PROCEEDINGS OF IV. INTERNATIONAL EDIBLE & OIL SEEDS CONGRESS EDIBOIL 2026

8-9 September 2026

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 was in 8-9 September 2026 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 gathered scientists from around the world. There were 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.

The 4th congress gathered scientists from around the world and presented their recent achievements. There are 10 orals and 4 poster presentations in the congress both joining and presenting normal and online with participants from 7 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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DATE PALM SEEDS: TRADITIONAL USES AND EMERGING APPLICATIONS FOR SUSTAINABLE AGRICULTURE AND HEALTH

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ABSTRACT

Date palm (Phoenix dactylifera L., Arecaceae) seeds are an important source of genetic diversity and have traditionally been used for the sexual propagation of date palm varieties. They also represent a valuable genetic resource for breeding programs aimed at developing new cultivars with improved agronomic performance, disease resistance, fruit quality and play an important role in the restoration of palm groves affected by Bayoud disease (Fusarium oxysporum) through the direct cultivation of seeds from the resistant cultivar 'Takerbucht'. Appropriate seed treatment before sowing can improve germination, seedling establishment, increase propagation success for date production, and reduce disease incidence. The use of resistant genetic material represents an effective strategy for restoring degraded oases while preserving local genetic resources and reinforcing the resilience of date palm agroecosystems. In addition, date palm seeds are a valuable source of bioactive compounds, including phenolics and flavonoids, with antioxidant, anti-inflammatory, and antimicrobial properties, making them promising ingredients for natural wound-healing creams and other pharmaceutical or cosmetic products. This study highlights their diverse applications and their potential contribution to sustainable agriculture and environmental restoration. A survey of seed uses showed that 62% are utilized as livestock feed supplements because of their high nutritional value, particularly as a coffee substitute. Other applications include soil fertilization through compost enrichment (15%), therapeutic, industrial, and cosmetic uses (12%), and the production of handicrafts (8%). These diverse uses illustrate the considerable economic potential of date palm seeds, which remain largely underutilized despite their abundance in date-producing regions. Overall, the wide range of applications of date palm seeds demonstrates their economic, agricultural, and ecological importance, while emphasizing their potential for enhancing date palm agrobiodiversity, supporting ecosystem restoration, and promoting the sustainable valorization of this underutilized by-product.

Key words: Date palm, seeds, bioactive compounds, cream

PRATOLOGICAL ASSESS OF GRAMINEOUS, LEGUMES AND THEIR MIXTURE MEADOWS

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ABSTRACT

The aim of the study was to analyses the pratologycal reliability of cultivated meadows with legumes, gramineous and its mixtures. The analysis was carried out regarding 3 fodder structures: V1 alfalfa (αα), V2 mixture of gramineous (G), respectively V3 mixture of gramineous and alfalfa. (Gα) The germination capacity and the share of spontaneous flora were analysed. Also, based on Braun Blanchet scales (BB), the abundance (A) and dominance (D) of botanical structures in the culture were determined. Alfalfa showed a good emergence (87%) with a 13% share of spontaneous flora. This characteristic was maintained in the dominant form also in the Gα ($p \leq 0.05$). The G proved to be uniform in germination, with no dominance abilities between species ($p > 0.05$). The BB analysis highlighted a good A but an initially average D of αα. The G had a reduced A ($p \leq 0.05$) while D was comparable to αα ($p > 0.05$). The presence of αα in G increases D ($p \leq 0.05$) compared to that associated with pure G. In conclusion, we can say that the meadows cultivated with G show an initially good agro technical dynamic on BB scale, which can be accentuated by including αα in the mixture. Thus, the production of biomass could be increased, the quality of the soil could be improved, the soil reserves could be used judiciously and, last but not least, the carbon footprint of crops could be reduced, which is one of the most important goal of farmers, in order to fit in the law requirement and increase the farm efficacy.

Key words: gramineous, legumes, meadows, mixture, pratologic assessment

INTEGRATED WEED MANAGEMENT STRATEGIES FOR SUSTAINABLE SUNFLOWER PRODUCTION

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ABSTRACT

Weeds are among the main constrains on sunflower producing. The control of broadleaf weeds, including parasitic plant *Orobanche cumana* and weedy sunflower, are more difficult comparing to the control of grass weeds. Herbicide-resistant weeds and invasive alien plants are contributing to increase weed problem as well. Historically, control of broadleaf weeds was the problem due to lack of proper herbicides, although parasitic weed problem was solved using broomrape resistant hybrids. CL (Clearfield) and CLP (Clearfield plus) sunflower hybrids have been used together with imazamox to control many weed species including broomrape. Another technology, based on hybrids tolerant to tribenuron-methyl, is used extensively for broadleaf weed control, with the hybrids also being resistant to broomrape. These technologies are based on the frequent use of herbicides with the same mechanism of action, which leads to increased selection pressure followed by the development of herbicide-resistant weeds. The latest, the so-called A.I.R. production system, enables the application of imidazolinones and tribenuron-methyl, and will increase the risk of developing weed resistance to these ALS inhibitors, regardless of the evident but small progress in weed control. In addition to ALS inhibitors in tolerant sunflower hybrids, it is desirable to include herbicides with a different mechanism of action, such as pendimethalin, aclonifen, terbuthylazine, metobromuron and diflufenican and some combinations thereof. Also, a special advance in post-emergence control of broadleaf weeds and anti-resistance strategies is the introduction of a new selective herbicide for all sunflower hybrids - halauxifen-methyl from the group of synthetic auxins. Fallow, crop rotation, tillage, hoeing/interrow tillage, false seedbeds, cover crops can be mentioned among the non-chemical methods of weed control, which to some extent have disadvantages. For example, fallow is not economical, cover crops are difficult to apply, and tillage contributes to carbon emissions. However, properly selected and combined non-chemical measures must be included to ensure sustainable sunflower production. In addition, introduction of AI supported smart farming techniques into sunflower production may decrease unnecessary herbicide consumption.

