedirler. Katılımcılardan bazıları kesilen kurbandan pay almayıp ihtiyaç sahiplerine verdiklerini ifade ederken bazıları ise eşit paylara bölünüp dağıtımın kendileri dahil çevrelerine dağıttıklarını ifade etmektedirler. Aynı zamanda bazı katılımcılar kesilen kurban etlerini daha sonra yenilmesi için sakladıklarını söylerken diğer katılımcılar kurban bayramı süresince tükettiklerini söylemektedirler. Ayrıca katılımcılara göre kurban etini genellikle kavurma şeklinde tüketmektedirler. Kurban bayramına özgü hazırlanan başka yemek olmadığını, sadece etin yanında genellikle pilav ve ayran tercih edildiğini ifade etmektedirler. İlçede kutlanan bir diğer dini bayram ise ramazan bayramı. Ramazan bayramında bayram sabahı öncesi yani arefe günü mezar ziyareti yaptıklarını belirtmektedirler. Bayram günü ilçede veya köyde bulunan camide cemaat ile namaz kıldıklarını ardından aile büyüklerini ziyaret ettiklerin söylemektedirler. Ramazan bayramında ziyaret sıralarında ikram edilen yemekler olduğunu ve bunlar arasında en çok tercih edilenin su böreği, baklava, yaprak sarması ve ayran yer almaktadır.



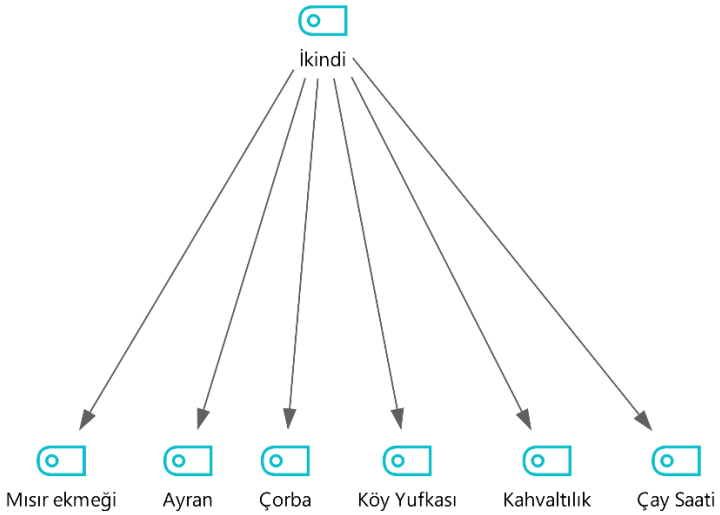
Şekil 7. Sabah Öğünü Hiyerarşik Kod-Alt Modeli

Şekil 7'de sabah öğününe ait alt kodlar bulunmaktadır. Bu kodlar kahvaltılık, yöresel, çorbalar, ekmek ve börek, içecekler ve kızartma şeklindedir. Aynı zamanda bu alt kodlarda da katılımcılardan gelen bilgiler ışığında alt temalar bulunmaktadır. Katılımcılara göre çocukluk dönemlerinde kahvaltıda daha organik beslenirken günümüzde bu ürünlerin yerini hazır gıdaların aldığı yer almaktadır. Kahvaltıda genel olarak tükettikleri ürünler; organik yumurta, zeytin, ev yapımı peynir ve reçel, kaymak, bal, ekmek kızartması, ev yapımı tereyağ ve pekmez tüketilmektedir. Ekmek kızartmasını daha çok kuzinede yapmaktadırlar. Kahvaltıda yöresel yemek de tercih eden katılımcıların en çok tükettikleri turşu kavurmasıdır. Fasulye turşusu, beyaz pancar turşusu, taflan turşusu bunlar arasında yer almaktadır. Özellikle turşularını bol soğanla (bir kiloya 3 adet soğan gibi) kavurduklarını ifade etmektedirler. Kahvaltıda yöresel olarak doğadan da faydalandıklarını ifade eden katılımcıların diken ucu olarak bilinen melocan kavurmasının da hem sabah hem de diğer öğünlerin yanında ek olarak tükettiklerini söylemektedirler. Genel ve yöresel kahvaltılık ürünlerinin yanı sıra zaman veya iş durumlarından kaynaklı ara ara çorba tüketmektedirler. Özellikle yöreye özgü pancar çorbası, mısır çorbası ve süt çorbası tercih edilmektedir. Kara lahana olarak bilinen pancarın haşlandıktan sonra salça, su, mısır taneleri ve kuru fasulye taneleriyle yaptıklarını söylemektedirler. Mısır çorbasının ana malzemesinde barbun, kuru fasulye, soğan ve sıvı yağ kullanmaktadırlar. Karadeniz bölgesinin özel çorbaları arasında yer alan mısır çorbası İkizce ilçesinde de oldukça fazla tüketilmektedir. Bir diğer çorba ise süt çorbası. Bu çorbayı tereyağını erittikten sonra unun azar azar konulup kavrulmasından sonra sütü yavaş yavaş ekleyerek kıvamını alana kadar karıştırarak yaptıklarını söylemektedirler. Kahvaltıda içecek olarak çay veya süt tercih etmektedirler. Sık sık olmasa da hamur işi de tüketen katılımcılarda yufka böreğinin kızgın yağda kızartılması kahvaltılarını şenlendirmektedir.



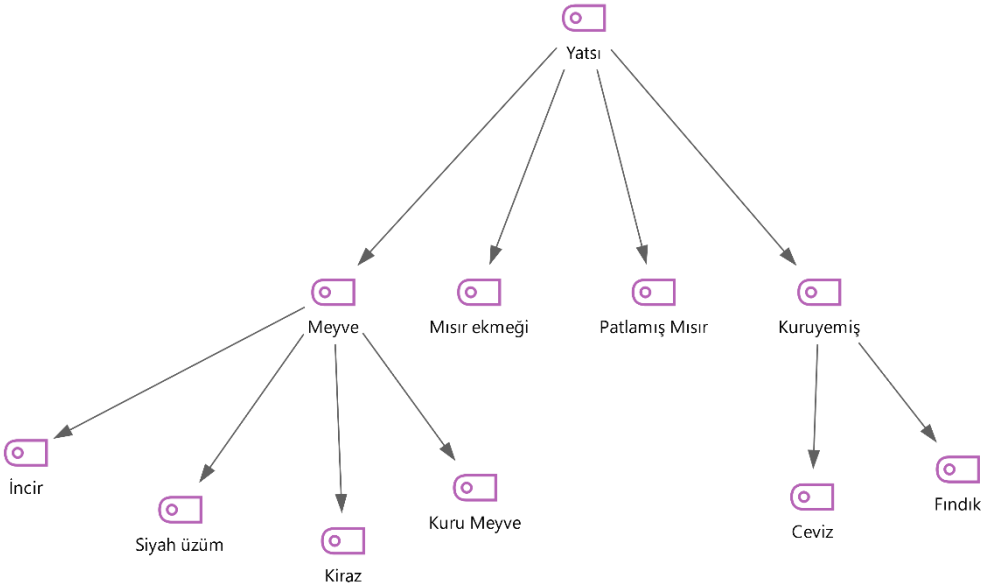
Şekil 8. Öğle ve Akşam Öğünü Hiyerarşik Kod-Alt Modeli

Şekil 8'de öğle ve akşam öğününe ait hiyerarşik kod alt modeli bulunmaktadır. Öğle ve akşam öğü birlikte analiz edilmiştir. Bunun sebebi katılımcılarının çoğunun öğle yemek kültürü olmadığından kaynaklanmaktadır. Modele göre öğün beş alt temadan oluşmaktadır. Ana yemekler, yardımcı yemekler, bakliyat, çorbalar ve tatlı şeklindedir. Genellikle öğlen vakti çalıştıkları için düzenli bir öğün olarak geçiremeyen katılımcılar akşam öğünü için hemen hemen aynı saatler aralığında ve her gün düzenli bir şekilde olduğunu ifade etmektedirler. Ana yemek olarak sebze, ot, et türleri ve fırın yemekleri yapılmaktadır. Sebze yemeklerinin arasında yöresel yemekler bulunmaktadır. Bunlar arasında melocan kavurması, pancar oturması (pancarın haşlanarak suyunu çekene kadar salçalı suda kaynatılması) ve fasulye turşusu kavurması yer almaktadır. Sebze yemeklerine ek olarak zeytinyağlı taze fasulye yemeği, kapçuk fasulye yemeği (kurutulnuş fasulyenin en az 2 saat haşlandıktan sonra üzerine soğan doğranarak ve bir avuç tane fasulyenin konarak pişirilmesiyle ortaya çıkan yemek) söylenebilmektedir. Et yemekleri olarak daha çok musakka tercih edildiği, etli biber dolması ve etli pilav yapılmaktadır. Balık yemeklerinde tercih ettikleri ise hamsili pilav, balık kızartması, fırında buğulatma şeklindedir. Bu yemeklerin yanında yardımcı yemek olarak pilav, makarna, yoğurt, cacık, börek ve hoşaf bulunmaktadır. Çorba olarak tercih edilenler; mısır, cingil (mantarların erişte gibi haşlanması ve salçalı suda kayanakay kadar karışıtırlmasıyla yapılan çorba) , süt, pancar ve şehriye çorbasıdır. Tatlı olarak stülü ve şerbetli olmak üzere iki şekilde tüketim yapmaktadırlar. Sütlü tatlılarda daha çok muhallebi ve sütlaç tercih edilirken şerbetli tatlılarda baklava ve şekerpare en çok tercih edilenler arasındadır.



Şekil 9. İkindi Öğünü Hiyerarşik Kod-Alt Modeli

Yapılan analiz sonucuna şekil 9'da ikindi öğünün hiyerarşik kod modeli bulunmaktadır. Katılıcımlardan elde edilen bulgulara göre ikindi öğün kültürü bulunmamaktadır. Ancak çalışma aralarında mola verdiklerinde isteyenlerin mısır ekmeği, çorba, köy yufkası veya zeytin, peynir gibi kahvaltılık ürünlerin yenildiği yanında çay veya ayranın tüketildiği belirtilmiştir.



Şekil 10. İkindi Öğünü Hiyerarşik Kod-Alt Modeli

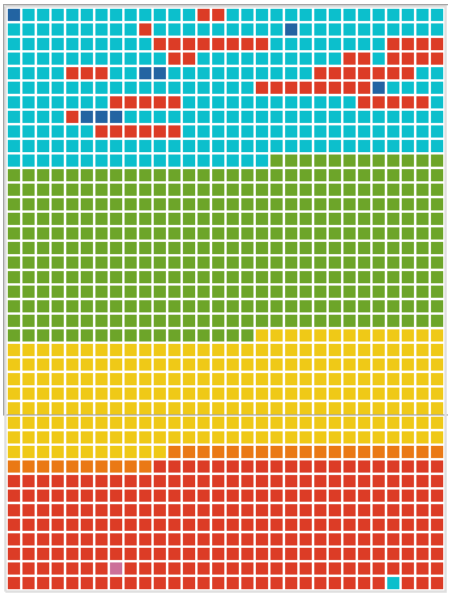
Şekil 10'da ikindi öğün için yapılan hiyerarşik kod analizi bulunmaktadır. Katılmcılarının cevaplarına göre yatsı öğün kültürü bulunmamaktadır. Nadir olmakla birlikte tüketilen bazı yiyecekler vardır. Bu ürünleri meyve, mısır ekmeği, patlamış mısır ve kuruyemiş

oluşturmaktadır. Meyve temasında meysim meyveleri ve kurutulmuş meyveler yer almaktadır. Kuruyemiş meyveleri arasında katılımcıların daha çok ceviz ve fındık tercih ettiği saptanmıştır.



Şekil 11. Kelime Bulutu

Şekil 11'de görülen kelime bulutunda büyük yazıda ve daha koyu renkte olan kelimeler en çok tekrarlananlardır. En çoktan en aza kullanılan kelimelerin boyutu ve rengi azalmaktadır. İlk bakıldığında yiyecek, etkinlik ve içecekler kelimeleri dikkat çekmektedir. Kelime bulutunda elde edilen kelimelerin sözcük frekansı toplamda 3768 kelime olarak MAXQDA programı aracılığıyla belirlenmiştir. Bu frekanslar içerisinde en çok tekrarlanan kelimenin frekansı %15,26 oranında ve 238 frekans ile "yiyecek" kelimesi olduğu tespit edilmiştir. İlk 10 kelimeye bakacak olursak 180 frekans ile "içecek", 156 frekans ile "etkinlik", 72 frekans ile "yemek", 70 frekans ile "ritüel", 111 frekans ile "sofra", 52 frekans ile "mevsimsel", 50 frekans ile "kurban", 45 frekans ile "cenaze", 33 frekans ile "bayram" ve 34 frekans ile "aşure" kelimesinin olduğu sonucuna varılmıştır.



Şekil 12. Belge Portresi

Şekil 12'de analizi yapılan çalışmanın belge portresi görünmektedir. Portrede farklı renklerde bulunan alanlar farklı kodlar oluşturmaktadır. Mavi renk öğünleri, yeşil renk gelenek ve görenekleri, sarı rengi kutsal günleri, lacivert demografik bilgileri, turuncu eğlence amaçlı etkinlikleri, hardal araç ve gereçleri ve son olarak kırmızı renk sofra adabı oluşturmaktadır. Analiz sonucuna göre bakıldığında portrede en çok alana sahip olan gelenek ve göreneklerdir. Ardından öğünler ve sofra adabı gelmektedir.

SONUÇ ve ÖNERİ

Araştırmadan elde edilen veriler doğrultusunda İkizce ilçesinde sıklıkla tüketilen yiyecekler belirlenmiştir. Araştırmada öğle ve akşam yemeklerinin genellikle benzer ürünler olarak tüketildiği, öğlen yemekleri iş dönemine geldiğinde nadiren öğün olarak tüketildiği katılımcılar tarafından belirtilmiştir. İş döneminde bu öğünü genellikle atıştırmalık tarzındaki yiyecekler ile geçiştirildiği belirlenmiştir. Araştırma kapsamında bu sebeplerden dolayı öğle ve akşam yemekleri birlikte değerlendirilmiştir. Katılımcıların vermis oldukları yanıtlar doğrultusunda öğünlere göre bakacak olursak;

- Sabah öğününde yöresel olarak genellikle mısır çorbası, yörede yetişen otlardan kavurmalar (melocan kavurması gibi) , turşu kavurması,
- Öğle ve akşam öğünlerinde; bölgede yetiştirilen otlardan kavurmalar, mısır ekmeği, keşkek, et yemekleri, mevsimine göre sebze yemekleri ve yine mevsimine göre balık çeşitlerinin gibi ürünlerin,
- İkindi öğününde; sıklıkla çay saati gibi ev yapımı pasta, kek, börek ve çörek gibi unlu mamulleri, meyveler, ayran, siyah çay veya ıhlamur çayının gibi ürünlerin,

- Yatsı öğününde; Siyah veya ıhlamur çayı yanında kuruyemişlerden kestane, ceviz ve fındık, mevsimine göre meyveler ve patlamış mısırların yer aldığı ve tüketildiği sonucuna varılmıştır.

Sofra adabı ile ilgili veriler incelendikten sonra, yöre halkının genellikle sofralarında hanenin en büyüğü (dede veya baba) sofraya oturmadan yemek tüketiminin gerçekleştirilmediği, anne, mevcut ailenin en büyük kızının ya da gelinin sofra hazırladığının ve servisini yaptığının sonucuna varılmıştır. Sofra sohbetlerinde genellikle gün içerisindeki işlerden, hoş sohbetlerin olduğu katılımcıların cevapları dikkate alınarak tespit edilmiştir. Genellikle yemeklerin tüketildiği alanın yer sofrası olduğu, günümüzde özellikle şehir merkezine doğru gidildikçe sofraların genellikle masalara kurulduğu görülmektedir.

Kutsal günlerde yöre halkının dini ritüelleri yerine getirmek için camiye gidildiği, kurban bayramında özellikle kurban kesimi sonrasında pay edilirken haneye az payın bırakıldığı ve ihtiyaç sahiplerine daha çok dağıtımının yapıldığı görülmektedir. Bayramlarda özellikle keşkek, ev yapımı baklava, Perşembe cevizli helvası, yahni ve sarmanın yapıldığı sonucuna varılmıştır. Mevlid davetleri cenazelerde, nişan daveti, sünnet daveti, asker uğurlama daveti, hac daveti ve yeni ev alınmasından sonra evin önünde bulunan harman (avlusu) denilen bölümde veya evlerde yapıldığı görülmektedir. Mevlit okutma sonrasında misafirlere yöresel yemeklerden keşkek, pilav ve sarmanın verildiği sonucuna varılmıştır.

Gelenek ve göreneklere bakıldığında, yer sofrasında siniler ve kaplar ile yemeklerin sunulduğu görülmektedir. Misafir ağırlamaya gösterilen önemin oldukça yüksek olduğu sonucuna varılmıştır. İlçede yaşayan halkın imece usulü yapılan işlere önem gösterdiği, durumu iyi olanların ise işçi çalıştırarak bahçe işleri, ürünlerin ayıklanması v.b gibi işleri yaptırmaktadır.

İlçede eğlence amaçlı yapılan etkinliklerin içinde en önemli etkinliklerin "Mayıs Yedisi" olduğu katılımcılar tarafından belirtilmiştir. Mayıs Yedisi'nde eskilerde katılımcılar bu etkinliğe katılmak için bulundukları köylerden merkeze yürüyerek, coşkuyla katıldığını ve günümüzde de aynı coşkunun yer aldığı söylemek mümkündür. Yöreye ait bu tarz etkinliklerin arttırılması yöresel lezzetlerin bir diğer nesile aktarılmasında faydalı olacağı düşünülmektedir.

Yöresel lezzetler tercihinin arttırılması adına medya unsurları kullanılabilir. Medya üzerinden birçok reklam ve tanıtım faaliyetleri gerçekleştirilmesi istenilen düzeyin daha fazla bir kitleye hitap edebileceği söylenebilir. Yöresel yemekler için markalaşmaya gidilebilir. Markalaşma süreçleri için mevcut yatırımlar arttırılıp, İkizce ilçesine ait yöresel ürünlerine taleplerin arttırılması sağlanabilir. Bölgede bulunan yiyecek ve içecek işletmelerinin yavaş şehir akımı hakkında bilgilendirilmesi ve mevcut bilgilerin geliştirilerek benimsenme oranının

arttırılmasına yönelik faaliyetlerde bulunulabilir. Yörede geçmişte yapılan etkinliklerin Örneğin; "Dereiçi Festival," gibi etkinliklerin güncellenerek yeni nesillere aktarılması sağlanabilir. Yöresel yiyecek ve içeceklerin içerisinde barındığı gastronomi kapsamındaki etkinlikler arttırılabilir. Yöreye özgü gastronomik temalar belirlenerek gastronomi alanında yarışmalar düzenlenebilir. Bu etkinliklerde yöresel kıyafetli personeller, yöreye özgü kullanılan araç ve gereçlerin kullanımı bölgenin tanıtımında misafirlerin ilgisini çekerek fark yaratabilir.

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SIVI SOLUCAN GÜBRESİNİN ÜÇ FARKLI DOZUNUN SAFRAN (*Crocus Sativus L.*) ÇİÇEK KISIMLARINA ETKİSİ

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ÖZET

Ticari olarak çok önemli bir yere sahip olan safran(*Crocus sativus* L.), sınırlı üretiminin olması, mahsulün mekanik ekipman olmadan insan gücüyle toplanması, yılda bir kez ve kısa bir süre hasat edilebilmesi gibi nedenlerle yüksek maliyetli bir baharat olarak sınıflandırılmaktadır. Mahsulün genel karlılığını arttırmak için yan ürünlerin potansiyelini ortaya koymak oldukça önemlidir. Bu çalışmanın amacı; stigma ile beraber, stamen ve petal gibi kısımları, içerik ve aktivite açısından değerlendirerek kullanılabilirliğini göstermek olarak belirlenmistir. Bu çalışmada Ağustos ayında rasgele belirlenen parsellere faktöriyel deneme desenine göre küçük boy(4-5 cm) safran kormları ekilmiştir. Çalışmada biri ekim zamanı diğeri ise çiçek açma zamanı olmak üzere iki farklı zamanda 0,5 L/da,1L/da ve 1,5 L/da dozlarında sıvı solucan gübresi verilmiş ve gübrenin çiçek kısımlarına etkisi araştırılmıştır. Antioksidan ifadeler spektrofotometrik olarak belirlenmiştir. DPPH serbest radikali süpürme aktivitesi, stigmada, 1,5 L/da uygulama dozunda, IC_{50}: 798,41µg/ml olarak hesaplanmış ve diğer gruplara göre istatistiksel anlamda fark yaratmıştır ($p<0,005$). Ayrıca yükselen dozda gübre uygulamalarına paralel olarak stamen, stigma ve petaldeki, DPPH serbest radikali süpürme aktiviteleri artış göstermiştir. Flavanoid açısından değerlendirilen çiçek kısımlarından en çok etkilenen petal olup, 0,32 mg KE/g ekstrakt ile 1,5 L/da uygulamasında önemli bir yükseliş göstermiştir. Total fenol içeriği için 1,5 L/da denemesinde stamen, stigma ve petal değerleri sırasıyla;53,13, 56,33 ve 53,80 mg GAE /g ekstrakt olarak artış göstermiştir. Kontrol grubunda stamen-petal ve stamen- stigma arasında oluşan istatistiksel olarak anlamlı fark 1,5 L/da uygulamasında kapanmış ve stamen ve petaller stigma değerlerine ulaşmıştır($p<0,005$). Bu da stigma gibi stamen ve petallerin antioksidan açısından değerlendirilebileceği sonucuna ulaşmamıza olanak sağlamıştır. Safran çiçek kısımları yaş ve kuru ağırlık açısından sadece stigmadaki kuru ağırlıkta, kontrol grubu 0,007 g dan 1,5 L/da' da 0,01 g 'a yükselmiş ve bu artış istatistiksel olarak anlamlı bulunmuştur ($p<0,005$). Dozlar dikkate alındığında kontrol grubu kuru ağırlıklarda petal- stamen ve petal stigma kuru ağırlıkları arasındaki fark azalmış ve 1,5 L/da dozunda her üç çiçek kısmı içinde 0,01 g'a yükselmiştir. Çalışma, arzu edilen boyutta verim artışını ve yan ürünlerin kullanılabilirliğini göstermek için hem doğaya zarar vermeden hem de sürdürülebilirlik açısından uygun bir protokol açıklamaktadır. Safran verimine etki edecek etmenler yalnızca stigma için çiçek üretimi değil diğer kısımlarından da faydalanılabilmesi için umut vaat etmektedir.

Anahtar Kelimeler: Safran, Solucan Gübresi, Antioksidan

EFFECT OF THREE DIFFERENT DOSES OF LIQUID VERMICOMPOST ON SAFFRON (*Crocus Sativus L.*) FLOWER PARTS

ABSTRACT

Saffron (*Crocus sativus* L.), which has a very important commercial place, is classified as a high-cost spice due to its limited production, manpower harvesting without mechanical equipment, and its ability to be harvested once a year and for a short time. It is very important to reveal the potential of by-products in order to increase the overall profitability of the crop. The aim of this study; It has been determined to show the usability by evaluating parts such as stamen and petal, together with the stigma, in terms of content and activity. In this study, small size (4-5 cm) saffron corms were planted in randomly determined plots in August according to the factorial trial design. In the study, liquid vermicompost was given at doses of 0.5 L/da,1L/da and 1.5 L/da at two different times, one at planting time and the other at flowering time, and the effect of fertilizer on flower parts was investigated. Antioxidant expressions were determined spectrophotometrically. DPPH free radical scavenging activity was calculated as IC 50: 798.41µg/ml in stigma, at an administration dose of 1.5/da, and made a statistical difference compared to other groups($p<0.005$). In addition, in parallel with the increasing dose of fertilizer applications, DPPH free radical scavenging activities(FRAP) in the stamens, stigma, and petals have increased. It is the most affected petal from the flower parts evaluated in terms of total flavonoid contents(TFC), and it showed a significant increase in the application of 0.32mg CAE/g extract to 1.5 L/da($p<0,005$). For total phenolic content (TPC), stamen, stigma, and petal values increased as 53.13, 56.33, and 53.80 mg GAE /g extract, respectively, in the 1.5 L/da trial. The statistically significant difference between the stamen-petal and stamen-stigma in the control group was closed at 1.5 L/da and the stamens and petals reached their stigma values. This enabled us to conclude that stamens and petals such as stigma can be evaluated in terms of antioxidants. In terms of the fresh and dry weight of saffron flower parts, only the dry weight of the stigma increased from 0.007 g to 0.01 g at 1.5 L/da in the control group, and this increase was found to be statistically significant ($p<0.005$). Considering the doses, the difference between the dry weights of the petal-stamen and petal stigma in the control group decreased and increased to 0.01 g in all three flower parts at a dose of 1.5 L/da. The study describes a protocol that is both environmentally friendly and sustainable to demonstrate the desired size increase in yield and the availability of by-products. Factors that will affect saffron yield are promising not only for flower production for stigma but also for benefiting from other parts.

Keywords: Saffron, Vermicompost, Antioxidant

GİRİŞ

Crocus sativus L., Iridaceae familyasından, safran adı ile bilinen ekonomik değeri yüksek bir baharat ve değerli bir bitkidir. Tıbbi özellikleri sayesinde antik çağlardan, modern zamana kadar çok çeşitli alanlarda kullanılmaktadır. Günümüz tıbbında mucizevi şifa kaynağı olarak nitelendirilen safran çiçeği, bir çok hastalığa karşı ümit vaat etmektedir (Özel ve Erden, 2005; Abdullaev ve ark., 2003; Chryssanthi ve ark., 2011; Hoshyar ve ark., 2013; Jabbarpoor Bonyadi, 2014). Sağlık sektöründen başka, renklendirme kapasitesi ve güçlü aroması sayesinde gıda ve boya sanayisinin önemli bir hammaddesidir.

Kullanım alanları itibariyle dünyada safrana olan talep oldukça yüksektir. Safran, tropikal ve subtropikal iklim bölgelerinde yayılış göstermekle beraber daha çok İtalya, İspanya, Yunanistan, Fas, Mısır, İran gibi ülkelerde yetiştirilmektedir (Kafi ve ark., 2006; Ahmad ve ark., 2014). Türkiye'de ise tarımı; Karabük ve Gaziantep şehirleri başta olmak üzere, çok dar bir alanda yapılmaktadır ve soyu yok olma tehlikesi ile karşı karşıya olduğu değerlendirilmektedir.

Safran; triploid (2n=3x=24) bir bitkidir. Bu nedenle genetik açıdan kısırdır, tohum oluşturamaz ve korm aracılığı ile vejetatif olarak çoğaltılmaktadır (Parray ve ark., 2012; Ahmad ve ark.,2014). Çok yıllık otsu yapıya sahip bu bitki, üç parçalı stigma, üç adet stamen bulunduran, eflatun-mor renkli çiçeğe sahiptir (Çavuşoğlu ve Erkel, 2005). Gövdesi toprak altındaki kormun metamorfoz olmuş şeklidir. Yaprakları dar yapılı ve 15-30 cm boylarındadır. Yarı gölge aydınlık yerleri ve ılıman iklimleri daha çok tercih eder. Drenajı iyi, verimli, kumlu, organik maddece zengin toprakları tercih etmektedir (Ünaldı, 2007; Yıldırım ve ark. 2016).

Tarımsal üretimin alanlarının arttırılmasının zorlaşması, nüfusun hızla çoğalması, insan ihtiyaçlarının çeşitlenmesi gibi sebepler ile birim alandan daha fazla ve kaliteli ürün elde edilmesini sağlayacak araştırmaların hızlanması önem arz etmektedir. Günümüzde tarımın geldiği noktada, üretimin iyileştirilmesi ve ürün niteliklerinin yükseltilmesi için; işleme ve sulama gibi gereksinimlerin yanında toprağa ilave edilen bileşiklere, yani gübrelere ihtiyaç duyulmaktadır. Uygulanacak gübrenin doğru zamanda, doğru miktarda ve doğru şekilde, çevreye zarar vermeden uygulanması dikkat edilmesi gereken bir noktadır.

Sıvı solucan gübresi, katı solucan gübresinden türetilen bir üründür. İçeriğinde, bitki büyümesi için gerekli organik maddeler, makro ve mikro elementler, enzimler ve yararlı mikroorganizmalar içermektedir. Solucan gübresinin hasat edilen ürünlerde verim artışına ek olarak, biyoaktif bileşenleri arttırdığı bir çok çalışma bulunmaktadır (Yıldırım ve ark.,2017; Sağlam ve ark.,2015;Uçar ve ark.,2020;Şener ve Ulukapı,2018).

İnsan beslenmesinde yer alan fenolik bileşikler, bitkilerde bol miktarda bulunan sekonder metabolitlerdir (Bacanlı ve ark., 2015). Sekonder metabolitler; bitkilerin biyotik veya abiyotik streslere karşı korunmasında rol oynamakla kalmayıp; çiçeklenme, meyve tutumu uyarmakta ve çok yıllık büyümeyi sağlamaktadır (Pagare ve ark., 2015; Teoh, 2015; Öztürk ve Tarakçıoğlu,2022). Dolayısıyla fenolik bileşikler üzerinde arttırıcı aktivite bulmak hem tarımsal açıdan hem ekonomik açıdan çok büyük bir katkıdır.

Safran, sınırlı üretiminin olması, kısır olması, hasadın mekanik ekipman olmadan insan gücüyle ve yılda bir kez yapılması, bitki başına ürünün küçük olması gibi nedenler ile yüksek maliyetli bir üründür (Sharifi ve ark., 2010). Bu ürünün maliyetini düşürücü, verimini arttırıcı etmenler yakalamak, tarımının sürdürülebilirliği için olmazsa olmaz bir gerekliliktir.

Çalışmamızdaki amacımız; stigma ile beraber stamen ve petal gibi kısımları içerik ve antioksidan aktivite açısından değerlendirmek, uygulanan gübre dozlarının bu kısımlara etkilerini araştırmak ve kullanılabilirliğini göstermektir.

MATERYAL ve METOT

Denemede tarla ekim düzeni; tüm parsellerde sıra aralığı 20 cm, sıra üzerleri 10 cm ve derinliği 10 cm olarak düzenlenmiştir. Kullanılacak safran (*Crocus sativus* L.), Geçit Kuşağı Tarımsal Araştırma Enstitüsü tarafından temin edilen ve 2014 yılında tescillenen Karaaslan yerel çeşididir. Kormlar orta boy, 4-6 g ağırlığında ve 6-7 cm çapındadır.

Çalışmada, kontrol ve üç farklı düzeyde (0,5 L/da,1L/da ve 1,5 L/da) gübre uygulanmıştır. Bu gübreler biri ekim zamanı diğeri ise çiçeklenme zamanı olmak üzere toplamda iki kez uygulanmıştır.

Çiçekler taç yaprakların henüz açmadığı sabah saatlerinde el ile toplanmış, karanlıkta açması beklenmiş ve çiçek kısımları birbirlerinden ayrılmıştır. Antioksidan aktivite deneyleri için ayrılan çiçek kısımları 60^0C'de 30-35 dakika kurutulmuştur.

Verimsel Parametreler

Hasat edilen bitki örnekleri tartılıp yaş ağırlıkları alınmıştır. Yaş bitkiler konularak 60 ^{o} C'lik fırında sabit ağırlığa gelinceye kadar kurutulmuş ve daha sonra kuru ağırlıkları alınıp kaydedilmiştir (Tüzüner, 1990).

DPPH Serbest Radikali Giderme Aktivitesi

Sharma ve Bhat(2009) tarafından belirlenen protokole uygun örneklerin, DPPH serbest radikalini yakalama aktiviteleri 517nm' de spektrofotometrik olarak ölçülmüş ve konsantrasyona bağlı inhibisyon yüzdesi (I%=(Ablank-Asample/Ablank)*100) eğrisi

kullanılarak%50 inhibisyon konsantrasyonu (IC_{50}) hesaplanıp, bu değerler standart antioksidanların IC_{50} ile karşılaştırmalı olarak değerlendirilmiştir.

Toplam Flavonoid Madde Miktarı Tayini

Özütlerin toplam flavonoid bileşik miktarları Arvouet-Grand ve ark. (1994) tarafından belirlenen yöntem kullanılarak quercetin'e eşdeğer olarak belirlenmiştir. İçerisinde 1.0 ml metanollü ekstrakt çözeltisi (1.0 mg/ml) bulunan test tüplerine AlCl3 çözeltisi ilave edilip oda sıcaklığında inkübasyona bırakılmıştır. Kör olarak sadece metanol kullanılmıştır. Absorbans ölçümleri 415 nm'de gerçekleştirilmiştir. Ekstraktların toplam flavonoid miktarları standart kuersetin grafiğinden elde edilen eşitlik kullanılarak belirlenmiştir.

Toplam Fenolik Madde Miktarının Belirlenmesi

Total fenollik bileşen miktarı tayini Folin-Ciocalteu yöntemi (Slinkard ve Singleton, 1977; Çağatay ve ark., 2020) ile yapıldı. Ekstrakte edilen örnekler Folin-Ciocalteu reaktifi ile birleştirilmiş ve reaktif aktif bileşenlerle karıştırıldıktan sonra optik yoğunlukları 765 nm de ölçülmüş ve gallik asit eşdeğeri olarak ifade edilmiştir.

İstatistiksel Analiz

Deneme sonunda elde edilen veriler; istatistiksel analizler IBM SPSS Statistics 25 paket programı kullanılarak yapılmıştır. Çalışmada tanımlayıcı istatistikler ortalama ve standart sapma ile verilmiştir. Çalışmada Kolmogorov Smirnov ve Shaphiro Wilk test istatistikleri kullanılarak normallik dağılımı incelenmiştir. Normal dağılım gösteren değişkenler için fark kontrolleri Independent Sample t test ile gerçekleştirilirken, normal dağılım göstermeyenlerde fark kontrolü Kruskal Wallis testi ile gerçekleştirilmiştir. Elde edilen analiz sonuçları 0,05 anlamlılık değeri ile karşılaştırılarak yorumlanmıştır.

BULGULAR VE TARTIŞMA

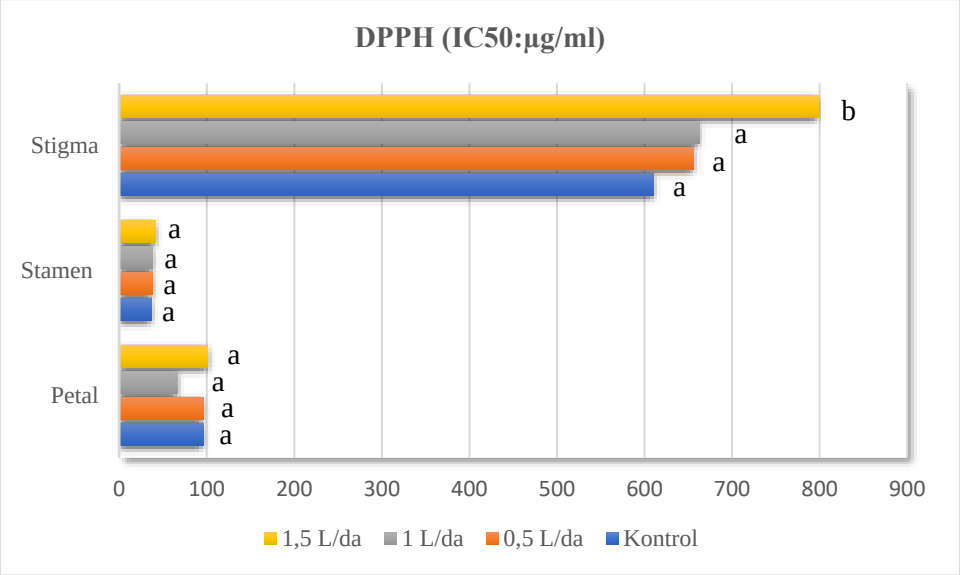
Gübre dozları uygulanan ve uygulanmayan kontrol grubu safran bitkilerinin, çiçek kısımlarından elde edilen ortalama bitki yaş ve kuru ağırlık değerleri Çizelge 1'de verilmiştir. Araştırma sonuçlarına göre uygulanan gübrenin petal ve stamen yaş ve kuru ağırlıklarında herhangi bir değişikliğe neden olmadığı fakat artan gübre değerlerine paralel stigma kuru ağırlığında istatistiki anlamda fark oluşturduğu açıkça gözükmektedir. Safran baharatı verimi açısından değerlendirildiğinde bu farkın ekonomik bir girdi olabileceği düşünülmektedir.

Çizelge 1. Safran çiçek kısımlarının ortalama bitki yaş ve kuru ağırlığı

	Petal yaş(g)	Petal kuru(g)	Stamen yaş(g)	Stamen kuru(g)	Stigma yaş (g)	Stigma kuru (g)
Kontrol	0,037±0,005a	0,006±0,003a	0,031±0,007a	0,006±0,001a	0,043±0,007a	0,008±0,001a
0,5L/da	0,042±0,006a	0,008±,001a	0,032±0,008a	0,006±0,002a	0,041±0,004a	0,007±0,001ab
1 L/da	0,048±0,020a	0,009±0,04a	0,039±0,008a	0,006±0,001a	0,055±0,008a	0,009±,001abc
1,5 L/da	0,040±0,004a	0,006±,008a	0,030±0,008a	0,005±,001a	0,061±,003a	0,011±,001c

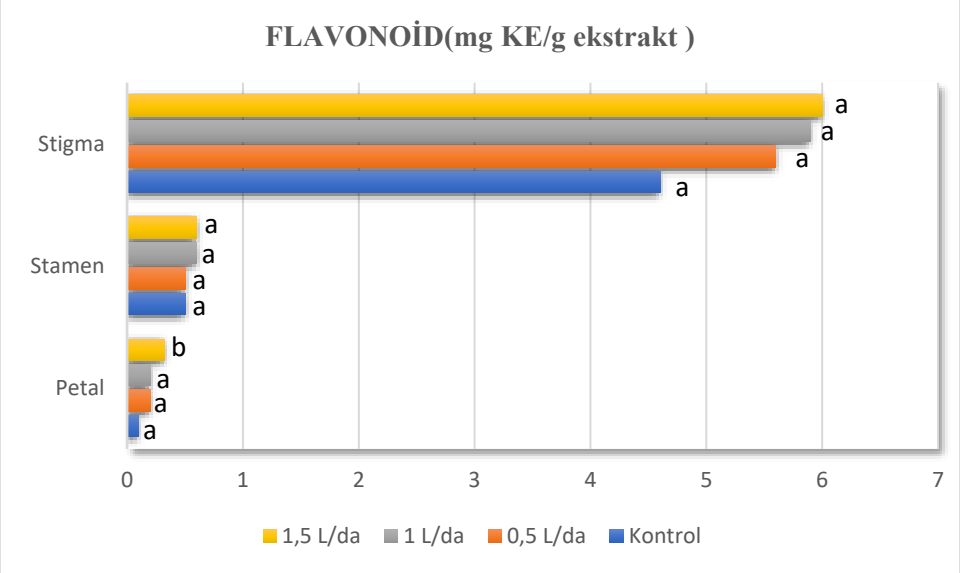
Aynı gruptaki farklı harfler istatistiki açıdan farkı ifade eder($p<0.05$).

DPPH radikali süpürme aktivitesi; farklı bileşiklerin maddelerinin ne derecede antioksidan etkili olduğunu değerlendirmek için yaygın olarak kullanılan hızlı bir yöntemdir. Antioksidanların farklı konsantrasyonlarına karşı hesaplanan DPPH radikalini süpürme aktivitelerinin % inhibisyon değerleri ile çizilen grafiklerden hesaplanmış ve %50 etkin konsantrasyon (EC50) değerleri Şekil 1'de gösterilmiştir. Stigma verileri için, kontrol grubu ile karşılaştırıldığında en yüksek antioksidan süpürücü aktiviteye sahip olan gübre dozunun 1,5 L'lik uygulaması olduğu ve istatistiksel anlamda bir fark yarattığı elde edilmiştir ($p<0,05$). Stamen ve petal açısından bakıldığında gübrenin DPPH radikali süpürme aktivitesine istatistiksel açıdan fark yaratmamakla birlikte sayısal olarak yükselmesi dikkat çekmektedir ($p>0,05$). Daha yüksek gübre dozları uygulandığında aktivitenin yükselebileceği düşünülmektedir.



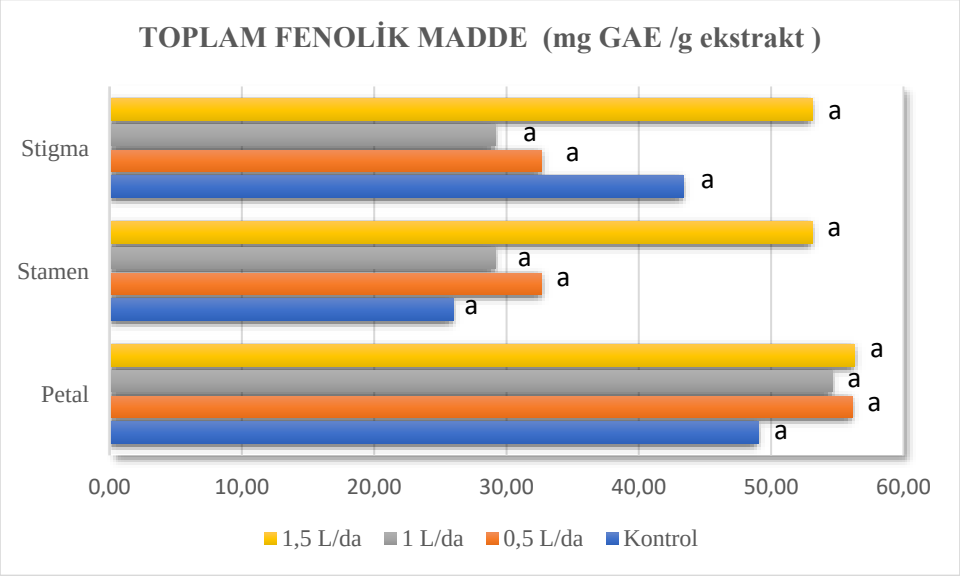
Şekil.1 Çiçek kısımlarındaki DPPH serbest radikali giderme aktivitesi. Aynı gruptaki farklı harfler istatistiki açıdan farkı ifade eder($p<0.05$).

Flavonoidler, tespit edilmiş birçok biyoaktiviteleri sahip olmakla birlikte en çok bahsedilen etkilerinden olan antioksidan özelliktir(Chun ve ark.,2003;Ikizler ve ark.,2007; Hertog ve ark.,1993). Şekil 2'de gösterildiği gibi flavonoid değerleri en yüksek doz olan 1,5 L'lik uygulamasında petalde 0,032 mg KE/g, stamende 0,61 mg KE/g ve stigmada 6,01 mg KE/g bulunmuştur.



Şekil 2. Çiçek kısımlarındaki toplam flavonoid madde miktarı. Aynı gruptaki farklı harfler istatistiki açıdan farkı ifade eder($p<0.05$).

Toplam fenolik madde miktarı uygulanan gübre dozlarına karşı bir artış göstermemiş ve istatistiksel anlamda bir farklılık elde edilememiştir ($p>0,05$). Flavonoid ile fenolik arasındaki fark, ekstraktlardaki diğer pro-oksidan bileşenlerle de ilişkilendirilebilir. Safran örnekleriyle araştırılan çalışmada toplam fenolik madde içerikleri 27,86 mg GAE/g,(Azarabadi,2011),farklı bir çalışmada örneklerinin toplam fenolik ve flavonoid madde miktarları sırasıyla 14,07-34,04 mg GAE/g; 3,16-33,64 mg CAE/g kuru madde olarak bulunduğu bildirilmektedir (Montalvo-Hernández ve ark.,2012). Mevcut çalışmada bulduğumuz değerin daha yüksek olması çözücü, kullanılan safran ve ekstraksiyon gibi parametrelerinin farklı olmasından kaynaklanabileceği düşünülmektedir.



Şekil 3. Çiçek kısımlarındaki toplam fenolik madde miktarı. Aynı gruptaki farklı harfler istatistiki açıdan farkı ifade eder($p<0.05$).

Fenolikler açısından zengin bitki materyalleri, lipitlerin oksidatif bozulmasını geciktirdikleri ve gıdanın kalitesini ve besin değerini iyileştirdikleri için gıda endüstrisinde giderek daha fazla kullanılmaktadır. Safran çiçeğinin kısımlarında yüksek oranlarda toplam fenolik madde içermesi, bu kısımların gıda ve sağlık gibi alanlarda kullanılabilirliğini göstermektedir.

SONUÇLAR ve ÖNERİLER

Literatür taramasında bitki bileşenlerinin kronik hastalık riskini azaltmada tam olarak hangisinin etkili olduğu bilinmemesine sonucuna varılmaktadır. Dolaysıyla net bir sonuç elde edilememesine rağmen antioksidan özellikli bileşiklerin katkı sağladığı bir gerçeği bir birçok çalışmada yer almaktadır. Sağlık üzerine pozitif etkilerinden dolayı, bitki kökenli yeni doğal antioksidanlar daha fazla tercih edilmektedir. Bu nedenle, bu antioksidanların üretimi için doğal

kaynakların etkisinin artırılması, ürün karlılığının yükselmesi, özellikle dışa bağımlı olunan ürünlerin Türkiye'de tarımının teşvik edilmesi ve bu konudaki araştırmaların detaylandırılması büyük önem taşımaktadır.

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YALOVA İLİ KESME ÇİÇEK YETİŞTİRİLEN SERALARDA BİTKİ PARAZİTİ NEMATODLARIN POPULASYON YOĞUNLUĞU VE BULAŞIKLIK ORANLARI

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ÖZET

Bitki parazit nematodlar, süs bitkisi üretiminde pazarlanabilir kesme çiçek kalitesini etkileyen bir tehdit olarak bilinmektedir. Bu araştırma, Yalova ili sera alanlarında kesme çiçeklerde görülen bitki paraziti nematodların populasyon yoğunluklarının ve bulaşıklık oranlarının belirlenmesi amacıyla gerçekleştirilmiştir. Bu amaçla; 6 farklı kesme çiçek türü; gül (*Rosa* spp.), şebboy (*Matthiola* spp.), krizantem (*Chrysanthemum* spp.), hüsnü yusuf (*Dianthus barbatus*), *Lisianthus* (*Eustoma* spp.) ve frezya (*Freesia* spp.) üretimi yapılan seralarda örneklemeler gerçekleştirilmiştir. Çalışma sonucunda Yalova ili kesme çiçek yetiştiriciliği yapılan seralardan alınan topraklarda bitki paraziti nematodlardan 8 cins; *Aphelenchus* (%45.0), *Aphelenchoides* (%40.0), *Meloidogyne* (%20.0), *Rotylenchus* (%20,0), *Pratylenchus* (%15), *Paratylenchus* (%7.5), *Trophurus* (%7.5), *Longidorus* (%2.5) tespit edilmiştir. Kesme çiçek türlerine göre bitki paraziti nematodların bulaşıklık oranları göz önüne alındığında gülde en yaygın tespit edilen nematodun %68.8 bulaşıklık oranı ile *Aphelenchoides* spp.; frezyada %75,0 bulaşıklık oranı ile *Meloidogyne* spp.; şebboyda %72.7 bulaşıklık oranı ile *Aphelenchus* spp.; Hüsnü Yusuf'ta %25.0 bulaşıklık oranı ile *Rotylenchus* spp.; *Lisianthus'*ta %75.0 bulaşıklık oranı ile *Aphelenchus* spp. ve *Aphelenchoides* spp. olduğu belirlenmiştir. Elde edilen nematodlar farklı yoğunluklarda tespit edilmiştir. En yüksek popülasyon yoğunluğu kök ur nematodları (*Meloidogyne* spp.)'nda 567 nematod/100 cm^3 toprak ile *Lisianthus* yetiştirilen topraklarda rastlanılmıştır. İkinci olarak *Pratylenchus* spp. cinsi nematodlar gül üretim topraklarında 450 nematod/100 cm^3 yoğunlukta tespit edilmiş olup, bunu 253 nematod/100 cm^3 *Aphelenchoides* spp., 156 nematod/100 cm^3 ile *Aphelenchus* spp., 140 nematod/100 cm^3 ile *Paratylenchus* spp., 90 nematod/100 cm^3 ile *Rotylenchus* spp., 16 nematod/100 cm^3 ile *Longidorus* spp., 12 nematod/100 cm^3 ile *Trophurus* spp. takip etmiştir.

Anahtar Kelimeler: Bitki Paraziti Nematodlar, Kök-ur Nematodları, Kesme Çiçek, Gül

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INCIDENCE AND POPULATION DENSTY OF PLANT PARASITIC NEMATODES ASSOCIATED WITH CUT FLOWERS IN GREENHOUSES IN YALOVA PROVINCE, TURKIYE

ABSTRACT

Plant parasitic nematodes are known as a threat in ornamental plant production, affecting the quality of marketable cut flowers. This research was carried out to determine the population densities and infestation rate of plant parasitic nematodes in cut flowers in greenhouse in Yalova province. For this purpose, 6 different cut flower species from 40 location including rose (*Rosa* spp.), gillyflower (*Matthiola* spp.), chrysanthemum (*Chrysanthemum* spp.), Hosni yusuf (*Dianthus barbatus*), Lisianthus (*Eustoma* spp.) and freesia (*Freesia* spp.)) were sampled in the greenhouses in 2017. As a result of the study, 8 genera of plant parasitic nematodes in the soils taken from cut flower greenhouses in Yalova province; *Aphelenchus* (45.0%), *Aphelenchoides* (40.0%), *Meloidogyne* (20.0%), *Rotylenchus* (20.0%), *Pratylenchus* (15%), *Paratylenchus* (7.5%), *Trophurus* (7.5%), *Longidorus* (2.5%) were detected. Considering the infestation rates of plant parasitic nematodes according to cut flower species, the most common nematode detected in roses was *Aphelenchoides* sp., with an infestation rate of 68.8%; *Meloidogyne* spp. with 75.0% contamination rate in freesia; *Aphelenchus* spp. with 72.7% infestation rate in gillyflower; *Rotylenchus* spp. with 25.0% contamination rate in Hüsnü Yusuf; Aphelenchus spp. with 75.0% infestation rate in *Lisianthus*. and *Aphelenchoides* spp. has been determined. The obtained nematodes were detected at different densities. The highest population density of root knot nematodes (*Meloidogyne* spp.) was found in soils grown with 567 nematodes/100 cm^3 of soil of *Lisianthus*. Secondly, *Pratylenchus* spp. genus nematodes were detected in rose growing soils at a density of 450 nematodes/100 cm^3, followed by 253, 156, 140, 90, 16, 12 nematodes/100 cm^3 *Aphelenchoides*, *Aphelenchus* spp., *Paratylenchus* spp., *Rotylenchus* spp., *Longidorus* spp., *Trophurus* spp. has followed, respectively.

Keywords: Root-knot nematodes, Plant Parasitic Nematodes, Cut Flower, Rose

GİRİŞ

Süs bitkileri genel olarak kesme çiçekler, saksılı salon bitkileri, dış mekân süs bitkileri ve doğal çiçek soğanları olarak dört farklı gruba ayrılır. Kesme çiçeklerin üretim ve satış oranı diğer gruplara göre oldukça yüksektir (Gürsan ve Erkal, 1998). Kesme çiçekler, çeşitli amaçlarla kullanılan bitkilerdir. İnsanların duygusal ifadelerini yansıtmak için, çevre düzenlemelerinde ve kentsel alanlarda ihtiyaçları karşılamak için sıkça tercih edilirler. Bu taleplerdeki artış, kesme çiçek üretimini önemli bir sektör haline getirmiş ve büyük bir ihracat potansiyeline sahip olmuştur. Bugün ise 50'den fazla ülke ticari olarak kesme çiçek üretimi yapmaktadır (Anonim, 2016). TÜİK 2022 verilerine göre, ülkemizdeki kesme çiçek üretiminin çoğunluğunu (% 69,22) karanfil oluşturmakta iken % 6,98 gül, % 5,90 krizantem, % 4,98 gerbera ve % 2,94 gypsophilla oluşturmaktadır. Yalova ili, Antalya, İzmir ve Isparta'dan sonra kesme çiçek üretiminin en yoğun olduğu 4. il konumunda bulunmaktadır. Yalova'da ise üretimin yaklaşık %47'si gül yetiştiriciliğiyle gerçekleşmektedir (Anonim, 2023).

Kesme çiçeklerde, diğer bitkilerde olduğu gibi zararlılar bulunmaktadır (Hague, 1972). Bitki parazit nematodlar, kesme çiçek üretiminde kaliteyi etkileyen bir tehdit oluşturmaktadır (Arbelaez, 1999; Benson ve Barker, 1985). Nematolar kesme çiçeklerde; solgunluk, yaprak klorozu, sürgün kısalması gibi belirtilerle verimde azalmaya neden olmaktadır (Epstein ve Bravdo, 1973). Enfekte olmuş bitki materyalleri, nematodun yeni alanlara taşınma riskini de beraberinde getirmekte, bu nedenle karantina önlemlerinin önemi artmaktadır. Süs bitkilerinde bitki paraziti nematodlara bağlı kayıp oranının %11.1 olduğu bildirilmiştir (Sasser, 1987).

Ülkemizde önemli bir üretim potansiyeli bulunan ve ihracatı yapılan kesme çiçeklerde problem olan bitki paraziti nematodlar konusunda çalışmalar sınırlı sayıdadır. Bu çalışma ile Yalova İli kesme çiçeklerde yetiştirilen sera alanlarındaki bitki paraziti nematodların yaygınlıkları ve populasyon yoğunluklarının belirlenmesi amaçlanmaktadır.

MATERYAL VE YÖNTEM

Materyal

Çalışma alanı Yalova ilindeki kesme çiçek yetiştiriciliği yapılan seralardır. Çalışmanın ana materyalini ise bu ildeki kesme çiçek yetiştiriciliği yapılan seralardan alınan toprak ve bitki örnekleri ve bu örneklerden elde edilecek olan nematod türleri oluşturmaktadır.

Yöntem

Arazi Çalışmaları

Arazi çalışmaları Yalova ilinde belirlenmiş olan kesme çiçek yetiştirilen seralarda 2017 yılı Haziran-Eylül aylarında gezilerek gerçekleştirilmiştir. Toplamda 102.900 m^2 lik sera

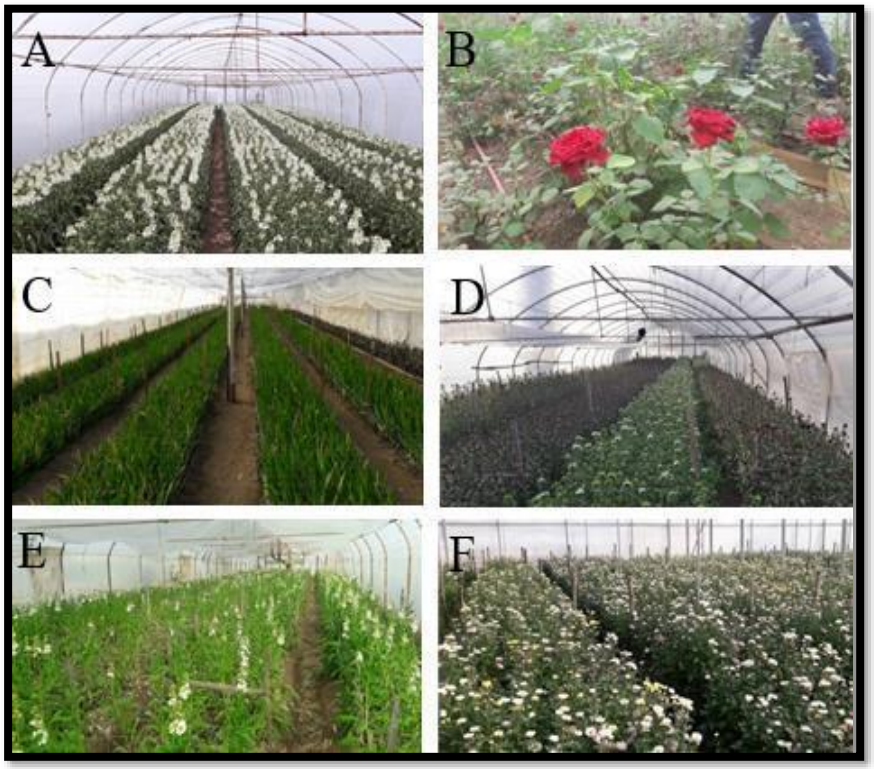
alanında seracılık faaliyetlerinin yoğun olarak yapıldığı Merkez, Çınarcık ve Çiftlikköy ilçelerinde surveyler yapılmış, toplamda 40 survey gerçekleştirilmiştir (Çizelge 1).

Çizelge 1. Yalova ili kesme çiçek yetiştirilen ilçeler, toplam sera alanları ve survey sayıları

İlçeler	Toplam Sera Alanı (m^2)	Survey Sayısı (adet)
Merkez	57.600	23
Çiftlikköy	29.000	11
Çınarcık	16.300	6

Toprak ve Kök Örneklerinin Alınması

Çalışmada örneklemeler kesme çiçeklerden gül, şebboy, frezya, krizantem, lisianthus ve hüsnü yusuf bitkileri yetiştirilen seralarda yapılmıştır (Şekil 1). Arazi çalışmalarında serayı temsil edecek şekilde seranın büyüklüğüne göre her seradan farklı noktalardan 0-45 cm derinliğinden örnekler alınmıştır (Barker ve Nusbaum, 1971). Daha sonra alınan topraklar bir kap içerisinde karıştırılmış ve bu karışımdan 1 kg'lık toprak alınarak örnekleme işlemleri yapılmıştır. Seralarda bulaşık olduğu düşünülen bitkilerden kök örnekleri alınarak etiketlenmiştir. Alınan örnekler araziden laboratuvara getirilinceye kadar +4 ^{o}C'de buz kabında saklanmış ve laboratuvarda yapılan incelemeler süresince de buzdolabında bekletilmiştir.



Şekil 1. Seralarda yetiştirilen kesme çiçekler; A: Şebboy, B: Gül, C: Frezya, D: Hüsnü Yusuf, E: Lisianthus, F: Krizantem

Laboratuvar Çalışmaları

Nematodların Topraktan ve Bitki Köklerinden Ekstraksiyonu

Toprakta bulunan aktif nematodları elde etmek amacıyla Geliştirilmiş Baermann Huni yöntemi kullanılmıştır (Hooper, 1986). 12 cm çapında, 2 cm yüksekliğinde plastik petriler kullanılmıştır. Elek ile petri arasında bir yükseklik sağlamak amacı ile petri kutularının tabanına 0,5 cm yüksekliğinde plastik çubuklar yerleştirilmiştir. Eleklerin yüzeyine bir çift filtre kâğıdı konulduktan sonra, her örnekleme alanından getirilen toprak dikkatlice karıştırılmış ve 100 gr tartılarak filtre kâğıdı üzerine yerleştirilmiştir. Petri kutularının içerisinde elekte bulunan topraklar ıslanıncaya kadar su ilave edilmiştir. 48 saat bekletildikten sonra eleğin altında kalan su 250 ve 500 lük meshlerden geçirildikten sonra 1 ml ye azaltılmış ve sayım kabına alınarak ZEISS marka İnverterd ışık mikroskobunda 20X de sayımları yapılmıştır.

