PROCEEDINGS OF III. INTERNATIONAL EDIBLE & OIL SEEDS CONGRESS EDIBOIL 2025

9-10 September 2025

İstanbul, Turkey

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Organized by
Trakya University
Istanbul Beykent University
International Researchers Association

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WELCOME NOTES

You are welcome to our International Congress Edible and Oil Seeds which is organized by Trakya University, Istanbul Beykent University and the International Researchers Association. The congress will be in 9-10 September 2025 in Istanbul Beykent University Taksim Campus, Istanbul, Turkey with the support of several national and international partners.

The Congress topics will cover Edible and Oil Seeds: Plant Breeding and Genetics, Molecular Genetics and Biotechnology, Biology and Physiology, Genetic Resources, Plant Protection, Agronomy and Production, Animal feeding, Food Science and Nutrients Fats, lipids, and Protein studies, Trade and Economy,

Oil crops are rich sources of oils, proteins, minerals, vitamins, and dietary fibers for both human and animal feeding and provide the raw material to produce biodiesel. Oil crops are soybean, cottonseed, sunflower, canola, rapeseed, peanut, safflower, flax, sesame, coconut, castor, copra, etc.

Almost 50% of the global food protein supply comes from cereal seeds. Soybean, peanuts, common bean, pea, lupine, chickpea, faba bean, lentil, grass pea, cowpea, pigeon pea, etc. are currently the most important legumes for human consumption and animal feed. Because of the edible contents of their seeds, grain legumes, cereals, and other minor crops etc. are edible seeds growing for plant protein for food and feed.

The Congress intends that the subjects to be kept broad in order to provide opportunity to the science and research community to present their works as oral or poster presentations. The Congress languages will be in English.

Researchers, breeders and others with an interest in the genetics and breeding of oil and protein crops are invited to participate. Among the topics to be discussed are directions of breeding for resistance to abiotic and biotic stresses, improved industrial use, and conventional versus organic production.

The congress will gather scientists from around the world and present their recent achievements. The organizers will also invite relevant stakeholders to provide a view on the current situation around the world as well as prospects to overcome the limitation for sustainable crop production to feed the world.

The first meeting has been organized in Lviv, Ukraine in 2019 by Trakya University, with part of more than 200 participants from all over the world with 376 scientific papers. In the 2nd congress in Antalya, Turkey in November 2024; 38 orals and 63 poster presentation in the congress both joining and presenting normal and online with 141 participants from 20 different countries from the world.

The 3rd congress will gather scientists from around the world and present their recent achievements. There are 15 orals and 15 poster presentations in the congress both joining and presenting normal and online with 90 participants from 10 different countries from the world.

With care for our nature and environment, we aim for the green congress, meaning that as little as possible paper will be used. Abstract books are published in electronic books and are distributed to the participants by e mail for online participants. All the e-posters are prepared in electronic form and then submitted via the congress e mail and exhibited in electronical poster boards as well as in online e poster hall in our web page during the congress.

We would like to thank all of you for joining this congress and we would like to give also special thanks to our sponsors and collaborators for giving us a big support to organize this event.

-Prof Dr Yalcin KAYA
Head of the Organizing Committee

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HARNESSING BIOACTIVE COMPOUNDS AND PROTEINS IN WILD SUNFLOWER SPECIES: A SUSTAINABLE PATH TOWARD ZERO WASTE AND FUNCTIONAL FOOD DEVELOPMENT

Nada Grahovac[*]*, Jelena Jocković, Siniša Jocić, Milan Jocković, Sandra Cvejić, Vladimir Miklič*

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ABSTRACT

Chlorogenic and caffeic acids are essential bioactive compounds known for their potent antioxidant properties, which play a significant role in neutralizing free radicals and promoting overall health. These phenolic compounds contribute to the nutritional value of sunflower seeds, making them a promising resource for functional food development. Wild Helianthus species, with their rich genetic diversity, serve as a critical reservoir of unique traits that can be harnessed to enhance the quality and resilience of cultivated sunflowers. By leveraging the genetic potential of these wild relatives, it is possible to improve key agronomic traits, including seed composition and nutritional value, in breeding programs. The objective of this research was to assess the variability in chlorogenic acid, caffeic acid, and total protein content among seeds from ten different genotypes of wild sunflower species. Total protein content was determined using the Dumas method, while chlorogenic and caffeic acid levels were quantified through high-performance liquid chromatography (HPLC) with PDA detection. Protein content in the seeds varied significantly, ranging from 19.77% to 33.44%, highlighting the genetic diversity among the studied genotypes. Chlorogenic acid content was observed to range from 0.61 to 1.96 g per 100 g dry matter, while caffeic acid content varied between 0.03 and 0.12 g per 100 g dry matter. The findings of this study underscore the immense potential of wild sunflower species as a genetic resource for breeding programs aimed at improving cultivated sunflowers. By leveraging the diversity in chlorogenic acid, caffeic acid, and protein content, these wild species can contribute to the development of sunflower hybrids with superior grain quality and broader functional applications. This research provides valuable insights that can guide the creation of nutritionally enriched and versatile sunflower varieties tailored for diverse industrial and dietary needs.

Key Words: Sunflower seed, protein, chlorogenic acid, caffeic acid, antioxidant capacity

Acknowledgements: This work is supported by the Ministry of Education, Science and Technological Development of Republic of Serbia, grant number 451-03-136/2025-03/200032, by the European Commission through Twinning Western Balkans project CROPINNO, grant number 101059784 and Project HelEx, grand number 101081974, funded by EC.

SUNFLOWER – A MODEL CROP FOR SUSTAINABLE AGRICULTURE

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ABSTRACT

The average global temperature is rising and setting records every year, accompanied by abnormal climate events such as supercell storms. In addition to numerous biotic factors that create problems in growing crops, abiotic factors such as extremely high temperatures and unpredictable rainfall present increasingly challenging conditions for successful production. At the global level, sunflowers are a strategic agricultural crop, due to its relatively moderate production needs compared to other crops. Benefits of growing cultivated sunflowers are multiple, such as: 1. Food and Feed Production: Sunflower seeds are a nutritious food source for humans and animals alike. They are rich in quality oil, protein, healthy fats, vitamins and minerals, making them a valuable addition to a balanced diet; 2. Biofuel Production: sunflower seeds are rich in oil, which can be extracted and processed into biodiesel. Biodiesel is a renewable and environmentally friendly alternative to conventional fossil fuels, reducing greenhouse gas emissions and dependence on finite resources; 3. Soil Improvement - Sunflower have deep root systems that can break up compacted soil, allowing better water infiltration and aeration. After harvest, sunflower stalks and roots decompose, adding organic matter to the soil and improving its fertility; 4. Pollinator Support: Sunflower are attractive to bees and other pollinators, providing them with nectar and pollen. Supporting pollinator populations is crucial for maintaining biodiversity and ensures the pollination of many other crops; 5. Crop Rotation: Sunflower are often used in crop rotation cycles because they have different nutrient requirements than many other crops. Rotating sunflower with other crops helps prevent soil depletion and reduces the risk of pests and diseases buildup. Overall, sunflower crop is extremely important because of its many benefits in agricultural systems with impact on environmental sustainability, soil health, biodiversity conservation, and the production of renewable resources. Current research on sunflower, in the Center of Excellence for Innovations in Breeding of Climate-Resilient Crops - Climate Crops of the Institute of Field and Vegetable Crops, is based on application of modern biotechnological methods for precise phenotyping, along with genotypic and epigenetic research, in order to examine the mechanisms of adaptation of sunflower to extreme abiotic factors, primarily drought and heat, as an increasingly frequent phenomenons caused by climatic irregularities. The findings of this research, along with the simultaneous use of the genetic base of wild Helianthus species, allow us to model new directions in sunflower breeding and create genotypes for future challenges.

Key Words: Sunflower, climate changes, sustainability

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OPTIMIZATION OF SUNFLOWER GENOTYPE SELECTION FOR SUSTAINABLE PROCESSING: BALANCING OIL EXTRACTION AND BIOMASS UTILIZATION

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ABSTRACT

Sunflower is a major oilseed crop, but its processing generates significant by-products, primarily seed hulls/pericarp. Efficient utilization of these by-products can enhance the sustainability of sunflower production, as pericarp with high lignocellulosic content has potential applications in pellet production, whereas genotypes with lower pericarp content are preferable for oil extraction. In order to optimize the industrial processing of seeds, four sunflower genotypes (H1, H2, H3, and H4) were analyzed. Head diameter was measured at the stage of physiological maturity, and plants from the two middle rows were used for yield calculation, based on yield per head with 11% moisture. Morphometric achene and seed traits (60 per genotype) were measured using calipers, while pericarp thickness was determined using a light microscope and image analysis software. The total oil percentage in the seed was measured using Maran Ultra Resonance NMR in accordance with the manufacturer's guidelines and ISO 10565 standard. The results indicate that H3 (27.5% pericarp, 429 µm pericarp thickness, 18.75 cm head diameter, 115.62 g yield per head) and H4 (25.9% pericarp, 318.2 µm pericarp thickness, 17.25 cm head diameter, 94.88 g yield per head) are the most suitable for pellet production, as their high pericarp content provides greater biomass yield and higher energy value. In contrast, H1 (17.42% pericarp, 194.9 µm pericarp thickness, 51.36% oil, 22.50 cm head diameter, 140.11 g yield per head) and H2 (20.85% pericarp, 157.9 µm pericarp thickness, 44.55% oil, 17.50 cm head diameter, 121.53 g yield per head) are better suited for industrial oil processing, as their lower pericarp percentage and thinner pericarp allow for a higher seed proportion and more efficient oil extraction. Notably, H1's thinner pericarp facilitates easier removal during processing, increasing efficiency and reducing technological losses. This study highlights the importance of genotype selection in optimizing sunflower processing and sustainability. High-pericarp genotypes (H3 and H4) are better suited for biomass utilization, while low-pericarp genotypes (H1 and H2) enhance oil extraction efficiency, reducing processing losses. Targeted use of these genotypes can minimize waste, improve resource efficiency, and support a circular bioeconomy in sunflower production. Future research should further evaluate their energy potential and oil quality to refine industrial applications.

Key Words: sunflower, seed, pericarp

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INTERCROPPING FORAGE SPECIES ENHANCES SOIL MICROBIAL HEALTH IN OLIVE ORCHARDS

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ABSTRACT

The overreliance on chemical fertilizers and pesticides in intensive agriculture has led to significant environmental degradation and health concerns. This study explores intercropping as a sustainable, low-input alternative to improve soil quality and microbial diversity in olive orchards. We compared monoculture systems with intercropped plots integrating various cover crops, focusing on their influence on plant growth-promoting rhizobacteria (PGPR). Results revealed a significant increase in beneficial PGPR populations specifically nitrogen-fixing, siderophore-producing, and phosphate-solubilizing bacteria in intercropped systems. These changes were associated with improved soil fertility and microbial resilience. Our findings support intercropping as a promising strategy to enhance the sustainability and productivity of Mediterranean olive agroecosystems.

