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Estimating the quantitative content of active compounds of Iraqi basil seeds *Ocimum basilcum L*

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ABSTRACT

The active compounds of basil seeds (Iraqi *Ocimum basilicum* L.) were studied using four extracts: cold and hot aqueous extracts, petroleum ether, and methanol. Phenolic and flavonoid content was studied using quantitative standard curves, and amino acids, water, fat-soluble vitamins, and minerals were identified and measured. The results showed that it contains many active compounds and unsaturated fatty acids, both of which are important in the human diet. Basil extracts contained phenols and flavonoids, and the petroleum ether extract contained 9 active compounds, most notably oxygenated monoterpenes, monoterpenes, sesquiterpenes, alkanes, and the unsaturated fatty acids linolenic and linoleic. The methanol extract showed the presence of 8 fatty acids, the most prominent of which is the unsaturated fatty acid alpha-linolenic acid, which amounted to 36%, followed by the fatty acid linoleic acid, which amounted to 9.04%. It also showed the presence of 13 amino acids, including 6 essential amino acids: phenylalanine (11.5%), leucine, histidine, tryptophan, isoleucine, and threonine, and 7 non-essential amino acids: glutamic, tyrosine, glycine, alanine, arginine, serine, and cysteine, in addition to containing many vitamins. The results also showed that it contains calcium, silicon, magnesium, sodium, potassium, and sulfur, with lower percentages of iron and zinc, and almost no traces of toxic elements such as cadmium and lead.

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1. INTRODUCTION

Throughout the ages, humans have relied on plants as sources of food, flavors, medicine, and perfumes [1]. These plants contain primary and secondary metabolites, which are used in many cosmetic products, hair tonics, and perfumes, and are also basic materials for some food and industrial products. On the therapeutic and medical levels, metabolites have a history dating back to the earliest ages and civilizations, such as the Indian civilization, 2500 years BC, which used plants and herbs to treat many common diseases. This type of treatment is called Ayurveda, derived from the word's life and knowledge [2]. The past two decades have witnessed a large, well-planned scientific trend to study the medicinal properties of metabolites. For plants and how to benefit from these medical products in treating diseases, especially incurable ones such as cancer [3].

Basil is one of the most famous herbs in the world, and its scientific name is *Ocimum basilicum*, where Ocimum means "fragrant" in Greek and the common name basil is derived from the Greek words basileus, meaning "king," or basilikon, meaning "royal." The pharaohs knew it as (Set) and the Arabian Peninsula as (Al-Hawk) [4]. Most types of basil are annual herbs, and some are tolerant of a wide range of climatic conditions. Basil is one of the plants with high nutritional and medicinal value and multiple uses. Consuming basil seeds is uncommon, and their use has not spread worldwide because their functional properties and nutritional value are unknown.

Basil seeds contain proteins of approximately (11.4 - 22.5%) with all the necessary acids, soluble and insoluble fibers ranging from 7.11 to 26.2 g/100 g with the highest percentages of sodium, calcium, potassium, magnesium and iron, and the percentage of carbohydrates is 63.8%, and fats 9.5-19.6%, where fats, carbohydrates and proteins provide an energy estimated at 442.4 calories, and the moisture in the seeds is estimated at 4.0 to 9.6%. Basil seeds contain basil seed gum, which represents approximately 17-20%, as it is considered one of the commercial food hydrocolloids. Basil gum is used in the pharmaceutical and food industries as a thickening and binding agent, and its importance is highlighted in the food industries as a thickening or fixing material and in improving the texture and consistency of the food product [5], and basil seeds contain unsaturated fatty acids such as linolenic and linoleic, the presence of which in the basic diet is essential for the health of the individual as they are considered natural protective factors for many diseases such as heart disease and cancer. Since basil seed oil contains a high percentage of alpha-linolenic fatty acid (C18:3), it is a promising source of omega-3 [6]. In addition to various chemical compounds such as phenols, flavonoids, saponins, and terpenes, all these properties have made basil seeds attractive to consumers looking for healthy foods as they are anti-cancer, anti-microbial, anti-oxidant, and anti-inflammatory [7], anti-diabetic, anti-asthmatic, and anti-coagulant. Based on the above and considering the importance of basil seeds for health and nutrition, and their abundance in the Iraqi environment.