Araziden laboratuvara getirilen bitki kökleri yıkanarak temizlenmiştir. Ardından urlu olan bitki köklerinden, ince uçlu nematod iğnesi yardımıyla yumurta kümeleri toplanarak yumurta kümelerinin açılması sağlanmış ve infektif haldeki 2. dönem *Meloidogyne* larvaları elde edilmiştir.

Nematodların Teşhisi

Ekstraksiyon sonucu topraktan elde edilen bitki paraziti nematodların teşhisi morfolojik karakterleri dikkate alınarak Jepson (1987) ve Siddiqi (2000)'den faydalanılarak cins düzeyinde ayrım yapılmıştır.

BULGULAR ve TARTIŞMA

Çalışma sonucunda Yalova ili kesme çiçek yetiştiriciliği yapılan seralardan alınan topraklarda bitki paraziti nematodlardan 8 cins ; *Aphelenchus* spp., *Aphelenchoides* spp., *Meloidogyne* spp., *Rotylenchus* spp., *Pratylenchus* spp., *Paratylenchus spp., Trophurus, Longidorus* spp. tespit edilmiştir

Yalova İlinin Bitki Paraziti Nematod Bakımından Bulaşıklık Durumu

Yalova İlinde yapılan bu çalışmada gül, lisianthus, şebboy, frezya, hüsnü yusuf ve krizantem çiçeklerinin yetiştirildiği toplam 40 farklı seradan toprak örneklemesi yapılmıştır. Bitki türlerinde göre il genelindeki üretim yoğunluklarına göre yapılan örneklemelerde nematod bulaşıklık oranı % 77,5 olarak tespit edilmiştir.

Örnekleme yapılan kesme çiçek yetiştirilen seralardan alınan örneklemelerde yapılan incelemelerde 31 örneğin bitki paraziti nematodlardan en az bir nematod türüyle bulaşık olduğu belirlenmiştir. Bitki türlerine göre gülde alınan numunelerin % 87,5'inde; şebboyda alınan numunelerin % 72,7'sinde; hüsnü yusufta alınan numunelerin % 25'inde; lisianthusta alınan

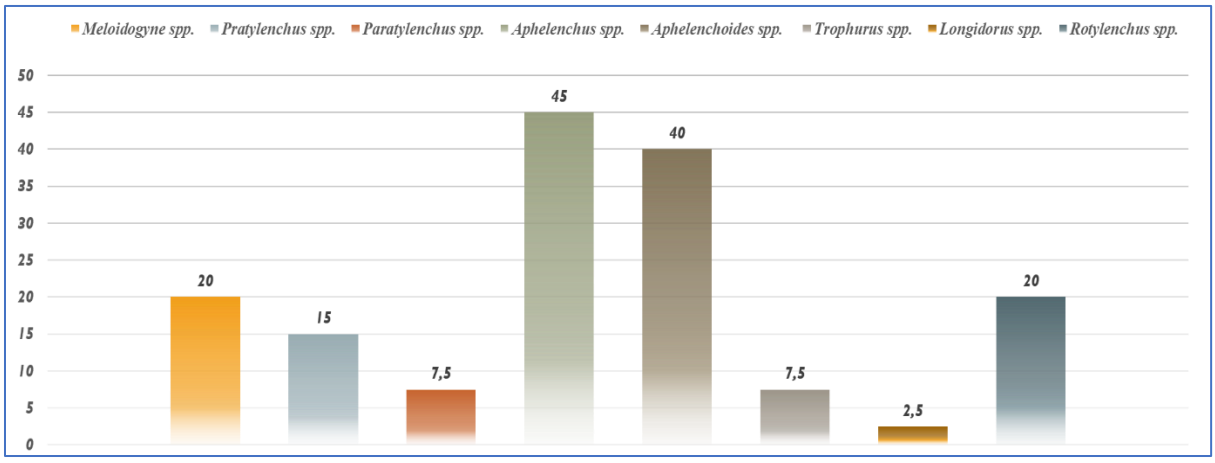
numunelerin % 75'inde; frezya ve krizantemde ise alınan numunelerin % 100'ünde bitki paraziti nematodların varlığı saptanmıştır. Alınan örneklerin % 22,5'lik kısmında ise herhangi bir bitki paraziti nematoduna rastlanmamıştır (Çizelge 2).

Çizelge 2. Alınan Toprak Örneklerinin kesme çiçek türlerinde göre dağılımı ve bulaşıklık durumu

Kesme Çiçek Türü	Latince Adı	Örnek Sayısı	Nematod Tespit Edilen Örnek	Nematod Bulaşıklık Oranı
Gül	*Rosa* sp.	16	14	87,50
Frezya	*Freesia* sp.	4	4	100
Şebboy	*Matthiola* sp.	11	8	72,73
Hüsnü	*Dianthus*	4	1	25,00
Lisianthus	*Eustoma* sp.	4	3	75,00
Krizantem	*Chrysanthemum*	1	1	100
Toplam		**40**	**31**	**77,50**

Kesme Çiçek Yetiştirilen Sera Alanlarındaki Bitki Paraziti Nematodların Yaygınlık ve Populasyon Yoğunlukları Durumu

Çalışmada alınan toprak ve bitki örneklerinden; *Meloidogyne* spp. (%20.0), *Pratylenchus* spp. (%15.0), *Paratylenchus* spp. (% 7.5), *Aphelenchus* spp. (%45.0), *Aphelenchoides* spp. (%40.0), *Trophurus* spp. (% 7.5), *Longidorus* spp. (% 2.5) ve *Rotylenchus* spp. (% 20.0) türü nematodlar tespit edilmiştir (Şekil 2; Çizelge 3).



Şekil 2. Çalışmada tespit edilen nematodların genel yaygınlık durumu (%)

Yapılan bu çalışmada kesme çiçek yetiştirilen seralarda en yaygın tespit edilen nematod % 45.0'lik oranla *Aphelenchus* spp. olurken bunu % 40.0 yaygınlık oranı ile *Aphelenchoides* spp. takip etmiştir (Şekil 2; Çizelge 3).

Çizelge 3. Kesme çiçek türlerine göre bitki paraziti nematodların yaygınlık durumu

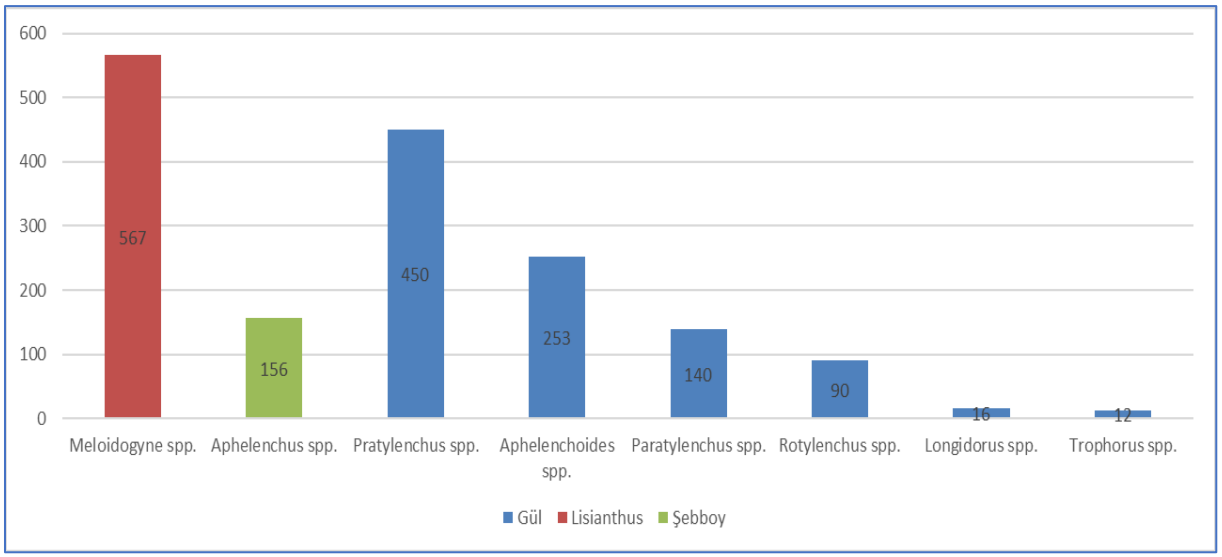
Bitki Çeşidi	*Trophorus*	*Aphelenchus*	*Aphelenchoides*	*Rothylenchus*	*Meloidogyne*	*Paratylenchus*	*Pratylenchus*	*Longidorus*
Gül	3	5	11	5	2	2	5	1
Frezya	0	2	1	0	3	0	0	0
Şebboy	0	8	1	2	1	0	1	0
Hüsnü Yusuf	0	0	0	1	0	0	0	0
Lisianthus	0	3	3	0	1	1	0	0
Krizantem	0	0	0	0	1	0	0	0

Örnekleme yapılan seralarda tespit edilen bitki paraziti nematodların kesme çiçeklere göre yaygınlık ve bulaşıklık oranları incelendiğinde, çalışmada tespit edilen nematod türlerinin her birine gülde rastlanılmış olup gülde en yaygın tespit edilen nematodun % 68,75 bulaşıklık oranı ile *Aphelenchoides* spp. olduğu belirlenmiştir. Frezya yetiştirilen seralardan alınan örneklerde yapılan incelemelerde 3 farklı nematod tespit edilmiş olup en yaygın tespit edilen nematodun % 75 bulaşıklık oranı ile *Meloidogyne* spp. olduğu belirlenmiştir. Şebboy yetiştirilen seralardan alınan örneklerde yapılan incelemelerde 5 farklı nematod tespit edilmiş olup en yaygın tespit edilen nematodun % 72,73 bulaşıklık oranı ile *Aphelenchus* spp. olduğu belirlenmiştir. Hüsnü yusuf yetiştirilen seralardan alınan örneklerde yapılan incelemelerde sadece *Rothylenchus* spp. tespit edilmiş olup bulaşıklık oranının % 25,0 olduğu belirlenmiştir. Lisianthus yetiştirilen seralardan alınan örneklerde yapılan incelemelerde 4 farklı cinsi nematod tespit edilmiş olup en yaygın tespit edilen nematodun % 75,00 bulaşıklık oranı ile *Aphelenchus* spp. ve *Aphelenchoides* spp. olduğu belirlenmiştir. Çalışmada krizantem yetiştirilen tek bir alandan numune alınmış olup *Meloidogyne* spp. tespit edilmiştir (Çizelge 4).

Çizelge 4. Kesme çiçek türüne göre nematod cinslerinin yaygınlık ve bulaşıklık durumu

Kesme Çiçek Türü	En Yaygın Cinsler	Bulaşıklık Oranı (%)
Gül	*Aphelenchoides*	68,75
Frezya	*Meloidogyne*	75
Şebboy	*Aphelenchus*	72,73
Hüsnü Yusuf	*Rotylenchus*	25,00
Lisianthus	*Aphelenchus*	75,00
Krizantem	*Meloidogyne*	100

Çalışmada tespit edilen nematodların 100 cm^3 topraktaki populasyon yoğunlukları ele alındığında; *Meloidogyne* spp.'nin en yüksek populasyon yoğunluğu Lisianthus'ta 567 birey; *Aphelenchoides* spp.'nin en yüksek populasyon yoğunluğu gülde 253 birey; *Aphelenchus* spp.'nin en yüksek populasyon yoğunluğu şebboyda 156 birey; *Pratylenchus* spp.'un en yüksek populasyon yoğunluğu gülde 450 birey; *Rothylenchus* spp.'nin en yüksek populasyon yoğunluğu gülde 90 birey; *Trophurus* spp.'nin en yüksek populasyon yoğunluğu gülde 12 birey; *Paratylenchus* spp.'nin en yüksek populasyon yoğunluğu gülde 140 birey ve *Longidorus* spp.'nin populasyon yoğunluğu ise gülde 16 birey olarak belirlenmiştir (Şekil 3).



Şekil 3. Tespit edilen nematodların 100 cm^3 topraktaki en yüksek populasyon yoğunlukları

Dünya'da yapılan pek çok çalışmada bitki paraziti nematodlar süs bitkilerinde rapor edilmiştir (Mullin, 1965; Coolen ve D'herde, 1970; Brzeski ve ark., 1978; Yamamoto ve Toida,

1995; Petit ve Crozzoli, 1995; Gimenes ve ark., 2009;Sigariova ve Karpliyk, 2015). Deimi ve ark., (2008) İran'da 10 farklı süs bitkisi üzerinde yaptıkları bir çalışmada 21 nematod türü saptamışlardır. Bridge ve Starr, (2007) yayınladıkları *''Plant Nematodes of Agricultural Importance A Colour Handbook*'' isimli kitapta kesme çiçeklerde zarara neden olan nematodları ele almış olup *Ditylenchus, Aphelenchoides, Meloidyogyne, Radopholus, Pratylenchus, Heterodera, Xiphinema, Longidorus, Paratrichodorus, Criconemoides, Belonolaimus* ve *Hoplolaimus* türlerinin önemli zararlara yol açtığı belirtilmiştir. Basterrechea ve Gonzalvez, (2002) tarafından Havana'da yapılan bir çalışmada süs bitkilerinde nematod faunasını tanımlamak için 120 bitki türünü temsil eden 1220 örnek toplanmıştır. Genel olarak 21 cinse ait 49 nematod türü tespit edilmiştir. En sık görülen cinsler ise sırasıyla *Meloidogyne* (% 70), *Helicotylenchus* (% 45.3), *Aphelenchoides* (% 32.7), *Rotylenchulus* (% 31.4) ve *Aphelenchus* (% 28.9) iken, *Meloidogyne incognita* (% 54), *Rotylenchulus reniformis* (% 31.4), *Aphelenchus avenae* (% 25.8) türleri olduğu belirtilmiştir.

Literatür taramaları göz önüne alındığında, ülkemizde kesme çiçek üretim alanlarında bitki paraziti nematodlar konusunda yapılan çalışmalar sınırlı sayıdadır. Karadeniz bölgesinde süs bitkilerinde yürütülen bir çalışmada *Meloidogyne incognita*'nın en yaygın tür olduğu belirtilmektedir (Bora, 1970). İstanbul ve çevresinde süs bitkilerinde yapılan bir çalışmada 31 tür bitki paraziti nematod saptandığı bildirilmiştir (Ercan, 1976). İzmir ve çevresinde yürütülen farklı bir çalışmada ise 19 tür saptanmıştır (Borazancı, 1977). Isparta ilinde yağ gülü yetiştirilen alanlarda yapılan çalışmada ise 22 tür tespit edilmiştir (Akgül ve Ökten, 1996).

SONUÇ ve ÖNERİLER

Çalışmada tespit edilen nematodlar, dünya genelinde kesme çiçekler başta olmak üzere birçok kültür bitkisinde önemli ürün kayıplarına neden olan zararlılardır. Ülkemizde kesme çiçek üretimi yapılan bölgelerde de benzer şekilde verim kayıplarına yol açabileceği düşünülmektedir.

Sonuç olarak, nematodlarla mücadelede uygulanacak metotların belirlenmesi açısından kapsamlı ve güncel çalışmalara ihtiyaç olup kesme çiçek üretim alanlarında nematod türlerinin yaygınlığı, bulaşıklık oranları ve etkileri hakkında daha fazla veri ortaya konulmalıdır.

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FARKLI SINIF KURU VE KONSERVE KÖPEK MAMALARINDA LİNOLEİK, ALFA LİNOLENİK VE EPA+DHA YAĞ ASİTLERİNİN NRC-2006 VE FEDIAF-2021 İLE KARŞILAŞTIRILMASI

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ÖZET

Köpekler için omega-3 ve omega-6 yağ asitleri esansiyel olup ev yapım ve ticari mamalarında mutlaka bu yağ asitleri bulunmalıdır. Eksikliğinde büyüme geriliği, bağışıklık sisteminin baskılanması, kıl dökülmesi, infertilite, epitel dokunun büyümesinin gerilmesi gibi belirtiler ortaya çıkmaktadır. Bu çalışmanın amacı, birinci sınıf (PC) ve ekonomik sınıf (EC) ticari köpek mamalarının yaş ve kuru tiplerinin +21°C stoklama sıcaklığında 12 aya kadar yağ asidi profilindeki değişimlerin belirlenmesiydi. Çalışmada 20 adet PC kuru mama ve 20 adet PC yaş mama ile 20 adet EC kuru mama ve 20 adet EC yaş mama olmak üzere 80 ticari mama kullanıldı. Mamalar satın alındığı anda ve stoklama süresi sonunda yağ asiti profilleri gaz kromatografide saptandı. PC kuru mama, PC yaş mama, EC kuru mama ve EC yaş mamaların toplam yağ asitleri içindeki linoleik asit, alfa-linolenik asit (ALA), eikosa pentaenoik asit (EPA) + dokosa heksaenoik asit (DHA) oranı NRC-2006 ve FEDIAF-2021'e göre yetişkin köpeklerin mamalarında bulunması gereken minimum düzeyin üzerinde olduğu saptandı ($P<0,05$). 12 aylık stoklama sonunda PC kuru mama, PC yaş mama ve EC yaş mamaların linoleik asit, ALA, EPA+DHA yağ asitleri düzeyleri NRC-2006 ve FEDIAF-2021 değerlerinin üzerinde olduğu belirlendi ($P<0,05$). Ancak EC kuru tip mamaların 12 aylık stoklama sonundaki linoleik asit ve EPA+DHA yağ asitleri düzeyinin uluslararası standartlarda bildirilen minimum değerin üzerinde olmasına karşın ALA düzeyinin düşük olduğu saptandı ($P<0,05$). Sonuç olarak hem ekonomik hem de premium sınıf mamaların kuru ve yaş tiplerin satın alındığı andaki yağ asiti profilinin mamada olması gereken değerin üzerinde olduğu görülmüştür. Premium sınıf mamaların kuru ve yaş mamalar ile ekonomik sınıf yaş mamalarda yağ asiti profillerinin içeriklerindeki muhtemel antioksidan maddeler nedeniyle yapılarının değişmediği ve yetişkin köpeklerin esansiyel omega-3 ve omega-6 yağ asitleri ihtiyacını karşılayabileceği ortaya konulmuştur. ALA yağ asitinin stoklanma süresiyle yapısının değiştiği ve yetişkin köpeklerde eksikliğe neden olacağı anlaşılmıştır.

Anahtar kelimeler: Esansiyel yağ asitleri, köpek maması, mama sınıfı, stoklama süresi, yağ asiti

COMPARISON OF LINOLEIC, ALPHA LINOLENIC AND EPA+DHA FATTY ACIDS IN DRIED AND CANNED TYPES OF DIFFERENT CLASS DOG FOOD WITH NRC-2006 AND FEDIAF-2021

ABSTRACT

Omega-3 and omega-6 fatty acids are essential for dogs, and home-made and commercial foods should definitely contain these fatty acids. Its deficiency causes symptoms such as growth retardation, suppression of the immune system, hair loss, infertility, and stretching of epithelial tissue growth. The aim of this study was to the determination of the changes in the fatty acid profile of wet and dry types of premium (PC) and economic class (EC) commercial dog foods at +21°C stocking temperature up to 12 months. In the study, 80 commercial foods were used, including 20 PC dry food and 20 PC wet food, 20 EC dry food and 20 EC wet food. Fatty acid profiles were determined by gas chromatography at the time of purchase and at the end of the storage period. The ratio of linoleic acid, alpha-linolenic acid (ALA), eicosa pentaenoic acid (EPA) + docosa hexaenoic acid (DHA) in total fatty acids of PC dry food, PC wet food, EC dry food and EC wet food NRC-2006 and FEDIAF- According to 2021, it was determined that it was above the minimum level that should be in the food of adult dogs ($P<0.05$). At the end of 12 months of storage, linoleic acid, ALA, EPA+DHA fatty acid levels of PC dry food, PC wet food and EC wet food were found to be above NRC-2006 and FEDIAF-2021 values ($P<0.05$). However, although the linoleic acid and EPA+DHA fatty acids levels of EC dry type foods at the end of 12 months of storage were above the minimum value reported in international standards, the ALA level was found to be low ($P<0.05$). As a result, it has been observed that the fatty acid profile of both economical and premium class foods at the time of purchase of dry and wet types is above the value that should be in the food. It has been revealed that the fatty acid profiles of premium class foods in dry and wet foods and economic class wet foods do not change in structure due to possible antioxidant substances in their content and that they can meet the essential omega-3 and omega-6 fatty acids needs of adult dogs. It has been understood that the structure of ALA fatty acid changes with the storage period and it will cause deficiency in adult dogs.

Keywords: Essential fatty acids, dog food, food grade, storage time, fatty acid

INTRODUCTION

Dietary fats, as well as specific fatty acids, are essential in the diet of dogs and cats, as outlined in the nutritional recommendations for pet food provided by the National Research Council (NRC) and the American Association of Feed Control Officials (AAFCO).

Fats and fatty acids: Provide energy, Aid in fat-soluble vitamin absorption, Modulate inflammation, Act as a precursor for eicosanoids and prostaglandins, Have structural roles as a component of cell membranes, Promote healthy growth and development. It affects skin and hair health. Dogs and cats need omega-6 and omega-3 fatty acids in their diets as they cannot produce these essential fatty acids on their own (NRC, 2006; FEDIAF, 2021). Omega-3 and omega-6 fatty acids are essential for dogs, and home-made and commercial foods should definitely contain these fatty acids. Its deficiency causes symptoms such as growth retardation, suppression of the immune system, hair loss, infertility, and stretching of epithelial tissue growth. The hypothesis of this study is that the fatty acid levels of dry type foods containing different types and ratios of starch sources (cereal types or potato-tapioca flours) and different animal protein sources (fish meal, lamb meal, poultry meal) will differ. The aim of this study was to determine the changes in fatty acid profile of premium class (PC) and economy class (EC) commercial dog foods, wet and dry types, up to 12 months at +21°C storage temperature.

MATERIAL and METHODS

Dry foods in pellet form were ground at the beginning of the study and at the end of 12 months of storage. Wet foods were also dried at the start of the study and after 12 months of storage, and then ground. Dry type foods (PC and EC) were ground to a size exceeding 1.0 mm diameter (IKA Mills, MF 10 basic Microfine grinder, Germany). Wet type formulas (PC and EC) were also dried at 55 °C for 24 hours and 12 hours. At 105 °C, it was then ground to a size exceeding 1.0 mm (IKA, Germany). Fats/oils in ground dog food were extracted using diethyl ether in the extraction unit (SER 148/3 Solvent Extractors, Velp Scientifica, Italy) (AOAC, 1990).

Fats/oils in dog food samples were methylated by a three-step procedure (Wang et al., 2015; Kara 2020). Supernatants (methylated fatty acids in n-hexane) were placed in a 1.5 ml screw-neck ND-9 amber GC-vial with a 9 mm screw cap (silicone white/PTFE caps) and in a gas chromatograph (TRACE 1300, Thermo Scientific, USA) analyzed. Samples were added with automated sampling (Thermo AI 1310, Thermo Scientific, USA). Injection chamber temperature 255°C, column 140°C and a column of fatty acid methyl esters (FAME column) (Length 60 m, Inner Diameter: 0.25 mm, film: 0.25 mm, and maximum temperature 250–260 °C) A flow rate of 30 ml/min was used for the 42 min treatment method. Fatty acid identification

was performed by comparing the peaks in the chromatogram with the retention times relative to the standard. A standard solution of FAME mixture (37 °C) in dichloro-methane (Chem-Lab, CL.40.13093.0001, Zedelgem, Belgium) was used to identify the peaks. Statistical analysis of the data was determined by the chi-square test in the SPSS 17.0 package program. The significance level was taken as P<0.05.

RESULTS

The ratio of linoleic acid, alpha-linolenic acid (ALA), eicosa pentaenoic acid (EPA) + docosa hexaenoic acid (DHA) in total fatty acids of PC dry food, PC wet food, EC dry food and EC wet food NRC-2006 and FEDIAF- According to 2021, it was determined that it was above the minimum level that should be in the food of adult dogs (P<0.05). At the end of 12 months of storage, linoleic acid, ALA, EPA+DHA fatty acid levels of PC dry food, PC wet food and EC wet food were found to be above NRC-2006 and FEDIAF-2021 values (P<0.05). However, although the linoleic acid and EPA+DHA fatty acids levels of EC dry type foods at the end of 12 months of storage were above the minimum value reported in international standards, the ALA level was found to be low (P<0.05).

Table 1. Comparison of the fatty acid levels and NRC (2006) values of dog foods at the beginning of the study

Food fatty acid values and NRC-2006 values at the beginning of the study			
	Premium-class dry dog food	NRC-2006*	P value
Linoleic acid	2,14[a]	0,95[b]	<0,001
ALA	0,256[a]	0,036[b]	<0,001
EPA+DHA	0,220(0,031+0,185)[a]	0,044[b]	<0,001
	Premium-class wet dog food	NRC-2006*	
Linoleic acid	3,08[a]	0,95[b]	<0,001
ALA	0,198[a]	0,036[b]	<0,001
EPA+DHA	0,390(0,158+0,234)[a]	0,044[b]	<0,001
	Economy-class dry dog food	NRC-2006*	
Linoleic acid	2,15[a]	0,95[b]	<0,001
ALA	0,071[a]	0,036[b]	<0,001
EPA+DHA	0,210(0,021+0,193)[a]	0,044[b]	<0,001
	Economy-class wet dog food	NRC-2006*	
Linoleic acid	4,34[a]	0,95[b]	<0,001
ALA	0,353[a]	0,036[b]	<0,001
EPA+DHA	0,470 (0,332+0,133)[a]	0,044[b]	<0,001

Table 2. Comparison of fatty acid levels and FEDIAF (2020) values of dog foods at the beginning of the study

Food fatty acid values and FEDIAF-2021 values at the beginning of the study			
	Premium-class dry dog food	FEDIAF-2021	P value
Linoleic acid	2,14[a]	1,53[b]	<0,001
ALA	0,256[a]	0,08[b]	<0,001
EPA+DHA	0,220(0,031+0,185)[a]	0,05[b]	<0,001
	Premium-class wet dog food	FEDIAF-2021	
Linoleic acid	3,08[a]	1,53[b]	<0,001
ALA	0,198[a]	0,08[b]	<0,001
EPA+DHA	0,390(0,158+0,234)[a]	0,05[b]	<0,001
	Economy-class dry dog food	FEDIAF-2021	
Linoleic acid	2,15[a]	1,53[b]	<0,001
ALA	0,071[b]	0,08[a]	<0,001
EPA+DHA	0,210(0,021+0,193)[a]	0,05[b]	<0,001
	Economy-class wet dog food	FEDIAF-2021	
Linoleic acid	4,34[a]	1,53[b]	<0,001
ALA	0,353[a]	0,08[b]	<0,001
EPA+DHA	0,470 (0,332+0,133)[a]	0,05[b]	<0,001

Table 3. Comparison of fatty acid levels and NRC (2006) values of dog foods at the end of 12 months of storage

Fatty acid level and NRC-2006 values at the end of 12 months of storage			
	Premium-class dry dog food	NRC-2006*	P value
Linoleic acid	2,04[a]	0,95[b]	<0,001
ALA	0,150[a]	0,036[b]	<0,001
EPA+DHA	0,150 (0,02+0,13)[a]	0,044[b]	<0,001
	Premium-class wet dog food	NRC-2006*	P değeri
Linoleic acid	2,88[a]	0,95[b]	<0,001
ALA	0,190[a]	0,036[b]	<0,001
EPA+DHA	0,380 (0,04+0,34)[a]	0,044[b]	<0,001
	Economy-class dry dog food	NRC-2006*	P değeri
Linoleic acid	1,72[a]	0,95[b]	<0,001
ALA	0,050[a]	0,036[b]	<0,001
EPA+DHA	0,160 (0,02+0,14)[a]	0,044[b]	<0,001
	Economy-class wet dog food	NRC-2006*	P değeri
Linoleic acid	4,36[a]	0,95[b]	<0,001
ALA	0,170[a]	0,036[b]	<0,001
EPA+DHA	0,180 (0,05+0,13)[a]	0,044[b]	<0,001

Table 4. Comparison of fatty acid levels and FEDIAF (2021) values of dog foods at the end of 12 months of storage

Fatty acid level at the end of 12 months of storage and FEDIAF-2021 values			
	Premium-class dry dog food	FEDIAF-2021	P value
Linoleic acid	2,04[a]	1,53[b]	<0,001
ALA	0,150[a]	0,08[b]	<0,001
EPA+DHA	0,150 (0,02+0,13)[a]	0,05[b]	<0,001
	Premium-class wet dog food	FEDIAF-2021	
Linoleic acid	2,88[a]	1,53[b]	<0,001
ALA	0,190[a]	0,08[b]	<0,001
EPA+DHA	0,380 (0,04+0,34)[a]	0,05[b]	<0,001
	Economy-class wet dog food	FEDIAF-2021	
Linoleic acid	1,72[a]	1,53[b]	<0,001
ALA	0,050[b]	0,08[a]	<0,001
EPA+DHA	0,160 (0,02+0,14)[a]	0,05[b]	<0,001
	Economy-class wet dog food	FEDIAF-2021	
Linoleic acid	4,36[a]	1,53[b]	<0,001
ALA	0,170[a]	0,08[b]	<0,001
EPA+DHA	0,180 (0,05+0,13)[a]	0,05[b]	<0,001

DISCUSSION and CONCLUSION

Premium class foods also contain nutrients that contain the nutrients needed by the dog far above the minimum level and show functional properties according to international standards. Fatty acid levels that should be found in dog food have been reported in international standards (NRC, 2006; FEDIAF, 2021). As a result, it has been observed that the fatty acid profile of both economical and premium class foods at the time of purchase of dry and wet types is above the value that should be in the food. It has been revealed that the fatty acid profiles of premium class foods in dry and wet foods and economic class wet foods do not change in structure due to possible antioxidant substances in their content and that they can meet the essential omega-3 and omega-6 fatty acids needs of adult dogs. It has been understood that the structure of ALA fatty acid changes with the storage period and it will cause deficiency in adult dogs.

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FARKLI PROTEİN İÇERİKLİ PREMİUM SINIF KÖPEK MAMALARININ MAKRO VE MİKRO MİNERAL DÜZEYLERİNİN KARŞILAŞTIRILMASI

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ÖZET

Karnivordan ziyade omnivor özellik gösteren köpeklerin ticari ekonomik, quality ve premium sınıf mamaları vardır. Premium sınıf mamalar uluslararası standartlara göre köpeğin ihtiyacı olan besin maddelerini minimum düzeyinin çok üstünde içeren ve fonksiyonel özellik gösteren besin maddelerine de sahiptir. Köpeklerin mamalarında bulunması gereken makro ve mikro mineral düzeyleri uluslararası standartlarda bildirilmiştir. Çalışmada kuzu eti/yan ürünü (n=12), kanatlı eti/yan ürünü (n=11) ve balıketi/yan ürünü (n=8) içeren premium sınıf kuru tip ekstrüde köpek mamalarının makro mineral ve mikro mineral düzeylerinin karşılaştırılması amaçlandı. Balık eti içerikli mamalarının kanatlı ve kuzu eti içerikli mamaların kalsiyum (Ca) ve fosfor (P) düzeylerinin düşük, kükürt (S) içeriğinin ise yüksek olduğu saptandı ($P<0,05$). Farklı protein içeriklerine sahip mamaların sodyum (Na) ve magnezyum (Mg) makro minerallerinin benzer düzeyde bulunduğu saptandı ($P>0,05$). En yüksek potasyum (K) düzeyi kanatlı eti içerikli mamalarda saptandı. Mamaların demir (Fe), mangan (Mn), bakır (Cu), alüminyum (Al), bor (B) ve krom (Cr) düzeyleri benzerdi ($P>0,05$). Balık eti içerikli mamaların kadmiyum (Cd) ve çinko (Zn) düzeyi diğer mamalardan yüksekti ($P<0,05$). Kanatlı eti içerikli mamaların kurşun (P) düzeyi ise diğer mamalarınkinden düşük, fakat nikel düzeyi ise diğer mamalarınkinden yüksekti ($P<0,05$). Sonuç olarak, NRC (2006) ve FEDIAF (2021)'e göre farklı tip protein içeriklerine sahip mamaların Ca, P, S, Na ve Mg düzeyleri ile Ca/P oranının yetişkin köpeklerin minimum ihtiyacının üzerinde olduğu, balık eti ve kuzu eti içerikleri mamaların K düzeyinin ise yetişkin köpek mamalarının minimum düzeyinin altında olduğu ortaya konuldu. Bakır düzeyini ise yetişkin köpek mamaları için minimum düzeyi (0,72-0,83 mg/100g) ile toksik sınırı (2,80 mg/100 g) arasında bulunduğu saptandı. Demir minerali ise yetişkin köpek mamaları için minimum (3,6-4,17 mg/100g) ve toksik sınırı (68,2 mg/100 g) arasında bulunduğu ortaya konuldu. Her üç tip köpek mamasının da Mn ve Zn düzeylerinin uluslararası standartlarda belirtilen maksimum sınırın altındaydı. Çalışmada saptanan ağır metaller için uluslararası standartlarda maksimum limit bildirilmediği için karşılaştırma yapılamamış, ancak farklı protein tiplerinin mamaların Cd, Co, Ni ve Pb içeriğinde farklılık oluşturduğu sonucuna varılmıştır.

Anahtar Kelimeler: Ekstrüde, köpek maması, mineral, protein, premium sınıf mama

COMPARISON OF MACRO AND MICRO MINERAL CONTENTS OF PREMIUM CLASS DOG FOODS WITH DIFFERENT PROTEIN CONTENTS

ABSTRACT

There are commercial economic, quality and premium class foods for dogs that show omnivorous characteristics rather than carnivores. Premium class foods also contain nutrients that contain the nutrients needed by the dog far above the minimum level and show functional properties according to international standards. The macro and micro mineral levels in dog food can be found at higher levels than those of international standards. The aim of the study was to compare the macro-mineral and micro-mineral levels of premium class dry type extruded dog foods containing lamb/by-product (n=12), poultry/by-product (n=11) and fish/by-product (n=8). It was determined that the calcium (Ca) and phosphorus (P) levels of the fish-containing foods were low and the sulphur (S) content of the poultry and lamb-containing foods was high ($P<0.05$). Sodium (Na) and magnesium (Mg) macro minerals were found to be at similar levels for dog foods with different protein contents ($P>0.05$). The highest potassium (K) level was found in foods containing poultry meat. Iron (Fe), manganese (Mn), copper (Cu), aluminium (Al), boron (B) and chromium (Cr) contents were similar ($P>0.05$). The cadmium (Cd) and zinc (Zn) levels of the foods containing fish were higher than those of other foods ($P<0.05$). The lead (P) content of the dog foods containing poultry meat was lower than those of the other foods, but the nickel (Ni) level was higher than those of the other foods ($P<0.05$). As a result, according to NRC (2006) and FEDIAF (2021), Ca, P, S, Na and Mg contents and Ca/P ratio of dog foods with different protein types are above the minimum requirement of adult dogs. Therefore, dog foods with fish meat and lamb meat were higher than the minimum requirement of adult dogs. It was revealed that the K content was below the minimum level of adult dog foods. The copper level was found to be between the minimum level (0.72-0.83 mg/100g) and the toxic limit (2.80 mg/100 g) for adult dog foods. Iron mineral was found to be between the minimum (3.6-4.17 mg/100g) and the toxic limit (68.2 mg/100 g) for adult dog foods. The Mn and Zn levels of all three types of dog food were below the maximum limit specified in international standards. Since the maximum limit for the heavy metals detected in the study was not reported in the international standards, a comparison could not be made, but it was concluded that different protein types made a difference in the Cd, Co, Ni and Pb contents of the formulas.

Keywords: Extruded, dog food, mineral, protein, premium grade food

INTRODUCTION

Dog foods contain more carbohydrates and less protein than cat foods (Case et al. 2011). Based on living energy requirements (MER) of 110 kcal/kg$^{0.75}$ and 95 kcal/kg$^{0.75}$, the recommended minimum protein requirements for adult dogs are 18% and 21% in dry matter (DM) respectively (FEDIAF 2021). These levels mean that high-quality protein is more than 16% of dietary energy (approximately 2 g/kg body weight/day). Protein needs of dogs increase during the growth period, late pregnancy and lactation periods and reach 25-30% of the dietary energy (Buffington et al. 2004). According to the National Research Council - NRC (2006), it has been reported that the diets of adult dogs with a density of 4000 kcal ME/kg containing high-quality protein should contain a minimum of 180 g/kg crude protein. Dry type dog foods are preferred more by pet owners due to ease of stocking and ease of presentation to dogs (Daumas et al. 2014). Some terms used on the labels of cat and dog foods can be decisive for the pet owner to purchase the food. These are the so-called generic brands, high-quality (premium, super and ultra-premium) and most commonly economical brands, as well as natural, holistic, organic and grain-free essential nutrition brands (Heinze 2016). In addition, dog owners prefer to store food for the long-term health of their pets in order to meet the optimum requirements of their dogs (Daumas et al. 2014). Apart from these, there are prescription foods that are recommended by veterinarians to provide or support the recovery of dogs and cats after nutritional diseases and operations. There are commercial economic, quality and premium class foods for dogs that show omnivorous characteristics rather than carnivores. Pet foods contain four main food groups: carbohydrates, protein, fat and minerals (Case et al. 2011). Premium dog foods may contain these substances in high quality and quantity. The dry type premium dog food industry generally uses different protein sources (lamb, fish, chicken, etc.) and various carbohydrate sources. In addition, the fat and dietary fiber substances of dog foods are other important components of dog food (Earle et al. 1998; Carciofi et al. 2008). The hypothesis of this study is that the macro and micro mineral levels of dry type foods containing different types and rates of starch source (cereal types or potato-tapioca flours) and different animal protein sources (fish meal, lamb meal, poultry meal) will differ. The aim of the study was to compare the macro-mineral and micro-mineral levels of premium class dry type extruded dog foods containing lamb/by-product (n=12), poultry/by-product (n=11) and fish/by-product (n=8).

MATERIALS and METHODS

The commercial extruded dry-type dog foods in the present study have been produced for (> 18 months of age) large breed adult dogs. The dog foods were premium quality and were purchased from a Distributor Company for dog foods (Istanbul, Turkey). The 31 different brand

dog foods were analysed. It has been reported that the foods were kept in the appropriate warehouse conditions until the sales stage. P, K, Ca, Mg, Na, S, Fe, Mn, Zn, Cu, B, Pb, Cd, Ni contents of dog food samples after wet burning with nitric acid-perchloric acid (Mertens 2005a) ICP-OES was determined by reading in a spectrophotometer (Inductively Coupled Plasma spectrophotometer) (Agilent 5800) (Mertens 2005a;2005b). Analyses were performed in parallel. 31 dog food samples were run in parallel and mean values were given according to the mean of these repetitions. Mineral prevalence in dog foods was determined by SPSS 17.0. Tukey Multiple Comparison Test, which is one of the Multiple Comparison Tests, was used to determine the significance (statistical significance level 0.05).

BULGULAR

Tablo 1. Büyük ırk köpekler için üretilen premium sınıf mamaların makro mineral içerikleri

ppm, DM	**Ca**	**P**	**S**	**K**	**Na**	**Mg**
Fish meat	8759.05b	7292.01b	4344.62a	3539.05b	2476.12	953.12
Poultry meat	10633.17a	8039.64a	3461.89b	4302.83a	2807.68	957.00
Lamb meat	10419.21a	7860.69a	3857.65b	2985.56b	2486.11	956.90
Average	10066.70	7777.43	3842.89	595.82	2597.64	955.96
SD	206.18	509.19	358.92	191.03	497.51	323.62
SEM	155.45	150.66	79.99	53.71	161.19	58.12
P value	0.015	0.016	0.001	0.017	0.642	0.996

It was determined that the calcium (Ca) and phosphorus (P) levels of the fish-containing foods were low and the sulphur (S) content of the poultry and lamb-containing foods was high ($P<0.05$). Sodium (Na) and magnesium (Mg) macro minerals were found to be at similar levels for dog foods with different protein contents ($P>0.05$). The highest potassium (K) level was found in foods containing poultry meat. Iron (Fe), manganese (Mn), copper (Cu), aluminium (Al), boron (B) and chromium (Cr) contents were similar ($P>0.05$). The cadmium (Cd) and zinc (Zn) levels of the foods containing fish were higher than those of other foods ($P<0.05$). The lead (P) content of the dog foods containing poultry meat was lower than those of the other foods, but the nickel (Ni) level was higher than those of the other foods ($P<0.05$).

Tablo 2. Büyük ırk köpekler için üretilen premium sınıf mamaların mikro mineral içerikleri

ppm, DM	**Al**	**B**	**Cd**	**Co**	**Cr**	**Cu**	**Fe**	**Mn**	**Ni**	**Pb**	**Zn**
Fish meat	76.54	20.50	0.27a	0.09	1.36	18.61	190.34	32.46	3.03b	1.22a	199.09a
Poultry meat	68.13	19.59	0.22b	0.08	1.58	15.70	186.43	33.65	4.78a	0.94b	168.90b
Lamb meat	98.47	17.01	0.20b	0.14	2.00	16.05	211.14	38.32	3.61b	1.35a	136.52b
Average	82.04	18.82	0.22	0.11	1.68	16.58	197.00	35.15	0.87	1.17	64.16
SD	67.55	7.14	0.04	0.10	1.00	6.79	101.90	15.81	0.10	0.12	26.68
SEM	12.13	1.28	0.01	0.01	0.18	1.22	18.30	2.84	0.05	0.06	15.56
P value	0.557	0.527	**0.035**	0.426	0.357	0.632	0.835	0.681	**0.047**	**0.034**	**0.028**

DISCUSSION and CONCLUSION

Premium class foods also contain nutrients that contain the nutrients needed by the dog far above the minimum level and show functional properties according to international standards.

The macro and micro mineral levels that should be found in dog food have been reported in international standards. As a result, according to NRC (2006) and FEDIAF (2021), Ca, P, S, Na and Mg contents and Ca/P ratio of dog foods with different protein types are above the minimum requirement of adult dogs. Therefore, dog foods with fish meat and lamb meat were higher than the minimum requirement of adult dogs. It was revealed that the K content was below the minimum level of adult dog foods. The copper level was found to be between the minimum level (0.72-0.83 mg/100g) and the toxic limit (2.80 mg/100 g) for adult dog foods. Iron mineral was found to be between the minimum (3.6-4.17 mg/100g) and the toxic limit (68.2 mg/100 g) for adult dog foods. The Mn and Zn levels of all three types of dog food were below the maximum limit specified in international standards. Since the maximum limit for the heavy metals detected in the study was not reported in the international standards, a comparison could not be made, but it was concluded that different protein types made a difference in the Cd, Co, Ni and Pb contents of the formulas.

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KADIN KOOPERATİFLERİNİN KIRSAL KALKINMADAKİ ROLÜ: ÇANAKKALE İLİ ÖRNEĞİ

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ÖZET

Günümüzde kadınlar iş dünyasında erkeklere oranla daha fazla eşitsizliklere maruz kalabilmektedir. Aynı işi yapmalarına rağmen daha az maaş alabilmekte, kariyer başamaklarını erkeklere göre daha zor tırmanabilmekte ve erkeklere sağlanan fırsatlar her zaman kadınlara sağlanmamaktadır. Bu eşitsizliklerle dünya çapında mücadele için Birleşmiş Milletlerin Bin Yıllık Kalkınma Hedefleri arasında cinsiyet eşitliğinin teşvik edilmesi ve kadınların güçlendirilmesi yer almaktadır. Türkiye'de de özellikle son yıllarda kadınlara ve kadın örgütlenmelerine olumlu bakış açısı ve faaliyetlerini destekleyici çalışmalar bulunmaktadır. Kadınların ekonomik olarak örgütlenmesinin en önemlilerinden olan kadın kooperatiflerine yapılan desteklerin en önemlilerinden biri de Ticaret Bakanlığı tarafından sağlanan Kooperatiflerin Desteklenmesi Projesi (KOOPDES) kapsamındaki hibe destekleridir. Çanakkale ili de kadın örgütlenmesinin güçlü olduğu illerden biridir. Tamamını veya çoğunluğunu kadınların oluşturduğu Ticaret Bakanlığının gözetim ve denetiminde 17 adet, Tarım ve Orman Bakanlığının gözetim ve denetiminde ise 5 adet kadın kooperatifi bulunmaktadır. Çanakkale ilindeki bu kadın kooperatifleri aynı zamanda kırsal kalkınmanın da en önemli unsurlarından biridir. Kadınlar, kırsal kesimde yıllarca el emeği ürünleri üretmelerine rağmen bu ürünlerin tam olarak ekonomik karşılığını elde edememektedir. Bunun en önemli sebeplerinden biri kadınların örgütlü bir şekilde hareket etmemeleridir. Kadın kooperatifi çatısı altında örgütlenilmesi, kooperatifin kurumsal yapısına olan güven nedeniyle ürünlerin bireysel üretime göre daha kolay pazarlanmasını sağlamaktadır. Çanakkale'de kırsal kesimde iş imkanları sınırlı seviyededir. Kurumsal firmalarda görülen ücret eşitsizliği kırsal kesimde de yine kadınların aleyhine görülmektedir. Kadın kooperatiflerine ortak olan kadınlar el emeği ürünlerini değerinden satabilmektedir. Ayrıca kooperatifleşme ile kayıtdışı üretim azalmakta ve üretim yasal standartlara uygun yapılmaktadır. Bu çalışmada kadın kooperatiflerinin kuruluş mevzuatı, üst birlik yapılanması ve Çanakkale'de faaliyet gösteren kadın kooperatifleri hakkında bilgiler sunularak kırsal kalkınmaya katkıları ele alınmıştır.

Anahtar Kelimeler: Kadın Kooperatifleri, Kırsal Kalkınma, Örgütlenme

THE ROLE OF WOMEN'S COOPERATIVES IN RURAL DEVELOPMENT: THE CASE OF ÇANAKKALE

ABSTRACT

Nowadays, women are exposed to more inequalities than men in the business world. Although they do the same job, they can receive less salary, they can climb the corporate ladder more difficult than men and the opportunities provided to men are not always provided to women. To combat these inequalities worldwide, the United Nations' Millennium Development Goals include promoting gender equality and empowering women. In Türkiye, especially in recent years, there have been works supporting the positive perspective and activities of women and women's organizations. One of the most important supports to women's cooperatives, which is one of the most important economic organization of women, is the grant support within the scope of the Support of Cooperatives Project (KOOPDES) provided by the Ministry of Commerce. Çanakkale province is one of the provinces where women's organization is strong. There are 17 women's cooperatives under the supervision and control of the Ministry of Commerce, which are all or mostly women, and 3 women's cooperatives under the supervision and control of the Ministry of Agriculture and Forestry. These women's cooperatives in Çanakkale are also one of the most important elements of rural development. Although women produce handicraft products in rural areas for years, they cannot obtain the full economic value of these products. One of the most important reasons for this is that women do not act in an organized manner. Being organized under the umbrella of a women's cooperative enables the products to be marketed more easily than individual production due to the trust in the institutional structure of the cooperative. In Çanakkale, job opportunities in rural areas are limited. The wage inequality seen in corporate firms is also seen to the detriment of women in rural areas. Women who are partners in women's cooperatives can sell their handicraft products at their value. In addition, with the help of cooperatives, unregistered production decreases and production is carried out in accordance with legal standards. In this study, the contribution of women's cooperatives to rural development is discussed by providing information about the establishment legislation, upper union structure and women's cooperatives operating in Çanakkale.

Keywords: Women's Cooperatives, Rural Development, Organization

GİRİŞ

Kooperatifçilik, insanoğlunun birlikte iş yapma, birlikte hareket etme ve birlikten güç doğar ilkelerine dayanmaktadır. Anadolu'da uygulanan imece usulü ya da Japonya'da 19. Yüzyıl ortalarında el sanatları işçileri ile köylülerin birlikte kurduğu Hotokuska örgütü gibi örgütler kooperatifçilik hareketinin temellerini oluşturmaktadır (Başar, 1978). Kooperatifçilik bireylerin yalnız yapamayacakları veya birlikte yapmalarında yarar bulunan işleri en iyi biçimde ve maliyet fiyatına yapmak üzere dayanışarak ekonomik güçlerini bir araya getirmeleridir (Mülayim, 2010).

En sade tanımıyla kırsal kalkınma; insan yaşamına olumsuzluklar getiren kırsal çevre koşullarının iyileştirilmesine yönelik çalışmalardır. Ülkeler kalkınmalarını gerçekleştirirken kırsal kesimde bulunan insanları ihmal etmemek ve kırsal kalkınma çalışmalarına önem vermek zorundadır (Tolunay ve Akyol, 2006). Kırsal kalkınma, bir ülkenin sürdürülebilir kalkınması için en önemli unsurdur. Özellikle büyükşehirlerde yaşanan aşırı nüfus, altyapı, trafik, yüksek suç oranı, çarpık kentleşme, işsizlik gibi sorunlara çözüm, kırsaldan kente göçün önlemesi ile sağlanabilmektedir.

Kırsal kalkınmanın en önemli unsurlarından biri ise kadınlardır. TÜİK verilerine göre 2022 yılı itibariyle Türkiye genelinde; Kadınların işgücüne katılım oranı % 28, istihdamda yarı zamanlı çalışma oranı %16,4, 25-49 yaş grubundaki 3 yaşın altında çocuğu olan kadın istihdam oranı %26,1, kadın büyükelçi oranı %27,2 kadın milletvekili oranı %17,3, yükseköğretimde görevli profesörler içinde kadın profesör oranı %33,2 ve yönetici pozisyonundaki kadın oranı %20,7 olarak gerçekleşmiştir (TÜİK, 2022). Tarım ve Orman Bakanlığının çiftçi kayıt sistemi verilerine göre Türkiye'de 289.333 kadın çiftçi bulunmaktadır. Bu verilere göre kayıtlı çiftçilerin %13,3'lük kısmı kadınlardan oluşmaktadır (Tarım ve Orman Bakanlığı, 2023). Türkiye Esnaf ve Sanatkârları Konfederasyonu (TESK) kayıtları incelendiğinde ülkemizde yaklaşık 285 bin kadın esnaf ve sanatkâr bulunmaktadır Türkiye'de kayıtlı esnafların % 18,3'lük kısmı kadınlardan oluşmaktadır (TESK, 2023). Çanakkale ilinde ise 2022 yılı itibariyle 6.492 kadın esnaf ve sanatkâr bulunmakta ve Çanakkale'deki esnafların % 25,8'lik kısmı kadınlardan oluşmaktadır (Çanakkale Ticaret İl Müdürlüğü, 2023). Dolayısıyla Türkiye'de kadınların ekonomide, istihdamda ve iş hayatında etkin rol alamadıkları görülmektedir. Ancak özellikle son yıllarda kadın kooperatiflerine sağlanan desteklerin etkisi ile kadın kooperatiflerinin hem sayılarının arttığı hem de kırsal kalkınmada daha etkin rol oynadıkları görülmektedir. Çanakkale ilinin kırsal kalkınmasında da kadın emeğinin ve kadın kooperatiflerinin rolü büyüktür. Bu çalışmada kadınların karşılaştığı sorunların çözümünde ve kırsal kalkınmada kilit rol oynayan kadın kooperatiflerinin kuruluş mevzuatı, üst birlik

yapılanması ve Çanakkale'de faaliyet gösteren kadın kooperatiflerinin faaliyetlerinin irdelenmesi amaçlanmaktadır.

KADIN KOOPERATİFLERİNİN KIRSAL KALKINMADAKİ ROLÜ

Kadın Kooperatiflerinin Kuruluş Mevzuatı

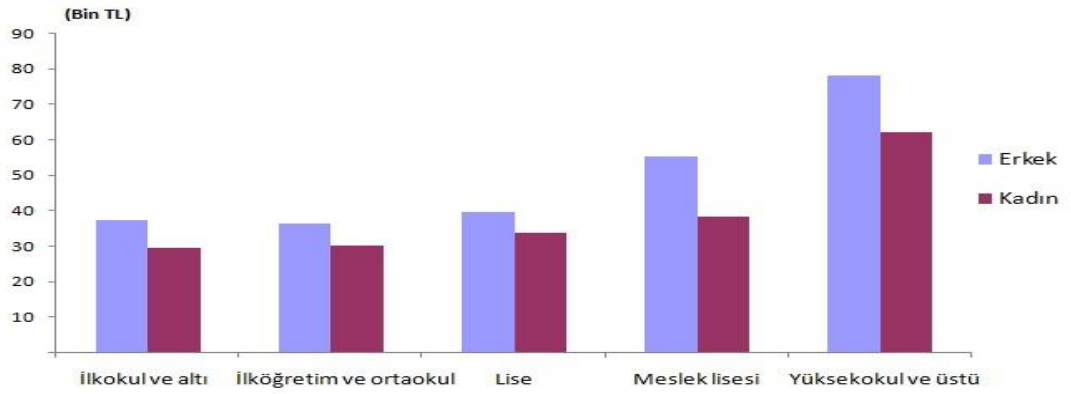
En az 7 kadının bir araya gelmesi ile kadın girişimi üretim ve işletme kooperatifi kurulabilmekte ve söz konusu kooperatif anasözleşmesine göre ortaklarının tamamının kadın olması gerekmektedir. Kuruluş işlemleri merkezi sicil sisteminden (MERSİS) kuruluş başvurusu yapmalarıyla başlamaktadır. MERSİS üzerinden kuruluş başvurusu yapan kurucu ortaklar ticaret sicil müdürlüğünde anasözleşmeyi imzalamaları gerekmektedir. Anasözleşmeyi imzaladıktan sonra bulundukları ildeki Ticaret İl Müdürlüğünden kuruluş izni almaları gerekmektedir. Kuruluş izninden sonra tescile tabi hususları tescil ve ilan ettirmesiyle kadın girişimi üretim ve işletme kooperatifi kurulmuş olacaktır (Ticaret Bakanlığı,2023) (1163 sayılı Kooperatifler Kanunu,1969)

Üst Birlik Yapılanması

En az 7 Kadın Girişimi Üretim ve İşletme Kooperatiflerinin bir araya gelmesiyle Ticaret Bakanlığı'nın gözetim ve denetiminde kurulabilir. Tarımsal kalkınma kadın kooperatifleri ise Tarım ve Orman Bakanlığı gözetiminde kuruluşu yapılmış kooperatiflerdir. Bir ortaklık payının değeri 100 Türk lirasıdır. Kooperatifler üst kuruluşuna iştirak edenler ise en az 50 pay taahhüt ederler. Kuruluş izninin verildiğinin izin merciince ilgililere tebliğinden itibaren kurucular 15 gün içerisinde kooperatifin tescil ve ilanı talebiyle Ticaret Sicil Müdürlüğüne başvurur. Tescil ve ilanın ardından kooperatif birliği tüzel kişilik kazanmış olur (Ticaret Bakanlığı, Tarım ve Orman Bakanlığı, 2023)

Türkiyede Kadin Kooperatifleri

Günümüzde kadınlar iş dünyasında erkeklere oranla daha fazla eşitsizliklere maruz kalabilmektedir. Aynı işi yapmalarına rağmen daha az maaş alabilmektedir. Bu eşitsizliklerle dünya çapında mücadele için Birleşmiş Milletlerin Bin Yıllık Kalkınma Hedefleri arasında cinsiyet eşitliğinin teşvik edilmesi ve kadınların güçlendirilmesi yer almaktadır. Türkiye'de Cinsiyet ve eğitim durumuna göre 2018 yılı yıllık ortalama brüt kazanç aşağıda grafikte gösterilmektedir (TÜİK,2018)



Şekil 1: Türkiye'de Cinsiyet ve eğitim durumuna göre 2018 yılı yıllık ortalama brüt kazanç

Kadınlar iş dünyasında çeşitli eşitsizliklere maruz kalsa da kadın kooperatifleri, sağlanan destekler ile başarılı işletmeler haline gelebilmektedir. Ticaret Bakanlığı tarafından 2020 yılında kooperatiflerin desteklenmesi (KOOP-DES) programı yürürlüğe konulmuştur. KOOP-DES Programı ile kooperatif ve üst kuruluşlarının üretim ve istihdama katkısı olacak yatırım projelerinin desteklenmesi, faaliyetlerinde etkinlik ve verimliliğin sağlanması, teknoloji ve yeni üretim tekniklerinden yararlanmalarına katkıda bulunulması, rekabet güçlerinin artırılması ve bireysel tasarrufların uygun kooperatif girişimcilik modelleri ile ekonomiye kazandırılması hedeflenmektedir. Özellikle bugüne kadar sadece kadın kooperatiflerine yönelik çağrıya çıkılmıştır. KOOP-DES programının 2020 Temmuz ayında başlamasından sonra Ticaret Bakanlığı'nın gözetim ve denetiminde toplam kurulan Kadın Kooperatif sayısı 2022 yılı sonu itibariyle 963'e ulaşmıştır (Ticaret Bakanlığı,2023).

Tablo 1: Kurulan Kadın Girişimi Üretim ve İşletme Kooperatifi Sayısı

Tarih aralığı	Kurulan Kadın Girişimi Üretim ve İşletme Kooperatifi Sayısı
31/12/2014'e kadar	20
01/01/2015-31/12/2015	24
01/01/2016-31/12/2016	15
01/01/2017-31/12/2017	27
01/01/2018-31/12/2018	21
01/01/2019-31/12/2019	93
01/01/2020-31/12/2020	250
01/01/2021-31/12/2021	321
01/01/2022-31/12/2022	192
Toplam	963

Kaynak: Kooperatif Bilgi Sistemi, Ticaret Bakanlığı

Çanakkalede Kadın Kooperatifleri

Çanakkale'de 17'si Ticaret Bakanlığı'nın 5'i Tarım ve Orman Bakanlığı'nın gözetim ve denetiminde toplam 22 kadın kooperatifi bulunmaktadır (Çanakkale Ticaret İl Müdürlüğü, 2023; Çanakkale Tarım ve Orman İl Müdürlüğü, 2023). Bu kooperatiflerden bazıları tarhana, erişte, mantı, kuskus, gözleme, salça, süt, peynir gibi gıda ürünlerinin üretimi yapmakta bazıları ise tekstil üretimi, cam işleme, el yapımı hediyelik eşyaların üretimi faaliyetlerinde bulunmaktadır. Kadın kooperatifleri tamamı ortaklarının ekonomik, sosyal ve kültürel ihtiyaçlarını karşılayacak faaliyetlerde bulunmaktadırlar.