Key Words: intercropping, olive orchards, soil health, PGPR, sustainable agriculture, microbial diversity

PHYSIOLOGICAL AND BIOCHEMICAL RESPONCE OF SOME SUNFLOWER HYBRIDS TO WATER DEFICIT

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ABSTRACT

Drought stress is a major limiting factor in sunflower (Helianthus annuus L.) cultivation, particularly during early developmental stages, such as germination and seedling growth. This study aimed to evaluate the physiological and biochemical responses of three local sunflower hybrids (H1–H3) under controlled water deficit conditions induced by polyethylene glycol (PEG 6000) at concentrations of 10%, 20%, and 30%. Stress was applied either during germination or at the seedling stage, for durations of 3 or 6 days, with and without rehydration. Water deficit induced during germination significantly reduced germination rates by 10–24% under mild and moderate stress and up to 40–60% under severe stress (30% PEG), with some genotypes showing complete germination failure. At the seedling stage (first pair of true leaves), drought stress caused plant height reduction by about 10–57%, while root elongation increased by 10–50% in most genotypes, particularly under prolonged exposure to 30% PEG for 6 days. Biochemical analyses revealed an increase in total peroxidase activity across most genotypes, indicating enhanced antioxidant defense, particularly under severe stress. Isoenzyme profile highlighted stress-induced changes, including the de novo synthesis of two peroxidase isoforms (42 and 45 kDa), especially in genotypes showing higher tolerance. Additionally, three polypeptide bands (19.5–21.7 kDa), potentially corresponding to dehydrins, were detected with increasing intensity under stronger drought conditions. A genotype-specific response was observed, with each hybrid demonstrating increased antioxidant activity under different drought conditions. Hybrid H1 showed the highest peroxidase (PO) activity increase under mild drought stress (+79%), while H2 exhibited enhanced PO activity under both mild (+47%) and severe (+118%) stress conditions. Notably, hybrid H3 responded most strongly to severe drought, displaying the greatest increase in PO activity. These variations highlight the diverse adaptive mechanisms among the sunflower genotypes and suggest their potential for targeted breeding strategies aimed at improving drought tolerance. These findings support the use of antioxidant activity and isoenzyme composition as potential selection markers in breeding programs aimed at improving drought tolerance.

Acknowledgement. This work was supported by the Subprogram 011101 Genetic and biotechnological approaches to agroecosystem management under climate change, financed by the Ministry of Education and Research of the Republic of Moldova.

Key Words: Helianthus annuus, Drought stress, Polyethylene glycol (PEG 6000), Germination, Seedling growth, Peroxidase activity, Isoenzyme

BIOLOGICAL STUDY OF PISTACIA ATLANTICA: PHENOLC PROFILE, ANTIOXIDANT, ANTI NFLAMMATORY AND WOUND HEALING ACTIVITIES

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ABSTRACT

Pistacia atlantica, a member of the Anacardiaceae family, is a valuable plant species widely used by rural populations in arid and semi-arid regions. Its fruit is rich in vegetable oil and has long been used in traditional medicine for the treatment of various ailments, as well as in the formulation of natural cosmetic and health products. In response to increasing consumer interest in edible seed oils with high unsaturated fatty acid content and strong antioxidant capacity, this study explores the biological potential of Pistacia atlantica oil. In vitro and in vivo assays were conducted to assess its anti-inflammatory, antioxidant, and wound healing activities. Phytochemical analysis revealed a significant presence of bioactive compounds, including polyphenols, flavonoids, and unsaturated fatty acids, which may account for the observed therapeutic effects. Antioxidant activity was evaluated using DPPH and ABTS assays, while anti-inflammatory activity was assessed through protein denaturation inhibition. The wound healing potential was demonstrated in rabbits with experimentally induced skin wounds, showing enhanced tissue regeneration, reduced local inflammation, and a protective barrier effect. These results highlight the promising medicinal and cosmetic applications of Pistacia atlantica fruit oil in managing oxidative stress, inflammation, and skin damage.

Key Words: *Pistacia atlantica*, antioxidant activity, wound healing, medicinal plant

IN VITRO ANTIOXIDANT, ANTI INFLAMMATORY ACTIVITIES AND TOTAL PHENOLIC CONTENT OF EXTRACTS FROM AN ALGERIAN MEDICINAL PLANT

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ABSTRACT

Ajuga iva (Lamiaceae) is a medicinal plant traditionally used in North African folk medicine for its anti-inflammatory and healing properties. This study aims to evaluate the in vitro antioxidant and anti-inflammatory activities of different extracts from Ajuga iva, along with the quantification of their total phenolic content. Extracts were prepared using solvents of varying polarity (aqueous, ethanolic, and methanolic), and total phenolic content was determined using the Folin–Ciocalteu method. Antioxidant capacity was assessed using DPPH and ABTS radical scavenging assays, while anti-inflammatory activity was evaluated via inhibition of protein denaturation and heat-induced hemolysis assays. The results showed that the ethanolic extract exhibited the highest phenolic content and the strongest antioxidant activity, correlating positively with its radical scavenging capacity. Additionally, significant inhibition of protein denaturation was observed, suggesting promising anti-inflammatory potential. These findings highlight Ajuga iva as a rich source of bioactive compounds with potential applications in natural antioxidant and anti-inflammatory therapies.

Key Words: Phenolic content, antioxidant activity, in vitro essays, anti nflammatory activity, Bioactives compounds

EVALUATION OF SOME HERBICIDES AND SOME ESSENTIAL OILS FOR WEED CONTROL IN PEANUT FIELDS

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ABSTRACT

Weed competition is one of the most serious biotic stresses reducing crop productivity worldwide. In the absence of weed control, yield losses in major crops such as maize, wheat, rice, soybean, and peanut can reach up to 70% depending on the weed spectrum and crop growth stage (Oerke, 2006; Zimdahl, 2018). Peanut (Arachis hypogaea L.) is a legume with high nutritional and economic value. In Türkiye, peanut cultivation covers about 37,000 hectares, with a production of over 140,000 tons annually, predominantly in the Mediterranean and Aegean regions (TUIK, 2023). Due to its creeping growth habit and slow canopy closure, peanut is particularly vulnerable to weed competition during early development stages (Hauser et al., 1982). Effective weed management in peanut cultivation is essential to prevent early-season competition, which can severely affect flowering and pod development (Wehtje et al., 2000). While mechanical and cultural practices are viable, they are often labor-intensive and insufficient alone. Chemical weed control remains a cornerstone of modern agriculture due to its efficiency and scalability (Vencill, 2002). The findings of this study confirm the strong efficacy of bentazone at 150 ml/da in controlling a wide range of broadleaf and grass weeds. Similar efficacy of imazamox-bentazone mixtures has been reported in soybeans and maize, particularly under Mediterranean climatic conditions (Kudsk & Streibig, 2003; Jursík et al., 2008). Imazamox is known for its systemic activity, primarily absorbed through foliage and translocated to meristematic regions where it inhibits ALS activity (Tranel & Wright, 2002). This mechanism is particularly effective against annual grasses like Echinochloa crus-galli, as shown in our study and others (Heap, 2024). Bentazone, a contact herbicide, complements imazamox by providing immediate phytotoxicity to broadleaf species, including Amaranthus retroflexus and Xanthium strumarium, which are notoriously competitive in peanut fields (Soltani et al., 2007). Our findings also align with previous reports suggesting that dose optimization is critical: while lower doses (50–100 ml/da) provided moderate suppression, the 150 ml/da dose achieved statistically significant control without phytotoxicity. Higher doses (300 ml/da) did not result in further gains and pose a risk for environmental load, consistent with the law of diminishing returns in herbicide application (Radosevich et al., 2007).

Key Words: Essential oil, Weed control, fresh, dry weight, yield

ASSESSMENT OF BIOLOGICAL CHARACTERISTICS OF THE POLYPHENOLS FROM THE BYPRODUCTS OF COLD-PROCESSED OLIVE OIL EXTRACTION FROM THE KHENCHELA AREA

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ABSTRACT

The production of olive oil generates huge quantities of effluents called “margins” which have little economic value in Algeria and are a powerful pollutant discharged into nature without any prior treatment, but which could be considered a potential source of natural products of high additive value because of their content of phenolic compounds and other natural antioxidants. This study aims to highlight the biological activities of polyphenols from these margines (chemlal variety) harvested in Khenchela. The physico-chemical characterization of the samples showed acidic rejects (pH = 4.64), brown color with a high moisture content (H = 95.45%), a high content of total suspended solids (TSS = 0.55%), rich in organic matter (OM = 14%), poor in mineral matter (MM = 2%), in nitrogen with 0.42 g/l, and in dry matter with 8.55 g/l. A liquid-liquid extraction was performed using acetone (Ac). The total polyphenol determination showed the richness of the extract with 70 µg EAG/mg of extract. TLC qualitative analysis revealed a wide range of phenolic compounds. The resulting antioxidant capacity showed that the extract inhibited DPPH oxidation with a very low IC50%, namely 30µg/ml. The anti-inflammatory action has been proven in vitro by the inhibition of protein denaturation and the increase of HRBC (human red blood cells) membrane stability up to 97.77% compared to the 74.33% established by aspirin at the same concentration. Activated partial thromboplastin and prothrombin times were used to analyze the extrinsic and intrinsic coagulation pathways to determine their anticoagulant activity, which had a great impact on the lengthening of both chronometric tests. In the light of the results obtained, we can conclude that the polyphenolic acetone extract derived from recycled margines is endowed with remarkable antioxidant, anti-inflammatory and anticoagulant activity. As such, it may represent a promising natural resource for alleviating the complications of oxidative stress associated with or triggering thrombolytic and cardiovascular diseases.

Key Words: Margins, polyphenols; anti-inflammatory activity; antioxidant activity; anticoagulant activity

STATUS OF VARIOUS SOURCES OF EDIBLE OIL AND PROSPECTS OF OIL PALM CULTIVATION IN PAKISTAN

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ABSTRACT

Oilseeds are essential for food nutrition, cooking, and industrial uses like lubricants, paint, and soap. Pakistan requires about 4 million metric tons of edible oil annually, but only 0.5 million tons are produced indigenously. Cotton, rapeseed, mustard, and sunflower contribute to the oil supply, but additional sources like olive and rice bran could provide a further 0.25 million tons. Local crops have not met the food industry's needs, and the demand grows by 7% annually. Sesame has emerged as a new income source, yet self-sufficiency remains distant due to rising consumption outpacing production. The country is in high need of the setting up of olive and rice bran oil industry. Oil palm cultivation has been suggested for Pakistan's coastal regions, where up to 0.5 million hectares could be used. However, low precipitation, humidity, and heat stress during peak months hinder its growth. Early attempts to establish oil palm plantations showed promise, but the lack of an oil extraction industry led to failure. With rising palm oil demand, mostly imported from Indonesia and Malaysia, reviving domestic palm oil production is crucial. Palm oil's environmental sensitivity limits its adaptation to local conditions, but modern technologies like CRISPR/Cas9 could enable genetic modifications to improve resilience and optimize oil production, making large-scale palm cultivation viable in Pakistan.

Key Words: Biotechnology, Environmental adaptability, Genetic modification, Oil crop expansion, Sustainable agriculture

CHEMICAL CHARACTERIZATION OF THE ARGAN TREE (*ARGANIA SPINOSA*)

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ABSTRACT

This review presents a comprehensive overview of the **chemical characterization** of the **argan tree** (*Argania spinosa*), an endemic species of North Africa highly valued for its ecological, economic, and therapeutic importance. This resilient tree, well-adapted to arid environments, plays a crucial role in soil stabilization, biodiversity conservation, and supporting rural livelihoods. The most valued product, **argan oil**, extracted from the kernels of its fruit, has gained global attention due to its rich composition and beneficial properties. Its chemical makeup is notably high in **unsaturated fatty acids**, primarily **oleic and linoleic acids**, along with a variety of other **bioactive compounds**. These include **tocopherols** (vitamin E), **polyphenols**, **sterols**, **saponins**, **carotenoids**, and **squalene**, all linked to antioxidant, anti-inflammatory, cardioprotective, and anticancer effects. It's important to note that the oil's composition can vary based on geographical origin, genotype, environmental conditions, and extraction methods. Beyond the oil, other parts of the argan tree also contain valuable **phytochemicals**. Studies show that the leaves, bark, and pulp are rich in **flavonoids, phenolic acids, tannins, and triterpenoids**, which contribute to the plant's antimicrobial, anti-inflammatory, and hepatoprotective activities. However, many of these compounds remain insufficiently studied, limiting a full understanding of their mechanisms and potential applications. Recent advancements in analytical techniques, such as **HPLC, GC-MS, and FTIR spectroscopy**, have significantly improved the identification and quantification of Argania spinosa's chemical constituents. Continued research is essential to fully unlock the **multifaceted pharmacological potential** of this remarkable tree and ensure the sustainable use and valorization of all its components.