This study aimed to do the following:

1-Estimating the quantitative content of phenols and Fatty acids.

2-Identifying the active compounds in the four extracts of basil seeds (cold aqueous extract, hot aqueous extract, petroleum ether extract and methanol extract).

3- Studying the chemical components of local basil seeds (protein, minerals and vitamins

2. Experimental Methodology

Preparation of standard compound solutions for quantitative estimation of active compounds:

The standard compounds gallic acid and catechin acid were prepared according to the method of [8] by dissolving 0.05 g of gallic acid in 25 ml of distilled water in a 25 ml volumetric flask, and 0.05 g of catechin acid in 25 ml of distilled water in a 25 ml volumetric flask

2-1 Prepare standard curves

2-1-1 Prepare the standard curve for gallic acid:

The method of [9] was followed to prepare the standard curve for gallic acid after preparing a stock solution of the standard compound. Then, different volumes of the prepared stock solution were taken into test tubes, and corresponding volumes of distilled water were added to bring the total volume to 2 ml. Then, the absorbance was measured at 760 nm using a spectrophotometer. After that, the solutions used in the phenol estimation method were added (0.5 ml of Folin's reagent and 2 ml of sodium carbonate solution (7.5%) to obtain the final concentrations of gallic acid and the final volume in each tube, as shown in Figure 1-A.

2-1-2 Prepare the standard curve for catechin acid:

The method mentioned in [10] was followed. In preparing the standard curve for catechin after preparing the standard compound solution for catechin, the standard curve was prepared by taking different volumes of the stock solution in test tubes, and appropriate volumes of distilled water were added to it to become 2 ml, then the absorbance was measured at a wavelength of 510 nm using a spectrophotometer, then the solutions used in the method of estimating flavonoids were added (5 ml of distilled water, 1% NaNO2, 0.3 ml, 0.6 ml NaOH, 10% AlCl3) and the volume was completed with distilled water to 10 ml.

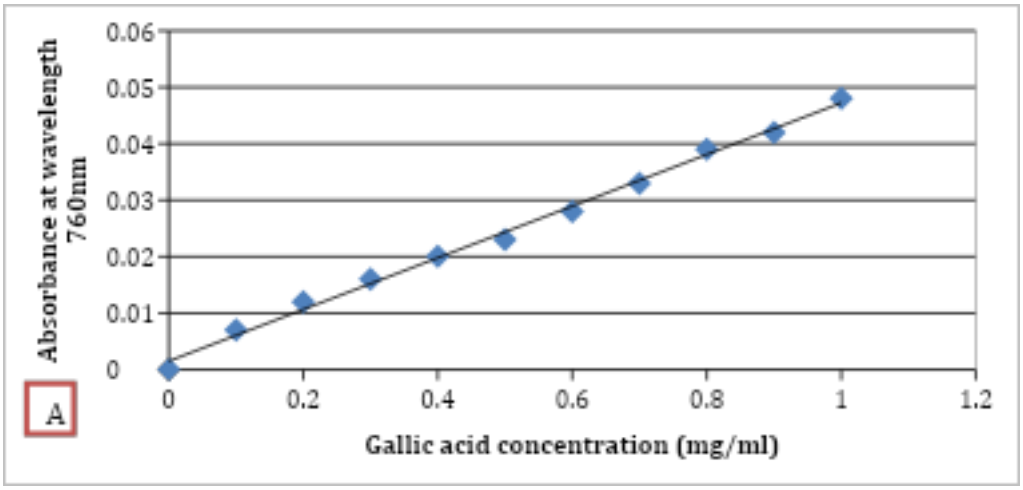
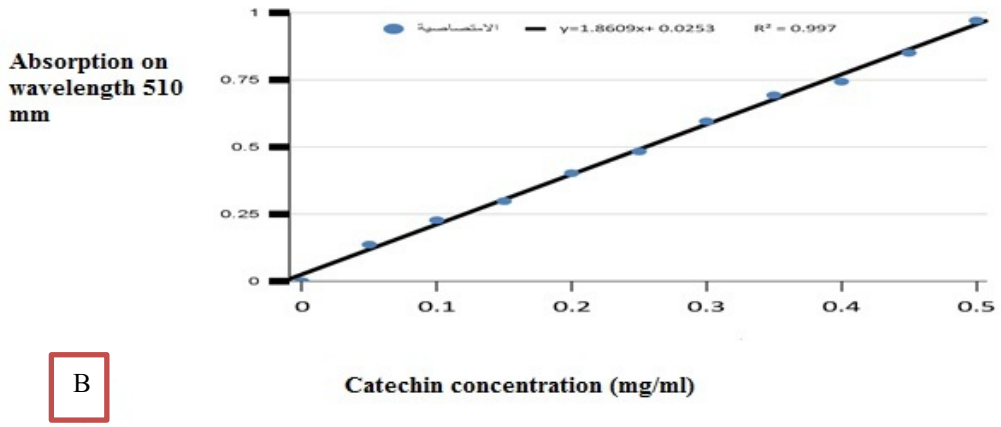