Tablo 2: Ticaret Bakanlığı'nın Yetki Alanındaki Kadın Kooperatifleri

	Kooperatifin Unvanı	İlçesi
1	S.S. Çanakkale Girişimci Kadınlar Üretim ve Pazarlama Kooperatifi	Merkez
2	S.S. Sanatçı Kadın Girişimi Üretim ve İşletme Kooperatifi	Merkez
3	S.S. Kazdağları Doğal Ürünler Kadın Girişimi Üretim ve İşletme Kooperatifi	Ayvacık
4	S.S. Ümmühan Hatun Kadın Girişimi Üretim ve İşletme Kooperatifi	Ayvacık
5	S.S. Ayvacık Şapköy Kadın Girişimi Üretim ve İşletme Kooperatifi	Ayvacık
6	S.S. Ayvacık Gülpınar Kadın Girişimi Üretim ve İşletme Kooperatifi	Ayvacık
7	S.S. Biga Kadın Çevre Kültür ve İşletme Kooperatifi	Biga
8	S.S. Karabiga Kadın Çevre Kültür ve İşletme Kooperatifi	Biga
9	S.S. Bozcaada Kadın Girişimi Üretim ve İşletme Kooperatifi	Bozcaada
10	S.S. Çanakkale Troida Kadın Girişimi Üretim ve İşletme Kooperatifi	Ezine
11	S.S. Kemallı Kadın Girişimi Üretim ve İşletme Kooperatifi	Ezine
12	S.S. Gökçebayır Köyü Kadın Girişimi Üretim ve İşletme Kooperatifi	Ezine
13	S.S. Çan Üretim ve İşletme Kooperatifi	Çan
14	S.S. Gelibolu Öncü Kadın Girişimi Üretim ve İşletme Kooperatifi	Gelibolu
15	S.S. Güneşin Kadınları Çanakkale Kadın Girişimi Üretim ve İşletme Kooperatifi	Lâpseki
16	S.S. Lâpseki Umut Işığı Kadın Girişimi Üretim ve İşletme Kooperatifi	Lâpseki
17	S.S. Nevruz Kadın Girişimi Üretim ve İşletme Kooperatifi	Yenice

Kaynak: Çanakkale Ticaret İl Müdürlüğü

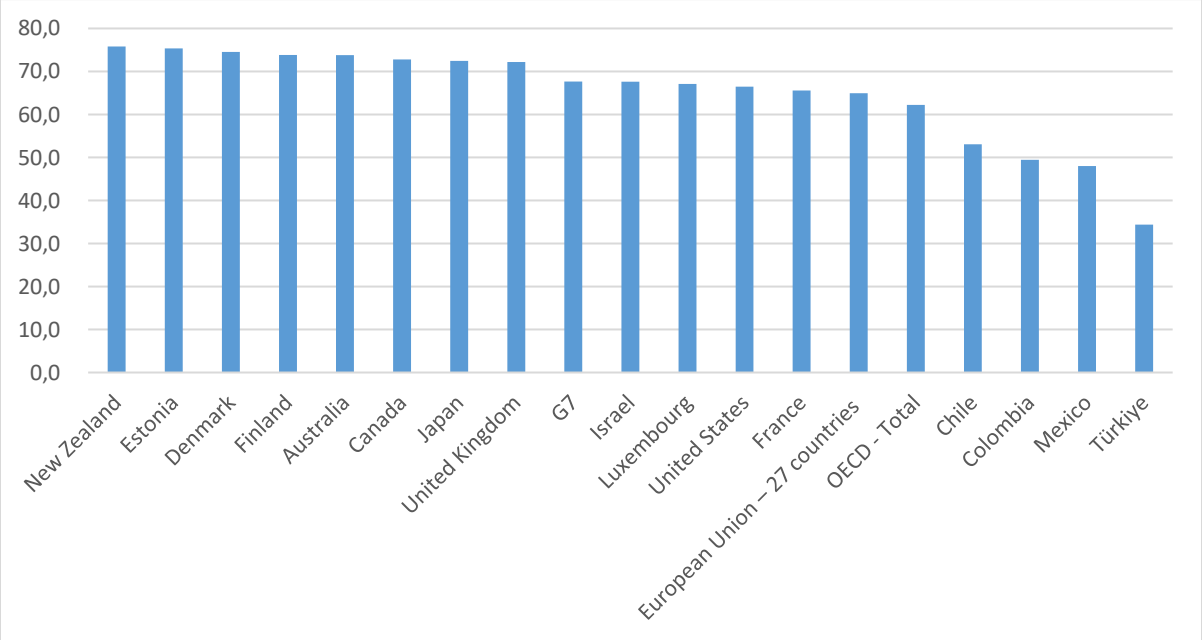
Tablo 3: Tarım ve Orman Bakanlığı'nın Yetki Alanındaki Kadın Kooperatifleri

	Kooperatifin Unvanı	İlçesi
1	S.S. Yağcılar Köyü Kadın Tarımsal Kalkınma Kooperatifi	Merkez
2	S.S. Babakale Köyü Tarımsal Kalkınma Kooperatifi	Ayvacık
3	S.S. Bektaş Köyü Kadın Emeği Tarımsal Kalkınma Kooperatifi	Ayvacık
4	S.S. Eceabat Merkez İlçe Kadın Emeği Tarımsal Kalkınma Kooperatifi	Eceabat
5	S.S. Gökçeada İlçe Merkezi Kadın Emeği Tarımsal Kalkınma Kooperatifi	Gökçeada

Kaynak: Çanakkale Tarım ve Orman İl Müdürlüğü

Kadın Kooperatiflerinin Kırsal Kalkınmadaki Rolü

Türkiye'de iş hayatında kadınlar eşitsizliklere maruz kalmakta ve ekonomik yönden birçok dezavantajla karşı karşıya kalabilmektedir. Bunun en iyi gözlemlendiği alan işgücü piyasasıdır. Türkiye'de kadınların işgücü piyasasına katılımları ve istihdam oranları diğer ülkelerle karşılaştırıldığında oldukça düşüktür (Adar ve Arkadaşları,2023).



Şekil 2: 2022 Yılı Ülkelere Göre Kadın İstihdam Oranları Kaynak: OECD

Bununla birlikte Türkiye'de kamu kurum ve kuruluşlarının, sanayi ve ticaret odalarının, ticaret borsalarının ve sivil toplum kuruluşlarının destekleri ile kadın kooperatiflerinin sayısı ve ortak sayıları her geçen gün artmaktadır.

Kadın kooperatifleri, kadın yoksulluğunun azaltmasında, kadınların sosyal ve kültürel etkinliklerinin arttırılmasında, kadınların güçlendirilmesinde ve toplumsal cinsiyet eşitsizliğinin ortadan kaldırılmasında etkin rol oynamaktadırlar (Aksoy ve Günay, 2018; Everest vd. 2022; Kutay, 2022; Serinikli, 2016; Taş ve Kazar, 2019; Topaloğlu ve Topaloğlu, 2017). Kadın kooperatifleriyle ilgili yapılan araştırmalarda; kadın kooperatiflerinin kadınların ve yaşadıkları toplumlarının yaşamlarında olumlu katkılar sağladığı görülmektedir (Duguid ve arkadaşları, 2015). Ayrıca kadın kooperatifleri, kadınların ekonomik olarak güçlendirilmesiyle yerel kalkınmaya katkı sağlamaktadır (Karakuş, 2022). Krizlere daha dayanıklı bir işletme modeli olan kooperatiflerin pandemi sürecinde bile kadınların hem ekonomik hem de sosyal alanlarda güçlenmesinde etkisi olduğu tespit edilmiştir (Demirkol, 2022).

Kadın kooperatifleri ortaklarına kırsalda istihdam oluşturmaktadır (Yıldırım, 2020). Kırsalda kooperatif ortağı kadınlara gelir ya da ek gelir oluşturmaktadır. Aile ekonomisine katkı sağlamaktadır. Kırsal kesimdeki alt ve orta gelir grubu kadınlar yerel ekonomide söz sahibi olabilmektedirler. Kadın kooperatifleri ortaklarının kırsal kesimdeki ekonomik ve sosyal pozisyonları güçlenmektedir. Kadınların kırsalda karar verme süreçlerine katılımları artmaktadır (Akkaya, 2018). Kırsalda emeğini tek elden değerlendiremeyen kadınlar için iş olanağı sağlanmaktadır. Kadın kooperatifleri örgütlü yapıları ile kamu kurum-kuruluşlarının daha fazla desteklerini elde ederek kırsal kesimde üretimi arttıracak tesisler kurabilmektedir (Şen, 2021). Özellikle son yıllarda kırsalda kadın kooperatiflerine yönelik eğitim (e-ticaret, kooperatifçilik, işletmecilik, muhasebe vb) faaliyetleri sayesinde ortakların iş yapabilme kabiliyetleri gelişmektedir.

SONUÇ ve ÖNERİLER

Kooperatiflerin etkin olduğu kırsal bölgelerde, kooperatiflerin üretime ve istihdama katkıları sayesinde kırsal ekonomi değer kazanmaktadır. Ayrıca birlikten gelen güç sayesinde kırsal kesimin sorunlarının çözümü için talep edilen desteklerin yetkili makamlara kooperatifler aracılığıyla daha etkili olmaktadır. Ayrıca kooperatifçilik ilkelerinde biri olan sosyal sorumluluk ilkesi gereği kooperatifler kırsal kalkınma ve kırsal kesimin sorunların çözümünde etkin rol oynamaktadırlar. Son yıllarda kadın kooperatifi kurma talebi artmıştır. Kurulan bu kadın kooperatifleri özellikle az sayıda ortak ile ve minimum sermaye tutarı ile kurulmaktadır. Bu şekilde kurulan kadın kooperatifleri finansal olarak sürdürülebilir bir işletme yapısına sahip değillerdir. Ancak bu kadın kooperatiflerinden bir kısmı kendilerine sağlanan destekler ve

hibelerle ile ayakta kalacak seviyeye gelebilmekte ve kırsal kalkınmanın en önemli unsurlarından biri olmaktadırlar. Ancak bir işletme modeli olan kadın kooperatiflerinin sürekli destek ve hibelerle ayakta durması mümkün bulunmamaktadır. Hem kırsal kalkınmada etkin rol oynayabilmeleri hem de sürdürülebilir bir işletme haline gelebilmeleri için mutlaka yatay ve dikey örgütlenmelerini güçlendirmelidirler.

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FARKLI POTASYUM DOZLARININ BAZI PATATES (*Solanum tuberosum* L.) ÇEŞİTLERİNİN VERİM VE KALİTE PARAMETRELERİ ÜZERİNE ETKİLERİNİN BELİRLENMESİ*

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ÖZET
Lady Clair, Opal ve Hermes çeşitlerinin materyal olarak kullanıldığı bu araştırma, farklı miktarlarda uygulanan potasyum dozlarının (0, 15, 30 kg/da) patatesin verim ve bazı özellikleri üzerine olan etkilerinin belirlenmesi amacıyla 2014 yılında Ordu ili Kabadüz ilçesinde yapılmıştır. Deneme, tesadüf bloklarında bölünmüş parseller deneme desenine göre 3 tekerrürlü olarak yürütülmüştür. Araştırma sonucunda bitki boyunun 42.13-69.06 cm, ocak başına sap sayısının 3.60-5.93 adet/ocak, ocak başına yumru sayısının 5.20-8.20 adet, ortalama yumru ağırlığının 50,36-60,18 g, pazarlanabilir yumru veriminin 1674.20 -3161.91 kg/da, kuru madde oranının %22.20-24.76, nişasta oranının %16.43-17.87, cips verimliliğinin de % 26.46-31.95 arasında değişim gösterdiği belirlenmiştir. İncelenen özelliklerden ocak başına yumru sayısı, dekara yumru verimi ve pazarlanabilir yumru verimi üzerine çeşit ve potasyumun interaksiyon etkisi istatistiki olarak önemli, diğer özellikler üzerine olan etkiler ise istatistiki olarak önemsiz bulunmuştur.

Anahtar Kelimeler: Gübreleme, Hermes, Ladyclair, Opal, Nişasta

DETERMINATION OF THE EFFECTS OF DIFFERENT POTASSIUM DOSES ON YIELD AND QUALITY PARAMETERS OF SOME POTATO (*Solanum tuberosum* L.) VARIETIES

ABSTRACT

This research used Lady Clair, Opal and Hermes varieties was done to determine the effects of different doses(0, 15, 30 kg/da) of potassium on the yield and some properties of potato in 2014 in Kabadüz, Ordu. The experiment was carried out in randomized blocks at split-plot design with 3 replications. As a result of the research, it was observed that the obtained values changed for plant height between 42.13-69.06cm, for stem number per hill between 3.60-5.93, for number of tubers per hill 5.20-8.20, for average tuber weight 50,36-60,18 g, for marketable tuber yield between 1674.20-3161.91 kg da-1, for dry matter content between 22.20-24.76 %, for starch rate between 16.43-17.87 % and for chips yield between % 26.46-31.95%. The interaction effects of potassium and varieties were statistically significant on number of tubers per hill, tuber yield per decare and marketable tuber yield, while the effects were statistically insignificant on other properties examined in this research.

Keywords: Fertilization, Hermes, Lady clair, Opal, Starch

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GİRİŞ

Patatesin de ait olduğu Solanum cinsinde 160–180 türün yumru oluşturabilme kabiliyetine sahip olduğu bilinmektedir. Bu türlerin içerisinde *Solanum tuberosum* dünyada en yaygın olarak bilinen ve yetiştiriciliği yapılan türdür. Karbonhidrat, protein, vitamin ve nişasta ihtiva etmesi sebebiyle patates çok fazla tercih edilen bir bitkidir (Rowe, 1993). Endüstride önemli bir hammadde kaynağı olan patates, buğdaydan sonra yiyecek olarak en fazla tüketilen ikinci bitkidir. Patatesin yaklaşık olarak %75'inden fazlası sudur. Geri kalan kısmı ise kuru maddeden oluşmaktadır, bu kuru maddenin büyük bir kısmı nişastadan oluşmaktadır. Nişasta ve nişastadan elde edilen ürünler tekstil, gıda ve ilaç gibi farklı endüstriyel alanlarda kullanılmaktadır (Er ve Uranbey, 1998). Patates içerdiği değerli besinler sebebiyle, özellikle az gelişmiş ülkelerde, insanların temel besin ihtiyaçlarını karşılayabilmektedir. Mutfaklarda beslenme amacıyla pişirilerek tüketilebilir ve endüstride farklı şekillerde işlenebilmektedir (cips, kızartma, püre vb). Ayrıca patates yumrularından patates unu da elde edilmektedir. Ekmek unu patates unu ile karıştırıldığında ekmeklerin lezzeti artmakta ve raf ömrü uzamaktadır. Ek olarak, sanayide ve insan beslenmesinde tüketilmeyen patatesler, hayvan beslenmesinde yem kaynağı olarak kullanılabilir. Patates, yetiştirildiği ülkelerde birim alandan elde edilen ürün miktarının yüksek olması sebebiyle üreticilere ve ülke ekonomisine kayda değer faydalar sağlamaktadır (Abed ve Demirhan, 2018).

Bitkisel üretimde nitelikli ürün elde edebilmek için, bitkilerin besin ihtiyaçlarının karşılanması da oldukça önemlidir. Bitki besin elementlerinin bir veya daha fazlasının eksikliği veya fazlalığı, ya doğrudan doğruya eksikliği sebebiyle ya da mevcut besin maddelerinin alımının zorlaşması sebebiyle bitkilerin büyüme ve gelişmesini sekteye uğratarak nicelik ve nitelik olarak kayıplara neden olmaktadır. Ürünün kalitesi ve üretimde devamlılığın sağlanabilmesi için gübreleme yapılmalıdır. Potasyum patates bitkisinin çok ihtiyaç duyduğu bir besin elementi olup, verim ve kalite açısından çok hassas bir rol oynamaktadır. Potasyum; fizyolojik ve biyokimyasal açıdan, bitki dokularında, gelişmekte olan bitkilerin ihtiyaç duyduğu bir besin elementidir. Ayrıca potasyum enzim aktivitesi ve fotosentezde de etkilidir, bitki içi gerekli olan mutlak gerekli besin elementlerinin taşınmasına yardımcı olur, protein içeriğini ve aktivitesini yükseltir, turgoru düzenler, bitkide su kaybı sebebiyle yaşanan solma durumunu engellemekte görev alır (Kacar, 2005). Potasyum, bitkilerde köklerin büyüme ve gelişimine pozitif olarak etki eder, yatmayı en aza indirir, soğuk stresine karşı koruyucudur ve azotun faydalı kullanımını artırır. Ek olarak, fizyolojideki temel işlevler olan enzim faaliyetlerini artırdığı bilinmektedir (Aktaş, 1995). Dolasıyla, bitkideki potasyum, hastalık ve zararlılara karşı direnç seviyesini artırır ve parazitlerin yarattığı hasarı azaltabilir. Bitki bünyesinde gerekenden

az potasyum bulunması karbonhidrat sentezinde aksamalara, yaprakta bulunan hücrelerin yapısının bozulmasına, selüloz ve lignin seviyesinde azalmalara sebep olmaktadır (Marschner, 1995). Ayrıca, enzim aktivitesi ve ATP sentezi yetersizliği durumunda bitkilerin tedavisinde potasyum etkili olurken (Krauss, 2000), yeteri miktarda potasyumla beslenen bitkilerin toplam fenol içeriği artmakta ve böylece fizyolojik stres durumlarında bitki bariyer hazırlayarak potasyumu savunma sisteminde temel olarak kullanmaktadır (Perrenoud, 1990). 2014 yılında tek yıllık olarak yürütülen bu çalışmada, 3 farklı patates çeşidinde farklı miktarlarda uygulanan potasyum dozlarının mevcut ekolojik koşullarda patatesin verim ve kalite parametreleri üzerine olabilecek etkilerinin belirlenmesi amaçlanmıştır.

MATERYAL ve METOT

Deneme Alanının Konumu, İklim Ve Toprak Özellikleri

Farklı patates çeşitlerinin ve potasyum uygulamalarının patatesin bitki gelişimi, verim ve kalite özelliklerine etkilerinin belirlenmesi amacıyla yürütülen bu çalışma, Ordu ili Kabadüz ilçesi Yukarı Kirazdere mevkiinde yürütülmüştür. İlçede Karadeniz iklimi hüküm sürmektedir. Yazları serin, kışları ılık ve bol yağışlı geçmektedir. Bu iklime bağlı olarak burada görülen tabi bitki örtüsü ormandır. Çalışmanın yürütüldüğü 2014 yılı vejetasyon dönemine ve uzun yıllara ait ortalama sıcaklık, oransal nem ve toplam yağış değerleri çizelge 1'de verilmiştir.

Çizelge 1. Denemenin Yürütüldüğü Ordu İli Kabadüz İlçesine Ait İklim Verileri*

	ORT. SICAKLIK (ºC)		ORANSAL NEM (%)		TOPLAM YAĞIŞ (mm)	
AYLAR	2014	Uzun Yıllar	2014	Uzun Yıllar	2014	Uzun Yıllar
NİSAN	5.1	10.5	56.7	85.7	20.2	45.2
MAYIS	6.2	12.7	64.9	86.6	88.5	71.2
HAZİRAN	10.4	16.5	64.0	89.0	43.0	66.1
TEMMUZ	13.2	18.6	55.2	91.0	74.4	62.0
AĞUSTOS	18.1	18.5	76.8	90.0	124.6	65.6
EYLÜL	14.2	15.2	87.0	89.9	83.2	53.3
ORTALAMA	11.2	15.3	67.43	88.7		
TOPLAM					433.9	363.4*

*: Anonim, 2014

Deneme alanının toprak özelliklerini belirlemek için, deneme alanını temsilen 0-30 cm derinlikten tekniğine uygun olarak alınan toprak örnekleri Ordu Üniversitesi Ziraat Fakültesi Toprak Bölümü Laboratuvarında analiz edilmiş olup; deneme alanı toprağının kireçsiz ve tuzsuz, toplam N bakımından çok fazla, yarayışlı P ve K bakımından ise yetersiz olduğu belirlenmiştir (Çizelge 2).

Çizelge 2. Denemenin Alanı Toprak Analiz Sonuçları ve Değerlendirilmesi

Analizler	Tekstür	pH	Organik Mad. (%)	Toplam N (kg da^{-1})	P (mg kg^{-1})	K (mg kg^{-1})
Sonuç	Kumlu Tınlı	4.39	11.07	0,32	2.51	72.69
Değerlendirme		Asidik	Çok fazla	Çok fazla	Yetersiz	Yetersiz

Yöntem

Yapılan bu araştırmada Lady Clair, Hermes ve Opal çeşitleri materyal olarak kullanılmış olup gübreleme için potasyum kaynağı olarak potasyum sülfat (K_2SO_4), N kaynağı olarak kalsiyum amonyum nitrat (CAN), ve fosfor kaynağı olarak ta triple süper fosfat (TSP) gübreleri kullanılmıştır. Deneme tesadüf blokları bölünmüş parseller deneme desenine göre 3 tekerrürlü olarak yürütülmüştür. Dikim işlemi 05.05.2014 tarihinde elle yapılmıştır. Faktör olarak incelenen potasyum dozları ve temel gübrelemede 10 kg/da dozunda uygulanan P_2O_5 gübreleri dikim öncesinde parsellere uygulanmıştır. Vejetasyon dönemi boyunca 2 çapalama yapılmış olup, 3 kez de mildiyöye karşı koruyucu olarak ilaçlama yapılmıştır. Hasat işlemi 15 Eylül 2014 tarihinde elle yapılmıştır.

BULGULAR ve TARTIŞMA

Yapılan bu araştırmada incelenen özelliklere ait ortalama değereler ile istatistiksel olarak önemli bulunan özelliklerin LSD grupları çizelge 3'te verilmiştir.

Çizelge 3. İncelenen özelliklere ait ortalama değerler ve LSD grupları

ÇEŞİT	Potasyum (K) Dozları (kg/da)	Bitki Boyu (cm)	Ocak Başına Sap Sayısı (adet)*	Ocak Başına Yumru Sayısı (adet)*	Ortalama Yumru ağırlığı (g)**
Lady Clair	0	65.83	5.93	5.23 d	54.77
	15	69.06	4.40	6.03 cd	53.28
	30	64.53	5.10	5.61 cd	56.27
Ort.		66.47	5.14 A	5.62	54.77 B
Hermes	0	60.50	3.56	8.20 a	52.39
	15	51.53	3.46	6.21 cd	50.36
	30	68.53	4.33	5.46 cd	51.88
Ort.		60.18	3.78 B	6.62	51.54 C
Opal	0	45.75	5.10	7.81 ab	54.40
	15	51.13	3.60	6.65 bc	60.18
	30	42.13	3.60	5.28 d	55.15
Ort.		46.33	4.10 B	6.58	57.58 A
	K_0 Ort.	*57.36*	*4.87 A*	*7.08 A*	54.85
	K_{15} Ort	*57.24*	*3.82 B*	*6.30 B*	54.61
	K_{30} Ort	*58.40*	*4.34 A*	*5.45 C*	54.43

•(P>0.05) ve ** (P>0.01): Aynı sütunda aynı harfle gösterilen ortalamalar arasındaki fark istatistiksel olarak önemli değildir.

İncelenen faktörlere göre bitki boyları 42.13-69.06 cm arasında tespit edilmiş olup, gerek çeşitler arasında gerekse gübre dozları arasında olan farklılıklar istatistiksel olarak önemsiz bulunmuştur. Boydak ve Kayantaş (2016)'da yaptıkları bir araştırmada patateste çeşitlerin bitki boylarını 44.73-64.33 cm arasında tespit etmişlerdir.

Ocak başına sap sayısı bakımından çeşitler arasında ve potasyum dozları arasında olan farklılıklar istatistiksel olarak %5 düzeyinde önemli bulunmuştur. Çizelge 3'te verilen ortalama değerler incelendiğinde; en fazla ocak başına sap sayısı Lady Clair çeşidinden (5.14 adet/ocak) en düşük ise Hermes çeşidinden (3.78 adet/ocak) elde edildiği görülmektedir. Potasyum dozları incelendiğinde ise; ocak başına sap sayısı bakımından en yüksek değer kontrol dozundan elde edilirken, en düşük değer 15 kg K/da gübre dozundan elde edilmiştir. Konu ile ilgili yapılan benzer çalışmalarda; Dede, (2004) yaptığı araştırmada sap sayısını Hermes çeşidinde 4.92 adet, Boydak ve ark. (2016)'nın yaptıkları bir çalışmada ise çeşitlerin sap sayısının 3.20-6.17 adet arasında değiştiğini tespit etmişlerdir. Ekin ve ark. (2013) ise potasyumlu gübre uygulamasında sap sayısını 3.1-4.8 arasında tespit etmiş olup uygulama dozu arttıkça sap sayısının arttığını belirtmişlerdir.

Ocak başına yumru sayısı bakımından potasyum dozlarının etkisi çeşitlere göre farklılık göstermiş olup, en düşük değer Opal çeşidine 30 kg/da K uygulamasında (5.28 adet/ocak), en yüksek değer ise Hermes çeşidinde kontrol dozunda (8.20 adet/ocak) olarak belirlenmiştir. Konu ile ilgili benzer çalışmalarda, Şanlı ve Karadoğan (2012) yaptıkları bir çalışmada çeşitlerin ocak başına yumru sayısını 6.3-9.2 adet/ocak, Kara (2016) 5.2-9.4 adet/ocak arasında tespit etmişlerdir. Abu-Zinada (2009) artan potasyum dozlarının yumru sayısını azatlığını, Uwah ve ark. (2013) ile Ekin ve ark. (2013) ise artan potasyum dozlarının ocak başına yumru sayısını artırdığını belirtmektedirler.

Farklı miktarlarda uygulanan potasyum dozlarının bazı patates çeşitlerinin ortalama yumru ağırlığı üzerine olan etkisi incelendiğinde; çeşitler arasında olan farklılıklar istatistiksel olarak % 1 düzeyinde önemli bulunmuştur. Buna göre en yüksek ortalama yumru ağırlığı57.58 g ile Opal çeşidinden elde edilirken, bunu azalan sıra ile Lady Clair (54.77 g) ve Hermes (51.54 g) izlemiştir. Patateste yapılan benzer çalışmalarda; Moinuddin ve ark. (2004) ile Sing ve Lal (2012) artan potasyum dozları ile ortalama yumru ağırlığının arttığını tespit etmişledir. Ancak, tek yıllık olarak Ordu ekolojik koşullarında yapılan bu çalışmada potasyum dozları arasında herhangi bir farklılık tespit edilememiştir.

Patates üretiminde esas ekonomik fark yaratan değer birim alandan elde edilen pazarlanabilir nitelikteki yumru verimidir. Zira, gerek büyüklük olarak gerekse nicelik olarak pazarlanma niteliğinde olamayan yumrular ekonomik olarak herhangi bir değer göstermemekte

ve hayvan yemi olarak çok düşük fiyat ile elden çıkarılmakta veya işletme içinde değerlendirilmektedir. Yapılan bu çalışmada elde edilen pazarlanabilir yumru verimi değerleri ve diğer kalite özelliklerine ilişkin ortalama değerler çizelge 4'de verilmiştir.

Çizelge 4. İncelenen özelliklere ait ortalama değerler ve LSD grupları

ÇEŞİT	Potasyum (K) Dozları (kg/da)	Pazarlanabilir Yumru verimi (kg/da)*	Kuru Madde Oranı (%)*	Nişasta oranı (%)*	Cips verimliliği (%)**
Lady Clair	0	1866.62 c	24.05	17.47	27.06
	15	2007.23 c	24.76	17.87	31.95
	30	2586.17 bc	23.88	17.37	29.39
Ort.		2153.34	24.23 A	17.57 A	29.47
Hermes	0	3489.49 ab	23.40	17.10	29.07
	15	3682.63 ab	23.50	17.16	31.12
	30	4212.53 a	22.20	16.43	31.31
Ort.		3794.88	23.03 B	16.90 B	30.50
Opal	0	2075.63 c	23.16	16.97	26.46
	15	2594.58 bc	22.81	16.77	30.95
	30	2091.50 c	22.79	16.76	30.93
Ort.		2250.57	22.92 B	16.83 B	29.45
	K_0 Ort.	2477.25	*23.54*	*17.18*	*27.53 B*
	K_{15} Ort	2761.48	*23.69*	*17.27*	*31.34 A*
	K_{30} Ort	2960.07	*22.96*	*16.85*	*30.54*

•(P>0.05) ve ** (P>0.01): Aynı sütunda aynı harfle gösterilen ortalamalar arasındaki fark istatistiksel olarak önemli değildir.

Çizelge 4 incelenecek olursa, pazarlanabilir yumru verimi üzerine potasyum dozlarının etkisinin çeşitlere göre farklılık gösterdiği ve çeşit X potasyum dozu interaksiyonun % 5 düzeyinde önemli olduğu görülmektedir. Buna göre, en yüksek pazarlanabilir yumru verimleri Hermes ve Lady Clair çeşitlerinde 30 kg K/da dozundan elde edilirken (sırasıyla 4212.53 kg/da ve 2586.17 kg/da), Opal çeşidinde ise 15 kg K/da dozundan (2594.58) elde edilmiştir. Benzer olarak yapılan çalışmalarda Davenport ve ark., (1999) artan potasyum dozlarının pazarlanabilir

yumru verimini artırdığını belirlerken, Kumar ve ark. (2017) potasyum dozları artıkça pazarlanabilir yumru veriminin azaldığını tespit etmişlerdir. Tarafımızca yapılan çalışmada, araştırma alanı toprağının K içeriğinin düşük olduğu belirlenmiş olup, uygulanan potasyum gübrelemesi de verim üzerinde etkisini göstermiştir.

Patateste kuru madde ve nişasta oranları genellikle birbirine paralellik arz etmektedir. Çünkü, patateste kuru maddenin büyük bir çoğunluğunu nişasta oluşturmaktadır. Patateste nişasta içeriği belirli oranlarda yetişme ortamı ve beslenme durumuna göre bir miktar değişiklik göstersede, esas olarak çeşit özelliğidir. Dolayısıyla çeşitler nişasta içeriklerine göre de yemeklik ve sanayilik gibi farklı alanlarda kullanılmaktadır. Yapılan bu çalışmada elde edilen kuru madde ve nişasta içeriğine ilişkin ortalama değerler çizelge 4'de verilmiştir. İlgili çizelge incelendiğine hem kuru madde ve hem de nişasta içeriği bakımından çeşitler arasında olan farklılıkların % 5 düzeyinde önemli olduğu görülmektedir. İncelenen çeşitlerden Lady Clair çeşidi % 24.23 oranında kuru madde ve % 17.57 oranında nişasta içeriği ile diğer iki çeşitten daha yüksek değerlere sahiptir. Hermes ve Opal çeşitleri ise her iki özellik bakımından birbirine çok yakın olan içeriğe sahip olup, istatistiksel olarak aynı grupta yer almışlardır. Sarikhani ve Aliasgharzad (2012) yaptıkları çalışmada potasyum dozları artıkça nişasta oranının artığını belirlemişlerdir. Ancak, tarafımızca yapılan bu araştırmada potasyum dozları arasında hem kuru madde oranı bakımından hem de nişasta oranı bakımından böyle bir farklılık belirlenememiştir.

Yapılan bu araştırmada uygulanan potasyum dozlarının çeşitlerin nişasta içeriği üzerine herhangi bir etkisi olmamasına rağmen, cips verimliği bakımından yapılan değerlendirmede potasyum dozları arasında olan farklılıklar istatistiksel olarak % 1 düzeyinde önemli bulunmuştur. Buna göre; en düşük cips verimliliği kontrol dozunda%27.53 olarak tespit edilirken, en yüksek cips verimliliği % 31.34 ile 15 kg K/da dozundan elde edilmiş ve uygulanan her iki doz aynı grup içerisinde yer almıştır. Yani denilebilir ki, potasyum uygulaması patateste cips verimliliğini artırmıştır. Karadoğan (2011) yürüttüğü çalışmada farklı patates çeşitlerinde cips veriminin %27.56- %48.21 arasında değiştiğini ve çeşit seçiminin istatistiki açıdan cips verimini etkilediğini tespit etmiştir. Yapılan bu çalışmada tespit edilen değerler araştırıcının bulguları ile benzerlik göstermektedir. Diğer taraftan, incelenen Lady Clair, Hermes ve Opal çeşitlerinin her üçünün de cipslik olması dolaysıyla cips verimliliği bakımından aralarında farklılık çıkmaması olağan bir durum olarak görülmektedir.

SONUÇ ve ÖNERİLER

Üç farklı potasyum dozunun 3 farklı patates çeşidinde bitki gelişimi, yumru verimi ve kalitesi üzerine olan etkilerinin belirlenmesi amacıyla yapılan bu araştırmada; ocak başına yumru sayısı ve cips verimi üzerine potasyumun etkili olduğu; sap sayısı, ortalama yumru

ağırlığı kuru madde ve nişasta oranının ise çeşitlere göre farklılık gösterdiği; potasyum dozlarının pazarlanabilir yumru verimi üzerine olan etkisinin ise çeşitlere göre farklılık gösterdiği belirlenmiştir. Buna göre; en yüksek pazarlanabilir yumru verimi Hermes çeşidinde 30 kg/da potasyum dozundan (4212.53 kg/ha) elde edilmiştir. Ayrıca, potasyum uygulamasının cips verimliğini artırdığı arttırdığı belirlenmiş ve en yüksek cips verimliliği 15 kg K/da dozundan elde edildiği belirlenmiştir. Ancak, araştırmanın tek yıllık olması nedeniyle kesin bir tavsiyenin yapılması öngörülemez.

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TAZE KESİLMİŞ MEYVE VE SEBZELERDE ENZİMSEL ESMERLEŞMENİN ÖNLENMESİNDE SİSTEİN KULLANIMI

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ÖZET

Ülkemizde soğuk zincirin çeşitli aşamalarında gerçekleşen kayıplar önemli boyutlara ulaşmaktadır. Yapılan çalışmalar gelişmekte olan ülkelerde taze meyve ve sebzelerde hasat sonrası işleme sırasında oluşan kayıpların %25-40 arasında değiştiğini ortaya koymuştur. Yaş meyve ve sebzelerin hasat sonrası kalitesinin arttırılması ve kayıpların önlenmesi için değişik uygulamalardan yararlanılmaktadır. Son yıllarda ürünlerin hasat sonrası kalitesinin korunması için özellikle aminoasitlerin kullanımı denenmeye başlamıştır. Proteinlerin yapı taşı olan amino asitler; bitki büyümesi ve gelişmesinde rol oynamakta, metabolik enerji üretimini etkilemekte ve hücre içi PH kontrolünü sağlamaktadır. Aminoasitlerin hasat sonrası dışsal olarak uygulanması ile ürünlerin yaşlanması geciktirilerek kalite kayıpları önlenebilmektedir. Bu derleme çalışmada aminoasitlerin yaş meyve ve sebzelerde kalitenin korunmasında kullanımına yönelik çalışmalar incelenerek özellikle sisteinin kullanım amaçlarının belirlenmesi hedeflenmiştir. Sistein, hasat sonrası yaşlanmayı engelleyen hidrojen sülfürü metabolize eden bir amino asittir. Sisteinin daha çok taze kesilmiş meyve ve sebzelerde enzimsel esmerleşmenin önlenmesi amacıyla kullanıldığı tespit edilmiştir. Bununla birlikte Longan meyvelerine L-sistein hidroklorit uygulaması tane bozulmasını geciktirmiş ve protein oksidasyonunu azaltarak, meyve kalitesini korumuş ve yaşlanmayı geciktirmiştir. Hasat sonrası %0,05 konsantrasyonundaki sistein uygulaması 10 gün depolanan kurt üzümü (goji berry) meyvelerinde, çürüme oranını ve ağırlık kaybını önemli ölçüde azaltmış ve SÇKM miktarını korumuştur. Taze kesilmiş marullarda %0,1 dozunda sistein uygulaması esmerleşme, solunum aktivitesi ve çözünür o-kinon oluşumunu yavaşlatmış ve antioksidan aktiviteyi korumuştur. Soya protein izolatı ve %0,5 sistein ile kaplanan taze kesilmiş patlıcanların yüksek oksijen şartlarında beyazlık indeksi en yüksek olmuş, sertlikleri ve ağırlık kayıpları korunmuş ve raf +ömrü 8 güne çıkmıştır. Ultrason ve L-sistein uygulanmış taze kesilmiş patateslerde 48 saat depolama süresi sonunda kontrol örneklerine göre enzimatik esmerleşme önemli oranda azalmıştır. Taze kesilmiş mantarlara 0,25 g/L, L-sistein uygulaması içsel H_2S miktarını arttırarak yaşlanmayı geciktirmiş ve raf ömrünü uzatmıştır. Sonuç olarak sisteinin hasat sonrasında özellikle taze kesilmiş meyve ve sebzelerin kalitesinin korunmasında farklı dozlarda ve farklı bileşiklerle kombinasyon halinde kullanıldığı tespit edilmiştir. Ancak yapılan çalışmalar oldukça sınırlı sayıda olup, bundan sonra yapılacak çalışmalarla sisteinin farklı türlerdeki optimum dozu ve uygulama süresinin belirlenmesinin faydalı olacağı sonucuna varılmıştır.

Anahtar Kelimeler: Meyve, sebze, hasat sonrası, sistein, enzimsel esmerleşme

USAGE OF SISTEIN IN PREVENTION OF ENZYMATIC BROWNING IN FRESH-CUT FRUIT AND VEGETABLES

ABSTRACT

The losses in various stages of the cold chain in our country reach significant dimensions. Studies have shown that losses during post-harvest processing of fresh fruits and vegetables in developing countries vary between 25-40%. Various applications are used to increase post-harvest quality and to prevent losses of fresh fruits and vegetables. In recent years, especially the use of amino acids has been tried to protect the post-harvest quality of the products. Amino acids, which are the building blocks of proteins, play a role in plant growth and development, affect metabolic energy production and provide intracellular PH control. With the exogenous application of amino acids after harvest, the aging of the products can be delayed and quality losses can be prevented. In this review study, studies on the use of amino acids in the preservation of quality in fresh fruits and vegetables were examined and it was aimed to determine the purpose of use of cysteine. Cysteine is an amino acid that metabolizes hydrogen sulfide, which inhibits postharvest aging. It has been determined that cysteine is mostly used to prevent enzymatic browning in freshly cut fruits and vegetables. On the other hand, L-cysteine hydrochloride application to Longan fruits delayed grain deterioration and reduced protein oxidation, preserved fruit quality and delayed aging. Cysteine application at a concentration of 0.05% after harvest significantly reduced the rotting rate and weight loss in goji berry fruits stored for 10 days, and preserved the amount of TSS. Cysteine application at a dose of 0.1% in freshly cut lettuce slowed browning, respiratory activity and soluble o-quinone formation and preserved antioxidant activity. Freshly cut eggplants coated with soy protein isolate and 0.5% cysteine had the highest whiteness index under high oxygen conditions, their firmness and weight loss were preserved and their shelf life increased to 8 days. Enzymatic browning of freshly cut potatoes treated with ultrasound and L-cysteine was significantly reduced after 48 hours of storage compared to control samples. Application of 0.25 g/L, L-cysteine to fresh cut mushrooms delayed aging by increasing the amount of intrinsic H2S and extended shelf life. As a result, it has been determined that cysteine is used in different doses and in combination with different compounds, especially in maintaining the quality of freshly cut fruits and vegetables after harvest. However, the studies are very limited, and it was concluded that it would be beneficial to determine the optimum dose and application time of cysteine in different species with future studies.

Keywords: Fruit, vegetables, postharvest, sistein, enzymatic browning

GİRİŞ

Hasat sonrası taze meyve ve sebzeler çeşitli nedenlerle kalite kayıplarına uğramakta, bu kayıplar tür ve çeşite göre değişmektedir. Çeşitli hastalık etmenleri, zararlılar, yanlış kültürel işlemler, ilaçlar ve iklim meyve ve sebzelerde kalitenin azalmasına, bu da pazarlanabilir ürün miktarında azalmalara yol açmaktadır. *Mekanik zararlanmalar:* yaralanmalar, kabuk sıyrılması, çizilmeler, yaprak yırtılmaları, çiçek düşmeleri şeklinde oluşmakta, bunun sonucunda metabolizma hızlanmakta, su kaybı ve ürün miktarında kayıplar meydana gelmektedir. *Su kaybı:* meyve ve sebzelerde ağırlık kaybı, solma ve buruşma ayrıca ürünün sertliği ve gevrekliğinde azalma, renk solması ve taze görünüş kaybına neden olmaktadır. *Fizyolojik bozulmalar:* derim öncesi ve sonrası oluşan metabolizma anormallikleri fizyolojik bozukluklara öncülük etmektedir. Hasat sonrası kalite kaybını azaltmak ve raf ömrünü uzatmak için, soğuk depolama, kontrollü atmosfer depolama, yenilebilir flim kaplamalar, uçuçu yağların kullanımı ve çeşitli amino asit kullanımları araştırmacıların üzerine durdukları yöntemler arasında yerini almaktadır.

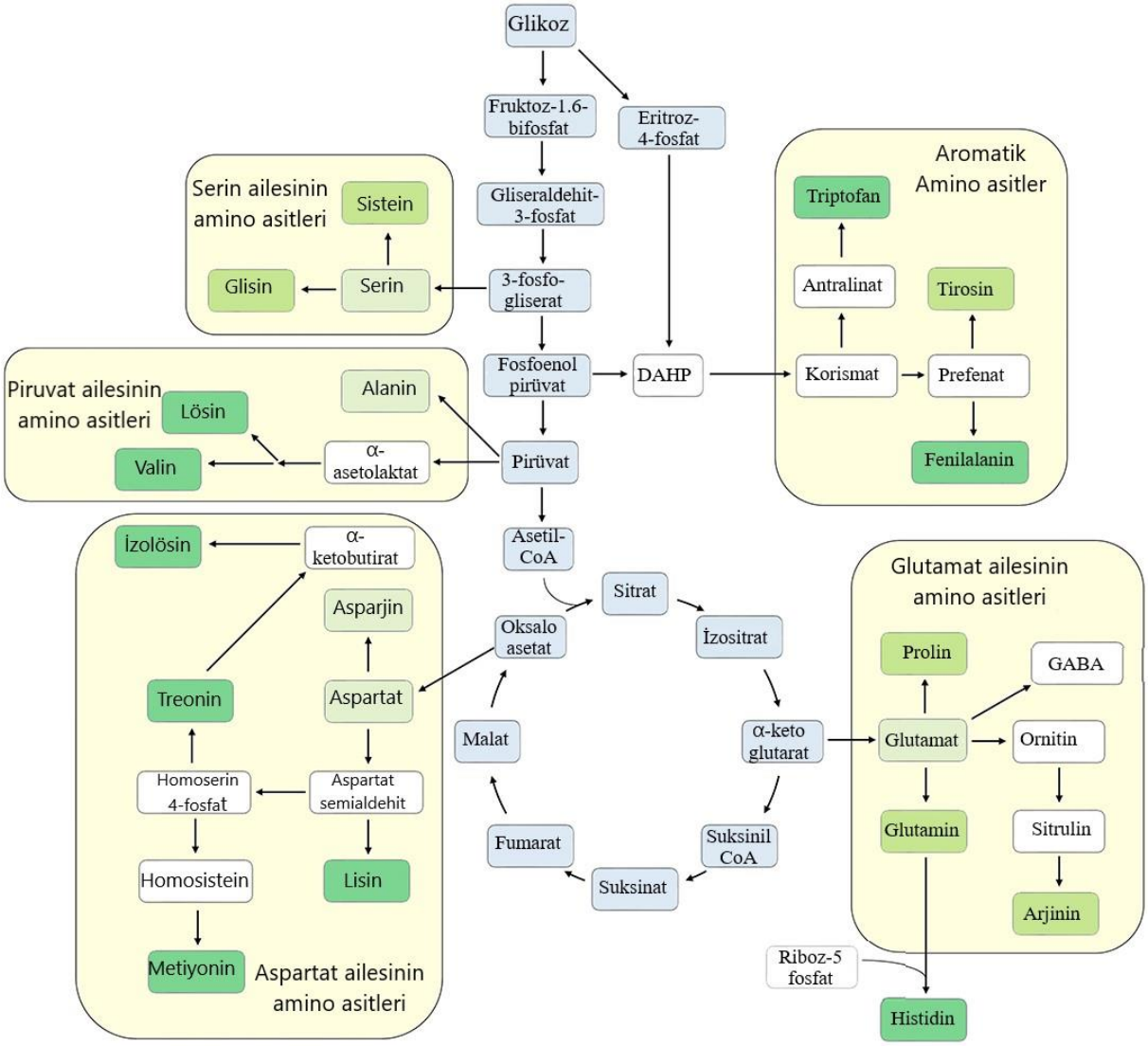
Amino asitler protein sentezi için yapı taşları olmalarının yanı sıra, protein sentezinde yer almayan birçok amino asit bitki gelişiminde aktif rol oynamakta ve bitkinin çevresel streslere karşı oluşturdukları tepkilere katılmaktadır (Trovato vd., 2021). Amino asitler çok sayıda hücresel reaksiyonlarda görev almakta (Çizelge 1) bu nedenle bitki büyüme gelişme, hücre içi pH kontrolü, metabolik enerji üretimi, abiyotik ve biyotik strese karşı direnç gibi birçok fizyolojik süreci etkilemektedir (Hildebrandt vd., 2015).

Çizelge 1. Aminoasitlerin bitki içindeki görevleri (Baqir vd., 2019).

Amino asit	Bitkideki rolü
Glisin	Fotosentezi aktive ederek etkinliğini arttırır, klorofil oluşumunu arttırır ve vejetatif büyümeyi teşvik eder, tozlanma ve verimde de etkilidir.
Alanin	Bitki büyüme hızını etkiler ve klorofil oluşumunu aktive eder
Valin	Büyüme hızını, kök oluşumunu ve tohum üretimini etkiler
Metiyonin	Etilen oluşum döngüsüne girerek meyve olgunlaşmasını hızlandırır ve kök aktivasyonunda rol oynar
İzolösin	Kök sistemini, büyümeyi ve erken verimi arttırır
Treonin	Bitkinin hastalıklara dayanımını arttırır
Sistein	Bitkilerde yaşamsal süreçlerin arttırılması ve düzenlenmesi ve hastalık direncinin arttırılması
Fenilalanin	Bitki hücrelerinin ve embriyo oluşumunun teşvik edilmesi
Serin	Bitkinin hastalık direncinin arttırılması, klorofilin aktivasyonu ve bitki içinde hormonların dengelenmesi
Tirosin	Bitkinin hastalık direncinin arttırılması
Lisin	Sürgün sistemi, büyüme ve erken verimin teşvik edilmesi
Lösin	Hastalıklara direncin arttırılması
Glutamik asit	Sürgün sistemi, büyüme ve erken verimin teşvik edilmesi
Aspartik asit	Bitkinin hastalık direncinin arttırılması
Arjinin	Bitkinin sıcaklık, don, kuraklık ve tuzluluk gibi abiyotik stres şartlarına direncinin arttırılması, klorofil oluşumu ve kök oluşumun, hücre bölünmesi ve poliamid oluşunun

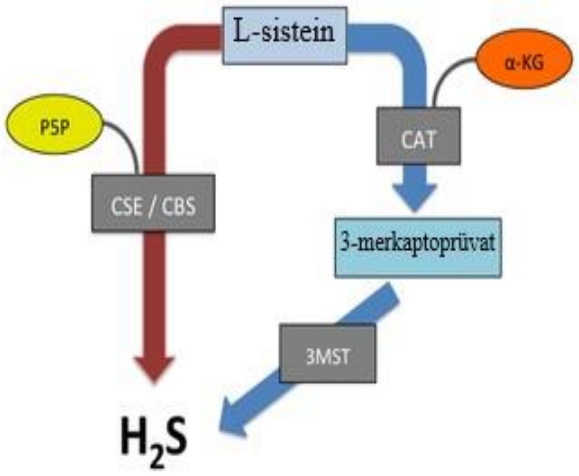
Ayrıca amino asitler birincil ve ikincil metabolitlerin çoğu için öncü görevi görmektedir. Bitkiler, insanlar ve hayvanların tersine proteinojenik yirmi bir amino asidin tamamını sentezlemektedir (Şekil 1, Trovato vd., 2021). Bu aminoasitler içerisinde yer alan ve yapısında kükürt içeren sülfirik amino asitler arasında bulunan sisteinin proteinlerdeki işlevi, polipeptit zincirleri arasında ve bunların içinde disülfit bağlarını (-S-S-) oluşturarak proteinlerin katlanmasını ve sarılmasını sağlamasıdır. Bu bağlar proteinin şeklini ve yapısını belirlemede önemlidir ve ayrıca protein enzimlerinin oluşumunda yer alır (Baqir vd., 2019). Bitkilerde ilk sentezlenen organik kükürt bileşiği L-sisteindir. Metionin, glutatyon, sistin, kofaktörler ve fitoaleksinler ve temel vitaminler ile diğer kükürt türevleri dahil olmak üzere tüm indirgenmiş kükürt içeren biyomoleküllerin merkezi öncüsü olarak işlev görmektedir. L-sistein bitkilerin birincil ve ikincil metabolizmasında merkezi bir konuma sahiptir. L-sistein artık genel olarak güvenli bir amino asit olarak kabul edilmektedir ve tarım, tıp, kozmetik, gıda katkı maddeleri,

taze kesilmiş meyve ve sebzelerin muhafazasında geniş çapta uygulanmaktadır (Wang vd., 2022). L-sistein, hidrojen sülfitin (H_2S) öncüsü olup, tek başına veya çeşitli kaplamalar ve organik asitle kombinasyon halinde yaygın olarak kullanılmaktadır (Wang vd., 2023) Hidrojen sülfit, L-sisteinden üç enzimatik yolla üretilmektedir (Şekil 2, Flannigan vd., 2013)



Şekil 1. Bitkilerde amino asit biyosentezi, GABA: γ-aminobutirik asit, 3-deoksi-D-arabinoheptulosonat-7-fosfat.

1. Piridoksal-5'-fosfat (P5P) bağımlı enzimler, sistatiyonin-β-sentaz (CBS) ve sistatiyonin-Y-liyaz (CSE), L-sisteini metabolize ederek H_2S oluşturabilir.
2. L-sistein a-ketoglutaratın (a-KG) varlığında, sistein aminotransferaz (CAT) enzimi aracılığıyla 3-merkaptopiruvata dönüştürülebilir.
3. Mitokondriye lokalize olan merkaptopiruvat transferaz (3MST), 3-merkaptopiruvatı metabolize ederek, H_2S oluşturabilir



Şekil 2. L-sisteinden hidrojen sülfit üretim yolu

Sistein meyve ve sebzelerde enzimatik esmerleşmeyi geciktirmekte, fenolik madde miktarını arttırmakta, üşüme zararını geciktirmekte dolayısıyla depo ve raf ömrünü uzatmaktadır (Ali vd., 2016, Ghidelli vd., 2018, Al Ubeed vd., 2019).Bu çalışmada taze kesilmiş meyve ve sebzelerde kalitenin korunması için yapılan sistein uygulamaları ve sonuçları derlenmiştir.

TAZE KESİLMİŞ MEYVE VE SEBZELERDE HASAT SONRASI SİSTEİN UYGULAMALARI

Son on yılda meyve ve sebzelerin hasat sonrası kayıplarını kontrol etmek üzerine yapılan çalışmalarda çoğunlukla arjininin kullanılmış olup, bu uygulamayı sistein kullanımı izlemiştir. Arjinin genel olarak yaşlanmanın önlenmesi açısından denenirken, arjinin ve sisteinin üşüme zararını baskılayıcı ve taze kesilmiş ürünlerde enzimatik esmerleşmeyi önleyici etkileri de bulunmuştur (Sohail vd., 2021). Taze kesilmiş bamyada esmerleşmenin önlenmesi ve fiziksel ve kimyasal kalitenin korunması üzerine anti-renk maddelerinin etkilerinin araştırıldığı çalışmada taze kesilmiş bamyalar %0,5`lik sistein, askorbik asit, kalisyum klorür ve sitrik asit çözeltilerine 5 dakika süre ile daldırıldıktan sonra polipropilen torbada 5°C sıcaklıkta %95 nemde 8 gün boyunca depolanmıştır. Askorbik asit ve sistein uygulamaları polifenoloksidazı (PPO) güçlü bir şekilde önlemeleri ve renkli kinonlarla reaksiyona girerek renksiz ürünleri oluşturmaları nedeniyle en iyi anti-renklenme maddeleri olmuştur (Saleh vd., 2013). Ghidelli vd., (2014), soya proteini izolatı ve sisteinden oluşan yenilebilir kaplama ve modifiye atmosfer paketlemenin taze kesilmiş patlıcanda raf ömrünün uzatılması üzerindeki etkilerini araştırmışlardır. Çalışmada soya protein izolatı ve %0,5 sistein ile kaplanan patlıcanlar, 80 kPa O_2 içeren modifiye atmosfer şartlarında paketlenmiş ve 5°C sıcaklıkta depolanmıştır.

Çalışmanın sonucunda sistein içeren yenilebilir kaplama ve yüksek oksijen şartlarındaki patlıcanların beyazlık indeksi en yüksek olmuş, sertlikleri ve ağırlık kayıpları korunmuştur. Ayrıca, yenilebilir kaplama içindeki sistein konsantrasyonunun arttırılması yüksek oksijen şartlarında taze kesilmiş patlıcanların raf ömrünü 8 güne çıkarmıştır.

Taze kesilmiş marullarda anti-esmerleşme maddesi olarak L-sisteinin etkilerinin araştırıldığı çalışmada taze kesilmiş marullara iki farklı konsantrasyonda L-sistein uygulanmış ve %0,1 sistein konsantrasyonunun esmerleşme, solunum aktivitesi ve çözünür o-kinon oluşumunu yavaşlattığı ve antioksidan aktiviteyi koruduğu belirlenmiştir. Dolayısıyla ikinci denemede kullanılan %0,1 sistein taze kesilmiş marulların raf ömrünü kontrole göre %40 arttırmış, ayrıca görünüş ve tekstür puanları yüksek olmuş, esmerleşmenin görülmemiş ve istenmeyen koku oluşumunu da önlemiştir. Bütün bu etkiler nedeniyle L-sisteinin taze kesilmiş marul için anti-esmerleşme maddesi olarak uygun olduğu sonucuna varılmıştır (Pace vd., 2015).

Litchi meyvelerine % 0, 0,25, 0,50, 0,75 ve 1,0 olmak üzere farklı konsantrasyonlarda L-sistein uygulanarak 5℃`de %90±5 oransal nemde 28 gün boyunca depolanmıştır. Farklı L-sistein dozlarından %0,25 konsantrasyonu meyvelerin ağırlık kaybını, hastalık insidasını, şiddetini, esmerleşme indeksini, membran sızıntısını ve malondialdehit (MDA) içeriği önemli ölçüde azaltarak, en etkili uygulama olmuştur. Bu uygulama ayrıca perikarp asidik PH`nı korumuş olup peroksidoz (POD) ve polifenol (PPO) enzim aktivitesinde azalma ile birlikte toplam antosiyanin, 2,2-difenil-1-pikril-hidrazil (DPPH) radikal süpürme aktivitesi ve toplam fenolik miktarında artışla sonuçlanmıştır. %0,25 dozunda sistein uygulaması aynı zamanda titre edilebilir asitlik (TA), askorbik asit miktarı ve katalaz (CAT), ile superoksit distumaz (SOD) enzim aktivitelerini korumuştur. Sonuç olarak litchi meyvelerine depolama öncesi L-sistein uygulaması (%0,25) perikarp esmerleşme indeksini azaltmış ve antioksidan sistemin 28 günlük depolama süresince korunmasını sağlamıştır (Ali vd., 2016).

Bir diğer tropik meyve olan ejderha gözü(longan) meyvelerinde tipik yaşlanma özelliği tane bozulması hasat sonrası ömrünü sınırlamaktadır. Longan meyvelerine L-sistein hidroklorit uygulaması tane bozulmasını geciktirmiş ve meyve kalitesini hidrojen peroksit birikimini ve protein oksidasyonunu azaltarak korumuştur. Genel olarak bu bulgular yapılan uygulamanın antioksidan ve oksitlenmiş protein onarım kapasitesini arttırdığı ve oksidatif hasarı azaltmaya katkıda bulunan daha yüksek indirgeyici durumu koruduğu ve böylece yaşlanmayı geciktirdiğini göstermiştir (Li vd., 2018).

Taze kesilmiş kırmızı pancarlara sistein uygulamasının biyoaktif bileşenlerin ve antioksidan kapasitenin korunması üzerindeki etkisinin araştırıldığı çalışmada, kırmızı pancar taze kesildikten sonra 2 mM, 4 mM, 8 mM ve 16 mM dozlarında sistein uygulanmıştır. Sistein gallik

asit, kafeik asit, klorogenik asit, kaempferol ve betalain miktarını 6 günlük depolama boyunca arttırmıştır. Sisteinin 4 mM'dan daha fazla konsantrasyonları gallik asit, kaempferol ve betalain miktarlarını korumuştur. Sisteinin polifenol ve betalain birikimini uyararak fenilpropanoid yolunu etkiliyor gibi görünmektedir. Kırmızı pancarda sistein PPO aktivitesini inhibe etmemiş, ancak PAL aktivetisini artırmıştır. Çalışmada betalainlerin, antioksidan kapasiteye fenoliklerden daha fazla katkıda bulunduğu ancak sistein ile ilişkilerinin tam olarak aydınlatılamadığı da belirtilmiştir (Preczenhak vd., 2019). Taze kesilmiş taroda 5 dakika süreyle %1 sistein uygulamasının 4°C`de %95 oransal nemde 12 gün süreyle kaliteyi önemli oranda koruduğu bulunmuştur (Haffez vd., 2020). Sabit 40 kHz frekansta 200 w'ta 2 dakika süreyle ultrases (US) ve %0.01 sisteinin tek tek ve birlikte uygulanmasının taze kesilmiş lotus köklerinde esmerleşmenin önlenmesi ve fizikokimyasal kalitenin korunması üzerine etkileri incelenmiştir. Çalışmada US+sistein uygulamasının esmerleşmeyi US ve sisteinin bireysel uygulamalarına göre geciktirdiği; esmerleşmenin geciktirilmesinin L değerinde ve WI değerlerindeki artış ile b, kroma, BI ve ΔE değerlerindeki azalma ile eşzamanlı gerçekleştiği belirlenmiştir. Sistein ve US+sistein PPO artışını US'den daha iyi kontrol etmiştir Tüm uygulamalar kontrole göre toplam fenol konsantrasyonundaki artışı geciktirmiştir. Uygulamaların hepsi lotus kök dilimlerinin sertliğini korumuş, fakat toplam şeker miktarını etkilememiştir. Her iki ultrases uygulaması ferrik azaltıcı antioksidant potansiyeli (FRAP) arttırırken serbest radikal süpürme aktivitesi sistein ile arttırılmıştır. Sonuç olarak hem sistein hem de US lotus kök dilimlerinin esmerleşmesini önleyebilir ve fizikokimyasal kalitesini korur ve eş zamanlı US ve sistein uygulaması sinerjistik anti-esmerleşme etkisi gösterir (Wen vd., 2020). Taze kesilmiş nilüfer (lotus) köklerinde L-sistein (L-sis) ve sitrik asit (CA) ile kombine edilmiş sodyum aljinat (SA) kaplamanın esmerleşme ve mikrobiyal büyüme üzerine etkisi 4°C sıcaklıkta depolama süresince incelenmiştir. SA+L-sis+CA uygulamaları görsel ve tat kalitesi üzerine SA ve L-sis+CA uygulamalarından daha etkili olmuştur. Üçlü kaplama süperoksit dismutaz, katalaz ve aksorbat peroksidaz enzimlerinin O_2^- ve H_2O_2 gibi reaktif oksijen türlerini süpürme yeteneğini iyileştirmiştir. Ayrıca kontrole göre fenil alanin amonyak liyaz, peroksidaz ve membran lipitlerini parçalayan fosfolipaz D, lipaz ve lipoksigenaz enzimlerinin aktivitesini azaltmış, ek olarak doymuş ve doymamış yağ asitlerinin yüksek oranda korumasının yanısıra fenoliklerin ve malondialdenitin düzeylerini düşürmüştür. Uygulanan kaplama taze kesilmiş lotus köklerinin raf ömrünü 4°C`de 14 gün boyunca koruyabilmiştir (Gouda vd., 2021).