Key Words: Argan tree, *Argania spinosa*, Argan oil, Chemical characterization, Phytochemicals

SAFFLOWER (Carthamus tinctorius l.) IN KAZAKHSTAN: OILSEED POTENTIAL UNDER ARID CONDITIONS

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ABSTRACT

This article presents the results of research on the cultivation of safflower (*Carthamus tinctorius* L.) under arid climate conditions. Safflower is a highly adaptive drought-tolerant oilseed crop capable of producing stable seed yields in the Aktobe region, effectively complementing the spectrum of oilseed crops cultivated in the area. Unlike many cereal crops, safflower maintains stable productivity even in years with critically low precipitation. Average seed yields range from 600 to 1000 kg/ha, while under favorable conditions, yields can reach 1400-1800 kg/ha. Due to its high cell sap concentration, the crop utilizes soil moisture efficiently. During various stages of vegetation, the aerial biomass of safflower can be used as animal feed. The green mass is suitable for silage production, non-standard seeds may be fed to poultry, and oil pressing by-products such as oilcake are valuable feed components for livestock. The field experiments were conducted at the Kazakh Research Institute of Horse Breeding and Fodder Production (formerly Aktobe Experimental Agricultural Station), where specific elements of safflower cultivation techniques were investigated. It was established that early sowing with a seeding rate of 0.4-0.5 million viable seeds per hectare ensures the highest productivity. The maximum yield obtained on fallow lands was 1400-1600 kg/ha; following the second crop - 1000-1200 kg/ha; the third crop - 800-900 kg/ha; and under stubble conditions - 400-500 kg/ha. Safflower cultivation in arid farming systems is economically efficient, with stable seed yield and low production cost. The study identified optimal agronomic practices, including seeding rates (20-25 kg/ha), early and ultra-early sowing dates, and primary autumn tillage.

Key Words: safflower, agronomy, crop rotation, tillage, sowing time, seeding rate, yield

PERFORMANCE OF SOME F1 HYBRID CONFECTIONARY PUMPKIN (CUCURBITA PEPO L) GENOTYPES AT TRAKYA REGION IN TÜRKIYE

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ABSTRACT

This study was conducted to evaluate the performance of some confectionery pumpkin (*Cucurbita pepo* L.) F1 hybrid genotypes at Edirne and Ahmetbey, Lüleburgaz, Kırklareli locations in 2018. In this study, 20 F1 improved promising hybrid, and 3 standard cultivars were tested. Vine length, number of fruits per plant, number of seeds per fruit, thousand seed weight, seed length, seed width, and seed yield were studied. Significant differences among genotypes were identified in both locations and in the combined analysis of locations for fruits per plant. The TGK-13 × TGK-14 F1 hybrid genotype had the highest average number of fruits per plant (2.92), followed by TGK-11 × TGK-12 (2.70) and TGK-14 × TGK-9 (2.68). Significant differences were observed among genotypes at the Edirne, Kırklareli locations and combined analysis of genotypes for number of seeds per fruit. The highest number of seeds per fruit was found in the K7-36 × TGK-17 F1 hybrid with 459.1 seeds, followed by TGK-11 × TGK-9 with 450.8 seeds. Statistically significant differences were observed at the Edirne and Kırklareli locations and the combined analysis of locations for thousand kernel weight. The TGK-12 × TGK-17 F1 hybrid had the highest thousand seed weight with 257.4 g, followed by K7-36 × TGK-17 F1 hybrid with 251.8 g. Significant differences among genotypes were observed in both Edirne and Kırklareli locations and the combined analysis of locations for seed length. The TGK-17 × TGK-9 F1 hybrid had the highest average seed length with 24.05 mm, followed by the control variety Mertbey with 22.87 mm. Significant differences among genotypes were observed in both Edirne and Kırklareli locations and the combined analysis of locations for seed width. The highest seed width was observed in the senahanım cultivar with 11.33 mm, followed by the TGK-11 × TGK-6 F1 hybrid with 11.11 mm. Significant differences in seed yield were observed among genotypes in Edirne, Kırklareli, and in the combined location analysis. In Edirne, the TGK-12 × TGK-9 F1 hybrid had the highest yield with 254.3 kg/da. In Kırklareli, the highest yields were obtained from the K7-36 × K7-37 F1 hybrid with 238.3 kg/da, TGK-13 × TGK-4 F1 hybrid with 234.7 kg/da, and TGK-12 × TGK-9 F1 hybrid with 232.3 kg/da. Based on the average yield of both locations, the highest seed yields were obtained from K7-36 × K7-37 F1, TGK-12 × TGK-9 F1, TGK-13 × TGK-14 F1 hybrid and the check cultivar senahanım with respectively 245,5 kg/da, 243,3 kg/da, 241 kg/da ve 239,3 kg/da/da.

Key Words: confectionery pumpkin, hybrid, yield performance, yield traits

AGRONOMIC AND NUTRITIONAL POTENTIAL OF THE FIRST RELEASED VARIETY OF WHITE LUPINE (LUPINUS ALBUS L.) AS ACONCENTRATE FEED FOR LIVESTOCK IN TUNISIA

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ABSTRACT

Legume grains are characterized by both high energy and nutrients content. Among them, white lupine is a promising pulse crop widely used in livestock feeding and suitable for low-input cropping systems. White lupine grains have long been recognized for their nutritional value and potential health benefits. Their high protein content, dietary fiber, and bioactive compounds with low fat content make lupine seeds a suitable alternative to soybean meals and represent a valuable source of phenols and antioxidant compounds. However, lupine in Tunisia is a minor crop and is restricted to the regions of Séjnane and Cap bon where soils are acidic to neutral and sandy and sensitive to active limestone (CaCO3).

Key Words: white lupine, *Lupinus albus* L, nutritional value, secondary compounds, ruminants, concentrate

VALORIZATION OF THE ANTIBACTERIAL PROPERTIES OF THE ESSENTIAL OIL OF A LOCAL MEDICINAL PLANT *ORIGANUM MAJORANA* L.

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ABSTRACT

In Algeria, we have long relied on traditional medicine thanks to our country's rich and diverse flora. The latter constitutes a veritable phytogenetic reservoir, with some 3,000 species belonging to several botanical families, which we need to develop for use in various pharmaceutical, agri-food, and cosmetic fields. The aim of this study is to analyze the antibacterial effect of the essential oil of an aromatic and medicinal plant from the Algerian flora, called Origanum majorana L., on 4 reference bacterial strains and 18 strains of hospital origin. Extraction of the essential oil from the aerial part of dry marjoram by hydrodistillation. As for antibacterial efficacy, using the disk diffusion method (aromatogram). Using the liquid and solid dilution methods, the MICs and BMCs of the essential oils studied were assessed, respectively. All the reference strains tested demonstrated sensitivity to the EO, with extreme inhibitory activity on Staphylococcus aureus reflected by an inhibition zone diameter of 26 mm. The essential oil showed varied antibacterial properties on the 18 Gram-negative clinical strains tested, 37% of which were multidrug-resistant, with high inhibitory activity on Escherichia coli and Proteus spp. Nevertheless, E. coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, and Enterobacter spp. demonstrated high sensitivity to the aromatogram. MICs ranged from 16 to 50 mg/ml and from 20 to 100 mg/ml, respectively. The results of the BMC determination demonstrated that the essential oil studied had bactericidal action against 99% of the strains tested. The essential oil derived from Origanum majorana L. possesses exceptional bactericidal activity. It can therefore be a natural resource and an excellent alternative to antibiotics for combatting bacterial infections.

Key Words: *Origanum majorana* L, Essential oil, Antibacterial activity, MIC, BMC.

NUTRITIONAL EVALUATION OF PLANT-BASED MILK ALTERNATIVES WITH EMPHASIS ON PROTEIN CONTENT: A FOCUS ON SOY-BASED BEVERAGES

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ABSTRACT

Over the past few years, consumers all over the world, especially in south Asia and Western Europe, have increasingly adopted plant-based diets. Indeed, plant-based milk alternatives are becoming one of the fastest-growing sectors of food industry, as the consumption of these substitutes has surged, thus it is quickly becoming increasingly popular, mostly because of their high nutritional value and many other positive impacts on human health. Approximately 65% of the world's population suffers from poor lactose digestibility or lactose intolerance, making plant-based milk an ideal solution to meet these consumers' daily nutritional needs. The results show that dairy products are regarded essential protein sources with a high Digestible Indispensable Amino Acid Score (DIAAS) ranging from 100 to 200. Plant proteins, on the other hand, are likely to contain lower levels of essential amino acids and DIAAS than dairy proteins. In this case pea and rice proteins have medium and low DIAAS values of 62 and 47, respectively. The current evaluation focuses on studying the nutritional quality of plant-based milk alternatives with an emphasis on protein content and quantity. Several studies examine multiple brands of almond-, oat-, rice-, coconut-, and soy-based drinks in a comparison analysis, revealing that most contain lower levels of total protein, lipids, amino acids, and minerals than cow and goat milk. Soy-based beverages were the lone exception, as their protein content (3.47%) exceeds that of cow (3.42%) and goat milk (3.25%). In addition, soy-based drinks exhibit a similar amino acid profile and a high mineral content. Soybeans are widely consumed globally because of their nutritional richness and adaptability. However, soy is also recognized as a possible allergen capable of causing IgE-mediated hypersensitivity reactions in allergic individuals. Soy allergy is estimated to affect 0.27% of the general population, with symptoms ranging from mild gastrointestinal discomfort to severe anaphylaxis. This underlines the need to develop alternative processing methods or formulations that reduce soy allergenicity while maintaining practical and nutritional qualities. Soybeans are widely consumed globally due to their nutritional richness and adaptability. A recent analysis of 219 plant-based milk alternatives indicates that these products generally contain lower levels of protein and saturated fatty acids than dairy milk and exhibit considerable variability in the content of added sugar. Soy-based products, particularly unsweetened and fortified variants, were found to offer the closest nutritional profile to dairy milk.

Key Words: plant-based milk, soy milk, protein quality, DIAAS, nutritional evaluation, lactose intolerance, alternative dairy, amino acid profile, soy allergenicity

EFFECTS OF HIGH-PRESSURE HOMOGENIZATION PRETREATMENT ON STRUCTURAL, FUNCTIONAL AND BIOACTIVE PROPERTIES OF GLYCATION OF SESAME PROTEIN ISOLATE

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ABSTRACT

In addition to being an important source of oil, sesame seeds are also a potential source of protein. The extraction of oil from sesame seeds results in an increased protein content of the by-product, sesame meal (41.15–49.58%). Protein is a valuable ingredient in functional foods and dietary supplements. Glycation is a protein modification technique based on the principles of the Maillard reaction. It does not require enzyme catalysis and has significant potential and advantages for the food industry.

