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PROCEEDINGS





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Romania

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GENERAL COORDINATOR'S PREFACE



Dear Participants,

Welcome to the 5th International Congress on Engineering and Life Science! Our congress is recognized as an important scientific event that brings together many disciplines with the theme of engineering and life sciences.

This year, 175 papers from 18 different countries were accepted to our congress, which we have organized for the 5th time in Piteşti, hosted by one of the deeply rooted educational institutions in Romania, National University of Science and Technology POLITEHNICA Bucharest. The scientific program, which lasted for 2 days with 27 sessions, have led to many different research opportunities and collaborations.

I would like to take this chance to express my sincere thanks and gratitude to the Rector of the host organization, Mihnea COSTOIU, to the Rector of Munzur University, Prof. Dr. Kenan PEKER, who have joined us from Türkiye, to Prof. Dr. Geoff LEVERMORE and to Prof. Dr. Alessio PAPINI, who have added scientific flavor to our congress with the important knowledge they have shared, and to Assoc. Prof. Dr. Nicoleta Anca ȘUȚAN, who made great efforts in the organization and finally to the entire Congress Organization Committee.

I sincerely hope that this event has been a productive program for all the participants.

Best regards

Assoc. Prof. Dr. Adem Yavuz SÖNMEZ

General Coordinator

HONORARY CHAIR'S PREFACE



Dear Researchers,

Welcome to the 5th International Congress on Engineering and Life Science! This has been an event dedicated to connecting scientists beyond borders and ignite cooperations which can be transformative – for a project or for an entire industry.

More than two centuries ago, the National University of Science and Technology POLITEHNICA Bucharest was founded and we are one of the most prolific universities in the region – with over 40.000 registered students and a community recognized for the important contributions brought to society and industry. Moreover, we are hosts to the largest research infrastructure in the country.

Our underlying philosophy and aim is to be an international collaboration platform, a beacon able to help researchers connect, create and share knowledge. It is the reason to why we are hosts to the most diverse, significant and interesting events, symposia and workshops. And we certainly hope the current event helped you create partnerships and great outcomes.

With this in mind, I would like to express our community's pleasure to host you at the National University of Science and Technology POLITEHNICA Bucharest, the Piteşti University Center, between 10-12 September 2024.

Warm regards

Mihnea COSTOIU

Honorary Chair

Rector-National University of Science and Technology POLITEHNICA Bucharest

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

KEYNOTE PRESENTATION

Getting Life Science Moving to Engineering; The progress of Optimization + Automation + IoT

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Abstract

Getting life science moving to engineering has been creating revaluation such as natural system (industry 0.0), agriculture (industry 1.0), industry (industry 2.0), electronic (industry 3.0), and industry 4.0. The method of this movement is the progress of optimization + automation + IoT. People contact, communicate, collaborate, get corporate responsibility, cooperate, and create for community development. The exploring contact within soil, water, and seed was create agriculture and people get start cultivation. Background is exploring natural system that combination of life sciences. Methods for the movement is the progress of optimization + automation + IoT. Some findings are the new definition of science, optimization of life sciences in the nature, the process of getting life science moving to engineering, implementation of IoT to manage the movement in the digital age in this study. As conclusion, science is the engine of growth. Knowledge base development create sustainability. The technology is the outputs of process from Life science to Engineering. Mathematic, statistic, econometry, operational research, and management information systems are the computational science for getting life science moving to engineering where cultural, art, and sports activities or actions are tools. In this case, one of the new definitions of science is to engineer the healthy living of human beings in natural and social balance through culture, arts, and sports activities. There is collaboration of supply chain of humanities sciences, natural sciences, social sciences, health sciences, engineering science in the science definition like process of production. For the transformation and modernization evolution required in getting life science moving to engineering on the way of process that optimization + automation + IoT. IoT is requiring new skills and analytical capacities like history of nature reading to ensure sustainability. The stage of transformation (mitigation, adaptation, resilience, and technology) required optimization of time, scale, and quantity. Based open on Management skills, Area information, and Technology competence (MAT) virtual reality and block chain (coin, energy, electric vehicles) are current trend for the combination of investment in the world. Entrepreneurs have been focusing on the combination of knowledge, science, and technology as capital of coin investment for energy, electric vehicles, etc.

Keywords: Optimization, Automation, IoT.

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KEYNOTE PRESENTATION

Autophagy and Stress in Plants

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Abstract

Autophagy is a fundamental process of eukaryotic cells aiming to recycle macromolecules and even entire organelles or portions of cytoplasm in order to recover basic molecules for starting new anabolism or for energetic recovery. Autophagy is always active, but it can increase due to a change in the cell shape and/or function or in case a very high metabolic activity and also as preliminary step before ending up into Programmed Cell Death. Moreover, some specific biosynthesis activities appear to be strictly related to autophagy for intermediate modification of metabolites. Autophagy may occur as macroautophagy o microautophagy in the cytoplasm, with the first type of autophagy implying the arrangement of ER cisternae around a portion of cytoplasm or an organelle to form a final autophagic vacuole. Microautophagy is more related to the transportation of vesicles towards an autophagic vacuole already present in the cell. Stress in plant cells is a strong effector of a cascade of events. The type of stresses that could be related to autophagy response are numerous, the most important being the direct or indirect oxidative stresses leading to damage of the biomembranes and of plastids and mitochondria. We will show some examples of stress due to excess of saline concentration, drought or presence of xenobiotics such as microplastics. The most useful technique for testing autophagic activities is microscopy, both as Transmission Electron Microscopy for the investigation of the specific events occurring inside the cells, and light microscopy (particularly fluorescence and confocal microscopy), with the visualization of the highest autophagic activity at the histological level. Several examples will be provided of different types of autophagic response in case of stress and of visualization.

Keywords: Autophagy, Stress, Plastids, Macroautophagy, Microautophagy.

KEYNOTE PRESENTATION

Climate Change, Net Zero, Technology and Ethics

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Abstract

It is now quite clear that the UNFCCC (IPCC) 1.5°C Paris target, and net zero by 2050, will be missed and that hopefully the temperature rise through the century, compared to pre-industrial times, will be restricted to 2°C. The science of climate change resulting in this situation is briefly discussed along with the increasing urban heat islands of expanding cities. The technology to mitigate carbon emissions is considered as the solution to combating climate change rather than lifestyle change, apart from dietary alterations. As the 1.5°C target will be missed, the challenge is to extract carbon dioxide from the atmosphere. This is briefly discussed in comparison with biomass, trees and photosynthesis. The paper concludes with the ethical principles needed for equity in the world so that a robust solution to climate change can be made.

Keywords: Climate Change, Net Zero Projections, Low Carbon Technology, Ethics, Climate Justice.

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ORAL PRESENTATION

Numerical Investigation of the Effect of Cross-Member Locations and Connection Geometries on Torsional Behavior of a Light Commercial Truck Chassis

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Abstract

The chassis is the basic structural framework that supports all subsystems of a vehicle and the components of these systems. The chassis, which carries many components such as the engine, powertrain, suspension system and the load of the vehicle, must provide the integration of these structural parts. In addition, during the operating conditions of the vehicle, it is required to show the necessary resistance against the tire forces that may occur during the motion of the vehicle. The chassis generally consists of two longitudinal carrier elements called side-members and multiple cross-members connecting them. In many applications, these cross-members are bolted to the chassis frame by means of gusset and flat brackets. During the motion of the vehicle on uneven road surfaces, asymmetric forces create moments on the chassis and subject the frame to torsion. The primary function of cross-members is to transfer a force acting on the chassis from one side-member to another and to resist load conditions such as torsion or bending. Due to these characteristics, cross-members are of critical importance in chassis design. By changing the number, size and arrangement of cross-members on a chassis, the structural behavior of the chassis can be optimized. In this study, the effect of locations and connection structures of cross-members on the torsional behavior of a light commercial truck chassis is numerically investigated. For this purpose, a sub-model is created to determine the location of the cross-members structures on the chassis. In this sub-model, the distance of the cross-members to the front of the chassis is defined as a parameter. With the Design of Experiments approach, the optimum location is determined by analyzing the effect of the cross-member positions on the chassis torsion angle. Then, the edge angle and cross-section profile of the cross-member structures are determined as the second and third parameters. The torsional stiffness of the chassis is optimized by increasing the edge angle and changing the cross-member profile. In addition, the effect of the brackets used for the integration of other structural elements to the body on the torsional behavior of the chassis is also considered within the scope of the study. With the new chassis design created with the values obtained from the analysis results, a lighter chassis form with the optimum torsion angle value was obtained.

Keywords: Chassis Design, Torsional Stiffness, Optimisation, Structural Analysis.

ORAL PRESENTATION

The Small-scale Tuna Fishery in Leyte, Eastern Visayas, Philippines

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Abstract

The Philippines is a significant producer of tuna globally and ranks among the major tuna-fishing nations. One of the areas where tuna fishery occurs in the country is the province of Leyte in Eastern Visayas. This study used both survey through a face-to-face interview with the tuna fishers and actual catch sampling to provide detailed information about the small-scale tuna fishery in the selected areas of Leyte covering the socio-demographic and fishery profile of tuna fishers, the fishing gears and practices employed, and the catch rate and composition. Based on the results, there are four types of fishing gears that are commonly used in targeting tuna in the province namely: 1) paired troll line, 2) single troll line, 3) multiple handline aided with light, and 4) single hook and line with float. The paired troll line is the most commonly used among tuna fishers. The average catch per unit effort varies depending on the type of fishing gear used. The catch composition of the four gears was comprised of four tuna species namely: longtail tuna *Thunnus tonggol* (53.53%), bigeye tuna *T. obesus* (23.23%), eastern little tuna *Euthynnus affinis* (19.19%), and frigate tuna *Auxis thazard* (4.04%). Two bycatch species were also recorded. Additionally, the survey was able to grasp the issues in the fishery including seasonality, illegal fishing, and border restriction. The results of this study may serve as baseline information that can be used by concerned government agencies and other institutions in formulating better management plans for the tuna fishery in the province.

Keywords: Small-Scale Tuna Fishery, Fishing Gears, Catch Per Unit Effort, Species Composition.

Acknowledgment

The authors sincerely thank the following: 1) Bureau of Fisheries and Aquatic Resources for the funding, 2) Visayas State University Tolosa, 3) Local Government Unit of Tolosa, Dulag, and Mayorga in Leyte, and Fritzie Gonzales for the support and technical assistance, and 4) Tuna fishers of the aforementioned municipalities for the cooperation.

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ORAL PRESENTATION

Effects of Seagrass Wrack Extract as Biofertilizers on the Growth, Ice-ice Disease Prevalence, and Carrageenan Quality of Eucheumatoid Seaweed *Kappaphycus striatus*

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Abstract

Eucheumatoid seaweed farming is a significant aquaculture activity, not only supplying carrageenan to the global market but also serving as a vital livelihood source for many marginalized coastal communities, particularly in Tawi-Tawi, Philippines. However, the practice of applying inorganic fertilizers to boost production by enhancing growth performance and mitigating ice-ice disease has become a contentious issue among local stakeholders. This study investigated the potential of utilizing seagrass wrack (*Thalassia hemprichii*) as a biofertilizer alternative, evaluating its effects on growth, ice-ice disease prevalence, and carrageenan quality (yield and gel strength) in the eucheumatoid seaweed *Kappaphycus striatus*. The experiment employed various concentrations of seagrass wrack extract (SWE): 0 mL L^{-1} (control), 9 mL L^{-1}, 18 mL L^{-1}, and 27 mL L^{-1}. The results revealed no significant effects of SWE on growth or ice-ice disease prevalence after 15, 30, and 45 days of cultivation. Additionally, no impact on gel strength was observed after 45 days. Interestingly, a significant difference was detected in carrageenan yield, with the 27 and 18 mL L^{-1} SWE treatment exhibiting a notably higher yield compared to all other treatments at the 45-day mark. While this study demonstrates the potential of SWE to influence carrageenan yield, its lack of significant effects on *K. striatus* growth and health raises concerns about its overall suitability as a biofertilizer. Therefore, further research is warranted to explore the potential optimization of the seagrass wrack extract, investigate the use of alternative seagrass wrack species or combinations, and identify strategies to improve the overall effectiveness of SWE as a biofertilizer.

Keywords: Biofertilizer, Carrageenan, Eucheumatoid Seaweed Farming, *Kappaphycus*, Seagrass Wrack.

Acknowledgment

The authors are grateful to the SEARCA PhD Research Scholarship for granting this study.

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ORAL PRESENTATION

Abundance of Marine Microorganisms on the Farmed Eucheumatoid Seaweeds (*Kappaphycus* spp.)

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Abstract

Eucheumatoid seaweeds, particularly those belonging to the *Kappaphycus* genus, are widely cultivated globally due to their high *kappa*-carrageenan content. *Kappa*-carrageenan has a broad spectrum of applications in the food and non-food industries. However, *Kappaphycus* cultivation is affected by environmental problems and microorganisms. Ice-ice disease remains the primary disease challenge affecting large-scale production. Microorganisms have been identified as one of the potential biotic agents contributing to this disease. This work investigated the abundance of microorganisms, such as heterotrophic marine bacteria (HMB), marine-derived fungi (MDF), and *Vibrio,* according to season (dry and wet), seaweed species (*Kappaphycus alvarezii* and *K. striatus*), and health status (ice-ice disease-infected and healthy). The results demonstrated that the abundance of marine microorganisms varied significantly based on season, health status, and species. In terms of HMB, their abundance (up to 10^{18} CFU g^{-1}) was significantly higher during the dry season compared to the wet season. Regarding species, *K. alvarezii* exhibited a significantly higher abundance of HMB compared to *K. striatus*. Furthermore, HMB abundance was significantly greater in ice-ice disease-infected seaweeds than in healthy ones. The MDF of up to 10^{5} CFU g^{-1} did not show significant variations according to season. However, similar to HMB, *K. alvarezii* displayed a significantly higher abundance of MDF compared to *K. striatus*. Additionally, the abundance of MDF was significantly higher in ice-ice disease-infected seaweeds compared to healthy ones. *Vibrio* abundance remained generally very low across all samples, regardless of species, health status, or season. Therefore, these findings suggest that marine microorganisms, particularly HMB and MDF, likely play a crucial role in the development of ice-ice disease, potentially exacerbated during the dry season. Additionally, *K. alvarezii* appears to be more susceptible to infection by these microorganisms. Future studies utilizing induction experiments are necessary to further elucidate the specific role of microorganisms in the development of ice-ice disease.

Keywords: Abundance, Heterotrophic Marine Bacteria, *Kappaphycus*, Ice-Ice Disease, Marine-derived Fungi.

Acknowledgment

The authors are grateful to the SEARCA PhD Research Scholarship for granting this study.

ORAL PRESENTATION

Comparative Study on the Sensory Quality Attributes of Various Seaweed (*Kappaphycus alvarezii*) Chip Formulations

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Abstract

Seaweed, recognized for its nutritional benefits has become increasingly popular as a functional food ingredient. This research assesses the sensory characteristics of various seaweed (*Kappaphycus alvarezii*) chip formulations using a structured sensory evaluation process. Five distinct formulations (FA-control, FB, FC, FD, and FE) were created by varying selected ingredients such as curry powder, white sugar, and cheese powder to determine their impact on flavor, texture, appearance, aroma, and overall acceptability. These ingredients were chosen based on preliminary assessments of optimized formulations already available which also served as the control. Other formulations were designated as experimental treatments. A panel of ten (n=10) faculty members and thirty (n=30) students from the College of Fisheries was selected to assess the seaweed chips using standardized sensory analysis techniques. They rated attributes such as flavor, texture, appearance, aroma, and overall acceptability, with statistical methods applied to analyze the data. The results revealed significant differences ($p<0.05$) in sensory quality attributes among the formulations. Formulation D (FD), which included 5 tablespoons curry powder, 5 teaspoons white sugar, and 4 tablespoons cheese powder, achieved higher acceptability (8.08 ± 0.01) due to its enhanced sensory attributes. Other formulations, including the control, showed consistent results. However, Formulation E (FE), which contained no curry powder, white sugar, and cheese powder, demonstrated potential for flavor versatility. According to feedback from the sensory evaluation, its plain flavor could be improved with the addition of different flavorings. This comparative analysis offers valuable insights into consumer preferences and the sensory properties that make seaweed chips acceptable. Future research should explore the nutritional benefits and shelf-life stability of these formulations to complement the sensory evaluation.

Keywords: *Kappaphycus alvarezii,* Seaweed Chips, Sensory Evaluation, Flavor Enhancer.

Acknowledgment

Fish Processing Technology Department, College of Fisheries, Mindanao State University Tawi-Tawi College of Technology and Oceanography.

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ORAL PRESENTATION

Hook and Line Fishery in Coastal Areas of Datu Odin Sinsuat, Maguindanao, BARMM, Philippines

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Abstract

Hook and line is one of the small-scale and traditional fishing gears employed by fishermen in the coastal waters in the Bangsamoro Autonomous Region in Muslim Mindanao (BARMM), Philippines. This study provides salient information on the socio-demographic and economic profiles of fishermen engaged in hook and line fishery in the coastal waters of Datu Odin Sinsuat, Maguindanao. The catch composition, volume, relative abundance, and catch per unit effort (CPUE) of hook and line were determined. Tracking of fishing coordinates was obtained to characterize the fishing location. Likewise, the marketing strategies and problems encountered by hook and line fishermen were also identified. A household interview and fishing activity were used to elucidate expected information. A total of 61 respondents across 6 coastal areas were interviewed. Results of the study revealed that hook and line fishers in Datu Odin Sinsuat, Maguindanao were mostly married (83.61%) male husbands (85.25%) with ages from 35-44 (29.51%) who never completed their elementary education (54.10%). Most fishermen practiced Islam faith (78.69%) spoke Maguindanaon (70%) with a household size of 5-8 (55.74%) and lived in Bahay Kubo- made out of woods, nipa and/or bamboos (80.33%). The fishermen devoted full time to fishing as their major source of income and earned about USD 89–179 (39.34%) monthly. Majority of these fishermen owned (62.29%) motorized (65.57%) boats. There were 32 species (pelagic and demersal) belonging to 13 families caught by hook and line fishermen. The estimated monthly mean volume of 101.95 kg (3.398 kg.d^{-1}). *Gymnosarda unicolor* under family Scombridae was the most dominant with 20.13% in terms of weight, while *Balistapus undulatus* and *Parupeneus multifasciatus* under family Balistidae and Mullidae were the prevailing species by numbers (10.81%). Scombridae was the most dominant family by weight (29.88%) while family Serranidae outnumbered them with 21.62%. The average catch per unit effort (CPUE) was 566 g.h^{-1} for the whole duration of fishing activity. Handliners operated their gears either in their respective municipal waters or in the neighboring coastal waters. The majority of the fishermen sold their catch directly to the buyers. Problems encountered by fishermen were damaged boats and gear, increasing number of fishermen and vulnerability to natural calamities. Appropriate solutions were suggested by fishermen to address the pressing problems.

Keywords: Hook and Line, Municipal Fisheries, Catch Volume, Catch Per Unit Effort.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Abundance and Characteristics of Microplastics in Commercially Sold Fishes from General Santos City Fish Port Complex, Philippines

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Abstract

The excessive global production and inadequate recycling of plastics have led to the accumulation of plastic waste, which degrades into microplastics and poses a threat to marine organisms and human health. The need to study microplastic contamination in wet markets, like the General Santos City Fish Port Complex the 2nd largest Fishport in the Philippines, is crucial for assessing exposure risks and implementing measures to mitigate pollution and protect public health. This study aimed to quantify and characterize the ingested microplastics in the gastrointestinal tract of *Decapterus macarellus*, *Euthynnus affinis*, and *Selar crumenopthalmus*, and compare the data among the different fish species. There were seven (7.07%) of 99 individuals contained ten microplastic particles with a mean size of 0.789 ± 0.379 mm. The most abundant microplastic recovered were microfragments (90%) with a dominant color of blue (100%). Based on the polymer composition, ethylene-propylene copolymer is the most prevalent (50%), followed by poly (vinyl stearate) (30%), polyethylene (10%), and polypropylene (10%). The results revealed that all fish species examined exhibited similar susceptibility to microplastic contamination, with *D. macarellus* ingesting 0.15 particles per individual, followed by *S. crumenopthalmus* with 0.12 particles per individual and *E. affinis* with 0.03 particles per individual. Additionally, there was a significant difference ($p<0.05$) in microplastic size, indicating that *D. macarellus* were likely to ingest larger debris compared to *S. crumenopthalmus*. The study revealed evidence of microplastic contamination in commercial fish species at the General Santos City Fish Port Complex. Highlighting the potential risks to human health and the environment of Southern Philippines, further assessment of smaller fish species and trophic transfer are necessary for a comprehensive understanding of the contamination patterns.

Keywords: Microplastic, Commercial Fish, Gastrointestinal Tract.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
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ORAL PRESENTATION

Effects of Different Natural Diets on the Growth, Serum Protein, and Survival of Blue Swimming Crab *Portunus pelagicus* (Linnaeus, 1758)

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Abstract

The study was conducted to determine the effects of different natural diets on the growth, serum protein, and the survival of blue swimming crab *Portunus pelagicus* (Linnaeus, 1758) at the Multi-Species Hatchery, College of Fisheries of the Mindanao State University Tawi-Tawi College of Technology and Oceanography, Sanga-Sanga, Bongao, Tawi-Tawi, Philippines. Blue swimming crabs were fed with four different natural foods, namely, cardinal fish (TI), polychaete (TII), horn snail (TIII), and jumping shell (TIV), for 45 days of culture. The results showed no significant differences ($p>0.05$) among the treatments. However, *P. pelagicus* fed with horn snail obtained the highest weight gain (35.58 ± 6.84 g) and survival rate (86.67 ± 11.55%). Serum protein levels remained relatively consistent across all groups, with cardinal fish (TI) at 1.37 ± 0.04 mg/dL, Polychaetes (TII) at 1.37 ± 0.02 mg/dL, horn snail (TIII) at 1.35 ± 0.00 mg/dL, and jumping shell (TIV) at 1.35 ± 0.00 mg/dL, suggesting comparable protein contents in the diet. Notably, crabs fed horn snails displayed evident improvement in shell deposition. Overall, this study demonstrates that *P. pelagicus* can thrive in 1.5L plastic containers when supplemented with natural food sources. Horn snails, in particular, may be a promising dietary option for crab aquaculture due to their positive impact on growth and survival.

Keywords: Blue Swimming Crab, Cardinal Fish, Polychaete, Jumping Shell, Horn Snail.

ORAL PRESENTATION

Characterization of Oven-Dried Sea Grapes *Caulerpa lentillifera* Stolon

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Abstract

This study was conducted to characterize the oven-dried and powdered Sea grapes *Caulerpa lentillifera* stolon using sensory qualities and microbial properties. A panel of 10 participants assessed the color, odor, texture, flavor, and general acceptability of the stolon from three treatments: T1 (55˚C), T2 (75˚C), and T3 (control). One-way ANOVA showed no significant differences ($p>0.05$) in odor, texture, flavor, and general acceptability. However, color in T1 differed significantly ($p<0.05$) and was rated as moderately liked. All treatments received slightly liked ratings for odor, texture, and flavor, while overall acceptability was rated moderately liked. Microbial analysis showed low aerobic plate counts for both T1 (2.5×10^2 CFU/g) and T2 (3.9×10^2 CFU/g). These findings suggest that oven-drying at temperatures between 55 ˚C and 75 ˚C preserves the sensory quality of sea grape stolon while ensuring microbial safety.

Keywords: *Caulerpa lentillifera*, Stolon, Microbial Load, Sensory Qualities, Dried.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
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ORAL PRESENTATION

Factors Influencing the Conservation of Trees in Urban Green Space in Timako Hill, Kalanganan II, Cotabato City, Bangsamoro Autonomous Region in Muslim Mindanao (BARMM), Philippines

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Abstract

Rapid urbanization and human population growth is one of the leading causes of declining tree diversity in the country. Urban trees had proven to have a social and ecological benefits to humans. In this study, the factors influencing the conservation of trees in an urban green space in Timako Hill, Cotabato City were investigated. Field survey was conducted to determine the tree species and their diversity in the Timako Hill. Face-to-face and online surveys through google forms were conducted to determine the factors affecting the intention to conserve urban trees in the study area. Structural equation modelling (SEM) was employed to analyze the factors that impact the behavioral intention to conserve trees. Correlation analysis was also employed to evaluate the relationship between tree diversity and the behavioral intention to conserve trees. Results showed that there were fifty (50) tree species present in the study area. *Diplodiscus paniculatus* was the most abundant tree species recorded. The critically endangered *Hopea foxworthyi* tree species based on DAO 2017-11 Philippine Red List was found in Timako Hill. Perceived behavioral control and perceived tree benefits were the factors influencing the intention to conserve urban trees in the study area. Correlational analysis showed that there was evidence of a significant positive correlation between tree diversity and attitude to conserve trees. Additional research is needed to investigate the influence of abiotic factors, including soil pH, humidity, temperature, and proximity to residential areas, on tree diversity in the study area.

Keywords: Tree Diversity, Conservation Behavior, Structural Equation Modelling (SEM).

ORAL PRESENTATION

Macro- and Microplastic Contamination in the Sinop Coast of the Black Sea

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Abstract

The contamination of marine environment with marine litter has become a growing concern over the past years. Plastics dominate marine litter that is one of the most widely used substances over the world. Excessive amounts of plastic go into the marine environment where it reaches micron size with degradation process (thermal oxidation, photo-oxidative degradation, biodegradation etc.) finally it is defined as microplastic. The Black Sea is seriously affected by this pollutant and plastics have been reported from seawater to the seabed and beaches and also in many organisms. Sinop peninsula is located middle of the southern Black Sea coast. Sinop is a fishing and tourism city and the settlement of people in the city is colonized on the peninsula. Factors that cause marine pollution in the city are; waste water, solid wastes, and pollution by shipping and fishing activities. Investigations in Sinop showed that the macro- and microplastics were detected on the beaches, on the sea floor, and in the seawater, it was observed that the marine species were affected by plastics. The results of the investigations show that the west coasts (Akliman, İnceburun, etc.) of the Penninsula were generally under the pollution pressure from plastics due to current and wind, while the east coasts of the Penninsula were generally under the influence of the plastics come from Sinop city and fishing. In the results, the main pollutants of the west coast were fragmented plastics, while on the east coast, foam-formed plastics from polystyrene boxes were the main pollutants. These pieces will be a source of secondary microplastics and may also pose a risk to the biota. The amount and distribution of plastics are affected by wrong waste management strategy, river discharge, climatological events, population density, and lifestyle of the local community. In the Sinop coast, the major sources of plastics are land-based sources and one of the most important components of marine pollution in the city is domestic solid wastes and mismanaged wastes. Sea-based sources also have an effect on pollution in the Sinop from fishing and shipping activities. Plastics cause harm to the marine environment and investigations on the transportation, accumulation, and distribution of plastics are important. Policies and effective measures are required to reduce plastics in the marine environment and this is only possible with reliable scientific data.

Keywords: Plastic, Pollution, Marine Litter, Black Sea, Sinop.

1. Introduction

Marine litter is defined as “Marine litter is any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment.” (UNEP, 2005). The contamination of marine environment with marine litter has become a growing concern over the past years. Marine litter originates from two sources; (i) Sea-based Sources: from passenger ships, fishing

vessels, military fleets and research vessels, recreational boats, and aquaculture facilities, (ii) Land-based sources: beaches, jetties, harbors, marinas, urban waste sites (dumpsites) and coastal tourism are the main sources of land-based marine litter (Ryan, 2015).

Since the beginning of intensive production in 1950, the amount of plastic production has increased from 1.5 million tons to >400 million tons in 2022 (Plastic Europe, 2023). One of the most often used materials in the world, marine litter, is mostly made of plastic. Overwhelming quantities of plastic enter the marine environment, where they undergo breakdown processes (thermal oxidation, photo-oxidative degradation, biodegradation, etc.) until they reach micron size and finally "microplastics" occurs. Microplastics are defined as “Microplastics are any synthetic solid particle or polymeric matrix, with regular or irregular shape and with size ranging from 1 μm to 5 mm, of either primary or secondary manufacturing origin, which is insoluble in water.” (Frias and Nash, 2019).

The Black Sea, which is one of the world's inland seas, has been progressively polluted, particularly in recent years, due to the release of pollutants from rivers and household litter items from coastal cities (Bat et al., 2018). This pollutant has a major impact on the Black Sea ecosystem and plastics have been reported from seawater to the seabed and beaches and also in many organisms (Suaria et al. 2015; Simeonova et al. 2017; Terzi et al. 2020; Bat et al., 2022; Aytan et al., 2022)

Sinop is at the center of the Turkish Black Sea coast and is located between 34° 14’ and 35° 26’ eastern longitudes and 41° 12’ and 42° 06’ northern latitudes where fishing and tourism are intense (Öztekin and Bat, 2020). In comparison to the Eastern Black Sea's shoreline, Sinop's coasts are indented and not stepped. From Hopa to the Bosphorus, the Turkish Black Sea coast lacks the presence of ports encircled by bays and gulfs, unlike Sinop (Bat et al., 2022).

The main factors that may cause marine litter pollution in Sinop Coasts are domestic solid waste, urban sewage system, river discharge, fishing activities, shipping activities, aquaculture (Öztekin and Bat, 2020). Wind, topography, and currents all have a significant impact on the deposition and dispersion of marine litter (UNEP 2009). The dispersion of litter in the Black Sea is influenced by the current system (Öztekin and Bat, 2020).

Scientific investigations in Sinop showed that the presence of macro and microplastics were detected and in the seawater, on the sea floor and beaches, (Öztekin, 2016; Öztekin and Bat, 2017a,b,c,d; Öztekin et al., 2020; Bat et al., 2022; Öztekin et al., 2024).

One of the research locations for marine litter contamination in the Sinop coasts is the Sarıkum Lagoon. One of the Black Sea's important wetlands, Sarıkum Lagoon, and its surroundings have been designated as a Natural Protected Area. Because of its location, this region is subject to significant solid waste deposits from the dominant winds, waves, and currents (Öztekin and Bat 2017a). Seasonal research operations in the area between 2015 and 2016 were used to determine the amount and composition of macro and micro litter (Öztekin, 2016).

Seasonal assessments of macro litter were carried out on the seabed and beach of Sarıkum Lagoon. Plastic comprises the majority of the litter observed along the coast. In Sarıkum, mixed packaging products (41.12%) and unidentified items (33.84%) comprised the majority of litter items (Öztekin et al. 2020). The amount, distribution, and types of seabed macro litter were assessed at four distinct depths

(5, 10, 20, and 30 meters) along the Sarıkum Lagoon shoreline, using a beam trawl and only plastic was found, plastic items were composed of plastic bags and pieces of ropes (Öztekin and Bat 2016).

On the Sarıkum Lagoon the coast, micro-litter investigations were conducted in seawater, beach, and seabed sediment (Öztekin, 2016). According to results from beach sediment, the most prevalent color of microplastic objects was white, and their major constituents were polystyrene pieces (58.72%) (Öztekin and Bat 2017c). The amount of microplastic in Sarıkum Lagoon's bottom sediments was examined at four distinct depths: 0.5, 5, 15, and 30 meters. According to the results of the categorization, the majority of microplastics are composed of plastic fibers (60.24%), blue was revealed to be the most prevalent color (38.79) (Öztekin and Bat 2017d). Microlitter pollution in seawater was investigated at the sea surface and in the water column at four distinct depths (0.5 m, 5 m, 15 m, and 30 m) at Sarıkum. According to the results of litter classification, the most prevalent categories of litter in both sample regions are other groups (sea surface: 55.45%; water column: 54.21%), which are followed by fibers, nylons, and hard plastic fragments (Öztekin and Bat 2017a).

The effects of marine litter on fish species were registered on two fish species in the Sinop (*Dicentrarchus labrax* (Linnaeus 1758) and *Belone belone* (Linnaeus 1760)) (Öztekin and Bat, 2020).

The abundance and composition of seafloor litter İnceburun coast of the Sinop were investgated in 2014. The plastic was found at the highest ratio (95.35%) and litter items were commonly consist of plastic bags (Öztekin and Bat 2017b).

Beach litter surveys were carried out on 9 different beaches, that had different pollutant sources, seasonally in 2019 (Bat et al., 2022). The cleanliness status of beaches was determined and none of the surveyed beaches was clean in the Sinop. The plastic was the highest ratio (88.14-98.46%). “Plastic pieces 2.5> <50cm” were the most common litter type and improper waste disposal, river runoff, fishing, tourism and other recreational activities, shipping, offshore activities, and sewage are sources of litter items

In 2019, beach litter investigations were conducted seasonally on nine distinct beaches with varying pollution sources in Sinop coasts (Bat et al., 2022). Beach cleanliness was assessed, and none of Sinop's beaches were found to be clean. The most encountered litter material was plastic (88.14–98.46%). The most prevalent type of litter was "plastic pieces 2.5> <50cm," and sources of litter items include sewage, river runoff, fishing, tourism and other recreational activities, shipping, offshore operations, and inappropriate waste disposal (Bat et al. 2022).

Öztekin et al. (2024) investigated the microplastic contamination in the water column of Hamsilos Bay, a natural protected region, which was a major fishing and tourism destination on the Sinop coast of the Black Sea. Fiber by kind (73.92%), 1-2 mm by size class (28.35%), and blue (37.98%) by color, and PET (47%) and PE (34%) by polymer types were the most common microplastics that were analyzed in this study. The study's results demonstrate the extensive microplastic contamination of the coastal region. The Black Sea's environmental challenges are being addressed by initiatives to improve sustainability, lessen pollution, and encourage the preservation of the area's natural resources (Öztekin et al., 2024).

The presence of microplastics in beach sediments was investigated in 4 different stations on the Sinop coast in May 2024 (Sevgi and Öztekin, 2024). Samples were classified and the amount of microplastics

was assessed. The results of the research demonstrated that Sinop's east shore had a greater quantity of microplastics than its west coast. In general, polystyrene fragments that come from polystyrene boxes—particularly those used during the fishing season—make up microplastics. (Sevgi and Öztekin, 2024).

2. Conclusion

The research shows that plastic litter has the highest percentage in the classification by material type. The disappearance time of plastics in nature and time-dependent degradation products were the most common types of litter encountered. These products are very important as they are the sources of microplastics. The high amount of litter per unit area in the research, as well as the similar situation observed in other studies conducted in the Black Sea region, indicate that marine litter is a major problem for the region. Although research shows that marine litter originates mainly from land-based sources, marine activities also cause a lot of pressure in the region. Research on the current situation and solutions to the problem is of utmost importance.

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ORAL PRESENTATION

Determinants of the Distribution Potential of Endangered Endemic Forest Species, Case Study - Morocco

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Abstract

Determining the potential range of a species is crucial for developing effective conservation and sustainable management strategies, especially for endemic species threatened by climate change. The Moroccan fir (Abies marocana), an iconic and endemic forest species of Morocco, is listed as endangered by the International Union for Conservation of Nature (IUCN) due to its declining habitat caused by various natural and human factors, such as deforestation, overgrazing, and changing climate patterns. Our study aims to predict the habitat and spatial distribution of the Moroccan fir based on key bioclimatic, topographical, and edaphic conditions that favor its establishment within its natural range. Using Geographic Information Systems (GIS) and maximum entropy modeling (Maxent), we have created an initial map of areas suitable for the fir tree and identified the environmental variables that influence its presence in Morocco. The integration of these advanced modeling techniques allows us to generate more accurate predictions of the species' potential range, thereby providing crucial insights into areas that require immediate conservation efforts. This research will support strategic planning for the conservation of biodiversity and the sustainable management of this endangered endemic species in Morocco, ensuring that future generations can continue to benefit from its ecological and cultural significance.

Keywords: Moroccan Fir, Endemic Species, Maxent, Climate Change.

ORAL PRESENTATION

Tuning the Properties of Hydrothermally Grown ZnO Nanorods through Nickel Doping: A Study of Structural, Morphological, and Optical Modifications

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Abstract

The impact of nickel (Ni) doping on the properties of zinc oxide nanorods (ZnO NRs) synthesized via hydrothermal growth was systematically investigated in this study. A sol-gel and dip-coating method was employed to deposit ZnO seed layers on glass substrates, followed by the hydrothermal growth of Ni-doped ZnO NRs at a fixed temperature of 90 °C for 5 hours. The resulting crystal structure, surface morphology and optical properties were thoroughly examined using X-ray diffraction (XRD), scanning electron microscopy (SEM), and UV-visible spectroscopy, respectively. XRD analysis confirmed the successful incorporation of Ni^{2+} ions into the ZnO crystal lattice, substituting Zn atoms. All samples exhibited a hexagonal wurtzite structure with preferential orientation along the (002) plane, indicating highly oriented growth along the c-axis. However, the incorporation of Ni^{2+} ions induced alterations in lattice parameters and crystallite size, attributed to the differences in electronegativity, ionic radius, and valence electron configuration between Ni^{2+} and Zn^{2+}. These structural modifications, alongside variations in doping concentration, also significantly impacted the morphological properties of the ZnO NRs. SEM analysis revealed changes in nanorod growth rates, surface morphology, roughness, and the prevalence of structural defects or secondary phases. Furthermore, the diameter and length of the nanorods were observed to be dependent on both the Ni^{2+} concentration and the growth conditions. The optical properties of the ZnO NRs were found to be influenced by both dopant concentration and the resulting changes in crystalline quality. An overall trend of increasing optical transmittance was observed with increasing dopant concentration, attributed to the reduction in defect-related scattering and absorption. However, this trend was not consistent for all samples, particularly those grown at lower temperatures, indicating the complex interplay between dopant incorporation and crystal growth. The substitution of Zn^{2+} sites by dopant ions led to notable changes in the band gap energy, which can be attributed to several mechanisms. In the case of Ni doping, the sp-d spin exchange interactions between band electrons and localized s-electrons of Ni^{2+} ions likely contribute to the observed band gap widening. For Ni doping, the initial increase in carrier concentration due to the formation of shallow donor states may lead to a Burstein-Moss shift, causing a blue shift of the absorption edge. However, at higher Ni concentrations, the formation of deep-level defects and potential NiO phases can act as recombination centers, narrowing the band gap and resulting in a red shift. Additionally, electron-electron and electron-impurity interactions can further modulate the conduction and valence bands, influencing the optical

properties. This study demonstrates the intricate relationship between dopant concentration, crystal structure, and optical properties in hydrothermally grown ZnO NRs. The observed trends in transmittance and band gap energy highlight the potential for tailoring the optical behavior of ZnO NRs through controlled doping and growth conditions, opening avenues for their application in optoelectronic devices and other technologies.

Keywords: ZnO, Nanorods, Nickel, Hydrothermal, Sol-gel.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
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ORAL PRESENTATION

Gd-Doping Induced Structural and Morphological Modifications in Hydrothermally Grown ZnO Nanorods

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Abstract

The influence of gadolinium (Gd) doping and growth temperature on the properties of zinc oxide nanorods (ZnO NRs) was investigated in this study. ZnO seed layers were deposited on glass substrates via a sol-gel and dip-coating process, followed by the hydrothermal growth of Gd-doped ZnO NRs on these layers at a constant temperature of 90 °C for 5 hours. The resulting crystal structure and surface morphology of the NRs were comprehensively characterized using X-ray diffraction (XRD) and scanning electron microscopy (SEM). XRD analysis provided compelling evidence for the successful substitution of Zn^{2+} ions by Gd^{3+} within the ZnO lattice. The characteristic peaks of the hexagonal wurtzite structure were observed in all samples, confirming the preservation of the ZnO crystal structure. However, the incorporation of Gd^{3+} ions induced subtle shifts in the peak positions, indicating a systematic alteration of the lattice parameters. This lattice modification, driven by the larger ionic radius of Gd^{3+} (0.93 Å) compared to Zn^{2+} (0.74 Å), resulted in an expansion of the ZnO unit cell. The increase in lattice parameters, as evidenced by the shift in diffraction peaks, was directly proportional to the Gd^{3+} concentration, suggesting a dose-dependent effect. Beyond the changes in lattice constants, the incorporation of Gd^{3+} also influenced the surface morphology of the ZnO NRs, as revealed by SEM analysis. While NRs grown at 90 °C generally exhibited well-defined hexagonal shapes, increasing Gd concentration led to a noticeable increase in NR diameter and a corresponding decrease in NR density. This morphological evolution can be attributed to the interplay between the dopant's ionic radius, charge imbalance, and the growth kinetics under hydrothermal conditions. The larger Gd^{3+} ions likely disrupted the regular ZnO lattice, leading to a preferential lateral growth and increased spacing between individual NRs. This, in turn, resulted in a reduction in the overall NR density as the available growth sites became more dispersed. The observed structural and morphological modifications induced by Gd doping have significant implications for the properties of ZnO NRs. The changes in lattice parameters and surface features can influence the electronic band structure, defect formation, and surface reactivity, which are crucial factors in determining the optical, electrical, and catalytic properties of the nanorods. Therefore, the ability to control the Gd doping concentration and growth temperature offers a powerful means to tune the properties of ZnO NRs for specific applications.

Keywords: ZnO, Nanorods, Gadolinium, Hydrothermal, Sol-gel.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
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ORAL PRESENTATION

A Comparative Performance Analysis of LSTM Autoencoder and TimeGPT Models in Time Series Anomaly Detection

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Abstract

Anomaly detection (AD) identifies outliers and patterns outside the expected behavior in financial, healthcare, and industrial systems. This task is critical for the early detection of operational risks and security threats in time series (TS) data. Researchers have recently applied deep learning techniques to analyze complex TS data and perform anomaly detection tasks. However, for existing methods to be developed to perform AD adequately in the face of the accelerating complexity of systems and data processing capacity, AD models need to be improved to provide higher accuracy and generalizability. Long Short-Term Memory (LSTM) networks have emerged as an effective method in AD because they capture long-term dependencies and patterns in TS data. This study investigates the effectiveness of AD approaches using LSTM-Autoencoder (LSTM-Ae) and the TimeGPT model explicitly developed for TS data. The performance of the models is evaluated through experiments on five different datasets from the Numenta Anomaly Benchmark dataset. The results show that the LSTM-Ae model achieves an F1-score of 0.80, and the TimeGPT model achieves an F1-score of 0.55. Both models showed strong performance in detecting anomalies in TS data. Moreover, this is one of the first studies to evaluate the comparative performance of the LSTM-Ae and TimeGPT models.

Keywords: Anomaly Detection, Time Series Analysis, LSTM-Autoencoder, TimeGPT, Deep Learning.

1. Introduction

Anomaly detection (AD) is a comprehensive analytical process that aims to identify outliers and unexpected patterns in datasets (Karaoğlan, 2023; Chandola et al., 2009). This methodology has a wide range of applications, including the detection of meteorological outliers and precipitation points and patterns (Karaoğlan et al., 2024; Karaoğlan, Kürşat Mustafa;Saka, 2023), as well as fraud detection in financial systems (Malini & Pushpa, 2017), disease diagnosis in healthcare (Liu et al., 2022), and traffic AD in transportation networks (Wang et al., 2022). Especially in natural sciences, industrial processes, and medical research, time series (TS), which are temporally indexed data sequences, are the focus of AD studies. In this context, research in literature focuses on developing sophisticated approaches to AD by considering the characteristics of TS data (Karaoğlan, 2023) . Traditional AD techniques include support vector machines (Schölkopf et al., 2001), distance-based algorithms (Angiulli & Pizzuti, 2002), linear model-based approaches (Shyu et al., 2003) and density-based methods (Breunig et al., 2000). However, these conventional methods face certain limitations, especially in processing high-dimensional and complex TS data and evaluating labeled anomalies. Researchers have increasingly turned to deep learning-based approaches to address these limitations in recent years (Choi et al., 2021).

In this context, Long Short-Term Memory (LSTM) networks play a paradigm-shifting role in time series analysis (TSA) and AD task (Shanmuganathan & Suresh, 2023).

LSTM networks, as a refined variant of Recurrent Neural Networks (RNNs), exhibit improved performance in capturing long-term dependencies in TS data (Nguyen et al., 2021). This characteristic makes LSTMs particularly effective for complex tasks, especially in forecasting and AD (Malhotra et al., 2015). LSTM-based autoencoders (Z. Xu et al., 2023) can effectively detect anomalies in TS data (Wei et al., 2023; Chen et al., 2023). For example, in a study on CO_2 emission data, the LSTM-Autoencoder (LSTM-Ae) method showed superior accuracy in detecting anomalies compared to conventional methods (Wei et al., 2023). Similarly, LSTM-Ae models have demonstrated high efficacy in detecting network attacks within cybersecurity (Elsayed et al., 2020) and identifying outliers in in-flight data within the aviation industry (Gao et al., 2023). The recently developed TimeGPT model (Paroha & Chotrani, 2024) has the potential to break new ground in TSA. Trained with over 100 billion data points from various sectors, this model exhibits wide-ranging capabilities in TS forecasting and AD (Garza et al., 2023). However, research that comprehensively evaluates the effectiveness of TimeGPT in AD still needs to be completed.

This study aims to provide a comparative analysis of the methods used for AD in TS data, specifically the LSTM-Ae and TimeGPT models. By analyzing the performance of these models on different data sets, our research aims to reveal their strengths and limitations. To this end, this study will comprehensively analyze the LSTM-Ae and TimeGPT models for AD in TS data. The performance of these models on different datasets and application scenarios will be comparatively analyzed, and their strengths and limitations will be evaluated in detail. The results of the experimental studies show that the proposed approaches have high performance. The LSTM-Ae model detected anomalies in the tested datasets with an average F1-score of 0.80. On the other hand, the TimeGPT model captured anomalies with an F1-score of 0.55. Moreover, TimeGPT detects anomalies without training compared to the LSTM-Ae model. These results show that both models provide effective solutions for TS-AD, but their performance may vary depending on the dataset size and application requirements.

The continuation of this study consists of four sections. The second section includes the proposed approach and the methodology used in the study. The third section, Experimental Environment, includes the dataset, hyperparameters, and performance metrics used in the study. The fourth section includes the results of the study and discusses the results. The last section provides a general evaluation of the study and offers suggestions for future research.

2. Proposed Approach and Methodology

This section provides detailed information about the architecture and components underlying the proposed approaches and the methodology applied. Figure 1 illustrates the methodological stages that sequentially outline the components and overall architecture of the proposed approach.

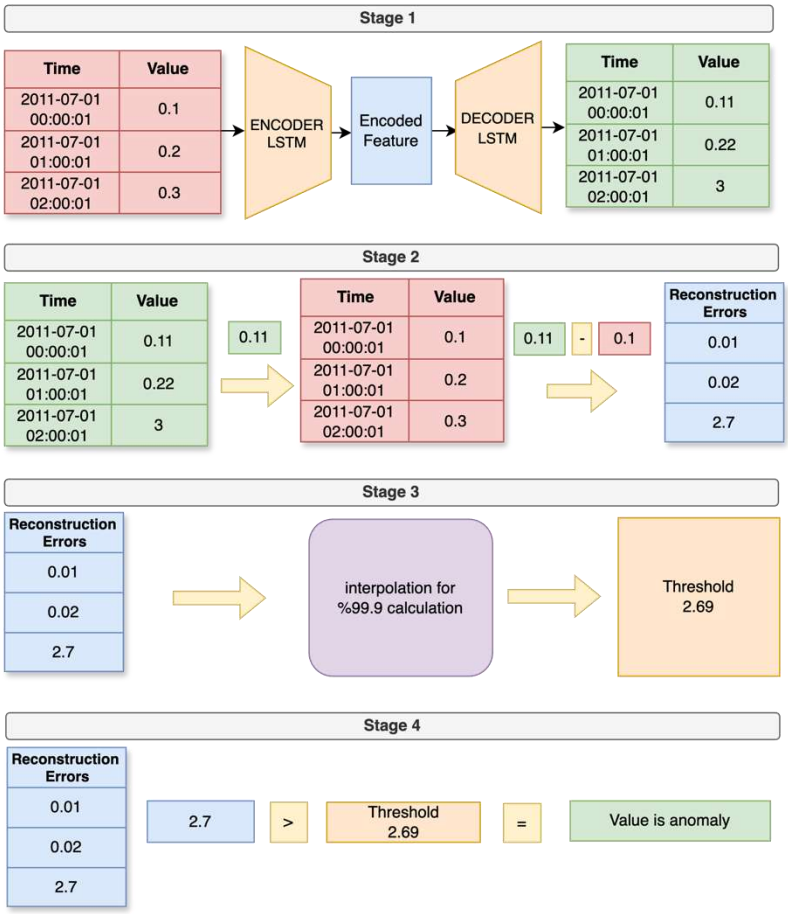


Figure 1. An overview of the components and stages of the proposed approach.

The LSTM-Ae model (Wei et al., 2023) is used in the first stage of the proposed method. LSTM is a particular type of RNN. It was developed to solve the vanishing gradient problem, which causes the problem of learning long-term dependencies (Md et al., 2023). The vanishing gradient problem refers to the loss of the network's ability to learn long-term dependencies due to the shrinkage of gradients during backpropagation in the RNN. The LSTM architecture overcomes this problem by efficient learning of long-term dependencies with the help of unique gate mechanisms (Lindemann et al., 2021). The LSTM-Ae is a type in which the encoding and decoding are composed of an LSTM network (Zha et al., 2022). In this model, the input data is compressed into latent space by the encoder and then decompressed back to its original size by the decoder. The decoder's output is compared to the original input, and the difference is used to update network parameters so the system can learn a better representation (Nguyen et al., 2021; X. Xu & Yoneda, 2021)

In the second stage, the reconstruction errors between the data generated by the LSTM-Ae and the original data were calculated. In the third stage, a threshold value was determined by calculating the 99.9th percentile on these errors. This threshold will be used to distinguish between normal and abnormal data points. In the final stage, the reconstruction errors calculated in the second stage were compared with the threshold value calculated in the third stage. As a result of the comparison, reconstruction errors exceeding the threshold value are marked as anomalies.

After AD with the LSTM Autoencoder, AD was performed using the TimeGPT model using the same data. TimeGPT is the first basic model designed for TS. This model can produce accurate predictions and AD in many data sets it has never seen during training. Using a Transformer structure designed for TSA, TimeGPT is trained on an extensive TS collection of more than 100 billion data from many fields such as finance, economy, health, weather, IoT sensor data, energy, web traffic, sales, transportation, and banking. Unlike conventional forecasting methods, TimeGPT has zero-shot inference, i.e., it does not require retraining for new data sets. This feature significantly speeds up and simplifies the AD process (Garza et al., 2023).

3. Experimental Setting

In this section, the dataset used in the study is introduced in detail, then the hyperparameters of the developed model are explained and information about the performance metrics is provided. The Numenta Anomaly Benchmark (NAB) dataset consists of 58 manually labeled data files and 365,558 data points for detecting anomalies in time series data. This dataset includes measurements collected from domains such as IT measurements, industrial machine sensors, and social media data. In addition, some artificially generated data files are added to this set. The NAB dataset is used as a standard benchmark to evaluate the performance of anomaly detection algorithms. In this study, the realAdExchange dataset in the NAB dataset is used, which is shown in Table 1. This dataset contains online ad click-through rates. Table 1 shows the total number of data points and the number of manually marked anomalies in each dataset. The total number of data points in the datasets varies between 1538 and 1643. The total number of anomalies varies between 1 and 4 (Ahmad et al., 2017).

Table 1. Total number of data points and anomalies of NAB datasets.

Acronyms	Datasets	# Data	# Anomalies
Dataset#1	exchange-2_cpm_results	1623	2
Dataset#2	exchange-3_cpc_results	1538	3
Dataset#3	exchange-3_cpm_results	1538	1
Dataset#4	exchange-4_cpc_results	1643	3
Dataset#5	exchange-4_cpm_results	1643	4

Table 2 shows the common hyperparameters of the LSTM-Ae model applied to the five data sets. Mean Square Error (MSE) is used as the loss function in these parameters. The Adam optimizer optimization algorithm was chosen to optimize the training process of the model. The maximum number of epochs was set to 100, and the ReLU activation function was applied. The early stopping method was applied to prevent overlearning during training, and training was stopped when no progress was made for ten epochs. With this hyperparameter configuration, the learning capacity of the model was optimized. For each data set, the time step that provides the best prediction performance was determined. For example, for the Dataset#5 dataset, 10-time steps gave optimal results, while a one-time step for Dataset#1 and five-time steps for Dataset#3 was sufficient. Two-time steps were preferred for the Dataset#4 and Dataset#2 datasets.

Table 2. Hyperparameters of the LSTM-Ae model and their descriptions.

Hyperparameters	Type/Value	Description
loss	MSE	Loss function used MSE
optimizer	Adam	Optimization algorithm used Adam optimizer
activation	ReLU	Activation function used in LSTM layers
epochs	100	Maximum number of training epochs
early_stopping_patience	10	Number of epochs with no improvement after which training will be stopped
early_stopping_min_delta	0.001	Minimum change in the monitored quantity to qualify as an improvement

A confusion matrix is a structure consisting of four components that indicate the performance of a model. True Positives (TP) represent correctly detected anomalies and False Positives (FP) represent normal cases that are incorrectly classified as anomalies. True Negatives (TN) represent correctly detected normal conditions and False Negatives (FN) represent missed, undetected anomalies. Micro precision, recall, and F1-score (Karaoglan & Findik, 2024) metrics were used to measure the performance of LSTM-Ae and TimeGPT models.

$$Precision = \frac{TP}{TP+FP} \tag{1}$$

$$Recall = \frac{TP}{TP+FN} \tag{2}$$

$$F1\ Score = \frac{2\times Precision\times Recall}{Precision+Recall} \tag{3}$$

4. Experimental Results and Discussion

This section is devoted to the results and discussions of experimental studies on the LSTM-Ae and TimeGPT models to perform the AD task. In this context, the chapter presents data on the training and validation processes of the LSTM-Ae model. In addition, graphical results of the anomalies detected by TimeGPT and LSTM-Ae models at the end of training are presented. In addition, the performance results of both models based on performance metrics are also evaluated. Figure 2 shows the training and validation loss changes for the LSTM-Ae model for five data sets at different epoch intervals. The training loss (blue line) represents the model's error rate during the training process. The Dataset#1 graph shows the rapid decrease in training and validation losses in the first epochs, indicating that the model learns quickly. From the fourth epoch onwards, the training and validation losses converge and almost overlap, showing the model has good generalization ability. After the sixth epoch, the losses stabilize at a meager value, indicating that the model has reached the optimum point. In all models, the losses stabilize after several epochs, indicating that the models converge, and the risk of overlearning is low.

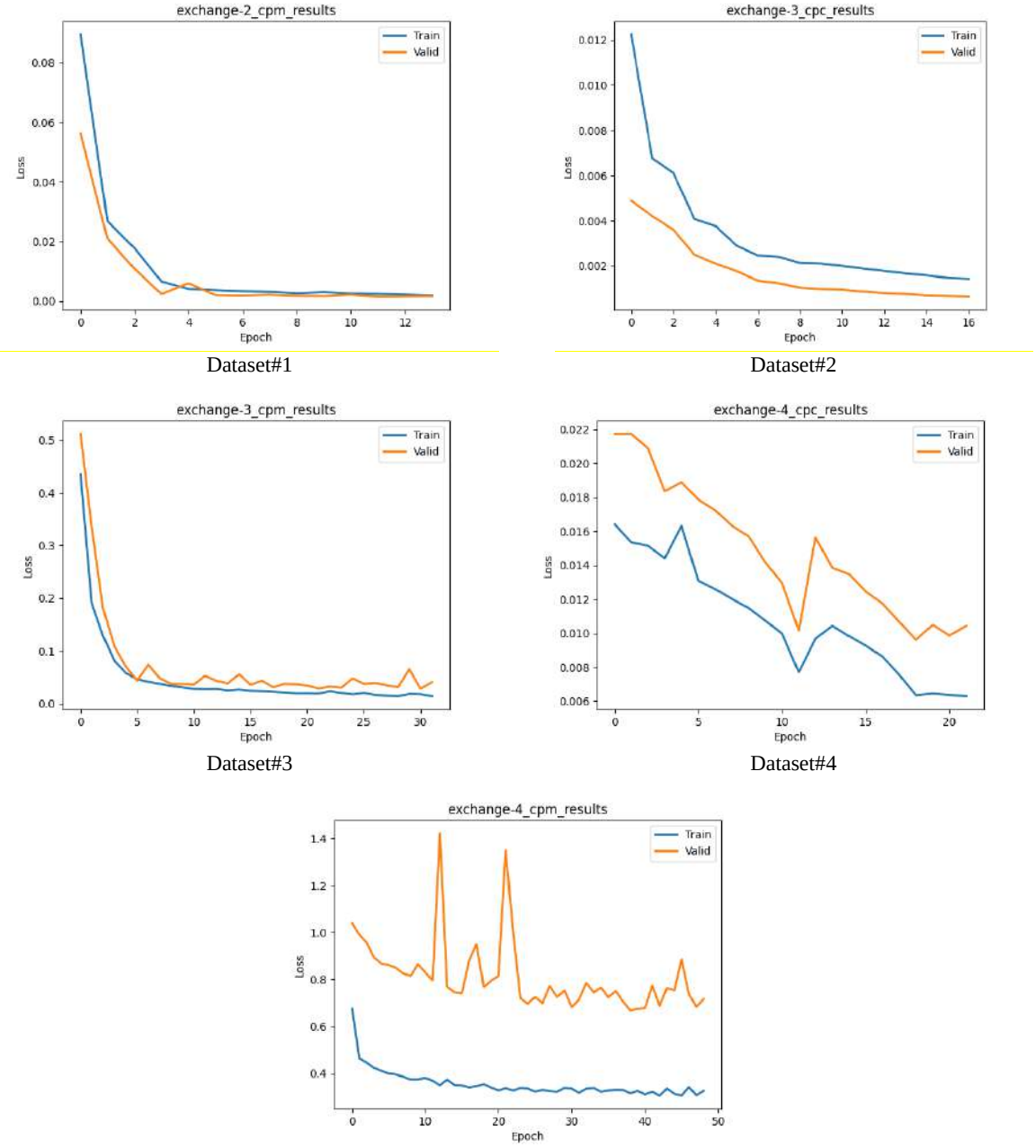


Figure 2. Training and validation loss curves of the LSTM-Ae model for each dataset.

Figure 3 shows the AD results of the LSTM Autoencoder, and TimeGPT models on the Dataset#1 dataset. The x-axis of the graph represents the timestamp and extends from July 1, 2011, to September 1, 2011. The y-axis shows a value scale ranging from 0 to 1. The blue line represents value changes over time. The colored dots in the graph represent the various states of AD: green dots (TP) represent correctly detected anomalies, red dots (FP) represent false positives, and orange dots (FN) represent undetected anomalies. In the dataset Dataset#1, the LSTM-Ae model detected two anomalies, only one of which was correct. On the other hand, the TimeGPT model failed to detect any anomaly.

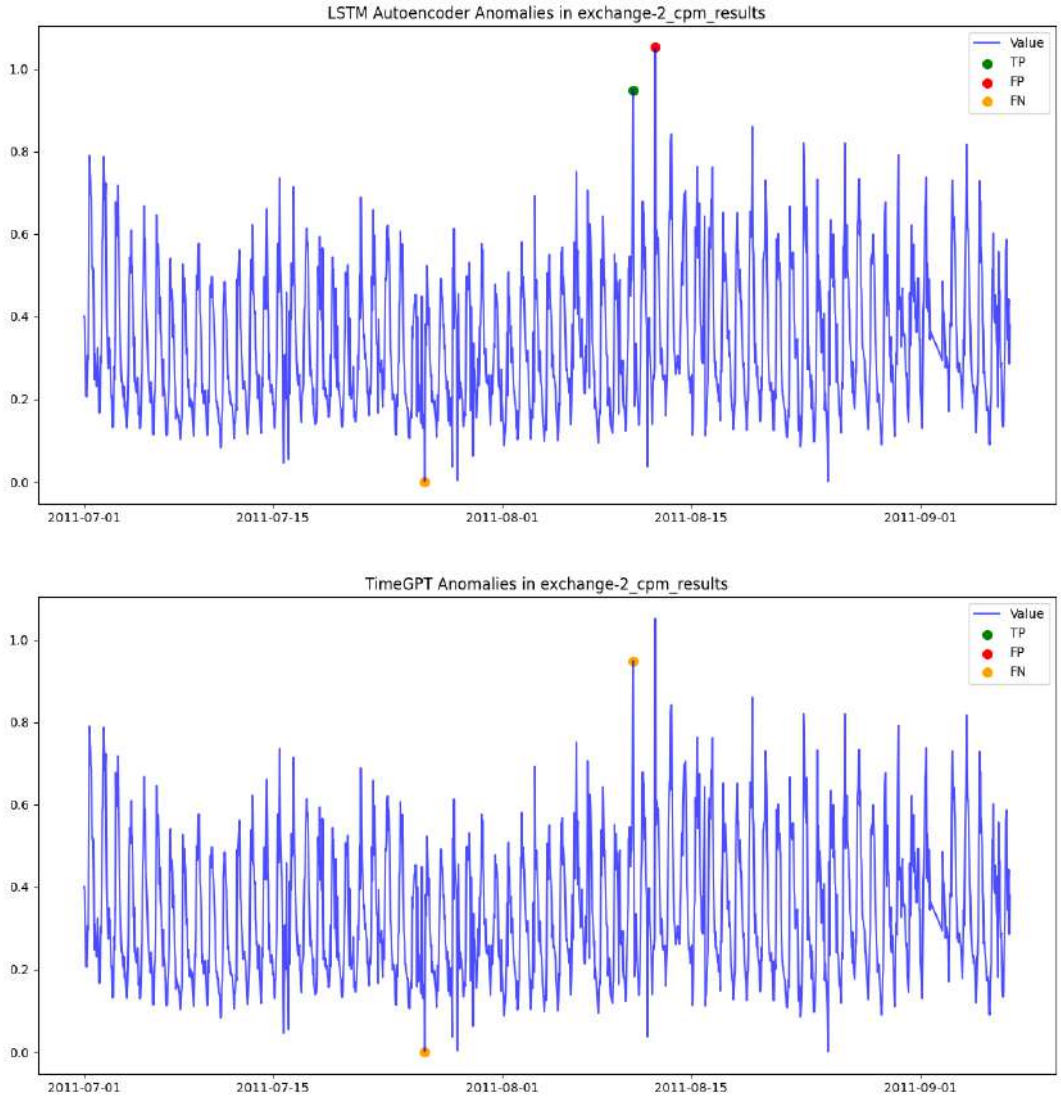


Figure 3. LSTM-Ae and TimeGPT anomalies in Dataset#1.

Figure 4 shows the AD results of the LSTM-Ae and TimeGPT models on the Dataset#2 dataset. There are three anomalies in this dataset. The LSTM-Ae model detected two anomalies, only one of which is correct. The TimeGPT model detected eight anomalies and two of them were correct.

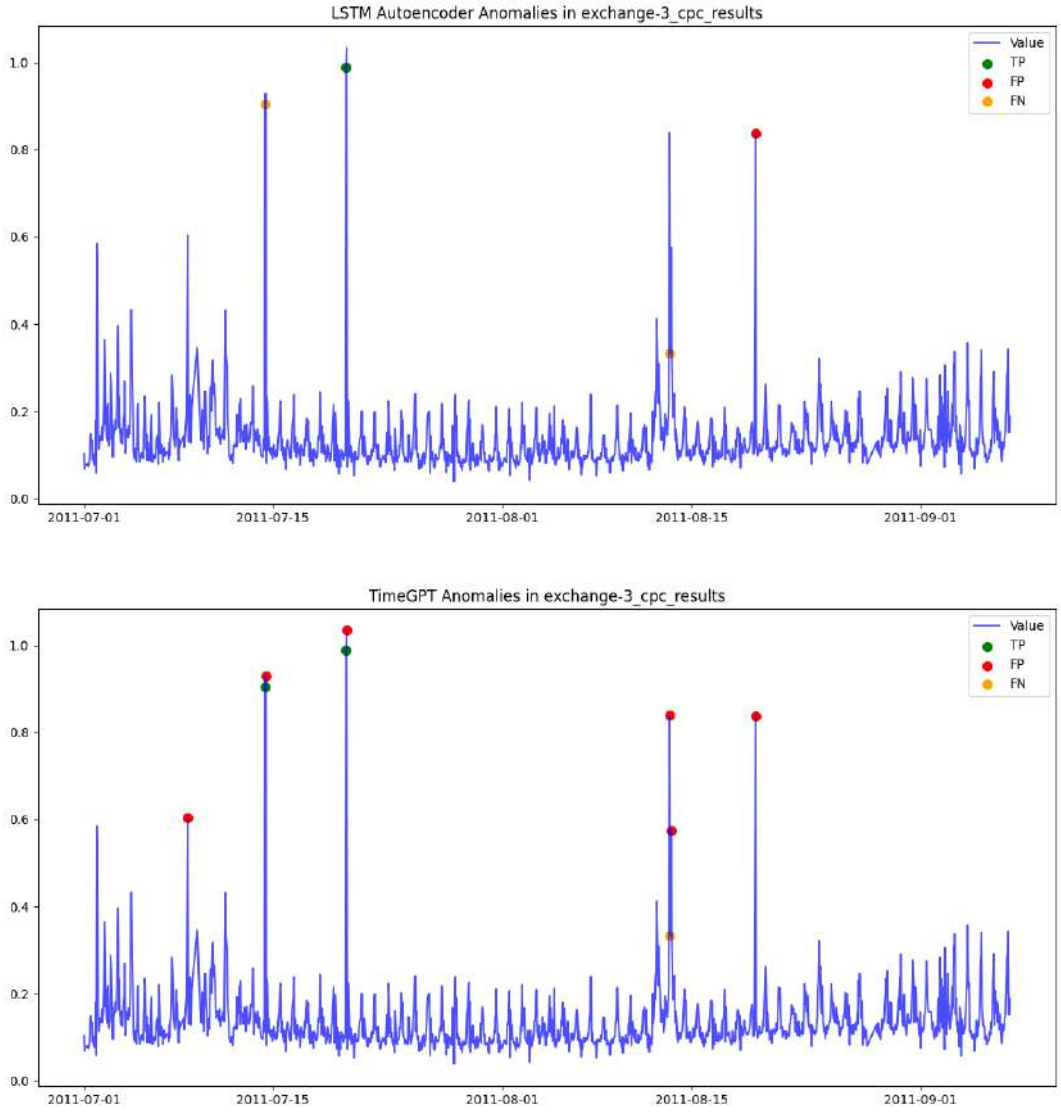


Figure 4. LSTM-Ae and TimeGPT anomalies in Dataset#2.

Figure 5 shows the AD results of the LSTM-Ae and TimeGPT models on the Dataset#3 dataset. There is only one anomaly in this dataset. The LSTM-Ae model detected two anomalies, only one of which is correct. The TimeGPT model detected three anomalies and one of them was correct

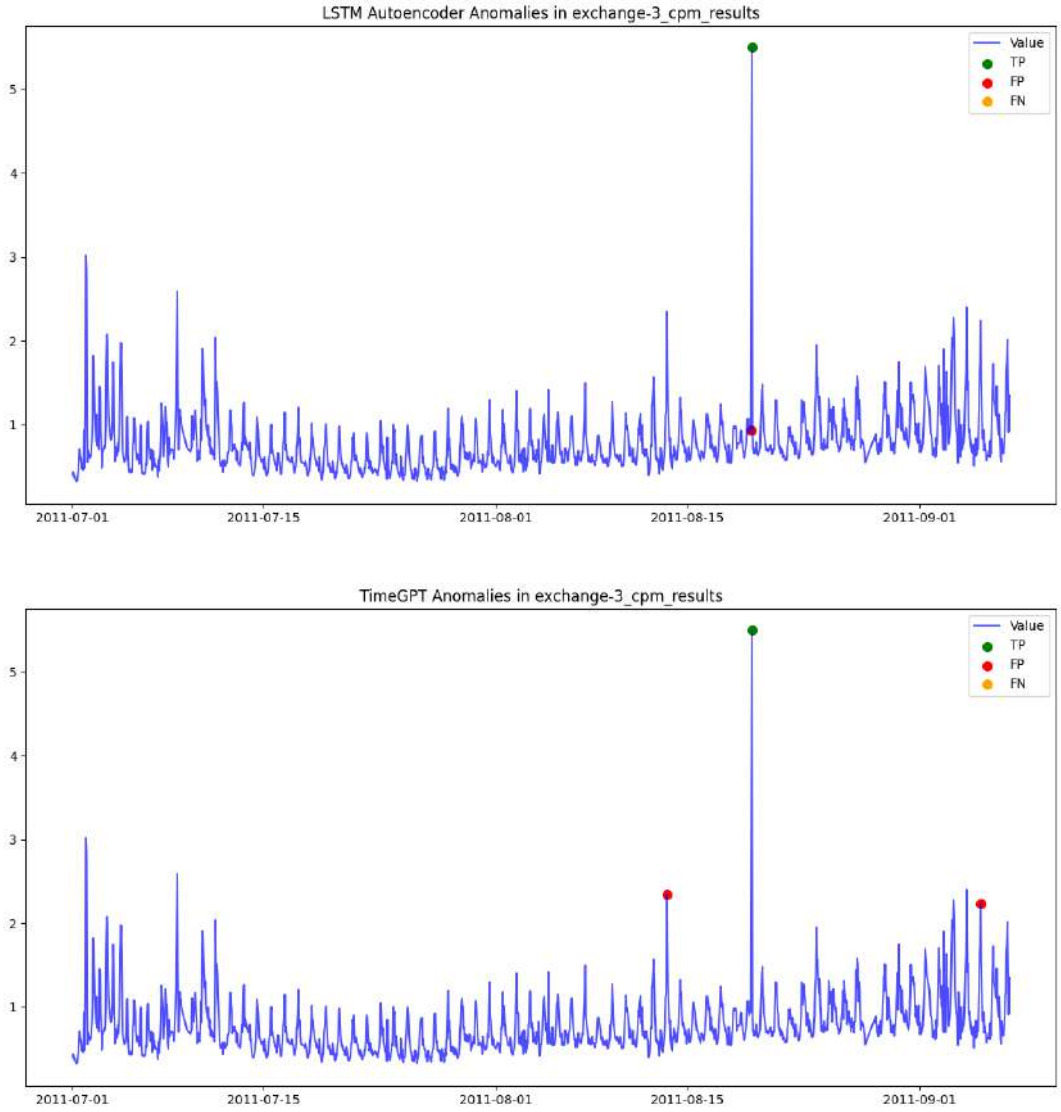


Figure 5. LSTM-Ae and TimeGPT anomalies in Dataset#3.

Figure 6 shows the AD results of the LSTM-Ae and TimeGPT models on the Dataset#4 dataset. There are three anomalies in this dataset. The LSTM-Ae model detected two anomalies, and both anomalies are correct. The TimeGPT model detected eight anomalies and only two of them were indeed anomalies.

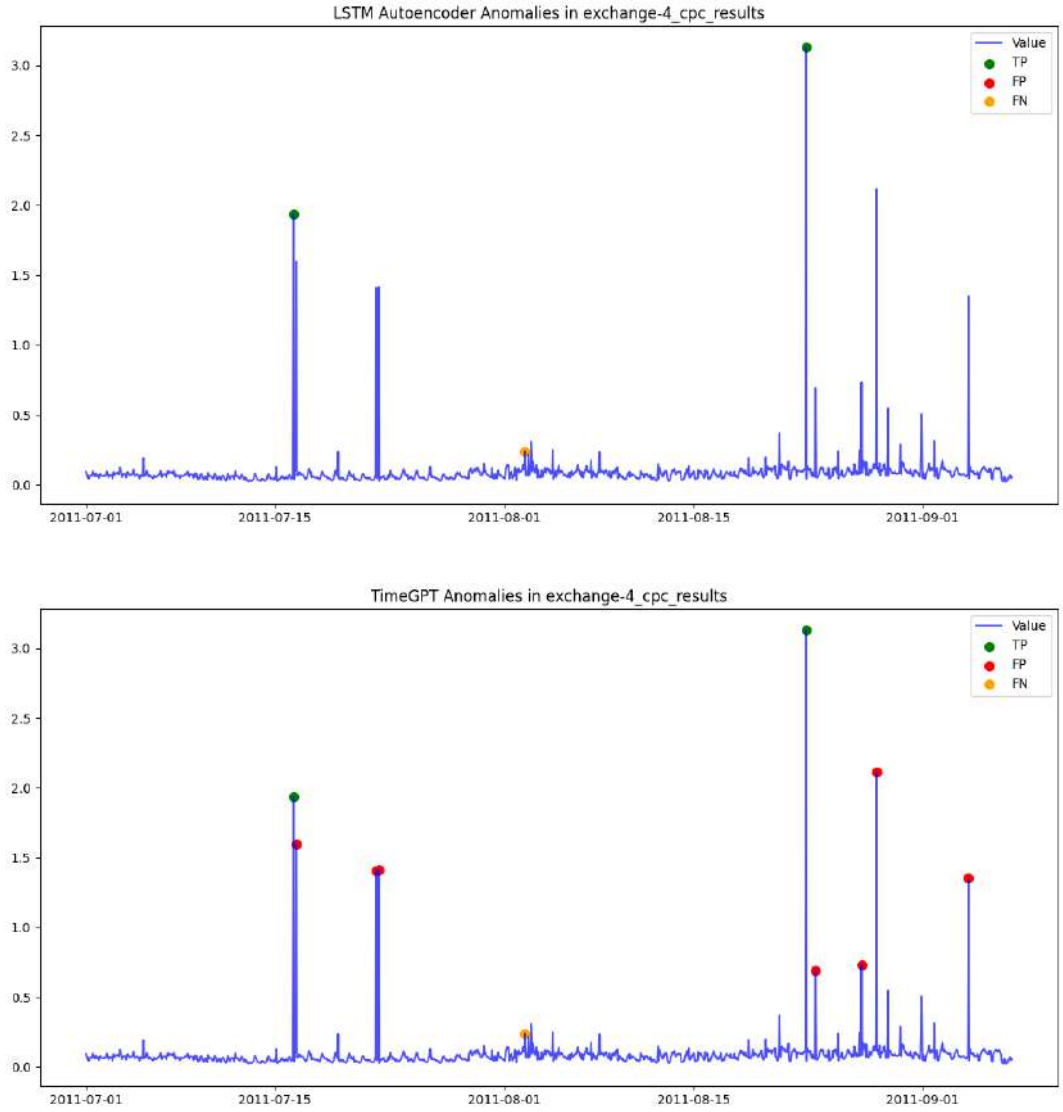


Figure 6. LSTM-Ae and TimeGPT anomalies in Dataset#4.

Figure 7 shows the AD results of the LSTM-Ae and TimeGPT models on the Dataset#5 dataset. There are four anomalies in this dataset. The LSTM-Ae model detected two of the four correct anomalies. The TimeGPT model detected seven anomalies and three of them were correctly identified.

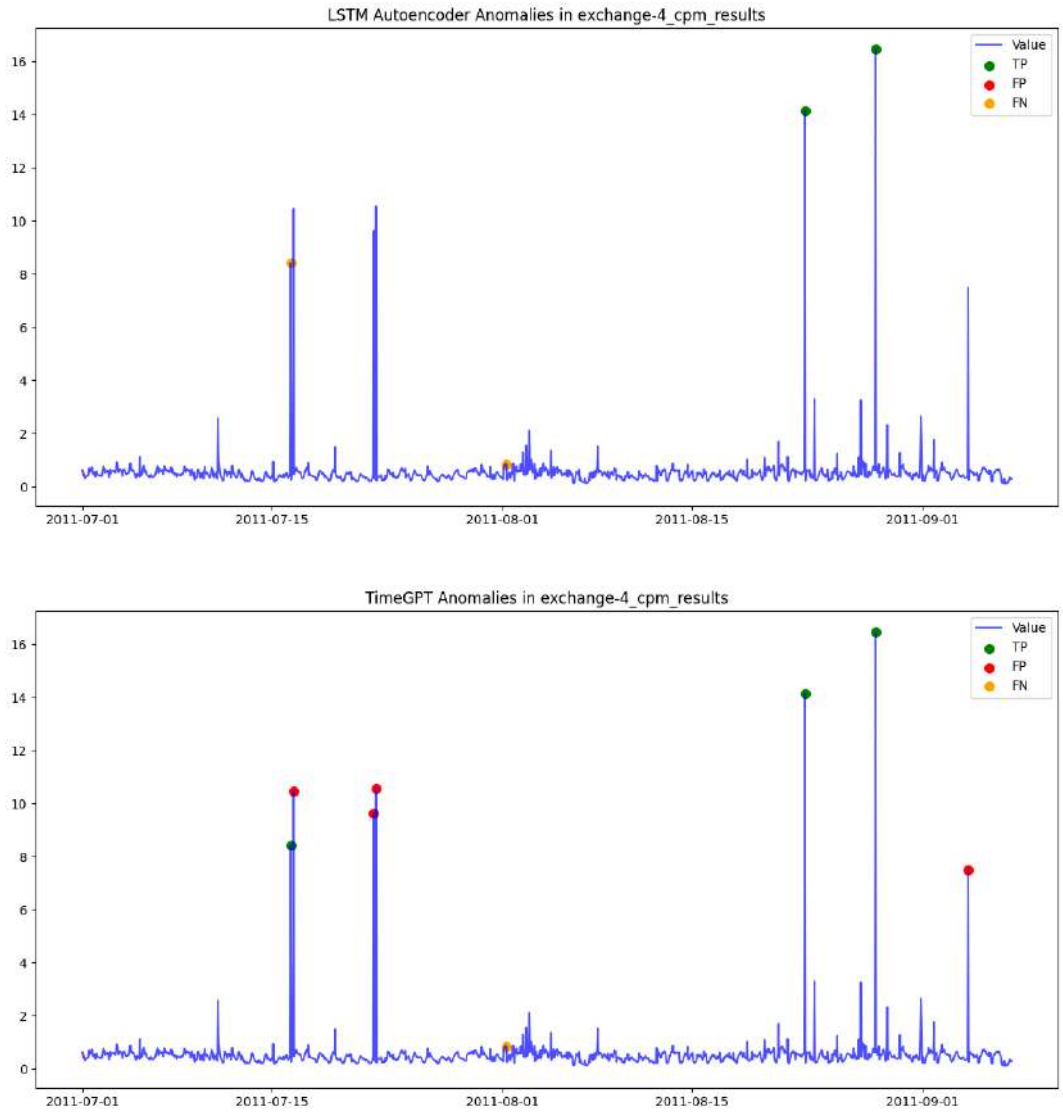


Figure 7. LSTM-Ae and TimeGPT anomalies in Dataset#5.

Figure 8 shows the performance of the LSTM-Ae and TimeGPT models on the datasets. F1-score, precision and recall values are presented for both models. The LSTM-Ae model detected anomalies for all data sets. The TimeGPT model failed to detect anomalies only for the Dataset#1 dataset. In general, the performance of the two models varies depending on the dataset and different results are obtained for each metric in different datasets.

Table 3 shows the results of various metrics evaluating the anomaly detection performance of the LSTM-Ae and TimeGPT models. This table shows the F1 score, precision and recall values obtained by both models on different datasets.

Table 3. Performance results of metrics for LSTM-Ae and TimeGPT models.

Dataset	LSTM Ae			TimeGPT		
	F1	**Precision**	**Recall**	**F1**	**Precision**	**Recall**
Dataset#1	0.50	0.50	0.50	NA	NA	NA
Dataset#2	0.40	0.50	0.33	0.36	0.25	0.60
Dataset#3	0.67	0.50	1.00	0.50	0.30	1.00
Dataset#4	0.80	1.0	0.66	0.33	0.22	0.66
Dataset#5	0.67	1.00	0.50	0.55	0.43	0.75

As a result of this study, both models have strong points. However, their performances vary depending on the dataset used. The LSTM-Ae model has high results in all datasets and reached the highest value with an F1 score of 0.80 in the Dataset#4 dataset. The fact that no result was obtained in the Dataset#1 dataset for the TimeGPT model indicates that this model may have potential applicability problems in some data structures. This situation emphasizes that care should be taken in the use of the TimeGPT model and explains the importance of the dataset features in model selection. Studies conducted on different datasets show that there is no single solution for AD. Future studies should focus on investigating the factors affecting the performance of these models. In addition, hybrid models that combine the consistency of the LSTM-Ae model with the high recall potential of the TimeGPT model can be developed to create AD applications that provide better results.

5. Conclusion

This study compares the AD performance of LSTM-Ae and TimeGPT models with experiments on NAB datasets. AD refers to identifying outliers and patterns outside the expected behavior and plays a critical role in analyzing TS data and decision support systems. This task is vital for the early detection of operational risks and security threats in finance, healthcare, and industrial systems. Deep learning techniques have been increasingly used to analyze complex TS data in recent years. In this context, LSTM networks have a high potential to capture long-term dependencies in TS data.

In this study, the AD performances of the LSTM-Ae and TimeGPT models are evaluated through experiments using different data sets in the NAB dataset. The results show that both models exhibit different performances in AD on various data sets. According to the results of the experimental studies, the LSTM-Ae model showed the highest performance with an F1 score of 0.80 on the Dataset#4 dataset. This model also performed well on the Dataset#3 dataset with an F1 score of 0.67. However, in the Dataset#1 dataset, only a limited success was achieved with an F1 score of 0.50. When Precision and Recall values were analyzed, it was observed that the LSTM Ae model achieved a high accuracy rate by reaching 1.0 in the Dataset#4 dataset. On the other hand, the TimeGPT model has a lower performance with an F1 score of 0.36 in the Dataset#2 dataset and an F1 score of 0.33 in the Dataset#4 dataset. In general, the TimeGPT model failed to detect any anomalies on the Dataset#1 dataset, indicating that the model may produce limited applicability to specific data structures.

As a result, the performance of both models varies significantly depending on the data set, suggesting that there is no single general solution for TS-AD. These findings emphasize the need to consider data characteristics in model selection in AD. Moreover, this study is among the pioneering studies that incorporate the TimeGPT approach and evaluate its performance on a large dataset.

Future work should focus on model improvements to improve the performance of the TimeGPT model as well as the development of hybrid systems using a combination of models such as LSTM-Ae and TimeGPT. This could contribute to the creation of more effective AD methods and enable the development of applications in various fields.

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ORAL PRESENTATION

Identification of Critical Factors for Risk Assessment Studies in Pharmaceutical Warehouses

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Abstract

Activities conducted in pharmaceutical warehouses to eliminate conditions that may harm health, create a safer working environment and minimize work-related accidents fall within the scope of occupational health and safety. Risk assessment is essential for the management of occupational health and safety in pharmaceutical warehouses. The aim of this study is to identify the specific dimensions required to evaluate occupational health and safety practices in pharmaceutical warehouses within the scope of risk assessment and to carry out a prioritization study among these dimensions. For this purpose, a multi-criteria analysis has been proposed to determine which criteria should be considered first, on behalf of the criteria determined as a result of the literature and expert opinions. Within the scope of this analysis, fuzzy sets have been used in order to best reflect the uncertainty inherent in the risk factors and decision process into the decision model. After the risk factors have been determined, decision makers who are the experts in the related area have been requested to evaluate the importance of the criteria relative to each other. These evaluations, provided with linguistic expressions, have been evaluated with the help of the type-2 interval fuzzy AHP method, and the factors that should be taken into consideration as a priority in the risk analysis studies to be carried out in order to create a healthy working environment in pharmaceutical warehouses have been determined. This study points to a significant gap in literature and will serve as a guide for future studies to be carried out in both warehouses and drug-related storage areas.

Keywords: AHP, Pharmaceutical Warehouses, Risk Assessment, Type-2 Interval Fuzzy Sets.

1. Introduction

Activities conducted in pharmaceutical warehouses to eliminate conditions that may harm health, create a safer working environment and minimize work-related accidents fall within the scope of occupational health and safety. Risk assessment plays an important role in managing occupational health and safety in many areas, including pharmaceutical warehouses. The process of analyzing the risks connected to each identified hazard in order to understand its nature, that is, the kind of harm that could result from the hazards, the extent of that harm, and the possibility that it may occur—is known as risk assessment. In addition to being morally and legally required, taking steps to protect workers' health and safety at

work also significantly affects both individual and organizational performance. Therefore, a risk assessment of the workplace is necessary for the effective implementation of environmental and workplace health and safety measures. One of the most significant commercial settings where risk analysis should be done to implement efficient occupational health and safety procedures is pharmaceutical warehouses (Taşçı, 2018). The aim of this study is to identify the specific dimensions required to evaluate occupational health and safety practices in pharmaceutical warehouses within the scope of risk assessment and to carry out a prioritization study among these dimensions. For this purpose, a multi-criteria analysis has been proposed to determine which criteria should be considered first, on behalf of the criteria determined as a result of the literature and expert opinions. Within the scope of this analysis, fuzzy sets have been used to best reflect the uncertainty inherent in the risk factors and decision process into the decision model. After the risk factors have been determined, decision makers who are experts in the related area have been requested to evaluate the importance of the criteria relative to each other. The evaluations, expressed using linguistic terms, were analyzed through the type-2 interval fuzzy Analytic Hierarchy Process (AHP) method. As a result, the key factors that should be prioritized in risk analysis studies aimed at ensuring a safe working environment in pharmaceutical warehouses have been identified. This study points to a significant gap in literature and will serve as a guide for future studies to be carried out in both warehouses and drug-related storage areas.

The following sections are organized as follows. Section 2 includes the relevant literature about the working topic. Section 3 gives the adopted methodology. Section 4 presents the real case analysis and finally Section 6 gives conclusion and future directions.

2. Literature Review

Within the scope of the study, detailed literature research has been applied to examine the papers conducted in pharmaceutical warehouses. With just a few research completed in pharmaceutical warehouses, risk analysis studies for pharmacies with adjacent working spaces have been also investigated, but again, very few studies have been found in this area. Tools such as fuzzy logic are not sufficiently utilized in modeling uncertainty in risk assessment studies. Furthermore, it became evident that existing literature predominantly considers risk within the pharmaceutical supply chain, lacking comprehensive insights into the intricacies of risks within the working environments of pharmacies and pharmaceutical warehouses. Some of the studies that can be references for this paper are summarized as follows. Yimenu et al. (Yimenu et al., 2021) evaluated the warehouse management practices of commercial pharmaceutical wholesalers in Gondar, Ethiopia. Masoumbeigi et al. (Masoumbeigi et al., 2021) looked into the evaluation and use of the principles of passive defense in hospital food and drug warehouses. Dilliard et al. (Dilliard et al., 2021) aimed to summarize and compare pharmacists' opinions about workplace patient safety according to practice setting type, duties played by pharmacists, average hours worked per shift, and average hours worked per week. Abideen and Mohamad (Abideen & Mohamad, 2020) implemented value stream mapping (VSM) in the manufacturing warehouse for pharmaceuticals in Malaysia. Tat et al. (Tat et al., 2020) examined a single pharmaceutical supplier and a single pharmaceutical retailer carrying a single kind of fixed shelf-life medication comprise a two-echelon pharmaceutical supply chain. Özkan et al.(Özkan et al., 2017) presented a goal programming approach with a fuzzy foundation to reduce risk in the pharmaceutical supply chain. Apart from all these studies, this study examines the specific dimensions needed to assess pharmaceutical warehouse occupational health and safety procedures as part of risk assessment, and to prioritize these factors.

3. Materials and Methods

The AHP was created by Thomas L. Saaty (Saaty, 1980). AHP considers qualitative factors in the assessment procedure and contrasts them with the paired comparison method and allows the criterion weights to be calculated analytically (Erdoŀan & Kaya, 2016a; Saaty, 1980). Zadeh created type-2 fuzzy sets as an expansion of type-1 fuzzy sets. When it is impossible to pinpoint the precise membership function of a fuzzy set, this kind of fuzzy set—which has membership degrees that are type-1 fuzzy sets—is highly helpful (Erdoŀan & Kaya, 2016a; N. Karnik & M. Mendel, 2001; Zadeh, 1965). The upper and lower membership functions in the interval type-2 fuzzy set theory would provide some leeway to highlight the high degree of impreciseness and vagueness of the real-life situations (Kayapinar Kaya & Aycin, 2021). In order to determine the criteria weights that more accurately reflect the uncertainties, the AHP approach is used in this study in the context of interval type-2 fuzzy sets. The suggested interval type-2 fuzzy AHP approach involves these steps (Erdoŀan & Kaya, 2016b, 2016a):

Step 1: Create a decision hierarchy with criteria and sub-criteria.

Step 2: A scale is chosen to assess the criteria. Table 1 displays the scale that this paper uses to translate language concepts into interval type-2 fuzzy sets.

Table 1. Linguistic words and corresponding interval type-2 fuzzy number.

Linguistic Term	**Interval Type-2 Fuzzy Number**											
Equal (E)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.9	0.9
Slightly Strong (SS)	1.0	2.0	4.0	5.0	1.0	1.0	1.1	2.1	3.9	4.9	0.9	0.9
Fairly Strong (FS)	3.0	4.0	6.0	7.0	1.0	1.0	3.1	4.1	5.9	6.9	0.9	0.9
Very Strong (VS)	5.0	6.0	8.0	9.0	1.0	1.0	5.1	6.1	7.9	8.9	0.9	0.9
Absolutely Strong (AS)	7.0	8.0	9.0	9.0	1.0	1.0	7.1	8.1	8.9	8.9	0.9	0.9
1/AS	0.1	0.1	0.1	0.1	1.0	1.0	0.1	0.1	0.1	0.1	0.9	0.9
1/VS	0.1	0.1	0.2	0.2	1.0	1.0	0.1	0.1	0.2	0.2	0.9	0.9
1/FS	0.1	0.2	0.3	0.3	1.0	1.0	0.1	0.2	0.2	0.3	0.9	0.9
1/SS	0.2	0.3	0.5	1.0	1.0	1.0	0.2	0.3	0.5	0.9	0.9	0.9

Step 3. For every criterion, pairwise comparison matrices are generated in the hierarchy. One way to generate a fuzzy pairwise comparison matrix is as follows:

$$\tilde{\tilde{A}} = \begin{bmatrix} 1 & \tilde{\tilde{a}}_{12} & \dots & \dots & \tilde{\tilde{a}}_{1m} \\ \tilde{\tilde{a}}_{21} & 1 & \dots & \dots & \tilde{\tilde{a}}_{2m} \\ : & : & \dots & \dots & : \\ : & : & \dots & \dots & : \\ \tilde{\tilde{a}}_{1n} & \tilde{\tilde{a}}_{2n} & \dots & \dots & 1 \end{bmatrix} \quad (1)$$

$$\tilde{\tilde{a}}_{ij} = \frac{1}{\tilde{\tilde{a}}_{ji}} \quad (2)$$

For example; $\tilde{\tilde{a}}_{31} = \frac{1}{\tilde{\tilde{a}}_{13}}$

$$\tilde{\tilde{a}} = ((a_{11}^U; a_{12}^U; a_{13}^U; a_{14}^U; H_1(a^U); H_2(a^U)), (a_{11}^L; a_{12}^L; a_{13}^L; a_{14}^L; H_1(a^L); H_2(a^L)) \quad (3)$$

So,

$$\frac{1}{\tilde{\tilde{a}}} = ((\frac{1}{a_{14}^U}; \frac{1}{a_{13}^U}; \frac{1}{a_{12}^U}; \frac{1}{a_{11}^U}; H_1(a_{12}^U); H_2(a_{13}^U), (\frac{1}{a_{14}^L}; \frac{1}{a_{13}^L}; \frac{1}{a_{12}^L}; \frac{1}{a_{11}^L}; H_1(a_{12}^L); H_2(a_{13}^L)) \quad (4)$$

Step 4. Every comparison matrix is defuzzified, and the consistency index is determined. The following formulas can be used to compute the consistency ratio. The pairwise comparison matrices are consistent if and only if the consistency index (CI) is less than 0.1.

$$CI = \frac{\lambda_{\max} - n}{n-1} \quad (5)$$

$$CR = \frac{CI}{RI} \quad (6)$$

"n" is the is the number of criteria which are compared and RI is the random index which varies randomly according to the criteria number

Step 5. For every criterion, the geometric mean is computed.

$$\tilde{\tilde{r}}_i = [\tilde{\tilde{a}}_{i1} \otimes \tilde{\tilde{a}}_{i2} \otimes \ldots \otimes \tilde{\tilde{a}}_{im}]^{1/n} \quad (7)$$

$$(\tilde{\tilde{a}}_{ij})^{1/n} = ((\tilde{\tilde{a}}_{i1}^U)^{1/n}; (\tilde{\tilde{a}}_{i2}^U)^{1/n}; (\tilde{\tilde{a}}_{i3}^U)^{1/n}; (\tilde{\tilde{a}}_{i4}^U)^{1/n}; H_1(a_{i2}^U); H_2(a_{i3}^U), (\tilde{\tilde{a}}_{i1}^L)^{1/n}; (\tilde{\tilde{a}}_{i2}^L)^{1/n}; (\tilde{\tilde{a}}_{i3}^L)^{1/n}; (\tilde{\tilde{a}}_{i4}^L)^{1/n}; H_1(a_{i2}^L); H_2(a_{i3}^L)) \quad (8)$$

Step 6. The procedure of normalizing is used to calculate the criterion weights.

$$w_i = \tilde{\tilde{r}}_i = [\tilde{\tilde{r}}_1 \oplus \tilde{\tilde{r}}_2 \oplus \ldots \oplus \tilde{\tilde{r}}_n]^{-1} \quad (9)$$

Step 7. To ascertain the relative relevance of the criteria, defuzzify the fuzzy numbers.

$$\mathcal{D}\left(\tilde{\tilde{A}}_1\right) = \frac{1}{8}\left(a_{11}^U + \left(H_1\left(\tilde{A}_1^U\right) \times a_{12}^U\right) + \left(H_2\left(\tilde{A}_1^U\right) \times a_{13}^U\right) + a_{14}^U + a_{11}^L + \left(H_1\left(\tilde{A}_1^L\right) \times a_{12}^L\right) + \left(H_2\left(\tilde{A}_1^L\right) \times a_{13}^L\right) + a_{14}^L\right) \quad (10)$$

4. Real Case Analysis

In this paper, the factors to be considered to evaluate occupational health and safety practices in pharmaceutical warehouses within the scope of risk assessment and to carry out a prioritization study among these factors. First of all, detailed literature research is carried out and which factors are considered in the risk analysis process of the pharmaceutical warehouses. Then, the experts whose evaluations are taken in this decision problem are determined and interviews are made with each expert and their evaluations about the criteria through a questionnaire. Six criteria are determined for the decision-making process such as C1: Human, C2: Equipment and Material, C3: Environmental, C4: Management, C5: Social and C6: Macro Level. Our decision-makers consist of three experts as decision-

makers who have previously sought solutions to risk analysis for pharmaceutical warehouses. As an example, evaluations of the Expert - 1 is presented in Table 2.

Table 2. Evaluations of Expert-1.

	C1	C2	C3	C4	C5	C6
C1	E	SS	FS	FS	VS	1/SS
C2	1/SS	E	SS	FS	FS	1/SS
C3	1/FS	1/SS	E	SS	VS	1/FS
C4	1/FS	1/FS	1/SS	E	SS	1/VS
C5	1/VS	1/FS	1/VS	1/SS	E	1/VS
C6	SS	SS	FS	VS	VS	E

After the evaluations are taken from decision makers, all the pairwise comparison matrices are checked whether they are consistent or not. The consistency degrees for each matrix are shown in Table 3.

Table 3. Consistency Degrees for evaluations of experts.

Consistency Degree	Expert-1	Expert-2	Expert-3
Criteria Matrix	0.093686	0.085551	0.095976

After each pairwise comparison matrix have been evaluated consistently; the weights of the determined dimensions have been determined by running interval type-2 fuzzy AHP steps. Firstly, the evaluations of three different experts have been aggregated via geometric mean calculation. Then, the geometric mean function is utilized again for every criterion. The decision matrix is normalized after the geometric mean calculation and the normalization procedure is conducted for criteria weights. As a result of all these operations, interval type-2 fuzzy numbers are defuzzified and the ranking of the criteria is obtained as in Table 4.

Table 4. Ranking of criteria.

	Defuzzified Values	Normalized Values	Ranking
C1	0.24	0.211	**2**
C2	0.24	0.208	**3**
C3	0.18	0.158	**4**
C4	0.07	0.063	**5**
C5	0.04	0.034	**6**
C6	0.38	0.326	**1**

The first criterion that has been came up is found to be "macro level". The macro level element includes hazards including natural disasters, terrorist attacks, pandemics, and financial threats that are outside of the pharmaceutical warehouse's direct control. Even though these occurrences might not be predicted, it is essential to create backup plans and modify safety procedures in order to reduce the impact on warehouse operations and guarantee the security of both workers and pharmaceuticals. The least important dimension is also defined as “social” factor.

5. Conclusion and Future Directions

Risk assessment is becoming more and more crucial to the effective prevention and management of illnesses and hazards associated to the workplace. Evaluating risks and hazards in corporate environments is one of the most important parts of taking on a risk analysis process. When it comes to implementing effective occupational health and safety standards, pharmaceutical warehouses rank among the most important locations for risk assessments. Risk identification, analysis, planning, and management in pharmaceutical warehouses should all go through a thorough evaluation process. Based on this purpose, in this study, we determined which factors should be addressed as a priority to evaluate occupational health and safety practices in the pharmaceutical warehouse within the scope of risk assessment. The AHP method, one of the most popular multi-criteria decision making (MCDM) methods for prioritization studies, has been implemented with interval type-2 fuzzy numbers, taking into account the uncertainty in decision making process. As a result of the multi-criteria analysis, macro-level factors have been identified as the factors that should be addressed as a priority in risk assessment studies in warehouses, while social factors have been found to be the least important criteria.

In future studies, weights can be recalculated using different MCDM methods and comparison analysis can be performed. In addition, the effect of fuzzy sets on the result can be measured using different fuzzy set extensions.

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Mass Reduction Study of a High Pressure Die Casting Aluminum Alloy Engine Part

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Abstract

In this work, a mass reduction study on an engine bracket, manufactured using high-pressure aluminum die casting, was conducted to examine the cost benefits of reducing its mass. For this purpose, firstly, using the Finite Element Analysis (FEA), the stress distribution on the engine bracket was determined by applying three load cases corresponding to different failure modes. In order to determine the material properties of the motor bracket, samples used for standard tensile test were taken from the bracket and the design load was determined. According to the results of the analyses, critical areas on the engine bracket and suitable areas for mass reduction were determined. Design of Experiments-Response Surface Methodology (DoE-RSM) was used to ensure that the mass-reduced part is not damaged at a force lower than the target force value. The optimized model obtained with DoE-RSM was produced and subjected to fracture tests. The equivalent stress values of the optimized and reference parts were compared, and no significant difference was observed. In addition, the results obtained from these analyses were validated by fracture tests. The manufacturability of the engine bracket part which was obtained after optimization was also investigated using high pressure casting simulation. It was found that the optimized engine bracket can be produced without functional loss, demonstrating the feasibility of lightweighting.

Keywords: Engine Bracket, Failure Analysis, Mass Reduction, Design of Experiments (DoE), Finite Element Analysis.

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ORAL PRESENTATION

Effects of Dietary Microplastics Inclusion on the Blood Profile and Stress Response of Nile Tilapia (*Oreochromis niloticus* Linnaeus, 1758)

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Abstract

The presence of microplastics in commercial feeds has been reported worldwide. Microplastics is incorporated in feeds through manufacturing processes or materials utilized for processing have been contaminated. The present study aimed to evaluate the effects of different inclusion levels of microplastics in commercial feed given to Nile tilapia *Oreochromis niloticus*, for a culture period of 15 days. The inclusion levels of microplastics are 0 g/kg-1 (T1), 0.2 g/kg^{-1} (T2), 0.4 g/kg^{-1} (T3), 0.6 g/kg^{-1} (T4), and 0.8 g/kg^{-1} (T5). Tests were done to assess the effects of these inclusions in Nile tilapia's blood profile as well as on its stress response which compose of hypoosmotic and anesthetic shock tests. In general, the blood biochemistry test results show no significance ($p > 0.05$) in all treatments and also indicates normal blood indices, only in a certain blood parameter such the blood glucose, eosinophiles, monocytes and segmenters show significant different ($p<0.05$) and demonstrate inconsistency of value specially those feed with high inclusion of microplastics. Meanwhile, result of hypoosmotic shock test, there was no significant difference ($p > 0.05$) and no mortality was recorded, but change and display of color pattern were observed in all treatments, with the highest number observed in T5. On the other hand, the effects of the anesthetic shock test showed that the control (T1) and lower MP inclusion levels (T2 and T3) showed resistance to the anesthetic effect for a longer period as compared to fish fed with the highest microplastics inclusion levels (T5). The highest inclusion level also demonstrated the longest period of recovery from anesthesia. In conclusion, this study suggested that a diet containing the highest inclusion level of microplastics (0.8 g/kg^{-1}) affects the fitness, blood profile, and stress response of Nile tilapia *O. niloticus*.

Keywords: Microplastic, Blood Profile, Stress Response, *Oreochromis niloticus*.

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ORAL PRESENTATION

Employee Acceptance and Implementation of Digital Business Platforms: A Cross-Country Study

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Abstract

In recent years, the use of the internet and information technologies has surged, triggering a technological revolution. The COVID-19 pandemic has disrupted the business market, necessitating a need for digital business platforms to be employed. This shift has prompted the creation of business model platforms where companies increasingly direct their operations toward remote users. Consequently, the primary aim of this paper is to explore employees' attitudes and behavior regarding the acceptance of digital networking and working on business model platforms. In response, this research involved a survey aimed at understanding employees' behavior and their willingness to incorporate business platforms into their daily business operations. The research was carried out in six countries such as Serbia, Hungary, the Czech Republic, Poland, Slovakia, and Bulgaria, offering a comprehensive perspective on the acceptance and implementation of digital business platforms across companies in various industries. The data collected was statistically processed using the software package SPSS. Statistical tests were used based on the collected data. The research results can provide companies with a roadmap to acquire new knowledge and implement the digital tools necessary to enhance the digitization of their business processes on digital business platforms.

Keywords: Digital Business Platforms, Attitudes, Employee Acceptance, Behavior, Cross-Country Analysis.

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ORAL PRESENTATION

Comparison of Calculation Methods of Criterion Weights thanks to Intuitionistic Fuzzy Sets

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Abstract

Intuitionistic fuzzy sets (IFSs) and fuzzy sets are both generalizations of classical sets used to handle uncertainty and vagueness. However, they differ significantly in their structure and the way they represent uncertainty. Fuzzy sets handle uncertainty with a single degree of membership. IFSs provide a more nuanced approach by separately accounting for both membership and non-membership, as well as the uncertainty (hesitation) in the assignment of these degrees. More flexible and expressive in representing uncertainty due to the additional degrees of non-membership and hesitation in intuitionistic fuzzy sets. Fuzzy sets widely used in various fields such as control systems, decision making, and pattern recognition. IFSs particularly useful in situations where a more detailed characterization of uncertainty is required, such as in complex decision making problems and situations involving higher degrees of uncertainty. In summary, intuitionistic fuzzy sets provide a richer framework for dealing with uncertainty compared to fuzzy sets by incorporating additional degrees of non-membership and hesitation, allowing for a more comprehensive representation of uncertain information. IFSs play a significant role in multi criteria decision making (MCDM) applications due to their enhanced ability to handle uncertainty and vagueness This allows for a more nuanced representation of uncertainty, which is often inherent in decision making processes. Decision makers can express their preferences, doubts, and hesitations more accurately. In MCDM, decisions are often based on evaluating multiple conflicting criteria. IFS enable decision-makers to better handle the uncertainty and imprecision associated with each criterion, leading to more robust and reliable decision-making outcomes. The additional degrees in IFS allow for more flexibility and expressiveness in modeling decision problems. This is particularly useful in complex and ambiguous scenarios where traditional fuzzy sets may fall short. IFS have been successfully applied in various domains within MCDM, including: Supplier Selection, risk assessment, resource allocation, environmental management, healthcare, education, engineering, etc. IFSs are often used in decision support systems to provide more accurate and reliable support for decision makers. These systems utilize the expressive power of IFSs to better capture and process the uncertain and vague information inherent in complex decision making scenarios. IFSs provide a powerful tool for handling uncertainty and vagueness in multi-criteria decision-making applications. Their ability to represent membership, non-membership, and hesitation degrees makes them highly suitable for complex decision problems where traditional methods may be inadequate. By enhancing the expressiveness and flexibility of decision models, IFS contribute to more robust, reliable, and comprehensive decision making processes across various domains. In this study, original applications of intuitionistic fuzzy sets with decision making methods are discussed. The focus is on the methods of obtaining criterion weights, which are very difficult for decision makers and are of serious importance.

Keywords: Fuzzy Sets, Intuitionistic Fuzzy Sets, Multi Criteria Decision Making.

1. Introduction

Fuzzy logic was firstly defined by Zadeh, then intuitionistic fuzzy set theory was described by Atanassov (Atanassov, 1989; Atanassov, 2017; Zadeh, 1965). Recently, most researchers have applications related to multi-criteria decision making using intuitionistic fuzzy set, especially in multidisciplinary fields. PROMETHEE method was firstly defined by Brans (Brans et al., 1982), it was developed by many researchers and was shown to give effective results in its application areas. In this study, the application of the intuitionistic fuzzy PROMETHEE method in personnel selection was examined. The most important principle of companies, firms and most general of all business sectors is good personnel. Technological developments, the increase in qualified personnel candidates, the strengthening of the competitive environment and the increasing demands day by day have made the importance of personnel selection for the company the main focus. There are many studies in the literature on personnel selection (Afshari et al., 2011; Akın, 2016; Asemi & Asemi, 2014; Boran et al., 2011; Değermenci & Ayvaz, 2016). Many different methods have been used to determine criteria weights so far. In this study, the weights of the criteria were calculated and compared separately with controlled sets and linguistic terms on the same data.

2. Materials and Methods

Definition 2.1: (Atanassov, 1989; Atanassov 2016) Let $X \neq \emptyset$. An intuitionistic fuzzy set A in X;

$A = \{\langle x, \mu_A(x), \nu_A(x)\rangle | \; x \in X\}$,

$$\mu_A(x), \nu_A(x), \pi_A(x): X \rightarrow [0,1]$$

defined membership, nonmembership and hesitation degree of the element $x \in X$ respectively.

$$\mu_A(x) + \nu_A(x) + \pi_A(x) = 1$$

Intuitionistic fuzzy value (IFV) defined by Xu (Xu, 2007) and is shown as follows: $\tilde{a} = (\mu_{\tilde{a}}, \nu_{\tilde{a}}, \pi_{\tilde{a}})$ in which $\mu_{\tilde{a}}, \nu_{\tilde{a}}, \pi_{\tilde{a}} \in [0,1]$.

Definition 2.2: For IFVs $\tilde{a} = (\mu_{\tilde{a}}, \nu_{\tilde{a}})$ and $\tilde{b} = (\mu_{\tilde{b}}, \nu_{\tilde{b}})$ operations specified (Xu & Yager, 2006; Xu, 2007):

$$(1)\tilde{a} \oplus \tilde{b} = (\mu_{\tilde{a}} + \mu_{\tilde{b}} - \mu_{\tilde{a}}\mu_{\tilde{b}}, \nu_{\tilde{a}}\nu_{\tilde{b}})$$
$$(2)\tilde{a} \otimes \tilde{b} = (\mu_{\tilde{a}}\mu_{\tilde{b}}, \nu_{\tilde{a}} + \nu_{\tilde{b}} - \nu_{\tilde{a}}\nu_{\tilde{b}})$$
$$(3) \bigoplus_{j=1}^{m} \tilde{a}_j = \left(1 - \prod_{j=1}^{m}(1-\mu_j), \prod_{j=1}^{m}\nu_j\right)$$
$$(4) \bigotimes_{j=1}^{m} \tilde{a}_j = \left(\prod_{j=1}^{m}\mu_j, \prod_{j=1}^{m}(1-\nu_j)\right)$$

As the value of the following function used to rank IFVs decreases, the preferability of that alternative increases (Szmidt & Kacprzyk, 2009).

$$\rho(\alpha) = 0.5(1 + \pi_\alpha)(1 - \mu_\alpha)$$

The weights are expressed as IFV in the intuitionistic fuzzy PROMETHEE. It is of great importance for decision makers to determine the specific importance level for each criterion. In this paper, linguistic expressions in the form of intuitionistic fuzzy values of decision makers and controlled sets were used. Some methods may help decision makers in determining IF weights (Çuvalcıoğlu, 2013; Çuvalcıoğlu, 2014; Liao & Xu, 2014; Wang, 2013; Xu, 2007).

While determining the weights of the criteria, first of all, decision makers are expected to express their opinions about the criteria in linguistic terms.

The importance of criterion is represented as linguistic terms in below table:

Table 1. Linguistic terms for rating the criterion.

Linguistic Terms	**IFNs**
Very Important	(0.9,0.1)
Important	(0.75,0.2)
Medium	(0.5,0.45)
Unimportant	(0.35,0.6)
Very Unimportant	(0.1,0.9)

The basic definitions for controlled sets are as follows:

Definition 2.3: [15] Let $\boldsymbol{E}$ be an universe, $\boldsymbol{\alpha}$ is a function from $\boldsymbol{E}$ to $\boldsymbol{I}$ then $\boldsymbol{E}$ is called $\boldsymbol{\alpha}$ −set.

Definition 2.4: [15] Let $\boldsymbol{E}$ be an $\boldsymbol{\alpha}$ −set. The set $\boldsymbol{E}$ is called $\boldsymbol{\alpha}$-controlled set if

$$\forall x \in E, \exists y \in E \ni 1 - \alpha(x) = \alpha(y).$$

The family of $\boldsymbol{\alpha}$ −controlled set on an universe $\boldsymbol{E}$ is represented by $\boldsymbol{E} \in \boldsymbol{CS}(\boldsymbol{\alpha})$.

Definition 2.5: (Çuvalcıoğlu, 2013; Çuvalcıoğlu, 2014) Let $\boldsymbol{E} \in \boldsymbol{CS}(\boldsymbol{\alpha})$. and $\boldsymbol{\alpha} \in \boldsymbol{E}$. The following set is called control set of $\boldsymbol{\alpha}$,

$$\bar{a} = \{b \in E | 1 - \mu(a) = \mu(b)\}$$

Definition 2.6: (Çuvalcıoğlu, 2014) Let $\boldsymbol{E}$ be an $\boldsymbol{\alpha}$ −set. We define the following mapping on $\boldsymbol{E}$ so that

$$\alpha^*(x) = \begin{cases} 1 - \alpha(x), & x \in E_\alpha \\ sup_y \alpha(y), & y \in E \ni \alpha(x) < 1 - \alpha(y) \\ 0, & otherwise. \end{cases}$$

where $E_\alpha = \cup_{a \in E} \overline{a}$.

Definition 2.7: (Çuvalcıoğlu, 2014) Let $\boldsymbol{E}$ be $\boldsymbol{\alpha}$ - set. Then the set $\boldsymbol{A} = \{\langle \boldsymbol{x}, \boldsymbol{\alpha}(\boldsymbol{x}), \boldsymbol{\alpha}^*(\boldsymbol{x})\rangle | \boldsymbol{x} \in \boldsymbol{E}\}$ is called $(\boldsymbol{\alpha}, \boldsymbol{\alpha}^*)$ −controlled set.

In this research, V shape criterion type was used (Brans & Vincke, 1985; Ziemba & Gago, 2022). V shape criterion type;

$$P(d) = \begin{cases} 0, & d \leq q \\ \dfrac{d-q}{p-q}, & q < d \leq p \\ 1, & d > p \end{cases}$$

Assess the alternatives with respect to the criteria and calculate the deviations based on pairwise comparisons:

$$d_j(x, y) = c_j(x) - c_j(y)$$

2.1. Intuitionistic Fuzzy PROMETHEE

Definition 2.1.1: (Xu, 2007)An intuitionistic fuzzy preference relation R on the set $X = \{x_1, x_2, \dots, x_n\}$ is represented by a matrix $R = (r_{ik})_{n \times n}$ where $r_{ik} = \langle (x_i, x_k), \mu(x_i, x_k), \nu(x_i, x_k)\rangle$ for all $i, k = 1,2, \dots, n$. For convenience, we let $r_{ik} = (\mu_{ik}, \nu_{ik})$ where μ_{ik} denotes the degree to which the object x_i is preferred to the object x_k, ν_{ik} indicates the degree to which the object x_i is not preferred to the object x_k, and $\pi(x_i, x_k) = 1 - \mu(x_i, x_k) - \nu(x_i, x_k)$ interpreted as an indeterminacy degree with the condition:

$$\mu_{ik}, \nu_{ik} \in [0,1],\ \mu_{ik} + \nu_{ik} \leq 1, \qquad \mu_{ik} = \nu_{ki},\ \mu_{ki} = \nu_{ik}$$

$$\pi_{ik} = 1 - \mu_{ik} - \nu_{ik},$$

for $\forall\ i, k = 1,2, \dots, n$.

The preference matrix is identified like this (Liao & Xu, 2014):

$$U^{(j)} = (\mu_{ik}^{(j)})_{n \times n} = \begin{bmatrix} - & \mu_{12}^{(j)} & \dots & \mu_{1n}^{(j)} \\ \mu_{21}^{(j)} & - & \dots & \mu_{2n}^{(j)} \\ \vdots & \vdots & - & \vdots \\ \mu_{n1}^{(j)} & \mu_{n2}^{(j)} & \dots & - \end{bmatrix}$$

The intuitionistic fuzzy preference relation matrix is like this:

$$R^{(j)} = (r_{ik}^{(j)})_{n\times n} = \begin{bmatrix} - & \left(\mu_{12}^{(j)}, \nu_{12}^{(j)}\right) & \dots & \left(\mu_{1n}^{(j)}, \nu_{1n}^{(j)}\right) \\ \left(\mu_{21}^{(j)}, \nu_{21}^{(j)}\right) & - & \dots & \left(\mu_{2n}^{(j)}, \nu_{2n}^{(j)}\right) \\ \vdots & \vdots & - & \vdots \\ \left(\mu_{n1}^{(j)}, \nu_{n1}^{(j)}\right) & \left(\mu_{n2}^{(j)}, \nu_{n2}^{(j)}\right) & \dots & - \end{bmatrix}$$

For this study, the IFWA operator was considered among many aggregation operators defined for intuitionistic fuzzy sets (Xu & Yager, 2006; Xu, 2007). The all intuitionistic fuzzy preference index of the alternative x_i to x_k on all criteria can be obtained as:

$$r(x_i, x_k) = r_{ik} = \bigoplus_{j=1}^{m} \left(\tilde{w}_j \otimes r_{ik}^{(j)}\right)$$

Overall intuitionistic fuzzy preference relationship is obtained like this:

$$R = (r_{ik})_{n\times n} = \begin{bmatrix} - & (\mu_{12}, \nu_{12}) & \dots & (\mu_{1n}, \nu_{1n}) \\ (\mu_{21}, \nu_{21}) & - & \dots & (\mu_{2n}, \nu_{2n}) \\ \vdots & \vdots & - & \vdots \\ (\mu_{n1}, \nu_{n1}) & (\mu_{n2}, \nu_{n2}) & \dots & - \end{bmatrix}$$

The intuitionistic fuzzy positive outranking flow:

$$\tilde{\phi}^{+}(x_i) = \frac{1}{n-1} \bigoplus_{k=1,k\neq i}^{n} r(x_i, x_k) = \frac{1}{n-1} \bigoplus_{k=1,k\neq i}^{n} r_{ik}$$

The intuitionistic fuzzy negative outranking flow:

$$\tilde{\phi}^{-}(x_i) = \frac{1}{n-1} \bigoplus_{k=1,k\neq i}^{n} r(x_k, x_i) = \frac{1}{n-1} \bigoplus_{k=1,k\neq i}^{n} r_{ki}$$

The difference between the intuitionistic fuzzy positive and negative outranking flow can be determined utilizing the function (Szmidt & Kacprzyk, 2009):

$$\rho(\phi(x_i)) = \rho(\tilde{\phi}^{+}(x_i)) - \rho(\tilde{\phi}^{-}(x_i))$$

3. Results

The alternatives of the study include 3 alternatives. Alternatives represent candidate. Furthermore, the criteria of the study include 5 criteria, namely and respectively; Experience, Skill of software, Responsibility, Aptitude for teamwork, Smoking. $A = \{A_1, A_2, A_3\}$ is set of alternatives, $B = \{B_1, B_2, B_3, B_4, B_5\}$is set of criteria. Determining the criteria weights is both a very important and a very sensitive issue for decision makers. Many different methods have been proposed to determine the criteria weights. In this study, criteria weights will be determined using linguistic terms and controlled sets and the results will be compared.

Table 2 depicts the values of the alternatives obtained after all operations depending on the criteria. Decision makers evaluated the candidates by giving them points, with the highest score being 100 points and the lowest being 0 points.

Table 2. Values of alternatives as to criteria.

	B_1	B_2	B_3	B_4	B_5
A_1	85	70	65	80	75
A_2	90	75	80	85	70
A_3	80	85	65	70	75

The criteria weights were evaluated by each decision-maker based on the linguistic terms. In line with, linguistic terms, the criteria weights are Very Important, Very Important, Important, Very Important, Unimportant, respectively. The mathematical equivalents of the linguistic terms are given below. The results obtained in linguistic terms are named as result 1.

Table 3. Weights of criteria using linguistic terms.

Criteria	Weights of Criteria
B_1	(0.90, 0.10)
B_2	(0.90, 0.10)
B_3	(0.75, 0.20)
B_4	(0.90, 0.10)
B_5	(0.35, 0.60)

The calculation of the criteria weights with controlled sets based on the table above is as follows. The results obtained in controlled sets are named as result 2.

Table 4. Weights of criteria using controlled sets.

Criteria	Weights of Criteria
B_1	(0.90, 0.00)
B_2	(0.90, 0.00)
B_3	(0.75, 0.00)
B_4	(0.90, 0.00)
B_5	(0.35, 0.00)

In the next step, the overall IF preference matrix was created. Moreover, the intuitionistic fuzzy positive and negative flow values for each alternative were calculated separately. A net outranking flow was needed to obtain a net ranking among alternatives.

Table 5. The intuitionistic fuzzy positive and negative outranking flows.

Result 1					
$\rho(\tilde{\varphi}^+(A_1))$	=	0,750392033	$\rho(\tilde{\varphi}^-(A_1))$	=	0,160244447
$\rho(\tilde{\varphi}^+(A_2))$	=	-0,061024081	$\rho(\tilde{\varphi}^-(A_2))$	=	-0,044932877
$\rho(\tilde{\varphi}^+(A_3))$	=	2,887121882	$\rho(\tilde{\varphi}^-(A_3))$	=	124,3675291
Result 2					
$\rho(\tilde{\varphi}^+(A_1))$	=	0,750168957	$\rho(\tilde{\varphi}^-(A_1))$	=	0,160244535
$\rho(\tilde{\varphi}^+(A_2))$	=	-0,061024094	$\rho(\tilde{\varphi}^-(A_2))$	=	-0,045043676
$\rho(\tilde{\varphi}^+(A_3))$	=	2,887326562	$\rho(\tilde{\varphi}^-(A_3))$	=	124,3675757

Table 6. Values of net outranking flows.

Result 1		
$\rho(\tilde{\varphi}(A_1))$	=	0,750392033
$\rho(\tilde{\varphi}(A_2))$	=	-0,061024081
$\rho(\tilde{\varphi}(A_3))$	=	2,887121882
Result 2		
$\rho(\tilde{\varphi}(A_1))$	=	0,750168957
$\rho(\tilde{\varphi}(A_2))$	=	-0,061024094
$\rho(\tilde{\varphi}(A_3))$	=	2,887326562

Upon analyzing the positive outranking flow and negative outranking flow, the ranking was made according to the net outranking flow since the incomparability between the alternatives was obtained. According to the calculations for each candidate one by one, net outranking flows were obtained. According to the values here, as the value gets smaller, the suitability of the alternative increases. Namely, when the candidates are sorted separately, the smallest values represent the best candidate.

According to the decision making mechanism created using the intuitionistic fuzzy PROMETHEE method; when the alternatives are listed separately for all candidates considering the net outranking flows, the order of candidate quality from the best to the worst is as follows. When the net outranking flow value is small, it means that the alternative is better.

For Result 1: A_3, A_2, A_1

For Result 2: A_3, A_2, A_1

According to the table above, when the candidates are ranked, it is seen that the candidate closest to getting the job is the 3. candidate, and the candidate farthest from getting the job is the 1. candidate. Here, it is observed that the criterion weights determined using different methods do not change the result in this data set. So why? Because the values in our data set do not include the control element, which is the main starting point of controlled sets. Therefore, the slight deviations in positive, negative and net flow values are due to this.

4. Conclusion

This study is a study that shows the application of PROMETHEE method, one of the multi-criteria decision-making methods, in detail. In the study, membership, non-membership and sensitivity levels of cluster elements were used by using intuitionistic fuzzy sets. One of the steps that decision makers attach the most importance to in the decision-making process is the determination of criteria weights. Many different methods have been used to determine criteria weights so far. In this study, the weights of the criteria were calculated and compared separately with controlled sets and linguistic terms on the same data.

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ORAL PRESENTATION

Recent Progress in Crispr-Cas9 in Aquatic Model Organisms

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Abstract

Recent progress in Crispr-Cas9 technology has revolutionized the field of genetic engineering, offering unprecedented precision and efficiency in targeted gene editing. In the context of aquatic model organisms, such as zebrafish (*Danio rerio*), medaka (*Oryzias latipes*), fugu (*Fugu rubripes*), stickeback (*Gasterosteus aculeatus*) and other marine species such as sea urchin (*Strongylocentrotus purpuratus*), starfish (*Asterias rubens*), sea hare (*Aplysia californica*), red hydra (*Hydra vulgaris*), Green Algae (*Chlamydomonas reinhardtii* and similar), sea anemone (*Nematostella vectensis*), sea squirt (*Ciona intestinalis*), marine worm (*Platynereis dumerilii*), the application of Crispr-Cas9 holds immense potential for advancing our understanding of biological processes and environmental interactions. This article explores the recent developments in Crispr-Cas9 techniques specific to aquatic model organisms, addressing both the opportunities and challenges in utilizing this technology for research purposes. From gene editing advancements to ethical considerations, this overview provides insight into the evolving landscape of genetic manipulation in aquatic environments

Keywords: Crispr-Cas9 Technology, Aquatic Model Organisms, Gene Editing.

1. Introduction

The Crispr-Cas9 system, consisting of the Cas9 enzyme and guide RNA, has revolutionized genetic engineering by enabling precise modifications to DNA (Bashir et al., 2020). This technology has been used in various fields, including medicine, agriculture, and livestock sciences (Ebrahimi et al., 2023). It ha s also been harnessed for genome manipulation in plants, animals, and human cells (Ebrahimi et al., 2023). The system's ability to cut targeted genomic DNA regions has the potential to cure genetic diseases (Croteau et al., 2018). However, a key challenge is the potential for off-target effects, which can be mitigated through structure-guided engineering (Han et al., 2020).

The development of CRISPR-Cas9 technology, rooted in the discovery of the adaptive immune system in bacteria, has significantly advanced genetic engineering (Barrangou et al., 2015, Kirchner and Schneider 2015; Kick 2017). This system, originally a bacterial defense mechanism, has been harnessed for a wide range of applications, including genome editing and gene regulation (Hryhorowicz et al., 2016). Its potential in treating genetic diseases, controlling microbial virulence, and creating animal models for research is particularly noteworthy (Rong and Liu 2023). Furthermore, CRISPR-Cas9 has

been instrumental in studying gene function and creating disease models, thus enhancing our understanding of disease processes and potential treatments (Torres-Ruiz and Rodriguez-Perales 2017).

The development of Crispr-Cas9 technology can be traced back to the early 2000s when scientists discovered the adaptive immune system in bacteria. Since then, researchers have refined and optimized this tool for a wide range of applications, making it one of the most powerful tools in genetic engineering today.

2. Applications of Crispr-Cas9 in Aquatic Model Organisms

This technology has the potential to revolutionize the fisheries and aquaculture sector by accelerating genetic improvement (Iqbal et al., 2023). The use of CRISPR/Cas9 in aquatic model organisms has seen significant progress, particularly in the field of neurosciences (Joly, 2017). However, there are still technical challenges and regulatory issues that need to be addressed (Roy et al., 2022). The CRISPR/Cas9 system has been successfully applied in marine organisms, and its potential for future applications, such as base editing and targeted gene transcription, is promising (Momose and Concordet, 2016). The CRISPR-Cas9 technology has revolutionized the field of genetic manipulation, offering a powerful tool for precise and efficient genome editing. Its applications in aquatic model organisms are vast and varied, with significant implications for research, conservation, and sustainable aquaculture practices.

CRISPR-Cas9 technology has revolutionized genetic manipulation in aquatic model organisms, offering a wide range of applications. It has been used for gene function analysis, disease modeling, trait modification, environmental monitoring, conservation biology, developmental biology, behavioral studies, evolutionary studies, and drug discovery (Roy et al., 2022). The technology's potential in fisheries and aquaculture is particularly promising, with the ability to introduce favorable changes and improve disease resistance (Roy et al., 2022, Ferdous et al., 2022). In neurosciences, CRISPR-Cas9 has enabled efficient knock-out and forward genetics in zebrafish and other marine models (Joly, 2017). Despite its potential, there are technical challenges and regulatory issues that need to be addressed (Roy et al., 2022). The CRISPR-Cas9 system's basic structure and potential challenges in aquatic organism genome editing have been discussed, providing a valuable reference for researchers in the field.

2.1. Genome Editing in Aquaculture Species

At the close of the twentieth century, the zebrafish was proposed as a promising model for genetic screens pertinent to human diseases (Mullins et al., 1994). However, an additional genome duplication in the teleost fish lineage during vertebrate evolution resulted in many duplicated genes within fish genomes, complicating the analysis of screening data. Another challenge was that zebrafish eggs carry maternal factors, so mutations in genes often do not show effects at early stages due to these factors ensuring proper development. Consequently, large-scale random mutagenesis screens in embryos yielded disappointingly few mutations. Many zebrafish screens were conducted during early larval stages, but most of the identified mutants did not exhibit phenotypes comparable to human rare diseases, which typically manifest later in life. After 2000, zebrafish emerged as an invaluable model for reverse genetics. Phenotypic analyses of mutants were enhanced by spectacular time-lapse imaging in live fish, facilitating studies in various areas such as early development (Olivier et al., 2010), neurogenesis (Barbosa et al., 2015), hematopoiesis (Renaud et al., 2011), and immune response (Levraud et al., 2014).

Aquatic model organisms, such as zebrafish, have become invaluable in studying genetics and environmental interactions (Dahm and Geisler, 2006). The application of Crispr-Cas9 in these organisms has opened up new possibilities for gene editing and understanding complex biological processes (Robinson et al., 2023). CRISPR-Cas9 has been successfully applied to various aquaculture species, including fish and shellfish, to introduce desirable traits such as improved growth rates, disease resistance, and enhanced nutritional content. This technology has the potential to accelerate the sustainable genetic improvement of aquaculture species, addressing the growing demand for protein-rich food sources while minimizing the environmental impact of aquaculture practices. Zebrafish's role in aquaculture nutrition research is particularly noteworthy, as it provides a cost-effective and efficient platform for diet evaluation (Ulloa et al., 2014). Furthermore, the zebrafish has been utilized as a model for diseases in aquaculture, offering unique tools for studying bacterial, viral, and parasitic diseases (Jørgensen, 2020). Transgenic animals with reporter genes that express in specific tissues or cell types are valuable tools, and numerous transgenic strains have been successfully generated in medaka (Watakabe et al., 2018). The generation of transgenic reporter and gene trap lines in medaka has been achieved using the Ac/Ds transposon system, with a high germline transmission rate (Froschauer et al., 2011). This has been further advanced by the use of the Sleeping Beauty transposable element, which has shown high efficiency in medaka transgenesis, resulting in novel expression patterns (Grabher et al., 2003). These transgenic lines have been used to monitor germ cells in live specimens, providing a valuable model for investigating germ cell migration and gonad development (Tanaka and Kinoshita, 2001). The successful generation of these transgenic strains in medaka underscores their potential as valuable tools for studying tissue-specific gene expression and cell type identification. Watakabe et al., (2018) have successfully integrated reporter constructs into specific genomic loci in medaka using CRISPR/Cas9-mediated non-homologous end joining (NHEJ). This method achieved high efficiency, with more than 50% of raised animals becoming transgenic founders. Additionally, the integration of reporter constructs can lead to the disruption of genes when targeted between the transcription start site and the initiation methionine. Due to its simplicity, design flexibility, and high efficiency, CRISPR/Cas9-mediated knock-in via NHEJ is proposed to become a standard method for generating transgenic and mutant medaka. The application of CRISPR-Cas9 in marine species, including fugu and stickleback, has the potential to significantly advance our understanding of biological processes and environmental interactions (Momose and Concordet, 2016). This is particularly relevant in the context of environmental monitoring, where the use of biomarkers in species like the clam *Ruditapes decussatus* can provide valuable insights into the impact of contaminants (Bebianno et al., 2004). Similarly, the histopathological assessment of invertebrates like the shore crab and brown shrimp can serve as a useful tool for monitoring the health of aquatic systems (Stentiford et al., 2005). Furthermore, the study of anti-microbial defense mechanisms in marine invertebrates, such as penaeid shrimps and the oyster *Crassostrea gigas*, can contribute to the development of disease management strategies in aquaculture (Bachère, et al., 2004). Fleming et al. (2021) used CRISPR/Cas9 mutagenesis to demonstrate the role of ABCB1 in sea urchin larvae's gut immune responses to *Vibrio diazotrophicus*. This finding is significant in the context of the broader understanding of host-microbial interactions, as it suggests a potential ancestral function of ABCB1 in this process. This study builds on previous research that has also explored the interactions between marine organisms and *Vibrio*. For example, Almada and Tarrant (2016) found that *Vibrio elicits* targeted transcriptional responses in copepod hosts, while Abraham (2004) identified an antibacterial marine bacterium that can suppress the activity of *Vibrio harveyi* in shrimp larvae. These studies collectively highlight the complex and dynamic nature of these interactions, and the potential for further research to uncover additional mechanisms and factors involved. Neal et al. (2019) demonstrates the effective use of CRISPR/CAS9 technology to disrupt the *Ct-r-opsin1* gene in

Capitella teleta, providing direct evidence of its role in larval phototaxis. This highlights the potential of CRISPR/CAS9 for gene editing in understudied species, advancing our understanding of gene functions related to animal behavior and visual systems. It underscores CRISPR/CAS9's utility in functional genomics, enabling precise genetic manipulations to elucidate biological processes in a wide variety of organisms. Ikmi et al. (2014) demonstrates the use of TALEN and CRISPR/Cas9 systems to create targeted mutations and achieve homologous recombination-mediated transgenesis in the sea anemone *Nematostella vectensis*. Additionally, the same stduy introduces a novel method to isolate genetically modified animals using engineered selection cassettes introduced through homologous recombination. These techniques enable advanced gain- and loss-of-function analyses in *Nematostella* and potentially other early metazoan species amenable to zygotic injection (Ikmi et al., 2014). Fodor et al. (2020) sequenced the full transcriptome of the central nervous system of *Lymnaea stagnalis* and identified evolutionarily conserved homologous sequences associated with aging and neurodegenerative/other diseases. This effort aimed to encourage researchers to utilize mollusk species for studying normal biological aging and neurodegenerative diseases. The study identified several key molecules, including gelsolin, presenilin, huntingtin, Parkinson's disease protein 7/protein deglycase DJ-1, and amyloid precursor protein, indicating that *L. stagnalis* possesses a solid genetic foundation in this research area. Consequently, the study supports the suitability of mollusk species for investigating molecular, cellular, and circuit mechanisms. These studies collectively underscore the significant contributions of aquatic model and CRISPR-Cas9 in advancing sustainable genetic improvement in aquaculture. The CRISPR-Cas9 system has been successfully adapted for gene editing in marine algae, particularly in the model species Phaeodactylum tricornutum (Nymark et al.,2016). This breakthrough has significant implications for the development of algae-based biofuels, nutritional supplements, and other products, as well as for understanding the biology of these ecologically important organisms (Tanwar et al., 2018). The technology has also been used to generate stable targeted gene mutations in other algal species, such as Nannochloropsis spp., further expanding its potential applications (Wang et al., 2016). The high efficiency of the CRISPR-Cas system in genome editing in microalgae makes it a valuable tool for biotechnological applications (Zhang et al., 2019).

2.2. Disease Control and Molecular Breeding

CRISPR-Cas9 presents a promising solution for disease control in aquaculture, offering the potential to introduce disease-resistant genes into farmed species and reduce the use of antibiotics and chemicals (Elaswad and Dunham, 2018; Laliberte 2020). This approach can also be used for molecular breeding, allowing for the precise introduction of desirable traits without transgenesis, addressing public concerns about GMOs (Jaganathan et al., 2018). However, the technology faces challenges such as off-target effects and regulatory issues (Laliberte 2020, Okoli et al., 2021). Despite these challenges, CRISPR-Cas9 holds great potential for improving the sustainability and productivity of aquaculture. Zebrafish and medaka are valuable models for studying human diseases due to their genetic similarities and high reproductive rates (Wang and Cao, 2021). The CRISPR-Cas9 system has further enhanced the utility of these models by allowing the introduction of disease-causing mutations, enabling the rapid establishment of clinically relevant disease models (Naert and Vleminckx, 2018). Aquatic model organisms have been used to model a range of neurodegenerative diseases, including Parkinson's, Huntington's, and Alzheimer's, and have proven to be effective in understanding disease mechanisms and screening potential therapies (Wang and Cao, 2021). While zebrafish and medaka are the most commonly used fish models, other fish species also hold potential for modeling specific diseases and

understanding the impact of environmental factors and genetic variation on disease phenotypes (Schartl, 2013).

2.3. Gene Function Analysis

Using CRISPR-Cas9, researchers can knock out specific genes in aquatic organisms to observe resulting phenotypic changes and this helps determine the roles of genes in development, physiology, behavior, and disease susceptibility Boonanuntanasarn (2008). The use of CRISPR-Cas9 in aquatic organisms has significantly advanced our understanding of gene function. Liu (2019) and Sharma (2021) both highlight the power of CRISPR-Cas9 in generating knockout and knock-in alleles, as well as its potential for disease modeling and drug screening. Boonanuntanasarn (2008), further emphasizes the utility of gene knockdown techniques, such as antisense technology, in studying gene function in fish.

2.4. Trait Modification

CRISPR-Cas9 technology has revolutionized the field of aquaculture by enabling precise genome editing in aquatic organisms. This has significant implications for the industry, as it allows for the introduction of desirable traits such as increased disease resistance, faster growth, and improved nutrient utilization (Gratacap et al., 2019; Elaswad and Dunham, 2018; Roy et al., 2022). The high fecundity and external fertilization of most aquaculture species make them particularly amenable to this technology, which can expedite genetic improvement and disease reduction (Gratacap et al., 2019; Elaswad and Dunham, 2018). Despite the potential of CRISPR-Cas9, there are technical challenges and regulatory issues that need to be addressed before it can be widely adopted in commercial aquaculture (Roy et al., 2022).

2.5. Environmental Monitoring

Aquatic organisms, including plants and microorganisms, are valuable bioindicators for assessing environmental quality (Ferrat et al., 2003; Sagova-Mareckova, 2020). These organisms can be used to detect a range of stressors, from contaminants to varying environmental conditions (Adams and Greeley, 2000). The use of these bioindicators is particularly important in the marine environment, where they can provide a comprehensive assessment of ecological status (Casazza et al., 2002). The integration of CRISPR-Cas9 technology to engineer these organisms for real-time environmental monitoring represents a promising advancement in this field.

2.6. Conservation Biology

CRISPR-Cas9 technology has the potential to revolutionize conservation efforts for endangered aquatic species by increasing genetic diversity, enhancing resilience to environmental changes, and reducing the effects of inbreeding (Monast 2019). However, its use requires careful consideration and oversight to prevent unintended consequences (NovakBen et al., 2018). The technology can also be applied to enhance the biopreservation ability of lactic acid bacteria in aquatic products, further contributing to conservation efforts (Dong et al., 2022).

2.7. Developmental Biology

Aquatic organisms, such as sea urchins and sea lampreys, are valuable models for studying embryonic development due to their accessibility and evolutionary significance (Lin and Su, 2016, Square et al., 2015). The CRISPR-Cas9 system has revolutionized the field of developmental biology by enabling precise gene manipulation during embryogenesis (Harrison et al., 2014). This technology has been successfully applied to sea urchin embryos, resulting in high mutation rates and minimal off-target effects (Lin and Su, 2016). Similarly, it has been used to disrupt specific genes in sea lamprey embryos, providing a powerful tool for understanding ancestral gene functions in vertebrates (Square et al., 2015). These studies highlight the potential of CRISPR-Cas9 in investigating the genetic mechanisms underlying development in aquatic organisms.

2.8. Behavioral Studies

The use of CRISPR-Cas9 in aquatic organisms has significantly advanced the study of behavior genetics. Joly (2017) highlight the potential of this technology in aquatic model organisms, particularly in zebrafish. This has been demonstrated in studies such as Yong et al., (2017), which used TAL effector nucleases to edit the androgen receptor gene in zebrafish, resulting in impaired courtship behavior. Similarly, Sommer-Trembo et al., (2024) identified a genetic link to exploratory behavior in cichlid fishes, further underscoring the potential of CRISPR-Cas9 in understanding the genetic basis of behavior in aquatic organisms.

2.9. Evolutionary Studies

CRISPR-Cas9 technology has revolutionized genome editing in aquatic organisms, allowing for the introduction of specific mutations and aiding studies on the genetic basis of evolutionary adaptations (Mokrani and Liu, 2015). This has been particularly impactful in the field of neurosciences, where the system is routinely used in marine model organisms such as zebrafish and the ascidian Ciona intestinalis (Joly, 2017). The technology has also been successfully incorporated into undergraduate laboratory courses, providing students with hands-on experience in exploring the gene-to-phenotype relationship (Martin et al., 2020). Furthermore, the CRISPR-Cas9 system has opened up new possibilities in marine genomics, enabling the testing of genome features and the experimental examination of the genotype-phenotype relationship (Momose and Concordet, 2016).

2.10. Drug Discovery

CRISPR-Cas9 technology has revolutionized drug discovery by enabling the creation of mutant strains with altered drug metabolism pathways, providing valuable models for studying drug efficacy and toxicity (Ahmad and Amiji, 2018, Lu et al., 2021). This has been particularly useful in the study of drug metabolism and pharmacokinetics, with the establishment of rat models using CRISPR-Cas9 (Lu et al., 2021). Aquatic organisms, such as zebrafish, have also played a crucial role in drug discovery, serving as effective models for drug screening and optimization (Yi, 2011; Gibert et al., 2013). The combination of CRISPR-Cas9 technology and aquatic organisms has the potential to significantly advance drug discovery and toxicology research.

CRISPR-Cas9 technology is revolutionizing research in aquatic model organisms by providing powerful tools for exploring diverse biological questions and addressing practical challenges in aquaculture, conservation, and environmental monitoring (Square et al., 2015; Nymark et al., 2016; Joly, 2017; Gutasi et al., 2023). The use of CRISPR/Cas9 in aquatic model organisms has significantly advanced genetic research. Nymark et al., (2016) demonstrated its effectiveness in generating stable targeted gene mutations in marine algae, while Joly (2017) highlighted its potential in aquatic model organisms for neuroscientific studies. In zebrafish, a prominent aquatic model organism, Chang et al., (2013) reported the efficient induction of site-specific somatic mutations and the potential for site-specific insertion. These studies collectively underscore the transformative impact of CRISPR/Cas9 in aquatic model organisms, particularly in understanding gene function and development.

Crispr-Cas9 technology is increasingly being used in aquatic environmental studies to understand the impact of pollutants and environmental factors on aquatic species (Joly, 2017). This technology has the potential to address challenges in fish aquaculture, such as diseases, reduced viability, and environmental pollution (Okoli et al., 2021). It can also be used in water sensing to detect biomarkers and hazardous substances (Safarkhani et al., 2024). Furthermore, the technology has been successfully adapted for gene editing in marine algae, offering a potential tool for studying and manipulating these organisms (Nymark, 2016).

3. Challenges and Future Directions

Off-Target Effects: CRISPR-Cas9 can introduce unintended mutations, known as off-target effects, which can lead to unpredictable outcomes and potentially harm the organism (Gohil et al., 2021).

The CRISPR-Cas9 system has shown great potential in genetic manipulation in aquatic models, but several challenges need to be addressed. These include the lack of well-assembled and annotated genome sequences for many aquaculture species, which hampers the identification of genes associated with desirable traits (Gohil et al., 2021). CRISPR-Cas9 can introduce unintended mutations, known as off-target effects, which can lead to unpredictable outcomes and potentially harm the organism (Zhang et al., 2015). Sun (2023) further discusses the causes and detection methods of these off-target effects, while Zhang (2015) suggests strategies for minimizing them. Boutin (2022) and Lee (2018) draw attention to the less recognized on-target genotoxicity, which can also lead to unintended genomic outcomes. These findings underscore the need for further research and safety measures in the use of CRISPR-Cas9 technology. Additionally, a robust understanding of the genetic background and genomic sequences of the target species is required, posing a significant hurdle for non-model organisms (Li et al., 2022). Despite these challenges, the technology has significant implications for sustainable aquaculture practices, disease control, and the development of algae-based products (Liu et al., 2023). To fully realize its potential, further research is needed to overcome these challenges and optimize the CRISPR-Cas9 system for use in non-model organisms (Supit, 2017).

Crispr-Cas9 technology, while promising for various applications, including aquaculture, also faces several challenges and limitations that need to be addressed to fully realize its potential in aquatic model organisms. Some of the key challenges and limitations include:

Regulatory Frameworks: Current regulatory frameworks are not well-suited to handle the complexities of CRISPR-Cas9 technology, which can hinder its commercialization and widespread adoption (Peck, 2017).

Delivery and Targeting: Efficient delivery and targeting of the CRISPR-Cas9 system to specific cells or tissues within aquatic organisms, particularly in vivo, is challenging due to various extra- and intra-cellular barriers, leading to the exploration of various delivery systems including plasmid-, RNA-, and ribonucleoprotein-based systems (Xu et al., 2019). Viral and nonviral delivery systems have also been investigated, with the latter showing potential for in vivo gene editing (Wei et al., 2020). Nonviral vectors, such as lipid- or polymer-based nanocarriers, have been proposed as potent carriers for the CRISPR-Cas9 system (Li et al., 2015). Despite these advancements, there are still challenges to be overcome, particularly in terms of safety and efficiency (Wei, 2020). Further research is needed to improve the delivery and targeting of the CRISPR-Cas9 system in aquatic organisms (Chuang et al., 2021).

Epigenome and Mitochondrial Editing: Editing the epigenome and mitochondria using CRISPR-Cas9 can be difficult due to the need for efficient transport and targeting of the system to these specific regions (Hussain et al., 2020). The challenges of off-target effects, inefficient delivery, stability, and immunogenicity in epigenome editing were highlighted by Pei et al., 2019 and Tadić et al., 2019. These studies collectively underscore the need for further research to overcome these challenges and optimize the use of CRISPR-Cas9 for editing the epigenome and mitochondria.

Public Acceptance: The four papers explore the potential of CRISPR-Cas9 technology in aquaculture, particularly in fish farming. While CRISPR offers solutions to challenges like disease resistance, enhanced growth, and environmental sustainability (Okoli et al., 2021), its implementation faces technical, regulatory, and ethical hurdles. Public acceptance is crucial for the successful adoption of gene-edited aquatic species (Robinson et al., 2023). A framework for risk-benefit analysis is proposed to assess the impacts of gene editing in aquaculture (Robinson et al., 2023). Stakeholder interviews reveal that respecting species borders is important but not decisive for acceptance; instead, moral reflections on technology use and outcomes play a significant role (Winther et al., 2023). Contrary to expectations, the concept of naturalness is not considered crucial in determining the acceptability of CRISPR use in farmed salmon; rather, respectful treatment of the animals is more significant (Winther, 2022). These studies highlight the complex interplay of scientific, ethical, and social factors in the adoption of CRISPR technology in aquaculture.

