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Detection of Fatty Acids Separated from *Melissa Officinalis* Leaves Using GLC Technology and Studying their Effect on the Vitality of *Staphylococcus Aureus*

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Abstract

The plant found in Mosul exhibited distinct characteristics in terms of its composition of Undecanoic acid and Linoleic acid. Notably, the highest concentration of fatty acids was observed in the leaves of the plant cultivated in the Aqrah district, measuring 9.908 mg/g. The findings of the present study demonstrate that fatty acids exhibit antioxidant properties against the free radical DPPH. Moreover, it was observed that the efficacy of these fatty acids in neutralizing the free radical increases proportionally with the concentration of the active compounds. At a concentration of 500 µg/ml, the fatty acids (Mosul) exhibited the highest level of inhibition, with a rate of 86.4%. This inhibition rate was found to be superior to that of fatty acids (Aqrah) at the same concentration, which showed an inhibition rate of 79.25%. Furthermore, the observed inhibition rate of fatty acids (Mosul) was statistically significant and comparable to the standard sample of ascorbic acid at the same concentration, which exhibited an inhibition rate of 85.6%. Following these results, the concentration of fatty acids (Mosul) is 400 micrograms per milliliter, exhibiting an inhibition rate of 81.2%. In comparison, fatty acids (Aqrah) achieved an inhibition rate of 72.3% at the same concentration. Other concentrations displayed varying degrees of inhibition capacity towards DPPH free radicals. The study provided confirmation of the inhibitory effects of fatty acids on the viability of Staphylococcus aureus strains isolated from infected individuals at Tikrit Teaching Hospital.

Introduction

The process of self-oxidation of fats refers to the natural oxidation that takes place when fatty components come into contact with molecular oxygen, resulting in the development of an undesirable taste known as rancidity. The nuclei consist of short-chain fatty acids, alcohols, aldehydes, and ketones. Undesirable odor and flavor in oxidized fats can be attributed to the ultimate endogenous oxidation process. Consequently, the stability of these fats or the products incorporating them diminishes, resulting in a reduction of their storage longevity. (Panichayupakaranant *et al* 2004; Kaewsuwan *et al* 2004). Moreover, the formation of compounds through the process of oxidation is implicated in the development of numerous diseases, with the potential to exceed 100 in number. Among these ailments, cancer, atherosclerosis, and heart disease are considered particularly significant (Okai *et al*; 2004). Currently, numerous industrial antioxidants are being employed on a commercial level to inhibit the self-oxidation of fats.

However, concerns have emerged in recent years regarding the safety of these antioxidants in relation to human health. These concerns have been raised due to indications suggesting potential health risks associated with the utilization of these antioxidants. The presence of

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carcinogenic or toxic substances within a given context has led researchers to prioritize the exploration of antioxidants derived from natural sources, particularly plants. Research findings indicate that various plant compounds, including fatty acids, phenolic compounds, and others, possess the ability to effectively inhibit the activity of free radicals. Natural products refer to chemical compounds that are derived from living organisms. These compounds are primarily classified as secondary metabolites, which are not directly involved in the growth or reproduction of the organisms. (Anulika *et al*; 2016). Plant biodiversity plays a significant role in the realm of traditional medicine, as a substantial portion of the global population, ranging from 60% to 80%, continues to depend on botanical remedies that have been employed since ancient civilizations. The medical significance of these substances arises from their active ingredients, which possess distinct physiological properties that impact the human body. (Shrivastava *et al* 2010; Leelavathi *et al* 2010).