Key words: Integrated weed management, sunflower, Broomrape, CL (Clearfield), Imazoamox, tribenuron-methyl

HISTORY OF DEVELOPING HERBICIDE RESISTANT DOMESTIC SUNFLOWER

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ABSTRACT

The history of developing herbicide resistant domesticated sunflower started in 1996 when acetolactate synthase (ALS) resistant common sunflower (wild *Helianthus annuus*) was discovered in a soybean field near Topeka Kansas. Research conducted at Kansas State University showed that the resistant mechanism showed that the imazethapyr- resistant biotype of common sunflower was approximately 170 times more resistant to imazethapyr than the susceptible biotype based on the rate required for 25% control. Resistance was due to altered acetolactate synthase (ALS) that is less sensitive to imazethapyr. The imazethapyr concentration required to inhibit in vitro ALS activity by 25% was 210-fold higher in the resistant biotype than in the susceptible biotype. Differences in absorption, translocation, and metabolism of imazethapyr in common sunflower biotypes were not sufficient to explain the resistance to imazethapyr. The imazethapyr resistant common sunflower was also resistant to all imidazoline and sulfonylurea herbicides but not triazolopyridines. The discovery of a wild sunflower population resistant to the imidazolinone (IMI) and sulfonyl urea (SU) class of herbicides has caused excitement among the sunflower industry. Immediately after this discovery, a research project by Jerry Miller of USDA and Kassim Al-Khatib of Kansas State University was initiated to transfer herbicide resistant factors from the wild population to USDA cultivated sunflower inbred lines. Techniques of embryo culture were utilized to advance plants to the BC2F6 generation. Plants were treated with imazethapyr and imazamox to identify resistant plants. Hybrids were produced by crossing resistant female and male lines, as well as resistant female by susceptible male lines, and susceptible female by resistant male lines, to study the dominance of the herbicide resistant characteristic. Hybrids produced by crossing a resistant parent with a susceptible parent were intermediate in resistance compared to hybrids produced by crossing two resistant parents. Herbicide resistance is controlled by partial dominance or controlled additively. Several germplasm populations and lines have been released by USDA-ARS to industry and public researchers. However, initially chemical companies were reluctant to register ALS-inhibiting compounds on ALS-resistance domestic sunflower. They were concerned that resistant traits would move to susceptible wild sunflowers creating a weed management problem in multiple crops. Domesticate sunflowers can successfully and easily hybridize with wild relatives with no strong barriers to prevent hybridization where flowering of domesticated and wild sunflowers occurs sympatrically. There were also concerns regarding gene flow of the IMI-resistance trait to wild species that causing fitness advantages and possible accompanying ecological consequences. Hybrids of domesticated sunflower with both common sunflower and prairie sunflower were created, with and without the ALS-resistance trait. The relative fitness of ALS-resistant hybrids was compared with their susceptible (IMI-S) counterparts. Greenhouse experiments were conducted to study the growth of resistant and susceptible common and prairie sunflower hybrids under noncompetitive conditions. The photosynthesis rate of ALS-susceptible prairie sunflowers was slightly higher than that of resistant plants. However, relative growth rate, net assimilation rate, leaf area, and total dry weight were similar in resistant and susceptible common and prairie sunflower. A replacement series study was conducted under field conditions to evaluate the

relative competitiveness of susceptible and resistant common and prairie sunflowers showed hybrids of both sunflower species were equally competitive. The results suggest that, in the absence of ALS-inhibiting herbicides, genes controlling resistance to ALS-inhibiting herbicides do not reduce or increase the competitive ability of either common or prairie sunflowers. Therefore, if the resistant trait is incorporated in these species, the frequency of resistance genes is unlikely to decrease, even in the absence of herbicide selection pressure. In a separate study, gene flow from imidazolinone (IMI)-resistant domestic sunflower to IMI-susceptible common sunflower and prairie sunflower was studied. Under greenhouse conditions, pollen from IMI-resistant domesticated sunflowers was applied to flower heads of IMI-susceptible common and prairie sunflower. In addition, field studies were conducted in 2000 and 2001 near Manhattan, KS, to evaluate IMI-resistant gene flow from IMI-resistant domesticated sunflower to common and prairie sunflower under natural conditions. Common and prairie sunflower were planted in concentric circles at distances of 2.5, 5, 15, and 30 m around a densely planted IMI-resistant domesticated sunflower species. For both greenhouse and field studies, IMI-resistant gene flow was determined by treating the progeny of both wild species with imazamox. Greenhouse crosses made by hand showed that 94% of common sunflowers and 79% of prairie sunflowers were resistant or moderately resistant. The resistant plants were allowed to grow in the greenhouse and were backcrossed with the corresponding susceptible wild parents. Progeny of the backcross showed a 1:1 ratio of resistance to susceptible plants. In the field, gene flow was detected up to 30 m from the pollen source for both species, and it decreased as distance from the pollen source increased. In 2000, 11 to 22% of the progeny were resistant at 2.5 m from the pollen source and 0.3 to 5% were resistant at 30 m. In 2001, the number of resistant progenies did not exceed 7 and 2% at 2.5 and 30 m from the pollen source, respectively. The results of this study showed that IMI-resistant domesticated sunflower outcrosses with common and prairie sunflowers over distances typically encountered near production fields. Also, backcrosses of resistant hybrids with wild parents are successful, further increasing the potential for the spread of IMI-resistant feral sunflowers. Despite the initial difficulties commercializing ALS-resistant sunflowers, today the majority (estimated between 70% and over 90%) of commercial cultivated sunflowers grown in major markets are herbicide-resistant.