This study investigated the effect of the glycation technique in combination with high-pressure homogenization on improving the structural and functional properties of sesame protein obtained from sesame meal. To this end, a solution of sesame protein isolate extracted from cold-pressed sesame meal was homogenized at a pressure of 100 MPa in one, two or three cycles, and glycation was performed using 2% glucose. The physical, structural, thermal, functional, and bioactive properties of the sesame protein isolates and conjugates were then determined.

High-pressure homogenization applied in different cycles was effective in the modification of sesame protein and absolute zeta potential, protein solubility, denaturation temperature, surface hydrophobicity, free-SH content, water and oil binding, foam and emulsification properties were significantly improved, while there was a significant decrease in particle size. In addition, in vitro bioaccessibility of the protein in gastric and intestinal environment was increased and its allergenicity was decreased compared to the control sample. However, high-intensity homogenization (3 cycles) mostly showed negative effects. Glycation of control and homogenized sesame proteins with glucose improved the structural and functional properties and allergenicity of the protein but negatively affected the in vitro bioaccessibility. High-pressure homogenization process played a role in shortening the reaction time and was more effective in improving the properties compared to the control sample. Especially, the negative effects on the degree of browning due to glycation and in vitro bioaccessibility were limited by the high-pressure homogenization pretreatment. In conclusion, while high-pressure homogenization and glycation made a significant contribution to the improvement of the functional properties of sesame protein, high-pressure homogenization applied before glycation revealed a significant potential in terms of final product properties.

Key Words: Sesame, protein, modification, high level homogenization, glycation, functional properties

COLOR STABILITY OF MARGARINE FORTIFIED WITH OIL PALM LEAF EXTRACT (OPLE): A PRELIMINARY INVESTIGATION AND ONGOING STUDY

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ABSTRACT

Color stability is a key quality indicator in margarine, with strong influence on consumer perception and product acceptance. The use of natural antioxidants, such as Oil Palm Leaf Extract (OPLE), is gaining attention as a clean-label alternative to synthetic additives. This study evaluates the initial effects of OPLE on the color characteristics of margarine using the CIELAB color space and outlines a longer-term assessment of color retention over two months. Preliminary, emulsion samples were prepared with OPLE at concentrations of 0 (control), 200, 400, 600, 800, and 1000 ppm. Color measurements were recorded in antivalues were assessed using a colorimeter, and Chroma (C*) and Hue angle were calculated to evaluate color intensity and tone

Results showed that the 400 ppm OPLE treatment maintained the highest color saturation (Chroma ~12.8 initially), with acceptable stability in hue over the 10-day period. The 200 ppm dosage demonstrated similar chroma values but slightly greater variability, suggesting a viable cost-effective alternative. In contrast, the 800 ppm showed where the hue shift is ~98° to 75°and 1000 ppm treatment exhibited significant hue shift (from ~97° to -38°), indicating undesirable red/orange discoloration.

Thus, based on the preliminary investigation, 200ppm, 400ppm and 600ppm are applied in margarine. However, these samples contains beta carotene with dosage same as the margarines available in the market, which makes the color analysis varied from the preliminary results.

Margarine samples were to be formulated with a control (commercial standard), and OPLE at 200 ppm, 400 ppm, and 600 ppm. Each sample was to be analyzed in triplicate for L* (lightness), a* (red-green), and b* (yellow-blue) using a calibrated Konica Minolta Color Chromameter. Chroma (C*) and Hue Angle were to be derived to interpret color intensity and tone. Ongoing weekly measurements over a two-month storage period provided a longitudinal understanding of OPLE's effectiveness in maintaining margarine color during shelf life. This work aims to inform formulation strategies for natural antioxidant systems in margarine and other lipid-based food products.

Key Words: Oil Palm Leaf Extract, OPLE, Margarine, Color Stability, Chroma, Natural Antioxidant, Clean-label

SENSORY PROFILE OF ITALIAN OLIVE OILS AND PERCEIVE QUALITY EVALUATED BY PANEL TESTERS

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ABSTRACT

Olive oil is one of the most appreciated products in the Mediterranean basin and is well-known at an international level for its nutritional and health benefits. However, the sensorial characteristics are difficult to recognize. The purpose of the present study is to compare the sensorial characteristics of three different types of extra virgin olive oil (EVOO) in terms of their certifications: one without a quality certification, an EU Organic EVOO, and a Protected Designation of Origin EVOO. A specific questionnaire was submitted to Italian consumers, to understand their habits in relation to olive oil consumption, their perception in terms of olive oil quality, and purchase intention. Subsequently, an evaluation by different panels of testers was performed. The evaluation took place in two different tasting sessions by a group of professional tasters, one of semi-trained experts, and another of habitual consumers of olive oil, first through a blind test first and then a normal one. The panels' performances were estimated using the coefficient of variation. The analysis demonstrated that the two more experienced panels recognized the sensory attributes as positive qualitative characteristics of the oils, unlike the panel of regular consumers. The participants in general were positively influenced by the PDO and organic certifications, demonstrating their comprehension of the sustainability of the product. Few studies investigate the ability to recognize the qualitative characteristics of extra virgin olive oil. Therefore, this study can help to contribute to the valorization of the olive oil supply chain from a qualitative and sustainability perspective.

Key Words: Olive oil consumption, Sustainable production, Sensorial quality, Certification

EFFECTS OF BLENDING SAFFLOWER SEED OIL WITH DIESEL FUEL ON ENGINE PERFORMANCE

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ABSTRACT

In recent years, the depletion of fossil fuel resources, economic concerns, and increasing environmental awareness have significantly boosted interest in alternative energy sources. Biodiesel derived from vegetable oils has attracted attention due to its environmentally friendly properties and compatibility with diesel engines. In this context, safflower (Carthamus tinctorius L.) oil offers both economic and technical advantages, thanks to its high content of unsaturated fatty acids, low viscosity, and adaptability to a wide cultivation area. In this study, 10% by volume of safflower seed oil was blended with standard diesel fuel to investigate its effects on engine performance and exhaust emission levels. The experimental results indicated that the use of this biodiesel blend (90% diesel + 10% safflower oil) did not lead to any significant changes in engine power or carbon monoxide (CO) emissions compared to conventional diesel fuel. However, fuel consumption increased by a maximum of 50 ml per hour depending on the applied engine load. Furthermore, under all load conditions (25%, 50%, 75%, and 100%), nitrogen oxide (NOx) emissions increased by up to 150 ppm. Based on the results of this study, it can be concluded that blending 10% safflower seed oil with conventional diesel fuel can be a feasible option for use in single-cylinder, four-stroke diesel engines. However, for the continuous use of such biodiesel blends, it is important to make minor modifications to the fuel system, including replacing seals and components made of nitrile materials with biodiesel-resistant alternatives.

Keywords: Energy, diesel engine, safflower seed oil, emissions.

INTRODUCTION

The limited reserves of fossil fuels and the increasing environmental concerns have accelerated the shift toward renewable alternative fuels. In this context, biodiesel especially that derived from vegetable oils has emerged as an environmentally friendly and sustainable alternative. Oilseed crops such as safflower (Carthamus tinctorius), which are known for their drought resistance and high oil yield, are considered to hold significant potential as biodiesel feedstock. In particular, high-oleic acid safflower varieties represent a promising candidate for

biodiesel production under the agricultural conditions of Turkey. Safflower is an annual long-day oilseed crop, typically growing to a height of 80–100 cm. It exists in both thorny and thornless forms and produces flowers in various colors including yellow, red, orange, and white. Its seeds contain approximately 30–45% oil content. Safflower is generally cultivated as a summer crop and matures within 130–150 days on average. The accelerating pace of industrialization and the global expansion of the automotive sector have made the search for alternative fuels and the transition to environmentally friendly energy sources a necessity. Simultaneously, natural reserves of fossil fuels such as diesel, gasoline, and natural gas are depleting at an alarming rate. Moreover, the combustion of such fuels releases a wide range of harmful gases particularly carbon monoxide (CO) and carbon dioxide (CO_2) into the atmosphere, posing serious environmental threats [1]. Against this backdrop, the utilization of biodiesel as a direct substitute for fossil fuels or as a blending component is gaining increasing importance. This approach supports both sustainability and enhanced engine efficiency [1–2]. Biodiesel is a renewable and eco-friendly fuel that can be derived from vegetable oils, plant-based resources, and animal fats, and can be used directly in diesel engines. Its renewable nature, consistent supply potential, and ecological advantages make biodiesel an attractive alternative to petroleum-based fuels. Furthermore, biodiesel is readily biodegradable, non-toxic, and characterized by low emission levels [3]. Among the most critical properties of diesel and biodiesel fuels used in compression ignition engines are viscosity and density [4–5]. Compared to fossil diesel, biodiesel derived from vegetable oils generally exhibits higher density, viscosity, cetane number, and cloud point values. Biodiesel can be used either in its pure form (B100) or blended with conventional diesel fuel [6]. The primary distinction between biodiesel and fossil diesel lies in their differing chemical structures and compositions. Studies have demonstrated that methyl esters obtained from sources such as canola, sunflower, soybean, cottonseed, corn oil, and waste palm oil possess higher viscosity values than conventional diesel fuel. Additionally, as the proportion of biodiesel increases in diesel-biodiesel blends, the blend's density and viscosity also tend to increase. However, blends containing up to 20% biodiesel have been found to maintain viscosity values similar to those of pure diesel [5].

A review of the literature reveals several experimental investigations on the performance and emission characteristics of different test fuels in compression ignition (CI) engines. For instance, syngas and pyrolytic oil derived from safflower have been tested in both single and dual-fuel modes. The results showed that brake thermal efficiency was higher in the dual-fuel mode compared to the single-fuel mode. The combination of diesel and SFS (Syngas Fuel System) yielded the highest efficiency, reaching 32.20%. Moreover, specific fuel consumption (SFC) was found to decrease in the dual-fuel mode. Emissions of carbon monoxide (CO) and hydrocarbons (HC) were also reduced in dual-fuel operation compared to single-fuel operation. These findings suggest that thermal efficiency can be improved and emissions moderately reduced through dual-fuel strategies [7].

Another study employed 100% safflower biodiesel (B100) as the base fuel in a single-cylinder compression ignition engine and investigated the effects of methanol and n-pentanol pre-injection into the intake manifold. Compared to the use of pure biodiesel, the introduction of methanol and n-pentanol led to increased brake thermal efficiency of the engine [8]. In another experiment, biodiesel was produced through transesterification of safflower oil using potassium hydroxide and methanol. The resulting biodiesel was blended with conventional diesel and tested in a diesel generator operating under constant load and speed conditions. The results indicated that biodiesel derived from safflower oil has the potential to reduce harmful emissions and can be considered a viable alternative to fossil-based diesel fuels [9–10].

In the existing literature, there has been a limited number of recent studies focusing on the use of blended safflower seed oil as a biodiesel component. In this study, the effects of

blending safflower seed oil at a volumetric ratio of 10% with conventional diesel fuel on engine performance and exhaust emission characteristics were investigated.

MATERIALS AND METHODS

This study was carried out at the Erin Motor R&D Center laboratories using a single-cylinder, four-stroke diesel engine, as illustrated in Figure 1. The main objective of the experimental work was to investigate the effects of an alternative fuel blend composed of 10% safflower seed oil biodiesel and 90% conventional diesel fuel by volüme on engine performance and exhaust emission characteristics. The test fuel blend was prepared by thoroughly mixing the two components to ensure homogeneity, and the resulting mixture was introduced into the engine's fuel system. Prior to conducting the performance and emission measurements, the engine was operated under no-load conditions in order to reach its nominal operating temperature and to stabilize thermally. During this warm-up phase, the coolant temperature was continuously monitored, and the engine was kept running until the radiator water temperature reached 82 °C, which was accepted as the reference operating temperature for all tests. Subsequently, experimental measurements were performed under four distinct load conditions: 25%, 50%, 75%, and 100% of the engine's full load capacity. At each load level, data regarding engine performance and exhaust emissions were collected systematically for analysis.