Farklı dozlarda prolin (0, 5, 10, and 15 mM) ve L-sistein (0, 0.2, 0.4 and 0.6%) uygulamalarının depolama süresince yassı (devebastı) `Maleki` şeftali meyvelerinde üşüme zararı ve iç kararması üzerindeki etkileri araştırılmıştır. Çalışmada, 25 mM prolin ve %0,4 sistein

uygulanan meyvelerinde içsel kararma düzeyleri azalmış ve bu uygulamalar suda çözünür toplam kurumadde miktarındaki (SÇKM) aşırı yükselmeyi önlemiş, TA miktarını ve meyve yumuşamasını azaltmıştır. Uygulama yapılmış meyvelerde hidrojen peroksit, malondialdehit (MDA), elektrolit sızıntısının birikimi azalmış ve askorbik asit miktarı ve antioksidan kapasite ile antioksidan enzimlerin aktivitesi yükselmiştir. Uygulama yapılmış meyvelerde ayrıca fenilalanin amonyak liyaz (PAL) aktivitesi artarken, polifenol oksidaz (PPO) miktarı azalmış bu da toplam fenol ve flavonoid birikiminin artmasına yol açmıştır (Gohari vd., 2021). Hasat sonrası %0, %0,1, %0,05 ve %0,10 konsantrasyonlardaki sisteinin 4°C`de % 90 nemde 10 gün boyunca depolanan kurt üzümü (goji berry) meyvelerinin duyusal kalitesi ve biyoaktif bileşenler üzerindeki etkilerinin araştırıldığı çalışmada, %0,05 sistein uygulamasının çürüme oranını ve ağırlık kaybını önemli ölçüde azalttığı ve SÇKM koruduğu bulunmuştur. Bu uygulama ayrıca toplam fenolik, askorbik asit ve toplam glutatyon içeriğini artırarak antioksidan kapasitesini de arttırmıştır (Wang vd., 2022). Taze kesilmiş mantarlar tüketiciler arasında popüler olmasına karşılık, kalite de meydana gelen değişimler raf ömrünü önemli oranda azaltmaktadır. Taze kesilmiş mantarlara 0,25 g/L dozunda L-sistein uygulaması esmerleşme derecesini geciktirmiş ve ağırlık kayıplarını azaltmıştır. Bu uygulama malondialdehit miktarı, lipoksigenaz aktividesi ve indirgen şeker seviyesini azaltırken, çözünür protein ve toplam fenolik miktarını arttırmıştır. Üstelik, L-sistein süperoksit dismutaz, glutatyon redüktaz ve fenilalanin amonyak liyaz aktivitelerini iyileştirirken, toplam polifenol oksidaz ve peroksidaz aktivitesini azaltmıştır. Ek olarak L-sistein uygulaması içsel H_2S miktarını arttırmıştır. Dolayısıyla L-sistein uygulaması yaşlanmayı geciktirmiş ve aktif oksijen türlerinin metabolizmasını ve su kaybını düzenleyerek ve içsel H_2S üretimini uyararak raf ömrünü uzatmıştır (Jiang vd., 2023).

SONUÇ

Sonuç olarak, L-sistein taze meyve ve sebzelerde ağırlık kaybını azaltmakta, fuenolik madde miktarını arttırmakta, meyve eti sertliğini korumakta, suda çözünür toplam kurumadde miktarını arttırmakta, olifenoloksidaz ve peroksidaz aktivitelerini arttırmakta dolayısıyla esmerleşmeyi önlemektedir. Dolayısıyla taze kesilmiş meyve ve sebzelerin depolanması süresince kalitelerinin korunmasını sağlamakta, olgunlaşma ve yaşlanmayı geciktirerek, muhafaza süresi ve raf ömrünü uzatmaktadır. Bununla birlikte taze kesilmiş meyve ve sebzelerde bu anlamda yapılan çalışma sayısı oldukça sınırlı düzeyde kalmıştır. Gelecekteki çalışmalarda sisteinin etkilerinin diğer sebze ve meyve türlerinde denenmesi, bu alandaki etkiyi genişletecektir.

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KENTSEL MEKANLARDA FARKLI SU FORMLARININ DIŞ MEKÂN TERMAL KONFORA ETKISININ ENVI-MET İLE ANALİZİ: ERZURUM KENT MERKEZİ

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ÖZET
Özellikle son yıllarda geçirimsiz yüzeylere bağlı olarak artan kentsel ısı adası ve bunun mikro-iklim üzerine etkisi dış mekân termal konforunu değiştirmektedir. Kamuya açık alanlarda mekân ihtiyacına cevap verebilen, mekâna uygun tasarlanan peyzaj tasarımları ile termal konfor iyileştirilebilmektedir. Bu amaçla çalışma kapsamında peyzaj tasarımının önemli bir elemanı olan su ve suyun kullanım formu incelenmiştir. Kullanılan su formlarının dış mekân termal konfora etkisi analiz edilerek çalışma verileri aktarılmıştır. Bu araştırmada özellikle kamusal alanlarda dış mekan termal konforunu en olumlu etkileyen su formu belirlenmeye çalışılmıştır. Erzurum kent merkezinde bulunan bir okul bahçesi çalışma alanı olarak belirlenmiş olup çalışma alanında kurulu bulunan meteoroloji istasyonundan 2022 yılı yaz ayları için saatlik olarak elde edilen mikro iklim verileri analiz edilmiştir. Seçilen okul bahçesinde farklı su formları kullanılarak peyzaj tasarım senaryoları oluşturulmuştur. Bu senaryoların oluşturulmasında kullanılan suyun fiskiyeli, hareketli ve durgun su yüzeyi sistemi olduğu durumları kurgulanmıştır. Üretilen senaryolardan hangisinin termal konfor açısından daha avantajlı olduğunu belirlemek için; ENVI-met BIO + Science modeli kullanılarak analizler yapılmıştır. Önemli bir kış kenti olan Erzurum ilinde kış ayında su yüzeyi kullanılmadığı için yalnızca yaz ayları için analizler yapılmıştır. Bu çalışma sonucu; kent merkezinde farklı su formları kullanarak dış mekân termal konforunun bölgenin doğal özelliklerine uygun peyzaj tasarımları ile ne kadar katkı verilebileceği gösterilmiştir. Özellikle su yüzeyi oranı artırıldıkça suyun serinletme etkisinin de arttığı belirlenmiştir. Kentsel mekanlarda dış mekân termal konforunun iyileştirilebilmesi için daha çok sayıda peyzaj su tasarım senaryosunun analiz edilmesi gerekmektedir. Kendi kendine yetebilen, yaşanabilir ve doğa dostu bir kentleşme oluşturulabilmesi için ilgili bilim dalları ile birlikte çalışılması gerektiği belirtilmiştir.

Anahtar Kelimeler: ENVI-met, Kent Merkezi, Su formu, FES

ANALYSIS OF THE OUTDOOR THERMAL COMFORT IMPACT OF DIFFERENT WATER FORMS IN URBAN SPACES USING ENVI-MET: ERZURUM CITY CENTER

ABSTRACT

Especially in recent years, the urban heat island effect, which has increased due to impermeable surfaces, is changing the outdoor thermal comfort, and its impact on microclimate. Thermal comfort can be improved with a landscape design that responds to spatial needs and is properly designed for outdoor areas open to the public. In this study, water and its usage form, which is an important element of landscape design, have been examined with the aim of analyzing the impact of water forms on outdoor thermal comfort. The study data was transferred by analyzing the effect of the water forms used on outdoor thermal comfort. This research particularly attempts to determine the water form that has the most positive impact on outdoor thermal comfort in public areas. A schoolyard located in the city center of Erzurum has been determined as the study area, and the microclimate data obtained on an hourly basis for the summer months of 2022 from the meteorological station in the study area has been analyzed. Landscape design scenarios were created using different water forms in the selected schoolyard. The scenarios included fountain, moving water, and stagnant water surface systems. To determine which scenario is more advantageous in terms of thermal comfort, analyses were conducted using the ENVI-met BIO + Science model. As Erzurum is an important winter city, the analyses were only conducted for the summer months as water surfaces are not used in the winter. As a result of this study, it has been demonstrated how much contribution can be made to outdoor thermal comfort in urban areas by using different water forms and landscape designs that are suitable for the natural characteristics of the region. It has been determined that the cooling effect of water increases as the water surface area is increased. In order to improve outdoor thermal comfort in urban spaces, a larger number of landscape water design scenarios need to be analyzed. It has been emphasized that collaboration with relevant scientific disciplines is necessary to create a self-sufficient, livable, and nature-friendly urban development.

Keywords: ENVI-met, City Center, Water form, PET

GİRİŞ

Yaşadığımız çağ dünyasında kentlerde ısıyı emen sert zeminlerin oranı giderek artmaktadır. Bu oluşumlara bağlı olarak kentsel ısı adaları oluşmaktadır. Oluşan bu kentsel ısı adaları mikro iklime etki etmektedir (Mirzai ve Hagigat, 2010; Sun vd., 2017; Oke vd., 2017). Kentsel mekanların tasarımının dış mekan termal konforu üzerinde büyük etkisi olduğu ve dikkate alınması gerektiği vurgulanmıştır. Su materyalini kullanarak farklı iklim modelleri ile kentsel peyzaj senaryolarının analizine olumlu katkı sağladığı vurgulanmıştır (Yılmaz vd., 2018; Chokhachian vd., 2020; Ma vd., 2020; Yılmaz ve diğerleri, 2021a, 2021b). İnsanların sağlıklı ve konforlu bir yaşam sürdürebilmeleri için termal konfor ihtiyaçları oldukça önemlidir. Bu nedenle, kentsel mekanların termal konfora etkisi üzerine araştırmalar yapmak son derece kritik bir öneme sahiptir. Çalışma yapılan alanın yüksek bir rakımda konumlanmış olması yakın çevrede bulunan halkın yaşam kalitesini kış aylarında olumsuz etkilemektedir. Kış mevsiminin uzun ve sert geçmesi nedeni ile hava kirliliği önemli bir sorun teşkil etmektedir. Karasal iklimin hüküm sürdüğü çalışma alanında da yaz ayları gündüzleri sıcak geçmektedir. Özellikle kentsel mekan içinde yer alan kent parklarında termal konforun iyileştirilmesi için alternatif su kullanımları analiz edilmiştir. Kentlerde özellikle peyzaj tasarımlarında su yüzeyleri yalnızca termal konforu iyileştirmek için değil, aynı zamanda psikolojik olarak da olumlu katkı sağlamaktadır (Yılmaz, 2022). ENVI-met modeli kullanılarak yapılan analizlerde özellikle yaz ayları için serinletici etkisi olduğu, bunun bitkilerle desteklenmesi halinde farkın daha da arttığı araştırmalar yapılmıştır (su yüzeyi seçeneklerinin denendiği (Wu et al., 2019; Gupta et al., 2019). Daha elverişli yaşam standardı sağlamak için çevrenin doğal yapısına uygun peyzaj tasarımlarına yer verilmesi gerektiği belirtilmiştir (Yılmaz vd., 2021a; Yılmaz vd., 2022). Bu çalışma; Erzurum kent merkezinde bulunan bir okul ve yakın çevresinde gerçekleştirilmiştir. Oluşturulan farklı peyzaj tasarımları için ENVI-met BIO + Science yazılımı kullanılarak okul çevresinin analizleri yapılmıştır. Bu amaçla çalışmada farklı su formlarının kentsel mekanlarda kullanımın termal konfora olan etkisi incelenmiştir.

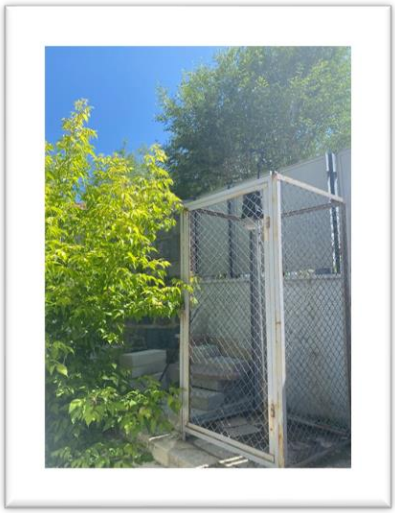
MATERYAL ve METOD

Çalışma alanı Erzurum il merkezinde yer almaktadır. Yaklaşık yirmi dört bin metrekare çalışma alanında yeşil alanlar, okul, iş merkezleri, cami vs. bulunmaktadır. Araştırma alanının konum haritası Şekil 1'de gösterilmiştir. Erzurum kent merkezinde çalışma alanında 1.5m yükseklikte ve 120 x 120 cm genişliğinde kurulan bir meteoroloji istasyonunun yıllık verilerinden yararlanılmıştır. Çalışma alanında kaydedilen 2022 yılına ait meteoroloji verileri kullanılmıştır.

Yılın en sıcak günü olan 15 Ağustos 2022 için 24 saatlik mikro iklim verileri, sıcaklık , nem, bulutluluk, rüzgar hızı , rüzgar yönü değerlendirilmiştir. Araştırma alanında mikro-iklim veri toplama için kullanılan Ventage Pro 2 plus cihazı ölçümler için kullanılmıştır. Cihaz, hırsızlığa ve çevresel hasara karşı korumak için koruyucu bir kafes içine alınmıştır (Şekil 2). Bu çalışmada kullanılan verilerin analizi, insanların açık alanı daha yoğun ve aktif olarak kullandığı saat 15:00'ten sonrası için değerlendirilmiştir.



Şekil 1 – Çalışma alanı lokasyon haritası



Şekil 2 -Okul bahçesinde kurulu ölçüm cihazı: Davis Vantage Pro 2

Bruse (2023) tarafından geliştirilen bu bilgisayar yazılımı, tek bir yapı maksimum 250 ızgara sağlayan, 0,5 ila 10 m arasında çözünürlükte, 24 saatlik veri kullanılarak, kentsel alanda yüzey havasını yeniden simülasyonlar yapabilen küçük ölçekli bir atmosfer için uyarlanmaktadır. Bu modelde tavan, taban ve yüksekliği içeren üç boyutlu bir kutu içinde gibi alan için simülasyonlar yapılmaktadır (Bruse, 2023; Guo et al., 2023). ENVI-met, çevresel mikro iklim simülasyonu yapabilen ve karmaşık termal etkileşimleri modelleyebilen bir araç olarak kentsel mekânların termal performansını değerlendirmek ve iyileştirmek için yaygın olarak kullanılan bir yazılımdır. ENVI-met BIO Science yazılımı, dış mekan termal konforunu analiz etmek için en yaygın kullanılan iklim modeli olarak kabul edilmektedir (Tsoka vd., 2018).

Erzurum Kent Merkezi İçin Hazırlanan Senaryolar

Erzurum kent merkezinde bulunan bir okulun bahçesinden mikro-iklim verileri ölçülerek kaydedilmiştir. Elde edilen veriler için farklı su senaryoları oluşturulmuştur. Tüm analizler yaz ayı için yapılmıştır. Bu senaryolar aşağıda verilmiştir.

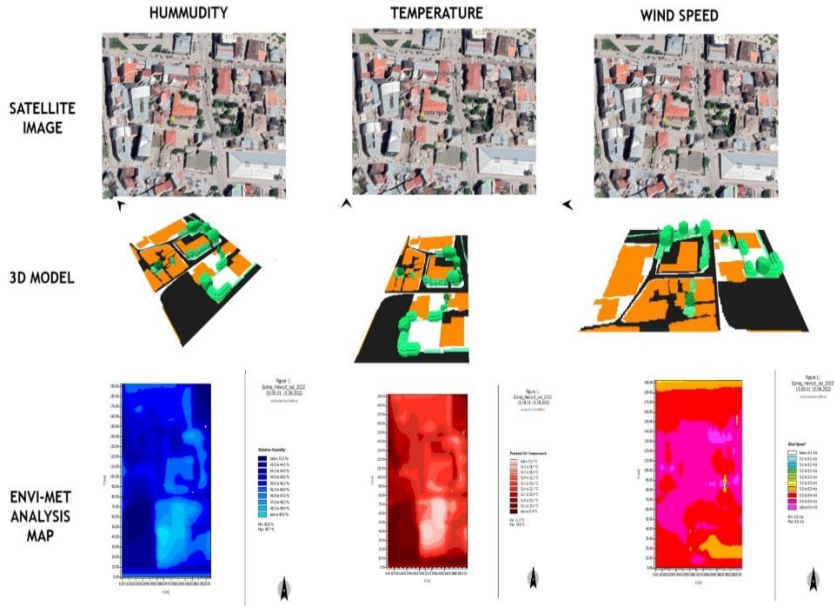
- Mevcut durum için analiz
- Durgun su yüzeyi içi analiz
- Kaskatlı su yüzeyi için analiz
- Tek parça ve parçalı su yüzeyi için analiz

ARAŞTIRMA SONUÇLARI

Bu çalışmada bölgenin mevcut durumu da dahil olmak üzere dört farklı senaryo analiz edilmiştir. Ancak analizlerden iki tanesinin sonuçları tamamlanmış ve bunlar sempozyum kapsamında sunulmuştur. Çalışmanın analizleri hala devam etmektedir. Çalışma alanının 3D çizimi oluşturulmuş ve çevre analizi de yapılmıştır. Çalışma alanına ait görselde sarı ile gösterilen yerler meteoroloji istasyonlarının yerini göstermektedir. 2022 yılının en sıcak günü olarak belirlenen 15 Ağustos günü mikro iklim verileri ENVI-met kullanılarak analiz edilmiştir. Bu analizlerin sonuçları sırası ile aşağıda belirtilmiştir.

Mevcut Durum Analizi

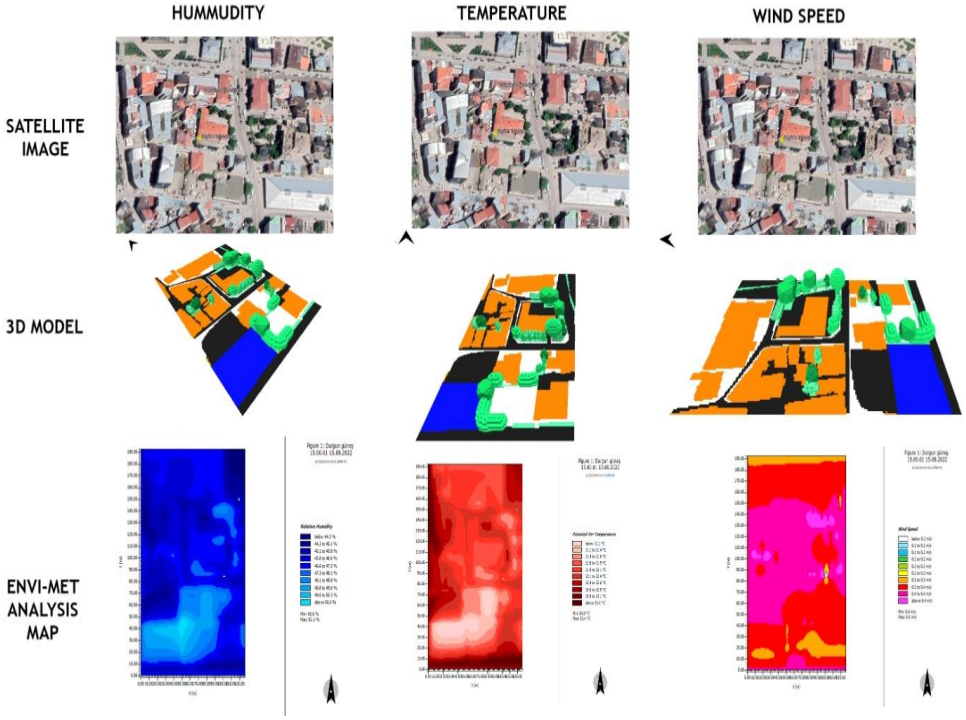
ENVI-met kullanılarak Erzurum kent merkezinin mevcut durumunun analiz sonuçlarını göstermektedir (Şekil 3). ENVI-met ile mevcut duruma ilişkin yaz analizi, sıcak havanın alanın güneydoğusunda sert zeminin yoğun olduğu bölgede daha fazla olduğu görülmüştür. Nem verilerine bakıldığı zaman bu durumun tersi bir olay ile karşılaşılmıştır. Rüzgâr hızının şiddetli olmadığı ve çalışma alanında homojen bir dağılım gösterdiği görülmüştür.



Şekil 3 – Mevcut Durum Analizi

Durgun Su Yüzeyi İçin Analiz

Bu senaryo çalışma alanında durgun su materyali kullanılarak oluşturulmuştur. Durgun su analizinde, su materyalinin kullanıldığı bölgede nem %1.4 oranının da arttırdığı görülmüştür. Sıcaklığın ise 0.2 C° azaldığı görülmüştür (Şekil 4). Çalışmalar dijital ortamda gerçekleştiği ve uzun zaman aldığı için diğer su formların analiz sonuçları tamamlanmamıştır.



Şekil 4 – Durgun su yüzeyinin yaz ayı için ENVI-met ile analizi

TARTIŞMA ve SONUÇ

Çalışma da ortaya çıkan analiz sonuçlarında açıkça görülmektedir ki artan kullanılan su materyali dışarıdaki alanın termal konforunu pozitif yönde etkilemektedir. Dış mekan termal konforu açısından su materyali önemlidir. Hangi su formunun daha etkili olduğunu saptamak için çalışmalar devam ettirilmelidir. Araştırmada, kent merkezinde su kullanımının yaz aylarında termal konforu arttırdığı sonucuna varılmıştır. Nitekim kullanılan su yüzeyinin de etkili olduğu yapılan araştırmalar ile ortaya konulmuştur. Yapılan bir araştırmada parçalı su yüzeyinden ise tek parça büyük su yüzeyinin serinletici etkisi daha fazla olarak belirlenmiştir (Yücekaya et al., 2022). Bu araştırmada su yüzeyinin olduğu alanda sıcaklıkta 0.2 C ‘lik bir düşme görülür iken rüzgar da bir değişiklik olmadığı belirlenmiştir. Oysa yine aynı kent merkezinde farklı bir alanda yapılan çalışmada rüzgâr hızını 1.3m/s artırdığı saptanmıştır (Yılmaz vd.,2023). Bu çalışmada, farklı su formlarının mikro ikliminin nasıl iyileştirilebileceği konusunda önemli bilgiler sağlamak ile birlikte, alanın özelliklerine göre de değişiklik olabileceği ortaya konulmuştur. Farklı iklim bölgeleri için farklı sonuçların elde edilmesi mümkün olarak görülmektedir. Kentsel mekanlarda peyzaj planlama ve tasarım araştırmaları için bir temel olarak farkındalık sağlayacak niteliktedir. Ayrıca, gelecekte yapılacak araştırmalarla bu konuda daha detaylı çalışmalar yapılmalı ve daha etkili çözümler geliştirilmelidi.

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ARPA BAZLI YUMURTACI TAVUK RASYONLARINA FİTOBİYOTİK VE PROBİYOTİK İLAVESİNİN PERFORMANS VE YUMURTA KALİTE ÖZELLİKLERİNE ETKİSİ

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ÖZET

Bu çalışma arpa ağırlıklı yumurta tavuk rasyonlarına fitobiyotik ve probiyotiğin ayrı ayrı ve birlikte ilavesinin performans, yumurta iç ve dış kalite parametreleri üzerine etkilerini tespit etmek amacıyla yapılmıştır. Çalışmada 59 haftalık yaştaki 105 adet Tinted ırkı yumurta tavuğu kullanılmıştır. Deneme, tesadüf parselleri deneme planına göre 5 farklı muamele ve her muamele için 7 tekerrürden oluşan toplam 35 alt grupta yürütülmüştür. Tavuklar her bir alt bölmede 3 adet olacak şekilde rastgele dağıtılmıştır. Deneme, arpa içermeyen bazal rasyon (pozitif kontrol), %35 arpa içeren bazal rasyon (negatif kontrol) ve %35 arpa içeren bazal rasyona ilave edilen 500 mg/kg fitobiyotik (Huverb, Huvepharma Inc.), 500 mg/kg probiyotik (*Bacillus licheniformis*, DSM 28710, $3.2x10^9$ CFU/g), 500 mg/kg fitobiyotik+probiyotik (250+250 mg/kg) olmak üzere toplam 5 adet muamele grubundan oluşmuştur. Çalışma 84 gün süreyle yürütülmüş ve deneme süresince 16 saat aydınlık olacak şekilde aydınlatma programı uygulanmış, yem ve su ad-libitum olarak verilmiştir. Çalışmada performans ve yumurta dış kalite parametrelerinde kontrol rasyonu ve deneme rasyonları arasında istatistiki açıdan önemli bir fark olmamıştır ($P>0.05$). Bununla beraber %35 arpa içeren rasyon ve bu rasyona fitobiyotik ve probiyotiğin ayrı ayrı veya birlikte verildiği rasyonlar ile yumurta sarı rengi a* ve b* değeri kontrol grubuna göre önemli derecede düşmüştür ($P<0.01$) Ancak diğer yumurta iç kalite parametrelerinde deneme rasyonlarının kontrol rasyonuna göre önemli bir etkisi olmamıştır ($P>0.05$). Bu sonuçlara göre yumurtacı tavuklarda, performans, yumurta dış kalite ve bazı yumurta iç kalite parametreleri bakımından mısır-soyaya dayalı rasyonlar yerine fitobiyotik ve probiyotik ilavesi olmaksızın %35 arpa içeren rasyonların kullanılabileceği söylenebilir. Bununla beraber %35 arpa içeren rasyonlara ilave edilen fitobiyotik ve probiyotiğin, rasyonda bulunan arpadan kaynaklı yumurta sarı rengi a* ve b* değerindeki düşmeyi önleyemediği görülmektedir.

Anahtar Kelimeler: Yumurta Tavuğu, Arpa, Fitobiyotik, Probiyotik, Yumurta Kalitesi

THE EFFECT OF PHYTOBIOTIC AND PROBIOTIC ADDITION TO BARLEY BASED LAYING HENS DIETS ON PERFORMANCE AND EGG QUALITY TRAITS

ABSTRACT

This study was carried out to determine the effects of adding phytobiotics and probiotics separately or together on barley-based laying hens diets on performance, egg internal and external quality parameters. In the study, 105 Tinted laying hens aged 59 weeks were used. The experiment was carried out in a total of 35 subgroups, consisting of 5 different treatments and 7 replications for each treatment, according to the randomized design. Laying hens were randomly distributed as 3 in each sub-group. The trial diets formed total of 5 treatment groups which that a basal diet without barley (positive control), a basal diet containing 35% barley (negative control), and negative control diets addition to 500 mg/kg phytobiotics (Huverb, Huvepharma Inc.), 500 mg/kg probiotic (*Bacillus licheniformis*, DSM 28710, $3.2x10^9$ CFU/g) and 500 mg/kg phytobiotic+probiotic (250+250 mg/kg). The study was carried out for 84 days and the lighting program was applied with 16 hours of light during the experiment, and feed and water were supplied ad-libitum. In the study, there was no statistically significant difference between the control and trial diets in terms of performance and external egg quality parameters ($P>0.05$). On the other hand, with the diet containing 35% barley and the diets in which phytobiotics and probiotics were given separately or together, the egg yolk color a* and b* values decreased significantly ($P<0.01$) compared to the control group. However, the trial diets did not have a significant effect on the other egg internal quality parameters compared to the control diet ($P>0.05$). According to study results, it can be said that diets containing 35% barley without the addition of phytobiotics and probiotics can be used instead of corn-soybean based diet in terms of performance, egg external quality and some egg internal quality parameters in laying hens. However, it is seen that phytobiotics and probiotics added to diets containing 35% barley cannot prevent the decrease in egg yolk color a* and b* values caused by barley in the diet.

Keywords: Laying Hens, Barley, Phytobiotic, Probiotic, Performance, Egg Quality

INTRODUCTION

Feed cost in poultry production constitutes approximately 60-75% of total production costs. Corn, whose prices constantly increase and fluctuate depending on the season and production level, makes it very difficult to prepare low-cost diets. Therefore, grains such as barley and wheat are used as alternative feed ingredients to reduce the production cost of laying hen feeds (Ceylan et al., 2022). However, the content of barley in particular is high in terms of anti-nutritional factors such as non-starch polysaccharides (NSP). Non-starch polysaccharides contain β-1,4 or β-1,3 glucosidic bonds, and chickens' digestive system lack the endogenous enzymes necessary to break such beta linkages. The β-glucan contained in barley is a component of the cell walls and bind with water in the intestine, causing gel formation, which increases the viscosity of the intestinal contents (Zielke et al. 2017), and also causes a decrease in digestive enzyme activities (Yaghobfar and Kalantar, 2017). This causes adverse effects on nutrient digestion in poultry, and therefore, feed intake, feed efficiency and performance in hens (Ceylan et al., 2022). After the ban of antibiotics, which are widely used as a tool to optimize intestinal health and increase digestive enzyme activity, natural alternatives such as enzymes, probiotics, prebiotics, organic acids and herbal extracts have been used in feeds (Gadde et al., 2017).

Probiotics are beneficial bacteria that help support a natural and beneficial microbiota in animals and can positively affect the health of animals (Pan et al., 2022). Probiotics improve the growth performance, egg production and egg quality (Khan et al., 2011; Mikulski et al., 2012) in poultry, regulate the colonization of symbiotic bacteria in the digestive system (Bai et al., 2013), improve feed digestibility by stimulating enzymatic activities. It has an increasing effect (Ahmed et al. 2014). *Bacillus licheniformis*, an aerobic probiotic, improves the breakdown, absorption and utilization of nutrients (Rozs et al., 2001), and products fermented with *B. licheniformis* can suppress the proliferation of pathogens by promoting intestinal health (Chen and Yu, 2020). Studies have shown that the use of *Bacillus licheniformis* in poultry diets can increase egg production and egg quality, and reduce the negative effects of conditions such as heat stress on egg production and quality (Deng et al., 2012).

Phytobiotics, also known as phytogenics, are products obtained from aromatic plants and are used as feed additives in poultry, thanks to the compounds such as phenolics, terpenoids, saponins, flavonoids and tannins, which improve the performance of poultry (Windisch et al., 2008). Some researchers have reported that phytobiotics have antimicrobial effects, such as modulating intestinal microflora and reducing intestinal pathogen pressure, as well as

performance-enhancing effects (Panghal et al., 2011; Giannenas et al., 2013). In addition, some studies have shown that phytobiotics can increase digestive enzyme activity and absorption capacity (Jang et al. 2004; Jang et al. 2007). Phytogenic feed additives have been found to be effective in improving laying performance and egg quality in laying hens, and have been reported to be safe, easy to use and environmentalist (Applegate et al., 2010; Akdemir et al., 2012).

It is thought that some feed additives cause a superior effect (synergistic effect) by combining their individual effects compared to their single application (Shipradeep et al., 2012). Hidayat et al. (2021) reported that a mixture of probiotics and phytobiotics added to the diet improved feed efficiency in laying hens aged 72 weeks. In another study (Putri et al., 2019) in young laying hens (22 weeks old), it was determined that diets in which probiotic and herbal extract were used together increased egg yolk color and eggshell thickness.

This study was carried out to determine the effects of adding phytobiotics and probiotics separately or together on barley-based laying hens diets on performance, egg internal and external quality parameters.

MATERIAL and METHODS

In the study, 105 Tinted laying hens aged 59 weeks were used. The experiment was carried out in a total of 35 sub-groups, consisting of 5 different treatments and 7 replications for each treatment, according to the randomized design. Laying hens were randomly distributed as 3 in each sub-group. The trial diets formed total of 5 treatment groups which that a basal diet without barley (positive control), a basal diet containing 35% barley (negative control), and negative control diets addition to 500 mg/kg phytobiotics (Huverb®; capsaicin, glucosinolate, saponin, terpene, curcumin), 500 mg/kg probiotic (*Bacillus licheniformis*, DSM 28710, $3.2x10^9$ CFU/g) and 500 mg/kg phytobiotic+probiotic (250+250 mg/kg). The phytobiotic and probiotic used were added to the diets according to the levels recommended by the manufacturer, and in order to provide a homogeneous mixture to the trial diets, the probiotic and phytobiotic samples were diluted with starch and mixed at 500 mg/kg levels. In order to preserve the stability of the products, the baits were stored in a cool, dry environment and in plastic buckets with lids during the trial period. Basal diets have been prepared to contain levels of nutrients recommended for laying hens by the NRC (1994). The raw material and calculated nutrient composition of the basal diets with and without barley used in the study are given in Table 1. The study was lasted for 84 days and the lighting program was applied with 16 hours of light during the experiment, and feed and water were supplied ad-libitum.

Table 1. Ingredients and calculated nutrient composition of basal diets with and without barley used in the study

Raw materials	**Control (+)**	**Control (-)**
	%	**%**
Maize	56,00	23,20
Barley	-	35,00
Soybean meal (% 47 CP)	18,75	14,00
Sunflower meal (% 28 CP)	10,00	10,00
Vegetable oil (8800 ME/kg)	3,90	6,45
Limestone	9,15	9,20
Dicalcium phosphate	1,60	1,50
Salt	0,25	0,25
Premix[1]	0,10	0,10
L-Lysine	0,10	0,15
DL-Methionine	0,15	0,15
Total	**100,00**	**100,00**
Calculated Chemical Compositions		
Metabolizable energy, kcal/kg	2748,70	2748,70
Crude protein, %	15,81	15,79
Crude fiber, %	4,49	5,05
Calcium, %	3,93	3,92
Available phosphorus, %	0,41	0,39
Lysine, %	0,78	0,76
Methionine, %	0,38	0,37
Methionine + Cystine, %	0,61	0,43

[1]Premix is supplied per kg of diet: Trans-retinly acetate, 4,0 mg; cholecalciferol, 0,055 mg; DL-a-tokoferil asetat, 11 mg; nicotine acid, 44 mg; calcium-D-pantotenat, 8,8 mg; riboflavin 5,8 mg; thiamin 2,8 mg; cyanocobalamin, 0,66 mg; folic acid, 1 mg; biotin, 0,11 mg; choline, 220 mg; Zn, 60 mg; Mn, 60 mg; Fe, 30 mg; Cu, 5 mg; 1,1 mg; Se, 0,1 mg.

In the study, the body weights of the hens were determined by weighing them as a group, at the beginning and end of the experiment, and the body weight gain (g/chicken) was calculated from these data. Eggs collected daily during the experiment were recorded and egg production (%) was calculated from these data. Performance and egg quality traits were determined in the eggs collected on the last two days of each 28-day period of the experiment (5 eggs from each subgroup, a total of 135 eggs from each treatment during the trial). After determining the weight of the eggs collected from each subgroup, egg mass; calculated with the formula (egg yield x egg weight) / 100. Hens were fed in groups and feed intake was calculated as g/day/hen according to the end of each period average. The feed evaluation coefficient was calculated with the formula of feed intake / egg mass in the same period.

During the experiment damaged eggs (broken, cracked, soft-shelled and unshelled) were detected in the eggs collected from all subgroups and were calculated as % of the number of eggs after daily recording. Eggshell breaking strength was determined in kg by applying

supported systematic pressure to blunt of the eggs (Egg Force Reader, Orka Food Technology, Israel). The eggs, whose eggshell breaking strength was determined, were broken on a clean glass surface, and after the egg residues in the shell were cleaned, the shells were dried at room temperature for three days and weighed to determine their weight. The eggshell thickness was determined with a micrometer with an accuracy of 0.001 mm. The albumen length, albumen width, and yolk diameter of these eggs were measured with a digital calliper and the albumen height and yolk height were measured with the height gauge. Using these measurements, the albumen index was calculated (albumen length / ((albumen width + albumen height)/2) x 100 formula, the yolk index was found (yolk height / yolk diameter) x 100, and the Haugh unit was obtained from 100 x log (albumen height + 7.57-1.7 x egg weight0.37 (Haugh, 1937). Egg yolk color was measured as L*, a* and b* values with Minolta colorimeter (CR-200, Minolta Co., Osaka, Japan). According to L*, a* and b* color values; L*: lightness, L*=0 black and L*=100 white; a*: red/green, +a* red, –a* green; b*: yellow/blue, +b* yellow, -b* blue (Sevim et al., 2020).

At the end of the research, the variance analyses have been applied to all variables obtained from the experimental groups (Minitab 2000). The differences among means of the groups were determined by the Duncan multiple comparison test (Duncan, 1955).

RESULTS and DISCUSSION

Addition of phytobiotic, probiotic and equal amounts of their mixtures to barley-weighted laying hen diets did not affect the investigated performance parameters statistically (P>0.05; Table 2).

Table 2. The effect of adding phytobiotics, probiotics and their combinations to barley-based laying hens diets on performance parameters.

Performance Parameters	CON (+)	CON (-)	PHTB	PRB	PHTB +PRB	SEM	P-Value
Initial body weight (g)	1769,0	1793,6	1798,7	1829,9	1795,3	16,910	0,874
Final body weight (g)	1776,7	1755,7	1829,4	1815,4	1778,0	15,678	0,581
Body weight gain	7,86	-37,86	30,57	-14,43	-17,43	11,268	0,378
Egg production (%)	93,43	90,30	92,37	90,89	90,67	0,633	0,502
Feed intake (g)	109,90	110,55	111,56	110,83	109,07	0,396	0,350
Egg mass (g)	65,53	66,23	65,97	66,05	66,34	0,352	0,965
Egg weight (g)	61,23	59,74	60,88	60,01	60,13	0,444	0,828
Feed conversion ratio	1,80	1,86	1,84	1,85	1,82	0,013	0,691

CON (+): Barley-free control; CON (-): Barley-based control; PHTB: Phytobiotic (500 mg/kg); PRB: Probiotic (500 mg/kg); PHTB+PRB: Phytobiotic+Probiotic (250 mg/kg+250 mg/kg); SEM: Standart error mean

In a previous study (Yalçın et al., 2002), which supports the results of the current study, it was reported that the addition of probiotics (*Saccharomyces cerevisiae*) alone to the barley and wheat-based diets did not have a significant effect on general performance parameters. However, Mahdavi et al. (2005) in laying hens, it was reported that the addition of a probiotic mixture (*Bacillus subtilis and Bacillus licheniformis*) to the diets containing three different levels of barley instead of maize did not affect the egg production and egg weight, but increased the feed intake and feed conversion ratio. Similarly, Ceylan et al. (2022) reported that the addition of probiotics (*Bacillus licheniformis*) to the barley-based laying hen diet did not affect some performance parameters such as egg production, egg weight and feed intake, the body weight gain, but significantly improved egg mass and feed conversion ratio.

The investigators attributed this improvement in egg mass and feed conversion ratio to the reduction of the negative effect of the NSP (non-starch polysaccharides) fractions in barley with the probiotic added to the diet. In addition, there are studies reporting that the addition of probiotics to maize-based diets in laying hens does not significantly affect performance (Forte et al., 2016; Upadhaya et al., 2019).

No study has been found in the literature examining the effects of adding phytobiotics to barley-based diets in laying hens. However, Kaya et al. (2013) reported that the herbal extract mixture (thyme, garlic, anise and fennel oils) added to the diet of laying hens did not significantly affect egg production, egg weight, feed intake and feed conversion ratio. In addition, some studies conducted in laying hens, it was reported that the addition of phytobiotics to the diet did not cause a significant difference in egg production, egg weight, feed intake and feed conversion ratio (Florou-Paneri et al., 2005; Bölükbaşı et al., 2010; Bozkurt et al., 2012). However, in another study (Radwan et al., 2008), it was stated that the addition of 1% thyme and 0.5% turmeric to laying hen diets significantly improved egg production, egg weight, egg mass and feed efficiency.

Similar to the present study, Natsir et al. (2018) addition of a mixture of phytobiotics (Black Cincau leaves) and probiotics (*Lactobacillus sp.* 5.4 $\times 10^7$ CFU/ g and *Bacillus sp.* 2,4 $\times$ 10^8 CFU/ g) to laying hen diets did not affect performance parameters such as feed intake, feed efficiency, egg weight, egg mass. In another study (Behnamifar et al., 2015), it was observed that diets containing thyme, garlic and cumin powders and probiotics did not affect performance parameters compared to the control diet. However, investigating the effects of single and combined use of probiotics (*L. acidophilus*; 10^8 CFU/mL) and phytobiotics (bay leaf, onion and garlic peel powders) in the diet that has been reported that it improves feed conversion, although it does not affect feed intake and egg mass on laying hens (Hidayat et al., 2021).

In the study, trial diets did not affect the rate of damaged eggs (%), eggshell breaking strength (kg), eggshell weight (g), eggshell thickness (mm), albumen index, yolk index and Haugh unit (P>0.05; Table 3).

Table 3. The effect of adding phytobiotics, probiotics and their combinations to barley-based laying hens diets on egg quality parameters

Egg Quality Parameters	CON (+)	CON (-)	PHTB	PRB	PHTB +PRB	SEM	P-Value
Damaged eggs (%)	6,92	9,55	5,88	8,32	8,36	0,908	0,764
Eggshell breaking strength (kg)	3,87	4,04	3,85	4,14	4,01	0,057	0,482
Eggshell weight (g)	6,22	6,40	6,37	6,33	6,19	0,058	0,753
Eggshell thickness (mm)	0,354	0,369	0,368	0,367	0,364	0,003	0,417
Albumen index	9,36	9,17	10,18	9,32	8,87	0,190	0,263
Yolk index	42,82	42,45	43,03	43,44	41,68	0,292	0,398
Haugh unit	83,94	81,71	84,32	82,45	81,48	0,783	0,725
Yolk colour values							
L^*	47,61	47,99	46,82	47,06	47,07	0,191	0,298
a^*	$8,10^A$	$3,04^B$	$3,71^B$	$3,58^B$	$3,67^B$	0,358	0,000
b^*	$32,90^A$	$30,34^B$	$29,36^B$	$30,24^B$	$29,71^B$	0,298	0,000

CON (+): Barley-free control; CON (-): Barley-based control; PHTB: Phytobiotic (500 mg/kg); PRB: Probiotic (500 mg/kg); PHTB+PRB: Phytobiotic+Probiotic (250 mg/kg+250 mg/kg); SEM: Standart error mean
$^{A, B}$: Means with different superscripts in the same row were significantly different (P<0.01).

In previous studies, it was reported that the addition of probiotics to barley-based diets did not affect eggshell thickness, eggshell breaking strength (Mahdavi et al., 2005), albumen index, yolk index and Haugh unit (Yalçın et al., 2002). Contrary to this study, Ceylan et al. (2022), on the other hand, reported that diets containing 0.5 g/kg probiotic (*Bacillus licheniformis*) improved eggshell thickness and Haugh unit, but did not affect these parameters at 1.0 g/kg level in their study on laying hens. Researchers stated that the availability of many nutrients, including calcium, may have increased thanks to probiotics, and the improvement in egg shell thickness could be attributed to this situation.

In some studies, were also found, which support the current study, the addition of phytobiotics to the diet did not effect of eggshell breaking strength, eggshell thickness (Li et al., 2016), eggshell weight (Moraleco et al., 2019) and Haugh unit (Li et al., 2016; Moraleco et al., 2019). However, Kaya et al. (2013) reported that the herbal extract mixture (phytobiotic) added to the diet did not affect the eggshell weight, egg yolk and white index, Haugh unit, but improved the eggshell breaking strength and eggshell thickness in laying hens. Researchers attributed the improvement in eggshell breaking strength and egg shell thickness to the increased production of digestive enzymes by phytobiotics and better absorption of nutrients from the intestines.

Have been reported that addition of probiotic, phytobiotic, butyric acid (Vishwanath et al., 2020) or thyme, garlic, cumin extracts and probiotic in single form (Behnamifar et al., 2015) to the diet of laying hens, did not effect on egg quality such as eggshell weight, eggshell thickness, eggshell breaking strength and Haugh unit. Similarly, Khalifa and Noseer (2019) added ginger to quail diets and probiotics to drinking water and reported that the treatments did not affect eggshell quality parameters. However, there were also studies reporting that eggshell breaking strength (Song et al., 2019) and eggshell thickness (Putri et al., 2019) increased with the addition of probiotic and phytobiotic combinations to laying hen diets. Song et al. (2019) reported that the combination of microencapsulated probiotic and camellia plant extract enhanced the absorption of calcium and other nutrients, which could positively effect on eggshell quality.

Another important egg quality criterion for consumers is the color of the yolk. It has been reported that in some European countries (Germany, England, Italy, France, Poland) consumers prefer eggs with darker yolk, and this is due to the belief that eggs with darker yolk color are better in terms of nutritional properties and health (Nys, 2000). This is the preference of consumers in our country. In the current study, barley-based diet did not significantly affect the L* value ($P>0.05$), but significantly decreased the a* and b* values ($P<0.01$). Phytobiotics, probiotics, and their combinations added to the barley-based diet were insufficient to compensate for this decline.

While the presence of sufficient amount of yellow corn in the diet is sufficient for the formation of the preferred yolk color, it has been stated that natural or synthetic coloring agents should be added to the diet in order to provide the preferred yolk color in diets that do not enough of dietary corn level (Sevim et al., 2021). In previous studies, it was reported that the addition of probiotics and herbal extracts to the diet of laying hens did not affect egg yolk color (Song et al., 2019; Ceylan et al., 2022; Cristina et al., 2022). However, in some other studies in layer hens has been reported that probiotics such as *Bacillus subtilis* (Upadhaya et al., 2019), *Bacillus velezensis* (Ye et al., 2020) and *Enterococcus faecium* (Macit et al., 2021) adding to the diet, increased the color of egg yolk were determined. Sobczak and Kozlowski (2015) stated that the probiotic (*Bacillus subtilis*) added to the diet can increase the absorption of carotenoids in feed and therefore increase the egg yolk color.

CONCLUSIONS

According to study results, it can be said that diets containing 35% barley without the addition of phytobiotics and probiotics can be used instead of corn-soybean based diet in terms of performance, egg external quality and some egg internal quality parameters in laying hens.

However, it is seen that phytobiotics and probiotics added to diets containing 35% barley cannot prevent the decrease in egg yolk color caused by barley in the diet.

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SİLİSYUMUN ABİYOTİK VE BİYOTİK STRES FAKTÖRLERİ ÜZERİNE İYİLEŞTİRİCİ ETKİSİ

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ÖZET

Silisyum (Si), oksijenden sonra yeryüzünde en çok bulunan ikinci elementtir ve yer kabuğunun silisyum içeriği yaklaşık olarak %28'dir. Bitki kuru ağırlık ilkesine göre, bitkilerin bünyesinde %0,1-10 oranında silisyum mevcuttur. Toprak çözeltisinde silisyum miktarı pH, sıcaklık, toprağın bünyesi, minerallerinin kimyasal bileşimi ve çözünürlüğü, organik madde ve su içeriği, redoks potansiyeli ve seskioksitlere bağlı olarak değişim göstermektedir. Silisyumun bitki bünyesindeki rolüne ait bilgiler sınırlıdır. Diğer taraftan, silisyum bitkide makro elementler kadar yüksek konsantrasyonlarda bulunmasına rağmen, bitkilerin gelişimi için mutlak gerekli bir bitki besin elementi değildir. Fakat bitkiler için yararlı olduğu bilinen bir bitki besin elementidir. Tüm dünyayı etkisi altına alan küresel ısınma ve iklim değişikliğine bağlı kuraklık, tuzluluk ve böcek gibi abiyotik ve biyotik stresler ya da farklı endüstriyel uygulamalar neticesinde yayılan ağır metaller dünya üzerinde yaşayan canlıları özellikle bitkileri olumsuz etkilemektedir. Bitkisel üretim bakımından değerlendirildiğinde, bu biyotik ve abiyotik stres faktörleri sadece bitkilerin morfolojisi ve fizyolojisi üzerine olumsuz etkiler yapmakla kalmaz, aynı zamanda ürün kalite ve veriminde önemli miktarda azalmaya neden olmaktadırlar. Bu nedenle, araştırmacılar organik ya da silisyum gibi inorganik materyallerin stres faktörlerinin bitki üzerindeki olumsuz etkilerini hafifletip hafifletmediği üzerine çok sayıda araştırma yürütmektedirler. Bitkilerin gelişim ve fonksiyonları üzerine silisyumun direkt veya indirekt olumlu etkileri nedeni ile Türkiye ve dünyada silisyuma artan bir yönelim mevcuttur. Silisyum özellikle kurak ve yarı kurak iklim koşullarında oluşan tuzluluk, aşırı sıcaklık, kuraklık, ağır metaller, mineral toksisitesi gibi abiyotik stres faktörleri üzerinde etkilidir. Aynı zamanda bitki hastalıkları ve böcek zararlılarına karşı koruyucu etkileri nedeniyle biyotik streslere karşı bitkiyi koruyan ve gelişimini destekleyen potansiyel etkilere sahiptir. Bu çalışmada çeşitli araştırmalar incelenerek stres şartlarında silisyumun bitki bünyesindeki metabolik işlevleri açıklanmıştır. Ayrıca, biyotik ve abiyotik stres faktörleri mevcudiyetinde silisyumun bitkide kullanımına yönelik önerilerde bulunulmuştur.

Anahtar Kelimeler: Silisyum, Biyotik Stres, Abiyotik Stres, Bitkisel Üretim

ALLEVIATING EFFECT OF SILICON ON ABIOTIC AND BIOTIC STRESS FACTORS

ABSTRACT

Silicon (Si) is the second most abundant element on earth after oxygen, and the silicon content of the earth's crust is approximately 28%. According to the plant dry weight principle, there is 0.1-10% silicon in the plants. The amount of silicon in the soil solution varies depending on pH, temperature, soil texture, chemical composition and solubility of minerals, organic matter and water content, redox potential and sesquioxides. Knowledge on the role of silicon in plants is limited. On the other hand, although silicon is found in the plant at concentrations as high as the macro elements, it is not an absolute essential plant nutrient for the development of plants. But it is known to be a beneficial plant nutrient for plants. Abiotic and biotic stresses such as drought, salinity and insects due to global warming and climate change that affect the whole world or heavy metals emitted as a result of different industrial applications negatively affect the living things on earth, especially plants. As considered in terms of plant production, these biotic and abiotic stress factors not only have negative effects on the morphology and physiology of plants, but also cause a significant decrease in product quality and yield. For this reason, researchers have been conducting numerous studies on whether organic or inorganic materials such as silicon alleviate the negative effects of stress factors on the plant. Due to the direct or indirect positive effects of silicon on the growth and functions of plants, there is an increasing trend towards silicon in Turkey and in the world. Silicon is especially effective on abiotic stress factors such as salinity, extreme temperature, drought, heavy metals, mineral toxicity, which occur in arid and semi-arid climate conditions. Also, it has potential effects that protect the plant against biotic stresses and support its growth due to its protective effects against plant diseases and insect pests. In this study, the metabolic functions of silicon in the plant under different stress conditions are elaborately explained by examining various studies. In addition, the utilization of silicon in plants was suggested when biotic and abiotic stressors were present.

Keywords: Silicon, Biotic Stress, Abiotic Stress, Plant Production

GİRİŞ

Tüm dünyayı etkisi altına alan küresel ısınma ve iklim değişikliğine bağlı kuraklık, tuzluluk ve böcekler gibi abiyotik ve biyotik stresler ya da farklı endüstriyel uygulamalar neticesinde yayılan ağır metaller dünya üzerinde yaşayan canlıları özellikle bitkileri olumsuz etkilemektedir. Bitkisel üretim bakımından değerlendirildiğinde, bu biyotik ve abiyotik stres faktörleri sadece bitkilerin morfolojisi ve fizyolojisi üzerine olumsuz etkiler yapmakla kalmaz, aynı zamanda ürün kalite ve veriminde önemli miktarda azalmaya neden olmaktadırlar. Bu bağlamda araştırmacılar oluşan çeşitli streslere karşı organik (Çiçek vd. 2022a) ya da silisyum gibi inorganik materyallerin (Erkan 2019; Badem 2021; Kınay ve Erdem 2022) stres faktörlerinin bitki üzerindeki olumsuz etkilerini hafifletip hafifletmediği üzerine çok sayıda araştırma yürütmektedirler

Bitkiler tarafından dissosiye olmamış silisik asit [H_4SiO_4=$Si(OH)_4$] formunda alınabilen silisyum yerkabuğunda oksijenden sonra en fazla bulunan ikinci elementtir (Kacar ve Katkat 2015; Çiçek vd. 2022b). Kuru ağırlık ilkesine göre karasal bitkilerin bünyesindeki silisyum oranı %0,1-10 oranındadır (Ma and Takahashi 2002).

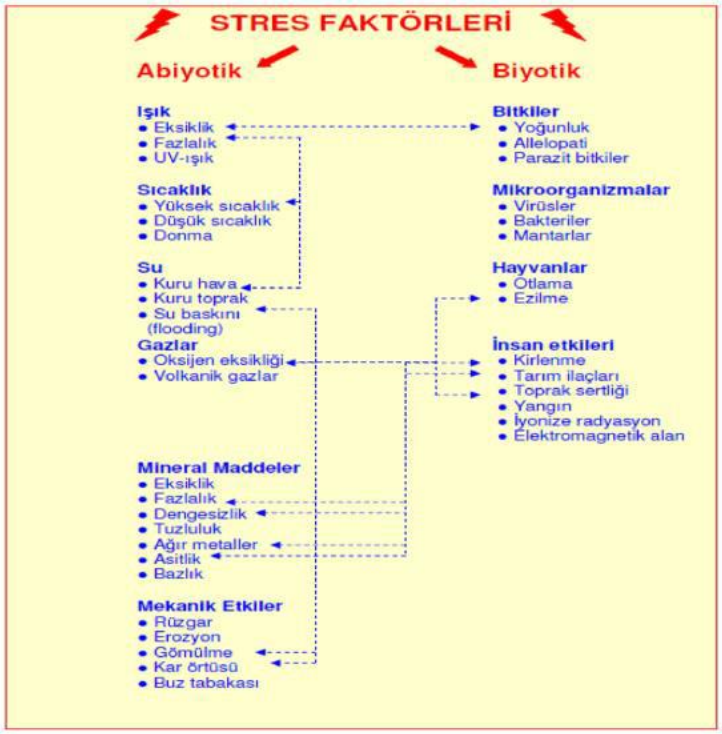
Silisyum konsantrasyonu sıcaklık, pH, tanecik boyu, organik madde miktarı, toprak nemi, minerallerinin kimyasal bileşimi ve çözünürlüğü, redoks potansiyeli ve seksioksitlere bağlı olarak değişim göstermektedir (Savant et al. 1997). Toprakların çoğunluğu silisyum bakımından zengin olmasına rağmen aşırı derecede ayrışmış, yıkanmış, asidik ve düşük baz doygunluğuna sahip oxisisol ve ultisol topraklarda yarayışlı silisyum miktarı genel olarak düşüktür (Snyder et al. 1986; Horuz vd., 2013).

Silisyum üzerine yapılan ilk çalışma 1840 yılında Justus Von Liebig tarafından gerçekleştirilmiştir. Çeşitli bitkilerde tarla ve serada yapılan araştırmalarda silisyumun bitkilere faydalı olduğu görülmüştür (Leibig 1840; Savant et al. 1997; Epstein 1999; Matichenkov et al. 1999). Silisyumun yüksek bitkilerde (Takahashi et al. 1990) ve çeltikteki (Singh et al. 2005), önemi yeteri kadar anlaşılamamış çok yönlü ve faydalı bir bitki besin element olduğu bilinmektedir. Silisyum, bitki bünyesinde makro bitki besin elementleri kadar yüksek konsantrasyonlarda bulunmasına rağmen (Ma et al. 2001), bitkiler için mutlak gerekli element olarak kabul edilmez (Kacar ve Katkat 2015; Horuz vd. 2017, Çiçek vd. 2022b). Son yıllarda bitkiler üzerine yapılan çalışmalarda bitkilerin büyüme ve gelişimini olumlu yönde etkileyen

çeşitli stress koşullarına karşın iyileştirici etkisi olan silisyum elementine Türkiye ve Dünya da yoğun bir ilgi söz konusudur.

BİTKİLERDE ABİYOTİK VE BİYOTİK STRES

Bitkilerde diğer canlılar gibi doğaları gereği dış çevreleri ile sürekli etkileşim halindedir. Bulundukları çevrede olumsuz koşullar oluştuğunda bitkiler uyum (adaptasyon) eksikliğine bağlı olarak stres faktörlerine maruz kalırlar. Çevre koşullarının bir bitkinin doğal büyüme ve gelişmesini negatif olarak etkileyecek kadar değişmesi durumunda bitkilerde stres meydana gelir. Diğer bir ifade ile bitki bünyesinde olumsuz etkileri olan dış faktörler olarak açıklanabilir (Büyük vd. 2012). Bitkilerde meydana abiyotik ve biyotik stres faktörleri Şekil 1'de gösterilmiştir.