Key words: Sunflower, Herbicide Resistance, Wild Helianthus, imidazolinone (IMI), sulfonyl urea (SU), Backross breeding

IMPACT OF ENVIRONMENTAL STRESSES ON THE PHYSIOLOGY OF EDIBLE AND OILSEED CROPS: STRATEGIES FOR VARIETAL IMPROVEMENT

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ABSTRACT

Edible and oilseed crops are major sources of proteins, lipids, vitamins, and dietary fibers for human and animal nutrition. Their yield and quality are strongly affected by abiotic stresses, such as drought, salinity, temperature fluctuations, and nutrient deficiencies, which disrupt plant physiology and metabolism. This study focuses on analyzing the physiological and biochemical responses of plants to these constraints, examining photosynthesis, stomatal regulation, osmolyte accumulation, antioxidant enzyme activity, and induced tolerance mechanisms. Identifying these adaptive traits is essential for plant breeding programs aimed at developing resistant and productive varieties of edible and oilseed crops. Integrating physiological and molecular data allows optimization of plant growth, maintenance of seed quality, and improved productivity under adverse environmental conditions. This approach also contributes to global food security and the sustainability of agricultural systems, especially in the context of climate change and the increasing demand for plant-based proteins. Participation in this congress offers the opportunity to present these findings, engage with researchers and industry professionals, and foster interdisciplinary collaboration. Such discussions will strengthen crop improvement strategies and promote the sharing of knowledge on key physiological and biological mechanisms essential for plant adaptation to environmental constraints.

Key words: Plant physiology, Abiotic stress, Oilseed crops, Edible crops, Stress tolerance, Plant breeding, Sustainable productivity, Plant biology, Crop improvement.

PHYSIOLOGICAL AND BIOCHEMICAL MECHANISMS OF EDIBLE AND OILSEED CROPS IN RESPONSE TO ENVIRONMENTAL STRESSES

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ABSTRACT

Edible and oilseed crops play a crucial role in human and animal nutrition due to their high content of proteins, lipids, vitamins, and dietary fibers. However, their yield and quality are strongly limited by abiotic stresses, such as drought, salinity, extreme temperatures, and nutrient deficiencies. This study explores the physiological and biochemical mechanisms that enable plants to tolerate these adverse conditions, focusing on photosynthesis, stomatal regulation, osmolyte synthesis, antioxidant enzyme activity, and induced adaptation strategies. Identifying these adaptive traits is essential for plant breeding programs aimed at developing more resistant and productive varieties capable of maintaining yield and quality under environmental constraints. Integrating these physiological and biochemical insights into varietal selection contributes to the sustainable improvement of crops, food security, and the resilience of agricultural systems in the context of climate change. Participation in this congress will provide the opportunity to present these findings, share best practices, and foster interdisciplinary collaborations among researchers, breeders, and industry stakeholders. Such scientific exchanges are essential to strengthen strategies for the improvement of edible and oilseed crops and to better understand the key physiological mechanisms that enable plants to adapt to environmental challenges.

Key words: Plant physiology, Abiotic stress, Oilseed crops, Edible crops, Stress tolerance, Plant breeding, Sustainable productivity, Plant adaptation.

RESILIENCE OF EDIBLE AND OILSEED CROPS TO ABIOTIC STRESSES: TOWARDS SUSTAINABLE AND SECURE PRODUCTION

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ABSTRACT

Edible and oilseed crops are essential for human and animal nutrition, providing proteins, lipids, vitamins, and dietary fibers. Their productivity is often affected by abiotic stresses such as drought, salinity, and extreme temperatures, which disrupt plant physiology, growth, and metabolism. This study aims to understand the resilience mechanisms of plants by examining photosynthesis, stomatal regulation, osmolyte synthesis, antioxidant enzyme activity, and induced adaptive responses. Identifying these key physiological and biochemical traits is crucial for plant breeding programs to develop varieties capable of maintaining yield and quality under adverse environmental conditions. Integrating this knowledge contributes to the sustainable improvement of crops, food security, and the resilience of agricultural systems in the context of climate change and the increasing demand for plant-based proteins. Participation in this congress will provide the opportunity to present the findings, exchange ideas with researchers and industry professionals, and foster interdisciplinary collaboration. Such discussions are essential to strengthen improvement strategies for edible and oilseed crops and to promote knowledge sharing on the physiological and biochemical mechanisms that support plant resilience.

Key words: Plant resilience, Plant physiology, Abiotic stress, Oilseed crops, Edible crops, Plant breeding, Sustainable productivity, Food security.

PHYTOCHEMICAL PROFILE OF ESSENTIAL OILS IN KEFE CUMIN (Laser trilobum (L.) Borkh.)

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ABSTRACT

Kefe cumin (Laser trilobum (L.) Borkh.) is a perennial herbaceous species belonging to the Apiaceae (Umbelliferae) family. Although it is not cultivated in Türkiye, it is known to occur naturally in many regions of the country. The species is known by various regional vernacular names, including Kefe cumin, mountain cumin, sıra baharatı, and geyik sırası. As a species widely distributed throughout the flora of Türkiye, *Laser trilobum* occupies an important place in the gastronomic and ethnobotanical traditions of the regions where it naturally occurs. From a gastronomic perspective, the spice obtained by drying and grinding the fruits into a powder is widely used as a flavoring agent in meat dishes and traditional beverages, particularly in the provinces of Mersin, Adana, and Hatay. The fruits of Kefe cumin, a medicinal and aromatic plant, have been reported to be rich in mineral nutrients. The major constituents of the plant's essential oil are known to be d-limonene and perillaldehyde. These monoterpenoid compounds are responsible for the characteristic lemon-like aroma and distinctive woody odor profile of the fruits. The essential oil composition of fruit samples collected from different geographical regions has been reported to exhibit variation. Furthermore, significant differences have been reported in the proportions of essential oil constituents among different plant parts. The rich essential oil content of Kefe cumin demonstrates its considerable potential and indicates that the species is of significant economic and industrial value among medicinal and aromatic plants. In conclusion, given its rich phytochemical properties and diverse traditional uses, further scientific research is required to better understand and fully explore the potential of *Laser trilobum*.

Keywords: *Laser trilobum*, d-limonene, perillaldehyde, medicinal and aromatic plants.