Figure (1): Standard curve for gallic acid (A).



B

Figure (1): catechin acid (B).

2.2 Preparation of basil seeds *Ocimum basilicum*:

Basil seeds of the Iraqi cultivar Figure (3-4) were obtained from the agricultural offices in the Al-Salihiya area in October 2021 and were genetically diagnosed at the Ministry of Agriculture / Iraqi Seed Inspection and Certification Department / Iraq. After that, four extracts were prepared (Cold aqueous extract, Hot aqueous extract, alcoholic extract with petroleum ether, alcoholic extract with methanol).

2. 2. 1. Cold water extraction:

The water extraction process of basil seeds was conducted according to the method described by [11] with some changes, where the seeds were ground and a volume of 1 g was taken to 29 ml of distilled water in a glass container and placed on the mixing plate device for 20 minutes, after which it was placed in the electric mixer for 30 seconds and then filtered using medical gauze, the precipitate was neglected and the filtrate was taken and then placed in the rotary evaporator device until it dries and turns into powder and is stored in sterile glass bottles until use in the study.

2. 2. 2. Hot water extraction:

Water extraction was carried out according to the method described by [11] without change, where 1 g of ground seeds was weighed and placed with 29 ml of distilled water in a glass container and placed in a shaking water bath at a temperature of 50 °C and a speed of (50-100) rpm for 20 minutes. Then it was placed in an electric mixer for 30 seconds, filtered through medical gauze or muslin cloth, the filtrate was collected, the precipitate was discarded, and the filtrate was dried using a rotary evaporator and stored in sterile containers until use in the study.

2. 2. 3 Extraction using petroleum ether:

The method of Gajendiran [12] was adopted, where the seeds were first purified from impurities, 25 g of seeds were ground in an electric grinder, and the ground seeds were placed in filter papers (filter bag) for the purpose of placing them in the SOXHLIT device (using petroleum ether solvent in it. After eight hours, the sample was collected from the device and dried at room temperature. Then it was stored in sterile containers until used in the study.

2. 2. 4. Extraction using methanol:

The same method was used, employing the SOXHLIT device, methanol as the solvent, and drying at room temperature.