The *Melissa officinalis* L plant is recognized as a significant botanical specimen due to its rich composition of bioactive compounds that exhibit potent antioxidant properties against free radicals. Commonly referred to as lemon balm, bee balm, or honey balm, *Melissa officinalis* L. is a perennial herbaceous plant belonging to the Lamiaceae family. This species is indigenous to southern Europe, northern Africa, the Caucasus, northern Iran and Iraq, the eastern Mediterranean region, western Asia, and various tropical countries. (Sepide *et al*; 2016). The substance in question was frequently employed for its anti-angiogenic, antioxidant, anti-probiotic, anti-cancer, anti-stress, anxiolytic, anti-viral, anti-tumor, anti-Alzheimer's, anti-diabetic, anti-cardiovascular, and memory-enhancing properties, as well as its ability to alleviate indigestion. (De *et al*; 2004).

Staphylococcus bacteria, characterized by their spherical morphology and positive Gram stain, have been investigated as one of the microorganisms subjected to the examination of the impact of plant-derived bioactive compounds. The diameter of *Staphylococcus* bacteria typically falls within the range of 0.5 to 1.5 nanometers. (Plata *et al*; 2009). The organism lacks motility and does not possess the ability to produce chalkboards. Staphylococcus bacteria represent a prevalent group of pathogens that commonly afflict humans, manifesting in various anatomical regions such as the skin and the upper respiratory tract. They give rise to numerous complications within the gastrointestinal tract. Staphylococci, known for their high pathogenicity, are widely distributed across the globe and account for over 80% of all infections. Suppurative disease, a condition documented in medical facilities, is known to give rise to numerous hospital-acquired infections, particularly in burn units. (Shittu *et al*., 2012)

Methods

Plant Leaves Collection

The botanical specimens were gathered from the regions of Mosul and Aqrah located in northern Iraq. The foliage of the plants was meticulously cleansed of particulate matter and suspended impurities. Subsequently, the cleansed leaves were carefully deposited into paper bags and stored under controlled conditions, ensuring a dry environment, until their intended utilization.

The Taxonomic Position of the Plant

Kingdom: Plantae
Division: Magnoliophyta
Class: Magnoliopsida
Order: Lamiales
Family: Lamiaceae

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Genus: Melissa
Species: *M. officinalis*

Preparation of Some Plant Extracts Using Continuous Soxhlet Apparatus

The plant's leaves were subjected to crushing using an electric mill. Subsequently, a quantity of 25 grams of finely ground powder was introduced into the Soxhlet system. To facilitate the extraction of oil from the Melissa leaves, 400 milliliters of petroleum ether with a temperature range of 40-60 degrees Celsius were added. The extraction process was conducted for a duration of 7 hours per day until the solvent employed in the apparatus achieved a colorless state. In conclusion, the extract should be concentrated using a Rotary vacuum evaporator. (Hasan *et al*; 2019).

Separation of fatty acids by the saponification method

The objective of this experiment was to obtain fatty acids in their unbound state through the saponification process. A quantity of 10 g of the crude extract from each of the petroleum ethers was utilized, and 100 ml of a 7.5 M KOH solution was added to it. Subsequently, thermal sublimation was conducted for a duration of 90 minutes at a temperature of 100 °C. The resulting mixture was then allowed to cool to room temperature, followed by the addition of an additional 100 ml. A volume of distilled water, measured in milliliters, was combined with the solution. The resulting mixture was then transferred into a separating funnel. Subsequently, 25 milliliters of ether were added to the mixture on three separate occasions in order to eliminate the fats that did not undergo saponification. Subsequently, the saponified layer was subjected to acidification using a 20% concentration of sulfuric acid (H2SO4) until a pH value of 2 was attained, resulting in the solution becoming transparent. The lipids that had undergone saponification were extracted using two separate additions of 25 mL of ether. The separation process involved using a separation funnel, where the upper layer consisting of ether was retained, while the lower layer containing the aqueous solution was discarded. (Arthur *et al*; 1972). The specimens were stored in glass bottles that were not transparent and were subsequently refrigerated until they underwent analysis using the gas-liquid chromatography (GLC) instrument, enabling the investigation of their antioxidant properties.