Şekil 1. Bitkilerdeki stres faktörleri (Larcher, 1995)

SİLİSYUMUN ABİYOTİK STRES FAKTÖRLERİ ÜZERİNE ETKİSİ

Silisyum, bitkileri su ve kuraklık stresinden, rüzgâr zararlarından, yüksek ve düşük ışık intensitesinden, aşırı radyasyondan, yatma ve don gibi fiziksel şartların oluşturduğu abiyotik stres faktörlerinden korur. Aşırı sıcağının ve kuraklığın neden olduğu yüksek transpirasyon şartlarında ksilemin epidermal hücre dokularında silisyum-selüloz membran şeklinde birikmesi

ile transpirasyonu azaltarak su kaybına önler ve aşırı transpirasyonun ksilem iletim demetlerinde meydana getireceği sıkıştırma basıncına da engel olur (Ma 2004, Yavaş vd. 2016; Horuz vd. 2017).

Silisyum, çeltik ve buğday gibi bazı tahılların sap hücrelerinin damar hacmini ve kalınlığını artırarak dolayısıyla dayanıklılığı artırarak rüzgârda bitkilerin yatmaya karşı dirençli olmasını sağlar. Bu durum yaprakların daha dik durmasını da desteklendiği için bitkilerin ışıktan yararlanma oranını yükselir (Hamayun 2010; Horuz vd. 2017).

Silisyum, özellikle kurak ve yarı kurak iklim koşullarında çok sık gözüken toprak tuzluluğunda sodyum elementi ile Na-silikat oluşturarak topraktaki sodyum konsantrasyonunu düşürerek bitkilerin daha az zarar görmesini sağlar (Matichenkov and Bocharnikova 2001).

Silisyum, hücre duvarı ile ağır metallerin arasına girerek ağır metallerle hücre duvarının katyon köprüleri oluşturmasını engeller ve böylece ağır metaller silisyumla kompleksler oluştururlar. Silisyumun bu özelliği sayesinde bitki metabolizması daha az zarar görür böylece fotosentetik pigmentlerin stabilitesi ve aktivitesi azalmaz (Horst and Marschner 1978).

SİLİSYUMUN BİYOTİK STRES FAKTÖRLERİ ÜZERİNE ETKİSİ

Fauteux et al. (2005) tarafından silisyumun bitki hastalıklarının meydana gelme sıklığını ve şiddetini azaltığı belirtilmiştir. Silisyumun koruyucu etkisinin nasıl meydana geldiği tam olarak açıklanamamıştır (Currie and Perry 2007). Fakat bir çok araştırmacı tarafından silisyum uygulamasının bazı bitkilerde fungal hastalıkların etkilerini azaldığı açıklanmıştır (Sun et al. 2002; Gillman et al. 2003; Rodgers-Gray and Shaw 2004; Bakış 2013).

Silisyum, epidermal hücrelerin hücre duvarlarındaki organik bileşiklerle kompleksler oluşturarak; funguslar tarafından salgılanan enzimler ile hücre duvarlarının parçalanmaya karşı direncini güçlendirir (Hodson and Sangster 1988).

Biyotik stres koşullarında silisyumun etkisi Horuz vd. (2017) tarafından açıklanmıştır.

1) bitki büyümesini ve gelişimini teşvik ederek verimi artırır,
2) bakteri ve mantarların neden olduğu hastalıkları baskılar,

3) koçan kurdu, sap tırtılı, yaprak örümceği ve değişik yaprak yiyicilerin zararlarını baskılayarak azaltır veya önler,
4) hücre duvarında birikerek bitkiyi dış etkenlere karşı güçlendirir,
5) hastalıklara neden olan mikroorganizmalar ile zararlanmalara yol açan böceklere karşı koruyucu etki gösterir.

SONUÇ

Silisyumlu gübreler, kalsiyum silikat ($CaSiO_3$), magnezyum silikat ($MgSiO_3$), potasyum silikat (K_2SiO_3), silis asidi [$Si(OH)_4$] veya monosilisik asittir (H_4SiO_4). Bu silisyum içerikli gübrelerin kullanımı bitkilerde direkt veya dolaylı olarak verim artışına sebep olduğu gibi abiyotik ve biyotik stres faktörleri üzerine iyileştirici etkiside üreticiler tarafından bitki zırhı diye adlandırılmasına ve tercih edilmesine sebep olmaktadır.

Çevresel faktörlerden dolayı bitkilerde meydana gelen abiyotik ve biyotik stres şartlarında ve özellikle bitki hastalık ve zararlılarıyla mücadelede harcanan para, insan ve çevre sağlığı göz önüne alındığında stres şartlarının üstesinden gelinmesinde silisyumun etkisi yapılan çalışmalar ile açık bir şekilde tespit edilmiştir.

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DİKEY TARIM SİSTEMLERİNDE KULLANILAN LED AYDINLATMA SİSTEMİNİN FARKLI BİTKİLERDEKİ OPTİMİZASYONU

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ÖZET

Işık, bitki gelişimini ve morfolojisini etkileyen en önemli çevresel faktörlerden birisidir. Özellikle yeterli güneş ışığı alamayan bölgelerde fotosentez ve bitki gelişimi için en önemli sınırlayıcı faktörlerden birisidir. Kapalı bitki üretim sistemlerinde de en önemli gelişim faktörü ışıktır. Yapay aydınlatma kullanılarak kontrollü ortamda yapraklı bitki üretimi yapılan kapalı üretim sistemleri geleneksel seralara ve açık alan üretimine göre suyun daha az kullanımı, toprak kökenli hastalıkların olmaması, işgücü tasarrufu gibi avantajlara sahiptir. Bununla birlikte ilk yatırım maliyeti yüksek olduğundan bu sistemlerde kullanılan LED aydınlatmaların bitkilere uygun olarak tasarlanması ile daha sonraki işletme maliyeti önemli ölçüde düşürülebilmektedir. LED lambalar genellikle tam spektrum olarak tasarlanmakta bununla birlikte spektrumdaki kırmızı ve mavi ışık oranları değiştirilerek fotosentez dolayısıyla bitki verimi için en uygun oranlar oluşturulmaya çalışılmaktadır. Kapalı üretim sistemlerinde daha çok yapraklı sebzeler ile süs bitkileri yetiştirilmekte, yapılan çalışmalarda bu bitkilerde fotosentetik foton akış yoğunluğu (PPFD), foto-periyot ve ışık kalitesinin farklı kombinasyonları denenmektedir. *Lactuca sativa* L. cv. Ziwei çeşidinde bitki büyümesi, fotosentez oranı ile enerji tüketimi açısından en uygun kırmızı/mavi ışık oranının 2,2, fotoperiyot miktarının 16 saat/gün ve PPFD'nin ise ile 250 µmol/m^2sn olduğu bulunmuştur. Green Coral ve Butterhead marul tiplerinde ise 204-241 µmol/m^2/s aralığında uygulanan PPFD aralığının yaprak sayısı ve alanını dolayısıyla verimi arttırdığı bu nedenle fide üretimi için uygun olduğu saptanmıştır. Ispanaklara 4 kırmızı/1 mavi ışık oranlarında 90, 140,190 ve 240 µmol/m^2/s PPFD uygulandığında, ışık yoğunluğunun artmasının bitki boyu, yaprak sayısı, yaprak genişliği, sürgün taze ve kuru ağırlığı, kök yaş ve kuru ağırlığının arttırdığı tespit edilmiştir. Bu derleme çalışmada kapalı bitki üretim sistemlerinde yetiştiriciliği yapılan marul (*Lactuca sativa* L.), roka (*Eruca sativa* Mill), ıspanak (*Spinacia oleracea* L.), siyah hardal (*Brassica nigra* L.), fesleğen (*Ocimum basilicum* L.) gibi yapraklı sebzelerde uygulanan günlük ışık integrali, fotosentetik aktif radyasyon, fotosentetik foton akış yoğunluğu (PPFD) verileri derlenerek, bitkilerin gelişimi için önerilen en uygun aralıkların ortaya konulması amaçlanmıştır.

Anahtar Kelimeler: Kapalı üretim sistemleri, LED ışık, PPFD, yapraklı sebzeler

OPTIMIZATION OF LED LIGHTING SYSTEMS USED IN VERTICAL FARMING SYSTEMS IN DIFFERENT PLANTS

ABSTRACT

Light is one of the most important environmental factors affecting plant growth and morphology. It is one of the most important limiting factors for photosynthesis and plant growth, especially in regions that do not receive sufficient sunlight. Light is the most important growth factor in indoor plant production systems. Indoor production systems, in which leafy plants are produced in a controlled environment using artificial lighting, have advantages such as less water use, no soil-borne diseases, and labor savings compared to traditional greenhouses and open-field production. However, since the initial investment cost is high, the subsequent operating costs can be significantly reduced by designing the LED lighting used in these systems in accordance with the plants. LED lamps are generally designed as full spectrum, however, by changing the red and blue light ratios in the spectrum, it is tried to create the most suitable ratios for plant yield due to photosynthesis. In closed production systems, mostly leafy vegetables and ornamental plants are grown, and different combinations of photosynthetic photon flux density (PPFD), photo-period and light quality are tested in these plants. For Lactuca sativa L. cv Ziwei, the most suitable red/blue light ratio for plant growth, photosynthesis rate and energy consumption was found to be 2.2, photoperiod amount was 16 h/day, and PPFD was 250 µmol/m2sec. In Green Coral and Butterhead lettuce types, it was determined that the PPFD interval applied in the range of 204-241 µmol/m^2/s increased the leaf number and area, thus the yield, therefore it was suitable for seedling production. When 90, 140,190 and 240 µmol/m2/s PPFD was applied to spinach at 4 red/1 blue light ratios, it was determined that the increase in light intensity increased plant height, leaf number, leaf width, shoot fresh and dry weight, root fresh and dry weight. This review study was aimed that daily light integral, photosynthetic active radiation, and photosynthetic photon flux density (PPFD) data applied to leafy vegetables such as lettuce, arugula, spinach, black mustard, and basil grown in indoor plant production systems were compiled and to reveal the most suitable intervals recommended for the optimum development and yield of plants.

Keywords: Indoor plant production, LED light, PPFD, leafy vegetable

GİRİŞ

Son yıllarda su kaynakları ve toprak verimliliği azalmaktadır. Bunun yanı sıra işgücü maliyetleri ve kent nüfusu giderek artmaktadır. Bu da birim alandan alınan verimin arttırılması gerekliliğini ortaya çıkarmıştır. Bu anlamda çevre faktörlerinin kontrol altında olduğu ve dış ortamla ilişkinin sınırlandırıldığı dikey tarım sistemlerine yönelim artmıştır. (Pennisi vd., 2019). Dikey tarım sistemlerinde üretim besin çözeltisi ve aydınlatma sistemleri kullanılarak yapılmaktadır. Bu sisteme 'bitki fabrikası' veya 'dikey çiftlik' adı da verilmektedir (Zhang vd., 2018).

Yapılan çalışmalar dikey tarım sistemlerinde marul üretiminin seralara oranla toprak, su ve besin kullanımının verimliliğini arttırabileceğini göstermiştir. Bununla birlikte aydınlatma sisteminin enerji ihtiyacının maliyetinin yüksek olması sistemin önemli dezavantajlarındandır Yapay aydınlatma sisteminin maliyetinin, bitki fabrikasının toplam maliyetinin %60'ını oluşturduğu belirtilmektedir. Bu nedenle yapay aydınlatmanın optimum kullanımı, üretilen bitkiler için optimum ışık bileşenlerinin ve sürelerinin kullanımının belirlenerek, bitki fabrikalarından optimum faydalanma ve üretimi teşvik etmek için önemlidir (Xu ve ark., 2021). Son 10 yılda LED teknolojisinin gelişmesi sonucu LEDler kapalı bitki üretim sistemlerinde ticari olarak kullanılmaya başlamıştır. LEDlerin spektral foton emisyonlarının kontrol edilebilmesi, ürünün fotosentezi ve fotomorfogenezinin düzenlenmesi için daha önce mevcut olmayan imkanları sunmaktadır (Mitchell ve Sheibani, 2020).

Işık bitkinin gelişme ve farklılaşmasını etkileyen en önemli faktörlerden birisidir. Dikey tarım sistemlerinde ise üretim tamamen yapay ışık kullanılarak yapılmaktadır. Kullanılan yapay ışıkların şiddeti, süresi ve kalitesi bitkinin gelişmesini önemli oranda etkilemektedir. Bu nedenle dikey tarım sistemleri için ışıkla ilgili kullanılan bu terimlerin de bilinmesi gereklidir. Dünya üzerine ulaşan ışıklardan 400-700 nm dalga boyunda olanları fotosentezde kullanılmakta olup, buna fotosentetik aktif radyasyon (PAR) denilmektedir (Carruthers vd., 2001). Tarımsal üretimde kullanılan ışıkların şiddetinin ifade edilmesinde fotosentetik foton akış yoğunluğu (PPFD) terimi kullanılmaktadır. PPFD (µmol/cm^{2}sn), birim yüzeye birim zamanda düşen PAR fotonlarının sayısını göstermektedir (Rabinowitz ve Vogel, 2009). Işığın kalitesi, kullanılan ışığın spektral kompozisyonu anlamına gelmekte olup, dikey tarım sistemlerinde kullanılan armatürlerdeki LED lambalar farklı spektral bileşenlerde ve dar veya geniş spektrumlu olarak üretilmektedir. LED aydınlatma sistemi bir armatür içerisinde değişik spektrumlarda LED çipleri yerleştirilerek üretilmekte ve bitkiyi aydınlatan sistem içerisindeki kırmızı, mavi, yeşil ve sarı ışık oranları yetiştirilecek bitkilere göre değiştirilebilmektedir. Bu renkler içerisinde fotosentezde daha etkili olan kırmızı ve mavi ışık oranlarının arttırılması daha çok

kullanılmaktadır. Bitkilerin günlük olarak aldıkları toplam foton miktarı ise günlük ışık integrali (DLI) olarak adlandırılmaktadır (Seyhan vd., 2022).

Dikey tarım sistemlerinde daha çok yapraklı sebzeler yetiştirilmekte olup, bu derleme çalışmada farklı yapraklı sebze türlerinde yapılan çalışmalar incelenerek, bu türlerde kullanılan ışık spektrumları, PPFD, DLI ve gün uzunlukları ile bunların bitkilerin gelişim parametrelerine olan etkileri ortaya konulmuştur.

DİKEY TARIM SİSTEMLERİNDE MARUL ÜRETİMİNDE KULLANILAN AYDINLATMA SİSTEMLERİ

Dikey tarım sistemleri, olumsuz iklim koşullarında ve kentsel ortamlardaki gıda ihtiyaçlarının karşılanması, verim ve kalitenin yükseltilmesi, su ve besin maddeleri gibi kaynakların verimli kullanılması nedeniyle giderek daha fazla popülerlik kazanmaktadır. Işık, bitki gelişimini ve morfolojisini etkileyen en önemli çevresel faktörlerden biri olmakla birlikte, elektrik maliyetleri dikey tarım sistemlerinin ticari ölçekte yaygın olarak benimsenmesini sınırlayabilmektedir. Bitki yetiştiriciliğine yönelik LED aydınlatma teknolojileri de hızla gelişmektedir ve iç mekân yetiştiriciliğine yönelik lambalar, tatmin edici verim için enerji gereksinimlerini azaltmak amacıyla genellikle fotosentetik olarak aktif spektrumdaki (yani kırmızı ve mavi) ışık emisyonlarını optimize edecek şekilde tasarlanmaktadır. Bununla birlikte, bu ışık rejimleri altında, yapraklı sebzelerin ve bitkilerin iç mekân üretimi için minimum fotosentetik foton akı yoğunluğu (PPFD) hakkında literatürde çok az bilgi bulunurken, mevcut literatür genellikle 100 ila 300 µmol/m^2s arasındaki ışık yoğunluklarını benimsemektedir.

Dikey tarım sistemleri, bitkisel üretimi dikey boyutta genişleterek birim alandaki verimi arttırırken, çevre kirliliği oluşturmadan kaynakların verimli olarak tüketilmesini sağlamaktadır. Bu sistemlerde kullanılan LEDlerin bitkilerin verimliliğin arttıracak şekilde düzenlenmesi için çalışmalar yapılmaktadır. Dikey tarım sistemlerinde başlangıçta farklı renklerin bitki gelişimi üzerindeki etkileri incelenmiş ancak tek bir rengin bitki gelişimi için yeterli olmadığı görüldüğünden, son çalışmalarda tam spektrum içindeki özellikle fotosentezde etkili olan kırmızı (K) ve mavi (M) ışıkların oranları değiştirilerek, bitkiler üzerindeki etkileri belirlenmeye çalışılmaktadır. Fotosentetik foton akı yoğunluğu (PPFD) 250 ± 3 µmol/m^2s (günlük ışık integralinin 14.40 mol/m^2'sine eşittir) korunduğu, ana PPFD, kırmızı (R) ve mavi (B) ışığın yanı sıra daha yüksek oranda mavi, yeşil (Y) veya ultraviyole (UV)-A dalga boylarıyla zenginleştirilmiş aydınlatma spektrumundan oluşan dikey tarım sisteminde kırmızı yapraklı marul (*Lactuca sativa* L. cv. Red Cos) üretimi sırasında fidelere ve gelişmiş bitkilere uygulanan ışık kombinasyonları Çizelge 1'de gösterilmiştir. Kırmızı yapraklı marullara

olgunluk döneminde ek UV-A ile fide dönemindeki MKY-MKUV uygulamaları stoma iletkenliği, hücre içi/dışı CO_2 oranını ve dolayısıyla fruktoz miktarını azaltmış, terleme oranının arttırmış, dolayısıyla olumsuz etkili olmuştur. Bununla birlikte MKY ile sürekli aydınlatma veya yüksek mavi ışık ile ek yeşil aydınlatma M>K-MKY uygulamaları tersi etki göstermiştir. Hem fide (MK: MKY) hem de olgun (M>K-MKY) bitkilere ek yeşil ışık uygulaması yaprak alanını artırmıştır. Fidelerde MKY ve olgun bitkilere M>K uygulaması spesifik yaprak alanını arttırmıştır. Buna göre kırmızı yapraklı marulların büyüme aşamasında M>K-MKY uygulaması, fideler içinse MKY uygulaması en uygun şartlar olarak belirlenmiştir. Ancak PCA korelasyon matrisi seçilen ışık şartlarının kırmızı yapraklı marul için uygun olmadığını göstermiştir (Samuolienė vd., 2020).

Çizelge 1. Dikey tarım sisteminde, fide aşamasındaki ve gelişmiş marul bitkilerine uygulanan M, K ve UV-A'nın farklı kombinasyonları

Uygulama	M452	K638	K662	Y530	UV390	Toplam DLI, m^2/gün
MK	2,88	2,88	8,647	-	-	14,40
M>K	4,32	2,88	7,20	-	-	14,40
MKY	2,88	2,88	7,49	1,15	-	14,40
MKUV	2,88	2,88	8,38	-	0,26	14,40

Kırmızı yapraklı marulun gelişme aşamalarında kullanılan ışık kombinasyonları	
Fide aşaması	Olgunluk Aşamaları
MK	MK
M>K	MK – M>K
MKY	M>K
MKUV	M>K-MKY
	MKY
	MKY-M>K
	MKY-MKUV
	MKUV
	MKUV-MKY
	MKUV-MK
M-mavi (452 nm), K-kırmızı (638 ve 662 nm), Y-yeşil (530 nm), UV-UV-A (390 nm)	

Dikey tarım sistemlerinde mavi ve kırmızı ışığın arttırılmasının bitkiler üzerindeki olumlu etkilerinin yanı sıra, bitkilerin görsel takibinde zorluklar da oluşturabilmektedir. K ve M ışık altındaki bitkilerin yaprakları morumsu-gri göründüğünden hastalanmış ya da böcek istilasına uğramış yaprakları gözle görmek zorlaşmaktadır. Oysa tam spektrumda bitkilerin yaprak yeşil renkte görülür. Dolayısıyla K ve M ışığın oluşturduğu bu olumsuz etki ortama yeşil (Y) ışığın eklenmesi ile oluşturulan beyaz ışıkta giderilebilir ve üreticinin bitkileri daha kolay kontrol etmesi sağlanmış olur. Bununla birlikte yeşil ışığın CO_2 asimilasyonu, düşük PPFD altında daha düşük soğurulması nedeniyle genellikle kırmızı ve mavi ışığa kıyasla daha düşüktür. Ancak daha yüksek PPFD (≥500 µmol/m^2s) de yeşil ışık, kırmızı ve mavi ışıkla karşılaştırıldığında, tam spektrumun (kırmızı, yeşil ve mavi) bitki içine ve daha aşağıdaki yapraklara bir örnek dağılımı nedeniyle daha yüksek CO_2 asimilasyonu gösterir. Bu nedenle dikey tarım sisteminde yetiştirilen marulun veriminin arttırılması için kırmızı ve mavi ışığa ek olarak yeşil ışıkla aydınlatmanın optimum ışık yoğunluğundaki etkileri de incelenmiştir. 30 µmol/m^2sn yeşil (Y) ışık, 211:30:53 (K:Y:M) oranını koruyarak K ve M ışıklar ile desteklendiğinde marul bitkilerinin taze ağırlığını arttırmaktadır. Bu anlamda marul yetiştiriciliğinde en uygun K:Y:M kombinasyonunun %72 K, %10 Y ve %18 M olduğu belirtilmiştir (Abdur Razzak vd., 2022).
Dikey tarım sistemleri sebze yetiştiriciliğinin yanı sıra fide üretimleri için de kullanılmakta ve fide üretimi, bitki fabrikalarında taze sebze üretiminin önemli bir kısmını oluşturmaktadır. Sağlıklı fide üretiminde de ışığın etkisi önemli olup, farklı ışık formülasyonları fidelerin büyüme performanslarında farklı etkilere neden olmaktadır. Farklı marul tiplerinin fide gelişmeleri üzerine farklı K:M oranlarının etkilerinin incelendiği çalışmada oranların değiştirilmesi marul tohumlarının çimlenmesi ve fide gelişimi üzerine farklı etkilerde bulunmuştur. Marul tohumlarının çimlenmesi üzerine tam spektrum aydınlatma, özellikle Butterhead tipi marulda, K:M oranlarının değiştirildiği uygulamalardan daha etkili olmuştur. Ayrıca özellikle kırmızı oranının daha yüksek olduğu spektral bileşimler Butterhead ve Green Coral marul tiplerinde yaprak sayısı ve yaprak alanını etkilemiş ve Green Coral marulunun verimini de arttırmıştır (Çizelge 2, Şekil 1, Basir ve Masri, 2021).

Çizelge 2. Uygulanan ışıkların özellikleri ile marul bitkilerine etkileri (Basir and Masri, 2021).

Işıklandırma			25 cm'de PPFD (µmol/m²/s)	Ortam sıcaklığı (°C)	Sonuçlar
K	M	Y			
5	1	0	204-237	28,9-29,1	'Butterhead' ve 'Green Coral' tiplerinde yaprak sayısı ve yaprak alanını etkilemiştir. 'Green Coral' marulunun verimini arttırmıştır.
1	1	0	177-198	27,5-27,8	'Green Coral' marulunun verimini arttırmıştır
4	1	1	220-241	28,2-28,4	'Butterhead' ve 'Green Coral' tiplerinde yaprak sayısı ve yaprak alanını etkilemiştir. 'Green Coral' marulunun verimini arttırmıştır
Tam spektrum			265-320	27,3-27,6	Fide üretimi aşamasında çimlenme oranı tam spektrumda diğer LED aydınlatmalara göre daha yüksek olmuş, yine 'Butterhead' çeşidinin çimlenme oranı ve zamanı diğer çeşitlere göre daha iyi olmuştur.

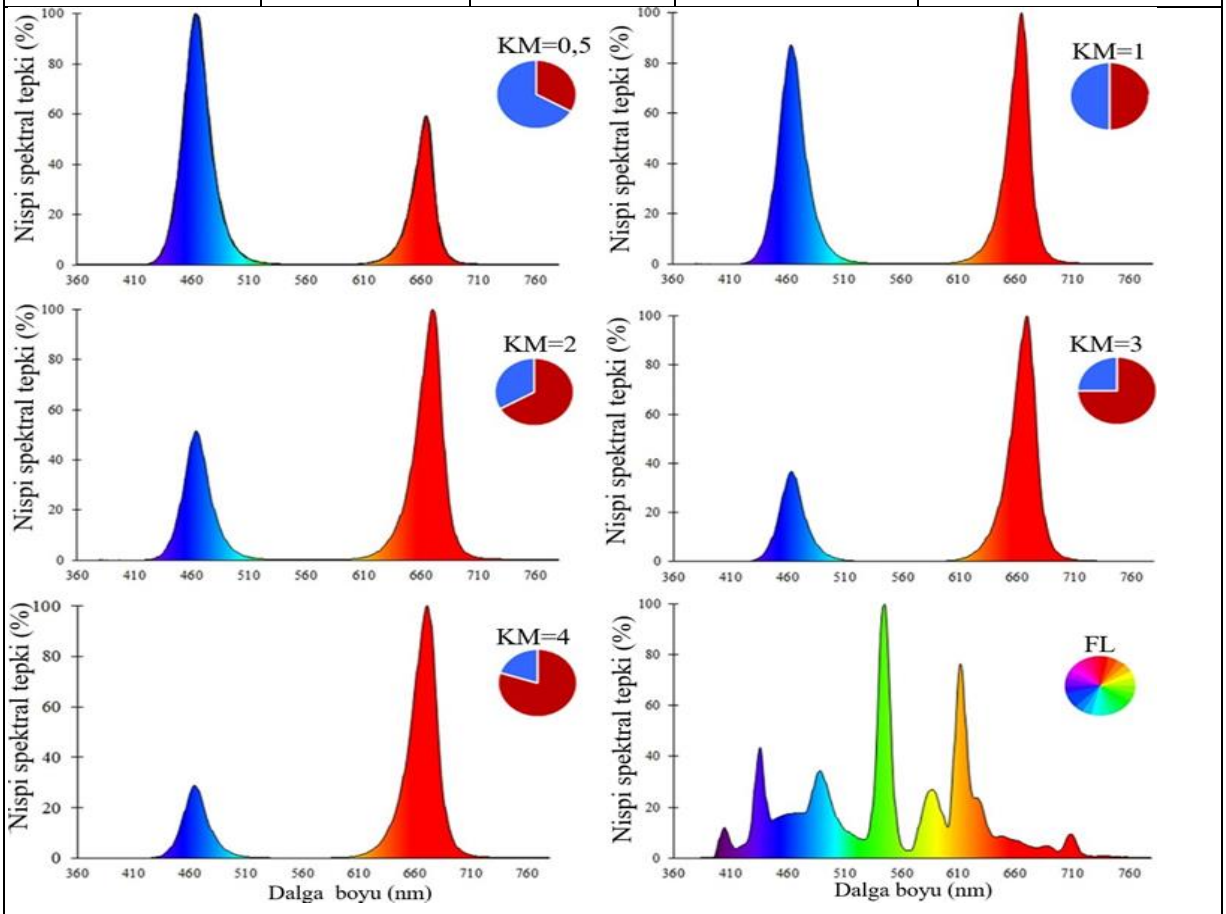
Şekil 1. Sistemin görünüşü



LED aydınlatma sistemindeki kırmızı ve mavi ışıkların oranların değiştirilmesinin verime olan etkisi, normal floresan lambalar ile de karşılaştırılmaktadır. Pennisi vd. (2019), 5 farklı K:M oranı kullandıkları (Çizelge 3) LED aydınlatma sisteminde (Şekil 2), LED aydınlatmanın floresana göre verimi 1.6 kat ve enerji kullanım etkinliğini 2.8 kat arttırdığını, yine KM=3 oranının 0,5'e göre yaprak klorofil ve flavonoid konsantrasyonlarını ve azot, fosfor, potasyum ve magnezyum alımını da arttırdığını bulmuşlardır. KM=3 oranı ayrıca transpirasyon hızını azaltırken, su kullanım (75 g FW/L H_2O) verimliliğini arttırmıştır. Sistemde KM≥3 oranları hem enerji hem de alan yüzey kullanım etkinliğini de önemli ölçüde arttırmıştır.

Çizelge 3. Çalışmada kullanılan ışık oranları, ışık enerjisi tüketim gücü, PPFD:elektrik oranları (Pennisi vd., 2019)

Uygulanan ışık (Kırmızı/Mavi)	**PPDF**	**Gün uzunluğu**	**Işık enerjisi tüketim gücü (W m^{-2})**	**PPFD:elektrik oranı (µmol J^{-1})**
0,5	215 µmol m^{-2} s^{-1}	16 saat	154	1,40
1			172	1,25
3			219	0,98
4			219	0,98
Floresan (K/M=1)				



Şekil 2. Kullanılan ışık spektrumları (Pennisi vd., 2019). Kırmızı (K) ışık dalga boyu 600-700 nm, Mavi ışık dalga boyu 400-500 nm.

Kapalı bitki yetiştiriciliği sistemlerinde kıvırcık (butterhead tipi) ve marul (Romain tipi) yetiştiriciliğinde kısa dalga boylu mavi ışık eklenmiş beyaz ışıkta (KNB1 ve KNB2) aynı elektrik gücü (Deney 1) veya aynı PPFD (Deney 2) uygulandığında KM'ye göre her iki marul çeşidi de daha fazla büyüme göstermiştir. KM uygulaması fenolik ve flavonollerin bazılarının

miktarını arttırırken, KNB2 uygulaması diğer fenolik ve flavonolların birikimini arttırmıştır. Bununla birlikte ışık ve enerji kullanım etkinliği KNB1 ve KNB2 uygulamalarında daha yüksek olmuştur. Bununla birlikte özellikle dikey tarım için KNB2 uygulaması önerilmiştir (Çizelge 4, Nyugen vd., 2021).

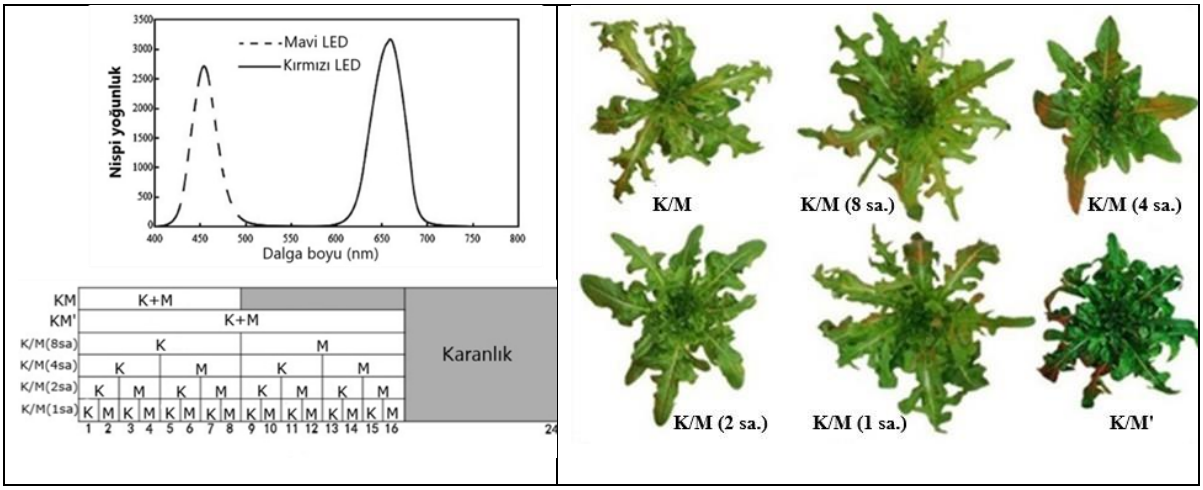
Çizelge 4. Dikey tarım marul yetiştiriciliğinde kullanılan LED ışıklar

Işık Kaynağı	Işık/Dalga Boyu	Oran (%)	Deney I		Deney II	
			PPFD µmol m^{-2} s^{-1}	Elektrik Gücü (W)	PPFD µmol/m^2s	Elektrik Gücü (W)
KM	M / 444	47	129.73	80	147,50	88,59
	Y / -	2				
	K / 665	51				
NB	M / 453	21	161,15			63,10
	Y / 586	42				
	K / 665	37				
KNB1	M /437	26	172,28			65,01
	Y /526	41				
	K / 665	33				
KNB2	M / 437	19	167,55			59,24
	Y / 578	43				
	K /664	38				

KM: Kırmızı, mavi: NB-Normal Beyaz, KNB-Kısa mavi normal beyaz

Dikey tarım sisteminde kullanılan LEDlerin ışık kalitesi ve yoğunluğu bitki gelişimini etkilerken, bu ışıklara maruz kalma süresi, yani günlük ışıklanma süresi (fotoperiyot) de bitki gelişimi için önemlidir. Bitkilerin fotoperiyot istekleri farklı olup, bazı bitkiler uzun günde, bazıları kısa günde ve bazıları da nötr günde daha iyi gelişme göstermekte ve daha verimli olmaktadır. Bununla birlikte örneğin nötr gün bitkilerinde gün uzunluğunun arttırılması verimi arttırabilmektedir. Bu nedenle dikey tarım sistemlerinde aydınlatma süresi bitkinin fotoperiyot istekleri dikkate alınarak yapılmalıdır. Hiroki vd. (2014), 'Greenwave' marul çeşidinde 16sa. /12sa. fotoperiyot uygulamasının 16sa./8sa. uygulamasına göre verimde %30 artış sağladığını tespit etmişlerdir. LED'ler ile oluşturulan dönüşümlü K ve M ışık uygulamasının 'Red Oak

Leaf' marulunun büyümesi ve besinsel özellikleri üzerindeki etkilerinin incelendiği çalışmada, aynı 8,64 µmol/m^2 günlük ışık integrali (DLI) ve benzer K:M (2:1) oranındaki dört alternatif ışık uygulaması, 16 sa. fotoperiyot boyunca sırasıyla 8 sa., 4 sa., 2 sa. ve 1 sa. dönüşümlü olarak uygulanmıştır *(*Şekil 3, Chen vd., 2017).



Şekil 3. 'Greenwave' marul bitkilerinde dönüşümlü K ve M ışık uygulamaları ve bitkilerin görünümü

Dönüşümlü K ve M uygulaması genel olarak marulun büyümesini ve kalitesini etkilemiştir. Bunun yanı sıra fotoperiyod sırasında 8 sa ve 1 sa aralıklı ışık uygulaması, bitki boyu/genişliği ve yaprak uzunluğu/genişliği gibi büyüme özellikleri ile büyüme hızını arttırmıştır. Eş zamanlı KM ile karşılaştırıldığında 8 sa.:8 sa. ve 1 sa.:1 sa., marulun sürgün biyokütlesini önemli ölçüde artırdı. 4 sa:4 sa ve 2 sa:2 sa uygulamaları, askorbik asit miktarını arttırmak ve nitrat içeriğini azaltmak suretiyle besin değerini yükseltmiştir (Chen vd., 2017).

Benzer şekilde Matysiak vd., (2022) 16 ve 20 sa. fotoperiyot ve 160 ve 240 µmol/m^{2}sn PPFD uyguladıkları marul çeşitlerinde yüksek PPFD yoğunluğu ve 16 sa. uygulamasının 'Elizium' çeşidinde duyusal kaliteyi arttırdığını, düşük PPFD ve 20s fotoperiyot uygulamasının 'Casual' çeşidinin duyusal kalitesini azalttığını bulmuşlardır. Ayrıca 'Casual' çeşidinde 17,3 µmol/m^{2}sn ve 'Elizium' çeşidinde 11,5-17,3 µmol/m^{2}sn DLI'nın sırasıyla 350 ve 240 g verim artışı sağladığını bulmuşlardır (Çizelge 5).

Çizelge 5. Farklı ışık yoğunluğu ve fotoperiyot uygulamalarının marulun büyüme, gelişme ve verimine etkisi

Bitki	**PPFD (µmol/m²sn)**	**Sıcaklık**	**DLI (mol/m²gün)**	**Gün Uzunluğu (Aydınlık/Karanlık)**	**Kaynak**
Lactuca sativa L. 'Greenwave'	110 ve 170	23°C-18°C	-	16sa./8sa., 16sa./4sa., 16sa. /2sa.	Hiroki vd., 2014
Etki	• Yüksek PPFD verimi arttırmasına karşın elektik tüketimini arttırmıştır 16s/2s fotoperiyot, marulun taze ağırlığını 16s/8s'te göre %30 oranında arttırmıştır				
(*Lactuca sativa* var. longifolium) Casual, Elizium	160 ve 240		9.2, 11.5, 13.8, 17.3	16 ve 20 sa.	Matysiak vd., 2022
Etki	• Casual': DLI 17.3 mol/m², 'Elizium' DLI 11,5-17,3 mol/m² sırasıyla 350 ve 240 g olarak taze ağırlığı arttırmıştır. 160 µmol/m^{-2} s^{-1} PPFD ve 16 saat gün uzunluğu (günde 9,2 mol m^{-2} DLI taze ağırlığı, yaprak sayısı ve baş çevresi uzunluğunu azaltmıştır. • Marullarda nitrat seviyesi her iki aydınlatma düzeyinde de Avrupa Birliği Yönetmeliğinin sınırlarının altında kalmıştır. • Yüksek PPFD yoğunluğu ve 16 saat fotoperiyot uygulaması 'Elizium' çeşidinin duyusal kalitesini yükseltmiş, oysa düşük PPFD ve 20 saat fotoperiyot uygulaması 'Casual' çeşidinde duyusal kaliteyi azaltmıştır				

Farklı fotoperiyotlara ek olarak farklı K:M oranları da fotosentez, bitki gelişimi ve enerji tüketimini etkilemektedir. Beyaz (B), K ve K-M LED kombinasyonunda yetiştirilen marul (*Lactuca sativa* cv. Youmaicai) bitkilerinde kırmızı ışık marul bitkilerinin radyal büyümesini teşvik ederken, mavi ışık enine büyümeyi ve fotosentez pigmentlerinin sentezini uyarmıştır. Yalnız kırmızı ışık altındaki marul bitkileri normal olarak büyüyememiş, buna karşın mavi ışık (%5-20) fotosentez, terleme, floresanı iyileştirmiş, fotosentez pigmentleri ve besin içeriği ile toplam biyokütleyi arttırmıştır. %10-20 M-LED oranında büyüme parametreleri beyaz ışıktan daha yüksek olmuştur. Bununla birlikte %25-50 M oranı marul bitkilerinin büyümesi üzerine olumsuz etkili olmuştur. Marul bitkilerinin gelişimi için en iyi aydınlatma şartlarının %90 K ve %10 M olduğu belirtilmiştir (Tang vd., 2009). Bir diğer araştırmada dikey tarım sisteminde K ve M LED ışık altında yetiştirilen marulların yaprak sayısı ve alanının arttığı, ayrıca bu şartlarda yetiştirilen marulun ağırlığının (3,04 kg), geleneksel hidroponik sistemine (2,18 g) daha yüksek olduğu belirlenmiştir (Amado vd., 2016). K:M oranı 1,8 olan floresan lamba ile K:M oranları 1,2 ve 2,2 olan LED lambalar ile farklı PPFD oranlarında ile 12 ve 16 saat gün uzunluğu şartlarında yetiştirilen marul bitkisinde fotosentez miktarı 250 µmol/m²sn PPFD'da daha yüksek olurken, aynı PPFD'de K:M=2 olan LED aydınlatma altında 16 saat gün uzunluğu en yüksek kalite ve verimi sağlamıştır (Çizelge 6, Şekil 4, Zhang vd., 2018).

Çizelge 6. Farklı ışık kaynakları ve oranları ile PPFD ve DLI'nın marulda bitki gelişimine etkileri

Bitki	Işık Kaynağı	K:M	PPFD µmol/m²sn	Gün Uzunluğu	DLI mol/m²gün	Kaynak
Lactuca sativa L. cv. Ziwei	Floresan	1,8	150	12	6,48	Zhang vd., 2018.
			200	12	8,64	
			250	12	10,80	
	LED	1,2	300	12	12,96	
			150	16	8,64	
			200	16	11,52	
			250	16	14,40	
	LED	2,2	300	16	17,28	
Etki	• Hasattan önce marul yapraklarının net fotosentetik oranı sonuçları, 250 µmol/m²sn PPFD'de yetiştirilen bitkilerde 300 µmol/m²sn PPFD'de yetiştirilenlere göre daha yüksek olmuştur. • Büyüme, fotosentez, kalite ve enerji tüketimi sonuçları K:M=2.2 olan LED altında 16 saat/gün fotoperiyot ile 250 µmol/m²s PPFD'nin, kapalı kontrollü ortamda ticari marul (cv. Ziwei) üretiminde maksimum büyüme ve yüksek kalite için uygun bir ışık ortamı olduğunu göstermiştir.					



Şekil 4. Marul bitkilerinin yetiştirildiği dikey tarım sistemi ve bitkilerin görünümü

Benzer ışık kaynakları ile 200-250 µmol/m²sn PPFD'da 14-16 saat gün uzunluğu şartlarında fide üretimi yapılan *Lactuca sativa* L. cv. Frill ice marulunda; K:M oranı 2,2 olan LED'ler tarafından sağlanan 16 saat/gün fotoperiyot ile 200 µmol/m²s PPFD şartları fide üretimi için uygun bulunmuştur (Çizelge 6, Yan vd., 2019). 24°C ve 450 µmol/mol CO_2'de K:M=3 oranında

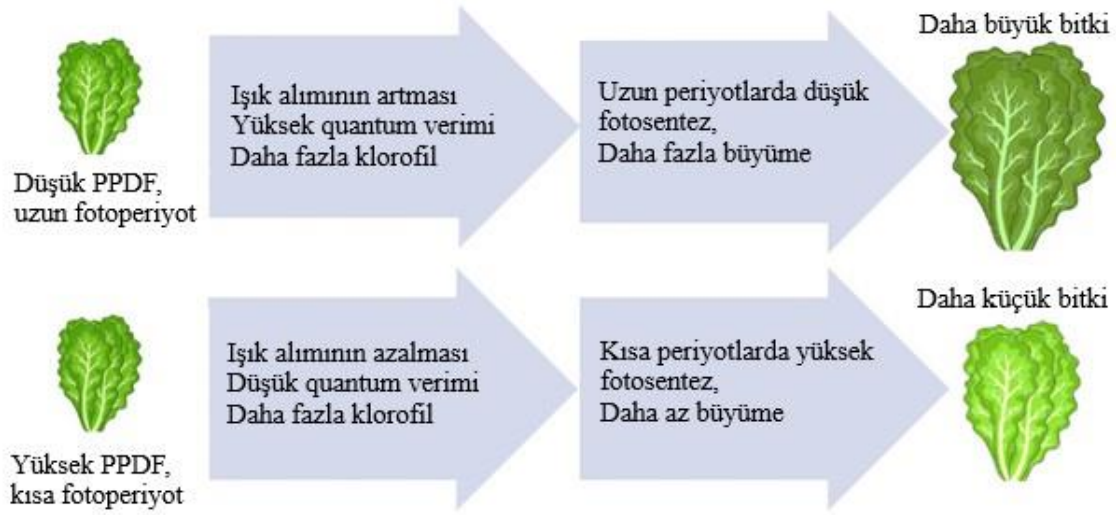
16 saat fotoperiyot şartlarında farklı PPFD ve DLI şartlarındaki büyüme odalarında yetiştirilen fesleğen fesleğen (*Ocimum basilicum* L.) ve marul (*Lactuca sativa* L.) bitkilerinde 250 µmol/m^{2}s PPFD'nin verim ve kaynak kullanım verimliliği optimize etmek için uygun bulunmuştur (Çizelge 7, Pennisi vd., 2020)

Çizelge 7. Farklı ışık kaynakları ve oranları ile PPFD ve DLI'nın marul ve fesleğende bitki gelişimine etkileri

Bitki	**Işık Kaynağı**	**K:M**	**PPFD µmol/m^{2}sn**	**Gün Uzunluğu**	**DLI mol/m^{2}gün**	**Kaynak**
Lactuca sativa L. cv. Frill ice	Floresan	1,8	200 ve 250	14 ve 16 sa.	-	Yan vd. (2019)
	LED	1,2				
	LED	2,2				
Etki	• Tohum ekiminden 20 gün sonra, DLI oranının artmasıyla yaprak uzunluğu (YU) ile YU/yaprak genişliği oranı logaritmik olarak azalmış, floresan altındaki fideler LEDlere göre daha büyük, yaprak alanı daha fazla, yaprak ve kök kuru ağırlıkları da yüksek olmuştur. • Marulların hasat sırasındaki yaprak ve kök yaş ağırlıkları fide aşamasındaki 16 saat fotoperiyot ve 200 µmol/m^{2}sn PPFD'de daha yüksek olmuştur. • K:M oranı 1,2 olan LEDler altındaki fidelerin C vitamini miktarı daha düşüktür.					
Ocimum basilicum L. *Lactuca sativa* L.	LED	3	100	16	5,8	(Pennisi vd., 2020).
			150		8,6	
			200		11,5	
			250		14,4	
			300		17,3	
Etki	• Hem marul hem de fesleğen için 250 µmol/m^{2}s PPFD'ye kadar biyokütle üretiminde aşamalı bir artış olmuştur. • En yüksek stoma iletkenliği marulda 250 µmol/m^{2}s ve fesleğende ≥200 µmol/m^{2}s ile ilişkili olurken, su kullanım etkinliği marulda ≥200 µmol/m^{2}s ve fesleğende 250 µmol/m^{2}s PPFD'de maksimum olmuştur. • Enerji ve ışık kullanım etkinliği marulda 200 ve 250 µmol/m^{2}s'de ve fesleğende 250 µmol/m^{2}s'de artmıştır. • Marulda 250 µmol/m^{2}s aldında antioksidan kapasite, fenolikler ve flavonoidler ≤150µmol/m^{2}s'e göre daha yüksek olmuştur.					

Fotoperiyodun fotosentez üzerinde önemli etkisi bulunmasına karşın, fotosentezin arttırılmasında PPFD'nin yüksek yada düşük olmasının, kısa süreli veya uzun süreli uygulanmasının fotosentez üzerindeki etkileri farklı olabilmektedir. Fotosentez daha düşük

PPFD'lerde daha verimli olduğundan düşük PPFD'de fotoperiyot süresinin arttırılması yüksek PPFD'de aynı DLI'yı sağlayan kısa fotoperiyotlara göre büyümeyi arttırmaktadır. İki farklı yeşillik ile yapılan çalışmada 20°C ve 819 µmol/mol CO_2 içeren ortamda 10, 12, 14, 16, 18 ve 20 saat fotoperiyotlarla beyaz ışık altında PPFD'si her uygulamada16 mol-m^{-2}-d^{-1} DLI sağlayan şartlarda yetiştirilen Mizuna (*Brassica rapa* var. *Japonica*) ve marul (*Lactuca sativa* L. 'Little Gem') bitkilerinde, PPFD'nin düşürülmesi ve fotoperiyotların arttırılması ışık alıkonmasını, klorofil miktarını, fotosistem II'de quantum verimini ve toprak üstü biyokütleyi arttırmış, fotoperiyodun 10 saatten 20 saate çıkarılması marulda %16 ve mizunada %18.7 verim artışı sağlamıştır (Şekil 5, Palmer ve van Iersel, 2020).



Şekil 5. PPFD miktarı ve fotoperiyot süresinin marul bitkisinin gelişimine etkisi

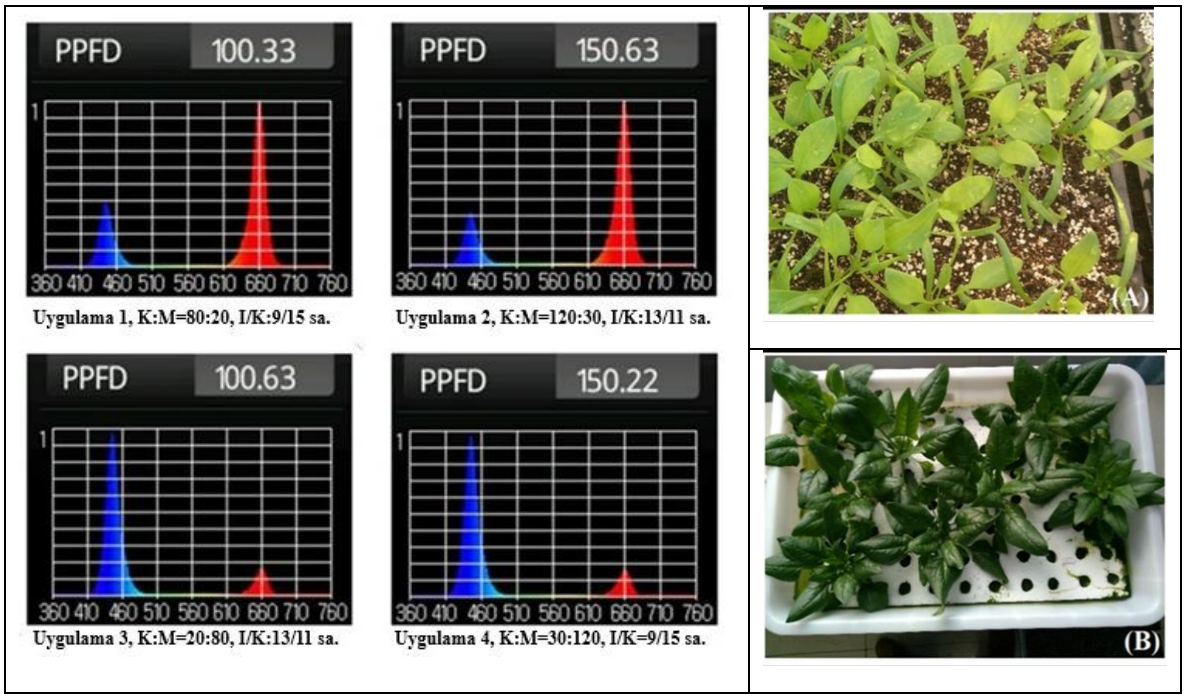
K:M ve K:M:Y LED kombinasyonunda ve 12/12 saat fotoperiyotta K:M LED ışık için 318 µmol/m^2sn PAR ve K:M:Y LED ışık için 327 µmol/m^2s PAR şartlarında, 28±1°C sıcaklıkta, %65-75 hava nemi ve 550 ppm CO_2 içeren çok katlı bitki fabrikasında yetiştirilen Coral tipi marullarda oluşturulan ışık şartları fitokimyasal miktarını olumlu etkilemiş, dikimden 30-35 gün sonra hasat edilen marullarda ek Y LED ışık uygulaması antioksidan aktivite, toplam fenolik içeriği ve klorojenik asit içeriği gibi fitokimyasal içeriğini önemli ölçüde arttırmıştır (Nur Syafini vd., 2022).

Fotoperiyotun bitki gelişmesindeki önemi bilinmesine karşın sürekli aydınlatılan ortamda bitkilerin nasıl geliştikleri de merak konusu olabilmektedir. Üç katlı dikey tarım sisteminde marul üretimi için sırasıyla 660-680, 420-440 ve 730-750 nm dalga boylarındaki kırmızı (K), mavi (M) ve uzak kırmızı (UK) ışıklar, %100K, %75 K:%25M ve %50K, %25 M ve %25 UK

oranlarında ve PPFD 250 µmol/m^2s olacak şekilde tasarlanmış, sistem 21±1°C sıcaklıkta sürekli aydınlatılmıştır. Sürekli ışık uygulaması K ve KM'de yapraklarda nekrotik lekeler oluşturmuştur. Yalnızca K uygulaması bitkilerin taze ve kuru ağırlıkları ile yaprak alanını arttırırken bu uygulamadaki yapraklar deformasyon göstermiştir. K:M:UK, yalnızca K'ya göre bitkilerin daha fazla uzamasına ve nekrotik lekelerin azalmasına neden olmuştur (Khoramtabrizi vd., 2020).

DİKEY TARIM SİSTEMLERİNDE ISPANAK ÜRETİMİNDE KULLANILAN AYDINLATMA SİSTEMLERİ

Dikey tarım sistemlerinde yetiştirilen sebzelerden biri olan ıspanakta da verim ve kalitenin arttırılmasına yönelik aydınlatma sistemleri tasarlanmaktadır. Ispanak üretimi için en uygun LED ışık ayarını bulmak amacıyla farklı K:M oranlarına sahip dört farklı aydınlatma sistemi oluşturulmuştur (Şekil 6). Bu sistemlerde yetiştirilen ıspanakların yaş ve kuru ağırlığı, kök uzunluğu gibi büyüme indekslerini arttıran etkili faktörün fotoperiyot olmuş, bunu ışık yoğunluğu ve ışık kalitesi izlemiştir. Bitki büyüme parametreleri açısından en iyi ışık şartları K:M= 4:1 ve PPFD =100 µmol/m^2sn ve 13/11 sa. fotoperiyot olarak belirlenmiştir. Çözünür şeker ve protein miktarı açısından en iyi ışık kombinasyonu K:M=4:1, PPFD: 150 µmol/m^2sn ve 9/15 fotoperiyot şartları olmuştur. Büyüme ve kalite için en uygun ışık parametreleri arasında bir denge olduğundan, üretim sırasında bitkinin verimi ve kalitesi arasında bir denge sağlamak gerekir. Bu sonuçlara göre ıspanağın yaprak alanını genişletmek dolayısıyla verimi yükseltmek açısından fotoperiyodun ayarlanmasına dikkat edilmeli ve ışık yoğunluğu düşürülerek daha fazla aydınlatma yapılmalıdır. Ancak ıspanak tadı ve besin değerinin iyileştirilmesi için ışık yoğunluğuna daha fazla dikkat edilmeli, ışık yoğunluğu yükseltilerek aydınlatma süresi kısaltılmalıdır (Zou vd., 2020).



Şekil 6. Dikey tarım sisteminde ıspanak yetiştiriciliği için kullanılan K:M oranları ile ıspanak fideleri (A) ve gelişmiş ıspanak bitkileri (B)

Yine K ve M LEDlerle (K660/M450= 4/1) 90, 140, 190 ve 240 µmol/m^2s ışık yoğunluğu altında yetiştirilen ıspanaklarda ışık yoğunluğunun artması; bitki boyu, yaprak sayısı, yaprak genişliği, sürgün taze ağırlığı, sürgün kuru ağırlığı, kök taze ağırlığı ve kök kuru ağırlığını arttırırken, spesifik yaprak ağırlığı ve sürgün-kök oranı etkilememiştir. 190 µmol/m^2sn ışık yoğunluğunda Fe^{+2}, ham lif, SÇKM, toplam polifenol ve C vitami artarken, organik madde miktarı azalmış olup, dikey tarım ıspanak yetiştiriciliği için 190 µmol/m^2sn ışık yoğunluğu önerilmiştir (Nguyen vd., 2022)

Benzer şekilde 115, 140 ve 160 µmol/m^2sn olmak üzere üç ışık yoğunluğu ve 500 ppm ve 800 ppm CO_2 şartlarında yetiştirilen ıspanak bitkilerinde 30 güne kadar ışık yoğunluğundaki artış bitkinin büyümesi üzerinde önemli etkide bulunmazken, 37 ve 44 günlerde ışık yoğunluğundaki artış 500 ppm CO_2'de yaprak sayısı, yaş ve kuru ağırlığı önemli ölçüde arttırmıştır. 37 günde hasat edilen ıspanaklarda ışık yoğunluğunun 115 µmol/m^2s'den 140 µmol/m^2s'ye ve ardından 160 µmol/m^2s'ye çıkarılması taze ağırlığı 2,1 ve 2,4 kat attırmıştır. 800 ppm CO_2 ile ışık yoğunlukları kombinasyonu 37 ve 44 günlük hasat aşamalarında bitki büyüme parametrelerini önemli ölçüde arttırmış, özellikle büyüme periyodunun son haftasında yaş ve kuru ağırlık 140 µmol/m^2s'de sırasıyla %37,5 ve %57,5 olarak artmıştır. Dolayısıyla ıspanak bitkisi için büyüme döneminin sonlarında 140 µmol/m^2s uygulaması ıspanağın gelişimini arttırmak için alternatif yol olarak önerilmiştir (Thuy vd., 2022).

Farklı K:M oranlarında yetiştirilen ıspanaklarda besin çözeltisindeki minerallerin arttırılmasının ıspanak verimi üzerine etkileri de araştırılmıştır (Çizelge 8). Farklı demir (Fe) konsantrasyonlarına (2, 5 ve 15 mg L^{-1}) sahip hidroponik çözeltilerde ve pik noktaları sırasıyla 665nm ve 450 nm olan farklı oranlardaki K:M altında yetiştirilen 'Corvair F_1' ve 'Space F_1' çeşitlerinde yüksek Fe konsantrasyonlarında K:M oranının azalması bitki yaş ağırlığı ve yaprak uzunluğu, genişliği ve sayısını azaltmıştır (Vaštakité-Kairiené vd., 2022).

Çizelge 8. Dikey tarım ıspanak yetiştiriciliğinde farklı K:M, PPFD ve Fe konsantrasyonlarının verime etkisi

K:M	**Fe (mg/L)**	**PPFD (% PPFD)**		**Sonuçlar**
		K	**M**	
9:1	2	225 (%90)	25 (%10)	• Yüksek Fe konsantrasyonlarında bitki biyokütlesi ve yaprak uzunluğu, genişliği ve sayısı genellikle K:M azaldıkça azalmıştır. • Daha yüksek Fe dozu diğer bazı minerallerin içeriğini arttırmış ancak etki K:M ve çeşide bağlı olarak değişmiştir. • Örneğin, Zn genellikle artan Fe ile artmış ancak Cu içeriği özellikle 'Space F_1'de azalmıştır. • K:M ve Fe dozunun metabolitler veya antioksidan kapasite üzerinde belirgin etkileri olmamıştır. • (Vaštakité-Kairiené vd., 2022)
	5			
	15			
3:1	2	188 (%75)	62 (%25)	
	5			
	15			
1:3	2	62 (%25)	188 (%75)	
	5			
	15			
K- kırmızı, 665 nm, M-mavi, 450 nm				

LED aydınlatma altında dikey tarım sisteminde ıspanak (*Spinacia oleracea* L.) üretiminde günlük ışık integralinin (DLI) ve ışık spektrumunun ıspanağın büyümesi, besin kalitesi ve enerji verimi üzerindeki etkileri araştırılmıştır (Çizelge 9, Gao vd. 2020).

Çizelge 9. Dikey tarım ıspanak yetiştiriciliğinde kullanılan farklı DLI, K:M, fotoperiyot ve ışık kaynakları

DLI (mol/m^{2}gün)	K:M	Işık yoğunluğu (µmol/m^{2}sn)	Fotoperiyot	Işık kaynağı
11,5	1,8	200	16	Beyaz floresan lamba
14,4		250		
17,3		300		
20,2		350		
11,5	0,9	200		LED (Beyaz)
14,4		250		
17,3		300		
20,2		350		
11,5	1,2	200		LED (Beyaz:kırmızı: 5:1)
14,4		250		
17,3		300		
20,2		350		
11,5	2,2	200		LED (Beyaz:kırmızı: 5:3)
14,4		250		
17,3		300		
20,2		350		

Çalışmada kullanılan sırasıyla K:M oranı 0,9, 1,2 ve 2,2 ve DLI'sı 14,4 mol/m^2 gün olan farklı aydınlatma ortamlarının (L0.9, L1.2 ve L2.2), ve kontrol olarak kullanılan K:M oranı 1,8 (F1,8) olan floresan lambaların spektral dağılımları Çizelge 10'da verilmiştir.