2. 3. Quantitative estimation of phenols and flavonoids:

The method of [9] was followed in the quantitative estimation of total phenolic compounds, where basil seeds were ground in an electric grinder, then 0.5 g was taken from them and 2.5 ml of Folin- Ciocalteu reagent was added to it, then 2 ml of sodium carbonate at a concentration of 7.5% was added to it and the mixture was left for 30 minutes at room temperature. Then, the absorbance was measured using a spectrophotometer at 760 nm, and the concentrations of phenolic compounds in the seed powder were calculated by referring to the standard curve for gallic acid (Figure 1-A). Total flavonoids of basil seed powder were determined according to Rao's method [10], where 1 g of seed powder was mixed in a 10 ml volumetric flask with 5 ml of distilled water, and 0.3 ml of $NaNO_2$ solution was added and left for 5 minutes, then 0.6 ml of 5% $AlCl_3$ solution was added. After another 5 minutes, 2 mL of 1 M sodium hydroxide solution was added, and the volume was brought to the mark; then the absorbance was measured at 510 nm. The standard curve was prepared using the standard compound catechin, and based on it, the flavonoid concentration was determined (Figure 1-B).

2. 4. Separation and identification using high-performance liquid chromatography (HPLC):

This method was used to identify the fat- and water-soluble vitamins in basil seeds. To detect fat-soluble vitamins, 1 g of basil seeds (dry and ground) was taken, 10 ml of ethyl acetate was added, and the mixture was placed in a shaking incubator for half an hour, then in a centrifuge for 10 minutes at 5000 rpm. Only the supernatant was taken and placed in a rotary evaporator to concentrate the sample and dry it completely, then the material was suspended in 2 ml of methanol, and the sample was filtered and injected into an HPLC device. As for the method of extracting water-soluble vitamins, 10 g of the ground seeds were taken and mixed with 300 ml of (60% water + 40% ethanol), mashed well and then placed in a heater at a temperature of (60-70°C) with a shaker and the result was filtered and then placed in a centrifuge at 4000 rpm for 10 minutes, then the supernatant was taken and injected into an HPLC device.

2. 5. HPLC technology in the diagnosis of amino acids:

Amino acids were digested and extracted by taking a weight of 0.2 g of the seeds, adding HCl acid at a concentration of 6 M and a volume of 12 ml, then placing the mixture in a dry laboratory oven at 110 °C for 24 hours, then filtered with a membrane filter with a pore size of 0.8 µm, then washed with distilled water twice and dried with a rotary evaporator at 50 °C. After the sample dries, 10 ml of distilled water is added, and the mixture is returned to the rotary evaporator until it dries. HCl acid (0.02 M, 3.5 ml) is then added, and the mixture is injected into the acid analyzer. The method followed by the manufacturer was adopted (Agilent USA).

2. 6. Gas chromatography-mass spectrometer technology:

GC-MS analysis was used to analyze fatty acids in the four basil seed extracts. The type of device was Agilent American and the conditions used were as follows:

Agilent HP-5ms Ultra Inert analytical column (30 m length × 0.25 mm inner diameter × 0.25 micron film thickness, pressure 11.993 / square inch, inlet line temperature; GC 50 ºC) was used. Then the auxiliary system was heated (temperature 320°C, carrier gas: He 99.99%, injector temperature: 250°C, scanning range: 25-1000, injection type: Splitless), and the oven program was: for ramp 1 it was 50°C held for 3.5 min, ramp 2 it was 50°C to 180°C/min, ramp 3 it was 180°C - 280°C/min, ramp 4 it was 280 - 300°C/min, ramp 5 it was 300°C for 4 min.

2. 7. Elemental analysis using X-ray fluorescence spectrometer Instrument XRF:

This analysis was conducted in the laboratories of the Geology Department / College of Science / University of Baghdad using the German X-Ray Fluorescence Instrument. The powder was compressed into pellets to obtain accurate results, and a special press was used at 5 tons of pressure, after which the results were recorded.

3. RESULTS AND DISCUSSION

3-1 Quantitative estimation of phenols and flavonoids:

The quantitative estimation of active compounds (phenolic compounds) in the local basil seeds used in the study was measured using the Folin- Ciocalteu method and using the gallic acid standard curve at approximately 1.5357 mg/g.. The results of estimating flavonoids for local basil seeds used in the study using the standard catechin compound also showed the presence of flavonoids at a rate of 2.365 mg/g, which is a higher rate than the flavonoid rate in Thai basil seeds, which was estimated at (0.22± 0.53 mg/g) [13].