Identification of fatty acids using gas-liquid chromatography (GLC)

The identification of fatty acids extracted from the leaves of a plant under investigation was conducted at the laboratories of the Ministry of Science and Technology / Department of Environment and Water. A GLC gas chromatography instrument, specifically a Shimadzu model 2010 of Japanese origin, was employed for this purpose. The analysis utilized a Flame Ionization Detector (FID) in conjunction with a capillary separation column of the type SE. The experiment involved a 30-meter long column with two different diameters, measuring 0.25mm and 0.5mm. The injection and detector areas were maintained at temperatures of 330°C and 280°C, respectively. The temperature of the separating column gradually increased from 120°C to 280°C at a rate of 8 degrees per minute. Inert nitrogen gas was used as the carrier gas. A vector with a magnitude of 100 kilopascals.

Study of the Antioxidant Efficacy of the Separated Compounds

To achieve a concentration of 200 mM, 7.9 mg of DPPH (Diphenyl pecril hydrazine) was measured and subsequently dissolved in 100 ml of methanol. Various concentrations of the study extracts were prepared at 200, 300, 400, and 500 µg/ml, with ascorbic acid serving as the control sample. Subsequently, 1 ml of DPPH solution was added to each concentration, including the control sample. The samples were then incubated at room temperature for a

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duration of 30 minutes under dark conditions. The measurements of each sample were conducted at a wavelength of 517 nanometers using a Shimadzo-UV-1800 spectrophotometer, which is a dual-cell instrument of Japanese origin. Subsequently, the percentage of inhibition of free radicals was determined by applying the following equation. (Sumathy et al; 2013).

% = (AbB- AbS) /AbB * 100
AbB = absorbance of control sample
AbS = absorbance of the sample

Collect Bacteria *Staphylococcus Aureus*

Bacterial specimens were obtained from male and female patients diagnosed with infections at Salahuddin General Hospital between September and December 2022. Samples were obtained from individuals with wounds and burns prior to undergoing lumbar scanning for treatment. Subsequently, the specimen was directly inoculated onto the appropriate bacterial culture media to facilitate diagnostic procedures. The age distribution of the individuals affected spanned from 23 to 40 years.

Preparation of Concentrations of Fatty Acids

A solution with a concentration of 200 mg/ml of the active fatty acid compounds was prepared by dissolving them in ethylene glycol. Subsequently, aliquots with concentrations of 100 and 50 mg/ml were derived from this solution. These aliquots were then subjected to pasteurization at a temperature of 62°C for a duration of 10-15 minutes. (Shareef *et al*, 1998).

Sensitivity test method (pit diffusion)

The study assessed the inhibitory activity of the active ingredients on bacterial growth through susceptibility testing using the drilling diffusion method. This method, as described by Peres and Bazerque (1991), involved creating 5 mm diameter holes in Mueller-Hinton medium. The bacterial suspension was prepared in nutrient broth medium after being cultured for 14-16 hours. Next, a volume of 0.1 cm^3 of the diluted bacterial suspension was aseptically transferred onto Acar Mueller-Hinton medium. The suspension was then evenly spread across the surface of the medium using a sterile cotton swab. Subsequently, the plates were incubated at a temperature of 37 °C for a duration of 30 minutes to allow for proper impregnation. Subsequently, the cavities were filled with 10 microns of the active compounds being investigated, at concentrations of 50, 100, and 200 mg/ml. The plates were then subjected to incubation at a temperature of 37 °C for a duration of 24 hours. Following this incubation period, the diameter of the inhibition zone was measured using a graduated ruler, and the resulting measurements were recorded in millimeters as the unit of measure.

Results and Discussion

Separation and identification of a number of fatty acids by (GLC)

Table 1 displays the results of the gas-liquid chromatography (GLC) analysis conducted on the petroleum ether extract derived from the leaves of the lemongrass plant (Aqra/Mosul). The analysis revealed the presence of various fatty acids that were isolated through the saponification process, aligning with the standard samples. The third figure

The findings of the research demonstrated the concurrence of the fatty acids isolated from the leaves of the orange plant (Aqra - Mosul) with the standard samples, as presented in Table 1 and Figure 1-2.