Figure 1: Test Engine and setup

Technical specifications and necessary information of the test engine are given in Table 1.

Table 1: Technical Specifications of The Test Engine

General Characteristics	**Technical Specifications**
Engine type	Erin Motor Base Model
Number of Valves	4
Continuous Power (kw/rpm)	11.5 / 1500
Bore (mm)	108
Stroke (mm)	127
Combustion System	Direct Injection
Compression Ratio	14.6 : 1
Engine Cooling	Water
Weight (kg)	157

The engine load was applied using a dynamometer, and at each load level, measurements were taken while the engine operated at a constant speed. In the initial stage, reference tests were conducted using standard diesel fuel only. Following this, the same test procedure was repeated using the biodiesel blend containing 10% safflower seed oil. Throughout the testing process, key parameters such as engine power output (kW), specific fuel consumption (SFC), carbon monoxide (CO), and nitrogen oxides (NOx) emissions were measured and recorded in real-time. All measurements were performed under identical environmental conditions and at a constant engine speed to ensure the accuracy and reliability of comparisons between the fuel types. Based on the collected data, the changes in engine performance and emission characteristics resulting from different fuel types were analyzed. The results were presented in graphical form, allowing for a clear interpretation of the effects of fuel composition. Within this scope, the influence of fuel type on engine efficiency and environmental impact was comprehensively evaluated.

RESULTS AND DISCUSSION

In this study, the potential of safflower seed oil as an alternative fuel for use in diesel engines was experimentally investigated. For this purpose, a biodiesel blend consisting of 10% safflower oil and 90% conventional petro-diesel by volume was prepared and tested in a single-cylinder, four-stroke, direct injection diesel engine. The effects of this fuel blend on engine performance and exhaust emissions were analyzed under varying engine load conditions and compared to those obtained using standard diesel fuel.

The experimental results showed that the biodiesel blend containing 10% safflower oil did not cause any significant negative impact on engine power output. As illustrated in Figure 2, the engine produced nearly the same power output across all load conditions when operating on the biodiesel blend, compared to conventional diesel fuel.

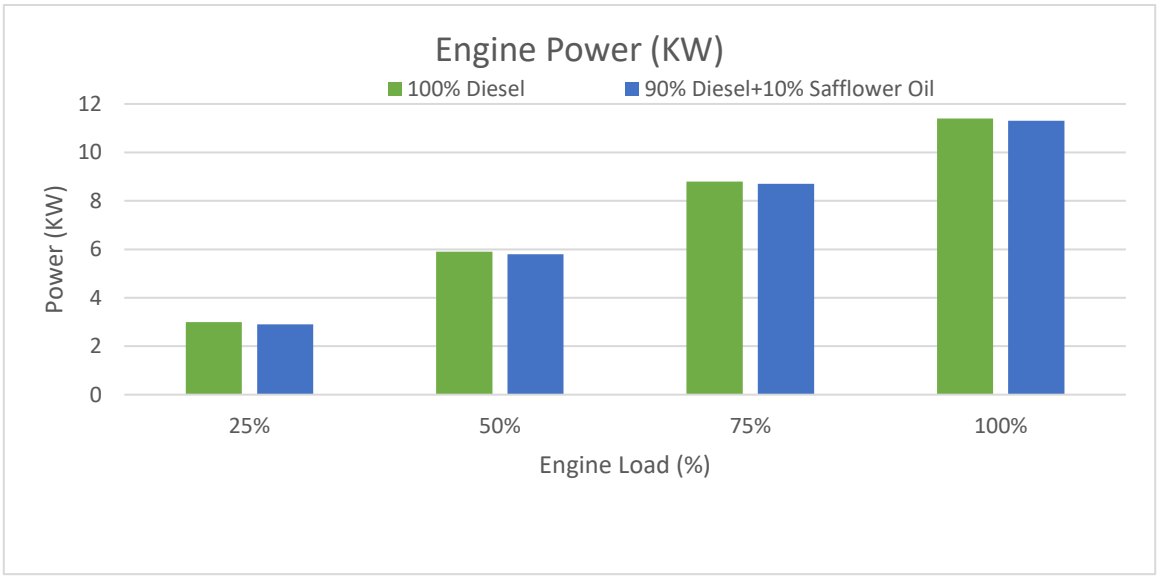

Figure 2 : Power variation according to the load on the engine

Similarly, when examining the fuel consumption of the test engine, it was observed that at **50% engine load,** the biodiesel blend containing 10% safflower seed oil resulted in a **slight reduction in fuel consumption**, as illustrated in **Figure 3**. At all other engine load conditions, there was **no significant difference** in fuel consumption between the use of conventional diesel fuel and the biodiesel blend with 10% safflower oil.

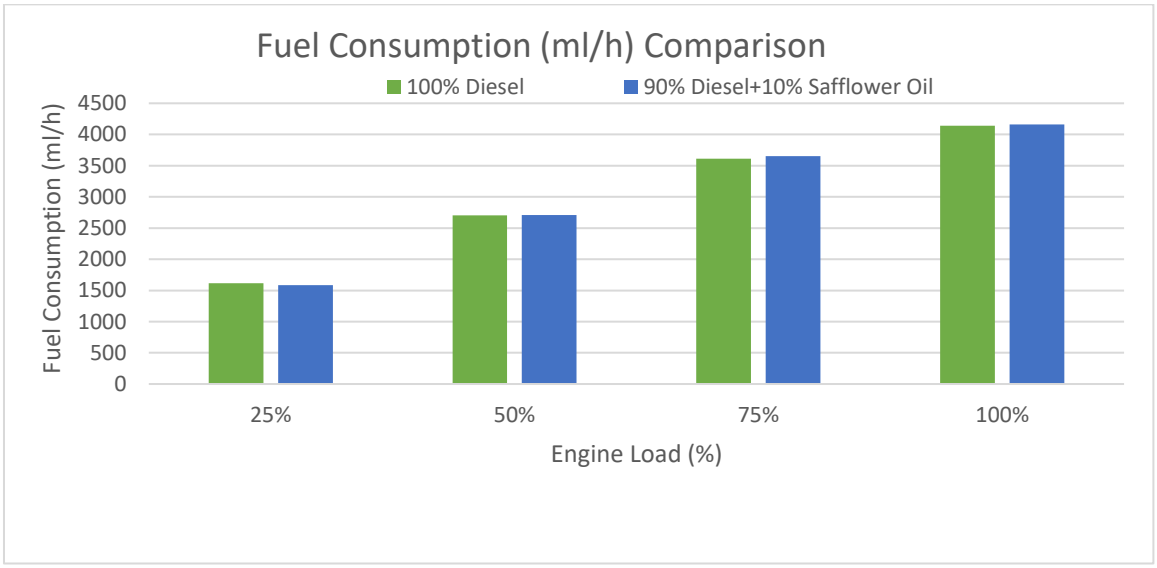

Figure 3: Change in fuel consumption as a function of engine load and fuel type

Simultaneously with the engine tests, exhaust emissions were measured, and the carbon monoxide (CO) levels in the exhaust gases are presented in Figure 4. When using the biodiesel blend containing 10% safflower seed oil at 75% engine load, a slight reduction of 0.01% in CO emissions was observed. However, this decrease is minimal, and at all other load conditions, CO emission levels remained nearly unchanged.

Considering that carbon monoxide is one of the most critical harmful gases in exhaust emissions, the fact that its level remains essentially constant with the use of the biodiesel blend containing 10% safflower seed oil can be regarded as a positive outcome.

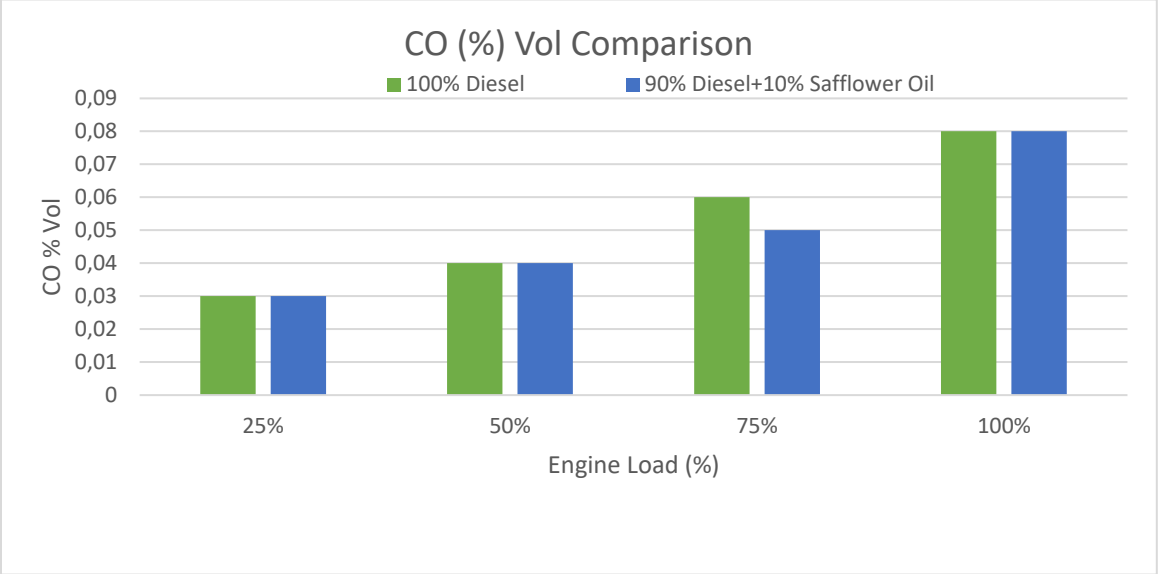

Figure 4: Change in CO in engine exhaust emissions as a function of load and fuel type

The variation in nitrogen oxide (NOx) emission levels depending on the type of fuel used in the test engine is presented in Figure 5. As shown in Figure 5, at 25% engine load, the NOx levels remained the same for both fuel types. However, increases in NOx emissions were observed at 50%, 75%, and 100% engine loads. Notably, at 100% load, NOx emissions increased by approximately 150 ppm. Despite this increase, the rise in NOx levels is considered to be within acceptable limits.