INTRODUCTION

Medicinal and aromatic plants are plants that contain bioactive compounds in one, several, or all of their organs, such as leaves, stems, flowers, bulbs, tubers, and fruits (Mokhtarzadeh et al., 2023). Owing to the presence of alkaloids, terpenoids, and phenolic compounds, these plants are used in the pharmaceutical, perfumery, cosmetic, and food industries (Bayram et al., 2010). This wide range of applications has enabled medicinal and aromatic plants to occupy an important place in human history from the past to the present.

Among medicinal and aromatic plants, the Apiaceae is a large family that includes important medicinal and aromatic plants such as cumin, coriander, anise, fennel, and dill. Plants belonging to the Apiaceae family, also known as the Umbelliferae family, are frequently preferred for their use as flavoring and aromatic agents, spices, and medicinal purposes. Members of the Apiaceae family, which have been known to be used in medicine since ancient times, have

attracted the attention of researchers because they are frequently preferred as raw materials in the pharmaceutical, cosmetic, and perfumery industries (Sayed-Ahmad et al., 2017).
One of the common characteristics of species belonging to this family is their richness in essential oil content. Owing to the essential oils they contain and their compositions, the utilization potential of these plants also becomes more diverse. One of these species, *Laser trilobum* (L.) Borkh., is among the species worthy of phytochemical evaluation due to its characteristic essential oil components and traditional uses (Demir & Kan, 2025; Ferahoğlu & Kırıcı, 2023).
Laser trilobum (L.) Borkh. (Kefe cumin) and *Cuminum cyminum* L. (cultivated cumin) both belong to the Apiaceae family; however, they are distinct species belonging to different genera (*Laser* and *Cuminum*). Therefore, although the designation "Kefe cumin" may botanically suggest that this plant is a species of cultivated cumin, its relationship with cumin is limited to the family level. In addition to this botanical distinction, Kefe cumin differs from the commonly used cultivated cumin by its sharp and distinctive woody aroma. This distinction has led to promising views that, owing to its rich essential oil composition, Kefe cumin may serve as an alternative in the food industry (Demir & Kan, 2025) and may also represent a novel spice for use in gastronomy (Bayraktar, 2009).
The essential oil content and composition of plants have been reported to vary depending on geographical and genetic variation, physiological characteristics, and environmental conditions (Chizzola, 2010). The wide geographical distribution of *Laser trilobum* and its ability to grow under different ecological conditions indicate that its essential oil composition may also be influenced by these environmental differences (Ferahoğlu & Kırıcı, 2023; Bayraktar, 2009). Indeed, the literature has reported that the proportions of limonene and perillaldehyde, which are the major constituents of the essential oil, vary over a wide range in fruit samples collected from different countries and regions, particularly Türkiye, Serbia, Austria, and Iran. In addition, a limited number of studies have investigated plant organs other than the fruit (rhizome, leaf, and herba) and have observed that the essential oil composition of these organs differs qualitatively and quantitatively from that of the fruit (Ferahoğlu & Kırıcı, 2023; Drobac et al., 2017; Chizzola, 2007).
However, these findings are fragmented throughout the literature, and no comprehensive review has been found that simultaneously evaluates the effects of variables such as geographical origin (country, region, and province), altitude, and plant organ on essential oil composition. The aim of this study is to review, in light of the available literature, the differences in the essential oil content of *Laser trilobum* samples collected from different regions, countries, and provinces, as well as the variations in essential oil composition among different plant organs.

General Information About Kefe Cumin

Laser trilobum is a naturally growing perennial herbaceous species belonging to the Apiaceae family that has not been sufficiently studied (Uçan Türkmen et al., 2024). The plant is also known by names such as Kefe cumin, mountain cumin, wild cumin, and sıra cumin (Tosun, 2021). It is referred to as “sıra baharatı” and “sıra kimyonu” in the Mersin region (Bayraktar, 2009), “kemun-kamun” in Kahramanmaraş (Üstüner, 2022), and “geyik sırası” in the Hatay region (Özmen, 2010).
Laser trilobum reaches a height of 50-120 cm, has trilobed glabrous leaves, and is characterized by white umbel-type flowers. Its fruits are elliptical in shape, measuring 5-10 mm in length and 2-4 mm in width (Ferahoğlu & Kırıcı, 2023). The plant flowers in spring, and its seeds are harvested in June-July. It is known to grow in forested areas, under trees such as pine and oak, in shrublands and semi-shaded habitats, and along the edges of vineyards (Parlatan et al., 2009). Kefe cumin has been reported to grow in calcareous soils (Chizzola, 2007), and its distribution ranges from approximately 500 to 1,800 m above sea level (Bayraktar, 2009).

Geographical Distribution of Kefe Cumin

Laser trilobum grows naturally in the Turkish provinces of Zonguldak, Gümüşhane, Samsun, Bolu, İstanbul, Edirne, Bursa, Balıkesir, İzmir, Muğla, Afyon, Konya, Ankara, Sivas, Kahramanmaraş, Erzincan, Eskişehir, Adana, Hatay, Isparta, and Mersin (Parlatan, 2005). Worldwide, it is naturally distributed in countries including Iran, Lebanon, Syria, Russia, Ukraine, Germany, Hungary, Albania, Bulgaria, Greece, Italy, and Romania (Demir & Kan, 2025). This broad geographical distribution indicates that the species can naturally occur under different ecological conditions.

Traditional Uses

The seeds of Kefe cumin (*Laser trilobum*) have a wide range of uses. The seeds of the plant are ground and used in dishes, particularly meat dishes, as an aromatic spice (Drobac et al., 2017; Chizzola, 2007; Parlatan et al., 2009). It has also been reported that the leaves of the plant are used as a vegetable (Chizzola, 2007). In addition, the plant is known to be used against ailments such as abdominal pain and cramps, hypertension, and diabetes. Furthermore, the prepared tea can be applied to the skin for the treatment of acne (Parlatan et al., 2009). In addition to its use in the treatment of diseases, it has been reported to be used for purposes of supporting the immune system (Demir & Kan, 2025).