Butyric acid: The compound in question is a carboxylic acid, denoted by the structural formula CH3CH2CH2-COOH. Animal fats and vegetable oils are sources of this substance. The flavor

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profile is reminiscent of butter, while the aroma is characterized by an unpleasant scent. The compound in question is classified as a short-chain acid. The substance is devoid of color and exhibits high solubility in water, ethanol, and ether. Acidic compounds play a crucial role in the prevention of colon tumors and the promotion of optimal health in colonic epithelial cells. Consequently, these compounds are classified as acids synthesized by advantageous coliform bacteria, and they additionally enhance resistance against type 2 diabetes. (Nabney *et al* 2017, Henagan *et al* 2017). The findings of the study indicated that the lemongrass leaves (Aqra/Mosul) petroleum ether extract contained butyric acid, which was detected at retention times of 3.570 and 3.060 minutes. The concentration of butyric acid in the extract was measured to be 0.109 and 0.002 mg/g, respectively.

Undecanoic acid: Decanoic acid, represented by the structural formula CH3(CH2)9COOH, is a carboxylic acid employed as an antifungal agent and for the treatment of foot sprains. However, it is worth noting that decanoic acid is associated with an unpleasant odor. (Al-Louizi *et al*, 2019). The chromatography findings revealed that the presence of undecanoic acid was not detected in the leaves of the lemongrass plant cultivated in the Aqra region. However, in the lemongrass plant grown in the city of Mosul, undecanoic acid was observed with a retention time of 4.633 minutes and a concentration of 7.370 mg/g.

Palmitic acid: This particular fatty acid, known as myristic acid, is highly abundant in animals, plants, and microorganisms. Its chemical composition can be represented by the formula CH3(CH2)14COOH. Palm oil is a crucial constituent and can be detected in various food items such as meat, cheese, butter, and other dairy products. According to the World Health Organization, the consumption of palmitic acid has been found to elevate the risk of developing cardiovascular disease. (Bee-Rogers *et al*, 2001). The results of the chromatographic analysis indicated that the turmeric plant cultivated in Mosul lacked palmitic acid. However, the turmeric plant grown in the Aqrah region exhibited the presence of palmitic acid, as evidenced by a retention time of 6.693 minutes and a concentration of 1.387 mg/g.

Hepadecanoic acid: The compound in question is a monounsaturated fatty acid, characterized by the structural formula (CH3(CH2)15CO2H). This compound is alternatively referred to as margaric acid. Numerous studies have demonstrated the potential health benefits associated with its consumption, particularly in relation to various diseases such as coronary heart disease. (Khaw *et al*., 2012). The findings of the study revealed the presence of hepadecanoic acid in the foliage of the turmeric plant cultivated in the Aqrah region, while it was absent in the same plant species grown in the city of Mosul. The hepadecanoic acid compound exhibited a retention time of 6.827 minutes and a concentration of 0.003 mg/g.

Stearic acid: The compound in question is a saturated fatty acid consisting of a carbon chain comprising 18 carbon atoms. The substance in question is a solid with a waxy consistency, and its chemical formula is C17H35CO2H. Stearic acid is widely recognized as a prominent saturated fatty acid occurring in nature, second only to palmitic acid in terms of its notoriety. It finds application in the production of soaps and cosmetics. (Hunter *et al*., 2009). The findings of the study have provided confirmation that the leaves of the lemongrass plant cultivated in both the Aqrah region and the city of Mosul exhibit the presence of stearic acid. The retention times for this compound were observed to be 8.207 and 8.890 minutes, while the corresponding concentrations were measured to be 0.0002 and 0.0001 mg/g, respectively.