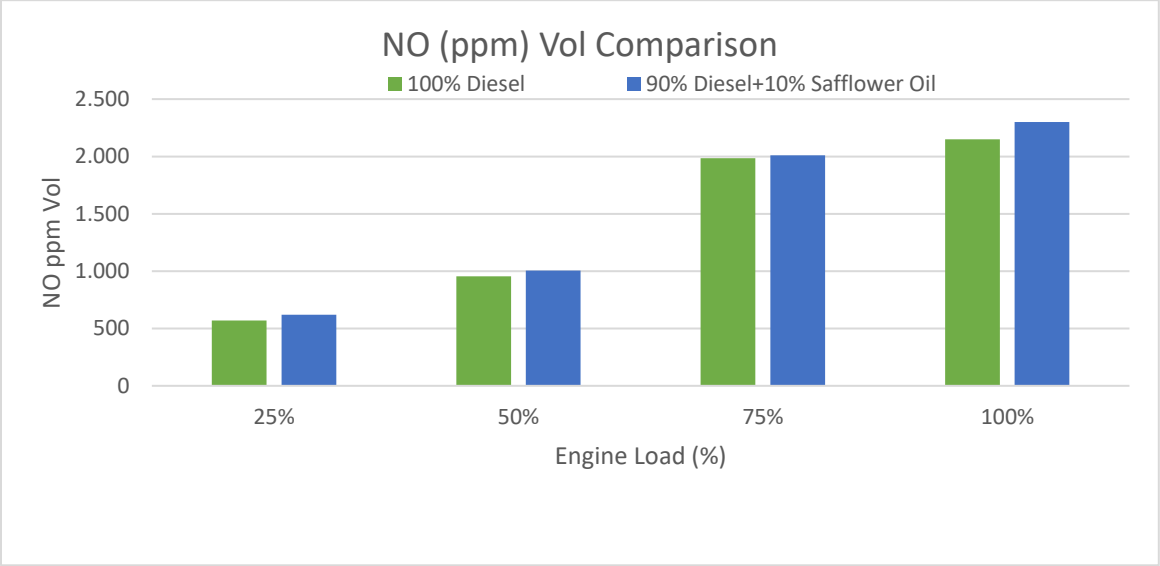

Figure 5: Change in NO in engine exhaust emissions as a function of load and fuel type

CONCLUSION

In this study, the effects of blending 10% safflower seed oil by volume with conventional diesel fuel on the characteristic performance parameters of a single-cylinder, conventional diesel engine were experimentally investigated. Based on the test results, it was

observed that blending 10% safflower seed oil with diesel fuel resulted in almost no change in engine power output and fuel consumption. No significant differences were detected in either engine power or fuel consumption. Similarly, the amount of carbon monoxide (CO), a critical harmful exhaust emission, remained consistent across all engine load conditions when using the biodiesel blend. However, at 100% engine load, an increase of approximately 150 ppm in nitrogen oxide (NOx) emissions was observed.

These findings indicate that blending safflower seed oil at a 10% volume ratio with diesel fuel does not cause significant changes in the characteristic behavior of a single-cylinder diesel engine, suggesting that this blend ratio can be effectively used in such engines. For fuel consumption and sustainability considerations, future studies are recommended to investigate the effects of biodiesel blends containing varying ratios of safflower seed oil.

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PERFORMANCE OF SOME F1 HYBRID CONFECTIONERY PUMPKIN (*CUCURBITA PEPO* L.) GENOTYPES IN THE TRAKYA REGION OF TÜRKIYE

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ABSTRACT

This study was conducted to evaluate the performance of some F_1 hybrid confectionery pumpkin (*Cucurbita pepo* L.) genotypes in Edirne and Kırklareli locations in 2018. In this study, 20 promising improved F_1 hybrids and 3 standard cultivars were tested. Vine length, number of fruits per plant, number of seeds per fruit, thousand seed weight, seed length, seed width, and seed yield were examined. Significant differences among genotypes were identified for vine length, fruits per plant, number of seeds per fruit, thousand seed weight, seed length, seed width, and seed yield. The TGK-13 × TGK-14 F_1 hybrid genotype had the highest average number of fruits per plant (2.92), followed by TGK-11 × TGK-12 (2.70) and TGK-14 × TGK-9 (2.68). The highest number of seeds per fruit was found in the K7-36 × TGK-17 F1 hybrid with 459.1 seeds, followed by TGK-11 × TGK-9 with 450.8 seeds. The TGK-12 × TGK-17 F_1 hybrid had the highest thousand seed weight at 257.4 g, followed by the K7-36 × TGK-17 F_1 hybrid at 251.8 g. The TGK-17 × TGK-9 F_1 hybrid had the highest average seed length at 24.05 mm, followed by the control cultivar Mertbey at 22.87 mm. The highest seed width was observed in the Senahanım cultivar at 11.33 mm, followed by the TGK-11 × TGK-6 F_1 hybrid at 11.11 mm. The highest seed yields were obtained from K7-36 × K7-37 F_1, TGK-12 × TGK-9 F_1, TGK-13 × TGK-14 F_1 hybrid and the control cultivar 'Senahanım' with 245.5 kg/da, 243.3 kg/da, 241.0 kg/da, and 239.3 kg/da, respectively.

Keywords: Confectionery pumpkin (*Cucurbita pepo* L.), Hybrid Breeding, Yield traits, Yield trials

1. INTRODUCTION

There are many pumpkin species worldwide, among which *Cucurbita pepo* L., *Cucurbita maxima* L., and *Cucurbita moschata* L. are the most widely cultivated globally. Their seeds have high nutritional and caloric value and are used in diets (Akoroda, 1990). In Türkiye, pumpkins cultivated for confectionery seed consumption are mostly of the *Cucurbita pepo* L. species, with a small amount from the *Cucurbita moschata* species (Yanmaz and Düzeltir, 2004). Pumpkin seeds are an important snack in Türkiye for both domestic consumption and export. The cultivation area for confectionery pumpkins varies between 615 119 da and 778 594 da over the years (TUIK, 2025).

Pumpkin seeds contain up to 50% fat, up to 30% protein, sugars, B vitamins, ascorbic acid, phytosterols, phytic acid, lecithin, oxycerotin, tyrosine, salicylic acid, and resins. The seed oil is rich for linoleic, oleic, palmitic, and stearic acids (Ekpedeme *et al.*, 2000). Research on pumpkin seed content has determined that seeds contain 31.8-33.76% protein, 41.63-46.06%

fat (Yegul, 2007), linoleic acid content between 40-57%, and vitamin E content varying between 100-600 µg/g (Murkovic *et al.*, 2000).

Abak *et al*. (1996), studied on sowing time using four hull-less pumpkin seed lines in the Harran Plain, conducted sowing at 15-day intervals starting from April 7th. They did not find a statistically significant yield difference among the lines. The study determined that seed weight changed depending on sowing time, with average seed weight decreasing in later sowings. Loy (1990) examined the effects of plant density on seed production and fruit quality in hull-less seeded pumpkin. As the number of plants per unit area increased, the number of fruits per plant and fruit size decreased, but seed yield increased. The research also noted that fruit size did not affect seed size. Şeniz (1988) conducted a study on plant density in confectionery pumpkin (*Cucurbita pepo* L.). The study examined different plant densities (2, 4, 6, and 8 plants/m²). The best yield was obtained at a density of 8 plants/m². The highest seed yield per plant (43.35 grams) and highest number of fruits per plant (1.67) were determined. The study reported that as the number of plants per square meter increased, the number of fruits per plant, number of seeds per fruit, and thousand seed weights decreased.

Abak *et al*. (1990), in a study on 48 hull-less and 12 hulled inbred lines obtained from populations collected from the Trakya region, found fruit weight ranged from 2-5 kg, seed yield per fruit from 30-100 g, and seed yield per plant from 80-300 g. They observed that hulled seed types yielded higher seed yield than hull-less types. Ercan and Kurum (2003), in a study with four hybrids and six populations in summer squash, found fruit diameter ranged from 3.7 to 4.44 cm, fruit length from 13.64 to 15.32 cm, and fruit weight from 112.6 to 140.3 grams. Regarding seeds, they determined seed width ranged from 6.6 to 9.9 mm, length from 11.1 to 14.8 mm, and seed yield per fruit from 35.3 to 110.1 grams. Yanmaz *et al*. (2008) conducted a study to investigate seed and fruit characteristics in 45 confectionery pumpkin lines. According to the results, fruit length varied between 21-41 cm, diameters between 13-18 cm, and length/diameter ratios between 1.4-2.7. Fruit weights varied between 2-4.5 kg, the number of fruits per plant was 2-5, and seed yield per plant was found to be 54-450 grams. Thousand seed weight varied between 140-253 g, while the seed index value (fruit weight/seed yield per fruit) was found in the range of 28-127. The researchers observed a positive relationship between fruit shape/weight and the seed index.

Toprakkarıştıran (1997), in a study on confectionery pumpkin, examined plant, leaf, flower, fruit, and seed characteristics in material obtained through selfing and selection. The study indicated that the lines Av/2, Av/4, 20/2, 24/3, 20/5, and 24/5 were promising for future work and that continuing selfing and selection with these lines would be beneficial. Düzeltir (2004), in a study on confectionery pumpkin, determined that four examined lines (3/1, 9/1, 19/1, and 20/1) possessed desired characteristics. Therefore, it was stated that continuing selection with these four lines in future years would be beneficial. Nerson (2005) found a positive relationship between fruit number and seed yield.

Seymen *et al*. (2023) conducted trials under irrigated and non-irrigated conditions in the Konya ecological zone in 2017 and 2018 to identify drought-tolerant confectionery pumpkin genotypes. The study used 44 inbred lines and the cultivars Mertbey, Sena Hanım, Hanım tırnağı, and Çerçeveli. According to the two-year trial results, seed yield under non-irrigated conditions varied from 7.9 to 68.6 kg/da. The lowest yield was from line G19, while the highest was from line G9. Under irrigated conditions, yield varied from 92.6 to 220 kg/da.

Evci *et al*. (2012) examined some agricultural characteristics of 16 hybrid lines and 3 standard cultivars under Edirne conditions for confectionery pumpkin. The researchers determined seed length varied from 17.5 - 23.0 mm, seed width from 8.8 - 12.5 mm, thousand seed weight from 136.6 - 304.2 g, and seed yield from 68 - 102 kg/da. The lowest seed yield was obtained from hybrid F4 SN:18 x F4 SN:14 B2, while the highest seed yield was from hybrid F4 SN:14 x F4 SN:15 B1.

Beşer *et al*. (2020), in their research with hybrid confectionery pumpkin under Edirne ecological conditions, found seed weight per fruit ranged from 16.80 - 105.50 g. The lowest seed weight per fruit was obtained from line TGK-3 x TGK-12, while the highest was from line TGK-14 x TGK-4.

Pumpkins grown in Türkiye for confectionery seeds have different seed types. These include 'hanım tırnağı' (characterized by thin, elongated seeds with a thin hull), the 'Nevşehir' type (also known as the 'framed' type, with a round or near-round seed structure, featuring a framed outline with two lines on the edges). This is the most widely cultivated type in Türkiye, primarily in dry farming areas. 'Ürgüp Sivrisi' (seed structure is long like 'hanım tırnağı' but wider, with a slightly thicker hull than 'hanım tırnağı', and mostly cultivated in irrigated areas). Production mostly involves local cultivars. However, in recent years, some domestic and foreign hybrid cultivars have begun to be cultivated. While hybrid cultivars show some advantages in terms of yield, sufficient seed quantities are not available, and there is a shortage of cultivars for the different seed types demanded by the market. This study was conducted to evaluate the performance of some new improved F_1 hybrid confectionery pumpkin (*Cucurbita pepo* L.) genotypes in Edirne and Kırklareli locations in Türkiye, in 2018

2. MATERIALS AND METHODS

This research was conducted in 2018 in Karaağaç village, central district of Edirne, and in Ahmetbey town, Lüleburgaz district, Kırklareli. Twenty candidate F_1 hybrid genotypes and three control F_1 hybrid confectionery pumpkin (*Cucurbita pepo* L.) cultivars were used as material of this study. During soil preparation, 30 kg/da of 20.20.0 (20% N, 20% P_{2O5}) fertilizer was used as basal fertilizer.

Seedlings grown in trays were planted at a spacing of 70 x 60 cm. The trial was established according to a randomized complete block design with 3 replications, with 10 plants per replication. Seedling planting was done on May 3, 2018, at the Edirne location and on May 5, 2018, at the Kırklareli location.

During the plant development period, two irrigations were applied at the Kırklareli location and one at the Edirne location. Weed control was performed by hand as needed. Plants were sprayed twice against aphids. Harvest and seed separation operations were done manually.