Besides the widespread use of the plant fruits, the essential oil components obtained from the plant are also known to have a wide range of applications (Drobac et al., 2017; Ferahoğlu & Kırıcı, 2023; Parlatan, 2005). d-limonene, one of the important components of the essential oil of Kefe cumin, is a monoterpene that is also found in high proportions in citrus peels. d-limonene is used as a flavoring and aroma agent in the food industry, as a perfume component in the cosmetics sector, and as a natural solvent in the cleaning industry; it also has potential for the development of antimicrobial agents and biopesticides (Demir & Kan, 2025).

Perillaldehyde, another major component obtained from Kefe cumin fruits, also has a wide range of applications. Perillaldehyde is widely used as a flavoring additive in food products to impart a spice- and citrus-like flavor (Ferahoğlu & Kırıcı, 2023). In addition, various studies have demonstrated that it exhibits high efficacy against food spoilage, particularly that caused by fungi, and that it can therefore be considered as a natural food preservative (Tian et al., 2015). Furthermore, findings indicating that the compound has antidepressant (Ji et al., 2014), antitumor (Andrae et al., 2018), and anticancer (Zielińska et al., 2021) effects suggest that *L. trilobum* may be considered an important natural source of perillaldehyde for the pharmaceutical industry.

Essential Oil Content and Major Components

Essential oils contain a complex mixture of compounds with various functional groups, which contributes to different biological activities, such as antimicrobial and antioxidant activities (Abbaszadegan et al., 2016). The biological activities of essential oils produced by aromatic plants as secondary metabolites are directly related to the types of compounds they contain, the concentrations of these compounds, and the interactions among these compounds. In addition, the major components present in plants are among the principal groups of compounds that determine the biological and sensory properties of essential oils (Bakkali et al., 2008). Determining the essential oil composition of a plant is important not only for revealing its characteristic aroma profile but also for evaluating its potential biological activity and possible areas of application.

The determination of the chemical composition of *Laser trilobum* essential oil is of interest in terms of understanding the characteristic aroma profile and biological properties of the species. Determining the chemical composition and aroma profile of the plants' essential oil will contribute to identifying the potential areas of application of *Laser trilobum*. Several studies

addressing this subject are available in the literature. Some studies on the plant have obtained samples from different locations, helping to determine whether differences in location result in variations in the essential oil, whereas other studies have focused on determining the essential oil contents of different organs of plants obtained from the same location.

When essential oil analyses conducted on samples of different origins and plant organs in the literature are examined, variable results have also been obtained in fruits collected from different provinces of Türkiye. For example, Kefe cumin fruits obtained from Mersin were found to have an essential oil content of 4.4%, and the major components of the obtained essential oil were determined as perillaldehyde at 50% and d-limonene at 45% (Ferahoğlu & Kırıcı, 2023). In contrast, although the essential oil content was lower (2.7%) in fruits obtained from Zonguldak, the dominance of perillaldehyde continued here as well (68%), while d-limonene ranked second at 24% (Meriçli & Meriçli, 1986). The essential oil content of plant herba collected from Artvin was found to be 1.2%; the major components were determined as 73% perillaldehyde, 7.6% perill alcohol, and 7.6% E-caryophyllene, while limonene was detected at a low proportion of 2% (Bayraktar, 2009).

In a study comparing seeds obtained from different countries, the essential oil contents of samples originating from Germany, India, and Türkiye were found to be 4.4%, 4.8%, and 5.8%, respectively, and perillaldehyde and d-limonene were determined as the major components in all three origins (Parlatan et al., 2009). In samples collected from Iran, plant herba was used, and the essential oil content was reported as 2.2% as a result of the analysis. The major components of the essential oil were found to be α-pinene at 34% and β-caryophyllene at 17% (Vahdat et al., 2006). This result differed from the perillaldehyde and limonene dominance observed in previous studies and suggests that variation in chemical composition may also be influenced by factors such as climate, soil structure, and harvesting period, in addition to geographical origin.

In another study, samples collected from different locations in Austria were examined separately for leaf and fruit essential oils. The major components of the essential oil obtained from the leaves were found to be α-pinene at 12% and bornyl angelate at 67%, whereas the major components of the essential oil obtained from the fruits of the same plant were determined as perillaldehyde and limonene (Chizzola, 2007).

In another study, when the essential oils of plant fruits and rhizomes obtained from Serbia were examined, α-pinene was found at a proportion of 31% as the major component of the essential oil obtained from the rhizomes, whereas this component was found at 7% in the essential oil obtained from the fruits. The second major component of the essential oil obtained from the rhizomes was γ-terpinene at 9%, whereas this compound was not detected in the essential oil obtained from the fruits. The major component of the fruit essential oil was limonene at 51%, while this compound was present at 2% in the rhizomes. The second major component of the fruit essential oil was perillaldehyde at 26%, whereas this compound was not detected in the rhizomes. In addition, although carvone was present among the components of the fruit essential oil in a small amount, this compound was not detected in the rhizomes (Drobac et al., 2017).

A similar study was also observed in samples collected from the Lakes Region, Türkiye. While the essential oil content remained quite low at 0.14% in herba samples, the major components were found to be α-pinene (33.22%) and β-pinene (24.09%). In fruits, however, the essential oil content increased to 11.37%, and the major component was dl-limonene (53.67%) (Tosun, 2021). The aforementioned studies are presented comparatively in Table 1.