CRISPR-Cas9 technology has emerged as a revolutionary tool in aquaculture and fisheries, offering potential solutions to challenges such as disease resistance, sterility, and improved growth (Harinivas Manthira Moorthi et al., 2023; Diwan et al., 2017). This gene-editing technique is cheaper, easier, and more precise than existing methods, making it an attractive option for addressing industry issues (Suvra Roy et al., 2022). The technology has been applied to over 20 aquaculture species, with some CRISPR-edited fish already approved for market sale (Suvra Roy et al., 2022). However, despite its potential, CRISPR-Cas9 faces technical, regulatory, and public acceptance challenges in the aquaculture sector (Harinivas Manthira Moorthi et al., 2023; Suvra Roy et al., 2022). In the broader context of translational research, CRISPR-Cas9 has numerous applications in biomedical research and precision medicine, with clinical tests now becoming possible (Liting You et al., 2019). As the technology continues to advance, it may revolutionize both aquaculture and medical fields.

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ORAL PRESENTATION

Computational Study of the *fkbp* Prolyl Isomerase 3 Gene in Fugu (*Takifugu rubripes*): Understanding Molecular Mechanisms and Functional Consequences

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Abstract

This study focuses on the bioinformatics analysis of the *fkbp* Prolyl Isomerase 3 gene in the fugu (*Fugu rubripes*). With advancements in molecular biology and bioinformatics, driven by recent technological progress, this research utilized online genome databases and statistical methods to identify and characterize genes. By examining conserved gene synteny, gene structure, and comparing similarity ratios between fugu and other teleosts and tetrapods, a detailed comparative analysis was conducted. Key bioinformatics databases, including NCBI-GeneBank, EMBL, ENSEMBL, and UNIPROT, were essential for this investigation. Tools like Bioedit and Mega were used to analyze and interpret the data. In silico techniques included identifying and characterizing the fugu *fkbp*3 gene, analyzing its exon-intron structure, constructing phylogenetic trees, and exploring gene synteny. The results of these analyses were presented in detailed tables and figures.

Keywords: Puffer Fish, Model Organisms, *fkbp Prolyl Isomerase 3*, Bioinformatics.

1. Introduction

Bioinformatics research covers topics such as protein structures, functions, enzyme activities, and pathways, and is essential for analyzing genomic data (Kumar et al., 2008).

The stress response in teleost fish shares similarities with terrestrial vertebrates, involving neuroendocrine and immune system interactions (Bonga, 1997). However, unique challenges arise from their aquatic environment, including increased epithelial permeability and hydromineral disturbances under stress (Bonga, 1997). FK506-binding proteins (FKBPs), including FKBP3, are immunophilins involved in protein folding, receptor signaling, and transcription (Tong and Jiang, 2015). These proteins, particularly those with peptidylprolyl cis/trans isomerase (PPIase) activity, may assist in maintaining cellular homeostasis under environmental stresses like temperature fluctuations and hypoxia in teleost fish, suggesting potential therapeutic applications for stress management in fish (Fei et al., 2016). The FKBP family proteins, including FKBP3, are immunophilins involved in various cellular processes such as protein folding, receptor signaling, and T-cell activation (Kang et al., 2008). While specific research on FKBP3 in teleost fishes is limited, studies on fish immune systems have revealed significant conservation of innate and adaptive immunity components with higher vertebrates (Zhu et al., 2013).

Teleost fish possess orthologous pattern recognition receptors and cytokines, as well as unique immune components not found in mammals (Aoki et al., 2008). The study of teleost immune systems provides valuable insights into the evolution of vertebrate immunity and may contribute to improved disease control in aquaculture (Aoki et al., 2008). FK506-binding proteins (FKBPs), including FKBP3, are immunophilins involved in protein folding, receptor signaling, and transcription (Kang et al., 2008). These proteins, particularly those with peptidylprolyl cis/trans isomerase (PPIase) activity, may assist in maintaining cellular homeostasis under environmental stresses like temperature fluctuations and hypoxia in teleost fish. FKBP ligands have shown promise in treating neurodegenerative disorders and protecting neurons in animal models (Kang et al., 2008), suggesting potential therapeutic applications for stress management in fish.

FKBP3 plays a crucial role in regulating transcription and chromatin structure in teleost fish and this gene also interacts with the immunosuppressant rapamycin, suggesting its potential involvement in immune regulation (Liu et al., 2014). Transcriptomic studies in tambaqui (*Colossoma macropomum*) have revealed that FKBP3 is upregulated in populations adapted to warmer farming conditions compared to those from cooler natural habitats (Fe Gonçalves et al., 2020). This suggests that FKBP3 may contribute to thermal adaptation in teleost fish by modulating cellular stress response pathways (Wang et al., 2009).

The fugu (*Takifugu rubripes*) genome has been extensively studied, providing valuable insights into vertebrate genome evolution and gene function. Research on the fugu IGFBP-4 gene revealed structural and functional conservation with mammalian orthologs, with expression patterns influenced by age and starvation (Li et al., 2009). The TNFAIP3/A20 gene in fugu, involved in immune regulation, showed higher expression in immune-related tissues and responsiveness to bacterial and viral stimuli (Hikima et al., 2017). A comprehensive genetic map of fugu integrated with genome assembly revealed higher recombination rates compared to other vertebrates and fewer chromosomal rearrangements than in Tetraodon (Kai et al., 2011). The fugu genome sequencing has provided a foundation for comparative fish genomics and genetic studies of other vertebrates, contributing to advancements in aquatic genomics research with implications for science and aquaculture (Jaillon et al., 2004). Fugu, specifically Takifugu rubripes, is an invaluable model organism for research across various fields, including developmental biology, toxicology, carcinogenesis, and behavior. It also serves as a significant resource for studies in molecular biology, genetics, and genomics. Fugu (*F. rubripes*) has emerged as an excellent model organism for vertebrate genomic research due to its compact genome of approximately 400 Mb (Elgar, 1996). This genome is about 7.5 times smaller than the human genome, yet contains a similar gene complement (Venkatesh, 2006). Fugu's genome is characterized by reduced intron sizes, minimal repetitive DNA, and high gene density, averaging one gene every 6-7 kb (Sarwal et al., 1996). Despite its compactness, Fugu's genome maintains high genetic conservation with other vertebrates, preserving intron/exon structures and coding sequences (Venkatesh, 2006). These features make Fugu valuable for comparative genomics, gene discovery, and identification of conserved regulatory elements (Brunner et el., 1999). Additionally, Fugu's genome has facilitated the characterization of multigene families and novel gene identification through PCR amplification (Sarwal et al., 1996; Angrist, 1998).

In summary, fugu serves as an advantageous model organism for a range of research fields, including studies on stress genes. Its small genome size contribute to its suitability for genomics research. This study primarily aims to investigate the *fkbp3* gene in fugu through computational analysis. By leveraging

various bioinformatics tools and techniques, we seek to uncover genetic variations and predict the structures and functions of associated proteins.

2. Materials and Methods

2.1. Survey of Computational Techniques for Sequence Alignment and Homology Modeling

Sequence alignment is a key method for comparing and identifying similarities between genetic sequences. In this study, we will use sequence alignment tools, specifically the BLOSUM62 matrix algorithm (as described by Gromiha in 2010), to examine genetic variations in the *fkbp3/FKBP3* gene and pinpoint conserved regions.

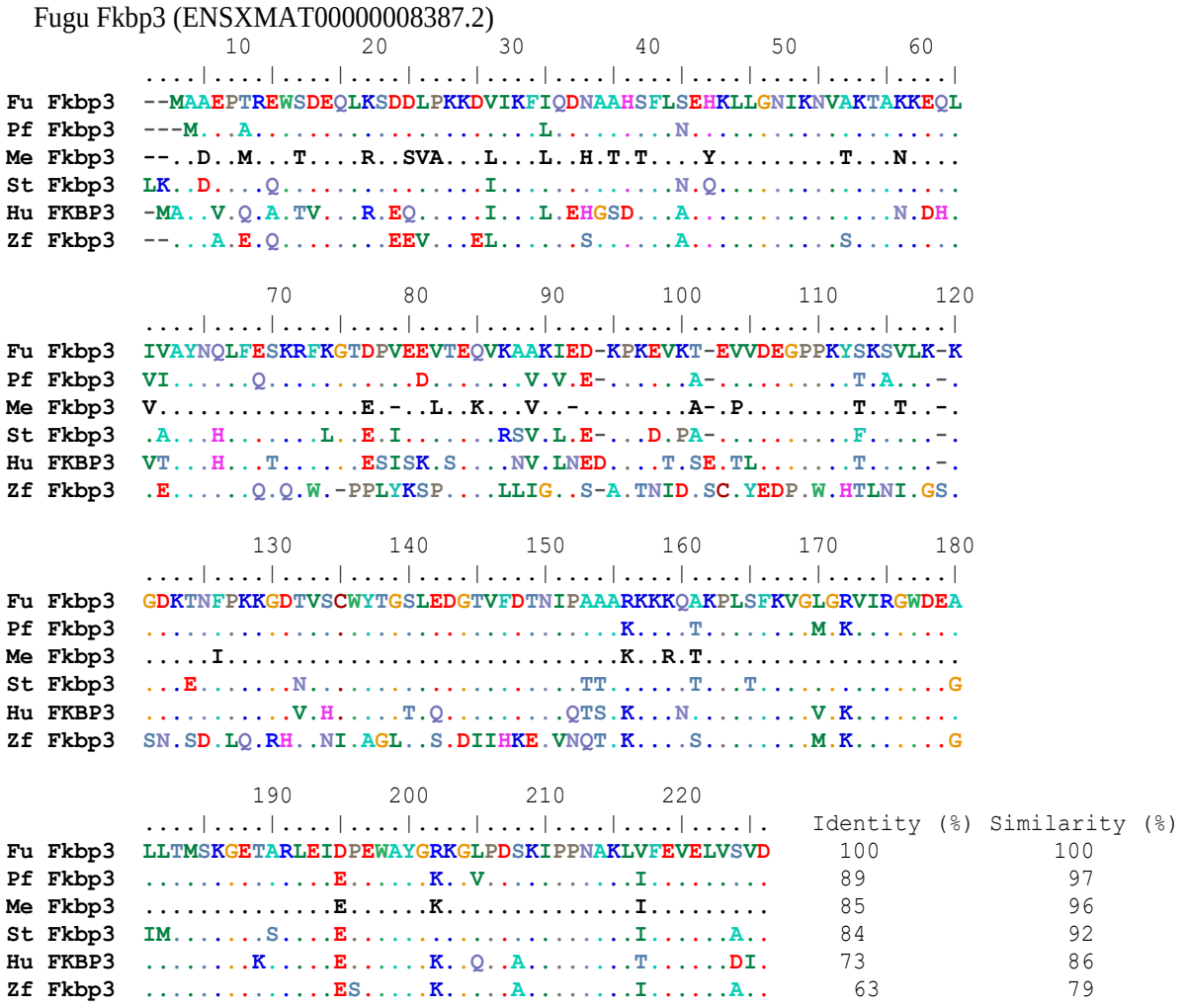


Figure 1. Identity-Similarity Rates between Fkbp3 protein Sequences of Fugu and Other Vertebrates' Fkbp3/FKBP3 Protein Sequences. The dots and lines refer to repeating amino acids and undetectable amino acids, respectively.

We performed a BLAST analysis using the cDNA sequences of the *fkbp3* gene from the NCBI database to verify the functionality of the *fkbp3* gene. Additionally, we examined the conservation of this gene in fugu, zebrafish (*Danio rerio*), and human (*Homo sapiens*) by locating the chromosome regions of the

medaka *fkbp3* gene and comparing these regions with those in zebrafish and humans. This comparison enabled us to identify corresponding gene regions in zebrafish and humans, thereby assessing the conservation of gene synteny.

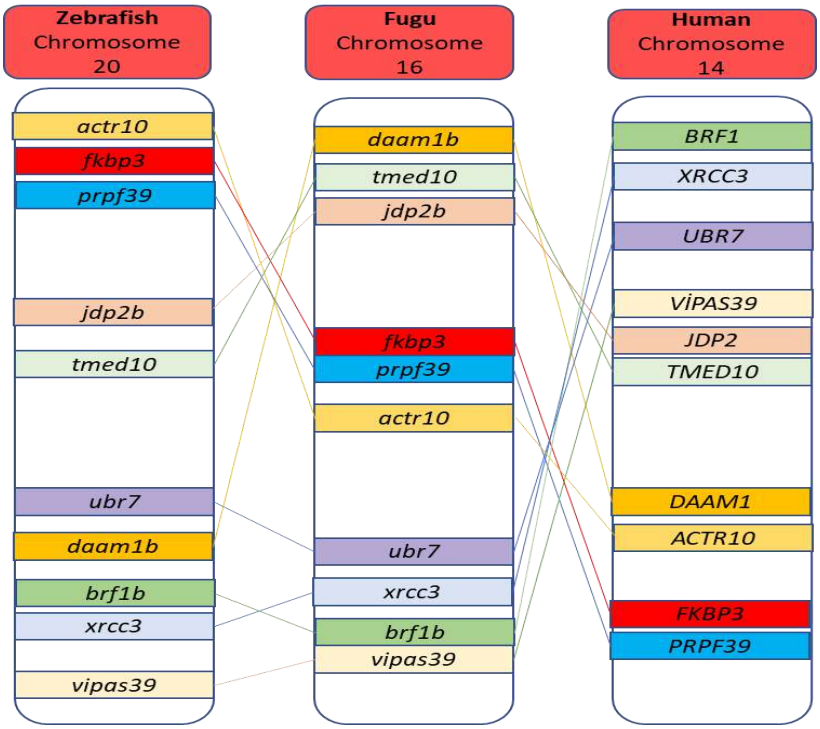


Figure 2. Conserved gene synteny in fugu.

To elucidate the evolutionary connections of the fugu fkbp3 gene with various teleost fish and vertebrates, we employed a maximum likelihood approach to construct a phylogenetic tree. This analysis was facilitated through the use of software tools, including CLUSTALW, BioEdit (available at http://www.mbio.ncsu.edu/bioedit/page2.html), and MEGA11 (Tamura et al., 2021).



Figure 3. Phylogenetic relationship between fugu and some teleost fish and some vertebrates.

In silico analyses were carried out using the longest available cDNA transcripts of the fugu *fkbp3* gene. The gene structure of *fkbp3*, encompassing its exon-intron layout, coding sequences, and 5'-3' ends, was examined through the Ensembl database. The research also pinpointed the transcription start site (+1), the TATA box, and the poly A tail, with these observations detailed in Table 1.

Table 1. Gene structure of fugu *fkbp3* gene.

Fugu *fkbp3* (ENSXMAT00000008387.2)

```
5′agtttaacaagtcagattgtcattttagactatgaatacgtgtttcaaatggaaattg
aagtttagtagtgtgtttagtagtagtgttttcttctatgtggcatcttacttcatctct
cttctttctgaaaatgtatttgtgtgtcttgtattaaatgttttcatcttaaatgatcaa
atattgtaataccaagtccaatattctagagatttacagcaaataccaaacaactgaatt
acctgaaagttcatgtttatttatatctctaaaaatggttttcaaaactcgaccactagg
+1
TGGCAGCCCATGCGGGTTTAAATCAGAAGGAAATCTTATATAATCAACGTTTTTAAACAC
TTGGTTTATTTTTATTTGAGTGCCACGGTTGGCTGTTTTTGCGGCAGCCGGCATTTAAAA
GAACATTTTTATTCGGATATAAAGTTAAATAAAAAGGTTAATTGTTGGTTCGTCGTGGGG
TGAAAGTTCACGCCTCTCCAAGATGGCGGCGGAACCAACACGAGAATGGAGCGACGAGCA
                      -M--A--A--E--P--T--R--E--W--S--D--E--Q
GCTCAAAAGTGACGATTTACCCAAAAAGGACGTGATAAAGTTCATTCAGGACAATGCGGC
--L--K--S--D--D--L--P--K--K--D--V--I--K--F--I--Q--D--N--A--A
CCACTCGgtatgN365cccagTTCCTCAGTGAGCATAAGTTGTTGGGAAACATCAAAAAT
--H--S-               -F--L--S--E--H--K--L--L--G--N--I--K--N-
GTGGCTAAAACGGCAAAGAAAGAACAGTTGATCGTTGCCTACAATCAACTCTTCGAGAGT
-V--A--K--T--A--K--K--E--Q--L--I--V--A--Y--N--Q--L--F--E--S-
AAAgtaag N72tgaagAGGTTTAAAGGCACGGATCCTGTTGAGGAAGTCACCGAGCAGGT
-K-               -R--F--K--G--T--D--P--V--E--E--V--T--E--Q--V
GAAAGCTGCCAAAATCGAAGACAAGCCCAAAGAAGTCAAAACAGAAGTTGTGGATGAGgt
--K--A--A--K--I--E--D--K--P--K--E--V--K--T--E--V--V--D--E-
actN55cccagGGTCCACCCAAGTACTCCAAGTCTGTGCTGAAAAAGGGCGACAAGACAA
           -G--P--P--K--Y--S--K--S--V--L--K--K--G--D--K--T--
ACTTTCCAAAGAAAGGAGACACTGTGAGCTGCTGGTACACCGGGTCCCTGGAGGACGGCA
N--F--P--K--K--G--D--T--V--S--C--W--Y--T--G--S--L--E--D--G--
CTGTGTTTGACACCAATATTCCCGCAGgtgaaN72tgcagCGGCGAGAAAGAAAAAGCAA
T--V--F--D--T--N--I--P--A--           A--A--R--K--K--K--Q-
GCGAAGCCGCTGAGCTTCAAAGTCGGCCTGGGGAGAGTCATCCGAGGGgtgagN58tcca
-A--K--P--L--S--F--K--V--G--L--G--R--V--I--R--G-
gTGGGACGAGGCCCTGCTGACGATGAGCAAGGGCGAAACGGCGAGATTGGAGATCGACCC
 -W--D--E--A--L--L--T--M--S--K--G--E--T--A--R--L--E--I--D--P
GGAGTGGGCGTATGGGAGAAAAGGGCTCCCCGACTCCAAgtatcN96atcagAATTCCTC
--E--W--A--Y--G--R--K--G--L--P--D--S--K             --I--P--
ACCATGCAAAGCTGGTTTTTGAAGTTGAACTGGTTTCTGTGGACTAGcaactgcatttgg
P--N--A--K--L--V--F--E--V--E--L--V--S--V--D--*-
attgtatcgtctcattgtcggccaccacttgattcatacggtggcttattacacgacacc
cttacagcgttttgcatgtacgtcttcaataaaaacccggtctcagactgaagtattca
ctcatttgggtttcgttctgcttctgtcaaagacttgtcagcacaattagtgccatgttt
ttatttccatcgacaagagtaaatttaattATAAAAAcacaatataaagccaggacagca
gtagctcagtgtgttgaggactgggctgatgatgtagagggttgtcagttcaagacccag
tgcagacaacacatggaaggtgctcagaatatgtgtaaggtgcacaaggactcccaattc
caag 3′
```

Note: The transcription start site is marked as +1. Exons of the *fkbp3* gene are displayed in capital letters, while 5' upstream sequences, 3' downstream sequences, and introns are shown in lowercase. The TATA box and the polyadenylation signal (AATAAAA) are highlighted in capital letters and shaded in yellow. Amino acids are represented in capital letters below the exons. The stop codon (TAG) is indicated by an asterisk.

3. Results and Discussion

Fugu has been used as a model to study cold stress responses, revealing tissue-specific adaptations in gene expression related to metabolism and stress tolerance (Han et al., 2022). Comparative genomic approaches using aquatic organisms can help identify conserved regulatory motifs and generate testable hypotheses about gene regulation mechanisms (Barnes et al., 2004).

To assess orthology between the *fkbp3* gene in fugu and its counterparts in other vertebrates, we calculated the sequence identity and similarity ratios. This involved aligning the amino acid sequences encoded by the fugu *fkbp3* gene with *fkbp3/FKBP3* sequences from various vertebrate species, including platyfish, medaka, stickleback, zebrafish, and humans, using the CLUSTAL W multiple alignment tool and the BLOSUM62 matrix algorithm. The percentage of sequence identity varied among the examined *fkbp3* genes, with the fugu fkbp3 showing the highest sequence identity and similarity with the platyfish (89% and 97%, respectively) (Figure 1).

The conserved gene synteny of the fugu *fkbp3* gene with the *fkbp3/FKBP3* genes in zebrafish and humans was manually assessed using the Ensembl genome database. We first identified the conserved genes and their positions in the fugu genome, then investigated their presence and location in human and zebrafish chromosomes. The analysis revealed a high level of gene conservation, as illustrated in the synteny diagram (Figure 2). Phylogenetic relationship is given in the tree (Figure 3) which created using protein sequences of fugu (*Fugu rubripes*), medaka (*Oryzias latipes*), zebrafish (*Danio rerio*), stickleback (*Gasterosteus aculeatus*), Goldfish (*Carassius auratus*), Atlantic salmon (*Salmo salar*), Brown trout (*Salmo trutta*), Rainbow trout (*Oncorhynchus mykiss*), Gilthead seabream (*Sparus aurata*), Human (*Homo sapiens*), Domestic cat (*Felis catus*), Chicken (*Gallus gallus*) *fkbp3/FKBP3* genes according to maximum likelihood method using MEGA11 program MEGA11 (Tamura et al., 2021). It was observed that the fugu showed clustering with other teleost fishes. Human *SOD3* gene is chosen as the outgroup. The longest cDNA transcript of the fugu *fkbp3* gene was used to perform in silico analyzes. The ensembl database was used to determine the gene structure of this gene. Fugu *fkbp3* gene exhibits a highly conserved gene organization consisting of 7 exons separated by for 6 introns.

4. Conclusion

Recently, there has been a growing interest in using aquatic organisms as model systems. In this research, we examined the bioinformatics of the fkbp3 gene in fugu, an aquatic model organism. By identifying and characterizing the fkbp3 gene, which shows differential expression between fish with high stress tolerance and those without, we aim to enhance aquaculture selection programs. This can improve stress resilience in fish and offer valuable genetic markers that may also be applicable to other vertebrates, including humans. This study's comparative analysis of the *fkbp* Prolyl Isomerase 3 gene across different species provides valuable insights into its evolutionary trajectory, shedding light on the patterns of conservation and divergence. The research establishes a foundation for future investigations into the *fkbp3* gene in fugu, highlighting the importance of assessing stress-related protein and enzyme expression to understand cellular responses under stress. Identifying and characterizing these genes is crucial for advancing aquaculture selection programs and generating valuable data for future research. By performing bioinformatics-based identification and characterization of the *fkbp3* gene in fugu, this study offers critical genetic insights. Future work should include experimental validation of the computational predictions regarding genetic variations, protein structures, and molecular interactions

related to *fkbp3*. Additionally, functional studies should investigate how *fkbp3* impacts various physiological processes. Comparative analyses with other species will further elucidate evolutionary patterns and conservation of FKBP3. Overall, this research paves the way for deeper exploration of the *fkbp3* gene in fugu.

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
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ORAL PRESENTATION

Eigenfunction Expansion of Sturm-Liouville Operator with Discontinuous Coefficient Under Transmission Conditions

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Abstract

In this study, we consider the boundary value problem which is generated by Sturm-Liouville equation with discontinuous coefficient under the transmission conditions at a point on the positive half line. The aim of this study is to obtain the expansion formula with respect to the eigenfunctions of this boundary value problem. First, we give the normalized eigenfunctions of this boundary value problem. Then, we construct the resolvent operator of this problem. Finally, the eigenfunction expansion formula of this boundary value problem is obtained by applying the method of Titchmarsh. Until now, the Sturm-Liouville problems containing transmission conditions and Sturm-Liouville problems involving discontinuous coefficients are studied as two separate problems. In this paper, we examine a new and generalized problem by combining these two different Sturm-Liouville problems. That is, this boundary value problem contains both discontinuous coefficient and transmission conditions at some point on the positive half line. Therefore, the Jost solution of the Sturm-Liouville equation with discontinuous coefficient under transmission conditions is different from the transformation operator and this Jost solution has an integral representation. In this study, we give the integral representation of this Jost solution and obtain the expansion formula with respect to the eigenfunctions of this boundary value problem by using this Jost solution.

Keywords: Sturm-Liouville Equation, Jost Solution, Eigenfunction Expansion.

1. Introduction

In this paper, we consider the Sturm-Liouville equation with discontinuous coefficient

$$-y'' + q(x)y = \mu^2 \rho(x)y, \quad x \in (0,a) \cup (a,\infty), \tag{1}$$

Under transmission conditions at the point $x = a \in (0,\infty)$,

$$y(a-0) = \alpha y(a+0), \quad y'(a-0) = \alpha^{-1} y(a+0), \tag{2}$$

and boundary condition

$$y'(0) = 0, \tag{3}$$

Where $0 < \alpha \neq 1$, μ is a complex parameter, $\rho(x)$ is discontinuous coefficient

$$\rho(x)=\begin{cases}\beta^2, & 0<x<a,\\ 1, & x>a,\end{cases}$$

with $0<\beta\neq 1$, and $q(x)$ is real-valued function and satisfies the following condition

$$\int_0^s x|q(x)|dx<\infty. \tag{4}$$

In classical case, (i.e. $\rho(x)\equiv 1$ and $\alpha=1$), the direct and inverse scattering problems were given in detail by Marchenko (Marchenko, 2011). The direct and inverse problems for Sturm-Liouville operator with discontinuous coefficient are worked in (Çöl, 2015; Guseinov & Pashaev, 2002; Mamedov, 2010; Mamedov & Palamut, 2009; Mızrak et al., 2017). The scattering theory of Sturm-Liouville operator with discontinuity conditions (or transmission conditions) on the positive half line is examined in (Akcay, 2021; El-Reheem & Nasser, 2014; Huseynov & Osmanova, 2007; Huseynov & Osmanlı, 2009; Huseynov & Mammadova, 2013; Manafov & Kablan, 2013). The new Jost solution of equation (1) with transmission conditions (2) is constructed in (Akcay, 2022).

2. Materials and Methods

In this paper, to obtain the eigenfunction expansion formula, we use the Jost solution of equation (1) with transmission conditions (2). This solution is given as follows:

Theorem (Akcay, 2022). The condition (4) holds. Then, for all μ from the closed upper half plane, the equation (1) with transmission conditions (2) has the Jost solution $e(x,\mu)$ that can be represented in the following form

$$e(x,\mu)=e_0(x,\mu)+\int_{\sigma(x)}^{\infty}|K(x,t)|e^{i\mu t}dt, \tag{5}$$

Where

$$e_0(x,\mu)=\begin{cases}e^{i\mu x}, & x>a,\\ \theta^+e^{i\mu\vartheta^+(x)}+\theta^-e^{i\mu\vartheta^-(x)}, & 0<x<a,\end{cases}$$

with $\theta^{\pm}=\frac{1}{2}\left(\alpha\pm\frac{1}{\alpha\beta}\right)$, $\vartheta^{\pm}(x)=\pm\beta(x-a)+a$, $\sigma(x)=\begin{cases}x, & x>a,\\ \vartheta^+(x), & 0<x<a,\end{cases}$ the kernel $K(x,.)\in L_1(\sigma(x),\infty)$ for each fixed $x\in(0,a)\cup(a,\infty)$ satisfies the following inequality:

$$\int_{\sigma(x)}^{\infty}|K(x,t)|dt\leq e^{cp(x)}-1$$

with $p(x)=\int_x^{\infty}s|q(s)|ds$ and $c=\theta^++|\theta^-|$. Besides, the following properties are valid:

$$K(x,\sigma(x))=\begin{cases}\dfrac{1}{2}\displaystyle\int_x^{\infty} q(t)dt, & x>a,\\[2ex] \dfrac{\theta^+}{2}\displaystyle\int_x^{\infty}\dfrac{1}{\sqrt{\rho(t)}}q(t)dt, & 0<x<a,\end{cases}$$

$$K(x,\vartheta^-(x)+0)-K(x,\vartheta^-(x)-0)=\frac{\theta^-}{2}\left\{\int_a^{\infty} q(s)ds-\frac{1}{\beta}\int_x^{a} q(s)ds\right\},\quad 0<x<a.$$

The solution $e(x,\mu)$ is regular with respect to μ in the upper half plane and continuous for $Im\mu\geq 0$. For real $\mu\neq 0$, the functions $e(x,\mu)$ and $e(x,-\mu)$ form a fundamental system of solutions of equation (1) with transmission conditions (2) and their Wronskian is equal to $2i\mu$.

A collection of quantities $\{S(\mu),\ (-\infty<\mu<\infty),\ \mu_k^2,\ \tau_k,\ k=\overline{1,n}\}$ is called the ***scattering data*** of boundary value problem (1)-(3). The function $S(\mu)=\frac{e\prime(0,-\mu)}{e\prime(0,\mu)}$ is defined as the ***scattering function*** of the problem (1)-(3). The function $w(\mu):=e'(0,\mu)$ may have only a finite number of zeros in the half, moreover; these zeros are all simple and lie on the imaginary axis. Denote the ***normalized numbers*** of problem (1)-(3) by τ_k:

$$\tau_k^{-2}=\int_0^{\infty}|e(x,i\mu_k)|^2\rho(x)dx=\frac{\dot{w}(i\mu_k)e(0,i\mu_k)}{2i\mu_k},\tag{6}$$

Where $i\mu_k$ are zeros of the function $w(\mu)$ and $\dot{w}(\mu)=\frac{d}{d\mu}w(\mu)$. The following solutions are bounded solutions of problem (1)-(3):

$$u(x,\mu)=e(x,-\mu)-S(\mu)e(x,\mu),\quad(-\infty<\mu<\infty),\tag{7}$$

$$u(x,i\mu_k)=\tau_k e(x,i\mu_k),\quad(k=1,2,\dots,n).\tag{8}$$

These functions form a complete set of ***normalized eigenfunctions*** of the problem (1)-(3).

Denote the function $\varphi(x,\mu)$ by the solution of equation (1) with conditions (2) under the initial conditions $\varphi(0,\mu)=1$, $\varphi'(0,\mu)=0$.

3. Results

In this section, we will obtain the expansion formula according to the normalized eigenfunctions of the discontinuous boundary value problem (1)-(3) by applying the method of Titchmarsh (Titchmarsh, 1962).

3.1. Resolvent Operator

Denote the scaler product in the space $L_{2,\rho}(0,\infty)$ as follows:

$$\langle f,g\rangle = \int_0^{\infty} f(x)\overline{g(x)}\rho(x)dx.$$

Consider the operator $L: f \to l(f)$ with the domain

$$D(L) = \begin{Bmatrix} f(x) \in L_{2,\rho}(0,\infty): f(x), f'(x) \in AC[0,a] \cap [a,\infty], f(a-0) = \alpha f(a+0), \\ f'(a-0) = \alpha^{-1} f'(a+0), f'(0) = 0, l(f) \in L_{2,\rho}(0,\infty), \end{Bmatrix}$$

Where $l(f) = \frac{1}{\rho(x)}\{-f''(x) + q(x)f(x)\}$. Now, we will construct the resolvent operator $R_{\mu^2}(L)$. Assume that μ^2 is not spectrum point of the operator L.

Lemma. The resolvent operator $R_{\mu^2}(L)$ is an integral operator with the following representation:

$$y(x,\mu) = R_{\mu^2}(L) = \int_0^{\infty} g(x,t,\mu)f(t)\rho(t)dt, \tag{9}$$

Where

$$g(x,t,\mu) = \frac{-1}{w(\mu)}\begin{cases} \varphi(x,\mu)e(t,\mu), & x \le t, \\ e(x,\mu)\varphi(t,\mu), & x \ge t. \end{cases} \tag{10}$$

Proof. Consider the following inhomogeneous boundary value problem:

$$-y'' + q(x)y = \mu^2\rho(x)y + f(x)\rho(x),$$

$$y(a-0) = \alpha y(a+0), \quad y'(a-0) = \alpha^{-1}y(a+0),$$

$$y'(0) = 0.$$

Applying the method of variation of parameters, the resolvent operator (9) and its kernel (10) are obtained.

3.2. Eigenfunction Expansion

Theorem. Assume that $f(x) \in D(L)$ is a twice continuously differential function and finite at infinity. Then, the expansion formula of normalized eigenfunctions of the boundary value problem (1)-(3) has the following representation:

$$f(x) = \sum_{k=1}^{n} \int_0^{\infty} u(x,i\mu_k)u(t,i\mu_k)\, f(t)\rho(t)dt + \frac{1}{2\pi}\int_0^{\infty}\int_0^{\infty} u(x,\mu)\overline{u(t,\mu)}f(t)\rho(t)dtd\mu.$$

Proof. Taking into account (9) and (10), we can write for $Im\mu > 0$:

$$y(x,\mu) = \int_0^{\infty} g(x,t,\mu)f(t)\rho(t)dt = -\frac{e(x,\mu)}{\mu^2 w(\mu)}\int_0^{x}[-\varphi''(t,\mu) + q(t)\varphi(t,\mu)]f(t)dt$$

$$-\frac{\varphi(x,\mu)}{\mu^2 w(\mu)}\int_x^\infty [-e''(t,\mu)+q(t)e(t,\mu)]f(t)dt.$$

Now, integrating by parts and using the transmission conditions (2) and boundary condition (3), we have for $x < a$

$$\int_0^\infty g(x,t,\mu)f(t)\rho(t)dt = -\frac{f(x)}{\mu^2}+\frac{H(x,\mu)}{\mu^2},$$

Where

$$H(x,\mu)=\int_0^\infty g(x,t,\mu)[-f''(t)+q(t)f(t)]dt.$$

For $x > a$, a similar relation is obtained.

Denote C_R by the positively oriented contour formed by the circle of radius R and center at zero. Assume that C_R^1 is positive oriented boundary of $D_1=\{z:|z|\le R,\ |Imz|\ge\varepsilon\}$ and C_R^2 is negative oriented boundary of $D_2=\{z:|z|\le R,\ |Imz|\le\varepsilon\}$. Then, multiplying both sides of the expression

$$\int_0^\infty g(x,t,\mu)f(t)\rho(t)dt = -\frac{f(x)}{\mu^2}+\frac{H(x,\mu)}{\mu^2}$$

by $\frac{\mu}{2\pi i}$ and integrating along the contour C_R with respect to μ, we calculate

$$\frac{1}{2\pi i}\int_0^\infty \mu y(x,\mu)d\mu = -\frac{1}{2\pi i}\int_{C_R}\frac{f(x)}{\mu}d\mu+\frac{1}{2\pi i}\int_{C_R}\frac{H(x,\mu)}{\mu}d\mu. \quad (11)$$

Moreover, we get

$$\frac{1}{2\pi i}\int_{C_R^1}\mu y(x,\mu)d\mu = \frac{1}{2\pi i}\int_{C_R}\mu y(x,\mu)d\mu+\frac{1}{2\pi i}\int_{C_R^2}\mu y(x,\mu)d\mu. \quad (12)$$

Thus, using the expressions (11) and (12), also the relation $\lim\limits_{|\mu|\to\infty}\sup\limits_{x\ge0}|H(x,\mu)|=0$ as $R\to\infty,\varepsilon\to0$, we find

$$\frac{1}{2\pi i}\int_{C_R^1}\mu y(x,\mu)d\mu = -f(x)+\frac{1}{2\pi i}\int_{-\infty}^{\infty}\mu[y(x,\mu+i0)-y(x,\mu-i0)]d\mu. \quad (13)$$

Applying the residue theorem and taking into account the relation (13), we obtain

$$f(x) = -\left(\sum_{k=1}^n \operatorname*{Res}_{\mu=i\mu_k}\mu y(x,\mu)+\sum_{k=1}^n \operatorname*{Res}_{\mu=-i\mu_k}\overline{\mu y(x,\mu)}\right)+\frac{1}{2\pi i}\int_{-\infty}^{\infty}\mu[y(x,\mu+i0)-y(x,\mu-i0)]d\mu. \quad (14)$$

Let $s(x,\mu)$ be a solution of equation (1) with transmission conditions (2) satisfying the following initial conditions $s(0,\mu)=0, s'(0,\mu)=-1$. Then, we can calculate

$$e(x,\mu)=e(0,\mu)\varphi(x,\mu)-w(\mu)s(x,\mu). \tag{15}$$

Taking into account the relations (10) and (16), we can write

$$g(x,t,\mu)=\frac{-1}{w(\mu)}e(0,\mu)\varphi(x,\mu)\varphi(t,\mu)+\begin{cases}\varphi(x,\mu)s(t,\mu), & x\le t,\\ s(x,\mu)\varphi(t,\mu), & t\le x.\end{cases}$$

Using this equality, we have for $Im\mu>0$,

$$\sum_{k=1}^{n}\operatorname*{Res}_{\mu=i\mu_k}\mu y(x,\mu)+\sum_{k=1}^{n}\operatorname*{Res}_{\mu=-i\mu_k}\overline{\mu y(x,\mu)}=$$

$$=\textstyle\sum_{k=1}^{n}\frac{-2i\mu_k e(0,i\mu_k)}{\dot{w}(i\mu_k)}\int_0^{\infty}\varphi(x,i\mu_k)\varphi(t,i\mu_k)f(t)\rho(t)dt. \tag{16}$$

On the other hand, the following equality is obtained:

$$\frac{1}{2\pi i}\int_{-\infty}^{\infty}\mu[y(x,\mu+i0)-y(x,\mu-i0)]d\mu=$$

$$=\frac{2}{\pi}\int_0^{\infty}\frac{\mu^2}{|w(\mu)|^2}\varphi(x,\mu)\int_0^{\infty}\overline{\varphi(t,\mu)}f(t)\rho(t)dtd\mu. \tag{17}$$

Thus, putting the relations (16) and (17) in the equation (14) and using the expressions (6)-(8), we obtain the following normalized eigenfunction expansion formula of the boundary value problem (1)-(3):

$$f(x)=\sum_{k=1}^{n}\int_0^{\infty}u(x,i\mu_k)u(t,i\mu_k)\,f(t)\rho(t)dt+\frac{1}{2\pi}\int_0^{\infty}\int_0^{\infty}u(x,\mu)\overline{u(t,\mu)}f(t)\rho(t)dtd\mu.$$

4. Conclusion

In this paper, we obtain the expansion formula with respect to the normalized eigenfunctions of discontinuous boundary value problem (1)-(3). Different from other studies, this problem has both discontinuous coefficient $\rho(x)$ and transmission conditions at the point $x=a\in(0,\infty)$. Therefore, The Jost solution $e(x,\mu)$ of this problem is not in the form of transformation operator, is in the form of integral representation (5) and its kernel function has a discontinuity along the line $t=\vartheta^{-}(x)=-\beta(x-a)+a$, for $0<x<a$. Consequently, the obtained results in this paper are new and novelty.

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
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ORAL PRESENTATION

An Analysis of the Education and Gender Influencing the Information Society Indicators in the European Union Countries

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Abstract

This study examines the influence of education and gender on Information Society indicators using multivariate MANCOVA and ANCOVA methods, controlling for country and year variables. The 424 complete cases come from Eurostat's annual EU survey on ICT usage in households and by individuals and include indicators such as knowledge of the use of cookies to track web movements, changing browser settings to prevent or limit cookies, using software that limits the ability to track web activities, and managing access to personal data on the web. The MANCOVA results showed significant differences in the linear combination of all indicators across education level and gender, after controlling for country and year, suggesting important influences of these factors on personal data protection behaviours and attitudes. The ANCOVA analysis also showed significant differences between education level and gender for each indicator. The study underlines the importance of paying greater attention to education and gender factors in developing social and educational policies, highlighting the significant differences between EU Member States and the need for strategic investment in education and gender equality to ensure long-term competitiveness and modernization. The results of this study serve as a basis for formulating future policies and assessing their impact on behaviour and attitudes towards the protection of personal data in the European Union.

Keywords: Eurostat, Multivariate Methods, Gender, Education, European Union.

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
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ORAL PRESENTATION

Digital Skills across the European Union: Progress and Challenges

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Abstract

The European Union (EU) has implemented several strategies to improve the digital literacy of its population in an age where digital skills are essential for active participation in the digital economy. The study is based on the analysis of data provided by Eurostat. The methodology includes the assessment of trends based on historical data and future projections, providing a clear picture of progress made and areas for improvement. In the European Union, digital literacy skills, ICT professionals, Gigabit connectivity, fiber to the premises (FTTP) and 5G coverage, edge nodes, quantum computing, use of cloud computing services, data analytics, artificial intelligence technologies, the number of unicorns, and online delivery of public services to citizens and businesses have seen significant increases between 2013/2014 and 2023, with ideal projections suggesting further increases until 2030. However, there are significant differences between EU member states, reflecting variances in resources and policies allocated to digital literacy. The study highlights the significant progress and continued potential of the European Union in digitalizing skills, infrastructure, and services, and underlines the importance of strategic investment and supportive policies to ensure long-term competitiveness and innovation. The study serves as a basis for formulating future policies and assessing their impact on digital literacy in the EU.

Keywords: Eurostat, Digital Literacy, Digital Economy, European Union.

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
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ORAL PRESENTATION

Investigation of Soil Salinity and Properties in the Meriç Delta with GIS Techniques

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Abstract

The Meriç Delta is one of the most critical ecosystems in Europe and attracts attention with its mild climatic conditions and location on the bird migration route. Frequent changes in water regimes in the Delta and alterations in the Meriç River bed due to various reasons affect soil properties. In this study, 89 samples were taken from 30 points in the Meriç Delta at 0-30, 30-60 and 60-90 cm depths and brought to the laboratory for analysis. Soil salinity was analyzed using Geographic Information Systems (GIS) methods, and salinity levels and their effects on soil properties were determined. Separate maps were created according to the determined properties' depths, and the Meriç Delta's current situation was revealed. The complex interplay of sedimentary processes, mineralogy and ecological factors contribute to the unique distribution of clay, salt and sodium in the Evros Delta and Lake Gala region. Understanding these factors is crucial for comprehensively explaining the observed patterns of soil composition and agricultural practices in the area. The variation in sodium in the Evros Delta is likely influenced by natural processes such as soil salinity dynamics, hydrological interactions and coastal effects, and human activities such as agriculture and land use practices. Understanding these factors and their interactions is crucial for managing soil salinity, maintaining soil quality and promoting sustainable land use practices in delta regions.

Keywords: Meriç Delta, Soil Properties, Salinity, GIS.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
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ORAL PRESENTATION

Gains to Soil from the Use of Legume Forage Crops as Green Fertilizer

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Abstract

Green manuring is the method of applying nitrogen-fixing green manure plants to the soil while they are still green in order to provide the nutrients needed by the soil and crops. This practice ensures that the soil is enriched in terms of organic matter, its fertility is increased and better quality products are obtained. Especially in places where barnyard manure is scarce, green manuring plays an important role in increasing the amount of organic matter in the soil. As green manure crops, legumes are among the best choices due to the high nitrogen content and other benefits they provide to the soil. Research shows that legume forage crops provide 10-30 kg of nitrogen per decare when used as green manure. Plants such as alfalfa, meadow ryegrass, soybeans are among the most preferred. Green manuring protects the soil from erosion, increases the amount and diversity of microorganisms, improves the physico-chemical properties of the soil and provides better growth of plants by shading. The biological nitrogen fixation and organic matter addition of legumes improves soil fertility in the long term. At the same time, the use of these crops in crop rotations contributes to sustainable agricultural practices by reducing the need for synthetic fertilizers. Co-cropping legume forage crops with cereals increases overall yields, with mutual benefit to both crop species. However, green manure application needs to be carefully managed. Otherwise, excessive nitrogen accumulation and food security problems may arise. The deep root systems of legumes increase the water-holding capacity of the soil and improve soil structure. Therefore, green manuring plays an important role in sustainable agriculture by improving soil health and fertility. Furthermore, these plants are also noted for their ability to control pests, reduce soil erosion and stimulate microbial activity. These properties encourage the widespread use of legume forage crops in agricultural systems. Green manuring contributes significantly to environmental sustainability and agricultural productivity.

Keywords: Green Manure, Legume, Soil.

1. Introduction

The use of legume forage crops as green manures has attracted attention due to their ability to improve soil fertility and sustainability. Legumes contribute to increasing soil organic matter (SOM) through processes such as biological nitrogen fixation (BNF) facilitated by symbiotic relationships with microorganisms such as rhizobia (Kebede, 2021). This increase in SOM leads to improved nutrient cycling, erosion control and soil conservation (Singh et al., 2023). In addition, legumes release nitrogen by decomposing plant parts, which improves soil fertility and productivity (Kumar et al., 2020).

Incorporating legumes into cropping systems can lead to increased soil fertility and improved physico-chemical properties over time (Iqbal et al., 2018).

2. Discussion

Green manuring is the plowing of nitrogen-fixing green fertilizer plants such as alfalfa, vetch and broad beans, which have been planted to provide the nutrients needed by the soil and crops, while they are still green. This method increases the fertility of the soil and helps to obtain more and better quality products. The main purpose of green manuring is to enrich the soil in terms of organic matter. Especially in places where barnyard manure is scarce, it is important to increase the amount of soil organic matter through green manuring (Kara 2022).

In order for a plant to be a green manure, it must be compatible with local growing conditions, grow fast, have dense biomass and not carry the risk of transmitting diseases and pests to other crops (Kara 2022). Although a wide variety of plants are grown as green manure crops, legumes are always considered the best green manure crops. Research shows that legume forage crops sown for green manuring provide about 10-30 kg N per decare. Plants such as alfalfa, meadow ryegrass, soybeans, rye, oats, barley, wheat and mustard are most commonly sown (Akgün, Türkay et al. 2023).

Green manuring with green manure plants protects the soil from erosion and acts as shading. It protects the soil structure and increases the amount and diversity of microorganisms. This provides a significant increase in the yield and quality of the plants to be grown afterwards (Hekimoğlu and Altındeğer 2006). In order to provide the organic matter needed by soils, forage crops are usually plowed and buried under the soil during the flowering period (Avcıoğlu et al. 2009).

Forage legumes play an important role in improving soil health and fertility. They contribute to enriching soil organic carbon stocks, maintaining activated carbon levels and improving soil health management (Lazali & Drevon, 2023). Legumes not only improve soil fertility, but also have the potential to increase resource use efficiency and resilience of cropping systems, especially under climate change conditions (Hassen et al., 2017). The benefits of legumes extend to livestock systems, where they increase the nutritive value of pastures and help rehabilitate nutrient-depleted soils (Gulwa et al., 2018). Furthermore, the inclusion of legumes in cropping systems positively affects soil organic matter, biological activity and residual soil fertility, leading to increased yields of subsequent crops (Kalkan and Avcı, 2020).

Legume forage crops play an important role in improving soil fertility and sustainability in agricultural systems. These crops provide numerous agroecosystem services that contribute to sustainable crop production and animal nutrition (Kumar, Yadav et al. 2020). An important advantage of legume green manures is their ability to prevent nutrient leaching during non-cropping seasons, provide low-cost nitrogen to subsequent crops, stimulate microbial activity, control pests and reduce soil erosion (Alluvione, Bertora et al. 2010).

The inclusion of legume cover crops in cropping systems can improve soil physico-chemical properties in the long term, leading to increased soil fertility through biological nitrogen fixation and organic matter addition (Iqbal, Iqbal et al. 2018). Furthermore, intercropping legume forage crops with cereals increases total yields by mutually benefiting each component, such as nitrogen fixation by legumes and shelter by cereals (Abusuwar and Omer 2011).

Studies have shown that legumes can reduce soil degradation, promote soil organic matter accumulation and enhance microbial activity through increased root biomass and residues (Ghimire et al., 2014). The integration of legumes in crop rotations can diversify production, provide carbon and nitrogen, and contribute to improving soil fertility for subsequent crops (Ro et al., 2016). Legumes also have the potential to transfer fixed nitrogen to non-legume crops, increasing production, nutritive value, soil structure and fertility in forage systems (Butler & Muir, 2012). The persistence of legume forages and grains in subsequent crops can provide production benefits that should be measured and exploited (Iannetta et al., 2016).

3. Conclusion

In conclusion, the use of legume forage crops as green manure provides significant benefits in terms of soil health and agricultural sustainability. Legumes contribute to soil fertility through processes such as biological nitrogen fixation, increasing nutrient availability and productivity. By increasing soil organic matter, improving resource use efficiency and reducing greenhouse gas emissions, legumes play a vital role in sustainable agricultural practices. Incorporating legumes into cropping systems not only improves soil health, but also increases crop yields and overall agricultural productivity.

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ORAL PRESENTATION

Effect of Reduced Tillage System on Sunflower Yield

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Abstract

Different tillage methods significantly affect sunflower yields. Firstly, vertical tillage provides deep aeration of the soil and increases its water-holding capacity, which is a great advantage to meeting the sunflower's water needs. However, continuous vertical tillage can cause compaction of the soil layer, which negatively affects root development. Surface tillage involves lightly cultivating the top layer of soil. This method reduces erosion and prevents soil loss while helping to preserve organic matter. However, it can avoid the adequate distribution of nutrients in the lower soil layers. Crop rotation is a method that involves planting different crops alternately. This practice improves soil structure and increases water permeability. Furthermore, the balance of nutrients between crops positively affects soil health and can help reduce diseases. Minimum tillage is based on the principle of minimizing soil disturbance. This method preserves the natural structure of the soil and allows more efficient use of water and nutrients. While it increases the amount of organic matter and promotes soil health, the increase in surface organic matter can also encourage the proliferation of some pests. Reverse tillage involves turning the soil completely upside down. This method facilitates better distribution of water and nutrients but can increase erosion risk. The combination of surface organic matter with deeper nutrients can promote root development. In conclusion, tillage methods directly affect sunflower yields. Each method has advantages and disadvantages; therefore, choosing the appropriate one requires consideration of local climatic conditions, soil characteristics and plant needs. This approach ensures optimum yields and sustainable agricultural practices.

Keywords: Sunflower, Tillage, Soil Structure.

1. Introduction

Agriculture is one of the oldest activities in human history and is important for food production and natural resource management. In this context, soil plays a critical role in agricultural production processes and is a fundamental factor in plant cultivation (Christov, 2008). The effects of reduced tillage systems on soil structure have been extensively studied, and several studies have highlighted both positive and negative effects. For example, reduced tillage practices such as direct seeding can improve soil structure by promoting the development of pores, reducing soil compaction and increasing soil porosity (Abrougui, Boukhalfa et al. 2014). Furthermore, reduced tillage has been observed to increase soil porosity and reduce bulk density, positively affecting soil physical properties (Buchkina, Rizhiya et al. 2013). Research on how different tillage methods in agricultural activities affect soil structure reveals

essential findings. Reduced tillage systems can contribute to the improvement of soil structure, primarily through the preservation of soil aggregates and the improvement of soil aeration (Fanigliulo, Biocca et al. 2016). On the other hand, it has been emphasized that conventional tillage methods have adverse effects such as soil compaction, nutrient loss and organic matter depletion, which can negatively affect soil structure, and that reduced tillage practices provide more effective soil protection against erosion and that tillage practices play a critical role in maintaining soil structure and preventing soil degradation (López, Gracia et al. 2000). These studies emphasize the importance of tillage systems in determining soil structure and stability.

Reduced tillage practices have also been observed to support soil biodiversity and ecosystem services, benefiting soil micro- and mesofauna populations (Betancur-Corredor, Lang et al. 2022). It has also been reported that reduced tillage systems can protect against microbial decomposition by conserving soil carbon and potentially maintain soil health and organic matter content (Becker, Giarola et al. 2024). Sunflower (Helianthus annuus L.) is a plant belonging to the Asteraceae family and known for its wide range of uses. It is considered an essential source for human nutrition, biofuel production and industrial use, mainly due to its high oil content (Smith, 2010). The genus Helianthus spp. is entirely native to the Americas and consists of 51 species, of which 37 are perennial, and 14 are annual (Christov, 2008). Sunflower can grow in a wide range of ecological areas thanks to the genetic diversity obtained from their wild relatives growing on sandy, barren, saline and rocky soils (Skoric, 2012; Kaya et al., 2012; 2020).

Soil management strategies used in sunflower cultivation play a decisive role in plant health and productivity. For example, modern tillage techniques such as direct seeding and minimum tillage reduce soil erosion and increase water holding capacity (Brown et al., 2015). Furthermore, plant nutrition is optimized by applying the right fertilization strategies, thereby increasing productivity (Johnson, 2012). The use of organic fertilizers is an essential factor for environmental sustainability. Organic fertilizers improve soil structure, break down plant residues and control weeds. Furthermore, proper tillage methods increase soil aeration, improve water drainage and promote plant root development. In sunflower cultivation, tillage methods may vary depending on soil structure, climatic conditions and local farming practices.

The impact of reduced tillage systems on sunflower yields is an essential focus of agricultural research. A global meta-analysis by Pittelkow and Linquist (2015) shows that no-tillage yields for oilseed crops are comparable to conventional tillage yields. These findings suggest that reduced tillage practices may not negatively affect sunflower yields. It is also recommended that sunflowers be grown under conventional tillage practices with specific irrigation intervals and nitrogen fertilization rates to obtain optimum seed and oil yields, as Mourad and Nawar (2020) suggested. These studies emphasize the importance of tillage systems and specific management practices to maximize sunflower productivity (Pittelkow & Linquist, 2015; Mourad & Nawar, 2020). For example, a winter wheat-sunflower-celtic cropping sequence study observed that wheat and spelled yields were reduced in reduced tillage plots, but sunflower grain yield was unaffected (Sans, Berner et al., 2011). These findings suggest that sunflowers may respond differently to different tillage methods than other crops in the rotation.

Furthermore, studies comparing the effect of different tillage systems on soil properties and sunflower productivity emphasize the importance of tillage practices for both soil health and crop productivity (Al-Hashem, Al-Fehaid et al., 2001; Khorami, Kazemeini et al., 2018). These studies emphasize that crop

productivity and soil health should be considered when evaluating tillage strategies. A study in Pakistan showed that conservation tillage can increase sunflower yields under low moisture conditions, supporting the potential benefits of reduced tillage systems for sunflower cultivation (Nasiyev & Dukeyeva, 2023).

In Zambia, the role of extension services in promoting minimum tillage practices was emphasized, leading to yield increases in crops such as sunflower (Jena, 2022). These findings highlight the importance of information dissemination and support systems in facilitating the adoption of reduced tillage methods.

A study in Northeast China investigated the impact of short-term conservation tillage on soil properties and emphasized the need to understand the effects of tillage practices on soil health (Zhu, Chen et al., 2024). This research deepens the relationship between tillage, soil properties and crop productivity, demonstrating that agricultural management strategies require a holistic approach. For example, in a study conducted in 2012 in Karaevli village of Tekirdağ, research on sunflower cultivation under dry conditions was carried out, and the Tunca sunflower variety, known to be mid-early maturing, drought tolerant, medium-sized, weed tolerant, non-soil selective and highly adaptable, was used in the trials. The study examined the effects of four treatments on sunflower grain yield and oil quality besides essential fertilization: slow-release fertilizer + foliar fertilizer, slow-release fertilizer only, farmer condition and foliar fertilizer only. The slow-release fertilizer + foliar fertilizer treatment was associated with the highest seed yield and oil content. In contrast, the lowest yield and oil content were observed in the farmer condition treatment. The highest thousand seed weight was obtained with the foliar fertilizer-only treatment, while the lowest value was recorded in the farmer condition treatment. The treatment that reduced stearic acid content was only associated with the slow-release fertilizer treatment, while the highest content was found only in the foliar fertilizer treatment. The changes in seed yield, oil content, thousand seed weight and stearic acid content were statistically significant ($P < 0.05$). However, the effects of four different treatments on hectoliter weight, oleic acid content, linoleic acid content and palmitic acid content were not statistically significant ($P > 0.05$) (Durmaz, 2012).

Sunflower is more drought tolerant than summer crops such as cotton, maize and sugar beet due to its deep root system. Drought tolerance is one of the primary objectives of breeders, and traits such as bud green vigor, delayed leaf maturity, transpiration coefficient and canopy morphology in sunflowers are critical to assess drought tolerance under stress conditions (Kiani et al., 2007). Determining the drought response of cultivars is of great importance in breeding programs. The most effective and economical strategy to develop genotypes resistant to drought stress is to focus on drought-tolerant genotypes. Therefore, it is important to observe the morphological and physiological characteristics of plants under drought stress and to study the plant responses to drought in detail. Moreover, there is an increasing number of studies at the biochemical and molecular levels on the development of drought-tolerant sunflower genotypes (Rauf, 2008; Grandón et al., 2021; Hladni et al., 2022). Some studies suggest that no-tillage and reduced tillage practices can maintain and even increase sunflower productivity compared to conventional tillage (Durmaz, 2012). Other studies emphasize the importance of considering specific management practices, soil health and environmental conditions.

Reduced tillage systems are known to increase soil porosity, reduce compaction and preserve soil aggregates. These practices contribute to improving soil physical properties and supporting soil biodiversity and ecosystem functions.

However, factors such as soil type, climate and crop management should be considered to maximize the benefits of reduced tillage practices on soil structure and overall soil health. These findings reveal the importance of holistic approaches to optimizing yield outcomes in sunflower cultivation (Durmaz, 2012).

2. Conclusion

Consequently, reduced tillage systems can have significant impacts on sunflower productivity and soil health. Research shows that these systems reduce compaction by increasing soil porosity and contribute to improving soil structure by maintaining soil aggregates. In addition, reduced tillage practices have been reported to support soil biodiversity and ecosystem services and protect against microbial decomposition by conserving soil carbon. However, maximizing these benefits requires careful consideration of factors such as soil type, climate and crop management. To achieve optimum yields and promote sustainable agricultural practices in sunflower cultivation, it is critical to adapt tillage methods to local conditions. In conclusion, the positive effects of reduced tillage systems on sunflower productivity, coupled with the potential to maintain and improve soil health, suggest that these methods should be more widely adopted in agricultural practices.

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ORAL PRESENTATION

The Effect of Siliconizing Process on the Wear Resistance of Inconel 738

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Abstract

Synthesis of new materials and different types of coatings are becoming increasingly important for the industry. The physicochemical properties of the surface can be changed with thermochemical coatings and it is one of the easiest coating methods to apply. Although it is known that siliconizing, a thermochemical process, improves the properties of parts such as corrosion, hardness and wear, there is still a need to examine its effects. For this purpose, in this study, microstructure, hardness and wear properties were examined by siliconizing the Inconel 738 alloy at different temperatures. As a result of the siliconizing process applied at 850 and 900 °C for 6 hours, a coating layer with a thickness of approximately 90-100 µm was obtained on the surface. In the XRD analysis, predominantly NixSiy phases were detected, along with other silicide phases in accordance with the composition of the substrate. Hardness measurements taken from the coating layer showed a 3-4 times increase in hardness compared to the substrate. Ball-on-disc dry sliding wear tests were performed to determine the wear performance of the coatings. As a result of the wear tests, it was seen that the siliconizing process made a positive contribution to wear resistance. The lowest wear loss was obtained with the siliconizing process at 900 °C for 6 hours.

Keywords: Inconel 738, Siliconizing, Wear, Hardness.

1. Introduction

Superalloys are generally known as alloys with high corrosion and oxidation resistance, which are frequently used in harsh working conditions and sensitive industrial applications. Superalloys are used in the aviation industry, chemical industry, power plants, and many areas where high corrosion and high thermal resistance are required (Garg et al., 2022; Küçük et al., 2022). Inconel 738 is a nickel-based superalloy used in components exposed to heat in harsh conditions of gas turbines. Despite its high corrosion and oxidation resistance, impurities in the fuel make the alloy's working conditions even more difficult (Naghiyan Fesharaki et al., 2019). Working life can be increased by applying surface modifications to improve the performance of the alloy.

Surface modification processes are a method used to increase the strength of a material and are widely used in materials science (Icin et al., 2023; Rastkar et al., 2013). Surface modification processes include thermal spray coatings, shot peening processes, laser remelting, and thermochemical coatings. Among

these methods, thermochemical coating is frequently used because it is easy to apply and generally economical. Boriding, carburizing, and aluminizing processes are thermochemical coating methods that are frequently applied to increase the resistance of surfaces (N. N. Li et al., 2016; Tuba Yener et al., 2022). In thermochemical coating processes, the desired coating type is deposited on the substrate by the diffusion method. The process consists of spreading a powder mixture containing the coating element onto the surface at high temperatures (Doleker et al., 2024). The layer formed by interaction with the substrate is expected to develop properties such as corrosion and oxidation resistance as well as hardness and wear resistance (Gök et al., 2017).

Siliconization, a thermochemical surface treatment technique, is a method that aims to form metal silicide on the alloy/metal surface (Balandin & Kolpakov, 2006; Othman et al., 2015). It is known that the wear, corrosion resistance and hardness of steels are increased by the siliconization process (Khammas Hussein, 2013; X. Li et al., 2021). It is also possible to improve the surface properties of superalloys by applying it to Ni-based alloys. Nickel silicides are an attractive candidate coating material for protecting Ni-based superalloys and nickel electrodes for applications in internal combustion engines, power generation plants and advanced industrial gas turbines (Wang et al., 2009). In this study, siliconization process was applied to Inconel 738 alloy for this purpose. The effect of siliconization process carried out at two different temperatures on the hardness and wear resistance of Inconel 738 alloy was investigated.

2. Materials and Methods

Commercial INC 738 superalloy is used as the substrate material. Table 1 lists the final chemical composition of the alloy. For the pack siliconizing process, experimental samples of "1 cm x 1cm" were used. Following conventional metallographic process, cross-sections of the specimens were polished and cleaned with acetone. The halide activator was NH_4Cl, and the inert filler was Al_2O_3. Si source was metallic Si in this study. The pack was then heated in a furnace. The process temperature was in 850 and 900°C for 6 h. The heating rate in the furnace employed was slow (10°C/min).

Table 1. Chemical composition of INC 738 alloy.

Element (wt%)	Co	Nb	Al	Cr	Ti	W	Mo	Ni
INC 738	8-9	1	3-4	15-16	3-4	2.4-2.8	1.5-2	Balanced

X-ray diffraction analysis was used to characterize the presence of the silicide's phases that developed on the Ni based alloy substrate (XRD). For characterizing the coating layer of the test samples, a Cu Kα radiation source with a wavelength of 1.541 Å across a range of 20° to 90° was used in a Rigaku X-ray diffractometer (DMAX 2200). The dispersion of the phases in the coating layer line analyses technique was applied using an energy dispersive spectroscopy (EDS) to ascertain the distribution of alloying components and equipment, as well as an electron microscopy (SEM, Model JEOL JSM-6060, Japan). Hardness values also determined used via Vickers Hardness method.

Wear tests were performed in a ball-on-disc device under a load of 10 N and a WC ball of 6 mm diameter. In tests conducted under dry sliding conditions, friction coefficient data were recorded continuously by a computer software. In the wear tests performed according to the reciprocating test procedure, the total sliding distance is 90 m and the wear stroke length is 5.5 mm.

3. Results and Discussion

3.1. SEM-EDS Analyses

Because of their superior combination of wear, corrosion, and oxidation resistance, nickel silicides are an appealing candidate coating material for protecting Ni-base superalloys and nickel electrodes for applications in internal combustion engines, power generation plants, and advanced industrial gas turbines (Yoon et al., 2003). So, it is aimed to obtain NiSi based coating formation on the surface of the Inc 738 alloy.

The SEM microstructures and EDS-line analysis results of the pack siliconization process applied at 850 and 900 °C for 6 hours are given in Figure 1. Although the 850 °C process temperature is sufficient for silicon deposition on the surface and nickel diffusion from the substrate, this period was not completely sufficient for the transport of the Cr element found in a high percentage in the substrate, as a result of that a Cr-free zone was formed on the upper surface. This coating layer belongs to the NiSi intermetallic and is relatively brittle and has low hardness (850 HV). It is also clearly seen a seperation on the surface between two layers. Besides this there is a hard Ni-Si-Cr dominant coating formation of approximately 65 microns thick on the lower surface. When the temperature is applied at 900 °C, a single layer of NiSi intermetallic coating containing Cr is formed. The hardness of this phase is 1300 HV and as it is it shown from Fig.1(b) quite good adhesion between substrate and coating layer. The coating thickness formed at 900 °C for 6 hours is approximately 100 microns and shows a homogeneous distribution. The line analysis results are also very important for the accumulation of silicon on the surface and the transport of nickel, indicating that the accumulation density of silicon increases as the temperature increases.

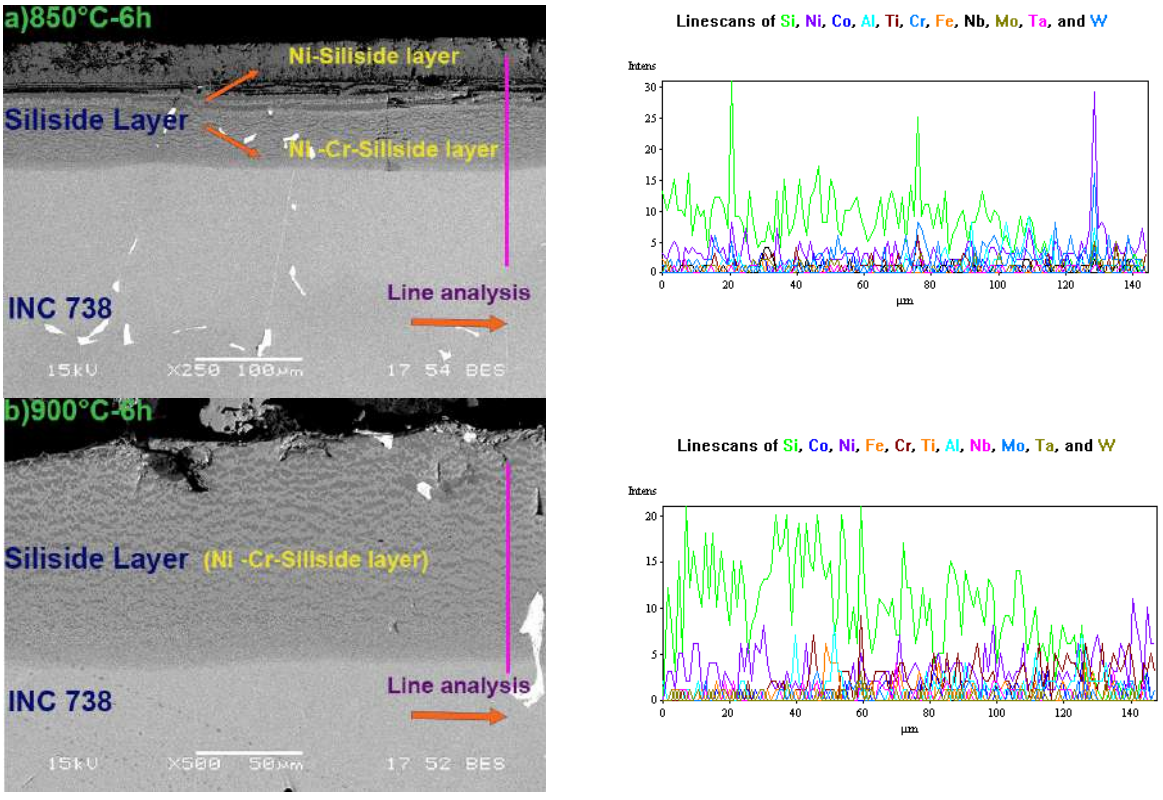


Figure 1. SEM-EDS line analyses of siliconized Inconel 738 alloy (a) 850°C-6h, (b) 900°C-6h.

3.2. XRD Analyses

When the XRD analysis results are examined, the formation of NiSi phases is clearly seen for both temperatures. Another remarkable result is that the peaks of the NiSi intermetallic compound showed a slightly drift and were diffracted at different angles due to Cr diffusion with the increase in temperature from 850 to 900 °C. Besides this Ni_3Si_2, Ni_2Si phases, as well as trace amounts of $MoSi_2$ and Cr-containing phases were obtained on the coating zone (Fig. 2).

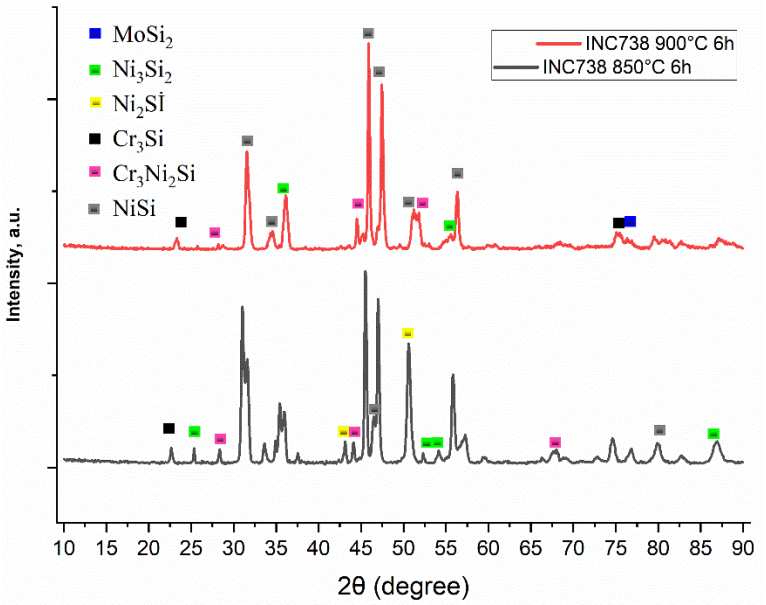


Figure 2. XRD analyses of siliconized for 850°C-900°C-6h Inconel 738 alloy.

3.3. Hardness

Ni-based super allay Inconel 738 alloy has a 400–430 HV hardness levels (Najafizadeh et al., 2023). These degradation pathways have the potential to severely harm the components in the absence of protective surface treatments, which might lead to a total system shutdown. Therefore, using protective coatings has two benefits: it keeps costly superalloy components safe from harm and keeps production from slowing down because of maintenance requirements (C. Bai et al., 2004; C. Y. Bai et al., 2004). Surface treatments like aluminization (Doleker K., M., Erdoğan, A., Yener, 2024; T. Yener, 2019), boronization (D'Souza et al., 2021; Küçük et al., 2022), and siliconization (Najafizadeh et al., 2022) can be applied to thermo-reactive coating processes to increase surface hardness without causing substrate degradation. For 6 h process temperatures of 850-900 °C, coating was successfully obtained for both temperatures. However, 850 °C created a limited area for Cr diffusion and since Cr could not reach the upper surface of the coating, the hardness remained relatively low compared to the 900 °C process temperature. While the hardness at 850 °C was at 800 HV, with the increase in temperature, Cr also entered the NiSi intermetallic lattice of the coating and the hardness value reached 1350 HV (Fig. 3).

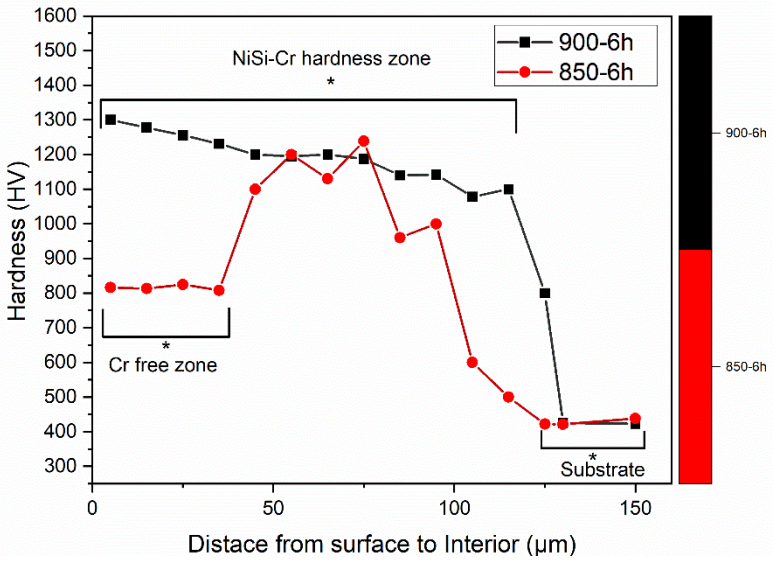


Figure 3. 850-900 °C; 6h siliconized Inconel 738 Alloy.

3.4. Wear Behavior

The coefficient of friction and wear losses of INC 738 and siliconized samples are given in Figure 4. The lowest volume loss was seen in the siliconized sample at 900 °C, while the highest volume loss was seen in the untreated INC 738. The siliconization process improved the wear resistance of INC 738. In addition, increasing the siliconizing temperature increased the wear resistance even more. Undoubtedly, the most important reason for the decrease in wear loss is the increased hardness. The layer consisting of silicides on the surface and having higher hardness provided an increase in wear resistance. The increased hardness showed higher resistance against the abrasive ball during the wear test and therefore the wear losses decreased. The fact that the siliconized sample at 850 °C showed more wear loss than the siliconized sample at 900 °C is also related to the hardness. However, the two-layer coating layer of the siliconized sample at 850 °C is also a reason for the high wear loss. The lower hardness of the surface layer due to the low Cr content caused the wear resistance to be weaker than the other coating. When the friction coefficient curves are examined, the friction coefficient of the sample coated at 900°C remained at lower values. The friction curves of the sample coated at INC 738 and 850°C have similar profiles. The friction curve of the INC 738 sample started with a high value at the beginning and then decreased, while the curves of the coatings increased after low values. It is possible that the oxidation in the wear track of INC 738 caused a decrease in the friction coefficient. The increase seen in the coatings is due to the adaptation process between the ball and the sample surface.

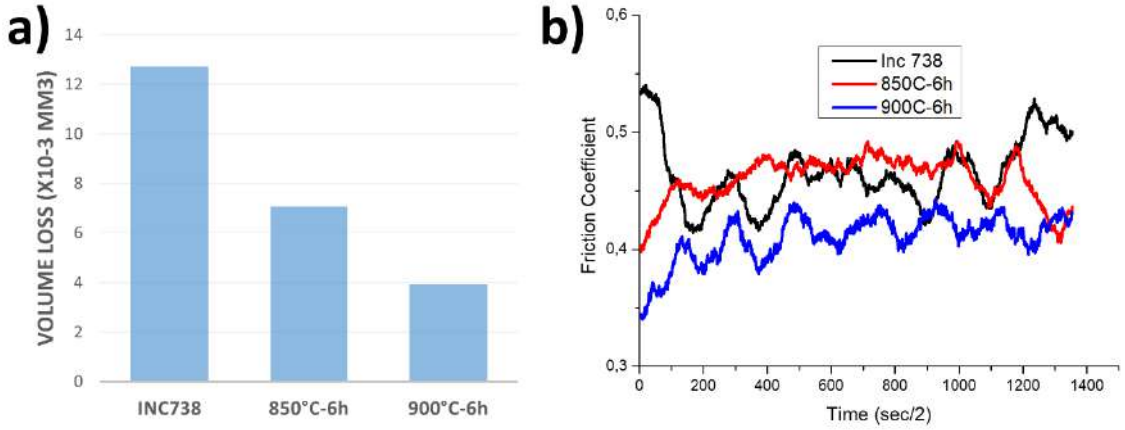


Figure 4. a) The wear losses and b) friction coefficient of INC 738 and siliconized samples.

Figure 5 shows SEM images taken from the wear marks of the samples. Plastic deformation is observed in the edge areas of the wear mark of the INC 738 substrate, and short cracks and oxidation are observed in the middle parts. This shows that wear starts with plastic deformation and then oxidation occurs. Cracks form in the oxidized areas due to the different properties of the substrate and oxide. Wear losses occur with the merging of these cracks. Two different regions are seen in the wear mark of the sample siliconized at 850 °C. A part of the mark is much wider and there are cracks with high oxidation in this part. This situation is thought to be due to the layered structure of the coating. It is likely that the outer layer will oxidize and form cracks due to the weak connection between layers. After a while, the interface will be reached by overcoming the layer with lower hardness. This oxidized part will start to break away from the surface due to the close approach to the interface. The wear mark widens due to the lower resistance of the outer layer to wear. In the sample siliconized at 900 °C, a smoother and lesser wide of wear mark is seen. The wear performance of this coating is more successful due to its harder and single-layer structure.

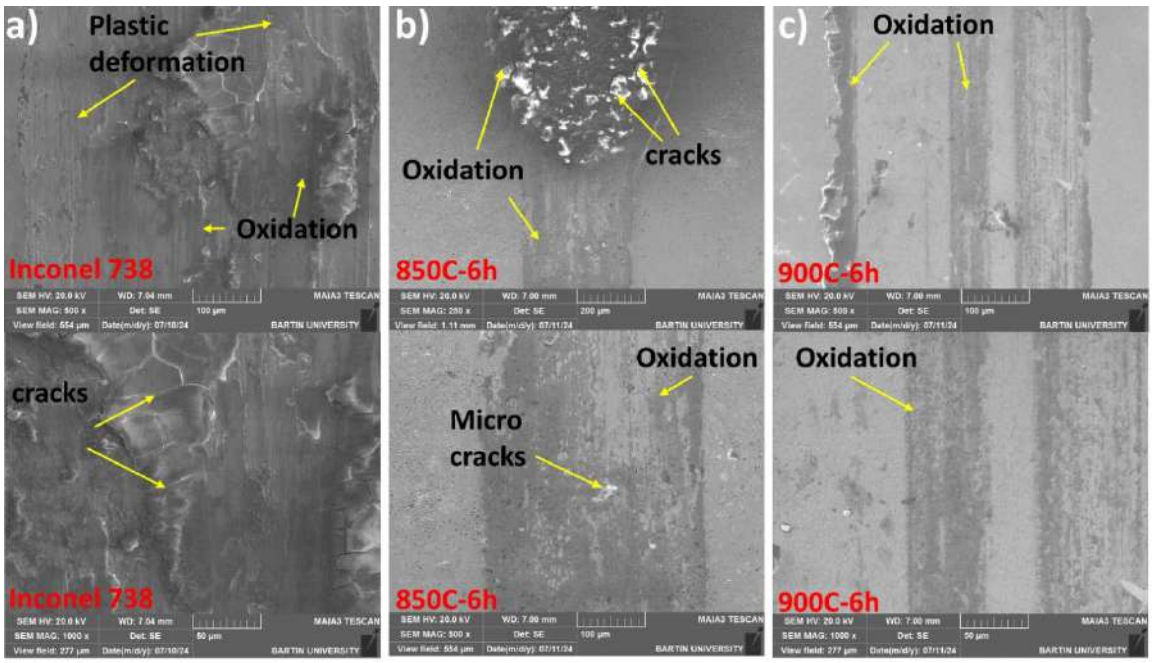


Figure 5. Wear mechanisms: a) INC 738, b) 850 °C 6 h, c) 900 °C 6 h.

4. Conclusion

In this study, siliconizing process, which is a thermochemical coating method, was applied to INC 738 alloy at different temperatures. The effects of siliconizing process applied at 850 °C and 900 °C for 6 hours on microstructure, hardness and wear resistance were investigated. The findings are briefly summarized below.

- After the siliconizing process, silicide layers with an average thickness of 100 µm were produced on the INC 738 substrate surface. A two-layer coating layer was obtained in the process carried out at 850 °C, and a single-layer coating layer was obtained in the process carried out at 900 °C.
- In XRD analyses, different types of nickel silicide phases were detected in the siliconizing process performed at both temperatures. The most significant difference between the two layers obtained in the siliconizing process performed at 850 °C is the Cr content. For this reason, the peaks of the NixSiy phases seen in the coating produced at 850 °C are stronger.
- After the process applied at 850 °C, a hardness of around 800 HV was determined on the surface, while a hardness of 1300 HV was observed as a result of siliconizing at 900 °C.
- The siliconizing process has a positive effect on the wear resistance of INC 738, regardless of the applied temperature, and has reduced volume losses. The best wear resistance was obtained with the siliconizing process applied at 900 °C for 6 hours.

Acknowledgment

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Investigation of the Effectiveness of Some Essential Oils Alone and Synergistic Combinations Against Beta Hemolytic Streptococcus

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[2]*Çanakkale Onsekiz Mart University, Faculty of Science, Department of Biology, Çanakkale, Türkiye*

[*]**Correspondence:** byapici@comu.edu.tr

Abstract

In this study, the antimicrobial activity of twelve different essential oils was evaluatedagainst human pathogens *Streptococcus pyogenes*, *Streptococcus agalactiae*, *Streptococcus dysgalactiae* subsp. *equisimilis*, *Staphylococcus aureus* and *Candida albicans*. Disk diffusion and microdilution methods were used in antimicrobial activity experiments. The chemical components of oregano, mint, sage, cinnamon, clove and garlic essential oils, which exhibited positive antimicrobial activity against microorganisms, were determined by Gas Chromatography-Mass Spectrometry Analysis. In addition, the Checkerboard Method was used to determine the synergistic combinations of these essential oils. The highest inhibition zones were determined as 27.50 mm, 26.75 mm, 29.75 mm, 42.00 mm and 59.50 mm for oregano essential oil against *Streptococcus pyogenes*, *Streptococcus agalactiae*, *Streptococcus dysgalactiae* subsp. *equisimilis*, *Staphylococcus aureus* and *Candida albicans* species, respectively. Minimum Inhibition Concentration and Minimum Bactericidal Concentration values of oregano essential oil were also found to be lower than other essential oils as 0.0625-0.125 % (v/v). The main components of oregano essential oil were determined as carvacrol, p-cymene and linalool. Oregano/mint, oregano/sage, oregano/cinnamon and clove/cinnamon mixtures were exhibited additive effect against *Streptococcus dysgalactiae* subsp. *equisimilis*, while the oregano/clove mixture showed synergistic effect against *Streptococcus agalactiae*. However, only the clove/cinnamon mixture showed a synergistic effect against *Candida albicans*. On the other hand, oregano/mint, oregano/clove and clove/cinnamon mixtures showed additive effects against *Streptococcus pyogenes*. The research results showed that oregano essential oil alone has a strong antimicrobial activity against all pathogens used in the study. In addition, it was revealed that the combinations of oregano essential oil with other essential oils and the clove-cinnamon mixture can be evaluatedas a potential agent against bacteria and *Candida albicans*, respectively.

Keywords: Essential Oils, Synergistic Effect, Beta Hemolytic Streptococci, Antimicrobial Activity.

Acknowledgment

This study was supported by the Canakkale Onsekiz Mart University Scientific Research Projects Unit (Project ID: FYL-2024-4622).

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Molecular Cloning and Characterization of CRABP (Cellular Retinoic Acid Binding Protein) Gene in Trout (*Salmo trutta*) in Trout Liver Tissue and Determination

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Abstract

The first aim of the experimental study is to obtain the cDNA of the cellular retinoic acid binding protein of brown trout (*Salmo trutta*) by using Bioinformatics methods and molecular cloning methods. Our second aim is to determine the phylogenetic connections of the crabp gene with other living species, to extract its nucleotide sequences, to reach its genomic structure and to obtain gene transcripts. Finally, we obtained mRNA expressions and tissue-specific distributions of the stress factors that we will apply to the liver tissues of brown trout.

Keywords: Bioinformatics, Crabp1a, Stress, Brown Trout, In Silico Analysis, Liver.

1. Introduction

Retinoic acid and its analogues are powerful modulators of animal development, cell growth and differentiation. They are also a potential chemotherapeutic agent in the treatment of RA, cancer, and were known to be critical for proper skin function. It is possible that RA reorganizations during vertebrate development may be mediated by the association of RA with stored RA protective proteins (CRABP) and nuclear RA receptors (RARs) and retinoid X receptors. In complex with RA, nuclear divisions are regulated in abundance into RA responsive elements (RAREs) such that they function as trans-acting elements that modulate the transcription of essential developmental genes, e.g. HoxB homeotic genes. However, understanding the roles of CRABPs in the action of RA has proven difficult. CRABPs are encoded by two different transcriptionally deletable genes that produce high levels of two proteins, type I and II CRABP (CRABP I and II). Proteins differ in viability and tissue expression, as well as in the finiteness of their ligand connections.

This study provides a body of data supporting the existence of CRABP in fish. However, given the putative roles of RA and CRABP in vertebrate biological processes (RA metabolism, sequestration and transport of RA to nuclear receptors, and transcriptional regulation), it makes sense that CRABPs are present in invertebrates. The vertebrate Hox genes are homologs of homeotic genes originally discovered in Drosophila . Given the roles of homeotic genes in evolutionarily conserved processes, such as segment differentiation, it is quite plausible that their regulation is also conserved during evolution. Therefore, RA may be a regulator of invertebrate homeotic gene expression via CRABP. This possibility is further confirmed by the discovery of homologs of vertebrate retinoid X receptors in Drosophila and other invertebrates. For this reason, the discovery of msCRABP has indicated that RA

may be an important morphogen in invertebrates, acting as a transcriptional modulator of key developmental genes mediated by nuclear receptors and CRABPs. However, perhaps the most important consequence of the discovery of msCRABP is the possibility that invertebrate models could be used to finally elucidate the function(s) of CRABP during development, both RA-dependent and -independent. This would be especially true if a CRABP-like gene exists in Drosophila. The combined use of Drosophila for genetic and molecular genetic manipulation and Manduca for cellular and physiological studies would offer the opportunity to address CRABP and RA function throughout the life cycle of an organism (Mansfield, G. et al. 1998). The presence of this gene in invertebrates and vertebrates also reveals phylogenetic relatedness.

2. Method

The acquisition of the data we aimed for was carried out in 3 stages. The first process was the cloning of crabp1, the cellular retinoic acid binding protein in brown trout. After this process was completed, the characterization of the crabp1a gene was completed and in the last stage, liver tissue samples of brown trout exposed to stress factors were taken at 3 different time periods and their mRNA expressions were read (Alsop 2001, Anderson 2012, Bayır 2015/2021/2022, Bohne 2012, Bucco 1996, Bulut 2012, Bustin 2005).

Brown trout (*Salmo trutta*) has cellular retinoic acid binding (crabp1a) protein from other organisms such as PinkSalmon (*Oncorhynchus gorbuscha*), Chinooks salmon (*Oncorhynchus tshawytscha*), Red Salmon (*Oncorhynchus nerka*), Atlantic salmon (*Salmo salar*), lake trout (*Salvelinus namaycush*).), protein sequences of arctic char (*Salvelinus alpinus*), Northern pike (*Esox lucius*), Striped catfish (*Pangasianodon hypophthalmus*), European eel (*Anguilla anguilla*) and crabp1a genes from therapods human (*Homo Sapiens*) and mouse (*Mus musculus*), with matrix algorithm Identity and similarity rates were calculated using the BLOSUM62 method (Gromiha 2010, Fogh 1993, Howe 2013, Huggett 2005 Jackson 2016, Jeong 2008).

Trial location and Trial Process: Atatürk University Faculty of Fisheries, Trout Facilities and Faculty of Agriculture, Agricultural Biotechnology Department Accredited Laboratories were used for the research. In the research, 2 different stresses and 3 different time periods were covered. Stresses as Capture Stress and Low Water Stress, The time interval was found as a result of molecular processes of liver tissues obtained from trout at 0, 90 and 120 minutes when stress was applied.

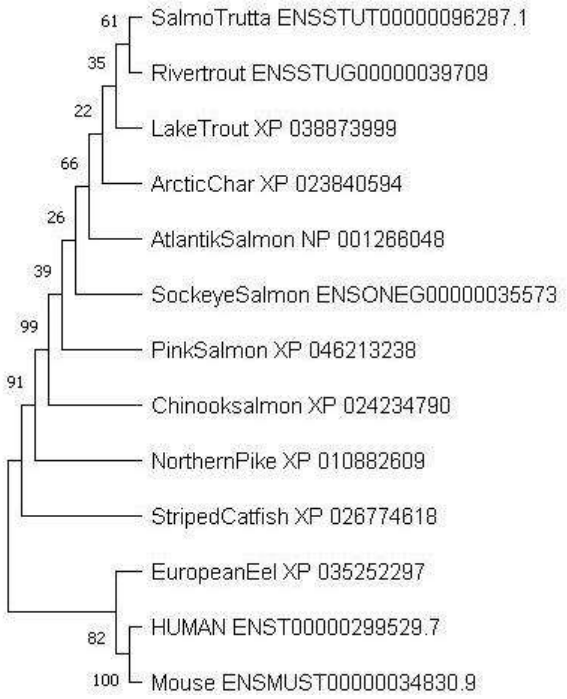


Figure 1. Expression of the brown trout crabp1a gene as a phylogenetic.

3. Results and Discussion

The crabp1a gene was cloned from liver tissue taken from brown trout and the expression of this gene was obtained in the 2nd stage. In the last stage, gene expressions of the obtained liver tissue were measured according to 2 different stress factors and 3 different time periods.

In light of the information obtained from the expression of the stress factors applied to brown trout in the capture stress factor, gene expression values increased 4-fold at minute 0 compared to the control group. When the gene expression at minute 60 was checked, it was found that the gene expression value was at the same measurements as the value at minute 0. Finally, when the values at minute 120 were checked, a decrease of half in gene expression was observed.

In the low water stress application of the same species, a decrease was observed in the values at minute 0 compared to the control value. When the liver tissue was checked for gene expression value at minute 60, it was recorded that the gene expression value started to decrease significantly and was almost half of the value at minute 0. When the values expressed in the liver tissue were checked at minute 120, it was observed that the gene expression values returned to the values obtained at minute 0.

In light of the information obtained from the expression of stress factors applied to brown trout in the catch stress factor, gene expression values increased 4 times at minute 0 compared to the control group. When the gene expression at the 60th minute was checked, it was found that the gene expression value was the same as the value at the 0th minute. Finally, when the values at the 120th minute were checked, a decrease in gene expression was observed by half.

When the mRNA expression levels of the crabp1a gene were evaluated in the liver and gill tissues of brown trout subjected to capture stress, at all measurement times and in both tissue types, the highest

mRNA expression level of the crabp1a gene was determined in the 0 min liver tissue (0.4), while the lowest mRNA expression level was determined in the control gill. It was detected in the tissue (0.007). On the other hand, when the mRNA expression level of the crabp1a gene was considered in liver tissue, the highest expression level was determined at 0 min (0.4), while the lowest expression level was obtained in the control (0.03). Again, when the mRNA expression level of the crabp1a gene was examined in gill tissue, the highest expression level was determined in the control (0.07), while the lowest mRNA expression level was detected at 120 min (0.01) (Kleinjan 1997-1998, Liu 2004-2005, Sharma 2003).

When the mRNA expression levels of the crabp1a gene were evaluated in the liver and gill tissues of brown trout subjected to low water level stress, at all measurement times and in both tissue types, the highest mRNA expression level of the crabp1a gene was determined in the 120 min liver tissue (0.14) while the lowest mRNA expression level was in the control. It was detected in gill tissue (0.007). On the other hand, when the mRNA expression level of the crabp1a gene was considered in the liver tissue, the highest expression level was determined in the 120-minute liver tissue (0.14), while the lowest mRNA expression level was determined in the control (0.02). Again, the mRNA expression level of the crabp1a gene was determined in the gill tissue, while the highest expression level was determined at 60 min (0.04) and the lowest mRNA expression level was detected in the control (0.007).

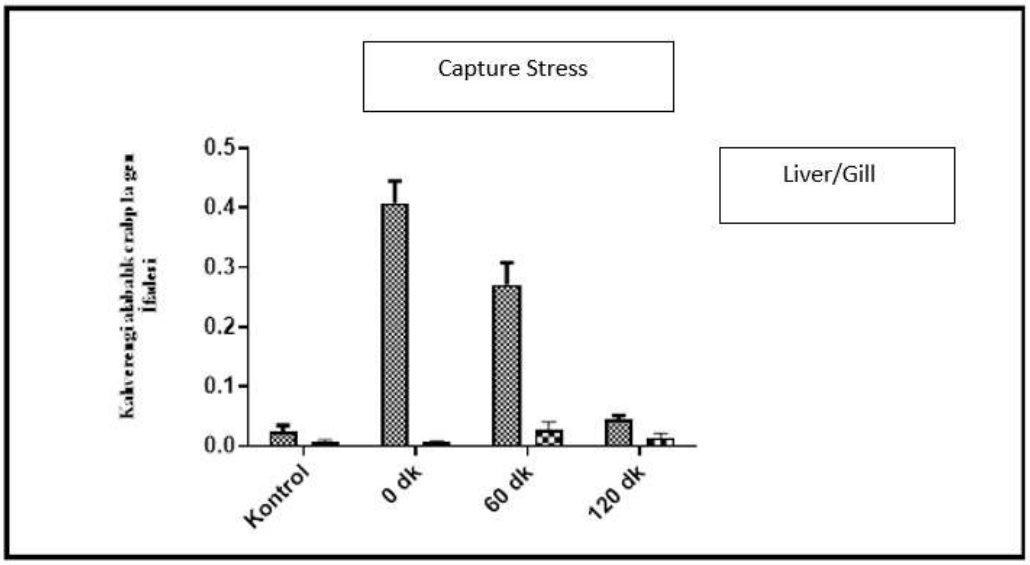


Figure 2. mRNA expression of the crabp1a gene in brown trout subjected to capture stress.

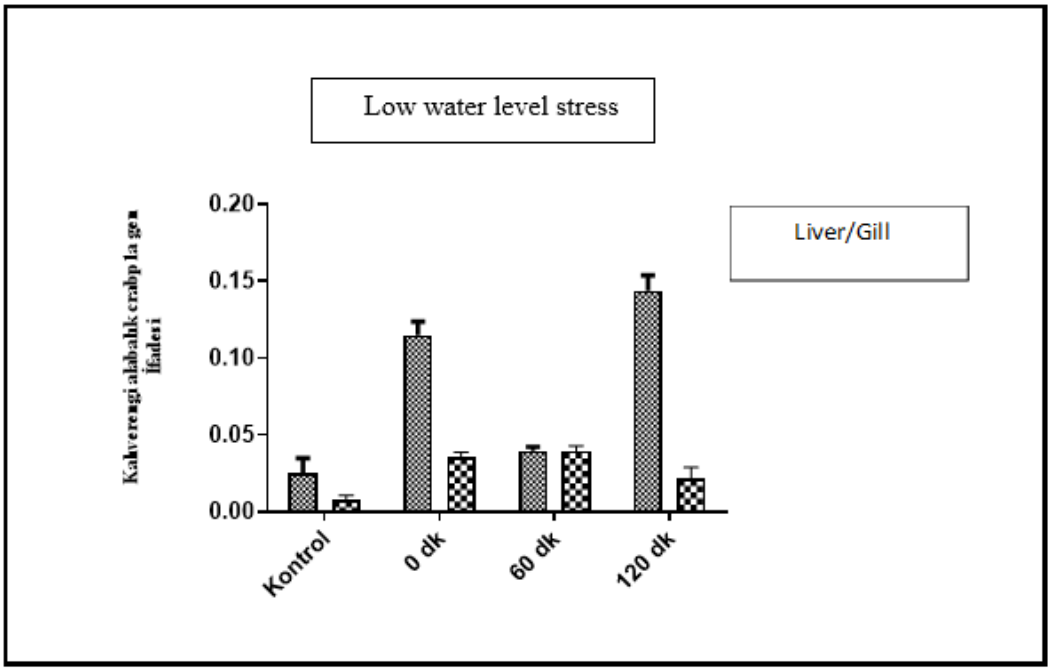


Figure 3. mRNA expression of the crabp1a gene in brown trout subjected to low water level stress.

Acknowledgment

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ORAL PRESENTATION

Aerosol Dynamics in the Human Respiratory System: A Literature Review

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Abstract

Respiratory tract diseases rank among the most significant health issues of our era. Environmental pollutants such as dust, smoke, forest fires, volcanic aerosols, prevalent in the outdoor environment, are primary sources contributing to these diseases. Inhaler medications, converted into aerosol form, are effectively utilized in the treatment of pulmonary diseases today. Directly delivering these aerosolized medications to their intended target areas in the respiratory system significantly influences the treatment success. Exposure to particulate matter correlates with increased disease and mortality rates. Understanding the behavior of aerosol particles and airflow dynamics within the respiratory system is crucial for achieving desired therapeutic outcomes. Measuring aerosol particle accumulation within the respiratory tract, both in vivo and in vitro, presents considerable challenges. Advances in technology have led to the development of image-based models that enhance numerical and experimental research efficacy. Computational Fluid Dynamics (CFD) plays a pivotal role in enabling these assessments. Through simulations, CFD facilitates the evaluation of key parameters affecting aerosol deposition. This study conducts an extensive literature review on various methods and solutions developed for aerosol dynamics in the human respiratory system. It critically analyzes existing studies in academic literature, examining suitable computational methods for airflow and particulate matter accumulation across different respiratory regions. This detailed literature review aims to investigate flow models in the respiratory system, determine airflow characteristics, assess geometric variations' impact on respiratory pathways, and examine aerosol particle properties such as size, morphology, hygroscopic growth, and location. The results underscore that aerosol dynamics are contingent on various numerical conditions, encompassing parameters like alveolar size, respiratory rate, pressure, temperature, humidity, shear stress, and alveolar wall thickness.

Keywords: Human Respiratory System, Computational Fluid Dynamics (CFD), Airflow Dynamics, Inhaler, Aerosol Deposition.

1. Introduction

Particles entering the human body through the respiratory system pose serious threats to human health. Particularly in developing countries, as industrialization accelerates, people are increasingly exposed to respiratory diseases due to the effects of environmental pollution. The major respiratory diseases include chronic obstructive pulmonary disease (COPD), lung cancer, pneumonia, tuberculosis, asthma, pharyngitis, cystic fibrosis, emphysema, and, more recently, the globally widespread COVID-19 syndrome. Inhaler medications are effectively used today for the treatment of potential diseases in the

lungs, the vital organ of the respiratory system. Inhalation therapy is not only fast-acting and long-lasting but also has very few side effects (Aydemir 2013).

Therefore, aerosol drug therapy via inhalers, administered through nasal or oral airways to the lungs in low doses, is a highly common treatment method that is suitable for each patient. In recent years, numerous studies have been conducted on drug therapy via inhalers. It is known that factors such as micro- and nanoparticle formulation, particle deposition in the respiratory tract, drug delivery devices, and exposure to toxic aerosols play a crucial role in inhaler drug delivery (Kolonjiyil and Kleinstreur 2013). In addition to the side effects of therapeutic aerosol particles in human airways, it is also known that exposure to toxic particles leads to serious illnesses (Shang et al., 2009). Therefore, it is essential to accurately determine the dosage of the medication and the deposition and transport of particles in the respiratory airways. Realistically and efficiently determining aerosol dynamics throughout the human respiratory tract plays a vital role in both toxic particle deposition and the treatment of various lung diseases.

2. Materials and Methods

The modeling of respiratory aerosol transmission requires an understanding of both the transport and deposition in the respiratory tract, as well as the dynamics within aerosol production devices. The first numerical models were developed to evaluate the effects of inhaled pollutants, such as coal dust, cigarette smoke, and radionuclides, on the lungs (Martonen 1993). Over time, these models have been improved and expanded through studies on the deposition of pharmaceutical aerosols. The methods used to evaluate the deposition of inhaled particles are derived from the application of mathematical models in fluid dynamics. These methods include:

- Empirical Models
- Deterministic Models
- Stochastic Models
- Computer-Based Models
- Computational Fluid Dynamics (CFD)

These are the most frequently used methods. While early models did not account for factors such as inhaler spray momentum (Longest et al., 2008) and droplet size (Longest and Hindle 2010), advancements in Computational Fluid Dynamics (CFD) technology have led to more accurate and realistic results. To simulate these limitations by focusing on laminar and turbulent flow, particle transport/deposition, and the solving of transport equations, the CFD method is used as the modeling approach (Kleinstreuer and Zhang 2010).

In silico numerical studies based on CFD models have been reliably used by researchers to design pharmaceutical inhalers and predict the behavior of aerosols in the respiratory tract (Byron 1986; Yu et al. 1996; Asgharian et al. 1994). Nowadays, CFD simulations are employed to calculate the flow of inhaler drugs and particles in 3D respiratory tracts and the physics of aerosols, replacing experimental methods that are expensive and difficult. CFD analyses assist healthcare professionals in diagnosing and

planning the treatment of many respiratory diseases, particularly COPD (Barnes et al. 2014). The numerical computations obtained through this method not only provide visual 3D changes in pressure and velocity within the computational domain but also deliver information on parameters such as pressure gradients and wall shear stresses, which are difficult to measure in vivo in the human body. Furthermore, the 3D simulations obtained can be used as clinical tools for individualized treatment methods (Coates et al. 2006).

3. Results and Discussion

3.1. Effect of Hygroscopic Growth

Chen et al. (2018) provide comprehensive information on the detection of particle trajectories and the prediction of local accumulation. In their studies, it has been emphasized that hygroscopic growth occurs as a result of the interaction between droplet vapor and environmental factors such as temperature and humidity. The accumulation efficiency in the upper respiratory tract (MT region) has been examined considering the heat transfer effects for hygroscopic particles dependent on temperature and humidity. Comparisons were made for different thermal airway wall conditions at a flow rate of 15 L/min. Research was conducted on evaporation in the mucus layer, heat transfer by transport, and the mucus layer at constant temperature. As a result, it was determined that the accumulation efficiency dropped by up to 10% due to the reduction in hygroscopic growth under mucus layer and thermal flow conditions.

Figure 1 shows the distribution of relative humidity (RH). It was observed that the RH value at the entrance was 34.7%, while it was above 99.5% in the mucus layer. Due to the high velocity in the oral cavity, the inhaled air does not become humid immediately through evaporation in the mucus layer, and this situation continues until the MT exit. In condition (a), the relative humidity rates for all three conditions were determined as 81.34%, 83.22%, and 83.52%, respectively. An decrease in the temperature of the mucus layer occurred as a result of evaporation. In conditions (b-c), for condition 2 RH=58.51 and for condition 3 RH=58.60 were determined, showing no significant difference.

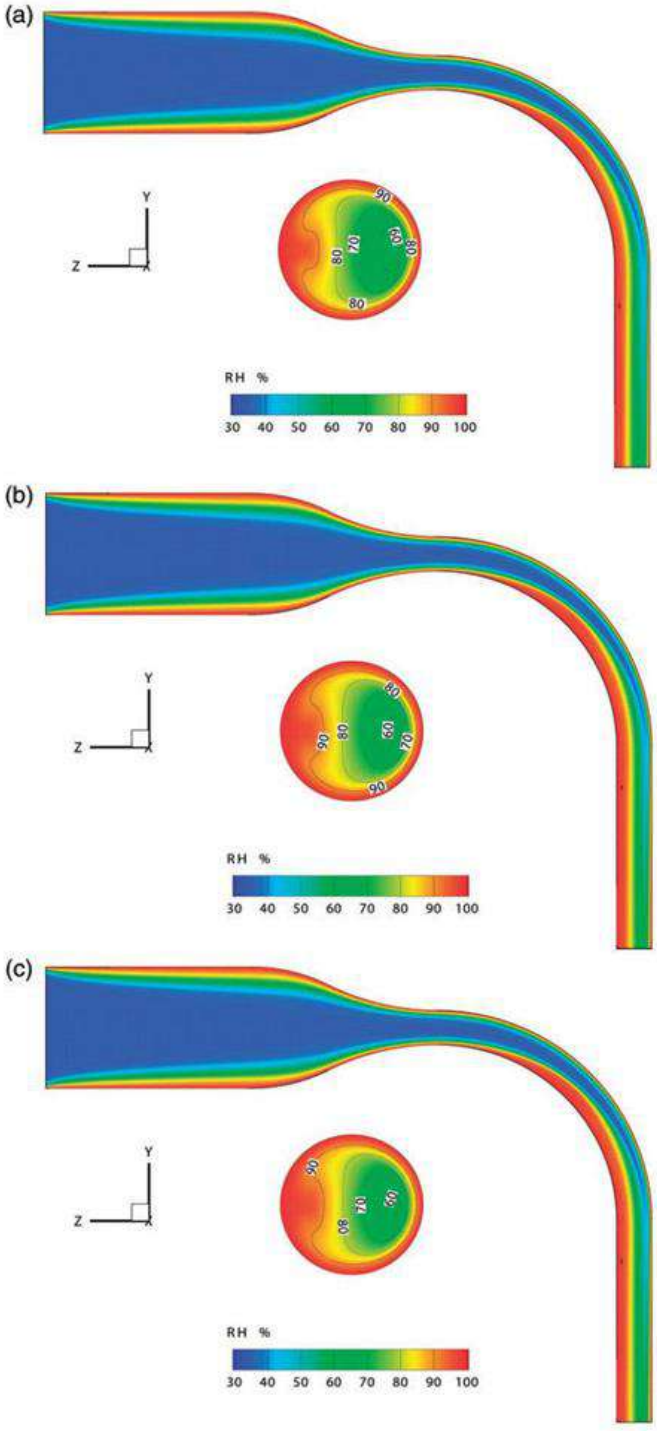


Figure 1. Relative humidity distributions in the mid-plane and outlet of the MT model for different boundary heat transfer conditions. (a) Condition 1, volume-averaged RH = 57.83%, average RH at the outlet = 81.34%; (b) Condition 2, volume-averaged RH = 58.51%, average RH at the outlet = 83.22%; (c) Condition 3, volume-averaged RH = 58.60%, average RH at the outlet = 83.52.

Xi et al. (2008) evaluated the effects of relative humidity and different temperature conditions on the condensation process during the accumulation and transport of cigarette smoke particles (CSP) in the upper respiratory tract. Since CSP consists of multiphase aerosol components, a MT model was

developed for dilute hygroscopic CSP particles throughout the G6 generation. At unsaturated temperature values, the increase in hygroscopic growth and CSP diameters due to substance evaporation remained below 50%. However, it was found that this increase was more pronounced at saturated temperatures. During inhalation, it was observed that under conditions where the saturated air temperature was 200°C and the body temperature was 3°C higher, the particle size reached from 400 nm to 3 µm in the direction of the trachea. For saturated air at 47°C, it was determined that droplets with a diameter of 7-8 µm entered the trachea. It was concluded that the increase in CSP is related to condensation in the upper respiratory tract, and that CSP's relative humidity is associated with local temperature and density.

Case	Inhaled temperature	Inhaled relative humidity (RH)	Representative description
1	23°C (296.15 K)	30%	Cool ambient SS smoke
2	27°C (300.15 K)	60%	Warm ambient SS smoke
3	40°C (313.15 K)	100%	Warm saturated MS smoke
4	47°C (320.15 K)	100%	Hot saturated MS smoke

In the study conducted for the four different conditions mentioned above, it was observed that in Condition 3 and Condition 4, particles grew by condensing under supersaturated conditions. In Condition 3, in the MT (upper respiratory tract) region, the particle diameter (dp) starts at 2.5 µm and continues to grow, reaching 4 µm near the outlet. In the tracheobronchial (TB) exit, this diameter value can increase up to 7 µm. In Figure 2, 3 µm and 7 µm particles with constant diameters are compared for Conditions 3 and 4 without condensation. In Condition 3, it was found that 3 µm particles accumulated in the larynx region, while in Condition 4, the accumulation in the oropharynx region was found to be related to condensation. Additionally, an aerosol with a constant diameter of 7 µm resulted in an accumulation of less than 2%. The total accumulation obtained for the 200 nm aerosol formed as a result of condensation and the constant 7 µm particles ranged from 10% to 12%.

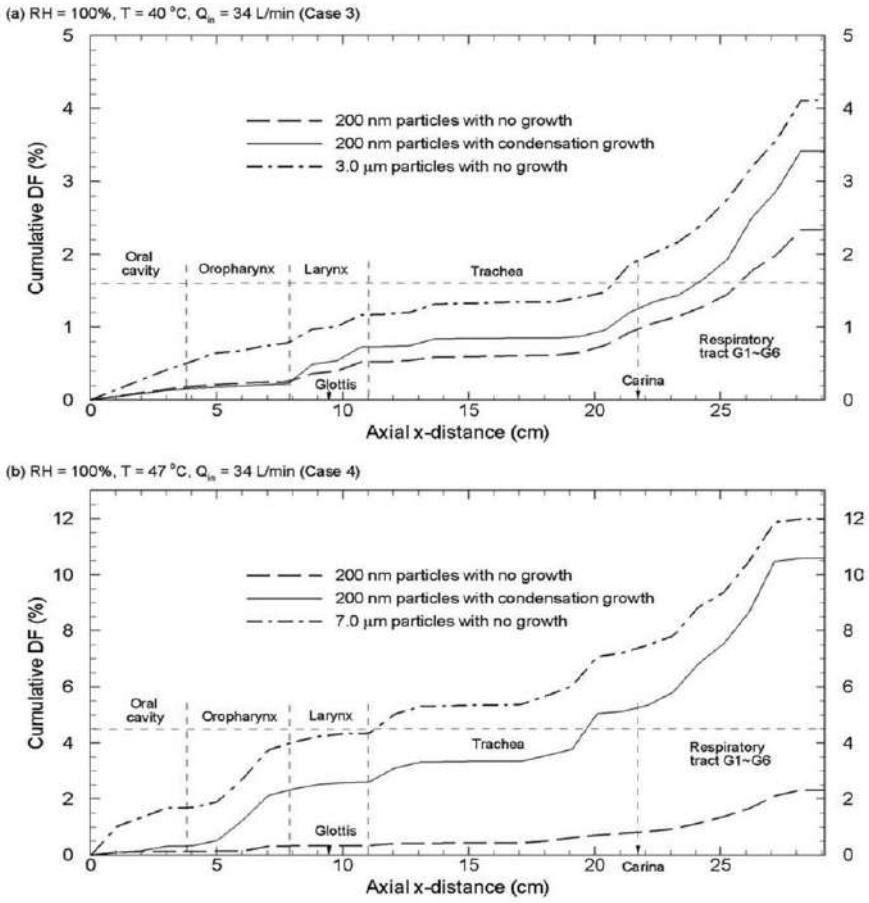


Figure 2. (a) The particle accumulation fraction (DF) as a percentage along the x-axis of the geometry for Condition 3 and (b) Condition 4.

3.2. Effect of Geometrty Variation

Çiloğlu et al. (2015) developed an alveolar fluid-structure model to investigate the alveolar respiratory mechanism of the human lung and particle deposition in alveolar sacs. Using this model, the effects of particle diameter, tidal breathing duration, flow lines, particle-liquid interaction, and gravitational orientation were studied. The results indicated that particles with diameters ranging from 1 to 5 mm tended to move in different directions depending on the gravitational force for generations G18-22.

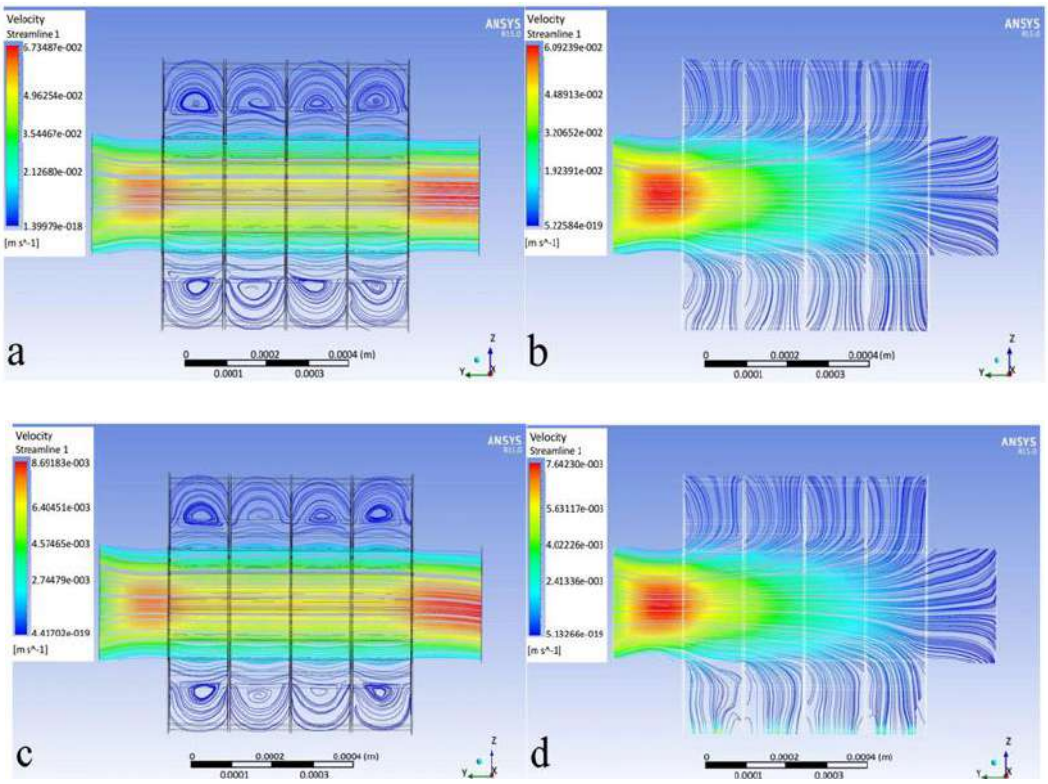


Figure 3. Fluid flow streamlines colored according to flow rate magnitude for generations 18 and 21 solids. For left-to-right flow, the fluid flow streamlines colored according to flow rate magnitude for the 18th and 21st generation solids and realistic models are shown as follows: (a) G = 18, t = 2.5 s, Re = 0.55, rigid walls; (b) G = 18, t = 2.5 s, Re = 0.55, moving walls; (c) G = 21, t = 2.5 s, Re = 0.06, rigid walls; (d) G = 21, t = 2.5 s, Re = 0.06, moving walls.

Xi et al. (2019) emphasized that the position of the tongue has a significant impact on the transport and accumulation efficiencies of particles for orally administered pharmaceutical drugs. To this end, an oropharyngeal model was developed considering the position and shape of the tongue in drug delivery. Airflow and aerosol dynamics were analyzed using a Fluid-Structure Interaction (FSI) model that simulates liquid-particle interactions.

Depending on the variations in tongue position and shape, the effects on the flow in the oral cavity and pharyngeal airway, as well as particle behaviors, were investigated. Changes based on particle size and respiratory characteristics were observed to range from 6% to 25%. The majority of these variations occurred in the oral cavity. It was also found that the position of the tongue resulted in differences in the distribution fraction (DF) of particles reaching the lungs. The volume of the developed model was determined to be 65,1 cm^3, and the surface area was 192,3 cm^2. In the model, the accumulation calculations are divided into three separate regions: the mouth, pharynx, and trachea. The curved position of the tongue obstructs the main airflow, causing an upward flow and resulting in acceleration. As shown in Figure 4, the tip of the tongue obstructs the airflow, creating a vortex layer, and it was observed that accumulation is greater at higher airflow rates.

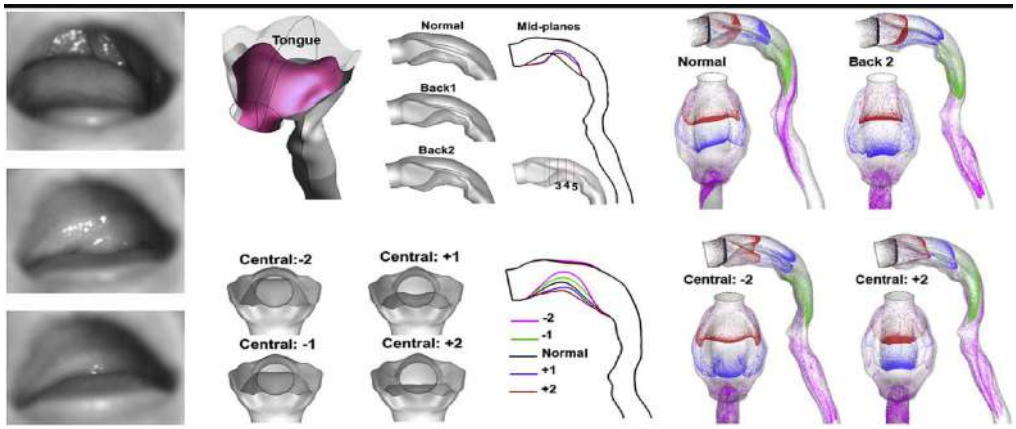


Figure 4. Vortex structures in the oropharyngeal airway for tongue positions at different flow rates. The red areas indicate a flow rate of 60 L/min, while the blue areas indicate a flow rate of 15 L/min (Xi et al. 2019).

Poorbahrami et al. (2019) investigated the airflow and particle trajectories in the G0-6 generations through simulations conducted on three different healthy adult women. The simulations accurately tracked how particles with diameters of 1, 3, and 5 μm accumulated throughout the lung regions during respiration. This study revealed that smaller airway diameters are associated with pressure gradients, while larger airways exhibit resistance. Secondary flow movements were observed due to the direction of airflow and irregular airflows. It was particularly found that accumulation of 1 μm particles was higher in the conductive and respiratory regions. As a result, it was emphasized that local accumulation is dependent on the flow dynamics within the airways and airway anatomy.

Nicalaou et al. (2013) investigated the effects of turbulence fluctuations and average flow patterns at a flow rate of 30 L/min across four different oral-pharyngeal geometries. To analyze the convective transport of particles, flow patterns and turbulence distribution were studied with the help of velocity fluctuations. These data were compared with in vitro studies, revealing the effects of geometric variation on average velocity profiles and turbulence intensity. The results of the study indicated that the flow could transition from a laminar state to turbulence. Additionally, it was determined that impact and dispersion, dependent on the Reynolds number, are significant accumulation mechanisms.

3.3. Effects of Aerosol Size and Density

Particle size significantly influences dust dynamics and accumulation rates. Particularly for larger particles, the inertial effect causes an increase in accumulation in the mouth as the airflow rate increases. However, lower accumulation in the mouth was observed in the idealized oral-pharyngeal model.

Liu et al. (2012) studied airflow patterns and aerosol particle accumulation in the upper respiratory tracts of adults, but it was understood that these results could not be directly adapted to children's airways. Therefore, an idealized model was used to analyze the upper respiratory tract (URT) to examine airflow patterns and particle accumulation. The accumulation properties of particles with diameters ranging from 0.01 to 10 μm were investigated at low (3.5 L/min), moderate (7.0 L/min), and high (10.5 L/min) inhalation flow rates using the Lagrangian method. The study found that airflow models during inhalation and exhalation differ, and these differences impact accumulation.

When comparing adults to a 3-year-old child, it was determined that the Stokes number and impact effect were higher in children. Parameters such as airflow rate, particle diameter, and particle density are key factors affecting accumulation. It was concluded that the particle accumulation rate is higher in children. As shown in Figure 5. while accumulation rates in the oral cavity were similar for both adults and children, higher accumulation rates were observed in the larynx, pharynx, trachea, and bronchi for children. Therefore, children are considered to be in a high-risk group in terms of particulate matter inhalation.

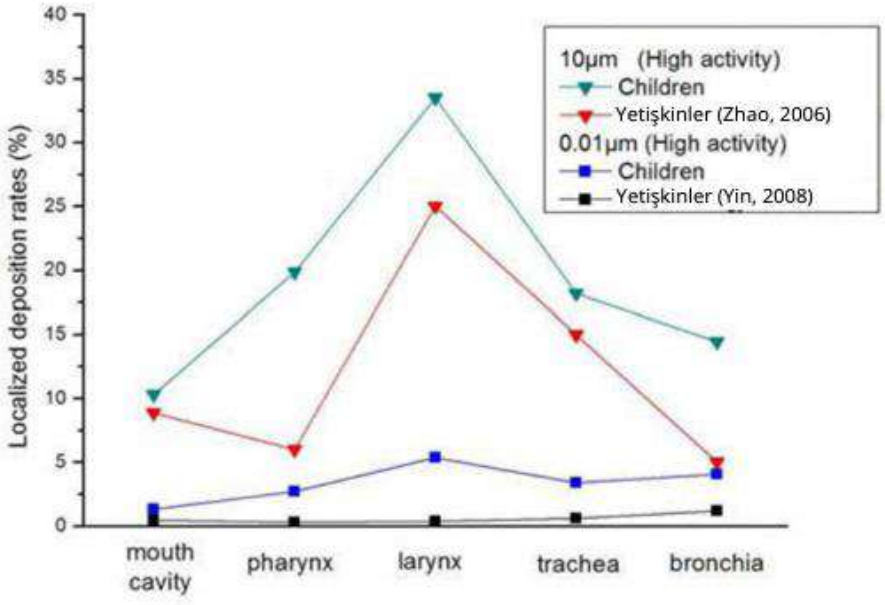


Figure 5. Comparison of local accumulation rates between children and adults for 10 μm and 0.01 μm particles.

Phalen et al. (1986) emphasized that aerosol accumulations are largely dependent on particle size. The study examined the inhalable particle mass for materials that could be hazardous in any region of the respiratory tract, particularly the thoracic particle mass that accumulates in the airways and gas exchange regions. In this context, it was noted that the accumulation of particles with diameters ranging from 0.01 to 11 μm in the upper respiratory tract is more challenging. It was concluded that as particle sizes decrease, the accumulation rates vary, and the accumulation characteristics of particles in different respiratory regions are significant.

Çiloğlu (2021) examined the airflow in the alveoli and the behavior of particles of different sizes under light, heavy, and normal breathing conditions and successive breath cycles in a respiratory bronchiole model located in the acinar region of the human lung, using Computational Fluid Dynamics (CFD). The results indicated that a symmetric flow profile in the lumen channel and an asymmetric flow profile with vortices in the alveoli were observed in all flow conditions. Additionally, it was found that the trajectories of aerosol particles differ during inspiration and expiration. The study also demonstrated that aerosol deposition in the respiratory bronchiolar model decreased with particle size and flow rate. Figure 6 shows the distribution of aerosol particles during inspiration and expiration at flow rates of 15, 30, and 60 L/min. Larger particles were found on the canal wall or had exited the channel at t=6 s, while

at t=8 and 12 s during expiration, the particles moved towards the upper lung generations. It was also reported that some particles in the alveoli were drawn back into the lumen channel. During expiration, due to the effect of gravity, the particle retention time increased, leading to greater particle accumulation. During inspiration at t=6 and 10 s, the remaining particles moved to the distal regions of the acinus, leaving no particles in the channel. Particles larger than 7 µm accumulated on the canal wall, while particles smaller than 5 µm accumulated in the alveolar spaces.

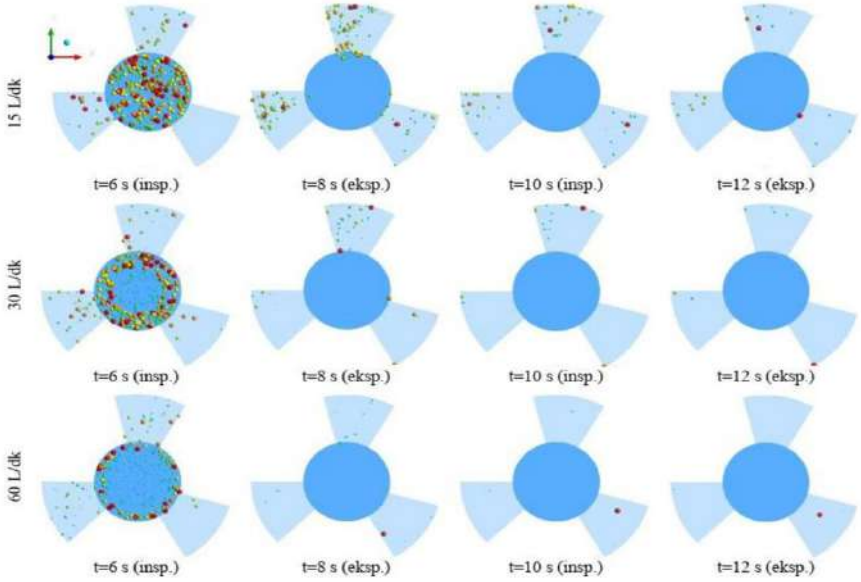


Figure 6. Distribution of aerosol particles during the respiratory cycle in the respiratory bronchiole model (Çiloğlu, 2021).

Çiloğlu et al. (2022) numerically investigated airflow and particle deposition using a realistic airway model of a healthy adult during repetitive breathing. Their study was conducted for particles with diameters of 2, 5, and 7 µm under three physical breathing conditions (normal, heavy, and light). The results indicated that particle deposition varied during both expiration (exhalation) and inspiration (inhalation) and was dependent on the inspiratory flow rate. They found that particles larger than 7 µm accumulated in higher generations due to particle impaction on the airway walls as a result of high inertia. Moreover, they observed that the deposition of all particles increased during repetitive breathing cycles, depending on the inspiratory flow rate. For heavy breathing conditions, deposition efficiency (DE) was reported to be 28.5% for particles with a diameter of 2 µm, 33.05% for particles with a diameter of 5 µm, and 38.4% for particles with a diameter of 7 µm.

3.4. Effects of Flow Characteristics

Xu et al. (2006) created upper respiratory tract models for three children with sleep apnea. These models were reconstructed using magnetic resonance imaging (MRI) during quiet inhalation and exhalation at peak resting flow. To model the effects of turbulence, low Reynolds number k−ε and k−ω turbulence models were used alongside unsteady Reynolds-averaged Navier-Stokes equations. The solutions were obtained under steady flow conditions during expiration. It was determined that the pressure drop in the pharyngeal region is related to the airway diameter. During inspiration, the pressure drop occurred in the narrowing region of the airway where the tonsils are located, rather than in the nasal cavities. During

expiration, the pressure drop was observed in the oropharynx (the back part of the tongue) and the region where the tonsils are located. It was found that the minimum pressure occurred near the nasopharynx. As a result, it was determined that the pharyngeal airway is effective against nasal resistance in terms of pressure contours (Figure 7).

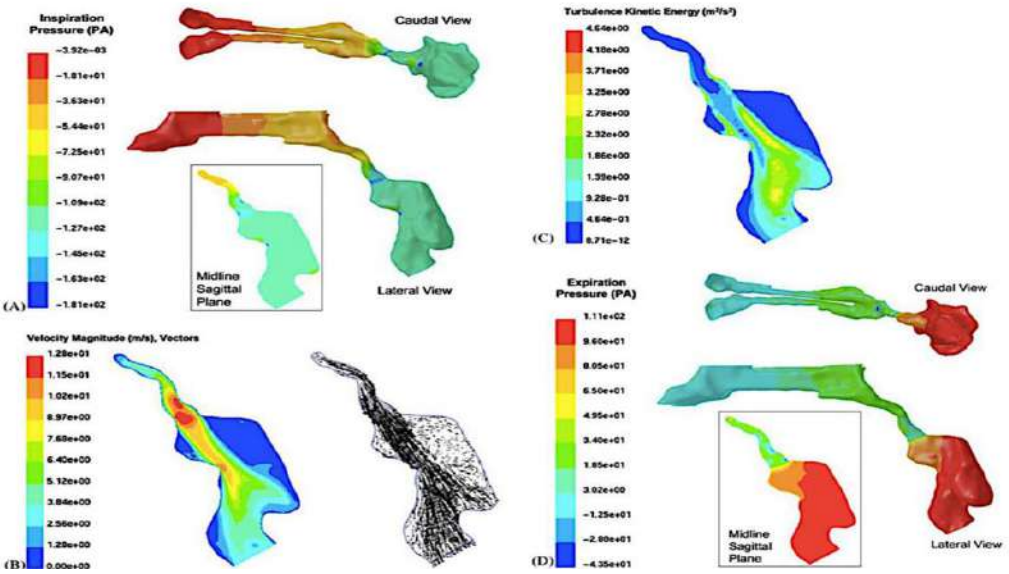


Figure 7. (A) Pressure contours during inspiration, (B) inspiration velocity vectors, (C) turbulence kinetic energy, (D) pressure contours during expiration (Xu et al. 2006).

Kleinstreuer and Zhang (2003) studied the transition from laminar to turbulent flow for incompressible airflow and non-interacting aerosols. For all flow regimes (500 <Re<10^4), the k−ε turbulence model was used in low Reynolds number (Re) conditions. Considering different inspiratory flow rates (15 <Q <60 L/min) and Stokes numbers, the results were summarized as follows: (i) After the narrowing in the larynx, turbulence was not observed at a low flow rate of 15 L/min, while turbulence was observed at a flow rate of 60 L/min. (ii) At high flow rates (60 L/min), flow fluctuations occurred due to the random and irregular motion of particles.

Dastan et al. (2014) investigated airflow in the nasal cavity using Navier-Stokes and continuity equations to study the accumulation and transport of irregularly shaped particles at four different flow rates (2.5, 5, 7.5, and 10 L/min). The aspect ratio (AR) of these non-spherical particles was identified as an important parameter affecting accumulation.

Kadota et al. (2018) utilized computational fluid dynamics (CFD) simulations to predict the therapeutic effects of DPI formulations and the accumulation of particles in the airways. The impact of breath-holding and flow rate on particle behavior and accumulation in the airways was examined. It was found that the flow rate in the bifurcation area of the bronchi dropped to 28.3 L/min due to the larger diameter of the right bronchus compared to the left. In the case of exhalation performed without breath-holding, a reduction in the number of accumulated particles was observed. Turbulence occurring without breath-holding increased particle accumulation. Consequently, CFD simulations demonstrated that the effectiveness of DPI formulations is dependent on breath-holding.

During exhalation, the flow characteristics resemble those of the inhalation phase, yet the reversed flow direction and the differences in flow characteristics prior to exhalation are notable. In the transition from inhalation to exhalation, the properties associated with low inhalation flow rates are not clearly observed due to the flow occurring in the opposite direction. In the upper lung airways, particles were observed to accumulate around the branching protrusions. Due to the low flow rate, the effects of sedimentation became more pronounced in the deeper lung airways. The residence time of particles in the airways parallels sedimentation, which leads to a decrease in airflow velocity, while with an increase in the number of generations, more particles reach the alveolar airways due to gravitational effects. For instance, a particle with a diameter of 3 mm can reach the 16th generation in 1.05 seconds and the 22nd generation in 1.75 seconds.

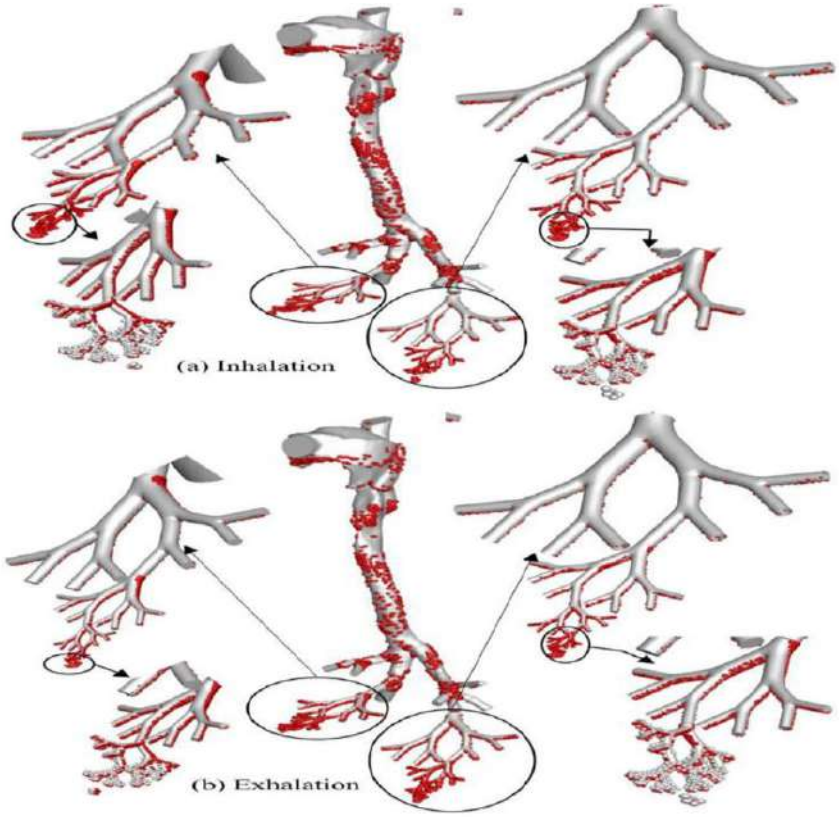


Figure 8. (a) inhalation and (b) exhalation with a tidal volume of 1000 ml (Kolonjeyel and Kleinstreuer 2017).

Figure (a) illustrates accumulation in the lower part of the oral cavity due to the effects of gravitational sedimentation at low inhalation flow rates. In Figure 8(b), it is observed that during exhalation, particles are drawn into the upper lung generations, and as a result of the alveoli's contraction, particles are expelled. The particle trajectories during exhalation show a significant difference; this causes the particles to remain in the lung region for a longer duration due to gravity.

Çiloğlu et al. (2017) investigated the accumulation of drug particles and airflow dynamics during multiple respiratory cycles. For this purpose, a model was created based on CT images obtained from a healthy adult male subject, including the oral cavity, pharynx, larynx, trachea, and the first three generations (G0-3) of the airways. Simulations were performed considering a tidal volume of 500 ml and a breath period of 4 seconds. Different flow rates were applied: normal (15 L/min), heavy (60

L/min), and light (30 L/min), using aerodynamic particles of varying diameters (2, 5, and 7 μm). Data regarding the number of particles remaining in the model during the second and third respiratory cycles are presented in Table 1. These findings provide an important basis for understanding the effects of respiratory flow rates and particle sizes on drug delivery.

Table 1. Number of particles remaining during multiple breaths.

Parçacik boyutu	Solunum durumu (LPM)	İnspirasyon sırasında (t = 6 s) (%)	Ekspirasyon sırasında (t = 8 s) (%)	İnspirasyon sırasında (t = 10 s) (%)
2 mm	15	10.27	1.166	0,033
	30	9	0,575	0,015
	60	8,67	0,46	0
5 mm	15	10,15	1,105	0,02
	30	8,92	0,545	0 0
	60	8,58	0,4616	0,012
7 mm	15	9,12	1,152	0
	30	8,9	0,548	
	60	8.55	0,48	0

An increase in airflow velocity has been observed to result in a decrease in the number of particles during multiple breathing cycles. At the end of the third inspiration, there was a decrease in the particle accumulation rate alongside an increase in particle size. The distribution factor (DF) exhibited higher values during the inspiration phase compared to expiration. It has been determined that the impact of collision during exhalation is low for all airflow rates. These results indicate that the inertial effects of particles increase with the rise in DF at high flow rates. These findings emphasize the significant role of respiratory flow dynamics and particle behaviors in drug distribution.

Gemci et al. (2017) examined the flow distribution in five different lobes using a 17th generation airway model. In Table 2, it was observed that the flow rate ratio in the right lung was 1.5 times greater than that in the left lung.

Table 2. Comparison of airflow distribution in different lobes of the 17th generation with other studies.

	Toplam Debi Dağılımı (%)		
Bölge	Cohen ve diğerleri. (1990) 7,5 (l/dak)	İslam ve ark. (2017c) 7,5 (l/dak)	Horsfield ve ark. (1971)
Sol alt	24.5	25.14	24.9
Sol üst	14,9	15.34	20.5
Sağ alt	32,1	36.17	23.2
Sağ orta	8.3	11.01	9.6
Sağ üst	20.2	12.48	21.7
Sol akciğer	39.4	40.48	45.4
Sağ akciğer	60.6	59.66	54.6

It has been determined that the airflow in the lower lobes of the right and left lungs is greater compared to other lobes. For the 17th generation airway model, it was observed that the pressure drop exhibited a nonlinear curve across different lobes (Figure 9). Additionally, the highest pressure drop was found to occur in the left upper lobe. These findings reveal that the airflow dynamics differ between lung lobes and that the left upper lobe is a region that requires special attention.

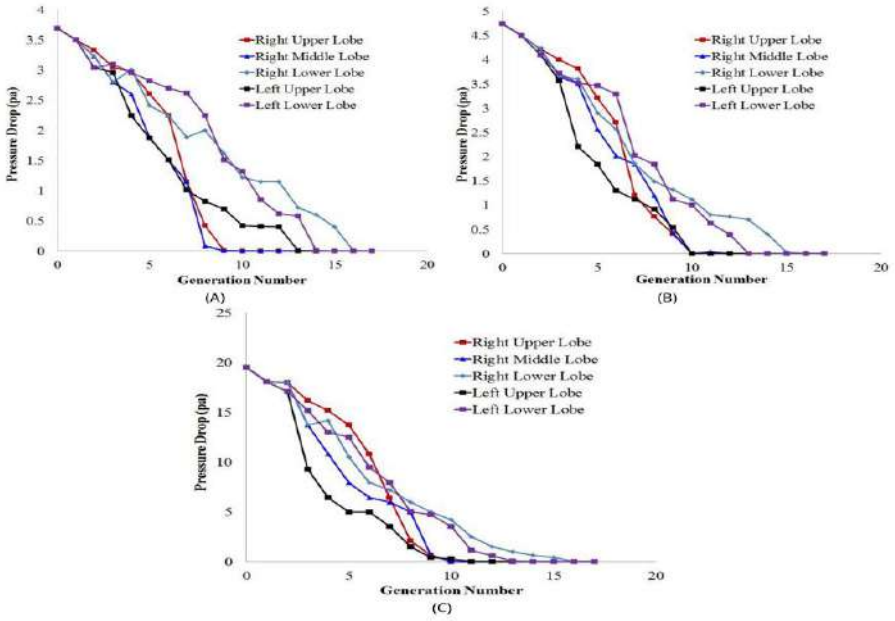


Figure 9. Pressure drop along the selected streamlines of the lobes. (a) 7.5 lpm, (b) 9 lpm, and (c) 25 lpm (Gemci et al. 2017).

Çiloğlu et al. (2020) developed idealized acinar models with alveolar wall movements representing the respiratory bronchi (G17), alveolar duct (G18), and alveolar sac (G23) to investigate airflow and aerosol transport. These models were applied under unsteady inspiration and expiration conditions at light (15 L/min), normal (30 L/min), and heavy (60 L/min) flow rate conditions. During expansion and contraction, the alveolar wall movement generated airflow and facilitated particle transport to the deeper regions of the lung, encompassing the acinar region. During exhalation, the force of gravity reduced the residence times of the particles. As the flow rate increased, greater particle accumulation occurred. The total deposition efficiencies for flow rates of 15, 30, and 60 L/min were found to be 24%, 47%, and 77%, respectively.

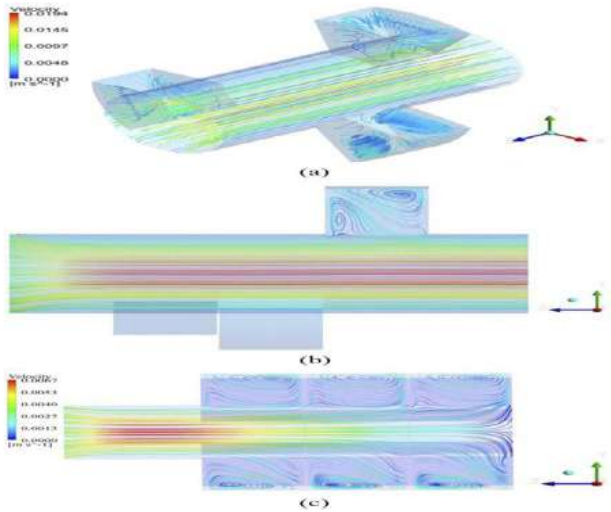


Figure 10. (a) G17 for a flow rate of 15 L/min; (b) G23 for a flow rate of 60 L/min; (c) 3D airflow model (Çiloğlu et al., 2020).

Ciloğlu (2024) evaluated the regional transport and deposition of aerosol particles of different micro sizes under realistic breathing conditions using an in silico assessment method.The simulations were conducted using a sophisticated CT-based model of the human airway, which encompassed the anatomical structures of the mouth-throat region as well as the tracheobronchial upper respiratory tract. To accurately track the trajectories and deposition patterns of aerosol particles, a one-way Lagrangian method was employed. This method allows for the analysis of particle movement in a fluid medium by following individual particles as they traverse through the respiratory system. In this study, three distinct breathing conditions were evaluated, each simulating varying levels of physical activity: light, normal, and heavy. The findings from these simulations were then systematically compared against steady-state breathing conditions to ascertain the effects of different activity levels on aerosol deposition. The analysis focused on aerosol particles with diameters of 2, 5, and 7 μm, specifically considering the dynamics of oral inhalation. It was observed that as the airflow rate increased, smaller particles moved toward the bronchial region, while larger particles deposited in the extrathoracic region. Additionally, it was found that the particle deposition fraction in the bronchial region was higher under cyclic breathing compared to steady-state breathing. The findings indicate that cyclic breathing conditions significantly affect the regional deposition of aerosol particles, with more deposition observed in the right bronchus compared to the left, particularly in the bronchial region.

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024
PITESTI-ROMANIA

ORAL PRESENTATION

Investigating Gastropod and Bivalve Market Dynamics During Ramadan in Tawi Tawi, Philippines

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Abstract

Ramadan market trend (RMT) is an important livelihood opportunity for the residents of Tawi-Tawi. This is a traditional practice observed every month of Ramadan, in which local foods or seafood products are sold and then consumed during iftar (breaking the fast). Our study investigated the market sales practices for gastropods and bivalves in Tawi-Tawi during the RMT season. A structured questionnaire was developed to obtain information regarding the current selling practices of gastropods and bivalves vendors (N=35). Additionally, all gastropods and bivalves recorded were classified according to IUCN Red List categories. During the RMT season in Tawi-Tawi, southern Philippines, 57.14% of vendors sold gastropods and bivalves as their primary means of income. The majority of vendors were female, married, between the ages of 41 and 50, Muslim, and of the Badjao and Sama tribes. Vendors in Tawi-Tawi do not harvest gastropods or bivalves themselves. Instead, they purchase them from various sources, including Simunul and Panglima Sugala municipalities, and they usually begin selling gastropods and bivalves between 1:00 PM and 3:00 PM and finish by 5:00 – 6:00 PM. In addition to hawking to increase sales, vendors also engage in barker transactions (Magsaliyu), where they exchange gastropods for iftar sweets, fresh fish, and dried fish. Moreover, out of 13 species of gastropods and bivalves sold during RMT, *Tridacna gigas* was listed as vulnerable on the IUCN Red List. Thus, these findings provide insight into the prevailing sales practices and strategies of gastropods and bivalves in Tawi-Tawi during Ramadan.

Keywords: Bivalves, Gastropods, Hawking, Magsaliyu, Ramadan Market Trend, Red List.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Bibliometric Analysis of GWAS Technologies in Livestock

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Abstract

With the development of molecular marker technologies, quantitative character loci (QTL) and Genome-wide association analysis (GWAS) are widely used in breeding programs in animal husbandry applications. Scopus (https://www.scopus.com/search) and Web of Science (WOS) (https://www.webofscience.com) databases were searched for studies on farm animals using the keywords "GWAS in livestock". Between 1993 and 2023, 1098 publications in Web of Science and 3065 publications in Scopus were found in the field of GWAS to livestock. Bibliometric analyses were performed using the studies presented in the WOS database through the VOSviewer version 1.6.20 program and Biblioshiny software was designed by Aria, M., & Cuccurullo, C. (2017). bibliometrix: An R-tool for comprehensive science mapping analysis. Journal of Informetrics, 11(4), 959-975. This study emphasized the systematic analysis of GWAS studies in breeding using the method of bibliometric analysis, the importance of GWAS studies applications in animal breeding and production, and their potential applications.

Keywords: GWAS, Livestock, SNP, Genetics, Breeding.

1. Introduction

Bibliometrics is broadly characterized as the application of quantitative methodologies to analyze the citation counts and data associated with various forms of scientific literature, such as articles, reviews, books, and other scholarly publications, utilizing mathematical and statistical techniques (Pesta et al., 2018; Tomaszewski, 2023). Bibliometric analysis, by means of meticulously documented citation metrics, effectively identifies and categorizes extensive volumes of unstructured data. This process not only promotes the progressive accumulation of scientific knowledge but also allows for a transparent, objective, and accurate evaluation of the global influence of scientific endeavors across various disciplines. By emphasizing precise citation counts, it enhances the comparative analysis of scholarly articles, aids in the organization and classification of research within databases, and improves accessibility to research outcomes (Van Raan, 2014; Meija et al., 2021; Donthu et al., 2021).

The utilization of Genome-Wide Association Studies (GWAS), initially introduced by Risch in 1996, represents a robust and effective genetic methodology for identifying genetic markers associated with specific traits of interest (Dehghan 2018; Tam et al. 2019; Uffelmann et al.2021).

Genome-wide association studies (GWAS) aim to determine the associations of genotypes with phenotypes, and this is done by testing for differences in allele frequencies of genetic variants between

genetically similar but phenotypically different individuals. Genome-wide association studies (GWAS) aim to characterise a large set of genetic variants, usually in the form of millions of single nucleotide polymorphisms (SNPs), to determine their association with a particular phenotype (Wang et al.2005; Uffelmann et al.2021).

GWAS has made advances with the use of haplotype-based and gene-based approaches to assess complex and quantitative traits. Compared to SNP-based GWAS, gene-based GWAS utilises all variants within a gene (Andersson et al.2009; Sharma et al. 2015; Manca et al.2020).

The aim of this study was to present bibliometric analyses of published data on genome wide association in farm animals using Bibliometrix and Vosviewer programmes.

2. Materials and Methods

The bibliometric analysis of Genome wide association studies from 1993 to 2023 was conducted during the study. Searches were performed in the Scopus database (Elsevier B.V., Amsterdam, The Netherlands, https://www.scopus.com) and Web of Science (WoS) database (https://www.webofscience.com) using the keywords "GWAS in livestock". These databases' original articles, reviews, book chapters, and proceeding papers were exported in CSV format for the Scopus database and Tab Delimited format for WoS.