Çizelge 10. Çalışmada kullanılan ışık kaynaklarının spektral fraksiyonları (%)

Parametre	Işık kaynaklarının spektral fraksiyonu (%)			
	F1,8	**L0,9**	**L1,2**	**L2,2**
Foton akışı (300-800)	100	100	100	100
Ultraviyole ışık (300-399)	1,4	0,0	0,0	0,0
Mavi ışık (400-499)	20,3	27,0	25,9	20,4
Yeşil ışık (500-599)	39,0	46,9	41,1	33,9
Kırmızı ışık (600-699)	35,8	24,2	31,4	44,1
Uzak kırmızı ışık (700-800)	3,5	1,9	1,6	1,6
K:M oranı	1,8	0,9	1,2	2,2

DLI'sı 17.3 olan L1.2 aydınlatması ıspanakların toplam taze ve kuru ağırlıkları ve enerji verimini; ışık kalitesinden bağımsız olarak yine 17.3 mol/m^{2}gün DLI net fotosentezi ve tüm LED uygulamaları C vitaminini arttırmıştır. Mavi ışık fraksiyonu yüksek olan L1.2 uygulaması ıspanakların C vitaminini arttırmış, nitrat miktarını azaltmıştır. Kırmızı ışık fraksiyonu yüksek L2.2 oksalat birikimini azaltmada etkili olmuştur. Farklı DLI'larda 1,2 K:M içeren LEDler altında toplam taze ağırlık artışına bağlı güç tüketimi, floresan lambalara göre %38'in üzerinde daha düşük olmuştur. Sonuç olarak, 1,2 K:M içeren LEDler kullanılarak 17,3 mol/m^2 gün DLI'da aydınlatma ortamı, hidroponik ıspanak üretimi için bir LED bitki fabrikasının tasarımı için önerilmiştir (Şekil 7, Gao vd. 2020)



Şekil 7. Çalışmada kullanılan aydınlatma sistemleri altında ıspanak bitkilerinin görünümü

DİKEY TARIM SİSTEMLERİNDE FESLEĞEN ÜRETİMİNDE KULLANILAN AYDINLATMA SİSTEMLERİ

Fesleğen (*Ocimum sp.*) Herbalizm, Agronomi, Etnobotanik, Gastronomi ve Bromatoloji alanlarında önemli bir bitki olarak kabul edilmektedir. Dünya üzerinde nüfustaki artışlar, gıda taleplerinde bir artışa yol açmıştır ve bu nedenle tüketicilerin isteği doğrultusunda bitkilerin üretilmesi için yetiştirme koşullarını optimize etme ihtiyacı artmıştır. Bu optimizasyon, dikey sistemlerde fesleğen yetiştirmeyi de kapsamaktadır. Fesleğen hem taze olarak tüketilmekte hem de yemeklere lezzet veren uçucu yağlardan dolayı önem kazanmaktadır. Fesleğen uçucu yağının kimyasal bileşimi çeşitlilik göstermekle birlikte yaygın olarak Estragole, Linalool, Eugenol, Cinnamate ve Eucalyptol içerir. Dikey tarım sistemlerinde fesleğenin verimini ve uçucu yağ bileşimini arttırmak için LEDlerden faydalanılmakta olup kullanılan LEDlerin optimize edilmesi bu açıdan önem kazanmaktadır (Aldarkazalı, 2020). Dikey tarım sisteminde yetiştirilen tatlı fesleğende (*Ocimum basilicum* L.) büyüme özelliklerini, polifenolik bileşikleri ve uçucu yağları arttırmak için en uygun LEDlerin belirlenmesi amacıyla yapılan çalışmada kullanılan ışıklar ve PPFD değerleri Çizelge 11'de verilmiştir.

Çizelge 11. Dikey tarım fesleğen yetiştiriciliği için kullanılan LEDlerin özellikleri

Işık uygulamaları			25 cm'de PPFD (µmol/m^2/sn)	Ortam sıcaklığı (ºC)	Oransal nem
K	M	B			
1	0	9	128	22,2±2,5	%80±5
3	2	5	119		
1	0	12	136		
5	0	5	128		

Işık kaynaklarından K5:M0:B5 (PPFD:119 µmol/m^2/sn), toplam yaş ağırlık ve sürgün taze ağırlığını ve K1:M0:B9 kök taze ağırlığını arttırırken, ışık uygulamaları bitki boyunu ve yaprak sayısını etkilememiştir. Fesleğende tanımlanan üç ana polifenolden rosmarinik asit içeriği en yüksek iken bunu şikorik ve kafeik asitler izlemiş olup, en yüksek rosmarinik ve şikorik asit içeriği K3:M2:B5 ile elde edilmiş, aynı uygulamadaki fesleğenlerin uçucu yağ miktarı da en yüksek olmuştur. Bunu K1:M0:B5, K1:MO:B12 ve K1:M0:B9 izlemiştir. Sonuç olarak, K3:M2:B5 ışık uygulaması, tatlı fesleğende polifenolleri ve uçucu yağların verimini arttırmada en uygun ışık bileşeni olarak bulunmuştur (Song vd., 2020). Benzer şekilde dikey tarım

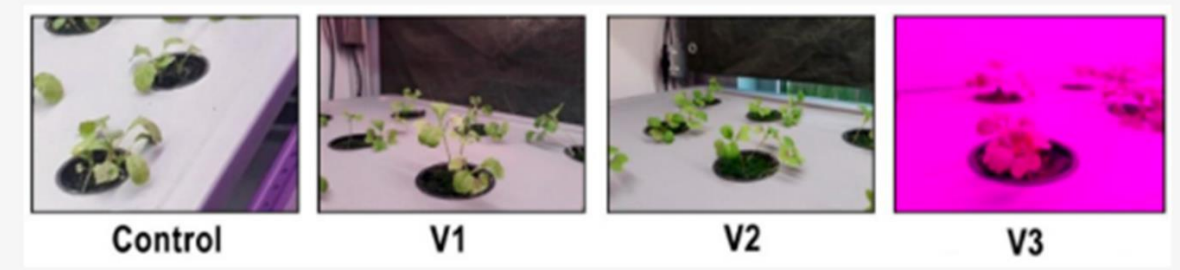
sisteminde fesleğen üretimini optimize etmek amacıyla 435 nm dalga boyunda mavi ve 663 nm dalga boyundaki kırmızı ışık ile, 1,6M:1K oranları kullanılarak, 300 µmol/m^{2}sn ışık yoğunluğunda çok katmanlı bir hidroponik sistem kullanılmış ve oluşturulan ortam fesleğenlerin büyümesini ve kalitesini iyileştirmiştir. Fesleğen uçucu yağında bulunan eugenol ve linalool bileşenlerinin miktarı ışık düzenlemesi ile değiştirilebilmiş ve hem verimi hem de kalitesi arttırılmıştır (Aldarkazalı, 2020).

DİKEY TARIM SİSTEMLERİNDE KIRMIZI YAPRAKLI HARDAL ÜRETİMİNDE KULLANILAN AYDINLATMA SİSTEMLERİ

Dikey tarım sistemlerinde üretilen diğer bir yeşillik olan kırmızı yapraklı hardal (*Brassica juncea* L.) yetiştiriciliği için en etkili LED kombinasyonunu belirlemek amacıyla farklı oranlarda mavi, yeşil kırmızı ve uzak kırmızı ışık yoğunluğu içeren 4 LED kullanılmıştır. LEDlerin özellikleri Çizelge 12'de, oluşturulan sistemde fidelerin görünümü Şekil 8'de ve gelişmiş bitkilerin görünümü Şekil 9'da verilmiştir.

Çizelge 12. Dikey tarım sisteminde kırmızı hardal üretiminde kullanılan ışıkların özellikleri

Uyg.	**Foton akışı, µmol/m^{2}sn**						**Işıkların % oranları (M:Y:K:UK)**
	PFD (400-800 nm)	**Mavi (400-500 nm)**	**Yeşil (500-600 nm)**	**Kırmızı (600-700 nm)**	**Uzak kırmızı (700-800 nm)**	**PPFD (400-700 nm)**	
Kont.	120 ± 2,8	17,5 ± 0,3	38,5 ± 1,2	51,0 ± 1,5	13,0 ± 0,2	107,0 ± 2,7	15:32:42:11
	180 ± 3,3	26,4 ± 0,6	58,0 ± 1,5	76,0 ± 1,9	19,6 ± 0,4	160,4 ± 3,2	
V1	120 ± 2,3	14,2 ± 0,2	26,2 ± 1,1	73,2 ± 1,6	6,4 ± 0,1	113,6 ± 2,2	12:20:63:5
	180 ± 3,1	21,4 ± 0,5	36,7 ±1,3	112,9 ± 1,5	9,0 ± 0,3	171,0 ± 3,0	
V2	120 ± 3,0	18,0 ± 0,2	36 ± 0,9	58,8 ± 0,9	7,2 ± 0,1	112,8 ±2,8	15:30:49:6
	180 ±3,3	26,2 ± 0,7	53,9 ± 1,6	88,8 ± 1,1	11,3 ± 0,5	168,9 ± 3,1	
V3	120 ± 1,5	36,5 ± 0,3	1,5 ± 0,1	81,0 ±1,0	1,0 ± 0,1	119,0 ± 1,5	30:1:68:1
	180 ± 3,8	54,5 ± 0,7	2,0 ± 0,2	122,0 ± 2,3	1,5 ± 0,1	178,5 ±3,8	



Şekil 8. Oluşturulan renk kombinasyonlarında kırmızı yapraklı hardal (*Brassica juncea* L) bitkilerinin görünümü



Şekil 9. Üretimin 30. gününde 120 µmol/m^{2}sn PFD (a) ve 180 µmol/m^{2}sn PFD (b) altındaki "Red Hill" çeşidinin kırmızı yapraklı hardal (*Brassica juncea* L.) bitkileri.

Sonuçlar, 120 µmol/m^{2}s PPFD'nin hem hardal yaprağı biyokütle birikimi hem de bitkilerdeki nitrat konsantrasyonu (%13-30 daha yüksek) üzerinde olumsuz etkili olduğunu göstermiştir. Kırmızı hardal yetiştirmek için en iyi aydınlatma seçeneği, elektriği biyokütleye dönüştürme açısından en verimli olan mavi-kırmızı spektrum (77 Wth/g) olmuştur. Bu ışık spektrumu, spektrum yüzdesi güneş ışığı spektrumuna maksimum benzerlik gösteren kontrole kıyasla daha büyük bir yaprak alanı (%60) ve taze kütle (%54) ile bitki gelişimine katkıda bulunmuştur. Aynı PPFD seviyesinde çeşitli oranlarda mavi-kırmızı ışık spektrumu ile yeşil ve uzak kırmızı radyasyonun varlığı, bitki taze kütlesi, yaprak yüzey alanı ve fotosentetik aktivite üzerinde olumsuz sonuçlara da neden olmuştur *(*Semenova vd., 2022*)*

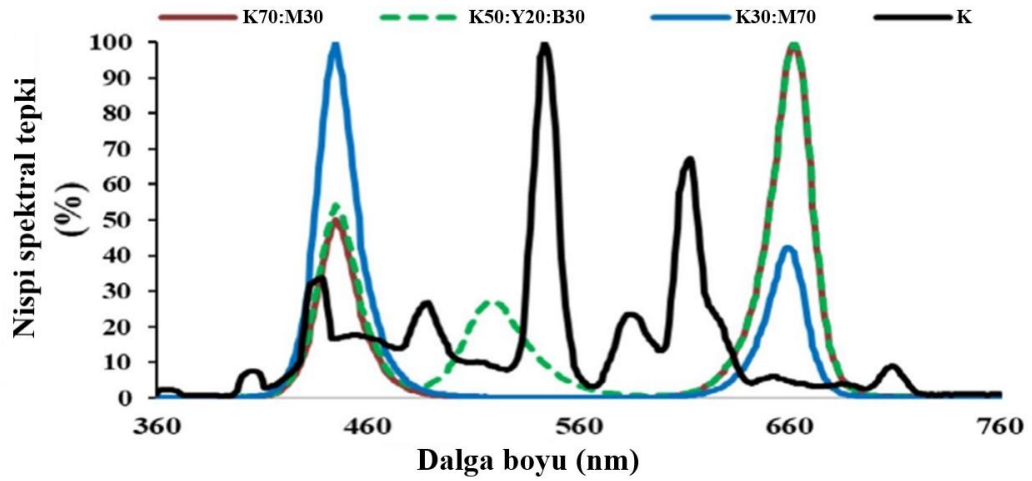
DİKEY TARIM SİSTEMLERİNDE ROKA ÜRETİMİNDE KULLANILAN AYDINLATMA SİSTEMLERİ

Farklı ışık modlarının rokanın (*Eruca sativa* Mill.) fotosentetik performansı ve diğer fizyolojik özellikler üzerindeki etkisi, ışık yoğunluğu, kalitesi ve fotoperiyod faktörleri arasındaki bir kombinasyona dayanan ortogonal bir tasarım kullanılarak değerlendirilmiştir (Çizelge 13, Elmardy vd., 2021).

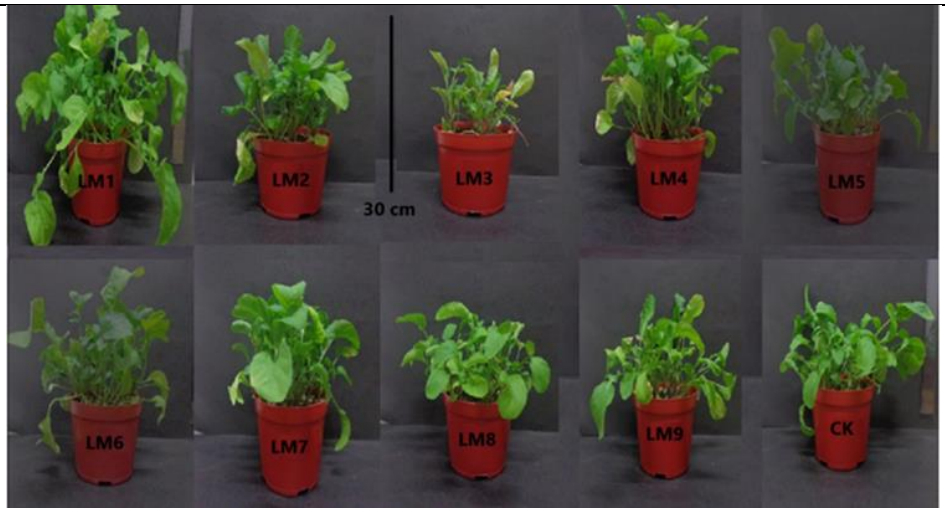
En yüksek klorofil a, klorofil b ve karotenoid seviyeleri sırasıyla LM4, LM3 ve LM1 uygulamalarındaki rokalarda elde edilmiştir. Kullanılan ışık yoğunluğuna bakılmaksızın, 14/10 saatten (aydınlık/karanlık) daha kısa bir fotoperiyotla K7:Y0:M3 (LM7) ışık modunun uygulanmasının, roka bitkilerinin büyümesinde önemli bir artışa ve daha yüksek fotosentetik kapasiteye neden olduğunu göstermiştir (Şekil 10 ve 11, Elmardy vd. 2021*)*

Çizelge 13. Roka bitkisi için kullanılan ışıkların özellikleri

Uygulamalar	**PFD (µmol/m^{2}sn)**	**Işık oranları**	**Fotopediyot Işık/Karanlık**	**Pik dalga boyu (nm)**
LM1	220	K7:Y0:M3	10/14	660:460
LM2	220	K3:Y0:M7	12/12	660:460
LM3	220	K5:Y2:M3	14/10	660:530:460
LM4	190	K7:Y0:M3	12/12	660:460
LM5	190	K3:Y0:M7	14/10	660:460
LM6	190	K5:Y2:M3	10/14	660:530:460
LM7	160	K7:Y0:M3	14/10	660:460
LM8	160	K3:Y0:M7	10/14	660:460
LM9	160	K5:Y2:M3	12/12	660:530:460
K	190	Beyaz floresan	12/12	544



Şekil 10. Çalışmada kullanılan ışık modlarının bağıl spektral tepkisi ve kontrol



Şekil 11. Farklı LED aydınlatma modları altında roka bitkilerinin gelişimi

SONUÇ

Bu derleme çalışmada dikey tarım sistemlerinde yetiştiriciliği yapılan yeşilliklerden marul, ıspanak, fesleğen, kırmızı yapraklı hardal ve roka bitkilerinde kullanılacak LEDlerin optimizasyonu amacıyla yapılan çalışmalar incelenmiştir. Bu çalışmalarda kullanılan kırmızı, mavi, beyaz ve yeşil ışıkların dalga boyları, fotosentetik foton akış yoğunlukları, bitkilerin günlük ışıklanma integralleri, günlük ışıklanma süreleri gibi ışıkla ilgili faktörler ve bunların bitki gelişimi ve verimleri üzerindeki etkileri derlenmeye çalışılmıştır. Yapılan çalışmaların genel olarak tam ışık spektrumundaki kırmızı ışık yoğunluğu arttırmak üzerine kurgulandığı tespit edilmiştir. Genel olarak spektrumdaki kırmızı ışık oranının arttırılmasının incelenen tüm

türlerde verim artışı sağladığı görülmüştür. Bununla birlikte ışık oranlarının değiştirilmesinin yanı sıra günlük ışıklanma süresinin arttırılmasının da bitki verimi üzerinde etkili olduğu tespit edilmiştir. Çalışmalarda kullanılan PPFD'nin 100-350 µmol/m^2sn arasında değiştiği, gün uzunluğunun ise en fazla 16 saat, en az 10 saat olarak uygulandığı belirlenmiştir. Buna karşın sürekli aydınlatmanın da denendiği görülmüş, ancak bu uygulama bitki gelişimi üzerinde olumsuz etki göstermiştir.

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HAŞHAŞDA OSCA GEN AİLESİNİN BİYOİNFORMATİK ANALİZLERİ

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ÖZET

Hücrelerde hiperozmolaliteye neden olan kuraklık ve tuzluluk gibi çevresel koşullarda, hücre dışı Ca2+, zardaki bir grup kanal proteini aracılığıyla hücre içine aktarılır ve bunun sonucunda hücre içi Ca2+ konsantrasyonu artar. Hücre içindeki kalsiyum iyonları ikincil habercilerdir ve hücrenin hiperozmolaliteye karşı savunmasını oluşturacak bir dizi sinyal yolunu başlatır. Hücre dışı Ca2+'yı hücre içi bölgeye taşıyan protein ailelerinden biri, hiperozmolalite kapılı kalsiyum geçirgen kanallardır (OSCA). Kapsülünden afyon, tohumlarından yağ elde edilen Papaver somniferum L., endüstriyel bir bitkidir. Bu çalışmada OSCA gen ailesi, biyoinformatik araçlar kullanılarak genom boyu analiz edildi. Sonuçlara göre, 16 PsOSCA proteini, on kromozom üzerinde eşit olmayan bir şekilde dağıldı, plazma zarında, çoğu endoplazmik retikulum ve vakuolde, birkaçı ise hücre dışı zarda (PsOSCA3 ve -7), Golgi body de (PsOSCA2 ve -5) ve kloroplast (PsOSCA4). Sonuçlara göre, 16 PsOSCA proteini tanımlandı ve on kromozom üzerinde eşit olmayan bir şekilde dağıldı ve tümü plazma zarında, çoğu endoplazmik retikulum ve vakuolde, birkaçı ise hücre dışı zarda (PsOSCA3 ve -7), Golgi body de (PsOSCA2 ve -5) ve kloroplast (PsOSCA4) yer aldı. Tüm PsOSCA proteinleri termal olarak stabil ve hidrofobiktir. Ancak 9 tanesi bir test tüpünde kararsızdır. 16 PsOSCA geninin promotorları, farklı sayıda ve tipte ışığa duyarlı, çevresel strese duyarlı, hormona duyarlı ve gelişimle ilgili cis-düzenleyici öğelere sahiptir ve bu onların özelleşmiş fonksiyonlara sahip olduklarını göstermektedir. Ayrıca, PsOSCA'nın çoğu, özelleşmiş çeşitli işlevlerini gösteren benzersiz motif dağılımlarına ve gen yapılarına sahiptir. Başlıca ribonükleotid bağlanması, sinyal reseptörü aktivitesi, iyon bağlanması, hücresel protein modifikasyon süreci, protein fosforilasyonu, fosfat içeren bileşik metabolik süreci, sinyal iletimi, hücre yüzeyi reseptörü sinyal yolu, uyarana yanıt, proteinden sorumlu olan dokuz farklı protein ile etkileşime girer. serin/treonin kinaz aktivitesi, hücre iletişimi ve hücresel anatomik varlık. PsOSCA9, esas olarak ribonükleotid bağlanması, sinyal reseptörü aktivitesi, iyon bağlanması, hücresel protein modifikasyon süreci, protein fosforilasyonu, fosfat içeren bileşik metabolik süreci, sinyal iletimi, hücre yüzeyi reseptörü sinyal yolu, uyarana yanıt, serin/treonin kinaz aktivitesi, hücre iletişimi ve hücresel anatomik varlıktan sorumlu olan dokuz farklı protein ile etkileşime girmiştir. Ayrıca PsOSCA 2 ve PsOSCA11, immün yanıtı düzenleyici sinyal yolağından, biyotik uyarana yanıtın negatif ve pozitif düzenlenmesinden, hücre ölümünün düzenlenmesinden sorumlu olan A0A4Y7K9T3 ile etkileşime girmiştir. Sonuç olarak, bu çalışma haşhaşta OSCA gen ailesi üyelerinin stres düzenleyici mekanizmalarının anlaşılmasında faydalı olabilir.

Anahtar Kelimeler: Haşhaş, OSCA gen ailesi, biyoinformatik

BIOINFORMATIC ANALYSES OF OSCA GENE FAMILY IN OPIUM POPPY

ABSTRACT

In environmental conditions such as drought and salinity that cause hyperosmolality in cells, extracellular Ca2+ are transferred into the cell via a group of channel proteins in the membrane, and as a result, the intracellular Ca2+ concentration increases. Calcium ions within the cell are seconder messengers and initiate a series of signal pathways that will form the cell's defense against hyperosmolality. One of the protein families that transport the extracellular Ca2+ to the intracellular region is hyperosmolality-gated calcium-permeable channels (OSCA). Papaver somniferum L., from which opium is obtained from its capsule and oil from its seeds, is an industrial plant. In this study, the OSCA gene family were genome wide analyzed using bioinformatic tools. According to results, 16 PsOSCA proteins were identified and distributed unevenly on ten chromosomes, and located all in the plasma membrane, most in the endoplasmic reticulum and vacuole, while a few were in the extra cellular membrane (PsOSCA3 and -7), Golgi body (PsOSCA2 and -5), and chloroplast (PsOSCA4). All PsOSCA proteins were thermally stable and the hydrophobic. But 9 of them were unstable in a test tube. The promotors of 16 PsOSCA genes had different number and type the light-responsive, environmental stress-responsive, hormone-responsiveness, and development-related cis-regulatory elements, suggesting that they have specialized functions. In additions, most of PsOSCA had unique motif distributions and gene structures, suggesting their specialized diverse functions. PsOSCA9 were the most interacted protein. It interacted with nine different proteins which are responsible for mainly ribonucleotide binding, signaling receptor activity, ion binding, cellular protein modification process, protein phosphorylation, phosphate-containing compound metabolic process, signal transduction, cell surface receptor signaling pathway, response to stimulus, protein serine/threonine kinase activity, cell communication, and cellular anatomical entity. Also, PsOSCA 2 and PsOSCA11 were interacted with A0A4Y7K9T3 which is responsible for immune response-regulating signaling pathway, negative and positive regulation of response to biotic stimulus, regulation of cell death. Consequently, this study can be useful for understanding of stress regulatory mechanisms of the OSCA gene family members in opium poppy.

Keywords: Papaver somniferum, OSCA gene family, bioinformatics

INTRODUCTION

Papaver somniferum (opium poppy) is an industrial plant containing alkaloids such as morphine and codeine and has effects of pain relief, cough suppressor euphoria, sleepiness and addiction. In addition, poppy seeds yield 45-50% oil for human consumption, and this oil is high in vitamin E and other tocopherols (Lewkowitsch and Warburton, 1914). Poppy seeds are produced mostly in five different countries of the world, including India, North Macedonia, Palestine, Serbia and Turkey (Faostat, 2021). Unfortunately, it is inevitable that poppy production and yield will be adversely affected by unfavorable conditions such as drought and salinity as a result of climate change. Therefore, it is very important to understand and develop a plant defense system against adverse environmental conditions.

Hyperosmolality is one of the stress factors that negatively affect plant growth and development. Calcium-permeable channels potentially act as osmosensors under osmotic stress. These channels are opened to allow calcium transportation from extracellular to intracellular (Murthy et. al. 2018). The elevation of the concentration of intracellular calcium triggers serial signal transduction, thus Ca2+ acts as a second messenger system.

The hyperosmolality-gated calcium-permeable channels (OSCA) is one of the ion channels and act as hyperosmotic stress sensor (Liu et. al. 2018). Since the OSCA gene family has potential roles in stress resistance against hyperosmolality in plants, it has been investigated in detail in some plant species (Li et. al. 2015; Yin et. al. 2021; Miao et. al. 2022; Shan et. al. 2023). OSCA proteins contain three conserved domains, namely late exocytosis (pfam13967), cytosolic domain of 10TM putative phosphate transporter (pfam14703), and calcium-dependent channel (pfam02714) (Swarbreck et. al. 2013).

In this study, it was aimed to carry out a comprehensive genome- wide analysis of OSCA gene family in P. somniferum, including identification of family members, phylogenetic relationship, subcellular localization, chromosome localization, gene structural features, cis-elements and protein-protein interactions.

MATERIAL and METHODS

Identification and Chromosomal Localization of OSCA Genes

To identify the OSCA genes, Arabidopsis thaliana OSCA protein sequences thrived from TAIR (https://www.arabidopsis.org/) were utilized as query sequences and blasted (BlastP) against the sorghum genome with an E-value of 1e-5 using NCBI (https://www.ncbi.nlm.nih.gov/). For identifying chromosomal positions, CDS sequences, and gene sequences of OSCA genes, the NCBI database (https://www.ncbi.nlm.nih.gov/) was utilized. The chromosomal distribution of

OSCA genes was mapped using the TBtools program (Chen et al., 2020). The physical and chemical parameters of OSCA proteins were predicted with Protparam (https://web.expasy.org/protparam/).

Analysis of the Phylogeny, Gene Structure, Conserved Protein Motif, and Synteny

Using default settings, CLUSTALW (https://www.genome.jp/toolsbin/clustalw) was used to align the OSCA protein sequences of *A. thaliana* and *S. bicolor* (Larkin et al. 2007). The phylogenetic trees were created using the MEGA-11 software's neighbour-joining approach (Saitou and Nei 1987; Tamura et al. 2021), and a bootstrap consensus tree was derived from 1000 replications (Felsenstein 1985). The MEME programme (http://memesuite.org/tools/meme) was used to obtain the conserved motifs of OSCA proteins. The Gene Structure Display Server (http://gsds.cbi.pku.edu.cn/) was applied to show the introns–exons (Hu et al. 2015). The cis-elements on the promoters were detected using plantCARE (http://bioinformatics.psb.ugent.be/webtools/plantcare/html/).

Identification of Protein-Protein Interactions

The protein-protein interactions were investigated (Szklarczyk et al., 2019) using STRING platform V11.5. Disconnected nodes in the network were concealed using a medium confidence value of 0.400 and no more than 10 interactions to display.

RESULTS and DISCUSSION

The first genomic sequence in *P. somniferum* was published in 2018 (Hu et. al. 2018). With the publication of genome sequencing, genome-wide identification of important stress-related gene families in this species will be possible. A gene family encode a group of genes which have similar amino acids sequence and have related but specialized tasks. In this study, hyperosmolality related gene family, OSCA, were detailed bioinformatic analyzed. Several studies have proved the special tasks of OSCA proteins in plant growth, development and response to abiotic stress (Ding et. al. 2019; Cai et. al. 2022; Chakraborty et. al. 2023; Kaur et. al. 2022). A total of 16 OSCA proteins in opium poppy were detected by searching three conserved Pfam domains (pfam13967, pfam14703, pfam02714), and redundant sequences were eliminated. The OSCA proteins were then numbered from PsOSCA1 to PsOSCA16 according to their chromosomal locations. Previous studies showed that the number of *PsOSCA* genes differed in several species, for example, 15 in Arabidopsis (Liu et. al. 2018), 11 in rice (Li et. al. 2015), 12 in maize (Ding et. al. 2019), 13 in four leguminous species (Chakraborty et. al. 2023), 14 in barley (Cai et. al. 2022), 21 in soybean (Liu, et. al. 2022), 35 in cotton (Yang et. al. 2019), and 42 in bread wheat (Tong et. al. 2021).

The physiochemical features of the PSOSCA proteins were given in (Table 1). The amino acid length ranged from 645 amino acids (PsOSCA8) to 775 amino acids (PsOSCA1, -10). The protein with the smallest and largest molecular weight (kDa) was PsOSCA6 (73.12 kDa) and PsOSCA10 (7-88.78 kDa) respectively. The gravy index scores ranged from 0.048 (PsOSCA1) to 0.457 (0PsOSCA8), indicating the hydrophobic nature of all these proteins. The aliphatic index lay from 99.43 (PsOSCA1) to 110.94 (PsOSCA9), indicating they are considered thermally stable. Also, the isoelectric point (pI) also varied from 8.65 (PsOSCA7) to 9.55 (PsOSCA12). Out of the 16 SbWAKs/SbWAKLs, 9 were unstable, with an instability index greater than 40.

Table 1. Physiochemical properties of PsOSCA proteins

Proteins	Protein accession number (NCBI)	Length of amino acids	Molecular weight kDa	pI	Grand average of hydropathicity (GRAVY)	Aliphatic index	Instability index
PsOSCA1	XP_026408256.1	775	88.77	8.92	0.048	99.43	39.72
PsOSCA2	XP_026404934.1	719	81.56	9.01	0.248	104.67	37.16
PsOSCA3	XP_026455562.1	782	88.70	8.97	0.248	101.34	43.53
PsOSCA4	XP_026453924.1	760	86.12	8.92	0.176	102.11	45.53
PsOSCA5	XP_026381252.1	649	73.42	9.08	0.426	115.15	37.00
PsOSCA6	XP_026381253.1	648	73.12	9.13	0.412	110.20	39.70
PsOSCA7	XP_026388439.1	691	78.64	8.65	0.312	104.93	46.91
PsOSCA8	XP_026386289.1	645	72.94	9.08	0.457	114.19	38.27
PsOSCA9	XP_026386291.1	648	73.20	8.83	0.424	110.94	39.13
PsOSCA10	XP_026392738.1	775	88.78	8.99	0.066	100.31	41.31
PsOSCA11	XP_026394975.1	719	81.35	9.16	0.268	104.55	36.27
PsOSCA12	XP_026401920.1	776	84.49	9.55	0.177	104.25	49.23
PsOSCA13	XP_026410511.1	766	88.67	9.53	0.123	101.41	48.39
PsOSCA14	XP_026418766.1	717	81.84	9.10	0.143	99.92	50.93
PsOSCA15	XP_026422721.1	765	87.73	8.73	0.135	101.74	46.00
PsOSCA16	XP_026425391.1	717	82.03	8.97	0.146	99.92	51.30

To investigate the evolutionary relationship between OSCAs of *A. thaliana* and *P. somniferum*, a phylogenetic tree was drawn using the Neighbor-joining method with 1000 replicates (Figure 1). The phylogenetic tree was grouped into four main groups. Group I was further three sub-grouped, consisting of 8 PsOSCA proteins (PsOSCA3, -5, -6, -7, -8, -9, -14, -16) and AtOSCA2.1, -2.2, -2.3, -2-.4, -2.5 proteins. The other group included AtOSCA1.1, -1.2, -1.3, -1,4, -1.5, 1.6) and six PsOSCA (-1, -4, -10, 12, -13, -15). AtOSCA4.1 and AtOSCA 3.1 are

separated the other proteins and PsOSCA2 and PsOSCA11 are closer them from the other PsOSCAs.

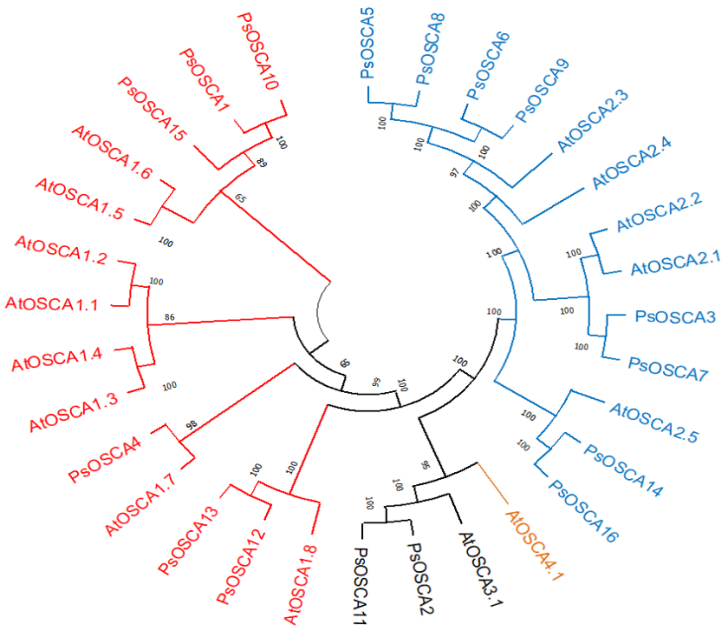


Figure 1. Phylogenetic relationship of OSCA gene family from *Arabidopsis thaliana and P. somniferum.*

Sixteen Ps*OSCA* genes was distributed on all chromosomes except chromosome 2 (Figure 2). The highest number of genes were found on chromosomes 5, while chromosome 7, 8, 9, 10 and 11 contained 2 genes, representing the least number of genes on a chromosome.

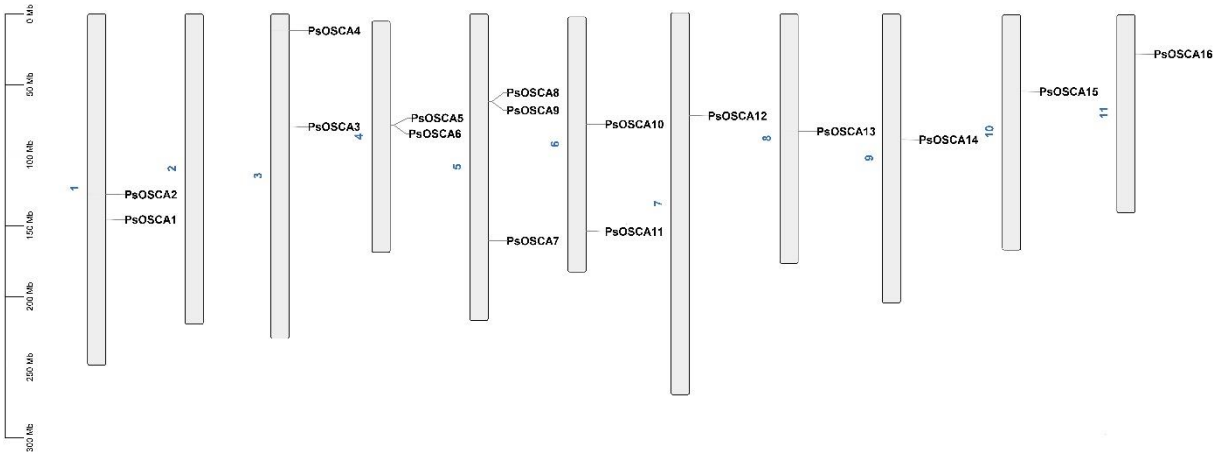
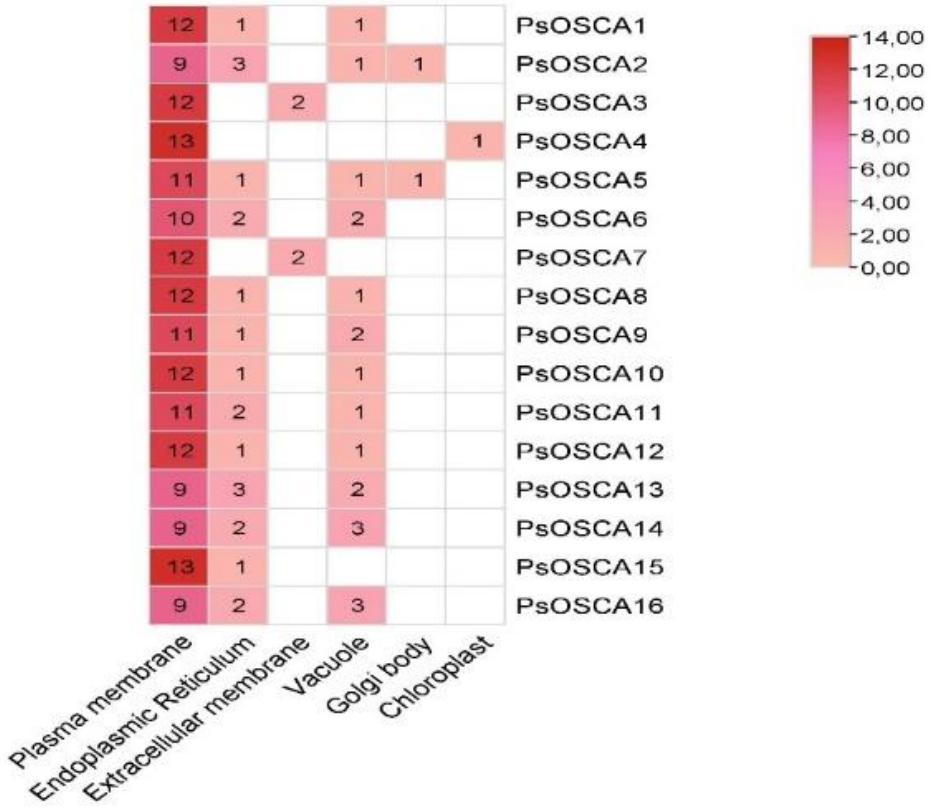


Figure 2. Chromosomal localization of the Ps*OSCA* genes in *P. somniferum* chromosomes. Chromosome numbers are shown beside each chromosome

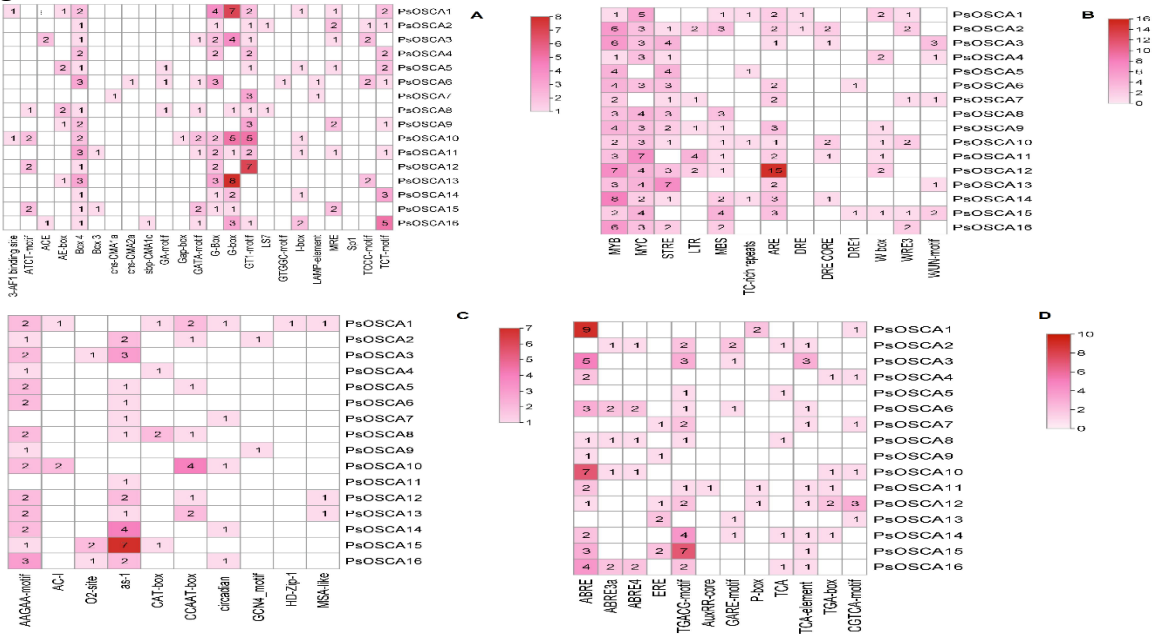
While all PsOSCA proteins were found in the plasma membrane (Table 2). Then, PsOSCAs were mostly found in the endoplasmic reticulum and vacuole. While there are only two PsOSCA proteins each in the extracellular and Golgi body, chloroplast contained only PsOSCA4 protein.

Table 2. Subcellular localization of PsOSCA proteins



Cis-regulatory elements regulate the transcription of genes in vicinity and have important roles in development (Wittkopp et. al. 2012). In this study, the light-responsive elements, environmental stress-responsive elements, hormone-responsive elements, and development-related elements were predicted in the promotor of *PsOSCA* genes. 23 light-responsive elements were detected (Table 3a). G-box, box 4, g-box and GT1 motif were most abundant. Considering environmental stress response element, MYB binding site (drought inducibility), MYC (drought, salt, and stress response), STRE (stress response), MBS (drought inducible) and ARE (anaerobic induction) were predominant. Of the 10 development-related cis-elements detected, two (AAGAA-motif; the endosperm-specific negative expression and as-1; root-specific expression) were the most abundant. Finally, 12 cis-regulotary elements were also identified as hormone-responsive elements. These findings showed that PsOSCAs are important for growth and development.

Table 3. A. Light responsive elements, B. Environmental stress response elements, C. Development response elements, D. Hormone response elements on the promotors of *PsOSCA* genes.



A total of 10 conserved motifs were identified in PsOSCA-1, -2, -4, -10, -11, -12, -14, -15 and -16 (Figure 3b). The least number of motifs were found in PsOSCA3. Only PsOSCA13 lacked one motif (motif 9) and PsOSCA3, 5, -6, -7, -8, -9 did not contain motif number 10. Phylogenetic group distribution (Figure 3a) of PsOSCA proteins did not showed concordance with motif patterns.

The structure analysis of *PsOSCA* genes was performed to reveal exon/intron distribution (Figure 3c). Interestingly, the *PsOSCA* genes classified into the same subgroups have different numbers and lengths of intron/exon, indicating their specialized diverse functions. *PsOSCA1, -4, -12* contained the highest number of exons (11) while *PsOSCA11,* -13 had lowest number of exon (2). The remaining number of exons ranged from 4 to 10 amongst *PsOSCA* genes. Additionally, all *PsOSCA* genes had a varied length of UTR region. The longest and shortest gene length was observed in *PsOSCA7* and *PsOSCA8* respectively.

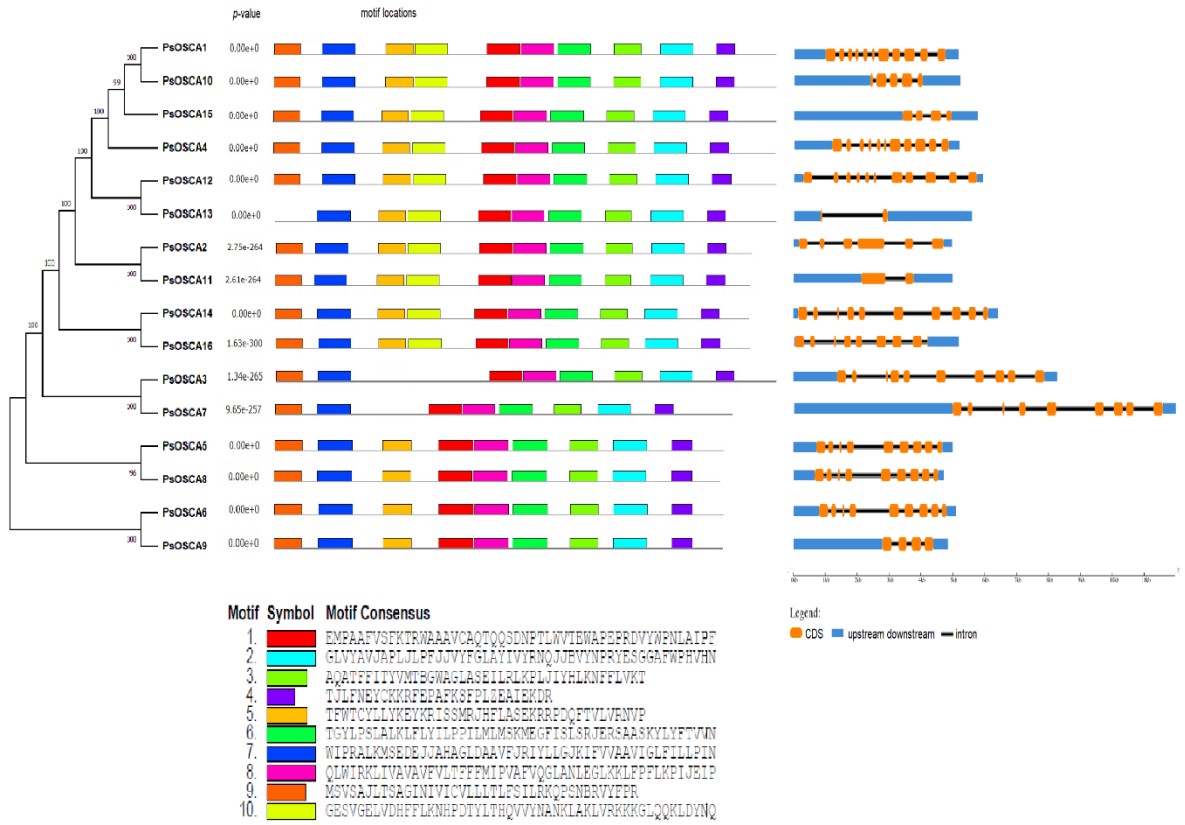


Figure 3. (a) The phylogenetic tree of PsOSCA gene family was constructed with 1000 bootstrap using the neighbor-joining algorithm, (b) the motifs of the SbOSCA protein sequences (c) The gene structure of PsOSCAs. The blue boxes, orange boxes and black lines represent upstream/downstream regions, exons, and introns, respectively.

To estimate the potential role of the PsOSCAs, a protein-protein interaction was assed. Only three PsOSCA (PsOSCA9, -2, -11) proteins were predicted to have interacted with various proteins (Figure 4). PsOSCA9 were the most interacted protein and interacted with nine different, many of which contain protein kinase domains. Seven proteins (A0A4Y7IVB7, A0A4Y7L054, A0A4Y7I5Q0, A0A4Y7IZI5, A0A4Y7KA48, A0A4Y7KRX7, A0A4Y7L172) that interact with PsOSCA9 have been found to have roles related to adenyl nucleotide binding, ribonucleotide binding, small molecule binding, signaling receptor activity, ion binding, anion binding, organic cyclic compound binding, carbohydrate derivative binding, heterocyclic compound binding, cellular protein modification process, protein phosphorylation, phosphate-containing compound metabolic process, signal transduction, cell surface receptor signaling pathway, response to stimulus, protein serine/threonine kinase activity, cell communication, cellular anatomical entity, ATP binding. Interestingly, PsOSCA 2 and PsOSCA11 were interacted with A0A4Y7K9T3 which is responsible for activation of innate immune response, immune response-regulating signaling pathway, response to molecule of bacterial origin,

positive and negative regulation of immune system process, negative and positive regulation of response to biotic stimulus, response to bacterium, regulation of cell death.

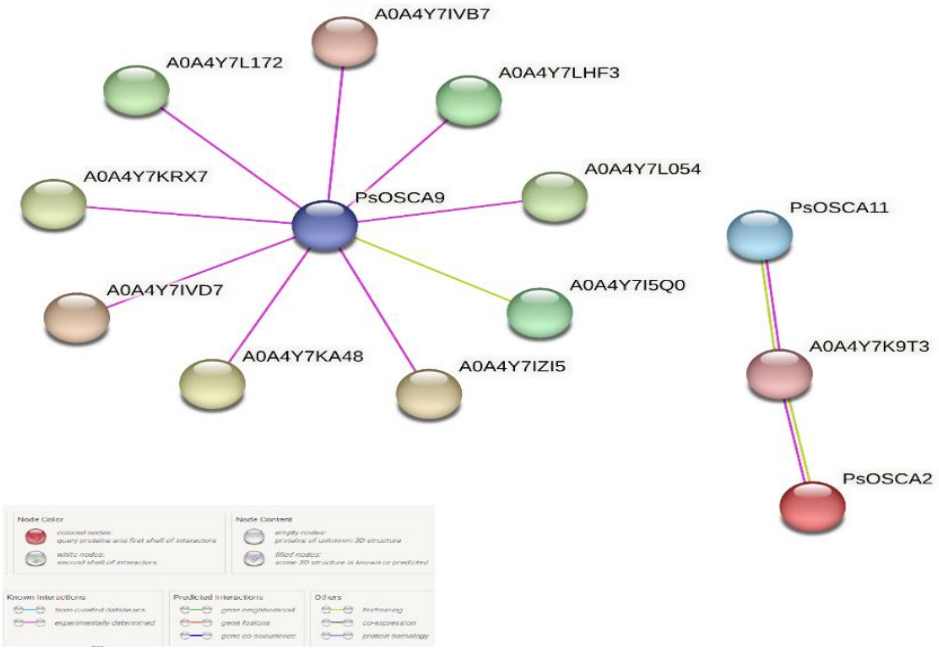


Figure 4. Protein-protein interactions of PsOSCA proteins

For the first time, a bioinformatic examination of the opium poppy OSCA gene family's structure and evolution was performed in this work. However, functional investigation of OSCA genes has to be performed in plant growth, development, and stress response, especially hyperosmolality stress response.

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WASTE TO WEALTH: A PATTERN SHIFT IN WASTE MANAGEMENT FOR DEVELOPING NATIONS

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ABSTRACT
"Waste is anything that the original customer has used only once and cannot be sold. Waste is one of the most important environmental issues that nations deal with. Wealth is a financial asset that can be converted into a form that can be traded. To discuss the waste and the possibility of creating wealth from it, this study uses the waste from pet bottles at the Federal Polytechnic, Ilaro, in Nigeria, is used as a case. We outline the actual process of turning waste into wealth in order to create true prosperity for the waste collectors, among other things. "Waste to wealth" is the process of transforming waste from a place where it cannot be used into something valuable and desired. The evaluation revealed that the school's two campuses, east and west, produced enough plastic waste to fill more than 3,000 PET bottles. The study's results show that waste collection can generate wealth up to tens of thousands of Nigerian Naira, and the income streams are very lucrative for both private and public entities, turning these wastes into tangible products through the process of recycling.

Keywords: waste, wealth, waste management, pet-bottles

INTRODUCTION

Getting rid of trash is one of the most important environmental problems that many countries all over the world are facing right now. In recent years, a nation's daily production of trash has substantially expanded. This is brought on by an increase in the rate of population growth as well as urbanization, industrialization, and economic expansion. Additionally, many cities don't have effective waste management systems. Because of this, the vast majority of urban families turn to recklessly burying, burning, or dumping solid waste. The term "trash" refers to the undesired consequences of human activities that are created from and within the environment (Ivanova et al., 2016). (Akinbola, Ojo, and Hakeem, 2015) claim that garbage is frequently perceived as useless or less significant than anything beneficial. According to Omole and Isiorho (2011), waste is the surplus from a production process that can be utilised to create other parts or materials. Because garbage can come in a variety of shapes and sizes, governments work hard to manage it efficiently in order to protect the environment and boost its economic worth. Examples of industrial waste include waste motor oils, ashes, and sewage sludge. The amount of garbage produced in any city is frequently a reflection of the intensity of human activities, such as population increase, urbanization, social development, resource exploitation, and unregulated technical innovation, claim Adejobi and Olorunmbe (2012) and Amuda et al. (2014). Pollution from inappropriate solid waste disposal affects the environment and health; hence, it is necessary to build a designed sanitary landfill for waste management to mitigate the effects of improper trash disposal. According to all evidence, when efforts are made to turn what is typically regarded as waste into wealth by recycling it to economic use to generate additional production and economic returns, what is typically deemed unused, unwanted, less important, or no longer useful, which may come in different forms, has been converted to wealth. (Egun, 2012) defines "waste-to-wealth" as the process of transforming rubbish from a platform of diminished utility to a desirable and desired level. This process requires some type of energy and financial resources for recycling. Since its makers would never forsake it if garbage were rich in and of itself, it cannot ever be. Consequently, it extends beyond the provision of services to also cover the distribution of goods or other types of value, such as energy. The phrase "waste-to-wealth" therefore refers to a program that eventually encourages the reduction of environmental contamination from human waste through the development of a management framework that focuses on potential post-treatment income. Waste-to-wealth is comprehensive when one considers current economic, health, resource, environmental, and sociocultural development, as well as sustainable development in general. This assertion backs up that made by Akinbola, Ojo, and Hakeem (2015), who contend that due to the high

unemployment and poverty levels affecting urban and peri-urban populations, both the government and the populace have expressed considerable concern about the push for wealth development.

LITERATURE REVIEW

In the Obio/Akpor local government area of Rivers State, (Ikechukwu 2015) performed research based on routine observations of the activities of scrap metal scavengers. The aim of the study was to evaluate the economic potential of scrap metal waste for both the general public and the government, as well as the practicality of scrap metal scavenging. The study's findings revealed a connection between waste and wealth in the scavenging of scrap metal.

The concept of "waste-to-wealth" involves transforming trash from a level of decreased utility to a valued and desired one. Engineering goes through two changes since it requires some form of energy and economics requires a factor of production. The fundamental issue with this is that "waste" can never be wealth unto itself; if it were, manufacturers would never get rid of it. Similar to how money is created, there are costs involved in producing wealth that the market perceives as a price. Therefore, not every garbage offers the possibility of future profit. The expression "waste-to-wealth" frequently implies that waste management efforts must go beyond the provision of a service to the provision of goods or values, such as energy (Egun, 2012).

The classic model of industrial growth is based on a linear model with inputs (raw materials, energy, and other resources) and outputs (wastes of products and products that are usually treated by end-of-pipe techniques). Once their useful life is through, the goods are either burned or dumped as trash in landfills. Take, Make, and Dispose is a typical industrial development model associated with significant environmental consequences and resource depletion (ISWA 2015; WEF 2014).

The Citizen's Agenda 2001 for Zero Waste, which also acknowledges recycling's limitations in converting the one-way industrial system into a circular economy, is seen as a complement to community and business positions that combine moral conduct and an economic outlook. This definition of "zero waste" is derived from this document. ZW promotes the growth of sustainable neighborhoods and companies by fusing industrial concepts with neighborhood practices like reuse, repair, and recycling (Cristina et al., 2019; Maria et al., 2019). Another alternate strategy for solving waste management problems is zero waste. This concept might promote environmentally friendly manufacturing and consumption, as well as recovery and recycling, and reduce landfilling and incineration (Zaman, 2015).

Solid waste generation has turned into a problem for the environment and public health, especially in developing nations, according to (Pinka Sankoh et al., 2012). These challenges with producing solid waste are also a result of societal upheavals, in which families have a big responsibility to play. These societal changes have a constant impact on the size, configuration, and characteristics of particular homes. Questionnaires were distributed in the designated electorates of the city in accordance with the outcomes of the organized election. These are the most densely populated electorates, and they provided 70% of the city's total solid trash. They therefore serve as suitable samples of the research field. Through the categorization and evaluation of created solid trash, five selected families from each constituency or community were visited using the "door-to-door" method to determine the extent of garbage generation. The generation of solid waste and other elements was a dependent variable, whereas family size, tutoring, and income levels were some examples of independent variables. The statistics were exposed to statistical analysis in order to use correlation to identify relationships between independent variables and dependent variables. The findings showed that the average family size, employment status, monthly drawings, and numerous rooms or places occupied by families had a significant impact on the formation of solid trash and configuration in Freetown. It frequently suggests fresh viewpoints on how socioeconomic issues affect the make-up and arrangement of home solid trash.

The scenario has stakeholders in Nigeria's solid waste management very worried, according to (Ezeah & Roberts, 2014). Ineffective collection and risky disposal are just two of the problems with waste management in the country, according to (Ogwueleka, 2009). It was estimated that the industrial system handled roughly 65 billion tons of raw materials by the end of the first decade of the twenty-first century, and this amount is expected to rise to about 82 billion tons in 2020. The WEF (2014); Hans et al. Resource depletion and the environmental effects of waste poured into the environment are linked to the ongoing increase in the price of raw materials, particularly those generated from natural resources, rising social demands, and regulatory limits.

METHODOLOGY

The study used a descriptive analysis from primary data collected from locals that pick pet bottles around the study area to determine the average number of pet bottle waste generated within the study area daily. Secondary data from books, websites, journal articles, and internal records were generated to understand waste recycling process to determine how pet bottle waste could be turned to other forms of products through recycling.

The Federal Polytechnic Institute in Ilaro is the study area. It is made up of technocrats, academics, and marketers, as well as small and major enterprises (Poly-Consult, Poly-Bakery, Cafeteria, Cyber-Café, and Fed Poly Water Factory). Purposive sample techniques were used at potential solid waste sites, construction sites, tile depots, picker sites for plastic, polythene, foam, nylon, waste papers, and other materials, as well as small, medium, and large-scale company garbage dumps. Tables, frequency counts, basic percentages, rank order, categorization of thoughts presented, and verbatim reporting were used to examine the data using both quantitative and qualitative methods. The suggested approach is strong enough to be adopted in every developing country and includes a number of benefits. It's simple and useful features are what make it advantageous. This will not only enhance the environment in which we live but also lay the groundwork for a system that functions more effectively. Garbage will be thrown into the bins, decreasing the health risks created by the waste that is already everywhere and turning it into an economic asset.

Study Area

The study location is an example of a typical Nigerian student neighbourhood. In the Nigerian town of Ilaro, 50km away from the metropolis of Abeokuta, sits the Federal Polytechnic Ilaro. Both students from The Federal Polytechnic Ilaro and Native citizens of the community reside in the neighbourhood. The average annual temperature ranges from 77 to 82 degrees Fahrenheit, or 25 to 28 degrees Celsius.