Table 1. Essential oil content and major components according to different origins and plant organs

Origin/Region	Plant Organ	Essential Oil Content	Major Components	Reference
Mersin (Türkiye)	Fruit	4.4%	Perillaldehyde 50%; d-Limonene 45%	Ferahoğlu and Kırıcı, 2023
Zonguldak (Türkiye)	Fruit	2.7%	Perillaldehyde 68%; d-Limonene 24%	Meriçli and Meriçli, 1986
Artvin (Türkiye)	Herba	1.2%	Perillaldehyde 73%; Perillyl alcohol 7.6%; E-Caryophyllene 7.6%; Limonene 2%	Bayraktar, 2009
Lakes Region (Türkiye)	Herba	0.14%±0.03	α-Pinene 33.22%; β-Pinene 24.09%; d-Limonene 7.65%; β-Caryophyllene 12.53%	Tosun, 2021
Lakes Region (Türkiye)	Fruit	11.37%±0.15	α-Pinene 13.44%; d-Limonene 53.67%; Perillaldehyde 29.34%	Tosun, 2021
Germany	Seed	4.4%	Perillaldehyde and d-Limonene (Not specified)	Parlatan ve ark., 2009
India	Seed	4.8%	Perillaldehyde and d-Limonene (Not specified)	Parlatan et al., 2009
Türkiye	Seed	5.8%	Perillaldehyde and d-Limonene (Not specified)	Parlatan et al., 2009
Iran	Herba	2.2%	α-Pinene 34%; β-Caryophyllene 17%	Vahdat et al., 2006
Austria	Leaf	0.1%-0.2%	α-Pinene 12%; Bornyl angelate 67%	Chizzola, 2007
Austria	Fruit	4.0%-4.7%	Perillaldehyde and limonene (Not specified)	Chizzola, 2007
Serbia	Rhizome	Not specified	α-Pinene 31%; γ-Terpinene 9%	Drobac et al., 2017
Serbia	Fruit	6.7%	Limonene 51%; Perillaldehyde 26%; α-Pinene 7%; Carvone 0.5%	Drobac et al., 2017

CONCLUSION

The evaluation of the literature data reveals that the chemical composition of *Laser trilobum* essential oils can vary considerably depending on geographical origin and plant organ. In fruit samples, d-limonene and perillaldehyde generally predominate, whereas different compounds such as α-pinene, β-pinene, β-caryophyllene, bornyl angelate, and carvone have been found as dominant or prominent components in some herba, leaf, and rhizome samples. In particular, the emergence of different essential oil profiles in different organs of the same plant demonstrates

the importance of plant organ in determining essential oil composition. Indeed, the high proportion of bornyl angelate in the leaf essential oil of *L. trilobum* reveals a chemical profile different from the limonene and perillaldehyde that predominate in the fruits.
However, the fact that the existing studies were conducted under different geographical, ecological, and methodological conditions makes it difficult to attribute the observed differences to a single factor. For these reasons, although the studies demonstrate that the essential oil composition of *L. trilobum* varies according to geographical origin and plant organs, they also indicate the need for studies that help elucidate its relationship with cultivation conditions.

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COMPARATIVE ANTIFUNGAL EFFICACY OF TRICHODERMA SPP AND BACILLUS SPP AGAINST OLIVE ANTHRACNOSE

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ABSTRACT
The olive tree (Olea europaea L.) is a cornerstone of Mediterranean agriculture, economy, and cultural heritage. However, olive cultivation is threatened by several fungal diseases that affect tree health, fruit yield, and olive oil quality. Among these diseases, anthracnose, caused by Colletotrichum spp., is one of the most destructive pre- and post-harvest diseases in olive-growing regions worldwide. The intensive use of chemical fungicides has led to the emergence of resistant pathogen populations, emphasizing the urgent need for sustainable and biological management strategies. Microorganisms such as Trichoderma and Bacillus spp. are promising biological control agents against fungal pathogens. In this context, the present study evaluated and compared the antifungal potential of Trichoderma spp. and Bacillus spp. isolates as biocontrol agents against Colletotrichum spp. Colletotrichum spp. and a Trichoderma isolate were isolated from the same olive orchard, with the Trichoderma isolate being recovered from the olive rhizosphere. Both were identified based on their macroscopic, microscopic, and molecular characteristics. A Bacillus isolate from the laboratory culture collection was included for comparison in the antagonism assays. Dual-culture confrontation assays demonstrated strong antagonistic activity of both microbial agents against Colletotrichum spp. The Trichoderma isolate achieved a mycelial growth inhibition rate of 74.34%, while the Bacillus isolate exhibited a comparable inhibition rate of 72.31%. No statistically significant difference was observed between the two antagonists, indicating similar biocontrol efficacy against the pathogen. These findings highlight the considerable biocontrol potential of the Trichoderma isolate and support its potential application as a promising biofungicide for the sustainable management of olive anthracnose.

Key words: Olea europaea; anthracnose; Colletotrichum spp.; Trichoderma; Bacillus spp; biocontrol; mycelial growth inhibition; Morocco

INSECTICIDAL ACTIVITIES OF SELECTED PLANT EXTRACTS AGAINST DACTYLOPIUS OPUNTIAE (COCKERELL) (HEMIPTERA: DACTYLOPIIDAE) UNDER LABORATORY CONDITIONS

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ABSTRACT

Growing scientific evidence supporting the dermatological benefits of prickly pear seed oil has made it one of the most sought-after cosmetic plant oils. This increasing demand has enhanced the economic importance of prickly pear cultivation. In Morocco, the crop and the activities orbiting it play a strategic role in the socioeconomic empowerment of rural communities. However, production is severely curbed by Dactylopius opuntiae, an invasive cochineal insect responsible for extensive losses in cactus plantations and for which few environmentally sound control options exist. Therefore, significant efforts are deployed in the country to find sustainable control methods against this pest. The present study evaluated the insecticidal potential of aqueous and methanolic extracts from five plant species (Hyoscyamus niger, Datura stramonium, Nicotiana glauca, Allium sativum and Urtica spp.) as environmentally friendly alternatives to conventional insecticides. In that sense, in vitro bioassays were conducted on adult females and first-instar nymphs using different extract concentrations, using pyriproxyfen as a positive control. Abbott corrected mortality was recorded for 12 days and 48 hours for females and nymphs, respectively. Methanolic extracts consistently outperformed aqueous extracts over all plants. Methanolic extracts of the three Solanaceae species (H. niger, D. stramonium and N. glauca) , at the concentration of 75%, achieved corrected mortalities exceeding 95% in adult females by 12 days after treatment and 79 to 85% in nymphs by 48 h. Tukey's test (95% CI) confirmed that these extracts significantly surpassed pyriproxyfen in the control of nymphs while all methanolic extracts except for urticae spp. outperformed the chemical reference on females. Our results demonstrate that unpurified, unformulated plant extracts can rival or exceed a registered synthetic insecticide against both mobile and sessile stages of D. opuntiae. This work supports the integration of locally sourced botanical extracts into integrated pest management strategies against D. opuntiae, offering a sustainable path to safeguarding cactus pear orchards.