Bibliographic analyses considering citation indices, publication numbers, authors, most prolific countries, research areas with high searches terms have been carried out in these databases. We used VOSviewer version 1.6.20, which was designed in 2010 by Van Eck and Waltman at ‘’www.vosviewer.com’’ and Biblioshiny software was designed by Aria, M., & Cuccurullo, C. (2017). bibliometrix: An R-tool for comprehensive science mapping analysis. Journal of Informetrics, 11(4), 959-975 to display and analyse the data.

The findings from the analyses have been presented through tables, graphical and figures.

3. Results and Discussion

The Scopus and Web of Science Databases (WOS) were searched by entering the keywords “GWAS in livestock”. As a result of the research, it appears that from 1993, when the first publications in the relevant field began, to 2023 there were 3065 publications in the Scopus database and 1098 publications in the Web of Science. Between 1993 and 2023, 1009 original articles, 71 review studies and 10 Meeting abstract were found in the Web of Science database Figure 1.

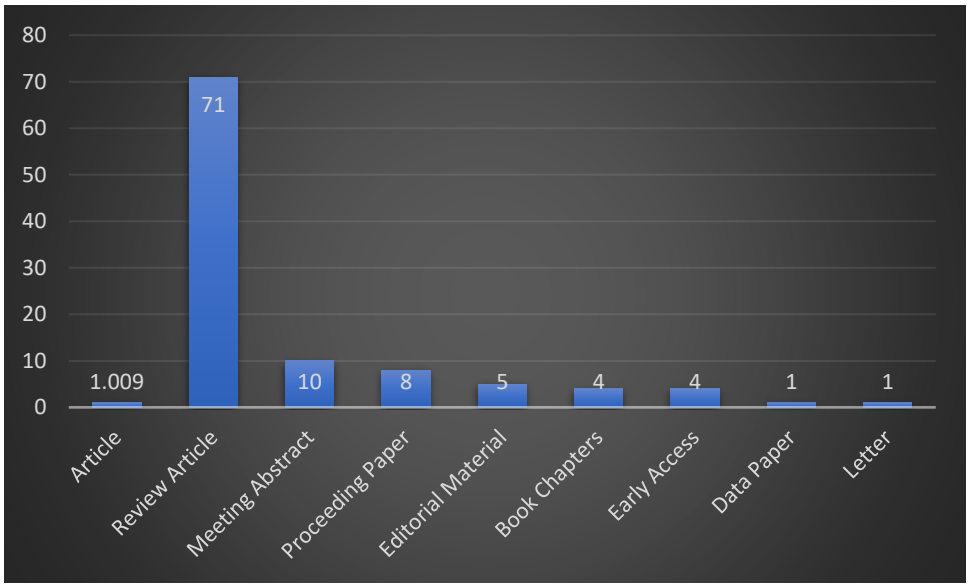


Figure 1. The most document types and numbers in the field of GWAS Studies in livestock.

As a result of the VOSviewer analyzes we conducted between 1993 and 2023 using data from WOS data banks, it appears that the most intensive studies cover the years 2013-2023, while the fewest studies cover the years 1994-2005 were carried out. The most intensive studies in this area were published in 2021 with 185 different publications, including original articles, reviews, book chapters and other publications.

The majority of studies in the field of GWAS studies in livestock are in the fields of Agriculture Dairy Animal Science (483), Genetics Heredity (433), followed by Biotechnology Applied Microbiology (131), veterinary science (104), Multidisciplinary Sciences (105) Figure 2.

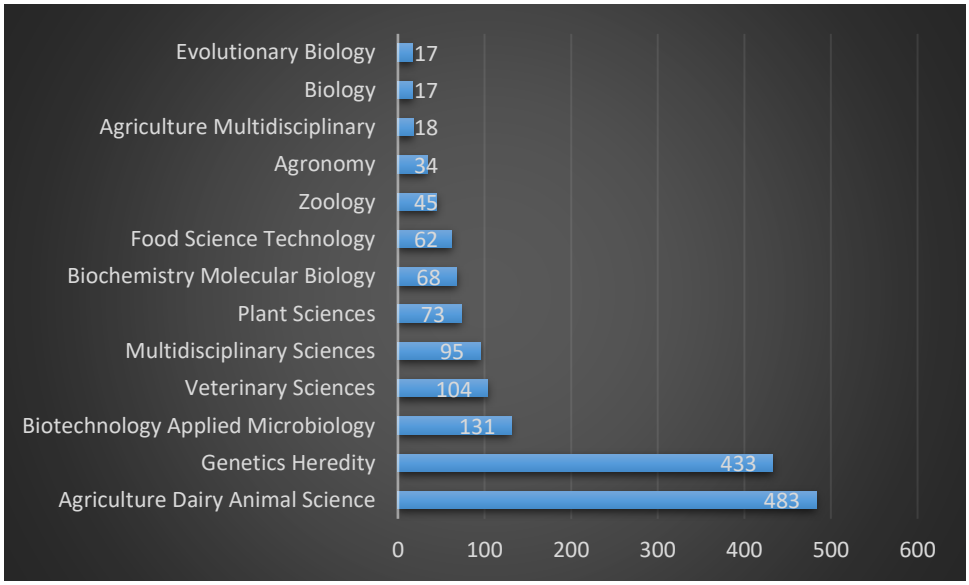


Figure 2. The majority of studies in the field of genome wide association studies in livestock are in the fields.

1098 studies were generally published in journals such as Livestock Science, BMC Genomics, Frontiers in Genetics, Animal Genetics Figure 3.

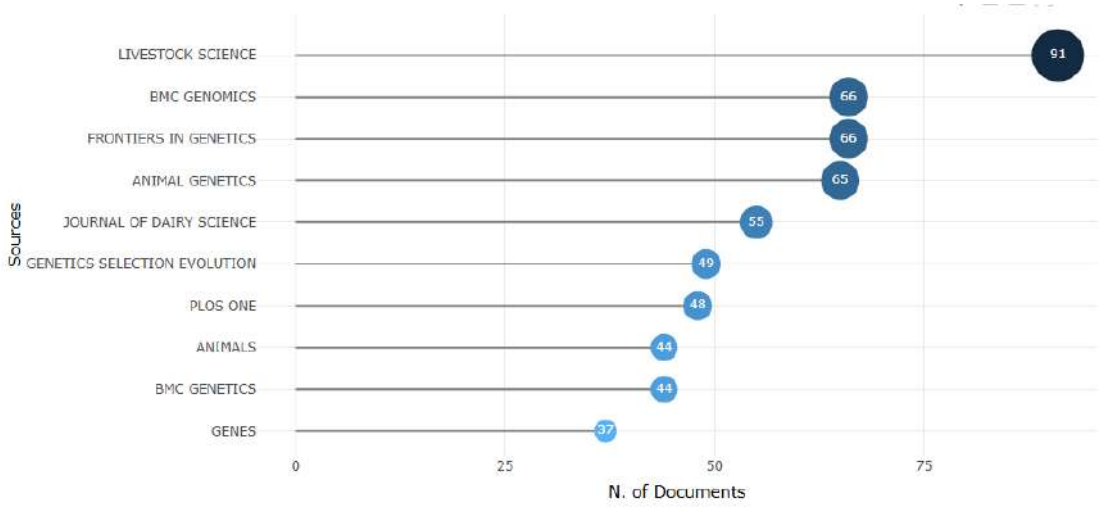


Figure 3. Source and Number of documents published in the GWAS studies on livestock.

3.1. Analysis of Keywords

Among the 1098 publications we examined, 2970 keywords were found among the most repeated words in publications and citations, and the most commonly used common words among these were gwas (168), genome wide association (117), SNP (60), cattle (44) qtl (37) Figure 4.

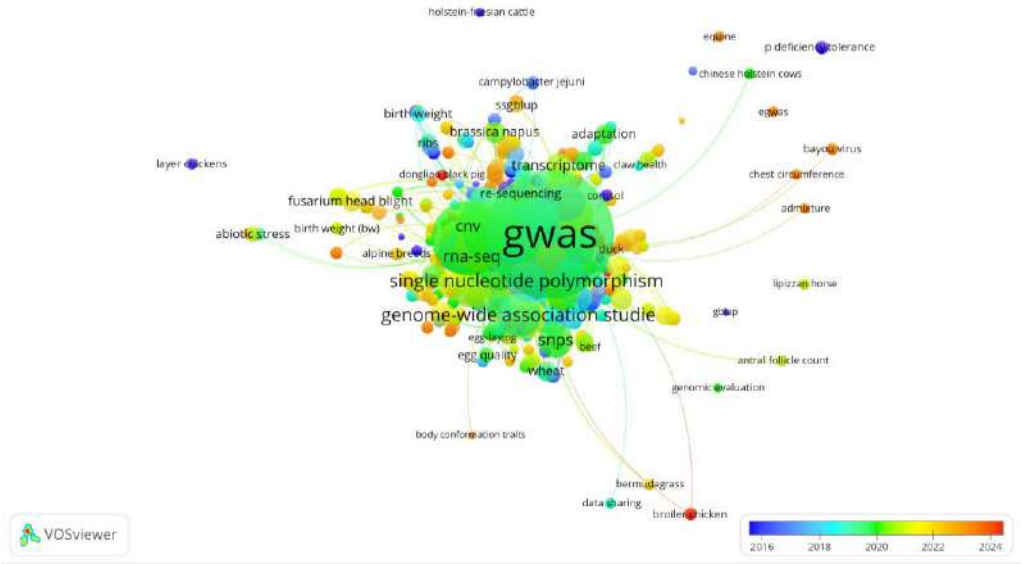


Figure 4. Among the 1098 publications founding 2970 keywords.

When the keywords repeated at least 5 times in the publications 2970 keywords were analysed, it is seen that 110 keywords are used and the majority of these words are gwas (169), genome wide association (103), snp (63), cattle (50) and candidate genes (40), which are widely repeated especially in review and original articles (Figure 5).

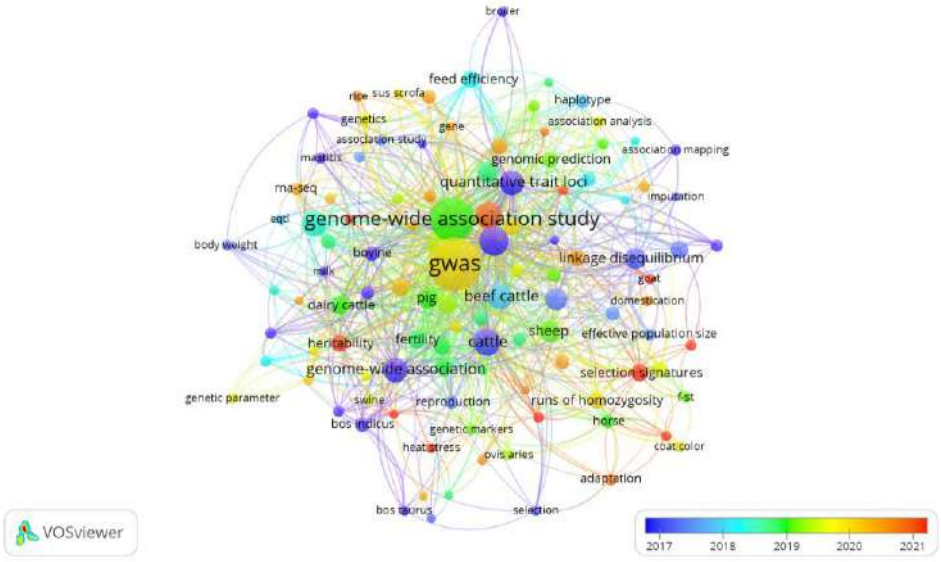


Figure 5. 110 Keywords repeated at least 5 times.

3.2. Most Prolific Authors

A total of 5941 authors participated in the study of GWAS in livestock and 5 authors published more than 212 articles. Brito, Luiz F. and Schenkel, Flavio Schramm are in the first place with their article studies conducted by Purdue University College Of Agriculture and China Agricultural University College Of Animal Science And Technology with 43 studies conducted between 2017-2023. Sargolzaei M with 26 genome analysis and association studies on cattle and pig breeds at Tohoku University Graduate School Of Agricultural Science Faculty Of Agriculture and Kobe University Faculty Of Agriculture Graduate School Of Agricultural Science departments in Japan and Plastow G with 25 publications in the third Figure 6.

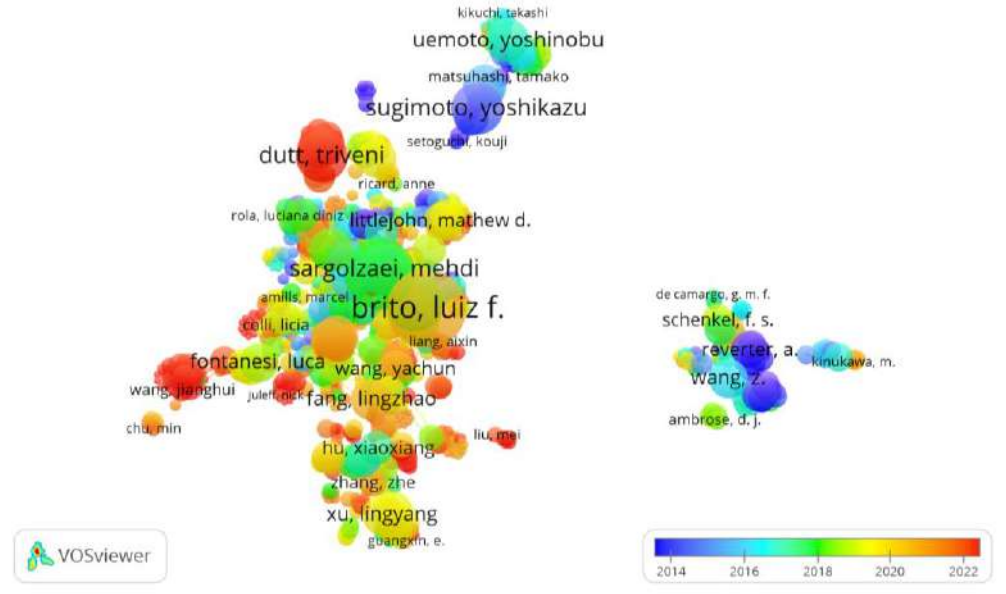


Figure 6. Network map of study authors. Of the 5941 authors.

Among 1009 original articles published between 1993 and 2023, the most cited authors are Gibbs RA, (644), and Daetwyler HD, (498) and Huang H (388). The other 10 most cited authors are shown in the Table 1.

Table 1. The most citation authors and publications.

Paper	DOI	Total Citations
Gibbs RA, 2009, Science	Genome-Wide Survey of SNP Variation Uncovers the Genetic Structure of Cattle Breeds (10.1126/science.1167936)	644
Daetwyler HD, 2008, Plos One	Accuracy of Predicting the Genetic Risk of Disease Using a Genome-Wide Approach (10.1371/journal.pone.0003395)	498
Huang H, 2017, Nature	Fine-mapping inflammatory bowel disease loci to single-variant resolution (10.1038/nature22969)	388
Daetwyler HD, 2013, Genetics	Genomic Prediction in Animals and Plants: Simulation of Data, Validation, Reporting, and Benchmarking (10.1534/genetics.112.147983)	305
Houston RD, 2020, Nat Rev Genet	Harnessing genomics to fast-track genetic improvement in aquaculture (10.1038/s41576-020-0227-y)	273
Farnir F, 2000, Genome Res	Extensive genome-wide linkage disequilibrium in cattle (10.1101/gr.10.2.220)	270
Vitezica ZG, 2011, Genet Res	Bias in genomic predictions for populations under selection (10.1017/S001667231100022X)	267
Karim L, 2011, Nature Genet	Variants modulating the expression of a chromosome domain encompassing PLAG1 influence bovine stature (10.1038/ng.814)	251
Cook JP, 2012, Plant Physiol	Genetic Architecture of Maize Kernel Composition in the Nested Association Mapping and Inbred Association Panels (10.1104/pp.111.185033)	249
Kijas JW, 2009, Plos One	A Genome Wide Survey of SNP Variation Reveals the Genetic Structure of Sheep Breeds (10.1371/journal.pone.0004668)	245

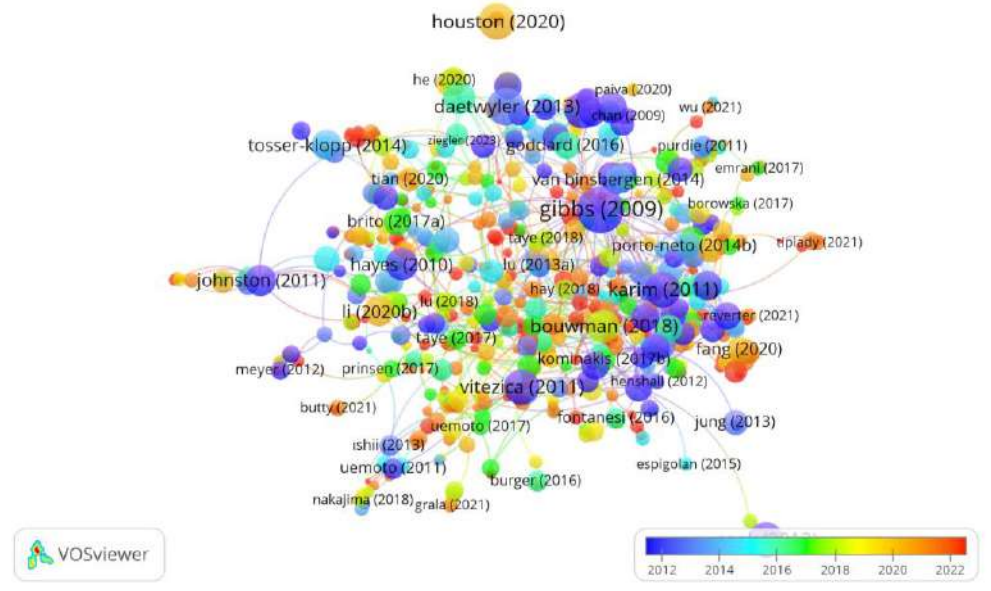


Figure 7. The most citation sources and writers-shows that different colours and clusters.

3.3. Countries and Collaborations

1098 studies on genome wide association in farm animals have been published in 99 different countries. Among these countries, the top three countries with the most publications are the People's Republic of China (266), USA (257), Canada (152) and Australia. The top 10 countries according to the number of publications in this field are presented in Figure 8.

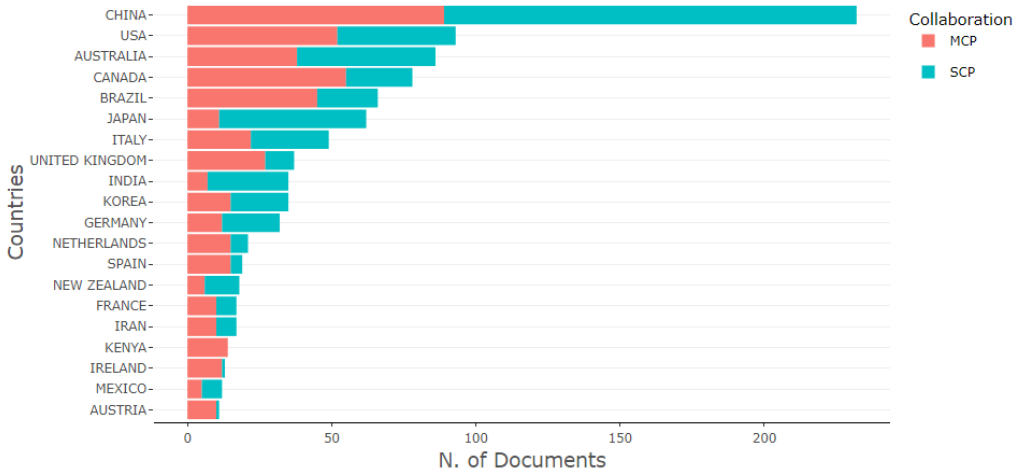


Figure 8. Countries with the most publications GWAS studies in livestock.

The most cited countries are Australıa (4337), USA (3493), Chına (3253), Canada (1994) and Unıted Kıngdom (1776) Figure 9.

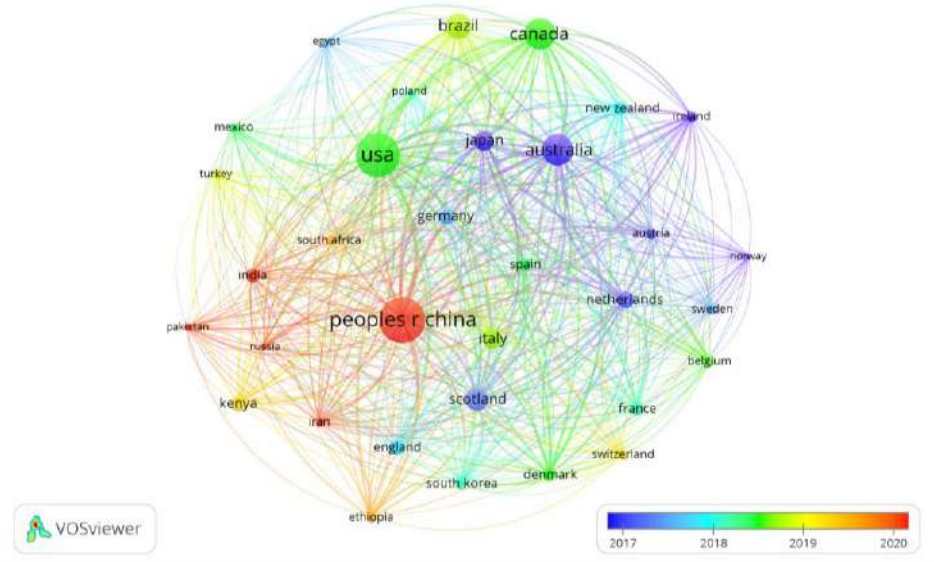


Figure 9. The most citation countries fields of GWAS studies in livestock.

4. Conclusion

In conclusion the peresent study used bibliometric methods to identify research in the field of Genome wide association studies in Livestock over the first publicution 1993 and 2023 years. In the application

of modern breeding techniques for livestock, it is observed that there is a need to promote the widespread use of Genome-Wide Association Studies (GWAS).

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Ethnobotanical and Floristic Study in the Maamora Forest, Morocco

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Abstract

To investigate the aromatic and medicinal plants found in the forest and their applications by the local community, a comprehensive floristic and ethnobotanical study was conducted in two communes within the Maamora forest. The primary aim of this research is to evaluate the impact of the local population on the forest's natural resources and to identify suitable methods for the valorization and conservation of the area's natural wealth. Initially, a detailed floristic inventory was performed, followed by ethnobotanical surveys conducted in the field using structured questionnaires to gather data on local knowledge and practices. The findings of this study revealed that the area is rich in aromatic and medicinal plants, which represent a significant therapeutic and economic resource for the local community. A total of 103 plant species were documented, belonging to 31 families, with Asteraceae, Poaceae, Fabaceae, and Liliaceae being the most prevalent. Most of these species are utilized as forage for livestock grazing in the forest, while 30% are recognized as medicinal plants used to treat various ailments, such as digestive and metabolic issues, and respiratory problems. The ethnobotanical results obtained also show that it is possible to use these plants in the local socio- economic development, in the framework of valuation of the human and natural potential.

Keywords: Medicinal Aromatic Plants, Ethnobotany, Maamora, Floristic Study, Local Population.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Comparison of Optimization Algorithms for Cost and Benefit Analysis in Water Loss Management

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Abstract

The basic rule in water management is the timely and continuous delivery of a sufficient quantity of quality water to subscribers. In order to ensure this, it is necessary to know the location and characteristic information of the pipes and elements serving in the field (with an up-to-date database), create operating plans, monitor hydraulic parameters regularly, monitor unusual changes in operating data (malfunctions, subscriber complaints, water interruption frequency). However, especially in large distribution systems, it becomes difficult to carry out these studies and monitor the data; the system's operating conditions deteriorate, the service level decreases, subscriber complaints increase, the frequency of failures increases, and causes water losses. While determining the ideal loss percentages in distribution systems, it will provide a more realistic approach to make a DMA based evaluation and to consider the existing network status, financial status, costs, benefits. For this reason, it is necessary to establish a model that covers all technical, financial, technological parameters for the water loss management (WLM) strategy. Cost/benefits were analyzed for the loss reduction methods adopted in WLM, and the aim was to determine the economic loss level for the system. In this context, Beluga Whale Optimization (BWO) and Salp Swarm Algorithm (SSA) algorithms were used, and the results obtained were compared. Although it is seen that the algorithms generally achieve similar results in the calculated sub-regions, there are differences in the loss reduction methods selected and the benefits obtained in some regions. This situation will allow similar benefits to be obtained by developing different strategies. The study provides important outputs in this sense in water loss management.

Keywords: Water Distribution System, Water Losses, Leakage Detection.

1. Introduction

Various methodologies or approaches creating serious costs for utilities have been implemented to reduce and control water losses. The current data and database related to the water distribution network and technical capacity are needed in order to implement the methods that are widely preferred and applied in reducing physical losses (Gonelas & Kanakoudis, 2015; Lambert et al., 1999; Liemberger & Wyatt, 2019). Current equipment capacity such as pressure control valves or newly constructed reservoirs, as well as local or regional detection devices and online monitoring systems for ALC, are needed. On the other hand, the economic contribution of the expenditures to be made to reduce water

loss to the administration is an important issue to be taken into consideration. Therefore, the best-fit leakage or apparently lost goal should be determined based on the current status of WDN conditions (Farley et al., 2008; Haider et al., 2019; Islam & Babel, 2013; Pearson, 2019). In determining the most appropriate loss goal, the following components should be taken into consideration (Islam & Babel, 2013; Liemberger & Wyatt, 2019);

- The goal, financial, technical infrastructure and technical personnel conditions in utilities
- The strategy implemented by the administration in reducing water losses, the current situation analysis of the system-priority-suitability of potential reduction methods
- The remaining useful life of pipes and fittings, the operation cost of the network under current conditions, the annual income provided by the existing network to the administration, and the hydraulic performance of the system.
- Annual inflation rate for long-term planning
- Status and potential of water resources, the possible cost of new source and transmission line, the energy cost of the current system
- The costs of the tools and methods to be applied for water loss reduction activities in the current system and the benefits to be obtained by applying these methods.
- Short-medium-long term cost-benefit analysis

The economic leakage level (ELL) refers to the level at which leakages in a WDS can be economically reduced. Water losses can be reduced below this level. However, very serious investments must be made. This creates a serious economic burden for institutions in many cases. When determining ideal loss percentages in distribution systems, the current network status, economic capacity, costs, and benefits should be taken into consideration (Deidda et al., 2014). In a system where operating and production costs of water are very high, the economic leakage level is different from the economic leakage level in a system where gravity water is transmitted. Hardeman (2009) revealed that reducing the loss rate to zero in a distribution system is an unrealistic and costly goal. In this context, it is thought that sustainable water management can be achieved by calculating the ELL. (Islam & Babel, 2013) expressed that the ELL could be changed with on network characteristics and status, pressure, water production and sales (tariff) cost, and leakage management costs.

Deidda et al. (2014) defined the term ELL in leakage reduction works as the balance between the costs of saving water and the marginal costs of providing an additional reduction in leakage. In other words, it has been stated that the target in the struggle should be determined by this balance point. In determining ideal water loss rates, the economic situation of the Administration is as important a factor as the need for water, the status of the existing network, and operating costs. Rudolph (2009) reported that leakages or losses should be evaluated for each country based on economic capacity. He stated that the leakage rate in Germany is about 8%. On the other hand, in lower-income countries, this rate could go up to 90%. The main reason for this is the difference between the budgets allocated for water management. Christodoulou et al. (2009) stated in their study that risk analysis, asset management, and

economic/social impacts should be evaluated together in order to provide systematic water management. They created a decision support module using artificial neural networks and fuzzy logic methods.

Cost/benefits were analyzed for the loss reduction methods adopted in WLM, and the aim was to determine the economic loss level for the system by evaluating the variables. BWO and SSA algorithms were used in this context, and the results obtained were compared. Although it is seen that the algorithms generally achieve similar results in the calculated sub-regions, there are differences in the loss reduction methods selected and the benefits obtained in some regions. This situation will allow similar benefits to be obtained by developing different strategies. The study provides important outputs in this sense in water loss management. Within the scope of the study, the previously prepared optimization structure (Firat et al., 2021; Yilmaz et al., 2023) was tested with different algorithms and the results were interpreted.

2. Materials and Methods

Various studies have been carried out by the utilities to reduce the rate of NRW in WDSs. These studies, which are carried out to reduce real and apparent losses, not only reduce water losses but also create various operating and application costs. Therefore, while carrying out loss reduction studies, separate cost/benefit analyses should be carried out for the relevant methods selected.

In drinking water distribution systems, if the inputvolume is defined as V_input and the accrued flow rate is defined as V_cons., the system loss amount is defined as equation (1);

$$V_{nrw} = V_{input} - V_{cons.} \quad (1)$$

Accordingly, the loss percentage is expressed as equation (2);

$$Nrw\ (\%) = \frac{V_{nrw}}{V_{input}} \quad (2)$$

This optimization method defines two objective functions (equations 3 and 4). During optimization, the total loss percentage equation is minimized while the benefit is maximized (Firat et al., 2021; Yilmaz et al., 2023).

$$Benefit = Benefit_{pressure} + Benefit_{ALC} + Benefit_{team} + Benefit_{water\ meter} \quad (3)$$

$$ELL = \frac{V_{loss} - Benefit}{V_{input}} \quad (4)$$

First of all, the possible benefits and costs for each water loss reduction method were calculated and compared with each other (Firat et al., 2021; Yilmaz et al., 2021, 2023). Thus, methods that can be economically applied for DMA regions with different network characteristics are determined and the economic loss level is calculated accordingly. The structure of the established algorithm is presented in Figure 1.

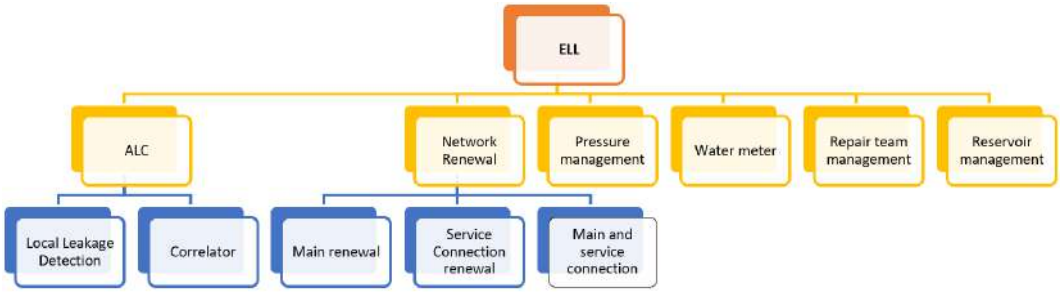


Figure 1. Structure of the established algorithm (Yilmaz et al., 2023).

Beluga Whale Optimization (BWO) and Salp Swarm Algorithm (SSA) were selected within the scope of this study to investigate the effect of the detailed water loss algorithm (Firat et al., 2021; Yilmaz et al., 2022, 2023).

Cost/benefits were analyzed for the leakage management methods adopted in NRW management, and the aim was to determine the economic loss level for the system by evaluating the common variables together. In this context, BWO and SSA algorithms were used, and the results obtained were compared.

A novel swarm-based metaheuristic algorithm inspired by the behavior of beluga whales called BWO, is presented to solve optimization problems. BWO is a competitive algorithm in solving unimodal and multimodal optimization problems, and the overall rank of BWO is the first in the scalability analysis of benchmark functions among compared metaheuristic algorithms through the Friedman ranking test (Zhong et al., 2022).

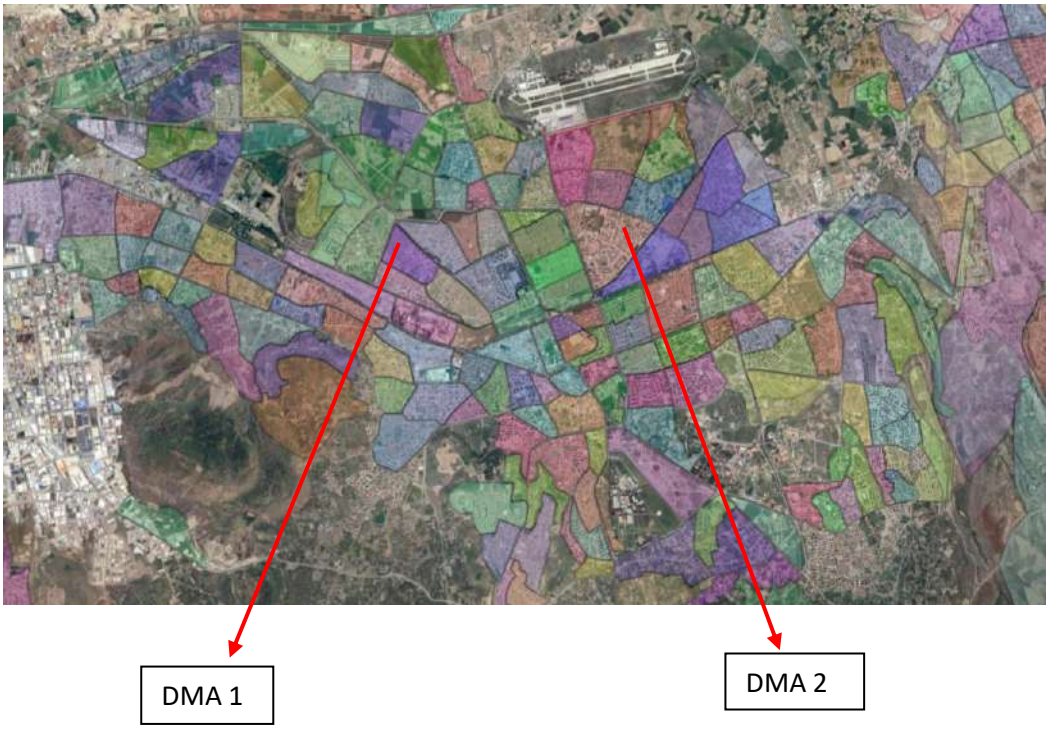


Figure 2. Study area and DMAs.

The main inspiration of SSA is the swarming behaviour of salps when navigating and foraging in oceans. This algorithm is tested on several mathematical optimization functions to observe and confirm their

effective behaviors in finding the optimal solutions for optimization problems. The results of the mathematical functions show that the SSA algorithm is able to improve the initial random solutions effectively and converge toward the optimum (Faris et al., 2020).

Within the scope of the study, 2 DMA regions belonging to Kayseri province were selected, and analyses were made with the determined optimization methods.

Table 1. The data for ELL analysis.

PARAMETERS	UNIT	DMA 01	DMA 02
MAIN LENGTH	m	44,081	22,624
NUMBER OF CUSTOMERS (COMMERCIAL)	No.	234	218
NUMBER OF CUSTOMERS (RESIDENTIAL)	No.	7,243	5,223
NUMBER OF SERVICE CONNECTIONS	No.	2,387	415
THE AVERAGE LENGTH OF A CONNECTION	m	1.65	26.09
AVERAGE PRESSURE AT NIGHT TIME	m	42	40
SYSTEM INPUT	m^3/month	133,013	82,382
AUTHORIZED BILLED CONSUMPTION	m^3/month	72,320	59,673
UNIT WATER PRODUCTION COST	TL/m^3	9.00	9.00
UNIT WATER TARIFF (RESIDENTIAL)	TL/m^3	25.36	25.36
UNIT WATER TARIFF (COMMERCIAL)	TL/m^3	34.08	34.08
NUMBER OF WATER METERS (AGES 10 AND UP)	No.	4,023	674
RATE OF OLD WATER METERS		54%	12%
NUMBER OF RESERVOIRS	No.	1	1
NUMBER OF FAILURES (SERVICE CONNECTION)	No.	268	47
NUMBER OF FAILURES (MAINS)	No.	24	28
NUMBER OF REPAIR TEAMS	No.	1	1
FAILURE REPAIR DURATION	hour/No.	39.56	39.56
IS THERE DMA?	Y/N	e	e
MAIN LENGTH IN DMAS	m	44,081	22,624
NUMBER OF DMAS	No.	1	1
NRW VOLUME	m^3/month	60,693	22,709
WATER LOSS VOLUME	m^3/month	60,693	22,709
REAL LOSS VOLUME	m^3/month	60,476	22,530
APPARENT LOSS VOLUME	m^3/month	217	179
AUTHORIZED UNBILLED UNMETERED CONSUMPTION	m^3/month	0	0
LEAKAGE IN RESERVOIRS	m^3/month	0	0
AUTHORIZED UNBILLED METERED CONSUMPTION	m^3/month	0	0
LOSSES DUE WATER METER INACCURACIES	m^3/month	217	179
NETWORK LINES OVER 30 YEARS	%	1%	1%
PIPE TYPE IN WDN	-	PVC	Ductile
PIPE RATE (<Ø 150 MM)	%	78%	72%
PIPE RATE (Ø 150 MM - 300 MM)	%	18%	28%
PIPE RATE (Ø 300 MM - 500 MM)	%	4%	0%
PIPE RATE (Ø 500 MM - 700 MM)	%	0%	0%
PIPE RATE (> Ø 700 MM)	%	0%	0%
PIPE TYPE IN RENEWAL	-	PVC	PVC

After obtaining the data, the current performance of the systems and water loss rates were first calculated with the help of equations 1 and 2. The results are given in Table 2.

Table 2. Current performances.

PARAMETERS	DMA1	DMA2
SYSTEM INPUT (M^3/MONTH)	133,013	15,674
AUTHORIZED BILLED CONSUMPTION (M^3/MONTH)	72,320	11,813
NRW (M^3/MONTH)	60,693	3,861
NON-REVENUE WATER (%)	**45.63%**	**24.63%**
AUTHORIZED UNBILLED CONSUMPTION (M^3/MONTH)	217	35
APPARENT LOSS (M^3/MONTH)	60,476	3,826

It is seen that the current loss rate of the DMA1 region is 45% and the DMA2 region is 24%. These values reveal that there is a need for water management in these regions and that loss reduction work should be carried out.

3. Results and Discussion

The WLM and reduction works should be carried out in the regions in question due to the high water losses and non-revenue water rates. However, the most important step to be taken in these administrations is to choose the most effective and efficient methodologies to reduce losses. When the regions are examined, it is seen that the factors causing water losses in the WDS may be different. In the simplest terms, the differences in pressure levels of the regions are expected to affect the current losses and the type of methods significantly. For this purpose, analyses were carried out with two different algorithms in the regions as detailed. The results are presented in Tables 3 and 4.

Table 3. DMA1 optimization results.

COMPONENT	UNIT	CURRENT STATUS	"BWO" OPTIMIZATION	"SSA" OPTIMIZATION
PRESSURE	m	42	30	42
NUMBER OF TEAMS	No.	1	1	1
WATER METER MANAGEMENT	-	-	1st option	1st option
NETWORK RENEWAL	-	-	1st option	1st option
ELL	m^3/day	60,693	14,925	22,607
ELL (%)	**%**	**45.63%**	**11.22%**	**16.84%**

Table 4. DMA2 optimization results.

COMPONENT	UNIT	CURRENT STATUS	"BWO" OPTIMIZATION	"SSA" OPTIMIZATION
PRESSURE	m	40	30	30
NUMBER OF TEAMS	No.	1	1	1
WATER METER MANAGEMENT	-	-	1st option	1st option
NETWORK RENEWAL	-	-	1st option	1st option
ELL	m3/day	22,709	3,714	3,714
ELL (%)	**%**	**27.57%**	**4.07%**	**4.07%**

Although BWO and SSA algorithms produce different loss management scenarios for the DMA1 region, they give the same results for DMA2. The algorithms used may give different results due to differences in their working principles. The different scenarios for the DMA1 region and the serious differences in implementation can be considered as an advantage for water channel administrations. In the DMA2 region, both algorithms suggested the same methods. The suggested methods and the possible benefits are given in Tables 5 and 6.

Table 5. Optimization results in DMA1.

DMA1					
"BWO" OPTIMIZATION					
COMPONENT	**Unit**	**Optimization result**	**Cost**	**Benefit**	**Difference**
DMA	No.	2 DMAs	₺550,000.00	₺0.00	-₺550,000.00
PRESSURE MANAGEMENT	m^3/month	24,623	₺0.00	₺2,659,300.00	₺2,659,300.00
ALC (YM)	m^3/month	7,224	₺671,280.00	₺780,220.00	₺108,940.00
RESERVOIR MANAGEMENT	m^3/month	0	₺0.00	₺0.00	₺0.00
NETWORK RENEWAL	m^3/month	0	₺0.00	₺0.00	₺0.00
WATER METER MANAGEMENT	m^3/month	0	₺0.00	₺0.00	₺0.00
REPAIR TEAM MANAGEMENT	m^3/month	0	₺0.00	₺0.00	₺0.00
ALC (CORRELATOR)	m^3/month	13,921	₺1,412,200.00	₺1,503,500.00	₺91,300.00
BENEFIT	m^3/month	**45,768**	**₺2,633,480.00**	**₺4,943,020.00**	**₺2,309,540.00**
"SSA" OPTIMIZATION					
COMPONENT	**Unit**	**Optimization result**	**Cost**	**Benefit**	**Difference**
DMA	No.	2 DMAs	₺550,000.00	₺0.00	-₺550,000.00
PRESSURE MANAGEMENT	m^3/month	0	₺0.00	₺0.00	₺0.00
ALC (YM)	m^3/month	15,168	₺667,250.00	₺1,638,100.00	₺970,850.00
RESERVOIR MANAGEMENT	m^3/month	0	₺0.00	₺0.00	
NETWORK RENEWAL	m^3/month	0	₺0.00	₺0.00	₺0.00
WATER METER MANAGEMENT	m^3/month	0	₺0.00	₺0.00	₺0.00
REPAIR TEAM MANAGEMENT	m^3/month	0	₺0.00	₺0.00	₺0.00
ALC (CORRELATOR)	m^3/month	22,918	₺1,392,200.00	₺2,475,100.00	₺1,082,900.00
BENEFIT	m^3/month	**38,086**	**₺2,609,450.00**	**₺4,113,200.00**	**₺1,503,750.00**

Table 6. Optimization results in DMA2.

DMA2					
"BWO" OPTIMIZATION					
COMPONENT	**Unit**	**Optimization result**	**Cost**	**Benefit**	**Difference**
DMA	No.	DMA Yeterli	₺0.00	₺0.00	₺0.00
PRESSURE MANAGEMENT	m^3/month	6,352	₺0.00	₺686,020.00	₺686,020.00
ALC (YM)	m^3/month	3,794	₺269,000.00	₺409,720.00	₺140,720.00
RESERVOIR MANAGEMENT	m^3/month	0	₺0.00	₺0.00	₺0.00
NETWORK RENEWAL	m^3/month	0	₺0.00	₺0.00	₺0.00
WATER METER MANAGEMENT	m^3/month	0	₺0.00	₺0.00	₺0.00
REPAIR TEAM MANAGEMENT	m^3/month	0	₺0.00	₺0.00	₺0.00
ALC (CORRELATOR)	m^3/month	8,849	₺772,160.00	₺955,740.00	₺183,580.00
BENEFIT	m^3/month	**18,995**	**₺1,041,160.00**	**₺2,051,480.00**	**₺1,010,320.00**
"SSA" OPTIMIZATION					
COMPONENT	**Unit**	**Optimization result**	**Cost**	**Benefit**	**Difference**
DMA	No.	DMA Yeterli	₺0.00	₺0.00	₺0.00
PRESSURE MANAGEMENT	m^3/month	6,352	₺0.00	₺686,020.00	₺686,020.00
ALC (YM)	m^3/month	3,794	₺269,000.00	₺409,720.00	₺140,720.00
RESERVOIR MANAGEMENT	m^3/month	0	₺0.00	₺0.00	₺0.00
NETWORK RENEWAL	m^3/month	0	₺0.00	₺0.00	₺0.00
WATER METER MANAGEMENT	m^3/month	0	₺0.00	₺0.00	₺0.00
REPAIR TEAM MANAGEMENT	m^3/month	0	₺0.00	₺0.00	₺0.00
ALC (CORRELATOR)	m^3/month	8,849	₺772,160.00	₺955,740.00	₺183,580.00
BENEFIT	m^3/month	**18,995**	**₺1,041,160.00**	**₺2,051,480.00**	**₺1,010,320.00**

It is revealed that pressure management, active leakage management ground microphone, and active leakage management regional correlator methods should be used for the DMA2 region. These applications allow 18,995 m3 of water to be added to the system monthly. In addition, while the cost required for applying these methods is approximately 1 million TL, the possible gain is calculated as 2 million TL. Thus, a gain of 1 million TL can be achieved.

For the DMA1 region, two algorithms suggest different loss levels and costs. While 45 thousand m3 of water can be added to the system monthly with the BWO algorithm, this value is calculated as 38 thousand m3 in the SSA algorithm. Again, while it is expected to gain 2,309,540.00 TL by spending

2,633,480.00 TL in the methods suggested by the BWO algorithm, it is calculated that 1,503,750.00 TL can be gained by spending 2,609,450.00 TL with the SSA algorithm.

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
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ORAL PRESENTATION

Cost and Benefit Analysis for Leakage Detection and Reduction Practices with the Regional Correlator Method

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Abstract

The unreported leakages could be determined and reduced by applying the active leakage control methodology. The volume of recoverable leakages increases due to the prolonged time to recognize and locate these leaks. Active leakage control includes detecting, mitigating, and unreported leakage in isolated measurement zones. Acoustic (zonal) correlators are considered one of the most effective tools for leak detection. Applying this tool establishes a mathematically based on the frequencies of signals at nodes/potential leak points. The acoustic devices could detect the unreported leakages with high accuracy. Various types of acoustic devices have been used in order to detect the leakages. Regional or local detection procedures could be applied. However, the location of valves, types of pipe materials and location of pipes in streets should be defined correctly. Within the scope of the study, the difficulties encountered during the application of this method were analyzed, and the possible benefits and implementation cost to be obtained in case of the method were calculated. According to the results obtained, this method is more useful for steel pipes, medium-high pressure level and leakages above 2 l/s leakage amount. In addition, the method was analyzed in 3 different DMA regions and the benefits and costs were calculated according to the characteristics of the network. According to the calculation results, while this method is beneficial in some regions, it is seen that the benefit to be obtained in some regions is lower than the cost. It is thought that the study will be guiding for decision makers in water loss management.

Keywords: Water Distribution System, Water Losses, Leakage Detection, Acoustic Method.

1. Introduction

Utilities and organizations that distribute water around the world evaluate water loss rates with the parameter of non-revenue water (NRW), and their performances are generally determined with this indicator. According to research conducted by the International Water Association (IWA), the ideal NRW rate varies between 8% and 24% in developed countries, and between 24% and 45% in developing countries. The average rate of leaks is approximately 25 to 30% (Liemberger & Wyatt, 2019). The rate of the leaks is between 3 and 7% of the supplied water in developed countries. Moreover, it is reported that there is more than 50% leakage in developing countries (Firat et al., 2021; Moslehi et al., 2021; Yılmaz et al., 2021). Active leak control strategy, including the detection, localization, and repair of unreported leaks, plays an important role in reducing the volume of real losses (Lambert et al., 1999).

However, planning and implementing the district-metered areas are quite important in order to achieve the potential gains in active leakage control. The volume of recoverable leaks is increasing due to the longer time of awareness and locating the leaks (Farley & Liemberger, 2005; Islam & Babel, 2013; Lipiwattanakarn et al., 2019). The four basic methods (pressure control, material replacement, active leakage control, and fault repair) have been applied to reduce physical water losses. However, these methods bring serious economic costs (Deidda et al., 2014; Farley et al., 2008; Liemberger & Wyatt, 2019; Yilmaz et al., 2021, 2022, 2023). The leakage volume could be reduced, and water resource efficiency can be provided depending on the application level of basic methods. However, it is very important for the administration to have sufficient technical infrastructure and experience and to make good planning in order for these methods to be applied and the expected benefits to be achieved. Moreover, these methods create costs within the scope of equipment, field manufacturing, and data monitoring. Therefore, the suitability, applicability, expected benefits, incurred costs, and necessity of these methods should be analyzed in detail (De Paola et al., 2017; Fantozzi et al., 2009; Lai et al., 2020; Mugabi et al., 2007; Pearson, 2019).

The aim of this study is to evaluate the difficulties encountered during the application of acoustic methods and to calculate the possible benefits and implementation costs to be obtained in the case of the method. According to the results obtained, this method is more useful for steel pipes, medium-high pressure levels, and leakages above 2 l/s leakage amount. In addition, the method was analyzed in 3 different DMA regions, and the benefits and costs were calculated. According to the calculation results, while this method is beneficial in some regions, it is seen that the benefit to be obtained in some regions is lower than the cost. This study will be guiding for technical personnel in water loss management.

2. Materials and Methods

Active leak control involves detecting, reducing, and preventing non-reported leaks in district-metered areas (Pearson, 2019). For this aim, the basic steps are the DMA design and implementation in the field, analyzing the potential recoverable leaks with MNF analysis, and localizing the unreported leak points (Firat et al., 2021). Active leakage control has no effect on reducing and preventing background leaks (Yilmaz et al., 2021). Leak detection refers to the recognition of the existence of unreported leaks in distribution systems or district-metered areas. Since reported leaks come to the ground surface, they are quickly noticed, and their location is known. However, since unreported leaks do not reach the ground surface, they are very difficult to detect. For this reason, active leak control methods should be applied. It is necessary to reduce the total leaks by performing MNF analysis in the isolated measurement area to determine their subcomponents, and to reduce the preventable leak volume by monitoring the minimum night flow rate. For this purpose, leak location detection efforts are carried out using devices and equipment such as ground microphones, regional recorders, and regional correlators. In the literature, it has been emphasized that the aim of active leak control studies is to detect and repair pipe bursts more quickly (Charalambous et al., 2014; Salguero et al., 2019). In this way, it has been argued that the potential environmental damage and the benefits of reducing water loss will be achieved. A leak detection team is of critical importance in combating leaks. Late detection of the leak location or failure to detect it causes the leak volume to increase.

Leak detection devices are the microphone (local detection), correlators, recorders, and real-time monitoring (Adedeji et al., 2017; Moslehi et al., 2021). Local leak detection involves monitoring the changes in sound waves step by step on the street using acoustic devices called microphones to detect

unreported leaks. Regional leakage detection devices determine the location of potential leakage points with the help of sensors in the DMA. Acoustic (regional) loggers can be thought of as compact units that contain sensors and loggers. These devices are generally placed at appropriate points to listen for leak sounds between 02:00 and 04:00 at night.

Acoustic (regional) correlators are one of the most devices used in determining the location of leaks. The type of pipe material that affects the propagation of sound waves and the system operating pressure should be taken into consideration. In this method, a fixed sound and vibration listening is performed with correlators (Figure 1).

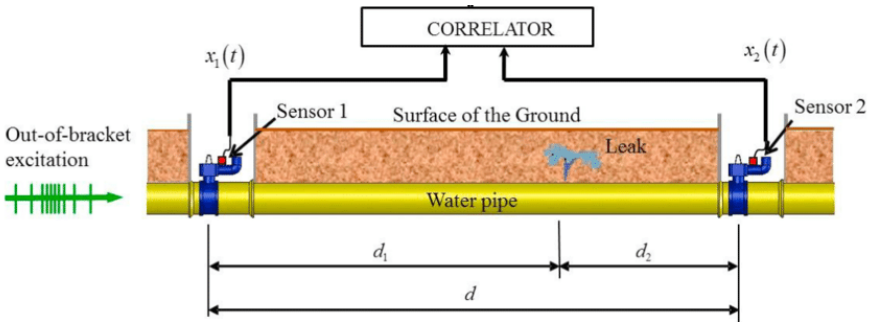


Figure 1. Use of regional correlators (Brennan et al., 2017).

A total of three district-metered areas in the Kayseri province of Turkey were selected within the scope of the study (Figure 2, Table 1).

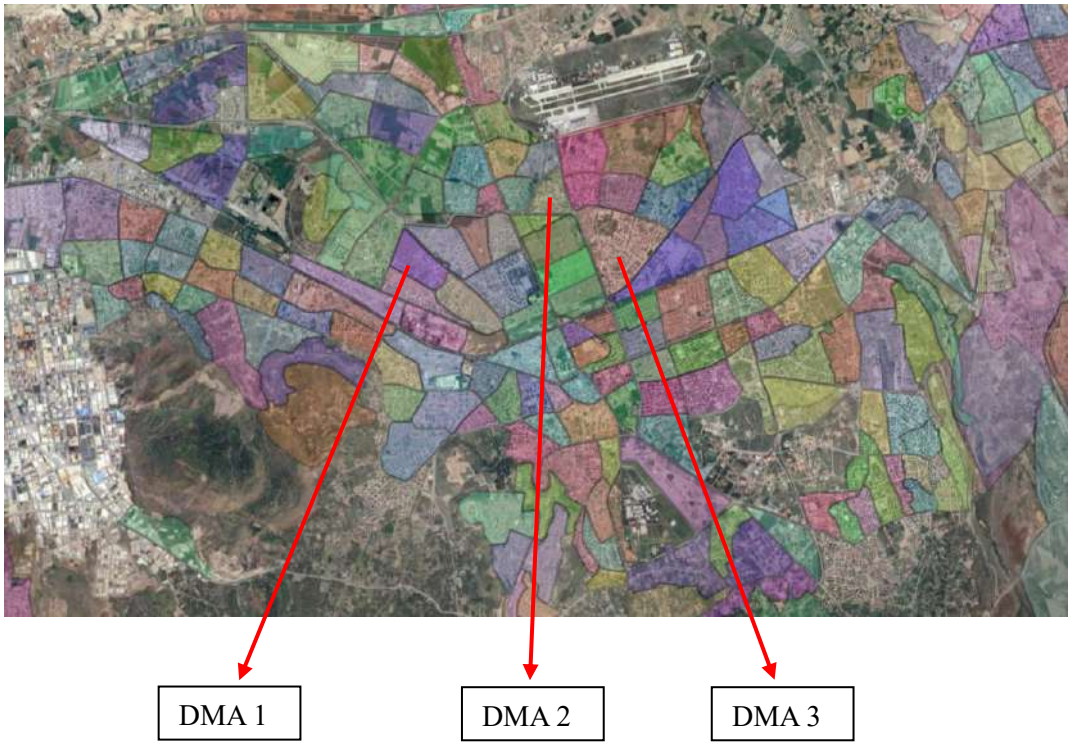


Figure 2. Study area and district-metered areas.

In selecting these regions, care was taken to ensure that variables such as region lengths, pipe type, number of subscribers, and current water loss were different. Thus, it was tried to determine in which regions the water loss reduction method was more successful.

Table 1. Characteristics of the regions

	UNIT	DMA1	DMA2	DMA3
TOTAL NETWORK LENGTH	km	44.081	37,495	22,624
TOTAL NUMBER OF CUSTOMERS	Piece	7,477	2,749	5,441
OPERATION PRESSURE AT MNF TIME	atm	4.2	7.5	4.0
DEMAND FLOW	m³/month	133,013	33,111	82,382
AUTHORIZED CONSUMPTION	m³/month	72,320	12,213	59,673
WATER PRODUCTION COST	TL/m³	9.00	9.00	9.00
WATER TARIFF	TL/m³	25.63	30.66	25,71
ANNUAL NUMBER OF FAILURES	No.	292	60	75
PIPE TYPE	-	PVC	PVC	Ductil

The data used and calculated in the analyses are presented in Table 2. The analyses are basically based on the calculation of the probability of finding the fault in different pipe types and pressure levels.

Table 2. Analysis variables.

NO	DATA NAME	UNIT	VALUE
1	Network Failure Repair Cost	TL/piece	₺3.200,00
2	Correlator Cost	TL/piece	₺5.500,00
3	Correlator System and Transmitter Cost	TL/piece	₺120.000,00
4	Estimated Number of Network Failures	pieces/month	Calculating
5	Calculation of Interceptable Flow	m3/month	Calculating
6	Water Saved with Microphone	m3/month	Calculating
7	Number of Correlators Required	piece	Calculating
8	Performance Assessment	%	Calculating
9	Calculation of Interceptable Flow	m3/month	Calculating
10	False Detection Cost	TL	Calculating
11	Detected Fault Repair Cost	TL	Calculating
12	Benefit Flow Rate with Correlator	m3/month	Calculating
13	Correlator Total Cost	TL/year	Calculating
14	Water Saved with Corrrelator	TL/year	Calculating

3. Results and Discussion

The cost benefit analysis of leak detection is difficult. The water saved with these tools could be varied based on the characteristics of the regions, experience of leak detection team, and sensitivity of devices. The benefits to be obtained and the costs that will occur in case of implementation of this method in the regions are given in Table 3.

Table 3. Results of cost and benefit analysis.

	Water Saved (m^3/month)	Cost (TL/Year)	Benefit (TL/Year)	+ / - (TL/Year)
DMA1	22,918	1,392,200.00	2,475,100.00	1,082,900.00
DMA2	0	0	0	0
DMA3	8,849	772,160.00	955,740.00	183,500.00

It has been calculated that the application of this method for the DMA1 and DMA3 regions is economical and that significant amounts of water will be added to the system. It is understood that the amount of water that is likely to be added to the system will significantly reduce the losses by considering the current water losses of these regions (Table 1). Significant economic gains can also be made in these regions. Especially in the larger DMA1 region, an annual profit of approximately 1 million TL will be achieved. The application of this method provides both water-saving and economic benefits for these two regions. However, it is seen that the useful flow rate in DMA 2 is calculated as zero. This result means that the cost that will occur if the regional correlator method is applied in the region is more than the marginal benefit cost of the water gained. In cases where there is no serious water resource problem in the region (if there is a need to turn to alternative water resources in cases where water losses are not reduced), it has become necessary not to apply this method. One of the reasons for this result can be shown as the fact that the number of subscribers and, therefore, consumption values are lower despite the region being very large. This situation increases the cost of leak detection/initial investment while decreasing the cost of benefit. In addition, the fact that the predominant pipe type in the region is PVC also decreases the quality of the search and reduces the benefit to be obtained.

4. Conclusion

It is revealed that a detailed field study is needed to analyze the cost-benefit of the method. When the studies are examined, the following results are obtained in general;

- The probability of detecting faults being correct is approximately 92% for steel pipes and 76% for plastic pipes.
- The operation pressure should be at least 20 meters.
- The probability of detecting faults occurring in subscriber lines with sensors placed on the system is calculated as approximately 22%. This probability is accepted as zero in the analysis.
- As the sensor range increases, the probability of correctly determining the fault location decreases, so a sensor should be used on average every 200 m.
- It is possible to detect leaks with a sensitivity of approximately 2 liters/second with sensors.

The results obtained and the analyses performed have shown that this method cannot provide useful results in every region. In determining water loss reduction strategies, decision-makers must definitely conduct cost/benefit analyses and make decisions accordingly. It is thought that this study will help water channel administrations in making decisions.

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Investigation of Some Physical Properties of MOS Type ZnO Based Nanorods Diodes

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Abstract

In this work, ZnO nanorods that were produced hydrothermally were used to create $Al/ZnO_{NRs}/ZnO/p-Si/Al$ type MOS diodes. In accordance with their molar concentration (mM) and the length of time they were maintained in hydrothermal solution (hours), the fabricated devices were given the names MD_{10-2}, MD_{10-4}, MD_{20-2}, MD_{20-3}, and MD_{20-4}. In order to improve the electrical properties of the gadget, they were produced at varying concentrations and timings. At room temperature, capacitance-voltage (C-V) and conductance-voltage (G/ω-V) measurements were performed at a frequency of 10 kHz to examine the fundamental electrical characteristics of the devices. In order to compute values such as the breakdown voltage (Vo), zero-supply potential barrier height (Φ_{Bo}), and depletion layer width (W_D), the C-2-V curves derived from these measurements were obtained. The aggregation, depletion, and reversal zones were evidently generated on the MOS-type diodes when examining the C-V curves for each structure. Through the use of the admittance approach, the voltage dependent Rs values of MOS type diodes were determined. The computed data showed that MD_{10-2} with low molar concentration and duration had the lower series resistance value. Therefore, the effect of interfacial states is said to be less in the MD_{10-2} device compared to other structures. The MOS type diodes were then examined by scanning electron microscopy (SEM) to analyze the diameter and arrangement of the nanorods. All the fabricated structures showed the formation of well-aligned ZnO nanorods according to SEM images.

Keywords: Hydrothermal Method, MOS Diode, SEM, Zno Nanorod.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Magnetic-Tectonic Investigation between Nevşehir-Kayseri-Niğde, Central Türkiye

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Abstract

The Central Anatolian Crystalline Complex provides broad new insights regarding their genesis of tectonic units of central Türkiye. Collision and post collision related magmatic processes during the closure of the northern branch of the Neotethyan Ocean, caused by northward subduction of the oceanic crust beneath the Sakarya continent in the Late Cretaceous-Eocene, led to the formation of tectonic-magnetic active structures in the upper crust. The Cappadocia extensional volcanic province was developed between Nevşehir-Kayseri-Niğde in central Türkiye. Geophysical traces of magnetized structures and buried faults in the upper crust between Nevşehir-Kayseri-Niğde in central Türkiye have been investigated using aeromagnetic data in this study. Magnetic data has been interpreted by applying advanced processing techniques (reduce to pole correction, high-pass filtering, and second vertical derivative methods). The effects of shallow structures have been emphasized by filtering and derivation methods. Considering the regional distributions obtained by geophysical analysis of magnetic anomalies and their relationship with the tectonic-geological evolution of the region, both magnetic disturbance masses and a significant part of the metallogenesis of the Central Anatolian Crystalline Complex have been revealed. The results show that the anomalies lie on known and buried faults on the active fault map of Türkiye within the Central Anatolian Crystalline Complex, and especially follow the sinistral Ecemiş strike-slip fault zone in the NE-SW direction towards Kayseri. Furthermore, looking closely at the maps, the region between Nevşehir and Niğde cities (namely Cappadocia Volcanic Province) displays stronger magnetic anomalies than the other parts of the area. It is considered that these anomalies correspond to volcanic products including ignimbrites, volcanic ashes, lavas, and volcanic sedimentary units originating from two volcanic activities that occurred in the Neogene and Quaternary.

Keywords: Tectonic, Magnetic, Geophysics.

1. Introduction

The Alpine Orogeny system is the primary factor in shaping the geology and tectonics of Türkiye, leading to the formation of the Central Anatolian Crystalline Complex (CACC) and its mineral riches and structural characteristics. The CACC is an assemblage of metamorphic, ophiolitic, and plutonic rocks lying roughly within a triangular area bounded by the cities Kayseri, Niğde, and to the west of Nevşehir. Collision and post-collision-related magmatic processes during closure of the northern branch of the Neotethyan Ocean, caused by northward subduction of the oceanic crust beneath the Sakarya Microcontinent in the Late Cretaceous-Eocene (Kuşçu and Erler, 1998; Kadıoglu et al., 2003).

The south-central part of the CACC includes the Cappadocian Volcanic Province (CVP) (Fig. 1), containing upper Miocene to Quaternary volcanic–volcaniclastic rocks and polygenetic volcanic centers (stratovolcanoes, cinder cones, volcanic ridges, and calderas) (Innocenti et al., 1975; Dilek et al., 1999).

In this study, the general characteristics, regional distribution, and relationships to tectonic features of magnetic deposits are discussed. For this purpose, the reduce-to-pole correction, high-pass filtering, and second vertical derivative methods have been applied to the magnetic data of the study area.

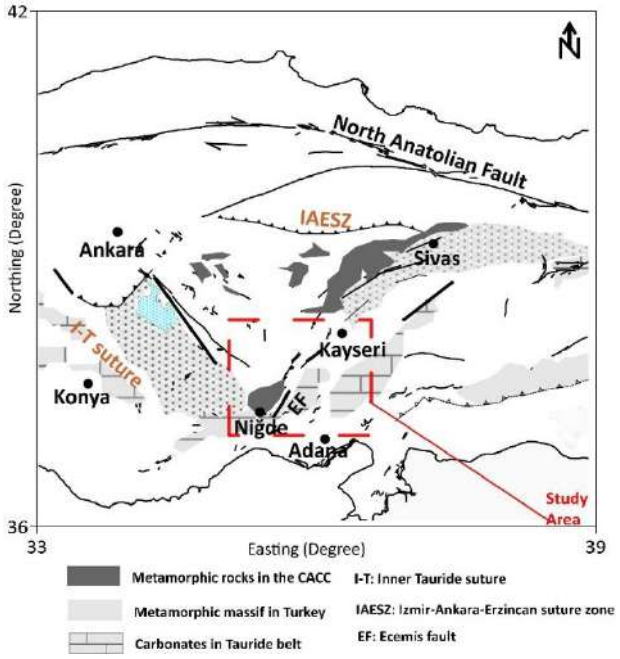


Figure 1. The simplified tectonic map of central Türkiye and the dashed red area shows the study region (modified from Gürsoy et al., 2003).

2. Materials and Methods

2.1. Aeromagnetic Data

Aeromagnetic data collected by the General Directorate of Mineral Research and Exploration (MTA) from a flight altitude of approximately 600 m have been used in the current study and the required corrections (IGRF-1982.5) have been applied to these data. The other technical knowledge is given in the previous research carried out by Ateş et al. (1999). Thus, they are not repeated in this section. The aeromagnetic anomaly map of the region is shown in Fig. 2. The anomalies vary from -1000 nT to +1000 nT along the region. Especially, the central region of the map has displayed high magnetic anomaly intensities. By a closer look at Fig. 2, it is observed that the high-intensity magnetic anomalies trending NE-SW direction correspond to the traces of the Ecemiş Fault (EF) Zone. As well-known, magnetic anomalies include undesirable effects such as the earth's magnetic field and body magnetization. To remove these effects, reduced-to-pole (RTP) correction has been applied to the aeromagnetic data. Hereby, the RTP aeromagnetic anomaly map is constituted (Fig. 3).

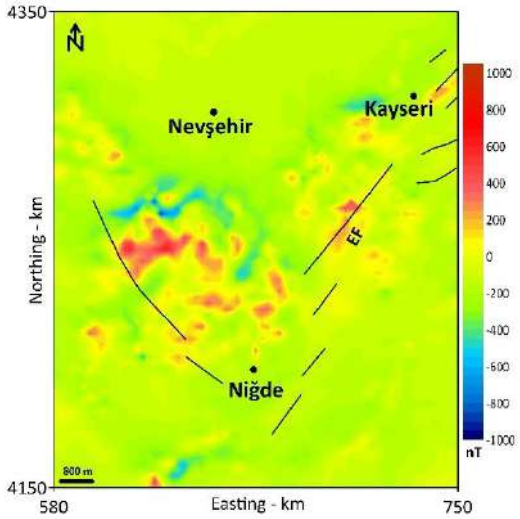


Figure 2. The aeromagnetic anomaly map of the study region. Black lines show the major faults in the region modified from Emre et al. (2013). EF: Ecemiş Fault Zone.

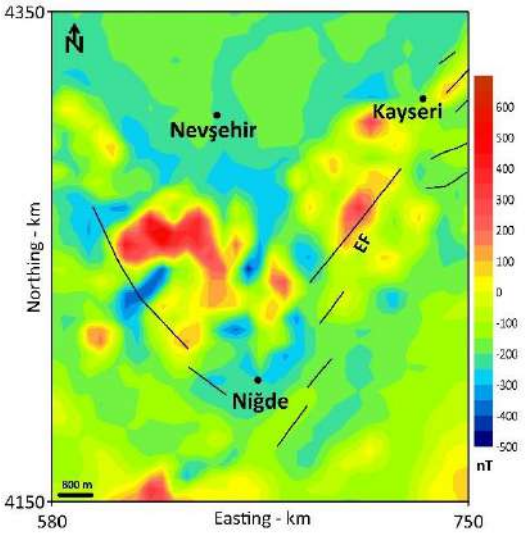


Figure 3. The RTP aeromagnetic anomaly map of the region. Other details are as in Fig. 2.

3.2. Method

Magnetic anomalies, as is known, consist of two components: regional and residual anomalies. Anomalies created by structures close to the surface at shallow depths are called residual anomalies, while anomalies created by structures located deeper are called regional anomalies. In this study, we aim to obtain the residual anomalies caused by the shallow sources in the region. Thus, a high-pass filter, which is one of the advanced potential field data techniques, has been applied to the RTP aeromagnetic data. Hereby, the effects caused by the deep magnetized bodies have been removed from the data (Fig. 4). As can be seen from the map, the residual anomalies in the region have been emphasized. These anomalies are generally located in the central part of the map. It is considered that these anomalies correspond to the Cappadocia Volcanic Province (CVP) including ignimbrites, volcanic ashes, lavas, and volcanic sedimentary units. Similarly, the extension of the EF zone has been made clearer on the map.

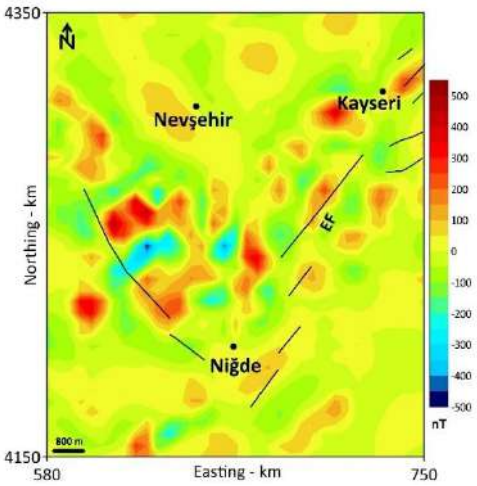


Figure 4. High pass filter anomaly map of the region. Other details are as in Fig. 2.

Derivative methods are widely used in geological interpretations of geophysical surveys. The second vertical derivative method (SVD) is generally preferred to reveal the course of the fault zone and the boundaries of the shallow geological structure. In other words, this method generally provides a better image for interpreting anomalies in geophysical surveys. The method suggested by Blakely (1995) using the Fourier transform is formulated as;

$$F = \left[\frac{\partial^n P}{\partial Z^n}\right] = |k|^n F|P| \quad (1)$$

where P is the potential field data, k is the wavenumbers, and n is the degree of vertical derivative. The anomaly map obtained as a result of the SVD method is shown in Fig. 5. The red colors on the map correspond to the maximum derivative values and they show the boundaries of the structures causing the anomaly. The anomaly located between Niğde and Kayseri City extends in an NE-SW direction. It could be said that this anomaly is related to the EF whereas the other anomalies located in the centre of the map could be associated with CVP products.

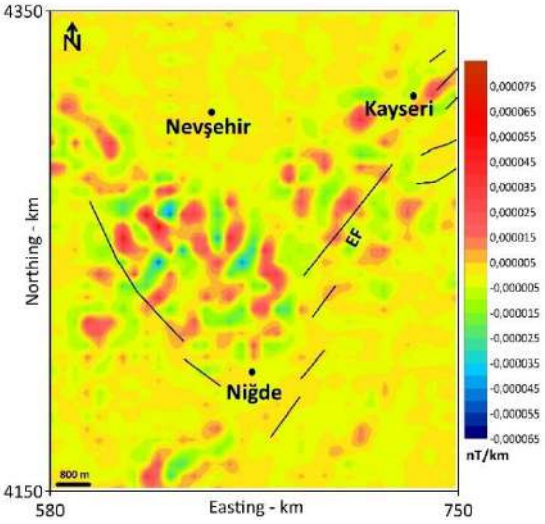


Figure 5. The SVD anomaly map of the region. Other details are as in Fig.2.

3. Results

This paper has presented the relationship between the tectonic structures and aeromagnetic anomalies in Central Türkiye and the analysis of these data. As shown in Fig. 1, Central Türkiye is bounded by crucial tectonic lineaments such as the inner Tauride suture zone covering the western part of the study region. Advanced potential field data techniques have been applied to these data to reveal the traces of this tectonic lineament and the bodies that caused the high anomaly. In this context, the residual anomalies have been emphasized using high-pass filter and second vertical derivative methods. The results show that the anomalies extend along the sinistral Ecemiş strike-slip fault zone in the NE-SW direction. The other anomalies are located between Nevşehir and Niğde cities known as Cappadocia Volcanic Province. It is considered that these stronger magnetic anomalies correspond to volcanic products including ignimbrites, volcanic ashes, lavas, and volcanic sedimentary units originating from two volcanic activities that occurred in the Neogene and Quaternary. In conclusion, image maps with high resolution have been constituted from this study to reveal the relation between tectonic structure and magnetic data. It is possible to say that the regions determined by this study deserve further investigation in the future.

Acknowledgment

The authors would like to thank Suleyman Demirel University (Project No: FBY-2018-5580).

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024
PITESTI-ROMANIA

ORAL PRESENTATION

Impact of Oenological Tannin Addition during Fermentation-Maceration Process on the Phenolic Complex at the Production of Dry Red from Copceac and Feteasca Neagră Grape Varieties

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Abstract

This study examines the impact of adding oenological tannins during the fermentation-maceration process on the phenolic complex in the production of dry red wines from indigenous grape varieties. The experiment was conducted with two local grape varieties, Copceac and Feteasca Neagră, during the 2023 winemaking campaign. Phenolic compounds play a critical role in the quality and stability of red wines, affecting their color, astringency, and antioxidant properties. The primary focus of this research was to determine the protective effect of tannin addition on the total proanthocyanidin content, a significant group of phenolic compounds known for their health benefits and contribution to the sensory attributes of wine. The wines were produced in microvinification conditions at the Scientifical-Practical Institute of Horticulture and Food Technologies (IȘPHTA) Republic of Moldova, ensuring similar conditions and volumes for all samples. The only variable was the addition of 1 gram and 2 grams of oenological tannins. Phenolic substances, including total phenolics, anthocyanins, and proanthocyanidins, were identified using spectrophotometric methods. The findings revealed that the addition of oenological tannins had a protective effect on the total proanthocyanidin content in wines from both grape varieties. This effect was more pronounced in the Copceac variety, which retained a higher level of proanthocyanidins compared to Feteasca Neagră. The protective mechanism is likely due to the tannins' ability to stabilize phenolic compounds during fermentation-maceration, thereby reducing oxidation and polymerization. In conclusion, adding oenological tannins during the fermentation-maceration process significantly enhances the phenolic profile of dry red wines from indigenous grape varieties. This practice not only preserves the quality and sensory characteristics of the wine but also contributes to the health benefits associated with higher proanthocyanidin content.

Keywords: Oenological Tannins, Proanthocyanidins, Phenolic Compounds, Dry Red Wine, Indigenous Grape Varieties.

Acknowledgment

This research was supported by the Institutional Program 200101 “Creation of fruit, grapevine, and vegetable varieties and clones, improvement of agrotechnical cultivation processes, and development of technologies for producing wines from local grape varieties and next-generation food products”.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
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PITESTI-ROMANIA

ORAL PRESENTATION

The Influence of Indigenous Yeast Strains for the Production of Dry Red Wines on the Concentration of Phenolic Substances and Color Indices

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Abstract

This study investigates the impact of selected yeast strains from two different winemaking centers, Purcari and Trifeshti, on the phenolic content and color indices of dry red wines, focusing on Cabernet Sauvignon. Yeast strains play a crucial role in winemaking as they directly affect the physicochemical properties of the wine, including phenolic compounds and anthocyanins, which contribute to wine quality and organoleptic characteristics. The enzymatic activity of yeast during fermentation catalyzes the condensation of these compounds, enhancing wine color stability during maturation and storage. The choice of yeast strain significantly influences the quality parameters of dry red wines. Phenolic compounds and anthocyanins, extracted during fermentation, play a vital role in determining the wine's color and stability. This study aims to explore the effects of various selected yeast strains from the Purcari and Trifeshti winemaking centers on these compounds in Cabernet Sauvignon wines. Different yeast strains from Purcari and Trifeshti were employed in the fermentation of must from Cabernet Sauvignon grapes. The phenolic content was determined using the colorimetric method with Folin-Ciocalteu reagent, while color intensity and hue were measured using spectrophotometric methods according to OIV standards. The results revealed that yeast strain Nr.30 - R-N-120-P-5 from Purcari significantly enhanced phenolic extraction, with a maximal phenolic content of 1542 mg/dm³ and anthocyanin concentration of 298 mg/dm³. This strain also yielded high color intensity. The control strain, Oenoferm Be-Red, showed high phenolic content but the lowest anthocyanin concentration due to significant adsorption during fermentation-maceration. Other strains from Purcari like Nr.21 - C-S-120-P-2 and Nr.24 - R-NNP-2 demonstrated lower phenolic and anthocyanin levels compared to Nr.30 - R-N-120-P-5. Similarly, in the Trifeshti center, strain Nr.41 - C-S60Tr-2 showed the highest phenolic content (1520 mg/dm³) and anthocyanin concentration (302 mg/dm³), followed by the control strain Oenoferm Be-Red. The Trifeshti strains Nr.27 - MTr-4 and Nr.35 - M100Tr-4 displayed lower phenolic and anthocyanin levels. The study concludes that the selection of yeast strains has a major impact on the phenolic content and color indices of dry red wines from both Purcari and Trifeshti winemaking centers. The yeast strain Nr.30 - R-N-120-P-5 from Purcari and Nr.41 - C-S60Tr-2 from Trifeshti were identified as the most effective in enhancing phenolic extraction and color intensity. Understanding the role of yeast strains can aid in optimizing wine quality through targeted selection during fermentation in different winemaking centers.

Keywords: Yeast Strains, Phenolic Compounds, Anthocyanins, Wine Color, Cabernet Sauvignon, Purcari, Trifeshti.

Acknowledgment

This study is a part of the Thesis PostDoc in Engineering Sciences "Scientific Bases for the Isolation and Selection of Indigenous Yeast Strains for the Production of White and Red Wines under the Conditions of the Republic of Moldova".

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Hybrid Magnetic Quantum Dot-Carbon Nanotube Nanostructures

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Abstract

The modification of magnetic quantum dots (MQDs) on the surface of multi-walled carbon nanotubes (MWCNTs) is a research topic of great interest in the fields of nanotechnology and materials science. This modification combines the superior properties of MWCNTs, such as high mechanical strength and electrical conductivity, with the unique magnetic and optoelectronic properties of MQDs. Thus, the resulting hybrid nanostructures can be used in advanced technology applications, especially in magnetic storage devices, biomedical imaging, targeted drug delivery systems and environmental sensors. In the biomedical field, these hybrid structures can be used as contrast agents in magnetic resonance imaging (MRI) or as targeted drug carriers in cancer therapy. In environmental applications, they can play an active role in the detection and treatment of toxic substances. Such innovative materials have the potential to lead to revolutionary developments in various disciplines as nanorobots. In our earlier research (ChemistrySelect, 7(25), e202104323,2022), we devised a reliable synthesis method for quantum dot nanoparticles with magnetic characteristics, ideal for bimodal imaging. These nanocrystals consist of a fluorescent semiconducting quantum dot core, surrounded by a paramagnetic iron oxide shell that serves as an MRI contrast agent. We used iron pentacarbonyl and oleylamine for coating CdSe/ZnS surfaces with iron oxide to impart magnetic properties and determined the optimum conditions. We found that the dimensions of the nanocomposites produced under these conditions were between 11-14 nm and quantum yields were 78%. Based on these nanostructures, we thought that the modification of carbon nanotubes with large surface area and usable inner surface in quantum dots with these magnetic properties would be advantageous. We modified the surface of MWCNTs using CdSe/ZnS@Fe_2O_3 nanoparticles. Firstly, the COOH group of MWCNTs was activated in HNO_3. The obtained MWCNTs-COOH was reacted with ethanol and 3 aminopropyltriethoxysilane (APTES). As a result, amine group active MWCNTs are obtained. The carboxyl groups of CdSe/ZnS@Fe_2O_3 nanoparticles are activated with a mixture of EDC (0.4 M) and NHS (0.1 M) in pyridine. Amine functionalized MWNT (dispersed in dimethylformamide, DMF) was added to the surface activated CdSe/ZnS@Fe_2O_3 nanoparticles and surface modification was achieved. At each stage, FTIR analyses were performed to determine the surface functional groups and modifications. Experiments were performed at different concentrations (0.6, 1, 1.3, 2, 4%w) of MWCNT-NH_2:(CdSe/ZnS@Fe_2O_3) ratio. Quantum efficiency and zeta potential values of these hybrid nanomaterials produced in the experimental results were measured. According to the results of the analyses, it was determined that the MWCNT-NH_2:(CdSe/ZnS@Fe_2O_3) ratio reached the maximum quantum efficiency of 70.2% until the value of 1.3 %w and the quantum efficiency decreased when the MWCNT-NH_2:(CdSe/ZnS@Fe_2O_3)

ratio of 1.3 %w exceeded this value. At these optimum conditions, the zeta potential value was found to be -18.2 mW. The nanomaterials we have produced combine the high mechanical strength and electrical conductivity of MWCNTs with the magnetic and optoelectronic properties of CdSe/ZnS@Fe_2O_3, allowing the modification of internal and external surfaces.

Keywords: Magnetic Quantum Dots, Multi-walled Carbon Nanotubes, CdSe/ZnS@Fe_2O_3, Nanorobots.

Acknowledgment

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Artificial Neural Networks Modelling for Nitrate Prediction of Surface Water of Gökırmak River (Türkiye)

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Abstract

This study aimed to estimate the nitrate content in the surface water of Gökırmak River using artificial neural networks. Samplings were carried out during 12 months from six stations between 2020 and 2021. Spectrophotometric determination was used to determine the nitrate content in the surface water. Nitrate content varied between 0.20 and 2.70 mg/l while mean value was 1.18 mg/l. This study developed an artificial neural network model to estimate the nitrate content. The developed model consists of two input layer (month and station) and one output layer (nitrate content). Feed-forward backprop was used as network type. Levenberg-Marquardt (TRAINLM) was used as training function, LEARNGDM was used as adaption learning function and mean squared error (MSE) was used as performance function. The number of neurons was 10 and TANSIG was selected as transfer function. Epoch number adjusted 1000 iterations. ANN model predicted the nitrate content between 0.24 and 2.61 with a mean value of 1.16 mg/l. The results showed that the best validation performance is 0.61264 at epoch 30. R values are 0.96257 and 0.84231 for training and testing, respectively. R value was found 0.85352 for all data. In conclusion, the developed ANN model provides reasonable results for predicting the nitrate content using only given time and location inputs. More inputs can be included in future studies to ensure higher accuracy in the development of ANN models.

Keywords: ANN, Estimate, Heavy Metal, Nitrate.

Acknowledgment

This study was financially supported by The Scientific Research Coordination Unit of Kastamonu University with project number: KÜBAP01/2020-09.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
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ORAL PRESENTATION

Determination of Changes in the Water Surface Area of Ayvacık Dam (Çanakkale, Türkiye) Using Remote Sensing and Geographic Information System

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Abstract

The aim of this study was to determine the changes in the water surface area of the Ayvacık Dam in Çanakkale, Türkiye. Landsat satellite images were processed and analyzed using remote sensing and geographic information system. The dataset covers the period between 2008 and 2019. The water surface area was digitized by manually. The minimum and maximum water surface area ranged between 1.27 km^2 and 3.11 km^2, respectively. The results showed that the water surface area increased during the study period. This is the first study to attempt the determination of changes in the water surface area of Ayvacık Dam in Çanakkale, Türkiye. Therefore, it should be monitored in future periods.

Keywords: Water Body, Surface Area, Remote Sensing, GIS, Satellite Image.

Acknowledgment

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
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ORAL PRESENTATION

The Promising News for the Endangered Species *Pinna nobilis* Linnaeus, 1758 in the Çanakkale Strait and the Marmara Sea (Türkiye)

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Abstract

The native population of *Pinna nobilis* Linnaeus, 1758 in the Mediterranean Sea has been damaged by illegal, unreported, and unregulated fishing, overfishing, environmental pollution, habitat loss, use of the inner shell for decoration, tourism, etc. *P. nobilis* was subsequently placed under protection in 1992 as a result of decisions taken by the Council of Europe. Since 2016, *P. nobilis* populations in various parts of in the Mediterranean have experienced 100% mortality due to highly pathogenic parasites, mainly *Haplosporidium pinnae*. As a result, IUCN has upgraded the status of the *P. nobilis* species to "critical level". In Turkish seas, mass mortalities have been reported in different locations in the Aegean Sea, Çanakkale Strait and Marmara Sea since 2020. On the other hand, healthy populations have also been reported in the Marmara Sea and Çanakkale Strait. The promising news is that young individuals were found at different stations in the study area in the summer of 2023. To aid in the restoration of damaged *P. nobilis* beds, it is imperative to identify resilient survivors of the disease and thriving populations unaffected by the mucilage event, all while conducting ongoing monitoring studies and establishing specialized protection areas. This is of great importance to ensure the sustainability of *P. nobilis* stocks. This study provides an overview of the current state of *P. nobilis* populations in the Marmara Sea, where both thriving populations and significant mass mortalities have been observed.

Keywords: *Pinna nobilis*, Mass Mortality, Survival, Juvenile, Healthy Population.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

A Study of the Lactation Potential of Jersey Cows in the Conditions of the Budzhak Steppe

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Abstract

The aim of this study was to identify the level of realization of the lactation potential of Jersey cows in the conditions of a climatically arid region, the Republic of Moldova. The object of the study was full-grown Jersey cows of the enterprise SRL "GÖMERT EVREM" with at least two completed lactations, in the amount of 12 heads. The conducted studies have established that the average milk yield coefficient for the dairy herd with a milk yield of 5226 kg and a live weight of 425 kg was 1229 kg. The distribution of annual milk yield in the context of three lactation periods was - respectively: 39.8%, 35.7% and 24.5%. The obtained data indicate that the peak of milk synthesis intensity occurs between the 1st and 2nd lactation periods, which indicates a good degree of milking of the cows. This circumstance had a very positive effect on the lactation constancy coefficients. It was noted that on average over two years their levels in terms of lactation periods corresponded to the following values: 89.59%; 62.47%; 55.97%, which indicates the manifestation of good lactation activity in cows. It is generally accepted that for well-balanced lactation, its level of completeness should be at least 80%. The level established in our studies was 77.42%, which indicates a relatively stable level of completeness of lactation of Jersey cows during two consecutive accounting periods. It should be noted that in our similar studies on the Holstein breed, it was revealed that the Jersey breed, under the same conditions, surpasses its Holstein peers in the milk yield coefficient by an average of 23%, but is inferior in the constancy coefficient by an average of 7.5%. The calculations carried out on the basis of the obtained results on the subject of the efficiency of breeding Jersey cows in general indicate the profitability of business activities and indicate the advisability of the enterprise's transition to expanded reproduction of the Jersey cattle herd.

Keywords: Jersey Breed, Milk Yield Coefficient, Lactation Constancy.

ORAL PRESENTATION

Physiological Characteristics of the Bianca Variety when Grown on Slopes

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Abstract

We have studied the effect of environmental factors on the growth and photosynthetic activity of the Bianca grape variety, using the chlorophyll fluorescence induction method to monitor the physiological state of the plants. We examined the Rfd indicator, also known as the "adaptation coefficient," which regulates the activity of the Calvin cycle's most sensitive enzyme to environmental factors, the RDF carboxylase. Additionally, we assessed how environmental parameters impact grape productivity and quality under various growing conditions. Long-term studies were conducted in the Central Viticulture and Winemaking Region of the Republic of Moldova, focusing on the environmental and agrobiological characteristics of the Bianca wine variety under specific growing conditions. Our research aimed to evaluate the growth parameters of shoots and leaves, photosynthetic activity, and their relationship with the productivity and quality of Bianca grapes grown on slopes. We selected slopes with an inclination of 3-8° and orientations NE, SW, and E, with the control plot located on the plateau. The Bianca variety (Villard blanc × Cha Sellas Bouvier), originating from Hungary, is an early ripening wine variety. The berries are medium-sized (90-120 g), of medium density, with a pleasant, neutral, harmonious taste and a varietal aroma. The core is juicy, with thin skin, and the juice yield constitutes 80% of the total crop weight. The sugar content can reach 20-28%, while titratable acidity gradually decreases from 9 g/l to 7 g/l under late harvest conditions. The vegetation period lasts 120 days. Depending on the degree of ripeness, Bianca grapes can produce dry, semi-sweet, strong, and dessert wines, as well as for distillates. Growth parameters were dynamically assessed, covering the flowering, berry growth, and ripening phases. Morphological changes in the growth parameters of the leaf surface were observed, depending on the vines' location on the slope or plateau. An increase in the average number of leaves per shoot, the area of the leaf blade, and both the leaf surface of the shoot and the total leaf area of the vine were noted. We also studied changes in the concentration of plastid pigments in relation to the vines' location on the slope. The results, confirmed by statistical analysis, emphasize the influence of slope and vine location on the leaf surface parameters and plastid pigment concentrations. Specifically, these changes in the growth and development of the leaf surface were most evident when the Bianca variety was planted in the lower parts of the slope. These changes included an increase in the number of leaves per shoot, an increase in the leaf blade area, and subsequently, the shoot. Additionally, the plastid pigment content in the leaves increased, depending on the slope's exposure and the nodes' location (top, middle, bottom). Our research suggests that the primary photosynthesis parameters in chloroplasts, as measured using the chlorophyll fluorescence induction method, can be used to monitor the physiological state of grape plants during growth on slopes and their adaptation to environmental conditions.

Keywords: Grapes, Environmental Conditions, Pigments, Photosynthetic Activity, Fluorescence.

Acknowledgment

This study is a part of the Thesis in Agricultural Sciences “Technological argumentation of ecological parameters for the placement of vineyards in the Central region of the Republic of Moldova”.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Effect of Peat-Based Feed Additive on Performance of Laying Hens

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Abstract

A strategy for improving the efficiency of the poultry industry is balanced nutrition for poultry, which plays a key role in achieving maximum productivity while maintaining health and reducing production costs through the use of feed additives or unconventional feed ingredients. Feed additives are mainly used to meet the needs of birds, improve their health, stimulate digestion, increase feeding efficiency, and enhance disease resistance. They positively affect the gastrointestinal tract, metabolism, immune system, suppress pathogens, and improve intestinal integrity. For this purpose, the research aimed to determine the impact of using a peat-based bioregulatory feed additive on the egg productivity of laying hens of the same-age industrial flock of the "Hy-Line Brown W-36" cross and to conduct a qualitative assessment of the eggs. A total of 480 laying hens (day-old), divided into five groups, were raised for 240 days. The feeding of hens in the groups consisted of five experimental diets: a basal diet and the basal diet mixed with a peat-based feed additive at levels of 0.5, 0.75, 1.0, and 1.25 kg/t. Experimental data showed a positive effect of using a peat-based feed additive in the composition of compound feeds for laying hens on their growth, overall productivity and product quality. The feed intake, calculated at a gram/hen/day rate, was high in Groups 1 and 2; however, the control group exhibited an even greater overall feed intake. A larger egg weight was noted for Groups 3 and 4. Based on these results, this study found that certain supplements did successfully improve egg shell integrity in older laying hens compared to a control. Thus, the use of peat-based feed additive for laying hens has a greater effect on egg-laying intensity (85.38%), average egg weight (63.24g), egg mass yield (664.1kg). The results obtained emphasize the necessity of including organic bioregulators in the diets of laying hens to achieve optimal productivity.

Keywords: Feed Additives, Laying Hens, Performance, Egg Production.

Acknowledgment

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Development of Introduced European Selection Grape Clones in the ATU Gagauzia, Republic of Moldova

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Abstract

In search of effective solutions, clones of classic European technical grape varieties are currently being introduced in the Autonomous Territorial Unit of Gagauzia (ATU Gagauzia), Republic of Moldova. Introduced grape clones, which have high biological indicators, yield, and product quality in their native regions, may not fully exhibit their characteristics in new conditions. To unlock their natural potential, it is necessary to ensure that the soil-climatic and technological care parameters for the grape plants match their biological potential. ATU Gagauzia is located in the southern part of the Republic of Moldova, in the Budjak steppe, part of the South Moldavian hilly plain. The soil cover is mainly represented by calcareous chernozems. The climate is moderately continental. In winter, the air temperature in ATU Gagauzia is unstable. January is the coldest month, with an average temperature of -2.5 to -5.5°C, and during Arctic invasions, the temperature can drop to -28°C. The summer is dry and hot, with peak temperatures in July, where the average temperature reaches 37-40°C, and at the soil surface, it reaches 62-66°C. The average annual precipitation is 350-420 mm, with characteristic summer showers that cause soil erosion. The lack of precipitation against the backdrop of high temperatures leads to droughts, which occur once every 3-4 years. The introduction of clones of European selection in the Autonomous is an important step in the development of the viticulture industry. However, to fully realize the potential of these clones, it is necessary to conduct a thorough study of their growth, development, and productivity characteristics in the agro-ecological conditions of ATU Gagauzia. Due to the specific agro-ecological conditions of the Autonomous Region, studying the adaptation of introduced European grape clones is a highly relevant issue. This study presents the results of growth, development, and productivity indicators of the introduced clones Cl R5 Cabernet Sauvignon and Cl 348 Merlot in the agro-ecological conditions of ATU Gagauzia. We have established that meteorological conditions, vineyard canopy architecture, training systems, and the genetic characteristics of the clones influence the development of annual growth, leaf surface development, and productivity of grape plants. It was found that the clone 348 Merlot is characterized by higher growth and development indicators of grape vines compared to the clone R5 Cabernet Sauvignon. The yield of introduced grape clones in the agro-ecological conditions of ATU Gagauzia is 150 centner per hectare for the R5 Cabernet Sauvignon clone and 190 centner per hectare for the 348 Merlot clone. The quality of the products meets technological requirements. A dependence of growth, development, and productivity parameters of the studied clones on meteorological conditions was revealed. The highest results were recorded in 2017, while the lowest were in 2020, during a drought. This indicates that dry conditions have a significantly negative impact on the growth processes and yield of introduced grape clones.

Keywords: ATU Gagauzia, Clones, Development.

Acknowledgment

This study is a part of the Thesis PostDoc in Agricultural Sciences “Development and Implementation of Modern Technologies for the Production of Grapes in the Agro-Ecological Conditions of the ATU Gagauzia” 19.00208.1908.16.

ORAL PRESENTATION

Physiological Adaptability of Grapevines to External Growing Conditions

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Abstract

The varied topography of the Republic of Moldova, with significant changes in elevation and the predominance of sloping lands of various forms, exposures, and inclinations, creates a diversity of climatic conditions in the region. Combined with the soil cover, which has considerable variation (over 900 types), this has led to the formation of numerous biocenoses. In agricultural production, agrobiocenoses are formed, and identifying the fundamental patterns of their functioning is one of the key scientific and practical tasks at present. Ignoring or neglecting these patterns can lead to a mismatch between the adaptive potential of cultivated plants and their environmental conditions, which, in turn, is one of the main reasons for variations in crop yield and quality. Technogenic impact on grapevines, on one hand, stimulates growth processes, but on the other hand, reduces their resilience to environmental stresses, especially under current conditions. A decrease in plants' resistance to one environmental factor usually leads to increased vulnerability to other stress factors, and the possibilities for optimizing the environment through technogenic means are currently quite limited. Therefore, accounting for specific plant responses to environmental conditions and developing optimal ecological parameters for their placement plays a crucial role in enhancing the resilience and productivity of vineyards. To achieve high-quality grape and wine production, it is essential to consider that the region's ecological resources are fixed and difficult to reproduce. Therefore, it is crucial to pay close attention to the region's ecological characteristics, to use its ecological potential wisely and carefully, while maintaining natural balance. Research has shown that the morphological adaptation of the root system and the development of annual growth allow for the identification of patterns in root distribution across soil layers. The highest concentration of roots, depending on soil type, density, and hardness, is found at depths of 40-60 cm, reaching up to 80 cm, and at distances of 20-50 cm from the vine. These parameters are crucial for developing grapevine variety-specific agronomy, including the selection of soil cultivation depth and placement, as well as fertilizer application. Identifying the patterns of physiological adaptation of grapevines to specific environmental conditions enables effective management of growth, development, and fruiting processes. This knowledge is particularly important for optimizing the application of mineral fertilizers, including their depth and placement, which enhances nutrient uptake and improves overall vineyard productivity. Considering the morphological adaptations of the root system in agronomic practice contributes to increasing vineyard resilience to extreme climatic conditions. In a changing climate with frequent stressors, such as droughts, proper management of the root system and soil allows vineyards to better adapt and maintain high productivity.

Keywords: Adaptability, Development, Growing Conditions.

Acknowledgment

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
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ORAL PRESENTATION

Nesting Behaviors and Competencies of Aquatic Macroinvertebrates

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Abstract

Aquatic environments include freshwater (rivers, lakes and wetlands) and marine systems (oceans, coral reefs and estuaries), where complex interactions of biotic and abiotic factors support diverse biological communities. These ecosystems play a critical role in the regulation of global biogeochemical cycles, the support of biodiversity and the provision of essential services such as water purification, climate regulation and resources for human livelihoods. Their diverse ecological roles and their direct and indirect effects on people make them important to the economy. In general terms, the role of insects in agriculture, medicine, processing industries and ecosystem services can be distinguished in terms of their economic importance. Aquatic organisms, which include fish, amphibians, molluscs and crustaceans, have diverse lifeforms adapted to different aquatic habitats. The reproduction of these organisms is highly variable, with some species using external fertilization and others using internal fertilization, and they often exhibit complex mating behaviour and life cycles. Nesting behaviour of aquatic microorganisms ranges from simple substrate spawning to complex nest construction, often providing protection and promoting offspring survival. Aquatic vertebrate nesting, such as fish and amphibians, often involves selecting or constructing specialized substrate or vegetation sites to protect eggs and young and enhance survival. Sediments, formed over time by the deposition and consolidation of mineral and organic particles, provide important insights into the geologic history of the Earth and past environmental conditions. Samples of aquatic invertebrate nests were collected during the study of insect habitats. Sedimentary rocks can preserve fossil aquatic invertebrate eggs, providing valuable insights into past dispersal mechanisms and historical distributions of these organisms in ancient aquatic environments. The study results discuss the ecological impact of floods and extreme floods on the distribution of aquatic invertebrates, such as insects, and provide new perspectives for developing fossil detection methods.

Keywords: Aquatic Macroinvertebrates, Insect Nests, Life Stages.

1. Introduction

From microscopic bacteria to blue whales, every aquatic species is unique (Barrena et al., 2014). Insects are important because of their diversity, ecological role and influence on natural aquatic resources (Scudder, 2017).

The adaptations of insects span a continuum of care, ranging from the passive guarding of eggs to an array of complex behaviors for grooming, feeding, protection and nesting. When reproducing, they are

vulnerable to predators and parasites. Predatory insects and parasites use a relatively dispersed, discrete and often mobile resource (Tallamy, Wood, 1986).

These are the physical structures that ants construct outside the nest. These structures, larger than an individual worker but smaller than the colonies, include burrows, burrows, porches, outposts, shelters above nectaries, food shelters along food routes, elevated walkways and bridges. Emphasis has been placed on the adaptive benefits that burrows can provide to the colony (Anderson and McShea, 2001), with burrows found in a wide range of species and constructed from a variety of materials.

For species that lay on particular substrates, environmental constraints on oviposition sites can limit the supply of eggs. Female mayflies of the genus Baetis lay egg masses on the underside of stream rocks that rise above the water surface (Lancaster et al., 2010).

Various insect remains were found in this formation, including sweatbee nests and Coleoptera pupae. The fossil nests of bees consist of inclined tunnels to which cells with a short neck are attached - a construction that is typical of bees (Genise et al., 2002). From an ecological point of view, the nests of macroinvertebrates, including insects, provide evidence of fossil feathers because of the effects of floods and unusual high water on their distribution.

2. Materials and Methods

Collection of sedimentary rocks and nesting materials from other aquatic macroinvertebrates: During the collection of aquatic insects, structures of this type were placed in plastic tubes. Locality data were included (Figure 1). The sedimentary rocks and other nesting structures were examined under a stereomicroscope. Sediment and sedimentary rocks were subjected to 1.3 hydrochloric acid tests to detect the presence of carbonates and calcium (Figure 2). Structures within the sedimentary rocks were examined under a microscope, and images were documented in a report to gain new insights into the nesting behavior of aquatic invertebrates, particularly insects.



Sampling point	Sample Coordinats	Altitude (metre) / Sampling time	Location/Vegetation (Erzurum /Türkiye)
1	40°08' 01" N 41° 31' 23" E	1853 / 25.05.2020	Karasu river / Yolgeçti village / Yakutiye
2	41°15' 05" N 42° 34' 52" E	1858 / 12.09.2020	Melikoglu creek / Aksar / Şenkaya / Herbaceous puddles
3	40°43' 00" N 41° 18' 36" E	1558 / 26.05.2020	Karasu river/ Küçükgeçit/ Aşkale / Herbaceous puddles
4	40°43' 01" N 41°18'36 " E	1555 / 25.05.2019	Karasu river / Küçükgeçit/ Aşkale/ sandy and grassy ponds
5	40°38' 38" N 41° 32' 49" E	1451 / 22.08.2017	Yellitepe creek / Anlı / Tortum / sandy and grassy ponds
6	39°33' 10" N 42° 19' 30" E	1722 / 15.07.2020	Başköy creek/ Ovaçevirme / Hınıs / Herbaceous puddles

Figure 1. Location information where samples were collected.



Figure 2. Detection of carbonate and calcium in sedimentary rock nests of macrovertebrates.

3. Results

It is known that insects are in constant interaction with the environment to lay eggs, to feed and for other vital reasons (Kansu, 2005). Therefore, this study looked at egg samples found in aquatic areas where aquatic invertebrates, particularly aquatic insects, lay their eggs or nest, and in river floodplains (Figure 3).



Figure 3. Detection of carbonate and calcium in sedimentary rock nests of macrovertebrates.

Insect eggs are typically laid in ideal hatching environments such as soil, plants, water or inside host organisms. As well as direct laying by the adult insect, these eggs can be spread by passive means such as wind, water or animal movement. In agricultural environments, insect eggs can spread rapidly through crops, leading to potential infestations if conditions are favorable for developing. (Danks, 2002; Potter et al., 2009; Fatouros et al., 2020). These eggs can sometimes be embedded in sedimentary rocks through natural processes such as being buried in soil or water and becoming covered by sediment over

time. These eggs can then be preserved as fossils, providing valuable insights into ancient ecosystems. These eggs can then be preserved as fossils and provide information about ancient ecosystems. Insect egg dispersal in such environments usually occurs as a result of insectivores laying their eggs in soil or near water sources, which later become part of sedimentary rock due to geologic processes (Hasiotis, 2004; Merritt and Wallace, 2009; Bétard, 2021). Flooding and abnormal water flows, particularly of aquatic insects, may spread to other water bodies.

The rounded structure of fluvial sedimentary rocks indicates prolonged exposure to water flows, during which time they were subjected to constant friction and abrasion as they were transported along the bed of the river. This action gradually smooths the edges of the rocks, resulting in their characteristic rounded appearance. The detection of carbonate and calcium in these rocks by means of tests using 1,3-hydrochloric acid (HCl) indicates the presence of minerals that are commonly found in sedimentary environments, especially those that have been influenced by biological and chemical deposition. The reaction of these compounds with HCl further confirms their composition, as carbonates typically effervesce on contact with the acid, releasing carbon dioxide. Figure 3 illustrates this geologic history and visually confirms the chemical and physical properties observed in the sediment samples.

4. Discussion

Aquatic habitats include all water-based ecosystems, including freshwater environments like rivers, lakes and wetlands, and marine systems like oceans, coral reefs and estuaries. They support a wide range of biotic communities through a complex interplay of biotic and abiotic factors. Aquatic systems play important roles in global biogeochemical cycles, support biodiversity and provide ecosystem services. These services include the purification of water, the regulation of climate and the provision of resources that are vital to human life. Due to their multiple interactions and their direct and indirect impacts on human activities, the role of insects within these ecosystems is particularly important, making them an important economic factor. The economic value of insects is generally divided into their contribution to agriculture, medicine, manufacturing and ecosystem services.

Aquatic organisms, which include fish, amphibians, molluscs and crustaceans, represent a great diversity of lifeforms that have adapted to a variety of aquatic habitats. The reproductive strategies of these organisms are very diverse. Some species make use of external fertilization, while others use internal fertilization, which is often associated with sophisticated mating behaviour and complex life cycles. The nesting behaviour of aquatic macro-organisms is also very diverse. It ranges from simple spawning in the substrate to complex nest building. This nesting behavior often serves to protect and increase the survival rate of the offspring.

In aquatic vertebrates, such as fish and amphibians, nesting usually involves the selection or construction of specific sites in substrates or vegetation. These sites are chosen to protect eggs and young and thus increase their chances of survival. Sedimentary rock, formed by the accumulation and compaction of mineral and organic particles over geologic time, provides important insights into the Earth's geologic history and past environmental conditions. In an investigation of insect habitats, the researchers collected nest samples from invertebrates living in the water. They then analyzed sedimentary rock with hydrochloric acid solutions to detect the presence of carbonates and calcium. The observations indicated that these sedimentary rocks had been transported by the water along the river beds and deposited at the edges of the rivers during floods.

In addition, sedimentary rocks can preserve the fossilized remains of aquatic invertebrate eggs, providing valuable insights into the dispersal mechanisms and historical distribution of these organisms in ancient aquatic environments. The results of the study highlight the ecological impact of floods and abnormal flooding events on the distribution of aquatic invertebrates, particularly insects. These findings provide new perspectives for the development of methods for detecting fossil species and understanding the historical biogeography of aquatic invertebrates.

5. Conclusion

In conclusion, insects are indispensable to various economic sectors due to their multifunctional roles. Their contributions to agriculture, medicine, industry, and ecosystem services underscore the need for their conservation and the sustainable management of insect populations. The economic implications of insects extend far beyond their immediate uses, affecting food security, public health, and environmental sustainability on a global scale.

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Exotic Fish Species of Kastamonu Province

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Abstract

Kastamonu province is located in the Black Sea Region, and more than 20 rivers are born within the provincial borders and flow directly into the Black Sea. Some, including Gökırmak and Devrez streams, the main tributaries of Kızılırmak, and Araç Stream, one of the main tributaries of the Filyos Stream, are tributaries of the rivers that originate outside the province and flow into the Black Sea. This study aims to reveal the effects of exotic fish species on inland water resources within the borders of Kastamonu Province. In this context, the collection of Mahmut Elp was examined, and the findings were supported by field observations. As a result of the collection studies and field observations, it was determined that *Alburnus chalcoides, Cyrinus carpio, Carassius gibelio, Siluris glanis, Perca fluviatilis* and *Oncorhynchus mykiss* species, which are distributed in Kastamonu province, entered the inland water resources of the province. Of these species, *Perca fluviatilis* is an invasive species with populations in many ponds. It has been observed that *Cyrinus carpio* has populations in environments where it is introduced and attracts the attention of anglers engaged in sportive fishing. It was also found that *Alburnus chalcoides*, which were accidentally introduced into Germeçtepe Dam Lake, formed hybrids with *Squalius cephalus*, which is widespread in the region. *Carassius gibelio and Siluris glanis species were found in only one pond each*. It is not known how *Perca fluviatilis* species entered the water resources of Kastamonu province. However, it has established populations in many ponds and is becoming more widespread and dominant. *Oncorhynchus mykiss* species is composed mainly of individuals escaping from trout breeding farms and has not been able to establish populations in water resources. Occasionally, sport anglers from outside the province who hunt *Oncorhynchus mykiss* species can be encountered in the water resources. It is the species that most attracts the attention of sport fishermen.

Keywords: Freshwater Ichthyofauna, Kastamonu, Non-Native Species, Aquatic Biodiversity.

1. Introduction

Throughout history, humans have built their settlements as close to safe water sources as possible. Water has been a protective shield, a symbol of fertility, and a food source. Together with water, human history has flowed under the name of time. In this process, humanity has tried to live peacefully with nature and extract its food from water.

Kastamonu is rich in river resources. Kastamonu has very rugged and high topography conditions and is surrounded by high mountain ranges from the north and south. The province is 74.6% covered with mountains, 21.6% with plateaus and only 3.8% with plains (İbret, 2004). This fractured structure did not allow the formation of stagnant water resources due to the high slope. Therefore, there are no natural lakes in Kastamonu province due to the geographical structure. However, humanity has created various ecological environments by building ponds for flood prevention or irrigation purposes and inoculating fish for sport fishing or commercial purposes in these environments. Sometimes, it has also caused the accidental introduction of non-target species into the environment.

Fish and similar alien species released into inland waters consciously or unconsciously for economic purposes cause irreversible changes in natural inland water biodiversity (Anonymous, 2008). Invasive species negatively affect other living things in the habitats they enter, increase their numbers and put pressure on natural populations in the environment. They generally have high adaptation ability (Parmaksız et al., 2022). Detection of these species and controlling their populations are essential for ecological sustainability. It has been reported that Alburnus chalcoides, Cyrinus carpio, Carassius gibelio, Silirus glanis, Perca fluviatilis and Oncorhynchus mykiss species were accidentally inoculated in various sources in Kastamonu province (Elp et al., 2018).

2. Materials and Methods

Within the research scope, the Mahmut ELP collection was examined. The samples were brought to the laboratory in 10% formol when they were first taken. After the specimens were kept in 10% formol, they were passed through an alcohol series and fixed in 70% ethyl alcohol. The collection materials preserved in this way were examined, photographed and metric and meristic measurements and counts were performed. Measurements were made using a point-to-point digital caliper. The data obtained were first processed in a form and then transferred to digital media, and statistical values were calculated. Geldiay and Balık (2002) were used to identify the specimens at family and genus level. Geldiay and Balık (2002), Kottelat and Freyhof (2007), Özuluğ (2018), Çiçek et al. (2020), Turan et al. (2017), Beyçelebi (2019) were used for taxonomic descriptions at the species level. In addition to the laboratory studies, a literature review and field observations were also made. Since there is no commercial fishing in Kastamonu inland water resources, commercial catch data could not be utilized; sport fishermen were interviewed.

3. Results and Discussion

Examination of the samples obtained from Kastamonu inland waters, literature research, and interviews with sport fishermen fishing in the water resources revealed that six species entered these resources later.

3.1. *Alburnus chalcoides*

Alburnus chalcoides was later introduced to Germeçtepe Dam Lake (Elp et al., 2018) (Figure 1). It is not known how the species entered the environment. In the interviews with amateur hunters in the region, they stated that the species was not present in the environment before and that they occasionally hunted in Germeçtepe Dam Lake and the river on which the dam is located after the production activities started in trout farms. It was also observed that they formed hybrid individuals with the naturally distributed Squalius cephalus species (Figure 2). This situation is considered a negative development in

terms of the change in the genetic characteristics of Squalius cephalus species that are naturally distributed in the environment due to human activities.

Its natural distribution area is the Caspian Sea, Lake Aral, and the river systems that flow into the Black Sea. In Turkey, apart from its natural distribution areas, it has been inoculated into many springs in different regions, sometimes for the enrichment of fish stocks and sometimes involuntarily (Başdemir, Balık and İlhan 2010; Çiçek et al., 2015; Yılmaz & Suiçez, 2010). It generally migrates to the upper regions of small river systems and breeds there. In closed reservoir areas, it is stated that they breed in the springs that feed the reservoir (Çiçek et al., 2015). Although it has been reported that the species is endangered in the Caspian Sea and Europe due to reasons such as overfishing, habitat loss, pollution and eutrophication, embankments/ dams built on rivers (Başdemir, Balık, & İlhan 2010; Çiçek et al., 2015), it is seen that their distribution area in Turkey is gradually increasing.

Although it is not an economically preferred species, it is fished and consumed with extension nets and fishing rods (Çiçek et al., 2015; Yılmaz & Suiçez, 2010). Although it does not grow much in size, its meat productivity is higher than mirror and scaled carp and freshwater mullet (Başdemir, Balık & İlhan, 2010).



Figure 1. *Alburnus chalcoides* - Daday Stream.



Figure 2. *Alburnus chalcoides* X *Squalius cf. cephalus* hybrid (taken from Elp et al. 2018).

The impact of a species new to any water source, for whatever reason, on aquatic life both in that source and in other sources that it may migrate to should be considered, and necessary measures should be taken. An effective population management policy should be implemented for species new to the

resource, considering factors important for a sustainable ecosystem, such as genetic diversity, diseases, competition for food, and breeding areas. The study of Elp et al. (2018) is one of the best examples of this. In the study conducted at Germeçtepe dam, the presence of hybrids of *Squalius cephalus* and *Alburnus*.

3.2. *Cyrinus carpio*

It is a naturally distributed species in Asia and Europe. It has been transported to different parts of the world and to different sources in the region, where it is naturally found through vaccination within the scope of fishery activities. In Turkey, it has been inoculated into many inland waters other than the areas where it is naturally distributed (Şen & Elp, 2009). It is one of the fish species that cause biological invasion (Çetinkaya, 2006).

Carp were inoculated into many ponds in Kastamonu province (Figure 3). The inoculated individuals have formed a population over time and have become attractive to sport fishermen. In some ponds in the province, it was observed that anglers caught individuals of 10 kg and over. It was observed that some people came from outside the province and camped at the edge of the ponds for 3-4 days, aiming at sporty carp fishing.



Figure 3. Carp - Germeçtepe Dam Lake, Türkiye.

After the establishment of Germeçtepe Dam Lake, carp were inoculated into the environment, and the inoculation activities continued for the following years (Saylar, 2001). During the field studies, the presence of *cyprinus carpio* fry smaller than the grafted size was detected. It is understood that carp are forming a population in the environment. Therefore, it is not necessary to inoculate carp into the environment in the following years (Elp et al., 2018). In this study, the presence of carp was observed in Germeçteğe Dam Lake as well as in other ponds in Kastamonu province (Yumurtacı, Karaçomak, Karadere, Beyler, Kınık). Studies on this species exist in the Karaçomak Dam (Saylar, 1995), Germeçtepe Dam, and Beyler Dam (Pekol, 2006).

3.3. *Carassius gibelio*

Carassius gibelio, also known as silvery pond fish and Israeli carp, is a member of the Cyprinidae family (Dağtekin & Baştürk, 2014; Yazıcıoğlu et al. 2013). It is estimated to have come to Europe from East Asia. The species, which is distributed in all regions of Europe except the Northern Baltic basin, Iceland, Ireland, Scotland, and Mediterranean islands, was first reported from Lake Gala in Thrace in Turkey and is currently distributed in many regions of our country (Uysal et al., 2015: Yazıcıoğlu et al. 2013). It is

thought to have entered many springs in Turkey and to have direct or indirect harmful effects on fish species there (Dağtekin & Baştürk, 2014). The population and geographical distribution of the species in Turkey's inland waters are increasing rapidly, and it is unknown who brought it to the country or how it entered our waters (Bostancı et al., 2016).

Its tolerance to pollution and low oxygen concentration is relatively high. In general, the fact that it competes with natural species for food and habitat has a high reproductive ability, and ecological tolerance causes it to multiply rapidly in the inoculated area and become dominant (Uysal et al., 2015; Parmaksız et al., 2022). It is omnivorous, and its diet consists of plankton, benthic invertebrates, plant materials and detritus (Yazıcıoğlu et al., 2013).

A biological characteristic of *Carassius gibelio* that is important for its invasiveness is its reproduction. Populations of the species may exhibit gynogenetic reproduction by utilizing the sperm of other species to activate their eggs. In such cases, the population is composed entirely of females. The species typically shows bisexual reproduction. There may be some genetic variation in growth rates and colouration among populations (Saylar et al., 2019).

The species, which is not preferred for consumption due to its taste, odour, and awned structure, has a low economic value. In the fight against this species, it is recommended to increase its consumption as food by processing and thus reduce the number of individuals (Dağtekin & Baştürk, 2014; Parmaksız et al., 2022).

Carassius gibelio has been introduced into many springs during carp vaccination or stocking and has formed dense stocks since it is not fished in the springs. To avoid unwanted inoculations and stocking, the live material used for inoculations should be clean and of a single species. The effects of exotic fish species inoculations are also complicated by ecological changes (Çetinkaya, 2006).

The presence of pond fish was detected in Belovacik Pond (Figure 4). It is not known how it entered the environment. It is thought to have entered the environment accidentally while carp were inoculated.



Figure 4. Carassius - Belovacık Pond, Türkiye.

3.4. *Siluris glanis*

Asar (Abdalhasan) Pond is an irrigation pond that was put into service in 2009. There are catfish in the pond (Figure 5). It is not known how the catfish entered the environment.



Figure 5. *Silirus glanis* - Taşköprü.

Silurus glanis L. has a flat, wide head and a large mouth, two long whiskers hanging from the side of the lips and four shorter whiskers hanging from the chin, a small dorsal fin, and an anal fin extending to the tail (Uysal et al., 2009). It is one of the largest freshwater fish. The species, which has a high economic value, is also cultivated in culture (Saylar, 2009; Uysal et al., 2009). Silurus glanis is found all over Europe, from the Aral Sea to the Netherlands, especially in the rivers flowing into the Black Sea. It is found in the Sakarya, Manyas, Apolyont, Iznik, Gülhisar, Samsun, Kura, and Aras rivers in Turkey. Their tolerance to physical and chemical changes in water is relatively high (Akyurt, 2011). There are pretty suitable water resources for aquaculture in Turkey (Sayğı & Güleç, 2019). It is understood from the studies that the species is present in Taşköprü/Kabalar pond within the borders of Kastamonu (Saylar, 2009). Interviews with fishermen engaged in sportive hunting in the source confirm the continuity of the species. It was also found to be present in the Asar (Abdalhasan) pond within the borders of Taşköprü district through interviews with sportive anglers.

3.5. *Perca fluviatilis*

It is found in Eurasia, excluding the Iberian Peninsula, central Italy, and the Adriatic basin, all over Europe up to the northernmost tip of Scandinavia, in the Aral Sea basin and Siberia. The species, which is reported to live up to 22 years, can reach 60 cm in length and 4.8 kg in weight. Adverse ecological effects have been reported in some countries where it is inoculated. It lives in different habitats, from estuary lagoons to lakes and medium-sized rivers. Larvae and small juveniles usually feed on planktonic invertebrates. After reaching a length of about 12 cm, they start feeding on fish. Its meat is delicious (URL-1, 2024). The species, which forms dense populations due to the lack of economic fishing in the water resources in Kastamonu, may put pressure on other species with its carnivorous characteristics. For this reason, the species' population should be monitored (Elp et al., 2018).

It is one of the fish species causing biological invasion (Çetinkaya, 2006). *P. fluviatilis* species, which is distributed in Beyler, Germeçtepe, Karaçomak, Taşçılar, Kulaksızlar, Bezirgân, Yumurtacı Ponds, entered the environment later. In Germeçtepe Dam Lake, it is the species that gives the most prey in the environment. Specimens of various sizes ranging from a few cm to 30 cm were encountered. In addition, individuals with a length of about 1 cm were also observed in the cages where trout breeding was carried out. All these show that the species has established a population in the dam lake and has become the

dominant species. Interviews were held with the authorities of DSI, Provincial Directorate of Agriculture, Provincial Directorate of Environment, Provincial Special Provincial Administration, and Provincial Gendarmerie Command. It could not be determined how P. fluviatilis entered the environment. Due to its feeding habits, the species may cause the extinction of naturally distributed populations in the environment within a few years (Elp et al., 2018).

It was reported by Elp et al. (2018) that *P. fluviatilis* species will put dramatic pressure on other populations in a short time. Indeed, the presence of the species was observed in many ponds in this study. It was predicted by Elp et al. (2018) that fishing of the *P. fluviatilis* population should be encouraged and reduced, and the relevant public institutions should take measures to prevent its spread in the river network. However, despite this prediction, no action has been taken regarding the P. fluviatilis species today. The species has also started to spread in rivers. In the sampling conducted in Daday Stream and Mancılık Stream, it was determined that the species entered the rivers (Figure 6).



Figure 6. *Perca fluviatilis* - Mancılık stream, Türkiye.

3.6. *Oncorhynchus mykiss*

Oncorhynchus mykiss, called rainbow trout in our country, is one of the most widely cultivated species in fresh waters and the sea and is widely used as experimental animals and sportive and commercial fisheries. It can form hybrids with local species in the sources where it is inoculated. Predation and competition may negatively affect the population of native species. Rainbow trout is among the top 100 invasive species in the world. However, Turkey has no such risk since there are no breeding populations (Polat, Zengin & Gümüş, 2011).

With the increase in trout production, the number of fish escaping from the facilities and growing in the natural environment is also increasing. Due to the flavour and economic value of its meat, hunting of the species is also increasing (Ateşşahin et al., 2011).

Rainbow trout is a species cultivated in cage and concrete pond systems. Among the inland water resources of Kastamonu province, it was determined that only the Mahmatlar fire pond was inoculated. In dams such as Germeçtepe, Donalar (Karadere), Kulaksızlar, and Beyler Ponds, where it is cultivated, it was observed that individuals escaping from cages from time to time attracted the attention of anglers.

O. mykiss species is not naturally distributed in the inland water resources of Kastamonu province; it is one species that entered the environment later. However, considering the species' characteristics and habitat, it is not expected to reproduce and form a population. The smallest specimens obtained were 12 cm in length (Figure 7). The specimens of this species are individuals that escaped from trout farms

engaged in aquaculture. Individuals representing *O. mykiss* escaped from fish production facilities and have not been able to form a population (Elp et al., 2018). The findings obtained are consistent with the report of Elp et al. (2018).



Figure 7. *Oncorhynchus mykiss* - Germeçtepe Dam Lake, Türkiye.

4. Conclusion

Invasive species are new species not in the natural fauna of a certain ecosystem but come to the region from outside by different means. The general characteristics of invasive fish include long life span, early maturity, short reproductive intervals, ability to produce offspring, body size, high physiological tolerance, and habitat flexibility (Polat, Zengin, & Gümüş, 2011). Invasive species are an important threat to fisheries and biodiversity and may cause the populations of local and endemic species to be negatively affected, extinct, or reduced production. A program to combat invasive species with high ecological risk potential should be carried out, and the increase in the population of the species should be prevented (Parmaksız et al., 2022).

There is a lack of information about the time, water source, species, species characteristics, the person or institution to inoculate, the success of the inoculation, the problems that arise, and the evaluations in the inoculation studies carried out (intentionally or accidentally) in Turkey's inland water resources. No guideline contains legislation and implementation criteria on inoculation, stocking, and transfer of native and exotic species. There is no information recording system about the work done (Çetinkaya, 2006). Eliminating these deficiencies is very important in revealing the effects of new species or individuals entering the environment on the habitat and correcting the problems in the early period.

The presence of 6 exotic species was determined in Kastamonu inland water resources. While *Oncorhynchus mykess* could not establish a population, the other five species established populations. It was concluded that *Alburnus chalcoides, Cyprinus carpio, Carassius gibelio, Siluris glanis,* and *Perca fluviatilis* had established populations and have become to the point where they affect other species in the habitats where they are found. In addition, it was observed that *Oncorhynchus mykess* and *Cyprinus carpio* species form the basis of sport fishing in the province.

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Small-scale Fishery Operation of Fish Corral in Sibutu, Tawi-Tawi, Southern Philippines

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Abstract

Fish corral small-scale operations have been practiced in Sibutu, Tawi-Tawi, a southern part of the Philippines, for decades, and they contribute to the livelihood and economy of the province. However, the operations in the said area still need to be well documented. Hence, this study aims to assess the fish corral fishing operations of the locality, specifically, locate the existing fish corral, document its history, identify its designs and fishing operations specifications, and determine its target and by-catch species. Key-informant interviews (KII) were done with the identified informants in the study site, followed by one-on-one interviews with all willing fish corral operators using a semi-structured questionnaire. Results revealed that eight out of sixteen barangays in the locality engaged in fish corral fishery. Thirty-two fish corrals were identified, with the highest number found at Barangay Tongsibalo. The historical development of fish corral designs in the area evolved from rock piles to galvanized chicken wire, and the current design uses sliced bamboo poles set perpendicular to the coastline. The specification of a fish corral in Sibutu, Tawi-Tawi consists of a series of primary playground, a secondary playground, a leader, and wings. Fish corral operation takes an overnight soaking time with peak season from the 10th phase to the 7th phase of lunar months, with ideal months during the southwest monsoon season, typically from June to early October. Results also revealed that *Gerres sp.* was identified as the target species. The by-catch species belong to 30 families, with the majority belonging to Carangidae, Sciaenidae, Tetraodontidae, Platycephalidae, Balistidae, Labridae, Lethrinidae, and Pomacentridae. The study area does not implement any management measures for fish corral operations. Moreover, record keeping of the catch is also absent. However, despite these challenges, the potential of the fish corral fishery in Sibutu, Tawi-Tawi, Philippines, is promising, and this study recommends conducting further studies to develop efficient management measures for its sustainability, which holds the promise of a thriving and balanced ecosystem.

Keywords: Fish Corral, History of Fish Corral, Fish Corral Specifications and Operations, Target Species, By-catch Species.

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ORAL PRESENTATION

Seafood Allergy

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Abstract

Food allergy is a significant food safety and public health issue. Food allergens can cause allergic reactions that seriously endanger human life. The first definition of allergy was made by Clemens von Pirquet in 1906. However, it has been known for more than 2000 years that foods cause adverse reactions in humans. The majority of patients with food allergies react to foods such as fish, shellfish, milk, nuts, legumes and eggs. Although seafood consumption has an important place in human nutrition, sudden hypersensitivity reactions to these products have become a significant problem as consumption increases. Fish and fish products are among the top eight food items responsible for almost 95% of food allergies worldwide, and fish and shellfish are particularly highly allergenic foods. Food Codexes consider fish and fish products as allergenic ingredients or allergenic processing aids and require them to be declared on the product label. Fish allergy was first described by Prausnitz and Kustner in 1921. The most important known fish and shellfish allergens are parvalbumin, gelatin, hemocyanin, amylase and tropomyosin. The first allergenic parvalbumins identified were compounds called “Gad c 1” from Baltic cod and “Sal s 1” from Atlantic salmon. This review will focus on seafood allergens that are important for food safety and health.

Keywords: Allergy, Health, Seafood.

1. Introduction

The term allergy was first used in 1906 by Austrian pediatrician Clemens von Pirquet and defined as "hypersensitivity, which is the body's exaggerated or unexpected immune response to an allergen or antigen" (Karakılıç et al. 2014).

Allergic reactions can be life-threatening as they cause respiratory and/or cardiovascular distress; however, most are not severe (Iweala et al. 2018).

The incidence of food allergies is increasing day by day in our country and in the world. Food allergy is a hypersensitivity reaction of the human immune system to certain foods and is an important issue that concerns many people. Millions of people may have allergic reactions to foods every year. Food allergies are more common in children than in adults (Sicherer and Sampson 2010; Hajeb and Selamat 2012; Kocatepe and Turan 2012; Özcan et al. 2015; Altıntaş and Yardımcı 2023).

It is an immune response to specific food components, called allergens, that affects hundreds of millions of people worldwide (2% of adults and 2-8% of children), and children under 3 years of age are the main victims (Fu et al. 2019).

Foods can cause many reactions in the human body. Some of the reactions that occur with foods are reactions that can occur in every person who consumes that food (Kocatepe and Turan 2012).70% of food allergens have been identified in plant-based foods, while 30% have been identified in animal-based foods (Tekiner et al. 2020).

Food allergies are classified into 3 groups: IgE-mediated, Non-IgE-mediated or combined (Eliçin 2011; Ulusoy 2017) .

IgE Mediated Food Allergies: Contain a risk of severe or fatal reactions. While milk, egg, wheat, and soy allergies of this type usually regress with age, peanut and shellfish allergies often continue into adulthood.

Non-IgE Mediated Food Allergies: Known non-IgE mediated food allergies mostly affect the gastrointestinal tract.

Combined Food Allergies: This group includes food allergies that develop with both IgE-mediated and non-IgE-mediated reactions.

Naturally occurring animal, fungal and plant food allergens are known. The most common animal food allergens include shellfish tropomyosins, fish β-parvalbumins, and milk caseins (Sathe et al. 2016).

The majority of patients with food allergies react to foods such as fish, shellfish, milk, nuts, legumes and eggs. Although seafood consumption has an important place in human nutrition, sudden hypersensitivity reactions to these products have become a significant problem as consumption increases. Fish and fish products are among the top eight food items responsible for almost 95% of food allergies worldwide, and fish and shellfish are particularly highly allergenic foods (Ruethers et al. 2018; Tekiner et al. 2020; Gargano et al. 2021; Anonymous 2024).

2. Seafood Allergy

Seafood is considered an important part of a balanced and healthy diet and has been consistently identified as health-promoting products. Aquatic products, which are rich in protein to meet animal protein requirements, are a basic industry that meets a significant portion of the world's nutritional needs and have shown significant development over the last 50 years thanks to technology. Aquatic products are a very beneficial food source for human health due to their very low carbohydrate content and richness in protein, essential amino acids, minerals, fatty acids and vitamins (Sangün et al. 2018).

Seafood plays an important role in human nutrition and health. The increasing international trade in seafood reflects the popularity and frequency of consumption of various seafood products in many countries. Unfortunately, the increased production and consumption of seafood has led to a greater incidence of adverse health effects among seafood consumers. Adverse reactions to seafood can be mediated by the immune system (allergies) and nonimmune mechanisms (Lopata and Lehrer 2009).

Fish allergy was first described by Prausnitz and Kustner in 1921 (Dibek Mısırlıoğlu and Bostancı, 2013). The first allergenic parvalbumins identified were compounds called “Gad c 1” from Baltic cod and “Sal s 1” from Atlantic salmon (Tekiner et al. 2020).

Seafood consists of a variety of marine organisms, many of which people are allergic to. Tropomyosin is a major allergen in many shellfish, especially crustaceans and mollusks (Lehrer et al. 2003).

Among the shellfish that cause food allergies, the main ones are crustacean and mollusk species. Crustacean species cause food allergies in individuals more frequently than mollusk species. Shrimp, in particular, is one of the most frequently reported sources of allergy among seafood (Tercanlı and Atasever 2021).

Shellfish allergy can be classified as a type of seafood allergy, which is an adverse immune response to any food protein found in shellfish. Like other food allergies, seafood allergies are caused by the presence of IgE-mediated Type I hypersensitivity to shellfish (Khora 2016).

The main fish and shellfish allergens that play a role in seafood allergy are high molecular weight proteins that are heat stable and are not inactivated during cooking. The allergic response to seafood occurs between 30 minutes and 2 hours after consumption of the food. The clinical symptoms of shellfish allergy are very similar to fish allergy. In addition, allergic reactions can be observed as a result of inhalation of the food's vapors during cooking. In shellfish allergy, symptoms such as urticaria, angioedema, vomiting, abdominal pain are usually observed and, less frequently, anaphylactic shock occurs (Prester 2016; Tercanlı and Atasever 2021).

The prevalence of fish allergy is similar worldwide. Seafood allergy is more common in the United States and Canada, parts of Europe, and especially in Southeast Asian countries and Australia (Prester 2016).

Some of the fish and seafood that cause allergic reactions are: shark, ray, cod, sardine, mackerel, tuna, lobster, crayfish, shrimp, crab, snail, scallop, mussel, oyster, squid and octopus (Öztürk ve Besler 2008).

The two most common causes of IgE-mediated food allergic reactions in both children and adults are fish and shellfish (Kocatepe and Turan 2012). Fish contain some substances that can cause allergies in their skin, cartilage, blood and body fluids. Fish β parvalbumin proteins are considered to be the main fish allergen that triggers IgE-mediated allergy. Among fish species, carp has the highest parvalbumin level (Tercanlı and Atasever 2021).

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Spirulina

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Abstract

Inadequate and unbalanced nutrition brings with it increasing health problems and draws consumers' attention to healthy, minimally processed functional products. Microalgae, which grow naturally in lakes, seas and fresh waters and have rich nutritional compositions, have been one of the basic food and livelihood sources of people in many parts of the world for many years. *Spirulina* has been widely used for nearly three decades both as a food supplement and as a source of bioactive compounds for the food, pharmaceutical, agriculture, cosmetic and medical industries. *Spirulina* is a filamentous, photosynthetic, multicellular spiral-shaped and green-blue microalgae. It is a rich source of some valuable bioactive compounds such as proteins, carbohydrates, vitamins, minerals, essential amino acids, pigments such as chlorophyll a, carotenes and phycocyanin, and polyunsaturated fatty acids such as eicosapentaenoic (EPA) and docosahexaenoic acid (DHA). It has many beneficial effects as well as therapeutic functions such as antibacterial, anticancer, antiallergic, antioxidant, antiviralanti-inflammatory, and antidiabetic. It is also used as a complementary food, protein and vitamin supplement for poultry, shrimp and fish. Especially *Spirulina platensis* has attracted much attention due to its high nutritional content. In this review, the physical and chemical properties of Spirulina, its usage areas and its effects on human health will be discussed.

Keywords: *Spirulina*, Food, Microalgae.

1. Introduction

Algae have become an important part of nutrition in recent years. Algae are an important producer link in the food chain. The fact that they are generally used as a food source in Southeast Asia and island countries increases the popularity of algae day by day (Nale 2021).

Algae products are attracting more and more attention due to their pleasant taste and high protein, essential amino acids, vitamins and mineral content. In particular, *Spirulina* products are widely used for their high vitamin B12 content (Grosshahauer et al. 2020).

They are photosynthetic organisms that convert light energy from the sun into chemical energy and have a simple reproductive structure. Their biomass contains various compounds with various functions and structures. Algae are divided into microalgae, macroalgae and cyanobacteria. The classification of microalgae includes prokaryotic and eukaryotic unicellular and multicellular. Microscopic microalgae, Cyanobacteria are prokaryotic (Soni et al. 2017).

Microalgae are one of the oldest forms of life on Earth. More than 50,000 different species of microalgae exist in oceans and freshwater (lakes, ponds, and rivers). Microalgae have been consumed as food by humans for thousands of years (Uzuner and Haznedar 2020).

Products obtained from microalgae are used in many areas such as food, pharmacy, agriculture, farming, environment. Microalgae are used in feeding young fish in aquaculture, and in dried forms in the cultivation of ornamental fish, crustaceans, and bivalves (Duru and Kargın Yılmaz 2013).

A few species of microalgae are of commercial importance, but they include *Phaeodactylum, Dunaliella, Haematococcus, Isochrysis, Chlorella, Chaetoceros, Crypthecodinium, Nitzschia, Botryococcus, Skeletonema, Porphyridium, Nannochloris, Schizochytrium, Tetraselmis* and *Spirulina* (Sathasivam et al. 2019).

Spirulina is the oldest plant that lived on Earth, approximately 3.6 billion years ago. It was first discovered in 1519 by Spanish Scientist Hernando Cortez and the Conquistadors and during his visit to Lake Texcoco in the Valley of Mexico, Cortez observed that it was eaten on the tables of the Aztecs. Pierre Dangeard, who observed that flamingos survived by consuming blue-green algae, discovered the health benefits of *Spirulina*, and Botanist Jean Leonard supported Dangeard's findings, and in a short time, people began to commercialize *Spirulina* due to its benefits. In fact, the first *Spirulina* processing plant was established by the French in 1969 (Soni et al., 2017).

It can play an important role in human, animal nutrition, wastewater recycling and environmental protection through energy conservation (Saranraj and Sivasakthi 2014).

It is a blue-green algae that is considered a complete food. It is photosynthetic, filamentous, spiral-shaped, and multicellular. It is found in free masses in alkaline waters. It is a natural food containing the highest protein (60-70%) among known protein sources. *Spirulin*a contains a significant amount of vitamin E. Vitamin E is necessary for the immune system and is a strong antioxidant. It can be digested very easily due to the absence of a cellulose wall. It is non-toxic. It is a natural food that can be used as a support in the treatment of many diseases. It is a protein source that is low in fat and calories, cholesterol-free, and contains all essential amino acids (Uzunağaç 2009).

The two most important species are *Spirulina maxima* and *Spirulina platensis*. It is used as human food in Asian and African countries due to its high protein content, and is widely used especially as bait for feeding tropical fish and for pigment formation applications (Baylan et al. 2012; Duru and Kargın Yılmaz 2013; Khair et al. 2021).

S. platensis has attracted attention with its rich protein, essential fatty acid, amino acid, carotenoid, vitamin and mineral content as well as its high yield and has been used as the main food in space travels by NASA (National Aeronautics and Space Administration) and ESA (European Space Agency). The United Nations and the World Health Organization (WHO) have declared that this food is a very useful food supplement for both children and adults. In our country, it was first produced by Ege University in the early 2000s. Its reliability has been proven by many toxicological studies, and it was included in the GRAS (Generally Recognised As Safe) list by the FDA (Food and Drug Administration) in 2012 and it is recommended to consume 3-10 g daily for health (Güler et al. 2021).

2. Nutritional Composition

Spirulina is a rich source of micronutrients, antioxidants, amino acids, vitamins and minerals. It contains much more protein than any other natural food with a protein content of 65% and the digestibility of the protein is high. It has a fat content of 15-20% and a high content of polyunsaturated fatty acids (Kargın Yılmaz and Duru 2011).

It is a source of many macro and micro minerals such as calcium, iron, magnesium, selenium, as well as high quality protein content. In addition, it has been stated that it has sufficient levels of beta carotene, vitamin E, thiamine, niacin, riboflavin, biotin, cobalamin and inositol. Its high biological properties, the freshwater algae *Spirulina* has been found to contain the antioxidant pigment necessary for the synthesis of many enzymes that play an important role in human metabolism. It contains significant amounts of protein, fat, carbohydrates, vitamins, minerals, chlorophyll, carotenoids, phycocyanin, and other pigments that are beneficial to health. It is the richest plant source of vitamin B12 in nature. It has a high absorption rate of iron and a rich content of calcium. Beta-carotene pigment is the most abundant in *Spirulina*. The cell wall of it is devoid of cellulose, making it a suitable food for humans and animals (Kargın Yılmaz and Duru 2011; Khair et al. 2021; Şekerci 2024).

Its general composition (dry weight percentage) consists of 15-25% carbohydrates, 50-70% protein, 6-13% lipids, 2.2-4.8% minerals and 4.2-6% nucleic acids (Özlü and Bayram 2022).

The cell wall consists of polysaccharides with 86% digestibility and can be easily absorbed by the human body (Soni et al. 2017).

3. Health Effects

Spirulina has anti-nephrotoxic effects caused by heavy metals and drugs. *Spirulina* has a variety of therapeutic effects, including reducing cholesterol, cancer, improving the immune system, increasing intestinal lactobacilli, and reducing nephrotoxicity caused by heavy metals, drugs, and radiation. It or its extracts have been shown to prevent or inhibit oxidative stress and liver damage caused by drug abuse and heavy metal exposure, and inflammation and cell degeneration in both humans and animals. Additionally, it benefits cardiovascular disease, Parkinson's disease, malnutrition, sclerosis, and wound healing. It has antiarthritic properties due to the presence of phycocyanin. It also has anti-atherogenic and anti-tumor properties, chemo- and radioprotective properties (Khair et al. 2021).

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ORAL PRESENTATION

Effects of Cellulosic Lacquer Paint Applied to Furniture Edge Bandings on Adhesion and Fire Resistance

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Abstract

Due to the workability of wood materials and the limited availability of resources, the use of plywood, particleboard, fiberboard, etc. has become widespread in furniture and decorative manufacturing. Medium Density Fiberboard (MDF) is particularly in demand for projects that will be painted. However, the edges of MDF panels absorb lacquer paint excessively, making the process somewhat laborious. In addition, problems such as cracking and swelling of the primer and lacquer can occur at the edges. To solve these problems, MDF edges coated with lacquer paint are often covered with PVC edge bands. However, the chemical industry has developed ABS edge bands as an alternative to PVC edge bands, which have been found to have some weaknesses in paint adhesion and fire resistance. The objective of this study was to determine the adhesion and fire resistance of cellulose paint applied to PVC and ABS edgebandings. For this purpose, the edge surfaces of test specimens prepared from MDF boards were covered with PVC and ABS edge bands, and then cellulosic paint was applied to these surfaces. The adhesion resistance of the cellulosic paint applied to PVC and ABS edge bandings was determined by the cross-cut test, and the fire resistance was determined according to the relevant standards by the single-flame source combustion test. According to the results of the study, while the adhesion resistance was found to be at the same level in PVC and ABS samples coated with cellulosic paint, the fire resistance was found to be higher in ABS samples coated with cellulosic paint. Future studies investigating the hardness resistance properties and gas emissions of PVC and ABS edgebands coated with different lacquers under the influence of temperature may contribute to the scientific community.

Keywords: PVC Edge Band, ABS Edge Band, Cellulosic Paint, Cross-Cut Test, Single-Flame Source Combustion Test.

1. Introduction

Today, due to the increasing demand for furniture and limited wood material resources, the use of particle and fiberboards in furniture has become widespread (Sakarya and Doğan, 2016). In the past, the edges of materials produced from particle and fiberboards were covered with solid and veneers, but today plastic edge bands are preferred. Among the various edge bands used in furniture production, PVC and ABS are the most preferred (URL 1, 2023).

PVC edge bands are so identified with the raw material that the term "PVC" is often used instead of "edge band" in the sector. PVC has been the preferred choice of manufacturers over the years due to its easy processability (Yılmaz, 2018). PVC edge bands are a type of edge band with high chemical

resistance. Warm/hot water or water-based cleaners should be preferred instead of alcohol and heavy solvents in PVC edge bands. If the stain does not come out, commercially available plastic material cleaners should be used. Using the wrong cleaner can cause discolouration on the material surface, and fading or breakage of parts in the edge band in long-term use (URL 2, 2018).

Although some sources state that PVC is resistant to burning (Çağlarer, 2004), the common view is that PVC is harmful to the environment and human health (Ergenç, 2007). When PVC edge bands are burned, they emit hydrochloric gas that is harmful to the environment due to the chlorine in their structure. For this reason, it is strictly forbidden to burn them together with waste chipboard pieces in furniture factories (Yılmaz, 2018). PVC products should be controlled in their production, use and recycling processes and alternative products should be developed (Balanlı and Taygun, 2002).

ABS edge bands attract attention as a healthier and higher quality edge covering material by removing heavy metals found in plastic raw materials (URL 3, 2018). ABS edge bands are frequently preferred in daily life due to their superior features such as food contact, chlorine-free, low density, flexible design, dimensional stability, chemical resistance, high impact resistance, easy workability, surface quality, brightness and electrical insulation (Yaşar, H., 2001). While acrylonitrile in the structure of ABS provides heat resistance, rigidity and chemical resistance to the material; butadiene provides strength and impact resistance at low temperatures. Styrene provides brightness, hardness and easy workability to the material (Çağlarer, E., 2004; Yaşar, H., 2001; McKeen, L. W., 2010; Pious, C. V., and Thomas, S., 2016).

ABS is a plastic that can be melted and reshaped repeatedly and is very easy to recycle. The disadvantage of ABS plastic is that it is sensitive to ultraviolet radiation. Therefore, additives must be added to prevent its decomposition (Baker, I., 2018).

PVC edge bands are more resistant to solvent-based chemicals than ABS (URL 2, 2018; URL 4, 2023). Alcohol, solvent, acid and alkaline cleaners should never be used on ABS edge bands. ABS edge bands can be painted more easily and have higher scratch resistance than PVC thanks to their paint-holding properties. For this reason, it is a preferred product for varnish applications and provides a significant cost advantage to manufacturers (URL 4, 2023).

Cellulosic dyes are widely used in dyeing edge bands. Some studies reported that cellulosic dyes are resistant to heat and combustion, and have high combustion temperatures and melting points (Sönmez, 1989; Seferoğlu, 2008; Kara and Atar, 2021), showing that they positively affect the combustion resistance in materials covered with protective layers. In different studies, it has been stated that the burning time is positively affected in cellulosic dyes modified with boron compounds (Baysal et al., 2003).

The connection (adhesion) of protective layers to the material surface on which they are used is an important feature. At the same time, some methods used to determine adhesion resistance make it possible to obtain comparable results in a short time in determining the protective layer performance (Altun and Esmer, 2017). Research on adhesion resistance has enabled the use of cellulosic paints on many different materials such as wood, metal, plastic, etc., as in all protective layers.

Good cellulosic paint layer performance depends on the applications being made according to the manufacturer's recommendations and relevant standards (ASTM-D 3023, 1998). Some studies have determined the adhesion resistance of cellulosic coatings to be low compared to alternatives (Budakçı and Sönmez, 2010). In another study, it was stated that the adhesion resistance of cellulosic coatings exhibited better performance than UV-cured nano lacquer and polyurethane varnishes, as well as synthetic and polyester varnishes (Kaygin and Akgün, 2008). Cellulosic coatings are widely used in different industrial areas because they provide sufficient performance.