Decree No. 33 of July 25, 1979, established the Federal Polytechnic, Ilaro. On November 15, 1979, the Polytechnic began accepting students at a temporary location offered by its host community, the historic town of Ilaro, Ogun State. The Anglican Grammar School property in Ilaro, which is a half-kilometer from the intersection of the townships of Ilaro, served as the Polytechnic's inaugural location. The Polytechnic remained at this temporary location until 1983, when it moved to its current location, which is three kilometers from Ilaro Township along the Ilaro/Oja-Odan Road. Additionally, Idiroko, a Nigerian border town with the Benin Republic, is roughly 60 kilometers away. Between Lagos and Abeokuta, the capital of Ogun State, is the ancient town of Ilaro. On its permanent campus, the Polytechnic takes up approximately 898.116 hectares of land. The Polytechnic currently has over 16,000 pupils enrolled, and it is anticipated that 6,000 bottles of water and assorted pet bottle drinks are consumed are there per day. One person drinks at least a bottle of water or assorted pet bottle drink a day on average with an average of 7, 000 students entering the school campuses daily.

The two distinct campuses of the Polytechnic, east and west, are shown in the institution's master plan. The Main Library, the Directorate of Student Affairs, the Medical Center, Poly-

Consult and Industrial Services, the Post Office, the Works and Services Department, the Petrol Station, the Staff Schools (Nursery, Primary, and Secondary), the Student Computer Center, the School of Applied Science, the School of Management Studies, Ilaro Polytechnic Microfinance Bank Ltd., United Bank of Africa Plc., and Polaris Bank are all situated there at the East Campus. The Engineering and Environmental Studies Schools are also located on the West Campus, along with other buildings and offices such as the Main Administrative Building and Annexes, the Record and Data Control Unit, the Information and Communication Technology [ICT] Center, the Physical and Academic Planning Unit, the Central Examination Building, the Library Annex, the Multi-purpose Hall, and others.

70% of academic works (lectures) takes place at the west campus, hence the influx of students to the west is higher that the east campus. Consequent upon this, the sales of water (bottled & Sachet) and assorted pet bottled drinks are much compared to the east campus. In same vein, waste generation at the west campus are more than what is generated at the east campus.

Method Of Analysis

Analysis of Pet Bottle Waste Generated Wıthın The Study Area

The results were analyzed using Equations, respectively. Charts were used to express data collected to give the weight of characterized waste Per Kg/day.

Total maximum waste generated in The Federal Polytechnic, Ilaro Per/Day = Total Waste per/day in East Campus + Total Waste Per/day in West Campus

Total maximum waste generated in The Federal Polytechnic, Ilaro Per/Week = Total maximum plastic waste generated in The Federal Polytechnic, Ilaro Per/day X 6

Total maximum waste generated in The Federal Polytechnic, Ilaro Per/Month = Total maximum plastic waste generated in The Federal Polytechnic, Ilaro Per/Week X 3.

Method of Data Collection

Data were collected through interaction with the shop owners at the campuses to determine the number of bottled water and drinks they sell per day. Similarly, the interaction sought to know the number of sachet water sold per day.

Likewise, researcher interacted with the locals that picks the pet bottles and nylons of water round the campuses very day. The interview sought to know the average number of bottles each persons picked per day and how much is made from the sale of this bottles to recycling companies through agents that gathers the pet bottles before moving them to recycling company.

Study Gap

It is reported that about 65 million metric tonnes of waste are generated annually in Nigeria about 150,000 metric tonnes of plastic waste enter the ocean in the country every day. According to experts, of the 65 million metric tonnes of waste, Lagos State alone, which is the undisputable commercial capital of the country and most populated, produces about 10,000 metric tonnes of plastic waste, most of which end up in landfills and waterways (Imouokhome, 2022). The Study area, The Federal Polytechnic, Ilaro has an estimated plastic waste of 6,000 pet bottles, with an average of 3 bottles per person. The school is populated with a student above the range of 10,000 with a very large study environment of 898.116 hectares of land area. The research work aims at creating wealth from waste, which can also be a means to improve waste management in the country.

Data Presentation

During the Survey the following secondary data was gotten in the study of the area. Table 1 shows the commonly used Inorganic waste in the study area and their recyclable use. Table 2 shows the statistical internal records of the Inorganic waste generated.

Table 1. Recyclables and their uses from Inorganic wastes

	Types	Recyclable value or use
INORGANIC WASTE	PET Bottles	Bottles, milk jugs, pipes, thin film packing, battery casings, etc.
	Nylon	shopping bags, waste disposal bags, wrapper nylons, and laundry bags

Inorganic wastes are waste that are not easily degradable or takes a long period of time to degrade. This materials easily forms mountains of solid waste in dumpsite and burning or burying these type of waste does not solve the problems generated by inorganic waste. Examples of inorganic waste are, pet bottles, plastics and nylons.

Table 2: Records of the Inorganic waste generated

Waste	Location With Campus	Per/ Day	Per/ Week	Per/Month
PET Bottles	East Campus	Max: 2500	15,000	45,000
		Min: 1500	9,000	27,000
	West Campus	Max: 3500	21,000	51,000
		Min: 1500	9,000	27,000
Nylon	East Campus	Max: 2000	12,000	36,000
		Min: 1500	9,000	27,000
	West Campus	Max: 2000	12,000	36,000
		Min: 1500	9,000	27,000

WASTE-TO-WEALTH CONVERSION PROCESS

Recycling waste involves a certain procedure that turns garbage into wealth; this process needs a certain number of people and technologies to produce wealth from waste. Although conversion technologies are currently used in a variety of waste management techniques, in general, they involve the utilization of thermal, biological, and chemical processes to transform waste into other beneficial products. Garbage must pass through several steps before it can be turned into wealth. By studying these processes, we may better comprehend how waste transitions from the trash can to the point where it can be recycled and put to new uses. We may see a brief illustration of the waste to riches process in the graphic below.



Figure 1: Recycling Process

According to fig. 1, trash collectors are employees who work for a private waste management company or the public service and are often responsible for collecting recyclable rubbish and goods and transporting them to a sorting facility or recycling center. A dumping ground is a location where waste is dumped, and a landfill is another name for a rubbish dump site. Depending on the product or kind of garbage, waste is sorted in batches at a sorting plant. The garbage is transported to the recyclable waste plant, where it is processed in a waste recycling machine to be employed in the creation of a new product. The last step of production is when the product is presentable; recycled trash may be used to make carpets, plastic bottles, buckets, etc. Compared to producing the same sort of product with fresh material, these phases use less than 70% more energy. The following two principal things or people gain from the waste-to-wealth conversion process:

- The Waste Collector
- The Recyclable facility

The Waste Collector: A person engaged by a governmental or private organization to gather and dispose of rubbish (refuse) and recyclables from residential, commercial, industrial, or other collections is known as a waste collector. Waste collectors are often referred to as trashmen, garbagemen, or garbage collectors. The waste produced by others is gathered by waste collectors, who then deliver it to a disposal place without processing or repackaging it. Indigenous Native people were the waste collectors in the case study. The school's grounds, which encompass both the east and west campuses, are where an estimated 3,000 pet bottles and nylon are collected. These materials are gathered and sold to a recycling company for 160 per kg. These recycling plants gathered rubbish from waste collectors and employed conversion technology to turn the waste into commodities that could be reused.

The Recyclable facility: The facility for recycling Waste, rubbish, and other materials are sorted, segregated, processed, or treated in recycling facilities so they can be recycled or used again. Recycling is the process of converting waste into fresh materials and goods. Recycling facilities are establishments or operations that receive, process, and transfer recyclable materials to others so they can be used for other purposes. A recycling facility processes, sorts, or organizes waste using technology in order to produce or recover useable materials. Among the recyclable materials are various types of glass, paper, cardboard, metal, plastic, tires, textiles, batteries, and electronics. The waste must be removed from the waste collector and recycled at the recycling facility before being used again.

Both the recycling facility and the waste collection make money off of waste. The waste collector transports the waste to recycling businesses after sorting it. We will be analyzing nylon

and PET bottles for the caste study at The Federal Polytechnic, Ilaro. According to the data, it is projected that more than 3000 pet bottles are wasted every day, or that each individual can eat at least 2 bottles.

RESULT and DISCUSSION

Tables 3 & 4 show the Waste-Wealth comparisons in the two sections (West Campus & East Campus), where waste generated from the West and East Campus halls are compared.

Table 3: Comparisons of Mass (Weight) of Inorganic waste

Sorting		**Average Weight(g)**	**Median Weight(g)**
Pet Bottles	**250ml**	**6.41**	**6.42**
	330ml	**14.31**	**14.03**
	750ml	**19.71**	**18.71**
Nylon		0.0411851129 lbs/in^3.	0.0411851129 lbs/in^3.

Table 3 sort the pet bottle bottles and nylon show the average and median weight in gram of the different sizes of pet bottles and nylon.

1000gram = 1kilogram

Total grams of the three various pet bottles (250ml, 330ml and 600ml) = 40gram

25 bottles = 1kg

3000 pet bottles = 3000/25 = 120kg

1kg of pet bottles = 160NGN

Hence, 120kg of pet bottles = 120 X 160 = 19,200NGN

Average Income made per week on an average of 30000 pet bottles sold per week is 19,200NGN.

Table 4: Comparison of Mass of the Waste in Different Locations

Location	PET Bottles	PET Bottles (kg/week)	PET Bottles (kg/month)	Nylon (lbs/day)	Nylon (lbs/week)	Nylon (lbs/month)
West Campus	**141.505**	**849.03**	**2,061.93**	**164.740**	**988.442**	**3,047.698**
East Campus	**101.075**	**606.45**	**1,819.35**	**82.37**	**494.221**	**1,482.664**

The amount of waste that is produced daily, weekly, or monthly is described in detail in the table above. The amount of wealth that can be created from garbage is in part based on this. All Stakeholders must adopt a systematic approach in order to create wealth from plastic waste; this leaves room for private players to generate cash by collecting trash from various locations and transporting it to recycling facilities where it may be recycled. This outcome, which provides an estimate of the amount of wealth that can be created from garbage, is based on the secondary data that was gathered. When weighing the waste produced on the East and West campuses, it can be seen that the West campus produced more plastic waste than the East campus did. This can be explained by the fact that the west campus has a greater population of staff members and students enrolled in classes than the east campus. The amount of people and enterprises on the West campus has a significant impact on the rate at which waste is produced there.

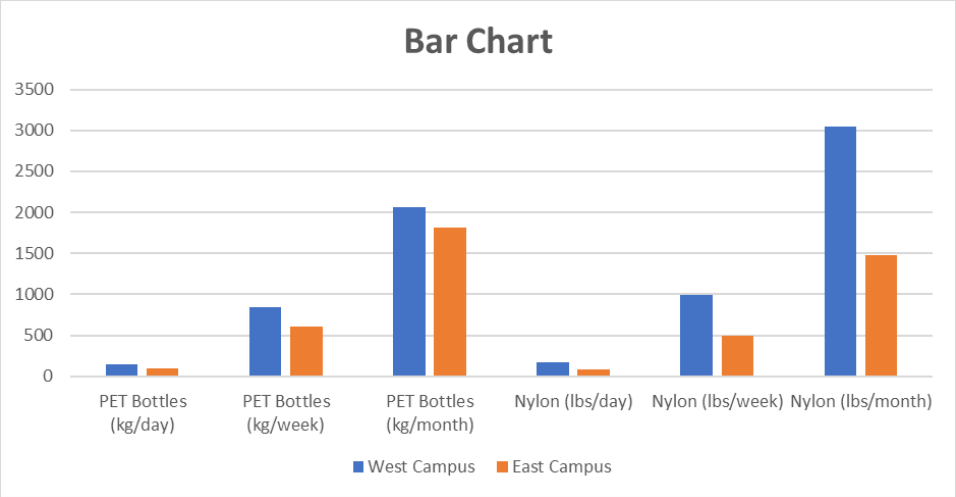

Figure 1. Comparison of Weight of Waste Chart

A kilogram of plastic waste = #160 Price in 2020

Total maximum plastic waste generated in The Federal Polytechnic, Ilaro Per/day = **141.505 + 101.075 = 242.58 Kg**

Total maximum plastic waste generated in The Federal Polytechnic, Ilaro Per/Week = **242.58 X 6 = 1,455.48 Kg**

Total maximum plastic waste generated in The Federal Polytechnic, Ilaro Per/Month = 1,455.48 X 3 = 4,366.44 Kg

Total maximum nylon waste generated in The Federal Polytechnic, Ilaro Per/day = **164.770 + 82.37 = 247.11 lbs**

Total maximum plastic waste generated in The Federal Polytechnic, Ilaro Per/Week = **247.11 X 6 = 1,482.66 lbs**

Total maximum plastic waste generated in The Federal Polytechnic, Ilaro Per/Month = 1,482.66 X 3 = 4,447.98 lbs

Table 5: Total Weight of Pet Bottle and Nylon Generated in the Federal Polytechnic, Ilaro

Sorting	Pet Bottles	Nylon
Per/Day	**242.58 Kg**	**247.11 lbs**
Per/Week	**1,698.06**	**1,482.66 lbs**
Per/Month	5,094.18	4,447.98 lbs

The table above shows the total weight of waste generated from both the East Campus and West Campus of the Federal Polytechnic, Ilaro at different intervals. The table below shows the revenue generated from collecting waste and selling them at the Price of #160 per/kg. Table 6 shows the income generated from the Total waste collected per day, week, and month.

Table 6: Analysis of Income from Plastic Waste

Price	Pet Bottles	Nylon
Per/Day	#38,812.8	#17,933.92
Per/Week	#271,689.6	#107,603.68
Per/Month	#815,068.8	#322,811.2

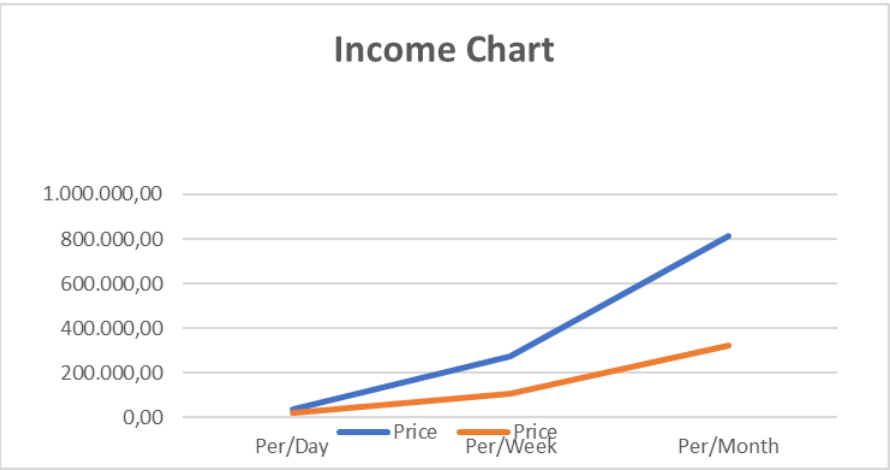

Figure 2. Income Analysis for Plastic Waste Generated

CONCLUSION

In order to improve waste management, our study aims to make wealth from garbage through the recycling process. According to the study's findings, recycling garbage to produce riches has a number of advantages. Daily waste production is inevitable, but with the correct techniques, it shouldn't be difficult to manage. The findings of the descriptive research survey show that the products that are supplied to and sold in various locations around the Federal Polytechnic, Ilaro East and West Campus, have a significant impact on waste formation and characterization. The government has yet to rise to the challenge of encouraging more creative skills in business to inspire recent graduates to venture into such activities rather than looking for the elusive "white collar jobs," and there is also a lack of encouragement and conflicting reactions from those venturing into some aspects of waste-to-wealth, such as those involved in pickings (scavengers) and litter collectors, to name a few.

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KENTSEL MEKANLARDA FARKLI YEŞİL ALAN ORANLARININ DIŞ MEKÂN TERMAL KONFORA ETKİSİNİN ENVI-MET İLE ANALİZİ: ATATÜRK ÜNİVERSİTESİ LOJMANLARI

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ÖZET
Son yıllarda artan geçirimsiz yüzeyler iklim değişikliğine ve dış mekân termal konforuna etki etmektedir. Bu yüzden kentlerde mikro-iklimi olumlu yönde etkileyen açık yeşil alanların tasarımı ve etkin kullanımı büyük önem arz etmektedir. Erzurum kentinde güneşli gün sayısının çok olması, yüksek rakıma sahip olması, yaz aylarının oldukça sıcak geçmesi ve kış aylarının ise soğuk geçmesinden dolayı açık yeşil alanlar termal konforu göz önünde bulundurularak tasarlanması önemlidir. Bu çalışmada amaç kentsel yeşil alan oranlarının termal konfora etkisini belirlemektir. Bu nedenle çalışma alanı olarak Atatürk Üniversitesi lojmanlarının bahçesi belirlenmiştir. Çalışma alanında kurulan meteoroloji istasyonundan 2022 yılı boyunca saatlik olarak elde edilen mikro-iklim verileri temin edilmiştir. Atatürk Üniversitesi lojmanlarında farklı oranlarda %0, %20 ve %40 yeşil alan miktarları kullanılarak peyzaj tasarım senaryoları oluşturulmuştur. Yapılan senaryolar; mevcut durumun yaz senaryosu, mevcut durumun kış senaryosu, bitki materyalinin %20 oranında arttırıldığı kış senaryosu ile çalışma alanında bulunan bitki materyallerinin tamamının kaldırıldığı yaz ve kış senaryoları hesaplanmıştır. Bu senaryolardan hangisinin termal konfor açısından daha avantajlı olduğunu belirlemek için ENVI-met BIO + Science modeli kullanılarak analizler yapılmıştır. Yeşil alan oranının artırıldığı yaz senaryosunda serin hava oluşumuna ve kışın rüzgârı keserek soğuk hava etkisini azaltarak ortamın termal konforunu iyileştirdiği görülmüştür. Termal konfor değeri yüksek, sürdürülebilir ve yaşanabilir bir kentleşme oluşturulabilmesi için multidisipliner bir ekibin birlikte çalışması gerektiği vurgulanmıştır.

Anahtar Kelimeler: ENVI-met, Atatürk Üniversite, Lojman, yeşil alan

ANALYSIS OF THE IMPACT OF DIFFERENT GREEN AREA RATIOS ON OUTDOOR THERMAL COMFORT IN URBAN SPACES USING ENVI-MET: ATATÜRK UNIVERSITY HOUSING SETTLEMENT

ABSTRACT

In recent years, impermeable surfaces have been increasingly affecting climate change and outdoor thermal comfort. Therefore, the design and effective use of open green spaces that positively influence microclimates in cities are of great importance. In the city of Erzurum, due to the high number of sunny days, high altitude, hot summers, and cold winters, it is important to design open green spaces considering thermal comfort. The aim of this study is to determine the impact of urban green space ratios on thermal comfort. Therefore, the garden of the Atatürk University housing settlement was chosen as the study area. Microclimate data obtained on an hourly basis throughout the year 2022 were obtained from the meteorological station established in the study area. Landscape design scenarios were created using different ratios of green areas (0%, 20%, and 40%) in the Atatürk University housing complex. The scenarios included the summer scenario of the current situation, the winter scenario of the current situation, the winter scenario with a 20% increase in plant material, and the summer and winter scenarios with the complete removal of plant materials in the study area. To determine which scenario is more advantageous in terms of thermal comfort, analyses were conducted using the ENVI-met BIO + Science model. It was observed that in the summer scenario with an increased green area, cool air formation and reduction of cold air effects by blocking the wind in winter improved the thermal comfort of the environment. It was emphasized that a multidisciplinary team needs to work together to create a high thermal comfort value, sustainable, and livable urban environment.

Keywords: ENVI-met, Atatürk University, Housing Settlement, green area

GİRİŞ

Birleşmiş Milletler verilerine göre dünyada kentleşme oranı hızla artmaktadır. Küresel alanda kentsel nüfus 1950'de 751 milyon iken 4,6 kat artarak 2018'de 4,2 milyara yükselmiştir. Bu sayının 2050'de daha artarak 6,4 milyara ulaşacağı tahmin edilmektedir (UN, 2019). Ancak yapılan bu tahminlere çok daha kısa sürede ulaşılacağıda görülmektedir. Kentsel mekânlara olan bu talep konut gereksiniminide hızla artırmaktadır. Kent kavramı çok geniş kapsamlı bir olgu olup, her geçen gün daha çok yapılaşarak, konut sayısını artırarak, sert ve geçirimsiz yüzeylerini artırmaktadır (Chandan et al., 2019; Bharath et al., 2019). Bu süreçte tahrip edilen veya dikate alınmayan çevre çanlıların yaşamını olumsuz etkileyen doğa olayları ile insanların karşısına çıkmaktadır. Çevre dikkate alınmadan yapılan kentsel planlamalar yaşam alanlarında daha fazla enerji tüketimi, çeşitli kirlilikler, geçirimsiz yüzey artışları, açık-yeşil alanların azalması ve buna bağlı olarak yaşam standartları düşük kentsel mekânların artmasını desteklemektedir (Topcu and Girgin, 2016; Huang et al., 2021). Bu nedenle canlılar için daha yaşanabilir mikro-iklim şartlarını sağlayan dış mekan termal konfor koşullarının planlama ve tasarım stratejileri üzerinde çalışılmaktadır (Okumuş and Terzi, 2022).

Kentsel mekanlarda yaşanan hızlı ve hazırlıksız kentleşme, çarpık yapılaşma, amaç dışı alan kullanımları ile azalan yeşil alanlar ve artan geçirimsiz yüzeyler kentsel ısı adası sorununu artırmıştır. Bu olumsuz etkinin azaltılması için farklı meslek disipplerince çalışmalar yapılmaktadır. Bitkilerin tür tercihleri ve bunların peyzaj tasarımıda termal konforu etkilemektedir (Irmak vd., 2018). Kentsel mekanlardaki yeşil alanlar ziyaretçiler açısından pozitif katkı sağlarken (Yılmaz, 2022) aynı zamanda dış mekan termal konforuda iyileştirme etkisine sahiptir (Park et al. 2012; Yılmaz vd., 2022). Yeşil alanların büyük ya da küçük olması, parkların serinletici etkisi açısından önemlidir. Daha büyük parkların daha küçük parklara göre ortamı 2.0 °C'ye kadar daha serinlettiği yapılan çalışmalarda görülmüştür (Zhang et al. 2022; Geng et al. 2022). Yeşil alanların dış mekan termal konforu olumlu etkilediği çok sayıda araştırma bulunmaktadır (Morakinyo vd., 2017; Salata vd., 2017; Lu vd., 2017;Mutlu vd., 2018).

Mekân kalitesini etkileyen pek çok parameter olmasına ragmen, iklim bunlardan sadece bir tanesi olmakla beraber atlanmaması gereken temel bir kavramdır (Yılmaz, 2020). Özellikle son yıllarda kentsel mekanlarda dış mekan termal konforun iyileştirilmesi için çalışmalar yoğun bir şekilde devam etmektedir. Kentsel mekanlarda oluşan Kentsel ısı Adası (KIA) etkisini en aza indirgemenin yolları aranmaktadır. Bu neden ile çeşitli özelliklere sahip iklim yazılım modelleri kullanılarak analizler yapılmaktadır.

Bu çalışmada amaç, Erzurum Kent merkezinde, yeşil alan bakımından daha iyi durumda olan Atatürk Üniversitesi Lojman bahçesinde çalışılmıştır. Farklı yeşil alan oranlarının yaz-kış ayları için dış mekan termal konfora etkisi analiz edilmek istenmiştir.

MATERYAL ve METOD

Çalışma alanı Erzurum Atatürk Üniversitesi lojmanlarında yer almaktadır. Çalışma alanı 130x230 metre genişliğindedir. Mekanda yeşil alanlar, kamelyalar, market vs. bulunmaktadır. Araştırma alanının konum haritası gösterilmektedir (Şekil 1). Çalışma alanında yaklaşık olarak 1.5 m yükseklikte ve 120 x 120 cm genişliğinde kurulan meteoroloji istasyonunun yıllık verilerinden yararlanılmıştır. Yılın en sıcak ve en soğuk günleri olan 15 Temmuz 2022 ve 18 Ocak 2022 için 24 saatlik mikro iklim verileri, sıcaklık, nem, bulutluluk, rüzgar hızı, rüzgar yönü kullanılmıştır. Araştırma alanında veri toplama için kullanılan Ventage Pro 2 plus cihazı yer almaktadır. Meteoroloji ölçüm cihazı, dışarıdan gelebilecek zararlardan korumak için demir bir kafes içine alınmıştır (Şekil 2). Çalışmadaki analiz verileri, insanların açık alanı daha yoğun kullandığı saat 15:00'ten sonra değerlendirilmiştir.



Şekil 3. Çalışma alanı lokasyon haritası



Şekil 4. Ölçüm cihazı: Davis Vantage Pro 2

Çalışma Alanı İçin Hazırlanan Senaryolar

Çalışma kapsamında kullanılan yeşil alan oranlarının belirlenmesi ve bitki listesi hazırlığı yapılmıştır. Bu amaçla belirlenen yeşil alan oranları aşağıda verilmiştir:

- Mevcut Durum Yaz Analizi
- Mevcut Durum Kış Analizi
- Çalışma Alanında Bitki Olmadan Yapılan Yaz Analizi
- Çalışma Alanında Bitki Olmadan Yapılan Kış Analizi
- %20 Bitki Artırılmış Yaz Analizi
- %20 Bitki Artırılmış Kış Analizi
- %40 Bitki Artırılmış Yaz Analizi
- %40 Bitki Artırılmış Kış Analizi

Yeşil alan için tercih edilen bitkiler, kente uyum sağlamış ve yaygın olarak kullanılan türlerden tercih edilmiştir. Çalışma alanımızda 110 adet sarıçam (*Pinus slyvestris*), 10 adet kuş üvezi (*Sorbus aucaparıa*), 9 adet servi (*Cupressus*), 8 adet söğüt (*Salix* spp.), 1 adet ıhlamur (*Tılıa cordota*), 9 adet kadın tuzluğu (*Berberis*), 7 adet ardıç (*Juniperus*), 37 adet vişne (*Prunus cerasus*), 44 adet leylak (*Syringa vulgaris*), 16 adet frenk üzümü (*Ribes aureum*), 7 adet süs elması (*Malus hybrida*), 13 adet doğu mazısı (*Thuja occidentalis*), 3 adet adi dişbudak

(*Fraxinus excelsior*), 12 adet hanımeli (*Lonicera*), 14 adet taflan (*Euonymus alatus*), 10 adet huş (*Betula pendula*), 9 adet gül (*Rosa canina*) ve 6 adet karaağaç (*Ulmus grabra*) tercih edilmiştir.

ENVI-met BIO Science Modeli

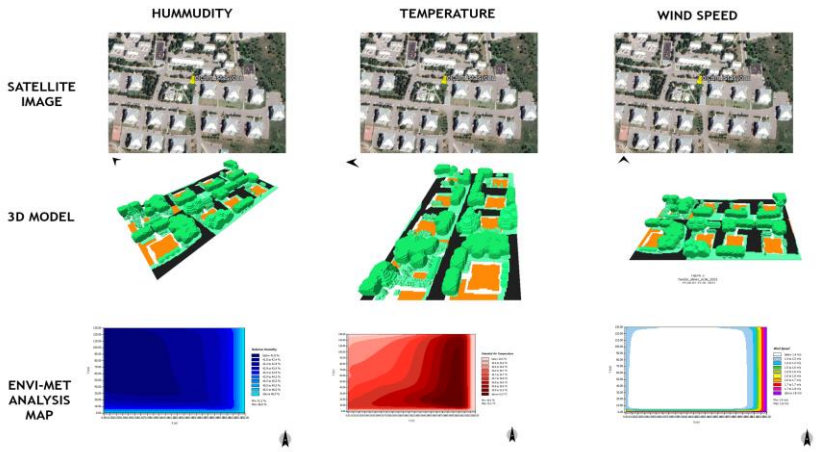
Kentsel mekânların iklim odaklı termal konfor açısından daha iyi planlanması konusunda, alternatif tasarımlara uygulanan ENVI-met bilgisayar modeli ile olası senaryolar üretilmektedir. İklim verilerinin planlamada kullanılmasına olanak sağlayan ENVI-met modeli Bruse ve Fleer (1998) tarafından geliştirilmiştir. ENVI-met yazılımı, akışkanlar mekaniği ve termodinamik teorilerine dayanmakta olup (Zhang et al., 2022), planlama ve peyzaj mimarlığı araştırmacıları tarafından ortamın termal konforunu iyileştirmek (Wang et al., 2018) ve ısı adası etkisini azaltmak için yaygın olarak kullanılmaktadır.

ARAŞTIRMA SONUÇLARI

Çalışmada bölgesinin mevcut durumu da dahil olmak üzere altı (6) farklı senaryo analiz edilmiştir. Çalışma alanının üç 3D çizimi oluşturulmuş ve çevre analizi yapılmıştır. Çalışma alanına ait görselde sarı ile gösterilen yerler meteoroloji istasyonlarının yerlerini göstermektedir. 2022 yılının en sıcak ve en soğuk günleri olarak belirlenen 15 Temmuz ve 18 Ocak tarihleri mikro iklim verileri ENVI-met kullanılarak analiz edilmiştir. Bu analizler sırasıyla aşağıda belirtilmiştir.

Mevcut Durum Yaz Analizi

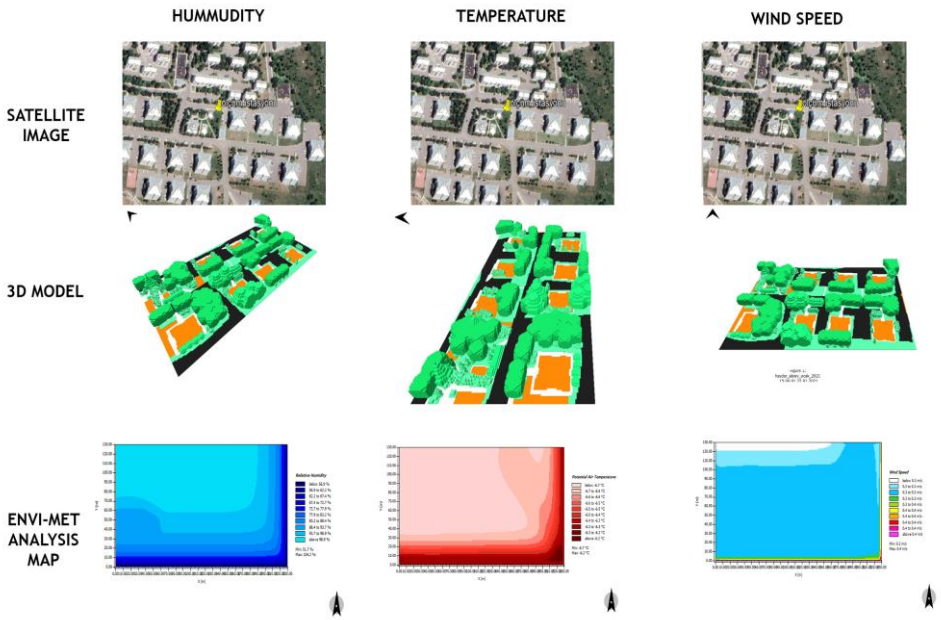
ENVI-met kullanılarak, Atatürk Üniversitesi lojmanlarının mevcut durumunun analiz sonuçları şekil 3'de gösterilmiştir. ENVI-met yazılımı ile yapılan analizde mevcut duruma ilişkin yaz değerleri, sıcak havanın alanın güneydoğusunda daha fazla olduğunu göstermiştir. Ayrıca sıcak havanın alanın güneydoğundan kuzeybatısına doğru kademeli bir şekilde azaldığı görülmüştür. Nem verilerine bakıldığı zaman bu durumun tersi bir olay ile karşılaşılmıştır. Rüzgâr hızının ise çalışma alanın orta kısmında düşük güneydoğu ve doğu kısmında yükseldiği görülmüştür.



Şekil 3. Mevcut Durum Yaz Analizi

Mevcut Durum Kış Analizi

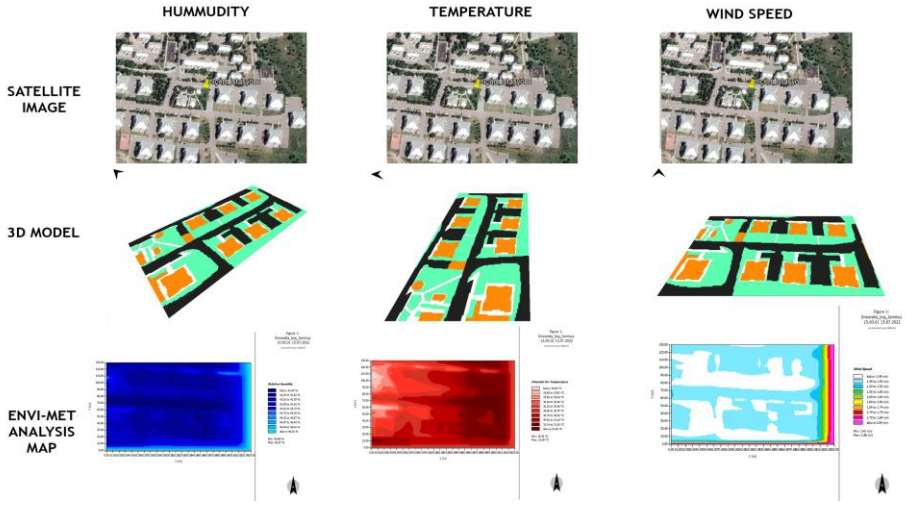
Mevcut durum kış analiz verilerine bakıldığında nem oranı yaklaşık iki kat artarak %104.2'e çıktığı görülmektedir. Ayrıca yaz analizinde düşük olan bölgenin kışın en yüksek değerleri verdiği anlaşılmıştır. Analizin sıcaklık verilerine bakıldığında en yüksek değerler yine alanın güneydoğunda görülmüştür. Ancak sıcaklık dağılımına bakıldığında soğuk hava kitlesinin çalışma alanın büyük bir kısmına hâkim olduğu belirlenmiştir. Rüzgâr hızı verilerinin 0,4 m/s' yelere kadar düştüğü ve alanın tamamında bu değerlerin hâkim olduğu görülmüştür (Şekil 4).



Şekil 4. Mevcut Durum Kış Analizi

Çalışma Alanında Bitki Olmadan Yapılan Yaz Analizi

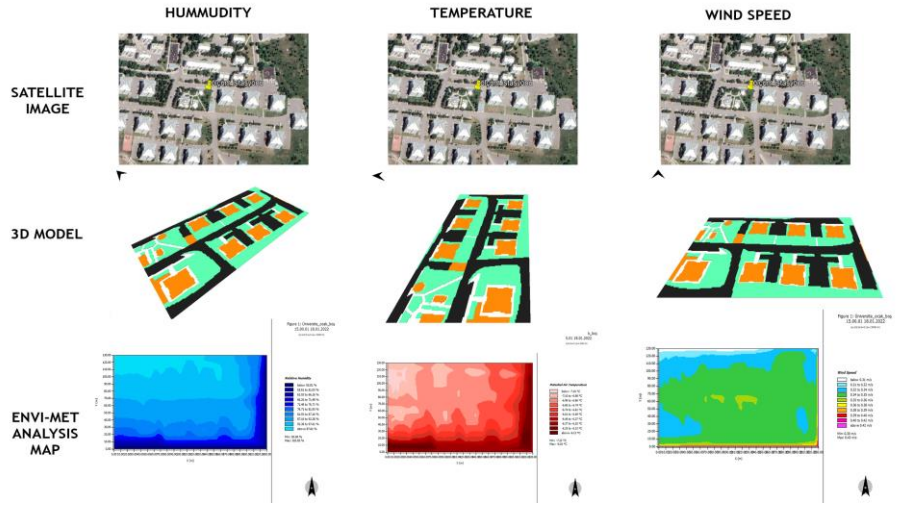
Çalışma alanımızı bitki materyallerinden arındırıp dijital ortamda analiz edilmiştir. Boş alan yaz analiz sonuçlarına bakıldığında sıcaklık verilerinde mevcut durum yaz analizlerine göre 0.4 C° artış görülmüştür. Nem ve rüzgâr hızı verilerinde ise önemli bir değişiklik görülmemiştir (Şekil 5).



Şekil 5. Boş Alan Yaz Analizi

Çalışma Alanında Bitki Olmadan Yapılan Kış Analizi

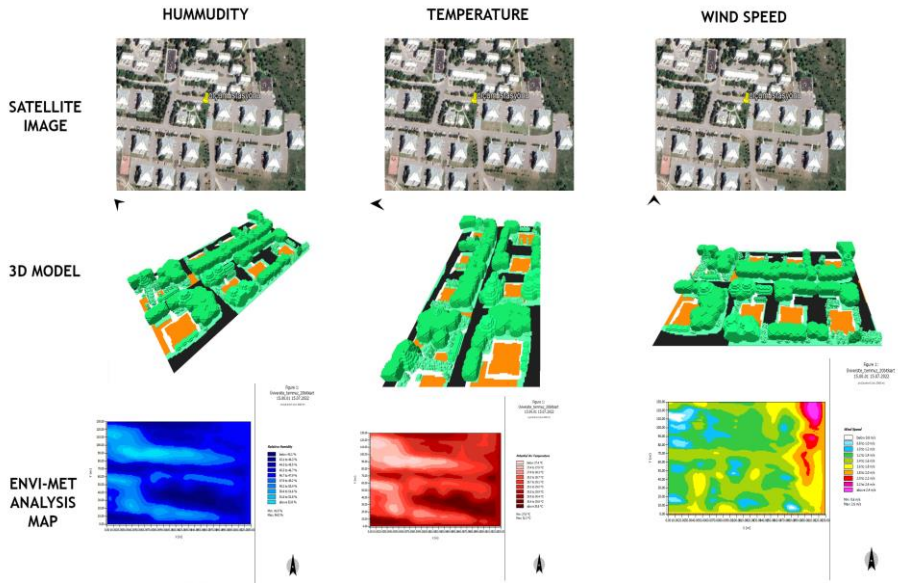
Çalışma alanımızı bitki materyallerinden arındırıp dijital ortamda analiz edilmiştir. Boş alan kış analiz sonuçlarına bakıldığında değerlerin çalışma alanına homojen bir şekilde dağıldı görülmüştür. Nem oranının %2'lik ve sıcaklık değerinde 0.2 C°'lik bir düşüş belirlenmiştir (Şekil 6).



Şekil 6. Boş Alan Kış Analizi

%20 Bitki Artırımı Yaz Analizi

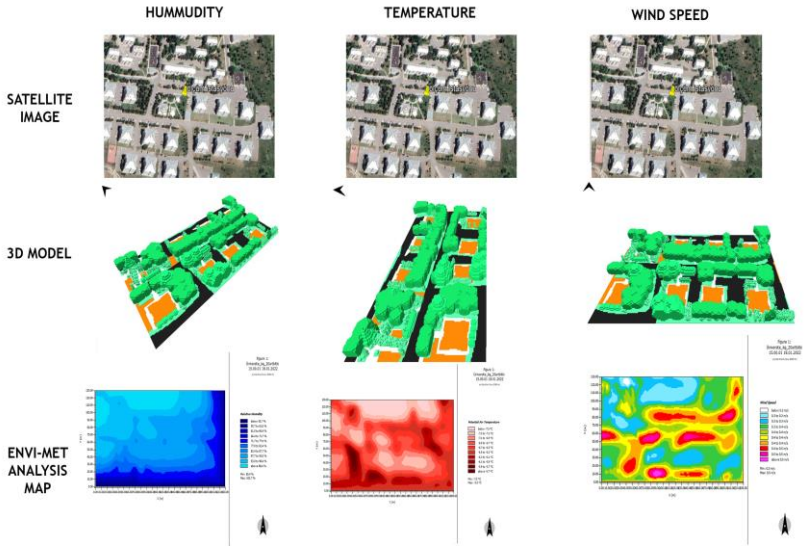
Çalışma alanındaki bitki materyallerinin artırıldığı yaz analiz sonuçlarına bakıldığında, mevcut durum yaz analizine oranla %8'lik artış görülmüştür. Sıcaklık verilerine bakıldığında ise yaklaşık olarak 1.0 C°'lik bir düşüş olduğu görülmüştür (Şekil 7).



Şekil 7. Bitki artırım oranı %20 olan yaz analizi

%20 Bitki Artırımı Kış Analizi

Çalışma alanımızda uygulanan bitki artırımı kış analizine bakıldığında, mevcut durum kış analiziyle karşılaştırıldığında 0.7 C°'lik artış görülmüştür. Nem oranında ise yaklaşık % 1.0'lik bir düşüş görülmüştür (Şekil 8).



Şekil 8. Bitki artırım oranı %20 olan kış analizi

TARTIŞMA ve SONUÇ

Çalışma sonucunda ortaya çıkan analiz sonuçlarında kentsel yeşil alanların dış mekan termal konforu pozitif yönde etkilediği görülmektedir. Ancak bu analizler devam etmektedir. Sempozyum sunumuna kadar tamamlananlar burada değerlendirilmiştir.

Dış mekan termal konforu açısından kentsel yeşil alanlar ve bunların tasarımı oldukça önem arz etmektedir. Bu araştırmada bitki materyalinin artması durumunda termal konforu arttırdığı sonucu görülmektedir. Ancak bu konuda daha fazla analiler ve verilerin doğruluk analizi yapılmalıdır. Sonuçların yorumlanması içinde istatistik analizleri yapılacaktır.

Bu çalışmanın analiz sonuçlarında da yeşil alanların sıcaklığı azaltmada olumlu katkı sağladığı görülmüştür. Nitekim bitki örtüsünün hava sıcaklığını belirgin bir şekilde azalttığı, çim ve büyük ağaçların kombinasyonunun 1,0 °C'ye kadar sıcaklığı düşürdüğünü göstermiştir (Wu vd., 2019). Yine benzer bir çalışmada, kent parkında ENVI-met ile yapılan analizde ağaç ve yeşil alan senaryosunun mevcut duruma göre sıcaklığı 0,5 °C daha düşürdüğü saptanmıştır (Teshnehdel et al., 2022). Bu alanda yapılan akademik çalışmalarda, bitki örtüsü olan ve olmayan alanlar arasındaki simülasyonlarda sıcaklık, nem, rüzgâr ve termal konfor farklılıklarının nedenleri belirtilmiştir. Bunlar arasında topraktaki nemin yüzey radyasyonu ile bir kısmının gizli ısıya dönüşmesi, ağaç yapraklarının gölge oluşturması ve bitkilerin evapotranspirasyon etkisi nedeni ile olduğu ifade edilmiştir (Yavaş ve Yılmaz, 2019; Yucekaya and Uslu, 2020).

Bu çalışma, kentsel yeşil alan oranlarının mikro ikliminin nasıl iyileştirilebileceği konusunda önemli bilgiler sağlayarak, farkındalık oluşturması için önemlidir. Ayrıca, gelecekte yapılacak araştırmalarla bu konuda daha detaylı analizler yapılmalı ve daha etkili çözümler geliştirilmelidir.

Teşekkür

Bu sunum Atatürk Üniversitesi, Fen Bilimleri Enstitüsü, Peyzaj Mimarlığı Anabilim Dalında Yüksek Lisans öğrencisi olan Muhammet Gölcü'nün yüksek lisans tezi ile ilişkilidir. Türkiye Bilimsel ve Teknolojik Araştırma Kurumu, TÜBİTAK 1001-TOVAG, proje numarası: 119O479 ve Türkiye Meteoroloji Genel Müdürlüğü'ne (MGM) teşekkür ederiz.

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ÖZET
Ambroksol mukolitik ve ekspekteron etkilerinden dolayı solunum sistemi enfeksiyonlarında sıklıkla reçete edilmektedir. Yan etkisinin tolere edilebilir düzeyde olması neden ile geniş kullanım alanına sahiptir. Ambroksol solunum sistemi dışında farklı hastalıklarda da kullanılabilmektedir. Bu derlemede ambroksolun yeni kullanım yerleri hakkında bilgiler verilmiştir.
Anahtar kelimeler: ambroksol, yeni kullanım alanları, mukolitik

NON-MUCOKINETIC EFFECTS OF AMBROXOL

ABSTRACT
Ambroxol is frequently prescribed in respiratory system infections due to its mucolytic and expectorant effects. Because the side effect of drug is at a tolerable level, it has a wide use area. Ambroxol can also be used in various diseases other than respiratory system. In this review, it has been reported that information about new places of use of ambroxol.

Keywords: Ambroxol, new uses area, mucolytic

GİRİŞ

Mukoaktif ilaçlar mukusun yapısına etkiyerek mukusun temizlenmesini sağlar. Bu ilaçlar etki mekanizmalarına göre ekspekteron, mukolitik, mukokinetik ve mukoregulatör olarak sınıflandırılır (Malerba 2008; Dhar 2013). Etkilerini mukusun içindeki mukoproteinlerin yapısını bozarak, DNA yapıları parçalayarak (Kayaalp 1995), mukusu sulandırarak, mukus sekresyonu artırarak, siliyalar üzerine etki ederek veya mukus sekresyonunu regüle ederek gösterirler (Kayaalp 1995; Malerba 2008; Dhar 2013).

Ambroksolun yeni kullanım alanları

Ambroksol (AMB), bromeksin hidroklorürün aktif bir N-desmetil metabolitidir. AMB sikloheksil zincirinin para-trans pozisyonundaki bir hidroksil grubunu ile bir metil grubunun yokluğu ile bromeksinden farkı olduğu ifade edilmiştir (Malerba 2008). Beşerî hekimlikte ekspektoran, mukokinetik, mukolitik ve antitissuf etkilerinden yararlanılarak solunum sistemi hastalıklarında kullanılır. AMB'un etki mekanizması tam olarak açıklanamamasına rağmen genel görüş surfaktan sentezini uyararak etki gösterdiğidir (Yildiz 2006). Havayolları üzerine etki eden ilaçların havayolları temizliği için iyon akımını stimüle etmesi gerektiği öne sürülmüştür (Greczko ve Tyrakowski 2001). AMB'un selektif olarak solunum yollarında Na^+ emilimini inhibe ettiği ve bu yüzden mukusun vizkositesini azalttığı ve havayolları yüzeyindeki sıvıdaki su birleşimini artırdığı ifade edilmiştir (Tamaoki ve ark 1991).

AMB 1973'den beri ilaç sektöründe bulunmaktadır. Deri döküntüsü, bulantı ve kusma, abdominal ağrı, dispepsi, anafilaktik reaksiyonlar ve alerji reaksiyonlar gibi yan etkilere sahip olduğu bildirilmesine rağmen çocuklar ve yetişkinlerin bu yan etkileri iyi tolere edebildikleri ifade edilmiştir (Malerba 2008; Gupta 2014). 4 hafta boyunca IV olarak 4, 14 ve 64 mg/kg dozunda ratlara ve 45, 90 ve 120 mg/kg dozunda köpeklere uygulandığında lokal, sistemik ve histopatolojik olarak hiçbir toksik etkisi olmadığı bildirilmiştir. AMB tavşanlarda 200 mg/kg ve ratlarda 3000 mg/kg oral olarak uygulandığında teratojenik ve embriyotoksik herhangi bir etkisinin olmadığı belirtilmiştir (Malerba 2008).

AMB'un solunum sistem hastalıkları dışında birçok hastalıkta farklı amaçlı olarak kullanım alanı bulur.

Antioksidan: Normal hücrelerde hücre içi oksidatif stres denge halindedir. Ancak yangıda bol miktarda üretilen serbest oksijen radikalleri (ROS)'ne karşı hücre kendi homeostasisini koruyamaz ve hücresel tahribat gerçekleşir (Beeh ve ark. 2008).

Hücre düzeyinde yapılan araştırmalarda; AMB'un ROS'ni ($H_2O_2^-$, $HClO^-$, O_2^-, OH^-, $ONOO^-$) detoksifiye edici etki gösterdiği ifade edilmiştir. AMB'un bu etkilerinden göz önünde bulundurulduğunda oksidatif hasara karşı doku/organları koruyucu olarak kullanılabileceği

belirtilmiştir. Özellikle endikasyon alanı dikkate alındığında solunum sisteme enfeksiyonlarında, doku hücrelerini oksidatif strese karşı koruyucu etki gösterebileceği ifade edilmiştir (Nowak ve ark. 1994, Gillissen ve ark. 1997). Antioksidan etkisinin araştırıldığı bir başka çalışmada nötrofillerde antioksidan etki gösterdiği, böylece AMB'un antioksidan ilaç olarak yeni bir perspektif açtığı ve özellikle lökosite bağlı inflamasyonda kullanılabileceği ifade edilmiştir (Peroni ve ark. 2013). Akciğer epitel hücreleri ve alveoller makrofajlarda bleomisinin neden olduğu GSH düzeyinde azalma, ROS oluşumunda artış, mitokondrial membran geçirgenliğinde değişiklik ve hücre ölümünü AMB'un baskıladığı belirtilmiştir (Hong ve ark. 2003). fMLP veya LPS ile uyarılan alveoller makrofajlardan salınan ROS ve enzimlerin üzerine AMB'un etkisinin incelendiği araştırmada, AMB'un makrofajlardan salınan asit fosfotaz, lizozimin, süperoksit, hidrojen peroksit ve nitrit oksit üretimini baskıladığı ifade edilmiştir (Lee ve ark. 1999). AMB'un fagositik hücrelerde solunum patlamasında rol alan peroksinitrit ($ONOO^-$) ve hipoklorik asit (HOCl) üretimi üzerine baskılayıcı etki gösterdiği ifade edilmiştir (Lee ve ark. 2002).

Şiddetlenmiş COPD bireylerde AMB antioksidan etkilerini canlıda TrxR/Trx sistemi üzerinden gösterdiği ifade edilmiştir (Huang ve ark. 2014). Yapılan başka bir araştırmada nitrik oksit oluşumunu engelleyerek etki gösterebileceği belirtilmiştir (Severina ve ark 2000). İn vitro olarak AMB ve N-asetil sistein(NAC) oksidan etkinlikleri araştırıldığında, AMB'un ROS kaynaklı hücre hasarını azalttığı ve antioksidan etkisinin NAC'e benzer olduğu bildirilmiştir. AMB'un özellikle $HClO^-$ ve OH^- radikallerine üzerine etkili olduğu rapor edilmiştir. Bu etkinin AMB molekülde bulunan aromatik kısım ile ilişkili olabileceği görülmüştür. Sonuçta AMB'un direk antioksidan fonksiyonu neden ile antioksidan tedavide kullanılabileceği belirtilmiştir (Gillissen ve ark. 1996). Farelerde doksorubisin ile indüklenmiş kalp hasarında, kalpteki lipid peroksidasyonu mitokondriyal düzeyde gösterdiği ve doksorubisinin bu etkisinin AMB uygulanması ile engellenebileceği ifade edilmiştir (Nowak ve ark. 1995). Benzer şekilde indometazinin neden olduğu gastrik mukoza üzerindeki hasarın, 30 dakika öncesinde AMB uygulanması ile azaltılabildiği bildirilmiştir (Štětinová ve ark. 2004). Premature bebeklere AMB uygulandığında akciğerlerde sürfaktan sentezini teşvik ettiği, antioksidan enzim sistemleri üzerine olumlu etki gösterdiği ve lipit peroksidasyonunu azalttığı belirlenmiştir (Novak ve ark. 1989). Toluen buharına maruz bırakılan ratlara AMB uygulandığında akciğer dokusundaki ROS'lerini önemli derece azalttığı ve akciğer dokusunda reaktiflerden kaynaklanabilecek oksidasyonu engellemek için yapılacak bir tedavide yardımcı olabileceği bildirilmiştir (Strapková ve ark 1999). İdiopatik pulmonary fibrosis etiyolojisi tam olarak bilinmeyen dönüşümsüz akciğer hastalığıdır. Patogenezisi tam olarak açıklanamamakla birlikte

patolojisinin anormal yara iyileşmesi olduğu ifade edilmektedir. İn vitro ve deneysel çalışmalarda AMB'un mukokinetik ile mukolitik etkisine ek olarak antioksidan, antiinflamatuar, sürfaktan sentezinin uyarıcı ve sitokin salınımı azaltıcı etkileri bulunduğu böylece idiopatik pulmonary fibrosisde rol aldığı inanılan düzensiz yara iyileşmesini kontrol etmek için potansiyel bir role sahip olabileceği ve intersitisyel akciğer hastalıklarında kullanılabileceği ifade edilmiştir (Gupta 2014). LPS uygulanan ratlara önceden AMB uygulandığında akciğer dokusuna fagosit birikimini engellediği ve fagosit kaynaklı hasarı engelleyebileceği rapor edilmiştir (Nawrocka ve ark. 1999).

Hepatik iskemi/reperfüzyon: Bu durum karaciğer rezeksiyonu, karaciğer transplantasyonu, hipovolemik şok ve travma gibi birçok klinik vakaya sebep olan yaygın patolojik bir süreçtir. Ratlarda deneysel olarak yapılan araştırmada AMB kullanımının histolojik olarak olumlu etkileri olduğu, serumda AST ile ALT düzeylerinin düşürdüğü, hepatik dokusundaki GSH, SOD ile CAT düzeyini artırdığı ve MDA düzeyini düşürdüğü belirlenmiştir. Sonuç olarak hepatik iskemi/reperfüzyonda AMB'un intraselüler antioksidan ile antiapoptotik sinyalizasyon yolağını uyarabildiği ve bu vakalarda faydalı olabileceği belirtilmiştir (Jiang ve ark. 2013).

Antiinflamatuar: AMB'un bazı yangı mediatörleri ve sitokinlerin salınımı engelleyerek etki gösterebildiği bilinmektedir (Su ve ark. 2016). AMB özellikle inhale yolla kullanılmasının hava yolları ve akciğerler dokusu sitokin düzeylerini düşürebilir (Zhang ve ark 2016). COPD'de inhalasyon yoluyla uygulandığında, inflamasyona sebep olan ve alerjik hastalıklarıda rol alan akyuvar ve mast hücre kaynaklı alerjik mediyatörlerin salınımı inhibe ettiği belirlenmiştir (Ge ve ark. 2016). In vitro araştırmada LPS ile uyarılan monositlerden TNF ve IL-1 salınımının AMB ile baskılanabildiği bildirilmiştir (Bianchi ve ark. 1990). Ancak AMB'un sitokinlerin üretimi ve salınımı üzerine antiinflamatuar etkisini açığa kavuşturmak için yapılan çalışmalarda etki mekanizması tam olarak açıklanamamıştır. Muhtemel etki mekanizmaları olarak fosfodiesteraz inhibe edici etkisi, transkripsiyon faktörü olan NF-κB ile etkileşime girerek pro-inflamatuar sitokinleri intraselüler olarak salınımı azaltıcı ve/veya protein tirozin kinaze ve protein kinaze C içeren hücresel aktivatörleri inhibe ederek etkisini gösterdiği ifade edilmiştir (Beeh ve ark. 2008). AMB'un alerjik reaksiyonlarda da rol alan mast hücrelerinden histamin salınımı %50 oranında inhibe ettiği, bazofillerden interleukin (IL-4, IL-13) ile lökotrien salınımı güçlü şekilde baskıladığı ve monositlerden lökotrien ve histamin salınımı azalttığı ifade edilmiştir. Sonuç olarak AMB'un alerjik solunum sistemi hastalıklarında etkili olabileceği belirtilmiştir (Gibbs ve ark. 1999). AMB ile inkube edilen alveolar makrofajlar sonra LPS'e maruz bırakıldığında IL-12 düzeyinin daha yükseldiği ve AMB'un IL-10 düzeyine etkisinin

olmadığı belirtilmiştir (Aihara ve ark. 2000). Nötrofillerden salgılana proteolitik enzimler akciğer dokusunda birçok yapı ve hücre içi mekanizmaya zarar verebilmektedir. AMB'un kemotaktik cevabı önemli oranda azalttığı ifade edilmiştir (Stockley ve ark. 1988). Farelerde LPS ile indüklenen akciğer enfeksiyon modelinde BAL sıvısındaki TNF-α, IL-6 ve TGF-β1 artışı AMB uygulaması ile düştüğü ifade edilmiştir (Su ve ark. 2004). Kardiyak cerrahi veya akciğer lobektomi operasyonlarından sonra postoperatif dönemde normal tedaviye ek olarak AMB kullanıldığında hastaların hastanede kalış süresinin azaldığı ve bu etkinin antiinflammatuar özelliğinden kaynaklandığı belirtilmiştir (Wang ve ark. 2014).

Antimikrobiyel: Yapılan araştırmada antibiyotikle birlikte AMB uygulandığında antibiyotiğin *P. aureginosa* karşı etkinliğinin arttığı ifade edilmiştir (Lee ve ark 2015, Wang ve ark 2016). AMB'un *Mycobacterium tuberculosis* üzerine etkisi incelendiğinde antitüberküloz ilaçlarla birlikte kullanıldığında ilaçların etkinliğinin artabileceği bildirilmiştir (Grange ve ark. 1996). İnsanlarda akut viral solunum sistemi enfeksiyonları *rhinovirus, coronavirus, parainfluenza* ve *respiratorik sinsiyal virüs* neden olur. AMB uygulaması ile viral replikasyonu baskıladığı, kış mevsimindeki akut üst solunum yolu insidensini azalttığı ve *ratlarda influenza A virüsünü* önemli oranda baskıladığı rapor edilmiştir (Beeh ve ark. 2008, Uchide ve ark. 2011). Memeli hücrelerinde bakteriyel yapışmaya karşı bazı mukolitiklerin etkinlikleri test edildiği araştırmada AMB'un *P. aeruginosa, E. coli* ve *staphycoccus spp.* bakteri türlerinin memeli hücrelere adhezyonun engellediği ifade edilmiştir (Hafez ve ark. 2009). Antibiyotiklerle birlikte AMB uygulandığında bazı antibiyotiklerin akciğer konsantrasyonunda artmaya neden olduğu bildirilmiştir. AMB ile birlikte ofloksasin ve sefalotin uygulandığında antibiyotiğin alveollere ve BAL sıvısında antibiyotik konsantrasyonun sırasıyla üç ve 1.5 kat arttığı ifade edilmiştir (Paganin ve ark. 1995; Matsuda ve ark. 1999).