Elaidic acid: The chemical formula of the compound in question is CH3 (CH2)7CHCH (CH2) 7CO2H, which falls under the category of organic compounds. This substance is categorized as an unsaturated fatty acid and is characterized by its colorless solid state. The activity of the cholesterol-lowering CETP protein is enhanced. (Tardy *et al*., 2011). The chromatograms

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indicated the appearance of elaidic acid in the extract The presence of curcumin, a compound found in the leaves of turmeric plants cultivated in the Aqrah region, was detected with a retention time of 9.267 minutes and a concentration of 0.0006 mg/g. However, curcumin was not observed in the leaves of the same plant species grown in the city of Mosul.

Oleic acid: Oleic acid is a naturally occurring fatty acid found in various animal and vegetable fats and oils. The substance in question is an oil that lacks color and odor, and it falls under the category of a monounsaturated omega-9 fatty acid. The predominant fatty acid found in natural environments. Oleic acid is attributed to the anticoagulant properties observed in olive oil, as well as its potential in mitigating the likelihood of breast cancer. (Teres *et al*., 2008). The findings indicated the occurrence of oleic acid in the leaves of al-Tarjan (Aqra/Mosul) with retention times of 10.017 and 10.260 minutes, and concentrations of 0.0005 and 0.0002 mg/g, respectively.

Linoleic acid: The compound in question is an unsaturated omega-6 fatty acid carboxylic acid with a molecular formula of C18H32O2. It is commonly present in various nuts and fatty seeds, such as flaxseeds, hemp seeds, poppy seeds, sesame seeds, and others. Wound healing is a process that is employed in the cosmetic industry due to its advantageous attributes for skin health, including anti-inflammatory and anti-acne properties. (Patwardhan *et al*., 2009). The findings of the research indicated that the lemongrass leaves extract obtained from the Aqrah region lacked linoleic acid. Conversely, linoleic acid was detected in the lemongrass plant cultivated in Mosul, with a retention time of 12.303 minutes and a concentration of 0.0001 mg/g.

Arachidic acid, Peanut acid, also known as arachidic acid, is a saturated fatty acid consisting of 20 carbon atoms and having the chemical formula C20H40O2. Peanut oil contains this particular component. The findings of the study revealed that the aqueous and Mosul extracts of lemongrass leaves were found to contain archidic acid. The retention times for the two extracts were measured at 14.183 and 14.177 minutes, respectively. The concentrations of archidic acid in the extracts were determined to be 0.0004 and 0.0005 mg/g, respectively.

Eicosenoic acid: Gendauic acid, a monounsaturated long-chain fatty acid with the molecular formula (C20H38O2), is present in various vegetable oils and nuts. The aforementioned acid serves as a primary constituent for the production of medical supplies and is also employed as a moisturizing agent in cosmetic formulations. (Kikukawa *et al*., 2015). The presence of Eicosenoic acid in the leaves of the altar plant, cultivated in the regions of Aqra and Mosul, was confirmed through the analysis of chromatograms. The retention times for this compound were observed to be 15,000 and 15,130 minutes, while the corresponding concentrations were measured to be 1,005 and 1,249 mg/g, respectively.

Linolenic acid: The substance in question is a polyunsaturated essential fatty acid with an extended carbon chain. The compound possesses a molecular formula of (C18H30O2) and is classified within the omega-3 fatty acid group. The substance in question is a transparent liquid devoid of color, which exhibits a high concentration in specific vegetable oils. This substance is recognized as an antioxidant and functions to mitigate inflammation and inhibit the development of cancer. Certain chronic diseases, including heart disease, stroke, type 2 diabetes, kidney disease, and specific forms of cancer, exhibit an anticoagulant effect. (Anderson *et al*,Ma, 2009 and Saffaryazdi *et al*., 2020). The The findings indicated that the lemongrass leaf extract obtained from the (Aqrah/Mosul) region exhibited retention times of 16.193 and 16.267 minutes, along with concentrations of 4.856 and 0.0004 mg/g, respectively.