As the world population increases, ecology is at risk. Manufacturers have stated that ABS pollutes our planet at a minimum level and does not contain chlorine. Although ABS has similar properties to PVC, unlike PVC, it can be burned with general waste and does not create dangerous pollution when burned. It is also more resistant to fire. In recent years, ABS has been preferred by many furniture manufacturers. Although there is a possibility that ABS wastes may be burned by some manufacturers who cannot produce large quantities, it is important to spread the use of ABS since it does not produce any dangerous emissions (URL 5, 2023). ABS, which is used for different purposes today, has become an indispensable part of modern life. ABS, which is very attractive to recycle economically, is blended with unprocessed material and used in the production of low-cost and different quality products (URL 6, 2023). It is known that ABS is not harmful to water and that it is not a problem to dispose of it with small amounts of household waste. According to some international agreements, ABS is not classified as a harmful substance (Henkel, 2000).

In terms of quality and environmental impacts, the use of PVC and ABS edge bands in the furniture industry and the determination of the burning resistance and adhesion resistance of cellulosic paints applied to the edge band surfaces are important. In this study, it was aimed to determine the adhesion resistance of cellulosic paint applied to PVC and ABS edge bands and the burning resistance of PVC and ABS edge bands.

2. Materials and Methods

2.1. Material

Considering that it does not produce too much emission in interior spaces, E1 quality MDF (Medium Density Fiberboard) was preferred as the test material. ABS (acrylonitrile butadiene styrene) and PVC (polyvinyl chloride) edge bands were used for covering the MDF edge surfaces, and hot melt glue was used for bonding the 1 mm thick edge bands. Black cellulosic lacquer paint was preferred for painting the edge bands. Being on the ERSA product list and its widespread use in the furniture industry were effective in the selection of the materials.

2.2. Preparation of the Specimens

The cutting of MDF test samples, bonding of edge bands to sample edge surfaces and coating of edge bands with cellulosic lacquer paint were carried out in ERSA workshops. Test samples were prepared from the MDF board with dimensions of 200x300x30 mm. ABS and PVC edge bands were bonded to MDF edge surfaces. A thin layer of primer was applied to the bonded edge bands and they were prepared for painting by sanding. Two layers of black cellulosic lacquer paint were applied to the surfaces of the edge bands with a spray gun and left to dry in the drying cabin. The preparation stages of the test samples

(a. Banding of edges, b. Sanding of primer paint, c. Application of lacquer paint) are given in Figure 1. The test samples were kept in the climate cabin for 48 hours at 50±5% relative humidity and 23±2ºC temperature to reach the equilibrium moisture content. Then, cross-cutting and single flame source combustion tests were applied to the ABS and PVC coated surfaces of the test samples.



a. Edge Banding b. Primer paint sanding c. Lacquer paint application

Figure 1. Preparation stages of test samples.

2.3. Single Flame Source Combustion Test

The test samples were first subjected to the combustion test in the apparatus prepared according to TS EN ISO 11925-2, then the burned surfaces were measured with a meter and the burn marks were examined. The test samples were burned by exposing them to a flame of approximately 20 mm in length from a distance of 2 mm for 15-30 seconds (sec) (TS EN ISO 11925-2, 2004). The samples subjected to the single flame source combustion test (a. Burning of the edge banded sample, b. Burning of the lacquered edge banded sample) are given in Figure 2.



a. Burning of edge-banded sample b. Burning of the lacquered edge banded sample

Figure 2. Samples subjected to single flame source combustion test.

2.4. Cross-Cut Test

According to TS EN ISO 2409, a cutting process was carried out on the coating with a cross-cutting blade at a 90º angle to each other. While cutting, the blade was completely cut through the paint layer on the surface of the material. Some preliminary tests (Budakçı, 2006) were carried to ensure a healthy cutting depth. After the cutting process, the edge band area where the test was carried out was cleaned with a soft cloth or brush. The tape was attached to the area cut in the form of a lattice with rubber eraser pressure. After waiting for 2-3 minutes, the tape was removed from the surface to which it was attached

with a smooth movement and attached to a white paper. The tape attached to the paper and the surface from which it was removed were examined with a magnifying glass, and the averages of the results of the amount of paint removed from the surface were evaluated (TS EN ISO 2409, 2020). Cross-cut cross-cutting tools are given in Figure 3.



Figure 3. Cross-cut tools.

2.5. Evaluation of the Data

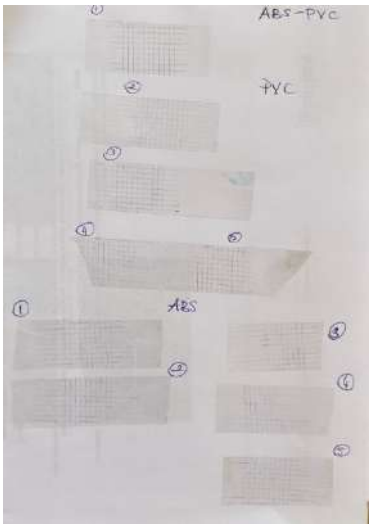
The evaluation was made by taking the arithmetic averages of the data of adhesion and burning resistance coefficients of ABS and PVC edge bands painted with cellulosic lacquer paint. Microsoft Excel program was used for drawing the averages, standard deviations and graphs of the data.

3. Findings

3.1. Cross-Cut Test

In cellulosic lacquer painted surfaces applied to ABS and PVC edge bands, the cross-cut surface and the band surfaces used for cross-cutting are given in Figure 4.





a. Cross-cut applied lacquered painted surface

b. Bands removed from the cutting surface

Figure 4. Cross-cut lacquered surface (a) and strips removed from this surface (b).

Cellulosic lacquer painted surfaces applied to ABS and PVC edge bands were subjected to cross-cut testing, and the average (X) values and Standard deviation (Sd) of the determined adhesion resistance results are given in Table 1.

Table 1. Cross-cut measurement results of test samples.

Rank	Application Surface	
	PVC	ABS
1	5	5
2	4	4
3	5	4
4	5	5
5	4	5
X	4.60	4.60
Sd	0.55	0.55

According to Table 1, the adhesion resistance was determined at the same level in cellulosic lacquer paint applied to both ABS and PVC surfaces. In two samples from each group, rupture was determined at level 4B in lacquer paint on ABS and PVC surfaces. According to this result, it can be said that the adhesion resistance is good in cellulosic lacquer paint applied to ABS and PVC edge bands.

3.2. Single Flame Source Combustion Test

The burnt states of the surfaces of the edge band coated samples and the cellulosic paint applied samples (a. Burning of ABS, b. Burning of PVC, c. Burning of painted ABS, d. Burning of painted PVC) are given in Figure 5.



a. ABS b. PVC c. Painted ABS d. Painted PVC

Figure 5. Burnt versions of edge-banded samples and lacquered edge-banded samples.

It was observed that the surfaces of the samples covered with ABS and PVC edge bands subjected to single flame source combustion test were burned (Figure 5a, b). In the region where the combustion took place (combustion zone), blackening occurred on the surface of these samples and the shape change was obvious. In the region in the upper parts of the combustion zone (soot zone), dirty yellow and dense soot occurred. It was observed that the paint on the surfaces of the samples to which cellulosic lacquer paint was applied and subjected to single flame source combustion test was clearly burned (Figure 5c, d). The single flame source combustion length was determined by measuring the burning zone and the

soot zone on the sample surfaces. In the combustion zone, blackening occurred on the surface of the samples to which cellulosic lacquer paint was applied and the edge band underneath was revealed. A small amount of soot formed on the upper parts of the painted surfaces and the paint shrank and changed shape in a short distance. The average values and standard deviation of the measurement results taken separately as the blackening region and the soot region on the sample surfaces exposed to the single-flame source combustion test are given in Table 2. The graph of the average values of the single-flame source combustion resistance of the test samples is given in Figure 6.

Table 2. Single flame source combustion test measurement results.

Length (cm) of Burned Area-Length (cm) of Soot Stained Area									
Burning Surfaces		PVC		ABS		Painted PVC		Painted ABS	
Burning Time	Rank	Burned Area	Soot st. Area	Burned Area	Soot st. Area	Burned Area	Soot st. Area	Burned Area	Soot st. Area
15 seconds	1	2	4	2.5	4	2.5	6	2.5	6
	2	2	4.5	2	4	3	6	2.5	6
	3	2	3.5	1.5	3.5	2.5	5.5	2.5	6.5
	4	2	4	1.5	2.5	2.5	6	2.5	5.5
	5	2	4	1.9	3.5	2.6	5.9	2.5	6
	X	2	4	1.88	3.5	2.63	5.88	2.5	6
	Sd	0	0.35	0.41	0.61	0.22	0.22	0	.35
30 seconds	1	3	8	4	8.5	4	11	3.5	9
	2	3.5	10	3	7	3.5	9	4	9
	3	3.5	9	4	7	4	9.5	3	7
	4	2.5	6	3	6.5	4	10	3.5	8
	5	3.13	8.3	3.5	7.3	3.9	9.9	3.5	8.3
	X	3.13	8.25	3.5	7.25	3.88	9.88	3.5	8.25
	Sd	0.41	1.48	0.5	0.75	0.22	0.74	0.35	0.83

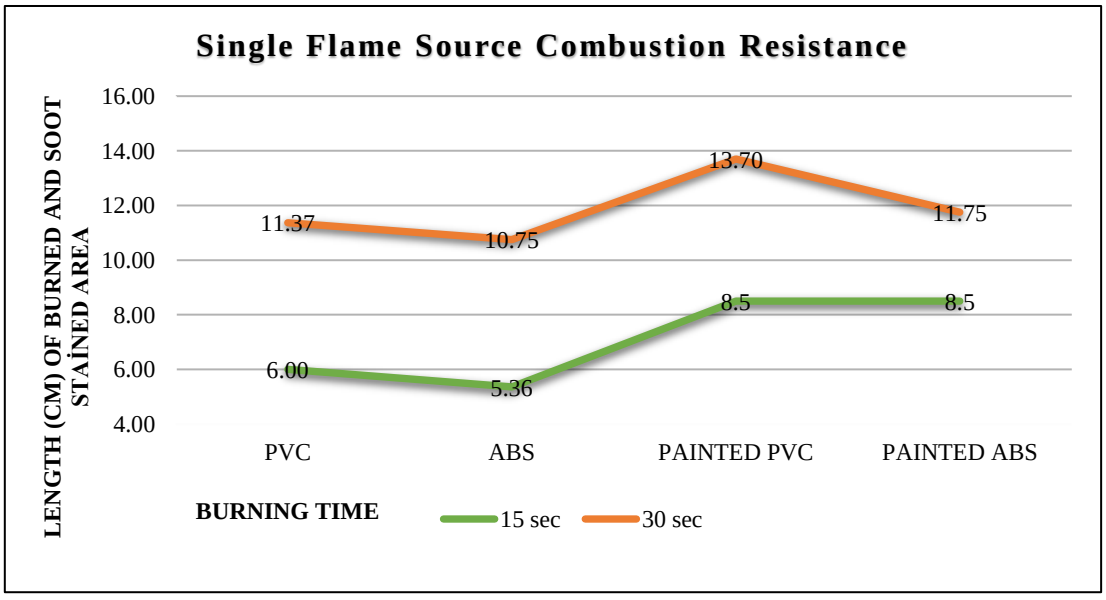


Figure 6. Average values of single flame combustion resistance of test samples.

In Table 2, the effect of combustion in test samples whose surfaces were exposed to single flame source combustion for 15 sec and 30 sec was measured and evaluated in two regions. The first region is the combustion region destroyed by the flame, and the second region is the soot region where the flame left a trace on the burned region. According to Table 2, in samples exposed to single flame source combustion for 30 sec, the total length of the combustion and soot region was determined as the longest in painted PVC test samples (13.76 cm), while the shortest burning length was determined in unpainted PVC test samples (10.75 cm). In samples exposed to single flame source combustion for 15 sn, the total length of the combustion and soot region was determined as the shortest in unpainted ABS test samples (5.38 cm). According to these results, it can be said that the burning resistance of ABS is higher than PVC and that cellulosic lacquer paint increases the burning resistance.

4. Conclusion and Recommendations

According to the cross-cut test results, it was observed that there was 4B level of rupture in the cellulosic lacquer paint applied to ABS and PVC edge bands. It can be said that the ability to hold the cellulosic lacquer paint was successful for both edge bands. Accordingly, it is recommended to apply cellulosic lacquer paint on ABS and PVC bands. The adhesion resistance of ABS and PVC edge bands to which cellulosic lacquer paint is applied is at the same level, and both can be preferred in jobs where high adhesion resistance is desired.

According to the results of the single flame source combustion test, it was determined that the cellulosic lacquer painted and unpainted ABS edge bands have better combustion resistance than cellulosic lacquer painted and unpainted PVC edge bands. ABS edge bands can be preferred in furniture production because their own waste can be recycled, they do not leave emissions when burned, and their combustion resistance is high.

In future studies, investigating the hardness resistance properties and gas emissions of PVC and ABS edge bands coated with different lacquer paints under the effect of temperature can contribute to the scientific world. Considering human and environmental health, we believe that the use of ABS edge bands in the furniture industry will become widespread.

Acknowledgment

This study is derived from a graduate thesis [Kutludeniz, A.S. (2024). Sustainability in Edge Banding Used in Furniture Industry] Gazi University, Faculty of Technology, Department of Wood Products Industrial Engineering, under the supervision of Dr. Haci İsmail Kesik. We would like to thank ERSA for their financial support.

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Cost-Effective and Time-Efficient Biosynthesis of Bioactive Nanoparticles Using Crude Plant Extracts: Unveiling Biological Activities

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Abstract

Anemone nemorosa L., commonly known as wood anemone, has garnered significant interest in ethnobotanical and pharmacological research due to its diverse bioactive compounds and associated health benefits. This perennial herb, widely distributed across temperate regions, has been utilized in traditional medicine for the treatment of various ailments, reflecting its cultural significance. The present study investigates the potential of *Anemone nemorosa L.* extracts in the biosynthesis of gold (AuNPs) and silver nanoparticles (AgNPs), emphasizing the optimization of cost-effective and time-efficient methods. Employing a series of experimental designs, we successfully synthesized nanoparticles while evaluating their structural and functional properties through advanced characterization techniques including FTIR, UV-Vis spectroscopy, STEM-EDS, and XRD analysis. The findings reveal that the size and morphology of the nanoparticles, which were confirmed to be below 50 nm, significantly influenced their physicochemical properties and biological activities. *A. nemorosa* extracts, especially when subjected to microwave-assisted extraction, exhibited notable antioxidant activity (up to 91.05%) in DPPH assays and implications for phytotoxicity, as evidenced by the inhibitory effects on *Triticum aestivum* L. seed germination and root elongation. Furthermore, these extracts demonstrated enhanced antimicrobial efficacy against various pathogens when supplemented with AgNPs, affirming their potential applications in various field. Toxicological assessments indicated a variable profile of cytotoxicity and genotoxicity. *In vivo* studies showed a promising anti-inflammatory effect, with the most significant results attributed to ultrasound-assisted extracted formulations. Detailed bioinformatics analysis revealed a favorable pharmacokinetic profile and adherence to drug-like properties for several bioactive compounds present in *A. nemorosa*. This research highlights the dual role of plant extracts in nanoparticle synthesis and their subsequent biological activities, paving the way for the development of green nanotechnology applications.

Keywords: *Anemone nemorosa* L., Biosynthesis, Nanoparticles, Bioactivity, Pharmacokinetics.

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Microplastics in the Turkish Marine Environment: Surface Water, Sediment and Biota

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Abstract

The particular needs of society are met by the extensive production and usage of plastics, which are known for their durability. Given the exponential growth of their trash, it is inevitable that they will end up in our oceans. Microplastics (MP) present a higher risk than macroplastics due to their ability to readily infiltrate the aquatic environment and their difficulty in being detected. Microplastics have the ability to affect many aspects of marine ecological systems, including the food chain. This study examined the presence of microplastics in surface water, sediment, and biota along the coast of Turkey. The results revealed that the occurrence of microplastics in Turkish coastlines has been historical and has been steadily rising. However, there is hope. We can find out where microplastics are coming from and stop them before they reach our seas. This is a crucial step if we want to stop the current microplastic contamination from getting worse.

Keywords: Microplastic, Turkish Coast, Biota, Sediment, Surface Water.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Assessing Occupational Health and Safety Risks in Offshore Aquaculture Systems in Türkiye

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Abstract

With globalization and increasing population, fishing and aquaculture have become among the most important activities. Since fish and other aquatic organisms are a crucial food source for humans, people have initially turned to fishing and subsequently to controlled aquaculture practices. Offshore aquaculture systems (OAS) clearly represent a significant part of aquaculture. However, despite the presence of skilled labor and modernization in OAS, occupational health and safety (OHS) practices remain underdeveloped. Due to the lack of a comprehensive data collection system in Türkiye, the exact number of workers employed in the offshore aquaculture sector is not known. Furthermore, the number of occupational accidents and diseases among workers in offshore aquaculture systems cannot be determined. As the variety of techniques and equipment used increases, so do the risks to occupational health and safety, along with both the likelihood and severity of these risks. In addition to fatal and non-fatal accidents, occupational diseases have also begun to emerge. According to the Food and Agriculture Organization (FAO), the number of people employed in the primary fisheries and aquaculture sector worldwide was approximately 58.5 million in 2020. This figure includes employment in both hunting and aquaculture and there has been significant stability in aquaculture employment. When considering full-time employment across the entire seafood value chain, including post-harvest activities, the proportion of workers engaged in offshore aquaculture systems rises to approximately 50%. The large numbers of employees increases the importance of occupational health and safety practices. Considering potential hazards and risk factors, one of the most important issues for OAS is employees health problems and working conditions. Offshore aquaculture operations are among the most hazardous areas when considering working conditions. In Türkiye, the Occupational Health and Safety Law, as explicitly stated in the Workplace Hazard Class Regulation (NACE) list, categorizes OAS activities under code 03.21.01 as "Dangerous". Additionally, when a risk assessment is conducted and risks are scored using various methods, the risks rated as "unacceptable" are both numerous and highly diverse. In this study, the risks associated with offshore aquaculture systems in Türkiye were examined from physical, chemical, biological, ergonomic, and psychosocial perspectives, and many of the criteria analyzed were evaluated using the "5x5 L-Type Matrix" method. Furthermore, a comparison was made of the potential improvements that could be achieved with the contribution of a OHS specialist using specific percentage-based methods.

Keywords: Occupational Health and Safety, Aquaculture, Offshore.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

The Case Study of Awareness of the Plastic Footprint among University Students of Environmental Engineering

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Abstract

Despite plastic is one of the most widely used materials in the world, there is a general lack of information on plastic flows within value chains. Quantifying these flows is essential for the effective management of plastic waste. The plastic footprint can serve as an analytical tool to determine the amount of polymers leaking into ecosystems and to promote a more sustainable use of polymers. The aim of this study, therefore, was to quantify and evaluate the awareness and attitudes of university students towards plastic pollution by measuring their plastic footprint and comparing the results with general averages. For this purpose, the waste generation of 74 students was monitored over a period of 10 days. Two different plastic footprint calculators were used to analyze the data, namely the Omni Calculator Plastic Footprint and the Plastic Footprint Calculator. The analysis showed that the highest amount of plastic waste per person comes from single-use plastic packaging (6.4 pieces per day), followed by PET bottles (4.0 pieces per day). The lowest amount of plastic waste per person comes from toothpaste packaging (0.2 pieces per day). Overall, the average plastic footprint of the participants was calculated at 15.62 kg per year. It is worth noting that the participants' plastic footprint was below both the global and US averages and more in line with the European average. This result suggests that the high awareness of university students significantly influences their plastic consumption behaviour. These results represent a pioneering attempt to quantify the individual plastic footprint in Türkiye. By quantifying the plastic footprint, the awareness of individuals can be raised and various organizations, particularly public institutions, can be supported in complying with legal regulations.

Keywords: Plastic Footprint, Plastic Pollution, Disposable Plastic Products, Waste Generation, University Students.

1. Introduction

Türkiye is one of the countries with the highest volume of plastic waste in the world (Aydemir & Öztürkçü, 2024). With a significant amount of waste in the Mediterranean region, Türkiye ranks 14th among the 20 countries with the worst plastic waste management (Karasik, 2022). According to data from 2019, 40% of Türkiye's packaging production consists of plastics, which means that almost 4 out of 10 packaging items produced are plastic products (Greenpeace, 2020). Of the total plastic waste

produced, it is estimated that 6% is recycled, 61% is regularly stored and the remaining part — over 1.1 million tons — is believed to be disposed of directly into the receiving environment, mainly into water bodies (Karasik, 2022).

In Türkiye, the fight against plastic waste is becoming increasingly important in line with the objectives of the Zero Waste Management System and the Green Deal (Ataseven, 2023; Koska &Erdem, 2023). The Zero Waste Management System aims to reduce waste production, promote recycling and ensure effective waste disposal. It seeks to minimize the impact of plastic waste on the environment by addressing it at source and encouraging recycling. The Green Deal, on the other hand, pushes Türkiye to commit to climate change mitigation and environmental sustainability and to promote the development of policies and practices in this direction. Reducing plastic waste, promoting recycling and minimizing its environmental impact are the main objectives of the Green Deal. Guided by these two significant approaches, Türkiye is committed to reducing the environmental impact of plastic waste and contributing to a more sustainable future (Coskun, 2022). In this context, the effective management of plastic waste is a crucial step for the environment, the economy and society, helping the country to achieve its environmental sustainability goals.

In order to reduce the impact of human activities on natural systems, "social awareness" must be promoted (Sivri vd., 2024). This includes recognizing the existence of environmental problems, identifying their causes, seeking solutions and implementing them. Increasing this awareness and encouraging behavioral change is crucial. An important aspect of achieving this is measuring the direct and indirect impact of human activities on ecosystems (Günal et al., 2018).

For the past fifty years, polymers have become a component in every aspect of daily life. They have increasingly integrated into our comfort zones, increasing societal dependence on them. This unique reliance on such a diverse material has resulted in significant challenges, particularly in terms of the management of polymer waste, especially regarding its reuse and recycling. The concept of the "plastic footprint"," which is now part of our daily lives, quantifies the visible impact of our dependence on plastic materials on the environment. This concept enables the assessment of the environmental impact and sustainability of activities carried out by individuals, institutions, organizations and even nations (Mallick et al., 2021). Just as in waste management, measuring and analyzing concrete data allows decision makers to make more informed and effective decisions.

Therefore, managing only measurable data plays a crucial role in ensuring better protection of the environment and natural resources. This study aims to calculate and evaluate the propensity of university students towards the plastic footprint. In this context, students from the Department of Environmental Engineering, who are expected to show a higher level of environmental awareness, were chosen as the target group. Over a period of 10 days, the students' solid waste generated due to their consumption habits (e.g. space, travel and personal use) was collected and the plastic waste was categorized. The students' individual plastic footprint was then calculated using various tools from the literature, applying different methods to determine the plastic footprint.

2. Materials and Methods

In this study, the sampling method used is a stratified random sample. The solid waste collected by the 74 students is categorized into paper/cardboard, plastics and derivatives, glass and metals (Günal et al.,

2018). The plastic footprint is then calculated using the "Omni Calculator Plastic Footprint" (PFP-A) and the "Plastic Footprint Calculator" (PFP-B), both of which are widely used tools for assessing individual plastic footprint. According to the "Omni Calculator Plastic Footprint"," there are four main categories: “Food and Kitchen Supplies”, “Bathroom and Laundry”, “Disposable Containers and Packaging”, and “Other”. For the first three categories, data inputs are based on various periods (daily, weekly, monthly, quarterly, semi-annually and annually). The "Other" category uses mass units based on the year (mg, g, kg, etc.). The calculator outputs the total plastic footprint as "kg per year" and compares the user's footprint with the average annual plastic footprint per capita in the US and Europe. The "Plastic Footprint Calculator", on the other hand, includes five main categories: Plastic Bags, Disposable Containers and Packaging, Kitchen Supplies, Personal Use and Disposables at Parties and Events. For all categories, the data inputs are based on different periods (daily, monthly, yearly). The output is presented as "kg per year" and "number of items".

3. Results and Discussion

The analysis showed that the highest amount of plastic waste per person originates from single-use packaging for plastic products, an average of 6.4 pieces per day. This is followed by PET bottles (4.0 pieces/day) and food packaging (3.1 pieces/day). These high numbers indicate that the convenience and accessibility of single-use plastics significantly contribute to the overall plastic waste generated by individuals. The widespread throwaway culture further exacerbates this problem, making single-use plastic the largest contributor to daily plastic waste (Nguyen et al., 2022). In the food and kitchenware category, PET bottles lead the way with an average of 4.0 pieces/day, followed by food packaging with 3.1 pieces/day and milk and dairy product packaging with 0.5 pieces/day. These results indicate that beverage and food packaging generate significant amounts of plastic waste, which is probably due to their widespread use and disposal after a single use. In the personal care products category, toothbrushes account for 0.6 pieces/day, shampoo and detergent packaging for 0.5 pieces/day, cotton buds for 0.3 pieces/day and toothpaste packaging for 0.2 pieces/day. It is worth noting that toothpaste packaging has the lowest average value, which indicates that these products have a longer useful lifespan and are replaced less frequently than other personal care items. The obtained data shows that single-use plastics, particularly in the form of product packaging and PET bottles, make up the largest proportion of university students' daily plastic waste. This trend is consistent with global patterns where convenience and accessibility lead to high consumption and disposal rates of single-use plastics (Xanthos & Walker, 2017).

When the distribution of plastic footprints was analyzed by gender, it was found that 73% of the students participating in the study were female and 27% male. According to the research results, the average plastic footprint of female students was 16.39 kg/year, while the average of male students was 14.92 kg/year and the overall average was 15.62 kg/year (Figure 1a-b). In the overall assessment of plastic footprint by gender, the fact that female students had a higher footprint was consistent with the studies conducted in the literature on footprint by gender (Eren et al., 2016). The fact that female students tend to use more personal care and hygiene products and that most of these products contain plastics can explain the fact that female students have a higher plastic footprint than male students (Makanjuola et al., 2021).

Regardless of the method used to calculate the plastic footprint, the participant with the highest plastic footprint had an average value of 48.35 kg/year, while the participant with the lowest plastic footprint

had an average value of 3.8 kg/year. The participant with the highest plastic footprint had a value of 52.7 kg/year in PFP-A and 44 kg/year in PFP-B, while the participant with the lowest plastic footprint had a value of 3.8 kg/year in PFP-A and 2.8 kg/year in PFP-B (Figure 2).

The global average plastic footprint is 50 kg/year, with the United States averaging 84 kg/year and Europe 30 kg/year (Urbańska et al., 2023). The results of this study indicate that the plastic footprints of the students participating in the study are below these global, US and European averages. Several factors may contribute to this result, including the socioeconomic status and lifestyle habits of the students (Beaumont et al., 2019). In addition, as the participants were environmental engineering students, their heightened awareness of environmental issues may have influenced their plastic consumption behavior.

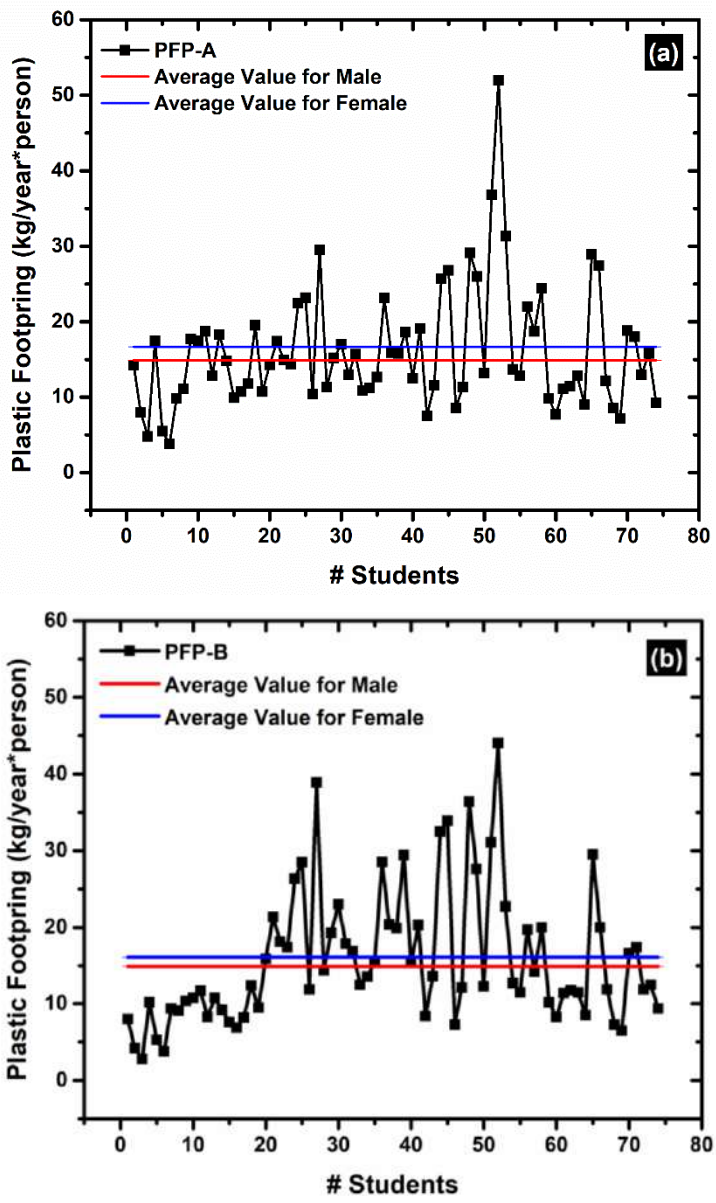


Figure 1. Plastic footprint calculation results for (a) PFP-A and for (b) PFP-B for each student.

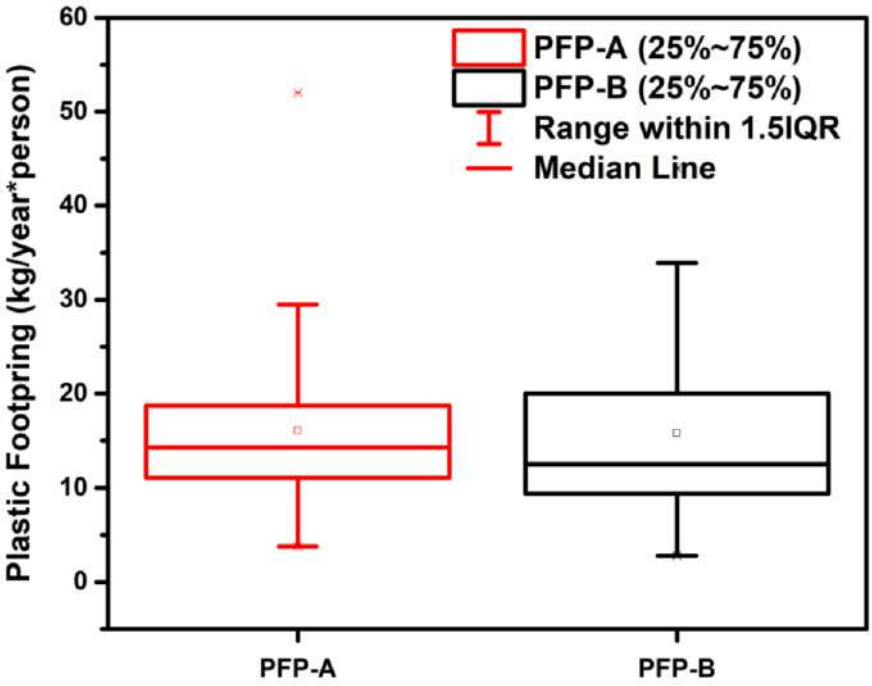


Figure 2. Distribution of plastic footprint values for PFP tools.

Previous studies that have looked at foot printing have often examined the individual carbon, water and ecological footprint of university students (Boucher et al., 2019; Fang et al., 2016; Günal et al., 2018; Lewis and Cohen, 2022). For instance, in a study by Güler et al. (2022), the ecological footprints of environmental engineering students at Sivas Cumhuriyet University were measured, focusing on aspects such as nutrition, transportation, housing and personal care habits. Like the present study, Güler et al. used a web-based survey to calculate the ecological footprint of 150 students. The average ecological footprint was calculated to be 2.84 gha, and the average carbon footprint was 11.47 tons. These results show that the average ecological footprint of students is lower than the national average of Türkiye (3.53 gha) and close to the global average (2.76 gha). This suggests that students, particularly those studying environmentally conscious subjects, tend to have a lower ecological and plastic footprint than the wider national and global figures. This highlights the influence of environmental education on sustainable behavior.

4. Conclusion

This study investigates the awareness of the plastic footprint among university students in Türkiye, with a particular focus on students in the Department of Environmental Engineering, where a high level of environmental awareness is expected. For this purpose, the waste generated by the university students over a period of ten days was collected and converted into data through a study, which made it possible to calculate their plastic footprint using various calculation tools. The results show that students generate an average of 6.4 pieces of plastic waste per day from single-use plastic products, 4.0 pieces from PET bottles and 3.1 pieces from food packaging. Remarkably, the average plastic footprint of the students is below the global average of 50kg/year, the US average of 84kg/year and the European average of 30kg/year. This discrepancy can be attributed to the socio-economic conditions of the students and their heightened environmental awareness.

Environmental awareness should lead to concrete actions that address current environmental problems. Therefore, this awareness should be strengthened through various educational tools, such as Footprint assessments. Integrating environmental awareness into the education and training processes of students can promote awareness of sustainable lifestyles, particularly among young people who represent the future of our society. In addition, the principles of a sustainable lifestyle should be transformed into concrete behaviors.

Given the results of this study, it is also recommended to apply the plastic footprint calculations to larger samples with different variables and to continue efforts to promote environmental awareness. However, while the awareness gained through the training is significant, due to economic reasons, it cannot always be implemented in daily life, or if implemented, it is not sustainable in the long term. The fact that plastic products are cheaper and environmentally friendly alternatives are more expensive makes it difficult for young people and university students to translate their awareness of plastic waste into actions.

Although the calculation tools used in this study do not take into account certain factors — such as cultural influences, age and gender — that could lead to higher plastic consumption, it is important to recognize that the actual plastic footprint may be significantly larger than the calculated figures. Gaps in the plastic footprint calculation tools used to estimate plastic consumption include products such as wet wipes, cosmetics, stationery containing plastic and plastic organizers for household use. Therefore, updating the plastic footprint calculation tools to include these additional products is essential to achieve results that more accurately reflect actual plastic consumption. The most important outcome of this study is the necessity of developing a national plastic footprint calculation tool. As with other calculation tools, studies should be conducted to create a special calculation tool that is compatible with Türkiye's traditional usage habits and creates awareness. With the results obtained, applications that can formulate legal regulations to control plastic usage and waste, similar to the 'Zero Waste Management' initiative, can be developed.

Acknowledgment

This research is supported by the Scientific and Technological Research Council of Türkiye (TÜBİTAK) under the 2209-A University Students Research Projects Support Program.

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Food and Feeding Habits of Freshwater Fishes in Lake Wood, Zamboanga del Sur, Philippines

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Abstract

Freshwater ecosystems, particularly lakes, play a critical role in supporting hydrology, fisheries, and food security. However, smaller lakes often receive less research attention compared to their larger counterparts. This study investigated the feeding habits and gut content of freshwater fish in Lake Wood, Zamboanga del Sur, Philippines, to understand the dietary preferences and trophic interactions within the fish assemblage. Nine fish species from five families were identified: Cichlidae (Nile tilapia *Oreochromis niloticus*, blue tilapia *O. aureus*, and tilapia *Oreochromis sp*.), Cyprinidae (common carp *Cyprinus carpio*, carp Barbodes sp., and "porang" *Rasbora sp*.), Channidae (mudfish *Channa striata*), Clariidae (catfish *Clarias batrachus*), and Anabantidae (climbing perch *Anabas testudineus*). These species were examined to determine their feeding behaviors, food preferences, and dietary compositions. Gut content analysis revealed a diverse diet, with consuming algae, mollusks, sand, shrimp, fish, and insects. The frequency of occurrence data indicated the prevalence of these food items in the stomachs of the studied fish. The Index of Preponderance was employed to rank the significance of food items within each species' diet. Algae emerged as the dominant food source for several species, followed by sand and mollusks. Cumulative percentage volume analysis demonstrated that algae accounted for the highest portion of the total volume consumed by the fish, with sand and mollusks also contributing significantly. These findings provide valuable information into the dietary ecology of Lake Wood's fish community. Understanding these feeding interactions is crucial for informing conservation efforts, sustainable fisheries management, and preserving the lake's biodiversity. Further research is needed to comprehensively understand the lake's ecosystem, including the influence of habitat structure and water quality on fish population.

Keywords: Gut Content Analysis, Feeding Behavior, "Porang", Species Composition, Philippine Lakes.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Comparative Analysis of the Effect of Changes in Machine Equipment Characteristics on the Temperature Distribution on the Machine and the Cooking of Soybeans during Extrusion in Full-Fat Soybean Extruders

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Abstract

Soybean is one of the most important and valuable raw materials used in the feed industry due to its rich protein, oil and vitamins. Soybean is a feed ingredient with a high degree of digestibility, which is preferred for animals to balance their diet formulations and complete their amino acid deficits. Soybeans obtained by applying one of the processes such as roasting, extrusion, micronisation without removing the oil is called full-fat soybeans. Full-fat soybean is a basic protein source with its balanced amino acid structure, energy, essential fatty acids, vitamin and mineral content. It is a product that increases the development and productivity of cattle and poultry. In the feed industry, soybean extruders, in which soybeans are extruded by a thermo mechanical process to obtain full-fat soybean, are considered as a kind of reactors in which the raw material is cooked under high pressure and temperature conditions. In this study, in order to ensure a complete and continuous cooking process, it was investigated how some hardware parameter variations, which constitute the extruder and play a key role in the cooking process. In particular, it was reported how steam locks and outlet nozzle sizes affect the temperature distributions in the extruder during the process. Steam lock and outlet nozzle diameters were changed during the extrusion trials and their effects on the cooking efficiency were noted. At the end of each trial, the extruded product was tested for urease activity in accordance with ISO5506 standards and the cooking conditions were also observed. The first trials were carried out with 4 steam locks with outer diameters of 250 mm and these diameters were increased up to 255 mm according to the temperature distributions on the machine and the degree of cooking of the product. With the change of this parameter, the temperature distributions on the machine were graphed and it was seen that the optimum result was achieved with steam locks with diameters of 250-252-252-255 mm from inlet to outlet. The outlet nozzle diameters were also reduced to 16 mm, starting with 25 mm in the first trials. Especially in the optimum cooking conditions provided in the steam lock configuration, it was observed that the reduction of the nozzle diameter positively affected the degree of cooking. As a result of the study, in an extruder with a screw diameter of 250 mm and a capacity of 5 tons of full-fat soybeans per hour, the dimensions of the steam lock and their positions on the configuration and the outlet nozzle diameters were determined. With the data obtained as a result of the study, the steam locks and outlet nozzle designs to be used in these machines were optimized, which led to the possibility of reducing operating costs and making more efficient production.

Keywords: Extrusion, Extruder, Steam Lock, Full-fat Soybean.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024
PITESTI-ROMANIA

ORAL PRESENTATION

Improving the Sievability of High Valued Zinc Borate in Centrifugal Screener by Mechanical Methods

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Abstract

Centrifugal screeners are machines that used in sieving processes, which have a rotor with blades rotating on the central axis and can screen micron-level particles with centrifugal effect. This study evaluated the feasibility of using a centrifugal screener to classify particles above a certain size in zinc borate, a valuable product in the chemical industry. Zinc borate, which is commonly preferred in sectors such as polymers, wood and textiles, constitutes as flame retardant inorganic additive. In this study, we are aimed to sieve zinc borate particles above 100 µ by means of rotary motion. At first, an additional level of circular sieve is placed inside the circular micron-level one to perform a precise sieving to separate the product above 250µ or foreign objects. The second stage aims to separate the grains between 100-250µ from the original raw material so that the material below 100µ can be packed and become the final product. During the first test, it was observed that there was very little material passing through the stainless sieve with 104µ mesh. System integration was provided to create an air circulation on the blades to the sieve rotor. This increased the amount of material passing through the sieve holes. On the surface of the stainless steel sieve, cracks and holes were observed in a short time due to the chemical properties of the product and the density of the dust cloud caused by the air blown from the blades. Monitoring the sieving quality in this case became very difficult. The second test stainless steel sieves were replaced with polyamide sieves. The main factor behind the choice of polyamide sieves was the idea that it could absorb impacts due to its flexible structure. However, it was observed that the product sticks to the 110µ mesh polyamide sieve surface and the air circulation is not able cleaning the material. The most important observation reached as a result of the tests was that the polyamide threads created blockages as a result of an interaction with zinc borate. For the third test, the polyamide sieves were replaced with polyester sieves. The polyester sieve successfully sieved zinc borate at the desired capacity and a successful trial was achieved. As a result of the analysis, it was concluded that 100% of the sieved product was below 60µ, 50% was below 4µ microns and 10% was below 1µ. It was observed that there was very little product sticking to the surface of the polyester sieve. Our experiments determined that the most suitable sieve for sieving zinc borate product using mechanical methods should be polyester material. The machine has been optimized with 2-stage sieving integrated into this machine and air spraying from the blades that throw the product. A centrifugal screener has been developed to be used as an alternative for sieving in zinc borate production facilities within the chemical industry.

Keywords: Zinc Borate, Centrifugal Screener, Polyester Sieve.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Magnetic-Depth Estimation and Geophysical Investigation of Cappadocia Volcanic Province, Central Türkiye

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Abstract

The study aims to reveal the relationship between the magnetic data and depth in the Cappadocia Volcanic Province, containing upper Miocene to Quaternary volcanic/volcanoclastic rocks and volcanic centers, in the south-central part of the Central Anatolian Crystalline Complex. The region which is one of the main Late Cretaceous continental crystalline massifs of Anatolia, provides broad new insights regarding their genesis of tectonic units of central Türkiye. It is the largest metamorphic domain exposed in Türkiye, which mainly consists of metamorphic rocks, ophiolites, and magmatic intrusions. Collision and post-collision-related magmatic processes during the closure of the northern branch of the Neotethyan Ocean led to the formation of active tectonic structures in the upper crust. Therefore, the current study plays an important role in understanding the depths of the subsurface structures in the region. To this end, magnetic data has been interpreted by applying advanced geophysical processing techniques: reduce to pole correction, analytic signal processing, first vertical derivative, and depth estimation methods. After the reduced-to-pole correction of the magnetic data, the effects of shallow structures have been emphasized by applying the first vertical derivation method and producing the anomaly map. The highest anomaly value appears to be 0.15 nT/km, most of the severe first derivative anomalies are concentrated in the Cappadocia Volcanic Province. This indicates magnetic effects on the surface or near the surface in the upper crust. We detected these magnetic effects in the Cappadocia Volcanic Region on the map obtained by applying the analytical signal technique. In the three-dimensional map we obtained as a result of the depth-to-basement contact of the region applied to the magnetic data, we found that the deepest magnetic anomalies extend up to 15 km in the study area. It is evaluated that these anomalies match volcanic products including ignimbrites, volcanic ashes, lavas, sedimentary volcanic units, etc.

Keywords: Cappadocia Volcanic Province, Magnetic, Depth.

1. Introduction

The Central Anatolian Crystalline Complex (CACC) is one of the main crystalline massifs in central Türkiye which is important to understanding the collision between the Pontides and Anatolide-Tauride block (e.g., Floyd et al., 2000; Whitney et al., 2001; Kadıoglu et al., 2003; Gürer and van Hinsbergen, 2019). The south-central part of the CACC includes the Cappadocian Volcanic Province (CVP) (Fig. 1), containing upper Miocene to Quaternary volcanic–volcaniclastic rocks and polygenetic volcanic centers (Dilek et al., 1999). The CVP represents a broadly NE–SW-oriented volcanic region that involves upper

Miocene to Quaternary volcaniclastic rocks and volcanic centers (stratovolcanoes, cinder cones, volcanic ridges, and calderas) (Innocenti et al., 1975).

In this study, subsurface geophysical survey and magnetic basement depth estimation have been carried out using aeromagnetic data in the Cappadocia Volcanic Region in central Türkiye. In this context, first vertical derivatives of magnetic anomalies has been calculated from the total field reduced to pole magnetic data, then analytical signal has been obtained and magnetic base depths were estimated from them.

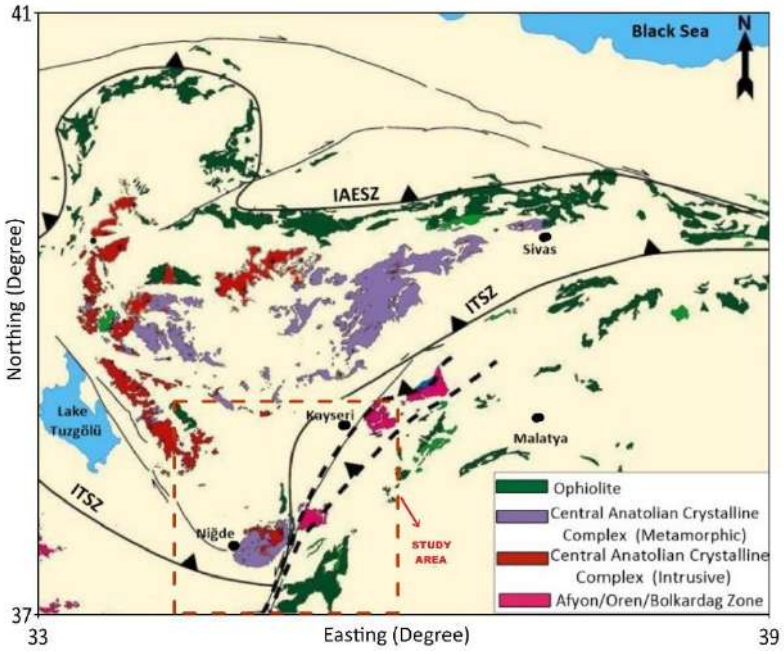


Figure 1. The simplified geological map of central Türkiye and dashed red area shows the study region (modified from MTA (General Directorate of Mineral Research and Exploration), 2002) and Çelik et al., 2023.

2. Materials and Methods

Geophysical surveys provide invaluable data on the subsurface, enabling researchers to make discoveries in the earth and its interior. For this purpose, measurements are taken from the air and the ground using various magnetometers. Magnetic data is collected by measurements taken on a line or in a grid pattern. Aeromagnetic data collected by the General Directorate of Mineral Research and Exploration (MTA) from a flight altitude of approximately 600 m have been used in the current study and the IGRF (1982.5) corrections have been applied. The other technical details are given in the previous research carried out by Ateş et al. (1999).

Since the magnetic data are affected by the ground magnetic field and structure magnetization, the Reduced-to-pole correction (RTP) has been applied to the magnetic data. Thus, these effects, which are expressed as undesirable effects in the data, have been removed from the data, and anomalies arising from the structures have been brought to their real positions.

2.1. First Vertical Derivative Method

Various techniques have been developed to separate the components within magnetic anomalies, which are a combination of regional anomalies created by deep structures and residual anomalies created by shallow structures. One of these techniques is the first vertical derivative method which is calculated from the residual magnetic field and enhances the short wavelength component of the field. The first vertical derivative is an enhancement technique that sharpens up anomalies over bodies and tends to reduce anomaly complexity, thereby allowing clear imaging of the causative structures (Revees, 2005). The first vertical derivative filter has been applied to the RTP magnetic data and the first vertical derivative anomaly map was produced (Fig. 2). Anomalies vary between -0.13 and 0.15 nT/km. When looking at the anomaly map, especially the polarized positive anomalies are observed in the south of Nevşehir province and the Ecemiş Fault Zone from Niğde to Kayseri trending NE-SW direction.

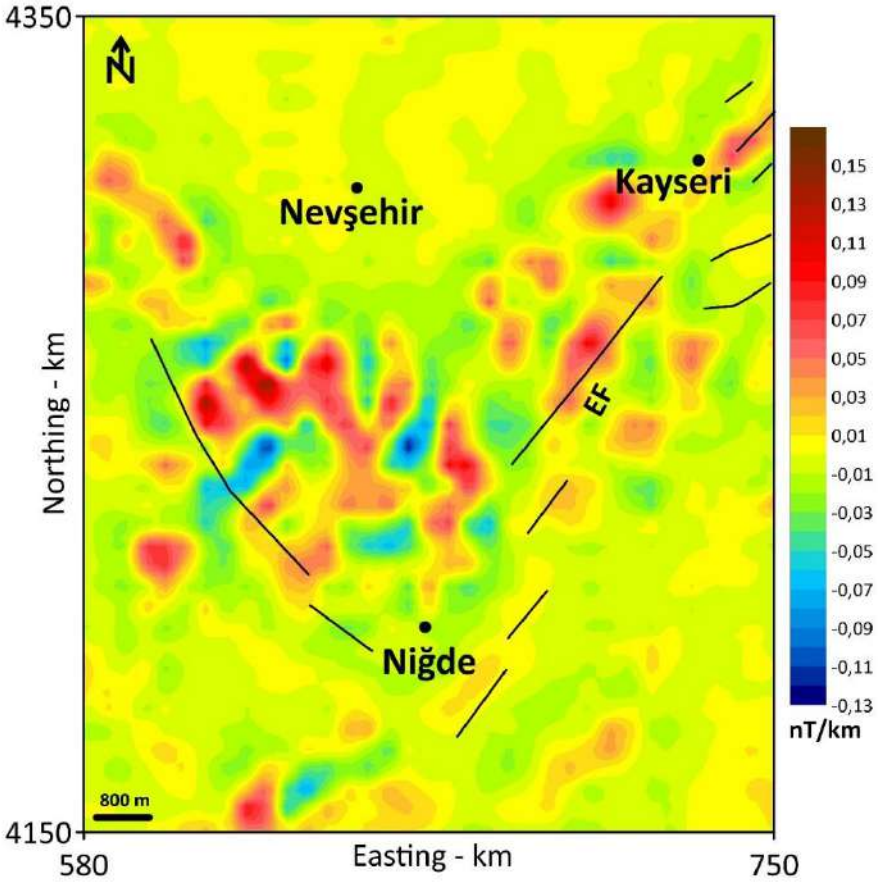


Figure 2. The first vertical derivative anomaly map of the study region. Black lines show the active faults modified from Emre et al. (2013).

2.2. Analytic Signal Method

One of the algorithms that gives effective results in determining the properties of structures causing anomalies is the analytical signal (AS) method. The method was developed by Roest et al. (1992) and is based on using first-order horizontal and vertical derivatives of the magnetic field. It is given with the relation,

$$AS = \sqrt{(\frac{\partial T}{\partial x})^2 + (\frac{\partial T}{\partial y})^2 + (\frac{\partial T}{\partial z})^2} \quad (1)$$

Here T refers to the total magnetic field. ∂T/∂x, ∂T/∂y and ∂T/∂z are the horizontal and vertical derivatives of the magnetic field, respectively. Since the method is independence of magnetization direction (inclination), it provides a great advantage in using AS to determine magnetic parameters in geophysical research. The map obtained as a result of the analytical signal method applied to the study area is given in Figure 3. Analytical signal amplitudes reach a maximum of 0.17 nT/km. The red rectangle on the map shows the region including intensive anomalies. This region has been selected to calculate the basement depth in the region.

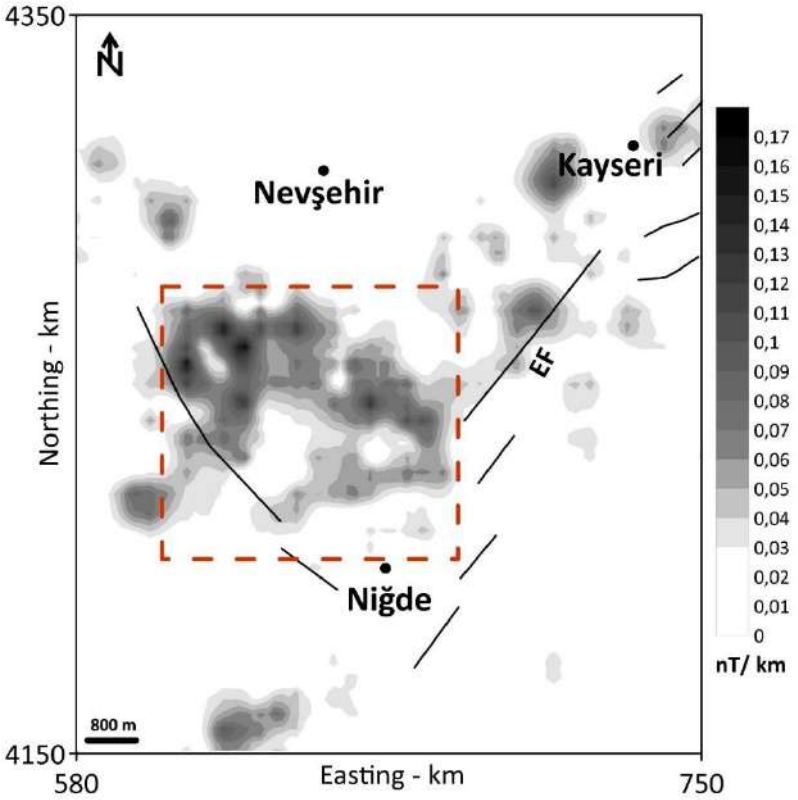


Figure 3. Analytical signal map of the study area. Dark black areas show where the analytical signal amplitude is maximum. Black lines show the active faults modified from Emre et al. (2013).

2.3. Basement Depth Estimation

The basement depth estimation of the subsurface structure causing anomalies is one of the most important topics in evaluating the magnetic data in the region. For this purpose, the analytical signal is used to obtain the depth of magnetic sources.

The magnetic sources depths from the Analytic Signal are estimated from the ratio of the total field AS to the vertical derivative analytic signal (ASI) of the total magnetic field;

$$ASI = \sqrt{(\frac{\partial T_v}{\partial x})^2 + (\frac{\partial T_v}{\partial y})^2 + (\frac{\partial T_v}{\partial z})^2} \quad (2)$$

∂T_v is the first vertical derivatives of the total magnetic field. Here, D, depth to the magnetic body is calculated from the equation;

$$D = \frac{AS}{ASI} xN \quad (3)$$

where N is accepted as a structural index about the source body of the magnetic data (N = 4 for sphere, N = 3 for pipe, N = 2 for the thin dike, N = 1 for contact) (Reid et al., 1990). We determined the variations of the basement depths of the study area according to the procedure mentioned here using N = 1 of structural index. The deepest regions are displayed by blue color while the shallowest places are illustrated by red color (Fig. 4). While the deepest depth appears to be around 15 km (NE of the map), average depths are around 6-8 km in the study area.

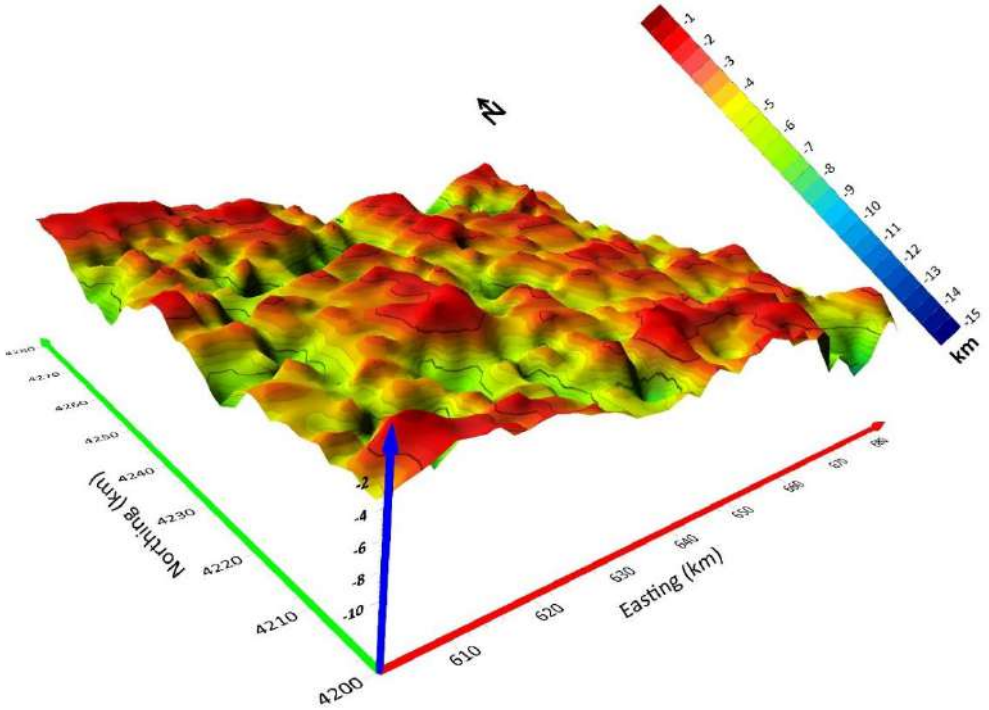


Figure 4. 3D view of basement depth by analytic signal method for the study area.

3. Conclusion

The Central Anatolian Crystalline Complex which is one of the main Late Cretaceous continental crystalline massifs of Anatolia, provides broad new insights regarding their genesis of tectonic units of central Türkiye. The south-central part of the CACC includes the Cappadocian Volcanic Province, containing upper Miocene to Quaternary volcanic/volcanoclastic rocks and volcanic centers. In this study, we present the relationship between the magnetic data and depths of the subsurface structures in the Cappadocia Volcanic Province using advanced geophysical processing techniques.

Reduce to pole correction, analytic signal processing, first vertical derivative, and depth estimation methods have been applied to the magnetic data. After the reduced-to-pole correction of the magnetic data, the first vertical derivation anomalies obtained show the highest 0.15 nT/km anomaly value in the

map. Most of the severe first derivative anomalies are concentrated in the Cappadocia Volcanic Province. We interpret that as indicating magnetic effects on the surface or near the surface in the upper crust. We also detected these magnetic effects in the Cappadocia Volcanic Region on the map obtained by the analytical signal application. In the 3-D magnetic basement map of the study region, we found that the deepest magnetic anomalies extend up to 15 km in the study area. It is assessed that these anomalies match volcanic products including ignimbrites, volcanic ashes, lavas, sedimentary volcanic units, etc.

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

A Study on the Shell Structure and Chemical Composition of *Flexopecten glaber* (Linnaeus, 1758) Collected from Bandırma Bay, the Sea of Marmara

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Abstract

Flexopecten glaber (Linnaeus 1758), commonly found in marine ecosystems, is a fascinating marine organism, particularly due to its shells. In this study, a detailed analysis of the chemical structure and composition of *Flexopecten glaber* shell has been conducted. Alongside the physical and chemical properties of the shells, determining the point of zero charge (PZC) has been a significant part of the study. PZC is a parameter that describes the conditions at which the electrical charge on a surface is zero. Thus, this parameter plays a critical role in understanding the interactions of the shells and their relationship with environmental factors. The point of zero charge (PZC) generally defines the pH value at which the net electric charge on the surface of a solid immersed in an electrolyte is zero. Theoretically, knowing the PZC can aid in the understanding of various applications and processes. Particularly in the field of surface chemistry, PZC stands out as an important criterion in the evaluation of particle interactions and adsorption processes. In this study, the PZC value determined for the shell particles of *Flexopecten glaber*, based on their surface properties, was found to be 8.33. This value provides a critical reference for understanding the behavior of the shells in acidic or alkaline environments and their interactions with environmental and biological factors. The chemical composition of the shells has been examined using X-Ray Diffraction (XRD) method. XRD is an effective method for providing detailed information about crystal structures, and in this study, it aims to compare the shells with calcium carbonate ($CaCO_3$) and aragonite crystal structures. Calcium carbonate is one of the main components of shells obtained from processed seafood, and the importance of this chemical substance is significant in terms of structural integrity. Additionally, the chemical contents of the shells were investigated using Scanning Electron Microscopy with Energy Dispersive Spectroscopy (SEM-EDS) analyses. EDS analyses provide important information about the elements present in the shells. According to the study results, the chemical composition of *Flexopecten glaber* shells was determined as follows: carbon (C) 32%, calcium (Ca) 8.34%, oxygen (O) 53%, and nitrogen (N) 6%, which is associated with proteins. These results have a significant impact on the biochemical and physical properties of the shells and contribute to a deeper understanding of their interactions with environmental conditions. This study opens new horizons in the fields of marine biology, ecology, and materials science, helping us better comprehend the effects of observed chemical compositions on the functions of the shells.

Keywords: *Flexopecten glaber*, Shell, Point of Zero Charge, SEM-EDS.

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
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ORAL PRESENTATION

Monthly Variations in Mineral Contents of *Mytilus galloprovincialis* Lamarck, 1819 Collected on the Kefken Coast, Western Blacksea (Türkiye)

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Abstract

Seafood plays a significant role in human nutrition due to its high protein content and rich mineral composition. *Mytilus gallopravincialis*, Lamarck 1819 species of mussel stands out for its rich content, serving both as a food source and as an important component of the ecosystem. In this study, the sodium, magnesium, potassium, and calcium contents of *Mytilus galloprovincialis* mussels were analyzed and examined monthly for a year. Investigating these mineral components is crucial for understanding the potential impacts of mussels on nutrition. Samples were collected during different seasons and analyzed under appropriate laboratory conditions. The analysis revealed that the sodium content in *Mytilus galloprovincialis* mussels ranged between 8.6 and 15 mg/g. This indicates that the sodium levels in mussels can vary depending on environmental conditions, dietary patterns, and the mineral content of their habitat. Sodium is an important mineral for the life cycle and health of mussels, and comparing these values with global mussel species can provide valuable information regarding ecosystem health and the impacts of seafood consumption. On the other hand, calcium, which is another significant mineral, varied between 1.57 and 8 mg/g. The range of calcium values is valuable for determining the calcium sources needed during the developmental stages of mussels. Magnesium and potassium levels ranged from 0.74-1.29 mg/g and 9.51-19 mg/g, respectively. Potassium plays a critical role in maintaining water balance and electrical conductivity in mussels. Magnesium, on the other hand, is important for nerve and muscle function, making mussels a healthy food source. These findings indicate that the mineral content of mussels varies with seasonal and environmental factors. This study on the mineral content of *Mytilus galloprovincialis* mussels provides valuable information from ecological, economic, and nutritional perspectives. As a result, *Mytilus galloprovincialis* is a nutritious seafood with a rich mineral content. *Mytilus galloprovincialis* also represents a sustainable resource from both environmental and economic viewpoints, making it a special species. Including mussels regularly in our diet would be an important step towards developing healthy eating habits and contributing to the preservation of marine ecosystems. Therefore, reinforcing the role of *Mytilus galloprovincialis* in nutritional guidelines emerges as a beneficial strategy for both individuals and communities.

Keywords: *Mytilus gallopravincialis*, Sodium, Magnesium, Potassium, Calcium.

Acknowledgment

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ORAL PRESENTATION

Reproduction Traits of Brook Trout (*Salvelinus fontinalis*) and Effects of Two Different Commercial Feeds on the Growth of Fry

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Abstract

In this research, 7 male and 7 female brook trout (*Salvelinus fontinalis*) broodstock fish materials were used. A total of 12.942 fertilized eggs were determined for incubation from these broodstock with dry fertilization method. Incubation period of eggs were 43 days with 92.73% hatching yield. After absorption of yolk sac, the fry with 0.34 g were fed with A and B brand name commercial feeds for 90 days. At the end of feding period, condition factors, tissue indexes of A and B groups were determined as 0.97±0.02; 1.01±0.01 and 11.32±0.44; 11.09±0.35 respectively. There were no significant differences between the groups with respect to condition factors, hepatosomatic indexes and tissue indexes. Growth parameters such as specific growth rate, protein efficiency ratio and feed conversion ratio from A and B feeds were determined as 3.54±0.03; 3.53±0.01 - 2.05±0.04, 1.95±0.03 and 0.89±0.01, 0.93±0.01 respectively with standard methods. There were no significant differences between groups all of these parameters. After a 90 day of feeding, mean weight gain of the groups fed with A and B feeds were increased from 0.34 g to 9.87±0.96 g and from 0.34 g to 8.93±0.45 g respectively. There were no significant differences to live weight increases. Hepatosomatic indexes of A and B groups were calculated as 1.54±0.28; 1,42±0.13 respectively ($p<0,05$).

Keywords: Brook Trout Eggs, Incubation Efficiency, Growth Parameters.

1. Introduction

The incubation period of eggs is an important criterion in the inclusion of alternative species in aquaculture. Egg quality is a factor that affects the success during the incubation period. For high incubation efficiency, high-quality eggs, high survival rates during incubation, and high hatching rates are among the important criteria (Güner and Tekinay 2002).

The native habitat of brook trout (*Salvelinus fontinalis*) is considered to be the fast and cold-running waters of North America between the latitudes of 32-55°N. The time required for brook trout to reach market size is approximately 2 years, and during this period, feed costs constitute a significant expense. For this reason, brook trout farming is less common compared to rainbow trout farming (Çelikkale 1994).

Different feeding techniques negatively affect feed intake in brook trout (*Salvelinus fontinalis*) and rainbow trout (*Oncorhynchus mykiss*), causing differences in growth parameters, and that continued use of such techniques could have adverse effects on growth (Refstie and Kittelsen 1976).

In this study, we aim to determine the reproduction traits of brook trout (*Salvelinus fontinalis*) and the effects of two different commercial feeds on the growth of fry.

2. Materials and Methods

In the research, 7 male and 7 female three-year-old brook trout (*Salvelinus fontinalis*) raised at the Freshwater Fish Research and Application Unit of the Faculty of Fisheries at Atatürk University were used. Female and male brook trout were stripped using the two-person method. The dry method, one of the artificial fertilization techniques, was applied during stripping. The fish to be stripped were placed in a 10-liter bucket, and 20 ml (2 ml/l) of clove oil was added to the water. Weight and length measurements were performed in sequence on the fish that were anesthetized with the clove oil (Uçar 2010). Two different feed brands were used in the experiment. The first group was fed with brand A feed, while the second group was fed with brand B feed (Table 1 and Table 2). In the experiment, 12.002 fry were obtained from the eggs of 7 female and 7 male brook trout (*Salvelinus fontinalis*). After these fry reached a weight of 0.34 g, they were divided into 2 groups with 3 replicates and subjected to feeding. Based on the live weights of the fish, the feed amounts were recalculated at the end of every 3 days, and feeding was carried out (6 meals/day).

Table 1. Chemical analysis of brand A dry feed.

Components	**Ratios %**
Crude protein	55
Crude lipid	18
Ash	10,5
Cellulose	0,5
Phosphorus	1,7
Calcium	2,5
Sodium	0,5

Table 2. Chemical analysis of brand B dry feed.

Components	**Ratios %**
Crude protein	55
Crude lipid	15
Ash	10,5
Cellulose	0,9
Phosphorus	1,8
Calcium	2,5
Sodium	0,7

2.1. Statistical Analyses

The data obtained in the study were subjected to an SPSS programme and T-test. The means of the significant sources of variation were compared using Duncan's multiple comparison test.

3. Results

3.1. Condition Factor

After 90 days of feeding, the condition factor of brook trout fed with brand A feed was calculated as 0.97±0.02, while the condition factor of brook trout fed with brand B feed was calculated as 1.01±0.01 (Table 3).

Table 3. Condition factor.

GROUP	Condition Factor
	Mean / Standard deviation
A FEED	0,97±0,02
B FEED	1,01±0,01

The results are given as mean ± standard deviation. Different superscripts in a row are significantly different (P≤0.05).

3.2. Hepatosomatic Index (HSI)

The hepatosomatic index (HSI) was calculated as 1.54±0.28 in brook trout fed with brand A feed, and 1.42±0.13 in brook trout fed with brand B feed (Table 4).

Table 4. Hepatosomatic index (HSI).

GROUP	HSI*
	Mean / Standard deviation
A FEED	**1,54±0,28^{b}**
B FEED	**1,42±0,13^{a}**

The results are given as mean ± standard deviation. Different superscripts in a row are significantly different (P≤0.05).

3.3. Visceral Somatic Index (VSI)

VSI was calculated as 11.32±0.44 in brook trout fed with brand A feed, and 11.09±0.35 in brook trout fed with brand B feed (Table 5).

Table 5. Visceral somatic index (VSI).

GROUP	VSI
	Mean / Standard deviation
A FEED	11,32±0,44
B FEED	11,09±0,35

The results are given as mean ± standard deviation. Different superscripts in a row are significantly different (P≤0.05).

3.4. Weight Gain (%)

While the group was determined to be statistically insignificant as a main source of variation in live weight gain ($p>0.05$), time was found to be statistically highly significant ($p<0.01$). The group x time interaction was also determined to be insignificant ($p>0.05$) (Table 6 and Table 7).

Table 6. Weight gain (%).

GROUP	WG (%)
	Mean / Standard deviation
A FEED	2,82±0,11
B FEED	2,55±0,11

The results are given as mean ± standard deviation. Different superscripts in a row are significantly different (P≤0.05).

Table 7. Evaluation of weight gain results over time based on days for brook trout fed with A and B feeds.

GROUP	TIME	WG (%)
		Mean / Standard deviation
	0-15 Day	0,59±0,28^{d}
	15-30 Day	0,76±0,28^{d}
	30-45 Day	0,96±0,28^{d}
A FEED	45-60 Day	1,50±0,28^{c}
	60-75 Day	2,12±0,28^{c}
	75-90 Day	3,94±0,28^{b}
	0-90 Day	9,87±0,28^{a}
	0-15 Day	0,55±0,28^{d}
	15-30 Day	0,79±0,28^{d}
	30-45 Day	0,73±0,28^{d}
B FEED	45-60 Day	2,13±0,28^{c}
	60-75 Day	1,81±0,28^{c}
	75-90 Day	2,92±0,28^{b}
	0-90 Day	8,93±0,28^{a}

The results are given as mean ± standard deviation. Different superscripts in a row are significantly different (P≤0.05).

3.5. Specific Growth Rate (SGR)

While the group was determined to be statistically insignificant as a main source of variation in specific growth ($p>0.05$), time was found to be statistically highly significant ($p<0.01$). The group x time interaction was also determined to be insignificant ($p>0.05$) (Table 8 and Table 9).

Table 8. Specific growth rate (SGR).

GROUP	SGR (%)
	Mean / Standard deviation
A FEED	111,12±1,40
B FEED	116,70±1,40

The results are given as mean ± standard deviation. Different superscripts in a row are significantly different (P≤0.05).

Table 9. Evaluation of weight-specific growth results over time based on days for brook trout fed with A and B feeds.

GROUP	TIME	SGR (%)
		Mean / Standard deviation
A FEED	0-15 Day	25,40±3,70^{g}
	15-30 Day	38,21±3,70^{f}
	30-45 Day	70,03±3,70^{e}
	45-60 Day	121,01±3,70^{d}
	60-75 Day	167,29±3,70^{c}
	75-90 Day	206,08±3,70^{b}
	0-90 Day	226,27±3,70^{a}
B FEED	0-15 Day	33,19±3,70^{g}
	15-30 Day	33,36±3,70^{f}
	30-45 Day	73,46±3,70^{e}
	45-60 Day	131,33±3,70^{d}
	60-75 Day	175,05±3,70^{c}
	75-90 Day	208,05±3,70^{b}
	0-90 Day	228,79±3,70^{a}

The results are given as mean ± standard deviation. Different superscripts in a row are significantly different (P≤0.05).

3.6. Protein Efficiency Ratio (PER)

The protein efficiency ratio (PER) was calculated as 2.05±0.04 for fish fed with feed A, and 1.95±0.03 for brook trout fed with feed B. The protein efficiency ratio values for the groups are presented in Table 10. No significant difference was found between the groups (p>0.05).

Table 10. Protein efficiency ratio (PER).

GROUP	PER
	Mean / Standard deviation
A FEED	2,05±0,04
B FEED	1,95±0,03

The results are given as mean ± standard deviation. Different superscripts in a row are significantly different (P≤0.05).

3.7. Feed Conversion Ratio (FCR)

The feed conversion ratio (FCR) was calculated as 0.89±0.01 for brook trout fed with feed A, and 0.93±0.01 for those fed with feed B. The feed conversion ratio values for the groups are presented in Table 11. No statistically significant difference was found between the groups (p>0.05).

Table 11. Feed conversion ratio (FCR).

GROUP	FCR
	Mean / Standard deviation
A FEED	0,89±0,01
B FEED	0,93±0,01

The results are given as mean ± standard deviation. Different superscripts in a row are significantly different (P≤0.05).

3.8. Survival Rate (SR)

The survival rate was calculated as 93.33±3.81% for brook trout fed with feed A, and 91.43±4.36% for those fed with feed B. The survival rate results for the groups are presented in Table 12. No statistically significant difference was found between the groups ($p>0.05$).

Table 12. Survival rate (SR).

GROUP	SR (%)
	Mean / Standard deviation
A FEED	93,33±3,81
B FEED	91,43±4,36

The results are given as mean ± standard deviation. Different superscripts in a row are significantly different ($P\leq0.05$).

4. Discussion Conclusion

A condition factor value of 1 or above is ideal. If the condition factor is 1, the fish is in good condition (Korkut et al. 2007). In a related study, the condition factor of newly fed trout fry was found to be 0.95. It was reported that as the fish gained weight, the condition factor increased to 1.2 or 1.3 (Brannon, 1991). The reason for the hepatosomatic index (HSI) value being statistically significant between the groups at the end of the study is that the fat content in brand A feed was higher than in brand B feed. It has been observed that feeding with high-fat diets increases the HSI value. This can be attributed to the high lipid content in the liver (Cheng et al. 2005). In a study conducted by Beyter (2008), rainbow trout with an average weight of 88.15±2.38 g were fed with three types of commercial feed (pellet (C), extruded (B), expanded (A)) over a ten-week trial period. The HSI values were found to be 1.29 for feed A, 1.18 for feed B, and 1.20 for feed C. The difference in HSI values was found to be significant ($p<0.05$). Differences in feed composition can create significant differences in HSI values. Particularly, when fish are fed diets with either high or low fat content, fat accumulation may occur in their internal organs. As a result, the visceral somatic index (VSI) value can increase. When fish are starved before slaughter, the potential for a high VSI value due to residual feed can be prevented (Cheng et al. 2005). In the study, the water temperature was measured between 9 and 9.25°C. In fry rearing, the ideal water temperature is desired to be in the range of 10-13°C. If the water in the environment where the trout are raised goes outside of the optimal temperature range, the growth of the fish can be negatively affected (Yıldırım et al. 2002). The Protein Efficiency Ratio (PER) value indicates the rate at which the protein in the feed consumed by the fish is converted into flesh over a specific period. The higher this value, the greater the efficiency of protein utilization is considered to be (Dulluç 2010). In general, a feed conversion ratio (FCR) below 1 or close to 1 is considered good in terms of feed efficiency. This value varies depending on the different sizes of the species, different farming conditions, and the composition of the feed (Korkut et al. 2007). At the end of the study, the FCR was calculated as 0.89±0.01 for brook trout fed with feed A, and 0.93±0.01 for those fed with feed B. In general, growth is defined as an increase in weight. To determine growth, the relationship between weight and the time taken for weight gain must be established, and this relationship is called the "Growth Rate" (Korkut et al. 2007). The specific growth rates obtained at the end of the study were found to be consistent with similar studies. The specific growth rate is influenced by factors such as fish species, size, age, feed composition, feeding level, stocking density, trial duration, water temperature, and oxygen levels (Halver 1972). Sonay and Kavuk 2023, Determination of Hatching Performance, Yolk-Sac Absorption, and Larval

Growth Rates in Abant Trout (*Salmo trutta abanticus*), Brook Trout (*Salvelinus fontinalis*), and their Hybrids. In the study, the hatching and larval survival rates of the fish were found to be 64.18% and 56.82%, respectively. The study indicated that the results showed significant linear relationships between degree-days and total live weight, as well as dry body weight, in brook trout. Başçınar and okumuş 2004 evaluated data on the incubation of eggs, survival rates, and development of brook trout (*Salvelinus fontinalis*) larvae and alevins. The durations for eyeing, hatching, and swim-up stages were 245, 415, and 675 degree-days at a temperature range of 4-12 ºC. Survival rates from fertilization to hatching and from fertilization to swim-up stages were 56.5% ± 24.28 and 52.0% ± 23.67, respectively. Alevin weight showed a positive correlation with egg size. When the studies mentioned above are evaluated as a whole, it is observed that there are similarities and differences with our experimental results. This is thought to be due to variations in incubation conditions, egg quality, and feed differences. Additionally, it has been concluded that these ratios and results should be further evaluated in a more comprehensive manner through additional studies and supported by further research.

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ORAL PRESENTATION

Climate Resilience Modelling at OMU Green University Krupelit Campus

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Abstract

Cities serve as collective living spaces by meeting the socialization needs and basic requirements of individuals. Every element and infrastructure play a vital role in shaping the quality of life in urban environments. The industrialization process has led to increased migration from rural to urban areas, resulting in a greater focus on cities. This rapid urbanization has caused changes in the social, political, cultural, economic, and climatic aspects of urban regions. Rapid population growth, indiscriminate migration, and rapid construction have led to various environmental degradations and challenges in urban cities. Universities, especially, are green areas within urban structures that breathe through green spaces and plants. OMU Kurupelit Campus, a rich example of this, prioritizes healthy campus planning by determining the impact of green spaces and construction on the climate. The quantity and quality of green spaces and their effects on urban climate are prominent. Green campuses influence healthy planning decisions. University structures and facilities significantly affect the mental and physical well-being of university residents. Green spaces are particularly necessary to promote a healthy lifestyle and strengthen the connection with nature. These spaces also play a crucial role in the temperature distribution and formation of heat islands in urban areas. However, unplanned urbanization has limited green spaces to enclosed areas. Urban green spaces and forests not only contribute to a healthier and more enjoyable life for city dwellers but also provide significant ecological benefits to urban environments. These areas enhance visual aesthetics, create comfortable and natural living spaces, improve air quality, support biodiversity, and help balance urban temperatures. This study was conducted at the OMU Green University Kurupelit Campus, where the effects of green spaces were investigated. Using ArcGIS and ENVI-met software, land use and building density were analyzed, and climate-based scenarios were created. The primary objective was to evaluate changes in urban temperatures within the university due to variations in the density of critical green spaces, plants, and forests. ENVI-met 5.2 software was used to facilitate climate-based scenarios and comprehensive analysis methodologies. The adequacy of existing green spaces, plants, and forested areas was assessed and modeled for the OMU Green University Kurupelit Campus. Subsequently, a green university climate scenario was created by reducing the number of buildings. The findings of the analysis showed that building materials and their heat absorption capacities significantly contributed to temperature increases in the current urban configuration. Additionally, buildings that obstruct wind flow exacerbate temperature rise. However, the green area climate scenario for the OMU Green University Kurupelit Campus provided a significant temperature reduction and alleviated urban heat islands. This can be attributed to the temperature-balancing effect of green spaces, plants, and forests that allow for uninterrupted wind flow. The study demonstrated that increasing green spaces and reducing building density in urban areas significantly affect the formation and intensity of urban heat islands. An increase in the extent of plants and green spaces within the green campus results in lower average temperatures and a cooler environment. Consequently, the quality and quantity of plants and green spaces in a green campus play a crucial role in combating urban heat islands.

Keywords: Climate Resilience, Green University, GIS, ENVI-Met, Urban Heat Island.

1. Introduction

Urban areas are increasingly recognized as critical spaces where the intersection of human activity and environmental change is most pronounced. Cities, as centers of economic, social, and cultural life, play a fundamental role in shaping the quality of life for billions of people worldwide. However, the rapid urbanization driven by industrialization has brought about significant challenges, particularly in relation to environmental degradation and climate change. The migration from rural to urban areas has led to increased population density, hasty construction, and the encroachment of natural landscapes, all of which have contributed to the emergence of urban heat islands (UHI) and other microclimatic alterations. (UN 2019; IPCC 2021; Oke 1987; Santamouris 2020; Kenworthy 2006; Wu and Zhang 2019; Gill et al., 2007; Bowler et al 2010; Thompson 2011; Tzoulas et al 2007; Rizwan et al 2008, Stone and Rodgers 2001; Norton, et al 2015; Kabisch and Haase 2014)

Universities, especially those located within urban settings, serve as microcosms of broader urban environmental dynamics. These institutions, often characterized by a mix of built environments and green spaces, provide unique opportunities for studying the interactions between urban development and natural ecosystems. The OMU Green University Kurupelit Campus, situated in Samsun, Turkey, is a prime example of such an environment, where the balance between green spaces and urban infrastructure significantly influences the local microclimate. (UN 2019; IPCC 2021; Oke 1987; Santamouris 2020; Kenworthy 2006; Wu and Zhang 2019; Gill et al., 2007; Bowler et al 2010; Thompson 2011; Tzoulas et al 2007; Rizwan et al 2008, Stone and Rodgers 2001; Norton, et al 2015; Kabisch and Haase 2014)

The concept of "green campuses" has gained traction as universities around the world strive to incorporate sustainability into their planning and development strategies. Green campuses are designed to minimize environmental impact through the strategic use of green spaces, energy-efficient buildings, and sustainable transportation systems. In addition to enhancing the aesthetic appeal of the campus, these green spaces play a crucial role in mitigating the UHI effect, reducing energy consumption, and improving air quality. (UN 2019; IPCC 2021; Oke 1987; Santamouris 2020; Kenworthy 2006; Wu and Zhang 2019; Gill et al., 2007; Bowler et al 2010; Thompson 2011; Tzoulas et al 2007; Rizwan et al 2008, Stone and Rodgers 2001; Norton, et al 2015; Kabisch and Haase 2014)

Green spaces within university campuses are particularly vital for maintaining a healthy microclimate. Vegetation, especially trees with extensive canopies, provides shade, reduces surface temperatures, and enhances evapotranspiration, thereby cooling the surrounding environment. Furthermore, green spaces contribute to the psychological and physical well-being of campus residents by providing areas for recreation, relaxation, and social interaction. The presence of diverse plant species also supports local biodiversity, offering habitat for various flora and fauna. (UN 2019; IPCC 2021; Oke 1987; Santamouris 2020; Kenworthy 2006; Wu and Zhang 2019; Gill et al., 2007; Bowler et al 2010; Thompson 2011; Tzoulas et al 2007; Rizwan et al 2008, Stone and Rodgers 2001; Norton, et al 2015; Kabisch and Haase 2014)

However, the benefits of green spaces are often compromised by unplanned urbanization and the expansion of built environments. As buildings proliferate and green spaces are encroached upon or fragmented, the cooling effects of vegetation are diminished, leading to increased temperatures and the exacerbation of the UHI effect. This phenomenon is particularly concerning in densely built urban areas

where the lack of adequate green infrastructure can result in significant temperature differences between the city center and its surrounding rural areas.

The OMU Green University Kurupelit Campus provides a unique case study for examining the impact of green spaces on urban climate resilience. The campus's diverse landscape, which includes academic buildings, residential areas, and expansive green spaces, allows for a comprehensive analysis of how different land use types influence microclimatic conditions. By utilizing advanced climate modeling tools such as ArcGIS and ENVI-met, this study aims to assess the effectiveness of green spaces in mitigating temperature increases and reducing the UHI effect on campus.

This study builds on existing research that emphasizes the importance of green infrastructure in urban environments. Previous studies have shown that strategically designed green spaces can significantly reduce urban temperatures, enhance air quality, and promote ecological sustainability. The findings from this research will not only contribute to the growing body of knowledge on urban climate resilience but also provide practical recommendations for the development of more sustainable university campuses.

In summary, the rapid urbanization of cities poses significant challenges to environmental sustainability, particularly in relation to microclimatic changes such as the UHI effect. Green spaces within urban environments, including university campuses, play a crucial role in mitigating these challenges. The OMU Green University Kurupelit Campus, with its mix of built and natural environments, offers a valuable opportunity to study the impact of green infrastructure on urban climate resilience. Through detailed climate modeling and analysis, this study aims to provide insights into the role of green spaces in promoting a cooler, healthier, and more sustainable campus environment.

2. Materials and Methods

This study aimed to assess the impact of green spaces, vegetation, and building density on the microclimate of the OMU Green University Kurupelit Campus. To achieve this, a combination of Geographic Information Systems (GIS), climate modeling software, and field observations was utilized.

OMU Green University Kurupelit Campus is located in Samsun, Turkey, and covers an extensive area with diverse land use types, including academic buildings, residential facilities, green spaces, and forests. The campus's geographic location and varied topography make it an ideal site for studying the interaction between urban development and natural landscapes. The campus is characterized by a Mediterranean climate with hot, dry summers and mild, wet winters, which further accentuates the importance of green spaces in mitigating heat-related issues.

2.1. Data Collection

2.1.1. Geographic and climatic data

Topographic Maps: High-resolution topographic maps of the campus were obtained to understand the terrain and elevation differences.

Land Use and Land Cover (LULC) Data: Satellite imagery and aerial photographs were analyzed to classify the different land use types within the campus, including built-up areas, green spaces, and forested zones.

Climatic Data: Historical weather data, including temperature, humidity, and wind speed, were collected from the Turkish State Meteorological Service (MGM) and the on-site weather stations within the campus. These data sets were essential for initializing and validating the climate models.

2.1.2. Field surveys

Vegetation Inventory: A comprehensive survey was conducted to catalog the types and densities of vegetation across the campus. This included identifying tree species, measuring tree heights, and estimating canopy cover.

Building Characteristics: Detailed information about the campus buildings, including their materials, heights, and orientations, was gathered. This data was crucial for accurately simulating heat absorption and wind flow in the models.

2.2. Modeling and Analysis Tools

3.1. Geographic Information Systems (GIS) ArcGIS software was used for spatial analysis and to create detailed maps of the campus's land use and vegetation cover. The GIS platform facilitated the integration of various data layers, such as topography, land use, and climatic variables, allowing for comprehensive spatial analysis of the study area.

3.2. ENVI-met Climate Model ENVI-met 5.2, a microclimate and environmental design software, was employed to simulate the campus's microclimate under different scenarios. ENVI-met is particularly well-suited for urban climate studies as it allows for high-resolution modeling of temperature, humidity, wind flow, and pollutant dispersion at the micro-scale (up to 100 meters resolution).

Model Setup: The study area was divided into a grid with a resolution of 10x10 meters to capture fine-scale variations in microclimate. The model was initialized using the collected climatic data and configured to run simulations for both summer and winter conditions.

Scenario Development: Several scenarios were developed to assess the impact of different levels of vegetation and building density on the campus microclimate. These scenarios included:

Baseline Scenario: Current land use and vegetation distribution.

Increased Green Space Scenario: Simulation of an increased proportion of green spaces by reducing built-up areas.

Reduced Building Density Scenario: Simulation of decreased building density by removing or redesigning certain buildings to enhance natural wind flow and reduce heat absorption.

2.3. Data Analysis

Temperature and Heat Island Analysis The output from the ENVI-met simulations was analyzed to evaluate temperature distribution and the intensity of the urban heat island effect across the campus. Temperature differences between the various scenarios were calculated to determine the effectiveness of green spaces in mitigating heat accumulation.

Wind Flow and Ventilation Wind flow patterns were analyzed to assess how different building configurations affected natural ventilation across the campus. Particular attention was given to identifying areas of stagnant air where heat accumulation was most pronounced.

Statistical Analysis The results from the simulations were subjected to statistical analysis to assess the significance of observed differences between scenarios. This included the use of analysis of variance (ANOVA) to compare temperature and wind speed variations under different land use configurations.

2.4. Validation

To ensure the reliability of the model simulations, the results were validated using on-site measurements of temperature and wind speed. Data loggers and anemometers were placed at various locations across the campus to collect real-time data, which was then compared with the ENVI-met model outputs. Discrepancies between observed and simulated data were analyzed, and model parameters were adjusted accordingly to improve accuracy.

2.5. Scenario Implementation

Based on the findings from the simulations, recommendations were made for optimizing green space distribution and building design to enhance climate resilience at OMU Green University Kurupelit Campus. The study's results were used to develop a "Green Campus Master Plan," which included specific guidelines for increasing vegetation cover, reducing building density, and improving natural ventilation pathways.

3. Results

This study aimed to evaluate the impact of green spaces, vegetation, and building density on the microclimate of the OMU Green University Kurupelit Campus, with a particular focus on mitigating the urban heat island (UHI) effect. The results obtained from the climate modeling and analysis are presented in the following sections (Figure 1, 2).



Figure 1. University areas of differences with building and green areas UHI effects.

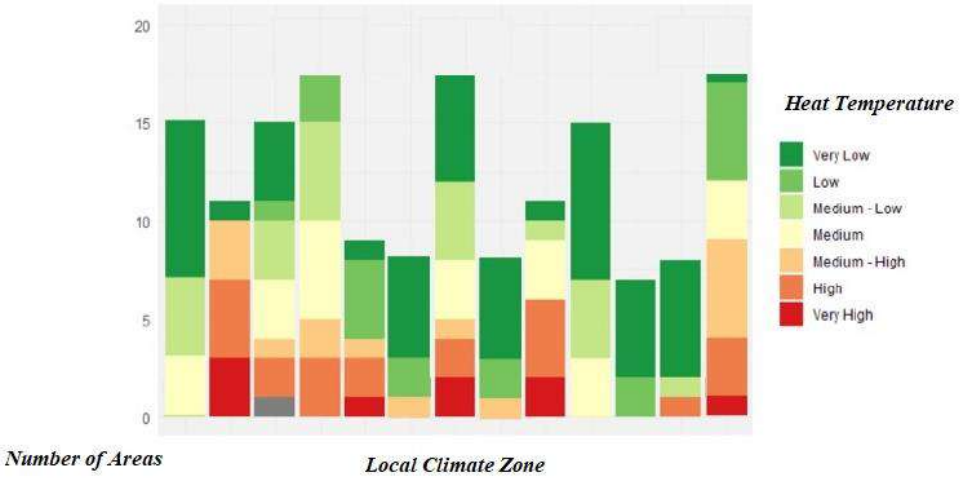


Figure 2. University areas of differences with building and green areas.

The simulation results revealed a significant relationship between the extent of green spaces and temperature distribution across the campus. In the Baseline Scenario, where the current distribution of green spaces and vegetation was maintained, the average temperature across the campus was notably higher in densely built-up areas. These areas exhibited temperature spikes, particularly during the peak summer months, indicative of the UHI effect. (Figure 3,4)

In contrast, the Increased Green Space Scenario demonstrated a clear reduction in temperatures across the campus. By increasing the green space coverage by 30%, there was an average temperature reduction

of 2-3°C in areas previously identified as heat islands. This cooling effect was most pronounced in regions where large, contiguous green spaces were introduced, suggesting that the size and continuity of green areas are critical factors in mitigating the UHI effect.

The study also assessed the role of different vegetation types and their densities in temperature regulation. Tree canopies with dense foliage, particularly those from native species such as Pinus brutia and Quercus spp., were found to be highly effective in providing shade and reducing ground surface temperatures. Areas with higher tree canopy coverage experienced a more substantial cooling effect compared to those with sparse or low-lying vegetation.

Moreover, the simulations indicated that increasing the density of vegetation, particularly in the form of mixed-species plantings, further enhanced the cooling effect. This finding underscores the importance of biodiversity in urban green spaces, as diverse plant species contribute to varying levels of shade, evapotranspiration, and overall microclimate regulation.

The Reduced Building Density Scenario provided insights into how the configuration and materials of buildings affect the campus microclimate. The results indicated that buildings constructed with high thermal mass materials, such as concrete and asphalt, significantly contributed to heat retention and subsequent temperature increases. Areas with high building density, especially those lacking adequate green buffers, were identified as hotspots with minimal cooling during the night, exacerbating the UHI effect.

When building density was reduced by 20% and replaced with green spaces, there was a marked improvement in temperature regulation. The reduction in building density allowed for better natural ventilation, as wind flow patterns were less obstructed by large, contiguous structures. This scenario demonstrated an average temperature reduction of 1-2°C in previously densely built-up areas, highlighting the potential of strategic urban planning in mitigating UHI effects.

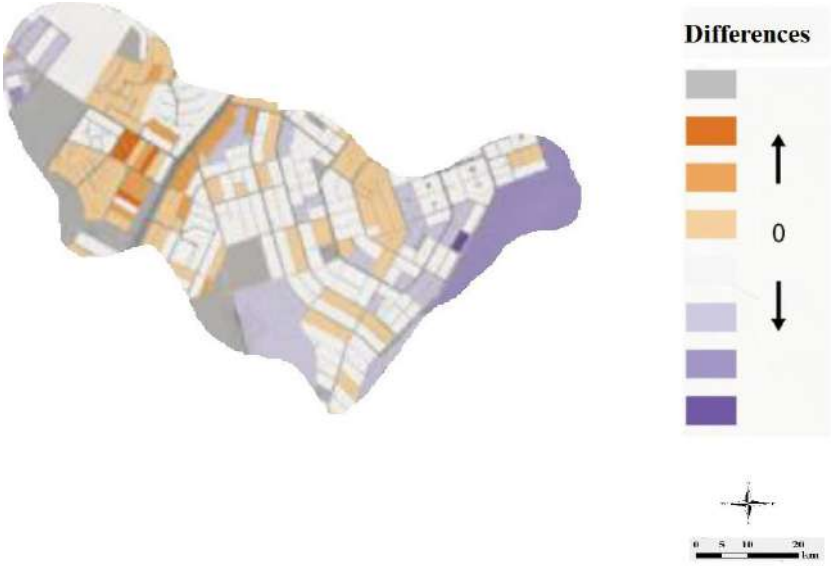


Figure 3. University areas of differences with building and green areas UHI effects.

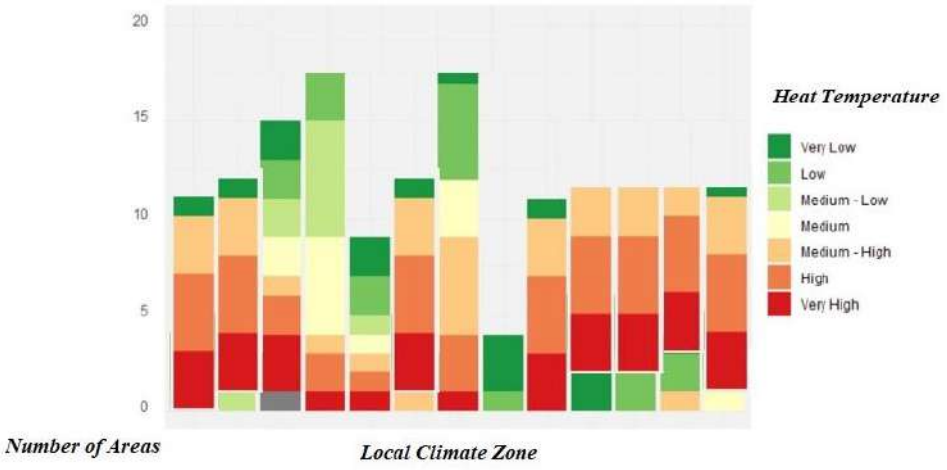


Figure 4. University areas of differences with building and green areas.

The analysis of wind flow patterns revealed that building configurations play a crucial role in determining the effectiveness of natural ventilation. In the Baseline Scenario, wind corridors were often blocked by tall buildings, leading to areas of stagnant air and increased heat accumulation. The ENVI-met simulations showed that these wind-blocking structures not only elevated local temperatures but also reduced the dispersion of pollutants, contributing to poorer air quality.

In the Reduced Building Density Scenario, the introduction of strategically placed green corridors and the reduction of building heights facilitated more effective wind flow across the campus. This enhanced natural ventilation led to cooler temperatures and better air quality, particularly in areas previously identified as wind-blocked zones.

The simulation results were validated against real-time temperature and wind speed data collected from various points across the campus. The comparison between observed and simulated data showed a high degree of accuracy, with temperature deviations of less than 1°C and wind speed discrepancies of less than 0.5 m/s in most locations. These results confirm the reliability of the ENVI-met model in predicting microclimatic changes in response to alterations in land use and building density.

The findings from this study have significant implications for the future planning and development of the OMU Green University Kurupelit Campus. The results underscore the importance of integrating large, contiguous green spaces into campus design to mitigate the UHI effect and enhance the overall environmental quality. Additionally, the study highlights the need for strategic building placement and material selection to promote natural ventilation and reduce heat retention.

Based on these findings, a series of recommendations have been proposed for the campus's Green Campus Master Plan. These include:

Increasing the coverage of native, high-canopy vegetation to maximize the cooling effect.

Reducing building density in key areas to improve wind flow and reduce heat accumulation.

Implementing green corridors that connect different parts of the campus, enhancing natural ventilation and creating cooler microclimates.

Utilizing building materials with lower thermal mass and reflective properties to minimize heat absorption.

In conclusion, this study demonstrates that strategic urban planning, with a focus on enhancing green spaces and optimizing building configurations, can significantly improve climate resilience in university campuses. By prioritizing green space expansion and reducing building density, it is possible to mitigate the UHI effect, create cooler microclimates, and improve the overall quality of life for campus residents. The OMU Green University Kurupelit Campus can serve as a model for other urban campuses seeking to balance development with environmental sustainability.

4. Discussion

The findings of this study on climate resilience modeling at OMU Green University Kurupelit Campus provide valuable insights into the complex interactions between urban development, green spaces, and microclimatic conditions.

The study demonstrates that increasing the quantity and quality of green spaces within urban environments, particularly on university campuses, can have a profound effect on mitigating the urban heat island (UHI) effect. The significant temperature reductions observed in scenarios with enhanced green spaces underscore the vital role that vegetation plays in regulating urban microclimates. This finding aligns with existing research, which has consistently shown that urban green spaces act as natural coolants, reducing surface and air temperatures through shading and evapotranspiration processes.

Moreover, the results highlight the importance of not only the presence of green spaces but also their spatial distribution and connectivity. Large, contiguous green areas were found to be more effective in mitigating heat accumulation than fragmented or isolated green patches. This suggests that urban planners and campus developers should prioritize the creation of extensive green networks that connect different parts of the campus, thereby maximizing their cooling potential and enhancing overall climate resilience.

The study also provides critical insights into the impact of building density and configuration on urban microclimates. High-density building clusters, particularly those constructed with materials that have high thermal mass, were identified as key contributors to localized heat accumulation. This is consistent with findings from other studies that have shown how dense urban environments with limited green space tend to exacerbate the UHI effect.

The simulation results suggest that reducing building density and optimizing building placement to enhance natural ventilation can significantly alleviate these heat-related issues. By strategically placing buildings to avoid blocking wind flow and incorporating reflective or low thermal mass materials, urban heat can be more effectively managed. These findings are particularly relevant for university campuses, where the balance between development and environmental sustainability is often a delicate one.

Based on the findings of this study, several recommendations can be made for enhancing climate resilience in university campuses and urban areas more broadly:

Expand Green Space Networks: Urban planners and campus developers should prioritize the creation of extensive, contiguous green spaces that are well-integrated into the urban fabric. These green networks can enhance cooling, improve air quality, and provide vital ecological benefits.

Optimize Building Placement and Design: Reducing building density and strategically placing buildings to enhance natural ventilation can significantly mitigate the UHI effect. Additionally, the use of materials with low thermal mass and high reflectivity should be encouraged to reduce heat absorption.

While this study focused on the cooling effects of vegetation, incorporating a diverse range of plant species can further enhance the ecological resilience of urban green spaces. Biodiversity in plantings can improve not only temperature regulation but also stormwater management, air quality, and habitat provision for urban wildlife.

Establishing long-term monitoring programs to track changes in microclimate and environmental quality is essential for adaptive management. This will allow for the continuous refinement of campus planning strategies and ensure that they remain responsive to changing climatic conditions.

The study investigated the role of urban green spaces in enhancing climate resilience at the OMU Green University Kurupelit Campus using ENVI-Met simulation software.

The current urban environment at the OMU Kurupelit Campus is characterized by high temperatures, ranging from 27.90°C to 31.49°C. This temperature variation is influenced by the density of buildings and the prevalence of impermeable surfaces like roads and residential blocks. The analysis highlighted how the existing land use, dominated by high building density and limited green spaces, contributes to elevated temperatures and decreased climatic comfort.

The simulations revealed that increasing green spaces can significantly mitigate urban heat. By expanding green areas to 66,000,000 m² and reducing the building footprint, temperatures in the modeled scenario decreased by approximately 2.7°C. This reduction underscores the cooling effects of green spaces and their ability to counteract urban heat islands, providing a more comfortable urban environment.

Beyond temperature reduction, green spaces offer additional microclimatic benefits. They improve air quality, enhance visual aesthetics, and contribute to better overall urban comfort. The shading effect of green spaces also lowers surface temperatures, which helps in energy conservation and reduces the urban heat island effect.

The study demonstrates that urban green spaces are crucial for enhancing climate resilience. By mitigating the direct effects of solar radiation and improving air quality, green spaces help cities adapt to climate change and reduce the adverse impacts of rising temperatures. The ability of green areas to absorb greenhouse gases further contributes to their role in combating climate change.

The use of ENVI-Met software provided valuable insights into the potential impacts of different urban planning scenarios. The model effectively simulated interactions between green spaces, buildings, and climate parameters, illustrating how changes in land use can affect urban temperatures and overall comfort. The study highlights the importance of using simulation tools to evaluate and optimize urban planning strategies for climate resilience.

The findings emphasize the need for strategic urban planning that integrates green spaces to enhance climate resilience. The study supports the adoption of nature-based solutions and sustainable practices in urban development. By increasing green areas and reducing building density, cities can achieve substantial improvements in temperature regulation and overall quality of life.

In conclusion, the study reinforces the significance of incorporating green spaces in urban planning to address climate change challenges. The results advocate for the strategic design and preservation of green areas to improve urban climates and foster resilient, sustainable cities.

5. Conclusion

The study clearly demonstrates that increasing urban green spaces can significantly enhance climate resilience. By expanding green areas and reducing building density, temperatures can be effectively moderated, resulting in a cooler and more comfortable urban environment. This finding underscores the critical role that green spaces play in mitigating the effects of urban heat islands and adapting to climate change.

The simulations revealed that expanding green spaces to 66,000,000 m² and reducing building area led to a notable temperature decrease of approximately 2.7°C. This substantial reduction highlights the effectiveness of green spaces in cooling urban areas and improving overall climatic comfort.

Green spaces offer numerous microclimatic benefits beyond temperature reduction. They enhance air quality, improve visual aesthetics, provide shading, and contribute to energy conservation. These benefits collectively improve urban living conditions and contribute to a healthier environment.

The findings emphasize the necessity of incorporating green spaces into urban planning strategies. Strategic integration of green areas into city landscapes is essential for achieving climate resilience and sustainable urban development. The study advocates for the proactive design and preservation of green spaces to optimize their climatic benefits.

The use of ENVI-Met simulation software proved instrumental in evaluating the impacts of various urban planning scenarios. The modeling provided valuable insights into how changes in land use affect urban temperatures and comfort levels. This highlights the importance of simulation tools in making informed decisions about urban planning and climate adaptation.

The study supports the adoption of nature-based solutions as a viable strategy for addressing climate change challenges. Green spaces not only improve urban microclimates but also contribute to broader environmental goals, such as reducing greenhouse gas emissions and enhancing biodiversity.

In conclusion, the study underscores the pivotal role of urban green spaces in fostering climate resilience and improving urban environments. By integrating green areas into urban planning, cities can better adapt to climate change, enhance living conditions, and promote sustainability.

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ORAL PRESENTATION

Determining Green Spaces as a Green University Strategy Based on Their Impact on Air Quality: OMU Krupelit Campus

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Abstract

Sustainability strategies at green universities positively transform the university environment socially, economically, environmentally, and health-wise by increasing the presence of green spaces and plants. These changes reduce air pollution and positively impact the health of university users. Air pollution has become an increasingly significant problem due to rapid population growth and intense industrial activities in urban areas. This issue, with its adverse effects on health, quality of life, and climate change, has become a critical area of research. Various strategies have been adopted to improve air quality in urban areas, but increasing green and forested areas stands out as a significant alternative in these efforts. These areas play a crucial role in reducing air pollution quickly and economically. This study analyzes the particulate matter air pollution problem within the framework of the green university strategy at Ondokuz Mayıs University (OMU) Kurupelit Campus. As OMU has a campus rich in green spaces, a detailed examination was conducted within the context of green campus areas. Particulate matter measurements were carried out using a CEM DT9880 device at 10 sampling points: 5 in green university areas and 5 in nearby urban settlements. The selection of measurement points considered the density of green spaces, plant density, traffic density, population density, open spaces, proximity to the university campus, and other notable features. The collected data were analyzed using the Inverse Distance Weighted (IDW) method in ArcGIS 10.8. The results show a noticeable decrease in particulate matter pollution as proximity to the green university Kurupelit campus increases, thanks to the pollution-absorbing and air-purifying properties of plants. These findings clearly demonstrate that green spaces play a significant role in improving air quality. As a green campus strategy, expanding green areas and supporting afforestation initiatives should be fundamental components of air quality management strategies. Given the high levels of air pollution in urban areas, such strategies are crucial for ensuring environmental sustainability. Green campus applications should be encouraged to protect the health of students, academic and administrative staff, and to provide valuable insights for environmental sciences and urban planning. Expanding green spaces should be prioritized as a solution to improve air quality in urban areas.

Keywords: Green University, Sustainability, Afforestation, Green Spaces.

1. Introduction

In the contemporary context of rapid urbanization and industrialization, air quality has become a critical concern for both public health and environmental sustainability. The escalating levels of air pollution, driven by increasing population densities, industrial activities, and vehicular emissions, pose significant

threats to human health, ecosystem balance, and overall quality of life. This growing challenge necessitates effective strategies to mitigate pollution and enhance environmental quality. (Amato et al., 2014; Wang et al., 2014; WHO, 2021; Pope et al., 2009; HEI, 2019; Querol et al., 2004; Amato et al., 2014).

Universities, as centers of education and research, play a pivotal role in promoting sustainability and environmental stewardship. The concept of "green universities" reflects a commitment to integrating ecological principles into campus operations, with a focus on reducing environmental impact and fostering a healthier campus environment. A key component of this initiative is the expansion and maintenance of green spaces, which are known to offer numerous benefits, including improved air quality, enhanced biodiversity, and a more pleasant campus experience.

Green spaces, including parks, gardens, and forests, contribute significantly to air quality by acting as natural filters for pollutants. Plants and trees absorb particulate matter, carbon dioxide, and other harmful gases, while releasing oxygen and promoting overall atmospheric health. This process not only reduces the concentration of airborne pollutants but also contributes to a more aesthetically pleasing and serene environment.

Ondokuz Mayıs University (OMU) Kurupelit Campus, located in an urban setting with a substantial amount of green spaces, provides an excellent case study for assessing the impact of green spaces on air quality. The campus's extensive green areas offer a unique opportunity to explore the relationship between green space density and particulate matter pollution.

This study aims to evaluate the effectiveness of OMU Kurupelit Campus's green spaces in improving air quality by analyzing particulate matter (PM) levels across different areas within and surrounding the campus. By comparing pollution levels in green university areas with those in adjacent urban settlements, this research seeks to highlight the role of green spaces in mitigating air pollution.

Particulate matter, a common air pollutant, is particularly concerning due to its potential to cause respiratory and cardiovascular health issues. The presence of fine particulate matter (PM2.5) and coarse particulate matter (PM10) in the atmosphere can exacerbate health problems and degrade overall air quality. Understanding how green spaces influence the concentration of these pollutants is crucial for developing effective strategies to enhance urban air quality. (Amato et al., 2014; Wang et al., 2014; WHO, 2021; Pope et al., 2009; HEI, 2019; Querol et al., 2004; Amato et al., 2014).

The study employs advanced measurement techniques using a CEM DT9880 device to capture particulate matter levels at multiple sampling points. By utilizing the Inverse Distance Weighted (IDW) method in ArcGIS 10.8, the research provides a detailed spatial analysis of air pollution and assesses the impact of green spaces on pollutant levels.

The findings of this study are expected to offer valuable insights into the effectiveness of green spaces as a strategy for improving air quality. The results will contribute to the broader discourse on sustainable campus development and urban environmental management, providing a model for other institutions and cities aiming to address air pollution through green initiatives.

In conclusion, as urban areas continue to expand and environmental challenges become more pronounced, the role of green spaces in enhancing air quality cannot be overstated. This research

highlights the importance of integrating green spaces into university campuses and urban planning efforts to promote a healthier and more sustainable environment.

2. Materials and Methods

The study was conducted at Ondokuz Mayıs University (OMU) Kurupelit Campus, which is located in a semi-urban area with a significant amount of green space. The campus features various types of green areas, including lawns, gardens, and wooded sections, providing a diverse environment for the assessment of air quality impacts related to green spaces. The study area was selected due to its rich green infrastructure and its contrast with nearby urban settlements that have less green coverage.

Ten sampling points were established for particulate matter measurement:

Five Sampling Points within Green University Areas: These points were chosen based on the density and distribution of green spaces on the campus. Criteria included proximity to lawns, gardens, and forested areas.

Five Sampling Points in Nearby Urban Settlements: These points were selected in areas with minimal green spaces, representing typical urban environments. Factors considered included traffic density, building density, and proximity to industrial activities.

2.1. Measurement of Particulate Matter

Particulate matter levels were measured using a CEM DT9880 device, which is equipped to detect both PM2.5 and PM10 particles. The device was calibrated according to the manufacturer's instructions before the measurements to ensure accuracy.

2.2. Measurement Procedure

Site Preparation: Each sampling point was prepared by ensuring that the measurement device was placed in a stable and representative location. Measurements were taken at approximately 1.5 meters above ground level to capture data reflective of the general breathing zone.

Data Collection: At each sampling point, particulate matter levels were recorded over a period of 24 hours to account for variations in pollution levels throughout the day. Measurements were conducted on weekdays to avoid potential variations due to weekend activities.

Frequency of Measurements: Measurements were conducted at each sampling point on three different days to account for temporal variations in pollution levels. Data from these days were averaged to provide a representative value for each location.

2.3. Data Analysis

Data Processing: The collected particulate matter data were processed using the Inverse Distance Weighted (IDW) interpolation method in ArcGIS 10.8. This spatial analysis technique was used to create detailed maps of particulate matter distribution and to assess the influence of green spaces on pollution levels.

Interpolation Method: The IDW method was selected due to its effectiveness in estimating values at unsampled locations based on the spatial distribution of measured points. This method assigns weights to data points based on their distance from the location of interest, with closer points having more influence on the estimated value.

Statistical Analysis: Statistical analyses were performed to compare particulate matter levels between green university areas and urban settlement areas. Descriptive statistics, including mean, median, and standard deviation, were calculated. Additionally, inferential statistics, such as t-tests, were used to determine if the differences in particulate matter levels were statistically significant.

Temporal Variability: Although efforts were made to capture a representative dataset, variations in pollution levels due to weather conditions and seasonal changes could influence the results.

Measurement Accuracy: The accuracy of the particulate matter measurements is dependent on the calibration and performance of the CEM DT9880 device. Regular maintenance and calibration were performed to mitigate potential errors.

3. Results

The data provided represents the concentrations of PM2.5 and PM10 across 20 stations at a Green Campus University in Figure 1 and Table 1

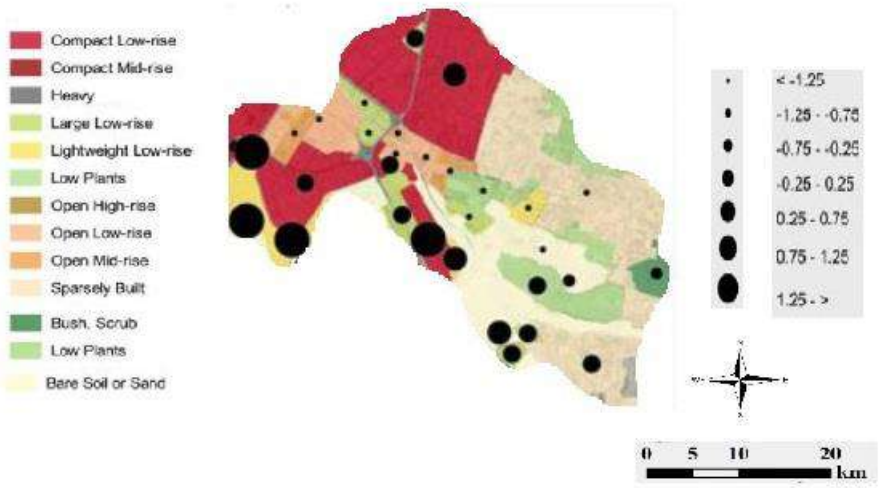


Figure 1. Spatial distribution of with the PM2.5 and PM10 values Green Campus University.

Table 1. PM2.5 and PM10 values.

Station Number	PM2.5	PM10
1	432.4	62.4
2	735.4	68.4
3	234.4	50.4
4	359.4	74.4
5	432.4	58.4
6	257.4	52.4
7	147.4	66.4
8	274.4	65.4
9	639.4	81.4
10	569.4	86.4

This table reflects the values both PM2.5 and PM10 for each station. The table shows the concentrations of PM2.5 and PM10 particulate matter at various stations. The PM2.5 values range from 147.4 to 735.4 across the different stations. Station 2 has the highest PM2.5 level at 735.4, indicating a potentially significant source of fine particulate matter at this location. Station 7 has the lowest PM2.5 level at 147.4, suggesting relatively cleaner air in terms of fine particles. The PM10 values range from 50.4 to 86.4 across the stations. Station 10 has the highest PM10 level at 86.4, which could be due to larger particulate matter being more prevalent in that area. Station 3 has the lowest PM10 level at 50.4, indicating lower levels of larger particulate matter compared to other stations.

Highest Levels: Station 2 stands out with the highest PM2.5 value (735.4) but has a comparatively moderate PM10 value (68.4). Station 10 has the highest PM10 value (86.4), but its PM2.5 is slightly lower at 569.4.

Lowest Levels: Station 7 has the lowest PM2.5 value (147.4) but relatively higher PM10 (66.4) compared to other low PM2.5 stations. Station 3 has both the lowest PM10 (50.4) and one of the lower PM2.5 levels (234.4). Stations with higher PM2.5 might be near high-traffic areas or sites of combustion, where fine particles are typically emitted. High PM10 levels might be indicative of dust and other coarse particles, possibly from construction activities or unpaved areas.

Health Implications: High levels of PM2.5, especially near Station 2, pose a serious health risk as fine particles can penetrate deep into the lungs and even enter the bloodstream. Elevated PM10 levels at Stations 9 and 10 can cause respiratory issues, particularly in sensitive populations such as children and the elderly. The data shows variability in particulate matter concentrations across different stations, with some locations exhibiting significantly higher pollution levels. This suggests localized sources of pollution and the need for targeted air quality management strategies to mitigate health risks associated with high particulate matter concentrations. The PM2.5 concentrations across the ten monitoring stations at Green Campus University exhibit a notable range from 147.4 µg/m³ to 735.4 µg/m³. The lowest concentration was recorded at Station 7 (147.4 µg/m³), while Station 2 registered the highest PM2.5 concentration at 735.4 µg/m³. This wide range of values indicates significant spatial variability in fine particulate matter levels across the campus, which may be influenced by various factors, including proximity to pollution sources, meteorological conditions, and local land use patterns.

Station 2 stands out with the highest PM2.5 concentration (735.4 µg/m³), suggesting the presence of a significant source of fine particulate matter in the vicinity. This could be attributed to emissions from nearby traffic, industrial activities, or other combustion-related processes. The elevated levels of PM2.5 at this station are a cause for concern due to the associated health risks, as fine particles can penetrate deep into the respiratory system, leading to various adverse health effects.

On the other hand, Station 7 recorded the lowest PM2.5 concentration (147.4 µg/m³), indicating relatively better air quality in terms of fine particulate matter. This station may be located in an area with fewer pollution sources or better ventilation, which helps in dispersing the particulate matter. The lower PM2.5 levels suggest that the air in this area is cleaner, potentially due to the presence of green spaces or a lower density of emission sources.

PM10 Concentrations: The PM10 concentrations at the stations also show variability, with values ranging from 50.4 µg/m³ at Station 3 to 86.4 µg/m³ at Station 10. The narrower range compared to PM2.5 indicates that the distribution of coarser particulate matter is slightly more uniform across the campus. However, the variations observed still reflect the influence of local sources and environmental conditions on PM10 levels.

Station 10 recorded the highest PM10 concentration (86.4 µg/m³), suggesting a higher presence of larger particulate matter in this area. This could be due to nearby construction activities, unpaved roads, or other sources of dust and coarse particles. The elevated PM10 levels at this station raise concerns about potential respiratory issues, particularly for individuals with pre-existing conditions or those who are more vulnerable to air pollution.

Station 3 recorded the lowest PM10 concentration (50.4 µg/m³), indicating lower levels of coarser particulate matter. This station might be located in a more open area or an area with effective natural filtration by vegetation, which helps reduce the presence of larger particles in the air. The lower PM10 levels at Station 3 suggest better air quality in terms of coarser particulate matter.

In general, stations with higher PM2.5 concentrations tend to have correspondingly higher PM10 levels, indicating that sources contributing to fine particulate matter are also responsible for generating coarser particles. However, some stations exhibit interesting deviations from this pattern.

Station 2, which recorded the highest PM2.5 concentration (735.4 µg/m³), has a relatively moderate PM10 concentration (68.4 µg/m³). This discrepancy might suggest that the primary source of pollution in this area emits more fine particles than coarse ones, such as from vehicular emissions or industrial combustion processes.

Station 10, with the highest PM10 concentration (86.4 µg/m³), has a PM2.5 concentration of 569.4 µg/m³. While this station exhibits high levels of both PM2.5 and PM10, the proportionally higher PM10 levels suggest that this area may be more affected by sources of coarse particles, such as dust from construction sites or natural dust re-suspension.

Interestingly, Station 7, which has the lowest PM2.5 concentration (147.4 µg/m³), shows a relatively higher PM10 level (66.4 µg/m³). This might indicate that while fine particulate pollution is minimal, the area still experiences a notable presence of larger particles, possibly due to localized dust sources or windblown particulates.

Station 3, which recorded the lowest PM10 concentration (50.4 µg/m³), also shows one of the lower PM2.5 levels (234.4 µg/m³). This station likely benefits from natural factors that reduce both fine and coarse particulate matter, such as high vegetation cover or favorable wind patterns that disperse pollutants.

Stations with higher PM2.5 concentrations, such as Station 2, are likely located near high-traffic areas or other combustion sources, which are known for emitting fine particulate matter. These areas may require targeted interventions to reduce emissions and improve air quality.

High PM10 levels at stations like 10 and 9 suggest that these areas may be impacted by dust from construction activities or other sources of coarse particulates. Dust suppression measures and improved urban planning could help mitigate the impact of these particles.

The elevated levels of PM2.5, particularly at Station 2, pose serious health risks, as fine particles can penetrate deep into the lungs and enter the bloodstream, leading to respiratory and cardiovascular issues. The high PM10 levels at Stations 9 and 10 also present health concerns, as coarse particles can cause respiratory irritation and exacerbate conditions like asthma.

The data reveal significant spatial variability in PM2.5 and PM10 concentrations across the Green Campus University, with certain stations showing alarmingly high levels of particulate matter. These findings underscore the need for targeted air quality management strategies, particularly in areas with high pollution levels, to protect the health of the campus community and improve overall air quality.

4. Discussion

The analysis of PM2.5 and PM10 concentrations across different stations at Green Campus University reveals significant spatial variability in particulate matter (PM) levels, which can have profound implications for air quality and public health.

The observed variability in PM2.5 and PM10 levels across the campus is consistent with findings from previous studies that highlight the influence of local sources and environmental conditions on particulate matter distribution. For instance, areas with high vehicular traffic, industrial activities, and construction work are often associated with elevated PM levels due to the emission of both fine and coarse particulates (Wang et al., 2014; WHO, 2021). In our study, Station 2, which exhibited the highest PM2.5 concentration, likely reflects the proximity to such pollution sources. Similarly, the high PM10 levels at Station 10 could be attributed to dust re-suspension from construction activities or unpaved areas, a phenomenon well-documented in urban environments (Amato et al., 2014). (Wang et al., 2014; WHO, 2021). (Pope et al., 2009; HEI, 2019). (Querol et al., 2004; Amato et al., 2014).

The health implications of high PM2.5 and PM10 levels cannot be overstated. Fine particulate matter (PM2.5) is particularly dangerous due to its ability to penetrate deep into the respiratory system and even enter the bloodstream, leading to a range of health issues, including respiratory and cardiovascular diseases, and premature mortality (Pope et al., 2009; HEI, 2019). The high PM2.5 levels observed at Station 2 pose a significant health risk to individuals in the vicinity, particularly vulnerable populations such as children, the elderly, and those with pre-existing health conditions.

Coarse particulate matter (PM10), while larger and less likely to penetrate as deeply into the lungs, can still cause respiratory irritation and exacerbate conditions like asthma and bronchitis (Chen et al., 2015). The elevated PM10 levels at Station 10, in particular, highlight the need for mitigation measures to reduce exposure in these areas, which could include dust suppression strategies and the implementation of green infrastructure to capture airborne particles (Nowak et al., 2013).

The findings of this study have important implications for campus planning and air quality management. The identification of hotspots with elevated PM levels suggests the need for targeted interventions to reduce pollution exposure. For instance, traffic management strategies could be implemented around Station 2 to reduce vehicular emissions, while dust control measures might be necessary near Station 10 to address the high levels of coarse particulates. Additionally, the strategic placement of vegetation, such as trees and shrubs, can serve as natural filters, reducing the concentration of particulate matter in the air (Abhijith et al., 2017).

The data also suggest the potential benefits of monitoring and managing air quality more dynamically, particularly in areas with high variability in PM levels. Continuous air quality monitoring, coupled with real-time data analysis, could help in identifying emerging pollution trends and implementing timely interventions (Borrego et al., 2015).

The levels of PM2.5 and PM10 observed in this study are comparable to those reported in other urban and campus environments. For instance, a study conducted by Wang et al. (2014) in a university setting in China found similar ranges of PM concentrations, with higher levels in areas closer to traffic and construction sites. The results align with global trends reported by the World Health Organization (WHO), which highlights urban areas as hotspots for PM pollution, particularly in developing regions (WHO, 2021).

Moreover, the proportionality between PM2.5 and PM10 levels observed in this study supports findings from previous research indicating that fine and coarse particulate matter often originate from similar sources, such as road traffic and industrial emissions, but their distribution can be influenced by factors like wind patterns and local topography (Querol et al., 2004; Amato et al., 2014).

5. Conclusion

The analysis of particulate matter (PM2.5 and PM10) concentrations across different locations at the Green Campus University reveals significant spatial variability in air quality, highlighting the complex interplay between environmental factors and pollution sources.

The data reveal significant spatial variability in PM2.5 and PM10 concentrations across the Green Campus University, with certain stations showing alarmingly high levels of particulate matter. These findings underscore the need for targeted air quality management strategies, particularly in areas with high pollution levels, to protect the health of the campus community and improve overall air quality.

The study supports the benefits of integrating green infrastructure as part of air quality management strategies. The strategic placement of vegetation, such as trees and shrubs, can act as natural filters for particulate matter, improving overall air quality. Enhancing green spaces on campus and surrounding areas could provide a sustainable solution to reduce particulate pollution and improve the health and well-being of the campus population.

This study has some limitations that should be considered in interpreting the results. The data collection was limited to a specific period, and temporal variations in PM levels, such as seasonal effects, were not accounted for. Future studies could benefit from longitudinal data to capture temporal trends in particulate matter concentrations. Additionally, the study focused on a limited number of stations within the campus; expanding the monitoring network could provide a more comprehensive understanding of spatial variability in PM levels.

The findings suggest that continuous air quality monitoring and real-time data analysis could be beneficial for managing air quality more dynamically. Regular monitoring can help identify emerging pollution trends, assess the effectiveness of implemented measures, and guide timely interventions to address air quality issues.

In summary, the study highlights the critical need for targeted air quality management strategies, enhanced green infrastructure, and continuous monitoring to address particulate matter pollution effectively. By implementing these measures, the university can contribute to a healthier campus environment and serve as a model for other institutions aiming to improve air quality and promote sustainability.

Further research could also explore the specific sources of particulate matter at the identified hotspots through source apportionment studies, which would provide more targeted recommendations for pollution control measures. Integrating air quality data with health outcome studies could also help in quantifying the public health impacts of PM pollution on the campus population.

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
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ORAL PRESENTATION

Evaluating the Impact of Sustainable Green Campus Initiatives on Air Quality at University Campuses

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Abstract

Air pollution has become an increasingly significant problem due to rapid population growth and intense industrial activities in urban areas. This issue has adverse effects on health, quality of life, and climate change, making it a critical area of research. Although various strategies have been adopted to improve air quality in urban areas, increasing green and forested areas stands out as a significant alternative. Green spaces play a crucial role in reducing air pollution quickly and economically. This study analyzes the particulate matter air pollution problem within the Ondokuz Mayıs University (OMU) Faculty of Architecture campus in the context of green campus areas. Particulate matter measurements were conducted using a CEM DT9880 device at 20 sampling points: 10 within the green areas of the campus and 10 in nearby urban settlements. The selection of measurement points considered traffic density, population density, open spaces, the density of green areas, proximity to the campus, and other notable features. The collected data were analyzed using the Inverse Distance Weighted (IDW) method in ArcGIS 10.8. The results indicate a noticeable decrease in particulate matter pollution as proximity to the campus increases, due to the pollution-absorbing and air-purifying properties of plants. Measurements in green campus areas revealed lower particulate matter levels compared to urban settlements. Consequently, it is evident that green spaces play a significant role in improving air quality. Expanding green areas and supporting afforestation initiatives should be fundamental components of air quality management strategies. These findings are of great importance for ensuring environmental sustainability. Green campus practices should be encouraged to protect the health of students, academic and administrative staff, and provide valuable insights for environmental sciences and urban planning. Expanding green spaces should be prioritized as a solution to improve air quality in urban areas.

Keywords: Particulate Matter, Green Campus, Sustainability, Urban Area, Green Spaces.

1. Introduction

Air pollution has emerged as a critical environmental concern, driven by rapid urbanization, population growth, and industrial activities. The detrimental effects of air pollution on human health, quality of life, and climate change underscore the urgent need for effective solutions to address this issue. Among various strategies proposed to mitigate air pollution, the development and expansion of green spaces—such as parks, gardens, and forested areas—have gained recognition as a promising approach. Green spaces are known for their ability to absorb pollutants, improve air quality, and provide numerous ecological and social benefits. The research shows the problem of air pollution, particularly in urban areas, and discuss its impact on health, quality of life, and climate change. it emphasized the importance

of sustainable green campus initiatives in mitigating air pollution. (WHO, 2018; UN, 2022) Nowak and Crane 2000; Escobedo et al 2011; (Esri 2020; Liu and Rossini 2007) Chaudhary and Mishra 2022; Venter et al 2020; Tong et al. 2016; Jiang and Larsen (2013) Pugh et al 2012 Adıgüzel 2023; Alkan et al 2017; Zeydan 2021; Adıgüzel Balta 2021; Chiesura 2004; Ulrich 1981)

University campuses, as microcosms of urban environments, present unique opportunities for implementing and studying sustainable green initiatives. These spaces, frequented by students, faculty, and staff, offer an ideal setting for evaluating the impact of green campus initiatives on air quality. This research focuses on the Ondokuz Mayıs University (OMU) Faculty of Architecture campus, a case study that explores the relationship between green campus areas and particulate matter (PM) pollution.

Urban centers, which concentrate economic, cultural, and industrial activities, face increasing emissions of harmful gases and particles, such as nitrogen dioxide, sulfur dioxide, ozone, carbon monoxide, and volatile organic compounds (Zeydan, 2021). Particulate matter (PM), particularly PM10 and PM2.5, poses a significant risk to health as these microscopic particles can enter the respiratory system and contribute to conditions such as asthma, bronchitis, and cardiovascular diseases (Adıgüzel, 2023). Prolonged exposure to PM can reduce overall quality of life and impact biodiversity and climate change (Zeydan, 2021).

Effective air quality management involves several strategies, including improved transportation management, promoting public transit, reducing vehicle emissions, and implementing stricter regulations on industrial emissions. Urban planning can also contribute by reducing traffic congestion and incorporating more green spaces. Increasing urban green areas, such as parks and gardens, can absorb particulate matter and enhance air quality. Plants help in trapping and cleaning particles, absorbing pollutants, and providing cooling effects (Alkan, Adıgüzel, & Kaya, 2017).

Urban green spaces, including parks, sports facilities, botanical gardens, and urban forests, play a crucial role in mitigating air pollution. Urban forests, with their dense vegetation, contribute to air purification, microclimate regulation, and carbon storage. However, their effectiveness depends on careful planning, maintenance, and protection, taking into account local conditions for sustainable urban planning (Ulrich, 1981; Chiesura, 2004; Adıgüzel & Balta, 2021).

Particulate matter, particularly PM2.5 and PM10, poses significant health risks, including respiratory and cardiovascular diseases. Addressing this pollutant requires a comprehensive understanding of its sources and mitigation strategies. By comparing particulate matter levels between green areas within the campus and nearby urban settlements, this study aims to assess the effectiveness of green spaces in reducing air pollution. (WHO, 2018; UN, 2022; EEA 2021) Nowak and Crane 2000; Escobedo et al 2011; (Esri 2020; Liu and Rossini 2007) Chaudhary and Mishra 2022; Venter et al 2020 ; Tong et al. 2016; Jiang and Larsen (2013) Pugh et al 2012

Using the CEM DT9880 device, particulate matter measurements were taken at 20 strategically chosen sampling points—10 within the campus's green areas and 10 in adjacent urban areas. The selection criteria for these points included traffic density, population density, the extent of open spaces, and proximity to the campus. The data collected were analyzed through the Inverse Distance Weighted (IDW) method in ArcGIS 10.8 to determine the spatial distribution of particulate matter pollution.

Preliminary findings suggest that the presence of green spaces within the campus contributes to a significant reduction in particulate matter levels. This study highlights the positive impact of green campus initiatives on air quality and underscores the importance of incorporating and expanding green spaces in urban planning and environmental management strategies. By fostering sustainable practices and enhancing green areas, universities can play a pivotal role in promoting environmental sustainability and improving public health.

2. Materials and Methods

This study analyzes the particulate matter air pollution problem within the Ondokuz Mayıs University (OMU) Faculty of Architecture campus in the context of green campus areas.

Particulate matter measurements were conducted using a CEM DT9880 device at 20 sampling points: 10 within the green areas of the campus and 10 in nearby urban settlements. The selection of measurement points considered traffic density, population density, open spaces, the density of green areas, proximity to the campus, and other notable features. The collected data were analyzed using the Inverse Distance Weighted (IDW) method in ArcGIS 10.8.

3. Results

The data provided represents the concentrations of PM2.5 and PM10 across 20 stations at a Green Campus University in Figure 1.

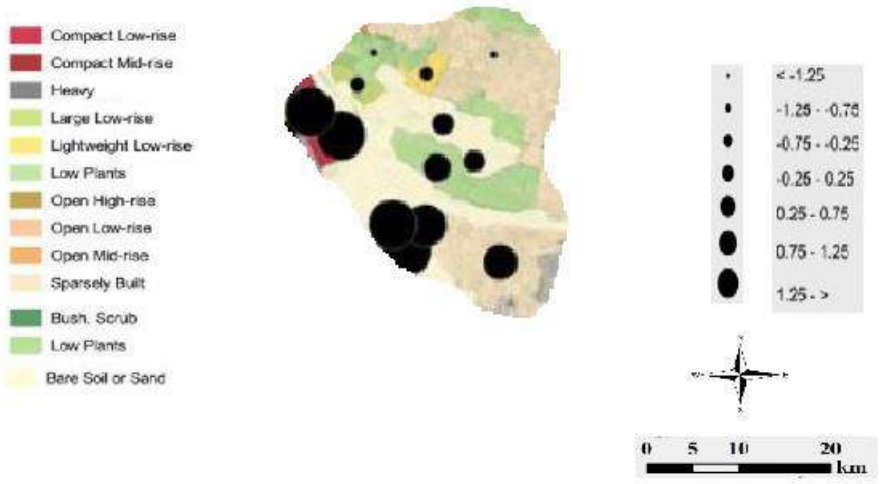


Figure 1. Spatial distribution of with the PM2.5 and PM10 values Green Campus University.

The data provided represents the concentrations of PM2.5 and PM10 across 20 stations at a Green Campus University in Table 1.

Table 1. PM2.5 and PM10 values Green Campus University.

Station Number	PM2.5	PM10
1	419.7	49.7
2	722.7	55.7
3	221.7	37.7
4	346.7	61.7
5	419.7	45.7
6	244.7	39.7
7	134.7	53.7
8	261.7	52.7
9	626.7	68.7
10	556.7	73.7
11	652.7	62.7
12	518.7	58.7
13	779.7	86.7
14	889.7	81.7
15	518.7	57.7
16	767.7	62.7
17	649.7	56.7
18	784.7	81.7
19	475.7	46.7
20	349.7	42.7

The data provided represents the concentrations of PM2.5 and PM10 across 20 stations at a Green Campus University.

3.1. PM2.5 Concentrations

Range: The PM2.5 values range from 134.7 (Station 7) to 889.7 (Station 14).

High Concentration Areas: Stations 13 (779.7), 14 (889.7), 18 (784.7), and 16 (767.7) have notably high PM2.5 levels, indicating areas with potentially poorer air quality.

These stations are closer to pollution sources or areas with less vegetation to filter out particulate matter.

Low Concentration Areas: Stations 7 (134.7) and 3 (221.7) have the lowest PM2.5 levels, suggesting these areas have better air quality or are further from pollution sources.

3.2. PM10 Concentrations

Range: The PM10 values range from 37.7 (Station 3) to 86.7 (Station 13).

Average: The average PM10 concentration provides insight into the overall exposure to larger particulate matter on campus.

High Concentration Areas: Stations 13 (86.7), 14 (81.7), and 10 (73.7) show higher PM10 levels. These stations are near construction sites, heavy traffic areas, or other sources of large particulates.

Low Concentration Areas: Stations 3 (37.7) and 20 (42.7) show lower PM10 levels, which may correlate with open spaces or areas with effective air filtration by trees and plants.

3.3. Comparison between PM2.5 and PM10

Proportionality: Generally, stations with high PM2.5 also have high PM10, indicating a consistent source of both fine and coarse particulate matter.

Station 14: This station has the highest PM2.5 and a high PM10, suggesting a significant source of air pollution in this area.

Station 7: Although this station has the lowest PM2.5, its PM10 is relatively higher, which might suggest that larger particles are more prevalent in this location.

The PM2.5 concentrations across the 20 stations exhibit considerable variation, ranging from 134.7 µg/m³ at Station 7 to 889.7 µg/m³ at Station 14. This wide range highlights the heterogeneous distribution of fine particulate matter across the Green Campus University. The disparity in PM2.5 levels suggests the presence of localized pollution sources or varying environmental factors influencing particulate matter dispersion and accumulation.

The overall average PM2.5 concentration can be calculated to provide a general assessment of the air quality across the campus. However, the data indicate that some stations significantly exceed the average, pointing to specific areas where air quality management may be necessary.

Stations 13 (779.7 µg/m³), 14 (889.7 µg/m³), 18 (784.7 µg/m³), and 16 (767.7 µg/m³) recorded the highest PM2.5 levels. The elevated PM2.5 concentrations in these areas suggest a strong presence of fine particulate pollution, possibly due to proximity to pollution sources such as vehicular emissions, industrial activities, or insufficient vegetation cover that could otherwise mitigate the dispersion of fine particulates. These stations are likely situated in areas with higher human activity or in zones with reduced air circulation, which may exacerbate the accumulation of PM2.5.

Conversely, Stations 7 (134.7 µg/m³) and 3 (221.7 µg/m³) recorded the lowest PM2.5 concentrations. The lower levels of fine particulate matter at these stations may indicate better air quality conditions, potentially due to fewer nearby pollution sources, more open spaces, or higher vegetation density that acts as a natural filter for airborne particulates. The lower PM2.5 levels suggest these areas are less impacted by fine particulate pollution, making them relatively safer for activities that involve prolonged outdoor exposure.

The PM10 concentrations vary between 37.7 µg/m³ at Station 3 and 86.7 µg/m³ at Station 13, demonstrating a narrower range compared to PM2.5. This variation reflects the distribution of coarser particulate matter across the campus, which can be influenced by factors such as road dust, construction activities, and other localized sources of larger particles.

The average PM10 concentration across the campus provides an indication of the overall exposure to larger particulate matter. Similar to PM2.5, some stations show significant deviations from the average, pointing to specific areas where larger particles are more prevalent.

Stations 13 (86.7 µg/m³), 14 (81.7 µg/m³), and 10 (73.7 µg/m³) exhibit the highest PM10 levels, suggesting that these locations are likely exposed to sources of larger particulates. The proximity to construction sites, heavy traffic areas, or areas with less vegetation could contribute to the elevated PM10 levels. The higher concentrations of PM10 in these areas may pose health risks, especially for vulnerable populations, as coarse particles can cause respiratory irritation and other health issues.

Stations 3 (37.7 µg/m³) and 20 (42.7 µg/m³) show the lowest PM10 levels, suggesting that these areas have relatively cleaner air in terms of larger particulate matter. These stations might be located in areas with fewer disturbances, such as construction, or in zones with effective air filtration provided by trees and other vegetation. The lower PM10 levels are indicative of a reduced presence of coarse particulates, contributing to better overall air quality.

The data generally show a proportional relationship between PM2.5 and PM10 levels across the stations. Stations with high PM2.5 concentrations tend to also have elevated PM10 levels, indicating that the sources contributing to fine particulate matter are also responsible for the generation of coarser particles. This consistent pattern suggests that both fine and coarse particulates are likely originating from common sources, such as traffic emissions, construction activities, or industrial processes.

Station 14, with the highest recorded PM2.5 concentration (889.7 µg/m³) and a high PM10 concentration (81.7 µg/m³), stands out as a critical area of concern. The substantial levels of both PM2.5 and PM10 at this station suggest a significant source of particulate pollution, which may be a combination of vehicular emissions, industrial activities, or insufficient mitigation measures in the surrounding environment. The high particulate matter levels pose serious health risks, particularly for individuals with respiratory conditions.

Interestingly, Station 7, which has the lowest PM2.5 concentration (134.7 µg/m³), shows a relatively higher PM10 level (66.4 µg/m³). This discrepancy might indicate that larger particles are more prevalent in this location, possibly due to localized sources such as road dust or nearby construction. The difference between PM2.5 and PM10 levels at this station suggests that the particulate matter composition might vary across the campus, with some areas being more affected by coarser particulates.

The data analysis reveals significant variations in PM2.5 and PM10 concentrations across the Green Campus University, with certain stations showing alarmingly high levels of particulate matter. The findings underscore the need for targeted air quality management strategies to address localized pollution sources and mitigate the potential health risks associated with elevated particulate matter levels.

4. Discussion

The observed variation in PM2.5 and PM10 concentrations across different stations at Green Campus University underscores the complexity of particulate matter (PM) distribution and its implications for air quality and public health. The results reveal several key insights that align with existing literature while also highlighting specific areas of concern that warrant further investigation and intervention.

The significant range in PM2.5 concentrations, from 134.7 µg/m³ at Station 7 to 889.7 µg/m³ at Station 14, suggests the influence of localized pollution sources, consistent with findings from urban air quality studies. Previous research has demonstrated that traffic emissions, industrial activities, and construction

work are major contributors to elevated PM levels, particularly in urban settings (Wang et al., 2014; Amato et al., 2014). The high PM2.5 levels at Stations 13, 14, 16, and 18 could be attributed to proximity to such sources, indicating areas where pollution control measures should be prioritized.

Conversely, the lower PM2.5 levels at Stations 7 and 3 might reflect the benefits of more open spaces or greater vegetation density, which can act as natural filters for airborne particulates. This aligns with studies that emphasize the role of green spaces in mitigating urban air pollution (Nowak et al., 2013). The presence of vegetation and reduced vehicular activity in these areas could contribute to the observed lower particulate concentrations.

The elevated PM2.5 and PM10 levels observed at certain stations pose significant health risks, particularly in areas where both fine and coarse particulate matter concentrations are high. Fine particulates (PM2.5) are especially concerning due to their ability to penetrate deep into the lungs and enter the bloodstream, leading to serious health issues such as cardiovascular and respiratory diseases (Pope et al., 2009; WHO, 2021). The high PM2.5 levels at Station 14, for example, suggest a critical need for intervention to protect the health of individuals who frequent this area, particularly those with pre-existing health conditions.

Coarse particulate matter (PM10), while less harmful than PM2.5, can still cause respiratory irritation and exacerbate conditions like asthma and bronchitis (Chen et al., 2015). The high PM10 levels at Stations 13 and 10 indicate potential exposure to dust and other larger particles, possibly from nearby construction sites or unpaved areas. These findings highlight the importance of implementing dust control measures and improving urban planning to reduce exposure to harmful particulates.

The generally proportional relationship between PM2.5 and PM10 levels across the stations suggests that the same sources may be contributing to both fine and coarse particulate pollution. This is consistent with studies that have shown that vehicular emissions, industrial processes, and construction activities are common sources of both PM2.5 and PM10 (Querol et al., 2004; Amato et al., 2014). However, the discrepancy observed at Station 7, where PM2.5 levels are low but PM10 levels are relatively higher, indicates that localized sources, such as road dust, might be more significant contributors to coarse particulate pollution in this area. This highlights the need for a nuanced approach to air quality management that considers the specific sources and types of particulates present in different areas.

The findings of this study have important implications for campus planning and air quality management at Green Campus University. The identification of areas with elevated PM levels suggests the need for targeted interventions to reduce pollution exposure. For example, traffic management strategies could be implemented around high PM2.5 areas such as Station 14, while dust control measures might be necessary near high PM10 areas such as Station 10. Additionally, enhancing green infrastructure in high-risk areas could help mitigate the impact of particulate pollution by acting as natural barriers (Abhijith et al., 2017).

The results also underscore the importance of continuous air quality monitoring to identify emerging pollution trends and implement timely interventions. Real-time data analysis could help in making informed decisions about where and when to deploy resources to protect public health, particularly in areas where air quality fluctuates significantly.

The PM2.5 and PM10 levels observed in this study are higher than those recommended by global air quality standards, such as those set by the World Health Organization (WHO, 2021). The WHO's guidelines suggest that annual average PM2.5 concentrations should not exceed 10 µg/m³, and PM10 should not exceed 20 µg/m³, highlighting the severity of the pollution levels observed at Green Campus University. These findings are consistent with global trends in urban air quality, where many cities, particularly in developing regions, exceed recommended PM levels due to rapid urbanization and industrialization (HEI, 2019).

5. Conclusion

While this study provides valuable insights into the distribution of PM2.5 and PM10 at Green Campus University, it is important to acknowledge its limitations. The data collection was limited to a specific period, and therefore, temporal variations in PM levels, such as seasonal effects, were not captured. Future research should include longitudinal studies to assess how particulate matter concentrations change over time. Additionally, expanding the monitoring network to include more stations across different parts of the campus could provide a more comprehensive understanding of spatial variability in air quality.

High-Risk Areas: Stations 13, 14, and 16 should be investigated further to identify specific sources of pollution, and mitigation strategies should be implemented (e.g., increasing vegetation, reducing vehicle emissions).

Air Quality Monitoring: Regular monitoring of these stations is essential to track trends and the effectiveness of any interventions.

Health Implications: Areas with high PM2.5 levels may pose a higher risk to respiratory health, so efforts should be made to reduce exposure in these zones, particularly for vulnerable populations like students and staff.

Policy Suggestions: The university should consider implementing policies that limit emissions, such as restricting vehicle access in high-risk areas and promoting green transportation alternatives.

Overall, the data highlights areas of concern within the campus and provides a foundation for targeted environmental health interventions.

Further studies could also explore the specific sources of particulate matter at identified hotspots through source apportionment techniques, which would provide more targeted recommendations for pollution control. Integrating air quality data with health outcome studies could also help quantify the public health impacts of PM pollution on the campus population, providing a stronger evidence base for intervention strategies.