Biyofilm: Mikroorganizmaların bir canlı veya cansız (hastane materyalleri) bir yüzeye yapışarak kendi ürettikleri organik bir polisakkarid madde içine gömülü ve hareketsiz olarak yaşamaları sonucu oluşturdukları yapıya biyofilm adı verilir. Akut ve kronik hava yolu enfeksiyonlarının gelişmesinde önemli role sahip bu yapılara özellikle *Staphylococcus aureus, Pseudomonas aeruginosa, Streptococcus pneumoniae* ile candida türleri neden olurlar. Biyofilm ile ilişki havayolu enfeksiyonlarının tedavisi oldukça güçtür. AMB'un havayollarında biyofilm oluşumu üzerine yararlı etkilerinin olabileceği ifade edilmesine rağmen sınırlı sayıda çalışma vardır (Uludağ ve ark. 2008, Cataldi ve ark. 2014). Neonatal yoğun bakım ünitelerinde sıklıkla kullanılan venöz kateter uygulamasından sonra staphylococal kaynaklı enfeksiyonların oluştuğu gözlenmektedir. AMB'un biyofilmlerin yapısını yıkılmayarak bazı antibiyotiklerin bakteriyel etkisini artırdığı ifade edilmiştir. AMB in vitro ve in vivo olarak *S. epidermidis*

kaynaklı biyofilmleri bozarak vankomisinin bakteriyel etkisini önemli ölçüde artırdığı gösterilmiştir. AMB'un biyofilm üzerindeki etkilerini biyofilm yapısında bulunması gereken bazı maddeleri azaltarak ve/veya biyofilme vankomisinin penetrasyonu artırarak gösterebileceği ifade edilmiştir (Zhang ve ark. 2015). AMB'un in vitro şartlarda Candida albikans kaynaklı biyofilm oluşumunu etkili şekilde baskıladığı ve oral kandidiazis tedavisinde alternatif teşkil edebileceği ifade edilmiştir (Rene ve ark. 2014). Antimikotik etkili vorikonazolun AMB ile birlikte kullanıldığında candida biyofilmleri oluşumunu azalttığı ve medikal aletler kullanımı sonrası hastalarda oluşabilecek candida biyofilmlerine karşı kombine kullanımının etkili olabileceği ifade edilmiştir (Pulcrano ve ark. 2012). Endotracheal intubasyon uygulamalarından sonra *P. aureginosa* kaynaklı biyofilmle neden olabildiği ve AMB'un endotracheal tüplerinin üzerindeki biyofilm mikroorganizma sayısını düşürdüğü belirlenmiştir. Sonuç olarak AMB uygulamasının intübasyon tüpleri üzerindeki biyofilm yapılarını yıkılmayabileceğini ve bakteriyel yükü azaltabileceği ifade edilmiştir (Li ve ark. 2011).

Antiparkinson*:* Substantia nigradaki yaşa bağlı ilerleyici kayıp Parkinson hastalığının patolojik özelliğidir. AMB kullanımı parkinsonda yeni bir yaklaşım olarak görülmüştür. Kan-beyin bariyerini geçebileceğinden AMB'un nöronal metabolik stresi azaltabildiği görülmüştür (Duda ve ark. 2016). Parkinson hastalığında rol alan bazı mutasyonlar üzerine AMB'un etkinliği transgenik farelerde incelendiğinde tedavide faydalı etkiler elde edildiği, ancak konu ile ilgili daha fazla araştırma yapılmasının gerektiği vurgulanmıştır (Migdalska-Richards ve ark. 2016). Parkinsonda AMB'un endostoplazmik retikülüm stresini azaltabileceği, otofajik azalttığı ve nöronal ölümü sebep olan inflamasyonu yavaşlatıcı etki göstererek etki gösterebileceği, Parkinson tedavisinde AMB ilavesinin faydalı olabileceği, ancak klinik deneyler ile değerlendirilmesi gerektiği ifade edilmiştir (Ishay ve ark. 2016; Yang ve ark. 2017).

Antikanser*:* Deneysel gastrik kanser oluşturulan ratlarda tedavi amacıyla kullanılan ilaca ek olarak AMB uygulanması sonrasında gastrik kanser düzeyinin daha düşük olduğu ve AMB'un H. pylori kaynaklı gastrik kanserlerde kullanım alanı bulabileceği ifade edilmiştir (Narahara ve ark. 2001). Akciğer kanser operasyonları sonrasında postoperatif dönemde AMB uygulandığında antibiyotik tedavisinin süresini, atelektazi ve akciğer enfeksiyonları görülme sıklığını azalttığı rapor edilmiştir (Wang ve ark. 2015a). Akciğer kanserli hastalarda operasyon öncesinde AMB uygulanmasının postoperatif komplikasyonları ve hastanede kalış süresini önemli orada azalttığı ve operasyon öncesinde kullanımının faydalı olabileceği belirtilmiştir (Wang ve ark. 2015b). Akciğer kanserinde kemoterapik ajanlar ile birlikte AMB

kullanıldığında kemoterapotiğin doku perfüzyonunun arttığı belirlenmiştir. Özellikle kemoterapik ajanlar uygulanmadan 48 saat önce AMB uygulanmasında bu etkinin fazla olduğu ifadesine yer verilmiştir (Li ve ark. 2016).

Ağrı kesici: AMB'un rodentlerde ağrıyla ilişkili davranışları azalttığı ve insanlarda ağrıyı yatıştırdığı ifade edilmiştir. AMB'un duyusal sinirlerdeki Na^+ akımın bloke ettiği böylece kronik ve akut ağrıların tedavisinde ağrı kesiciler ile kombine edilmesinin faydalı olacağı ifade edilmiştir. Ancak AMB'un merkezi sinir sistemi üzerine direk etkisinin olmadığı bildirilmiştir (Weiser ve ark. 2008; Leffler ve ark. 2010).

Diğer etkiler: Solunum güçlüğü sendromlu prematüre bebeklerde mekanik ventilasyon yanında AMB uygulamasının tedavide altın standart olabileceği ifade edilmiştir (Zhou ve ark. 2017). Gebe doğum öncesi AMB uygulamasının yavrularda sekretör organellerin gelişimini önceden indüklediği ifade edilmiştir (Sepúlveda ve ark. 1982).

SONUÇ ve ÖNERİLER

Adhotoda vasica bitkisinden ekstrat edilen vasicanın sentetik türevi olan ambroksol antioksidan, hepatik istemi düzeltici, antiinflamatuar, antiviral, antibakteriyel, biyofilm önleyici, antiparkinson, antikanser, ağrı kesici ve gebelikte fetüs sekretörik organellerinde gelişme gibi ekstra etkilere sahip olabilir. Bu etkileri sayesinde birçok hastalıkta radikal tedaviye ek olarak kullanım alanı bulabilir.

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A REVIEW: MAIZE (*Zea Mays* L.) SILAGE

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ABSTRACT
Whole-plant maize silage is the main fodder utilised by the dairy industry in many developed countries. Dry matter (DM) yields of maize silage are frequently higher than the majority of substitute cool-season forages; in many regions, yields of 13 to 20 t DM/ha are achievable. Producers can choose whether to harvest maize for forage or grain, which is another key benefitof using maize as a forage crop. Snaplage is a maize crop product that has been ensiled and is made up of maize grain, cob, husks, shank, and some broken leaves. Maize stalk leftovers froma grain harvest can also be used as forage as well. This substance, also known as stalklage, canbe added to the diets of beef cows, dry cows, and heifers.

Keywords: Maize, *Zea mays*, silage, snaplage, stalklage, drought

1. Introduction

For growing and finishing beef cattle (Bos taurus), for growing dairy heifers, as supplemental energy for cow and calf production, and for lactating dairy cows, maize (*Zea mays* L.) is a high energy, low protein forage that is frequently combined with a complementary high-protein forage like alfalfa (Medicago sativa L.). Dry matter (DM) yields of maize silage are frequently higher than the majority of substitute cool-season forages; in many regions, yields of 13 to 20 t DM/ha are achievable. High yields allow for the development of alternative crops or the feeding of more animals because they lower the amount of land needed for fodder production (Allen et al., 2003). Due to its high levels of production of a highly digestible, high-energy crop and its simplicity in adjusting to mechanised harvesting and feeding, maize silage is a popular high-quality feed crop. Silage maize is a common crop that is planted all over the world. The crop has a high energy content and good ensiling properties, as well as a very steady yield under a wide range of environmental and agronomic conditions. In the past, in many nations, the main source of food for dairy cows during the winter months was grass silage. However, grass silage DM yield, its nutritive value and ensiling quality are highly variable (Khan et al., 2015).

Also, the crop's forage quality doesn't deteriorate as fast with maturity as some other forage crops, harvesting can frequently be prolonged for up to two weeks. Silage gives farmers a longer window of time to harvest maize crop and spreads out the labour requirements in the fall because silage harvest occurs a few weeks sooner than grain harvest in many regions. Producers can choose whether to harvest maize for forage or grain, which is another key benefit of using maize as a forage crop. In years with a productive crop, maize can be harvested for grain; conversely, in years with low maize yield expectation, the majority of the crop may be cut for silage (Allen et al., 2003).

The nutritional content of maize silages varies greatly. The nutritional content of maize silages can vary due to a number of reasons, but the vast majority of these variances in nutrient composition and total tract digestibility are caused by high variations in the maturity of the maize at harvest. Early-stage ensiled maize (DM 250 g/kg) has a relatively low starch/NDF ratio, which lowers the DMI as well as the yields of milk and milk protein. When maize is ensiled, the DMI and milk and protein yields reach their peak at DM levels between 300 and 350 g/kg, and begin to gradually drop at maturity above 350 g/kg. The changes in starch/NDF ratio are positively correlated with changes in milk and milk protein yields as a function of maize silage maturity. In diets based on grass silage, adding maize silage increases the forage DMI by 2 kg daily on average, the milk yield by 1.9 kg daily, and the milk protein content by

1.2 g kg daily. The milk FA profile of dairy cows is altered by the maturity of maize silage and an increase in the amount of maize silage in grass-based diets; specifically, the concentration of cis-unsaturated FA, C18:3n-3, and n-3/n-6 FA ratio reduced in the milk fat (Khan et al., 2015).

Maize silage's impact on the soil is a potential drawback. If no cover crops are grown after harvest, the little residue that maize silage leaves on the land result with increases in soil erosion. Lower levels of soil organic matter can also occur from continuous cropping with maize silage. When soils are moist and being harvested, heavy harvesters, waggons, and vehicles may induce soil compaction. To prevent these issues, crop rotation, cover crops, and careful management are required. On shallow or sloping soils, the potential for maize silage may be limited because of erosion concerns or because of a low maize yield potential. In addition, maize silage is a bulky crop and markets are limited (Allen et al., 2003).

2. Growing maize silage

2.1. Hybrids

Whole-plant maize silage is the main fodder utilised by the dairy industry in many developed countries. Traditionally, hybrids with high grain production features have been cultivated to produce whole-plant maize silage. Farmers can decide to harvest maize grain or whole-plant maize silage using conventional or dual-purpose hybrids, depending on the requirements of their feed stocks. To improve the nutritional value of whole-plant maize silage, farmers have started to plant and harvest more hybrids made suitable for silage in an effort to fulfil the demands of dairy cows with high milk production. The nutritional content of whole-plant maize silage may be improved by altering its stalk or kernel qualities (Ferraretto & Shaver, 2015).

High grain yielding maize hybrids are frequently also excellent silage producers. For silage, a variety that reaches maturity slightly later than one for grain is frequently ideal. Both hybrids will dent at roughly the same time, but the types that mature later do so while losing moisture more gradually. This gives the silo filling process an additional time. Although hybrid cultivars with no ears are typically offered for their high sugar content (earless), they are richer in fibre and lower in energy than types with large grain yields. Many special silage varieties are simply tall growing, long season hybrids and may not yield as much nutrients as a top grain yielding hybrids (Wheaton et al., 1993).

2.2. Agronomy

Silage maize is a perfect choice for no-till and double-cropping strategies. It makes sense that high grain yields and good silage yields are connected since maize silage is generally used

as an energy feed. One of the easiest methods for increasing grain content is to plant maize for silage early in the season. Higher grain yields and slightly shorter stalk heights are the results. Between maize planted in late April to late may, the total dry matter produced will vary little, but the grain content may (Wheaton et al., 1993).

Maize that will be used for silage is frequently planted later than maize intended for grain harvest. Conversely, in regions with shorter growing seasons, delaying planting can raise the risk of frost before maturity (Allen et al., 2003). The ideal plant density for the production of commercial silage is 7.5 to 20% greater than for grain. In some circumstances, increasing plant density might lead to higher fibre concentrations, lower crude protein concentrations, or lower feed quality in the silage (Allen et al., 2003). In narrow rows, silage yields rise at a rate that is similar to the rise in grain yield. The increase can be up to 10 percent. When considering whether to switch to narrow row silage, the costs associated with purchasing new silage harvesting equipment should be the primary factor (Wheaton et al., 1993). For the production of silage, 150 to 200 kg N ha-1 of nitrogen fertiliser is needed. Crude protein concentrations rise with higher N rates, while ADF and NDF concentrations fall. In dry cows, high K concentrations might cause nutritional problems (Allen et al., 2003).

2.3. Harvesting maize for silage

Crop production, nutrient composition, digestibility, and ensiling potential are all impacted by maturity at harvest. Most changes in kernel growth as the maize crop matures are related to how far along it is, which changes how much DM each fraction of the kernel contributes (Buxton and O'Kiely, 2003). Sugars in maize kernels are changed into starch as the plant ages, increasing the kernels' DM content. DM digestibility and yield rise as maize silage ages, whereas whole-plant NDF and crude protein concentrations fall until the early dent (ED) stage of kernel development. The quality of the stover is usually lost in favour of grain development. For commercial silage harvested at DM concentrations larger than 300 to 350 g/kg, whole-plant digestibility decreases with maturity. Maize that is being harvested for silage must be harvested at the proper DM concentrations for the silo in order to promote optimal fermentation and reduce DM losses during storage. Wetter silages undergo more extensive fermentation, which lowers the pH and may also lower the DMI. Wetter silages also carry a higher risk of clostridial fermentation and the generation of amines, which can weaken DMI (Allen et al., 2003).

When silage is chopped, seepage from the silo may occur if the moisture content is too high. The requirement for more lactic acid to lower the pH while cutting silage with too much moisture is another issue. On the other hand, if the plant is too dry, it will not pack tightly in

the silo, there will be more oxygen present, and it will take longer to transition from the aerobic phase of fermentation into the anaerobic phase. Moreover, this leads to silage of lower quality. Maize that has been chopped for silage should have a moisture content of between 60 and 70 percent. Generally, when the milk line is 1/2 to 2/3 down the kernel, the moisture will be in the 60 to 70 percent range (Bates, 2015).

3. Snaplage silage

Snaplage is a maize crop product that has been ensiled and is made up of maize grain, cob, husks, shank, and some broken leaves. Self-propelled foragers with snapper heads are used to harvest and prepare it (Lardy & Anderson, 2010; Akins & Shaver, 2014). The logistics advantages, the stalk remaining in the field for no-till systems (direct drilling), and the cob and husks in the snaplage's ability to stimulate chewing activity are the key factors contributing to its acceptance (Lardy & Anderson, 2010). It differs from earlage (grain and cob) in terms of morphological composition mostly due to the presence of husk, though according to some studies, earlage also contains husks. Snaplage allows the entire ear to be harvested and processed in an one operation, which has significant logistical advantages over traditional earlage (grain and cob), which necessitates at least two distinct procedures (harvesting and grinding). Snaplage has substantial levels of both NDF (200-250 g/kg) and starch (500-600 g/kg) due to the cob and husk (200-300 g/kg, DM base) that are present. Depending on the maize hybrid and location, cobs and husks are generally moister at harvest than grain, hence snaplage typically has a moisture level that is 50–80 g/kg higher than grain (Daniel et al., 2019). Aerobic stability is a concern in snaplage, as in other grain silages. Higher counts of yeasts and moulds can be observed during the aerobic exposure of snaplage compared with high-moisture maize grain silage (Santos et al., 2018).

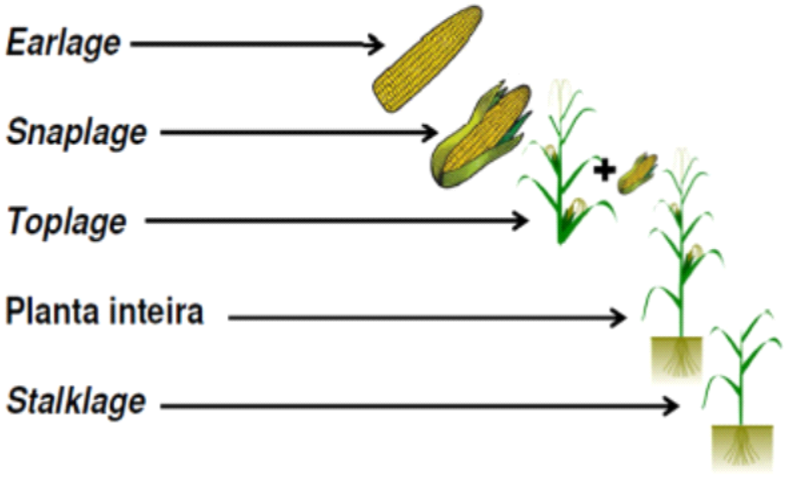

Fig. 1. Earlage, snaplage, toplage, planta interia, stalklage (Anonymus, 2020).

To improve the amount of energy available from the maize harvest, whole-ear maize silage (snaplage) production has increased popularity in recent years in every country that grows maize (Daniel et al., 2019). Despite the fact that dairy and beef cattle have long been fed fermented ear maize, harvesting methods have significantly changed in the last ten years. A self-propelled forage chopper fitted with a snapper head is now used to make snaplage (Ferraretto et al., 2018). Snaplage offers significant logistical benefits, particularly for beef feedlots, by enabling the harvesting and processing of the entire ear (cob, kernels, husk, and shank) in a single operation (Daniel et al., 2019). As kernels reach the "black layer stage," which denotes physiological maturity, ear maize is often harvested (Akins and Shaver, 2014). At that time, snaplage has DM ranging from 650 to 700 g/kg (Akins and Shaver, 2014). Maize hybrids differ in their proportions of vitreous and floury endosperm. Furthermore, the proportions of ear components (cob, kernels, and husk) vary among hybrids, and this variation may affect the nutritive value of snaplage (Gusmao et al., 2021). Snaplage growers seek maximum return on investment, determined by DM yield and nutritive value (Owens et al., 2018).



Fig. 2. Snaplage (Anonymus, 2020).

4. Stalklage

Maize stalk leftovers from a grain harvest can be used as forage as well. This substance, also known as stalklage, can be added to the diets of beef cows, dry cows, and heifers. When the residue is gathered shortly following a high moisture grain or ear harvest, the finest grade stalklage is formed. The moisture and feed quality of the stalklage are maintained by this

treatment. As harvesting is postponed, the stalklage's DM concentration will rise and the quality of the forage will decrease. If the stalklage becomes dry, then water can be added or the crop can be chopped at a 0.64-cm theoretical length of cut (TLC) to pack tightly. After harvesting the grain, hybrids differ in terms of the feeding quality and moisture content of the stover (Allen et al., 2003).

5. Damaged maize for silage

Silage can be made from maize that has been injured by drought, extreme heat, blight, frost, or hail. Quality will not be as high as where maize has reached the dent stage. Feeding value will be determined by the level of development and the response to the injury. Silage made from young maize typically has more moisture, does not ferment as well, commonly smells sour, and when served in large numbers, is more laxative. Frosted maize should be chopped as soon as possible because it contains less carotene. It will quickly dry out and start to lose leaves. Maize that has frozen and grown too dry to pack properly may require the addition of water. Drought maize also may need added water. Keep the chopper knives sharp and chop the maize forage as finely as you can once it has dried. It is not recommended to quickly ensile maize that has been injured by extremely high temperatures. Delaying harvest may result in some further stalk growth and, as a result, some additional feed, even if these plants may never yield an ear. If the plants are collected for silage shortly after they have suffered significant heat damage, the stalks will be so moist that the silage will be of very poor quality. Nutrients also will decline significantly through seepage. Frequently, silages are produced from maize that has been harmed by leaf diseases like the southern maize leaf blight. It is not considered that the blight organism is hazardous to ruminants. It has also been demonstrated that it does not survive the ensiling procedure. In extreme circumstances, a secondary mould infection on the plant's injured portions may result in the production of a toxic substance. The main issues with this kind of silage are its lack of energy from decreased grain development and poor fermentation from the very dry plant damage. Fermentation issues brought on by a lack of plant moisture may manifest in extreme situations when huge portions of the maize plant are dead (Wheaton et al., 1993).

6. Immature and frosted maize silage

Immaturely harvested maize forage will have higher sugar, crude protein, and NDF concentrations than more mature maize silage, but lower DM yield, starch, and energy concentrations. If the moisture concentration is high, harvesting young maize forage may lead to considerable effluent loss and extensive fermentation, both of which may lower DMI. The first frost is when immature maize is at its peak dry matter yield and digestibility, and as the

frosted maize forage stays in the field, significant decreases in DM yield might occur. When diets containing maize silage were given to lactating dairy cows, their apparent DM digestibility decreased after the first frost and further between the second and sixth frosts. After a killing frost, the maize may appear to be more drier, but the DM content rises gradually over time rather than abruptly as a result of the frost. Immature maize silage that has been destroyed by a frost should be harvested as soon as the proper moisture content for the silo is attained to ensure good fermentation quality and reduce effluent since tissue death from frost may increase growth of moulds and formation of toxins (Allen et al., 2003).

7. Making maize silage

The length of the cut in maize silage is favourably correlated with the passage of whole kernels into the manure and negatively correlated with the packing density of DM in silos as well as the quantity of large cob pieces in the silage. The ideal cut length for maize silage varies on the roughage requirements of the animals being fed. For animals with relatively modest roughage requirements, such growing or finishing beef cattle, finely cut maize silage (0.64 cm TLC) (total lenght of cut) may improve DMI and digestibility (Allen et al., 2003). To prevent the passage of hard, dry kernels, the length of cut of maize silage should not exceed 0.95 cm or less. Longer lengths of cut produce silage with larger cob pieces, which are frequently rejected by animals and reduce packing density unless the maize silage is rolled. Rolling reduces particle size, therefore processed maize silage should be chopped for longer, at a TLC of 1.5 to 1.9 cm (Bal et aI., 2000).

Fill the silo as rapidly as you can and pack tightly to reduce the quantity of air pockets in the silage to preserve as much of the maize silage as you can. The fermentation process will start more quickly, there will be less losses, and the silage will be of higher quality if the silo is filled and covered more quickly. Bigger silos require more time to fill and can carry more silage. Level the silage and make a trench in it around the silo wall in upright silos. With the cover's edges in the trench and up the walls of the silo, cover the silage. In Trench or bunker silos, pack to form a crown above the sides of the silo. To guide water drainage to the exterior of the silo and away from the silage, place the cover over the silage and stretch it over the walls of the silo. To hold plastic and sawdust in place, old tyres can be spread on the cover (Bates, 2015). To properly remove the maize silage from the silo front and prevent rotting, the silo must be the proper size. Horizontal silos for small farms might require use of bags because a minimum width is required for bunker silos to pack adequately (Allen et al., 2003).

To achieve airtight conditions, may need to add water to silage if it is too dry. As a general rule, for every 1% increase in moisture content that is required, add four gallons of

water per tonne of silage. As the silo is being filled, add this water. If water is added to a silo after it has already been filled, it usually seeps down the walls rather than permeating the silage pile. This could result in poor fermentation, seepage that could compromise the air seal, and leaching of silage nutrients (Wheaton et al., 1993).

A correctly made maize silage should be green or yellowish and smell softly nice and somewhat vinegary. If it is dark brown or smells rancid, burnt, or fruity, inappropriate fermentation or excessive heating may have taken place. The pH will continue to decline until enough lactic acid is produced to reach about 4.2, at which point all bacterial activity ends. This often happens three weeks after a silo has been filled. If only little amounts of lactic acid have generated, butyric acid, a pungent acid, is formed, and the silage degrades (Bates, 2015).

In general, maize that has been chopped for silage will ensile quite effectively. Silage fermentation may be delayed if storage or cutting are not perfect, resulting in a reduction in the quality of the forage. In these circumstances, silage additives have been advised to enhance the silage's fermentation. As maize silage is being prepared for storage in a silo, the following three types of substances can often be added: 1) Bacterial inoculants 2) Acids 3) Non-protein sources of nitrogen (Bates, 2015).

The bacteria that produce lactic acid are present in considerable quantities in bacterial inoculants. The concentration of "good" bacteria is enhanced when they are added to maize silage, which causes the levels of lactic acid to rise more quickly and the pH to decrease more quickly. Due to the high concentration of naturally occurring bacteria on maize plants and the high concentration of soluble carbohydrates in maize silage, these inoculants typically do not aid in the fermentation of maize silage. In order to improve unfavourable fermentation conditions, bacterial inoculants might be added (Bates, 2015).

The preserving acids help avoid the growth of bacteria and moulds that lead to incorrect fermentation. The lactic acid-producing bacteria should have more time to begin producing lactic acid as a result. Similar to the bacterial inoculants, these acids are typically not advantageous for maize silage. Nonetheless, in the case of bunker or trench silos, acids may be advantageous on the upper surface of the silo. The higher layers of the silage contain an excessive amount of oxygen since packing is not as good in these silos. This area of the silo can be sealed after adding an acid to reduce the amount of deterioration. Buffered acids can be used to preserve silage with little risk of equipment corrosion (Bates, 2015).

Maize silage is not considered to be high in protein. The crude protein content of the silage can be increased by adding a non-protein nitrogen (NPN) source, such as urea, as the silage is being placed in the silo. Using urea as a feed source takes energy. Maize silage is a

perfect feed to use in conjunction with NPN due to its high energy content. The most effective way to use NPN is to add 10 pounds of urea per tonne of silage (Bates, 2015).

The maize plant may accumulate excessive amount of nitrogen molecules in certain types of soil and environmental conditions. Although the condition is hard to define, nitrate toxicity and drought conditions are frequently linked. The level of drought and nitrogen availability typically make the situation more complicated. Allowing the maize plant to grow beyond the point of drought damage is one strategy that could help reduce the quantity of nitrate in the silage. The plant could be able to employ a large portion of its excess nitrogen reserves for additional regrowth if it can recover from a drought and produce some new growth. The bottom part of the stalk typically has the largest levels of excess nitrogen. Raising the chopper cutter blade so that the lower 18 or 20 inches of the stalk remain in the field also may reduce the concentration in the silage (Wheaton et al., 1993).

Kaynakça

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CHANGES IN STOMATAL CONDUCTIVITY IN SILAGE MAIZE UNDER DIFFERENT IRRIGATION REGIMES IN ORGANIC FERTILIZED SOIL

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ABSTRACT

Soil moisture management affects microbial activity that causes carbon mineralization. In frequent irrigation events that cause low stress on the soil, an increase in mineralization and hence nitrogen release is expected in a soil containing farm (cattle) manure. Silage maize actively uses nitrogen and water for high yield. Therefore, nitrogen earning with a good soil water management can increase crop growth and productivity. Because stomata control both water loss and CO_2 uptake, they can be an important indicator of the manageability of stress with the contribution of nitrogen recovery from the soil. In this study, the seasonal variation of stomatal conductivity values in silage maize applied three different irrigation regimes (the irrigations when the sum of the difference "Evapotranspiration - effective precipitation" reaches 20, 40 and 60% of the available water in the soil) in an organic fertilized soil was compared with that in mineral fertilized soil. As a result, the stomatal conductivity decreased with the increase in the irrigation regime, the values were determined higher in the organic fertilization than the mineral fertilization, and resulting in more silage yield.

Keywords: Cattle manure, Irrigation regime, Stomatal Permeability, Silage maize

INTRODUCTION

It is a common practice to mix organic materials into the soil for purposes such as reducing fertilizer input costs, eliminating the negative effects of mineral fertilizers on the soil structure, improving the structural and nutritive properties of the soil and waste disposal to protect environment (Bogunovic et al., 2020; Badaou and Sahin, 2022; Guo et al., 2022). For this purpose, farm (cattle) manure due to high organic matter content and it is easily accessible is widely used in agricultural production areas. Barn manure contains many plant nutrients (P, K, Ca, Mg, Cu and Zn, especially N), and also improves the physical, chemical and biological properties of the soil contribute to the sustainable use of agricultural areas together with the environmental protection (Nazlı et al., 2014; Arslan, 2016). Organic fertilization also activates soil microorganisms and forms plant nutrients easily available (Fandika et al., 2007). Irrigation and fertilization are important inputs that increase productivity in agriculture. Silage maize one of the most important fodder crops in the world and in Turkey, provides high yields as long as available water and nitrogen in soil. In many studies, it has been reported that increasing nitrogen doses increase plant yield and quality in maize (Çiçek, 2019; Souza et al., 2020; Uzun et al., 2020). The stomatal conductance is affected the water content of the soil (Taiz and Zeiger, 2008). One of the most important responses of plants under water stress conditions is to reduce water loss by transpiration by closing their stomates. However, this event effects also CO2 assimilation while reduces water consumption (Uçkay and Akkuzu, 2022). As a result of the closure of the stomata, the heat accumulation in the leaves and the restriction of CO_2 diffusion cause the inhibition of photosynthesis (Karimi et al., 2018). It has been revealed by some researchers that there is a positive relationship between leaf N and stomatal conductivity, and that N uptake increases stomatal conductivity (Küçük Kaya, 2021). Increased N contents in soil with the organic matter mineralization from farm manure with the controlling of irrigation regimes can be improve maize crop N uptake. Therefore, the aim of this study is to examine the seasonal variation of stomatal permeability by managing of the irrigation regime in a silage maize field irrigated with organic (cattle manure) fertilized compared to mineral fertilization and to reveal its relationship with silage yield.

MATERIAL AND METHOD

The study was carried out in Erzurum region with a semi-arid climate in 2021 year. DKC6777 variety of silage maize with high green grass yield was grown with 5 plant rows, 70 cm spacing in each plot. The experiment was carried out in a total of 18 plots with 3 replications considering two fertilization applications (cattle manure and mineral fertilizer) and three different irrigation regime levels. Incubated cattle manure was spread homogenously by hand on the surface of the

plots, and mixed into the upper 15 cm soil layer (Ergene, 1993; Özyazıcı et al., 2016; Gürbüz et al., 2019; Negiş et al., 2020). The manure dose was adjusted to increase the organic matter content of the soil to a good/high level (≈4%). The mineral fertilization was applied at suggested doses for silage maize in the experimental region considering the total nitrogen and available phosphorus contents in the 0-20 cm surface soil layer before planting (Çelebi et al., 2010; Güney et al., 2010; Tan, 2021). Half of the required nitrogen was applied at planting and the other half was applied when the plants reached 4-6 leaves (Kuşvuran et al., 2015). Irrigations for the low (S1), medium (S2) and high (S3) irrigation regimes as different irrigation treatments in the experiment were made when the sum of the "real time evapotranspiration - effective precipitation" difference reached to 20, 40 and 60% of available water content in the effective rooting depth, respectively. Evapotranspiration (ETc) values were estimated by mulltiplying reference evapotranspiration (ETo) and crop coefficients (kc).

ETc = ETo x kc

ETo values were calculated with the FAO56_Penman-Monteith equation using the CROPWAT (Ver. 8.0) program with real time daily climate data obtained from Erzurum Airport Meteorology Station. The “kc” values according to the plant development periods were obtained from the plant water consumption guideline of the irrigated plants in Turkey (TAGEM, 2017). The precipitation values were measured with the pluviometer located in the experimental field. In the initial period (before the period of 4-6 leaves), considering the 0.30 wetting rate, all plots were drip irrigated equally with the water sufficient to bring the reduced moisture in 30 cm to the field capacity. In the period of irrigation regime application (after the period of 4-6 leaves), irrigations were carried out with the amount of irrigation sufficient to bring the reduced moisture in 90 cm to the field capacity with a wetting rate of 0.65 in each irrigation regime (Çakmakcı, 2018). The soil moisture was determined by gravimetric method at three layers (0-30, 30-60 and 60-90 cm). A dripline was placed in each plant row in surface drip method used.bThe stomatal conductivity was measured by using a portable porometer (Decagon Devices, Inc. SC-1 Leaf Porometer) between 10:00 and 14:00 on the middle leaves of three plants in each plot during the growing period (Fischer et al., 1998, Pietragalla and Pask, 2012). The values were analyzed using SPSS software, and comparison test was applied for significant means.

RESULTS AND DISCUSSION

The highest stomatal conductivity values were determined in manure and S1 treatments (Figure 1). It was determined that stomatal conductivity decreased significantly ($p<0,01$) due to the increased dry period from S1 to S3 (Figure 1).

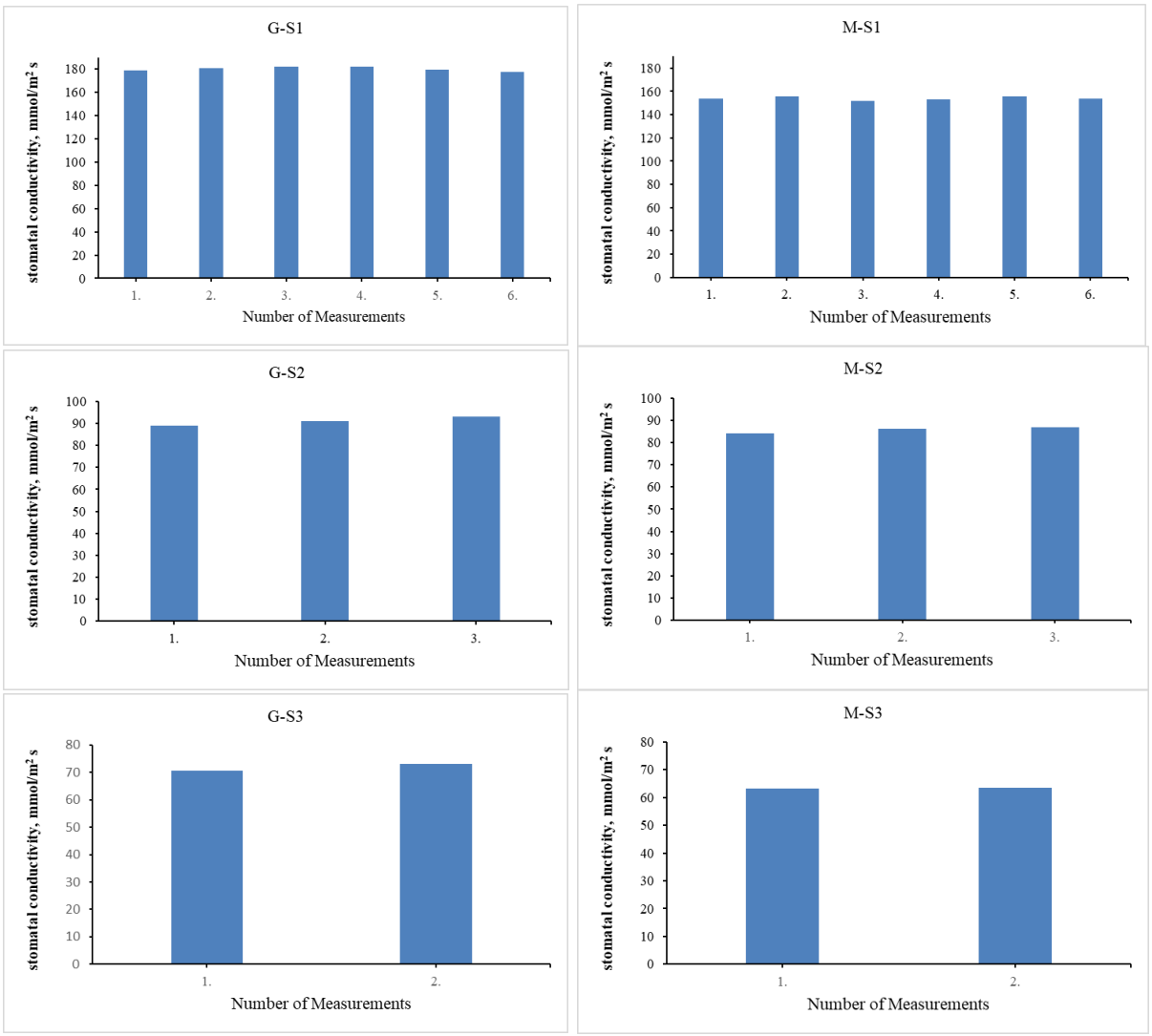

Figure 1. Temporal variations of stomatal conductivity values with fertilization and irrigation regimes.

Considering the mean values all measurements, a significant difference ($p<0.05$) was determined between organic and mineral fertilization in stomatal conductivity values. A higher (13.1%) stomatal conductivity value was obtained in cattle manure treatment than in mineral fertilizing (Figure 2). In the emergence of this result, it may be important that the nutrients increased by the organic matter in the soil affect the stomatal conductivity positively by promoting plant health and vitality.

In particular, the photosynthetic contribution of the recovered nitrogen can be mentioned (Küçük Kaya, 2021). The relationship stomatal conductance with soil nitrogen has been widely explored, and determined that stomatal conductance generally increases with nitrogen additions to soil (Zhu et al., 2020).

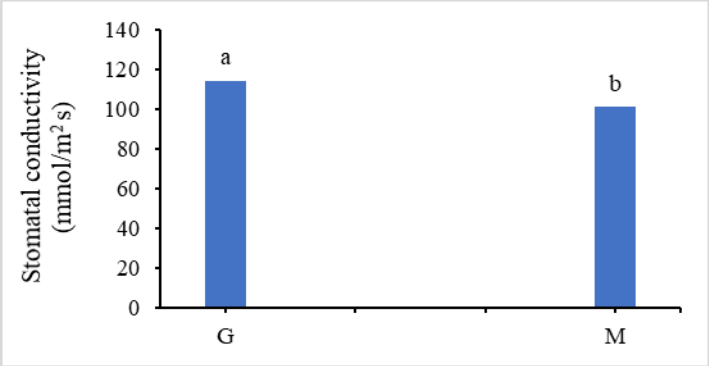

Figure 2. Stomatal conductivity values in organic (G) and mineral (M) fertilization

Among irrigation regimes, the highest stomatal conductivity was determined for S1, increasing stress decreased stomatal conductivity (Figure 3). When plants experience water stress, their stomata tend to close partially or completely as a defense mechanism to reduce evaporation. Drought signals promote stomatal closure to reduce water loss (Liu and Qin, 2021). Therefore, more stoma opening allow greater conductivity and consequently show potentially higher rates of transpiration (Pietragalla and Pask, 2012).

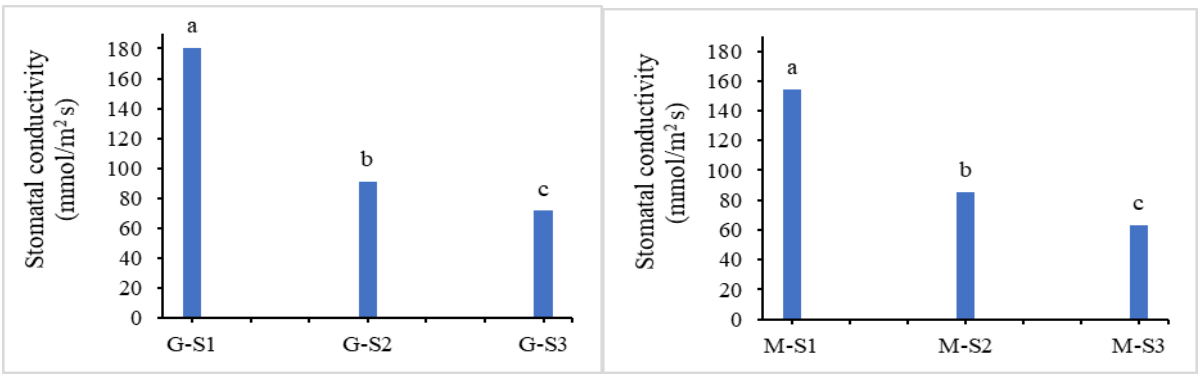

Figure 3. Stomatal conductivity values in irrigation regimes

Although stomatal conductivity increased under cattle manure treatment, a decrease of 47.1% and 59.7% was determined in S2 and S3 irrigation regimes compared with S1, respectively (Figure 3). It shoh that organic treatment did not provide adequate protection against stress in silage maize under increased stress conditions. Therefore, silage yield linearly decreased with decrease of stomatal conductivity (Figure 4).

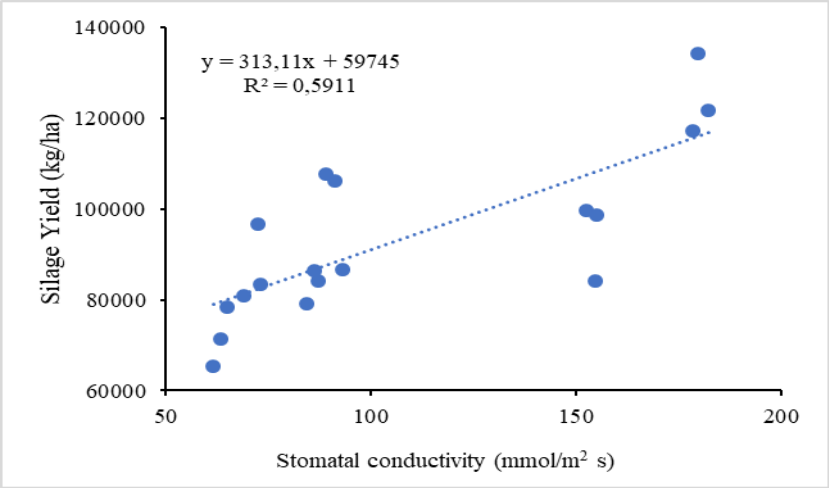

Figure 4. The relationship between stomatal conductivity and silage yield

CONCLUSION

Since organic fertilization with cattle manure has a high N ratio, it has been observed that the mean of stomatal conductivity increases more than mineral fertilization, and the stomatal conductivity values decrease with the increase of water stress process with irrigation regimes. It was determined that the increase in stomatal permeability values in cattle manure application had a positive effect on silage corn yield, and this was the highest under full irrigation conditions.

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Statement of Conflict of Interest

The authors declare that they are no conflict of interest.

Authors' Contributions

Authors designed, analyzed and arranged the research, worked together on the preparation of figures. The authors contributed to the writing of the article and took part in the process of publication of the article and read and approved it.

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FARKLI DOZLARDA KULLANILAN BAZI HERBİSİTLERİN ADİ FİG ÇEŞİTLERİNDE FİTOTOKSİTE ETKİSİNİN BELİRLENMESİ

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ÖZET
Adi fiğ (*Vicia sativa* L.), ülkemizde ve dünyada yaygın olarak yetiştirilen bir baklagil yem bitkisidir. Hayvan beslenmesinde önemli bir yem bitkisi olan adi fiğ bitkisinin gelişimini yabancı otlar erken dönemde bile engelleyebilmektedir. Bu nedenle, çalışmanın amacı, iki farklı herbisitin ekonomik zarar eşiği, kritik dönem ve ilaçlama zamanlaması dikkate alınarak mücedeleye karar vermektir. Çalışma, 2022-2023 yıllarında Bilecik Şeyh Edebali Üniversitesi Ziraat ve Doğa Bilimleri Fakültesi Tarımsal Araştırma Merkezinde petri ve saksı denemesi şeklinde yürütülmüştür. Çalışmada Fig (*Vicia spp*) çeşitlerinden Ürkmez, Jaoe, Taşkent ve Alper çeşitleri üzerine farklı dozlarda herbisit ilacı uygulanmıştır. Denemelerde Aclonifen ve İmdacloprid iki farklı ilaç her ilaç dozunda toplamda 4 uygulama 1 kontrol olmak üzere 5 uygulama yapılmıştır. İlaç dozları X, 2X, 3X, 4X olarak 7, 14 ve 21 gün süreyle uygulanmıştır. Yapılan çalışmada, Aclonifen ilacının 2X dozunun 21.gün uygulanması sonucunda en uzun boy 26 cm olarak tespit edilmiş, bitki kalınlıklarının ise yapılan tüm uyguları belirgin bir değişiklik gözlenmemiştir.
Anahtar Kelimeler: Fitotoksite, Herbisit, Verim

DETERMINATION OF PHOTOXICITY EFFECT OF SOME HERBICIDES USED IN DIFFERENT DOSES ON VARIETY OF COMMON VETCH

ABSTRACT

Common vetch (*Vicia sativa* L.) is a legume fodder plant widely grown in our country and in the world. Weeds can prevent the development of common vetch, which is an important forage plant in animal nutrition, even in the early period. Therefore, the aim of the study is to decide on the struggle by considering the economic damage threshold, critical period and spraying timing of two different herbicides. The study was carried out as a petri dish and pot experiment at Bilecik Şeyh Edebali University Faculty of Agriculture and Natural Sciences Agricultural Research Center in 2022-2023. In the study, different doses of herbicide were applied to Fig (*Vicia spp*) cultivars Ürkmez, Jaoe, Taşkent and Alper. In the trials, Aclonifen and Imdacloprid were two different drugs, and 5 applications were made, 4 applications and 1 control, in each drug dose. Drug doses were administered as X, 2X, 3X, 4X for 7, 14 and 21 days. In the study, as a result of the application of 2X dose of Aclonifen on the 21st day, the longest length was determined as 26 cm, and there was no significant change in plant thicknesses in all applications.

Keywords: Phytotoxicity, Herbicide, Yield

1.GİRİŞ (AMAÇ)

Dünya üzerinde 150'den fazla türü bulunan fiğ cinsinin en çok tarımı yapılan türü adi fiğ (*Vicia sativa* L.) dir (Kurt, 2021; Yazıcılar ve Bezirganoğlu, 2021). Ülkemizde yetiştirilen önemli yem bitkilerinden biri olan adi fiğ (*Vicia sativa* L.) eski çağlardan beri tarımı yapılan tek yıllık serin iklim baklagil bitkisidir (Kitiş vd., 2016; Kurt, 2021; Yazıcılar ve Bezirganoğlu, 2021). Fiğ, yaş ot verimi yüksek olmasının yanı sıra ve elde edilen otunun besin değeri de yüksektir (Kurt, 2021). Adi fiğin ham proteini %25-30, ham yağı %1-2, ham külü %4-6, ham selülozu %5-6, N'siz öz maddeleri %53-55 ve metabolik enerjisi 28003000 kcal/kg arasında değişmektedir. N'siz öz maddelerin %36'sını nişasta, %4-5'ini sakkaroz ve galaktoz oluşturmaktadır (Sezmiş ve Macit, 2018). Ülkemizde yetiştirilen fiğ bitkisi yaş veya kuru ot elde etmek, tane yem elde etmek, yeşil gübre bitkisi olarak, mera bitkisi olarak ve silajlık bitki olarak kullanılmaktadır (Kurt, 2021). Fiğ (*Vicia sativa* L), kışı sert geçen soğuk bölgelerde ilkbaharda, kışı ılık ve yumuşak geçen yörelerde sonbaharda ekilmektedir (Özpınar vd., 1999). Adi fiğin toprak yüzeyinde sık bir örtü oluşturarak yoğun bir gölgeleme yaptığı, ortamdaki kaynaklardan hızlı bir şekilde faydalandığı ve sahip olduğu fırsatçı karakteri sayesinde birçok yabancı ot türü ile rekabette üstün özelliklere sahip olduğu, yapılan çalışmalarla ortaya konmuştur.(Kitiş, 2016; Hançerli ve Uygur, 2021). Sahip olduğu bu özelliklerden dolayı adi fiğ, tüm dünyada yabancı otlara karşı canlı malç olarak en çok tercih edilen bitkilerden biridir (Kitiş, 2016). Bu çalışmada, farklı dozlarda ve sürelerde uygulanan Acloniden ve İmdacloprid herbisit ilaçlarının Adi fiğ yem bitkisinin morfolojik özellikleri üzerine etkisi incelenecektir.

2.YÖNTEM

2.1.Materyal

Denemede, Ürkmez, Jaoe, Taşkent, Alper çeşitlerinin kullanılmıştır. Uygulamada, piyasada en çok kullanılan herbisit ilaçlarından olan Aclonifen ve imdacloprid ilaçları kullanılmıştır.

2.2. Yöntem

Denemelerde herbisitler, çıkış sonrası uygulaması şeklinde uygulanmıştır. Bu amaçla fiğ tohumları petri kutularının içine konulan ıslatılmış tohum çimlendirme kağıtlarının arasına yerleştirilerek oda sıcaklığında 1-2 gün boyunca ön çimlenmeye alınmıştır. Çimlenen tohumlar perlit içeren 0,76 hacimli saksılara ekilmiş ve iklim odası koşullarında yetiştirilmiştir. Saksılar 16 saat ışık (24±1°C ve 100 µE m^{-2} s^{-1} ışık şiddeti), 8 saat karanlık (15±1°C) koşullardaki iklim odasına yerleştirilmiştir. Saksılar deneme süresince gerektikçe deiyonize su ile sulanmıştır (Alanso-Prados vd., 2002; Serim ve Maden, 2011). Çıkış yapan fideler 2-4 gerçek yapraklı döneme geldiklerinde herbisit denemesi için iklim odasından alınmıştır. Herbisit uygulaması hassas bina içi ilaçlama makinası (Spray chamber)'nda yapılmıştır.

Uygulanacak aktif madde deiyonize suda çözüldükten sonra uygulanmıştır. Herbisit; öldürücü doz (X)'unun X, 2X, 3X, 4X oranlarında uygulanmıştır. Herbisit uygulamalarında norm 20 l/da olarak alınacak olup herbisit uygulamalarında Teejet EVS11002 pülverizatör memeleri kullanılmıştır.

2.2.1. Deneme Yöntemi

Denemede viyollere; 8 bitki kontrol, 8 bitki 1X, 8 bitki 2X, 8 bitki 3X, 8 bitki 4X olmak üzere ekim yapılmıştır. Her çeşitte 2 viyol (80) bitki yetiştirilmiştir. Bitkilerin ekiminden sonra periyodik olmak üzere düzenli 3 günde 1 sulama işlemi yapılmıştır. Kontrol hariç diğer uygulamalarda ilaç dozları ayarlanmış ve sırt pülivazötür yardımıyla aynı zaman aralığı, aynı mesafe aralığında ilaçlama yapılmıştır.

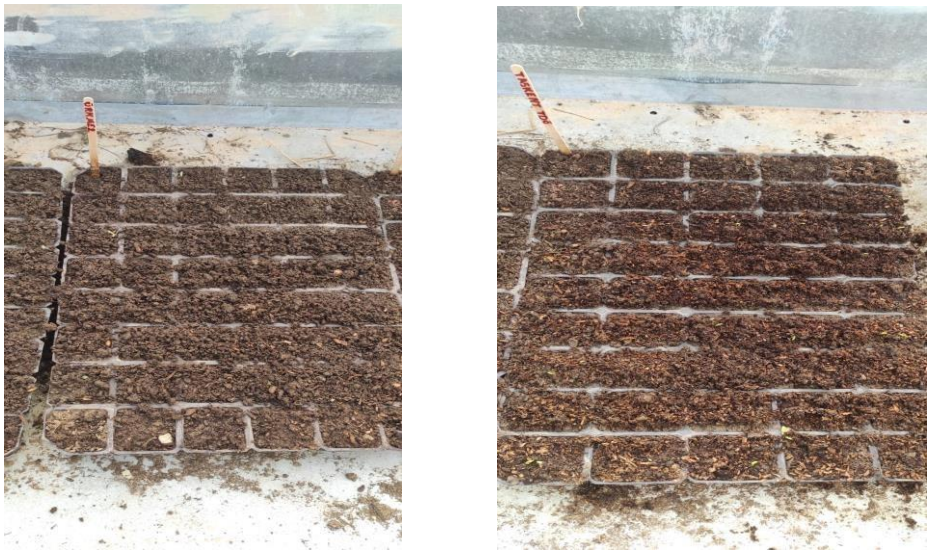
İlaçlama yapıldıktan sonraki adımda periyodik olarak iki günde bir sulama yapılmıştır. Bitkiler üzerindeki ilk fototoksite belirtileri gözlenmiştir.

2.2.2. Herbisit uygulaması

Denemede kullanılan 2 herbisit ilacı Aclonifen ve Imdacloprid ticari olarak piyasada en çok bulunan ilaçlardır. İlaç ml dozunu ayarlanıp su ile seyreltilmiştir. Kullanılan her ilaç dozundan sonra sırt pülivazötürü temizlenmiş yeni ilaç dozu aktarılmıştır.

2.2.3. Deneme hazırlıkları ve işlemleri

Şekil 1'deki gibi Viyollere perlit doldurulmuştur ve tohum ekimi yapılmıştır ardından sulama işlemi yapılıp sera koşullarında çimlenmeye bırakılmıştır ve düzenli aralıklarla 3 günde bir sulama işlemi yapılıp çimlenmeye bırakılmıştır.



Şekil 1. Perlit doldurulan viyoller

2.2.4. İncelenen Özellikler

İlac uygulamasından sonra 7. gün, 14. gün ve 21. günde boy ve bitki kalınlık kriterleri gözlenmiştir ve ölçümler alınmıştır.

3.BULGULAR ve YORUMLAR

Ürkmez adi fiğ bitkisine herbisit uygulaması sonucunda 1X, 2X, 3X ve 4X dozları için Aclonifen ve Imdacloprid ilaçlarının bitkinin morfolojik özellikleri yakın bulunmuştur. İki herbisit ilacının da uygulanması sonucunda bitki boy ve kalınlığı yakın bulurken uygulama zamanlarına bağlı olarak bitki boyunda değişiklik gözlenmiştir, bitki kalınlığı ise değişmemiştir (Tablo 1).

Tablo 1. Ürkmez Adi Fiğ Çeşidine Farklı Dozlarda Aclonifen ve İmdaclopid Herbisidleri Uygulanması Sonucunda Elde Edilen Boy ve Kalınlıklar (cm)

Doz	Uygulama zamanı (gün)	Aclonifen		Imdacloprid	
		Boy (cm)	Kalınlık (cm)	Boy (cm)	Kalınlık (cm)
1 X	7	12	0,02	13,3	0,01
	14	18	0,02	15	0,01
	21	24	0,02	19	0,01
2 X	7	12	0,01	14,5	0,01
	14	14,5	0,01	16,5	0,01
	21	18	0,01	19	0,01
3 X	7	13,5	0,02	14	0,01
	14	19,5	0,02	14,5	0,02
	21	23	0,02	18,5	0,02
4 X	7	15	0,02	14	0,01
	14	18,5	0,02	17,5	0,02
	21	21	0,02	22	0,02

Taşkent adi fiğ bitkisine herbisit uygulaması sonucunda 1X, 2X, 3X ve 4X dozları için Aclonifen ve Imdacloprid ilaçlarının bitkinin morfolojik özellikleri yakın bulunmuştur. İki herbisit ilacının da uygulanması sonucunda bitki boy ve kalınlığı yakın bulurken uygulama zamanlarına bağlı olarak bitki boyunda değişiklik gözlenmiştir, bitki kalınlığı ise değişmemiştir (Tablo 2).

Tablo 2. Taşkent Adi Fiğ Çeşidine Farklı Dozlarda Aclonifen ve İmdaclopid Herbisidleri Uygulanması Sonucunda Elde Edilen Boy ve Kalınlıklar (cm)

Doz	Uygulama zamanı (gün)	Aclonifen		Imdacloprid	
		Boy (cm)	Kalınlık (cm)	Boy (cm)	Kalınlık (cm)
1 X	7	12	0,02	6,5	0,01
	14	15,5	0,02	8,5	0,01
	21	17	0,02	11	0,01
2 X	7	13	0,01	12	0,02
	14	17	0,02	14,5	0,02
	21	19	0,02	17	0,02
3 X	7	11	0,01	12,5	0,01
	14	15	0,02	12,5	0,01
	21	17	0,02	15	0,01
4 X	7	11,5	0,02	11,5	0,01
	14	11,5	0,02	15	0,02
	21	14	0,02	18	0,02

Jao adi fiğ bitkisine herbisit uygulaması sonucunda 1X, 2X, 3X ve 4X dozları için Aclonifen ve Imdacloprid ilaçlarının bitkinin morfolojik özellikleri yakın bulunmuştur. İki herbisit ilacının da uygulanması sonucunda bitki boy ve kalınlığı yakın bulurken uygulama zamanlarına bağlı olarak bitki boyunda değişiklik gözlenmiştir, bitki kalınlığı ise değişmemiştir (Tablo 3).

Tablo 3. Jaoe Adi Fiğ Çeşidine Farklı Dozlarda Aclonifen ve İmdaclopid Herbisidleri Uygulanması Sonucunda Elde Edilen Boy ve Kalınlıklar (cm)

Doz	Uygulama zamanı (gün)	Aclonifen		Imdacloprid	
		Boy (cm)	Kalınlık (cm)	Boy (cm)	Kalınlık (cm)
1 X	7	12,5	0,01	12,5	0,01
	14	20	0,01	15	0,01
	21	24	0,01	18	0,01
2 X	7	13	0,01	12	0,01
	14	22	0,01	15	0,01
	21	26	0,01	17	0,01
3 X	7	15	0,02	11	0,01
	14	21	0,02	14	0,01
	21	25	0,02	16	0,01
4 X	7	12,5	0,01	13,5	0,01
	14	16,5	0,01	19,5	0,01
	21	20,5	0,01	22,5	0,01

Alper adi fiğ bitkisine herbisit uygulaması sonucunda 1X, 2X, 3X ve 4X dozları için Aclonifen ve Imdacloprid ilaçlarının bitkinin morfolojik özellikleri yakın bulunmuştur. İki herbisit

ilacının da uygulanması sonucunda bitki boy ve kalınlığı yakın bulurken uygulama zamanlarına bağlı olarak bitki boyunda değişiklik gözlenmiştir, bitki kalınlığı ise değişmemiştir (Tablo 4).

Tablo 4. Alper Adi Fiğ Çeşidine Farklı Dozlarda Aclonifen ve İmdaclopid Herbisidleri Uygulanması Sonucunda Elde Edilen Boy ve Kalınlıklar (cm)

Doz	Uygulama zamanı (gün)	Aclonifen		Imdacloprid	
		Boy (cm)	Kalınlık (cm)	Boy (cm)	Kalınlık (cm)
1 X	7	9	0,01	10,5	0,01
	14	14,5	0,01	12,5	0,01
	21	20	0,01	15,5	0,01
2 X	7	15	0,02	13	0,01
	14	23	0,02	21	0,01
	21	25	0,02	24	0,01
3 X	7	14,5	0,01	15	0,02
	14	20	0,01	20	0,02
	21	24	0,01	22	0,02
4 X	7	12,5	0,01	15	0,02
	14	19,5	0,01	19,5	0,01
	21	23,0	0,01	24	0,01

SONUÇLAR

Yapılan çalışma sonucunda, Jaoe adi fiğ çeşidine 2X dozunun 21. gün uygulanması sonucunda en uzun boy uzunluğu 26 cm olarak belirlenmiştir. En kısa boy uzunluğu ise Taşkent adi fiğ çeşidine Imdacloprid herbisidinin 21. gün uygulaması sonucunda 11 cm olarak bulunmuştur. Bu sonuçlara göre herbisid uygulamasının uygulanan doz ve zamanla ilişkili olduğu sonucuna varılabilmektedir. Bunun yanında bitkinin boy ve kalınlığı değerlendirilerek kesin bir sonuca varmak mümkün değildir. Bu yüzden çalışmanın derinleştirilmeye ihtiyacı vardır.

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