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Erucic acid: The research findings revealed the existence of Erucic acid, a type of fatty acid, in the foliage of the lemongrass plant cultivated in the Aqrah region. The analysis determined a retention time of 17.453 minutes for this compound, which was present at a concentration of 0.002 mg/g. Conversely, no traces of Erucic acid were detected in the lemongrass plants grown in the city of Mosul. Cisdocosadienoic: The analysis indicated that the lemongrass leaves obtained from the Aqrah and Mosul regions contained Cisdocosadienoic fatty acid. The retention times for this fatty acid were found to be 19,040 and 1,990 minutes, with corresponding concentrations of 19,040 and 1,286 mg/g, respectively.

Nervonoic acid: This particular fatty acid is classified as an omega-9 monounsaturated fatty acid, and it plays a crucial role in the biosynthesis of myelin within the brain. Nervonic acid serves various functions, including the facilitation of brain development, enhancement of memory, and the retardation of brain aging. Adolescents who are obese exhibit elevated concentrations of Nervonic acid within phospholipid fatty acids present in their bloodstream, in comparison to individuals with lower body mass. (Karlsson *et al*., 2006). The findings indicated that Nervonoic acid was not detected in the leaf extract of lemongrass plants cultivated in the urban area of Mosul. However, it was present in the lemongrass plants themselves. The cultivation of the specimen occurred in the Aqrah region, where it exhibited a retention time of 20.073 minutes and a concentration of 0.0001 mg/g.

According to the data presented in Table 1, there was variability observed in the number of fatty acids that were identified in the leaves of the tarnjan plant (Aqra/Mosul). The plant cultivated in the Aqra region exhibited a total of 12 compounds, whereas the plant cultivated in the city of Mosul demonstrated a total of 9 compounds. Furthermore, the study has confirmed the presence of heterogeneity. The study examined the overall concentration of fatty acids in lemongrass plants grown in two different locations: the city of Mosul and the Aqrah region. The results indicated that the lemongrass plants in Mosul exhibited a slightly higher concentration of fatty acids at 9.908 mg/g compared to the lower concentration of 9.353 mg/g in the leaf extract of lemongrass plants from the Aqrah region. Furthermore, the analysis revealed that the highest concentration of fatty acids was observed in the leaves of orange trees grown in Mosul. Specifically, Undecanoic fatty acid had the highest concentration at 7.370 mg/g, followed by linolenic acid at 4.856 mg/g. The remaining fatty acid concentrations were relatively similar. The potential cause can be attributed to various environmental factors, including fluctuations in temperature, humidity levels, soil composition, and elemental content. These factors influence the secondary metabolism's functionality in synthesizing fatty acids, leading to an elevation in their concentration within the plant component. The potential lack of certain fatty acids in plants could be attributed to their interaction with the aforementioned factors, or the possibility that some of these fatty acids underwent chemical reactions that impacted their presence.

Table 1. Fatty acids identified using the GLC technique for the leaves of the lemongrass plant (Aqrah/Mosul)

No	Standard Fatty Acid Compounds	Retention Time (Min)	Fatty Acids (Aqrah)		Fatty Acids (Mosul)	
			Retention Time (Min)	Concentration (Mg/G)	Retention Time (Min)	Concentration (Mg/G)
1	Butyic acid	3.485	3.570	0.109	3.060	0.002
2	Undecanoic acid	4.786	----		4.633	7.370
3	Palmitic acid	6.260	6.693	1.387	---	---

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4	Hepadecanoic acid	6.918	6.827	0.003	---	---
5	Stearic acid	8.663	8.207	0.0002	8.890	0.0001
6	Elaidic acid	9.904	9.267	0.0006	---	---
7	Oleic acid	10.731	10.017	0.0005	10.260	0.0002
8	Linoleic acid	12.550	---		12.303	0.0001
9	Archidic acid	14.184	14.183	0.0004	14.177	0.0005
10	Eicosenoic acid	15.683	15.000	1.005	15.130	1.249
11	Linolenic acid	16.303	16.193	4.856	16.267	0.0004
12	Erucic acid	17.041	17.453	0.002	----	---
13	Cisdocosadienoic	19.517	19.040	1.990	19.597	1.286
14	Nervonoic acid	20.573	20.073	0.0001	----	---
Total Concentration				9.353		9.908