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ORAL PRESENTATION

Evaluation of Climate Parameters and Biocomfort Analysis in Mersin Province

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Abstract

Biocomfort is a factor that significantly affects the quality of life and the efficiency of tourism activities. The impact of climatic conditions on human biocomfort levels is particularly pronounced in summer, with parameters such as temperature and humidity playing crucial roles. This study aims to determine biocomfort levels in Mersin province during the summer months using Geographic Information Systems (GIS) and the New Summer Index (SSI). By doing so, it seeks to identify areas suitable and unsuitable for tourism. The climate data used in this study were obtained from the Mersin Meteorology Directorate. Daily temperature and humidity data covering the summer months (June, July, August) were prepared for analysis using GIS software. SSI calculations were performed based on temperature and humidity data. The calculated SSI values were categorized according to biocomfort levels, represented as "cold," "comfortable," and "hot." Using GIS software, SSI values for different regions of Mersin province were mapped, and suitable areas were identified based on biocomfort levels. The analysis results show that different biocomfort levels are present in Mersin province. It was determined that Gülnar district falls into the second biocomfort zone in June and the third zone in July and August, indicating that Gülnar is more suitable in terms of biocomfort during the summer months. In other districts, biocomfort levels vary. The results of this study provide important information for tourism planning by revealing the geographical distribution of biocomfort levels in Mersin province. Identifying regions with high biocomfort levels during the tourist season is crucial for tourist satisfaction and the success of tourism businesses. The higher biocomfort levels in Gülnar district during the summer months suggest that new residential areas or prioritizing tourism activities in these areas may be beneficial. Future studies could obtain more comprehensive results by considering more climatic parameters and using larger data sets to determine biocomfort levels. This study was conducted to determine biocomfort levels in Mersin province during the summer months using GIS technology. The results show that different biocomfort levels exist throughout Mersin, with Gülnar district having higher biocomfort levels during the summer. This information serves as an important guide in tourism planning and directing tourists.

Keywords: Biocomfort, Planning, Climate, Geographic Information Systems.

1. Introduction

Weather conditions affecting a specific location in a short period are defined as atmospheric conditions, while the average weather conditions that remain the same over a broad region and a long period are defined as climate (Sensoy et al., 2008). Climate, which plays a significant role in human life, not only shapes the physical environment but also has a major impact on all kinds of economic and social

activities (Çalışkan and Türkoğlu, 2014). Thus, climate is an extremely influential factor in many aspects of human life, including the distribution of people across the globe, their basic needs, living spaces, and even their physical structure and character (Cetin 2016; Cetin 2018; Cetin 2015a; Cetin 2019; Cetin et al 2019; Cetin et al 2018; Cetin and Zeren, 2016)

Understanding and assessing the climate of the area where people live and creating an environment where they feel comfortable is crucial (Cetin 2016; Cetin 2018; Cetin 2015a; Cetin 2019; Cetin et al 2019; Cetin et al 2018; Cetin and Zeren, 2016). Therefore, an initial analysis of the current situation is necessary. For people to feel comfortable, the environment must fall within certain temperature, wind, and humidity ranges. This range is known as the comfort zone. Generally, conditions with temperatures ranging from 21-27°C, relative humidity between 30-65%, and wind speeds less than 5 m/s are considered bioclimatically comfortable (Cetin 2016; Cetin 2018; Cetin 2015a; Cetin 2019; Cetin et al 2019; Cetin et al 2018; Cetin and Zeren, 2016; Zhao et al 2020; Zomorodian et al 2016 Arıcak et al 2016 Zeren Çetin 2019; Çalı 2018).

The suitability of temperature, humidity, and wind speed values in the environment for human comfort is termed "biocomfort." When biocomfort values are not met, discomfort is experienced, and individuals may wish to leave the area (Cetin, 2016). Temperatures above or below the comfort range can cause symptoms such as fatigue and irritability, as well as issues with the circulatory and respiratory systems, dry throat, and burning eyes (Cetin 2016; Cetin 2018; Cetin 2015a; Cetin 2019; Cetin et al 2019; Cetin et al 2018; Cetin and Zeren, 2016).

Additionally, people prefer to live in areas where no extra heating or cooling is required. Consequently, the demand for regions within the comfort range of climate conditions is increasing. Considering both human satisfaction and the energy required to maintain comfortable thermal conditions, it is crucial to identify biocomfortable areas when selecting new residential areas.

Biocomfort is directly related to climatic parameters. Our country is under the influence of three distinct climate zones (Çetin et al., 2018). Therefore, determining how biocomfort status is shaped in areas dominated by these climate types is of great importance.

This study aims to determine biocomfort status using summer temperature indices in areas Mersin. To this end, biocomfort maps for each province were created using data obtained from meteorological stations and summer temperature indices.

In environments where precipitation, humidity, wind, and temperature are maintained at certain levels, people feel healthier and better. Maintaining these values at biocomfort levels is known as "biocomfort." When these values are above or below biocomfort levels, it causes discomfort, and people may wish to leave the area (Cetin, 2016).

In developing countries, unplanned urbanization has led to environments where people face difficult and aesthetically unpleasing conditions. Ecological planning could prevent these issues from escalating and turning into environmental problems. Concepts like a clean environment, ecological balance, and comfort, which were previously not given much importance, have gained prominence with increased income levels, and people now consider these factors when choosing cities to live in (Çetin et al., 2010; Çetin, 2016).

Çetin et al. (2009) identified bioclimatic comfort zones in Kütahya province, examining these areas within the landscape architecture profession and attempting to determine suitable areas for landscape planning standards. Çetin et al. (2017) discussed the importance of bioclimatic comfort and methods for its determination in urban planning. The study provided information on some bioclimatic comfort studies and drew conclusions about their focuses and gaps.

Çetin (2018c) assessed bioclimatic comfort in Karabük province using climate data, formulas, and the RayMan 1.2 program. The study produced a bioclimatic comfort map for Karabük and identified suitable areas for bioclimatic comfort. Çalı (2019) aimed to identify areas suitable for bioclimatic comfort in Manisa province using meteorological data from regional weather stations. Data from these stations were transferred to GIS using ArcMap GISTM 10.2 software to create a climate map and determine areas suitable for bioclimatic comfort (Çalı, 2019). Çetin (2016) created bioclimatic comfort maps for the Cide district in the north of Kastamonu province. The study aimed to use these maps as a basis for areas in coastal regions, analyzing the climate data of the Cide area using the Physical Equivalent Temperature index. Çetin et al. (2018d) aimed to create a bioclimatic comfort map for Elazığ province. The study used climate data, base maps, and formulas with GIS software to produce and analyze maps, identifying suitable areas for bioclimatic comfort.

Zeren Çetin (2019) examined the bioclimatic comfort conditions in Trabzon province. The study investigated the role of natural factors like water, land cover, and vegetation in the changes of the thermal heat island and the effects of urban land use on local climate. Landsat 7, 8 satellite imagery and meteorological ground measurement stations were used, and single-band sections were used to analyze comfort value areas and local effects of urban heat.

Kilicioğlu et al. (2020) also identified bioclimatic suitable areas for site selection in Samsun, considering landslide and flood zones.

In a 2018 study, Akpınar aimed to evaluate the sustainable ecotourism potential in Şehit Şerife Bacı Nature Park in Kastamonu in terms of landscape management and planning, and conducted a bioclimatic comfort assessment of the area along with survey studies.

This study, conducted using GIS technology, aimed to determine biocomfort levels in Mersin province during the summer months. The results show that Mersin has varying biocomfort levels depending on the period. This information serves as an important guide for urban planning and identifying new settlement areas.

2. Materials and Methods

Mersin Province is located between 36-37° northern latitudes and 33-35° eastern longitudes. It has a land border of 608 km and a sea border of 321 km (URL-1, 2024).

Unlike surrounding provinces, extreme temperatures are rarely encountered in Mersin (such as very high temperatures or below-zero values). For a long time, Mersin has had an average temperature of 22°C, making it the warmest region in Turkey and Europe. However, the high humidity can be particularly oppressive during the summer months. Mersin experiences its heaviest rainfall between December and January. During the flood disaster of 2001, 669 mm of rainfall was recorded within two days (URL-2, 2024). The average climate values for Mersin Province are provided in Table 1.

Table 1. Average climate values for Mersin province.

MERSİN	O	Ş	M	N	M	H	T	AG	EY	EK	K	AR	Annual
OS (°C)	10.1	11.0	13.7	17.4	21.2	25.0	27.7	28.3	25.7	21.4	16.1	11.8	19.1
OEYS (°C)	14.5	15.4	18.1	21.6	24.9	28.1	30.7	31.5	30.0	26.6	21.5	16.4	23.3
OEDS (°C)	6.2	6.8	9.1	12.8	16.8	20.8	23.9	24.2	20.8	16.2	11.5	7.8	14.7
OGS (hrs)	4.7	5.6	6.7	7.6	8.4	9.8	9.9	9.8	9.1	7.5	5.7	4.7	89.5
OYGS	10.6	9.2	7.6	6.7	5.1	2.2	0.9	0.8	1.7	5.0	6.6	10.4	66.8
ATYMO (mm)	118.5	85.5	56.2	34.8	23.8	10.2	11.6	6.9	11.7	39.2	77.8	139.6	615.8

3. Results

Biocomfort is largely shaped by climatic parameters. Therefore, climate parameters were examined on a monthly basis for the summer months, and the temperature map for June is provided The biocomfort map for June in Mersin Province, created using meteorological data. (Figure 1)

When we examine the biocomfort map for Mersin, it is observed that the Gülnar region and its surroundings fall within the 3rd zone, covering 4.11% of the total area. The 4th zone encompasses the areas around Mut, Aydıncık, and Erdemli, covering 50.72% of the total area. The 5th zone is observed around the areas of Anamur, Silifke, Toroslar, Yenişehir, Akdeniz, Mezitli, Tarsus, and Çamlıyayla, covering 45.16% of the total area.

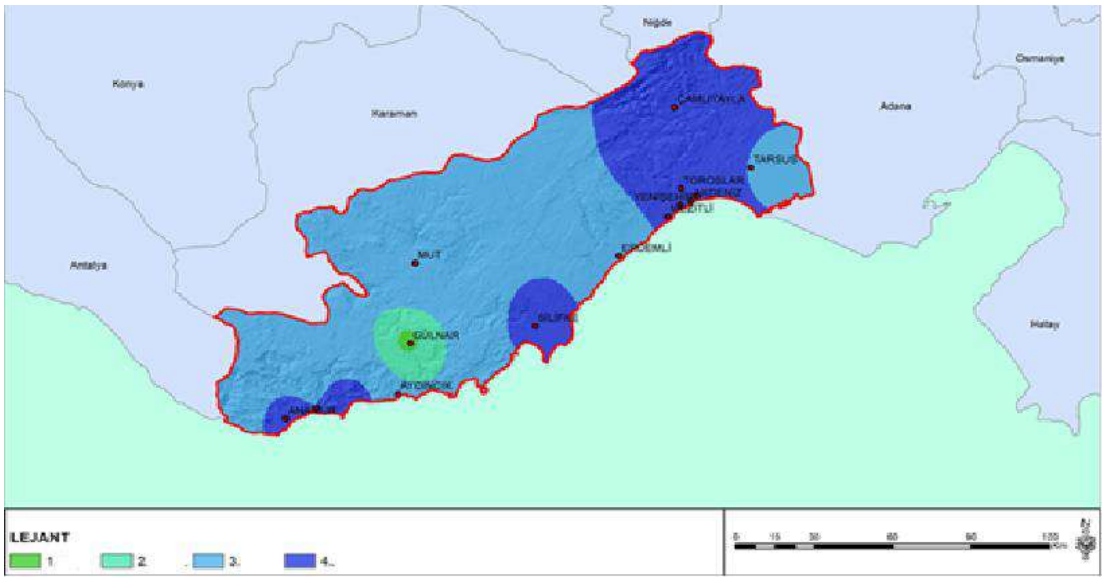


Figure 1. Bio comfort map.

4. Discussion

In the study conducted, biocomfort areas in Turkey's Mersin Province were determined using meteorological climate data for the summer months. According to the results, Mersin Province is more comfortable in June compared to other months. In July and August, it is observed that the comfort values in Mersin Province decrease due to high temperatures. According to the maps, the most uncomfortable areas are located in the northeastern part of the region.

In the study, biocomfort areas in Mersin Province, located in different climatic regions of Turkey, were examined. According to the meteorological data, June is more comfortable compared to other months in Mersin Province. However, in July and August, the comfort values in Mersin decrease due to high temperatures. According to the maps, the least comfortable areas are located in the northeastern part of the province.

In recent years, one of the factors people consider when choosing their living spaces is the biocomfort conditions of the areas they choose to live in. People feel more comfortable, dynamic, and healthy when the biocomfort conditions of their living spaces are suitable. These conditions are referred to as "biocomfort." When biocomfort conditions are not within certain ranges, people may feel uncomfortable and wish to leave the area (Cetin, 2016). Therefore, many studies have been conducted on biocomfort in different regions.

Due to population growth in almost all our cities, new residential areas are emerging, and the structure of cities is changing. However, people's expectations from living spaces in the modern age have evolved. Factors that were previously neglected are now playing a significant role. These factors include social amenities, air quality, activity opportunities, and proximity to nature (Cetin et al., 2018).

5. Conclusion

In this study, Remote Sensing and Geographic Information Systems were used to evaluate climate data and determine biocomfortable areas based on summer indices, considering the topographic conditions of the study area. The meteorological data was analyzed to assess the biocomfort status of the area during the summer months.

When examining the biocomfort maps for Mersin Province, it was observed that the Gülnar district is classified as a 2nd Level biocomfort area in June and as a 3rd Level biocomfort area in July and August. For planning activities in Mersin Province, new residential areas could be developed in the Gülnar district and its surroundings, or these areas could be considered for tourism activities, as they are biocomfortable.

Considering bioclimatic conditions in planning will be effective in creating more sustainable and comfortable cities. Landscape architecture and urban-regional planning can be improved by applying bioclimatic comfort principles and design criteria. Therefore, it is crucial to conduct similar studies to identify biocomfort areas and to consider the results of these studies when planning new development areas.

Developing new residential areas in biocomfortable zones can significantly reduce heating and cooling costs, providing substantial economic benefits and contributing significantly to environmental protection. Additionally, identifying biocomfortable areas for the summer months will facilitate planning for tourism activities and the annual vacations of many people.

Biocomfort is an essential consideration in landscape planning. However, it is observed that many studies are limited to very specific areas and remain only as research. It is evident that sufficient progress has not yet been made in applying these studies to practice. Therefore, studies on biocomfort should be considered in urban planning. Utilizing studies like this one for planning tourism activities during the summer months, and calculating how future development will affect biocomfort to shape planning

decisions, is of great importance for providing more comfortable living spaces. Especially in provinces with high population growth rates, biocomfort studies should be considered when determining areas for development, and studies covering specific time periods should be taken into account in tourism planning.

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
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ORAL PRESENTATION

Identification of Biocomfortable Areas using the New Summer Index in Sinop

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Abstract

Biocomfort is a factor that affects individuals' quality of life and plays a significant role in tourism activities. Particularly in the summer months, climatic parameters such as temperature and humidity directly influence biocomfort levels. Regions with high biocomfort levels are more preferred by tourists. This study aims to determine biocomfort levels across Sinop province during the summer months. Using Geographic Information Systems (GIS) and the New Summer Index (SSI), areas suitable and unsuitable for biocomfort were identified. The study utilized the New Summer Index (SSI) to determine biocomfort levels throughout Sinop province during the summer months. SSI is an index that assesses biocomfort levels based on climatic parameters such as temperature and humidity. Using GIS technology, SSI values were calculated for different regions of Sinop, and biocomfort levels were mapped accordingly. For data collection and preparation, climate data obtained from the Sinop Meteorology Directorate were used. This data includes daily temperature and humidity values covering the summer months (June, July, August). The data were transferred to GIS software and prepared for analysis. SSI calculations were performed based on the temperature and humidity data. The calculated SSI values were categorized according to biocomfort levels, represented as "cold," "comfortable," and "hot." Using GIS software, SSI values for different regions of Sinop were mapped, and suitable areas based on biocomfort levels were identified. The analysis revealed that approximately 60.12% of the areas in the southern part of Sinop province fall into the "cold" category. These areas are considered unsuitable for tourism activities during the summer due to their low biocomfort levels. The most comfortable region in the province, identified as the area covering approximately 25.26% and located in the northern part near the coast, was found to have high biocomfort levels, making it highly suitable for tourism activities during the summer. The results of this study provide important information for tourism planning by revealing the geographical distribution of biocomfort levels in Sinop province. Identifying regions with high biocomfort levels during the tourist season is crucial for tourist satisfaction and the success of tourism businesses. Future studies could achieve more comprehensive results by considering additional climatic parameters and using larger data sets to determine biocomfort levels. This study used GIS technology to determine biocomfort levels in Sinop province during the summer months. The results show that low biocomfort levels are predominant in the southern part of the province, while high biocomfort levels are found in the northern region. This information serves as an important guide for tourism planning and tourist direction.

Keywords: New Summer Index, Biocomfort, Geographic Information Systems, Sinop, Tourism.

1. Introduction

This study underscores the importance of understanding and evaluating the climate of inhabited areas to create environments that foster human comfort. The initial step in achieving this is to analyze the current climatic conditions. Human comfort is closely tied to specific ranges of temperature, humidity, and wind speed, collectively known as the comfort zone. Generally, a temperature range of 21-27°C, relative humidity between 30-65%, and wind speeds under 5 m/s are considered bioclimatically comfortable. (Cetin 2016; Cetin 2018; Cetin 2015a; Cetin 2019; Cetin et al 2019; Cetin et al 2018; Cetin and Zeren, 2016; Cetin and Zeren, 2016; Zhao et al 2020; Zomorodian et al 2016 Arıcak et al 2016 Zeren Çetin 2019 ; Çalı 2018; Sensoy et al., 2008 Çalışkan and Türkoğlu, 2014 Cetin 2016; Cetin 2018; Cetin 2015a; Cetin 2019; Cetin et al 2019; Cetin et al 2018; Cetin and Zeren, 2016)

Weather conditions, which are the short-term atmospheric phenomena in a specific location, differ from climate, which is the long-term average weather pattern over a large area. Climate significantly influences human life by shaping the physical environment and affecting economic and social activities. Therefore, climate is a crucial factor in determining where people live, their needs, living spaces, and even their physical characteristics and behaviors. (Cetin 2016; Cetin 2018; Cetin 2015a; Cetin 2019; Cetin et al 2019; Cetin et al 2018; Cetin and Zeren, 2016. Cetin and Zeren, 2016; Zhao et al 2020; Zomorodian et al 2016 Arıcak et al 2016 Zeren Çetin 2019 ; Çalı 2018; Sensoy et al., 2008 Çalışkan and Türkoğlu, 2014 Cetin 2016; Cetin 2018; Cetin 2015a; Cetin 2019; Cetin et al 2019; Cetin et al 2018; Cetin and Zeren, 2016)

The concept of "biocomfort" refers to the suitability of environmental temperature, humidity, and wind speed for human comfort. When these conditions are not met, discomfort arises, potentially leading individuals to avoid or leave the area. Extreme temperatures can cause physical symptoms such as fatigue, circulatory issues, and respiratory problems. (Cetin, 2016;. Cetin 2016; Cetin 2018; Cetin 2015a; Cetin 2019; Cetin et al 2019; Cetin et al 2018; Cetin and Zeren, 2016; Çetin et al., 2018; Çetin et al., 2010; Çetin, 2016; Çetin et al. 2009 Çetin et al. 2017; Çetin 2018c; Çalı 2019 ;Çalı, 2019 Çetin 2016 Çetin et al. 2018d;Zeren Çetin 2019)

People naturally prefer to live in areas where the climate falls within the comfort zone, as this reduces the need for additional heating or cooling. This preference underscores the growing demand for regions that naturally provide bioclimatic comfort. Identifying these areas is essential, particularly in the context of sustainable urban planning, where both human satisfaction and energy efficiency are key considerations. (Cetin, 2016;. Cetin 2016; Cetin 2018; Cetin 2015a; Cetin 2019; Cetin et al 2019; Cetin et al 2018; Cetin and Zeren, 2016; Çetin et al., 2018; Çetin et al., 2010; Çetin, 2016; Çetin et al. 2009 Çetin et al. 2017; Çetin 2018c; Çalı 2019 ;Çalı, 2019 Çetin 2016 Çetin et al. 2018d;Zeren Çetin 2019)

Biocomfort is inherently linked to climatic parameters, and Turkey, being influenced by three distinct climate zones, presents a diverse range of bioclimatic comfort conditions. Understanding how these conditions vary across different regions is vital for effective planning and development. (Cetin, 2016;. Cetin 2016; Cetin 2018; Cetin 2015a; Cetin 2019; Cetin et al 2019; Cetin et al 2018; Cetin and Zeren, 2016; Çetin et al., 2018; Çetin et al., 2010; Çetin, 2016; Çetin et al. 2009 Çetin et al. 2017; Çetin 2018c; Çalı 2019 ;Çalı, 2019 Çetin 2016 Çetin et al. 2018d;Zeren Çetin 2019)

In many developing countries, rapid and unplanned urbanization has led to environments that are both uncomfortable and aesthetically displeasing. Ecological planning is critical in mitigating these issues

and preventing them from becoming more severe environmental problems. As income levels rise, concepts like environmental cleanliness, ecological balance, and comfort have gained importance, influencing people's choices in where to live.

Previous studies have identified bioclimatic comfort zones in various provinces of Turkey, using methods such as climate data analysis, Geographic Information Systems (GIS), and specific indices like the Physical Equivalent Temperature index. These studies have provided valuable insights into how bioclimatic comfort can be assessed and mapped, offering guidance for urban and landscape planning.

This particular study focuses on determining bioclimatic comfort in areas with diverse climate types, using the summer temperature index as a key metric. By creating bioclimatic comfort maps for each province, with a specific emphasis on Sinop province, the study aims to provide a detailed understanding of the local climatic conditions that contribute to human comfort.

This study aims to determine the bioclimatic comfort in areas dominated by different climate types using the summer temperature index. To achieve this, bioclimatic comfort maps for each province were created using data obtained from meteorological stations and the summer temperature index. The study focuses on the province of Sinop in Turkey.

2. Materials and Methods

Sinop Province, located in the Western Black Sea Region of northern Turkey, has an area of 5,792 km², which constitutes approximately 0.75% of Turkey's total area. The province is located between latitudes 41°12′ and 42°06′ north and longitudes 34°14′ and 35°26′ east. (URL-1, 2024).

Due to the continuous rainfall in Sinop, it has dense forests and lush vegetation. The highest number of rainy days in the province occurs between December and January, while the least amount of rainfall (125-135 mm) is observed in July and August. The annual average rainfall is 56.79 mm. The highest recorded temperature in the province is 34.4 °C, and the lowest is -7.5 °C (data from 1954 to 2013). The continuous wind in Sinop, due to its open northern position, sometimes causes very strong north (polar) winds. The average sea temperature in Sinop Province is 15.9°C, and the average sunshine duration is 5.46 hours per day. In terms of relative humidity, the coastal regions have an average humidity of over 75%, while the inland areas have a humidity level below 60% (URL-2, 2024). (Table 1)

Table 1 Average climate data for Sinop province by year.

Month	OS (Average Temperature °C)	OEYS (Average Maximum Temperature °C)	OEDS (Average Minimum Temperature °C)	OGS (Average Sunshine Duration Hours)	OYGS (Average Number of Rainy Days)	ATYMO (Average Monthly Total Rainfall mm)
Jan	7.0	9.6	4.5	2.2	15.3	72.4
Feb	6.7	9.6	4.1	2.9	13.4	51.5
Mar	7.4	10.5	4.9	3.9	13.5	52.6
Apr	10.6	14.0	7.9	5.2	11.1	38.2
May	14.9	18.2	12.1	6.6	10.1	34.9
Jun	19.8	23.0	16.8	8.8	7.7	34.8
Jul	22.8	25.8	19.8	9.7	5.3	33.4
Aug	23.2	26.3	20.2	8.7	6.1	41.3
Sep	20.0	23.1	17.2	6.8	8.8	67.2
Oct	16.2	19.2	13.6	4.7	12.2	87.4
Nov	12.6	15.5	9.9	3.3	12.5	83.2
Dec	9.2	11.9	6.7	2.2	15.4	90.6
Annual	14.2	17.2	11.5	65.0	131.4	687.5

3. Results

In the study, biocomfort maps for the summer months in Sinop Province were created. Biocomfort is largely shaped by climatic parameters. (Figure 1)

Upon examining the biocomfort map for June in Sinop, it is observed that the Dikmen region and its surroundings fall into the 1st Zone. This area constitutes 10.35% of the total area. The 2nd Zone includes Sinop (Central), Erfelek, Türkeli, Ayancık, Gerze, Boyabat, Durağan, and Saraydüzü regions. This area covers 89.64% of the total area.

Upon examining the biocomfort map for August in Sinop, it is observed that the 3rd Zone includes Türkeli, Ayancık, Gerze, Boyabat, Durağan, Saraydüzü, Sinop, Dikmen, and Erfelek regions. This area covers 98.04% of the total area. The 4th Zone is located in the area west of Sinop (Central) and its surroundings. This area constitutes 1.95% of the total area.

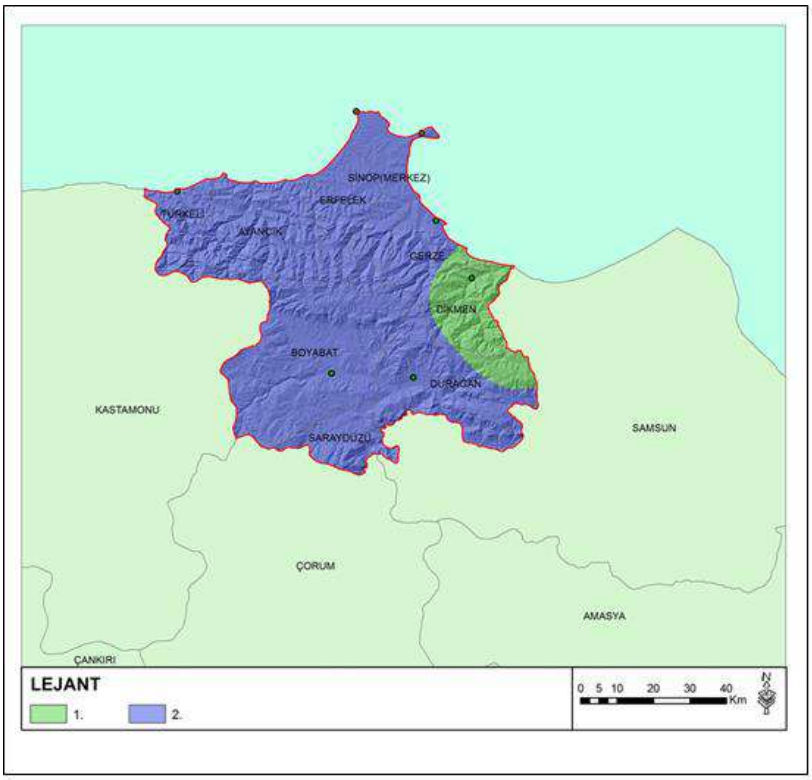


Figure 1. Bio comfort map.

4. Discussion

In the study, biocomfort areas for the summer months in Sinop Province, located in different climatic regions of Turkey, were determined using meteorological climate data. The results showed that for June, the general biocomfort level of the region can be considered comfortable. However, July was found to be the least comfortable month of the summer. Generally, this discomfort in the northern areas decreases as one moves towards the interior, where more comfortable areas are observed.

In recent years, one of the factors people consider when choosing their living spaces is the biocomfort conditions of those areas. People feel more comfortable, dynamic, and healthy when the biocomfort conditions of their living spaces are suitable. This is why certain levels of biocomfort are important. If biocomfort conditions are not within certain ranges, people feel uncomfortable and wish to move away from that area (Çetin, 2016; Çalı, 2018). Therefore, many studies have been conducted on biocomfort in different regions.

5. Conclusion

In this study, the aim was to evaluate climate data and determine areas suitable for biocomfort during the summer months, taking into account the topographic conditions of the study area, using Remote Sensing and Geographic Information Systems (GIS) across three different provinces with varying climate types. Meteorological data were analyzed to assess the biocomfort status during the summer months.

Examining the biocomfort maps for Sinop Province, it was found that Sinop Central district and İnceburun township in the northern part of the area were classified as Zone 2 in June, Zone 4 in July, and Zone 4 and Zone 3, respectively, in August. The Dikmen district, which is coastal and borders Samsun Province, was found to be comfortable throughout the summer months. For tourism activities, the central area of Sinop Province, as well as Dikmen district, can be considered for planning due to its biocomfort status. Overall, the interior parts of Sinop Province were found to be generally comfortable.

Considering bioclimatic conditions in planning will be effective in creating more sustainable and comfortable cities. Landscape architecture and urban-regional planning can be enhanced by applying bioclimatic comfort conditions and design criteria. Therefore, it is important to determine biocomfort areas by conducting similar studies and to consider the results of these studies, especially when planning new development areas.

Placing new settlement areas in biocomfortable regions can significantly reduce heating and cooling costs, thereby providing substantial economic benefits and contributing significantly to environmental protection. Additionally, identifying biocomfortable areas for the summer months will enable planning for tourism activities and annual vacations.

Biocomfort is a crucial factor to consider in landscape planning. However, it is observed that many studies have been conducted in very limited areas and remain only as research. There has not been sufficient progress in translating these studies into practice. It is important to consider these studies in urban planning, as in this study, and to use summer studies for tourism planning. Planning decisions should account for how construction will impact biocomfort, aiming to provide more comfortable living spaces for people. Therefore, in provinces with high population growth rates, it is recommended to consider biocomfort studies for the entire province, as well as studies covering specific time periods for tourism planning.

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ORAL PRESENTATION

Impact of Climatic Parameters on Settlement Preferences

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Abstract

Biocomfort is a critical factor affecting individuals' quality of life and overall health. In an era of accelerated urbanization and prominent climate changes, evaluating biocomfort conditions plays a significant role in urban planning. Especially during the summer months, climatic parameters such as temperature and humidity directly influence biocomfort levels. This study aims to determine biocomfort levels across Muş province during the summer months and integrate this information into urban planning processes. In this study, the New Summer Index (SSI) was used to assess biocomfort levels in Muş province during the summer months. SSI is an index that determines biocomfort levels based on climatic parameters such as temperature and humidity. Using Geographic Information Systems (GIS) technology, SSI values were calculated for different regions of Muş and biocomfort levels were mapped accordingly. Climate data from the Muş Meteorology Directorate, including daily temperature and humidity values for the summer months (June, July, August), were used. This data was transferred to GIS software and prepared for analysis. SSI calculations were based on temperature and humidity data, and the calculated SSI values were categorized according to biocomfort levels. These categories represent "cold," "comfortable," and "hot" biocomfort levels. Using GIS software, SSI values for different regions of Muş were mapped, and suitable areas based on biocomfort levels were identified. The analysis revealed that in June, Muş province is predominantly characterized by discomfort. In July and August, however, the regions fall into the 2nd and 3rd categories, indicating that these areas are more suitable for biocomfort. This suggests that there are periods during the summer when high biocomfort levels are present in Muş. The results of this study provide important information for urban planning by revealing the geographical distribution of biocomfort levels in Muş. Regions with high biocomfort levels offer significant advantages in creating more comfortable and sustainable living environments. Incorporating bioclimatic comfort conditions into landscape architecture and urban-regional planning will enhance the livability of cities. Considering bioclimatic conditions in planning for Muş will be effective in creating sustainable and comfortable cities. Using biocomfort maps in identifying new settlement areas and applying appropriate bioclimatic design criteria will improve the livability of cities. Future studies should consider additional climatic parameters and use larger data sets for a more comprehensive determination of biocomfort levels. This study, conducted using GIS technology, aimed to determine biocomfort levels in Muş province during the summer months. The results show that Muş has varying biocomfort levels depending on the period. This information serves as an important guide for urban planning and identifying new settlement areas.

Keywords: Biocomfort, Urban Planning, Climate, Geographic Information Systems, Urban and Regional Planning.

1. Introduction

Humans live in a physical space, and the characteristics of this space are influential throughout their lives. When people feel comfortable in the area where they live, they continue their activities there; otherwise, they want to leave the area. Areas with a certain range of humidity and temperature and clean air are places where people feel comfortable, and these areas are defined as comfort zones. (Cetin 2016; Cetin 2018; Cetin 2015a; Cetin 2019; Cetin et al 2019; Cetin et al 2018; Cetin and Zeren, 2016; Cetin and Zeren, 2016; Zhao et al 2020; Zomorodian et al 2016 Arıcak et al 2016 Zeren Çetin 2019 ; Çalı 2018; Sensoy et al., 2008 Çalışkan and Türkoğlu, 2014 Cetin 2016; Cetin 2018; Cetin 2015a; Cetin 2019; Cetin et al 2019; Cetin et al 2018; Cetin and Zeren, 2016) Depending on their physical and psychological conditions, comfort can be explained as a concept that establishes a connection between the human body and the environment in which they live . Thermal comfort, where people feel relaxed and comfortable, can be defined as the state of satisfaction with the thermal environment in which a person lives. In general, thermal comfort is explained as a mental process that determines an individual's satisfaction with the thermal environment in which they live The concept that expresses satisfaction for a person's mental state, which refers to health and dynamic air conditions, is thermal comfort (Cetin 2016; Cetin 2018; Cetin 2015a; Cetin 2019; Cetin et al 2019; Cetin et al 2018; Cetin and Zeren, 2016; Cetin and Zeren, 2016; Zhao et al 2020; Zomorodian et al 2016 Arıcak et al 2016 Zeren Çetin 2019 ; Çalı 2018; Sensoy et al., 2008 Çalışkan and Türkoğlu, 2014 Cetin 2016; Cetin 2018; Cetin 2015a; Cetin 2019; Cetin et al 2019; Cetin et al 2018; Cetin and Zeren, 2016; Topay 2013; Boschat et al 2015)

In environments where precipitation, humidity, wind, and temperature are at a certain level, people feel healthier and better. Keeping these values at a certain level is called "biocomfort." When these values are not within biocomfort levels, meaning they are either above or below the biocomfort values, people start to feel uncomfortable in those environments and want to leave the area (Cetin, 2016). In developing countries, as a result of unplanned urbanization, people living in those environments have faced cities that are difficult to use and lack aesthetic appeal. Ecological planning can prevent these problems from growing and turning into environmental issues in the future. Until recently, concepts such as a clean environment, ecological balance, and comfort conditions did not mean much to people and were not considered important. However, with the increase in income levels, these concepts have come to the forefront, and people have started to give importance to these factors when choosing the cities they will live in (Çetin et al., 2010; Çetin, 2016).

One of the most important issues to consider in ecological planning is the climate. The average of weather events observed over a long period in a region is defined as climate. Although climate refers to long-term weather events, it has a variable nature. Moreover, many mechanisms influence the elements that make up the climate, such as temperature, precipitation, pressure, and wind

Çetin (2018c) assessed bioclimatic comfort in Karabük province using climate data, formulas, and the RayMan 1.2 program. The study produced a bioclimatic comfort map for Karabük and identified suitable areas for bioclimatic comfort. Çalı (2019) aimed to identify areas suitable for bioclimatic comfort in Manisa province using meteorological data from regional weather stations. Data from these stations were transferred to GIS using ArcMap GISTM 10.2 software to create a climate map and determine areas suitable for bioclimatic comfort (Çalı, 2019). Çetin (2016) created bioclimatic comfort maps for the Cide district in the north of Kastamonu province. The study aimed to use these maps as a basis for areas in coastal regions, analyzing the climate data of the Cide area using the Physical Equivalent

Temperature index. Çetin et al. (2018d) aimed to create a bioclimatic comfort map for Elazığ province. The study used climate data, base maps, and formulas with GIS software to produce and analyze maps, identifying suitable areas for bioclimatic comfort. Zeren Çetin (2019) examined the bioclimatic comfort conditions in Trabzon province. The study investigated the role of natural factors like water, land cover, and vegetation in the changes of the thermal heat island and the effects of urban land use on local climate. Landsat 7, 8 satellite imagery and meteorological ground measurement stations were used, and single-band sections were used to analyze comfort value areas and local effects of urban heat. Kilicioğlu et al. (2020) also identified bioclimatic suitable areas for site selection in Samsun, considering landslide and flood zones. In a 2018 study, Akpınar aimed to evaluate the sustainable ecotourism potential in Şehit Şerife Bacı Nature Park in Kastamonu in terms of landscape management and planning, and conducted a bioclimatic comfort assessment of the area along with survey studies.

This study, conducted using GIS technology, aimed to determine biocomfort levels in Muş province during the summer months. The results show that Muş has varying biocomfort levels depending on the period. This information serves as an important guide for urban planning and identifying new settlement areas.

2. Materials and Methods

Biocomfort is a critical factor affecting individuals' quality of life and overall health. In an era of accelerated urbanization and prominent climate changes, evaluating biocomfort conditions plays a significant role in urban planning. Especially during the summer months, climatic parameters such as temperature and humidity directly influence biocomfort levels. This study aims to determine biocomfort levels across Muş province during the summer months and integrate this information into urban planning processes. In this study, the New Summer Index (SSI) was used to assess biocomfort levels in Muş province during the summer months. SSI is an index that determines biocomfort levels based on climatic parameters such as temperature and humidity. Using Geographic Information Systems (GIS) technology, SSI values were calculated for different regions of Muş and biocomfort levels were mapped accordingly. Climate data from the Muş Meteorology Directorate, including daily temperature and humidity values for the summer months (June, July, August), were used. This data was transferred to GIS software and prepared for analysis. SSI calculations were based on temperature and humidity data, and the calculated SSI values were categorized according to biocomfort levels. These categories represent "cold," "comfortable," and "hot" biocomfort levels. Using GIS software, SSI values for different regions of Muş were mapped, and suitable areas based on biocomfort levels were identified. The analysis revealed that in June, Muş province is predominantly characterized by discomfort. In July and August, however, the regions fall into the 2nd and 3rd categories, indicating that these areas are more suitable for biocomfort. This suggests that there are periods during the summer when high biocomfort levels are present in Muş.

Muş Province is located in between 39°29' and 38°29' north latitude and 41°06' and 41°47' east longitude. It constitutes 1.1% of Turkey's total area (URL-1,2 2024).

Muş Province experiences a harsh continental climate. The temperature ranges from -29°C to +37°C. The temperature exceeds +30°C for 120 days of the year and drops below 0°C for another 120 days. It snows heavily in winter. The annual precipitation ranges from 1000 mm to 350 mm. Winters are very cold and long, while summers are short, hot, and dry (URL-2, 2024).

Table 1 Average climate data of Muş Province by years.

Month	J	F	M	A	M	J	J	A	S	O	N	D	Year
AT	-7.1	-5.7	1	9	14.7	20	24.9	24.9	20	12.7	4.6	-2.7	9.7
AHST	-3	-1.1	5.9	14.7	21.2	27.4	33	33.1	28.2	19.8	9.8	1	15.8
ALST	-10.7	-9.5	-2.8	4.2	8.7	12.6	16.9	16.9	12.2	6.8	0.5	-5.8	4.2
ASS	1.8	2.8	4.2	5.6	7.8	10.1	10.7	10.4	9.1	6.2	3.6	1.8	74.1
ARDD	13.7	12.3	14.2	14.5	14.1	6.4	2	1.5	3	9.3	9.8	12.7	113.5
MAMP	90.4	98.3	104	104.7	69.1	27.6	7.6	5.5	15.8	64.2	89.6	90.7	767.5

3. Results

In the study, biocomfort maps for the summer months have been created for the entirety of Muş Province. The biocomfort map for July, created using meteorological data for the entire province of Muş, is presented in Figure 1.

When we examine the July biocomfort map of Muş Province, it is observed that the 2nd Zone region includes the areas around Varto, Bulanık, Korkut, and Malazgirt. This area covers 62.65% of the total area. When looking at the 3rd Zone region, it is observed that it includes the areas around Muş (Center) and Hasköy. This area constitutes 37.34% of the total area. The temperature situation for August across Muş Province

When we examine the August biocomfort map of Muş Province, it is observed that the 2nd Zone region includes the areas around Malazgirt, Varto, and Bulanık. This area covers 48.09% of the total area. When looking at the 3rd Zone region, it is observed that it includes the areas around Muş (Center), Korkut, and Hasköy. This area constitutes 51.90% of the total area.

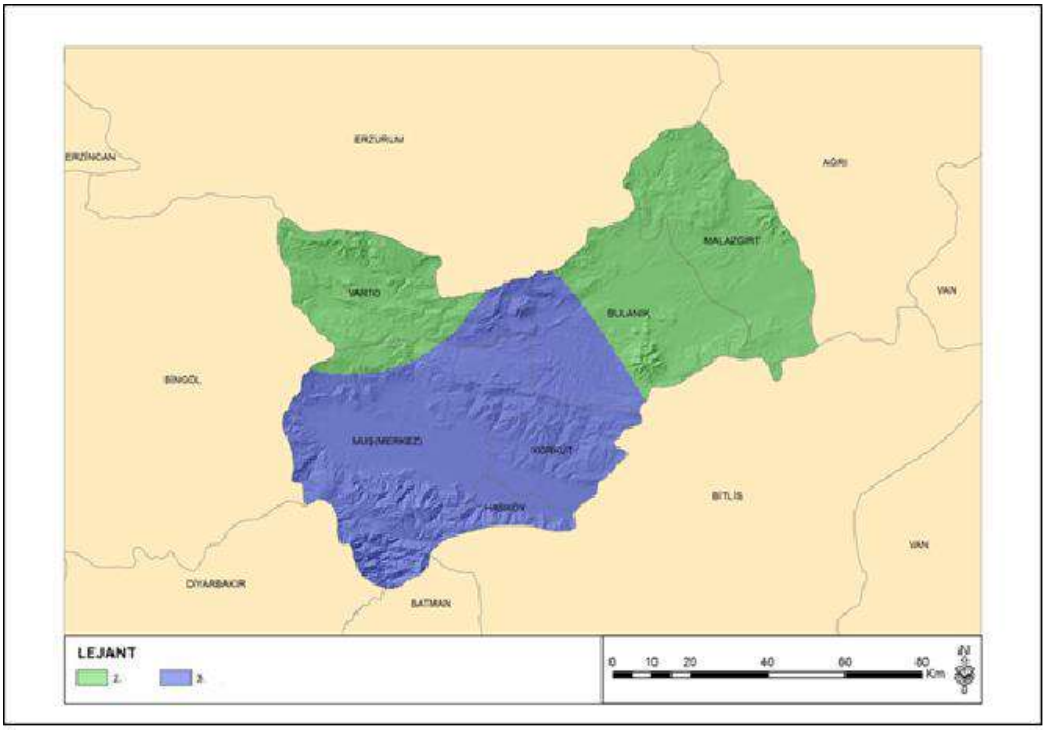


Figure 1 Biocomfort map of Muş province.

4. Discussion

When we look at Muş Province, the northern and northeastern regions are characterized as cold in terms of biocomfort in June. In July and August, most of the regions in the province are considered suitable for comfort.

In recent years, one of the factors people consider when choosing their living spaces is the biocomfort conditions of the area they will live in. When the biocomfort conditions of living spaces are appropriate, people feel more comfortable, dynamic, and healthy. This state of comfort at certain levels is referred to as "biocomfort." When biocomfort conditions are not within specific ranges, people feel uncomfortable and may want to move away from that area (Cetin, 2016; Çalı, 2018;). Therefore, numerous studies have been conducted on biocomfort in different regions.

Due to the population increase occurring in almost all of our cities, new residential areas are being established, and the structure of cities is changing. However, people's expectations from their living spaces in the modern age are also evolving. Factors that were once not considered important, such as social amenities, air quality, opportunities for activities, and proximity to nature, now play a significant role (Cetin et al., 2018a; Çalı, 2018). Studies on biocomfort generally show that urban center areas are less comfortable, primarily due to the heat islands caused by urbanization (Zeren Çetin, 2019).

5. Conclusion

In this study, it is aimed to evaluate climate data across the province using Remote Sensing and Geographic Information Systems, taking into account the topographic conditions of the study area, and to determine areas suitable for biocomfort during the summer months based on the summer index. The research analyzes the biocomfort status of the area during the summer months by evaluating meteorological data.

When we examine the biocomfort maps for Muş Province, it is observed that the province is generally uncomfortable in June in terms of biocomfort. In July and August, the 2nd and 3rd Zones dominate the province, and these areas are classified as comfortable. There do not appear to be any obstacles in terms of biocomfort that would affect planning.

Considering bioclimatic conditions in planning will be effective in creating more sustainable and comfortable cities. Landscape architecture and urban-regional planning can be improved by applying bioclimatic comfort principles and design criteria. Therefore, conducting similar studies in future planning to identify biocomfort areas, and especially considering the results of biocomfort studies for areas that will be opened for new settlements, is crucial.

Constructing new settlement areas in locations that are suitable in terms of biocomfort can significantly reduce heating and cooling costs, thus providing substantial economic benefits and contributing significantly to environmental protection. Additionally, determining areas suitable for biocomfort during the summer months will particularly facilitate planning for tourism activities and for individuals who spend most of their annual vacations in the summer.

Biocomfort is one of the topics that must be considered in landscape planning studies. However, most studies are conducted in very limited areas and remain only as research. It is evident that sufficient

progress has not yet been made in transferring these studies into practice. Considering these studies in urban planning, using studies like this one that focus on summer months in the planning of tourism activities, assessing how construction associated with planning decisions will affect biocomfort, and shaping planning decisions accordingly are all of great importance for providing more comfortable living spaces to people. Therefore, especially in provinces with high population growth rates, it is recommended that biocomfort studies be conducted when determining areas to be opened for development, and that studies covering a specific time period, like this one, be considered in the planning of tourism activities.

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024
PITESTI-ROMANIA

ORAL PRESENTATION

Assessing the Economic Potential of Sea Urchin Roe Trade in Tawi-Tawi, Philippines during Ramadan

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Abstract

The local markets of Tawi-Tawi prominently feature sea urchin roe, especially during the Holy Ramadan, which is typically used as an appetizer and food by the local communities. This product remains available throughout the entire 30-day Ramadan period. This study aimed to determine the economic significance of sea urchin roe in Tawi-Tawi, Philippines. The research was conducted at two primary markets: Tabu-Tabu market in Batu-Batu, Panglima Sugala, and Bongao Wet market, spanning the Ramadan period from March to April 2024. Interviews with 120 vendors were conducted to provide valuable insights into socio-demographic information, production, and fishing location details. The results showed that most vendors were female, married, unaware of their age, had no formal education, and belonged to the *Sama Dilaut* tribe. While the majority identify as Muslim (68%), a significant portion do not affiliate with any religion (52%). Most vendors have households of 5-6 members. The income of the vendors ranged from ₱1,000 to ₱5,000, relying mainly on fishing and selling sea urchin roe. The majority have 1-5 years of experience selling sea urchin roe. The roe sold mostly originated from collectors, although some vendors are also collectors. Out of 120 vendors interviewed, only one sold gracious sea urchin, *Tripneustes gratilla*, locally known as *Teheh-teheh*. In contrast, the others sold long-spined sea urchin *Diadema setosum*, locally known as *Tayum* (n=119). The sea urchin roe is sold between 1:00-2:00 in the afternoon for ₱30-40 per glass (150 mL or 175 mL). The sea urchin roes were previously collected from Panglima Sugala and Simunul waters. Most vendors could sell 10-20 glasses per day, earning ₱100-500 per day. This socio-economic snapshot provides valuable insights into the sea urchin roe market and the lives of the vendors who sustain it. The findings highlight the critical role of sea urchin roe in the local economy and underscore the need for sustainable practices to ensure the long-term viability of this important resource.

Keywords: Sea Urchin Roe, *Diadema setosum, Tripneustes gratilla*, Vendors, Fishing Ground, Ramadan.

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
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ORAL PRESENTATION

A Comparative Study on the Species Composition and Catch Efficiency of Two Different Designs of Fish Pots

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Abstract

Traditional fish traps are a prevalent fishing method in Tabawan, South Ubian, Tawi-Tawi, Philippines. These traps play a pivotal role in the local economy, providing a reliable source of food and income for the community. The design of these traps is crucial for maintaining sustainable fishing practices. This study aims to compare the effectiveness of circular and square fish traps in capturing target fish, such as Siganid species. Conducted at Tahing-Tahing Island, Tabawan, South Ubian, Tawi-Tawi, Philippines, the study utilized two trap designs: circular and square. A total of 10 fish traps (five replicates per design) were deployed for 12 hours, from 7:00 AM to 7:00 PM, baited with green algae (*Ulva* spp.). After collection, the fish were identified, weighed, and counted to calculate the total catch and catch efficiency of the two trap shapes. A total of 101 individual fish were caught. The results reveal that circular traps had a higher catch with 58 individuals weighing 5,342 g and captured a greater species diversity. Square traps caught 43 individuals weighing 3,258 g. Five species of fish were caught using the two trap shapes. The target species, *Siganus canaliculatus*, was caught only in the circular trap. The other four non-target species caught were *Oxycheilinus digramma* (Bukan), *Sargocentron rubrum* (Tahik-tahik), *Lutjanus russellii* (Bahaba), and *Plectorhichus lessoni* (Dorong). These findings suggest that trap shape significantly affects fish catches, making trap design crucial for efficiency and sustainability. Circular traps, with their higher catch rates and greater species diversity, offer promising benefits for the future of fishing in the Sulu archipelago. This study highlights the importance of optimizing fishing gear to support fisheries management and conservation in the region.

Keywords: Fish Traps, Non-target Species, *Oxycheilinus digramma*, *Siganus canaliculatus*, *Ulva* spp., Catch.

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The authors would like to express their gratitude to the Mindanao State University-Tawi-Tawi College of Technology and Oceanography for their continuous support, as well as the College of Fisheries.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
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ORAL PRESENTATION

Effects of Hermit Crab Meal as an Alternative to Fish Meal on Growth, Survival, and Feed Utilization of Tilapia (*Oreochromis niloticus*, Linnaeus, 1758)

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Abstract

Hermit crabs are prevalent organisms in coastal areas, typically considered to have no commercial value. However, they can pose a threat to other univalve shells as they require new shells for growth. To date, no published research has explored the use of hermit crab meal as an alternative protein source to fish meal. This study aimed to evaluate the growth performance, survival rate, and feed utilization of tilapia when fish meal is replaced with hermit crab meal in their diet. The experiment was conducted at the Multi-Species Hatchery, College of Fisheries, Mindanao State University Tawi-Tawi College of Technology and Oceanography (MSU-TCTO), Bongao, Tawi-Tawi, Philippines (05˚02'13.71'' N 119˚44'34.98" E) over a four-month period from February to June 2024. Wild Nile tilapia (*Oreochromis niloticus*) were collected from the swamps of Sanga-Sanga, Tawi-Tawi, Philippines using a mosquito net. Wild hermit crabs were manually collected from the coastal area of Sanga-Sanga. The hermit crab shells were removed, oven-dried for two days, and pulverized using a grinder.The study's treatments involved varying replacement levels of Hermit Crab Meal (HCM) for Fish Meal (FM) in the tilapia diet: T1 = 0%, T2 = 25%, T3 = 50%, T4 = 75%, and T5 = 100%. The fish were transported to the study site, acclimatized in a circular tank (1 ton) for one week, and fed commercial feeds. A total of 450 fish were equally stocked into 15 mega boxes (20 L), with 30 fish per container. Aeration and flow-through systems were provided throughout the study. All tilapia were individually weighed, and sampling was conducted every fifteen days. Results indicated that the diet with 75% HCM (T4) resulted in significantly higher ($p<0.05$) weight gain (3.27±0.16 g) compared to the 25% HCM diet, but showed no significant difference from other treatments. The highest survival rate was observed in the 25% HCM group (T2) at 82.22±6.19%, with no significant difference ($p>0.05$) among treatments. The lowest Feed Conversion Ratio (FCR) was observed in the 50% HCM group (T3) at 2.03±0.17. This study concludes that diets containing 50% (T3) and 75% (T4) hermit crab meal improve the growth performance of tilapia, with 50% hermit crab meal being well-accepted by the fish. These findings contribute to the aquaculture industry by potentially reducing the cost of fish meal in formulated diets.

Keywords: Hermit Crab Meal, *Oreochromis niloticus,* Growth Performance, Survival Rate, Feed Utilization.

Acknowledgment

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Feed Alternatives for Ornamental Fish and Risks

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Abstract

Aquarium fish breeding has spread all over the world as well as in our country. Thanks to its high adaptability, fish grown almost everywhere have quickly become the focus of people's attention. After economic development, people have begun to grow aquarium fish for stress, for interior design, or other reasons such as responsibility awareness for children. Ornamental fish whose homeland is not Türkiye. They come as imports goods and we pay severely according to fish species. Especially the fish which are rare or have different qualities are sold at high prices. So much so that the museum-shaped aquarium complexes were built in the big cities and they were seen. We declerated about this situation in our previous studies. It is also important to feed the aquarium fish, which is part of our life. Particularly suitable for mouth structure and rich protein value feeds should be preferred for growing offspring. Feed elements that are necessary for coloration, health status, development of immune systems, and good reproductive performance should not be forgotten. Large amounts are paid to these imported goods and cause economic losses. However, recently, due to the expensive feed, fish have started to be fed with foods such as food scraps. In this research, (the use of live feed that can be easily grown instead of leftovers will be explained to raise people's awareness) some of the nutrient alternative live baits (especially the cultivation is easy and feasible) that can be used in the feeding of aquarium fish will be explained. These nutrient sources are both cheap and easily obtainable species. Such as daphnia magna, white worm, artemia salina, sea monkey fresh water mussels etc.

Keywords: Ornamental Fish, Alternative Fish Feed.

1. Introduction

This study aims to provide an overview of the ornamental fish trade, covering a multitude of aspects, from the 19th century naturalists who first discovered the interesting ornamental fish species, to the production and propagation in various exporting countries, from socioeconomic, regulatory and technical factors to the procedures and documentation techniques required for importing ornamental fish from Asia and South America. In a socioeconomic context, this growth is also very important for the development of rural and poor populations who can use this sustainable and renewable source of income with minimal impact on natural ecosystems. In contrast to marine species, more than 90% of freshwater ornamental fish are reared in aquariums. Indeed, most marine species, both fish and invertebrates, are often caught directly in their habitats of origin using inappropriate methods, which has been reported to cause depletion of marine ecosystems and the destruction of coral reefs, especially in Southeast Asia. Therefore, ornamental fish species caught in the wild by fish producing and exporting countries do not always meet the environmental protection and biosecurity requirements of the importing countries,

which have been reported to become increasingly strict in terms of animal health and welfare over the years. The current economic crisis has led to a significant decline in the ornamental fish trade, which has experienced rapid growth and development to date and is seen as providing a basis for socio-economic opportunity in several developing countries. The most important issues in the sector relate to the interpretation of the many regulations in the field of health and animal welfare, and the protection of endangered and red-listed species.

2. Method

In our research, It has been determined that food residues cause pollution and deaths when not used correctly. Some of the live baits suitable for the feeding and development of aquarium fish will be explained. White worm, daphnia magna, artemia salina, sea monkey species will be given information about their cultivation.

Although fish have long been kept as ornamental fish and the development of feeds since 50 years ago has contributed to the growth of the hobby, the rearing of ornamental fish is based on extrapolation from the results obtained from food fish under intensive farming. Some research on the nutritional requirements of freshwater species growing in an environment has been conducted, particularly in countries such as Singapore, with emphasis on the provision of live feed in the early stages of the life cycle. Protein requirements range from approximately 30% dietary protein for omnivorous goldfish to 50% for carnivorous discus. Although mineral requirements in guppies have received some attention, little research has focused on the vitamin requirements of ornamental species. Fatty acid requirements have been studied primarily in marine ornamental plants, emphasising the need for dietary supplementation with n-3 highly unsaturated fatty acids. Fish kept in public and home aquariums present the problem of a diversity of species, each with their own specific requirements and needs in the same enclosure. Maintenance energy levels of ornamental fish range from 0.068 kJ per day for small neon tetras to 0.51 kJ per day for moonlight gouramis kept at 26 °C water temperature. Research on the nutritional requirements of ornamental fish has led to the investigation of appropriate measures other than growth rate to determine optimal dietary inclusion levels (Sales and Janssens 2003).

By yourself grow live feeds, cheap and easy to grow because they are remarkable. Some are extracted from eggs and some are produced directly. The production of water fleas, white wolves and freshwater crustaceans is very easy and there is information about how to produce them almost everywhere.

In addition to these, alternative feeds with more nutritive properties will be mentioned. It is thought that aquarium enthusiasts will contribute to cheaper and healthier fish production. We will also prevent diseases and indirect deaths.

Trade data on the internet for these researches have also been examined. For this purpose, blog comments and the opinions of aquarium lovers and manufacturers were also taken into account.

3. Results and Discussion

International trade provides vastly expanded opportunities for species to be carry to new places through a wide range of paths. Those lessepsian species for ornamental purposes may have serios negative effects on the new habitat and native species as well. For example disease trasnfer, consuption of fish eggs,

reduction of fish stocks, consumption of large amounts of macophytes, direct and indirect effects on other aquatic species.

Ornamental fish production is a major cash crop of the aquaculture economy for the United States, with the retail value of fish trade being approximately US$1 million. However, there are few studies to document this trade. An estimate was made using import and export documentation. In addition, the value of the most frequently imported ornamental fish was estimated. The Port of Los Angeles accounted for 39% of all trade, Miami 22%, New York 16%, Tampa 6%, and Honolulu 6%. Freshwater fish accounted for approximately 96% of the total volume and 80% of the import value. The majority of freshwater ornamental fish were farm-raised and imported from Southeast Asia. Most of the US ornamental fish exports originated in Florida. Although marine aquarium fish had a high market value (20% of the declared value of imports), the volume of these fish was only 4%. Most of the imported and exported saltwater ornamental fish was reported as wild-caught. Of the 1,539 species declared as ornamental fish, 32 dominated the trade. All of these were of freshwater origin. Guppies and neon tetras were the most popular ornamental fish kept in households in the United States. The results of this study document the importance of the ornamental fish industry and also reveal the most valuable species in trade for potential domestic culture and conservation in the wild (Chapman et al 2007).

They must be healthy for this and should be fed with cheap and quality food. In this study, some cheap and high quality live feeds and their cultivation tecniques which can be alternative in the feeding of aquarium fish are explained. In this respect, aquarium fish lovers are more conscious and will be able to contribute to their economies. And thus deaths and economic losses will be prevented.

In the proposed system, aquarium fish can be fed with different food sources. However, the risks they may pose must be foreseen and precautions must be taken. Before feeding, it is necessary to have information about the species, diseases, feeding behavior and environmental conditions.

Since fish both feed and live in the same environment, they must be treated sensitively. However, in the studies to be carried out, small experiments and observations should be made first, and then large-scale feedings should be made.

All kinds of small aquatic creatures or tissue parts of aquatic organisms can be used as a source of nutrition. But necessary research should be done to use them frozen or fresh.

Necessary research and observations should be made to prevent the physico-chemical structure of the water from deteriorating and the contamination of pathogens.

This review addresses some of the issues related to the health and welfare of ornamental fish. The general care and maintenance of the aquatic facility and its ecosystems are directly related to the general health of the fish. Keeping the areas behind non-public areas clean is essential to good sanitation practices. Excessive food and detritus accumulation are predisposing factors to poor water quality and can serve as substrates for facultative pathogens. In order to maintain a high quality sanitation program in a breeding facility, cleaning and disinfecting of supplies is essential. Providing proper nutrition and quality water are important aspects of maintaining a successful aquarium. Since there are hundreds of different species of fish in the aquarium hobby, ornamental fish nutrition must be approached systematically and holistically. When an aquarium facility is opened or when the home hobbyist acquires a large number of aquariums, a preventive health care program should be implemented. Health issues

should be addressed on a daily basis, not just when a problem arises. When problems occur, a treatment regimen should be implemented that provides a short-term solution to the problem and keeps a long-term plan in mind. The important thing to remember is to never transmit the disease (Miller and Mitchell 2009).

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
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ORAL PRESENTATION

The Effect of *Pantoea agglomerans* on the Growth and Macro-Micro Element Content of *Begonia semperflorens*

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Abstract

Bacteria, which are an environmentally friendly alternative that contributes to the reduction of chemical inputs in agricultural production, are used commercially due to their plant growth-promoting properties. *Pantoea agglomerans*, a bacterium that promotes plant growth through biological nitrogen fixation, phosphate solubilization, growth hormone production, and enhanced nutrient uptake, is emerging as a potential biofertilizer in agriculture and horticulture. This study was initiated due to the limited use of such bacteria, which have been employed in numerous investigations, in ornamental plants. *Begonia semperflorens*, an evergreen perennial plant with a long flowering period and colorful flowers, widely used in landscaping and floral applications due to its high commercial value, was selected for this study. *Pantoea agglomerans* RK-79 isolate was used for bacterial treatment, and begonia seedlings were irrigated twice at 15-day intervals with bacteria-containing media. At the end of the study, the total number of bacteria in the soil, as well as the effects on plant growth, quality, and macro-micro element content (P, K, Ca, Mg, Mn, and Fe), were determined. As a result of the bacterial treatment, there was an increase in plant height, the number of leaves per plant, leaf area, stem diameter, flower stem length, and the number of blooming flowers compared to the control. Additionally, micro and macro nutrient values in soil and plant samples were analyzed. The results showed that applying *Pantoea agglomerans* in begonia cultivation positively impacted plant characteristics, leading to high-quality products.

Keywords: *Pantoea agglomerans*, *Begonia Semperflorens*, Ornamental Plants, Biofertilizer.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
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PITESTI-ROMANIA

ORAL PRESENTATION

From Tiny Particles to Big Problems: The Story of Microplastics

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Abstract

Microplastics are minuscule plastic particles, less than 5 millimeters in size, originating from the breakdown of larger plastic items or from intentionally manufactured products. This presentation explores the pervasive issue of microplastics, highlighting their types -primary and secondary- and their widespread environmental and health impacts. Primary microplastics are designed to be small, such as those found in cosmetics, while secondary microplastics result from the degradation of larger plastics. Their presence in oceans, rivers, and soils poses significant threats to wildlife and ecosystems, with documented ingestion and physical harm observed in various species. Additionally, microplastics have been detected in drinking water and food, raising concerns about potential health risks for humans. The presentation discusses current mitigation efforts, including regulatory measures and innovative solutions, and emphasizes the importance of individual and collective actions in addressing this global challenge. By understanding the origins, impacts, and solutions related to microplastics, we can better advocate for and implement strategies to reduce plastic pollution and protect environmental and human health.

Keywords: Microplastic, Health Impacts, Human, Ecosystem, Global Challenge.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
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ORAL PRESENTATION

Evaluation of Fermented Banana Peel on the Survival Rate and Growth Performance of Juvenile Whiteleg Shrimp (*Litopenaeus vannamei*) in Pond Culture

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Abstract

The present study aims to investigate the efficiency of fermented banana peel flour inclusion on the Specific Growth Rate (SGR), Weight Gain (WG) and Survival Rate (SR) of commercially important aquaculture species on the whiteleg shrimp scientifically known us (*Litopeneaus vannamei).* Banana peel has been used as traditional medicine to various illments, banana peel contain 7.26% of protein, 15.29% of fat and 24.13 crude fiber. Fermetation is a process changing organic matter from a complex structure to simplier one that increase livestock. The study was conducted in pond with a duration of 30 days culture period. This study used a Completely Randomized Design with an experimental plot consisting of 4 treatments and 3 replications: T1 (commercial feeds), T2 (50g), T3 (100g), T4 (150g) each triplicate received 20 juvenile prawn respectively. SPSS One-way Analysis of Variance (ONE-WAY ANOVA) was used to analyse the data and continued with Duncan's multiple range test. The results of statistical analysis showed that there was no significant different ($p > 0.05$) in terms of growth rate, specific growth rate and survival rate among all treatments. This shows that commercial feeds substitution using fermented banana peel (*Museceaea* sp.) with different inclusion level in feeds has the same SGR, WG and SR values as well as the control feeds respectively.

Keywords: *Litopeneaus vannamei,* Aquaculture, Banana Peel, Fermentation. Commercial Feeds.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

The Pearl of Munzur, Red Spotted Trout

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Abstract

Red-spotted trout (*Salmo munzuricus* Turan et al., 2017), which is found in Munzur River within the borders of Tunceli Province and has both economic and social value, is like the pearl of Munzur River. It is also the most important fish species of the region and is seen as a source of healing by the people besides its flavor. As a result of indiscriminate and unconscious hunting in Munzur River and in general in Pülümür River and its tributaries, the red-spotted trout, which is identified with Munzur and considered sacred by the people, has gradually decreased and faced extinction. Global warming, construction activities on the river, sewage wastes, agricultural activities, sand and gravel quarrying in the river are all serious threats to the extinction of this trout. This fish population has been taken under protection in order to ensure its survival and hunting of red-spotted trout in the Munzur River, which is protected and controlled by the General Directorate of National Parks, has been banned throughout the period. However, it is known that amateur fishing is practiced by the local people with various types of fishing rods and spreader nets. Red-spotted trout, which live in the Munzur River and are facing extinction, are facing extinction due to uncontrolled hunting. For this reason, all our people should take responsibility for the protection of the red-spotted trout, the pearl of Munzur. In addition, necessary studies should be carried out for the production of red-spotted trout through “aquaculture” and the continuation of the species.

Keywords: Red-Spotted Trout, Munzur Pearl, Hunting, Tunceli.

1. Introduction

In recent studies on trout in Turkey, 18 species have been reported to be distributed in Anatolia: *S. abanticus* (Abant Lake Basin), *S. rizeensis* and *S. coruhensis* (in rivers along the Black Sea coast of Turkey), *S. duhani* (in rivers in the Marmara and Aegean regions), *S. ardahanensis* (in the upper basin of the Kura River), *S. araxensis* and *S. murathani* (in the upper basin of the Aras River), *S. euphrataeus* and *S. fahrettini* (in the upper basin of Karasu, a tributary of the Euphrates River, and Terme Stream), *S. fishi* (in the upper basin of the Murat River), *S. munzuricus* (Munzur Stream), *S. okumusi* (in Tohma and Göksu streams, tributaries of the Euphrates River), *S. tigridis* (from Tigris River, Persian Gulf basin), *S. platycephalus* (upper basin of Seyhan River), *S. labecula* (lower basin of Seyhan River), *S. chilo* (Ceyhan River), *S. opimus* (Alara and Manavgat streams), *S. kottelati* (Alakır Stream) (Turan et al., 2010).

Salmo munzuricus, commonly known as red-spotted trout, is distinguished by having a large adipose fin in males (almost as large as the dorsal or anal fins in older males) with a very narrow white margin, then a red submarginal band, then a white stripe or spots. It is an endangered trout species with high economic value in Munzur Stream, an important water source (Turan et al., 2017).

The species distributed in Munzur Stream (Euphrates basin) and previously identified as *Salmo trutta macrostigma* was identified as *Salmo munzuricus* by Turan et al. (2017). In the literature, it is named differently as "Munzur trout" and "Red-spotted trout". In recent years, natural trout populations have decreased due to reasons such as pollution, poaching, and hydroelectric power plant projects, and have even entered the process of extinction in some regions. Trout adapt to cold waters and always live in the upper reaches of rivers. This has led to an increase in trout habitat diversity. It prefers the parts of the rivers close to the source defined as "trout zone". The species, which has a carnivorous diet, has economic and ecological importance (Özcan and Serdar, 2018).

Although there are natural trout populations in many regions of Turkey, information on their growth and reproductive characteristics is very insufficient. Red-spotted trout is distinguished from other subspecies by blackish-gray body color, black and spotted dorsal fin, bifurcated caudal fin, 10-12 large red spots in a row on the lateral line, large and prominent post-orbital spot, relatively low number of vertebrae, prominent black spots on the gill cover and black spots on the gill cover do not go below the lateral line on the body (Kuru, 1975; Geldiay and Balık, 1996; Duman et al. , 2011).

Since the red-spotted trout (*Salmo munzuricus*), the pearl of the Munzur River, is an endangered fish with economic value, it is very important to draw attention to maintain the natural population, to introduce the species to aquaculture and to protect its natural population.

2. Materials and Methods

The Munzur River flows through the Munzur Valley, one of the largest national parks in Turkey with an area of 42,000 hectares. Born in Ziyaret Tepe, 15 km away from Ovacık District of Tunceli, the river flows through steep valleys and feeds the Uzunçayır Dam Lake after traveling a distance of approximately 90 km (URL-1, 2024) (Figure 1). The Munzur River has been the subject of myths, folk songs and sayings as it is considered sacred by the people of the region. Likewise, *Salmo munzuricus* (Figure 2), the most important fish species in the Munzur River, is seen as a source of healing as well as its flavor. In some regions of our country, swallowing live red-spotted trout fry is used in the treatment of stomach ailments such as ulcers (Çiçek et al., 2020). Fishing is prohibited in the Munzur River, which is protected and controlled by the General Directorate of National Parks. However, it is known that amateur fishing is practiced by the people of the region with various types of fishing rods and spreader nets.

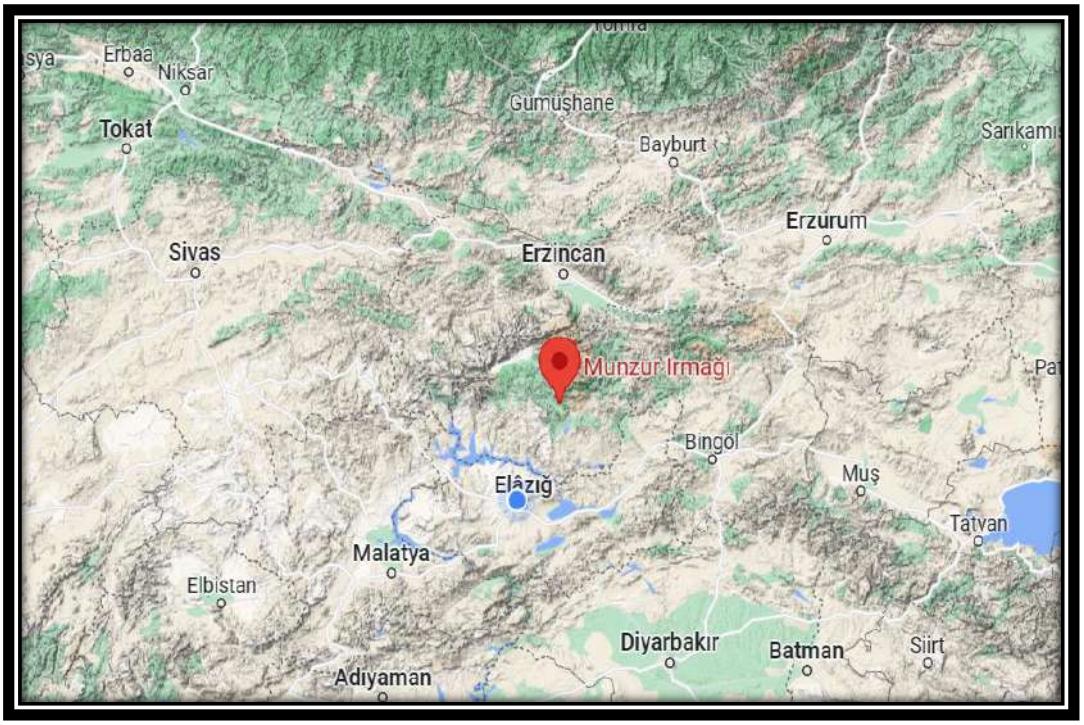


Figure 1. Munzur River (URL-2, 2024).



Figure 2. Red-spotted trout (Original).

3. Results and Discussion

In our province, this fish, which is called red-spotted trout, Latin *Salmo munzuricus*, is a subspecies and its body is shuttle-shaped and slightly flattened from the sides. This fish has red spots on its side and dorsal region. *S. munzuricus* is known to be distributed in the Munzur Stream and its tributaries in

Tunceli province. It lives in small stream pools with cold, clear and fast flowing water. The bottom consists of rocks, stones and pebbles. This fish spends its whole life in streams with cold water. The spawning period is November-December throughout our province, and they lay their eggs in nests on fine sand and pebbles in places close to the source (Mercan Stream, Mercan Stream in the flow direction of Munzur Stream (between the lower parts of Ovacık District and Koyungölü Village), and streams and tributaries flowing into Pülümür Stream). It has been determined that the Munzur natural trout carries eggs up to 20% of its live weight and an average of 1900 eggs are taken from a female fish of one kg live weight. This carnivorous fish feeds on flies, fly larvae, aquatic insects, molluscs, crustaceans, maggots, spiders and larvae and eggs of other fish (URL-3, 2024).

As a result of indiscriminate and unconscious hunting in Munzur Stream in particular and Pülümür Stream and its tributaries in general in our province, the red-spotted trout, which is identified with Munzur and considered sacred by our people, has gradually decreased and faced extinction. Thus, both the biological balance in our rivers has been disrupted and a resource that meets the animal protein needs of the local people has gradually decreased (URL-3, 2024).

Global warming, construction activities on the river, sewage wastes, agricultural activities, sand and gravel quarrying in the river are all serious threats to the extinction of this trout population. This fish population has been taken under protection in order to ensure its survival and hunting of red-spotted trout in the Munzur River, which is protected and controlled by the General Directorate of National Parks, has been banned throughout the period. However, it is known that amateur fishing is practiced by the local people with various types of fishing rods and spreader nets. Red-spotted trout, which live in the Munzur River and are facing extinction, have faced extinction due to uncontrolled hunting. This fish population has been taken under protection in order to ensure the continuation of its population and in accordance with the “Circulars for the 2004-2006 Hunting Period regulating Commercial/Sportive Fishing in the Seas and Inland Waters” published by the General Directorate of Protection and Control of the Ministry of Agriculture and Rural Affairs, the fishing of red-spotted trout in all inland waters within the borders of our province has been banned throughout the period. Unfortunately, the fact that the penal sanctions imposed on those who hunt, transport, sell and use this fish in production during the prohibition period are low and that a kilogram of red-spotted trout can be bought at an exorbitant price of 20-25 million makes the hunting of this fish even more attractive (URL-3, 2024). Although it is a natural right for the people living in our province to benefit from the fish living in their own inland waters, when the problem is an endangered fish, either the academic circles should investigate the conditions for the cultivation of this fish, artificially reproduce it and release it into natural waters and limit the bans by ensuring the biological balance in these areas, or our people should be more sensitive and protect our red-spotted trout, which carries the beauty of our Munzur (URL-3, 2024).

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ORAL PRESENTATION

Suitability for Aquaculture in Uzunçayır Dam Lake (Tunceli, Turkey)

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Abstract

In this study, information on what to do in order to reveal the suitability of Uzunçayır Dam Lake located within the borders of Tunceli province for aquaculture is given. For this purpose, in order to create a new investment and employment area to be made in Uzunçayır Dam Lake, firstly, water measurements should be made on the surface and at different depths in the dam lake and samples should be taken. After analyzing the samples in the laboratory, water quality parameters (water temperature, pH, turbidity, dissolved oxygen, depth and electrical conductivity) should be determined to determine whether the dam lake water is suitable for production. Strategies should be developed to determine what can be done for cage fishing without harming fish species in the dam basin and to reduce the risk of spread of diseases and harmful organisms in aquaculture. In particular, attention should be paid to whether the ground is cleaned, which may create a negative impact on cage farming. Investors should be informed about the determination of site selection in Uzunçayır Dam Lake and applications to the relevant institutions for this process. This study is a preliminary study to determine the suitability of Uzunçayır Dam Lake for aquaculture and it is aimed to contribute to the economy of the region and the country by providing direction for future investments.

Keywords: Aquaculture, Temperature, Oxygen, Uzunçayır Dam Lake.

1. Introduction

With the increasing population in the world, the demand for food products is increasing day by day. The desire for healthy nutrition in societies also affects the interest in aquaculture. The environmental pressure that has emerged with industrialization in many production branches has also manifested itself in this sector with the gradual increase in aquaculture production in recent years. This environmental pressure has caused the aquaculture sector to search for new solutions and the issue of sustainable aquaculture has come to the agenda. Sustainability is the ability of a society, an ecosystem or other similar interactive systems to function continuously without depleting their basic resources and without adversely affecting the environment (Peterson and Dorsey, 2000). Sustainable development is a management approach in which natural resources are conserved while technological and institutional changes are made to ensure that the needs of current and future generations are continuously met (Frankic and Hershner, 2003). Aquaculture production activities have an impact on the ecosystem in which they take place. The concept of sustainability in aquaculture is important to manage this impact correctly. Sustainability can only be achieved through rational planning and appropriate management strategies (Yavuzcan et al., 2010). However, in terms of the continuity of resources such as lakes, ponds

and reservoirs and sustainable fish farming, it is extremely important to monitor the changes that may occur in these ecosystems over time and to manage the resources (Tekinay et al., 2006). Determining the carrying capacity of an inland water resource and predicting the impact of fish production facilities to be established in advance is essential for the sustainable management of the resource and eutrophication control (Pulatsu, 2003; Ayekin et al., 2018).

There are *Salmo trutta macrostigma* (Dumeril, 1858), *Acanthobrama marmid* Heckel, 1843, *Alburnoides bipunctatus* (Bloch, 1782), *Alburnus mossulensis* Heckel, 1843, *Barbus lacerta* Heckel, 1843, *Capoeta trutta* (Heckel, 1843), *Capoeta umbla* (Heckel, 1843), *Chondrostoma regium* (Heckel, 1843), *Cyprinus carpio carpio* (Linnaeus, 1758), *Squalius cephalus* (Linnaeus, 1758), *Oxynoemacheilus angorae* (Steindachner, 1897), *Paracobitis tigris* (Heckel, 1843) species in Uzunçayır Dam Lake (Çoban et al., 2013).

In this study, the suitability of Uzunçayır Dam Lake for aquaculture was investigated. In order to make new large-scale investments, some studies should be carried out on the lake and the results of these studies should be analyzed and evaluated well.

2. Materials and Methods

Uzunçayır Dam was constructed between 1996 and 2003 to generate energy on the Munzur River in Tunceli. Uzunçayır Dam Lake is one of the important reservoirs and hydroelectric power plants of the region with a rock body filling type, 551.000 m³ body volume, 308 hm³ lake volume at normal water level and 13,43 km² lake area, generating 317 GWh of electricity with 74 MW power per year. It is a natural protection area and recreation area (DSİ, 2024) (Figure 1).



Figure 1. Uzunçayır Dam Lake (URL-1, 2024).

With the operation of Uzunçayır Dam on the Munzur River, pollutants (domestic liquid waste, leachate from the city's unregulated solid waste site, elements washed from rocks, etc.) introduced into the reservoir may cause negative impacts on the water quality parameters of the reservoir. In addition, new urbanization activities have started around the reservoir (Boztuğ et al., 2012).

3. Results and Discussion

It is important to analyze the dam lake water and lake structure, especially in the summer period in Tunceli region, which is mostly used for cold water fish farming, and to determine whether the lake is suitable for production in this season. For this reason, water quality parameters such as water temperature (daily and depth-dependent water temperature differences, seasonal water temperature values), soil particles, organic and planktonic turbidity levels, daily and seasonal dissolved oxygen levels should be determined annually. In addition, determining the type and richness of planktonic organisms, which are an important source of live feed, is among the factors that provide advantages in aquaculture (Report, 2024).

In cage aquaculture, the water depth should be three times the cage depth in small cages. In order to determine the suitability of the lake for cage farming, the water depth should be measured seasonally and the locations suitable for cage farming should be determined according to the data obtained. In addition, soil analyses that may pose a problem for cage breeders in dam lakes should also be carried out, and it should be determined whether soil cleaning (trees, buildings, etc.) has been done in the areas that will be flooded before the water retention works. In addition, it is necessary to determine the risks of phytoplankton blooms (algal bloom) and diseases in the summer months, especially in cage farming areas, and to develop strategies to reduce the risk of spread of diseases and harmful organisms in aquaculture (Report, 2024).

In newly formed reservoirs, some changes occur in environmental factors such as ecosystem and climate and accordingly in living plants and animals. These include the disappearance of some plant and animal species and some changes in species populations. In response to these changes, the fresh water, fauna and flora in the new dam lake areas that are formed or will be formed may also have a great potential. In this respect, it is necessary to continuously monitor natural resources and to carry out researches in order to take necessary measures. Determination of physical and chemical parameters is also important in this respect (Özdemir et al., 2007).

Boztuğ et al, (2012) in their study on the Physico-Chemical Properties and Water Quality Assessment of Uzunçayır Dam Lake (Tunceli), it was found that the dam, which is a terrestrial freshwater lake, has a good water quality (Water temperature (1.1-12.8-29.4^{o}C), pH (7.7-8.1-8.6), disolved oxygen (5.5-9.7-14.7 mg/L), BOD5 (1-1.5-2 mg/L), acidity (101-154.3-285 mg/L), total hardness (12.5-26.4-67.6 mg/L), total alkalinity (66-132.1-198 mg/l), conductivity (148- 276.9-381 µS/cm), suspended solid (0.03-1.04-3.03 mg/L)), there is no significant pollution problem. They also reported that physicochemical parameters should be kept at static level to maintain this situation.

In order to make large investments in Uzunçayır Reservoir, the above-mentioned factors should be analyzed within the scope of private sector-university-public sector cooperation and logistics site selection should be determined in accordance with these characteristics.

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Effects of Co-Exposure to Simple and Mixed Treatments Involving Polypropylene and Ketoprofen on Zebrafish Behavior

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Abstract

This research describes the multiple impact of plastic waste and pharmaceutical residues on the environment. Single-use plastic products, such as polypropylene, pose a widespread threat, resulting in large-scale pollution that can adversely affect ecosystems and fauna. At the same time, the introduction of pharmaceutical residues into the environment through various routes, such as improper disposal and sewerage, poses a significant challenge to aquatic ecosystems, but also to the quality of drinking water, which, in turn, ends up being contaminated. Urgent attention is needed to address the growing concerns associated with plastic waste and pharmaceutical contamination. Comprehensive waste management strategies and public awareness are essential for preserving ecosystems and mitigating environmental degradation. Inadequate scientific research has been carried out on the coexistence of pharmaceuticals and plastics, despite their presence in the ecosystem. The aim of the study was to evaluate, in laboratory conditions, the effects of a drug and a polymer in both single and mixed doses. Relevant environmental concentrations were used to investigate effects on various parameters, such as swimming performance and behavior using the Danio rerio animal model. Swimming parameters, including total distance traveled, swimming speed, activity levels, inactivity periods, and indicators of anxiety and sociability, were influenced by the tested concentrations. However, in the administration of the mixture, more pronounced toxic effects were revealed in terms of swimming parameters, but from the point of view of the sociability test, the tested batches spent more time next to the other fish. In the natural environment, visible changes in swimming patterns associated with significant effects of anxiety or sociability can pose challenges to species survival, whether it be feeding, predator avoidance or reproduction. In conclusion, these findings underscore the detrimental effects of both single-use plastics and pharmaceutical residues on aquatic organisms, particularly when these pollutants co-exist. The observed alterations in swimming behavior highlight the potential ecological consequences of exposure to such contaminants. Further research is warranted to elucidate the underlying mechanisms of toxicity and to develop effective strategies for mitigating the impact of these pollutants on aquatic ecosystems.

Keywords: Zebrafish, Toxicity, Polymer, Drugs.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

An Overview on the Hydrotreated Vegetable Oil: Production, Specifications, Performance in Use

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Abstract

The increase in energy demand and the depletion of oil resources have led to the search for alternative fuels that are sustainable. Fuels that are derived from biomass could be substitutes for fossil fuels. One of the easiest obtained products through biomass processing is crude vegetable oil. Unfortunately, due to its physico-chemical properties, it cannot be used directly as fuel for diesel engines of road vehicles. In order to improve the physico-chemical properties of vegetable oil suitable for its use in thermal engines, several methods are currently practiced. Transesterification of vegetable oil is a way in which the viscosity can be reduced, thus making it suitable for use in diesel engines, the product being usually called biodiesel. Another method is hydrotreating vegetable oil, obtaining the diesel fuel named Hydrotreated Vegetable Oil (HVO). The purpose of this overview, first of all, is to present the importance of replaceing fossil fuls by new sustainable fuels, which, in the current context of climate change, could ameliorate or even stop this process of environmental damage, considering that the transport sector has a significant contribution in this regard. The paper presents aspects regarding the HVO manufacturing process: raw materials and their selection, their processing stages, the selection of catalysts. The HVO specifications provided in the EN 15940 norm are presented in comparison with the fossil diesel specifications in the EN 590 norm and pure biodiesel (B100) specifications in the EN 14214 norm. Also, the energetic and ecological performances of the HVO in diesel engines are presented. It is concluded that: physico-chemical properties of HVO are very close to those of fossil diesel, it is less polluting than fossil diesel, is renewable, contains no sulfur and has very good lubricating properties, which increases engine life; HVO can be used in its pure state, but also mixed with fossil diesel in any percentage.

Keywords: Hydrotreated Vegetable Oil, Fuel, Diesel.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Online Dead Time Compensator for PMSM Based on Harmonic Injection

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Abstract

In high-performance applications where efficiency and precision are crucial, dead-time compensation is a crucial factor in the operation of Permanent Magnet Synchronous Motors (PMSMs). Dead-time refers to the intrinsic delay introduced by the switching operations of the inverter, which can lead to several performance issues. These include increased harmonic distortion, noticeable torque ripple, and a reduction in overall system efficiency. Such problems can severely impact the effectiveness and reliability of PMSMs in demanding industrial environments. To address these challenges, this study introduces a novel dead-time compensation technique designed to enhance PMSM operational stability and control accuracy. The proposed method features an innovative online adaptive harmonic injection algorithm. This algorithm dynamically responds to feedback signals and varying operating conditions of the motor, allowing it to continuously assess and compensate for the detrimental effects of dead-time. The main advantage of this approach is its ability to minimize the discrepancies between the actual performance of the motor and the desired performance. By effectively counteracting the distortions and ripples caused by dead-time, the technique results in improved torque response and reduced harmonic distortion. This is achieved through real-time adjustments that align motor performance with operational goals more closely. Simulation results have demonstrated the efficacy of the proposed method. The simulations indicate a significant improvement in PMSM performance, showcasing the method's potential to enhance motor operation in a range of industrial applications. Overall, the study highlights how advanced dead-time compensation strategies can contribute to more efficient and reliable PMSM performance in high-demand scenarios.

Keywords: Permanent Magnet Synchronous Motors (PMSMs), Dead-time, Adaptive Harmonic Injection.

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ORAL PRESENTATION

The Use of *Daphnia magna* to Evaluate the Toxic Effects of CuO and ZnO Nanoparticles

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Abstract

Nanotechnology has become an important priority for many sectors today. Due to its effects on the improvement of materials, design and production of new products in various industries, it is thought that the upcoming era will be the "Nanotechnology Age". In parallel with the developments in the field of nanotechnology, the number of nanoparticles synthesized and used has also increased. However, nanoparticles may cause toxicity due to their increased large surface areas and increased chemical/catalytic reactivity. Metal oxide-based nanoparticles have a wide range of applications due to their physicochemical properties and some of these particles are released into the environment as waste nanoproducts. The release of undegradable metal ions into the environment is one of the most important indicators of toxicity. These particles can lead to the formation of reactive oxygen species, structural changes in cell membranes, oxidation of proteins, genotoxicity, disruption of energy transmission mechanisms in aquatic and terrestrial organisms. The widespread use of CuO and ZnO, which are metal oxide nanoparticles, in cosmetic products, coatings, paints and pigments, causes their accumulation in the ecosystem. Therefore, their short- and long-term toxicity is a concern for 'non-target' organisms. It is of great importance to determine the toxic effects of nanomaterials on the development and physiology of non-target organisms and the environment. Daphnia magna, a freshwater invertebrate, is a test organism that is widely used in eco-toxicology studies and is important for laboratory tests. D. Magna is considered a suitable model for toxicity studies due to its short life span, high sensitivity and easy maintenance under laboratory conditions. In this study, the toxic effects of CuO and ZnO nanoparticles on Daphnia magna were evaluated in the light of literature information.

Keywords: CuO, ZnO, Toxicity, *Daphnia magna*.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Enhancing K-Means Clustering Performance with Genetic Algorithms: A Comparative Analysis

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Abstract

The volume of data today is continuously growing. The aim is to extract valuable insights by analyzing this data. Clustering, the process of grouping data based on their similarities, is a widely used technique. Among clustering methods, the K-Means algorithm stands out as one of the most popular. However, the K-Means algorithm is sensitive to the choice of initial cluster centers, which can significantly impact the clustering outcomes. In this thesis, the K-Means algorithm has been combined with a genetic algorithm to improve its performance. The genetic algorithm was employed to select the initial cluster centers for the K-Means algorithm. The study involved iris data sets, which were used to compare the clustering performance and results of the standard K-Means algorithm and its hybrid version with the genetic algorithm. The findings indicated that the hybrid approach outperformed the traditional K-Means algorithm in terms of clustering effectiveness.

Keywords: Clustering Analysis, K-Means Algorithm, Genetic Algorithm, Data Mining, Machine Learning, Clustering Performance Metrics.

1. Introduction

Data clustering has become a fundamental tool in the age of big data, where organizations seek to uncover patterns and structures from vast amounts of unstructured data (Arslan, 2024). Clustering, an unsupervised learning method, groups similar data points, making it indispensable in various fields such as marketing, image processing, and bioinformatics. Among the various clustering techniques, K-Means is particularly popular due to its simplicity and efficiency. However, K-Means clustering is sensitive to the choice of initial cluster centers, which can result in convergence to local optima, leading to suboptimal clustering results (Islam et al., 2021; Zhang et al., 2022).

To overcome the limitations of K-Means, researchers have explored integrating optimization techniques, such as Genetic Algorithms (GA), to improve the initial center selection. GA, inspired by the principles of natural selection, optimizes solutions by iterating through processes of selection, crossover, and mutation. When combined with K-Means, GA can determine more optimal initial cluster centers, enhancing clustering stability and accuracy by preventing convergence to local minima. This hybrid approach, known as Genetic K-Means (GKM), has shown significant improvements in accuracy, particularly for high-dimensional and complex datasets (Nguyen et al., 2021; Ramadhana & Jambak, 2020).

This study introduces a hybrid GKM model that employs GA to optimize initial centers and subsequently applies K-Means to finalize clustering. Six datasets of varying complexity, size, and dimensionality are utilized to test the performance of the hybrid model compared to traditional K-Means. Clustering effectiveness is assessed through metrics such as Rand Index, Homogeneity, Completeness, V-measure, and Fowlkes-Mallows Index. The results demonstrate that GKM consistently outperforms traditional K-Means, providing a more robust and reliable clustering solution applicable across diverse fields.

2. Materials and Methods

2.1. Datasets and Standardization

The study analyzes Iris datasets sourced from the UCI Machine Learning Repository and the University of Eastern Finland's dataset repository (Arslan, 2024). Data standardization is performed before clustering using the StandardScaler function from Python's scikit-learn library to prevent biases caused by scale differences.

2.2. Clustering Algorithms and Evaluation Metrics

The K-Means and Genetic K-Means (GKM) algorithms are utilized, with the Genetic Algorithm optimizing initial clustering centers. The evaluation metrics include Rand Index, Homogeneity, Completeness, V-measure, and Fowlkes-Mallows Index, assessing clustering quality from multiple perspectives (Zhang et al., 2022; Nguyen et al., 2021).

2.3. Methodology

GA is employed to optimize initial centers by minimizing the Sum of Squared Errors (SSE). The hybrid model is implemented in Python using the PyGAD library, with key GA parameters set to a mutation rate of 0.20 and a crossover rate of 0.80, iterated over 50 generations. The optimized centers from GA serve as inputs to the K-Means algorithm, resulting in the GKM hybrid model.

2.4. Hybrid Clustering Method

The GKM model combines GA optimization for initial centroid selection with the iterative clustering process of K-Means. The GA parameters were configured with a mutation rate of 0.20, crossover rate of 0.80, and a single-point crossover technique. The algorithm's goal function, based on minimizing the Sum of Squared Errors (SSE), was optimized to enhance clustering accuracy. The best solutions from GA were then used as the initial centroids for K-Means, ensuring improved initialization and optimized cluster formation.

3. Results

The GKM algorithm consistently outperformed traditional K-Means across all datasets, showing significant improvements in clustering accuracy and reduced convergence times. For instance, in the Iris dataset, the GKM achieved higher Rand Index and Homogeneity scores, indicating more accurate clustering.

When examining the performance results of algorithms using the Iris dataset, the results of the K-Means algorithm based on the Rand index for the Iris dataset are presented in Figure 1. As seen in the figure, the Rand index performance of the K-Means algorithm shows a minimum value of 0.55, a maximum value of 0.90, an average value of 0.72, and a standard deviation of 0.09.

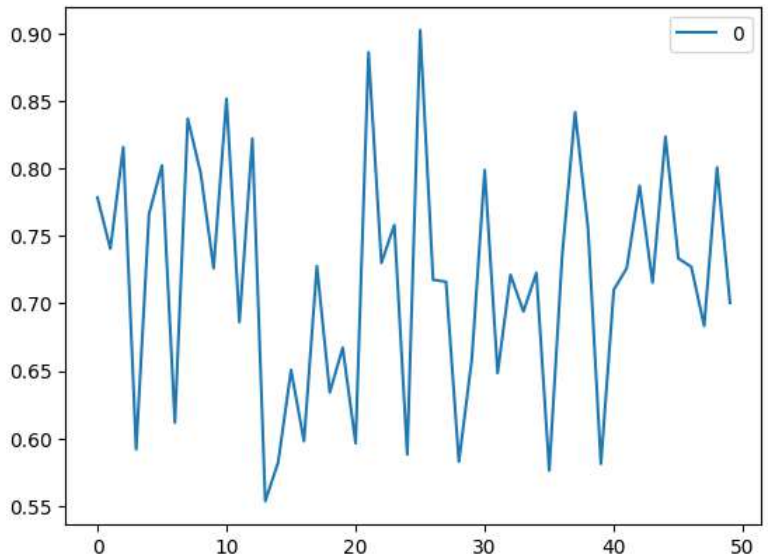


Figure 1. Results of the Iris data set according to the RAND index in the K-Means algorithm.

The results of the GKM algorithm based on the Rand index for the Iris dataset are presented in Figure 2. As observed in the figure, the performance of the GKM algorithm based on the Rand index shows a minimum value of 0.33, a maximum value of 0.96, an average value of 0.79, and a standard deviation of 0.16.

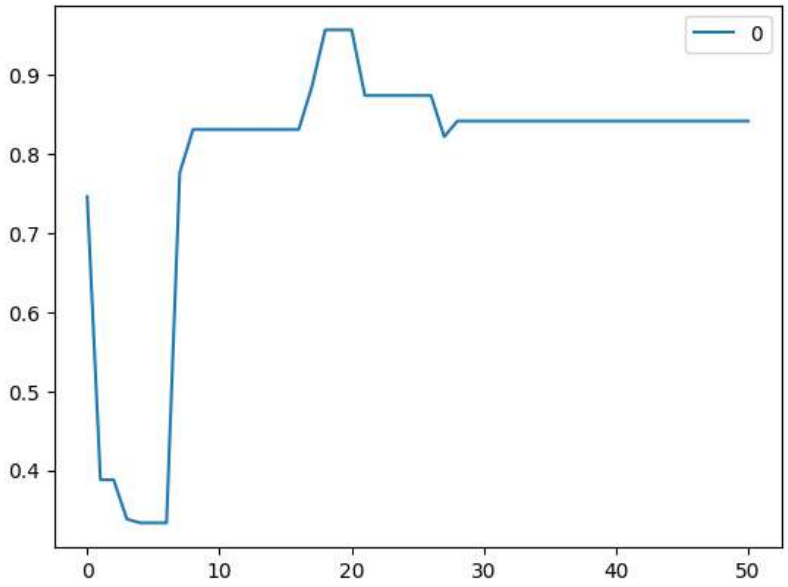


Figure 2. Results of the Iris data set according to the RAND index in the GKM Algorithm.

The results of the K-Means algorithm based on the homogeneity measure for the Iris dataset are shown in Figure 3. As seen in Figure 3, the performance of the K-Means algorithm based on the homogeneity measure has a minimum value of 0.06, a maximum value of 0.77, an average value of 0.46, and a standard deviation of 0.18.

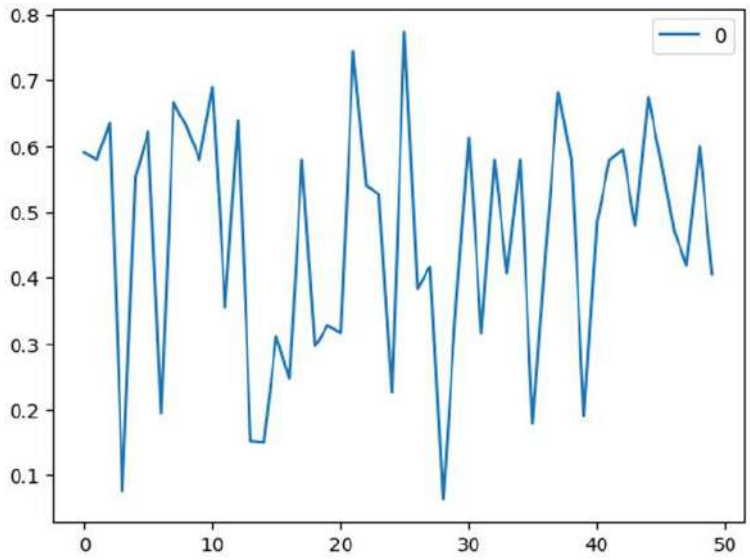


Figure 3. Results of the Iris data set according to the homogeneity measure in the K-Means algorithm.

The results of the GKM algorithm based on the homogeneity measure for the Iris dataset are shown in Figure 4. As seen in Figure 4, the performance of the GKM algorithm based on the homogeneity measure shows a minimum value of 0.007, a maximum value of 0.87, an average value of 0.63, and a standard deviation of 0.23.

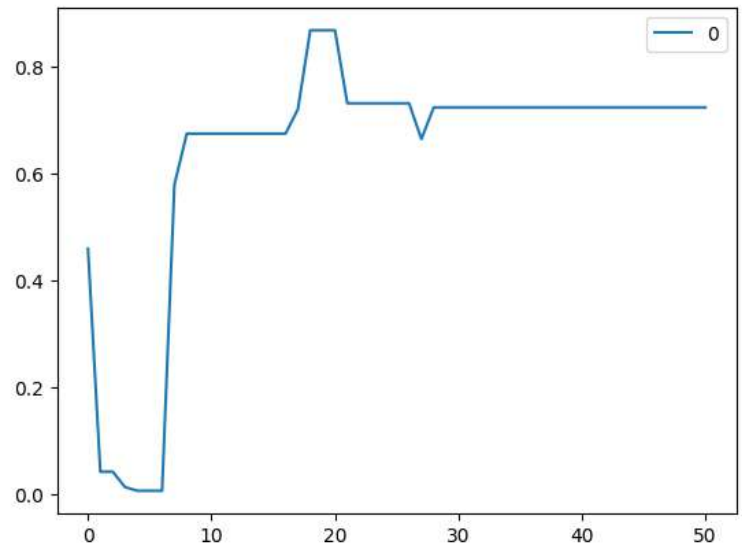


Figure 4. Results of the iris data set according to the homogeneity measure in the GKM Algorithm.

The results of the K-Means algorithm based on the completeness measure for the Iris dataset are presented in Figure 5. As seen in Figure 5, the performance of the K-Means algorithm based on the completeness measure shows a minimum value of 0.06, a maximum value of 0.85, an average value of 0.53, and a standard deviation of 0.21.

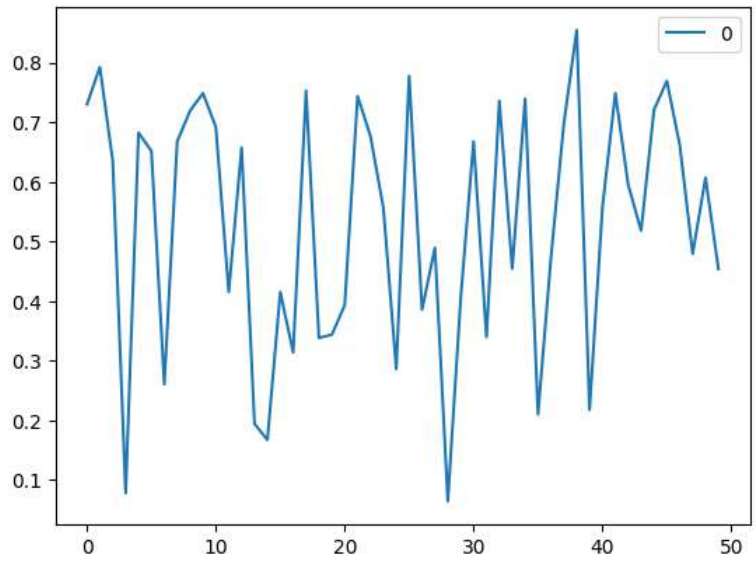


Figure 5. Results of the Iris data set according to the completeness measure in the K-Means algorithm.

The results of the GKM algorithm based on the completeness measure for the Iris dataset are shown in Figure 6. As seen in the graph, the performance of the GKM algorithm based on the completeness measure shows a minimum value of 0.17, a maximum value of 0.99, an average value of 0.70, and a standard deviation of 0.19.

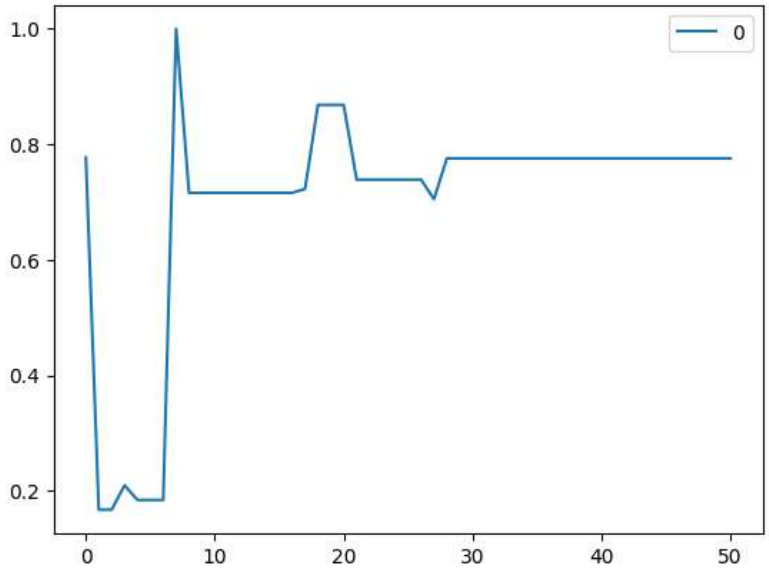


Figure 6. Results of the iris data set according to the completeness measure in the GKM Algorithm.

The results of the K-Means algorithm based on the V-measure for the Iris dataset are presented in Figure 7. As observed in Figure 7, the performance of the K-Means algorithm based on the V-measure shows a minimum value of 0.06, a maximum value of 0.78, an average value of 0.49, and a standard deviation of 0.19.

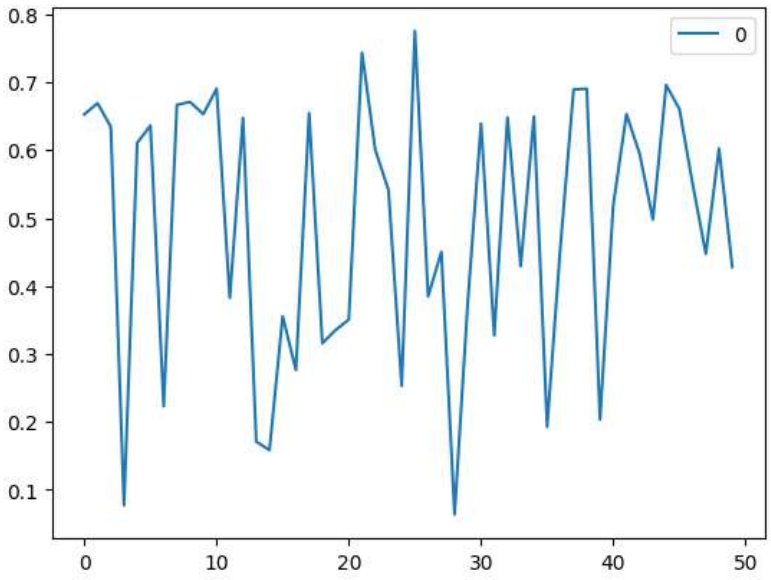


Figure 7. Results of the Iris data set according to the v measure in the K-Means algorithm.

The results of the GKM algorithm based on the V-measure for the Iris dataset are shown in Figure 8. As observed in Figure 8, the performance of the GKM algorithm based on the V-measure shows a minimum value of 0.13, a maximum value of 0.87, an average value of 0.66, and a standard deviation of 0.23.

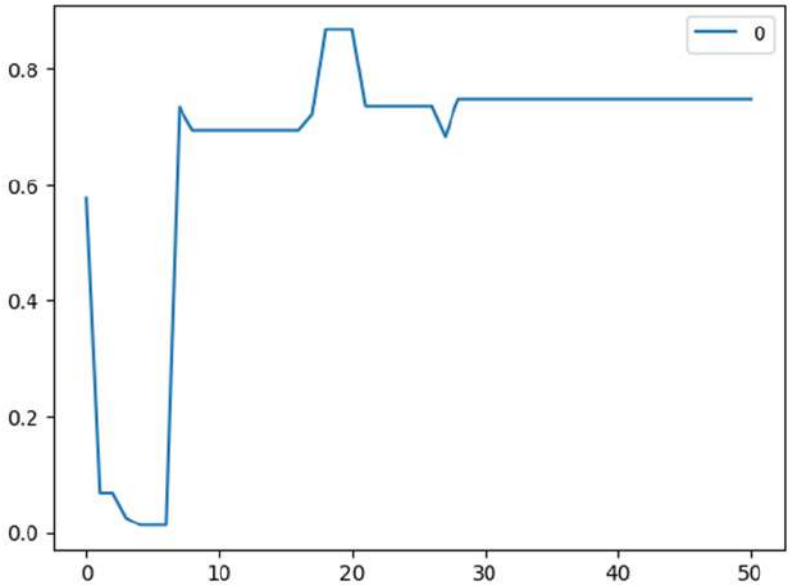


Figure 8. Results of the iris data set according to the v measure in the GKM Algorithm.

The results of the K-Means algorithm based on the Fowlkes-Mallows measure for the Iris dataset are presented in Figure 9. As seen in Figure 9, the performance of the K-Means algorithm based on the Fowlkes-Mallows measure shows a minimum value of 0.37, a maximum value of 0.85, an average value of 0.63, and a standard deviation of 0.11.

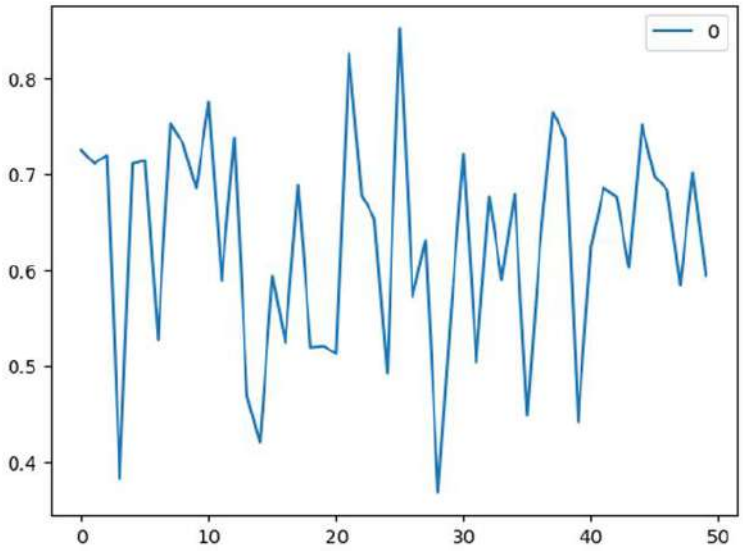


Figure 9. The iris data set is determined according to the results of fowlkes-mallows analysis in the selection of K-Means.

The results of the GKM algorithm based on the Fowlkes-Mallows measure for the Iris dataset are presented in Figure 10. As seen in Figure 10, the performance of the GKM algorithm based on the Fowlkes-Mallows measure shows a minimum value of 0.54, a maximum value of 0.93, an average value of 0.76, and a standard deviation of 0.08.

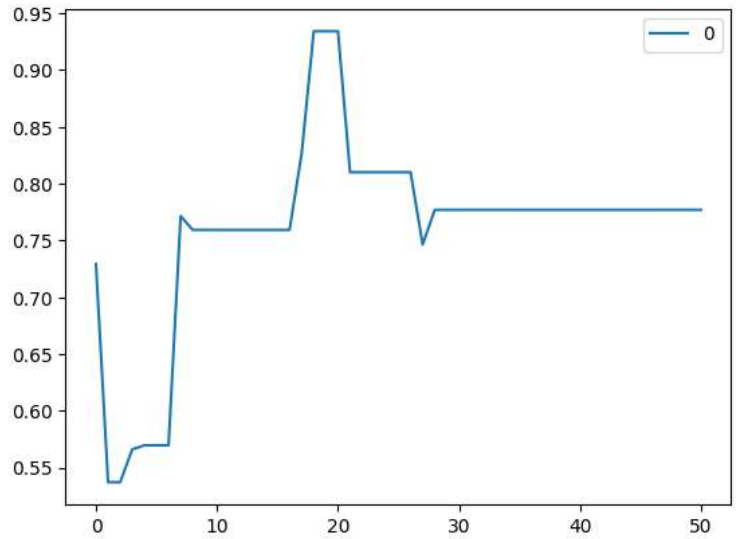


Figure 10. Results of the iris dataset according to the fowlkes-mallows measure in the GKM Algorithm.

The clustering results obtained using the K-Means algorithm and the GKM algorithm on the Iris dataset are presented in Figure 11. Examining the figure, the success of the clustering in the GKM algorithm can be observed.

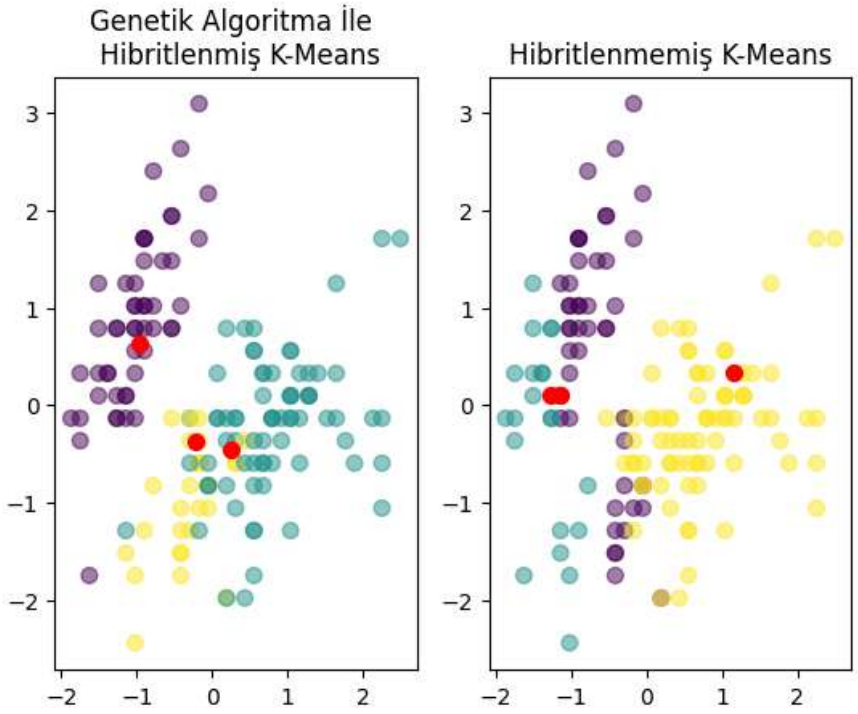


Figure 11. Clustering results of the Iris data set using K-Means and GKM Algorithm.

The objective function in the GKM Algorithm for the Iris dataset is shown in Figure 12. Observing Figure 12, it is seen that the best solution was found in the 28th generation.

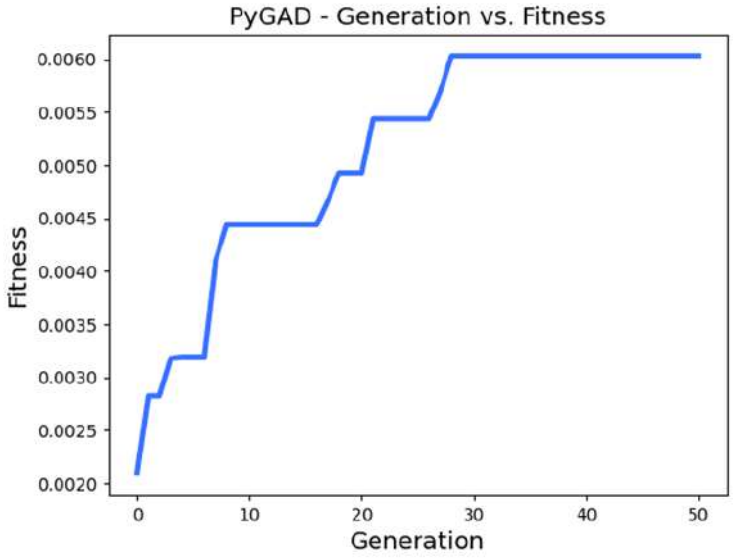


Figure 12. Objective function of the iris data set in the GKM Algorithm.

Table 1 shows the comparison between the K-Means and GKM algorithms for the Iris dataset. Based on the average value of the Rand index, the GKM algorithm is 10% more successful than the K-Means algorithm. In terms of the homogeneity measure, the GKM algorithm is 37% more successful than K-Means. For the completeness measure, GKM shows a 32% improvement over K-Means. In the V-measure, GKM performs 35% better than K-Means. Lastly, based on the Fowlkes-Mallows measure, the GKM algorithm is 21% more successful than K-Means.

Table 1. Clustering results table of iris dataset using K-Means and GKM algorithm.

Clustering Performance Metrics	K-Means Algorithm	GKM Algorithm	Change Rate
Rand Index	0.72	0.79	%10
Homogeneity Measure	0.46	0.63	%37
Completeness Measure	0.53	0.70	%32
V Measure	0.49	0.66	%35
Fowlkes-Mallows Measure	0.63	0.76	%21

4. Discussion

The GKM algorithm demonstrates improved clustering performance across all datasets, particularly in complex data scenarios. By optimizing initial cluster centers, the GA reduces the susceptibility of K-Means to local optima, producing clusters that more accurately reflect data structure. These findings align with prior studies, underscoring the efficacy of GA in enhancing K-Means (Shi & Xu, 2020; Ramadhana & Jambak, 2020).

The findings from this study highlight the effectiveness of integrating GA with K-Means to optimize clustering outcomes. By addressing the limitation of random centroid initialization in K-Means, GKM successfully avoided convergence to local minima, achieving more accurate and stable clusters. The hybrid approach's enhanced initialization provides a competitive edge in clustering applications where high accuracy and adaptability are required.

Future research could explore alternative genetic operators or combine GA with other clustering algorithms to extend the hybrid model's adaptability. Additionally, the model could benefit from performance enhancements by parallelizing the GA component to manage large datasets more efficiently. These potential improvements suggest that the GKM model can be further refined and adapted for various clustering applications in machine learning and data science.

5. Conclusion

This study confirms that the hybrid Genetic K-Means model (GKM) offers substantial improvements in clustering accuracy over traditional K-Means, especially for datasets with complex patterns. Future research may extend this model to real-time data applications or further refine the genetic parameters for enhanced clustering performance.

This study demonstrates that the Genetic K-Means (GKM) algorithm offers a viable solution to the limitations of traditional K-Means clustering. By optimizing initial centroid selection through GA, the GKM model achieves better clustering accuracy and stability. These findings underscore the potential of hybrid models in advancing clustering methods, providing a robust tool for data-driven fields. Future

work could extend the GKM model's capabilities by incorporating different optimization techniques or exploring its application in dynamic data environments.

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
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ORAL PRESENTATION

The Effects of Some Stand Characteristics on Stand-level Biomass Allocation in Scots Pine Stands

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Abstract

In this study, the effects of some stand characteristics (i.e. stand stage, crown closure and site class) on stand-level biomass allocation were investigated in Scots pine (*Pinus sylvestris* L.) stands, which is one of main coniferous tree species of Türkiye. The study was conducted in pure and even-aged Scots pine stands located in Karadere Forest Enterprise of Kastamonu Regional Directorate of Forestry, Türkiye. As study material, diameters at breast height (*dbh*) were measured of the trees greater than or equal to 8 cm dbh in 96 temporary sample plots, and stand stage (b, bc, c, cd and d), crown closure (%11-40, %41-70 and >%70), site class (I, II and III) and stand type of the stands where the sample plots located were defined. The above-ground components' (stem, branch, needle and bark) biomasses of all measured trees within sample plots were predicted using biomass equations developed by Yavuz et al. (2010), and the total above-ground biomasses were calculated by summing the component biomasses. Then, stand-level total and componential above-ground biomasses (ton per ha) were obtained. To compare the biomass allocation in terms of stand characteristics, biomass allocation of stand-level stem, branch, needle and bark biomasses were calculated as percent values. The Kruskal-Wallis test was used for comparisons, and the differences between the stand characteristics' groups were analyzed by the Mann-Whitney U test. The study results revealed that the stand characteristics except crown closure has statistically important (p<0.05) effects on stand-level biomass allocation in Scots pine stands. According to the results, in parallel with the increase in stand stage, the ratios of stem and branch biomasses in total above-ground biomass gradually increase, while the ratios of needle and bark biomasses decrease. For instance, while the stem, branch, needle and bark biomass ratios were 81.22%, 6.82%, 5.95% and 6.01% respectively in "b" stage, they were 85.79%, 7.36%, 4.52% and 2.33% in "d" stage. In point of site classes, Site Class-II had the highest stem and branch biomass ratios (85.27% and 7.21%, respectively) while the lowest needle and bark biomass ratios (4,41% and 3,11%, respectively). On the other hand, the lowest stem and branch biomass ratios (83.40% and 6.97%, respectively) and the highest needle and bark biomass ratios (4.92% and 4.71%, respectively) were observed in Site Class-I.

Keywords: Biomass Partitioning, Climate Change, *Pinus sylvestris*.

1. Introduction

Forest ecosystems are essential to the global carbon cycle since they are significant carbon sinks and absorb around one-third of annual anthropogenic carbon dioxide emissions (Bonan, 2008). Forests absorb over 30% of the carbon deposited in terrestrial ecosystems, which emphasizes their vital role in reducing the effects of climate change (Canadell and Raupach, 2008). The Intergovernmental Panel on

Climatic Change (IPCC) also highlights that forests, with other terrestrial ecosystems, considerably reduce atmospheric CO_2 levels, contributing to global climatic stability (IPCC, 2014). Pointing to the critical role that forests play in balancing global carbon emissions, according to Pan et al. (2011), forests played a crucial role in reducing global carbon emissions, sequestering an estimated 2.4 ± 0.4 gigatons of carbon years between 1990 and 2007. FAO (2021) highlights that forest ecosystems remain the most significant terrestrial carbon sink, with an annual absorption of over 2 gigatons. According to a comparable estimate from the United Nations Forum on Forests Secretariat (2021), forests play a substantial role as carbon sinks, absorbing roughly 2 gigatons of CO2 annually. Global forest carbon stocks, however, have decreased due to deforestation and forest degradation, from 668 gigatons in 1990 to 662 gigatons in 2010. Carbon is stored in three different forms; dead wood and litter (68 gigatons), living biomass (295 gigatons), and soil organic matter (300 gigatons) (FRA, 2015). According to more recent estimates, 861 gigatons of carbon are stored in forests, of which 44% are in the soil, 42% are in live biomass, 8% are in dead wood, and 5% are in litter (FAO, 2021). Comprehending this biomass allocation is imperative to successfully manage carbon stocks and maintain the carbon cycle's sustainability (Dimobe et al., 2018; Meng et al., 2021).

As a measure of carbon storage capacity and a facilitator of sustainable management of energy flow, nitrogen cycling, and ecosystem functioning, biomass is essential to the biological processes of forests (Affleck & Dieguez-Aranda, 2016; Dong et al., 2016a). Forest biomass is also an essential element in the global carbon cycle, with roughly 80% of terrestrial carbon stored aboveground and 20% belowground (Dixon et al., 1994). With the acceleration of climate change, precise biomass assessment has become increasingly vital for evaluating carbon sequestration capacity and supporting global carbon accounting efforts, including the Kyoto Protocol and REDD+ (Brown, 2002).

Calculating the biomass of forests is crucial for efficient forest management and international attempts to slow climate change. Models based on observable tree attributes such as height and diameter are typically used to estimate the biomass (Bonan, 2008; Affleck & Dieguez-Aranda, 2016; Zeng et al., 2017; Meng et al., 2021). Biomass models are essential for estimating carbon stocks and enhancing our comprehension of forest productivity and ecological sustainability (Clark and Murphy, 2011). In this context, the allometric biomass models are frequently employed and have been essential resources for producing precise biomass estimations in various forest ecosystems. Allometric models, which connect tree biomass or carbon to readily measured tree dimensions like diameter at breast height (*dbh*) and height, are frequently used to produce accurate estimations of biomass and carbon stocks (Bond-Lamberty et al., 2002; Wang, 2006). Besides allometric biomass models, biomass expansion factors (BEF) can also be used to estimate biomass (Somogyi et al., 2007). Although allometric models are typically favored for individual-tree biomass assessment due to their reliance on readily quantifiable factors like diameter at breast height (DBH) and tree height, BEF is frequently employed to extend stem volume into aboveground biomass estimations (Zianis et al., 2005). Nevertheless, the precision of these models might fluctuate greatly depending on ecological, climatic, and geographic factors; hence, it is necessary to create species-specific, localized models to increase accuracy in various site conditions.

Biomass is often classified into tree components such as stems, roots, branches, and leaves, each with varying carbon storage capacities (Dong et al., 2016a; Widagdo et al., 2020). Leaves, in particular, have greater carbon density than other components (Dong et al., 2016a; Meng et al., 2019). In their study for *Abies nephrolepis*, Dong et al. (2016a) discovered that the carbon content of leaves was roughly 10% higher than that of stems and roots. Understanding the differences in carbon storage capacities among

tree components is critical for accurately modeling forest carbon dynamics, as components with higher turnover rates, such as leaves, have a significant impact on short-term carbon fluxes, whereas stems and roots are more important for long-term carbon sequestration (Dimobe et al., 2018; Xu et al., 2022).

The division of biomass and carbon within forest ecosystems is also essential to comprehending the global carbon cycle and assessing the productivity and structure of forests (Goodale et al., 2002; Houghton & Goodale, 2004). Houghton (2005) asserts that trees are important carbon sinks that absorb CO2 from the atmosphere and lessen global warming. Many factors, including crown closure, stand stage, stand type and site class, alter the allocation of carbon and biomass among tree components, and each contributes uniquely to the overall carbon balance of forests (Clark et al., 2001). For example, stems store most of the biomass above ground, but roots are critical to belowground carbon sinks, which are necessary for long-term carbon sequestration and cycling (Goodale et al., 2002).

Biomass models are vital for estimating forest biomass across multiple spatial scales, but their accuracy depends mainly on the error structure and assumptions inherent in the modeling process (Xiao et al., 2011). Additive models are especially preferred because they provide consistency between total biomass and its constituent parts (Parresol, 2001; Bi et al., 2004). To increase the accuracy of these models, species-specific modifications are frequently required, particularly in diverse forest ecosystems.

Although numerous studies have been conducted on forest biomass in Türkiye, most of these studies have focused on the development of allometric models for the estimation of total and componential tree biomass (Aydın, 2010; Tolunay, 2013; Sakici et al., 2018). Because these studies highlight the significance of species-specific and regional assessments, they significantly aid in both local forest management and global efforts to reduce climate change. These regional studies have significance for Türkiye's forest ecosystems and offer insights that support estimations of the worldwide forest biomass. They address the difficulties brought about by Türkiye's distinct topography and climate (Aydın, 2010; Tolunay, 2013). However, the effects of various stand characteristics on the biomass allocation among tree components have not been investigated in these studies.

This study examines the effects of stand parameters such as stand stage, crown closure and site class on biomass allocation in Scots pine (*Pinus sylvestris* L.) stands, one of main conifer species of Türkiye. The study, conducted in pure and even-aged Scots pine stands in the Karadere Forest Enterprise of the Kastamonu Forest Regional Directorate, focused on how these parameters influence biomass allocation. The results of the study will help to construct more accurate biomass estimation models and provide critical data for assessing carbon stocks in Türkiye's forests. These results will also help to strengthen national forest management strategies and increase our understanding of the crucial role woods play as carbon sinks in combating climate change.

2. Materials and Methods

2.1. Study Area

The study area is situated northwest of Türkiye, within the boundaries of the Karadere Forest Enterprise, which operates under the Kastamonu Regional Directorate of Forestry (Figure 1). The research region is located at elevations between 761 and 2022 m above sea level, with an average slope of 32%. The

mean annual precipitation is 532 mm and mean annual temperature is 10.6°C, characteristic of a humid continental climate.

Of the 90300 ha that constitute the Karadere Forest Enterprise, 54500 ha (60.4%) comprise forested land, while 35800 ha (39.6%) are non-forest land. 51500 ha (94.5%) of the total forest area are classified as productive. Approximately 34300 ha (66.6%) are pure forest stands, while 17200 ha (33.4%) consist of mixed forests. Coniferous species dominate the pure forests, covering around 31400 ha (91.5%). The most widespread species is black pine (*Pinus nigra*), which occupies approximately 23900 ha. Scots pine (*Pinus sylvestris*), a focal species in this study, covers around 5800 ha (18.4%). In addition, fir (*Abies nordmanniana*) occupies 1700 ha of the area.

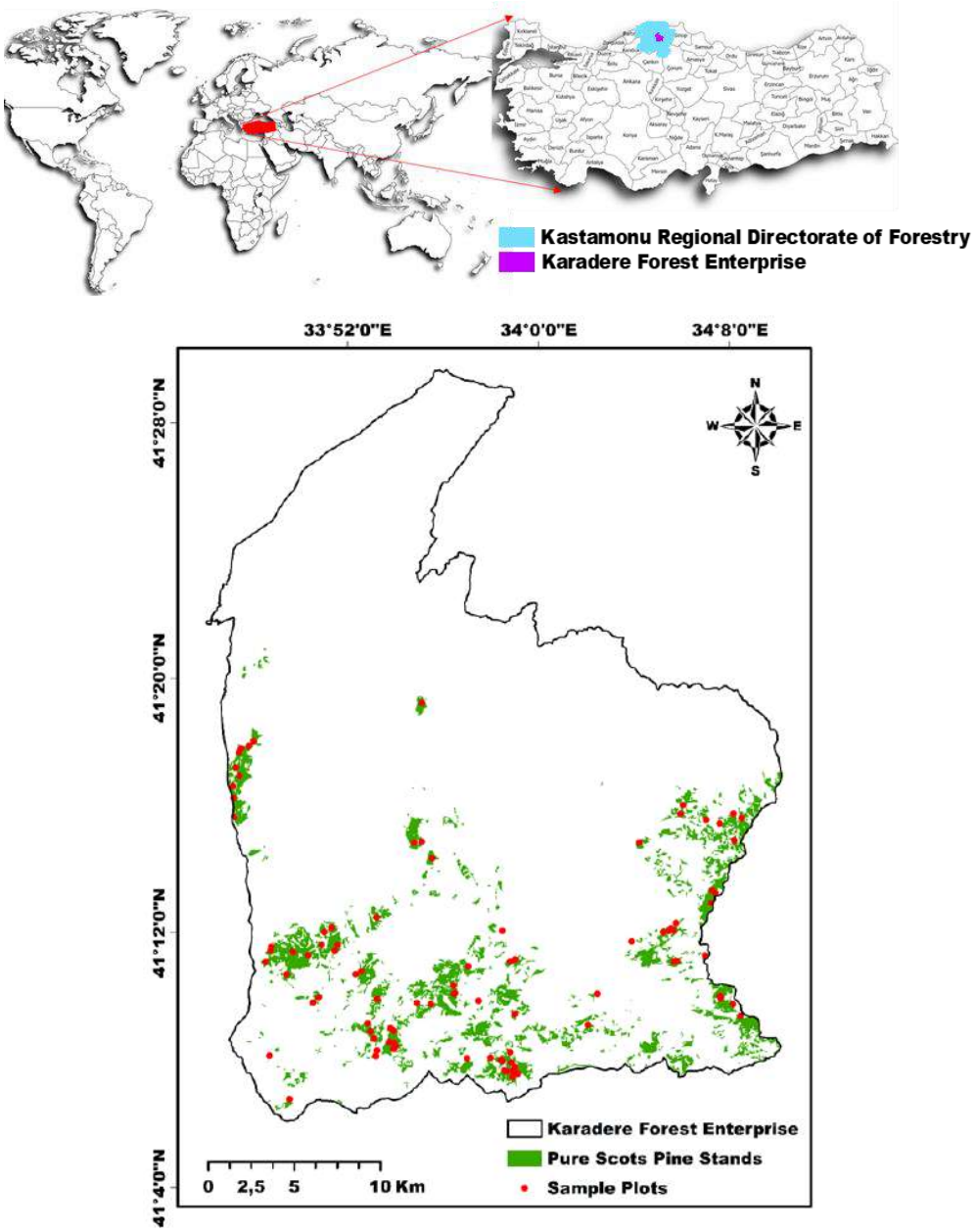


Figure 1. The study area and the location of the sample plots within the study area.

2.2. Field Measurements and Biomass Calculation

In the course of the study, 96 temporary sample plots were established. The diameters at breast height (*dbh*) of all trees with a *dbh* more than 7.9 cm within each plot were measured using a caliper with a precision of 0.1 cm. In addition, the stand stage, crown closure, and site class of the stands containing the sample plots were assessed. The stand stages of the stands were categorized as follows: "b" for young stands, "bc" for young to middle-aged stands, "c" for middle-aged stands, "cd" for middle-aged to mature stands, and "d" for mature stands. Crown closure was classified into three groups: "1" representing low canopy coverage (11-40%), "2" representing medium canopy coverage (41-70%), and "3" representing high canopy coverage (>70%). Site classes were defined based on the potential dominant height of the stand at 100 years: "Class I" included stands with dominant heights greater than 26.5 m, "Class II" included heights between 20.5 m and 26.5 m, and "Class III" included heights less than 20.5 m. The size of the sample plots was determined based on crown closure: 800 m² for low closure (11-40%), 600 m² for medium closure (41-70%), and 400 m² for high closure (>70%).

The above-ground components' (stem, branch, needle and bark) biomasses of all measured trees within sample plots were predicted using biomass equations developed by Yavuz et al. (2010), and the above-ground total biomass was calculated by summing the component biomasses. These equations are as follows:

Stem biomass (M_{st}, kg):	$M_{st} = 15.0845 - 3.3166dbh + 0.3358dbh^2$
Branch biomass (M_{br}, kg):	$\ln(M_{br}) = -5.2780 + 2.3650\ln(dbh)$
Needle biomass (M_{nd}, kg):	$M_{nd} = 1.1331dbh^{1.0704}$
Bark biomass (M_{bk}, kg):	$\ln(M_{bk}) = 2.9764 - 26.7853/dbh$
Above-ground total biomass (M_{AGT}, kg):	$M_{AGT} = M_{st} + M_{br} + M_{nd} + M_{bk}$

Since the branch and bark biomass equations are in logarithmic form, the biomass values obtained with these equations were multiplied by correction factors (1.1311 and 1.1134 for branch and bark biomass equations, respectively).

Stand-level above-ground biomasses ($M_{S\text{-}st}$, $M_{S\text{-}br}$, $M_{S\text{-}nd}$, $M_{S\text{-}bk}$, $M_{S\text{-}AGT}$) were obtained by summing the biomass values of the sample trees and converting them into hectare values. To compare the biomass allocation in terms of stand characteristics, biomass allocation of stand-level stem, branch, needle and bark were calculated as percent (%) values. Descriptive statistics of biomass allocation of stem, branch, needle and bark at the stand-level are presented in Table 1.

Table 1. Descriptive statistics of stand-level above-ground biomass (*n*=96).

		Mean	Std. Dev.	Minimum	Maximum
Stand-level above-ground total biomass	ton/ha	129.265	71.488	37.096	388.031
Stand-level stem biomass	ton/ha	109.176	61.736	29.566	332.945
	%	83.92	1.93	78.72	86.30
Stand-level branch biomass	ton/ha	9.180	5.280	2.510	28.391
	%	7.04	0.20	6.69	7.62
Stand-level needle biomass	ton/ha	5.983	3.257	2.104	20.500
	%	4.77	0.86	3.81	7.80
Stand-level bark biomass	ton/ha	4.925	2.132	1.446	13.754
	%	4.27	1.41	1.32	6.79

2.3. Statistical Analysis

The Kolmogorov-Smirnov test was used to check whether the data are normally distributed, and the results showed that none of the componential biomasses had a normal distribution (p<0.05). The Kruskal-Wallis test was used in biomass allocation comparisons according to stand characteristics, and the differences between groups were analyzed with the Mann-Whitney U test. Statistical analyses were performed using IBM SPSS Statistics 23 software, and the significance level was set at a p value of 0.05.

3. Results and Discussion

The allocation of the above-ground biomass in Scots pine (*Pinus sylvestris* L.) stands varies significantly throughout stand stages. As stands age, stem biomass increases significantly, approaching 85.79% in the mature stands (d stage) from 81.22% in the young stands (b stage). A more significant percentage of biomass is assigned to the stem component as the stand ages, shown by this statistically substantial (p<0.001) increase in stem biomass. On the other hand, there is a statistically significant (p<0.001) increase in the proportion of branch biomass with stand development, increasing from 6.82% in the young stands to 7.36% in mature stands. But as stands age, needle biomass decreases; it begins at 5.95% in young stands and decreases to 4.52% in mature stands (p<0.001). Similarly, there is a significant decrease in bark biomass, with the mature stands showing 2.33% (p<0.001), compared to younger stands 6.01% (Table 3, Figure 2 and 3).

Table 2. Allocation of the above-ground biomass by stand stage.

Stand Stage	*n*	M_s		M_{br}		M_n		M_{bk}	
		Mean (%)	*p*	Mean (%)	*p*	Mean (%)	*p*	Mean (%)	*p*
b	20	81.22^{e}	<0.001*	6.82^{e}	<0.001*	5.95^{a}	<0.001*	6.01^{a}	<0.001*
bc	25	83.16^{d}		6.91^{d}		4.86^{b}		5.07^{b}	
c	18	84.81^{c}		7.03^{c}		4.17^{c}		3.99^{c}	
cd	21	85.62^{b}		7.21^{b}		4.18^{c}		2.99^{d}	
d	12	85.79^{a}		7.36^{a}		4.52^{c}		2.33^{e}	

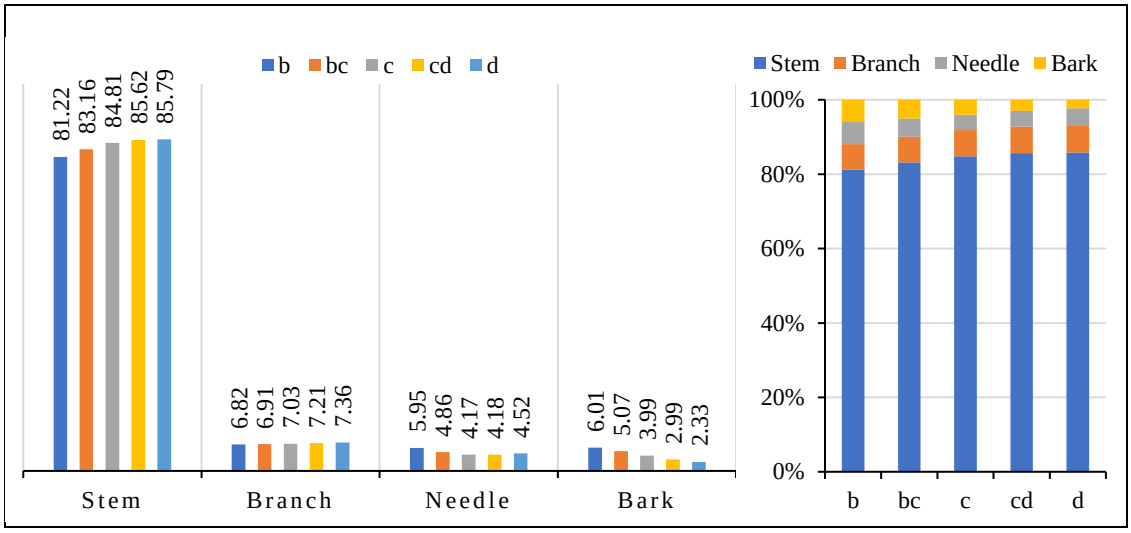


Figure 2. Proportional allocation of above-ground biomass by stand stage.

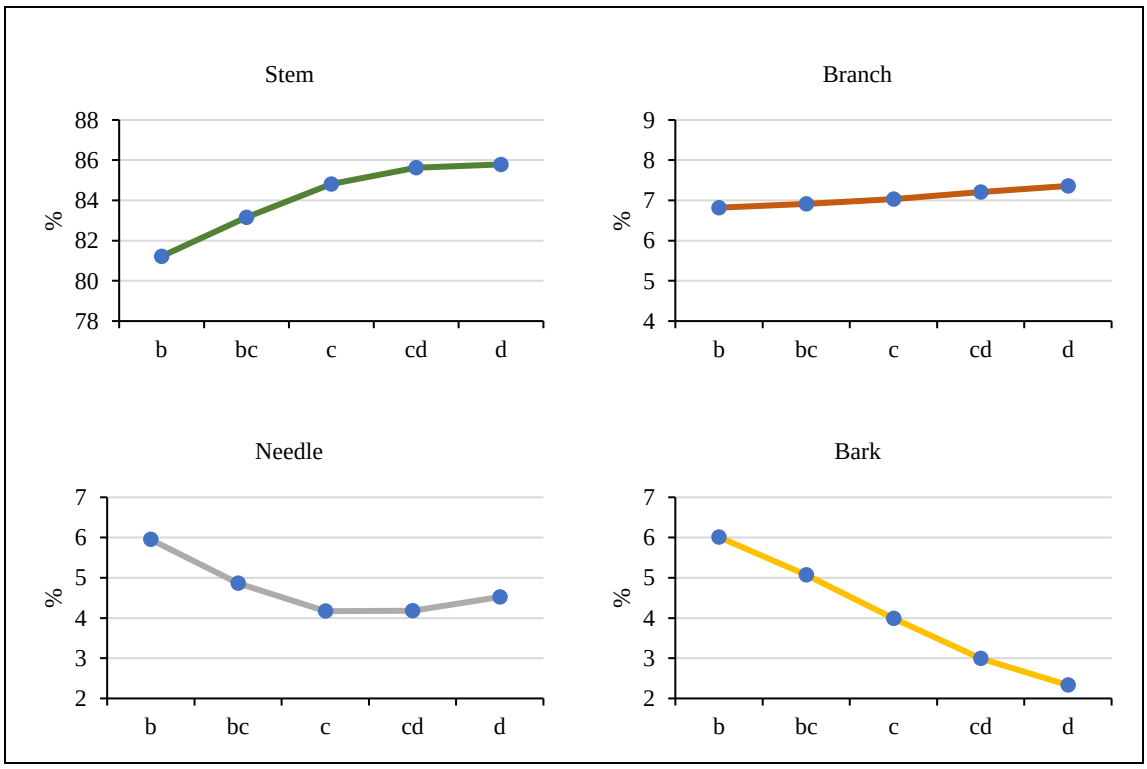


Figure 3. The impact of stand stage on the biomass allocation in Scots pine stands.

The crown closure analysis's results show that the allocation of biomass among Scots pine (*Pinus sylvestris* L.) stands was not substantially impacted by the degree of crown closure. With 84.52% allotted to the stem in stands with 11-40% crown closure, 84.00% in stands with 41-70% crown closure, and 83.52% in stands with more than 70% crown closure, stem biomass decreased as crown closure increased. However, at $p>0.05$, this difference was not statistically significant. Again, the differences were not statistically significant ($p>0.05$) for branch biomass allocation. Branch biomass was similar across the crown closure levels, ranging from 7.08% in stands with low closure to 7.01% in stands with full closure. Needle biomass showed a minor increase from 4.50% in stands with low crown closure to

4.99% in stands with full crown closure; however, this variation was also not statistically significant (p>0.05). Although bark biomass increased from 3.90% in low closure stands to 4.48% in full closure stands, it was not statistically significant (p>0.05). These results show that, in Scots pine stands, the allocation of biomass among tree components is not significantly affected by crown closure (Table 3, Figure 4 and 5).

Table 3. Allocation of the above-ground biomass by crown closure.

Crown Closure	*n*	M_s		M_{br}		M_n		M_{bk}	
		Mean (%)	*p*	Mean (%)	*p*	Mean (%)	*p*	Mean (%)	*p*
11-40%	25	84.52	0.133^{ns}	7.08	0.263^{ns}	4.50	0.245^{ns}	3.90	0.247^{ns}
41-70%	30	84.00		7.03		4.69		4.28	
>70%	41	83.52		7.01		4.99		4.48	

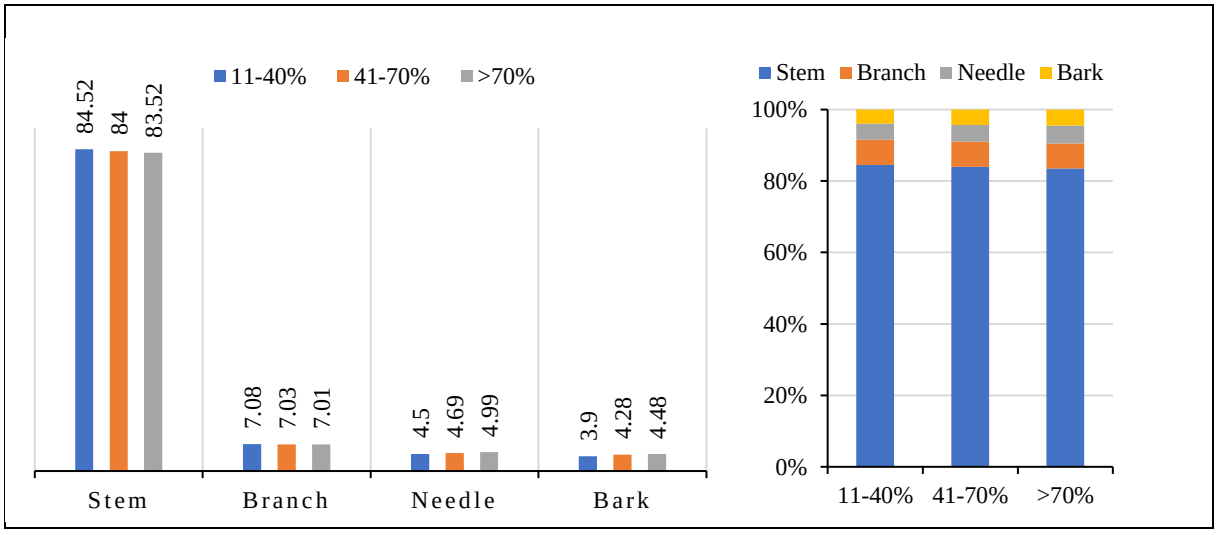


Figure 4. Proportional allocation of above-ground biomass by crown closure.

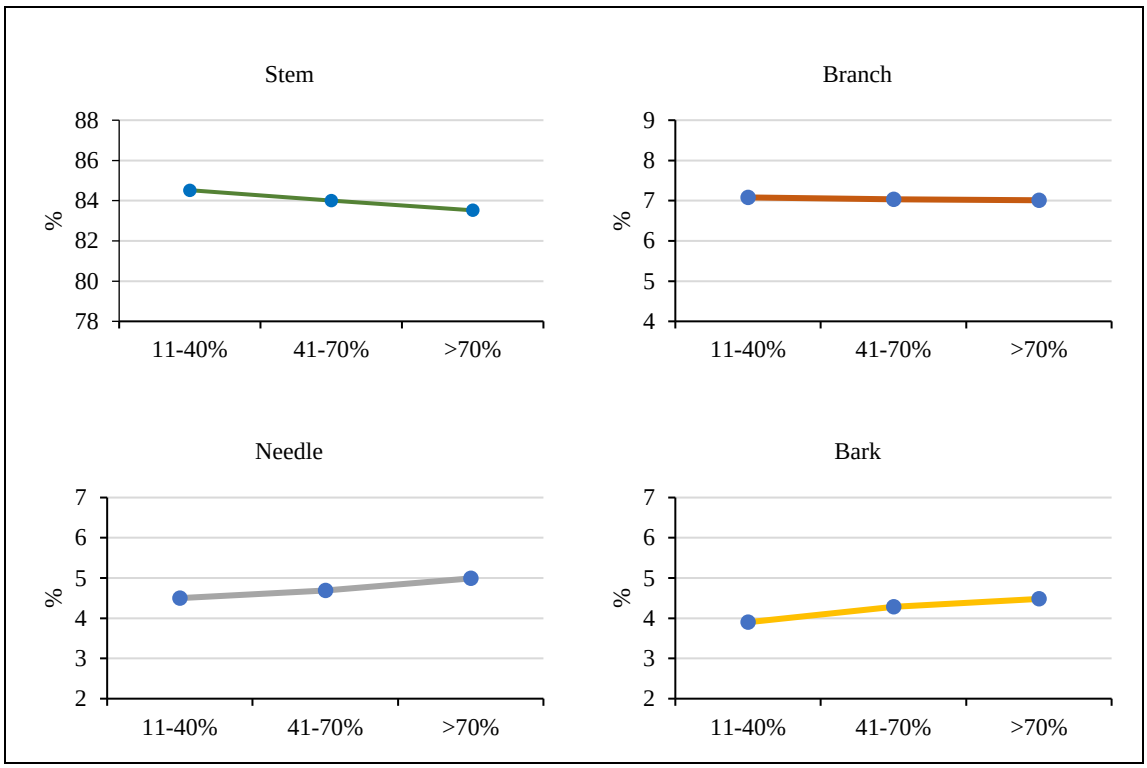


Figure 5. The impact of crown closure on the biomass allocation in Scots pine stands.