Key words: Dactylopius opuntiae, Opuntia ficus-indica, bioinsecticides, Hyoscyamus niger, Datura stramonium, Nicotiana glauca, Allium sativum, Urtica spp.

OIL RECOVERY FROM POPPY SEED CAKE BY SUPERCRITICAL FLUID EXTRACTION AND SOXHLET EXTRACTION

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ABSTRACT

Poppy seed cake, a by-product generated after cold pressing of poppy seeds for oil production, represents an underutilized by-product with significant potential for valorization. In this study, Supercritical Fluid extraction (SFE) was applied for the recovery of bioactive compounds from poppy seed cake and compared with conventional Soxhlet extraction with two different solvents (Methylene-chloride and n-Hexane). Furthermore, the SFE process was optimized using a Box–Behnken Design (BBD) considering three independent variables: extraction temperature, pressure, and CO_2 flow rate. Process parameters were CO2 flow rate (0.2, 0.3 and 0.4 kg/h), pressure (250, 325 and 400 bar) and temperature (40, 50 and 60 °C). A total of 18 experimental runs were performed, and the extraction yield as well as antioxidant activity were measured by 2,2-diphenyl-1-picrylhydrazyl (DPPH) and 2,2′-Azino-bis (3-ethylbenzothiazoline-6-sulfonic acid) diammonium salt (ABTS+) assays. The extraction yield ranged from 13.50% with the following process parameters (pressure 250 bar, temperature 50 ˚C and CO2 flow rate 0.2 kg/h) to 16.91% with the following process parameters (pressure 400 bar, temperature 50 ˚C and CO2 flow rate 0.4 kg/h). While the antioxidant activity determined by DPPH radical scavenging assay varied between 0.85 µM Trolox/g sample and 1.12 µM Trolox/g sample. The ABTS radical scavenging activity ranged from 1.49 µM Trolox/g sample to 2.30 µM Trolox/g sample. The obtained results demonstrated a significant influence of extraction parameters on both extraction efficiency and antioxidant potential of the extracts. The optimization study identified the extraction conditions that maximized the recovery of antioxidant compounds from poppy seed cake. Compared to Soxhlet extraction, SFE provided an environmentally friendly alternative with competitive extraction performance. Overall, the findings highlight the potential of poppy seed cake as a valuable source of natural antioxidants and support its sustainable valorization within the framework of circular economy and waste reduction strategies.

Key words: Poppy seed cake; by-products; SFE extraction; antioxidant activity; circular economy

UNLOCKING THE ANTIOXIDANT POTENTIAL OF ESSENTIAL OIL, HYDROLATE, AND SUPERCRITICAL FLUID EXTRACTS FROM *SOLIDAGO VIRGAUREA*

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ABSTRACT

Solidago virgaurea is a medicinal plant rich in biologically active lipophilic compounds with promising antioxidant potential. The main goal of this research was to compare the efficiency of conventional extraction techniques and supercritical fluid extraction (SFE) for isolation of lipophilic compounds with antioxidant activity. Essential oil (EO) was obtained by hydrodistillation using a Clevenger apparatus, while the corresponding hydrolate was collected as a by-product. Conventional Soxhlet extraction was performed using methylene chloride and n-hexane as extraction solvents. In addition, SFE was optimized using a Box–Behnken design (BBD), evaluating the effects of temperature (40, 55, and 70 °C), pressure (100, 300, and 500 bar), and CO_2 flow rate (4, 7, and 10 g/min) through 20 experimental runs. Extraction yield and antioxidant activity, using DPPH and ABTS assays, were determined for all samples. The EO yield was 0.34%, whereas Soxhlet extraction yielded 6.53% and 4.07% using methylene chloride and n-hexane, respectively. SFE extraction yields ranged from 0.83% to 2.70%, depending on the extraction conditions. In the DPPH assay, the highest antioxidant activity was observed for the hydrolate (51.15 μM Trolox/g) and the optimized SFE extract (49.32 μM Trolox/g), followed by EO (26.49 μM Trolox/g), n-hexane extract (25.33 μM Trolox/g), and methylene chloride extract (14.39 μM Trolox/g). In contrast, the ABTS assay showed the highest antioxidant activity for EO (684.75 μM Trolox/g), followed by hydrolate (412.08 μM Trolox/g), n-hexane extract (393.90 μM Trolox/g), methylene chloride extract (353.27 μM Trolox/g), and the optimized SFE extract (292.01 μM Trolox/g). The extraction method significantly influenced both extraction yield and antioxidant capacity. The results demonstrate that EO, hydrolate, and SFE extracts of S. virgaurea represent valuable natural sources of antioxidants. Moreover, SFE provides an environmentally friendly alternative to conventional solvent extraction by producing solvent-free extracts suitable for potential application in functional foods, nutraceuticals and cosmetics.

Key words: *Solidago virgaurea*; essential oil; hydrolate; SFE extraction; antioxidant activity.