Studying the antioxidant activity of the Fatty acids of the leaves of the lemongrass plant (Aqra/Mosul)

The findings from Table (2) demonstrate that the utilization of fatty acid compounds derived from lemongrass leaves in the Aqrah region and the city of Mosul as antioxidants, at concentrations of 200, 300, 400, and 500 micrograms per milliliter, were compared to ascorbic acid as a standard reference. These compounds exhibited significant scavenging activity against the free radical DPPH. Notably, the highest inhibition rate of 86.4% was observed at a concentration of 500 µg/ml for fatty acids from Mosul, surpassing the inhibition rate of 79.25% for fatty acids from Aqrah at the same concentration. Furthermore, the inhibitory effect of ascorbic acid at the same concentration was 85.6%, which was statistically comparable to the fatty acids from Mosul. The concentration of fatty acids (Mosul) is 400 micrograms per milliliter, exhibiting an inhibition rate of 81.2%. In comparison, fatty acids (Aqrah) achieved an inhibition rate of 72.3% at the same concentration. Other concentrations demonstrated varying degrees of inhibition capacity towards DPPH free radicals. The findings indicate that there is a positive correlation between the concentration of effective antioxidant compounds and the rate of scavenging of free radicals. Furthermore, the maintenance of our overall well-being is heavily reliant on the capacity of our physiological systems to counteract the detrimental effects caused by free radicals. Hence, antioxidants assume a crucial function in the prevention of diseases, thereby conferring benefits to individuals across the population. Antioxidants are of significance in the context of their natural occurrence in various food sources, particularly fruits, vegetables, and herbs.

Table 2. Concentration and percentage of standard sample and fatty acids of lemongrass plants as antioxidants

Concentration / Sample	200 µg/mL	300 µg/mL	400 µg/mL	500 µg/mL
Fatty acids Aqrah	66.1%	68.6%	72.3%	79.25%
Fatty acids Mosul	70.2%	76.4%	81.2%	86.4%
ascorbic acid	65.8%	%67.3	76%	85.6%

Inhibitory effect of fatty acids on the vitality of *Staphylococcus aureus*

The findings presented in Table (3) demonstrate that the fatty acid natural products extracted from lemongrass leaves, obtained from plants cultivated in Mosul city and Aqrah district, exhibited significant effects on the viability of *Staphylococcus aureus* across all tested

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concentrations. Notably, the highest inhibition was observed for the fatty acids extracted from Aqrah, specifically at a concentration of 200 mg/ml, resulting in an inhibition diameter of 10 mm. The experiment involved the application of fatty acids/Aqrah at a concentration of 100 mg/ml and fatty acids/Mosul at a concentration of 200 mg/ml, resulting in an observed inhibition diameter of 8 mm. The concentration of fatty acids Aqrah/Mosul at the lowest level was measured to be 50 mg/ml, resulting in inhibition diameters of 6 mm and 4 mm, respectively.

Table 3. The effect of fatty acids of lemongrass and antibiotics on the inhibition of *Staphylococcus aureus*

Compound	Aqrah Fatty acids			Mosul fatty acids		
The concentration is mg/mL	50	100	200	50	100	200
Damping diameter (mm)	6	8	10	4	6	8

Conclusion

The conducted research study has demonstrated that the fatty acids derived from the altar plant, which is cultivated in northern Iraq, exhibit varying degrees of inhibitory activity against DPPH free radicals. Moreover, it was observed that the inhibitory effect becomes more pronounced as the concentration of the fatty acids increases. Additionally, the fatty acids were found to exert an impact on the viability of Staphylococcus bacteria.

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