The results of this study show that the biomass allocation in Scots pine (*Pinus sylvestris* L.) stands is significantly affected by site class. With 85.27% of the total biomass, the largest stem biomass was found in site class II, considerably higher than the 83.40% found in site class I and the 84.14% seen in site class III (p<0.001). Similarly, compared to 6.97% in site class I and 7.05% in site class III, branch biomass was considerably greater in site class II (7.21%, p<0.001). Site class I had the highest amount of needle biomass (4.92%), while site class II had the lowest (4.41%, p<0.05). There were also significant differences in the amount of bark biomass, with site class I contributing the highest percentage (4.71%), followed by site class III (4.15%) and site class II (3.11%, p<0.001) (Table 4, Figure 6 and 7).

Table 4. Allocation of the above-ground biomass by site class.

Site Class	*n*	M_s		M_{br}		M_n		M_{bk}	
		Mean (%)	*p*	Mean (%)	*p*	Mean (%)	*p*	Mean (%)	*p*
I	62	83.40^{b}	<0.001*	6.97^{b}	<0.001*	4.92^{a}	0.040*	4.71^{a}	<0.001*
II	23	85.27^{a}		7.21^{a}		4.41^{b}		3.11^{b}	
III	11	84.14^{ab}		7.05^{b}		4.66^{ab}		4.15^{a}	

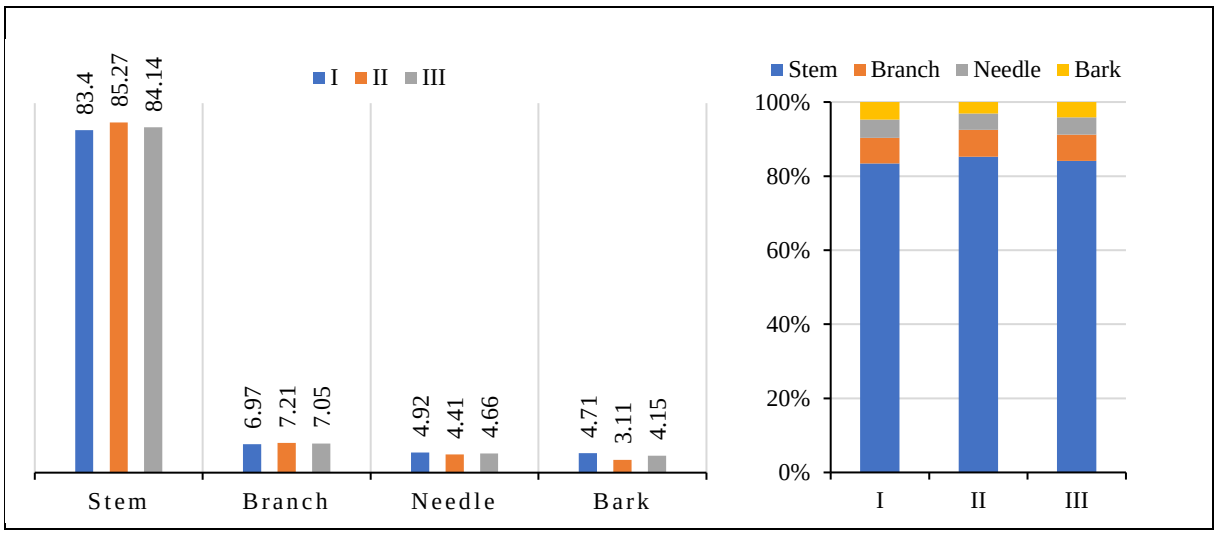


Figure 6. Proportional allocation of above-ground biomass by site class.

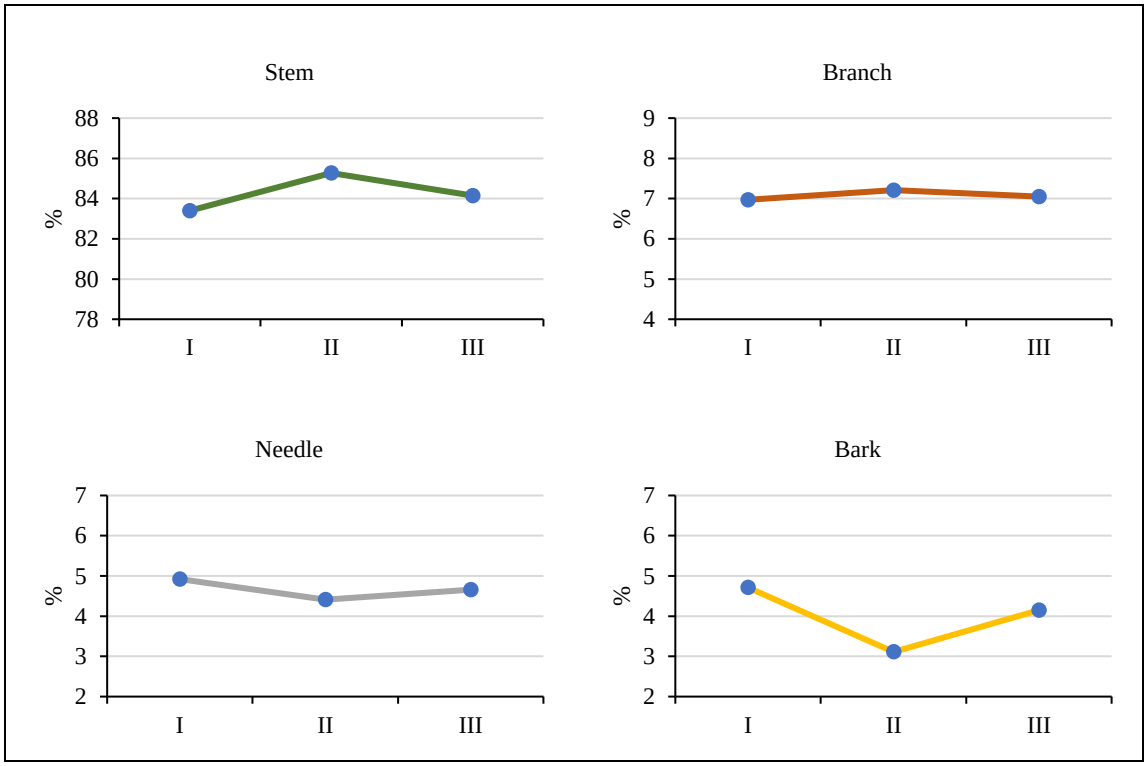


Figure 7. The impact of site class on the biomass allocation in Scots pine stands.

This study has observed significant variations in biomass components among various stand stages. The biomass allocation of components was more balanced in young stands, whereas in mature stands, stem biomass predominated. These results are consistent with those of Dong et al. (2016b), who observed a similar change in biomass allocation toward the stem and away from branches and needles as stands age for larch (*Larix gmelinii* Rupr.) and Mongolian pine (*Pinus sylvestris* var. *mongolica* Litv.) stands. Usoltsev et al. (2018) reported similarly that the biomass allocation of birch trees changes with age and growth, with a greater concentration of biomass concentrated in the stem and less in the branches and

foliage. Specifically, their analysis demonstrated that stem biomass, which makes up more than 60% of the total biomass in mature stands, dominated biomass allocation in older trees throughout the Ural region. These results, which align with our results, imply that biomass allocation advantages the stem as trees mature in various species and geographical locations, improving structural integrity and stability.

According to this study, crown closure did not considerably impact the biomass allocation in Scots pine (*Pinus sylvestris* L.) stands crown. This is in contrast to the results of Dong et al. (2018), who reported that increasing crown closure in Korean pine and larch forests increased stem biomass, especially in thicker trees. In contrast, this study suggests that crown closure affects the biomass components in Scots pine stands less. Similar results were made by Meng et al. (2019) in *Pinus tabulaeformis*, who discovered very slight variations in branches and needles but an essential rise in stem biomass by approximately 80% with increasing crown closure (Siddique et al., 2021). This is consistent with the results of our study.

The allocation of biomass was influenced significantly by site class. Higher productivity sites in Dahurian larch (*Larix gmelinii* Rupr.) and white birch (*Betula platyphylla* Suk.) trees in West Africa allocated more resources to the stem and less to branches and leaves, according to Dimobe et al. (2018). This is consistent with our results, which showed that in site class II, stem biomass predominated. Similar results were also seen by Meng et al. (2021) in Mongolian oak (*Quercus mongolica* Fisch. ex Ledeb.) forests, where the stem predominated in more productive sites while more biomass was distributed to branches and leaves in less productive site classes. Behling et al. (2018) and Dong et al. (2016a) similarly showed that stem biomass predominated in more productive sites, whereas branches and leaves contributed more to the total biomass in less productive places.

4. Conclusion

While developing biomass equations is necessary, recognizing how total biomass is allocated among tree components is similarly critical. The results of this study show that biomass allocation in Scots pine (*Pinus sylvestris* L.) stands is significantly affected by stand stage and site class. Based on the stand stage and site class characteristics, these statistics can be utilized to predict the biomass allocation in the stands.

Site class does not change substantially over time, but the stand stage varies as the stand ages and offers a way to track how the stand biomass is allocated differently. Thus, long-term monitoring of biomass allocation dynamics may provide crucial information on how forests grow and their capacity for storing carbon.

More study on various tree species is needed to improve estimates of carbon stocks and enhance our understanding of biomass allocation. These studies are essential for developing carbon management plans and laws to slow climate change and global warming.

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Small-scale Fisheries in Sanga-Sanga, Bongao, Tawi-Tawi, Philippines

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Abstract

Fishing is a primary source of livelihood for the residents of Sanga-Sanga, Bongao, Tawi-Tawi, Philippines. However, the fishing practices of the particular area are not well documented. Hence, this study aimed to assess the small-scale fishery of Sanga-Sanga, Bongao, Tawi- Tawi, Philippines, with specific objectives including the identification of fishing gear operations, determining fishing gear specifications as well as to determine the socio-demographic status of the fisherfolks in the area through survey and interview method. The results have revealed a total number of 93 fishing gears among the fishermen in the area and were classified as three types of passive gears such as gillnet ('linggis'), hook and line ('tamsi') and speargun ('pana'), with some owning multiple gears while others had only one. These passive gears are predominantly used in fishing operations along the coastal waters of Sanga-Sanga. The findings revealed that the fishermen in the area heavily relied on fishery resources for their daily livelihoods, with fishing being their primary source of income. However, the income generated from fishing was insufficient. The surveyed fishermen were exclusively male, primarily aged between 25 and 42 years old, mostly married, and identified as Muslim and belonging to the *Sama Daliya* tribe. The educational attainment of the respondents varied, with a notable 58.5% having no formal schooling. Despite years of fishing experience, the income generated is insufficient, ranging between 17 to 88 USD monthly. None of the surveyed families owned land, and the respondents were not affiliated with any organization. Most of the respondents originated from Bongao, with a significant number residing in Panglima Sugala municipality. The majority had been residents in the area for 16 to 20 years. To support the fishermen in Sanga-Sanga, it is recommended that the local government provide livelihood training and financial literacy programs specifically tailored to the local fishermen. These initiatives would help them manage their income more effectively and improve their economic productivity. Additionally, by providing a solid foundation for future studies in promoting sustainable fishing practices, along with preserving the cultural heritage of other indigenous groups will significantly enhance the overall well-being of the fishermen in the province of Tawi-Tawi.

Keywords: Small-scale, Fishing Practices, Fishing Gear, Fishermen.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Assessing Fish By-Product as a Fish Meal Replacement in Tilapia Fry Diets

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Abstract

Tilapia is a promising species in aquaculture production due to its high tolerance and demand in the Philippines. Nile Tilapia (*Oreochromis niloticus*) is one of many economical freshwater species farmed worldwide. However, the aquaculture sector has faced a significant challenge due to the high cost of feeds arising from expensive protein sources like fish meal. The utilization of fish by-products, which contain high protein sources, offers a promising solution to this issue. This study aimed to evaluate the growth performance of Nile tilapia (*Oreochromis niloticus*) fed with formulated feeds containing different percentages of fish by-products (T1-0%, T2-25%, T3-50%, T4-75%, and T5-100%) as replacements for fish meal as a protein source. The study was conducted at the Multi-Species Hatchery, College of Fisheries, Mindanao State University Tawi-Tawi College of Technology and Oceanography, Sanga-Sanga, Bongao Tawi-Tawi, Philippines, for 60 days from February to April 30, 2024. Nile tilapia *Oreochromis niloticus* fry was collected from the Sanga-Sanga swamp, Bongao, Tawi-Tawi, acclimatized for 1 week and fed with a commercial diet. A total of 450 fish were equally distributed to culture tanks, each with a capacity of (34 L), composed of 30 fish in each tank. The study utilized a complete randomized design (CRD) with 5 treatments and three replicates. Sampling was done every fifteen days by weighing each fish; all tilapia were measured, and mortality was recorded. Results indicated that the highest specific growth rates and weight gain are in T5, a diet with 100% fish product with 2.85 ± 0.18 % d-1 and 2.00 ± 0.22 g, respectively, significantly higher ($P<0.05$) and no significant difference ($P>0.05$) to T4 for the weight gain. The survival rate of all treatments and replicates is 100%. Therefore, fish by-products are suitable for replacing fish meals in tilapia diets as a source of protein. However, further analysis, including proximate analysis and carcass composition, is necessary for more reliable data.

Keywords: *Oreochromis niloticus*, Fish By-Product, Alternative Source of Protein, Valuable Product.

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Investigation of the Effect of Electrode Type on Microstructure and Mechanical Properties in the Welding Process of Miilux 500 Protection Armor Steels with Shielded Metal Arc Welding Method

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Abstract

In response to the kinematic properties of various bullets fired from modern weapons used today, metal, ceramic, polymer, and composite-based armour materials have been developed. Armour technology continues to develop in parallel with weapon technology and welded and non-welded joining processes of armoured materials have been among the subjects of interest in recent years. In literature studies conducted for armour steels, which are intensively used, especially in the heavy defence industry, it is known that the heat-affected areas and microstructural changes in the weld metal have lower mechanical and metallurgical properties compared to the base metal due to the high heat applied in welded joining processes. Improving and developing the weld area of armour steels, whose metallurgical, mechanical and ballistic properties are weakened due to the welding process, is a critical and vital issue for the defence industry. For this purpose, in this study, plates produced from Miilux Protection 500 armour steel were joined by the electric arc welding method with Citochromax and Tenacito 80 shielded electrodes produced by Magmaweld. To characterise the mechanical and metallurgical performances of the joints, tensile, hardness and bending tests were performed on the samples taken from the joints and optical microscope and scanning electron microscope examinations were performed. When all the results were evaluated in the shielded electrode electric arc welding applications of Protection 500 armour sheets of steel, the most suitable metallurgical and mechanical performance electrode was Tenacito 80.

Keywords: Armour steel, Miilux Protection 500, Shielded metal arc welding, Citochromax, Tenacito80.

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Department of Mechanical Engineering for performing the microstructure and hardness examinations, Gazi University Faculty of Technology, Department of Metallurgy and Materials Engineering for performing the tensile tests, and Karabük University Faculty of Technology, Department of Manufacturing Engineering for performing the macrography investigations and bending tests. We would also like to thank Magmaweld company for supplying the electrodes.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Catch Per Unit Effort and Length-Weight Relationship of Target Fish Species in Fish Corral Fishing Operations in Sibutu, Tawi-Tawi, Southern Philippines

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Abstract

Target species are determined based on the dominant species caught in every fishing gear, including fish corrals, a popular fishing gear used explicitly for collecting fish along tidal flats. Sibutu, a coastal municipality in Tawi-Tawi consisting mainly of low flat islands, has been practicing fish corral fishery for years. However, studies have not been done on this area's target species on fish corral fishery. Therefore, this study aims to assess the target species of fish corral in Sibutu, Tawi-Tawi, Southern Philippines. Specifically, the goal is to determine its catch per unit effort (CPUE) by month and determine the length-weight relationship. A field sampling through actual fishing was conducted over 90 days from December 2023 to March 2024. Four hundred eighty-two (482) specimens, which accounted for twenty percent (20%) of the total catch per sampling, were sampled with a size distribution (total length) ranging from 9.2cm to 22.4cm over 90 days. The results revealed that *Gerres* sp. was identified as the target species, as it was the fish most caught during the sampling. The length-weight relationship of *Gerres sp.* was $W=14.79x10^{-2}xTL^{2.88}$, where the *b* valueof 2.88 indicates a negative allometric growth patter. The catch per unit effort of the fish corrals (CPUE) used showed that March exhibited the highest mean CPUE at 6.17±0.41 kg/hr, followed by February with a mean CPUE of 4.28±0.69 kg/hr. In contrast, January had the lowest mean CPUE of 3.32±0.46 kg/hr. These findings indicate distinct differences in the catch rates among the sampling months, suggesting potential seasonal variations in fish abundance or fishing success. The analysis of CPUE data underscores the importance of evaluating the efficiency of fish corrals in capturing fish, with the observe variations in CPUE values reflecting the effectiveness of the fishing method. This study recommends lengthening the sampling period to observe a complete trend of the length and weight data of the identified target species, including seasonal variations for CPUE. Understanding the target species, abundance, and growth patterns is crucial for developing effective management strategies to protect this valuable resource. The study also noted the need for further research to implement effective management measures to ensure the sustainability and enhancement of the fish corral fishery in Sibutu is necessary, as it could significantly impact the fishery management in the region.

Keywords: Catch Per Unit Effort, Fish Corral, *Gerres* sp., Length-Weight Relationship, Target Species.

Acknowledgment

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Exploring the Effect of Fertilizers on the Growth of Red Seaweed *Kappaphycus alvarezii* Farmed in Simunul, Tawi-Tawi

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Abstract

Seaweed has high demand due to its carrageenan content and its various uses in food and pharmaceuticals. With this, the people in Tawi-Tawi tend to enhance their farmed seaweed, Kappaphycus alvarezii, by enriching it with inorganic fertilizer. However, some seaweed farmers complain that the practice of applying fertilizers to their seaweeds doubles their labor and costs. To verify the effect of fertilizer on the growth of farmed seaweed, this study was conducted by measuring the growth performance of *Kappaphycus alvarezii* every 15 days for 1 month. The research was conducted at Brgy. Bakong, Simunul, Tawi-Tawi, Philippines, for 30 days. The seaweed used was unenriched with any fertilizers and was healthy and disease-free. *Kappaphycus alvarezii* variety tambalang was bought from Brgy. Tonggusong, Simunul, Tawi-Tawi. The farming method used in this study is a fixed-off bottom method, and 50 g of seedlings were tied to the line. A total of 25 seedlings per line were tied, and 3 lines were used per treatment. The treatments used were T1 - *Acanthophora specifera* (organic), T2 - *Ulva* spp. (organic), T3 - inorganic fertilizer (14-14-14), and T4 – control (no enrichment). The seaweed *Acanthophora specifera* and Ulva spp. were collected at Brgy. Bakong, Simunul, Tawi-Tawi, Philippines. The two seaweeds were prepared separately and processed in the same manner. The collected seaweeds were washed, cleaned, and sundried. They were boiled for hours, and the extracts were filtered and cooled down for 30 min. The 14-14-14 inorganic fertilizer was bought from the local market of Bongao and was dissolved in a liter of distilled water with 10 g of fertilizer as a stock solution. *Kappaphycus alvarezii* tied in the lines were soaked simultaneously in solutions for 30 seconds, placed in a mat, and then covered overnight. Farming was done early in the morning. Re-enrichment of the seaweed was done every week, mimicking the method used by seaweed farmers. Sampling was done every fifteen days by weighing each seedling using a weighing scale. After 30 days of farming, the results showed that the T4 or control had the highest final weight with 104.91 ± 3.39 g and 108.2 ± 4.54 g at 15 and 30 days, respectively, which was statistically significant compared to those soaked in organic and inorganic fertilizers. The study concludes that the use of both organic and inorganic fertilizers did not enhance the growth of *Kappaphycus alvarezii* compared to the control group. This suggests that the application of fertilizers may not be necessary for optimizing the growth of this seaweed species in the studied conditions.

Keywords: *Kappaphycus alvarezii*, Seaweed, Growth, Inorganic Fertilizer, Organic Fertilizer.

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ORAL PRESENTATION

Toxicity of Cigarette Butts on *Trichopsis vittata* (Cuvier, 1831)

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Abstract

Smoked cigarettes butts are one of the most prevalent forms of litter worldwide, often finding their way into our oceans and inland waterways. An estimated 5.7 trillion cigarettes are produced every year and between one third and two-thirds of these are deposited each year into the environment. Once smoked, cigarette butts contain thousands of chemicals including nicotine, polycyclic aromatic hydrocarbons and heavy metals which, once entering an aquatic environment, can leach out into the surrounding water. The present study aimed to investigate the toxicological effects of cigarette butts (CBs) leachates on the freshwater fish species *Trichopsis vittata*. Cigarette butt leachate of 10 CB/L stock solution was prepared by overnight stirring of cigarette butts in chlorine free distilled water with the help of magnetic stirrer followed by filtration of the stock solution. Fish were exposed to cigarette butt leachates at different concentration viz. 0, 0.125, 0.25, 0.5, 1.0, 1.5, 1.75 and 2.0 CB/L as per OECD (Organisation for Economic Co-operation and Development) guidelines. The results revealed significant mortality, histological alterations in the liver, and bioaccumulation of heavy metals and microplastics in the fish body upon exposure to various CB concentrations. The LC_{50} value at 96 hours was found to be 1.69 CB/L, indicating that 50% mortality of *T. vittata* occurs at this concentration. The mortality rate increased with higher CB concentrations, reaching 100% at 2 CB/L within 2 hours of exposure. Histological analysis of the liver revealed several pathological changes in the exposed fish, including necrosis of cells, infiltration of inflammatory cells, nuclear and cytoplasmic degeneration, cloudy swelling of hepatocytes, disintegration of liver lobules, and swelling. The study demonstrated a positive correlation between CB concentrations and the deposition of heavy metals, such as cadmium, copper, iron, lead, arsenic, chromium and zinc, in the water and bioaccumulation of these heavy metals were observed to some extent after 28 days of exposure. As the CB concentration increased, the levels of these heavy metals also increased in the fish body, with the highest concentrations of Fe (4.06 ppm), Cd (0.13 ppm), Cr (0.139 ppm) were observed at 1.75 CB/L as compared to control (3.52 ppm Fe, 0.092 ppm Cd and 0.004 ppm Cr). The presence of microplastics, was also detected in the fish gut, with the highest concentration (37 particles) observed at 1.75 CB/L as observed in microscope after staining with rhodamine B. As cigarette butt is composed of cellulose acetate fibre, these microplastic can easily leached into water from butt. The bioaccumulation of microplastics can lead to various health issues for the fish and potentially other aquatic organisms. In conclusion, this study highlights the significant detrimental effects of cigarette butts on the freshwater fish species *Trichopsis vittata*, emphasizing the importance of proper disposal and management of CBs to minimize their impact on aquatic ecosystems.

Keywords: Cigarette Butt Leachate, Toxicity, LC_{50}, Heavy Metals, Histology.

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ORAL PRESENTATION

Growth Performance and Survival Rate of Mangrove Whelk (*Terebralia sulcata*) Fed with Different Natural Diets

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Abstract

Terebralia sulcata, also known as the mangrove whelk or creeper whelk, is a univalve mollusk species that is commercially important, as it is edible and consumed in many parts of Asia, including the Philippines. Despite its market value, there are no records of aquaculture for this species in the Philippines. *T. sulcata* feeds on various foods in the natural environment, including seaweed. Different species of seaweeds can be found associated with this species and in mangrove areas. This study was carried out to investigate the effects of different natural food sources on the growth performance and survival of *T. sulcata.* The *T. sulcata* were reared in 6-liter plastic bottles and fed with five natural foods for a period of 45 days. The findings showed no significant differences in the specific growth rate, final weight, shell length gain, and survival rate among the different food treatments ($p>0.05$). However, the shell width gain of T2 fed with *Ulva lactuca* (0.27 ± 0.16 mm) after 45 days was significantly lower than the other treatments. The results demonstrate the potential use of various natural food sources to feed *T. sulcata* and enhance its growth for sustainable aquaculture practices. The study contributes to the scientific knowledge on the growth and survival rates of *T. sulcata* and may inform further research on the culture of this species.

Keywords: *Terebralia sulcata*, Shell Width Gain, Shell Length Gain, Growth, Survival.

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ORAL PRESENTATION

Recent Advances in Genome Editing in Nile Tilapia (*Oreochromis niloticus*)

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Abstract

Nile tilapia (*Oreochromis niloticus*) has an important role in the world aquaculture industry and is critical for sustainable aquaculture production. Tilapia has a high adaptability, short reproductive cycle, disease resistance, and a protein-poor omnivorous diet, making it an economically advantageous species. However, the effectiveness of selection-based genetic improvement programs is often limited by high costs, time, and genetic factors such as heritability, which is why genome editing technologies have great potential to enhance genetic improvement in fish species. In addition to these factors, the sequencing of the tilapia genome has further established it as the most extensively genome-edited farmed fish species. In this study, genome-edited Nile tilapia has been approved for production in some countries. The objective of this study was to provide a comprehensive overview of existing gene editing methods, zinc finger nucleases (ZFNs), transcription activator-like effector nucleases (TALENs), and clustered regularly interspaced palindromic repeat (CRISPR)-Cas systems, as well as their applications in tilapia breeding. The CRISPR-Cas9 system is considered the most efficient genome editing method due to its technical simplicity, low-cost technology, and high in vivo mutagenesis rates. The aim of this study was to provide a general perspective by reviewing current gene editing studies on improving economic traits, such as growth rate, disease resistance, environmental adaptability, pigmentation, reproduction, and development, in tilapia species. In this context, potential impacts on aquaculture practices are discussed, providing an overview of the current state and future prospects of genome editing in tilapia.

Keywords: CRISPR/Cas, Gene Editing, Fish, Aquaculture.

1. Introduction

Nile tilapia (*Oreochromis niloticus*) is a significant aquaculture species due to its fast growth, adaptability, and nutritional benefits. Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR) and its associated protein Cas9 have emerged as revolutionary tools for genome editing due to their precision, efficiency, and cost-effectiveness. The CRISPR-Cas9 system was originally created as an adaptive immune mechanism in prokaryotes to enable cleavage of the foreign DNA that entered into a cell at specific genomic loci, permitting targeted genetic changes, which is now utilized for gene editing in diverse species (Rovelli et al., 2021; Zhang et al., 2014). Genome editing technologies, particularly CRISPR/Cas9, have emerged as powerful tools in the genetic improvement of tilapia, targeting traits like growth rate, disease resistance, and pigmentation. This article reviews recent

advancements in genome editing applications in *O. niloticus*, highlighting key successes and challenges (Huang et al., 2024).

Nile tilapia (*Oreochromis niloticus*), native to Africa, is one of the most widely farmed fish species worldwide, contributing significantly to global aquaculture due to its rapid growth, ease of breeding, and resistance to harsh environmental conditions. These qualities have made tilapia an essential protein source in many developing countries, offering both economic and nutritional benefits. In 2021 alone, tilapia production accounted for nearly 8 million metric tons globally, reinforcing its vital role in the food security of various regions (FAO, 2022). However, while its biological traits are advantageous, challenges like disease susceptibility, growth limitations, and environmental adaptability remain, which has led to the exploration of biotechnological solutions (Li et al., 2021).

One of the most exciting developments in modern aquaculture is the application of genome editing technologies. In particular, CRISPR/Cas9 has emerged as a transformative tool due to its precision, versatility, and relative ease of use compared to earlier technologies such as TALEN (Transcription Activator-Like Effector Nucleases) and ZFN (Zinc Finger Nucleases)(Gutási et al., 2023). Genome editing enables scientists to make targeted changes to the tilapia genome, allowing for precise improvements in growth rate, disease resistance, reproduction, and physical traits like pigmentation. These modifications not only improve the efficiency and yield of tilapia farming but also address the challenges posed by climate change and disease outbreaks, which threaten aquaculture industries worldwide (Li et al., 2021, Gutási et al., 2023).

Over the last decade, the introduction of CRISPR-based editing in *O. niloticus* has opened new doors for selective breeding programs. By targeting specific genes, such as those responsible for muscle growth (like the myostatin gene) or disease susceptibility, researchers can enhance desirable traits in a fraction of the time required for traditional breeding methods. These advancements have the potential to revolutionize the production of Nile tilapia, helping to meet the growing demand for sustainable, high-quality protein sources (Gutási et al., 2023).

This article aims to review the latest developments in genome editing of Nile tilapia, highlighting key advancements, their applications in aquaculture, and the ongoing challenges in the field.

2. TALEN and ZFN Technologies

While CRISPR/Cas9 has garnered widespread attention for its precision, simplicity, and efficiency in genome editing, earlier genome editing technologies like transcription activator-like effector nucleases (TALENs) and zinc finger nucleases (ZFNs) laid the groundwork for genetic modifications in a variety of organisms. TALENs and ZFNs both operate by inducing double-strand breaks (DSBs) in the DNA at specific sites, which are then repaired by the cell's natural repair mechanisms, leading to mutations or insertions/deletions.

TALENs, in particular, have been employed to study and modify traits in various fish species, including Nile tilapia. TALENs are designed by fusing a transcription activator-like effector (TALE) DNA-binding domain with a nuclease, allowing for precise targeting of genomic sequences. In fish, TALENs have been used to study pigmentation by targeting specific genes that control color and melanin production. For instance, TALEN-mediated mutations in the *SLC45A2* gene, responsible for

pigmentation, have been successfully carried out in other teleosts like medaka, resulting in loss of pigmentation and albino phenotypes (Gutási et al., 2023)

However, TALENs are generally considered less efficient than CRISPR/Cas9 due to the more complex design and assembly of TALEN constructs. CRISPR/Cas9 offers greater versatility as it requires only a simple guide RNA (gRNA) to direct the Cas9 enzyme to the target sequence. The higher efficiency and ease of use of CRISPR, especially with respect to editing multiple genes at once, have contributed to its dominance over TALENs and ZFNs in recent years (Li et al., 2021, Gutási et al., 2023).

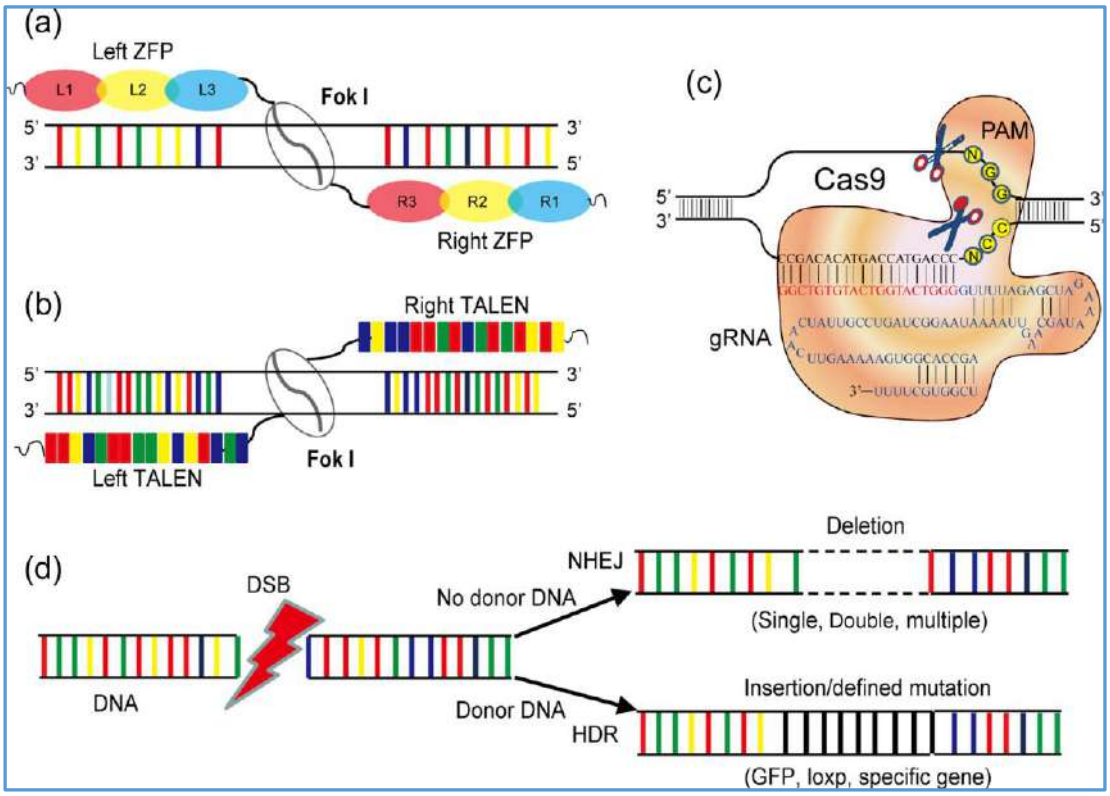


Figure 1. Schematics summarizing the mechanisms of gene editing nucleases. a) ZFN mediated genome editing. b) TALEN mediated genome editing. c) CRISPR/Cas9 mediated genome editing. d) Nuclease induced DSB can be repaired by NHEJ or HDR pathway (Li and Wang, 2017).

ZFNs, another early genome editing tool, function similarly to TALENs but use zinc finger proteins to recognize specific DNA sequences (Figure 1) (Li and Wang, 2017). Despite being the first customizable nucleases used for targeted gene editing, ZFNs are more challenging to design due to the complexity of constructing the zinc finger arrays needed to target unique sequences in the genome. Consequently, their application in fish species, including Nile tilapia, has been relatively limited compared to TALENs and CRISPR (Li et al., 2021, Gutási et al., 2023).

Overall, while TALENs and ZFNs provided foundational techniques for gene editing, CRISPR's simplicity and adaptability have made it the preferred choice for researchers in the field of aquaculture and genetic enhancement in fish (Figure 1) (Li and Wang, 2017). Nevertheless, TALENs remain useful for applications where CRISPR's dependence on the protospacer adjacent motif (PAM) site limits its versatility, offering an alternative for sites in the genome where PAM sequences are not readily available (Li et al., 2021, Gutási et al., 2023). These early technologies still contribute to current research and are

occasionally employed alongside CRISPR in complex gene-editing projects, proving their ongoing relevance despite the rise of CRISPR/Cas9 as the leading genome editing tool.

3. CRISPR/Cas9 in Tilapia

CRISPR/Cas9 has revolutionized the field of genetic engineering by enabling precise and efficient modifications in various organisms. In tilapia, this tool has been effectively used to introduce targeted mutations (Figure 2). For example, a study by Fang et al. demonstrated the knockout of the nuclear progestin receptor (Pgr) in tilapia, leading to subfertility in males, showcasing the potential for manipulating reproductive traits (Fang et al., 2018).

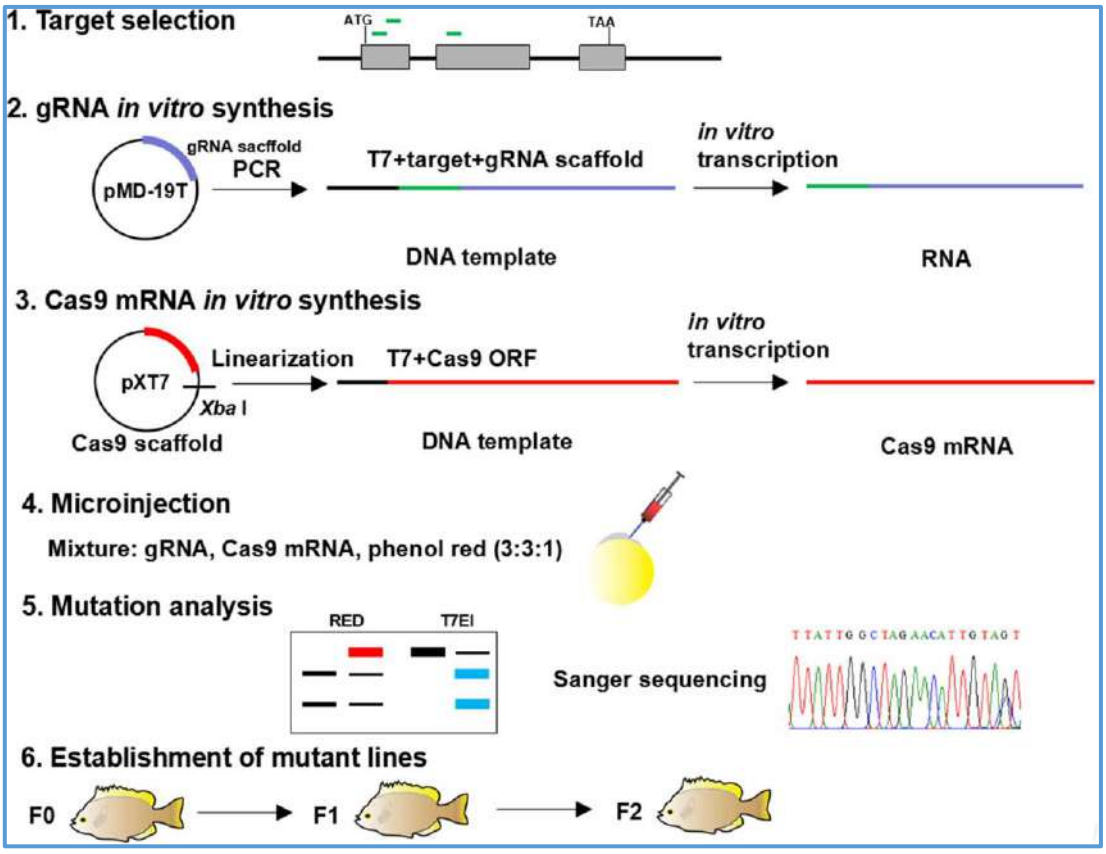


Figure 2. Workflow for production of mutant tilapia using the CRISPR/Cas9 (Li et al., 2021).

Similarly, researchers have utilized CRISPR/Cas9 to create albino phenotypes by targeting the *SLC45A2* gene, responsible for melanin biosynthesis. This study not only demonstrated high efficiency, with up to 99% albino fish in the F0 generation, but also showed the heritability of these traits, proving that genome edits can be passed to offspring (Li et al., 2021). Such findings suggest significant potential for CRISPR to enhance economically important traits, such as growth and color, in aquaculture. Table 1 provides the traits that have been modified through genome editing.

Table 1. Genes, genome editing method, and traits.

Target Gene	Trait	Method	Delivery Method	References
DMRT1/NANAOS2-3/FOXL2	Reproduction and development	gRNA, Cas9 mRNA	Microinjection	Li et al. 2014
GSDF	Reproduction and development	gRNA, Cas9 mRNA	Microinjection	Jiang et al. 2016
ALDH1A2/CYP26A1	Reproduction and development	gRNA, Cas9 mRNA	Microinjection	Feng et al. 2015
SF-1	Reproduction and development	gRNA, Cas9 mRNA	Microinjection	Xie et al. 2016
DMRT6	Reproduction and development	gRNA, Cas9 mRNA	Microinjection	Zhang et al. 2016
AMHY	Reproduction and development	gRNA, Cas9 mRNA	Microinjection	Li et al. 2015
AMH	Sex Determination	gRNA, Cas9 mRNA	Microinjection	Liu et al. 2020
WT1A/WT1B	Reproduction and development	gRNA, Cas9 mRNA	Microinjection	Jiang et al. 2017
EEF1A1B	Fertility	gRNA, Cas9 mRNA	Microinjection	Chen et al. 2017
IGF3	Sex Determination	gRNA, Cas9 mRNA	Microinjection	Li et al. 2020
RLN3A/3B	Reproduction and development	gRNA, Cas9 mRNA	Microinjection	Yang et al. 2020
ESR1, ESR2A, ESR2B	Fertility	gRNA, Cas9 mRNA	Microinjection	Yan et al. 2019
CYP11C1	Reproduction and development	gRNA, Cas9 mRNA	Microinjection	Zheng et al. 2020
PIWIL2	Reproduction and development	gRNA, Cas9 mRNA	Microinjection	Jin et al. 2020
FOXH1	Reproduction and development	gRNA, Cas9 mRNA	Microinjection	Tao et al. 2020
TSP1A	Reproduction and development	gRNA, Cas9 mRNA	Microinjection	Jie et al. 2020
MIRNA, VASA-3'UTR	Reproduction and development	gRNA, Cas9 mRNA	Microinjection	Li et al. 2019
MSTN	Growth	gRNA, Cas9 protein	Microinjection	AquaBounty Company,
SLC45A2	Pigmentation	gRNA, Cas9 protein	Microinjection	Segev-Hadar A et al. 2021
FOXL2, CYP19A1A	Sex Determination	TALEN, mRNA	Microinjection	Zhang et al. 2017
PMELA, PMELB	Pigmentation	gRNA, Cas9 protein	Microinjection	Wang et al., 2022a
HPS4	Pigmentation	gRNA, Cas9 protein	Microinjection	Wang et al., 2022b
CSF1RA	Pigmentation	gRNA, Cas9 protein	Microinjection	Lu et al., 2022a
TYRB	Pigmentation	gRNA, Cas9 protein	Microinjection	Lu et al., 2022b
MITFA, MITFB	Pigmentation	gRNA, Cas9 protein	Microinjection	Wang et al., 2023
PMEL17	Pigmentation	gRNA, Cas9 protein	Microinjection	Liu et al., 2022a
MSTNB	Growth	gRNA, Cas9 protein	Microinjection	Wu et al., 2023

4. Genome Editing Studies in Different Traits in Nile Tilapia

4.1. Growth

Growth enhancement is a key issue for yield improvement and sustainability in aquaculture. The *MSTN* gene plays a critical role in regulating muscle growth by acting as a negative regulator. Mutations or disruptions in the *MSTN* gene have been shown to result in increased muscle growth in livestock (Kim et al., 2020). By targeting genes like myostatin (*MSTN*), which regulates muscle growth, researchers have demonstrated substantial increases in muscle mass and overall body size in tilapia. Wu et al. (2023) induced hyperplasia in muscle mass by null mutation in the mstnb gene in male Nile tilapia by CRISPR/Cas9 method. As a result of the study, a 150% growth increase was obtained in male fish. A commercial company, AquaBounty, has successfully applied CRISPR/Cas9 gene-editing technology to improve economically important traits such as muscle mass, weight gain, and fillet yield in the FLT-01 line of Nile tilapia in Argentina. In this study, microinjection was used to deliver mRNA nucleases, resulting in a 26-bp homozygous deletion at the early stop codon of the myostatin gene. Notably, no off-target effects were observed during the process (Hallerman, 2021). Studies on other species, such as channel catfish, show a 29.7% increase in body weight after CRISPR-mediated *MSTN* knockouts, suggesting similar potential for tilapia (Khalil et al. 2017).

4.2. Pigmentation

Pigmentation is one of the key factors influencing consumer preferences in tilapia, both in the ornamental fish trade and food consumption. It plays a significant role in determining the market value of tilapia in these sectors (Segev-Hadar et al. 2021). To reduce black pigmentation in fish, genetic engineering technologies can be employed to induce targeted mutations in genes responsible for either melanophore development or pigment synthesis (Antinucci and Hindges, 2016). Solute carrier family 24 member 5 (slc24a5) gene, which is conserved across vertebrates, from zebrafish to humans, is one of the most extensively studied genes in gene-editing research related to skin color variation (Puthumana et al. 2024). Segev-Hadar et al. (2021) used highly specific guide RNAs to induce loss-of-function mutations in this gene. By injecting these *SLC45A2*-specific ribonucleoproteins into Nile tilapia zygotes, they successfully induced 97-99% albinism, including loss of melanin in the eye. Genetic sequencing revealed mutant alleles in the injected fish and the mutations were transmitted to the offspring. This research demonstrates that somatic and germline mutations in the *SLC45A2* gene lead to complete albinism in Nile tilapia.

Mitf genes, part of the MiT family of bHLH-ZIP transcription factors, include tfec, which regulates the development of common pigment cell precursors for melanophores and iridophores and plays a crucial role in pigment cell lineage specification in zebrafish (Lister et al. 2011; Petratou et al. 2018). In a recent study using the CRISPR/Cas9 method to mutate both mitfa and *Mitfb* genes in tilapia, the importance of these genes in body color formation was highlighted, with mitfa playing a more dominant role than mitfb. The study compared the phenotypes of *mitfa−/−;mitfb−/−, pmela−/−;pmelb−/−,* and *hps4−/−* mutants, revealing that disruptions in genes involved in various melanogenesis pathways resulted in distinct body color variations. The research confirmed that Mitf is the most crucial gene involved in melanophore differentiation in Nile tilapia (Wang et al. 2023).

4.3. Reproduction

The short reproductive cycle of tilapia allows rapid observation of the effects of genome editing on traits such as sex reversal and sterility. This makes it ideal for studying mechanisms such as hormone regulation and germ cell differentiation, which are essential in reproductive studies. Sterility helps prevent the genetic introgression of farmed species into wild populations, maintaining ecological risk (Wargelius 2019). The gonadal soma-derived factor (*gsdf*) was identified as a downstream gene of Dmrt1 in the male sex determination pathway of the Nile tilapia. Through genetic loss-of-function studies and promoter analyses, it was shown that gsdf is essential for testicular differentiation, likely by inhibiting estrogen production (Jiang et al. 2016).

In another study was identified a missense SNP (C/T) in the Y-specific duplicate of the anti-Müllerian hormone (*amhy*) gene, which differs from the X-linked anti-Müllerian hormone gene (*amh*) gene, leading to an amino acid change (Ser/Leu92) in the N-terminal region. Both amhy and amhΔ-y are expressed only in XY gonads from five days post-hatching. CRISPR/Cas9 knockout of *amhy* in XY fish caused male-to-female sex reversal, while *amhΔ-y* knockout alone did not. Overexpression of amhy in XX fish led to female-to-male sex reversal, but AmhΔ-y did not. Additionally, knocking out *amhrII* in XY fish resulted in 100% male-to-female sex reversal (Li et al. 2015).

Yang et al. (2021) used CRISPR/Cas9 technology to knock out the cytochrome P450 family 17 subfamily A member 1 (*Cyp17a1*) gene in Nile tilapia. The results showed that both *cyp17a1-/-* XX and *cyp17a1-/-* XY fish were sterile. The study concluded that gene editing technology targeting the *Cyp17a1* gene could be used to create sterile, all-male Nile tilapia populations. In the case of sex reversal, particularly in species like Nile tilapia, the process is used to produce all-male populations, which are preferable in aquaculture due to their faster growth rates compared to females. The Nile tilapia is a gonochoristic teleost species. It is characterized by an XX/XY chromosomal sex determination system (Li et al. 2021). Mutations in genes like *star2*, *cyp17a1*, and *cyp19a1a* lead to sex reversal due to estrogen deficiency in XX tilapia (Yang et al. 2021). The study showed that estradiol can reverse infertility in *foxh1* knockout tilapia. This was supported by the development of phase III and IV oocytes and the suppression of Cyp11b2 expression. The findings indicate that *foxh1* plays a pivotal role in oogenesis by promoting cyp19a1a expression, which is essential for estrogen production. In the absence of foxh1, estrogen synthesis and oocyte growth are disrupted, resulting in arrested oogenesis and infertility in tilapia (Tao et al. 2020).

In other study on tilapia shows that *foxl2* and *foxl3* play crucial roles in determining somatic and germ cell fates, respectively. Dmrt1, expressed in both somatic and germ cells, influences the fate of both cell types. Notably, germ cells in *foxl3* mutant XX individuals lose their sexual plasticity, as estrogen (E2) treatment cannot restore their phenotype. These results highlight that both *dmrt1* and *foxl3* are essential for maintaining germ cell sexual plasticity and proper reproductive development (Li et al. 2024).

5. Conclusion

Recent advances in genome editing, particularly CRISPR/Cas9, offer unprecedented opportunities for the genetic improvement of Nile tilapia. These technologies are poised to transform aquaculture by enabling targeted modifications that enhance economically important traits such as growth, disease

resistance, and pigmentation. However, continued research is necessary to overcome the current technical and ethical challenges.

Despite the promising results, challenges remain in fully optimizing these technologies for aquaculture. Off-target effects, efficient delivery systems, and regulatory hurdles are key issues that need to be addressed. Future research will likely focus on improving the precision of genome editing tools and ensuring their safe and ethical application in food production.

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
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ORAL PRESENTATION

Gonadal Somatic Index and Length-Weight Relationship of Mackerel Scad *Decapterus macarellus* Landed in Bongao Wet Market, Tawi-Tawi, Philippines

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Abstract

Mackerel Scad *Decapterus macarellus* is the most dominant species caught by the multiple handline in the coastal water of Tawi-Tawi, Philippines. This study investigated length-weight relationship of *Decapterus macarellus* landed in Bongao Wet Market, Bongao, Tawi-Tawi, Philippines. Results revealed that a total of 368 Mackerel Scad *Decapterus macarellus* were sampled from the Wet-Market, Bongao, Tawi-Tawi, Southern Philippines, of which 53.53% were male, and 46.47% were female with a sex ratio of 1.15:1 and GSI of 5.59 ± 0.06%. The length-weight relationship of Mackerel Scad *Decapterus macarellus* was $W = 11.94 \times 10^{-2} TL^{3.090}$, with a *b* value of 3.090, indicating a positive allometry growth pattern, which implies that fish live in the normal environment suitable for their growth, where multiple handline is relatively efficient to catch Mackerel Scad *Decapterus macarellus*. Therefore, Mackerel Scad fishing in Tawi-Tawi waters, southern Philippines, is one of the important sources of food and livelihood for many local fishers.

Keywords: *Decapterus macarellus,* GSI, Length-Weight Relationship, Philippines, Sex Ratio.

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PITESTI-ROMANIA

ORAL PRESENTATION

The Flavonoid Compound, Quercetin Promotes Growth and Captive Maturation in Highfin Barb, *Oreichthys crenuchoides*

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Abstract

An experiment was conducted to evaluate the effect of a flavonoid compound, quercetin on growth and gonadal development of highfin barb, *Oreichthys crenuchoides*, which is a native ornamental fish of India with a significant demand in international market. Quercetin is a potent antioxidant found in several fruits and vegetables and used for puberty enhancement in veterinary animals. The study aimed to determine the optimal dose of quercetin to enhance growth and maturation of *O. crenuchoides*, contributing to its sustainable production and export. In this experiment, the highfin barb (650.12±8.54 mg) was fed with five diets containing different doses of quercetin as treatments, 0, 0.1, 1.0, 10 and 100 mg/kg designated as control, Q1, Q2, Q3 and Q4, respectively for 60 days. The results demonstrated a significant growth increment in fish under Q3 and Q4 compared to that of the control. Additional evidences such as antioxidant enzymes (superoxide dismutase and catalase), relative glucose content, tissue cortisol levels, digestive enzymes such as lipase, amylase and protease that were recorded at higher levels in Q3 and Q4 support the growth promoting characteristic of quercetin. Moreover, the reproductive augmenting property of quercetin was evident with the best gonado-somatic index (GSI) recorded in females under Q3 and Q4. Examination of the tissue reproductive hormones, namely 11α-keto testosterone (KT), 17-ß estradiol (E2), dihydroxy progesterone (DHP), follicle stimulation hormone (FSH) and luteinizing hormone (LH) along with histo-structural patterns of gonads, absolute fecundity and number of matured oocytes indicated their marked increases in fish under Q3 and Q4 further confirming the potent role of quercetin as reproductive enhancer. Based on the results, it was evident that the fish under treatments, Q3 and Q4 displayed superior performances across various assessed parameters. Notably, Q3 demonstrated a significantly higher number of oocytes in females, leading to the conclusion that a dietary supplementation of 10 mg/kg of quercetin is recommended to achieve the captive maturation of *O. crenuchoides*.

Keywords: Quercetin, Growth, Reproduction, Highfin Barb.

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ORAL PRESENTATION

Artisanal Fishery of Bigfin Reef Squid *Sepioteuthis lessoniana* Landed in Bongao Wet Market, Bongao, Tawi-Tawi, Philippines

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Abstract

The bigfin reef squid (*Sepioteuthis lessoniana*), a species of significant importance in the Bongao wet market, is a cornerstone of the resource-rich Tawi-Tawi province in the heart of the Coral Triangle. These squids provide essential sustenance and contribute significantly to the local economy. Despite their crucial role, a comprehensive scientific investigation into the length-weight relationship, condition factor, fishing grounds, fishing gear used for *Sepioteuthis lessoniana* in Bongao, and the demographic profile of fishers has yet to be conducted. This research, conducted over three months from February to April 2024, aimed to address this gap. Weekly samplings resulted in the collection of total length and weight measurements for 20-30 bigfin reef squids being sold at Bongao market each week. Additionally, the socio-demographic profiles, fishing grounds, and gear of 30 squid fishers were documented. Most fishers were from the Sinama tribe, married men aged 31-50, with primary or no formal education, and an average monthly income of ₱6,000.00 to ₱10,000.00, indicating that the municipal fishers in the study area belong to the below-poverty threshold. Their households, typically with 5-6 members, were equipped with cellular phones and solar power, while water and waste management relied on local resources and practices. Fishing methods involved using *Ullang* (squid jiggers) and motorized boats, with fishing sessions lasting 4 to 6 hours in the waters of Sangay Siapo. These efforts yielded an average annual catch value of ₱71,000-90,000 during peak fishing months, January to June, with incidentally caught rabbitfish and garfish. A notable finding is the negative allometric growth pattern in bigfin reef squids, indicated by a length-weight relationship exponent of 2.4178. This pattern suggests that weight gain does not increase as rapidly as length, pointing to a trend towards more elongated bodies as squids mature. Additionally, the condition factor or K-value of the 257 squids studied is 1.0189, suggesting that the squids are in moderate health.

Keywords: Bigfin Reef Squid, Fishing Gears, Fishing Grounds, Length-Weight Relationship, Condition Factor.

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ORAL PRESENTATION

Evaluating Growth and Survival of *Mugil cephalus* Fry with Telescope Snail Meal Inclusion in Formulated Diets

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Abstract

Fish feed is one of the major costs of aquaculture due to the expensive protein sources, like fish meal. To decrease the cost of feeds, there is a need to look for other sources of protein that are low-cost and underutilized. Telescope snails are one of the ideal candidates for replacing fish meal. The telescope snail, *Telescopium telescopium*, has a high protein content and can be found mostly in mangrove areas. *Mugil cephalus*, or flathead mullet, is a widely consumed aquaculture species in the Philippines and other Southeast Asian countries. Hence, this study was carried out to evaluate the growth and survival rate of *Mugil cephalus* with different replacement levels of telescope snail meal to fish meal. The study was conducted at the Multi-species Hatchery, College of Fisheries, Mindanao State University Tawi-Tawi College of Technology and Oceanography, Bongao, Tawi-Tawi, Philippines, for 45 days. Telescope snails, *Telescopium telescopium*, were collected from the coastal area of Bongao, Tawi-Tawi. The whole body parts of the telescope snails were removed from their shells, dried in the oven, and powdered. The feeds were prepared based on the replacement levels of telescope snail meal to fish meal: Treatment (T) 1 – 0%, T2 – 25%, T3 – 50%, T4 – 75%, and T5 – 100%. The flathead mullet, *Mugil cephalus* fry, was collected from the coast of Barangay Tubig Sallang and acclimatized at the study site for 1 week, fed with commercial diets. A total of 450 fry were used in the study and was distributed equally to 15 plastic containers (34 L capacity); aeration and flow-through were maintained in the culture system throughout the 45 days. Before stocking, the initial weights were recorded, and sampling was done every 15 days. The results showed significant differences in T3 among treatments in SGR on days 15, 30, and 45, with values of 6.10±0.26, 4.79±0.62, and 3.07±0.43, respectively. The highest survival rate was obtained in T3 with a rate of 97%. Replacing fish meal with 50% telescope snail meal in the diet of *Mugil cephalus* can significantly improve growth performance and survival rates, making it a viable alternative protein source in aquaculture feeds.

Keywords: Telescope Snail, *Telescopium telescopium, Mugil cephalus*, Fish Meal, Growth.

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ORAL PRESENTATION

Effect of Different Implantation Methods in Freshwater Mussel, *Lamellidens marginalis* with respect to Stress Parameters, Immune Parameters, And Hematological Parameters

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Abstract

An experiment was conducted to evaluate the effect of implantation in freshwater mussel, *Lamellidens marginalis* which is one of the important candidate species for pearl formation in the freshwater aquaculture. Implantation is the surgical method for inserting the nuclear beads in the pearl mussels for pearl formation. The study aimed to determine the impact of implantation procedure in the pearl mussels. So the different implantation methods (Mantle Cavity, Mantle tissue and Gonadal method) are undertaken for a period of 30 days. The immune parameters, histopathology, stress enzymes and hematological parameters were undertaken at an interval of 1hrs, 3hrs, 6hrs, 12hrs, 24hrs, 48hrs, 96hrs, 7days, 14days and 28days.The stocking density was maintained @1mussel in 1L of water. The mussels were kept 35L aquarium. The physicochemical parameter of the water is recorded. The mussels were kept in aerated condition and *Spirulina* powder was given as diet. The pre-operative and post-operative condition was maintained properly. The mortality of the mussel was recorded. Based on the results, it was evident that the mussels under the gonadal surgery were under much stress and better survival is found in mantle cavity and mantle tissue respectively. From this study it is found the recovery rate of the mussels for mantle tissue and gonadal implantation needs higher duration compared to the mantle cavity method.

Keywords: Freshwater Mussels, Mantle, Gonad, *Lamellidens marginalis*.

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ORAL PRESENTATION

The Use of Forest Products as a Renewable Energy Source: Biomass Energy Potential from Forest Residues

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Abstract

The conversion of forest residues into biomass energy holds significant potential, particularly in the utilization of waste generated during silvicultural interventions and forest management. Silvicultural practices encompass maintenance and rejuvenation activities aimed at enhancing the health and productivity of forests. The branches, roots, leaves, and other organic materials resulting from these activities are often considered waste. However, these residues represent valuable resources for biomass energy production. This study examines the processes of converting these residues into biomass energy through methods such as direct combustion, pyrolysis, gasification, and fermentation. The efficiency, environmental impacts, and economic feasibility of each method are analyzed to identify the most suitable approaches for residues obtained from silvicultural activities. Biomass energy offers substantial environmental benefits, including carbon neutrality and the reduction of greenhouse gas emissions. Furthermore, the integration of biomass energy production with sustainable forest management plays a critical role in ensuring both the long-term health of forests and energy production. Turkey's extensive forest areas and forestry activities indicate a high potential for biomass energy. This study demonstrates that forest residues obtained through silvicultural interventions can make significant contributions to Turkey's renewable energy targets and overall energy security.

Keywords: Biomass Energy, Silviculture, Forest Residues, Renewable Energy, Sustainable Forest Management.

1. Introduction

1.1. The Importance of Biomass Energy in Sustainability

The increasing global energy demand and environmental challenges have made the use of sustainable energy sources imperative. The depletion risk of fossil fuels and their high carbon emissions have further emphasized the importance of renewable energy sources. In this context, biomass energy plays a crucial role in achieving sustainable development goals due to its environmentally friendly nature, contribution to the carbon cycle, and efficient utilization of local resources. Among renewable energy sources, biomass supports carbon neutrality in energy production processes by not adding extra carbon to the atmosphere, thus promoting the balanced use of natural resources (Toklu, 2017). Moreover, biomass

energy contributes to waste management by utilizing forest residues and agricultural by-products, thereby supporting energy security and fostering the development of rural economies.

1.2. The Importance of Forest Residues in Biomass Energy Production

With the increasing use of sustainable energy sources today, biomass energy has emerged as a significant alternative. Forest residues play a crucial role in biomass energy production. Branches, leaves, and deadwood resulting from logging activities, pruning, and silvicultural interventions are valuable biomass resources that can be utilized for energy production. These residues can be collected while maintaining ecosystem balance within the forest's natural processes and converted into energy to reduce reliance on fossil fuels. This not only reduces carbon emissions but also contributes to the production of sustainable energy (Çanka Kılıç & Kaya, 2007). Establishing local energy plants to convert these resources into energy can promote a more sustainable approach to waste management. Thus, this process also contributes to combating climate change by lowering carbon emissions.

2. Literature Review

2.1. Studies on Biomass Energy in Turkey

Studies evaluating the biomass energy potential and its utilization in Turkey emphasize that the country possesses a significant biomass energy potential. Biomass energy is critically important for sustainable development, environmental sensitivity, and energy efficiency. Various research projects in Turkey have explored energy production from sources such as wood, agricultural waste, and animal waste. For instance, biogas production projects, energy generation from municipal waste, and the utilization of agricultural residues indicate that biomass can contribute to the country’s energy supply. Additionally, Turkey's diverse biomass sources and the potential to convert these into clean and continuous energy using modern technologies have been assessed as highly promising (Aslantaş, 2018).

2.2. Assessment of Forest Residues Obtained from Silvicultural Practices

Forest residues obtained through silvicultural interventions represent a significant potential source for energy production. Studies indicate that biomass production is feasible through the utilization of pruning residues, thinned trees, and non-timber forest products generated during forest management. Forest products and residues hold a substantial share in Turkey's biomass energy potential. Specifically, organizing forest management plans with the objective of energy production can enhance biomass energy production capacity (Şenol, Elibol, Açıkel, & Şenol, 2017). In this context, implementing silvicultural interventions in a manner that ensures sustainability in forest management and optimizes the use of biomass energy will play a critical role in Turkey's efforts to achieve its renewable energy targets.

2.3. International Studies on Biomass Energy Potential and Practical Examples

Research conducted globally on the evaluation of biomass energy potential demonstrates that this energy source occupies a significant position in sustainable energy systems. For instance, successful implementation examples of converting agricultural waste, animal waste, and forest residues into energy can be found in countries across Europe, America, and Asia. International studies highlight the potential of biomass for electricity generation, heating, and biofuels, while also indicating that Turkey could

benefit from this potential (Çağal, 2009). In order to enhance Turkey's biomass energy potential, shaping energy policies by considering international collaborations and successful implementation examples would be a strategic step towards achieving energy supply security and sustainability goals.

3. Materials and Methods

3.1. Methods Used for Biomass Energy Production

Biomass energy production methods commonly used include direct combustion, pyrolysis, gasification, and fermentation processes.

3.1.1. Direct combustion

Direct combustion is the oldest and most widely used method for biomass energy production. This process occurs through the thermal combustion of biomass in the presence of oxygen, and the heat generated is converted into electrical energy via steam turbines. Although the direct combustion method is frequently used in biomass energy production plants, it is optimized with advanced combustion systems to enhance efficiency. Modern direct combustion facilities are equipped with electrostatic filters and advanced gas cleaning systems to reduce smoke and other emissions.

The efficiency of direct combustion depends on factors such as the type of biomass and its moisture content. For instance, drier biomass materials (e.g., forest waste or agricultural residues) exhibit higher combustion efficiency due to their high energy density. This method is typically suitable for solid biomass sources such as agricultural wastes, wood residues, chips, and other wood derivatives. However, efficiency may decline in biomass with low energy density (e.g., leaves or wet biomass) (Nacar Koçer & Ünlü, 2007).

3.1.2. Pyrolysis

Pyrolysis is a thermochemical conversion process where biomass is decomposed at high temperatures (300-700°C) in the absence of oxygen. During this process, biomass breaks down into three primary products: bio-oil, syngas, and biochar. Bio-oil serves as an alternative to petroleum-based fuels, syngas can be utilized for heat and power generation, and biochar is valuable for soil enhancement or carbon sequestration.

Pyrolysis is categorized into three main types:

- Slow Pyrolysis: Operated at low temperatures over a long duration, prioritizing the production of biochar.
- Fast Pyrolysis: Conducted at higher temperatures (500-700°C) with shorter reaction times, primarily yielding bio-oil.
- Flash Pyrolysis: Involves even higher temperatures and extremely short durations (in the range of seconds), leading to increased syngas production.

Through pyrolysis, biomass's chemical composition is altered to enhance its combustibility, producing high-energy products from waste biomass (Acaroğlu, 2003).

3.1.3. Gasification

Gasification is a method that produces combustible gases (such as hydrogen, carbon monoxide, and methane) by thermally treating biomass in an oxygen-limited environment. These combustible gases are referred to as "synthetic gas" or "syngas" and can be used as fuel for energy production or as chemical feedstock.

Gasification involves processing biomass at high temperatures ranging from 700 to 1000°C, converting solid biomass into gas phase. During this process, solid carbon, liquid tar, and solid ash may be formed. The resulting syngas can be utilized to generate electricity and heat energy in internal combustion engines, gas turbines, and fuel cells. Gasification is considered a highly efficient method because it increases the energy density of biomass and can also be used for biofuel production (Karaosmanoğlu, 2002).

This gasification process is particularly suitable for low-quality biomass (such as non-wood forest products and agricultural residues), economically converting these wastes into gases with high energy density.

3.1.4. Fermentation

Fermentation is a biochemical process in which the sugars and starches in biomass are processed by microorganisms to produce biofuels. This method is particularly favored for the production of liquid biofuels, resulting in two main types of biofuels: ethanol and biodiesel.

- Ethanol Production: Plants rich in sugars and starches, such as sugarcane, corn, and wheat, are processed through fermentation to produce alcohol (ethanol). Biomass undergoes fermentation using enzymes and microorganisms (e.g., yeast), and the resulting ethanol can be used in internal combustion engines when blended with fossil fuels.

- Biodiesel Production: Vegetable oils and animal fats are converted into biodiesel through a chemical process known as transesterification. In this process, fatty acids react with alcohol to produce biodiesel and glycerin as a byproduct. Biodiesel can be utilized directly in diesel engines or blended with fossil diesel fuel.

Fermentation methods play a significant role in biomass energy production due to their potential for achieving carbon neutrality and their capacity to produce renewable fuels. Additionally, the portability of biofuels and their ability to be stored in liquid form are among the advantages of this method (Kusdiana & Saka, 2007).

3.2. Integration of Waste from Silvicultural Interventions

Waste generated from forest management and silvicultural practices (such as branches, leaves, and pruning residues) can be utilized for biomass energy production. The integration of these wastes ensures the sustainable management of forests and the efficient use of local biomass resources in energy

production. Particularly in countries like Turkey, waste from silvicultural interventions can reduce energy dependence by increasing energy efficiency (URL1, 2024).

The effective integration of these methods supports the evaluation of biomass as a sustainable energy source and contributes to the reduction of carbon emissions. Additionally, converting forest waste into energy is important for reducing the risks of forest fires and preserving the health of forest ecosystems. In this regard, adopting sustainable approaches in forest management and utilizing biomass energy strategies to mitigate forest fires and environmental risks is recommended**.**

4. Findings

4.1. The Potential of Biomass Energy Obtained from Forest Waste in Turkey

Turkey possesses rich forest resources, and the biomass waste derived from these forests has significant potential as a renewable energy source. According to the General Directorate of Forestry (OGM, 2024), Turkey's total forest area is approximately 22.7 million hectares, a substantial portion of which presents potential waste sources for biomass energy. Forest waste obtained from silvicultural interventions and forest maintenance activities, such as tree pruning, roots, branches, and bark, serves as raw materials for biomass energy production. Studies estimate that the energy potential of such forest wastes is approximately 6-10 million tons annually. This amount is considered a significant resource that could contribute to Turkey's energy production and especially support energy security in rural areas (Toklu, 2017). The utilization of forest waste for biomass energy production in Turkey will enhance energy security in rural areas and make important contributions to the sustainability of energy supply.

4.2. International Comparisons and Evaluation of Turkey's Potential

On the international stage, leading countries in biomass energy production include the USA, China, Brazil, and EU countries. For instance, in the USA, biomass energy production is approximately 60 million tons of oil equivalent (Mtoe) per year, while Turkey has yet to reach this level of potential. Considering Turkey's annual energy production capacity, it is projected that biomass energy obtainable from forest waste could meet approximately 5-7% of total energy consumption. This value indicates that Turkey is still at the initial stage of biomass energy utilization and that infrastructure and technological investments are necessary to reach international standards. On the other hand, given the existing forest resources and sustainable silvicultural practices, Turkey is believed to have the capacity to enhance its biomass energy potential and utilize this resource more effectively in energy production (URL2, 2024). By focusing on infrastructure and technological investments while leveraging international examples, Turkey can increase the share of biomass energy in its total energy consumption and contribute to energy supply security.

4.3. Environmental and Economic Impacts

Biomass energy is considered a carbon-neutral energy source and significantly reduces greenhouse gas emissions compared to fossil fuels. Utilizing forest waste for energy production ensures the efficient management of forests and helps mitigate potential harmful effects on the environment (e.g., fire risk) by recycling waste. In Turkey, the use of forest waste in biomass energy production promotes environmentally friendly energy generation while contributing to increased job opportunities in rural areas and revitalizing the local economy. For example, forest waste collected by villagers can provide

raw materials to local biomass energy plants, creating additional income sources. However, there is a need for investments in advanced technologies and sustainable management practices to enhance efficiency in the biomass energy production process and minimize environmental impacts (Karayılmazlar, Saraçoğlu, Çabuk, & Kurt, 2011).

Such evaluations necessitate the development of a strategic roadmap for Turkey to become more competitive in terms of the sustainability of its biomass energy and energy security.

5. Discussion

5.1. Contribution to Turkey's Renewable Energy Goals

Turkey aims to provide 30% of its energy production from renewable sources by 2023, in line with its objective to increase the share of renewable energy resources. Biomass energy can play a significant role in achieving this goal. The conversion of forest waste into biomass energy will not only help secure the country's energy supply but also reduce dependence on imported fossil fuels. Fully utilizing Turkey's biomass energy potential will particularly contribute to local economies in rural areas and create diversity in energy production. Achieving these targets will also aid in the country's efforts to reduce carbon emissions and enhance environmental sustainability (Ar, Akdağ, Malkoç, & Çalışkan, 2003). Fully leveraging Turkey's biomass energy potential will facilitate the achievement of renewable energy goals and strengthen rural economies. Aligning this process with environmental objectives, such as reducing dependence on fossil fuels and decreasing carbon emissions, will support Turkey's sustainability efforts. To reach these goals, it is crucial to invest in technological advancements and effectively utilize existing resources.

5.2. Long-Term Effects of Silvicultural Interventions on Forest Management and Energy Production

Silvicultural interventions are critical for ensuring the long-term sustainability of forests while also creating a regular source for biomass energy production. Proper management of forests not only protects carbon sinks but also provides raw materials for sustainable energy production. Furthermore, consistent waste production for biomass can reduce risks such as forest fires and aid in the conservation of biodiversity. However, mismanagement of these processes can harm forest ecosystems and jeopardize long-term forest health. Therefore, sustainable forest management practices require a significant balance between energy production and environmental protection (URL3, 2024).

In addressing the role of sustainable forest management in biomass production, it is important to emphasize the necessity of maintaining ecological balance while providing economic benefits. Additionally, the contributions of silvicultural interventions to biomass energy production must be considered alongside potential risks. Consequently, the development of effective management strategies will be a determining factor in the success of these processes.

5.3. Opportunities for International Cooperation and Technology Transfer

International cooperation in biomass energy production can enhance Turkey's access to technology and improve efficiency in energy generation. Biomass energy policies and technologies implemented in regions such as the European Union can provide valuable models for Turkey. Specifically, the transfer

and adaptation of technologies that increase the efficiency of biomass energy facilities will contribute to Turkey's achievement of international standards in this field. These collaborations will enable Turkey to become a global player in biomass energy production and accelerate its renewable energy goals (URL2).

6. Conclusion and Recommendations

6.1. The Future of Biomass Energy in Turkey

Biomass energy is emerging as a sustainable and renewable option within Turkey's energy portfolio. The country's extensive forest areas and agricultural waste resources present significant potential for biomass energy production. However, fully realizing this potential depends on modernizing energy infrastructure, increasing technological investments, and developing renewable energy policies. In the coming years, biomass energy will play a critical role in ensuring Turkey's energy security and achieving carbon emission reduction targets.

Notably, biomass energy plants in rural areas can revitalize local economies and contribute to sustainable development (Kapluhan, 2014). The assessment of Turkey's biomass energy potential offers substantial opportunities for both economic development and environmental sustainability. Establishing biomass energy plants at the local level could enhance rural employment and reduce energy costs. Additionally, examining the positive impacts of biomass energy on local economic development reveals its potential to increase the economic independence of local communities.

6.2. Policy Recommendations and Sustainable Practices

The following policy recommendations can be developed to promote and sustain biomass energy in Turkey:

6.2.1. Increased investments and incentives

Enhancing state-supported incentives for biomass energy plants and providing tax reductions for companies investing in this sector can stimulate the potential of biomass energy. These investments would also facilitate technology transfer and foster the development of local capacity (Alemdağ, 1980).

6.2.2. Sustainable forest management

Silvicultural interventions play a critical role in ensuring that forest waste is regularly utilized for energy production while also safeguarding forest ecosystems through sustainable practices. The sustainable management of forest resources can enhance biomass energy production while ensuring the long-term health of forests (Tolay, Baileys, & Waterschoot, 2010). Utilizing forest waste for energy production not only strengthens ecosystem services but also enhances resilience against threats such as forest fires and pests. Therefore, silvicultural interventions and sustainable forest management are crucial for effectively harnessing the potential of biomass energy and protecting forest ecosystems.

6.2.3. Renewable energy legislation

Establishing a legal framework for biomass energy and introducing more concrete regulations for renewable energy sources would pave the way for investments in the sector. Additionally, international collaborations and green energy agreements could assist Turkey in increasing its biomass energy production capacity.

6.2.4. Public awareness and education programs

Informing the public about the benefits and sustainability of biomass energy and organizing educational programs for relevant stakeholders can enhance public interest in this energy source and contribute to the promotion of local production.

In light of these recommendations, Turkey can progress towards becoming a leader in the field of biomass energy both locally and globally.

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Effect of Nutrient Enrichments on the Survival Rate and Disease Occurrence of Seaweed *Eucheuma denticulatum* in Micro-Propagule Indoor Culture

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Abstract

Tawi-Tawi is known for its seaweed farming, which provides livelihoods for many people. However, extensive seaweed farming can result in disease infestations, such as ice-ice, which can be problematic for farmers, and alternative methods have been developed in order to reduce the incidence of ice-ice diseases. Thus, this study examined the effect of nutrient enrichment on the survival rate and disease occurrence of Seaweed *Eucheuma denticulatum* in the micro-propagule indoor culture. Three nutrient enrichment: T1 (control), T2 (*Sargassum* sp. extract), and T3 (Ammonium Phosphate) with four replicated each. A total of one hundred twenty (120) micro propagules were divided into twelve (12) sterilized containers containing 200 mL of sterile seawater cultivated for 91 days in an indoor culture enriched with different nutrients. Results revealed that the application of *Sargassum* sp. extract (T2) significantly increased ($p<0.05$) the survival performance (95.00%) of Seaweed *Eucheuma denticulatum*. In addition, a significant decrease ($p<0.05$) in ice-ice disease in seaweed *Eucheuma denticulatum* indoor cultures was observed following the application of *Sargassum* sp. extract (T2) with 5.00%, compared with the enriched with ammonium phosphate (T3) and control (T1). Hence, *Sargassum* sp. extract reduced the incidence of ice-ice disease occurrence in seaweed *Eucheuma denticulatum* cultures and increased their survival rate

Keywords: *Euchema denticulatum*, *Sargassum sp.*, Indoor Culture, Incidence of Ice-Ice, Nutrient Enrichment.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Contribution of Low Nitrogen to Cabbage Seedling Growth in Water Deficit

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Abstract

Drought is an important factor that limits the cultivation of vegetable species that require regular water. In addition, improper fertilization causes many problems. Excessive use of nitrogen fertilization, which is especially used extensively in vegetable growing, is a major threat to living things and the environment. In this study, the effects of low-dose nitrogen fertilization on the plant growth of cabbage seedlings under a water-limited environment were examined. The effect of 5 kg/da N application on cabbage seedlings during irrigation at 100% and 60% of the field capacity was investigated. The effects of the treatments in terms of plant height, stem diameter, SPAD, number of leaves, leaf area, LRWC, plant fresh weight, plant dry weight, root fresh weight and root dry weight were determined. There was a significant decrease in these parameters with water deficit. However, low nitrogen application reduced this negative effect of water limitation. According to the results of the study, it was determined that nitrogen used in sufficient amounts without excessive nitrogen use could contribute to the development of cabbage seedlings even under water deficit.

Keywords: Drought, Mitigation, Nitrogen, Seedling.

1. Introduction

Drought is a major environmental stress that threatens agricultural production worldwide. The increasing demand for water alongside parallel to the intensive agricultural production to support the growing global population, has become a significant problem. This is especially true due to the inadequacy of water resources for irrigation, worsened by drought. Drought stress causes a decrease in leaf water content, closure of stomata and consequently a decrease in CO_2 content, inhibiting photosynthesis and further causing plant death (Farooq et al., 2009; Bijalwan et al., 2022; Bandurska, 2022; Qiao et al., 2024). With drought, respiration, translocation, ion uptake, nutrient assimilation and growth promoters in the plant are damaged, while reactive oxygen species (ROS) increase and enzyme activity changes with the resulting oxidative stress (Sachdev et al., 2021).

To obtain efficient and high-quality products in plant cultivation in agriculture, various fertilizers that support plant growth are used. Most of these are chemical fertilizers. Excessive and unconscious use of chemical fertilizers brings many problems. The intensive use of chemical fertilizers not only increases costs but also causes serious environmental problems. Nitrogen in particular is one of the most widely used fertilizer sources.

The majority of nitrogenous fertilizers used in agriculture that are not used by plants are mixed into the ecosystem in the form of evaporation, flow or leakage. This situation leads to environmental problems such as greenhouse gas emissions, water pollution and soil acidification, as well as a decrease in biodiversity (Tyagi et al., 2022).

The major source of atmospheric N pollution (60%) comes from the agricultural sector, and N pollution is expected to be 102-156% higher by 2050, based on the 2010 starting point (Martínez-Dalmau et al., 2021). Since N fertilization is an important source of increased yields in vegetable production, N fertilizer use is often over actual product demand. In many vegetable crops, this, combined with low fertilizer N recovery and proper irrigation, can lead to both health and environmental risks related to high nitrate concentrations in water leaving the root zone (Tei et al., 2020).

Many basic processes such as water and nutrient uptake, photosynthesis, carbon sharing, enzyme and plant hormonal activities are regulated by N. It is known that nutrient uptake in plants decreases in dry soils and normal plant functioning is disrupted due to nutrient deficiency. Under water stress, nutrient deficiency problem occurs and different strategies are emphasized for this. It has been stated in the studies that nitrogen application alleviates the negative effects of drought (Ahmad et al., 2014; Du et al., 2020; Lv et al., 2021; Ahmad et al., 2022).

Cabbage is one of the vegetables where nitrogenous fertilizer is used a lot. It is also sensitive to water stress. It is an important strategy to prevent high N use and increase stress tolerance. In this study, the effect of low-dose nitrogen in alleviating water stress damage in cabbage was investigated.

2. Materials and Methods

The study was conducted as a pot experiment under greenhouse conditions. The average greenhouse temperature and humidity measured were about 25±2 °C and 55±2%. Cabbage (*Brassica olerecae* var. capitata, cv. Yalova1) seeds were used as plant material. First, the seeds were sown in multi-celled trays containing peat: perlite (2:1, v:v). After approximately 30 days, homogeneous seedlings were planted in 1.5 L pots containing a mixture of soil: peat: perlite (2:1:1, v:v:v).

The study was designed according to a completely random trial design with 3 replications and 6 pots in each replication. Two irrigation level applications (100% and 60%) and two nitrogen doses (0 and 5 kg/da) were applied in the study. Nitrogen application was made by mixing the calculated amounts of urea into the pot soil. The amount of irrigation water was determined by volume with a portable moisture meter (HH2 Moisture Meter, Delta-T Devices, Cambridge, England). In the first stage, the volumetric water amount held by the medium in the field capacity was determined and irrigations were performed to reach the field capacity for full irrigation and 60% of the field capacity for water deficit environment.

Plant height was determined by measuring the height from the soil level to the tallest tip of the plant with a ruler, and the stem diameter was determined by measuring different parts of the stem with a

digital caliper. The area of seedling leaves was determined using a leaf area meter (LI-3100, LI-COR) and the number of leaves per plant was noted. A portable chlorophyll meter (SPAD-502; Konica Minolta Sensing, Inc., Japan) was used to measure leaf chlorophyll value (SPAD). The relative water content (LRWC) of leaves was determined based on the fresh, turgor, and dry weights of the leaf samples. Fifty-five days after planting, the plants were harvested and the plant and root fresh weights were determined. Then, the dry weights of the plants and roots dried at 65 °C were measured.

Data were subjected to variance analysis and the differences between the applications were determined by Duncan multiple comparison test with SPSS.

3. Results and Discussion

There was a decrease in growth in cabbage seedlings under water-limited environment. Without nitrogen use, plant height, stem diameter, leaf number and leaf area decreased by 20%, 19%, 4% and 56%, respectively, compared to the control. Additionally, LRWC decreased by 15% with water stress. However, fertilization increased these parameters in both non-stressed and stressed plants. In water-limited environments, the application of 5 N reduced plant height by 10%, stem diameter by 12%, and leaf area by 46% compared to the control, while leaf number remained unchanged. However, in plants experiencing water deficit stress, the reductions with 5 N were less pronounced than in the control (Figures 1 and 2).

Plant fresh weight, plant dry weight, root fresh weight and root dry weight decreased by 52%, 50%, 46% and 47%, respectively, with water stress. However, N fertilization increased plant growth under full irrigation. However, water stress caused a decrease in these parameters to be less under water stress. The decrease in these parameters with N fertilization under water stress was 46%, 41%, 39% and 35%, respectively, compared to the control (Figure 3).

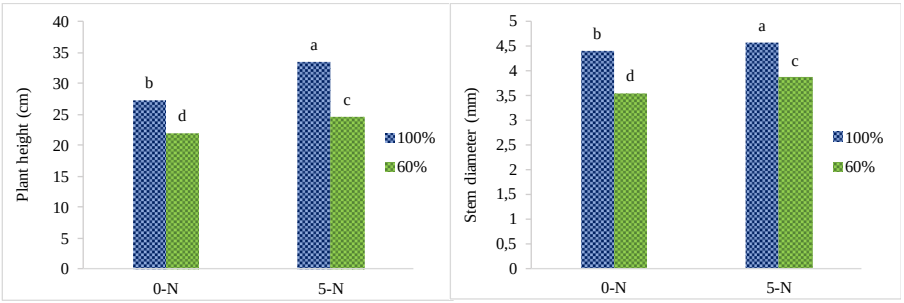


Figure 1. Effect of nitrogen fertilizer on plant height and stem diameter of cabbage seedlings under water deficit environment. There is no statistical difference between means indicated by the same letter in each column ($p<0.001$).

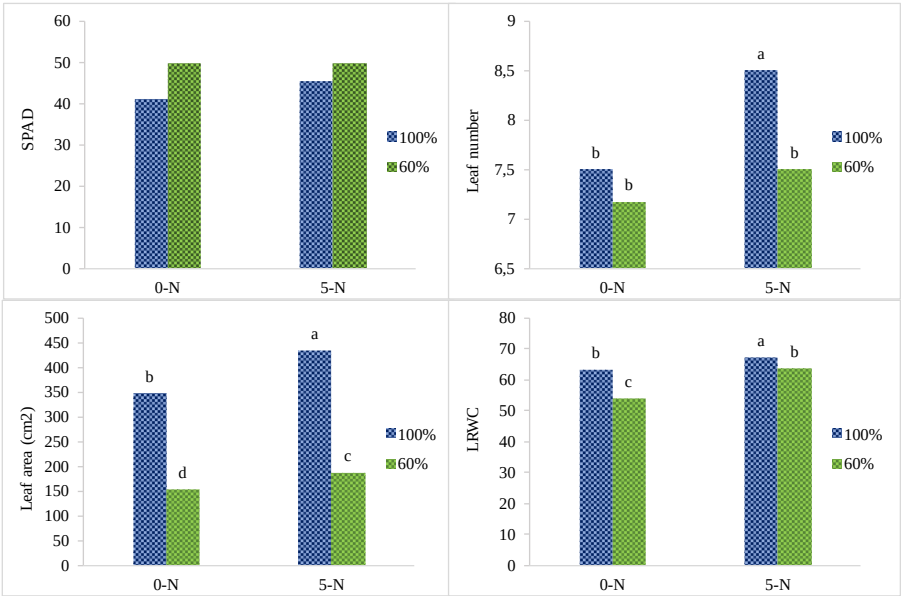


Figure 2. Effect of nitrogen fertilizer on SPAD, leaf number, leaf area and LRWC of cabbage seedlings under water deficit environment. There is no statistical difference between means indicated by the same letter in each column ($p<0.001$).

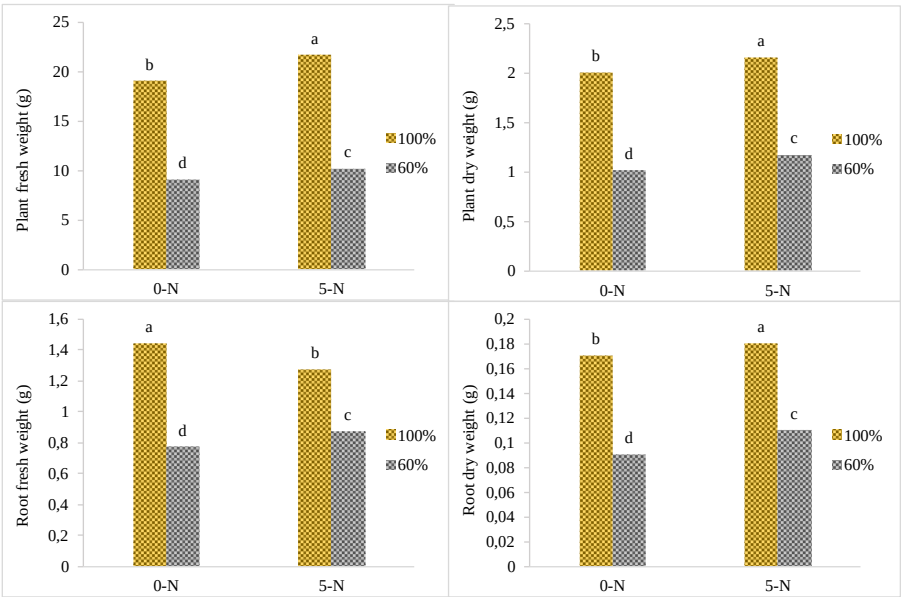


Figure 3. Effect of nitrogen fertilizer on plant fresh weight, plant dry weight, root fresh weight and root dry weight of cabbage seedlings under water deficit environment. There is no statistical difference between means indicated by the same letter in each column ($p<0.001$).

Growth and development of cabbage seedlings decreased significantly with water deficit irrigation based on the examined parameters. In a previous study conducted on cabbage seedlings, it was determined that antioxidant activity, proline and sucrose contents, and parameters indicating oxidative damage such as electric leakage (EL), malondialdehyde (MDA) and hydrogen peroxide (H_2O_2) increased with drought. It was also determined that increasing drought stress levels negatively affected plant growth, including chlorophyll content (SPAD), leaf relative water content (LRWC), photosynthesis, shoot, root fresh and dry weights (Sahin et al., 2018; Yildirim et al., 2021). Water stress

causes a decrease in plant leaf size and root elongation, a decrease in plant water use efficiency, a deterioration in plant metabolism due to its negative effects on intracellular structures, photosynthesis and nitrogen metabolism, a decrease in mineral uptake due to its negative effects on turgor pressure and transpiration (Bayoumi et al., 2008; Farooq et al., 2009).

In plants, the effect of N is important in many basic processes such as water and nutrient uptake, protein metabolism, photosynthesis, enzyme and plant hormonal activity. The effects of N in this process are manifested as an increase in plant growth rate, net photosynthesis production, plant development and yield (Ahmad et al., 2014). In our study, N improved plant growth in cabbage seedlings both under full and deficit irrigation conditions. It is an important result especially with the low level of N we used in this study. N fertilizer stated to increase drought tolerance mainly due to N2 fixation in the plant (Purcell and King, 1996). In maize, where drought stress reduced leaf relative water content, photosynthetic levels, and N accumulation, N application increased grain yields in both normal and drought conditions. The researchers stated that the yield reduction caused by drought increased with increasing N application, and that N fertilizer inputs should be reduced and N fertilization should be further reduced in drought-sensitive varieties (Wang et al., 2020). In dry conditions, especially the prevention of nutrient uptake in the plant can increase the damage caused. For this reason, various alternatives are used to cope with the problem of nutrient deficiency in water stress. Fertilizer applications are important in this sense. In fact, N application is effective in alleviating the negative effects of drought through soil or foliar feeding (Ahmad et al., 2014). Similarly, in a soybean field experiment, it was determined that NH_4NO_3 (N) applications to soybean under normal irrigation and drought conditions increased seed growth rate and decreased seed filling time, and N application increased the number of seeds per unit area and provided higher yields in both conditions (Purcell and King, 1996). It has been also reported that the negative effects of drought in soybeans can be reduced by N-fertilizer application (Basal and Szabó, 2020).

4. Conclusion

In our study, we investigated how the effects of water deficit irrigation during the seedling period in cabbage can be altered with low-dose N fertilization. A significant decrease was observed in the measured parameters under water limited condition. However, low nitrogen application reduced this negative effect of water stress. The results of the study revealed that applying adequate amounts of nitrogen, without excessive use, can support the development of cabbage seedlings, even under water limited conditions.

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Plant Growth Stimulators-Enriched Surfactant Improve Growth of Lettuce Seedlings

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Abstract

Plants continue their lives as long as they can get the nutrients they need. For this purpose, various fertilizers are used in agricultural production. Surfactants are used to ensure that these nutrients are more easily absorbed by plants. In this study, the effects of plant growth stimulators (containing various enzymes, microorganisms, hormones and fulvic acid (FA)) enriched surfactant applied to lettuce seedlings were investigated. Applications were applied to plants by soil irrigation and foliar spray, as single or mixed preparations. The effects of the applications on plant diameter, plant height, SPAD, stem diameter, plant fresh weight, root fresh weight, plant dry weight, root dry weight and leaf mineral content of lettuce seedlings were investigated. The applications used in the study provided an increase in all the parameters examined at different levels and statistically significantly. This effect of the applications used in the study on the seedlings will also be beneficial in the later stages of plant development. Therefore, it can be used as an alternative plant growth supporting product in plant production.

Keywords: Enzyme, Lettuce, Regulator, Seedling.

1. Introduction

Lettuce (*Lactuca sativa* L.), used for its leaves, is an important fresh vegetable and is usually consumed raw in salads, and in some countries its stems are cooked, pickled, and dried (Mou, 2008). Lettuce is generally rich in mineral nutrients such as potassium, calcium and magnesium, and therefore has an important place in human nutrition. However, lettuce also accumulates significant amounts of nitrate (Zandvakili et al., 2019). The source of this nitrate is nitrogenous fertilizers used during its cultivation. In particular, excessive and incorrect use of chemical fertilizers causes damage to both the environment and human health. The effect of these fertilizers on lettuce is excessive nitrate accumulation, which is particularly harmful to human health. Therefore, fertilization is a practice that should be taken into consideration in lettuce cultivation.

Biostimulants are defined as products containing various substances and/or microorganisms that increase nutrient uptake, nutrient efficiency, stress tolerance, and product quality when applied to plants

or the rhizosphere (Brown and Saa, 2015). Biostimulants, which are also environmentally friendly, increase flowering, plant growth, fruit set, yield and nutrient use efficiency and provide tolerance to various abiotic stress factors (Rouphael and Colla, 2020). In terms of agricultural production, biostimulants mainly include various bioactive natural substances such as humic acid, fulvic acid, animal and plant protein hydrolysates, macroalgae seaweed extracts, silicon and beneficial microorganisms (Rouphael and Colla, 2020). Various studies conducted on lettuce have stated that biostimulants with different contents increase plant growth and yield (Abdelgawad et al., 2018; Giordano et al., 2022), nitrogen use efficiency (Shehata et al., 2016; Navarro-León et al., 2022), and provide many advantages such as tolerance to drought stress (Hidalgo-Santiago et al., 2021; Chaski and Petropoulos, 2022) and salt stress (Lucini et al., 2015; Ikiz et al., 2024).

Another product that has been emphasized in agriculture in recent years is surfactants. Biosurfactants, known as green surfactants, can be produced by various bacteria, yeasts, and fungi. Biosurfactants are known to be environmentally friendly and are used in agriculture to eliminate plant pathogens and increase the bioavailability of nutrients for beneficial plant-associated microbes. They are also used to improve agricultural soil quality (Sachdev and Cameotra, 2013).

Fertilization is a crucial factor in the intensive cultivation of lettuce worldwide. In this study, the impact of enriched surfactant applications on lettuce plant development was evaluated.

2. Materials and Methods

Experiment was carried out in greenhouse conditions (20°C/16°C day/night temperature, 50% humidity). Lettuce (*Lactuca sativa* var. crispa) seeds were used as plant material. First, the seeds were sown in multi-celled trays containing peat: perlite (2:1, v:v). After approximately 30 days, homogeneous seedlings were planted in 2.5 L pots containing a mixture of soil: peat: perlite (2:1:1, v:v:v). In the study, applications were made to the soil and leaves as given in Table 1. Applications were repeated three times at one-week intervals.

Plant height, stem diameter, plant diameter, plant and root fresh weights, plant and root dry weights and mineral content of leaf were measured. Data were subjected to variance analysis and the differences were determined by Duncan multiple comparison test with SPSS.

Table 1. Treatments and their contents.

Treat.	Product	Contents
C	Control	-
T1/soil T1/leaf	FA+M+E+H	Fulvic acid + Enzyme (proteaz, ksilinaz, alfa amilase, selulaz, hémuselor, fitar) + Microorganisms (*Paenibacillus polymyxa, Pseudomonas fluorescens, Pseudomonas fluorescens, Bacillus megaterium, Bacillus pumulis, Bacillus subtilis, Bacillus amyloliquefaciens, Bacillus licheniformis, Azotobacter chroococcum, Azospirillum brasilense*) + Hormones (cytokinin, auxine, gibberellic acid)
T2/soil T2/leaf	Enriched-Surfactant	Proteaz, lipase, selulaz, hémuselor, fulvic acid, trisiloksan alkoksilat
T3/soil T3/leaf	E-S+FA+M+E+H	Combination of the above applications

3. Results and Discussion

In the study, the applications had a significant effect on lettuce plant development. The effects of the applications on various parameters are given in Figures 1, 2, 3 and 4. The T1/soil application resulted in the highest plant diameter, height, and stem diameter, with increases of 21%, 21%, and 22%, respectively, compared to the control. The highest SPAD value was observed with the T1/leaf application, showing a 20% increase over the control. Other treatments also showed improvements across these parameters. Specifically, plant diameter increased by 14%-20%, plant height by 4%-17%, SPAD value by 8%-19%, and stem diameter by 11%-18% compared to the control (Figure 1).

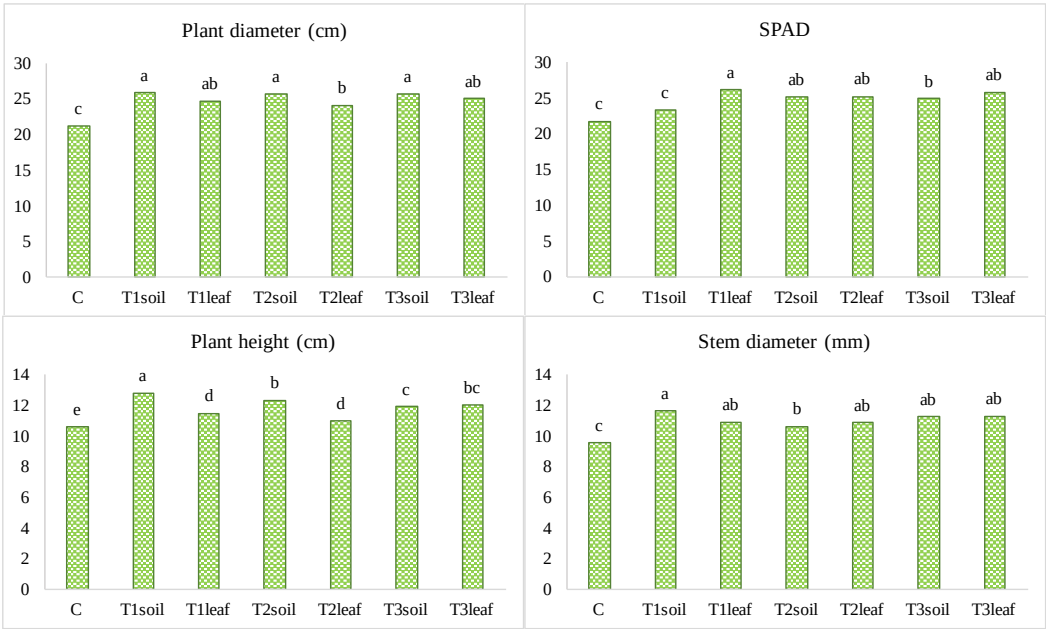


Figure 1. Effects of applications on plant diameter, SPAD, plant height and stem diameter of lettuce. There is no statistical difference between means indicated by the same letter in each column ($p<0.001$).

The effects of the applications on plant fresh weight, dry weight, root fresh weight, and root dry weight in lettuce were statistically significant, showing an increase compared to the control. The highest increases in plant fresh weight (70%-69%), root fresh weight (50%-49%), and root dry weight (51%-45%) were observed with the T2/soil and T3/leaf applications, respectively. The greatest increase in plant dry weight was seen in the T3/soil (59%) and T3/leaf (71%) applications. Other treatments also produced higher values across these parameters compared to the control (Figure 2).

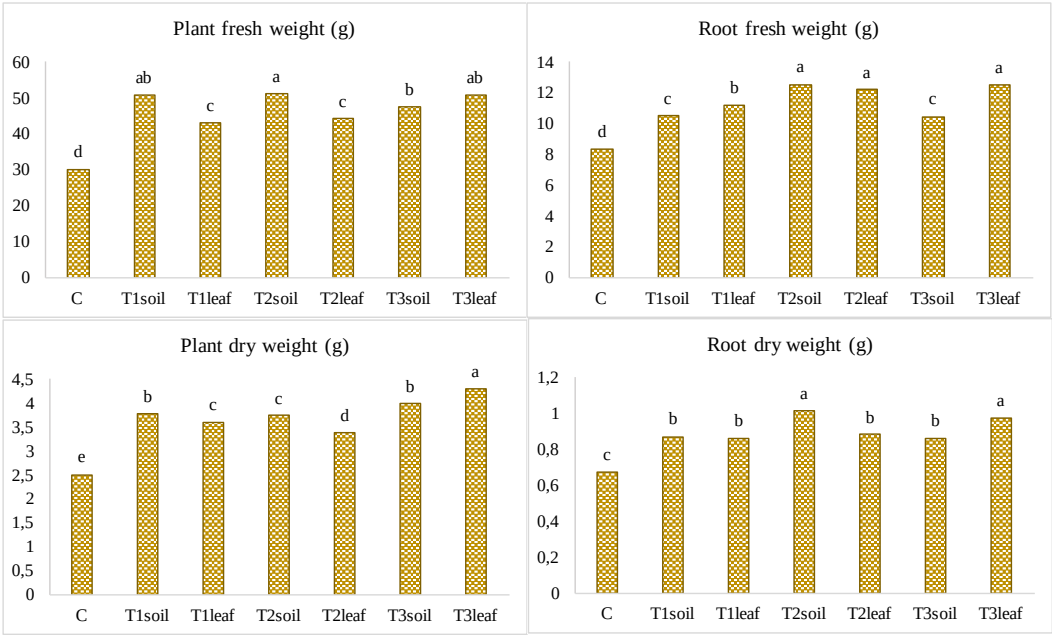


Figure 2. Effects of applications on plant fresh weight, root fresh weight, plant dry weight and root dry weight of lettuce. There is no statistical difference between means indicated by the same letter in each column ($p<0.001$).

The applications also provided a significant increase in lettuce leaf mineral content. The applications increased N content by 76%-171%, P content by 88%-219%, K content by 24%-106%, Ca content by 8%-75%, Mg content by 14%-105% and S content by 43%-381% as compared to the control. T1/soil application had the highest values for N, K and Ca, T3/soil application had the highest values for P and S and T1/leaf application had the highest values for Mg (Figure 3).

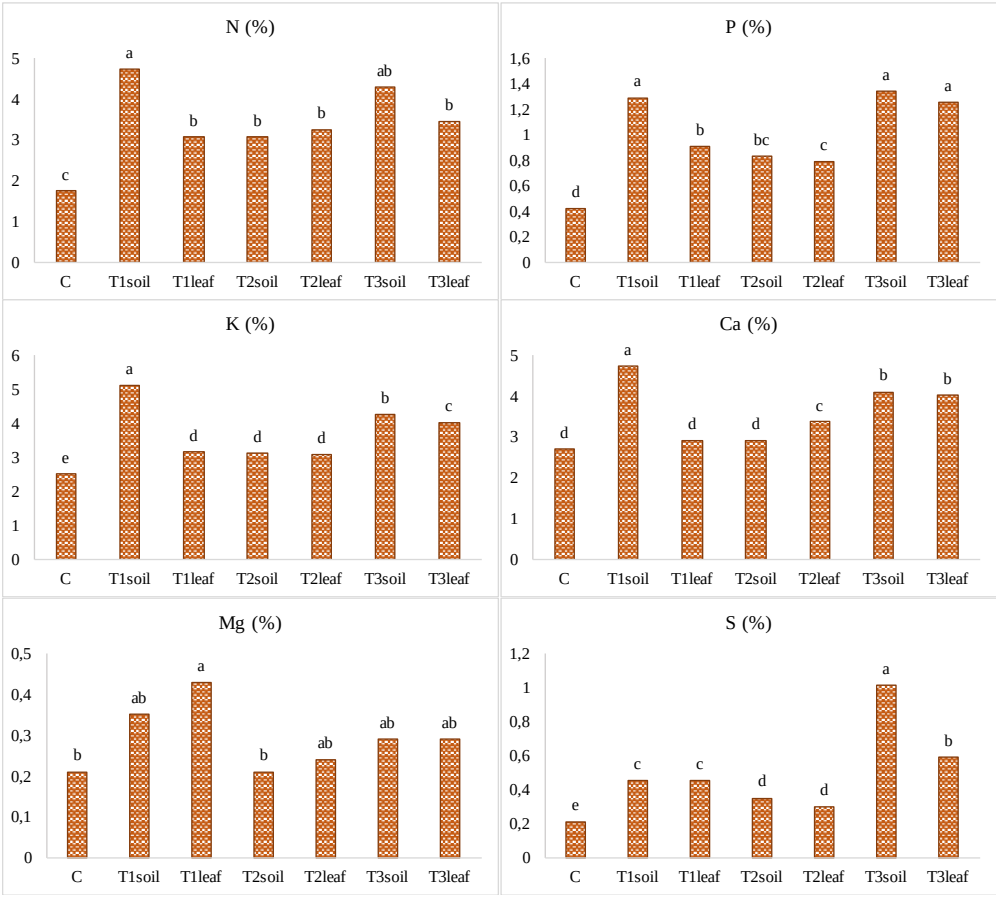


Figure 3. Effects of applications on N, P, K, Ca, Mg and S content of lettuce. There is no statistical difference between means indicated by the same letter in each column ($p<0.001$).

The effects of the applications on the Mn, Fe, Zn, B, Cu and Na contents in lettuce leaves were found to be statistically significant. Compared to the control with the applications; Mn content increased by 21%-97%, Fe content by 11%-61%, Zn content by 41%-108%, B content by 16%-52%, Cu content by 17%-183% and Na content by 9%-25%. The highest concentrations of manganese (Mn), iron (Fe), and zinc (Zn) were observed in the T1/soil application, while the highest levels of boron (B) and copper (Cu) were recorded in the T3/leaf application. Additionally, the T2/soil application resulted in the highest sodium (Na) levels (Figure 4).

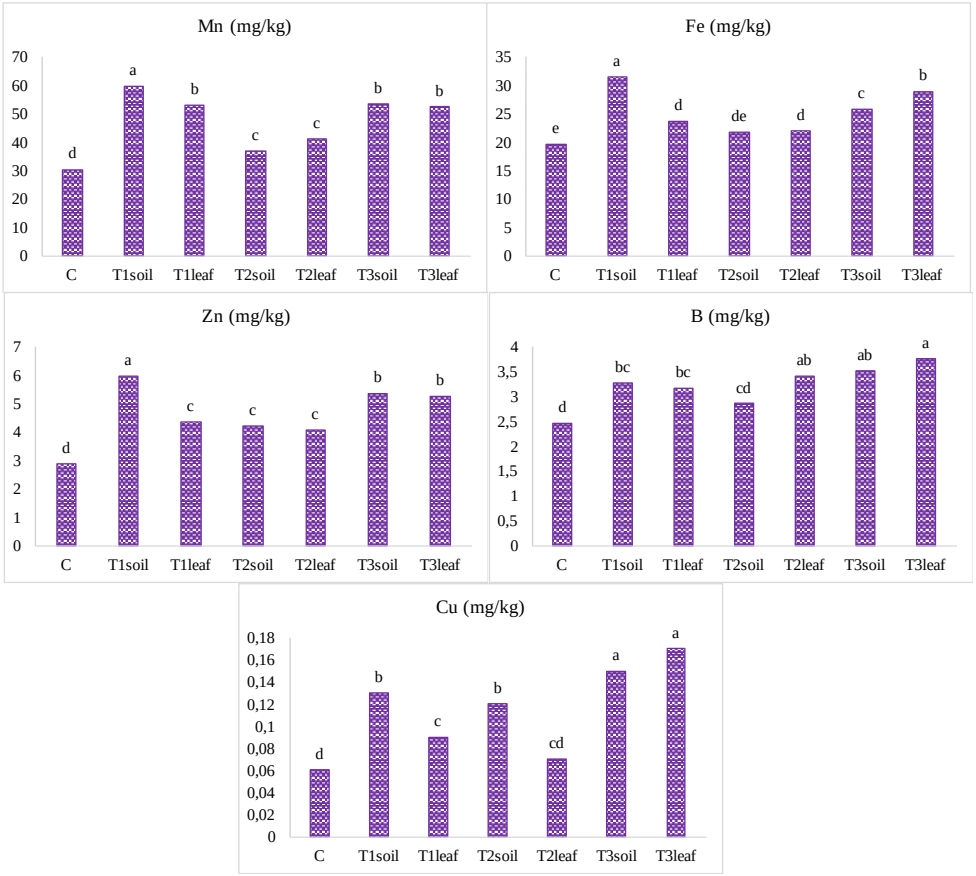


Figure 4. Effects of applications on Mn, Fe, Zn, B and Cu content of lettuce. There is no statistical difference between means indicated by the same letter in each column ($p<0.001$).

The biostimulant and surfactant used in this study were found to have significant effects on lettuce, both individually and in combination. Previous studies have also determined that biostimulants obtained from different sources can increase plant development, yield and quality in lettuce. In a study examining the effect of a plant-based biostimulant containing triacontanol (TRIA) on lettuce, it was stated that the yield increased by 21% and the use of biostimulants may be important for sustainable production and quality (Ottaiano et al., 2021). In another study, the biostimulant Bio-algeen S-90 had a positive effect on the growth and total yield of lettuce, plant height increased by approximately 62%, and an increase in the number of leaves was also observed (Dudaš et al., 2016). The treatments we used in our study were effective in lettuce plant development due to the various enzymes, microorganisms, hormones and fulvic acid they contain. Similarly, in a study, the biostimulant containing seaweed extracts + macronutrients + amino acids gave the highest values in terms of plant weight, leaf weight and chlorophyll content in lettuce cultivation where there was insufficient irrigation (Chaski and Petropoulos, 2022). The applications used in this study also include various microorganisms that increase plant growth. It is seen that it is effective in this sense. In fact, Kopta et al. (2018) reported in their studies that a combined biostimulant application consisting of plant growth promoting bacteria (*Bacillus licheniformis*, *Bacillus megatherium*, *Azotobacter* sp., *Azospirillum* sp. and *Herbaspirillum* sp.) and freshwater algae has a positive effect on lettuce yield, total antioxidant capacity and total carotenoids. The effect of the surfactant we used in the study was also important due to its biostimulant effect. Similarly, a study investigating the biostimulant effects of mannosylerythritol lipids (MELs), a biosurfactant known for its antimicrobial and amphiphilic properties as well as low toxicity, found that it could enhance seed

germination, plant growth, and root development in lettuce seeds (*Lactuca sativa* L.) depending on the concentration used (Matosinhos et al., 2023). Biosurfactants have many functions such as reducing surface tension, being suitable for various agricultural applications including pesticide and agrochemical formulations, acting as biopesticides due to their antimicrobial activities, being a nutrient source for plants, and helping in the distribution of nutrient elements in the soil. For this reason, they also provided a growth-promoting effect on lettuce (Silva et al. 2024).

Studies have shown that biostimulants in the form of certain functional compounds affect seedling and plant growth and development, and that combining several biostimulants can have stronger effects than their individual applications. However, since biostimulant effects may be specific to plant species, it is also stated that the composition of biostimulants should be examined according to plant species (Parađiković et al., 2019).

4. Conclusion

The effects of plant growth stimulators enriched surfactant applied to lettuce seedlings were investigated. The applications utilized in the study led to statistically significant increases in all examined parameters at various levels. These effects will also be beneficial in the later stages of plant development, suggesting that these products can serve as alternative growth enhancers in plant production. Furthermore, it may be advantageous to assess the preparations used in this study as alternative inputs in lettuce cultivation alongside other production inputs, such as fertilizers and pesticides. This approach could potentially reduce the excessive use of chemicals in agriculture.

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Introduced and Invasive Alien Woody Species in North Macedonia (GRIIS v1.3)

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Abstract

The investigation refer to an overview focused on introduced (alien) and (potentially) invasive woody species known to occur in North Macedonia as part of the Global Register of Introduced and Invasive Species (GRIIS), version 1.3. The checklist/dataset was compiled by collating data and information through a comprehensive literature overview. The input in this global online register supports the country towards achieving Target 7 of the Convention on Biological Diversity, and Related Strategic Goals/Aichi Biodiversity Target 9: 'Invasive alien species'. The checklist/dataset on woody plants within the GRIIS database for North Macedonia consists of eight terrestrial alien species introduced in the first half of the 20th century for two main purposes: i) erosion mitigation measures; and ii) ornamental use. Fifty percent are native to Asia and 50% to North America. Regarding the growth form, 6 species are trees, and 2 are shrubs. Most represented botanical family with 3 species is Fabaceae, and 2 species are classified in the family Sapindaceae. Each of the species is classified to a different genus. Some woody plants are found in urban and peri-urban areas, and some of them colonise disturbed areas along roads or invade abandoned arable lands, even extent the area of occupancy in riparian zones. There are species that occur occasionally, with rare, sporadic or localised abundance. Some species are without evidence of impact. Yet certain invasive woody plants modify successional patterns and reduce or inhibit the growth of other species. So far, the country has no national list of invasive species, whilst three species are included in the List of Invasive Alien Plants (LIAP), and one species within the Observation List of Invasive Alien Plants (OLIAP) of the European and Mediterranean Plant Protection Organization (EPPO). Likewise, one more species not in the checklist/dataset is recently added on the EPPO Alert List (extract), and should be considered investigating in the future.

Keywords: Invasive Alien Woody Species, Introduced Woody Plants, North Macedonia.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Assessing the Viability of Chicken Manure as a Nutrient Source for *Nannochloropsis oculata*: A Comparative Study with Conventional Media

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Abstract

The increasing interest in sustainable aquaculture practices has prompted the exploration of alternative nutrient sources for microalgae cultivation. This study evaluates the viability of utilizing chicken manure as a sustainable nutrient medium for the growth of *Nannochloropsis oculata*, compared to conventional growth media. The study involved five treatments: Treatment 1 (T1) served as a negative control using only treated seawater, while Treatment 2 (T2) utilized Conway medium as a positive control. Treatments 3 (T3), 4 (T4), and 5 (T5) incorporated chicken manure at concentrations of 2.0%, 1.5%, and 1.0%, respectively. Over a seventeen-day cultivation period, the growth of *Nannochloropsis oculata* was monitored, with Treatment 4 (T4) demonstrating the highest biomass at approximately $4.47\times10^6 \pm 1.72\times10^5$ cells/mL on day eight. The results suggest that chicken manure, particularly at a concentration of 1.5%, can serve as an effective nutrient alternative to conventional media, promoting enhanced algal growth and contributing to sustainable agricultural practices. Future research should explore optimal manure formulations and their effects on various algal species to further validate the potential of chicken manure in algal cultivation.

Keywords: *Nannochloropsis oculate*, Chicken Manure, Nutrient Source, Algal Growth, Conventional Media.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

The Function of Cytokines in Fish Immunity

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Abstract

Cytokines, which serve as important regulators of the immune system, represent the most extensively studied group of intracellular molecules involved in immune system function. It is known that cytokines have potential applications in the development of vaccines and immunostimulants in the fight against diseases in aquaculture. In the evaluation of immune responses of fish, the expression levels of various cytokine genes are analyzed and the findings obtained can be used as immune markers. The aim of this review is to provide a brief overview of the cytokine network identified in fish, with a particular focus on the role of cytokines such as interleukins (ILs), interferons (IFNs), tumor necrosis factors (TNFs), transforming growth factors (TGFs) and chemokines in the interpretation of immune system function.

Keywords: Fish Immune System, Cytokines, Interleukins, Interferons, Tumor Necrosis Factors, Transforming Growth Factors.

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ORAL PRESENTATION

What is Happening in the Micro World of Plastics in Türkiye?

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Abstract

Considering that a significant amount of plastics, the production of which is increasing day by day, is also disposable, and if waste management is not implemented well, the environmental burden is a global problem that must be taken into account. Plastics, which are used intensively in every sector due to their extraordinary properties, accumulate in aquatic environments by decomposing into micro particles with the effects of different factors. The presence of microplastics (MPs) in different components of different ecosystems has aroused great concern and has led to numerous studies. In this study, it was tried to draw attention to the extent of the danger by bringing together the microplastic studies conducted in this field in our country and determined in different aquatic species.

Keywords: Water Pollution, Plastic Pollution, Aquatic Environment.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Genotoxicity of Glyphosate on Aquatic Animals: A Review

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Abstract

Pesticide are vital tools to combat pests, and thus to increase yield, in agriculture due to lack of a better alternative. "Due to lack of a better alternative" expression was used here because pesticides bring along many problems, including toxicity to non-target organisms and other environmental concerns. Glyphosate is a herbicide widely employed for many years in weed control. Although it has been labelled safe by authorities, there is growing evidence regarding its toxic effects. This paper examines the toxic effects of glyphosate and glyphosate-derived products in aquatic animals, focusing its genotoxicity. According to the literature studies investigated, it is clear that there is non-negligible amount of evidence to conclude that glyphosate is genotoxic to aquatic animals. However, some studies evaluate that the amount of evidence is currently limited. Since genotoxicity depends on the species, more research on different animal models is needed to understand genotoxic effects of glyphosate more deeply. Despite the limited evidence, we believe that authorities should follow the International Agency for Research on Cancer (IARC)'s lead, who classified glyphosate as "probably carcinogenic to humans", and take necessary actions.

Keywords: Non-target Organism, Genotoxicity, Pesticide, Herbicide, Aquatic Toxicology.

1. Introduction

Pesticides, substances used to control or eliminate pests, have been a cornerstone of agricultural practices for centuries. While they have significantly contributed to increased food production and reduced crop losses, their widespread use has also raised concerns about their potential negative impacts on human health and the environment (EEA, 2023).

Pesticides encompass a broad range of chemical and biological agents designed to target pests, including insects, weeds, fungi, rodents, and other organisms that can damage crops, livestock, or human health (EPA, 2024a). They can be classified into various categories based on their chemical composition or the specific pests they control.

The use of pesticides dates back to ancient civilizations, who employed natural substances like sulphur, arsenic, and plant extracts to protect their crops (Tudi et al., 2021). The development of synthetic pesticides in the 20th century, such as DDT and organophosphates, revolutionized pest control but also led to widespread environmental contamination and public health concerns (Khan & Ahmad, 2019).

Pesticides offer several benefits, including:

- Increased crop yields: By controlling pests that damage crops, pesticides help farmers produce higher quantities of food (National Research Council (US) Committee on Biosciences, 1985).
- Reduced food losses: Pesticides can prevent post-harvest losses due to pests, ensuring that more food reaches consumers (WHO, 2022).
- Disease control: Certain pesticides are used to combat vector-borne diseases, such as malaria and dengue fever (WHO, 2024).
- Pest eradication: Some pesticides can be used to eradicate invasive species that threaten native ecosystems (Naisma, 2020).

Despite their benefits, the use of pesticides has also raised significant concerns:

- Environmental contamination: Pesticides can contaminate water bodies, soil, and air, harming wildlife and ecosystems (Piselli, 2023).
- Resistance: Overuse of pesticides can lead to the development of pest resistance, making it more difficult to control them (EPA, 2024b).
- Human health risks: Exposure to pesticides can have adverse effects on human health, including respiratory problems, skin irritation, and neurological disorders (EEA, 2024).
- Biodiversity loss: Pesticides can contribute to biodiversity loss by harming non-target organisms, such as pollinators and beneficial insects (Zaller & Brühl, 2019).

Glyphosate salts, such as glyphosate isopropylamine salt, glyphosate potassium salt, glyphosate ammonium salt, and glyphosate sodium salt, are primarily known for their effectiveness in controlling weeds. They are derivatives of glyphosate, a non-selective herbicide that inhibits the synthesis of an amino acid essential for plant growth. The salt formulations enhance the solubility, stability, and bioavailability of glyphosate, improving its efficacy.

The widespread use of glyphosate or glyphosate-derived products has led to both significant benefits and concerns (Baylis, 2000). On the positive side, it has increased agricultural productivity by reducing weed competition and facilitating crop management. However, its environmental impact has been a subject of considerable debate. Concerns include potential negative effects on aquatic ecosystems, biodiversity, and human health (Gudiño et al., 2024).

2. Negative Health Effects of Glyphosate

Glyphosate has been the subject of considerable controversy due to concerns about its potential health risks. While the overall consensus among regulatory agencies is that glyphosate is low in toxicity when used as directed, there have been ongoing debates and studies examining its potential negative health effects (Rolando et al., 2017).

Cancer: One of the most significant concerns surrounding glyphosate is its potential link to cancer. Some studies have suggested a correlation between glyphosate exposure and an increased risk of non-Hodgkin lymphoma, while others have not found a definitive connection. The International Agency for Research on Cancer (IARC) has classified glyphosate as "probably carcinogenic to humans."

Endocrine Disruption: Glyphosate has been implicated in endocrine disruption, which can interfere with the body's hormone production and regulation (Young et al., 2015). This could potentially result in various health problems, such as metabolic disturbances, thyroid disorders, and reproductive issues.

Reproductive Health: Some studies have suggested that glyphosate exposure may negatively impact reproductive health, particularly in males (Teleken et al., 2020). These studies have linked glyphosate to decreased sperm quality and fertility.

Neurotoxicity: There is growing concern about the potential neurotoxic effects of glyphosate (Moser et al., 2022). Some research has indicated that glyphosate may disrupt the development and function of the nervous system, particularly in developing organisms.

Gastrointestinal Issues: Exposure to glyphosate has been associated with gastrointestinal problems, such as nausea, vomiting, and diarrhoea (ATSDR, 2020).

3. Genotoxicity of Glyphosate in Aquatic Animals

Glyphosate has been shown to induce DNA damage in aquatic animal cells by both *in vitro* and *in vivo* studies. For instance, a study by Alvarez-Moya et al. (2014) investigated the genotoxic effects of glyphosate isopropylamine salt in Nile tilapia (*Oreochromis niloticus*) erythrocytes along with human lymphocytes and staminal nuclei of *Tradescantia*. They found that exposure to the pesticide increased tail length of the tilapia DNA and there was a positive correlation between genotoxicity and the concentrations.

In another research, Hong et al. (2018) explored the genotoxicity of Roundup, a glyphosate-based commercial pesticide, in a freshwater shrimp species, *Macrobrachium nipponensis*. The study results indicated that Roundup exposure significantly increased DNA damage in experimental animals in a concentration-dependent manner.

Likewise, a 2014 study by Moreno et al. (2014) also investigated genotoxic effects of another commercial formulation of the same pesticide under the name of Roundup Transorb and its active compound, glyphosate, in *Prochilodus lineatus*. Both the commercial formulation and glyphosate led to DNA damage in erythrocytes and gill cells of the experimental fish.

Moreover, genotoxicity of glyphosate was also examined in rohu (*Labeo rohita*) in a 2021 study. It was reported that glyphosate exposure caused significant DNA damage in rohu (Ghaffar et al., 2021). Similar to the research mentioned above, this study also reported an elevated frequency of DNA damage as the exposure concentration increased.

Furthermore, Taştan (2024) showed that glyphosate isopropylamine salt exposure results in increased DNA damage in narrow-clawed crayfish (*Pontastacus leptodactylus*). Similarly, glyphosate or glyphosate-based products caused genotoxicity in various aquatic animals, including the European eel

(*Anguilla anguilla*) (Guilherme et al., 2012), zebrafish (*Danio rerio*) (Santo et al., 2018), goldfish (*Carassius auratus*) (Çavaş & Könen, 2007).

In summary, numerous studies, which demonstrate the genotoxic potential of glyphosate or glyphosate-based products in aquatic animals, appear in the literature. Based on these researches, the general conclusion drawn is that glyphosate is toxic to aquatic animals. However, the toxicity greatly varies depending on the species, concentration and exposure duration.

4. Conclusion

Despite being labelled safe by some authorities such as European Food Safety Authority (EFSA) and U.S. Environmental Protection Agency (EPA), there is growing evidence that indicate glyphosate may be genotoxic to aquatic animals as well as humans. In fact, the International Agency for Research on Cancer (IARC) has classified glyphosate as "probably carcinogenic to humans". However, with the current knowledge, it can be inferred that the evidence in the literature is limited. Therefore, more research is needed to better understand glyphosate's genotoxic potential.

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ORAL PRESENTATION

Turkish Salmon

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Abstract

Türkiye's seafood production was recorded as 1 million 7 thousand 921 tons in 2023 and the amount of aquaculture production increased by 18.6% compared to the previous year. While 454 thousand 59 tons of product was obtained from capture in total production, aquaculture production was 553 thousand 862 tons. The biggest share in this success of the seafood sector, where 1.7 billion dollars of income is obtained with exports to approximately 100 countries, is the fact that the amount of products obtained from aquaculture continues to increase every year. One of the products that is cultivated and has provided the greatest added value for the sector in recent years is the Turkish Salmon. The project, which has been developed as an alternative to commercially renowned brands such as Norwegian Salmon or Peruvian Salmon in the world market under the name of Turkish Salmon since 2019, has reached 41,742.264 tons of production with an export amount of 240,300,329 USD to 44 countries as of July 2024. Turkish Salmon production has grown by 39% compared to the same month of the previous year and is developing its commercial brand every day. Within the scope of this study, some projections will be put forward by examining the production, branding and commercialization trends of Turkish Salmon, which has an important place in both Türkiye's exports and branding value.

Keywords: Turkish Salmon, Branding, Aquaculture, Commercial Success.

1. Seafood Production and Türkiye

Aquaculture, one of the world's greatest sources of animal protein, is among the important sectors that provides continuous input to the economy of all countries today. In the report published by the OECD and Food and Agriculture Organization of the United Nations (2017), it was noted that aquaculture production showed the fastest growth among agricultural products. Similarly, the Food and Agriculture Organization of the United Nations (FAO, 2022) also conveyed in a 2022 report that the aquaculture industry has developed the most among agricultural sector in recent years.

In this context, Türkiye is in a suitable location in terms of water resources potential that provide source for aquaculture production. With 25 million hectares of sea and 1.5 million hectares of inland water area, nearly 200 natural lakes and 706 dam lakes, 33 large rivers reaching a total length of 177,714 km and 8,333 km of coastline, Türkiye produces 126 different types of economically important seafood products

(Tolon, 2019). The amount of seafood products obtained especially through aquaculture is increasing day by day.

Türkiye's seafood production was recorded as 1 million 7 thousand 921 tons in 2023 and the amount of aquaculture production increased by 18.6% in comparison with the previous year. Within the total production, 454 thousand 59 tons of seafood were obtained from catch and 553 thousand 862 tons from aquaculture production (TÜİK, 2023). Undoubtedly, this growth trend also contributes significantly to Türkiye's trade and even carries the seafood industry to a very substantial place among other production branches that create added value. This situation is also proven by Türkiye's net exporter position in seafood export trade. Depending on the changes in the sector's aquaculture production and processing techniques, the growth in seafood exports is increasing each year. As of 2022, 1 billion 651 million US dollars worth of seafood products have been exported to 103 countries, and 67% of these countries are European Union members (TÜİK, 2023). One of the biggest factors in the increase of this production and export trend is Turkish Salmon, which has been on its way to becoming one of the world's brand values in recent years. With a project that started in 2018, the Turkish Salmon production model was presented with the aims of diversifying production, marketing existing products with different alternative models and utilizing suitable water resources. In this review, a demonstration will be presented by exploring the production model of Turkish salmon, its comparison with alternative products in the market, its competitive power and the most recent situation in its production.

2. Turkish Salmon and Branding Efforts

Rainbow trout can be reared in different culture environments due to its very good adaptation to environmental conditions. This fish, which is an anadromous species, have periods of passage from freshwater to saltwater in its natural life cycle. For this reason, this species is suitable for marine farming after being grown in land facilities. Rainbow trout is a species belonging to the Salmonidae family and there are over 20 different species in this family. *Salmo salar*, known as Norwegian Salmon among the public in Türkiye, is one of these. Norwegian salmon is a product consumed in many countries around the world today. This species is also imported to Türkiye and offered to consumers. Periodically, production studies have been carried out in Türkiye's seas. For example, in Türkiye, Atlantic salmon farming was attempted in the Black Sea, which displays the most suitable conditions, but the desired results were not achieved. Although the two species are members of the same family, they do not appear to have the same characteristics (Özal, 2023).

Nonetheless, efforts to create alternative products or diversify existing production have gained another dimension with a new initiative. The term "Turkish Salmon" is still a very new concept in the world aquaculture arena. The General Directorate of Fisheries and Aquatic Products of the Ministry of Agriculture and Forestry, in line with the demands of seafood producer associations, decided to name the commercial trout produced in and exported by Türkiye as "Turkish Salmon" with an official letter dated 07.04.2020 within the scope of a project initiated in 2018. The scientific name of this species, which has been branded as Turkish Salmon, is *Oncorhynchus mykiss* and is known worldwide as the "Rainbow Trout". By means of this initiative, Türkiye has been able to transfer its experience and knowledge in trout farming to a new commercial industry, and the seafood sector has brought new momentum to the world arena with a different version of an existing product. At this stage, Turkish Salmon has undoubtedly met expectations and has progressed towards becoming an alternative to Norwegian salmon as one of the leading stakeholders of the sector.

3. Turkish Salmon in terms of Nutrition

Nutritional value content, which is referred nutritional value among the public, is the reason for preference among animal protein sources. In other words, consumption trends are often increased or decreased by the attractiveness of a product's price, as well as its quality, durability and, especially in the food sector, its nutritional values. With the examination of nutritional components and the knowledge of the effects of nutrients on our health, fish is today considered a significant source of protein.

In this context, the nutritional values of the most cultivated and consumed fishes in salmonid family have always been on the agenda and a matter of curiosity for consumers. For this reason, many studies, which investigated the nutritional components or nutritional values of these species, from past to present appear in the literature.

The continuous increase in the production and export of Turkish Salmon in our country in recent years and the fact that this product has gained a place in the world market has brought the concept of nutritional value back to the agenda. Despite the species in question is a known species, the Rainbow Trout (*Oncorhynchus mykiss*) belonging to the Salmonid family, comparisons have begun to be made with the Norwegian Salmon (Atlantic salmon), which has a certain place as "salmon" in the world market. This is unequivocally a natural situation in terms of marketing trends and consumer behaviour. Therefore, studies on this subject reveal that these two species are not very far apart in terms of nutrition.

In a study conducted by Keskin et al. (2022), the nutritional components of Turkish salmon and Atlantic salmon were compared and the results are given in Table 1.

Table 1. Nutritional contents of Turkish and Atlantic salmons (Keskin et al., 2022).

Nutritional Content	Turkish Salmon	Atlantic Salmon
Crude Protein	19.04±0.02	20.34±0.00
Lipid	6.30±0.00	8.57±0.00
Moisture	71.26±0.01	69.68±0.01
Raw Ash	1.03±0.01	0.79±0.01
Carbohydrate	2.39±0.01	0.63±0.01
Energy (kcal/100 g)	142.35±0.05	161.00±0.00

As can be seen in the study results given in Table 1, it has been reported that both fish species displayed approximate values in terms of protein or lipid amounts and that the differences between them may be attributed to feeding habits, the environment in which they are grown and certain other environmental factors. The fatty acid compositions of the two species according to the results of same study are presented in in Table 2.

Table 2. Fatty acid contents of Turkish and Atlantic salmons (Keskin et al., 2022)

Fatty Acid	Turkish Salmon	Atlantic Salmon
ΣSFA	23.99±0.02	14.62±0.05
ΣMUFA	35.59±0.03	50.34±0.10
Σ Omega-3 (n-3)	12.96±0.06	11.46±0.08
Σ Omega-6 (n-6)	23.58±0.04	25.62±0.00
Σ PUFA	36.54±0.03	37.08±0.01
n-3/n-6	0.54±0.00	0.48±0.00
EPA+DHA	7.54±0.01	7.88±0.01

As can be inferred from Table 2, it has been conveyed by Keskin et al. (2022) that rainbow trout, called Turkish salmon and raised in the Central Black Sea region, showed better total unsaturated fatty acids, n-3/n-6 ratio, total omega-3 (Σn-3) and DHA amount, which are important for human health, than Atlantic salmon.

Likewise, in certain other studies, which compare Atlantic Salmon (*Salmo salar*) with Rainbow Trout (*Oncorhynchus mykiss),* their nutritional contents were reported to be similar to each other (Atanasoff et al., 2013, Turan et al., 2006, Souci et al., 1981).

In light of the studies conducted on this basis, it is clear that the product called Turkish Salmon, which has a significant place in the world market, is not very different from Norwegian Salmon, which possesses a large share in the market, in terms of nutritional quality and content, and is even more nutritious regarding certain values. Although the culture type and environment are certainly effective parameters in this regard, today's comparison of these two species in the context of nutrition is not enough to negatively affect the market size in terms of causing biased preference against either species.

4. Turkish Salmon Production and Export

Seafood is one of the most traded food products in the world. Economic growth and cultural and technological progress due to globalization have been effective in the growth of international seafood trade. The trade value of seafood increases relatively more than the amount of trade. This is because the trade is performed by creating added value with processing the high-value products (FAO, 2022).

Türkiye's seafood production, especially in terms of aquaculture, is constantly increasing and this situation is also reflected in the foreign trade. Türkiye's seafood production was recorded as 1 million 7 thousand 921 tons in 2023 and this amount corresponded to a 18.6% increase compared to the previous year. While 454 thousand 59 tons of products were obtained from catch in total production, aquaculture production was 553 thousand 862 tons. The biggest share in this success of the seafood sector, where 1.7 billion dollars of income is achieved through exports to approximately 100 countries, belongs to continuous annual increase in the amount of products obtained from aquaculture.

Furthermore, Türkiye's Turkish Salmon export quantities as of August 2024 are depicted in Table 3 below.

Table 3. Turkish Salmon export data (DKİB, 2024).

Country	January-August 2023		January-August 2024		Change (%)	
	Kg	$	Kg	$	Amount	Value
Russia	25.292.349	153.595.304	35.083.290	195.622.278	39	27
Germany	3.540.736	36.494.869	1.867.096	22.892.117	-47	-37
Belarus	2.231.401	15.166.990	2.495.941	17.128.448	12	13
Vietnam	2.850.622	19.538.181	2.793.835	13.645.684	-2	-30
Japan	147.220	1.419.544	2.290.902	11.762.270	1.456	729
USA	666.229	7.197.272	732.496	7.770.496	10	8
Poland	234.467	1.551.427	1.226.194	6.590.183	423	325
Lithuania	123.876	583.523	888.631	4.882.699	617	737
Canada	162.961	1.989.063	268.676	2.891.499	65	45
Netherland	152.287	1.902.485	232.661	1.929.087	53	1
Ukraine	48.206	382.408	255.512	1.606.794	430	320
Georgia	17.638	199.286	230.980	1.102.234	1.210	453
Malaysia	60.796	518.224	157.625	1.049.262	159	102
Greece	34.398	227.459	188.900	1.005.454	449	342
Iraq	10.285	103.626	279.045	974.868	2.613	841
Indonesia	60.152	471.274	163.804	893.206	172	90
France	2.215	29.621	66.720	796.201	2.912	2.588
Romania	26.015	148.679	72.390	420.550	178	183
Denmark	33.870	449.262	18.695	232.645	-45	-48
T.R.N.C.*	1.500	6.964	36.893	191.490	2.360	2.650
Philippines			24.402	161.187	100	100
Egypt			30.199	151.358	100	100
Bulgaria	62.120	325.135	28.859	140.342	-54	-57
Dubai	80.000	545.674	14.933	121.926	-81	-78
China	290.165	1.822.424	20.702	111.037	-93	-94
Kazakhstan			22.000	110.783	100	100
Singapore	20.105	164.663	21.032	108.289	5	-34
UAE	4.308	45.107	14.077	101.310	227	125
Oman			8.852	91.267	100	100
Qatar	18.097	88.710	12.700	81.463	-30	-8
UK	9.848	76.329	7.285	76.022	-26	0
Austria	23.090	279.729	4.660	61.047	-80	-78
Portugal	10	5	8.200	58.134	81.900	1.135.331
Belgium	19.574	154.996	2.188	29.323	-89	-81
Azerbaijan - Nakhichevan	1.363	14.754	6.000	26.250	340	78
Hungary	5.400	42.848	1.800	22.305	-67	-48
Kenia			1.890	19.706	100	100
Slovenia			1.060	14.096	100	100
Bahrain			1.360	8.536	100	100
Uzbekistan			1.500	7.321	100	100
Serbia			1.000	6.535	100	100
Spain	774	5.282	612	4.307	-21	-18
Italy	40.271	324.519	524	3.292	-99	-99
Thailand	657.652	4.513.142	102	702	-100	-100
South Korea	35	391			-100	-100
Kuwait	20	15			-100	-100
Myanmar	59.629	391.339			-100	-100
Israel	11.092	153.143			-100	-100
Switzerland	2.450	33.537			-100	-100
Total	**37.003.224**	**250.957.204**	**49.586.222**	**294.904.004**	**34**	**18**

*Turkish Republic of Northern Cyprus.

When Table 3 displaying Turkish salmon production and export data is examined, it is seen that as of August 2024, exports were made to a total of 49 countries, and 294,904,004 $ of export revenue was acquired in return for 49,586,222 kg of production. Russia is the leading country among Turkish Salmon buyers from Türkiye. Approximately 70% of the total amount is exported to Russia. The amount of export from Far Eastern countries to Japan has increased significantly compared to the same period of the previous year. Moreover, significant exports to countries such as Vietnam, Indonesia and Malaysia continue. The striking element in the current data is that exports to EU member countries are rather low within the current exports. The export data of the Turkish Salmon sector, which has grown significantly each year compared to the previous year, should also reach a certain level with regards to the EU member states. On the other hand, it is apparent that the positive results of the efforts of Russia, the current largest market, to produce its own products will cause contractions in this market in the following years. Therefore, alternative markets need to be created. Undoubtedly, an industry, growing such rapidly, emerges problems. Both political and technical problems arise not only in the export aspect of the business, but also in the production stages. Efforts to increase production volumes bring along various needs and issues, including the employment of new cultivation areas, decreases in product quality, difficulties in obtaining feed or raw materials, and new health problems due to high stock density. This necessitates that executive organizations act more rapidly and accurately and pave the way for the sector.

5. Conclusion and Recommendations

Turkish Salmon has reached a very significant place in Türkiye's aquaculture production and export. The industry is growing and developing each passing day. However, eliminating the problems caused by this growth with rational and permanent solutions as well as paving the way for the sector are inevitable measures. In this context;

- It is inevitable that the market should be diversified and new export areas should be provided so that it does not remain confined to a single area. In this regard, the Ministry of Agriculture and Forestry, which is the executive institution, should take measures to make the relevant legislation and technical criteria suitable. In particular, more exports should be made to the EU member states and the products should be made fit to the standards of the relevant union in order to be able to achieve this export. Considering that the current market will shrink after a while, it is inevitable to initiate new markets and even to enter all markets where Norwegian Salmon is available.

- In the case of increasing current exports, it is undoubtedly necessary to produce products that will meet this need. In other words, renewal and diversification are also necessary in production conditions. Therefore, studies on determining potential aquaculture areas in the seas should be concluded urgently, and especially in the Black Sea region, new production areas should be constructed. Of course, when opening and allocating these areas, technical factors rather than political or policy concerns should be taken into consideration, and when distributing them, producers or entrepreneurs who come from within the sector or experts in this business should be considered.

- If it is desired to enter the EU market sufficiently or create more export areas, it is inevitable that the products should be diversified and processed by taking consumption habits into account. In other words, in addition to fresh or frozen products, emphasis should be given to processed products and various processed versions of the product should be manufactured as per the consumption habits of

the countries. This reveals the necessity of prioritizing processing facilities as much as production areas in the domestic market.

- Measures should be taken to eliminate the difficulties experienced in fry and feed supply in order to increase the production and export amounts. By switching to a regional production model, hatcheries should be established in suitable water resources and only fry should be produced in these water resources. Likewise, technical and academic studies should be initiated to solve the raw material problems experienced here and there in feed production.

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
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ORAL PRESENTATION

Effects of Some Nanoparticles Applied at Different Doses on Seedling Development in Sugar Beet (*Beta vulgaris* L)

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Abstract

In recent years, the development of nanotechnology and the results from various studies conducted in this field have shown that it contributes significantly to plant germination, growth, development and product yield. Moreover, it has been demonstrated that nanoparticle applications positively impact cell structure and cell function, in terms of physiological and biochemical mechanisms, in regulating adverse effects of varying environmental stressors. In this study, Zinc Oxide (ZnO) and Copper Oxide (CuO) nanoparticles were pre-applied to the seeds of the sugar beet (Bernache) variety, and the effects on germination and changes in radicle and plumule weight and length measurements were examined. It was determined that seeds displayed different responses to both nanoparticles. In our study, Copper Oxide pre-application resulted in an increase in radicle and plumule lengths. In terms of weights, it was observed that 1800 mg/l of Copper Oxide application led to a significant increase in shoot and root wet weights. It was concluded that 1800 mg/l of Copper Oxide pre-application positively affected all parameters examined.

Keywords: *Beta vulgaris* L., Nanoparticle, Seedling Development.

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ORAL PRESENTATION

CRISPR-Cas9 Applications in Cattle: Advancing Gene Editing for Improved Traits and Disease Resistance

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Abstract

Gene-editing technologies, which include the recently developed CRISPR-Cas9 system, are set to redefine cattle breeding. This review presents the existing and potential applications of the CRISPR-Cas9 technology to improve economically important traits in cattle such as disease resistance, meat quality, and milk yield. Owing to its accuracy, CRISPR-Cas9 genome editing has made it feasible to introduce targeted genetic changes at specific locations in the genome, which conventional animal breeding is unable to accomplish. Applications described in agriculture-related cases show the potential of the CRISPR-Cas9 system for highly efficient genetic improvement toward developing healthier, more productive, and reproductively capable cattle. These developments highlight the significance of effective and secure delivery strategies that would reduce off-target activity and raise the overall effectiveness of CRISPR technology. The potential of CRISPR-Cas9 in cattle breeding could lead to significant enhancement in genetic gain and production efficiency through precise selection, while also bettering means of addressing animal welfare concerns. Precision breeding is expected to include CRISPR-Cas9 in its toolbox because consumers are expecting more environmentally friendly meat products and new regulatory frameworks for genetic technologies are on the horizon. This technology is increasingly recommended for inclusion in the cattle breeder's toolkit, as CRISPR-Cas9 editing enables precise genetic alterations, positioning it as a revolutionary technology with the potential to enhance cattle traits and reduce their environmental impact, thereby supporting more productive and environmentally sustainable livestock systems.

Keywords: CRISPR-Cas9, Cattle Breeding, Genetics, Gene Editing.

1. Introduction

The advent of CRISPR-Cas9 technology has revolutionized the field of genetic engineering, offering unprecedented precision and efficiency in gene editing across a wide array of species, including livestock. In the cattle breeding industry, CRISPR-Cas9 presents a transformative opportunity to enhance productivity, improve desirable traits, and increase resistance to diseases. Traditional breeding practices, though effective over time, are often slow and subject to genetic limitations. CRISPR-Cas9 allows for targeted modifications at the molecular level, accelerating the development of cattle with optimized characteristics such as enhanced growth rates, improved meat and milk quality, and increased

resistance to infectious diseases. This technology holds significant potential to address the growing demand for food security in a sustainable manner while reducing the economic losses associated with livestock diseases (Decker et al., 2014). However, the application of CRISPR-Cas9 in cattle also raises important ethical and regulatory considerations, which must be carefully addressed to ensure its responsible use. This introduction seeks to explore the advancements of CRISPR-Cas9 technology in cattle, highlighting its potential to enhance genetic traits and disease resistance, while considering the challenges of its implementation in modern animal agriculture. The CRISPR-Cas9 technology has significantly advanced the field of cattle breeding, particularly in enhancing production traits such as milk yield, meat quality, and reproductive efficiency. By enabling precise genetic modifications, this technology allows for the rapid introduction of desirable traits that can improve the overall productivity and sustainability of cattle farming. This article aims to review the latest developments in genome editing of cattle, highlighting key advancements, their applications in cattle breeding, and the ongoing challenges in the field.

1.1. Evolution of Cattle Breeding: Challenges and Opportunities

Historically, the traditional method of cattle breeding has been to select for particular phenotypic traits, such as fertility, disease resistance, milk production, and meat quality. These breeding techniques are based on Mendelian inheritance, which supports generation-by-generation gains made possible by restricted gene action. Nevertheless, genetic improvement is often slow because of the long generational intervals and complex inheritance of economically important traits (Decker et al., 2014).

Today, cattle breeding has been greatly affected by challenges like environmental change, genetic diversity, and market demand, shaping the evolution of livestock. Climate change represents a greater danger than any other factor that has influenced available pastures and the physiological confirmation of different breeds. Another example is the global trend for cattle breeds with lower resource use, leading to the loss of genetic integrity and local adaptation, as shown by a study on Boran cattle (an adapted breed for arid environments) affected by crossbreeding with smaller zebu cattle (Bayssa et al., 2021). This dilution not only endangers the distinctive adaptive characteristics of the Boran breed but also highlights concerns about genetic diversity, which is vital for disease and environmental resistance (Bayssa et al., 2021; Decker et al., 2014).

In addition, the genetic architecture of bovine forms has been shaped by an interaction between natural selection and targeted human-driven selection through breeding practices. Studies have identified different genomic signatures in several breeds reflecting their response to particular environments (Signer-Hasler et al., 2023; L. Xu et al., 2015). The adaptation of certain breeds to high temperatures and humidity has driven parallel evolution in body size, a critical factor for enhancing survival in these challenging environments (Elayadeth-Meethal et al., 2018).