To determine the performance of the genotypes in the trial, the following characters were examined: vine length, number of seeds per fruit, thousand seed weight, seed length, seed width, and seed yield.

3. RESULTS AND DISCUSSION

In this study, the performance of some F~1~ hybrid confectionery pumpkin (*Cucurbita pepo* L.) genotypes was investigated for certain characteristics. The results obtained from the study conducted at two different locations are given below.

3.1. Vine Length

The results of variance analysis showed statistically significant differences among genotypes for vine length in both Edirne and Kırklareli locations, as well as in the combined analysis across locations. At the Edirne location, the hybrids K7-36 x TGK-9, TGK-3 x TGK-9, and TGK-5 x TGK-13 F_1 hybrids gave the highest vine lengths of 325 cm, 273 cm, and 235 cm, respectively. At the Kırklareli location, the TGK-17 x TGK-9 F_1 hybrid gave the highest vine length with 250 cm. On the other hand, the lowest vine length at the Kırklareli location was given by the K7-36 x K7-37 F_1 hybrid at 81 cm. In the combined analysis of both locations, the highest vine length was obtained from TGK-3x TGK-9 F_1 hybrid with 273 cm ıt was

followed by TGK-14 X TGK-9 F_1 hybrid with 256 cm and TGK-5 X TGK-13 F_1 hybrid with 249,8 cm, while the shortest vine length was obtained from TGK-11 x TGK-17 F_1 hybrid with 87,67 cm (Table 1).

Vine length is important for determining the number of plants to be planted per decare and for ease of inter-row cultivation during maintenance operations. Local cultivars are typically of the vining type with long vines, while newly developed hybrid genotypes are generally bush or semi-bush types with short or medium vine lengths. As can be seen from Table 1, there are candidate hybrid genotypes with short and medium vine lengths. Previous study Beşer et al. (2020) found vine length ranged from 58.33 - 339.66 cm, which is smiliar of this study.

3.2. Number of Fruits per Plant

The results of variance analysis showed statistically significant differences among genotypes for the number of fruits per plant in both Edirne and Kırklareli locations, as well as in the combined analysis across locations. At the Edirne location, the highest number of fruits per plant was given by the TGK-5 x TGK-7 F_1 hybrid with 2.93 fruits per plant, followed by TGK-14 x TGK-9 and TGK-5 X TGK-7 F_1 hybrids with 2.84 and 2.82 fruits per plant, respectively. On the other hand, the lowest number of fruits per plant at the Edirne location were obtained from Çağlayan, Mertbey, and TGK-17 x TGK-9 F_1 hybrids with 1.44, 1.50, and 1.50 fruits per plant, respectively.

At the Kırklareli location, the highest number of fruits per plant were obtained from TGK-13 x TGK-14 F_1 and TGK-11 x TGK-12 F_1 hybrids with 3.00 and 3.04 fruits per plant, respectively, followed by the TGK-11 x TGK-17 F_1 hybrid with 2.75 fruits per plant. On the other hand, the lowest number of fruits per plant at the Kırklareli location were from the Çağlayan and Senahanım control cultivars with 1.14 and 1.18 fruits per plant, respectively.

In the combined analysis across locations, the highest number of fruits per plant was given by the TGK-13 x TGK-14 hybrid with 2.92 fruits. This was followed by TGK-14 x TGK-9 and TGK-11 x TGK-12 F_1 hybrids with 2.68 and 2.70, respectively. On the other hand, the lowest number of fruits per plant in the combined analysis was from the Çağlayan control cultivar with 1.29 fruits per plant, followed by the Mertbey cultivar with 1.60 fruits per plant (Table 1).

The control cultivars used in the trial, Çağlayan, Mertbey, and Senahanım, gave averages of 1.29, 1.60, and 1.85 fruits per plant, respectively, across both locations. Most of the candidate F_1 hybrids used in the trial had a higher number of fruits per plant than all three control cultivars.

The number of fruits per plant is an important yield-related characteristic in confectionery pumpkin. The number of fruits per plant also varies with planting density and management. In this study, the highest number of fruits per plant across both locations was obtained from the TGK-13 x TGK-14 F_1 hybrid at 2.92 fruits, while a study by Turgut (2015) reported this value reached 4.40 in the 'Tortum' cultivar. Seymen (2020) found the number of fruits per plant ranged from 1.00 - 2.50, which is partially consistent with the data from this study.

3.3. Number of Seeds per Fruit

The results of variance analysis showed statistically significant differences among genotypes for the number of seeds per fruit in both Edirne and Kırklareli locations, as well as in the combined analysis across locations.

At the Edirne location, the highest number of seeds per fruit was given by the TGK-11 x TGK-17 F_1 hybrid with 505 seeds per fruit. On the other hand, the lowest number of seeds per fruit at the Edirne location was from the Mertbey control cultivar with 319.3 seeds per fruit.

At the Kırklareli location, the highest number of seeds per fruit was given by the K7-36 x TGK-17 F1 hybrid with 506.3 seeds, followed by the TGK-17 x TGK-9 F_1 hybrid with 473.3 seeds. On the other hand, the lowest number of seeds per fruit at the Kırklareli location was from the Mertbey cultivar with 299 seeds.

In the combined analysis across locations, the highest number of seeds per fruit was given by the K7-36 x TGK-17 F_1 hybrid with 459.1 seeds per fruit. This was followed by the TGK-11 x TGK -9 F_1 hybrid with 450.8 seeds. On the other hand, the lowest number of seeds per fruit in the combined analysis was from the Mertbey cultivar with 309.1 seeds. The control cultivars used in the trial, Mertbey, Çağlayan, and Senahanım, had average numbers of seeds per fruit across both locations of 309.1, 376.8, and 428 seeds, respectively. In contrast, the K7-36 x TGK-17 F_1 hybrid had a higher number of seeds per fruit (459.1) than the three control cultivars (Table 1).

The general rule for yield is (number of fruits per square meter) x (number of seeds per fruit) x (thousand seed weight). Therefore, the higher the number of seeds per fruit, and the higher the number of fruits per unit area and the thousand seed weight, the higher the yield proportionally. For this reason, the number of seeds per fruit is an important yield component recognized by producers. When evaluating the yield of the K7-36 x K7-37 F_1 hybrid, it was found to be a promising hybrid with its high number of seeds per fruit and performed well in both locations. Many of the candidate genotypes we used in the trial had a higher number of seeds per fruit than the control cultivars used. In studies related to the number of seeds per fruit, Beşer et al. (2020) determined a range of 172.00 - 498.00 seeds. It was found that the present study partially aligns with the data from Beşer et al. (2020).

Table1. Some agronomic values of genotype studied

Line/Variety	Characters		
	Kol Uzunluğu (cm)	Bitki Başına Meyve Sayısı (Adet)	Meyvede Tohum Sayısı (Adet)
Mertbey (K)	151.8 i	1,6 l	309,1 h
Çağlayan (K)	95,0 l	1,29 m	376,8 e-g
Senahanım (K)	137.7 j	1,85 jk	428 a-d
Tgk-12 X Tgk-17	126.7 k	2,32 e-h	411,5 a-f
Tgk-12 X Tgk-7	162.8 h	2,35 d-g	415,6 a-f
Tgk-5 X Tgk-13	249.8 b	1,98 jk	431,6 a-d
Tgk-14 X Tgk-9	256 b	2,68 ab	383,5 d-g
Tgk-3 X Tgk-9	265 a	2,25 g-i	369,6 fg
K7-36 X Tgk-9	223.2 df	2,08 h-j	394,5 c-g
Tgk- 5 X Tgk-10	150.3 i	1,93 jk	355,5 gh
Tgk-12 X Tgk-9	124.3 k	2,39 c-g	419,1 a-f
Tgk-5 X Tgk-9	175 g	1,94 jk	394,8 c-g
Tgk-13 X Tgk-14	216.3 e	2,92 a	395 c-g
Tgk-11 X Tgk-12	120.8 k	2,7 ab	406,5 a-f
Tgk-5 X Tgk-7	226.3 cd	2,56 b-e	426,1 a-e
Tgk-11 X Tgk-17	87.67 m	2,6 bc	442,3 a-c
Tgk-11 X Tgk-7	125.7 k	2,01 i-k	410,3 a-f
Tgk-8 X Tgk-5	195.5 f	2,26 f-h	426,1 a-e
Tgk-11 X Tgk-6	96.33 l	2,59 b-d	383,1 d-g
Tgk-11 X Tgk-9	233.5 c	2,41 c-g	450,8 ab
K7-36 X K7-37	193.7 f	2,49 b-f	411 a-f
TGK-17 x TGK-9	228.8 cd	1,77 kl	427,6 a-b
K7-36 x TGK-17	162 h	1,98 jk	459,1 a

Means not sharing the letter similar differ significantly
Values are means of two years

3.4. Thousand Seed Weight

The results of variance analysis showed statistically significant differences among genotypes for thousand seed weight in both Edirne and Kırklareli locations. Differences were also observed among genotypes for thousand seed weight in the combined analysis of both locations.

At the Edirne location, the highest thousand seed weights were obtained from TGK-12 x TGK-17, K7-36 X K7-37, and K7-36 X TGK-17 F_1 hybrids with 273.8 g, 273.7 g, and 273.7 g, respectively. On the other hand, the lowest thousand seed weights at the Edirne location were from TGK-12 X TGK-7, TGK-11 X TGK-6, and TGK-11 X TGK-12 F_1 hybrids with 172.2 g, 172.2 g, and 173.0 g, respectively.

At the Kırklareli location, the highest thousand seed weight was from the Senahanım cultivar with 255.2 g, followed by the TGK-12 X TGK-17 F_1 hybrid with 241.0 g and the TGK-5 X TGK-7 F_1 hybrid with 239.3 g. On the other hand, the lowest thousand seed weight at the Kırklareli location was from the TGK-12 X TGK-7 F_1 hybrid with 152.7 g, followed by the TGK-5 X TGK-10 F_1 hybrid hybrid with 168.5 g.

In the combined analysis, the highest thousand seed weight was from the TGK-12 X TGK-17 F_1 hybrid with 257.4 g. This was followed by the K7-36 X TGK-17 F_1 hybrid with 251.8 g. On the other hand, the lowest thousand seed weight in the combined analysis was from the TGK-12 x TGK-7 F_1 hybrid with 162.4 g (Table 2).

At the Edirne location, the average of the control cultivars was 237.4 g, while the average of the candidate hybrid genotypes was 225.9 g. The hybrid genotypes TGK-12 X TGK-17, TGK-14 x TGK-9, TGK-3 x TGK-9, K7-36 x TGK-9, TGK-5 x TGK-9, TGK-8 x TGK-5, K7-36 x K7-37, K6-2 x TGK-9, TGK-17 x TGK-9, and K7-36 x TGK-17 had higher thousand seed weight than the check cultivar average.

At the Kırklareli location, the average thousand seed weight of the control cultivars was 230.8 g, while that of the hybrid F_1 hybrid genotypes was 201.1 g. The hybrid genotypes TGK-12 X TGK-17 and TGK-5 x TGK-7 had higher thousand seed weights than the cultivar average. The average for the Edirne location was 227.4 g, while it was 205.0 g for the Kırklareli location. The average across both locations was 216.2 g.

The control cultivars used in the trial, Mertbey, Çağlayan, and Senanım, had thousand seed weights of 228.5 g, 235.3 g, and 238.4 g, respectively, across both locations. In confectionery pumpkin in Türkiye, thousand seed weight and seed size are considered important quality criteria, and generally, larger seeds find buyers at higher prices. In our research, the hybrids TGK-12 x TGK-17, K7-36 x K7-37, and TGK-17 x TGK-9 F_1 hybrids had higher thousand seed weights than the Senahanım cultivar, which had the highest weight among check varieties, making them candidate genotypes with better quality (Table 2).