UNVEIL THE BIOLOGICAL POTENTIAL OF SUPERCRITICAL FLUID EXTRACTS FROM *COTA TINCTORIA*

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ABSTRACT

Cota tinctoria is an under-researched plant from Asteraceae family, traditionally used for dyeing due to its intense color. The main goal of this research was to investigate the potential of C. tinctoria extracts obtained with supercritical fluid extraction (SFE). Soxhlet extraction with methylene chloride and n-hexane was performed as conventional extraction technique and compared with SFE extracts. SFE was performed at 40 °C and 0.2 kg CO2/h and pressure of 100, 200, 300, and 400 bar. Two additional experiments at 0.2 kg CO2/h, 300 bar and 50 °C and 60 °C were done. Extraction yield, content of total phenols, content of chlorophyll A, B and carotenoid and antioxidant activity were determined for all samples. The yield of Soxhlet extract with methylene chloride was 1.78% and for Soxhlet extracts with n-hexane was 0.81%. SFE extraction yields were 0.45%, 1.01%, 1.49%, and 1.42% at 100, 200, 300, and 400 bar, respectively and 1.73% at 0.2 kg CO2/h, 300 bar and 50 °C and 1.96% at 0.2 kg CO2/h, 300 bar and 60 °C. The antioxidant activity in DPPH assay varied in range from 18.27 to 31.84 µM Trolox/g sample in SFE extracts, and Soxhlet extracts. Moreover, the antioxidant activity throughout ABTS assay showed that results were in range from 85.65 to 216.79 µM Trolox/g sample. The content of total phenols was in range of 6.55 to 22.14 mg Gallic acid equivalent/g sample, however the carotenoids content was from 0.13 to 3.97 mg/g sample. The type of extraction and the extraction parameters (pressure and temperature) had an impact on extraction yield, antioxidant activity and content of bioactive compounds. Eco-friendly SFE extracts from C. tinctoria enables high opportunity for safe application in food products in order to obtain functional product enriched with phenolic compounds with antioxidant capacity and chlorophyll and carotenoids.

Key words: Cota tinctoria; SFE extraction; antioxidant activity; total phenolic content; chlorophyll and carotenoids contents

THE EFFECT OF REFINING STAGES ON THE PHYSICOCHEMICAL PROPERTIES OF HAZELNUT MEMBRANE OIL

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ABSTRACT

This research comprehensively examines the physicochemical characterization of hazelnut membrane oil, a significant waste product of the hazelnut processing industry, and the quantitative effects of industrial refining steps on these parameters, within the scope of sustainable food technologies and byproduct management. Although hazelnut skin is a potential raw material due to its high lipid content and valuable fatty acid profile, it is not suitable for direct consumption due to its high free acidity and dark pigments. In this study, the effects of neutralization, grounding, winterization, and deodorization stages applied to crude hazelnut skin oil on its quality were systematically analyzed. The experimental data obtained proved that the refining process is highly effective on the chemical purity of the oil. The free fatty acid content (expressed as oleic acid), initially measured at a very high level of 6.88 ± 6.66% in crude hazelnut skin oil, was reduced to 0.11% with the first stage of refining, neutralization and grounding, and to 0.07 ± 0.07% at the end of the final deodorization process. This indicates that the acid removal efficiency exceeded 99%, and the oil fully complies with commercial refined oil standards. Color analysis results showed that the red value of the crude oil, which was 10.7, decreased to 4.6 units after deodorization, while the yellow value stabilized in a controlled manner. This physical improvement enhances the sensory acceptability and industrial use potential of the oil. Evaluations regarding fatty acid composition revealed that the applied thermal and chemical processes did not disrupt the basic lipid structure of hazelnut husk oil. Oleic acid (C18:1), the major fatty acid, remained quite stable at 76.53% to 76.63% throughout all stages of refining. Similarly, linoleic acid (C18:2), a polyunsaturated fatty acid, was maintained at 15.08% to 15.20%. No statistically significant loss was observed in the amounts of saturated fatty acids palmitic acid (5.32% - 5.53%) and stearic acid (1.89% - 1.94%) during the process. In conclusion, this study scientifically confirms that hazelnut husk oil, thanks to its high monounsaturated fatty acid content and balanced profile, can be recycled into a high-quality edible oil or functional food component. The study findings offer unique contributions to the lipid technology literature and waste utilization strategies.

Key words: Hazelnut shell, physicochemical, refining process, oil, food

PHYTOCHEMICAL COMPONENTS, SUN PROTECTIVE PROPERTIES AND ANTIBACTERIAL ACTIVITY OF DESERT DATES (Balanites aegyptiaca) KERNEL OIL

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ABSTRACT

Balanites aegyptiaca (L.) Delile (lalob Helgleg), family Balantiaceae, is a wild tree grown in dry and savannah areas of Africa and South Asia, which is well adapted to different agro-climatic regions with arid and semi-arid climatic features; commonly it is known as ‘desert date.' The current study aims to evaluate phytochemical compounds and investigate the in vitro antimicrobial activities and sun protection factor of desert date (Balanites aegyptiaca) kernel oil collected in southern Algeria. A press oil machine was used to separate the crude oil from the seed . A classical spectrophotometric technique was used to assess the total phenolic compounds and flavonoids, as well as the chlorophylls and carotenoids. The oil's fatty acid composition was determined using GC-MS as FAME; also, the tocopherol compounds were quantified using an HPLC-UV detector. Balanites aegyptiaca seed kernels are high in vegetable oil. The oil's phytochemical analysis revealed the presence of phenolic content (flavonoid content, saponin content, chlorophyll, and carotenoid content). The main fatty acid contents were palmitic acid (79.9%), oleic acid (54.4%), and linoleic acid. Also, this oil is rich in tocopherols, including alpha-tocopherol (580.8 mg/kg) and delta-tocopherol (18.1 mg/kg). This same oil had good inhibitory activity against Bacillus cereus (11.2 mm), but no inhibitory activity against the other microorganisms tested was observed. The oil could be used as a skincare agent in cosmetic formulations, providing excellent sun protection. It is regarded as an excellent source of biomolecules and can be used as a component in food or cosmetic products.

Key words: Balanites aegyptiaca, seed oil, phytochemical compounds, GC/MS, Antimicrobial, sun protection factor

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