The cattle breeding industry is not only facing environmental challenges but also catering to global market needs. The extinction of native breeds that are acclimated to their surroundings has resulted from increased selection for better functional traits and rising demand for high-yielding varieties (Decker et al., 2014; Iso-Touru et al., 2016). Concerns about the long-term viability of breeding methods and the decline of significant genetic resources have been raised by this trend. In order to address these problems and maximize the fitness of regional breeds in low-input systems, community-based breeding programs have recently gained prominence (Mapiye et al., 2019; Ouédraogo et al., 2021).

Finally, developments in genomic technologies have provided greater potential for enhancing cattle breeding applications. By providing improved predictions for economically important traits (e.g., milk production and fertility) (da Silva et al., 2016; Zhang et al., 2014), genomic selection has been revolutionary to the dairy industry. The application of these technologies in cattle breeding is not new, but they are still relatively recent and have great potential for increasing productivity and sustainability (Rovelli et al., 2021). Nonetheless, there are still issues faced in the adoption of these technologies to large cattle populations, especially in non-wealth regions with minimal infrastructure (Rovelli et al., 2021).

In summary, a compelling requirement for cattle breeding is to address these major challenges (climate change and genetic dilution) in the evolution of cattle. Nonetheless, the combination of genomic technologies and community-based breeding programs provides valuable opportunities to improve the robustness and performance of diverse populations. While traditional breeding practices work to preserve the genetic diversity of breeds with the dual demands of modern livestock production, new gene-editing methodology tools such as CRISPR-Cas9 provide an unprecedented opportunity to improve genetics at a much more rapid rate and more specifically.

1.2. Emergence of CRISPR-Cas9 as a Revolutionary Gene-Editing Tool

Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR) and its associated protein Cas9 have emerged as revolutionary tools for genome editing due to their precision, efficiency, and cost-effectiveness. The CRISPR-Cas9 system was originally created as an adaptive immune mechanism in prokaryotes to enable cleavage of the foreign DNA that entered into a cell at specific genomic loci, permitting targeted genetic changes, which is now utilized for gene editing in diverse species, including livestock. CRISPR-Cas9 technology has transformed genetics, providing an efficient system for precision genome modification in livestock including cattle. It is a powerful and revolutionary tool that can specifically target and modify the genome and allows researchers and breeders to improve valuable economic traits whilst reducing the impact of genetic disorders as well as abiotic stresses (da Silva et al., 2016; Zhang et al., 2014). CRISPR-Cas9 has the ability to introduce favorable traits without a noticeable presence of vector sequences and markers by improving growth rates, climate resilience, disease resistance, and reproductive performance in livestock breeds (Rovelli et al., 2021; Zhang et al., 2014).

The use of CRISPR technology in breeding cattle aligns with the continued work being done to combat climate change and the push for sustainable livestock production. For example, CRISPR-Cas9 may allow some genes such as those for heat tolerance to be edited precisely, leading to increased understanding and development of better-able cattle breeds that can cope with increasing temperatures or fluctuating conditions like agriculture (da Silva et al., 2016; Elayadeth-Meethal et al., 2018). This feature is especially important in areas where local breeds tend to have difficulty adapting, thus ensuring the future sustainability of cattle farming despite climate challenges (Bayssa et al., 2021; Rovelli et al., 2021).

Furthermore, CRISPR-Cas9 is considered as a promising technology that contributes to the conservation of genetic diversity within cattle populations. This was thought to include preserving local breeds by facilitating the targeted improvement of particular traits, without introducing new foreign genes (Xu et al., 2015; Zhang et al., 2014). Given the potential susceptibility of cattle to endemic diseases, it is assumed that these limitations could be transferred to larger genetic indices, and this approach would

simultaneously conserve valuable genetic resources while advocating sustainable local breed use these are typically more fit for local environmental conditions (Mapiye et al., 2019; Zander, 2011), that may ultimately keep up or improve production efficiency in specific traits.

Bioethical considerations regarding the moral dimensions of gene editing, along with challenges related to regulatory frameworks and public acceptance, represent significant issues that require careful deliberation and resolution (Corman et al., 2015; Rovelli et al., 2021). Moreover, the welfare of animals and the stability of ecosystems after gene editing in the long term are unresolved questions under active debate (Corman et al., 2015; L. Xu et al., 2015).

In conclusion, cattle breeding change is a combination of constraints and opportunities. Ecosystem degradation and market needs were great threats to conventional practices, but in the future, the application of genomic technologies, including CRISPR-Cas9, provided a silver lining effect on productivity enhancement as well as sustainability. By strategically adopting these emerging technologies, the cattle breeding industry can effectively navigate natural and economic challenges while preserving the traits that enhance the resilience of livestock during adverse conditions.

2. The CRISPR-Cas9 System: Mechanism and Potential in Livestock

CRISPR-Cas9 is a revolutionary genetic engineering tool, because of its capacity to precisely alter DNA sequences in the genomes of diverse organisms, including livestock. This system is a part of the adaptive immune response of bacteria and provides immunity against invading viruses by a process called RNA-guided DNA cleavage (Palermo et al., 2016; Zakrzewska & Burmistrz, 2023). CRISPR-Cas9 comprises the following core units: a Cas9 endonuclease, and distinct single guide RNA molecules (sgRNAs), which direct the Cas9 protease to sites on DNA through complementary base-pairing with target DNA sequences (Bhattacharya & Satpati, 2023; Yuan et al., 2015). Upon binding, Cas9 creates a double-strand break (DSB) in the DNA that triggers the repair systems of the cell, mainly non-homologous end joining (NHEJ) or homologous recombination (HR) (Casalino et al., 2020; Palermo et al., 2016).

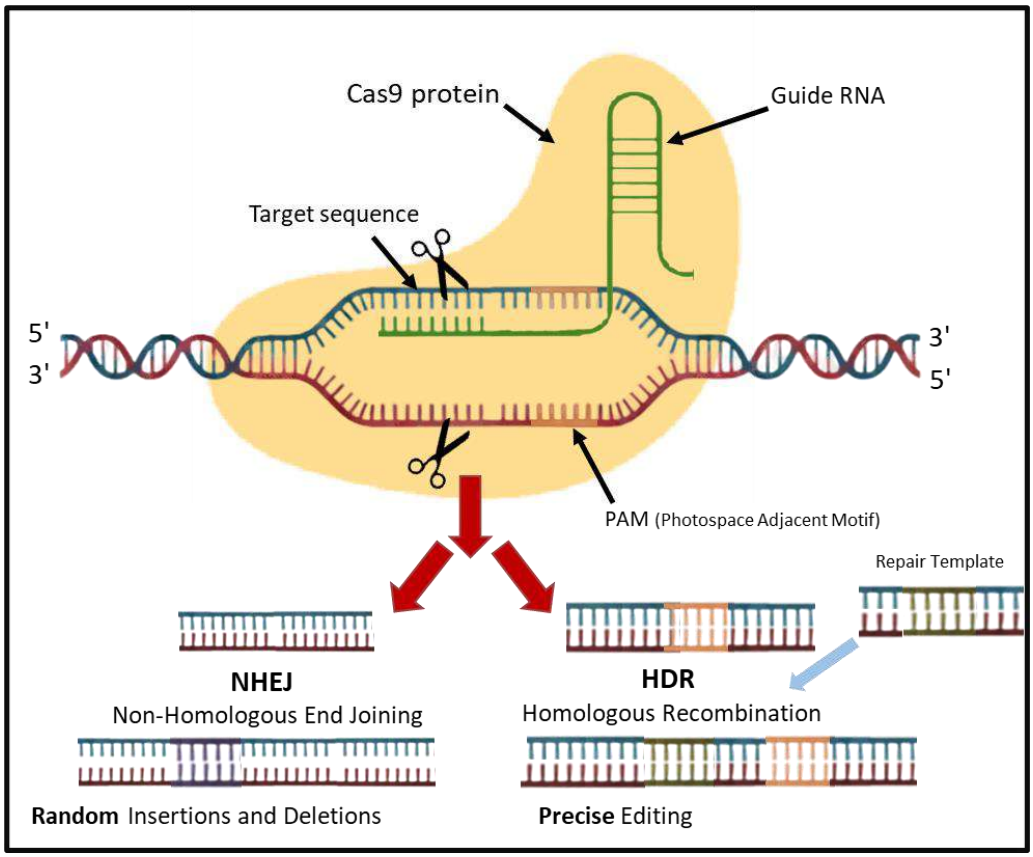


Figure 1. Mechanism of CRISPR-Cas9 Gene Editing via NHEJ and HDR.

This specificity of CRISPR-Cas9 can be attributed in large part to the sgRNA being sequence-specific and the ability to target almost any DNA sequence within the genome (Kruminis-Kaszkiel et al., 2018; Liu et al., 2022). Specifically, the protospacer adjacent motif (PAM) sequence is recognized by Cas9 to target DNA and form a complex for cleavage (Palermo et al., 2017). This is important to avoid off-target effects, that may result in unsolicited mutations at other sites through the genome (Ricci et al., 2019). Quite recently, researchers derived key information about the molecular mechanism driving CRISPR-Cas9 function, including the involvement of non-target DNA in defining how cleavage is realized (Bhattacharya & Satpati, 2023; Casalino et al., 2020).

Furthermore, the CRISPR-Cas9 system has been refined for different use cases and more efficient delivery approaches have been developed so that it can be coupled to more transfect-efficient cell lines (Han et al., 2015; C. L. Xu et al., 2019). The power to edit genes in non-dividing cells has also been increased by techniques like homology-impartial focused insertion (HITI), which allows sturdy gene insertion without the necessity for homologous sequences (Khan et al., 2018). Overall, the CRISPR-Cas9 technical evolution demonstrates how powerful and versatile this gene-editing tool really is in genetic research and bioengineering.

3. Applications of CRISPR-Cas9 in Cattle Breeding

3.1. Disease Resistance: A Genetic Shield Against Pathogens

The CRISPR-Cas9 system, which focuses on the potential for disease resistance in cattle breeding, has revolutionized cattle breeding through precise editing of the genome. Through targeted mutations in the *NRAMP1* gene, CRISPR-Cas9 has been used to create cattle that are more resistant to diseases like tuberculosis (Islam et al., 2020). This enhancement has major benefits for animal husbandry and food security because tuberculosis can cause considerable damage to cattle in their populations and agricultural efficiency (Yuan et al., 2021).

Using CRISPR-Cas9, breeders can introduce disease-resistant traits much faster compared to traditional breeding methods, which take years to accumulate desired traits over generations It has been found that gene knockouts or deletions generate more resistance to viral infections in cattle, achieved through the application of this technology where transgenic gene-edited animals with enhanced immunity or even total resistance to particular pathogens have emerged (Islam et al., 2020). In cattle, CRISPR has also been employed to enhance immune gene expression by introducing favorable alleles for disease resistance. In addition to dealing with viral infections, CRISPR-Cas9 helps address bacterial infections by targeting colonization and virulence genes, including those associated with mastitis in dairy cattle (Mehra & Kumar, 2021; Wang et al., 2016). This method not only holds the promise of reducing antibiotic use in livestock but also addresses concerns related to antibiotic resistance in public health (Islam et al., 2020).

CRISPR-Cas9 goes beyond disease resistance and leads to healthier, more sustainable cattle. A case in point is the production of genetically polled (hornless) cattle for the dual purpose of improving animal welfare and safety, as it obviates the need for dehorning procedures which are very invasive and cause a great deal of pain (Deykin et al., 2020; Schuster et al., 2020). The application of CRISPR to introduce the Polled Celtic variant here demonstrates the flexibility of the technology in enhancing both animal welfare and livestock productivity. Furthermore, CRISPR technology has augmented cattle reproduction using the gene-edited bovine fibroblasts for somatic cell nuclear transfer (SCNT), providing a single genetic background that promotes multiple advantageous traits like disease resistance (Ishino et al., 2018). Moreover, using adult fibroblasts can improve the quality of genetically modified cattle (Yum et al., 2018). Allowing for advantageous traits to be stacked is a major advancement in cattle breeding.

In summary, CRISPR-Cas9 is a promising technology that can be used to enhance disease resistance, animal welfare, or output in cattle. This fine-tuning of the genome has been proposed to be a rev for the cattle industry leading to highly productive, economically feasible, and animal-friendly livestock production systems (Mehra & Kumar, 2021; Wang et al., 2016).

3.2. Milk Yield and Composition

Cattle breeders are using CRISPR-Cas9 in a variety of creative ways to improve milk output in terms of both quality and quantity. By concentrating on these genes, milk production can greatly increase in both volume and quality. Using CRISPR-Cas9 technology, the beta-lactoglobulin gene has been knocked out. This change lowers allergenic characteristics and may enhance total milk supply by changing the protein composition, and improving the nutritional profile of milk (Sun et al., 2018).

Furthermore, the expression of genes linked to milk production has increased as a result of the use of CRISPR-Cas9. Genes linked to lactation have been the subject of research, especially those controlling the growth and operation of the mammary glands. According to Mehra and Kumar (2021), this genetic change increases the efficiency of milk synthesis and secretion, resulting in an overall increase in milk supply. Improving these characteristics makes the CRISPR-Cas9 technique more accurate, making it a useful tool for the genetic modification of dairy cattle.

Furthermore, the creation of genetically modified cattle without horns, known as polled cattle, is one of the biggest innovations. This characteristic increases safety when handling cattle and improves animal comfort by reducing the need for disbudding. Owing to these advantages, studies have successfully used CRISPR/Cas12a to introduce the Polled Celtic variant, giving dairy calves a polled genotype that is increasingly in demand in the dairy industry (Schuster et al., 2020). Similarly, strategies for creating hornless dairy calves using genome editing were highlighted, with the observation that this approach preserves the breed's phenotypic traits while enhancing well-being (Deykin et al., 2020).

3.3. Meat Quality and Carcass Traits

CRISPR-Cas9 technology is advancing significantly in enhancing meat quality and carcass characteristics in cattle. One of the notable applications is the targeted editing of the myostatin (MSTN) gene, a negative regulator of muscle growth, whose inhibition has been linked to increased muscle mass and improved carcass yield. (Zhao et al., 2022) demonstrated the successful editing of the *MSTN* gene in Chinese Yellow Cattle, resulting in enhanced growth traits and improved meat quality. Similarly, Gim et al. (2022) reported the successful use of CRISPR-Cas9 to produce genetically modified calves by targeting the *MSTN* gene, with one calf showing a 99.9% mutation rate and exhibiting a double-muscling phenotype. These studies highlight the potential of CRISPR technology to produce cattle with superior muscle development, paving the way for improvements in meat production.

Moreover, Hennig et al. (2020) evaluated mutation rates and off-target effects when injecting Cas9 mRNA or protein into bovine embryos, reporting high efficiency in generating targeted mutations. This efficiency is essential for producing genetically edited livestock that consistently exhibit desired traits, thereby enhancing the overall quality of beef. Also, (Zheng et al., 2017) discovered that modifying the *UCP1* gene in pigs could diminish fat storage, a strategy that could be extrapolated to cattle breeding. The ectopic expression of *UCP1* in white adipose tissue enhanced lean muscle mass and diminished fat, indicating that reducing excess fat while augmenting lean muscle mass may improve meat quality in cattle.

Integrating CRISPR-Cas9 with conventional breeding techniques can accelerate improvements in carcass quality. Genetically engineered animals possessing advantageous traits can enhance livestock production and satisfy the growing demand for high-quality meat (Mehra & Kumar, 2021). This method may improve meat quality and production efficiency by swiftly incorporating beneficial features into the breeding pool.

3.4. Reproductive Efficiency

CRISPR-Cas9 technology offers the potential for improving reproductive efficiency in cattle, although its applications in this area remain limited. One promising example is the editing of genes that regulate reproductive hormones, such as the prolactin receptor (*PRLR*) gene. Modifying this gene has been

associated with improved thermotolerance, which is crucial for maintaining fertility in heat-stressed environments, such as tropical regions (Cuellar et al., 2024). Heat stress can severely impact fertility rates, and genetic improvements in thermoregulation could help sustain reproductive efficiency.

Additionally, potential applications of CRISPR-Cas9 in cattle reproductive efficiency include accelerating sexual maturity in heifers by targeting genes linked to early reproduction (Bonamy et al., 2019). Combining CRISPR with assisted reproductive technologies (ART) could further boost breeding success, producing genetically superior embryos with enhanced fertility outcomes (Oguejiofor, 2019). Developing efficient protocols, such as using gene-edited cells in embryo transfer, could help apply these genetic improvements effectively (Ishino et al., 2018). While these applications show promise, more research is needed to fully explore CRISPR-Cas9's impact on reproductive efficiency in cattle.

4. Future Prospects and Conclusion

CRISPR-Cas9 possesses significant promise to transform cow breeding by facilitating rapid genetic improvements that address the foremost challenges in the industry, including disease resistance and productivity. However, use in cattle remains limited due to the need to overcome technological challenges, obtain regulatory approval, and address public concerns over the ethics and safety of gene editing. As a result, there is relatively little research on CRISPR-Cas9 applications in cattle to date. The integration of CRISPR-Cas9 into cattle breeding programs may herald a new phase of precision livestock farming characterized by enhanced productivity, improved animal welfare, and reduced environmental impact.

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
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ORAL PRESENTATION

Evaluation of Cyto-Genotoxicity and Histological Alterations in Arsenic Exposed *Labeo rohita* and Its Mitigation with *Moringa oleifera* Leaf Extract

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Abstract

The current study evaluated the efficacy of *Moringa oleifera* leaf extract in mitigating the histo-biochemical alterations in *Labeo rohita* caused by arsenic. A medical plant (*Moringa oleifera*) known for its numerous pharmacological qualities, was added to three different diets at 0, 2, and 4% level, prepared by mixing *M. oleifera* leaf extract with the basal diet. The 96hr lethal concentration of arsenic to *Labeo rohita* was 20.25 mg L^{-1}. One hundred and eighty healthy individuals of *Labeo rohita* were divided into four groups. One group served as control and other three groups were subjected to sub-lethal concentration 4.05 mg L^{-1} ($1/5^{th}$ of LC_{50}) of arsenic, with or without *Moringa oleifera* leaf extract supplementation for 28 days. Severe histological alterations, level of liver enzymes (ALT, AST and ALP), cortisol, anti-oxidant status and relative expression of cytochrome P450 gene were increased in fish exposed to arsenic. But, in fish fed with diets containing 2% or 4% *M. oleifera* leaf extract, the histological alterations were reduced, level of liver enzymes, cortisol and the upregulation of anti-oxidant enzyme and cytochrome P450 gene expression was normalized, with (4%) *M. oleifera leaf* extract supplemented diet exhibiting stronger effects. These results suggest the protective and therapeutic roles of *M. oleifera* as a feed supplement in *Labeo rohita* against arsenic induced toxicity.

Keywords: Fish, Liver, Stress Hormone, Histology, Oxidative Stress, *Moringa oleifera*.

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ORAL PRESENTATION

A Review on the Genotoxic Potential of Antibiotics on Aquatic Organisms

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Abstract

One contaminant with potential genotoxicity in the aquatic environment is pharmaceutical compounds. Antibiotics, one of the pharmaceutical compounds, are frequently used for the prevention and treatment of bacterial diseases in humans and animals, and to stimulate the growth and reproduction of livestock. Antibiotics, like other pharmaceutical compounds, can be toxic to non-target aquatic organisms by entering surface waters. Toxicity studies generally include acute toxicity studies, but genotoxic effects of antibiotics in the aquatic environment should also be examined due to their persistence and toxic effects of their metabolites. The aim of this review is to emphasize the existence of genotoxic potential of antibiotics, which can show genotoxic, mutagenic and clastogenic effects, on aquatic organisms.

Keywords: Antibiotics, Genotoxicity, Aquatic Organisms.

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ORAL PRESENTATION

Corno-Quercetum petraeae Máthé et Kovács 1962 Association (*Quercion pubescenti-petraeae* Br.-Bl. 1932) in the "Dobrușa" Landscape Reserve in the Republic of Moldova

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Abstract

Mesophilic forests from the alliance *Carpinion betuli* Issler 1931 predominate in the "Dobrușa" landscape reserve, seldom, as a rule, on the plateaus and in the upper part of the hills, xero-mesophilic sessile oak forests (from the *Quercion pubescenti-petraeae* Klika 1933 alliance) develop on smaller areas, and through the meadows of the valleys stretches of meso-hygrophilous forests of pedunculate oak with ash from the alliance *Fraxino-Quercion roboris* Passarge 1968. As a result of the phytocenological research carried out based on the methods of the *Central European School* (Braun-Blanquet, 1964) on the territory of the "Dobrușa" landscape reserve, 6 relevés were described in which the edifying species *Quercus petraea* (Matt.) Liebl. predominate and *Cornus mas* L. which are grouped in the association *Corno-Quercetum petraeae* Máthé et Kováks 1962. The surface of the relevés is 600 m². In the Republic of Moldova, the phytocoenoses of the given association are recorded on the calcareous slopes of the Dniester River valley. The plant communities described develop at an altitude of 280-300 m, on the plateau or in the upper part of the slopes with a predominant North-East exhibition and with an incline that varies from 5-7° to 40-45°. The soil type phaeozem, with a pH = 4.5-6.0, formed on quaternary sands. The tree layer coverage varies between 70-80%, dominated by *Quercus petraea* mixed with *Fraxinus excelsior* L. and *Acer campestre* L. The height of the trees is (17) 20-21 m, the diameter of the sessile oak varies between 30-46 cm. The shrub layer forms a cover of 40-60%, in which *Cornus mas* predominates with an insignificant participation of *Crataegus monogyna* Jacq. species. and *Staphylea pinnata* L. The herbaceous layer is better developed in the spring, due to the higher degree of humidity in the soil, covering 80-100% of the surface, consisting of the mesophilic species: *Anemonoides ranunculoides* (L.) Holub, *Corydalis cava* (L.) Schweigg. et Körte, *Corydalis solida* (L.) Clairv., *Galium aparine* L., *Anthriscus longirostris* Bertol., *Veronica hederifolia* L., *Scilla bifolia* L. During the summer the herbaceous layer has a lower coverage (between 20-45%), determined by the increase in aridity during this period. The most frequently reported species are the xero-mesophilic ones: *Pulmonaria mollis* Wilen ex Hornem., *Symphytum tauricum* Willd., *Scutellaria altissima* L., *Polygonatum hirtum* (Bosc ex Poir.) Pursch, *Brachypodium sylvaticum* (Huds.) P. Beauv., and among the mesophylls – *Stellaria holostea* L. The floristic composition of the phytocenoses includes 56 species of vascular plants aut of which 5 species are characteristic to the *Quercion pubescenti-petraeae* Klika 1933 alliance, 5 – the order *Quercetalia pubescenti-petraeae* Br.-Bl. 1932, 8 – of the *Carpinion betuli* Issler 1931 alliance, 14 – of the *Fagetalia sylvaticae* Luquet 1926 order, 13 – of the *Querco-Fagetea*

sylvaticae Br.-Bl. et Vlieger in Vlieger 1937 class, 3 – *Crataego-Prunetea* Tx. 1962 class and 8 – Variae syntaxa. The *Corno-Quercetum petraeae* Máthé et Kováks 1962 association presents xero-mesophilic, Central-European-West Pontic phytocenoses, dominated by *Quercus petraea* and *Cornus mas*, formed on phaeozem soil type, acid and moderately acidic. In conclusion, we consider the inclusion of the studied phytocenoses in the adopted cenotaxons justified: the alliance – *Quercion pubescenti-petraeae* Klika 1933, the order – *Quercetalia pubescenti-petraeae* Br.-Bl. 1932, class – *Querco-Fagetea sylvaticae* Br.-Bl. et Vlieger in Vlieger 1937.

Keywords: *Corno-Quercetum petraeae*, "Dobrușa" Landscape Reserve, Republic of Moldova.

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ORAL PRESENTATION

Semiconducting Textiles via Low-Temperature Atomic Layer Deposition

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Abstract

In recent years, research on electronic textiles has accelerated, with some applications now transitioning into daily life, including flexible devices such as sensors, solar cells, and energy storage systems. Zinc Oxide (ZnO), a promising n-type material with a wide bandgap, stability under extended light exposure, and high sensitivity to UV/visible radiation, is ideal for textile-based photodetectors. Similarly, NiO, a stable p-type material, has shown promise as a hole transport layer in emerging optoelectronics. However, incorporating thin film devices onto textiles often affects their flexibility, durability, and washability. This study explores the use of low-temperature atomic layer deposition (ALD) of semiconductors on textiles to develop flexible PDs without compromising the fabric's natural properties. ZnO was deposited on cotton (woven bleached, 98 gsm) substrates using diethylzinc (DEZ) and H2O as Zn precursor and co-reactant respectively in a thermal ALD reactor at 120 °C. The unit ALD cycle in which 20 sccm N2 is used as the carrier gas consists of 0.5s DEZ pulse, 30s purge, 0.5s H2O pulse, 30s purge steps. Following the deposition of ZnO layers on cotton, interdigitated electrodes consisting of 25/150 nm Ti/Al layers were evaporated by e-beam deposition to create the metal-semiconductor-metal (MSM) structures. NiO was deposited on nonflexible substrates using nickelocene (NiCp2) and O2 plasmas in a plasma-ALD reactor with a hollow-cathode plasma source, equipped with an in-situ ellipsometer. Optimal growth conditions were identified as 90 ms NiCp2 pulse / 10 s purge / 20 s O2-plasma at 100 W plasma exposure / 10 s purge. To check the growth linearity and obtain thicker films for materials characterization, 800 cycle long runs were conducted to evaluate the substrate temperature impact (100 - 250 °C) on growth-per-cycle (GPC) and film properties. The resulting films on textile and nonflexible substrates are characterized in terms of their structural, morphological, compositional, and photo-response properties. X-ray diffraction analysis revealed the polycrystalline nature of the as-grown ZnO and NiO layers. SEM and EDX analyses showed that ZnO is uniformly synthesized on cotton. The photo-response of the fabricated ZnO MSM-PD device structures were examined by placing a visible light source at a distance of 30 mm. The bias voltage was scanned from –1 to 1V in a 50-mV step under dark and illuminated conditions. The resulting photo-current at 1V bias showed ~2.5-fold increase when compared to dark current (from 57 to 130 μA). Our study displays an effective ZnO-based photodetector on cotton at low bias voltages highlighting the potential for low-power wearable sensing applications. Future work could focus on further characterizing the spectral photoresponse under various environmental conditions and optimizing the device architecture by using different doping strategies or creating pn junction structures that can enhance light absorption.

Keywords: Semiconducting Textiles, ZnO, NiO.

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ORAL PRESENTATION

Effect of Chitosan on the Color Profile of Rainbow Trout (*Oncorhynchus mykiss*) Fillets Stored at the Refrigerator

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Abstract

Fish meat is an essential alternative to a healthy diet with its high protein, unsaturated fatty acids, and rich mineral content. Aquatic product consumption, while preferred in regions close to the source in the past, has a more widespread consumption area today. This situation has brought problems that emerge while storing and transporting aquatic foods. Different preservation techniques have been used for many years to delay the spoilage of fish meat. Nowadays, with the developing technology, both these techniques have been developed, and combined methods where these techniques are used together are applied. In this study, trout fillets were coated with chitosan biopolymers, increasing the protective properties of these techniques and extending the preservation duration. Chitosan is the second most abundant biodegradable substance in nature after cellulose. In addition to being antimicrobial, antifungal, anticarcinogenic, edible, and non-toxic, it has high film-forming properties. It is known that the storage period of fish coated with chitosan is prolonged, and sensory and physical analyses performed on fish meat yield favorable results. In this context, wastes of crab species, which were discarded as non-target species due to fishing activities from the Western Black Sea region, were used for chitosan extraction. In order to determine the physicochemical and color characteristics of the extracted chitosan (the yield, degree of deacetylation, moisture, and ash contents) and trout fillets were measured using a variety of techniques, including HunterLab color measurement. According to the study, the physicochemical analysis results of chemically extracted chitosan, the yield was 9.26%, the moisture was 1.57%, crude ash was 0.91%, the deacetylation degree was 86.26%, and the color of chitosan was creamy-white. The color analysis results of rainbow trout fillets showed that the fresh sample's L*, a*, b*, chroma, hue, and whiteness values were 56.47, 1.05, 14.64, 14.70, 1.50, and 54.04, respectively. On the last day of the storage, the L*, a*, b*, chroma, hue, and whiteness values were 48.52, 1.04, 13.04, 13.08, 1.49, 46.85 in the control group, 59.12, 1.26, 14.39, 14.45, 1.48, 56.64 in the 0.5% chitosan added group, and 58.30, 1.95, 16.78, 16.89, 1.45, 55.00 in the 1% chitosan added group, respectively. In conclusion, it was observed that the shelf life of rainbow trout fillets coated with chitosan biopolymers was prolonged compared to the control group in terms of color values during 18 days of storage in refrigerator conditions.

Keywords: Biopolymer, Crab Chitosan, Chitosan-coating, Sustainable Consumption, Waste Reduction.

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ORAL PRESENTATION

Low Impact Development (LID) on Campus: A Case Study of the University of Connecticut's Storrs Campus

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Abstract

In densely developed areas, such as city centers, campuses, and shopping areas, drainage problems can occur due to surface imperviousness. The main issues are surface runoff and flooding due to increased speed and volume of water and the inability of groundwater recharge. Especially with the effects of climate change, the number of floods has increased worldwide in recent years due to higher than average rainfall intensity and duration. In order to mitigate the effects of extreme rain events, stormwater issues must be controlled. In this context, one of the methodologies applied is low impact development (LID), which includes many different types of applications focused on stormwater control. This study examines examples of LID applied in the main campus of the University of Connecticut (UConn), located in Storrs Mansfield, Connecticut, USA. As the first step, the conceptual framework of LID was identified with the help of international literature. In the second stage, the operations of the sustainability office within UConn were reviewed. In the third phase, some of the LID sites on campus were visited for on-site inspection and visual documentation. These are application areas created, such as bioretention swales, rain gardens, and porous pavers, with LID techniques. Finally, in the fourth phase, suggestions were developed to motivate LID practices, which are planned for the future on other campuses.

Keywords: Stormwater Management, Environmental Sustainability, Infrastructure Development, Climate Change Mitigation, Land Use Planning.

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ORAL PRESENTATION

Impact of AI on Publishing: Current Status and Future Focus

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Abstract

Artificial intelligence (AI) is gaining widespread use in the preparation and publication of manuscripts. The technology enables the automation of time-consuming tasks including literature searches and review, and the management of largescale data sets. However, there is concern about the role of AI in the construction/writing of manuscripts, and the associated issue of authorship. Issues regarding ethics, copyright ownership and intellectual property need to be resolved. However, the current AI systems do not replace human thought processes and expertise.

Keywords: Fuzzy Sets, Intuitionistic Fuzzy Sets, Multi Criteria Decision Making.

1. Introduction

There is a commonly held view that [technical] knowledge doubles every 10-years. Indeed in the period since the end of the Second World War, there have been substantive changes in many walks of life. Technologies have undergone rapid changes, negating the value and use of older approaches. For example, computer floppy disks came, were widely used for home computing, and are now largely forgotten (Davies, 2023). In terms of scientific publishing, manuscripts used to be hand written, and typed on manual typewriters by professional typists. Corrections were made using white-out or pages would be re-typed. Progress saw the arrival of electric typewriters, and versions with the ability to change the typeface (and rudimentary memory capable of storing a few pages of typescript). Then, there came dedicated word processors with memory and associated printers. We remember the first word processors which took two minutes and 40 seconds to print a single page! At the time, this was considered to be so fast – in comparison to typing the page. Diagrams were prepared using India ink, set squares, French curves and rulers. These diagrams were photographed, and the film developed and printed in dark rooms. The finished manuscript would be posted to the journal, which in turn would send the hard copies to reviewers. Subsequently, the complete task of manuscript preparation and submission would be accomplished with computers using word processing and drawing programmes without the need for printing the documents. Photographs are taken with digital cameras, and incorporated directly into computer files. Moreover, in less than half a century, computers developed from main frame monstrosities that occupied air-conditioned suites and needed large staffs to the present generation of laptop models, many of which are more powerful than those earlier large machines. The system of entering data onto punch cards or tape has been replaced by the use of keypads, which are integral to each home and office computer. Remote working has become a norm. Thus, from the home environment and a laptop computer attached to the Internet, individuals may write and submit

manuscripts, communicate with each other by typed messages, voice mail and/or video links, and surf the Web. We may exchange data with colleagues and access the content of libraries across the globe. Word processing programmes incorporate spelling and grammar checks although any changes need to be checked carefully as it is not so unusual for incorrect words/phrases to be substituted in the text. This raises the issue of an ongoing topic that could be associated with the perception of machines replacing humans as depicted in science fiction films, namely Artificial Intelligence (AI).

2. What is AI?

According to International Business Machines (IBM), AI is technology that started in ~2006, and allows computers to simulate human intelligence and their problem-solving abilities, i.e. intelligence exhibited by computers. In brief, computer scientists develop systems and software that use learning and intelligence to achieve defined outputs (Russell & Norwig, 2021)! A noteworthy development came with Chat Generative Pre-Trained Transformer (ChatGPT), which is a chatbot (=chatterbot; this is software developed to mimic human conversation via interactions with text or voice [Maudlin, 1994; Adamopoulou & Moussiades, 2020; Caldarini et al., 2022; Brink, 2024]) and virtual assistant, launched in November 2022. ChatGPT has found widespread and increasing use in science. To put this interest into perspective, there were one million users of ChatGPT within 5-days of its launch (Marr, 2023), and over 100 million/month within the first two months (Hu, 2023).

3. Uses for AI

Already, AI is used extensively in applications, including surveillance cameras, talking robots, self-driving cars (Brink, 2024). AI allows rapid access to huge data bases of information with integral analytical functions, i.e. the technology has the ability to analyse data sets, which would otherwise be difficult to interpret by more conventional means. Of relevance to publishing, AI has been involved in constructing reports, manuscripts/essays and solving mathematical problems. Herein lies the problem – who is actually writing the manuscript, AI or a human author (or both)?

4. The Benefits of AI

The benefits reflect time saving on information retrieval, the ability to understand the significance of large amounts of data quickly, to translate foreign languages, and the use within messaging services (Brink, 2024). The technology has led to facial recognition for smart mobile/cell phones (Brink, 2024). Also, chatbots are capable of speech recognition thus engaging in conversations with humans, such as customer queries, (Brink, 2024) although the value of any dialogue will reflect the nature and accuracy of the computer database.

In the realms of publishing, AI is used to optimize titles, key words and abstracts, which make articles more accessible to other users (Martin & Chu, 2015; Martin, 2020; 2023). The ability to carry out literature reviews, analyse and summarise extensive data sets (which are difficult to analyse manually), recognise patterns, produce and refine models reflecting the data, and identify important conclusions that assist with decision making has been revolutionary (Davies, 2023; Brink, 2024). Publishers use AI to suggest referees, check for plagiarism (Brink, 2024) and make editorial suggestions. The algorithms allow publishers to assess market trends, and determine priorities for investment with less human

involvement. In short, AI has allowed the automation of tasks that would be regarded as time consuming and/or a waste of time (= boring). Consideration needs to be given to copyright and intellectual property – whom owns the rights for material generated by AI? It would appear that in the case of the European Union and the USA, AI generated text would not be covered by existing copyright law as author (Trapova, 2023) or patent law as inventor (Kappos & Fodouop, 2022). Perhaps, disputes over ownership of intellectual property could be resolved be arbitration, involving the use of blockchain technologies (= involving secure database systems that store the data in blocks that are linked in a chain) (Frolova & Kupchina, 2023).

There are many benefits associated with the introduction and use of AI. Let us not forget that in human medicine, AI has been beneficial for achieving accurate diagnoses, devising personalised treatment regimes and enacting robotic surgery (Brink, 2024). For agriculture, AI has been involved with monitoring the health of plants, and managing plant growth conditions (Brink, 2024).

5. Actual and Perceived Problems with AI in Publishing

There is a view that AI could be used (and has been used) to write academic manuscripts (Khalifa & Albadaawt, 2024). The question to be addressed is who wrote the manuscript? One could envisage non-specialists submitting review manuscripts written by AI on subjects about which they have limited or no knowledge. Research articles could be based on data analysis and subsequent manuscript preparation by computer with negligible human intervention. This raises the possibility for the generation and dissemination of misinformation. Again, the overriding question is who is responsible for the published work? A false impression could be obtained about the expertise and abilities of the submitting author(s). Clearly, it is essential to have confidence in the quality of the published work and the competence of the submitting authors. It is important to maintain a balance of academic rigour, ethics and safety in all aspects of publishing (Glumbe et al., 2024). The concerns about AI safety have led to international co-operation, and thus the formulation of the Bletchley Declaration [named after the British-based cryptanalysts during the Second World War] (Bletchley, 2023; Guzik & Sitek, 2023). In essence, it is accepted that AI has great potential for humanity, but it is essential to ensure safe and responsible use (Bletchley, 2023). It is timely and relevant to identify, address, research and manage the risks associated with AI in order to formulate and refine policies to ensure safety (Bockting et al., 2023). It is appropriate to re-iterate a sentiment first expressed in 1957 (*The Hammond Times,* November 10, 1957): "garbage in, garbage out", i.e. the computer is not always correct; individuals need to check the output! Society should not forget that AI relies on data bases, and any errors will be reflected in the outputs. We need to think about the likely accuracy/meaning of outputs from AI without giving them glib acceptance.

6. Conclusion

It is all too apparent that new technologies regularly emerge; maybe there is an initial reticence followed by more general - perhaps reluctant - acceptance. However, users need to know the advantages and constraints of any new development, i.e. outputs need to be checked carefully for feasibility and accuracy. AI is now used widely in many aspects of life, including publishing, and will continue to evolve. Hopefully, society will benefit from the rapid advances that continue to be made in AI (Murray et al., 2023). Already, the publishing process accepts some aspects of AI, including spelling and grammar checks and the management of references. AI is not going away, so we must strive to use its potential responsibly. However as with all technology, it is important to understand the constraints, and

not accept everything without thought. Notwithstanding, the current AI systems do not replace human thought processes and expertise (Brink, 2024). We need to AI use sensibly and ethically; authors should not hide behind text generated by computers.

Who knows what the future might hold, but with Ai society is venturing into the unknown!

7. Recommendations for the Use of AI in Publishing

There are certainly conflicting views surrounding the use of AI in publishing. What are the possibilities?

7.1. Ban the Use of AI in Publishing

This scenario is a nonstarter insofar as AI is already used – sometimes unknowingly- for various functions in publishing from the author checking spelling and grammar to the publisher looking for evidence of plagiarism and choosing referees. One compromise approach would be to define exactly what aspects of AI may be used in the preparation of manuscripts. Of course, this will be a fluid situation reflecting and responding to all the new developments in AI.

7.2. Include AI in the List of Co-authors

AI would qualify for authorship according to the criteria for many journals! However, some publishers have already concluded that AI must not be included as authors of articles (Sample, 2023) although this is not universally agreed (Stokel-Walker, 2023). In practise, AI could surely not respond meaningfully to questions from other authors – or could it! It would be an interesting scenario insofar as an author AI could suddenly have impressive numbers of publications and citation indices.

7.3. Ensure that AI is Mentioned in the Acknowledgements

This is the most reasonable and practical outcome, i.e. authors must clearly acknowledge the precise contribution of AI to the science and publication. However, considering that many readers do not look at the acknowledgements, a separate clearly identified category entitled “Use of Artificial Intelligence” could be introduced in the manuscript immediately below the list of authors and their contact details.

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Reconstruction Methods in Lip Cancer - Case Report

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Abstract

Lip cancer tends to become an increasingly important public health problem with an increasing incidence globally. In Europe, lip carcinoma has an incidence of 12%, the overall prevalence being 1-2%. Men are significantly more affected than women, with some studies showing a ratio of 5-8:1. The predominant location is the lower lip (85-95%). Case presentation: A 74-year-old man from the countryside, with frequent and prolonged exposure to solar radiation, a smoker for over 40 years, a chronic consumer of ethyl alcohol, presents an ulcerated, foul-smelling exophytic polypoid tumor formation on the lower lip modified that occupy the entire thickness and the entire length of the lip, except for 1.5 cm from the right commissure, of a hard consistency, relatively well defined, adherent to the adjacent planes, covered by lympho-hematous crusts, painless spontaneously or on palpation. The probable diagnosis is extensive cutaneous squamous carcinoma of the lower lip, with bilateral submandibular adenopathy. Surgical excision of the tumor formation is performed through an incision of the entire thickness of the lip with an excision margin of 1 cm from the apparent edges. After the complete excision of the tumor results in a defect covering approximately the entire surface of the lower lip and the left commissure, which is why two types of flaps are combined, respectively a Karapandzic type flap on the right side and a Nasogenian flap on the left side. No intra- or postoperative complications were recorded. The evolution was favorable, with good functional and aesthetic results. The histopathological result confirmed well-differentiated squamous carcinoma – G1 of the lower lip with bilateral submandibular adenopathies, thus falling into the TNM classification as pT3Nx.

Keywords: Carcinoma, Lip, Reconstruction Methods.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Variation in Bark Thickness of *Pinus sylvestris* L. in Kastamonu Region of Türkiye

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Abstract

Although bark is not as valuable as stem wood economically, it is very important to determine the bark volume of trees since the volume of woody products in forestry are estimated without bark. On the other hand, since tree bark is an important non-wood forest product used in industrial sectors such as pharmacology, perfumery, wood industry, energy, etc., accurate estimation of the bark amount is also important in terms of revealing its economic value. Bark thickness varies according to tree-level characteristics such as tree species, diameter and height as well as stand characteristics like site index, stand density and age. In this study, the variation of bark thickness at breast height of Scots pine trees in Kastamonu region in terms of diameter at breast height and height of trees and site index, density and age of the stands was investigated. The data obtained from 270 sample plots were used and the relationships between bark thickness and tree- and stand-level characteristics were revealed by statistical analyzes. The study results showed that tree- and stand-level characteristics had a statistically significant (p<0.05) effect on the bark thickness of Scots pine trees. Developing bark thickness models was also aimed in the study, and single-entry bark thickness equations were fitted. In single-entry bark thickness models, diameter at breast height was used as the independent variable.

Keywords: Diameter Over Bark, Scots Pine, Stand Characteristics.

1. Introduction

Forests, as self-sustaining natural resources, provide not only economic benefits but also ecological and socio-cultural advantages. Additionally, trees represent a fundamental component of forests. A variety of products can be derived from trees, including wood, bark, tannin, resin, and seeds (Atıcı, 2009). The protective function of tree bark is to safeguard the tree stem from external factors, including extreme climatic conditions, fire, and insect infestation. It is also a significant non-wood product in many fields, including landscaping and medicine (Sönmez et al., 2016). Estimating thickness of the bark is also important in terms of studying forest growth and yield. The accurate assessment of volume of timber and its value is contingent upon an understanding of bark thickness (Meyer, 1946). Although bark is not as valuable as stem wood economically, it is very important to determine the bark volume of trees since the volume of woody products are estimated without bark (Sönmez et al., 2007).

For some coniferous species, it has been demonstrated that bark thickness can be effectively characterized by tree-level characteristics, such as tree species, diameter outside the bark, tree age, and total tree height (Sönmez et al., 2007; Li and Weiskittel 2011; Stängle et al. 2017). Moreover, bark

thickness varies according to stand-level characteristics like site index, diameter class, stand density and stand age (Carus and Çatal, 2010; Cellini et al. 2012; Eler, 2013; Sakıcı et al. 2018). There are various studies investigating the effects of various tree- and stand-level characteristics on bark thickness. Bark thickness relationships were investigated by Durkaya and Durkaya (2003) for Uludag fir, Scots pine and beech, by Sönmez et al. (2007) for spruce, by Atıcı (2009) and Carus and Çatal (2010) for beech, by Kahriman et al. (2016) for Calabrian pine, and by Sakıcı et al. (2018) for Crimean pine.

The purpose of present study was (*i*) to determine the effects of diameter at breast height and tree height, and (*ii*) of forest stand parameters such as mean diameter, stand age, site index, and stand density on bark thickness at breast height of Scots pine in Kastamonu region of Türkiye and (*iii*) to develop single−entry bark thickness model.

2. Materials and Methods

This research was carried out in pure and productive Scots pine stands in the Kastamonu region. Study area is situated in the western Black Sea region of Türkiye (Figure 1). The region is notable for its extensive forest cover, with a total area of 0.88 million ha. Furthermore, the total growing stock in the region is estimated at 144 million m^3 (General Directorate of Forestry, 2023).

The data analyzed in this study was gathered from 270 temporary sample plots featuring a variety of stand ages, site index, and stand densities within even-aged, pure, and natural stands of Scots pine (*Pinus sylvestris* L.). The sample plot sizes ranged from 400 m² and 1200 m² depending on stand crown closure. In each sample plot, the diameters at breast height (*dbh*) of all trees with a *dbh* more than 8 cm were measured using a caliper with a precision of 0.1 cm, and quadratic mean diameters were calculated. Then, bark thickness, age and height of 7-8 trees with diameters close to the mean diameter were measured in each sample plot. For bark thickness measurements at breast height, a metric bark gauge was used with a precision of 1 mm and measurements were taken at two points. Two bark thickness measurements were taken at right angles to each other, and the bark thickness values were calculated by averaging these measurements. The double bark thickness was determined as twice the average bark thickness. In the subsequent step, stand age, site index, and stand density were calculated for each sample plot.

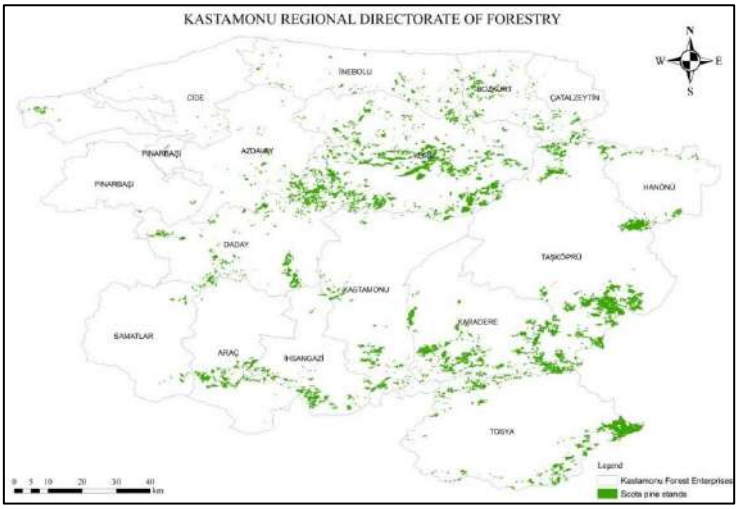


Figure 1. Study area.

The data obtained from 2146 trees across 270 sample plots were used and the relationships between bark thickness and tree- and stand-level characteristics were revealed by statistical analyzes. The dataset (*n*=2146 sample trees) was divided into two groups: a modelling dataset (*n*=1717, 80% of total data) used to develop the double bark thickness equations and a control dataset (*n*=429, 20% of total data) used to test the applicability of these equations to Scots pine stands. Descriptive statistics, including the mean, minimum, maximum, and standard deviation, for tree characteristics such as double bark thickness, diameter at breast height, and tree height are presented in Table 1. Additionally, descriptive statistics for stand-level characteristics, including stand age, site index, stand density, and mean diameter, are provided in Table 2.

Table 1. Descriptive statistics of tree characteristics.

Data Group	Tree Characteristics	Mean	Std. Dev.	Min.	Max.
Modelling data (*n*=1717)	Bark thickness (mm)	36,6	13,8	8,0	90,0
	Diameter at breast height (cm)	27,9	11,0	8,0	69,5
	Tree height (m)	16,9	5,3	5,7	29,4
Control data (*n*=429)	Bark thickness (mm)	36,9	13,7	10,0	88,0
	Diameter at breast height (cm)	27,8	10,9	8,0	60,8
	Tree height (m)	16,8	5,2	5,7	29,4
Total data (*n*=2146)	Bark thickness (mm)	36,7	13,8	8,0	90,0
	Diameter at breast height (cm)	27,9	10,9	8,0	69,5
	Tree height (m)	16,9	5,2	5,7	29,4

Table 2. Descriptive statistics of stand characteristics (*n*=270 sample plots).

Stand Characteristics	Mean	Std. Dev.	Min.	Max.
Mean diameter (cm)	26,2	9,9	9,1	55,7
Stand age (year)	68,3	29,5	19	149
Site index (m)	24,9	4,9	12,3	38,2
Stand density	8,09	3,06	2,48	19,57

The correlation analysis was conducted to investigate whether there is a significant relationship between the bark thickness and tree- and stand-level characteristics. Additionally, parameters for ten single-entry models were estimated to model the relationship between diameter at breast height and bark thickness (Table 3). The analyses were conducted using the IBM SPSS Statistics 23 software.

Table 3. Models tested.

Model	Equation
Linear	$BT = b_0 + b_1 dbh$
Logarithmic	$BT = b_0 + b_1 \ln dbh$
Inverse	$BT = b_0 + \frac{b_1}{dbh}$
Quadratic	$BT = b_0 + b_1 dbh + b_2 dbh^2$
Cubic	$BT = b_0 + b_1 dbh + b_2 dbh^2 + b_3 dbh^3$
Compound	$BT = b_0 * {b_1}^{dbh}$
Power	$BT = b_0 * dbh^{b_1}$
S-curve	$BT = e^{b_0 + \frac{b_1}{dbh}}$
Growth	$BT = e^{b_0 + b_1 dbh}$
Exponential	$BT = b_0 * e^{b_1 dbh}$

BT= Bark thickness, *dbh*= Diameter at breast height, b_o, b_1, b_2, b_3=model parameters.

In order to evaluate the fitted models and select the most predictive ones, the coefficient of determination (R^2) was employed as follows:

$$R^2 = 1 - \frac{\sum(y_i - \hat{y}_i)^2}{\sum(y_i - \bar{y})^2}$$

Where y_i, $\hat{y}_i$ and $\bar{y}$ are the observed, predicted, and mean values of the dependent variable, respectively.

The validity of the developed equations was tested using the Wilcoxon test by comparing the observed and predicted bark thickness values of the sample trees in the control group.

3. Results and Discussion

The variation of bark thickness in relation to tree- and stand-level characteristics is illustrated in Figure 2 and Figure 3, respectively. Within the scope of the study, the correlations between bark thickness and tree- and stand-level characteristics were examined, and the results are presented in Table 4.

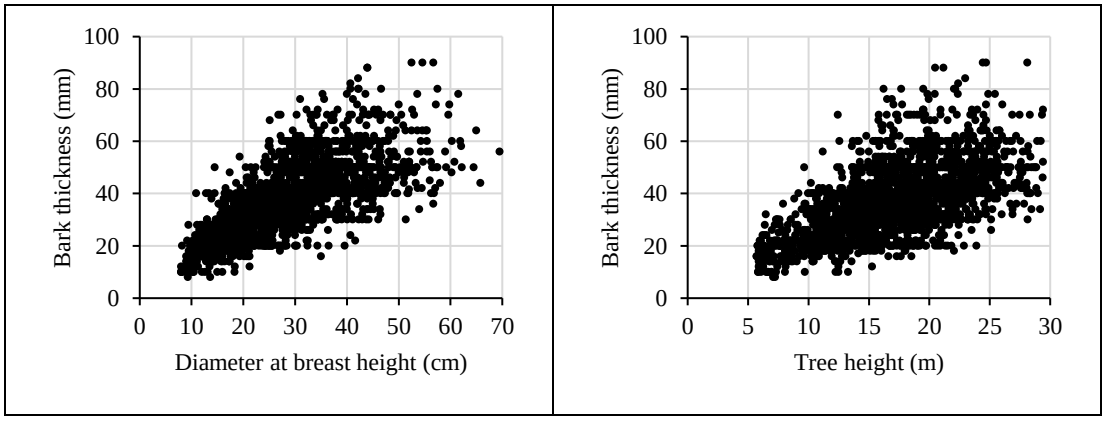


Figure 2. Variation of bark thickness according to tree characteristics.

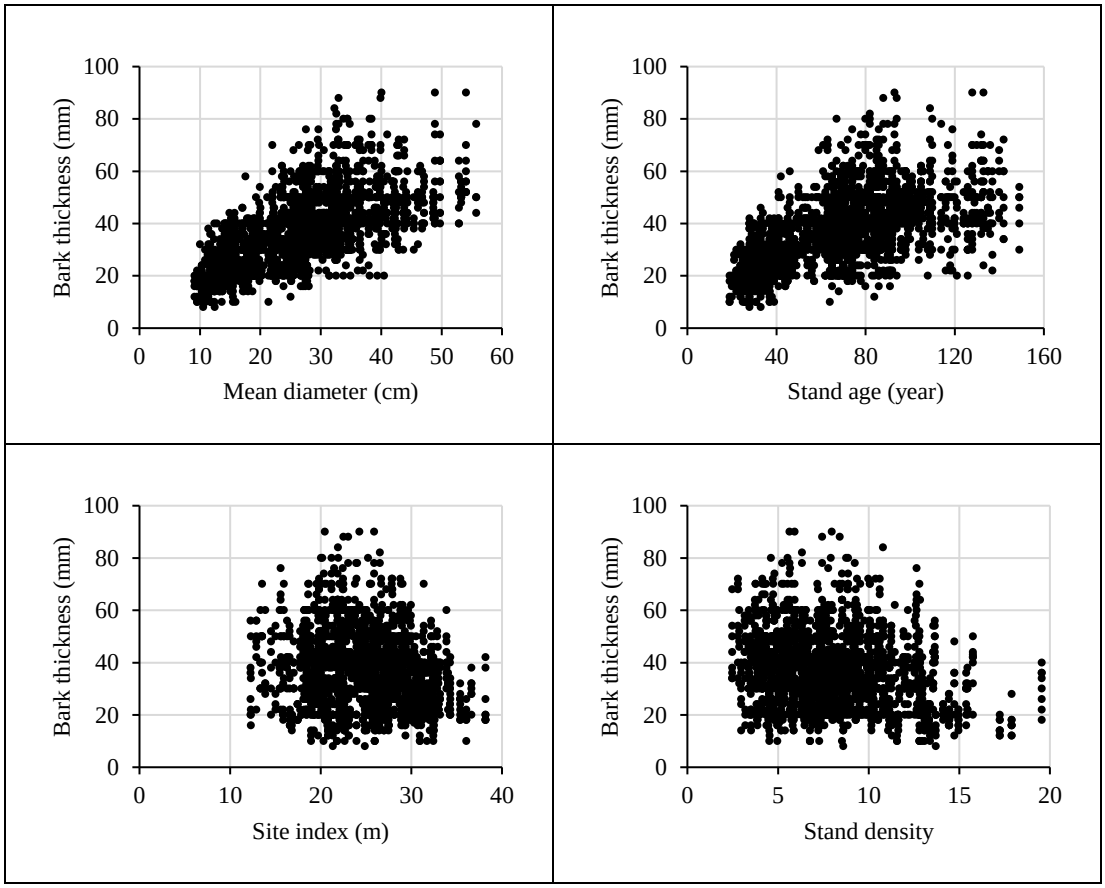


Figure 3. Variation of bark thickness according to stand characteristics.

Table 4. Correlations between bark thickness and individual tree/stand characteristics.

	Tree and Stand Characteristics	***r***	***p***
Bark thickness (mm)	Diameter at breast height (cm)	0,776	<0,001
	Tree height (m)	0,647	<0,001
	Mean diameter (cm)	0,700	<0,001
	Stand age (year)	0,647	<0,001
	Site index (m)	-0,203	<0,001
	Stand density	-0,176	<0,001

The parameter estimates and R^2 values for the bark thickness equations developed using regression analysis are given in Table 5. As shown in the table, all equations are significant in terms of bark thickness estimations (p<0.05). Furthermore, all coefficients of the equations were statistically significant at the 0.05 level. It was found that the bark thickness models explained approximately 50.4% to 60.6% of the total variance in the diameter-bark thickness relationship at breast height. Considering all statistics, Power model was selected to be the best predictive model for diameter−bark thickness relationship at breast height, with the highest R^2. Figure 4 shows the Power model curve modeling the relationship between diameter and bark thickness at breast height.

Table 5. Model summaries and parameter estimations.

Model	R^2	*p*	b_0	b_1	b_2	b_3
Linear	0,538	<0,001	10,9377	0,9219		
Logarithmic	0,557	<0,001	-44,3188	24,9367		
Inverse	0,504	<0,001	58,5706	-516,0224		
Quadratic	0,562	<0,001	-0,4932	1,7744	-0,0137	
Cubic	0,562	<0,001	-0,7882	1,8081	-0,0149	0,0001
Compound	0,543	<0,001	16,1459	1,0271		
Power	0,606	<0,001	2,9749	0,7504		
S-curve	0,595	<0,001	4,2136	-16,1699		
Growth	0,543	<0,001	2,7817	0,0267		
Exponential	0,543	<0,001	16,1459	0,0267		

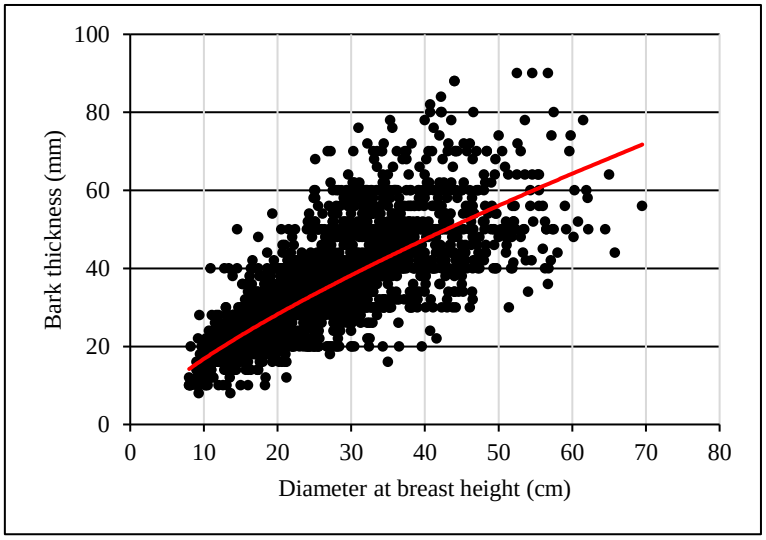


Figure 4. Fitting curve of the Power function.

In order to check the validity of the equations developed for bark thickness estimation, the predicted bark thickness values for 429 sample trees (control group data) were subjected to a comparison with the observed values of these trees using the Wilcoxon test. The results of the statistical analysis demonstrated that there was no statistical difference between the predicted and observed bark thickness values ($p>0.05$), indicating that the equations are suitable for the prediction of bark thickness in Scots pine trees in the region.

Statistical assessments revealed that the Power function was the most predictive model for bark thickness predictions. For this equation, the observed and predicted values of 429 sample trees in the control group were presented in Figure 5. As illustrated in the figure, there was no discernible trends in residuals. Also, the Power function for bark thickness predictions had biologically realistic curves.

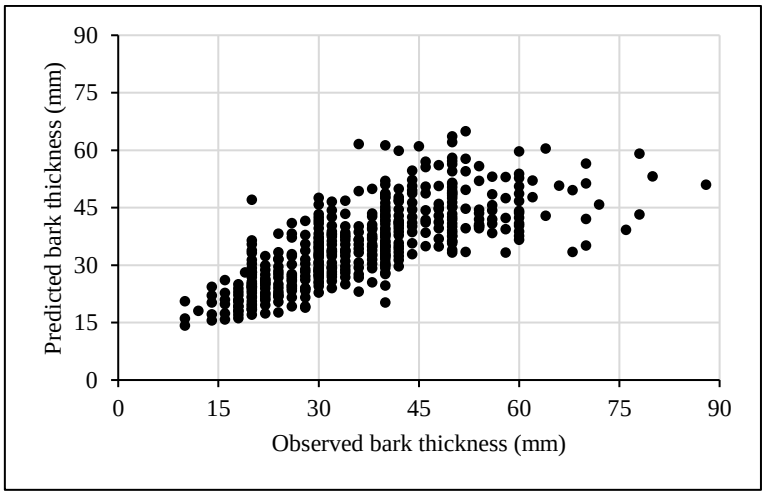


Figure 5. Observed vs. predicted bark thickness values for control data.

As a result of the evaluations, the best model is represented by the following mathematical formulation:

$BT = 2.9749\ dbh^{0.7504}$ (R^2=0.606)

Although there are several studies in the literature investigating the effects of various tree and stand characteristics on bark thickness, none have been found for *Pinus sylvestris* trees in the Kastamonu region of Türkiye. In the study conducted by Durkaya and Durkaya (2003) on Scots pine in the Zonguldak region, a very low correlation between diameter and bark thickness at breast height was observed (R^2 = 0.18), and bark thicknesses were not estimated using regression equation.

4. Conclusion

In this study, the variation of bark thickness at breast height of Scots pine trees in Kastamonu region in terms of diameter at breast height, height of trees and mean diameter, site index, density and ages of the stands was investigated. The study results showed that tree- and stand-level characteristics had a statistically significant (p<0.05) effect on the bark thickness of Scots pine trees. The diameter at breast height from tree characteristics has been identified to have the most significant effect on bark thickness. Additionally, mean diameter and stand age have shown meaningful effects on bark thickness as well. Consequently, it is recommended that stand characteristics be incorporated into future studies to enhance the reliability of the predictions.

The bark thickness is very important for a reliable estimation of the stem wood volume. For this reason, research on bark thickness is also economically significant. At the same time, bark thickness represents a valuable non-wood forest product used in many areas. In order to determine its economic value, there is a need for more studies on this subject.

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ORAL PRESENTATION

Is Clear Cutting an Ecologically Correct Preference in Turkish Red Pine (*Pinus brutia* Ten.)

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Abstract

Turkish red pine (*Pinus brutia* Ten.) forests are one of the most widely distributed forest ecosystems in Türkiye. *Pinus brutia* is important in terms of multi-purpose forestry and has high ecological value. It also represents the main source of timber products in some Mediterranean countries, especially in Türkiye and creates economic potential for the forestry sector. The clear-cutting method, which is suitable for Turkish red pine biology, is one of the regeneration methods used provided that ecological conditions are suitable. Clear-cutting is widely applied in forests operated for wood production in many parts of the world, because it allows working in large areas and is a fast method. However, it is stated that clear-cutting Turkish red pine forests are generally characterized by relatively less structural and compositional diversity, and that this causes the biodiversity, habitat functions and ecological durability of these forests to decrease. In this case, there is concern about how intensive management activities affect biodiversity. At the same time, clear-cutting is not a method that can imitate nature one hundred percent. Because silvicultural practices carried out within the understanding of forestry suitable for nature are primarily based on protecting biodiversity and ecological balance. Although clear-cutting seems to be a similar and correct method in terms of regeneration of Turkish red pine by fire in the natural process, it creates significant differences in terms of composition of regeneration, species richness, ecosystem biodiversity and carbon storage and sequestration. In this case, it should be revealed how and in what way all components of the ecosystem are affected by the negative situations in this system, not only for Turkish red pine individuals, in terms of sustainable forest management. In particular, it should be evaluated how ecologically correct clear-cutting studies carried out in these areas without any consideration for flora and fauna are. Sustainable practices are of critical importance to reduce these effects in Turkish red pine forests and when considering wood production, it is necessary to minimize ecological damage. Today, in deciding on forestry activities and silvicultural interventions carried out for sustainable management of forests, protecting and developing biodiversity is taken as a basis, in addition to other forestry objectives. On the other hand, it is inevitable to continue the current natural regeneration practices in the Turkish red pine species, which provides a significant portion of our country's wood needs. Therefore, it is necessary to reduce this negative effect of clear-cutting on the ecosystem and develop alternative silvicultural systems. In addition, climate change, which makes its effect felt more each passing day, is now questioning ecologically inappropriate forestry practices. In this study, the effects of clear-cutting on flora and fauna in Turkish red pine forest ecosystems were investigated. In the regeneration of Turkish red pine forests; ecologically alternative methods that are based on natural processes, perceive the ecosystem as a whole and encourage the diversity of the forest were proposed.

Keywords: *Pinus brutia* Ten, Clear-cutting, Biodiversity, Silviculture, Sustainable Forestry.

1. Introduction

Forest ecosystems contribute to human well-being and economy through the benefits and complex ecosystem services they provide (Taye et al., 2022; Raihan, 2023). However, although forests are considered as the main sources of ecosystem services, they are constantly threatened or degraded by anthropogenic impacts (Foley et al., 2005) such as global climate change (Lindner et al., 2010), land use change (Deng et al., 2013) and unsustainable management practices (Haberl et al., 2007). Therefore, many basic values in forests, including forest biodiversity and forest carbon stocks, are under threat and are rapidly decreasing (Butchart et al. 2010; Saatchi et al., 2011). Therefore, this decrease in biodiversity indirectly affects other services and functions provided by the forest ecosystem. Because there is an important relationship between the services and functions provided by the ecosystem and biodiversity. As biodiversity increases, there is an increase in the products and services provided by the ecosystem (Tilman et al., 1997; Simberloff, 1999). In addition, diversity in nature is an indicator of forest health and resilience (Chavez & Macdonald, 2012; Zhang et al., 2015).

Increasing scientific evidence suggests that biodiversity is an indicator of various ecosystem functions and services that are essential for sustaining human well-being (Cardinale et al., 2012). Forest biodiversity can be viewed as key to life-sustaining ecological services such as primary production, nutrient cycling, soil formation, microclimate regulation, pollution abatement, carbon sequestration, food supply and maintenance of ecosystem resilience (Schuler et al., 2017; Gamfeldt vd., 2013; Ammer, 2019). Therefore, sustainable and consistent provision of multiple ecosystem services by forests requires more knowledge about biodiversity in these complex ecosystems and a better understanding of the roles of biodiversity component.

The management of forests with traditional forest management approaches for many years has resulted in the disregard of other products and benefits that are important components of biodiversity. At the same time, the management of forests to focus on maximizing a single ecosystem service has led to the creation of a simple management plan that does not take into account environmental conditions and environmental change (Albrich et al., 2018). In this case, one of the most discussed issues has been the simplification of forest structure and composition within the scope of intensive wood production (Puettmann et al., 2009). In particular, the decrease in biodiversity is the cause of the lack of complexity that occurs in forest areas and forest landscapes, and this has resulted in a decrease in basic environmental services (Thompson et al. 2011). Traditional forest management plans, especially those implemented in enterprise forests, have accelerated the loss of biodiversity and increased the pressure on protected areas. For this reason, the protection of biodiversity in forests outside protected areas is at least as important as in protected areas. However, incorrect forestry practices have reduced the biological and genetic diversity of forests in Türkiye. Forests are still perceived as wood raw material production areas and attempts are made to reconcile them with the concepts of ecological sustainability and biodiversity (Lahde et al., 1999). However, the determining criteria in the operation of the ecosystem are ecological functions (Sayer et al., 2004) and biological characteristics. In this context, many perspectives have developed with the need to perceive and evaluate forest ecosystems in their most natural form. Because close-to-nature forestry is a management approach that considers the forest as a multifunctional ecological system. Close-to-nature silviculture, on the other hand, tries to achieve management goals with the minimum necessary human intervention, aiming to accelerate processes that nature would do more slowly on its own. Today, the aim of modern forest management is not only timber production but also the protection of biodiversity (Česonienė et al., 2019). Forestry is increasingly

focusing on multiple values rather than just timber production. However, one of the important issues in forests operated outside protected areas, especially for the purpose of carrying out various forestry activities, is the concern about biodiversity (Bengtsson et al., 2000; Lindenmayer & Franklin, 2002). In Sustainable Forest Management (SFM), therefore, it is vital to address the issue of biodiversity conservation within the framework of active forestry (Mann et al., 2022). One of the goals of Sustainable Forest Management is to prevent the decline in biodiversity that may occur as a result of timber harvesting. SFM aims to protect ecological processes, biodiversity and improve natural regeneration throughout forest areas (Moore & Allen, 1999; Ito et al., 2006). The most appropriate planning approach that ensures sustainable management in forests in our country is Ecosystem-Based Multi-Purpose Planning. It is a planning approach that focuses on the sustainability of biodiversity, production, regeneration capacity, vitality and the adequacy of ecological, economic and sociocultural functions of forest ecosystems without harming their long-term balance (Özçelik, 2006).

In recent years, emphasis has been placed on management approaches closer to natural dynamics in order to ensure sustainable management of forest ecosystems (Kuuluvainen, 2002; Gauthier et al., 2009). Because forestry close to nature is a management approach that considers the forest as a multifunctional ecological system. The correct use of sustainable management can only be achieved by a nature-oriented forestry. Silvicultural interventions carried out to protect or improve long-term natural forest productivity should be an integral part of SFM (Günter et al., 2012). In this context, all silvicultural interventions to be carried out in the forest should first of all be of a nature that will protect the natural structure, biological diversity and the balance of the existing ecosystem. In fact, such a silvicultural approach is called Close-to-Nature Silviculture. Close-to-nature silviculture attempts to achieve management objectives with the minimum necessary human intervention, aiming to accelerate processes that nature would do more slowly on its own (Odabaşı & Özalp, 1994).

Understanding the effects of forestry practices on biodiversity and related ecosystem processes is essential for developing sustainable forest management approaches. Because the forest ecosystem is a complex system consisting of soil, trees, understory plants, animals, insects, etc. (Česonienė et al., 2019). Therefore, it is important to evaluate the responses of individual elements and their adaptation to changing ecological conditions, such as after clear-cutting. It is well known that the practices carried out in the forest and the intensity of these practices strongly affect the dynamics and structure of forests by affecting the microclimate, light availability, and soil conditions due to changes in the upper layer structure (Flores et al., 2019). In this case, the changes in the ecological conditions of forests have a strong impact, both directly and indirectly, on the suitable conditions for the establishment of flora species and thus on their composition. It is also stated that the habitat conditions and breeding conditions of wild animals will be affected to a greater or lesser extent depending on the forestry activities and intensity (Akdemir & Özdemir, 2015).

In this study, the effects of clear-cutting on the forest ecosystem were evaluated within forestry systems. In particular, considering the possible effects of clear-cutting on flora and fauna in red pine forests, alternative approaches for protection and sustainability were proposed.

1.1. Turkish Red Pine (*Pinus brutia* Ten.)

Turkish red pine (*Pinus brutia* Ten.) forests are the most widespread forest ecosystems in Türkiye. *Pinus brutia* is a species that is well adapted to the Mediterranean type climate in terms of various physiological and morphological characteristics and is resistant to drought (Dafis, 1986; Korakis, 2019).

It has the ability to regenerate itself after forest fires (Fischer et al. 2008). It generally establishes pure and single-layered forests depending on ecological conditions (drought) and biology (light demand). The ability of red pine to grow in a wide variety of soils and altitudes, its high growth rate and high productivity potential have made it one of the most promising pine species in the Mediterranean basin (Shater et al., 2011).

Pinus brutia forests are important for multi-purpose forestry and have high ecological value (Panetsos, 1985). It also represents the main source of timber products in some Mediterranean countries, especially in Türkiye, and creates economic potential for the forestry sector (Fischer et al. 2008; Shater et al., 2011). Red pine is the most widely used main forest tree species in Türkiye in terms of meeting wood raw material needs. Wood obtained from *P. brutia* forests is used in construction, industry, furniture, fuelwood, charcoal production and as pulp (Petrakis et al. 2007; Tolunay et al. 2008). In addition, many non-wood forest products such as honey, mushroom, resin and aromatic and medicinal plants obtained from red pine forests are important in socio-economic terms (Sabra & Walter 2001; Yeşil et al., 2005; Satil et al., 2011). In addition to the direct benefits provided by red pine forests, important environmental and ecological benefits such as biodiversity conservation, carbon sequestration, climate change mitigation and adaptation, soil stabilization, wildlife habitat, water resource protection, erosion prevention, and recreation require special attention (Fischer et al. 2008; Keten & Gülsoy 2020). Like most Mediterranean ecosystems, *P. brutia* forests are fragile and vulnerable ecosystems historically affected by intense anthropogenic pressure and harsh climatic conditions. Considering the global changes in climate, land uses, societies, and lifestyles, *Pinus brutia* forests need to be managed appropriately and adaptively to meet social demands for forest goods and services at multiple scales (global, regional, and local). The wide geographical distribution of the species in our country and the different ecological conditions that arise as a result should be taken into account in the development of strategies for management and planning, and should be investigated in a multifaceted manner against possible threats. It also represents the main source of timber products in some Mediterranean countries, especially in Türkiye, and creates economic potential for the forestry sector.

Given the complexity and multifunctionality that characterize *P. brutia* forests, it is necessary to manage forests and implement practices that primarily take into account ecological functions to ensure the provision of multiple wood and non-wood forest products and ecosystem services in a changing world. Since Turkish red pine forests are complex adaptive systems facing ecological and socioeconomic changes, ensuring their sustainable management can be achieved by balancing economic gains with ecological impacts (Messier et al. 2013).

1.2. Clear-cutting Operation in Red Pine (*Pinus brutia* Ten.)

Clearcutting is one of the most widespread regeneration methods worldwide due to its economic profitability (Duguid & Ashton 2013). This is largely based on economic considerations such as cheap felling and quality timber (Keenan & Kimmins, 1993). It is also preferred in early succession, fast growing and easily regenerating species. Clearcutting is a management method based on the simultaneous cutting of old trees on an area and their subsequent regeneration, usually by seeding (flying), sowing or planting. Clearcutting, which is suitable for red pine biology, is the most commonly used regeneration method in Türkiye, provided that ecological conditions are suitable. The rapid growth of red pine (*Pinus brutia* Ten.) and the fact that it is a species that is rarely encountered with regeneration problems, bring about intensive management activities in red pine forests (Akdemir & Özdemir, 2015).

It is stated that clearcutting carried out in red pine forests for the purpose of wood production in our country simplifies the forest structure by making it homogeneous. Compared to mature forest, clearcutting causes significant changes in microclimate, resulting in changes in ecosystem biodiversity, resilience and carbon balance (Bradshaw et al., 2009). The effects of clearcutting vary considerably depending on site conditions (such as climate, geology and topography) and the structure and composition of the forest, the extent and distribution of harvest, the method used to remove logs and their size (Keenan & Kimmins, 1993).

Natural ecosystem dynamics support self-organizing heterogeneity and diversity which are fundamental to maintaining healthy, diverse and resilient ecosystems (Gauthier et al., 2015; IPBES, 2019). This feature contrasts with structurally and functionally homogenized forests, which are often managed for high yields in wood production. This is the fundamental distinction between natural and anthropogenic systems. It reflects the eternal dilemma between exploitation or conservation. To overcome this dilemma and ensure the long-term sustainability of forest management (Castañeda, 2000), it is necessary to find a balance between the two. This depends on the balance in forest management between management system designs that promote the production of specific goods and services and natural ecosystem designs characterized by self-organizing features such as heterogeneity, biodiversity, resilience and adaptive capacity (Kusumoto et al., 2020; Kuuluvainen, 2021).

Clearcutting is a practice that has been criticized for its negative effects on biodiversity and the environment. It is a controversial practice that is widely applied in forests operated for wood production, especially in Turkish Red Pine. Clearcutting changes natural ecosystem dynamics. In this case, it simplifies the structural and compositional complexity of the forest and causes a decrease in the biodiversity, habitat functions and ecological resilience of these forests (Lindenmayer & Franklin 2002; Puettmann et al., 2009; Lindenmayer et al., 2012). Other concerns about this technique are the potential harmful effects on soil erosion (Iroumé, 2006), nutrient cycling (Prescott, 1997), wildlife habitat (Mannan & Meslow, 1984), alien invasions (Selmants & Knight, 2003) and aesthetics (Levine and Langenau, 1979).

In order to survive in ecosystems subject to repeated clear-cutting in the Mediterranean Basin, all living organisms in the ecosystem must be resistant to it. Clear-cutting abruptly removes the forest cover and causes qualitative and quantitative changes in light (Federer & Tanner, 1966), temperature and moisture (Collins & Pickett, 1987; Chen et al., 1993) in the understory, as well as changes in chemical and microbiological soil properties (Kropp & Albee, 1996). Some microhabitats of the stand are also affected by maintenance cutting after clear-cutting.

Degradation of natural forests is caused by factors such as fire, windfall, insects and fungi, and occurs at varying spatial scales, from the death of single-grown trees to the death of groups of trees and large-scale impacts (Kuuluvainen et al., 2021). Clearcutting is similar to fire in that it abruptly removes forest cover, causes changes in microclimate (Keenan & Kimmins, 1993), and changes the structure and age of the forest landscape with a large increase in young, even-grown forests and a decrease in old-growth forests (Kuuluvainen & Gauthier, 2018). However, there are distinct differences between the two types of degradation in the composition of regeneration (Heikkala et al., 2014), woody debris (Hamalainen et al., 2016), impact on ecosystem biodiversity (Martin et al., 2021), and carbon storage and sequestration (Seedre et al., 2011). At the same time, unlike natural disturbances, clearcutting reduces old forest areas and thus causes a decrease in the basic structures (standing dead, old trees, rotten logs, dead wood,

hollow trees, wood residues, shrubs, etc.) that are vital for species in protecting and maintaining biodiversity in old stands (Özkan & Özdemir, 2016). Therefore, many "biological heritages" that constitute structural diversity remain in place after natural disturbances such as fires and storms, and the resulting structural complexity plays an important role in the functioning of the forest ecosystem and biodiversity (Lindenmayer & Franklin, 2002). Therefore, if structural features of old forests such as live and dead trees, logs, standing dead trees of various sizes are consciously preserved in the clearcuts, the similarity between clearcutting and natural disturbances can be increased (Franklin et al., 1997; Beese et al., 2003). This ecological approach is important for ensuring the continuity of ecosystem structure, function and species composition in the forest after clearcutting. Therefore, the results of studies on natural degradation processes and their effects should be taken as reference for management systems that aim to maintain biodiversity and ecosystem productivity.

2. Results and Discussion

One of the main goals of sustainable forestry is to protect plants and animals, which are important components of biodiversity. Therefore, silvicultural practices that take into account the natural dynamic structure are very important for the sustainable management of forests (Günter et al., 2012). The basic philosophy to be adopted in the forestry systems to be implemented here is to know that forests do not consist of trees that are viewed only as timber, but also that they form a complex ecosystem with the interaction of many living and non-living entities. For plans to be made for the protection and sustainability of biodiversity, it is necessary to first reveal the effects that forestry activities will have on species. Therefore, the effects of clear-cutting, which has been a debated practice for many years in the Red Pine (*Pinus brutia* Ten.) forest ecosystem in our country, on biodiversity have been investigated.

Since all the trees in the area are cut down indiscriminately with clear-cutting, it is important to evaluate the reactions of the individual elements that make up the forest and their adaptation to the changing ecological conditions after clear-cutting. It is suspected that some species are inadequately adapted to maintain healthy populations in anthropogenic environments. While some species can adapt to these areas after clear-cutting, species that require specific conditions for survival are negatively affected by the dramatic landscape changes caused by clear-cutting. In a study investigating different forestry systems on songbird species, it was noted that the species lost were generally typical of mature forest habitats (Harrison et al., 2005). Forestry practices cause temporal and spatial changes in wildlife habitat in particular (Lyang & Lee, 2010). These changes in wildlife habitat use can affect the distribution and microhabitat use of a species (Kang et al., 2013; Escobar et al. 2015). While clear-cutting changes some species in that area, others are not affected. Forest structures that change due to clear-cutting may restrict forest species adapted to closed forest conditions. However, it may positively affect some species due to abundant regeneration and the resulting food availability. Gagné et al. (2016) reported that the decrease in forest cover in the cleared area reduced habitat use by *Rangifer tarandus*, but the increase in regeneration in the cleared area supported habitat use by *Alces alces.* Again, Thornton et al. (2012) reported that there was a decrease in rabbit abundance because there was not enough vegetation for *Lepus americanus* in cleared areas. In addition, the cutting of trees, especially in the upper layer, also affects the plants in the lower layer. A significant decrease in plant biomass occurs in the lower layer, which in turn affects the decrease in nutrient pools in cleared areas. For example, there was a decrease in the biomass of *V. myrtillus* L. after clear-cutting (Palviainen et al. 2005). At the same time, the forest understory is important due to its ability to provide food and cover for animals. In addition, the plants that form the understory in particular are indicators of forest health. In a study conducted in Western

Mediterranean Red Pine forests, the effect of clear-cutting on bird species richness and abundance was investigated and it was revealed that clear-cutting affected the composition of bird species. It has also been determined that some of the bird species in the region are only observed in old stands (Akdemir & Özdemir, 2015). In addition, many shrub species that appear in newly clear-cut areas in the first years increase stand diversity and can also provide habitat for many animals.

Old stand features have rich structural features in terms of habitat, reproduction and food areas for many wild animals. However, natural regeneration studies cause the loss of some old stand features. The hollows and trunks of standing dry trees in old forests provide a home for *Chalinolobus tuberculatus*, which is under threat of extinction (Allen et al., 2003). A large number of dead trees in the forest provide habitat for butterflies, insects, fungi and saprophytic plants. The disappearance of these species in Scandinavian forests is related to the removal of dead trees and production residues (Siitonen & Martikainen, 1994). Despite the negative situations caused by clear-cutting, the increasing demand for wood shows that production will continue with this method in Red Pine forest ecosystems. Therefore, there is a need to establish a balance between the goals of protecting biodiversity and wood production. Based on this idea, the method of implementing management activities by imitating natural destructive factors should be preferred (Seymour & White, 2002; Nyamai, 2020). Mimicry of natural destructive factors aims to achieve sustainability by gaining knowledge about natural forest dynamics and heterogeneity at multiple spatial and temporal scales and by making a rigorous assessment of how forest management affects ecosystem components. Therefore, ecologically alternative methods are suggested for the regeneration of red pine forests, which are based on natural processes, perceive the ecosystem as a whole and promote forest diversity. Retention forestry has been implemented in many countries in recent years. This approach aims to integrate biodiversity conservation with timber production and to maintain the provision of other ecosystem services by preserving important forest attributes, habitats and structures (Lindenmayer et al., 2012; Rosenvald & Lohmus, 2008). These elements intended to be protected may include both structures and areas such as single trees of particular ecological value, groups of trees, standing dead trees, fallen dead trees, etc. and areas with valuable habitats (e.g. flooded forests and buffer zones bordering waterways, lakes and wetlands). In addition, in the long term, it is important to accelerate the return to pre-harvest conditions and to preserve the features that increase the structural complexity of future stands (Franklin et al. 1997; Lindenmayer et al. 2006). In addition, instead of clear-cutting in large areas that homogenize the forest structure, harvesting should be done in smaller areas and old stand islands should be created (Asan & Özdemir, 2005; Rosenvald & Lohmus, 2008). Applications that mimic natural disturbances have gained popularity in recent years and their effectiveness is an important subject of forest research. With moderate treatments applied in a forest management compatible with nature, the yield that would be obtained from 20 hectares in a clear-cutting operation, for example, can be obtained from 40 hectares. However, this situation allows all stands to be maintained, damage from external factors to be minimized, the lower and intermediate floors to be protected, and the damage from sudden clearings to be eliminated Accordingly, the continuity of the habitat productivity that secures future production is ensured (Odabaşı & Özalp, 1994). As we work to increase the resilience and adaptive capacity of forest ecosystems around the world, it becomes clear that adopting and developing ecologically based forestry approaches is critical. Therefore, sustainable efforts should be made to create forests that are resilient to the effects of global climate change and to protect biodiversity.

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
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ORAL PRESENTATION

Microstructure Studies of Aluminum Alloys Produced by Extrusion Method

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Abstract

In this study, microstructure studies of two different aluminium alloys produced by the extrusion method, which is used in many areas today, were carried out. In the study, AA6061 and AA6063 alloys cast by the DC casting method were subjected to homogenisation heat treatment before extrusion to increase surface quality and mechanical property values in the material and ensure the homogeneous distribution of grains. The artificial ageing process was also applied to the samples produced using the extrusion production method. Optical microscope and scanning electron microscope investigations were performed on the test samples taken from the produced materials and the results were evaluated comparatively.

Keywords: Extrusion, Aluminium, Microstructure, AA6061, AA6063.

1. Introduction

Aluminum, which is used in a wide range of sectors in the industry with its lightness, durability and environmentalist properties, is a metal that is one of the basic materials that has become an indispensable element of modern life (Kumruoğlu, 2019).

One of the most important properties of aluminum is its lightness. Since its density is low, it is much lighter than other metals of the same volume. For this reason, it is an ideal choice for many applications. It provides an ideal lightness to reduce the weight of vehicles used in the logistics and automotive sector. Thanks to its light weight, fuel efficiency increases, emission emissions decrease and negative impacts on the environment are minimized. Another important feature of aluminum is its strength. The protective oxide layer that naturally forms in the outdoor environment creates a protective shield against rust and corrosion. Aluminum is a material that shows durability for a long time in outdoor and various weather conditions. Aluminum products such as structural components, roof coverings, door and window profiles used in the construction industry are preferred due to their durability and low maintenance requirements (Ayan, 2022).

The processability of aluminum also provides a great advantage over other materials. It can be produced in various shapes and forms through processes such as forging, rolling, extrusion and injection. Thanks to its easy processability, it offers a wide range in different sectors. Especially in the construction industry, profiles and panels are used in building facade cladding, roof systems and interior applications. In the automotive industry, it is used in car bodies, engine components and chassis. In the electrical and electronics industry, it is preferred in the production of cables, radiators and coolers thanks to its good electrical conductivity and heat dissipation properties.

Aluminum is an environmentally friendly material. With its high recyclability, aluminum can be reused and energy can be saved in this way. The recycling process greatly reduces the energy consumption required for aluminum production and plays an important role in protecting natural resources. The quality of recycled aluminum can be reused several times and the recycling cycle can be repeated (Pul and Özerkan, 2022).

In conclusion, aluminum is one of the most important materials in the modern world. It is widely preferred in many sectors thanks to its lightness, durability, processability and environmental properties. There are various applications of aluminum in the construction, automotive, electrical, electronics and packaging sectors.

In the future, it is inevitable that the areas of use of aluminum will expand even further and innovative applications will emerge. Advances in science and technology will further improve the properties of aluminum and play an important role in seizing new opportunities. Aluminum will continue to increase its diversity of uses in the modern world for a sustainable and innovative future.

This study focuses on the determination of the effects of extrusion speed on microstructure in the profile production process by extrusion method, which is one of the areas where aluminum is used extensively. In the study, EN AW 6061 and EN AW 6063 alloys, which are among the most frequently produced alloy groups, were produced by direct extrusion method. In the study, the temperature was determined as 450 ºC, extrusion speeds were determined as 10 m/min, 13 m/min and 15 m/min and 6 experiments were carried out at these parameters to determine the optimum production parameter in terms of microstructure.

2. Experimental Studies

In this study, EN AW 6061 and EN AW 6063 alloy aluminum profiles with T6 heat treatment were produced and the microstructures of the samples taken from the produced profiles were examined. Profile productions were carried out at Asist Alüminyum Profil San. ve Tic. A.Ş. and microstructural investigations were carried out at Gazi University, Faculty of Technology, Department of Metallurgical and Materials Engineering Laboratories.

2.1. Material

The chemical compositions of EN AW 6061 and EN AW 6063 alloy raw materials used in this study were determined according to TS EN 573-3 standard. Table 1 shows the chemical composition (spectral analysis) of EN AW 6061 and EN AW 6063 aluminum alloys that were cast.

Table 1. 6061 and 6063 alloy raw material spectral analysis results.

Element	EN AW 6061 Alloy	EN AW 6063 Alloy
Al	98,0	98,8
Si	0,636	0,430
Fe	0,217	0,175
Cu	0,199	0,0287
Mn	0,0499	0,0173
Mg	0,824	0,474
Zn	0,0109	0,0111
Cr	0,0066	0,0077
Ni	0,0065	0,0114
Ti	0,0143	0,0146
Be	0,0002	0,0002
Pb	0,0062	0,0065
V	0,0135	0,0135
Zr	0,0010	0,0010
Ga	0,0103	0,0110

2.2. Method

For the production of aluminum profile materials, the cast billets were first cast by DC casting and airslip method in the aluminum foundry of the enterprise. The aluminum raw materials, which came to the plant as scrap and pure aluminum, were thrown into the melting furnace at a temperature of 720°C to form liquid metal and produced by adding alloying elements suitable for the desired properties. After the desired alloy ratios were checked with the spectrometer device and the correct ratios were obtained in accordance with the relevant standards (TS EN 573-3), the casting process started.

The aluminum billets used in this study were produced with a diameter of 178 mm and a length of 6000 mm. Then the samples were subjected to homogenization process in heat treatment furnaces at temperatures of 560-580 °C for 10-12 hours in order to make the casting microstructure more homogeneous. After the homogenization process was completed, the samples were also subjected to cooling for 4 hours to preserve the grain structure. The billets produced in accordance with the plan of the study were then cut on a hot cutting saw to obtain aluminum wedges to obtain lengths suitable for the machine capacity. The length of the raw materials used in this study is 75 cm. Visuals representing the production process of aluminum billets by casting process are given in Figure 1.



Figure 1. Production of aluminum billets by casting process.

The preferred production method in this study is extrusion. Extrusion is a hot forming process in which the aluminum billets produced are heated at specified temperatures and passed through a mold with hydraulic pressure power. The mold to be used in sample production was heated in mold annealing furnaces for at least 3 hours. The ideal printing readiness temperature for the mold removed from the mold annealing furnace is 450 °C. The mold is placed on the mold bed (cassette) appropriately. In the extrusion process, a single-figure solid box profile mold was preferred because it is suitable for production and experimental sampling conditions. The container temperature was set at 420°C. The container clamping pressure was set to 200 bar and the main cylinder pressure was set to 165 bar when the flow regime was reached. Again, extrusion (printing) speeds were also changed in order to be suitable for the content of the study and production was carried out at three different speeds in total. The cooling rate, which has a direct effect on the mechanical properties of the profile, was measured as 95°C/min in this study. In order to determine the speed changes more accurately during the extrusion of the profile, changes were made by stopping the press for speed transitions. In this way, the speed transition zones were determined, the samples were prevented from mixing and the samples were classified separately by writing the experiment numbers on them.

In this study, in order to determine the effect of extrusion speed on production and material properties in the production of EN AW 6061 and EN AW 6063 materials by extrusion method at 450 ºC, the speeds were determined as 10 m/min, 13 m/min and 15 m/min. The temperature determined as 450 ºC is the first entry temperature of the cast billets into the mold. In this way, the experimental setup was created for the study in the order and parameters given in Table 2.

Table 2. Production sequence of test specimens and parameters.

Sequence No.	Test No.	Alloy	Temperature (°C)	Extrusion Speed (m/min)
1	61-1	EN AW 6061	450	10
2	61-2			13
3	61-3			15
4	63-1	EN AW 6063		10
5	63-2			13
6	63-3			15

The aluminum billet raw materials cut to the appropriate length on the hot cutting saw are first transported to the processing equipment by means of a transfer trolley. The processing process is carried out in order to prevent the aluminum billet from sticking to the equipment (punch) that presses at the end of printing. The billet transported to the loading by means of the transfer device is ready for the extrusion process. The mold to be commissioned is transported to the press outlet by means of cassette bearings. The billets are transported by loading between the back of the billet mold and the container. Then the container was closed and the billets were made ready for extrusion process. Extrusion started with the forward movement of the main cylinder horizontally. Ø178 mm and 750 mm long cast aluminum billets, including process wastes, were produced as box profiles with an average cross-sectional thickness of 2.5 mm and a length of 38000 mm. Visuals of the productions are given in Figure 2.

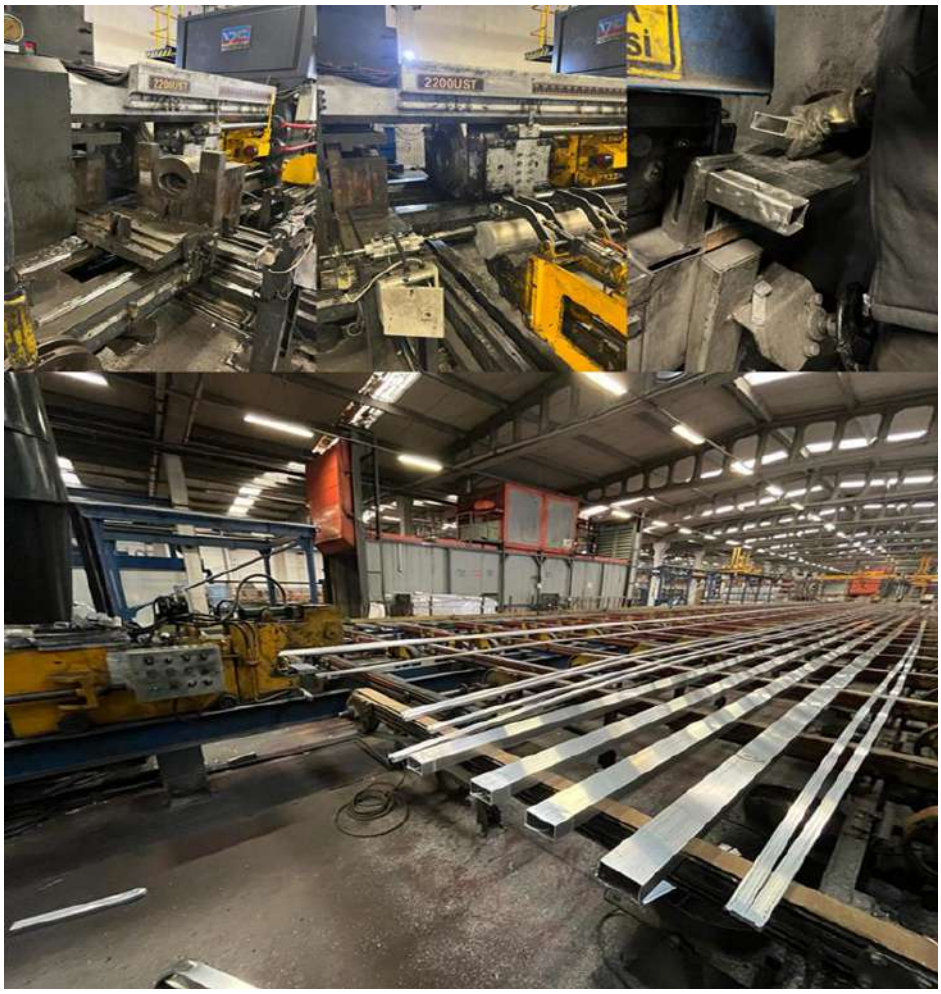


Figure 2. Profile production from aluminum billets by extrusion process.

At the press exit, the extruded aluminum profile is transported upstream to the tractor robot. After the tractor robot completes the process according to the profile weight and preferred raw material length, it transfers the profile to the next robot and returns to the cutting point to complete the production of the first length. As the second billet enters the press, a welding point is formed between it and the end point of the previous billet. Profile lengthening is based on this welding point. For the purpose of this study, each billet was called from the furnace at the appropriate parameter in order to change the parameters given in Table 5.1. After the production of the appropriate sample during pressing, a welding (splicing) point was obtained by stopping the press before switching to a different speed at the same temperature. This welding point was used to ensure that parameter transitions were not missed.

Extruded profiles were subjected to the stretching process after production in order to eliminate process errors such as curvature, fluctuation and deflection that may occur during the process, and were separated from each other by cutting at the speed separation points on the longitudinal saw. After the stretching process, the profiles were cut at the attachment points indicating the parameter changes and the test parameters were noted separately on each profile. The EN AW 6061 and EN AW 6063 aluminum profiles were then artificially aged under T6 heat treatment conditions for 8 hours at a temperature of 185 °C.

2.2.1 Preparation of samples

In this study, different aluminum alloys (EN AW 6061 and EN AW 6063) were produced at 450 °C and different extrusion speeds (10 m/min, 13 m/min, 15 m/min) and it was aimed to determine the effects of extrusion speed on the structure of the materials. In order to perform microstructure examinations of the samples produced under the specified parameters, the samples were first machined on CNC in appropriate dimensions and appropriate markings were made on them.

2.2.2. Microstructure investigations

Optical Microscope (OM) and Scanning Electron Microscope (SEM) analyses were performed within the scope of microstructure investigations of the samples. The internal structural changes caused by the extrusion speed in the samples taken from the produced profiles were examined and evaluated at this stage. In order to obtain the most suitable image for OM and SEM examinations, the surfaces of the bakelite embedded samples were polished and sanded. The surface roughness of the samples was eliminated gradually with 100, 200, 320, 400, 400, 500, 600, 800, 1200 and 2500 grit abrasives respectively. Then polishing was carried out with the help of 6 and 3 micron felt and solutions and the samples were dried with alcohol. For etching of the samples, 6 ml HCl, 8 ml HNO3, 4 ml HF and 82 ml pure H2O were used. In etching processes, EN AW 6061 materials were kept in etching reagent for 120 seconds and EN AW 6063 materials for 180 seconds. After the etching process was completed, the samples were cleaned with alcohol and prepared for microstructural examinations. In microstructural examinations; OM examinations were performed with Leica brand DM4000 model and SEM examinations were performed with Jeol brand JSM 6060 LV model devices.

3. Results and Discussion

Samples taken from EN AW 6061 and EN AW 6063 profiles produced by extrusion method were subjected to microstructural investigations (OM and SEM). The results obtained are given under the following headings respectively.

3.1. Evaluation of Optical Microscope Images

The samples taken from EN AW 6061 and EN AW 6063 profiles were first subjected to microstructure examinations. OM images are given between Figure 3 and Figure 8. Optical microscope images show that the microstructure consists of coaxial grains that are generally similar to each other (Demirtaş et al., 2021). It was determined that the grain size varied depending on different extrusion speeds.

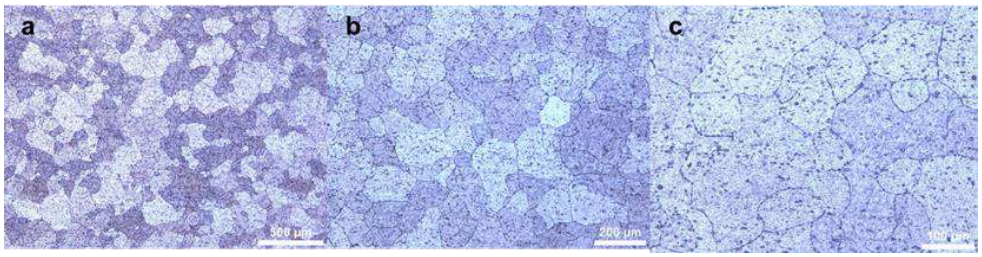


Figure 3. OM images of sample 61-1 (a.50x, b.100x, c.200x).

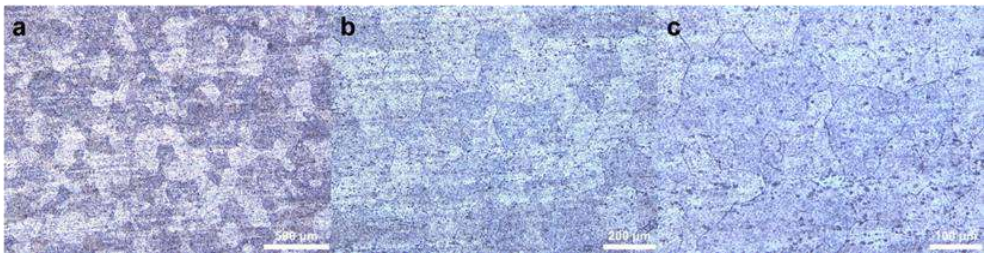


Figure 4. OM images of sample 61-2 (a.50x, b.100x, c.200x).

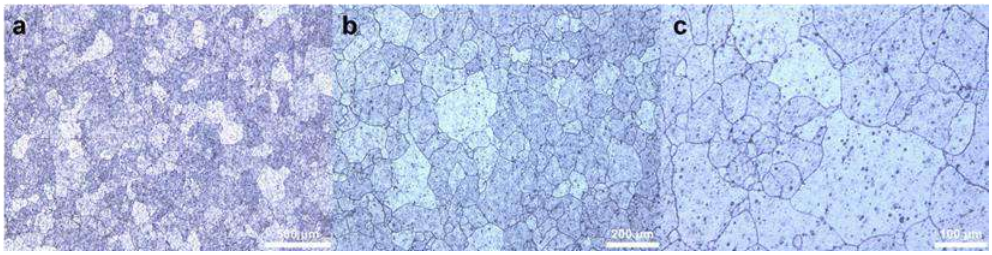


Figure 5. OM images of sample 61-3 (a.50x, b.100x, c.200x).

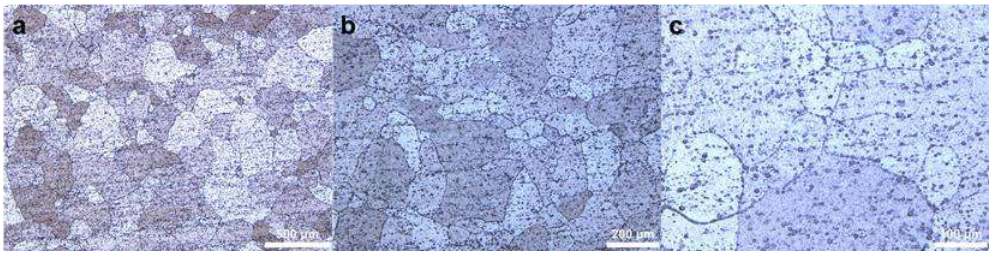


Figure 6. OM images of sample 63-1 (a.50x, b.100x, c.200x).

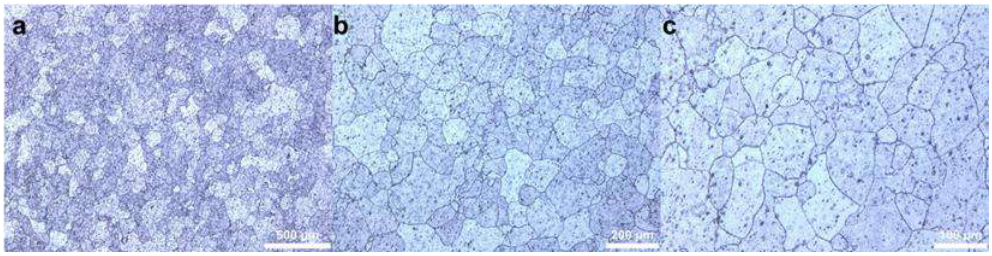


Figure 7. OM images of sample 63-2 (a.50x, b.100x, c.200x).

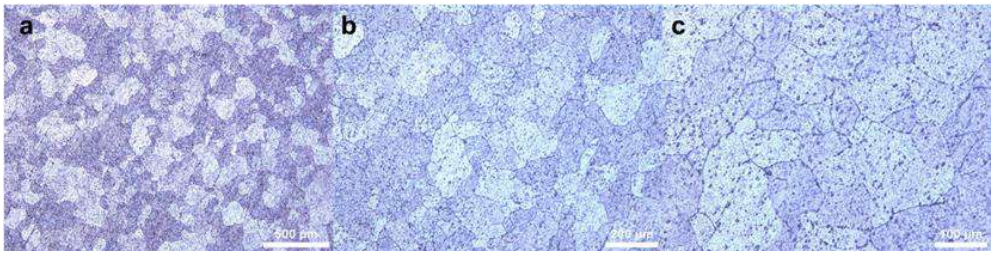


Figure 8. OM images of sample 63-3 (a.50x, b.100x, c.200x).

3.2. Evaluation of SEM Images

SEM images of the samples taken from EN AW 6061 and EN AW 6063 profiles were taken to support the images and results obtained after OM examinations and grain size analysis. SEM images are given between Figure 9 and Figure 15. It is understood that the microstructures obtained with SEM images are similar to OM images, and the grains were obtained at higher resolution and magnifications (Demirtaş et al., 2021).

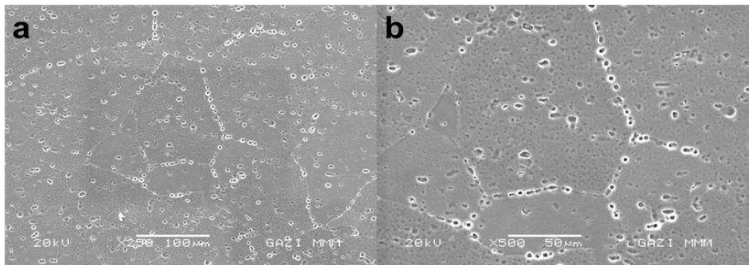


Figure 9. SEM images of sample 61-1 (a.250x, b.500x).

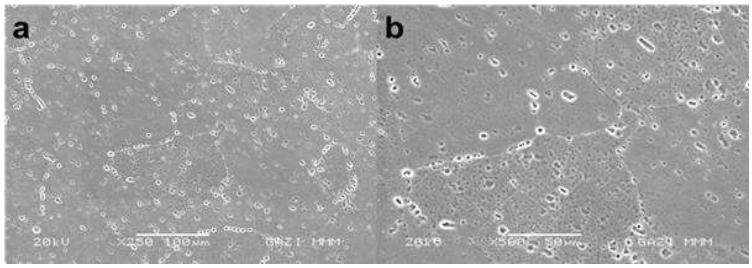


Figure 10. SEM images of sample 61-2 (a.250x, b.500x).

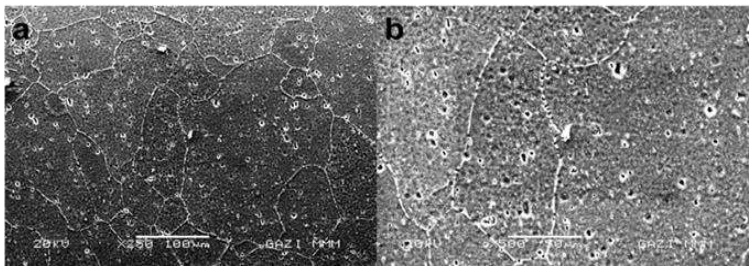


Figure 11. SEM images of sample 61-3 (a.250x, b.500x).

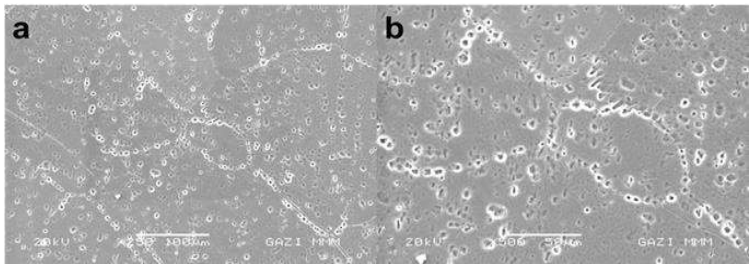


Figure 12. SEM images of sample 6063-1 (a.250x, b.500x).

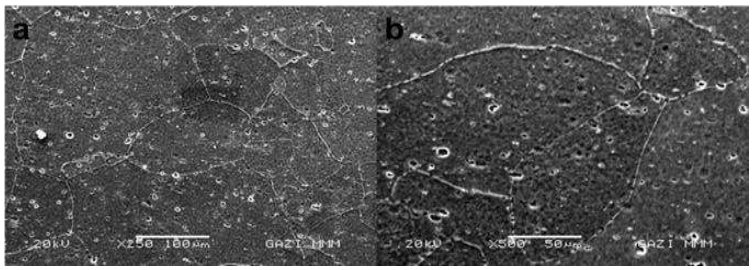


Figure 13. SEM images of sample 6063-2 (a.250x, b.500x).

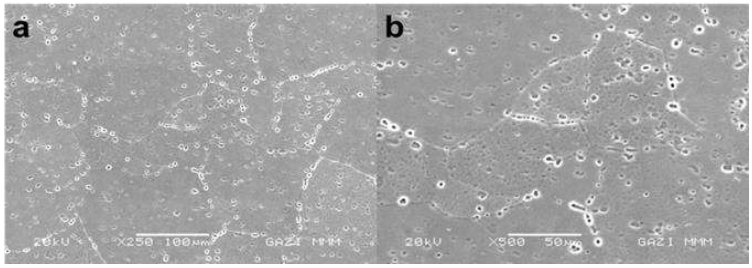


Figure 14. SEM images of sample 6063-3 (a.250x, b.500x).

While optical microscope images were taken to detect these changes in grain size, grain size analysis was also performed on the samples in accordance with the device specifications in order to support the microstructure images. The analysis revealing the grain size of the samples is given in Table 3.

Table 3. Grain size analysis of the produced samples

Experiment No.	Material	Temperature (°C)	Extrusion Speed (m/min)	Grain Size (µm)
4	EN AW 6061	450	10	70,06
5			13	53,76
6			15	64,54
13	EN AW 6063		10	72,77
14			13	62,96
15			15	69,72

It was reported that the finest grained microstructure in EN AW 6061 and EN AW 6063 profile productions was reported in test number 2 (53.96 µm) and test number 5 (62.96 µm), which were profiles produced at extrusion speeds of 13 m/min. It was observed that the changes in grain size were dependent on the extrusion speed. The decrease in grain size despite increasing extrusion rates is related to dynamic recrystallization. Despite the increase in extrusion rates, fine-grained structures were formed due to high deformation and numerous nucleations.

4. Conclusion

In this study, EN AW 6061 and EN AW 6063 alloy aluminum profiles with T6 heat treatment were produced and the microstructures of the samples taken from the produced profiles were examined. The results obtained are summarized below.

- Optical microscope and SEM images show that the microstructure consists of coaxial grains that are generally similar to each other. It was determined that the grain size varied depending on different extrusion speeds.

- While optical microscope images were taken to detect these changes in grain size, grain size analysis was also performed on the samples in accordance with the device feature in order to support the microstructure images.

- In the analysis revealing the grain size of the samples, it was reported that the finest grained microstructure in EN AW 6061 and EN AW 6063 profile productions was reported in experiment number 2 (53.96 µm) and experiment number 5 (62.96 µm), which were profiles produced at extrusion speeds of 13 m/min.

- It was observed that the changes in grain size were dependent on the extrusion speed. The decrease in grain size despite increasing extrusion rates is related to dynamic recrystallization. Despite the increase in extrusion rates, fine-grained structures were formed due to high deformation and numerous nucleations.

Acknowledgment

The authors thank Asist Alüminyum Profil San. ve Tic. A.Ş company for carrying out the profile production, Gazi University Faculty of Technology, Department of Metallurgy and Materials Engineering and Kastamonu University Faculty of Engineering and Architecture, Department of Mechanical Engineering for performing the microstructure examinations.

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

ORAL PRESENTATION

Main EU Policy Instruments to Improve the Sustainability of Agri-Food Systems

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Abstract

According to EUROSTAT, there were 9.1 million farms across the EU in 2020. They used 38.4 % of the EU's land area and employed 8.7 million persons. Agri-food systems are mainly based on the use of natural resources. Currently, agri-food systems face multiple challenges related to climate change, biodiversity decline, environmental degradation, reducing greenhouse gas (GHG) emissions and food waste. European environmental and agricultural policies play a key role in determining and improving the state of sustainability of agri-food systems. At the European Union (EU) level, a series of instruments and interventions are promoted that support the implementation of sustainable practices for agri-food systems. Nowadays, the European Green Deal is the most important EU's strategy for green transition and sustainability, which includes a package of policy initiatives and instruments: EU Biodiversity Strategy for 2030, European Climate Law, Farm to Fork Strategy for a fair, healthy and environmentally-friendly food system, Circular Economy Action Plan. EU Common Agricultural Policy (CAP) is the main policy instrument for sustainable food systems. EU member states must spend at least 25% of their direct payments budget allocations for 'eco-schemes' through their CAP Strategic Plans. Even if some progress has been registered in recent years, there is still a need for sustained policies, European cooperation, innovations and research, and financing instruments to improve the sustainability of agri-food systems.

Keywords: Agri-food Systems, Eco-Schemes, Policy Instruments, Sustainability.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

POSTER PRESENTATION

Arc-Melting Fabrication of 45S5 Bioactive Glasses

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Abstract

It is well known that the 45S5 bioactive glasses are nontoxic to tissue, facilitate bone bonding and soft-tissue bonding and provide osteoconductivity, as well as exhibiting biocompatibility. The glasses' ability to bond securely with both hard and soft tissues makes them ideal for a variety of medical applications, including bone implants, dental repairs, and tissue scaffolds. Therefore, these materials are widely used in clinical applications today. In this study, we present the results on the 45S5 bioactive glasses fabricated by the arc-melting technique, which is the first in literature. From analysis on non-isothermal crystallization studies, information about crystallization temperature and thermal properties, including activation energy for crystallization, Ea, has been obtained. The oxidization rates and the activation barrier for oxygen out-diffusion process were evaluated using the TG analysis. Mass gain was calculated in the fabricated sample and it was seen that oxygen absorption in the system is fast enough. Based on the DTA results, we conducted heat treatments at different temperatures and durations to obtain the 45S5 materials in the best physical properties. Optimum heat treatment temperature and duration were determined from XRD analyses. The results clearly demonstrate that the arc-melting technique is a suitable method in the production of these materials.

Keywords: 45S5 Biomaterials, Glass-ceramics, Crystallization Activation Energy.

Acknowledgment

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
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POSTER PRESENTATION

Electrical and Morphological Investigation of Schottky Devices from Monolayer and a Double Layer Oxide Interface

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Abstract

In this study, the structural properties of a monolayer and a double layer oxide interface layer, as well as the current transport mechanisms of heterojunction diodes based on them, are investigated. All oxide thin films are grown by sol-gel spin-coating. The current-voltage characterization of metal oxide semiconductor (MOS) heterojunction diodes are presented, showing that these diodes exhibit current transport linked to tunneling and that exponentially distributed traps contribute at large voltage bias. X-ray diffraction (XRD) spectra reveal that all films crystallize in the hexagonal wurtzite structure. Surface roughness and topography information of thin film samples are determined using Atomic Force Microscopy (AFM). All films demonstrate homogeneous and uniform distribution

Keywords: Schottky Devices, MOS, Diodes.

Acknowledgment

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

POSTER PRESENTATION

Economic Efficiency of the Production of Complete Ration Compound Feed using Protein and Vitamin Supplements for Broiler Chickens Aged 6-8 Weeks 5%

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Abstract

To study the economic efficiency of the production of complete ration compound feed using protein and vitamin supplements for broiler chickens aged 6-8 weeks. In order to achieve this goal, it was necessary to develop a recipe for a complete nutritional compound feed and a protein-vitamin supplement for broiler chickens aged 6-8 weeks, to weigh the young at 35 and 56 days of age, to determine the conversion of compound feed and the cost of 1 kg of live weight gain of broiler chickens. The research was carried out in the conditions of the private enterprise Riznychuk I.F. Odesa district of Odesa region. Feeding of young birds was carried out with complete ration compound feed for broiler chickens aged 6-8 weeks. The nutritional value of 1 kg of complete ration compound feed is 12.5 MJ of exchangeable energy. 1 kg of mixed feed contains: dry matter - 860 g, crude protein - within 200 g, lysine - at least 12 g, methionine + cystine - 8, threonine - 8, tryptophan - 2.2, crude fat - 50, crude fiber - no more than 40, sodium - no more than 2, calcium - no less than 8 and phosphorus - 6 g. Combined feed for broiler chickens is balanced in terms of the content of trace elements and vitamins, includes enzymes, an antioxidant, an adsorbent and a prebiotic. The basis of the complete combined feed for broiler chickens 6-8 weeks old is grain feed, vegetable protein concentrates, a protein-vitamin supplement and vegetable oil. 1 kg of protein-vitamin supplement for broiler chickens aged 6-8 weeks contains: exchangeable energy - at least 5 MJ, dry matter - 900 g, crude protein - 190, lysine - 46, methionine + cystine - 43, threonine - 24 , tryptophan – 1, crude fat – 10, crude fiber – no more than 20, sodium – 30, calcium – no less than 130 and phosphorus – 47 g. The protein-vitamin supplement contains vegetable protein concentrates, critical amino acids, calcium carbonate, monocalcium phosphate, sodium chloride, sodium bicarbonate, a prebiotic, and a premix, which includes trace elements, vitamins, an enzyme complex, an antioxidant, and an adsorbent. The live weight of broiler chickens at the age of 8 weeks is 4415 g, with an average daily gain for the period at the level of 105 g. Consumption of compound feed during the period of feeding broiler chickens aged 6-8 weeks – 3.97 kg, conversion of compound feed – 1.8 kg . A conclusion was made about the high productive qualities of broiler chickens, the economic efficiency of compound feed production using protein-vitamin supplements for broiler chickens aged 6-8 weeks of 5%. According to the results of the conducted research, it is possible to conclude about the high productive qualities of broiler chickens, the economic efficiency of compound feed production using protein-vitamin supplements for broiler chickens aged 6-8 weeks of 5%.

Keywords: Broiler Chickens, Compound Feed, Concentrates, Lysine, Methionine, Threonine, Calcium, Phosphorus, Compound Feed Conversion.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024
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POSTER PRESENTATION

Yield and Harvesting Moisture of Grain of Corn Hybrids at Different Sowing Dates

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Abstract

During early sowing (in the second decade of April at t ≈ 8–10°C), the seeds of most annual grasses and dicotyledonous weeds, as well as the shoots of perennial rhizomes, do not yet begin to germinate and appear on the soil surface together with the seedlings of the crop or after that. This can lead to a significant increase in weediness of crops and unproductive consumption of soil moisture, because weeds consume moisture at the same level as cultivated plants, or even more. In this regard, it is necessary to maintain early crops in a clean state from weeds and apply intensive methods of their destruction. The conducted experimental studies showed that the timing of sowing significantly affects the development of plants, the formation of grains of corn hybrids of different FAO groups. Depending on the factors of the experiment, culture plants fall into different agrometeorological conditions, grow and develop differently, that is, they form unequal productivity. During the 2021–2023 research, the "grain yield" indicator for hybrids of different FAO groups varied depending on the sowing dates from 3.12 to 8.79 t/ha. The results of research indicate the significant role of sowing dates in shaping the yield of corn hybrids. It should be noted that, along with the timing of sowing, the level of favorable weather conditions during the growing season of the crop is a significant factor influencing the productivity of corn hybrids. Based on the results of the research, it was established that the early-ripening hybrid Steppe (FAO 190) showed the maximum grain yield in 2021 for sowing on April 25 – 7.51 t/ha. The minimum yield of 4.81 t/ha was shown for sowing on May 15, the decrease in yield was 2.7 t/ha, or 35.9%. The mid-early hybrid Oleshkivskyi (FAO 280) showed the maximum seed yield in 2021 for sowing on 05.05 – 8.67 t/ha. The minimum yield of 4.43 t/ha was shown for sowing on May 15, the decrease in yield was 4.24 t/ha, or 48.9%. The medium-ripe hybrid Tronka (FAO 380) showed the maximum grain yield in 2021 for sowing on 05.05 – 8.79 t/ha. The minimum yield of 3.91 t/ha was shown for sowing on 15.05, the decrease in yield was 4.88 t/ha, or 55.5%. The mid-late hybrid Gilea (FAO 420) showed the maximum grain yield in 2021 for sowing on 05.05 – 8.65 t/ha. The minimum yield of 3.12 t/ha was shown for sowing on 15.05, the decrease in yield was 5.53 t/ha, or 63.9%. Thus, based on the results of the research, it was established that the early-ripening hybrid Steppe (FAO 190) showed the maximum grain yield in 2021 for sowing on April 25 – 7.51 t/ha. The mid-early hybrid Oleshkivskyi (FAO 280) showed the maximum seed yield in 2021 for sowing on 05.05 – 8.67 t/ha. The medium-ripe hybrid Tronka (FAO 380) showed the maximum grain yield in 2021 for sowing on 05.05 - 8.79 t/ha. The mid-late hybrid Gilea (FAO 420) showed the maximum grain yield in 2021 for sowing on 05.05 – 8.65 t/ha. In the Arid Steppe without irrigation, the potential high yield of intensive-type hybrids can be

detrimental to real productivity, so it is necessary to select hybrids for production according to the principle of adaptation to agro-ecological conditions.

Keywords: Hybrids, Corn, Productivity, Harvest Moisture of Grain, Sowing Period.

Acknowledgment

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PITESTI-ROMANIA

POSTER PRESENTATION

Fungicidal Control of *Botritis cinerea* on Strawberry Plantations in the Forest-Steppe Zone of Ukraine

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Abstract

Strawberries are the most common berry crop in Ukraine and a valuable dietary food product, with a mass share of 70% in the production of this product. In recent decades, the most common disease of strawberries in the Forest-Steppe zone is gray rot (Botrytis cinerea), which can lead to 60% of annual yield loss. Colonization by the pathogen occurs during flowering, and the disease manifestation begins at the beginning of berry ripening. To control this disease, producers use fungicides during flowering and before the berries ripen. Our research was conducted in the Cherkasy region at Rusalivka in 2020-2021. The climatic conditions of the 2020-2021 growing season were characterized by high average daily air temperature and excessive precipitation in the third decade of May and the first decade of June. Thus, the weather conditions affected the pathogen Botrytis cinerea on strawberry plantations. The following fungicides were used to determine the technical efficiency: Switch 62.5 WG, v.g. (d.r. ciprodonil 375 g/l + fludioxonil 250 g/l — consumption rate 1.0 kg/ha); Teldor 50 WG, v.g. (d.r. fenhexamide 500 g/kg - consumption rate 1.0 kg/ha); Miravis Prime 400 SC, CS (d.r. fludioxonil 250 g/l + adepidin 150 g/l - consumption rate of 1.0 l/ha); Luna Sense 500 SC, CS (fluopyram 250 g/l + trifloxystrobin 250 g/l — consumption rate of 0.8 l/ha); Signum, VG (pyraclostrobin 67 g/l + boscalid 267 g/l — consumption rate of 1.8 kg/ha). The first treatment with the studied preparations was carried out on 01.06–03.06, the second on 11.06 and 13.06, respectively, by years. It was found that the development of the disease in the control was 15.0-30.5%. The effectiveness of the fungicide Switch 62.5 WG was high and reached 88.0-91.8%, respectively, by the years of research. Due to the reduction of infection, it was possible to maintain the berry yield at the level of 14.4%. The use of Teldor 50 WG also reduced the defeat of Botritis cinerea pathogens, the effectiveness was 87.5% during the years of research. The saved yield in the variants was 11.6%. The use of the fungicide Miravis Prime 400 SC allowed to obtain an efficiency of 78.4%, the berry yield exceeded the control by 9.3%. The use of Luna Sensation 500 SC also reduced the degree of pathogen development, the effectiveness of the action averaged 74.5%. The preserved yield to the control was 7.0%. Treatment with Signum, VG ensured technical efficiency by 52.1%. By reducing the pathogen, it was possible to increase the yield by 2.8% compared to the control variant.

Keywords: Strawberries, Pathogen, Botrytis Cinerea, Berry Yield, Disease.

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POSTER PRESENTATION

Increasing the Resistance of Grape Plants Under the Influence of Growth Stimulants

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Abstract

At present, in times of certain economic constraints, the use of physiologically active substances is proving to be an effective and relatively inexpensive method with a significant payback. The analysis of these research results shows that the effect of growth regulators on different varieties and cultivars is a very individual indicator, so determining the optimal substances and formulations for a particular ampelocenosis and on a particular grape variety is an urgent issue. Our research was devoted to the study of the effect of growth stimulants of different etiologies in the conditions of Private Enterprise "Prydunayskiy" on grapes of Odesskyi Black variety. The purpose of the work was to study and determine the effectiveness of foliar application on non-irrigated vineyards of Odesskyi Black variety to reduce the level of influence of stress factors, such growth regulators as: FRUITLIPS® from DOLINA Ukraine and MaxiCrop Cream from Valagro, Italy. As a result of the research, it was proved that the use of organic (Maxicrop Cream) and synthetic (FRUITLIPS) growth stimulants for foliar treatment of plants increased the total increase in leaf surface area by 18-29%, the volume of annual growth by 23-32%, and the average bunch weight by 12.7 g and 20.8 g, with the smallest significant difference being 4.42 g. The yield per bush and hectare of plantings increased by an average of 13-18%, in accordance with the substances studied, which led to an increase in economic efficiency. The conducted economic analysis confirmed the effectiveness of the use of growth regulators in the cultivation of Odesskyi Black grape variety with a planting scheme of 3.0x1.5 m, with an obvious advantage of using Maxicrop cream, which is confirmed by the lowest cost of production and the highest gross income and profitability of production.

Keywords: Grape, Foliar Application, Growth Stimulants, Yield.

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POSTER PRESENTATION

Agrobiological Characteristics and Technological Features of Clones of Technical Grape Varieties Identified at the National Science Center «V.Ye. Tairov Institute of Viticulture and Winemaking»

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Abstract

The article examines the impact of climate changes on traditional grape varieties and substantiates the need to improve technical grape varieties through clonal selection. It was found that traditional varieties used for wine production are negatively affected by climate change, which reduces their productivity and disease resistance. The importance of clonal selection for quality improvement and restoration of technical grape varieties is emphasized. The article presents the results of the study of clones of the Odessa Black grape variety, in particular clones (67131) and (642012). The study found that the Odessa Black clone (67131) showed the highest fruiting and productivity rates, with coefficients of 1.52 and 1.77, respectively. Regarding the biometric characteristics, the largest leaf area was recorded in the Odessa Black clone (642012) and was 5.96 m², which is 0.47 m² more compared to the control variant and 0.85 m² more compared to the clone (67131). The annual volume of bush growth of clones Odessa Black (67131) and (642012) exceeds the control variant by 278.5 and 275.6 cm³, respectively, and clone (67131) exceeds clone (642012) by 2.9 cm³. In terms of yield per hectare, the Odesa Black clone (67131) was the leader with a yield of 15.53 t/ha. The wine produced from Odesa Black grapes and its clones (67131) and (642012) was highly appreciated for its taste qualities, thanks to the distinct aroma and taste profile characteristic of this variety. Regarding profitability, the Odesa Black clone (67131) demonstrated the highest level of profitability – 102.9%, which is 15.1% higher than in the control variant. On the basis of the obtained results, it is recommended to grow clones of the Odessa Black variety, in particular (67131) and (642012), in the conditions of the soil and climate region, similar to the conditions of the NSC "IViV named after V.E. Tairov", where these clones demonstrated optimal growth, yield and quality indicators.

Keywords: Clonal Selection, Odessa Black, Biometric Characteristics, Winemaking, Climatic Conditions.

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POSTER PRESENTATION

Behavioral Activity of Cows under Conditions of Year-Round Untethered Box Housing and Temperature Stress

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Abstract

The goal of our work was to study the physical, comfort and feed activity of cows of the Ukrainian red-speckled dairy breed under the conditions of year-round untethered box housing and year-round silage-hay-concentrate feeding. The results of the conducted research showed that under conditions of stable uniform feeding, cows in the winter and summer periods of the year spend almost the same amount of time on feed consumption during the day, as evidenced by the feed activity index. However, in the summer period, a slight and improbable increase in the duration of feed consumption by 19.51 min. and frequency by 3.91 times was observed compared to the winter period. According to the duration of chewing, cows spent less time in the standing position than in the lying position. The probable time difference was 27.7 minutes. The difference in the duration of chewing in different positions of cows may be a consequence of temperature factor. In summer cows drank water 2.58 times more often and by 21.46 minutes longer. The cows approached the drinkers between feed intakes. Comfortable and hygienic behavior of cows is aimed at removing hard and soft metabolic products from the body and maintaining the cleanliness of the skin. It includes urination and defecation, brushing, licking and scratching (grooming). There were no seasonal differences in fat loss and the frequency of defecation and urination in cows. Visual observations showed that during physiological discharges the floor was almost not contaminated. The scratching of cows stands out significantly among the indicators of comfortable behavior. In summer, the scratching of cows' duration increases by almost 2 times, which is associated with temperature stress. The use of scratching brushes does not provide simultaneous two-sided scratching of the body and cooling of animals, so this device was modernized and a new massage-cooling device was developed for combing and cooling cows. Cooling the body together with cleaning the skin contributes to a probable decrease in skin temperature by 7.4º C, heart rate by 31 bpm., and the number of respiratory movements per minute by 22 times. Adaptation to the massage-cooling device is quick and lasts the first two days. Our research established that its use had a positive effect on most hematological indicators during the period of the temperature stress factor; probable increase in milk productivity being 2.32 kg or 9.99%. On the basis of the obtained results, it can be concluded that the developed massage-cooling device provides better hygienic comfort of the animal due to water irrigation, skin massage, cooling the body and helps to increase milk productivity. The economic efficiency of using a massage-cooling device due to the cost of additional products is UAH 16.19 per cow per day.

Keywords: Cow, Comfort, Behavior.

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POSTER PRESENTATION

Technological Properties of Skin and Pelt Qualities of Karakul Lambs

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Abstract

The purpose of our research was to evaluate the histological parameters of the skin of Karakul lambs obtained from ewes of different constitution types. The groups were formed taking into account age, live weight, pelt type and coloration. It was established that in terms of total skin thickness, lambs obtained from ewes of coarse constitution exceeded their peers obtained from ewes of gentle constitution type by 901.0 μm or by 45.8% (P>0.999), and from ewes of strong constitution type – by 285.2 μm or by 11.1% (P>0999). The thickness of the skin layers was also different. In terms of the epidermis thickness, lambs obtained from ewes of coarse constitution type exceeded this indicator in lambs obtained from ewes of gentle and strong constitution types, respectively, by 6.2 μm or by 30.8% (P>0.99) and by 2.42 μm or by 10.2% (P=0.99). The development of the reticular layer of the skin determines its strength. The lambs obtained from ewes of gentle type of constitution were inferior to the lambs obtained from ewes of coarse type of constitution by 374.4 μm or by 42.4% (P>0.999). In terms of the density of follicles and the ratio of secondary follicles to primary ones, the offspring of ewes of strong constitution type had better results compared to their peers from mothers of coarse and gentle constitution types – by 2.09% and 1.26%, respectively. In terms of the secondary follicles number, the offspring of ewes with a coarse type of constitution were inferior to the offspring of a strong type of constitution by 9.7%, gentle type – by 8.0%; and in terms of the primary follicles number, they prevailed by 14.0 and 28.0%, respectively (P<0, 95). The ratio of secondary follicles to primary ones was higher in the offspring of ewes of the gentle constitution type, compared to the offspring of the coarse constitution type by 39.39%, and by 10.04% of the strong constitution type. The quantitative ratio of secondary follicles to primary ones determines the density of the location of curls and the clarity of the pattern on the pelt. The lambs obtained from ewes of gentle constitution type, in which the ratio of secondary follicles to primary ones was 2.3:1 were the best in terms of the density of curls per pelt, while the worst were the lambs from ewes of coarse constitution type, having the ratio at the level of 1.65:1. In the ewes with coarse constitution, the marketable quality of the lamb's wool decreases as a result of thickening of the skin and an increase in the diameter of the follicles and wool. Thin, dense, easily movable skin of the lambs ensured the formation of the most valuable curls and high-quality raw materials. It can be noted that the commercial value of pelts is determined by many factors, among which the quality of the hair cover and its components are of primary importance.

Keywords: Type, Constitution, Live Weight, Female Lambs.

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POSTER PRESENTATION

Efficiency of Use of Evolution Graminicide in the Sunflower Protection System

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Abstract

The processing of LG 59580 hybrid crops was carried out on June 15, 2023, when the hybrid crops were in the phase of 4-6 true leaves (VVSN 14-16). After 4 days, namely on 19.06.2023, an inspection of the condition of sunflower crops was carried out in order to assess the effect of herbicides on sunflower plants. Thus, it was established that none of the herbicides had a negative effect on hybrid LG 59580 (Table 2), phytotoxicity in all variants was zero, and no changes in the color of sunflower plants of hybrid LG 59580 were observed. After 8 days after processing the sunflower crops, an examination of the experimental options was carried out. Thus, the sunflower plants were in the phase of 6-8 real leaves (VVSN 16-18). Two types of weeds were found in the crops of the hybrid LG 59580, namely common sedge and mouse green. Thus, in the control (without treatment with herbicides), an average of 10 pieces/m2 of common sedge and 3 pieces/m2 of green mouse was noted. The use of any herbicide led to a significant reduction in the number of weeds in sunflower crops. However, if we analyze the data in more detail, it was established 241 that the most effective against both weeds was the variant using Evolution (0.25 l/ha) + Amigo Star (0.75 l/ha) - 97% efficiency. The lowest efficiency in this period was in the version of Fusilade Forte (0.8 l/ha) against common smut, 83% efficiency and 88% against green mouse. A week in a row, or 15 days after processing the crops in the phase of VVSN 18-20, namely on 30/06/2023, the next monitoring of the LG 59580 sunflower hybrid crops was carried out. The last monitoring of the state of the LG 59580 sunflower crops was carried out on 07/09/2023 in the phase of VVSN 22-24, i.e. 24 days after herbicide application. It was found that the maximum efficiency in this period was the Evolution (0.25 l/ha) + Amigo Star (0.75 l/ha) variant - the effectiveness against both weeds was 100%. Also, high efficiency was observed in the variants Evolution (0.35 l/ha) + Amigo Star (0.75 l/ha) - the efficiency varies from 100% to 99% according to the weed; Agil (0.6 l/ha) and Kaiman (0.6 l/ha) – 100% and 97%, respectively. Thus, in the crops of the hybrid LG 59580, the most effective against common smut and green mouse is characterized by the variant Evolution (0.25 l/ha) + Amigo Star (0.75 l/ha), which at all phases of sunflower development showed the greatest effectiveness against common smut and green mouse It was established that the maximum effectiveness against green leafy mildew is observed with the herbicide Agil (0.8 l/ha) and was 90% effective. Evolution (0.25 l/ha) + Amigo Star (0.75 l/ha) had the maximum effectiveness against the green mouse. The Fusilade Forte (1.0 l/ha), Agil (0.8 l/ha) and Evolution (0.35 l/ha) + Amigo Star (0.75 l/ha) variants were also quite effective, the effectiveness of which was higher than 90%. The worst efficiency in this period is characterized by the variant PANTERA (0.8 l/ha) with efficiency at the level of 67 and 65%, respectively, for weeds. The next survey was carried out in the development phase of sunflower VVSN 20-22, it was on 14.07.2023, i.e. 15 days after the introduction of herbicides. During this period, the Agil variant (0.8 l/ha) is characterized by maximum efficiency with 97% efficiency against both weeds. The worst efficiency in

this period is characterized by the variant PANTERA (0.8 l/ha) with efficiency at the level of 73 and 67%, respectively, for weeds. All other options are characterized by more or less the same effectiveness against weeds at the level of 92-93%, respectively. The third survey was carried out 24 days after the introduction of herbicides, namely on 23.07.2023, which corresponded to the phase of development of sunflower plants VVSN 26-30. 242 During this period, the maximum efficiency at the level of 97-98% remained with the Agil variant (0.8 l/ha). The lowest effectiveness of the herbicide against weeds was in the PANTERA variant (0.8 l/ha) and amounted to 82 and 70%, respectively. All other options are characterized by more or less the same effectiveness against weeds at the level of 92-93%, respectively. Thus, in P64LE25 hybrid crops, the Agil variant (0.8 l/ha) is characterized by the greatest effectiveness against common smut and green mouse, which showed the greatest effectiveness against common smut and green mouse at all phases of sunflower development. It should also be noted that, in general, the effectiveness of herbicides in this experiment decreased compared to the experiment on hybrid LG 59580. This can be explained by the later application of herbicides in this experiment (14 days later), which led to an increase in the sensitivity of sunflower plants to Fusilade Forte herbicides (1.0 l/ha), Agil (0.6 l/ha) and Agil (0.8 l/ha) and accordingly reducing the effectiveness of all options against weeds

Keywords: Sunflower, Herbicides, Weeds, Efficiency, Productivity.

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POSTER PRESENTATION

Effectiveness of Using Chlorella Microalgae Suspension in Rations of Lactating Goats

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Abstract

The purpose of our work was to determine the effectiveness of using a suspension of chlorella microalgae in feeding lactating goats and its effect on the intensity of growth of kids at the early stage of postnatal ontogenesis. 5 groups of goats of the Zaanen breed were formed, 10 animals in each one. There were 4 experimental and 1 control group. Chlorella microalgae suspension was fed to female goats of experimental groups in the amount of 2, 4, 6, 8 ml per 1 kg of live weight in the first 20 days after calving. The highest amount of milk was produced by female goats of the 4th experimental group per animal. During the 20-day lactation period, they exceeded their peers of the control group by 2.13 kg. The advantage in terms of milk productivity of the female goats of the experimental groups over their peers of the control group was probable and constituted, respectively, for the groups studied: the 1st group – 1.27 kg, the 2nd group – 1.57 kg, the 3rd group – 1.75 kg, the 4th group – 2.13 kg. After the first 20-day lactation period after calving and feeding the lactating female goats with a suspension of chlorella microalgae, the live weight of their offspring increased significantly compared to peers of the control group. This probable excess of the live weight of kids obtained from female goats of the experimental groups was, respectively, by groups: 1st group – 2.41 kg, 2nd group – 3.14 kg, 3rd group – 3.48 kg, 4th group – 4.09 kg. The greatest increase in terms of live weight had the kids obtained from female goats of the 4th experimental group, whose mothers were fed 8 ml of chlorella microalgae suspension per 1 kg of live weight per day. The kid goats obtained from the mothers of the research groups were born healthy and viable. They grew and developed well. Their average daily gain in live weight ranged from 203.5 g to 289.5 g. The highest average daily gain in live weight (289.5±32.226) g was achieved by goat kids obtained from the mothers of the 4th experimental group. Feeding chlorella microalgae suspension to lactating female goats also improved the quality of milk. The fat content in the milk of the female goats of the experimental groups increased by (0.9-2.09) fat units; the protein increased in the milk of the female goats of the 4th experimental group by 0.13 absolute percent. The reaction of goats of the first research group to chlorella microalgae suspension indicates a decrease in nutrients in milk, except for fat, which is caused by an insufficient amount of additives in the diet. The animals of the 4th experimental group, which received 320 ml of chlorella microalgae suspension per animal per day or 8 ml per 1 kg of live weight per day, had the highest levels of milk components.

Keywords: Female Goat, Chlorella, Live Weight.

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POSTER PRESENTATION

New Techniques and Applications for Erosion Prevention

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Abstract

Erosion prevention is a critical aspect of land management to ensure environmental sustainability and ecosystem health. This paper reviews new techniques and practices for erosion prevention, focusing on innovative strategies to reduce soil erosion risks and lower erosion rates. Research highlights the importance of understanding soil erosion processes, scaling erosion rates in space and time, and developing new techniques to prevent or minimize erosion. Innovative approaches such as geo-informatics technology to assess soil erosion hazard, thermal spray coating methods for surface erosion resistance, and microbial-induced calcium carbonate precipitation to enhance wind erosion resistance are highlighted as effective erosion prevention measures. Furthermore, the integration of agriculture, forest management and hydraulic engineering practices is recommended as a holistic approach to protect soils against erosion. Furthermore, the use of erosion control techniques such as sodium fluoride and titanium tetrafluoride applications, environmentally friendly soil amendments and vegetation types for erosion prevention are discussed. The study emphasizes the importance of exploring various methods ranging from biological conservation practices to advanced technological applications to effectively combat erosion problems and promote sustainable land management practices. In conclusion, the adoption of new and integrated erosion prevention techniques is essential for conserving soil resources, enhancing ecosystem resilience and promoting long-term environmental protection efforts.

Keywords: Erosion, Soil, Soil Conservation.

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POSTER PRESENTATION

Increase Soil Organic Matter (SOM) and Reduce Carbon Footprint

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Abstract

Soil organic matter (SOM) plays a crucial role in carbon sequestration, essential for reducing the carbon footprint and mitigating climate change. Sustainable agricultural practices such as reduced tillage, contour plowing and terracing help minimize soil erosion and maintain organic matter content, increasing carbon sequestration. Increasing the soil organic carbon (SOC) pool through carbon sequestration in soils has received considerable attention as a strategy to combat climate change. SOM, the largest carbon pool in the terrestrial biosphere, undergoes decomposition, a critical process linking soil and atmosphere. Adopting soil and crop management practices such as conservation agriculture, irrigation, straw return and crop rotation can increase soil organic carbon content, improve input efficiency and reduce greenhouse gas emissions. Strategies to increase carbon sequestration rates include CO^2 absorption through photosynthesis, transfer to the soil through root biomass and litter, and storage as SOC. By sequestering carbon as organic matter, soils help regulate atmospheric CO^2 concentrations, an important greenhouse gas. Recommended measures to increase soil carbon sequestration include conservation tillage, organic fertilizer application, no-tillage, deep tillage, straw return, biodegradable film mulching and strategic cropping arrangements. SOM dynamics, influenced by climate, soil texture, land use and management practices, are crucial for soil carbon sequestration. Increasing soil carbon sequestration involves increasing global carbon inputs to soils, sequestering carbon at higher productivity levels and slowing down decomposition processes. Consequently, promoting sustainable agricultural practices, optimizing soil and crop management techniques and focusing on increasing SOC content are crucial steps to increase soil organic matter, reduce carbon footprint and contribute significantly to climate change mitigation efforts.

Keywords: Organic Matter, Carbon Footprint, Soil.

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POSTER PRESENTATION

Water Holding Capacity and Water Movement of Soils

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Abstract

Understanding the water holding capacity and water movement of soils is crucial for sustainable agriculture and ecosystem management. Soil water holding capacity, a fundamental soil property, is significantly influenced by organic matter. Organic matter plays a vital role in increasing soil water-holding capacity by boosting cation exchange capacity, promoting soil aggregation, and improving water infiltration. Its presence in the soil leads to improved soil structure, increased water infiltration, increased water holding capacity, and better soil moisture retention, thereby enhancing plant growth, carbon allocation, nutrient cycling, and photosynthesis rates. Research has shown that increasing soil organic matter content can increase soil water holding capacity in soils with similar textures, promote more excellent aggregate formation and create more significant volumes of pore spaces. Sustainable soil management practices such as no-tillage, crop rotation and organic amendments such as compost, biochar and manure have been highlighted for their benefits in improving soil structure, fertility and carbon storage capabilities. Furthermore, implementing conservation tillage measures, organic fertilizers and strategic cropping arrangements can further enhance soil carbon accumulation, improving soil health and resilience to drought conditions. In conclusion, the investigation of the relationship between soil organic matter, water holding capacities, and water movement is not just important, but essential. This research is crucial for optimizing agricultural practices, enhancing carbon sequestration, and promoting sustainable land management strategies to address climate change issues. It underscores the need for further exploration and the potential benefits that could be reaped from a deeper understanding of these relationships.

Keywords: Soil, Soil Water Movement, Water Holding Capacity.

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POSTER PRESENTATION

Influence of Agrobiological Characteristics of Potato Varieties on Harvest Quality Indicators

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Abstract

Potatoes are one of the main food products in Ukraine, which are widely used for fodder and industrial purposes. Its value lies in the high content of vitamins, amino acids, starch, protein and mineral salts. The research was conducted at Forest Steppe Zone of Ukraine. The field similarity of tubers, the onset of phenological phases, the total yield, and the structure of the crop were determined. They studied 10 varieties of Ukrainian potato selection of different maturity groups and 1 variety of German selection. Phenological observations showed that full emergence (75%) appeared between May 25 and June 1. Plantings of potato varieties were equalized in phase and density, the completeness of seedlings in the experiment was 98-100%. The beginning of budding was observed from June 2 to 13. The most massive flowering of varieties took place in the period from June 9 to June 21. The growing season of varieties by group was established: early – Kimmeria, Skrabnytsia, Bellarosa, Serpanok (42-55 days); mid-ripening – Fantasia, Letana, Gurman, Slovianka, Okolitsia (56-65 days) and mid-late – Sluch, Chervona Ruta (102-105 days). The shortest vegetation period was characterized by the early Serpanok variety – 42 days, and the longest, 105 days – by the mid-late variety Chervona Ruta. When determining the productivity of varieties over the years of research, the highest yield in the early ripeness group was established in the Bellarosa variety – 49.3 t/ha, the lowest in the Kimmeria variety – 34.5 t/ha. Serpanok and Skarbnytsia varieties were also high-yielding – 38.6-39.8 t/ha. The highest yield in the medium-ripe group was provided by the Slovianka variety – 52.4 t/ha, the lowest was the Letana variety – 26.7 t/ha. The varieties Gurman, Fantasia, Okolitsia were distinguished by their high yield – 28.7-32.5 t/ha. In medium-late varieties Sluch and Chervona Ruta, it was 34.3 and 47.4 t/ha, respectively. Thus, all studied varieties are of great value to producers. Bellarosa, Slovianka, and Chervona Ruta varieties were characterized by the highest productivity.

Keywords: Varieties, Potato, Productivity.