Seymen (2010) obtained the highest thousand seed weight of 332 g from line number 27 in his research. In our research, the highest thousand seed weight was 257.4 g from the TGK-12 x TGK-17 F_1 hybrid.

3.5. Seed Length

The results of variance analysis showed statistically significant differences among genotypes for seed length in both Edirne and Kırklareli locations, as well as in the combined analysis across locations.

At the Edirne location, the highest seed length was from the K7-36 x TGK-17 F_1 hybrid hybrid with 25.03 mm, followed by the TGK-17 x TGK-9 F_1 hybrid with 24.49 mm. On the other hand, the shortest seed lengths at the Edirne location were from the TGK-11 x TGK-6 and TGK-13 x TGK-14 F_1 hybrids with 17.73 mm and 17.76 mm, respectively.

At the Kırklareli location, the highest seed length was from the TGK-17 x TGK-9 F_1 hybrid with 23.61 mm, followed by the Senahanım cultivar with 23.11 mm. On the other hand,

the shortest seed length at the Kırklareli location was from the TGK-11 x TGK-12 F_1 hybrid with 17.38 mm. This was followed by the TGK-13 x TGK-14 and TGK-11 x TGK-7 F_1 hybrid with 17.70 mm and 17.71 mm, respectively.

In the combined analysis across locations, the highest seed length was from the TGK-17 x TGK-9 F_1 hybrid with 24.05 mm. This was followed by the Mertbey cultivar with 22.87 mm. On the other hand, the lowest seed length in the combined analysis was from the TGK-13 x TGK-14 F_1 hybrid with 17.73 mm (Table 2).

The control cultivars used in the trial, Çağlayan, Senahanım, and Mertbey, had average seed lengths across both locations of 21.95 mm, 22.33 mm, and 22.87 mm, respectively. On the other hand, the TGK-17 x TGK-9 F_1 hybrid hybrid had a higher seed length (24.05 mm) than the three control cultivars seed length.

In Türkiye, seed size is considered an important quality characteristic, and generally, larger seeds find buyers at higher prices. Especially in cultivars recognized as the 'Ürgüp Sivrisi' type, seed length is the most important quality characteristic. In our research, the TGK-17 x TGK-9 F_1 hybrid, which had the highest seed length, was found to be a promising hybrid of the 'Ürgüp Sivrisi' type in terms of quality due to its high seed length value and performed well in both locations.

When examining some studies, Seymen (2020) found seed length to be 15.62 - 23.68 mm, Beşer et al. (2020) found 15.65 - 22.68 mm, and Evci et al. (2012) found 17.5 - 23.0 mm. The findings of this study were fully consistent with Evci et al. (2012), and partially consistent with Seymen (2020) and Beşer et al. (2020).

3.6. Seed Width

The results of variance analysis showed statistically significant differences among the genotypes in the trial for seed width in both Edirne and Kırklareli locations and in the combined analysis of both locations.

At the Edirne location, the highest seed width was from the TGK-12 x TGK-17 F_1 hybrid with 11.42 mm, followed by the TGK-11 X TGK-6 F_1 hybrid with 11.30 mm. On the other hand, the lowest seed width at the Edirne location was from the TGK-5 x TGK-13 hybrid with 9.72 mm.

At the Kırklareli location, the highest seed width of 11.5 mm was obtained from the Sena Hanım cultivar, followed by the Çağlayan cultivar with 10.99 mm and the TGK-11 X TGK-6 F_1 hybrid with 10.93 mm. On the other hand, the lowest seed widths at the Kırklareli location were from the TGK-5 x TGK-10 and TGK-5 x TGK-9 F_1 hybrids with 9.36 mm and 9.40 mm, respectively.

In the combined analysis across locations, the highest seed width was from the Senahanım cultivar with 11.33 mm. This was followed by the TGK-11 x TGK-6 F_1 hybrid with 11.11 mm. On the other hand, the lowest seed widths in the combined analysis were from the TGK-5 x TGK-13, TGK-5 x TGK-10, TGK-5 x TGK-7, and TGK-8 x TGK-5 F_1 hybrids with 9.82 mm, 9.85 mm, 9.85 mm, and 9.84 mm, respectively (Table 2).

The control cultivars used in the trial, Mertbey, Çağlayan, and Sehanım, had average seed widths across both locations of 10.38 mm, 11.01 mm, and 11.33 mm, respectively. The Sena Hanım cultivar with 11.33 mm had the highest value in the combined location averages, and the closest value to this was obtained from the TGK-11 x TGK-6 F_1 hybrid.

Beşer *et al*. (2020) determined seed width to range from 7.99 - 11.58 mm in their study. This study's data on seed width were found to be fully consistent. *Evci et al*. (2012) determined seed width to range from 8.8 - 12.5 mm in their study, which was found to be fully consistent with the data from this study. Seymen (2020) determined seed width to range from 8.33 - 13.15 mm in his study, which was found to be fully consistent with the data from this study.

3.7. Seed Yield

The results of variance analysis showed statistically significant differences among genotypes for plot yield in both Edirne and Kırklareli locations and in the combined analysis of both locations.

At the Edirne location, the highest seed yield was from the TGK-12 x TGK-9 F_1 hybrid with 254.3 kg/da. On the other hand, the lowest seed yields at the Edirne location were from the TGK-17 x TGK-9 and TGK-5 x TGK-10 F_1 hybrid hybrids with 118 kg/da and 121 kg/da, respectively.

At the Kırklareli location, the highest seed yields were from the K7-36 x K7-37, TGK-13 x TGK-14, and TGK-12 x TGK-9 genotypes with 238.3 kg/da, 234.7 kg/da, and 232.3 kg/da, respectively, followed by the Senahanım cultivar with 231.3 kg/da. On the other hand, the lowest plot yield at the Kırklareli location was from the TGK-5 x TGK-10 F_1 hybrid with 111.7 kg/da, followed by the TGK-5 x TGK-9 F_1 hybrid with 121.3 kg/da.

Table 2. Some quality values of genotypes studied

Line/Variety	Characters			
	Thousand Seed Weight (g)	Seed leght (mm)	Seed width (mm)	Seed yield kg/ha
Mertbey (K)	228,5 de	22,87 b	10,38 d-h	160,1 g-i
Çağlayan (K)	235,3 cd	21,95 cd	11,01 a-c	200,1 de
Senahanım (K)	238,4 b-d	22,33 bc	11,33 a	239,3 a
Tgk-12 X Tgk-17	257,4 a	20,43 e-h	11,05 a-c	230,8 ab
Tgk-12 X Tgk-7	162,4 n	18,83 i	10,18 d-h	198 de
Tgk-5 X Tgk-13	188,5 k-m	19,85 gh	9,82 h	181,6 ef
Tgk-14 X Tgk-9	228,1 de	20,29 e-h	10,58 b-e	202 cd
Tgk-3 X Tgk-9	235,1 cd	22,02 b-d	9,88 g-h	149 h-j
K7-36 X Tgk-9	225,8 de	20,60 e-h	10,37 d-h	228,6 ab
Tgk- 5 X Tgk-10	196,9 i-l	20,12 f-h	9,85 h	116,3 l
Tgk-12 X Tgk-9	226,2 de	20,11 f-h	10,27 d-h	243,3 a
Tgk-5 X Tgk-9	223,4 d-f	22,32 bc	9,92 f-h	128 kl
Tgk-13 X Tgk-14	192,5 j-l	17,73 j	9,98 e-h	241 a
Tgk-11 X Tgk-12	176 mn	18,77 i	10,49 c-f	171,1 fg
Tgk-5 X Tgk-7	218,8 e-g	20,89 ef	9,85 h	204,6 cd
Tgk-11 X Tgk-17	216,4 e-h	20,72 e-g	10,61 b-d	165,5 f-h
Tgk-11 X Tgk-7	209,4 f-i	19,74 h	10,61 b-d	142,1 i-k
Tgk-8 X Tgk-5	206,5 g-j	20,32 e-h	9,84 h	219,5 bc
Tgk-11 X Tgk-6	183,5 lm	19,87 gh	11,11 ab	206,8 cd
Tgk-11 X Tgk-9	202 h-k	22,30 bc	10,74 a-d	220 bc
K7-36 X K7-37	223,9 d-f	21,14 de	10,73 a-d	245,5 a
TGK-17 x TGK-9	245 a-c	24,05 a	10,46 c-g	133,5 j-l
K7-36 x TGK-17	251,8 ab	22,52 bc	10,61 b-d	145,1 i-k

Means not sharing the letter similar differ significantly
Values are means of two years

In the combined analysis across locations, the highest plot yields were obtained from genotypes K7-36 x K7-37, TGK-12 x TGK-9, TGK-13 x TGK-14, and Senahanım with 245.5 kg/da, 243.3 kg/da, 241.0 kg/da, and 239.3 kg/da, respectively. These were followed by the TGK-12 X TGK-17 and K7-36 x TGK-9 F_1 hybrids with 230.8 kg/da and 228.6 kg/da, respectively. On the other hand, the lowest plot yield in the combined analysis was from the TGK-5 x TGK-10 F_1 hybrid genotype with 116.3 kg/da.

The control cultivars used in the trial, Mertbey, Çağlayan, and Sehanım, had average seed yields across both locations of 160.1 kg/da, 200.1 kg/da, and 239.3 kg/da, respectively. On the other hand, the K7-36 x K7-37 F_1 hybrid had a higher plot yield

(245.5 kg/da) than the three control cultivars. In our research, the K7-36 x K7-37 F_1 hybrid with the highest plot yield gave 245.5 kg/da seed yield and showed good performance compared to the control cultivars.

The seed yields in this research were found to be higher in both the Edirne and Kırklareli locations than the previous study carried out at Edirne location by Evci *et al*. (2012). It was determined that the newly developed hybrid genotypes had better seed yield.

Seymen et al. (2023) found in their study that seed yield varied from 7.9 - 68.6 kg/da under non-irrigated conditions and from 92.6 - 220 kg/da under irrigated conditions. Compared to this study, the seed yield was found to be higher than Seymen *et al*.'s (2023) study under non-irrigated conditions, and partially consistent with the irrigated trial. Some hybrid genotypes performed better than the yields obtained by Seymen *et al*. (2023) under irrigated conditions. This is thought to be due to the high genetic yield potential of the studied lines, in addition to environmental conditions.

4. CONCLUSION

In confectionery pumpkin, the economically important characteristics are quality traits and yield per unit area. Looking at the performance of the candidate F_1 hybrid genotypes, in terms of thousand seed weight, the TGK-12 x TGK-17 F_1 hybrid genotype had the highest thousand seed weight across both locations at 257.4 g, followed by the K7-36 x TGK-17 F_1 hybrid genotype at 251.8 g. In terms of seed length, the TGK-17 x TGK-9 F_1 hybrid genotype had the greatest seed length across both locations at 24.05 mm, followed by the Mertbey cultivar at 22.87 mm. In terms of seed width, the Senahanım cultivar had the highest seed width across both locations at 11.33 mm, followed by the TGK-11 x TGK-6 F_1 hybrid genotype at 11.11 mm. In terms of seed yield, based on the average of both locations, the highest seed yields were obtained from K7-36 x K7-37, TGK-12 x TGK-9, TGK-13 x TGK-14, and Senahanım with 245.5 kg/da, 243.3 kg/da, 241.0 kg/da, and 239.3 kg/da, respectively. There are higher yielding candidate F_1 hybrids than the best check variety Senahanım used in this experiment.

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