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POSTER PRESENTATION

Yield of New Varieties of Pea Under the Conditions of the Steppe Area Ukraine

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Abstract

Significant climate changes in recent decades, especially in the steppe zone of Ukraine, need to review the structure of cultivated areas. In dry years there is a sharp decrease in the yield of most agricultural crops, including winter wheat, barley, sunflower, corn. One of promising ways to change this state are wide implementation legumes, as it is done in Canada, USA, Australia, and India. They are distinguished by drought resistance, due to their nitrogen-fixing ability, they contribute improving soil fertility, are good precursors for almost everyone agricultural crops. The agro-climatic conditions of Ukraine allow growing significant amount types of legumes, but significant changes have taken place over the past decades both their assortment and the area sown. In the second half of the 20th century in our country the main crop was pea, which was sown on about 1.5 million hectares, and gross harvest reached almost 3.5 million tons. But at the beginning of this century, production of pea decreased sharply, but the position of soybeans significantly strengthened. If in 2000 60.6 thousand hectares were sown with it, then already in 2010 - 1038 thousand hectares, and in 2016 – 2158 thousand hectares. During this period, soybean yield increased from 1.1 t/ha in 2000 to more than 2 t/ha since 2013. In dry conditions, Hajduk was the best, Otaman and Tsarevich were characterized by approximately the same productivity of Odesa origin varieties. Among the breeding lines L 09-118, L 10-37, L 11-32, L 11-176 and L 11-213 stood out. Hayduk, Malachite and Oplot varieties were distinguished by the maximum yield value under dry conditions. And the Hajduk variety was better both under dry conditions and during overmoistening. Among the breeders lines best to drought and lodging were L 11-203 and L 10-37. Their yield with a sufficient amount of moisture reached almost 5 t/ha. So contrasting weather conditions during the research period clearly highlighted two the most important problems of modern pea breeding are resistance to drought and against lodging. Increase significantly the yield of pea, especially in the arid steppe zone, is possible for winter sowing .With this technology, it is better to use winter spring moisture, plants avoid high temperatures in the second half May and early June, harvesting begins 15-20 days earlier. A significant number of farms have mastered this technology and grow pea on area of 200-500 hectares.

Keywords: Pea, Varieties, Technology, Harvest.

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ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

POSTER PRESENTATION

The Effects of Turmeric Powder (*Curcuma longa*) Supplementation into Broiler Diet on Color Parameters and Sensory Evaluation

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Abstract

This research was conducted to investigate the effects of turmeric powder supplementation at different levels (0, 2, 4, 6, 8 and 10 g/kg) into diets of broilers on color parameters and sensory evaluation in the tissue. Three hundred Ross 300 broilers (150 male, 150 female), 1 day of age, were assigned randomly to six treatment groups, each group had 5 replicates included 10 birds. The birds received six diets with 0, 2, 4, 6, 8 or 10 g/kg turmeric powder respectively. Experiment lasted for 42 days. At the end of trial L* (lightness) and b* (yellowness) values of the cooked breast muscles, a* (redness) and b* (yellowness) values of the raw breast muscle increased in the chicks fed with turmeric powder. Supplementation of turmeric powder into broiler diet decreased b* (yellowness) value of raw leg muscle. The a* values of raw leg tissue was higher in the group fed on 10 g/kg turmeric powder. Meat color increased when the odor of raw breast tissue was decreased by adding turmeric powder. As a result, it is thought that 2 and 4 g/kg, except for 6, 8 g/kg, of turmeric powder may be used in broiler diet because it reduced the smell and increased the color of meat

Keywords: Broiler, Turmeric Powder, Meat Color, Sensory Evaluation.

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POSTER PRESENTATION

Comparison of the Cost of Heating Indoor Structures with Different Types of Biofuel

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Abstract

An analysis of the Ukrainian market of greenhouse vegetables showed that the volume of their cultivation in closed soil has dropped significantly due to serious difficulties with the energy carriers necessary for production.Tod ay, due to the increase in the price of energy sources, domestic manufacturers are significantly reducing the area of greenhouses, which will have significant negative consequences for the industry. The basis of agricultural production's independence from instability in the energy market is renewable energy sources. Today, the Ukrainian market of renewable energy sources has enough capacity to replace a significant share of imported energy resources with its own renewable generation. In 2021, the share of electricity generated from renewable energy sources was 8.1%. Of them, more than half is obtained due to solar radiation, more than 30% - due to wind energy, and only 8% is obtained due to the burning of biomass and biogas. At the same time, in some countries of the European Union, the share of biomass from all renewable sources ranges from 30 - 40% to 80 - 95%. Replacing natural gas or electricity with biomass in the production of heat for underground structures in Ukraine is one of the most effective ways. Today, Ukraine can offer the cheapest raw materials for the production of biomethane. The main argument for the transition to the use of renewable energy is the economic component, and it is considered in the context of comparing the cost of heating closed ground structures using different types of biofuel. It has been established that in order to reduce costs for heating indoor structures, the most cost-effective is the use of various types of biofuel, in particular sunflower and soybean husks.

Keywords: Renewable Energy Sources, Biomass, Biofuel, Thermal Energy, Closed Soil.

1. Introduction

Renewable energy is one of the key areas of global energy development, as it provides safe energy and at the same time uses inexhaustible resources, which are abundant in almost every region of Ukraine and the entire planet (Kravchenko & Bogatyreva, 2006). According to the International Energy Agency, investments in the development of renewable energy are growing annually. The European Renewable Energy Council notes in its report: "By 2040, renewable energy sources will be able to provide 50% of the world's primary energy consumption" (Kravchenko & Bogatyreva, 2006).

Today, in individual EU countries, the share of biomass from all renewable sources ranges from 30-40% (Luxembourg, Cyprus, Ireland) to 80-95% (Estonia, Latvia, Lithuania, Hungary, Poland, Finland) (URL-1, 2024). In Ukraine, a very small share of the total potential of biomass is used for energy needs.

At the same time, mainly wood biomass is used: firewood, wood chips, etc., which in recent years has increased significantly (by 3-3.5 times). Plant waste is used the least actively in our country for this purpose (URL-1, 2024). Then, as from the remains of agricultural products, in particular from straw, stalks of corn and sunflower, pulp of sugar beets and others, it is possible to potentially obtain up to 10 billion m 3 of biomethane per year (Geletukha et al., 2022).

2. Materials and Methods

The purpose of our research was to conduct an economic evaluation of the use of various types of biofuel that can be used to heat indoor structures. The task of our research included conducting a comparative assessment of the cost of a unit of production of different types of fuel and establishing the cost of one KW of thermal energy obtained from different types of biofuel.

Research methods included the study and analysis of literary sources, statistical data, analysis of economic calculations of the cost of a unit of energy in various energy carriers in Ukraine.

3. Results and Discussion

Our analysis of the received data showed that the lowest cost per unit of heat energy is provided by the burning of sunflower and soybean husks. On average, it is 0.18 hryvnias/kWh, which is 10 times less compared to the use of natural gas (K1). The burning of straw is also characterized by a fairly low cost per unit of thermal energy - 0.21 hryvnias/kWh. Compared to other types of biofuel, the cost of using sawdust as biofuel is somewhat overestimated. We believe that this is caused by the increased demand for this raw material in other industries, in particular furniture factories.

Despite the higher cost of pelletized biofuel compared to other types, its final cost can be reduced by adjusting factors such as logistics costs, heating automation costs, and labor costs for operation.

The most expensive type of heating of closed ground structures today is electricity, the cost of which reaches UAH 8.33/kWh. But this indicator can be reduced by more than 5 times if heat pump technology is used.

4. Conclusion

Thus, in order to reduce the costs of heating closed ground structures, it is effective to use various types of biofuel, in particular, sunflower and soybean husks. The use of granulated biofuel is also effective when certain factors are regulated.

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
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POSTER PRESENTATION

Post-Harvest Sowing of Grain Crops in the System of Intensive Farming

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Abstract

Irrigation, aside from the undeniable advantages of achieving higher crop productivity, requires significant economic costs and poses substantial environmental risks. Utilizing such lands to obtain additional yields after the primary crop is an important element of modern intensive technologies, which also manifests a powerful soil-protective and eco-stabilizing effect. The conditions of the Southern Steppe of Ukraine and current global climate changes facilitate the adoption of experiences in obtaining full-fledged harvests of millet, soybeans, and other crops with short growing periods after the harvesting of winter grain crops. However, the conditions of the post-harvest period significantly differ from their cultivation during the main periods. Previous studies in the area revealed significant differences in water supply, nutrient availability, temperature regimes, and light conditions, which require adjustments to traditional cultivation technologies for these crops. The greatest differences relate to the periods of seedling emergence and crop maturation, which primarily demand a well-grounded selection of varieties adapted to such atypical conditions. The scientific problem is solved through long-term field studies based at the Institute of Climate-Oriented Agriculture. The recommended methodology for irrigation conditions was applied for the establishment and conduction of the research. Serial technical means for shallow no-till tillage were used. Phenological studies were conducted, and the productivity and efficiency of resource use under different levels and systems of plant nutrition were assessed. It was found that under post-harvest cultivation conditions, the grain yield of early-maturing soybean varieties reaches 1.7-1.8 t/ha, and millet 2.4-2.8 t/ha. The high effectiveness of soybean seed inoculation with HiStick 1.2 l/t was noted, which increased the number of nodules by 2.8 times and contributed to a yield increase of 1.5 c/ha. The advantages of using mineral fertilizers in combination with soil algae 5 l/ha foliar feeding were determined for the studied crops. Such foliar feeding promoted the payback of applied mineral fertilizers. From the standpoint of efficient fertilizer and energy use, optimal levels of soybean and millet nutrition after winter wheat cultivation under irrigation conditions were identified. The effect of post-harvest sowing dates on the progression of growth and development phases of crops and their thermal resource requirements was determined. The specific reactions of certain soybean and millet varieties to cultivation under these conditions were established.

Keywords: Millet, Soybean, Intermediate Crops, Irrigation.

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POSTER PRESENTATION

Oil Flax in the Farming System of the Steppe Zone

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Abstract

The production and processing of oil raw materials are important sectors of the Ukrainian agricultural industry due to favorable soil-climatic conditions, historically established production potential, and favorable external market conditions. Expanding the list of cultivated oil crops is an important practical issue. The Steppe zone is extremely promising for the production potential of less common oil crops. For Ukraine as a leading agricultural country, expanding the cultivation of oil flax is justified due to technological indicators and oil quality, stable supply of oil raw materials to processing enterprises, and achieving high profitability in crop production. For this zone, oil flax serves as a desirable predecessor, balancing existing grain crop rotations. Unfortunately, in recent years, the crop has been characterized by significant fluctuations in sowing areas and relatively low yields. The reasons for this are deficiencies in the cultivation technology. The aim of this work is to study and analyze modern zonal technologies for growing oil flax from the standpoint of resource conservation and rational use of material resources. The main tasks are to study the efficiency of material resources use, identify general trends and the impact of basic technology elements on crop yield and cultivation efficiency, and establish systematic connections between productivity and individual technology elements as components of costs. The work was performed based on scientific research conducted at the "Askaniyskaya" State Agricultural Research Station of the Institute of Irrigated Agriculture of the NAAS. It was found that intensive measures for growing oil flax, such as fertilization, mechanization of production processes, irrigation, and chemical protection, constitute a significant portion of production and energy costs. Combining intensification factors at optimal values for each positively affects crop yield and ensures the most rational use of resources. Unilateral increase in fertilizer rates without balancing with other components is accompanied by a sharp increase in costs and a decrease in fertilizer payback. It was established that the feasibility of growing oil flax with a row spacing of 45 cm is exclusively due to obtaining ecological food-grade products. It was proven that from the standpoint of the overall productivity of irrigated crop rotations, oil flax is advisable solely as a supplementary crop. When building its cultivation technology based on the principles of systematization and adaptability, it ensures high economic and energy payback of intensification factors. The highest profit is ensured by early sowing dates with a row spacing of 15 cm when applying fertilizers at a rate of N60P45K45. It was found that the optimal crop density is a seeding rate of 6 million units/ha without irrigation and 7 million units/ha under irrigation. The varieties that provide the highest resource payback were determined under conditions of natural moisture and irrigation.

Keywords: Oil Flax, Fertilization, Irrigation, Cultivation Technology, Economic Efficiency.

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POSTER PRESENTATION

The Impact of Anthropozoogenic Activity on Grasslands in the Sub-Mountain Zone. Case Study: Sasului Valley-Argeș County, Romania

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Abstract

Overgrazing is the main cause of the structural-functional degradation of grasslands. This paper evaluates the pastoral activity in the grasslands of the sub-mountain area of Argeș County. Therefore, 10 plots were established in Sasului Valley and analyzed using geobotanical method. For each plot, the pastoral value, the grazing capacity, and the quality of the meadow were determined. All meadow phytocenoses analyzed in Valea Sasului belong to the Natura 2000 - 6520 Mountain meadows habitat. Depending on the analyzed plot, the pastoral value of the meadows in Sasului Valley was medium, with values between 1.63-2.01 and mediocre due to values from 0.83 to 1.2. Grazing capacity registered the lowest values in highly degraded areas (0.33 – 0.72 UVM/ha), which means a reduction in the number of animals that can graze in these areas. The most important factors that caused imbalances in the meadows of Sasului Valley were: intensive grazing with sheep and cows; abandonment of pastoral activity in some points; development of invasive plants species and shrubs. In order to restore the structure of degraded grasslands in Sasului Valley, it is necessary to implement some management measures to ensure their sustainable conservation, such as: limiting grazing in degraded areas and respecting animal loading; mowing the vegetation for 5 years and sowing with species characteristic of the 6520 habitat; shrub clearing and invasive weed removal; monitoring tourism activities; monitoring of timber extraction activities; providing compensation and subsidies to grassland owners for sustainable management.

Keywords: Overgrazing, Meadows, Management.

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POSTER PRESENTATION

Determination of Chemical Composition and Biological Activity of Flaxseed (*Linum usitatissimum*) Essential Oil

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Abstract

The essential oil was obtained from flaxseed (*Linum usitatissimum*) through cold press oil machine of ripe seeds. The chemical composition of flaxseed essential oils were analyzed by GC-MS. The results revealed that the chemical composition of flaxseed essential oil was found as 9,12-Octadecadienoic acid (Z,Z)-(33.16%), Tributyl acetylcitrate(15.31%), 9,12,15-Octadecatrienoic acid, (Z,Z,Z)- (15.28%), 9,12,15-Octadecatrienoic acid, 2,3-dihydroxypropyl ester, (Z,Z,Z)- (12.72%), and Ethanol, 2-(9,12-octadecadienyloxy)-, (Z,Z)-(9.54%) were found as major compounds followed by ETHYL LINOLEOLATE(3.64%), Tricyclo[6.4.0.0(3,7) and dodecane(2.04%). These chemical compounds identified has general biological activities (Antioxidant, Antimicrobial Activity, anti-inflammatory, Nematicide, Antihistaminic Antieczemic, Insectifuge) As a result of this study; it can be suggested that flaxseed essential oil in the biological application.

Keywords: Flaxseed, Essential Oil, GC-MS, Antimicrobial Activity, Chemical Composition.

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POSTER PRESENTATION

Virtual Laboratory in Biology Education: New E-Learning Tool

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Abstract

Traditional laboratories play an effective role in the educational process for the majority of applied science students. On the other hand, these laboratories face many difficulties, including the high costs of equipping them, in addition to the high prices of experimental materials of various types, as well as their limited capacity to accommodate the increasing number of students and other disadvantages that affect students. Virtual laboratories are a unique educational experience and are characterized by addressing many of the disadvantages of traditional laboratories. Biology students enjoy the availability of a safe and controlled environment while conducting laboratory experiments, in addition to the high benefit from valuable virtual tools, which contribute to enhancing and deepening their understanding of various complex fields in biology, in addition to mitigating the risks associated with the traditional laboratory environment. This study aims to evaluate the extent of benefit from the use of virtual laboratories in practical biology lessons.

Keywords: Traditional Laboratories, Virtual Laboratories, Biology, Laboratory Experiments.

1. Introduction

Virtual laboratories have become increasingly popular in educational settings due to their many benefits (Abdulrahman Nami Alshaikh, 2022). One of the key advantages of virtual laboratories is the ability to provide students with hands-on experience in a safe and controlled environment (Alvarez, 2021). This is particularly important in the field of biology, where students may be working with delicate or potentially hazardous specimens. Moreover, virtual laboratories offer students the opportunity to explore concepts and conduct experiments that may not be feasible in a traditional classroom setting (Martin Bílek, 2009). For example, students can manipulate variables and observe real-time outcomes, helping them to develop critical thinking and problem-solving skills (Jackson, 2015). In addition, virtual laboratories can be accessed anytime and anywhere, allowing students to engage with the material at their own pace and convenience (Diwakar *et al.*, 2012).

In the specific context of zoology, botany, and microbiology, virtual laboratories can enhance students' understanding of complex biological processes (Son *et al.*, 2016). For instance, students can use virtual dissection tools to explore the anatomy of different organisms or simulate the growth of plants under different environmental conditions (Maldarelli *et al.*, 2009). In microbiology, students can observe the behavior of microorganisms and conduct experiments to investigate their role in various ecosystems (Zumbach *et al.*, 2006). Overall, virtual laboratories have the potential to revolutionize biology

education by providing students with a dynamic and interactive learning experience. By incorporating virtual laboratories into their teaching strategies, educators can inspire students to pursue careers in the biological sciences and prepare them for success in the rapidly evolving field of biology.

2. The Advantages of Virtual Laboratories in Biology Education

2.1. Accessibility and Flexibility

Virtual laboratories provide a safe and controlled environment for students to conduct experiments without the risk of injury or damage to equipment (Soares, 2023). This allows learners to explore and experiment freely, making mistakes and learning from them without any negative consequences (Abdulrahman Nami Alshaikh, 2022). Additionally, virtual labs can offer a wide range of resources and tools that may not be available in traditional laboratory settings, providing students with a more comprehensive learning experience (Ayega and Khan, 2020). Furthermore, virtual laboratories can be easily customized to meet the specific needs of individual students or classes (Maldarelli *et al.*, 2009). Educators can tailor the experiments and simulations to align with their curriculum objectives, ensuring that students are able to achieve their learning goals. This personalized approach not only enhances student engagement but also allows for more targeted and effective instruction. Virtual laboratories are revolutionizing the way students learn and engage with scientific concepts. By offering accessibility, flexibility, safety, and customization, virtual labs are empowering students to take control of their learning journey and develop a deeper understanding of biology. As technology continues to advance, virtual laboratories will continue to play a crucial role in enhancing STEM education and preparing students for future careers in the sciences (Stuckey-Mickell and Stuckey-Danner, 2007; Ray *et al.*, 2012).

2.2. Cost-Effectiveness

High cost is often one of the biggest problems in equipping most traditional science laboratories. Furthermore, students in traditional laboratories are often constrained by limited access to equipment and facilities, as well as strict schedules for laboratory sessions (Soares, 2023). In contrast, virtual laboratories can be accessed anytime, anywhere, allowing students to conduct experiments and simulations at their own pace and convenience (Ayega and Khan, 2020). This not only enhances the learning experience for students but also enables educational institutions to reach a wider audience of learners, including those who may not have access to traditional laboratory resources. Another advantage of virtual laboratories is their versatility and adaptability. With traditional setups, once equipment is purchased and set up, it is often difficult and costly to make changes or updates. In comparison, virtual laboratories can be easily modified and updated to reflect advancements in technology or changes in curriculum requirements (de Vries and May, 2019). This ensures that students have access to the most up-to-date resources and experiences, enhancing their overall learning outcomes (Abdulrahman Nami Alshaikh, 2022). In addition, virtual laboratories offer a safe and controlled environment for experimentation. With traditional setups, there is always a risk of accidents or mishaps occurring during practical sessions, especially when working with hazardous materials or complex equipment. Virtual laboratories eliminate these risks by providing a simulated environment where students can conduct experiments without any safety concerns (Rowe *et al.*, 2018). This not only ensures the well-being of students but also eliminates the need for expensive safety measures and procedures, further reducing the overall cost of laboratory operations. Overall, virtual laboratories present a cost-

effective, accessible, flexible, and safe alternative to traditional laboratory setups, making them an invaluable tool for educational institutions looking to enhance their practical learning experiences without breaking the bank (Bactol, E. Laursen and de Araujo, 2017).

2.3. Safety and Increased Experimental Opportunities

Virtual laboratories not only provide a secure environment for students to conduct their experiments safely but also offer the opportunity for more hands-on learning experiences (Rowe *et al.*, 2018; Abdulrahman Nami Alshaikh, 2022). In traditional laboratory settings, students may be restricted in the number or types of experiments they can perform due to limitations on resources or safety concerns (de Vries and May, 2019). Nevertheless, in virtual laboratories, students have the freedom to explore a wider range of experiments without any constraints. Furthermore, virtual labs allow students to make mistakes and learn from them without any real-world consequences. In molecular biology, for example, students can experiment with different techniques and procedures without worrying about contaminating their samples or causing harm to living organisms (Zumbach *et al.*, 2006). This trial-and-error approach can help students develop critical thinking skills and problem-solving abilities that are essential in the field of biology. Overall, virtual laboratories offer a unique and valuable learning experience for biology students by providing a safe and controlled environment for experimentation (Tatli and Ayas, 2010; Jordá, 2013). By utilizing these virtual tools, students can enhance their understanding of complex biological concepts while mitigating risks associated with traditional laboratory settings (Suryanti *et al.*, 2019; Soares, 2023).

3. Virtual Laboratories in Biology Education

3.1. Virtual Laboratories in Zoology Education

In addition to the benefits of virtual dissections, virtual laboratories in zoology also offer advanced features such as simulations and interactive quizzes. These tools can help students test their knowledge and reinforce their understanding of complex biological concepts (Nella Puspita Sari, Munawir Yusuf, 2023). By incorporating multimedia elements such as videos and animations, virtual laboratories can provide a more engaging and interactive learning experience compared to traditional lecture-based instruction (Maldarelli *et al.*, 2009; Martin Bílek, 2009; Udin, Ramli and Muzzazinah, 2020) Furthermore, virtual laboratories in zoology can be accessed remotely, allowing students to learn at their own pace and on their own schedule. This flexibility is especially beneficial for students who may have busy schedules or limited access to physical laboratory facilities. Additionally, virtual laboratories can accommodate a larger number of students simultaneously, making it easier for educators to provide hands-on learning experiences to a larger audience (Ray *et al.*, 2012).

Virtual laboratories in zoology offer a cost-effective and efficient way for students to gain practical experience in the study of animals. By providing a realistic and interactive learning environment, virtual laboratories can help students develop critical thinking skills, problem-solving abilities, and a deeper appreciation for the natural world. As technology continues to advance, virtual laboratories will likely play an increasingly important role in the field of zoology education.

3.2. Virtual Laboratories in Botany Education

This experiential learning approach allows students to engage in hands-on activities without the limitations of physical space and resources (Jordá, 2013). With virtual laboratories, students can access a wide range of plant species from different ecosystems, exposing them to a diverse array of plant adaptations and responses to environmental conditions. Through interactive simulations, students can conduct experiments that would otherwise be impractical or impossible in a traditional classroom setting, enhancing their critical thinking and problem-solving skills (Pearson and Kudzai, 2015). Furthermore, virtual laboratories offer a safe environment for students to explore and experiment without the risk of damaging live plant specimens (Maldarelli *et al.*, 2009). This allows for repeated trials and data collection, reinforcing concepts and theories taught in lectures. Students can also receive immediate feedback on their experiments, helping them to better understand the cause-and-effect relationships in plant biology (Bactol, E. Laursen and de Araujo, 2017).

Virtual laboratories provide a dynamic and engaging platform for teaching botany, offering students a rich and immersive experience that complements traditional lectures and textbooks. By incorporating virtual labs into the curriculum, educators can enhance the learning experience and better prepare students for careers in plant science and related fields.

3.3. Virtual Laboratories in Microbiology Education

In today's digital age, virtual laboratories have revolutionized the way students learn and interact with the complex world of microbiology. The traditional methods of studying microorganisms, such as using microscopes and Petri dishes, have limitations when it comes to providing a comprehensive understanding of these tiny organisms (Son *et al.*, 2016; Baumann-Birkbeck *et al.*, 2021). Virtual laboratories bridge this gap by providing a realistic and immersive environment where students can explore the intricate details of microbial life (Brockman *et al.*, 2020). One of the key advantages of virtual laboratories is the ability to visualize the growth and behavior of microorganisms in real-time. Students can observe how bacteria multiply and spread, or how viruses infect host cells, all within the confines of a computer screen (Alvarez, 2021). This hands-on experience allows for a deeper understanding of microbial processes and dynamics, which is essential for future research and medical applications (Brockman *et al.*, 2020; Udin, Ramli and Muzzazinah, 2020) Furthermore, virtual simulations enable students to conduct a wide range of experiments that would be difficult or impossible to perform in a traditional laboratory setting (Martin Bílek, 2009). For example, students can study the mechanisms of antibiotic resistance by testing different drug compounds against bacterial strains, or explore the intricacies of genetic engineering by manipulating the DNA of virtual organisms (Ramdani, Handayani and Firdiana, 2018; Baumann-Birkbeck *et al.*, 2021) These experiments not only enhance students' theoretical knowledge but also develop their practical skills in microbiology techniques. Moreover, virtual laboratories provide a safe and controlled environment for students to practice aseptic techniques, which are crucial for preventing contamination in real laboratory settings (Ramos *et al.*, 2016). By simulating tasks like streaking agar plates, inoculating cultures, and handling microbial specimens, students can hone their skills in sterile procedures and become more proficient in microbiological practices (Flint and Stewart, 2010).

Virtual laboratories offer a unique and engaging platform for students to delve into the fascinating world of microbiology. By leveraging the power of technology, students can explore, experiment, and learn in ways that were previously unimaginable. As the field of microbiology continues to advance, virtual

laboratories will undoubtedly play a significant role in shaping the future of scientific education and research.

4. Conclusion

Virtual laboratories have revolutionized the way biology is taught, providing students with immersive, accessible, and cost-effective learning experiences. In the fields of zoology, botany, and microbiology, virtual laboratories offer unique opportunities for students to explore complex concepts, conduct experiments, and develop critical thinking skills. By integrating virtual laboratories into biology education, teachers can provide students with a deeper understanding of complex scientific concepts and equip them with the knowledge and skills needed to excel in the dynamic world of biology.

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POSTER PRESENTATION

Application of Statistical Methods for Aquatic Ecosystem Assessment

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Abstract

Various statistical methods were applied to predict and assess aquatic ecosystems. Linear regression analysis was performed to determine if there was any change in the R-statistic for the indicators from Lake Vaya and the added indicators from the Aytoska River. From the results obtained it was found that, there is a direct relationship between some of the significant factors - nitrate content on biological oxygen demand. This is due to the fact that the Aytoska River has a high load along its course, as it passes through many agricultural areas, pastures of animals and the wastewater from the sewage treatment plant of the town of Aytoska is discharged into it.

Keywords: Statistical Methods, Aquatic Ecosystem, Assessment.

1. Introduction

Prediction of water quality trends plays an essential role in the field of environmental modeling (Zhang et al., 2019; Mokarram et al., 2024; Chen et al., 2020), most commonly through linear predictive models (LPMs) and machine learning techniques, pattern and correlation discovery, and anomaly detection in environmental variables (Hino et al., 2018). The most widely used method for predicting water quality parameters is through the use of artificial neural networks (ANNs) and their various adaptations (Moeinzadeh et al., 2023; Maier & Dandy, 2000). ANN models are able to handle complex linear and nonlinear modeling problems of rivers, lakes, reservoirs, wastewater treatment plants (WWTPs), groundwater, and streams and reliably estimate water quality with appropriate variables. Input variables may include both physical parameters such as temperature and turbidity, chemical factors such as total dissolved solids (TDS) and total nitrogen (TN) (Palabıyık & Akkan, 2024), or biological such as chlorophyll-a (Rajaee & Boroumand, 2015). In a study aiming to evaluate the relationships between water quality parameters is best represented by linear regression, also a predictive model for dissolved oxygen (DO) utilization in a lake is developed using regression analysis and artificial neural network (ANN) techniques (Selim et al., 2023). In another study, the authors proposed a deep learning model that integrates deep matrix factorization (DMF) and deep neural networks (DNN) to softly detect and predict BOD_5 values in harbor waters (Ma et al., 2020). An artificial neural network (ANN) and support vector model (SVM) were developed to predict total nitrogen (TN) and total phosphorus (TP) concentrations in a river (Liu & Lu, 2014). An ANN model and a three-dimensional circulation model were implemented to predict water temperature in a lake (Liu & Chen, 2012). A model using a back

propagation neural network (FFBP NN) was developed to estimate river loads based on selected water quality parameters: biochemical oxygen demand (BOD), chemical oxygen demand (COD), suspended solids (SS) and ammonia nitrogen (NH_3 -N) and a classical statistical multiple linear regression (MLR) model to validate the model (Khairudin et al., 2024). (ANN) were used to estimate the concentration of major ions (Na^+, K^+, Mg^{2+}, Ca^{2+}, HCO_3 -, SO_4 ^{2}-, Cl- and NO_3-) in river water based on pH, alkalinity and temperature (Nhantumbo et al., 2018). Artificial neural networks (ANN) were used to develop a model to predict the concentrations of DO, BOD, TDS, HCO_3 and SAR index in a river using three different methods namely Principal Component Analysis (PCA), Factor Analysis (FA) and Cluster Analysis (CA) to identify the most influential water quality parameters (Pany et al., 2023).

2. Materials and Methods

The requirements on analytical methods for monitoring these pollutants are laid down in Directive 2009/90/EC (URL-1, 2024). According to this Directive, "The provision of chemical data by Member States must be ensured by analytical methods that comply with relevant international and national standards or analytical methods that are not standardised but provide data of equivalent or better scientific quality. Member States should ensure that all analytical methods used for the purposes of chemical monitoring programmes are validated and documented in accordance with EN ISO/IEC 17025 or another internationally accepted standard."

2.1. Sampling Methods

To determine water quality, samples were subjected to sample preparation and filtration with Sartorius NY 0.45 µm syringe filters. Laboratory analyses were performed with a spectrophotometer DR3900, HACH Lange with cuvettes for the respective analyses: for PO_4-P-cuvettes LCK349, for ammonium-LCK304, for nitrate-LCK339 and for total nitrogen -LCK238.

2.2. Physicochemical Analyses of Water

Measurements of physicochemical parameters follow basic physicochemical parameters and standards. The quantification of the physicochemical parameters in the samples analysed shall be carried out by measuring the light absorbance by the UV/VIS spectrometer technique.

For the different water body types, a refined assessment of the physicochemical quality elements and the main indicators for establishing water quality in the selected surface water bodies has been carried out, The parameters pH, electrical conductivity, temperature, and dissolved oxygen/oxygen saturation are measured in situ. All nutrients (NO_3-N, NO_2-N, total N and P-PO_4) are measured in the laboratory according to the specified international standards (analytical methods) - Table 1 (BSS - Bulgarian State Standard).

Table 1. Physicochemical parameters and standards.

Physicochemical analysis of water samples			
№	**Parameters**	**Standards**	**Detection limit of the method**
1	Determination of active reaction (pH)	BSS ISO 10523	0,00
2	Determination of electrical conductivity (μS cm^{-1})	BSS EN 27888	0,2
3	Determination of dissolved oxygen/oxygen saturation (mg L^{-1})/(%)	BSS EN ISO 5814	0,02
4	Determination of nitrite nitrogen (mg L^{-1})	EN 26777	0,002
5	Determination of nitrate nitrogen (mg L^{-1})	ISO 7890-1	0,2
6	Determination of total nitrogen (mg L^{-1})	EN ISO 11905-1	0,5
7	Determination of orthophosphates (mg L^{-1})	EN ISO 6878	0,01

Ammonia nitrogen in water consists of dissociated ammonium and gaseous ammonia. The ratio of the two forms depends on the pH and temperature of the water. Ammonium is primarily determined by a spectrometric method based on the reaction with salicylate and hypochlorite. This reaction produces blue-coloured compounds of the indophenol type whose absorbance is measured at 655 nm. Nitrogen in water can be divided mainly into inorganic nitrogen and organic nitrogen. Typically, inorganic nitrogen includes ammoniacal nitrogen and nitrate nitrogen, in which ammoniacal nitrogen includes free ammoniacal nitrogen (NH_3-N) and ammonium nitrogen (NH_4^+-N), and nitrate nitrogen includes nitrate nitrogen (NO_3-N) and nitrite nitrogen (NO_2-N). The concentration and proportion of different forms of nitrogen in water are often determined by specific circumstances of the water body.

2.2.1. Photometric determination of ammonium ions with Nessler's reagent (URL-2, 1984)

Ammonia reacts in an alkaline medium with potassium mercuriiodide $K_2[HgJ_4]$ to form a yellow-brown precipitate. At low concentrations of ammonia, a colloidal solution suitable for colorimetric determination is obtained. To 50 ml of sample, add 1-2 drops of a solution of the salt of S and homogenise the mixture carefully. Then add 1 ml of Nessler's reagent and homogenise again. After 10 min, measure the absorbance at 400 nm with a DR 3900 spectrophotometer (Hach). The concentration of ammonium ions ρNH^{4+} [mg L^{-1}] was calculated using Eq1:

$$\rho_{NH4+} = \frac{(A - A_0)V_{max}}{f \times V_s}$$

Where: A - the absorbance of the sample; A_0 - the absorbance of the blank sample; f - the slope in the calibration graph, L g-1; Vmax - volume of the flask, ml; Vs - volume of sample in the flask, ml.

2.2.2. Determination of orthophosphates PO_4-P mg/l. (URL-3, 2004)

After sampling, the sample was filtered through a 0.45 μm syringe filter. The filtrate should have a pH between 3 and 10. A maximum of 40 ml of sample solution is introduced into a 50 ml volumetric flask, 1 ml of ascorbic acid solution and 2 ml of acid molybdate solution are added, brought to the mark with distilled water and stirred. After 10 minutes, measure the absorbance at 880 nm with a DR 3900 spectrophotometer (Hach).

The orthophosphate concentration ρPO_4 [mg L^{-1}] was calculated using Eq 2:

$$\rho_{PO4} = \frac{(A - A_0)\, V_{max}}{f \times V_s}$$

Where: A - the absorbance of the sample; A_0 - the absorbance of the blank sample; f - the slope in the calibration graph, L g-1; Vmax - volume of the flask, ml; Vs - volume of sample in the flask, ml.

2.2.3. Determination of BOD_5, mg/l (URL-4, 1989)

The pH of the sample is measured to be within 6.5 - 7.5 and adjusted if necessary. Dilute the sample with distilled water at 20°C. The sample volume corresponds to the expected BOD value. A Lovibond OxiDirect® apparatus is used which operates with ranges from 0 - 40 to 0 - 4000 BOD mg L^{-1} and sample volumes from 428 ml to 21.7 ml. An anti-nitrification inhibitor is added to the sample and 3 - 4 drops of 45% potassium hydroxide solution (to absorb CO_2) are added to the cap seal. Insert the magnetic stirrer and close tightly. Thus prepared, the sample is annealed at 20°C, then the measurement is started usually for 5 days at the same temperature. The result is expressed in mg L^{-1}, specifying for how many days the measurement was made (5, 10, 20 days).

3. Results and Discussion

3.1. Pearson Correlation Coefficient

Correlation analysis is one of the most used methods for measuring the strength or degree of relationship between two or more variables. Pearson's mathematical formulation to quantify the degree of relationship between variables, namely, *x* and *y*, can be given as:

$$r_p = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}},$$

Where: *n* - number of observations; *x* - measures of Variable 1; y - measures of Variable 2; Σxy - sum of the product of respective variable measures; Σx - sum of the measures of Variable 1; Σy - sum of the measures of Variable 2; Σx^2 - sum of squared values of the measures of Variable 1; Σy^2 - sum of squared values of the measures of Variable 2.

Pearson's *r* returns a value between -1 and +1. An *r* value of positive one (+1) indicates a strong positive correlation, while an *r* value of negative one (-1) indicates a strong negative correlation. An *r* value of zero indicates no correlation. The degrees of correlation, together with their boundaries are listed in Table 2.

The *p*-value is the probability of observing a non-zero correlation coefficient in the sample data when the null hypothesis is true. A typical threshold for rejecting the null hypothesis is a *p*-value of 0.05 or greater. So, if a *p*-value is less than 0.05, the null hypothesis would be rejected in favour of the alternative hypothesis – that the correlation coefficient is different from zero.

Table 2. Degrees of correlation.

Degree	Positive	Negative
Perfect	+ 1	- 1
High	Between +0.75 and +1	Between -0.75 and -1
Moderate	Between +0.25 and +0.75	Between -0.25 and -0.75
Low	Between 0 and +0.25	Between 0 and -0.25
Zero	0	0

3.2. Linear Regression

Linear regression analysis is used to predict the value of a variable based on the value of another variable. The variable you want to predict is called the dependent variable. The variable you are using to predict the other variable's value is called the independent variable.

This form of analysis estimates the coefficients of the linear equation, involving one or more independent variables that best predict the value of the dependent variable. Linear regression fits a straight line or surface that minimizes the discrepancies between predicted and actual output values. There are simple linear regression calculators that use a “least squares” method to discover the best-fit line for a set of paired data and then estimate the value of X (dependent variable) from Y (independent variable).

Assumptions to be considered for success with linear-regression analysis:

- *For each variable:* the number of valid cases, mean and standard deviation.
- *For each model:* regression coefficients, correlation matrix, part and partial correlations, multiple R, R^2, adjusted R^2, change in R^2, standard error of the estimate, analysis-of-variance table, predicted values and residuals, 95-percent-confidence intervals for each regression coefficient,
- *Plots:* scatterplots, partial plots, histograms and normal probability plots.
- *Data:* dependent and independent variables should be quantitative.

The correlation heatmap for the combined data for Vaya Lake and Aytoska River shows in Figure 1.



Figure 1. Correlation heatmap - Vaya Lake and Aytoska River.

The result indicates that the best correlation is between BOD5 and Dissolved Oxygen (0.38). The *r*-Pearson for the "BOD5-Temperatire" is -0.17. Both values show decrease in the correlation compared to the results from the first analysis. BOD value is a variable that is dependent on time and temperature. This is because the metabolic rate of aerobic microorganisms depends on temperature and its growth continues over time following the microbial growth curve with the exponential and stationary phases. The "BOD5–N-NO_3" pair, however, demonstrates a much higher correlation coefficient (-0.29). Table 3 combines the pairs' *r*-Pearson value with their *p*-values.

Table 3. Correlation analysis results.

Pair	r-Pearson	p-value
BOD5 - DO	0.38	0.003
BOD5 - Temperature	-0.17	0.175
BOD5 – N-NO_3	-0.29	0.166

Based on the comparison between the results from the correlation analysis on both Vaya Lake and Vaya Lake with Aytoska River, we can conclude that relationship between BOD5 and Dissolved oxygen is most reliable and consistent (*r*-Pearson is over 0.35 and p-values are under 0.05).

From the results obtained, it was found that, there is a direct correlation between some of the significant factors - nitrate content on biological oxygen demand. This is due to the fact that the river Aitoska has a high load along its course, as it passes through many agricultural areas, pastures of animals and the wastewater from the sewage treatment plant of the town of Aitoska is discharged into it. Aytos.

Linear regression analysis is performed for the pairs to find if there is any change in the *R*-statistics for the Vaya Lake indicators and the ones added from Aytoska River – Figure 2 and 3.

In Table 4 the results from analysis on the different pairs and places of measuremnt are summarized.

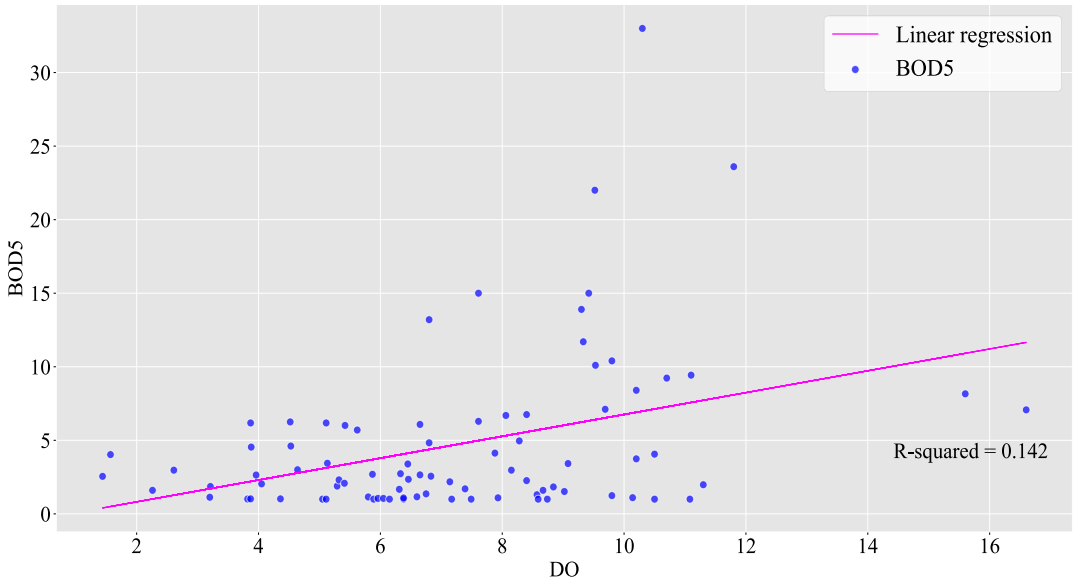


Figure 2. Linear regression Dissolved oxygen-BOD5 (Vaya Lake and Aytoska River).

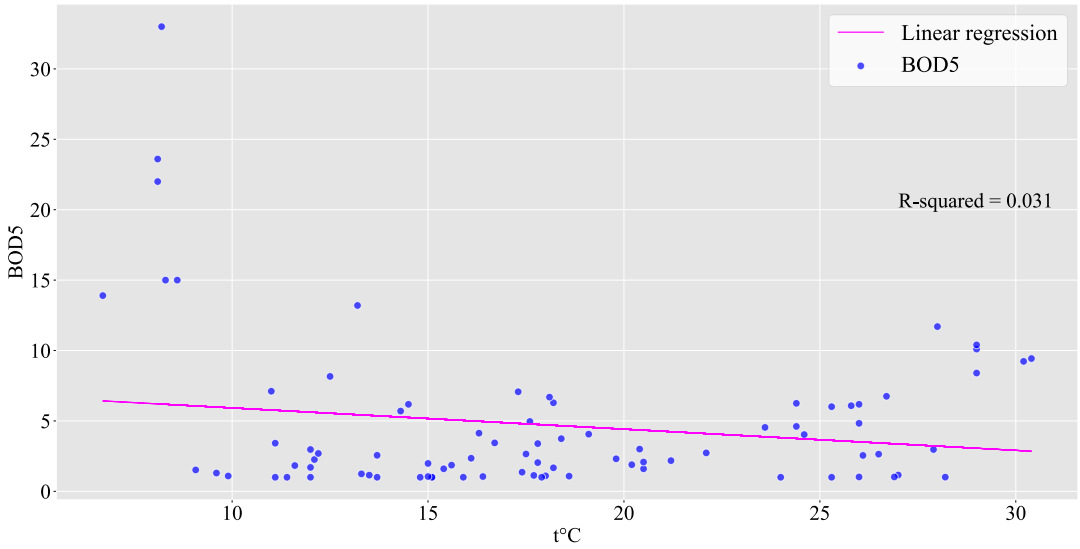


Figure 3. Linear regression Temperature-BOD5 (Vaya Lake and Aytoska River).

Table 4. R-statistics from linear regression analysis.

Pair	Place	R-squared
DO-BOD5	Vaya Lake and Aytoska River	0.142
Temperature-BOD5		0.031

3.3. Multiple Regression Analysis

For improving the robustness of the model, multiple regression is performed over the collected data (N-NH_4, N-NO_2, N-NO_3, N-tot, PO_4-P, P-tot, Temperature, Conductivity, pH, Dissolved oxygen to BOD5). The results are summarized in Table 5.

Table 5. Multiple regression results.

	Multiple R	R-square	Adjusted R-square
Vaya Lake and Aytoska River	0.58	0.34	0.25

Table 5 shows that when the *R*-statistics are substantially improved when the rest of the predictor parameters are added to the model with the ones for the Vaya Lake slightly higher than the combined results with Aytoska River.

4. Conclusion

The obtained model is not very accurate due to the confluence of the Aitoska River, which is parallel to the confluence of two other rivers - the Chakrliyka and the Sarundere.

The mixing of the three river flows with the lake waters is associated with a change in the processes occurring in the lake. The Aytoska River is the most full-flowing river, and the model takes into account its influence on the BOD5 indicator affecting the dynamics and functionality of the lake.

Further exploratory monitoring of both aquatic ecosystems is needed to assess the seasonal dynamics of pollutants entering the lake.

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
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POSTER PRESENTATION

Analysis of Controlled Cutting and Regeneration, Sustainable Strategies for Forest Conservation

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Abstract

Environmental conservation in forest districts has become increasingly important against the background of climate change and the need to maintain biodiversity. This paper analyzes the impact of controlled cuttings and forest regeneration from a monitoring perspective. Controlled cuttings are important for maintaining ecosystem balance and promoting natural regeneration. This practice involves the strategic selection and removal of certain trees to allow light penetration and encourage the growth of seedlings, thus contributing to the diversification of forest structure and reducing the risk of forest fires. Forest regeneration can be natural or supported by human interventions, such as planting seedlings. Monitoring the impact of controlled cuttings and forest regeneration involves the assessment of relevant ecological and socio-economic indicators, such as species diversity, soil health, water quality, and carbon stocks. Systematic and long-term monitoring of these indicators allows the identification of trends and the adjustment of management strategies in accordance with conservation objectives. This paper explores the specialized literature and analyzes relevant case studies in order to understand better the effectiveness of controlled cuttings and regeneration in the context of environmental conservation in forest districts. Both successes and challenges are examined, providing a solid foundation for future policy and practice recommendations. Additionally, the paper emphasizes the importance of integrating local communities into the forest management process, recognizing that the long-term success of conservation strategies depends on their involvement and support. The aim of this paper is to contribute to the knowledge and improvement of conservation strategies in forest districts by providing a detailed analysis of the impact of controlled cuttings and regeneration based on rigorous monitoring. The results will be useful for both forestry practitioners and policy makers in their efforts to promote sustainable forest management.

Keywords: Environmental Conservation, Silvicultural Activities, Biodiversity, Monitoring.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
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POSTER PRESENTATION

Stimulating Students for Learning Development through Research

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Abstract

This study investigates the impact of research-based learning on student engagement and cognitive development. The increasing complexity of educational requirements, driven by social and technological developments, calls for innovative teaching methods. This paper explores how structured stages of the thinking process can stimulate student learning, emphasizing the important role of the teacher in guiding this process. A qualitative and quantitative mixed-method approach was utilized, involving interviews, questionnaires, observations, and document analysis with a participant group of students and three teachers. The data collection aimed to evaluate the effectiveness of inquiry-based learning and identify obstacles to its implementation. Data were analyzed through participatory observation and factorial analysis to identify trends and relationships between variables. Key findings reveal that research-based learning promote a partnership between teachers and students, enhancing independent thinking and the pleasure derived from self-achievement. Students actively participate in the learning process, guided by teachers who design and project the stages of learning. This approach moves away from predefined models, encouraging students to think critically and solve problems independently. The study concludes that learning through research significantly enhances critical thinking and practical skills across various disciplines, including topography, physics, and ecology. The teacher's role is essential in stimulating and guiding students' cognitive processes, leading to a deeper understanding and application of knowledge. The study presents recommendations for improving inquiry-based learning and future research directions are discussed.

Keywords: Education Improvement, Student Engagement, Cognitive Development, Inquiry-based Learning, Independent Thinking.

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POSTER PRESENTATION

Impact of Silver Nanoparticles on Polyphenolic Content and Proline Accumulation in *Cucumis sativus* L. Seedlings

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Abstract

The widespread use of silver nanoparticles (AgNPs) necessitates a comprehensive investigation into their biological implications across various organism categories, whether target or non-target. This study adheres to the OECD Test No. 125 standardization protocols for the physicochemical characterization of nanomaterials, aiming to elucidate the impact of AgNPs on polyphenolic compounds and proline levels in the plantlets leaves of cucumber (*Cucumis sativus* L.), a widely cultivated vegetable. Cucumber seeds were hydrated for one hour, followed by immersion in serial dilutions of a silver nanoparticle stock solution (Thermo Scientific) characterized by a size of 20 nm and a concentration of 0.02 mg/ml in 2 mM sodium citrate. The treatments included direct exposures to AgNPs solutions at 10x (N1), 100x (N2), and 1000x (N3) dilutions, alongside control groups subjected to water and 2 mM sodium citrate. The experimental design was replicable, with ten seeds evaluated per variant, across three replicates. Polyphenol content was quantified utilizing the Folin-Ciocalteu assay, while proline levels were assessed via the Bates method, 21 days post-treatment initiation. Results indicated an increase in polyphenol concentrations across treatments, though statistical significance was not achieved, with the 1000x AgNPs solution yielding the highest polyphenol content. Conversely, proline accumulation peaked in the 1000x dilution, also showing statistically insignificant variations. These findings suggest that the biochemical parameters evaluated were not markedly influenced by the AgNPs treatment levels. Further research is warranted to investigate the morphological, physiological, and cytological ramifications of AgNPs exposure on Cucumis sativus L. for a holistic understanding of their environmental impact.

Keywords: Silver Nanoparticles, *Cucumis sativus* L., Phenols, Proline.

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POSTER PRESENTATION

Effects of Solid Matrix Priming on Spinach Seed Vigor

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Abstract

Solid Matrix priming provides a much more aerated, oxygen-rich environment than other priming methods, especially osmopriming, and therefore does not require additional aeration, which makes this method particularly advantageous for some species. The study was carried out in Uşak University Horticulture greenhouse and Faculty of Agriculture laboratory. In the experiment, 4 different media (vermiculite, perlite, peat and equal mixture of these three media by volume), 2 different water ratios (1 part water/2 parts and 1/3 priming media), 3 different media temperatures (4°C, 20°C, 25°C) and 3 different duration (2, 6, 10 days) Solid Matrix Priming (SMP) combinations were used. Seed germination (3x50 replicates/seed, 25 °C, 14 days), emergence (3x50 replicates/seed, 20-25 °C, 21 days) and EC (3x50 replicates/seed, 20 °C, 24-48 h) tests were performed on spinach seeds of Matador variety. According to the results, 4V/3 (225.66 µS), 20P/2 (224 µS) and 20 Mix/2 (219 µS) environments gave the lowest EC results in 2-day SMP treatment, while similar results were obtained from 4V/3 (212.46 µS), 4P/2 (241 µS), 20T/2 (119.86 µS) environments in 6-day SMP treatment. 20K/3 and 25 Mix/2 environments gave the highest germination values as a result of 2 and 6-day SMP treatment. In emergence results, 20Mix/3 (23%), 25Mix/3 (82%) and 4T/2 (88.6%) treatments stood out. In 6-day treatment results, 4T/3 (74.6%) and 4V/3 (67.3%) showed the best performance.

Keywords: Solid Matrix Priming, Spinach, Seed Viability, EC Test.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
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POSTER PRESENTATION

Antibacterial Efficacy of *Pistacia lentiscus* Extracts

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Abstract

The use of medicinal plants today is the form of the most widespread medicine worldwide. Utilizing aromatic plants as interesting source of phytochemicals constitute one of the largest scientific concerns. The mastic tree (*Pistacia lentiscus*) is a medicinal and aromatic plant bush knowns in antiquity for the usefulness and effectiveness of its parts (leaves, seeds, fruits, gum). This plant is distributed in different parts of the world, particularly in the Mediterranean region. The present study aims to evaluate the antibacterial activity of aqueous, methanolique and essential oil extracts of *Pistacia lentiscus* L. collected from Ouled Driss region, Souk Ahras. Furthermore, the antibacterial activity was valuated using three bacterial strains: *Staphylococcus aureus*, *Escherichia coli* and *Klibesiella pneumoniae*. Commercial antibiotics were used as references. The phytochemical analysis indicated that leaf of *P. lentiscus* comprising anthocyanins, leucoanthocyanins, flavonoids, tanins and terpenoids. The obtained results showed also that aqueous extract of *P. lentiscus* in its dilution state has the greatest antibacterial effect against the three strains, comparable to the all antibiotics used. On the other hand, both essential and vegetable oils have weak activity only against the *S. aureus* strain. Dilution of extracts in DMSO increased their antibacterial power. The present research demonstrated the antibacterial efficacy of *P. lentiscus* extracts against the present strains of bacteria.

Keywords: Antibacterial, *Pistacia lentiscus*, Extracts, Bacteria.

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POSTER PRESENTATION

The Effects of Various Moringa Extracts on Spinach Seed Performance in Different Growing Media

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Abstract

The use of organic matter to increase seed germination rate and uniform seedling emergence has gained importance in recent years. Different organic substances such as seaweed, humic acid, fulvic acid, *Moringa oleifera* leaf extract, marigold herbal tea and grapefruit juice are used in seed treatments. Among the herbal extracts, the leaf extract of the moringa plant is one of the most widely used. Marigold herbal tea is another important organic priming agent in studies on the effect and different species. In this study, the effects of organic priming and drying treatments with Moringa leaf extract (MLE) solution on germination and emergence performance of spinach seeds (*Spinacia oleracea* L.) were investigated. Spinach seeds were sown in different growing media with different ratios (1:1, 1:2, 2: 1); (peat (T), perlite (P), garden soil (GS), leonardite (L), L+T mixture, L+P mixture, L+BT mixture, tomato pellet (TP), TP+T mixture, TP+P mixture, TP+GS mixture), organic priming with MLE (1% and 2% soaking and irrigation, 2 and 4 hours), followed by drying. Seedling length (cm), shoot length (cm), root length (cm), wet weight (g), hypocotyl length (cm), dry weight (g), germination rate (%), and mean germination time (days) (MGT) parameters of spinach seeds were evaluated after emergence. In the control group, the highest emergence rate was 20% in L+T (1:2) and the fastest emergence was obtained in L+GS (1:2). The highest and earlier emergence resulted in 1:2 P medium with 33% after 2 hours of 1% MLE treatment, while the highest emergence resulted in L+T medium with 86.6% after 2 hours of 2% MLE treatment. While 1% MLE for 4 hours gave the highest emergence rate in L+GS medium with 71.7%, 2% treatment for the same period was determined in GS medium with 67.5%. In germination results, the irrigation group with 1% MLE gave the best performance with 92%. According to hypocotyl length measurements, the best treatment was irrigation with 2% MLE with 18 mm. MLE treatment gave positive results on seed and seedling quality parameters.

Keywords: Organic Priming, *Spinaca oleracea* L., Moringa Leaf Extract, Seedling Quality.

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POSTER PRESENTATION

Technological Processes of Breeding and Intensity of Growth of the Karakul Lambs

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Abstract

The purpose of our research was to evaluate the intensity of growth of Karakul lambs obtained from mothers of different constitution types. The formation of research groups of sheep was based on the type of ewes' constitution. Lambs obtained from mothers of different constitution types were divided into 3 groups. Before weaning, the lambs were reared by the pen-base method with supplementary feeding according to the feeding norms for Karakul lambs, and after weaning – by the pasture-stall system. Growing of female lambs from 8 to 18 months partially coincided with stable maintenance in the winter period. Our research established that the type of lambs' birth affects their live weight at birth. The rams born among twins had a lower live weight than those born among singletons. The live weight of singleton rams obtained from mothers with a strong constitution is 2.3% higher than that of twins, and by 9.1% from mothers with a delicate constitution. Among the twins obtained from mothers of a strong type of constitution, rams were born larger than from mothers of a delicate type prevailing in live weight by 8.1% ($P>0.95$). In female lambs, the offspring of mothers with a coarse type of constitution had the largest live weight at birth. During the period from birth to 10 months old, the highest average daily gain in live weight was achieved by single male lambs, obtained from mothers of coarse constitution type. They outnumbered their peers obtained from mothers with a strong type of constitution by 7.2%, and by 14.4% the peers obtained from mothers with gentle type ($P>0.999$). Twin male lambs had a balanced intensity of live mass growth. Characterizing the intensity of growth of female lambs obtained from mothers of different types of constitution for the period from birth to 18 months old, it should be noted that the type of birth does not have a significant effect on their average daily growth. However, among the singletons, the female lambs obtained from mothers of a coarse constitution type had a higher average daily increase compared to the ones obtained from mothers of strong constitution type by 1.64% ($P\leq0.95$), and gentle – by 4.6% ($P>0.999$). Among female lambs – twins, the animals obtained from mothers of a strong constitution type had a higher average daily increase in live weight than their peers obtained from mothers of gentle type of constitution by 4.0% ($P>0.99$). It has been established that under technological conditions of the zone of high-intensity agriculture, ewes of the Karakul breed of different constitution types can have viable, well-developed offspring capable of forming high productivity. The type of constitution of ewes affects the intensity of the offspring' growth. The offspring of mothers with a rough type of constitution had a higher potential for early maturity compared to their peers – offspring of mothers with strong and gentle constitution types.

Keywords: Type, Constitution, Live Weight, Female Lambs.

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POSTER PRESENTATION

Production of Environmentally Safe Beekeeping Products under Conditions of the Southern Region of Ukraine

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Abstract

Under conditions of widespread use of chemicals in agriculture and forestry, the problem of protection of bees from poisoning is becoming increasingly acute, since the main cause of bee deaths is the use of plant protection products during their flowering period without timely warning beekeepers. Therefore, the processing of nectaries should be carried out in the period when bees do not fly – in the morning and evening hours. Processing is also allowed during the day, but in cool weather, when the bees do not fly out of the hives. Poisoning of bees with toxic chemicals causes not only their poisoning, but also the poisoning of the products obtained from them and very often the death of the bees themselves from the entry of poisonous and heavy metals into their bodies. Mineral substances are important for the normal vital activity of the bee body, but their excessive supply is harmful to bees. The goal of our research was to determine the content of heavy metals and proline in honey, royal jelly and perga. Samples of biological material were collected at a private apiary in the Odesa region of Ukraine. The content of Iron, Lead, Cobalt, Cadmium, Zinc, Copper was determined in the selected samples using an atomic absorption spectrophotometer SF 115 PC. As a result of the conducted research, it was established that honey contains all the investigated mineral substances, but in different amounts. The highest content of all the minerals studied was Copper (207.40) µg/kg, and the content of such minerals as Iron, Cobalt, Cadmium and Zinc was almost at the same level and amounted to (from 3.78 to 5.39) µg/kg, with the exception of Zinc (5.39) µg/kg, the content of which being almost 2 times greater than the content of Iron, Cobalt and Cadmium. Honey contained Lead 28.53 µg/kg. The proline content was at the level of 404.48 mg/kg. Royal jelly contained the following amount of minerals in µg/kg: Iron – 3.96, Lead – 6.46, Cobalt – 13.6, Cadmium – 1.46, Zinc – 0.531, Copper – 266. Copper is an irreplaceable mineral element for animal life. It is necessary for the formation of blood. With Copper deficiency, the number of erythrocytes decreases without a change in their hemoglobin concentration. Both a lack and an excess of Copper in the body of animals leads to various disorders of their growth and development and causes diseases. Perga contains the largest amount of Iron (141000 µg/kg) and Zinc (38550 µg/kg) and the least amount of Cobalt (3.6 µg/kg) and Lead (42.0 µg/kg). Therefore, for the production of clean and safe beekeeping products, it is necessary to comply with the current legislation on the management of the beekeeping industry, in accordance with the location of apiaries in relation to industrial enterprises, as well as sanitary and hygienic rules for keeping bees.

Keywords: Royal Jelly, Honey, Heavy Metals.

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POSTER PRESENTATION

Therapeutic Potential of the Self-Heal Herb *Prunella vulgaris* L.

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Abstract

Prunella vulgaris L. (Lamiaceae), a perennial herbaceous species found in Europe, Asia, Africa, and North America, has been used for thousands of years in traditional medicine in China, Japan, Europe, Turkey, and Iran. The approximately 250 phytocompounds isolated and identified belong to the triterpenoid, sterols, flavonoids, phenylpropanoid, volatile oils, organic acids, and polysaccharides classes. The presence of Cu, Fe, Zn, Ni, Cd, and Cr in different amounts in the aerial and underground parts of the plant is also known. The complex chemical composition provides this species with remarkable therapeutic potential, among the pharmacological activities proven by *in vitro* or *in vivo* research: antitumor, antiviral, antibacterial, antioxidant, anti-inflammatory and immunoregulation, hypotensive, hypoglycaemic and hypolipidemic, and hepatoprotective activities. Some current research highlights the phytosynthesis capacity of nanoparticles of gold, silver, platinum, or copper in extracts, callus, or cell cultures of *Prunella vulgaris* L., which gives this species new or improved therapeutic valence. The obtained nanoformulations/nanostructures can be useful in the medical, food, environmental, and other fields.

Keywords: *Prunella vulgaris* L., Phytocompounds, Therapeutic Potential, Nanoparticles.

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POSTER PRESENTATION

The First Record of *Ablepharus kitaibelii* (Bibron and Bory de Saint-Vincent, 1833) in the North of Olt County

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Abstract

The lizards of the fam. Scincidae are represented by a single species over most of South East Europe. The Snake-eyed Skink is one of the smallest lizards in Europe with a relatively secretive lifestyle. Regarding the distribution of this species, the Snake-eyed Skink - *Ablepharus kitaibelii* (Bibron & Bory de Saint-Vincent, 1833) has not been reported so far in the north of Olt County. It is the first observation (recording) in this area. This research indicates for the first time two populations of *Ablepharus kitaibelii* situated in the commune of Bărăști, in an area where the species was not previously documented. This commune is located in the north of Olt County, 50 km away from the municipality of Slatina, county residence. Bărăști commune is situated in the hilly region with an altitude of up to 318 m, part of the territory between the Cotmeana and Vedea rivers, known as the Cotmeana Platform, on the line Drăgășani-Spineni-Mârghia-Pitești, which makes the transition between hill and plain. The Snake-eyed Skink is considered threatened in Romania. This rare species with a restricted and fragmented distribution is present in Annex IV of the Habitats Directive, the local protection of this species being necessary through special conservation measures, such as: stopping deforestation, stopping the expansion of agricultural or residential areas in the researched area, controlling intensive grazing (there being several sheep and goat pens in the area), replacement of False Acacia and Pine plantations with Oak, supervision of stray cats and dogs, etc.

Keywords: *Ablepharus kitaibelii*, Distribution, New Localities.

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POSTER PRESENTATION

Active Principles Contained in the Species *Prunella vulgaris* L.

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Abstract

Today, all over the world, plants are studied biologically and chemically in detail for their therapeutic, action and stimulation properties on parts of the body. The species of the genus Prunella have been used, since Prehistory, for the treatment of various ailments, having cicatrizing, antimicrobial, hypotensive, carminative, antioxidant, tonic, antiseptic, anti-inflammatory, diuretic and antihemorrhagic action. Due to the high content of fatty acids, volatile oil, flavonoids, ursolic acid, rosmarinic acids, tannins and vitamins, such as A, B, C, K, the species is widely used in naturopathic therapy with cicatrizing, antimicrobial, hypotensive, carminative, antioxidant action, tonic, antiseptic, anti-inflammatory, diuretic and antihemorrhagic. Prunella herba is the medicinal product used, in the form of tincture, infusion, decoction, syrup, instant medicinal tea, to treat the following conditions: reduce bleeding, sores, wound, herpes, boil oral thrush, eye inflammations, hoarseness, catarrh, tonsillitis, sore throat, laryngitis cough, bronchitis, jaundice, release of gallbladder obstruction, gastritis, migraine, headaches, stimulation of the nervous system, hemorrhoids, leucorrhea, diarrhea, urinary infections, sexual dysfunctions, conjunctivitis, crmaps, intestinal bloating, neuralgia, lack of appetite, diabetes, stomatitis, stimulation of lactation, intercostal stab. Prunella vulgaris L. also has an effect on the HIV or hepatitis B virus, as well as an immunostimulatory, immunosuppressive and antiestrogen effect, as well as thyroid modulatory action, in the prevention/treatment of uterine cancer, breast cancer or endometriosis.

Keywords: *Prunella vulgaris* L., Medicinal Product, Extractive Solution, Biologically Active Compounds, Therapeutic Effect.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

POSTER PRESENTATION

Methods of Drying and Extraction of Biologically Active Compounds from Plants

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Abstract

In the primary processing action of plants, the drying operation plays an essential role in order to keep the biologically active compounds intact. The main factors that influence the choice of the optimal method of drying the plant are: the variety and quantity of the plant, its sensitivity to air/temperature, its degree of drying. The effectiveness of conventional (maceration, percolation, Soxhlet extraction, distillation) and non-conventional (microwave, electric pulse, supercritical fluid extraction) extraction methods is directly proportional to a number of factors that influence the obtaining of plant extracts. The steps for the extraction of biologically active compounds are complex and involve the completion of some steps starting from the reception, weighing, crushing and homogenization of the plant sample until obtaining the biologically active compounds, filtering, purifying and establishing the concentration of the resulting solution, respectively the control of the obtained samples. Biologically active principles from plants are extracted with aqueous, alcoholic and hydroalcoholic solvents under certain working conditions. Extractive solutions are varied (infusion, decoction, tincture, macerate, syrup, medicinal wine, instant medicinal tea, freeze-dried powders from extractive solutions, capsules, fluid extracts, gels, injectable solutions) and contain active substances, but also inactive substances in a variable proportion, which are analyzed by a series of specific methods and techniques in order to establish the composition, the spectroscopic, chromatographic fingerprint and the antioxidant activity.

Keywords: Drying Methods, Extraction Methods, Plant Extracts, Extractive Solutions, Biologically Active Compounds.

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POSTER PRESENTATION

Green Algae-Bioindicators of the River Ialomița

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Abstract

Algae have a very essential role in nature, but also for humans, as follows: - through the process of photosynthesis, they produce oxygen and fix carbon; - captures solar energy and transforms it into food, constituting an important source of organic substances and, therefore, food for aquatic species; - helps maintain ecological stability; - contributes to the self-purification of aquatic ecosystems, being an important indicator of their quality; - source used to control the oxygen level in an aquatic ecosystem; - helps to fertilize the soil, by enriching it in calcium and silicon; - constitutes a raw material in the food, pharmaceutical, or perfume and cosmetic industries; - source of natural fertilizer; - basis for the production of culture media for the cultivation of microorganisms; - raw material for obtaining chemical products or biofuels. The density of green algae is directly proportional to the quality of the respective ecosystem, being considered true bioindicators of water quality. And in the water of the Ialomița river, on a 1 km stretch, green algae were identified. The impact of these pollutants on the biocenosis is determined both by direct contact with water (swimming, washing, fishing, etc.) and by the transfer of toxins through the food chain (water-plankton-fish-human being or water-soil-plant-animal-being human). Nitrogen compounds are plant nutrients. The transfer of these substances to the surface of the water body causes the excessive development of aquatic plants and then their decomposition, respectively the elimination of dangerous toxins and the decrease of the amount of oxygen. The phenomenon of eutrophication leads to phytoplankton blooms, which prevent the penetration of sunlight to aquatic plants and change the composition of the flora. Also, the specific microbial flora of the water is altered, which leads to a decrease in its self-purification capacity. The accumulation of pollutants takes place in different vegetative organs of the plant, with predilection at the level of the root, leaves and flowers, the negative effects consisting in changing the size of the affected organs (plants affected by pollution have larger vegetative organs, in size, and of a more intense color than the unaffected ones).

Keywords: Ialomița River, Polluting Agents, Green Algae, Bioindicators, Eutrophication.

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POSTER PRESENTATION

Analysis of the Physico-Chemical Indicators of the Water of the Ialomița River

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Abstract

The sources of surface water pollution are numerous and varied, the effects on the respective ecosystem being appreciable and persistent, even if the polluting agents dissolve in the water, the ability to absorb/eliminate naturally/artificially these polluting factors, being far exceeded, which endangers the biocenotic balance. That is why combating the pollution of water courses is a priority of every nation/every individual, because water, the indispensable factor of life, must be maintained at the parameters that allow all living organisms to maintain health and improve the quality of life. Therefore, the general objective of the study is the inventory of the main sources of pollution of the Ialomita River and their effects on human health. The analysis of the physico-chemical indicators revealed by testing the water body of the Ialomița river, the Doicești collection point, in March 2023 indicates a low pollution level of the water of the Ialomița river. The analysis of the water of the Ialomița river revealed the presence of large amounts of chlorides (21 mg/L) and suspended matter, such as: silt, clay, fine silt in an amount of 48 mg/L. The presence of these pollutants in the water body limit causes the disruption of the biocenotic balance, with direct effects on fauna and humans.

Keywords: Ialomița River, Polluting Agents, Green Algae, Bioindicators, The Effects of Pollution.

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POSTER PRESENTATION

The Allelopathic Effect of Some Organic Husks and Coffee Waste on Germination of *Lolium perenne* L. and *Agrostemma githago* L.

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Abstract

Lolium perenne L. is one of the most common species of narrow-leaved weeds in cereal crops, both in Turkey and in the world. The plant typically exhibits high population density in agricultural fields, primarily due to the difficulty in distinguishing it from wheat at the early growth stages, coupled with the tendency for it to intermingle with wheat seeds. The plant *Agrostemma githago* L. has the capacity to compete with wheat at an early stage of growth, exhibiting rapid germination and subsequent development. For these reasons, they are generally among the weed species targeted in chemical control. It is therefore imperative to develop alternative control methods, given the environmental pollution caused by herbicides, the high costs involved, human health, and the necessity to prevent the formation of resistance. One of the fundamental principles of sustainable agriculture is the control of weed seeds in the soil through the exploitation of allelopathic potential among plants. It is recommended that allelopathy be incorporated as a tool in an integrated weed management plan, as this could significantly reduce the need for herbicide application. In this purpose, rice husk, sesame husk, and coffee waste were tested against *L. perenne* and *A. githago*, in screen house conditions. The effect of the applications was also examined in wheat. The study was carried out with 5 replications according to the randomized plots experimental design, rice husk, sesame husk and coffee waste was evaluated at two different doses while a control application was also included in the study to compare the effectiveness. Once a week, the number of weed and wheat seeds emerging in pots was recorded. As a result, it was determined that the organic materials used in the experiment did not significantly inhibited the seed germination of weed species. Nevertheless, no adverse effects were observed about wheat germination. It is thought that the allelopathic potential of these organic materials on seed germination in suppressing the weeds used in the study should be addressed at varying doses and depths, and monitored in different species.

Keywords: *Lolium perenne, Agrostemma githago*, Seed Germination, Organic Husk.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

POSTER PRESENTATION

Determination of Awareness Levels of Vineyard Producers about Weeds and Weed Control: Alaşehir (Manisa) Case

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Abstract

Grapes are currently the most significant fresh fruit crop globally, with a wide range of uses, including dried, processed, and fresh goods like wine. As in other cultivated plants, weeds compete and adversely affect the development of both newly established and productive vines. In vineyard areas, which are of great importance for the country's economy and agriculture, both high yield loss occurs and the quality of the product to be produced may be at a low level depending on the purpose due to weeding. In addition, weeds act as intermediate hosts for some diseases and pests that are problematic in vineyard areas, negatively affect the development of the vineyard with their allelopathic effects and make harvesting difficult. Therefore, when all these negative effects are taken into consideration, it is very important to reveal the level of awareness of the producers in the region in terms of control approaches, considering that the weed problem in vineyard areas varies from region to region and even from field to field for a sustainable production. In this study; it was aimed to reveal the cultivation experiences, weeds and their control approaches and plant protection problems of vineyard producers in Alaşehir district of Manisa province. For this purpose, a questionnaire survey was carried out by conducting interviews with 67 randomly selected producers operating in Alaşehir district in 2024. As a result of the questionnaire survey, it was stated that most of the producers produce vineyards on their property and the most important plant protection problem encountered in vineyard cultivation is plant diseases. It was determined that all of the producers took advice from the plant protection products dealer in the control of weeds and the preferred herbicide was Glyphosate. The number of producers who were satisfied with the level of efficacy of the herbicides used in the control of weeds was high and it was determined that they generally preferred to apply herbicides alone without using additives. The most significant weed species were identified *Chenopodium album* L. and *Convolvulus arvensis* in vineyards.

Keywords: Vineyard, Weed, Questionnaire, Alaşehir.

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ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

POSTER PRESENTATION

Restoration of Predator Biodiversity in Strawberry Fields through the Use of *Lobularia maritima* in Dnipro, Ukraine

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Abstract

The study investigates the restoration of predator biodiversity in strawberry fields (*Fragaria* × *ananassa*) by utilizing *Lobularia maritima* (alyssum) in the city of Dnipro, Ukraine. *Lobularia maritima* was planted between strawberry rows, blooming from June to October, to attract beneficial entomophages such as *Orius spp.*, *Aphidius spp.*, and other beneficial insects. The presence of these entomophages is crucial for controlling key strawberry pests, including thrips (*Frankliniella occidentalis*), spider mites (*Tetranychus urticae*), and aphids (*Aphidoidea*). The study compared experimental plots with planted *Lobularia maritima* to control plots without alyssum. The results showed a significantly higher diversity and abundance of entomophages, including *Orius spp.*, *Stethorus spp.*, *Aphidius spp.*, predatory mites (*Phytoseiidae*), and lady beetles (*Coccinellidae*) in the experimental plots. In contrast, the control plots exhibited lower biodiversity and fewer predator numbers. To manage the increasing population of spider mites on the control plots, bifenazate was applied. Azadirachtin was used on both experimental and control plots to control thrips, chosen for its compatibility with entomophages. Early planting of *Lobularia maritima* proved effective in timely attracting entomophages, providing efficient control of phytophagous pests. The use of pesticides that are safe for entomophages is crucial for maintaining biodiversity within the agroecosystem. Weekly monitoring through visual inspections revealed that integrated pest management (IPM) strategies, including the planting of *Lobularia maritima* and the introduction of additional entomophages, are essential to prevent pest resistance and ensure effective pest control. Implementing this pest control scheme can significantly reduce crop losses and enhance the ecological sustainability of the agroecosystem.

Keywords: Biodiversity, Entomophages, *Lobularia maritima*, Integrated Pest Management, *Fragaria* × *ananassa*.

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POSTER PRESENTATION

Identification of Some Patterns of Accumulation of Elements in Assimilation Organs of Scots Pine *Pínus sylvéstris* L. and Silver Birch *Betula pendula* Roth. and Identification of Some Patterns in Zones of Aerotechnogenic Magnesite Pollution in the Southern Urals of Russia

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Abstract

The purpose of the work is to study the features of accumulation of elements in the soil and assimilation organs of 40-year-old experimental crops of Scots pine *Pinus sylvestris* L. and silver birch *Betula pendula* Roth. on technogenic pollution of the environment by the Combine Magnezit in the Southern Urals of Russia, which has existed since 1901 to the present day and is the world's largest enterprise for the production of highly resistant refractory materials. Atmospheric precipitation in natural conditions always has a slightly acidic reaction of the environment, which is determined by the concentration of carbon dioxide in the air. However, caustic magnesite dust is highly dispersed and has a very low settling rate, and high acidity of the dust pH = 10-11 units. The pH of snow water does not directly depend on the amount of dust that has fallen. Over an 18-year observation period, the acidity of snow water in the zone of severe pollution remained highly alkaline pH from 9.1 to 10.4. In these conditions, the most negative factor is the high soil pH from 9.2 to 8.9 under birches (A0 and AB) and from 9.0 to 8.8 under pines (soil horizons A0 and AB). Highly alkaline soil acidity (pH) is toxic to plants. We have found a decrease in the growth and development of tree species in the zone of severe pollution. Comparative analysis of element accumulation in birch leaves and branches, in pine needles of different ages and in soil showed that the main element concentrated in soil is exchangeable Mg in the zone of strong pollution up to 90 mg-eq. per 100 g of soil. However, maximum concentrations of K were found in branches and leaves of shortened birch shoots in the zone of strong and moderate pollution from the emission source - from 32 to 34 g / kg and in leaves up to 14 g / kg in the zone of strong pollution; Mg concentration values are up to 24 g / kg. Maximum Mg concentrations in soil are 2.2 times higher in the zone of strong pollution than in the background, both under pines and birches. In branches of shortened birch shoots, Mg accumulation is 8 times higher than in the background. The accumulation of Mg in leaves from shortened birch shoots near the emission source is 6 times higher compared to the background, and in second-year needles in the highly polluted zone it is 1.6 times higher – up to 4566.6 mg/kg, than in the background up to 2597.4 mg/kg and is statistically significant depending on the distance ($F(42.6)$, $p<0.0001$). This is the difference between the distribution patterns of Mg concentrations in all the organs studied under these conditions, according to the results obtained under conditions of other types of pollution, where the Mg content decreases with increasing age of pine needles or birch leaves, as well as branches from shortened birch shoots. As we approach the plant in the zone of severe pollution, the accumulation of Ca in the second-year needles increases by 16 times, and in the leaves on shortened shoots and in the branches from the same shoots in birches - by 4 times

compared to the background. However, the content of exchangeable Ca in the soil decreases with an increase in the technogenic load. The increased content of Ca in the zone of severe pollution leads to a decrease in the concentration of Mn in the needles, but contributes to the accumulation of Fe concentrations. In our case, such a pattern was found in the zone of moderate pollution at a distance of 3 km from the Combine.

Keywords: Soil, Experimental Forest Cultures, Aero-Technogenic Emissions, Accumulation of Elements.

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POSTER PRESENTATION

Profibrogenic Factors and Their Involment in the Development of Hepatic Fibrosis

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Abstract

Liver fibrosis is a dynamic process in which chronic injury of any etiology, including viral infection, alcohol consumption, and steatosis, causes persistent inflammation and leads to the accumulation of extracellular matrix material represented by collagen types 1 and 2. In later stages, more in advanced stages, fibrosis can cause severe morbidity and mortality. The progression of fibrosis is a complex process that involves the recruitment of many types of cells such as: macrophages, hepatocytes, sinusoidal endothelial cells, natural killer cells, B lymphocytes, platelets. However, the key cellular event that initiates liver fibrogenesis is the activation of local resident hepatic stellate (CSH) cells, which differentiate from vitamin A-storing cells into proliferative, fibrogenic myofibroblasts. The hepatocyte response to inflammation plays a decisive role in the pathophysiology of liver fibrosis, involving the recruitment of both pro- and anti-inflammatory cells such as monocytes and macrophages. The present work highlights the role of some plasma proteins as profibrogenic factors present in the blood plasma of people with viral hepatitis B and C, as well as in people with alcoholic and non-alcoholic liver cirrhosis. Through the quantitative determination by the ELISA method of the CD5L and TGF β1 proteins, the aim is to establish the degree of liver fibrosis in these patients through noninvasive techniques. In order to complete the picture of liver damage, correlations were made with changes in the values of the hematological and biochemical parameters in the groups of patients investigated.

Keywords: CD5L, TGF β1, Fibrosis, Profibrogenic, Liver.

INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
ICELIS 10-12 SEPTEMBER 2024 PITESTI-ROMANIA

POSTER PRESENTATION

Heavy Metal Stress in Plants: Effects and Ways to Alleviate

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Abstract

Industrialization, urbanization, certain techniques practiced in agriculture, as well as other anthropogenic activities, have determined an increase in heavy metals (HM) in the environment. The effects are major when we talk about ecosystems, and crop plants are in the attention of researchers in order to alleviate this type of abiotic stress. The excess of heavy metals causes changes in plants at the molecular, cellular, tissue level, as well as in the whole organism. The most common symptoms of exposure to high doses of heavy metals are growth reduction, chlorosis, lipid peroxidation, protein degradation, decrease in the intensity of photosynthesis, intensification of the production of reactive oxygen species (ROS), imbalances in mineral nutrition and water status, which, in the end, can culminate in the death of the organism. The plants possess different mechanisms for tolerance or detoxification in the conditions of toxic doses of HM. But, first of all, plants adopt strategies to prevent the absorption of HM at the root level: with the participation of mycorrhizae or with the help of exudates. In the specialized literature, several ways of alleviating the stress determined by HM are described: the increase of antioxidant mechanisms, hormonal regulation, modulation of gene expression, involvement of osmoregulatory substances, etc. For clean crops, for a sustainable agriculture, as much research as possible is needed to prevent HM from entering the organism, to eliminate heavy metals, to identify cultivars tolerant to HM stress.

Keywords: Excess of Heavy Metals, Symptoms, Mechanism of Detoxification, Reactive Oxygen Species.

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ORAL PRESENTATION

Investigate Use of Insect Larvae in Food Rations of Goldfish and Chickens After Experiments of Small-scale Insect Farms

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Abstract

Rapid industrial development and urbanization have improved living standards, but have also exacerbated environmental problems. Because of their high nutritional value, edible insects have emerged as a promising solution to the protein deficit in modern food systems. Insect farming offers a sustainable alternative to traditional livestock farming to address the global protein shortage exacerbated by rising CO_2 levels. The Food and Agriculture Organization of the United Nations (FAO) supports insect farming because of its potential to improve food security and reduce environmental impact. It points to the lower greenhouse gas emissions, reduced land and water consumption and comparable or better nutritional value compared to conventional animal products. The study comprised a systematic approach to the evaluation of feed based on edible insects in four key phases: Preparation of insect cultures and procurement of experimental animals, feeding trials, measurement of antimicrobial activity and evaluation of new feed rations. Edible insects were cultured under controlled conditions and used to produce different feed rations for fish and chickens, while monitoring their effects on animal health and development. Despite financial constraints that limited the scope of the project, such as the use of only 10 fish and observational studies on chickens, scientific protocols were strictly adhered to and detailed insights into the efficacy of insect-based feeds and their potential applications were gained. Survival and growth effects of insect-based feeds, containing varying proportions of larvae and adult forms of *Cybister* sp., *Rhantus* spp., and *Dytiscus* sp., were tested on fish and chickens. Fish fed with insect-based rations at concentrations of 0%, 5%, 10%, and 25% showed survival across all groups, but higher insect concentrations led to faster tank contamination. Despite similar experimental protocols applied to chickens, no significant changes were observed in their growth or health, and contamination issues persisted in some insect chambers, even with the use of antiviral agents. This study highlights the economic and environmental benefits of insect rearing, documents its application in animal nutrition and emphasizes its potential role in promoting sustainable agriculture and food security despite existing challenges.

Keywords: Edible Insects, Famine, Feed Rations, Population Growth.

1. Introduction

In recent years, social and demographic changes have created significant challenges for the agricultural and food sectors. Food production has become indispensable as population growth has increased demand for different types of food. Particularly in the aftermath of the COVID-19 pandemic, there has been a notable trend towards sustainable agricultural production and research into alternative sources of

protein. The significant increase in global population and urbanization has accelerated industrial development (Akengin & Kaygı, 2013). Although industrial development has improved the quality of human life, it has also led to environmental problems (Kaypak, 2011). Population growth has also contributed to solving human and animal nutrition problems (Yılmaz et al., 2020). The coming century is expected to see an increase in research and practices related to alternative food sources. Edible insects, with their rich nutrient profile, could potentially be a solution to the current protein gap in the modern food sector. In Western civilizations, edible insects have begun to be utilized in food production systems as alternative food sources and food ingredients, with uses extending to animal feed and human consumption (Altun, 2019).

In Asia and Africa, insect-derived foods account for half of the food consumed. In Europe and the Americas, on the other hand, this proportion remains very low due to bans and lack of acceptance by experts (Muslu, 2020). Switzerland was the first country in Europe to break this ban by officially authorizing the sale of mealworms, crickets and grasshoppers. Since May this year, Coop, the country's second largest supermarket chain, has been selling 'insect burgers' for 8 euros (Çelik, 2020; Anonim a, 2023). Moreover, in Japan, crickets in sugar, known as *inago*, are a popular cocktail snack (Mitsuhashi, 1997).

According to the Food and Agriculture Organization of the United Nations (FAO), insect farming could be an environmentally sustainable solution to global hunger, similar to traditional meat production. At the 2014 'Insect to Feed the World' meeting, the FAO invited the private sector to contribute to the fight against famine and encouraged governments to remove legal barriers to insect production and consumption (FAO, 2014). Germany bans the production of insects for food, but the Cologne-based company 'Swam Protein' has received permission to import insect-based crackers from Thailand. These crackers contain 80 to 90 crickets and are available in flavours such as chocolate, hazelnut and fruit (Jiménez-Vega et al., 2004). In countries with large populations, such as Nigeria, edible insects form a significant part of the daily diet. Even when dried, these insects retain high quality proteins and supplements (minerals and vitamins) and are consumed in this form (Emmanuel et al., 2023). To reduce dependence on foreign feed ingredients, insect farming could be considered as an alternative feed source alongside crop production. Low-cost and high-efficiency solutions for poultry nutrition are being sought through the development of new methods and markets, such as insect farming (Anıç, 2006).

Various insects are used in animal feed, including flies (Diptera), mealworms (Tenebrionidae), moths, silkworms (*Bombyx mori*), locusts (*Schisocerca gregaria*), worms, cockroaches (Blattodea), crickets (*Gymnogryllus lucens*), and termites (*Macrotermes bellicocus*) (Güneş et al., 2017). In Tibet, chickens grazing in areas with high locust populations have been observed to have meat with stronger antioxidant potential and longer shelf life, and their eggs show increased fat content due to insect consumption (Tekeli, 2014). The larvae of *Cirina forda* (Diptera) could replace traditional fish meal as a poultry feed ingredient. These maggots are known to be a good protein source for both poultry meat and egg production (Sevilmiş et al., 2019).

Ecologically, it is projected that by 2050, rising atmospheric CO_2 levels could put around 150 million people at risk of protein deficiency in their diets. This situation presents significant threats to the stability of the global food chain. In this context, insect farming has emerged as a potential alternative solution to the global protein deficit. The study proposes that, by ensuring suitable economic conditions, edible insects can be cultivated and multiplied using small-scale setups. Additionally, since the use of poultry

by-products for animal feed has been banned in the European Union as of January 2017, there are concerns that this ban will increase poultry meat prices due to high production costs. The sector is calling for the Ministry of Agriculture and Livestock to reconsider this ban. In Turkey, the largest share of poultry production costs, at 68%, is attributed to feed expenses. In 2020, the amount of poultry feed produced was 10 million tons, with 37% of this being egg feed. The primary inputs for these feeds are corn and soybeans. An increase of 39.5% in soybean prices in 2020 explains the 28.3% decrease in the egg/soy ratio (Bayraktar, 2020; Anonim b, 2023).

In addition, insects produce relatively lower levels of greenhouse gases and ammonia than livestock, and require significantly less land and water. The nutritional quality of edible insects is comparable to, and sometimes superior to, that of bird and mammalian foods (Lange & Nakamura, 2021). Insect farms are considered "sustainable protein enterprises" (Fleming, 2016; Kurgun, 2016). In animal husbandry, particularly in rural areas, increasing productivity per animal is key. When the cost of imported protein sources like soybeans is high, using edible insects as alternative protein sources can help reduce costs (Bektaş & Güler, 2019; Bektaş, 2024).

In conclusion, it is anticipated that the use of insects obtained from insect farms in feed rations will provide favorable economic outcomes and significantly benefit the national economy. It is expected that projects similar to or more advanced than this study will be conducted using such technologies. This study aims to highlight the potential contributions of insect farming to sustainable agriculture and food security. Edible insect larvae and adults collected from the environment were grown in different insect habitats, and the challenges and issues encountered during cultivation were meticulously documented. Larvae and adult insects were added to fish feed in specific rations, and their development was detailed in the report. The project could not be applied to broiler chickens due to cost constraints. This research seeks to demonstrate the potential of insect farming to contribute to sustainable agriculture and food security.

2. Materials and Methods

Following the identification of the main goals and objectives of the project, the preliminary preparation phase was initiated. At this stage, a general planning was made by taking into account factors such as the use of the laboratory areas of our school, the suitability of the laboratory equipment and the outbuildings where the materials were stored (Figure 1).

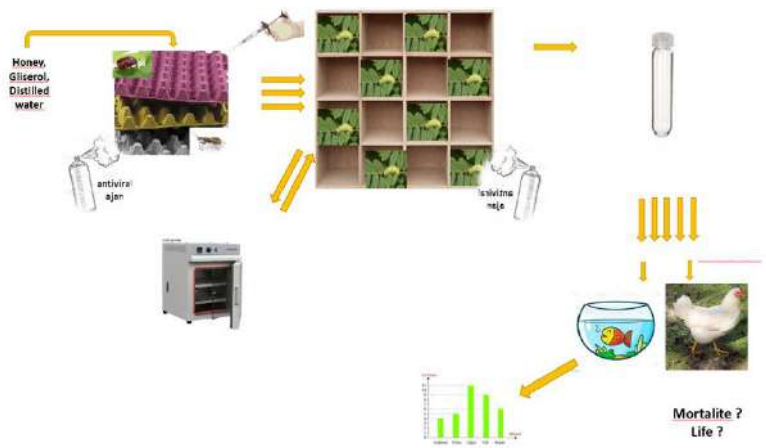


Figure 1. Illustration of working set-up and general planning.

Following the planning, the project was carried out in four main steps. These steps were; *preparation of edible insect cultures* and *obtaining chickens and fish for experimental purposes*, *feeding experiments*, *measurement of antimicrobial effects* and finally *evaluation of the results by testing new feed rations of fish and chickens*:

2.1. Preparation of Edible Insect Cultures and Obtaining Chicken and Fish for Experimental Purposes

During this phase, the different edible insect species were cultivated and the conditions needed to keep them alive were established. At the same time, the fish to be used in the feeding experiments were obtained and kept in a suitable environment.

In this study, the unused buildings of Hınıs Vocational School were equipped with cabins (4 x 1m² cabins with shelves). These were used as insect farms made of egg boxes. Similar insects collected from the environment and included in the list of edible insects (e.g. insects of the genus *Cybister* sp., *Rhantus* sp., *Dytiscus* sp. of the order Coleoptera) were interspersed on these egg colonies. As an alternative, live larvae were purchased and added to the colonies (mealworms were ordered and attempted to be reared with captured environmental insects when available), taking into account the possibility that larvae collected from the environment with sieves and paper clips might not survive.

The late larvae of these insects (after reaching instar VII) were transferred to 1000 ml glass containers. Using artificial nutrients such as strained honey, glycerol and bran, the insect larvae were reared in a continuous dark environment in an oven in the laboratories of the vocational school at a temperature of 28 ± 2 ºC and a relative humidity of 65 ± 5%. Setups were prepared in egg boxes (Figure 3) and artificial food jars were filled with 420 g bran, 150 ml filtered honey, 150 ml glycerol, 20 gr ground dark honeycomb and 30 ml distilled water as standard food (Figure 4). Egg wrappers were cleaned and reused for new larvae and disposed of in medical waste bags at the end of the project. In some stages of the laboratory studies, the methodologies of Hamzaoğlu (2012) were used and adapted to the insect rearing protocol (Figure 2).

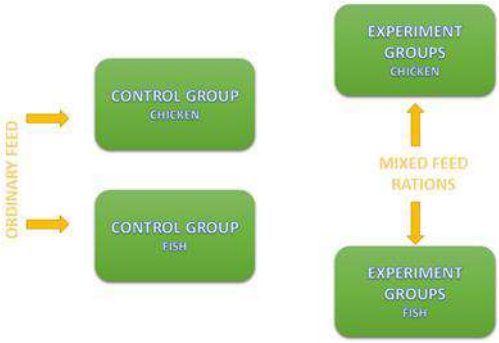


Figure 2. Schematic representation of control and experimental groups.



Figure 3. Preparation of insect cabins.



Figure 4. Feeding experiments.

Due to the recent economic growth and the fact that providing chickens and fish and transporting them to Hınıs Vocational Collage (Ataturk University) would be a significant financial burden, 10 aquarium fish were provided to create a small application area. The delivery of all the materials and all the transport operations were carried out by Asst. Prof. Dr. Mehmet BEKTAŞ, the project advisor, used his own vehicle. It was not possible to use it experimentally on chickens because of the cost. The feed rations of edible insects were used in chicken eggs provided by the project advisor himself. Thus, all stages of the project were meticulously planned and executed, and the data reported with scientific accuracy.

2.2. Feeding Experiments

In the second phase, feeding experiments were carried out with larval and adult specimens of the reared insects and added to the fish food rations. The effects of the edible insects on the development and general health of the animals were carefully observed. In chickens, these rations were not used experimentally for cost reasons and only the biological development of individual chickens was observed. Two to three newly hatched female insects were placed in plastic cups and a sieve lid was used together with the cup for egg deposition. In the feeding experiments, different amounts of artificial feed were prepared and supplemented with natural feed treated with an antiviral agent. The larvae of the control group were fed with food without antiviral agent. The desired concentrations for the natural

feeds were prepared with distilled water at a ratio of g/100 ml. These studies were conducted to evaluate the larval feeding processes and the effects of the diets in detail. The experimental methods and protocols were rigorously applied to ensure scientific accuracy and reliability (Figures 4 and 5).



Figure 5. Captured adult insects.

2.3. Measurement of the Antimicrobial Effects

In the third phase, the antimicrobial effects of insect-based feeds were investigated. For this purpose, the larvae and adult insects were subjected to laboratory analysis during and after the feeding experiments and the data obtained were evaluated.

During the experiments, acyclovir-like antiviral agents were sprayed at concentrations of 0.01, 0.1, 1.0 and 3.0 g/100 ml distilled water in 5 ml volumes on 20 cm² surface area. Similar to the stock conditions, ten to four replicates of larval cultures per replicate were set up in each experiment. At this stage, some trials were adapted to the insect rearing protocol using the methods described by Hamzaoğlu (2012) (Figure 4). The aim was to evaluate larval responses to antiviral agents and feeding processes. The experimental protocols were carefully planned and implemented to ensure scientific validity and reliability.

2.4. Trial of New Feed Rations for Fish and Chickens and Evaluation of Results

In the final phase, the long-term effects of insect-based feed rations on fish and chickens were evaluated. Parameters such as growth rates, general health status and feed efficiency of the animals were analyzed in detail.

The insects obtained were dried at both the adult (Figure 5) and larval stages and the feeds were prepared by mixing 0%, 5%, 10% and 25% of insects into the feed rations. Diets containing 0% insects were used as the control group, while feeds containing 5%, 10% and 25% insects were used in the experimental groups.

Due to limited economic and budgetary possibilities, 10 fish in fishbowls were used for the trials with these baits. Due to financial constraints, only biological changes were observed in chickens provided by the project advisor himself as a little more amateur. All results obtained during the experiment were evaluated by comparison with the existing literature.

The effects of insect-based feeds on chickens and fish were examined in detail and the data obtained was analyzed with scientific accuracy and rigor. The results of the experiments were interpreted and reported in the context of the relevant literature. These four main steps ensured that the project was successfully completed and the data obtained was analyzed and reported with a scientific approach.

3. Results

Firstly, insects belonging to the genera *Cybister* sp., *Rhantus* spp. and *Dytiscus* sp., all of which are members of the order Coleoptera and included in the World List of Edible Insects (Ramos-Elorduy et al., 2009), were collected by sieving from environmental wetlands. Procedures were implemented to ensure both the survival and reproduction of the larvae of these insects. While adult beetles were successfully kept alive, the larvae perished within a few days. Deceased individuals were promptly removed from the insect chambers to prevent putrefaction and contamination. To ensure the project's success, mealworms, which are also edible insects, were ordered and procured, and feeding experiments were conducted to sustain these larvae for several weeks.

The larval and adult forms of the reared insects were incorporated into chicken and fish feeds, and the effects of these feeds on animal development were observed. The impacts of these feeds were evaluated in detail by using formulations containing varying proportions of insects. In the second phase, feeding experiments were conducted by adding the larval and adult forms of the reared insects to fish feed rations. During this process, the effects of feeds prepared by grinding edible insects in a mortar and mixing them with existing commercial feeds on the growth and overall health of the animals were carefully monitored. However, due to cost constraints, these rations were not experimentally used with chickens and biological development was monitored only in individually obtained chickens. In the experiments conducted on fish kept in glass aquariums, both adult and larval forms of the insects were dried and added to the feed rations at concentrations of 0%, 5%, 10%, and 25%, resulting in different formulations. The 0% concentration served as the control group, while the 5%, 10%, and 25% concentrations were used in the experimental groups. These feeds were administered in small aquariums containing ten fish that had been previously obtained. As a result of the observations, it was determined that the fish were able to survive in all rations containing edible insects; however, the tanks with the 25% ration became contaminated more quickly. No changes were observed in the individually supplied laying hens after treatment (Figure 6).

Acyclovir-like antiviral agents were applied at concentrations of 0.01, 0.1, 1.0 and 3.0 gr, along with 5 ml of acyclovir diluted in 100 ml of distilled water, to a 20 cm^2 surface to prevent contamination in insect chambers. Each experiment was replicated between four to ten times under consistent laboratory conditions, mirroring the stock conditions. Certain stages of the laboratory procedures were adapted from the insect-rearing protocol outlined by Hamzaoğlu (2012). In some cabinets, contamination could not be entirely avoided; therefore, dead insects and larvae were promptly removed and disposed of in designated medical waste areas.

Experiment Overview:

1.Subject: Fish in Glass Aquariums (Tested for Feed Formulations)

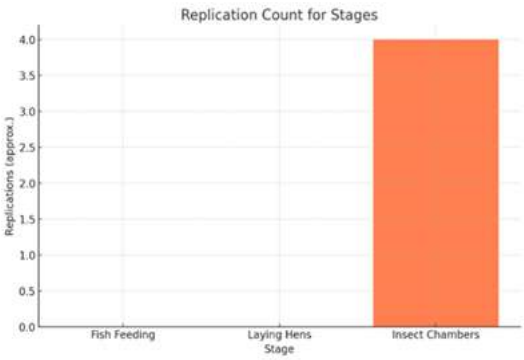
1. **Insect Feed Concentrations:** 0%, 5%, 10%, 25%
2. **Control Group:** 0% Insects
3. **Experimental Groups:** 5%, 10%, 25% Insects
4. **Tank Observation:** Contamination increased with 25% ration.
5. **Outcome:** Fish survived in all rations, but tanks with 25% feed contaminated faster.

2.Subject: Laying Hens (Testing Feed Formulations)

1. **Observation:** No changes after treatments.

3.Insect Chambers: Antiviral Agent Application to Prevent Contamination

1. **Acyclovir Concentrations:** 0.01 g, 0.1 g, 1.0 g, 3.0 g
2. **Dilution:** 5 ml acyclovir in 100 ml distilled water
3. **Surface Area Treated:** 20 cm²
4. **Replications:** 4 to 10 times under consistent conditions.



Stage	Details	Observations	Replications
Fish Feeding	Insect feed at 0%, 5%, 10%, 25% concentrations	Fish survived; 25% caused faster contamination	N/A
Laying Hens	Same insect feed concentrations	No changes observed	N/A
Insect Chambers	Acyclovir concentrations: 0.01g, 0.1g, 1.0g, 3.0g	Contamination prevention tested	4-10 times

Figure 6. Test results.

The effects of insect-based feeds on fish and chickens were thoroughly evaluated in terms of growth rates, overall health status, and feed efficiency. As a result of these experiments, the efficacy of insect-based feeds was assessed. Edible insects were found to cause no mortality in both aquarium fish and chickens, provided by the consultant due to cost constraints and evaluated solely through observational methods. However, in aquarium fish kept in small glass vases, there was noticeable pollution in their habitat. This study has provided our associate degree veterinary program students with valuable insights into the challenges and differences between scientific research applications in laboratory settings and the practical exercises conducted in the field.

4. Discussion and Conclusion

The production of edible insects in small farms to be established in unused buildings in our professional college and their use in fish and chicken feed rations is an ideal example for students to create new areas of scientific research and has the potential for student papers and field publications on the potential for application in industrial settings. Insect farming can be a means of sustainable food production. As edible insects are high in calories and highly nutritious, their consumption has the potential to reduce famines worldwide. Their high quality protein and diverse micronutrients, as well as their potential environmental and economic benefits, make edible insects an important potential food of the future. By developing alternative application methods with the data to be obtained, it has prepared the ground for entrepreneurial activities that will pay off economically. In addition, this project contributes to the writing and project completion skills and academic careers of researchers at the associate degree level and creates a perception of the scientific approach with academic knowledge and technical equipment. The results demonstrate the potential contribution of insect breeding to sustainable agriculture and food security. The project results can form the basis for future studies with similar or more comprehensive technologies.

Acknowledgment

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INTERNATIONAL CONGRESS ON ENGINEERING AND LIFE SCIENCE
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ORAL PRESENTATION

Effects of Water-Based Thermal Insulation Paint Applied to Scots Pine (*Pinus sylvestris* L.) Wood Wall Panels on the Thermal Conductivity Coefficient

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Abstract

In regions affected by earthquakes and floods, the need for shelter is traditionally met with mobile wooden houses. However, temperature differences caused by seasonal changes adversely affect people living in wooden houses with insufficient thermal insulation. It is thought that using paints containing hollow microglass spheres can improve thermal insulation by protecting the wood from external influences. In this study, water-based thermal insulation paint was applied on wooden panels produced from Scots pine wood and the aim was to determine the effects of these applications on thermal conductivity coefficient. For this purpose, 54,6 mm thick panels of Scots pine wood were produced, and 850 microns thick water-based thermal insulation paint containing hollow micro glass beads was applied to the surfaces of these panels. Scots pine wood panels were chosen for this study due to their widespread use in outdoor environments and water-based insulation paint was selected because it does not harm the environment or human health. The thermal insulation coefficients of Scots pine panels coated with water-based insulation paint were determined according to the relevant standard. According to the results of the study, while the thermal conductivity coefficients were lower in solid panels, it was found that the water-based paint containing hollow microglass spheres reduced the thermal conductivity coefficients. Future studies investigating the thermal insulation, hardness, and adhesion resistance properties of paints containing different amounts of hollow glass spheres could contribute to the scientific community.

Keywords: Wooden Wall Panel, Water-based Thermal Insulation Paint, Thermal Conductivity Coefficient, Hollow Glass Sphere.

1. Introduction

Since the known history of humanity, wood has been continuously used as a material, and its usage has become more widespread today. Natural building materials like wood are considered to be healthier and more sustainable (Sönmez, 2005). Wood and wood products are used in a wide range of applications, from housing and furniture to boat and toy production. The widespread use of wood and wood products is influenced by several characteristics, such as their lightness, earthquake resistance, renewability, and properties like thermal and sound insulation (Usta, 2015).

Following frequent natural disasters, people face numerous problems. The most significant impacts of earthquakes, in particular, are often seen in the need for shelter. Various designs have been developed

globally for temporary housing after earthquakes. However, because these designs are planned and produced after earthquakes, solutions for housing needs are often delayed. Consequently, earthquake survivors face harsh weather conditions during winter, and health problems arise in earthquake regions (Avlar et al., 2023). To address the housing needs of many people affected simultaneously by earthquakes, it is necessary to produce and install a large number of temporary housing units quickly (Torus and Şener, 2015). In many cases, the process of providing permanent housing takes longer than expected due to reasons such as debris removal and finding safe and suitable areas for reconstruction (Nocera et al., 2020).

Globally, different designs have been developed for temporary housing, and shelters have been built to meet the basic needs of survivors in the most appropriate and fastest way after earthquakes. Solutions to the housing problem include temporary housing outside the earthquake zone, mass temporary housing within the earthquake zone, and temporary dwellings. Although there is no specific criterion for choosing the type of solution, the decision is generally made by authorities. Temporary shelters, which provide better living conditions than tents, offer a secure, private, and healthy living environment. It is thought that important issues such as protection, security, privacy, comfort, living standards, adequate dimensions, location, thermal and acoustic performance, lighting, ventilation, and durability should be considered for the quality and comfort of temporary housing units (Felix et al., 2013).

When selecting a material for thermal insulation, it is crucial that the material adheres well to wooden surfaces and possesses a robust structure, especially if it is paintable. Additionally, the performance of protective layers applied to wooden surfaces, such as varnishes and paints, should be evaluated by testing their hardness and adhesion properties. Hardness tests are conducted based on factors like scratch resistance, resistance to the penetration of foreign substances, and durability against deformation due to continuous use. Similarly, adhesion tests measure the resistance of the protective layer to being removed from the surface when it is applied. These tests play a significant role in determining the performance of coatings.

There is a substantial body of literature dedicated to enhancing the thermal insulation properties of wood, and this research continues to be relevant to the development of new materials. The ability of wood to conduct heat varies depending on the type of wood, fiber direction, specific gravity, moisture content, and type of adhesive used (Özcan, 2007; Arslan, 2015; Öztürk et al., 2017). For example, the thermal conductivity coefficient of Scots pine wood perpendicular to the fibers has been determined to be 0.1032 W/m.K (Öcal, 2016), while the thermal conductivity coefficients of laminated Scots pine bonded with different adhesives have been reported to range from 0.1384 to 0.1633 W/m.K (Arslan, 2015).

In wood composite panels, the ability to conduct heat varies depending on the fillers, additives, and binders used. Some studies have found that creating voids in intermediate layers during composite panel production and adding certain additives can reduce the thermal conductivity coefficient (Öztürk et al., 2017; Babenko et al., 2018; Sarıkaya, 2022; Bülbül and Keskin, 2023; Kaya and İmirzi, 2023), while other additives have been found to increase it (Büyükkaya, 2020). The variations in thermal conductivity coefficients may be attributed to volumetric differences in the fillers used (Canlı and Sepetçioğlu, 2021).

In some studies, the aim has been to reduce the thermal conductivity coefficients of various wood and composite material surfaces, as well as reinforced concrete structures, by applying different coatings (paint, varnish, felt, foam, felt, plant-based materials, etc.). In a study involving ten different panels composed of solid wood and composite materials, the lowest thermal conductivity coefficient was

determined to be 0.083 W/m.K in MDF panels coated with resin-impregnated paper (Şahin and Döngel, 2018). Kabakcı and Kesik (2020) found that the thermal conductivity coefficients of HDF panels coated with water-based paint containing hollow glass microspheres ranged from 0.104 to 0.120 W/m.K, with this variation attributed to the thermal insulation paint applied in different layers to raw and resin-impregnated HDF surfaces. It has been reported that the thermal conductivity values of hollow water-based paints range between 0.10 and 0.18 W/m·K, with the paint layer thickness being a contributing factor (Chukhlanov et al., 2017; Bozsaky, 2018). Even when dealing with the same types of materials, comparisons of thermal conductivity coefficients may not always lead to accurate conclusions, as variations in measurement methods can also contribute to different results.

Thermal insulation in temporary housing after earthquakes is important both for comfort and energy savings. In this context, water-based thermal insulation paints containing nano-sized glass microspheres offer an effective solution. These glass microspheres, due to their non-conductive nature, reduce heat loss when applied to walls, making the indoor temperature more stable and comfortable. These environmentally friendly paints are easy to apply and pose no harm to human health. In addition to thermal insulation, glass microsphere paints also provide sound insulation, making them ideal for creating a quiet environment in temporary shelters for earthquake victims. For these reasons, the use of glass microsphere thermal insulation paints in temporary shelters for earthquake victims provides comfort and energy savings. Thermal insulation is crucial for creating more resilient and sustainable living spaces in the face of future natural disasters. The purpose of this study is to determine the thermal conductivity coefficients of wall panels made from Scots pine wood treated with water-based thermal insulation paint containing hollow glass microspheres.

2. Materials and Methods

2.1. Wood Material

In this study, Scots pine (Pinus sylvestris L.) wood was chosen as the experimental material due to its widespread use in areas exposed to external effects. The wood samples used in the experiments were randomly selected from the lumber storage of the Department of Woodworking Industrial Engineering at Gazi University Faculty of Technology.

Additionally, water-based paint containing hollow glass microspheres was selected to enhance the thermal insulation properties of the wood surfaces. The water-based thermal insulation paint with hollow glass microspheres applied to the wooden materials was obtained from Kimetsan Ltd. Şti. The company stated that the water-based paint, produced using nanotechnology, can be used without any issues on surfaces made of metal, stone, plastic, and wood. The hollow glass microspheres contained in the thermal insulation paint are visible as accumulated on the upper part when the packaging is opened. Therefore, the paint must be thoroughly mixed before application to ensure proper viscosity. The SEM image of the hollow glass microspheres is shown in Figure 1. The water-based nano insulation paint is a two-component material, with the second component added during the application process. It can be applied using a brush, roller, or paint spray gun (nozzle diameter = 1.8-2.5 mm). However, the smoothest surface is achieved with spray guns. Depending on the characteristics of the area where energy losses occur, it is important to apply the paint in layers of 400-1200 microns thickness, allowing 30 minutes of drying time between layers to ensure the quality of the application (Kimetsan Technical Bulletin, 2018).

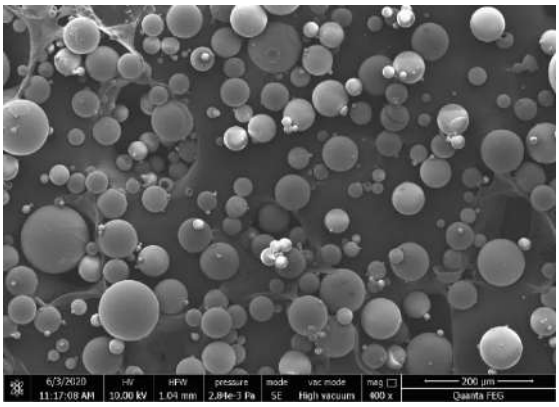


Figure 1. SEM image of hollow glass spheres (Kesik and Kabakcı, 2022).

2.2. Preparation of the Specimens

The air-dried Scots pine wood was first bonded with PVAc adhesive and prepared as three preliminary panels with dimensions of 300x300x60 mm, as shown in Figure 2. Subsequently, the edges were trimmed with a circular saw, and the surfaces were processed using a calibration sander to achieve final dimensions of 290x290x55 mm. The prepared test samples were conditioned at a temperature of 20±2°C and a relative humidity of 65±3% in a climate chamber until a constant weight was reached. Before being coated with a water-based thermal insulation paint, the test samples were sanded sequentially with 150-grit and 220-grit sandpaper, resulting in a final thickness of 54.60 mm. The dust was removed, and the samples were prepared for painting.

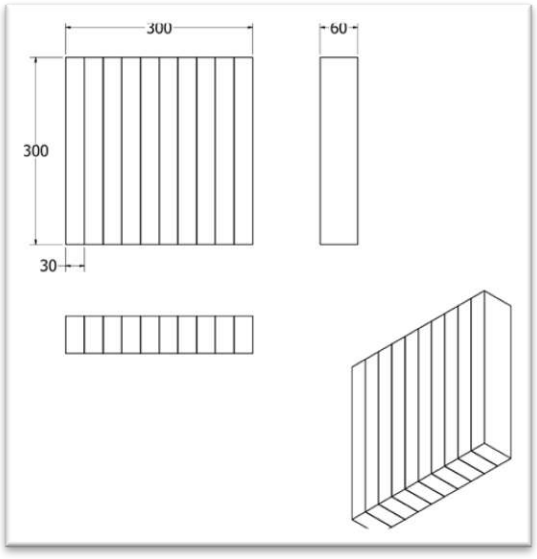


Figure 2. Sample drawing.

Upon opening the paint can, the paint was thoroughly mixed with a sturdy mixer until a homogeneous consistency was achieved. A hardener amounting to 0.012 of the paint was mixed with an equal amount of distilled water and gradually added to the paint while stirring continuously. To ensure proper adhesion to the primer, one coat of filler varnish (Figure 3) was applied, followed by seven coats of water-based

thermal insulation paint (Figure 4). The application was carried out in layers, with each layer being dried using a drying machine between applications.



Figure 3. Application of filler varnish.



Figure 4. Application of thermal insulation paint.

2.3. Determination of Thermal Conductivity Coefficient

Linseis HFM 300 test device, located in the test laboratory of the Department of Wood Products Industrial Engineering at Gazi University's Faculty of Technology, was used (Figure 5). Before the experiments, calibration was performed at 20°C using rock wool with the code IRMM 440, with the upper plate set to 25°C and the lower plate to 15°C. The test specimen placed in the device is shown in Figure 6, and care was taken to ensure that the painted surfaces were positioned to face the upper plate. At the end of the test, initiated via computer software, the values for thermal conductivity and thermal transmittance coefficients were recorded.



Figure 5. Linseis HFM 300 test device.

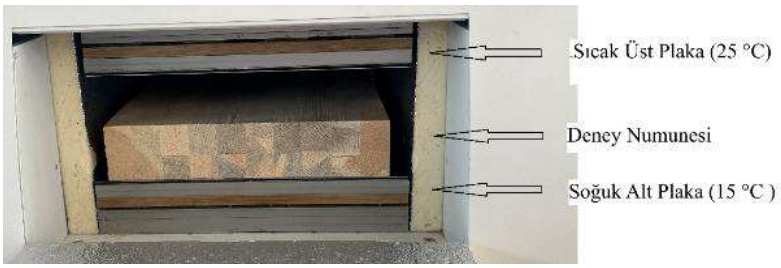


Figure 6. Test specimen in the test device.

The thermal conductivity coefficient (Lambda) (λ) was calculated using computer-controlled software according to the equation:

$\lambda = q * d / (A * \Delta T)$ [W/m.K]

and

The thermal transmittance coefficient (U) was calculated using the equation;

$U = \lambda / d$ [W/m².K]

Where;

λ: Thermal conductivity coefficient (W/m.K),

q: Power supplied to the measurement section of the heating unit,

d: Thickness of the test specimen,

A: Measurement area of the test piece,

ΔT: Temperature difference between the plates.

2.4. Evaluation of the Data

The evaluation of the thermal conductivity and thermal transmittance coefficients of Scots pine wall panels coated with thermal insulation paint was conducted by calculating the arithmetic means of the data. The averages of the data, standard deviation, and the drawing of graphs were performed using Microsoft Excel.

3. Results and Discussion

The table showing the average values of the thermal conductivity coefficient (λ) and thermal transmittance coefficient (U) for both uncoated and thermal insulation paint-coated test specimens is presented in Table 1. The thickness of the uncoated test specimens placed in the test device was measured as 54.60 mm, while the thickness of the coated test specimens was measured as 55.45 mm, with the paint thickness determined to be 850 microns.

Table 1. Thermal conductivity and transmittance coefficients of test specimens.

Sıra	Unpainted Sample		Painted Sample	
	λ=W/m.K	U=W/m².K	λ=W/m.K	U=W/m².K
1	0,1491	2,721	0,1133	2,047
2	0,1642	3,001	0,1131	2,037
3	0,1778	3,276	0,1173	2,112
M	0,1637	2,999	0,1146	2,065
SD	0,0144	0,2775	0,0024	0,0407

According to Table 1, the highest thermal conductivity coefficient (0.1637 W/m.K) was observed in the uncoated test specimens, while the lowest (0.1146 W/m.K) was found in the coated test specimens. This ranking remained unchanged in the thermal transmittance coefficient measurements, with the highest value (2.999 W/m².K) in the uncoated test specimens and the lowest value (2.065 W/m².K) in the coated test specimens. The literature (Öcal, 2016; Chukhlanov et al. 2017; Bozsaky, 2018; Şahin and Döngel, 2018; Kabakcı and Kesik, 2020) reports that factors such as the structure of wood materials, grain direction, density, porosity, moisture content, whether or not the material is coated, and the thickness of the coating can influence thermal conductivity coefficients, with measurement ranges for these coefficients varying between 0.08 and 0.18 W/m·K. These findings are consistent with the results of our study. In another study, the thermal conductivity coefficient of a test specimen prepared from Scots pine wood was determined to be 0.1049 W/m.K (Doğan and Altunok, 2018). However, in our study, despite using Scots pine wood, the lowest thermal conductivity coefficient was found to be 0.1637 W/m.K, indicating a significant difference in measurements. This discrepancy could be attributed to factors such as thickness, grain direction, density, porosity, and moisture content in different Scots pine woods. The graphs showing the average values of the thermal conductivity and thermal transmittance coefficients of the test specimens are presented in Figure 7.

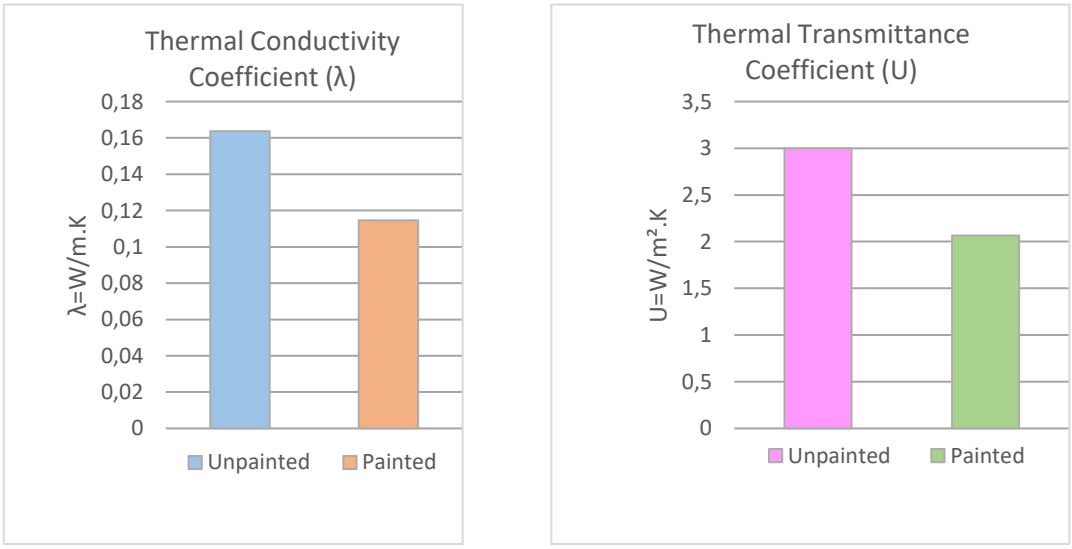


Figure 7. Average thermal conductivity and transmittance coefficients of the test specimens.

In the graphs, the average values of the thermal conductivity and transmittance coefficients of the uncoated test specimens were found to be higher compared to the coated test specimens. The thermal insulation paint applied to the test specimens reduced the thermal conductivity coefficient by 30%.

4. Conclusion and Recommendations

The study found that water-based paints containing hollow glass microspheres can be applied to panels made from pine wood. According to the study results, the water-based thermal insulation paint was determined to reduce the thermal conductivity coefficient by approximately 30%. This finding suggests that water-based paints containing hollow glass microspheres could offer significant advantages in wooden structures, especially considering the importance of thermal insulation for comfort and energy savings in wooden houses. Additionally, these paints are known for their beneficial properties, such as being environmentally friendly and safe for human health. These characteristics will make water-based thermal insulation paints with hollow glass microspheres a preferred choice in sustainable new living spaces. Future studies investigating the thermal insulation, adhesion, hardness, gloss, colour, and other properties of paints with varying amounts of hollow glass microspheres could contribute valuable insights to the scientific community.

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ORAL PRESENTATION

Mapping the Second-Level Digital Divide: A study of Internet Skills and Usage Among Older Adults in European Countries

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Abstract

The adoption of information and communication technologies (ICT) is rapidly increasing, leading to a global narrowing in the digital access gap. However, digitalization changes everyday patterns, work processes, and necessary skills required to avoid social deprivation and exclusion. Some individuals have lower digital competencies and struggle to adapt to technological changes. Therefore, digital divides have become an important issue in the transformation of society. Although access to ICTs is the initial and most apparent factor used to examine digital inequalities, there is a growing gap related to users' motivation, capabilities, and skills to use ICT safely and confidently. The phenomenon is known as the second-level digital divide. Despite the advancements and efforts made by policymakers, a second-level digital divide still exists, whether referring to disparities between countries (the global digital divide) or within different groups in the population (the social and demographic digital divide). The vision for digital Europe is for residents to attain the necessary level of digital knowledge and competence to address the challenges brought by the digital transformation era. On the other hand, the population and the labor force are growing older, and the aim is to prolong the employment duration of elderly individuals, thus decreasing the financial burden of pensions and the ratio of old-age dependency. The workers aged 55-64 are particularly vulnerable due to the increasing digital transformations. Older employees face the challenge of mastering new skills and meeting specific qualifications, which can lead to potential job loss if they are unable to meet these requirements adequately. This study investigates how the digital skills of older adults (55-64 years) contribute to the digital divide among European countries. Data from the Eurostat database on the composite indicator, The Digital Skills Indicator 2.0 (DSI), was used to shed light on this question. Using the Multi-Criteria Decision Analysis (MCDA) method, Evaluation Based on Distance from Average Solution (EDAS), European countries were ranked based on the components of DSI for five specific digital skill areas. Since multidimensional scaling is used, the EDAS method has enabled the analysis of similarities and differences between European countries. The results highlighted a digital divide and indicated significant variation in digital skills among European countries' older population (55-64 years). Also, certain countries requiring specific attention and efforts to tackle digital challenges were singled out.

Keywords: Digital Skills, Digital Divide, Older Adults, EDAS, European Countries.

1. Introduction

Digital technologies are a fundamental part of modern society. Their integration and necessity continue to strengthen over time, reshaping traditional ways of living and the working environment. For a long

time, it was considered that the problem of evident emerging differences in digital levels could be solved by improving physical and material access to information and communication technologies, that is, by facing the first-level digital divide. However, even after access to the Internet reaches a high rate, a certain part of the population remains deprived and has not overcome the digital gap, even in developed countries (van Deursen & van Dijk, 2019). This is why research on digital divides has been shifted towards socio-demographic characteristics such as education, skills, residence, age, etc. The term "second-level digital divide" emerged in the literature to emphasize the gap that arises as a consequence of inequality in digital skills and the use of digital technologies, primarily the Internet (Büchi et al., 2015), caused by factors other than physical access.

The development of digital technologies and the Internet is taking place very intensively, with the constant need for people to adapt knowledge and skills to that pace. These changes are especially challenging for older adults, who, at the very beginning, have fewer internet skills than the younger population, which further leads to a limited possibility of using the benefits of ICT (Shi et al., 2022). The ageing of the population also conditions the ageing of the workforce. On the other hand, the digitalization of business processes and operations does not mean a simultaneous transition of employees to a digital environment. Namely, the digital environment requires a new set of digital skills that workers do not necessarily acquire at their workplaces. On the other hand, machines and robots replace certain jobs, endangering human employment. According to some sources, even 52% of the European workforce will need to be reskilled (DIGITALEUROPE, 2020) to develop resilience to job loss and improve employability. Also, there is an increased need for new employees with specific educational profiles who are still in deficit. Thus, workers aged 50 years and older make up a significant part of the workforce whose productivity is counted on for at least a dozen years until retirement (Xie et al., 2023). The challenges of acquiring digital skills for older employees and upskilling the existing workforce are additionally complicated by the fact that it is a diverse population with varying socio-economic backgrounds, education, employment history, and geographic locations.

Certain research that dealt with this topic tackled the problem of digital divides in different geographical areas, taking into account the economic and social characteristics of the studied countries (Büchi et al., 2015; Botrić & Božić, 2021; Shi et al., 2022). It has been noted that there is a lack of research that deals with age and geographical digital divides at the same time. Therefore, there is still room for research on how the increasing demand for digital skills affects the older population in Europe. Therefore, the research aims to explore the impact of the digital skills of older adults (55-64 years) on the digital gap across European nations. To address this issue, the study examines data from the Eurostat database, specifically the Digital Skills Indicator 2.0 (DSI). By employing the Multi-Criteria Decision Analysis (MCDA), particularly the Evaluation Based on Distance from Average Solution (EDAS) method, the study ranks European countries based on the components of DSI across five digital skill domains. The paper makes a valuable contribution to the current research body by offering a detailed examination of the internet skills of individuals aged 55-64. It focuses on indicators of digital literacy, and it may point to certain countries that require particular attention from policymakers and companies to define measures and activities to enhance the older population's job-losing resilience.

1.1. Theoretical Background

Although access to digital technologies is the initial and most apparent factor for examining digital inequalities, a second-level digital divide is related to users' motivation, capabilities, and skills to use

ICT safely and confidently. Büchi et al. (2015) confirmed the existence of a second-level divide even in countries with high network coverage and internet availability. In their research, the authors examined both the frequency and manner of Internet use, confirming that younger users use the Internet more often, especially in social interactions. Older adults are not completely independent in deciding whether and in what way they want to use digital technologies. Namely, studies indicate that the environment significantly affects their attitude towards specific social networks or content on the Internet. Research by Shi et al. (2022) confirmed that when the environment intensively uses digital content, older adults tend to follow their peers. In addition, Hargittai and Dobransky (2017) and Arroyo-Menéndez et al. (2022) found that higher education and higher income also significantly impact the use of the Internet by the older population.

The ageing of the population and, at the same time, labor force is notable and demands additional attention. The workers aged 55-64 are particularly vulnerable due to numerous barriers they must overcome during increasing digital transformation. Older employees face the challenge of mastering new skills and meeting specific qualifications. Difficulty in employing digital technologies in the working environment can lead to potential job loss if they cannot adequately meet these requirements. On the other hand, late-career workers possess valuable experience that cannot be easily replaced in companies (Chetty, 2023).

Two sets of factors can be identified when analyzing the literature on the second-level digital divide: individual-level and social-context factors (Friemel, 2016). Individual factors include education, motivation, technical interest, income, age, and gender. The social context includes marital status, social surroundings, and peers' internet usage. It is essential to consider not only personal and social factors but also the residential and national contexts of older adults in order to effectively address the challenges posed by the digital transformation era within specific cultural and economic settings. This paper tackles the issue of the second-level digital divide, referring to disparities between countries using data on the digital skills of older adults (55-64 years). The contemporary composite indicator, known as The Digital Skills Indicator 2.0 (DSI), was utilized to address this question.

2. Methodology

In order to define a solid conceptual framework for the study, a thorough research of the literature dealing with digital divides, ageism and internet skill-related studies was conducted. Van Deursen et al. (2015) developed specific Internet skill scales for research on digital divides conducted in the UK and the Netherlands, in which the measuring instrument consists of five types of Internet skills: operational, navigation information, social, creative, and mobile. Ragnedda and Kreitem (2018) used the Digital Skills Indicator to analyze the second-level digital divide in the EU. Similarly, Brătucu et al. (2022) used Eurostat data to analyze households in the EU about home internet access. Other authors used data collected in various national surveys on ageing (Friemel, 2016; Yuan & Jia, 2021; Shi et al., 2022; Kortmann et al., 2023; Park & Chun, 2024).

Although many tools were used to assess digital competencies, applying them on an international scale presented several challenges. First, it is impossible to compare data from research carried out in different countries with different data-collecting methodologies. Then, the questionnaire's distinct structure and, finally, the use of self-assessment can lead to certain biases. To overcome the challenges in this research,

data from the Eurostat database was used, which contains data on many countries that were collected according to the same methodology and are mutually comparable.

The Digital Skills Indicator 2.0 (DSI) is an aggregated metric that measures specific internet and software-related activities undertaken by individuals across five distinct areas: Information and data literacy, Communication and collaboration, Digital content creation, Safety, and Problem solving. Table 1 presents the indicators used to determine the level of digital skills, and there are 30 of them divided into the five mentioned groups. In the Eurostat database, the up-to-date data collected in 2023 are available for 34 European countries. Data on the Instant messaging indicator are unavailable for specific age groups, so this indicator is excluded from further analysis. Based on the indicators in each particular area of digital skill, a ranking of European countries can be performed.

Table 1. Digital skills indicators.

	Indicator	**Index**	**Source**
1. Information and data literacy skills	Finding information about goods or services	IUIF	[isoc_ci_ac_i]
	Seeking health-related information	IHIF	[isoc_ci_ac_i]
	Reading online news sites, newspapers or news magazines	IUNW1	[isoc_ci_ac_i]
	Activities related to fact-checking online information and its sources	TIC	[isoc_sk_edic_i21]
2. Communication and collaboration skills	Sending/receiving emails	IUEM	[isoc_ci_ac_i]
	Telephoning/video calls over the internet	IUPH1	[isoc_ci_ac_i]
	Instant messaging	IUCHAT1	No data
	Participating in social networks	IUSNET	[isoc_ci_ac_i]
	Expressing opinions on civic or political issues on websites or social media	IUPOL2	[isoc_ci_ac_i]
	Taking part in online consultations or voting to define civic or political issues	IUVOTE	[isoc_ci_ac_i]
3. Digital content creation skills	Using word processing software	CWRD1	[isoc_sk_cskl_i21]
	Using spreadsheet software	CXLS1	[isoc_sk_cskl_i21]
	Editing photos, video or audio files	CEPVA1	[isoc_sk_cskl_i21]
	Copying or moving files (such as documents, data, images, video) between folders, devices or on the cloud	CXFER1	[isoc_sk_cskl_i21]
	Creating files (such as documents, images, videos) incorporating several elements such as text, picture, table, chart, animation or sound	CPRES2	[isoc_sk_cskl_i21]
	Using advanced features of spreadsheet software to organize, analyse, structure or modify data	CXLSADV1	[isoc_sk_cskl_i21]
	Writing code in a programming language	CPRG2	[isoc_sk_cskl_i21]

Table 1. (continued).

	Indicator	Index	Source
4. Safety skills	Managing access to own personal data by checking that the website where the respondent provided personal data was secure	MAPS_CWSC	[isoc_cisci_prv20]
	Managing access to own personal data by reading privacy statements before providing personal data	MAPS_RPS	[isoc_cisci_prv20]
	Managing access to own personal data by restricting or refusing access to own geographical location	MAPS_RRGL	[isoc_cisci_prv20]
	Managing access to own personal data by limiting access to profile or content on social networking sites or shared online storage	MAPS_LAP	[isoc_cisci_prv20]
	Managing access to own personal data by refusing allowing the use of personal data for advertising purposes	MAPS_RAAD	[isoc_cisci_prv20]
	Changing settings in own internet browser to prevent or limit cookies on any of the respondent devices	PCOOK1	[isoc_cisci_prv20]
5. Problem solving skills	Downloading or installing software or apps	CINSAPP1	[isoc_sk_cskl_i21]
	Changing settings of software, app or device	CCONF1	[isoc_sk_cskl_i21]
	Online purchases (in the last 3 months)	IBUY	[isoc_ec_ib20]
	Selling online	IUSELL	[isoc_ci_ac_i]
	Used online learning resources	IUOLC or IUOLM	[isoc_ci_ac_i]
	Internet banking	IUBK	[isoc_ci_ac_i]
	Looking for a job or sending a job application	IUJOB	[isoc_ci_ac_i]

The proposed methodological framework aims to tackle the complex and multidimensional nature of the cross-country digital divide. It enables the analysis of differences in the level of digital knowledge and competence among older adults in European countries. A similar approach based on MCDA methods was used in the works of Ziemba and Becker (2019), Brodny and Tutak (2021), Ataman et al. (2022), Stojanović et al. (2022), etc. Evaluation Based on Distance from Average Solution (EDAS) is a well-known MCDA method based on the procedure of ranking alternatives based on aggregated distance scores. The advantage of EDAS over other methods is that it uses an average solution for obtaining ranks (Ghorabaee et al., 2016; Torkayesh et al., 2023). EDAS enables the comparison of alternatives with respect to an infinite number of criteria in various complex multi-criteria problems. A detailed description of the steps of implementing EDAS used in this study is presented in the paper by Ghorabaee et al. (2015).

Therefore, to identify a second-level digital divide using the EDAS method, a model that determines alternatives and criteria was first defined. Empirical data from the EUROSTAT database, which included information on 34 European countries and 29 indicators, were gathered. The countries represented alternatives, while the indicators represented criteria. Based on the procedure explained in the work of Ghorabaee et al. (2015), a ranking was conducted.

3. Results

The results obtained using the EDAS method are shown in Table 2 and Figure 1 and were used to analyze and confirm the presence of a digital gap among European countries.

Table 2. Ranking of European countries by digital skills of older adults obtained with EDAS.

Rank	Country	Asi	Rank	Country	Asi	Rank	Country	Asi
1	Netherlands	1.000	13	Hungary	0.544	25	Croatia	0.314
2	Norway	0.885	14	Ireland	0.544	26	Lithuania	0.302
3	Finland	0.873	15	European Union	0.516	27	Greece	0.293
4	Denmark	0.868	16	Belgium	0.513	28	Latvia	0.290
5	Switzerland	0.848	17	France	0.505	29	Poland	0.213
6	Sweden	0.765	18	Italy	0.491	30	Serbia	0.186
7	Austria	0.682	19	Germany	0.477	31	Bulgaria	0.133
8	Spain	0.643	20	Montenegro	0.436	32	Romania	0.072
9	Luxembourg	0.605	21	Portugal	0.427	33	Bosnia and Herzegovina	0.046
10	Czechia	0.570	22	Slovakia	0.359	34	Türkiye	0.022
11	Malta	0.558	23	Cyprus	0.352	35	Albania	0.016
12	Estonia	0.553	24	Slovenia	0.347			

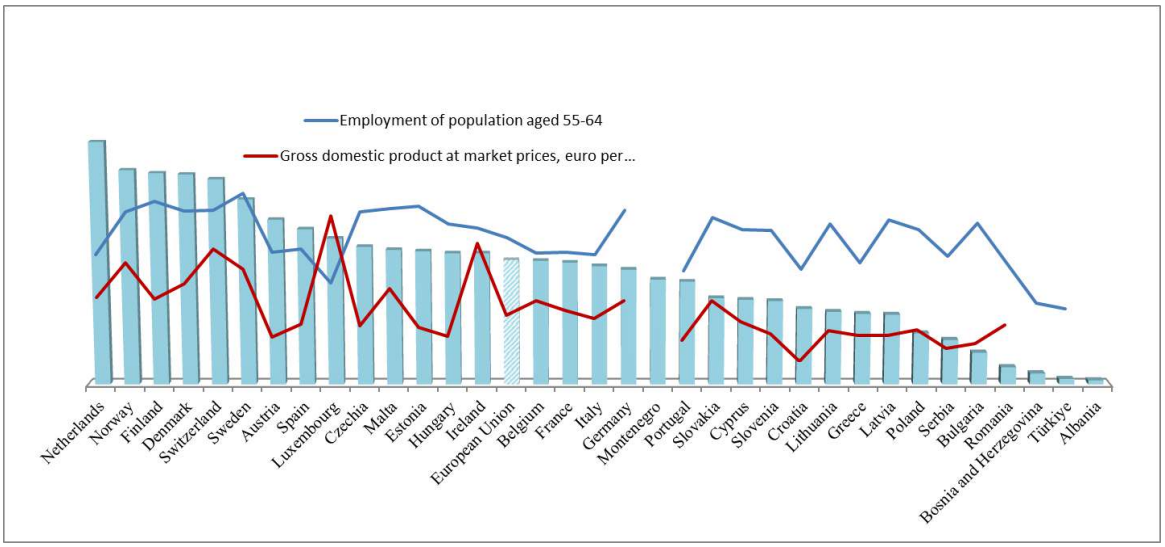


Figure 1. Ranking of European countries by digital skills of older adults.

Countries are represented on the graph based on their ranks. It can be seen that the Netherlands dominates among the analyzed countries. Next are Norway, Finland and Denmark. Albania, Turkey, and Bosnia and Herzegovina have the worst rankings. In order to analyze the results further, data on the employment rates of the population aged 55-64 and GDP per capita in studied countries (represented by broken lines) were added to the ranking chart. Values are not presented in absolute terms but reflect variations, making it useful for comparing indicators across countries. It can be seen that in the Netherlands, despite older adults having high digital skill levels, their employment rate is not the highest among the analyzed countries. A similar situation is observed regarding GDP per capita. It is evident that Sweden has the highest employment rate among the population aged 55-64. The graphs indicate,

on the other hand, that the countries ranked at the bottom of the list in terms of the levels of digital skills of the population aged 55-64 have both very low employment levels and GDP per capita. All presented results point to the existence of a second-level digital divide among European countries when it comes to older adults. In order to better understand the spatial nature of the digital divide, the results are presented in Figure 2.

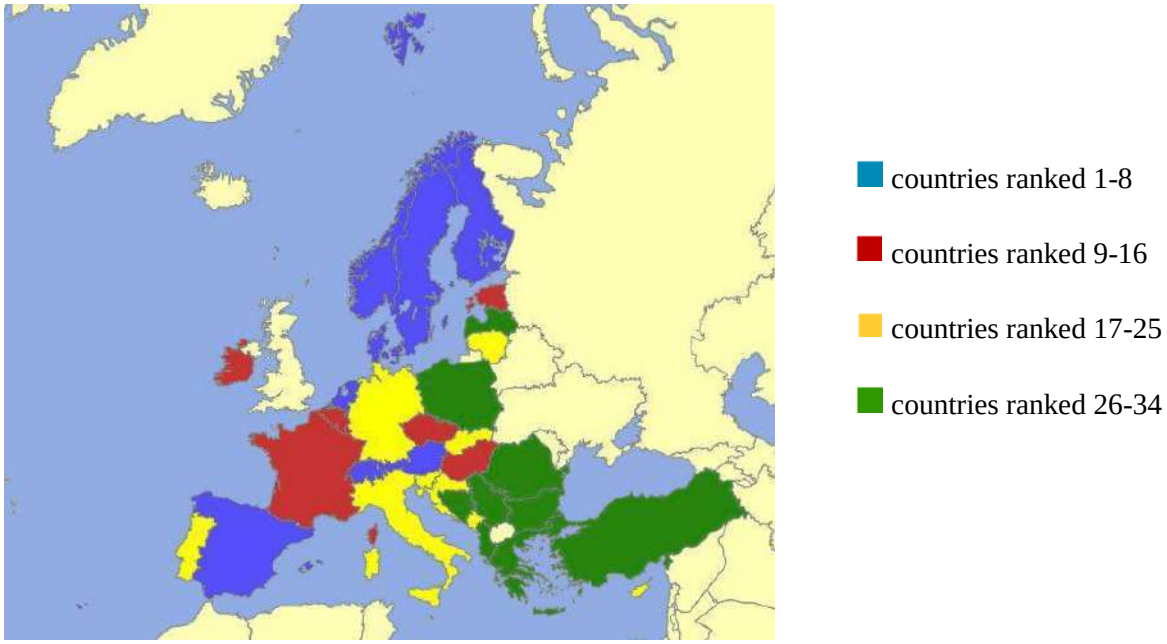


Figure 2. Map of the second-level digital divide across Europe.

The analyzed states are divided into four groups based on the obtained rank. The figure clearly shows that the worst-ranked states are grouped together, as well as those that showed the best results. From a geographical standpoint, it can be concluded that there is a northwest/southeast pattern in the digital divide across European countries among the population aged 55-64.

4. Discussion and Conclusion

Considering that the paper examines the second-level digital divide, referring to disparities between European countries, it points to certain countries that require specific attention and efforts to tackle digital challenges. The results, therefore, indicate that the level of digital skills is related to demographic, economic and spatial factors. The visual presentation of the results obtained using the EDAS method indicates significant geographical differences in digital skills among older adults across Europe. Regardless of their membership in the European Union, Northern and Western European countries reported higher levels of digital literacy among older adults compared to their peers living in Eastern and Southern Europe. Those countries with detected low levels of digital skills are, at the same time, countries with a lower economic level.

Due to different socio-economic levels, some countries fail to adequately keep up with the pace of digital transformation, enabling all their citizens to avoid digital exclusion. Considering the significant social consequences of the digital divide, it is important to analyze it from various angles to fully understand its complexity. The importance of differences in digital skills of older adults aged 55-64 is undoubtedly reflected in the fact that they represent experienced workers who are now at risk of digital backwardness,

deterioration, or job loss. The institutions of the European Union have already taken certain significant steps in enabling the increase of digital competencies through the adoption of strategies and regulations, but also concrete projects such as the 2030 Digital Compass, which represents the European Commission's plan for achieving the digital transformation of Europe with precisely indicated goals, the Digital Skills and Jobs Platform which enables finding adequate training for different social groups, AI Skills Alliance (ARISA), Digital SkillUp and others. For some countries, the digital divide represents a more significant challenge that must be approached systematically by introducing education programs, lifelong learning promotion and investments in new jobs.

Beyond enhancing employability, digital skills are crucial for enabling citizens to utilize e-services and e-government and fully participate in modern society. This leads to the emergence of a new level referred to as the third-level digital divide. It is essential that future research pays attention to this phenomenon, as it significantly affects the quality of life of older adults. Based on the results of this study, future research should explore the interrelationships between different levels of digital divides, with a particular focus on the links between the second and third levels of digital divides.

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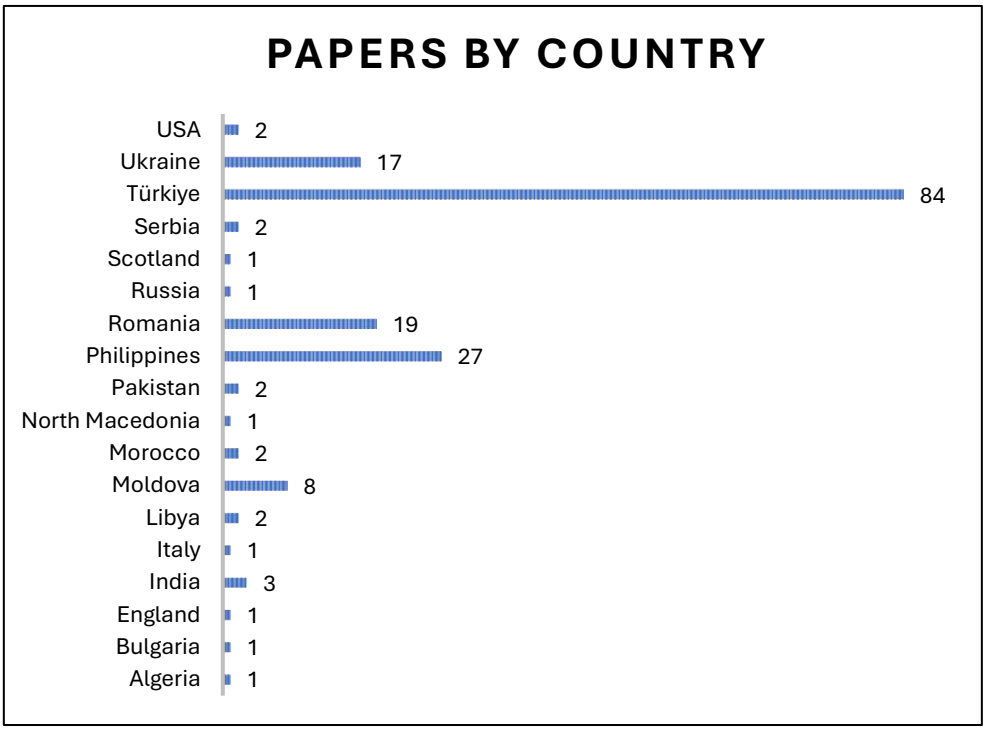
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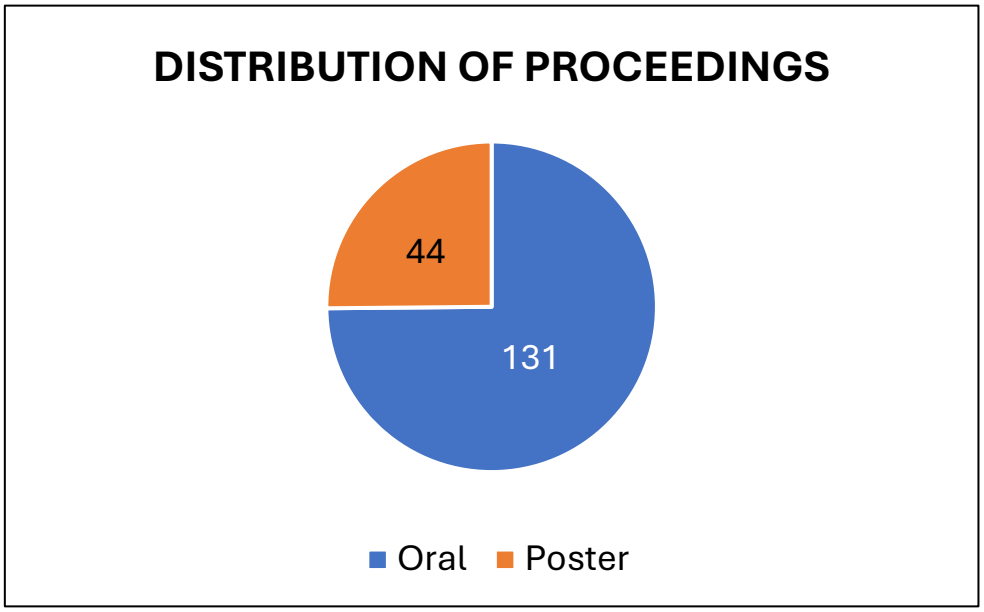
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