3.2. Techniques for separation and identification of active compounds in basil seeds *Ocimum basilicum*:

Gas chromatography-mass spectrometry (GC-MS) examination of the four basil seed extracts showed the total compounds (cold aqueous extract, hot extract, petroleum ether extract and methanolic extract), as in the following tables (1, 2, 3, 4) and figures (2, 3, 4, 5).

Table (1): Active Compounds in the Cold Aqueous Extract of Basil Seeds (GC-MSS) Abundan

Compound name	Molecular weight	Chemical formula	Top area	uses
Butanol	74.12	C4H10O	99.0	Food additives and flavoring agent [14]
Butyl alcohol	112.12	C5H10O2	4.98	Natural aromatic and flavoring compounds used in food and pharmaceutical industries [15].
Acetic acid, propyl ester	116.16	C6H12O2	3.54	Food additives and flavoring agents [16]
Acetic acid, Butyl ester	228.37	C14H28O2	4.01	Anti-inflammatory and anti-cancer [17]

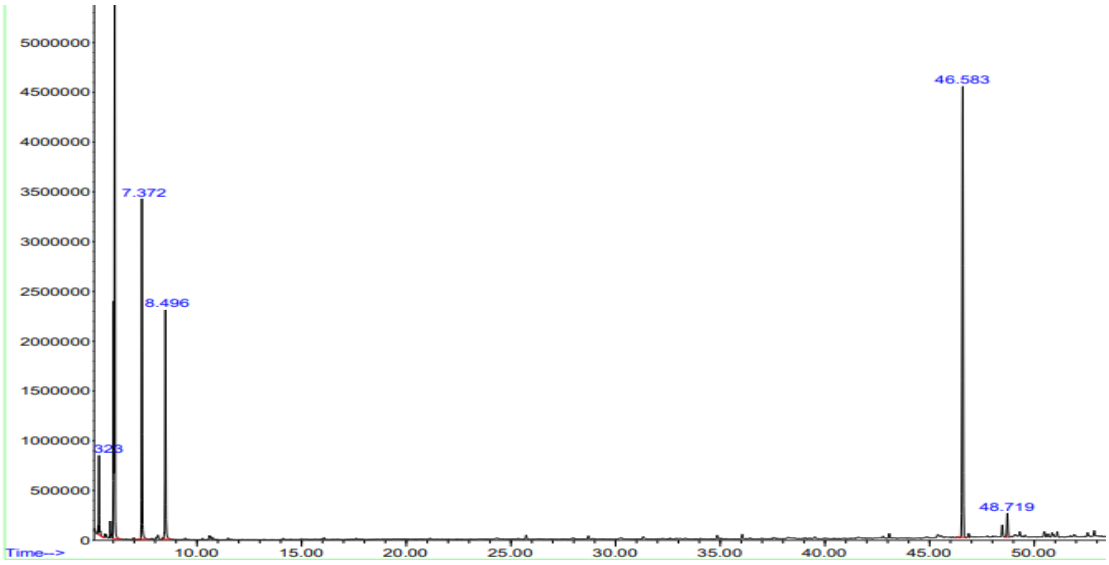


Figure (2): GC-MS analysis of the cold aqueous extract

Table (2): Active compounds in the hot aqueous extract of basil seeds GC-MSS Abundance

Compound NAME	MW	MF	Top area	Uses
Acetic acid Propal ester	121.12	C5H1OO 2	54.17	It is used in perfumes and food flavourings [15].
Butanol	12.74	C4H10O	8.11	Food additives and flavoring agents [14].
Nonadecane The cane are straight strain	156.26	C19H40	1.51	white wax block
Citronellol Oxygenated Monoterpen	156.26	C10H20O	5.92	It is used as a flavouring agent, rose and floral compositions are used, and it is used in insecticides and is responsible for its insect repellent and anti-inflammatory properties [18], [19].

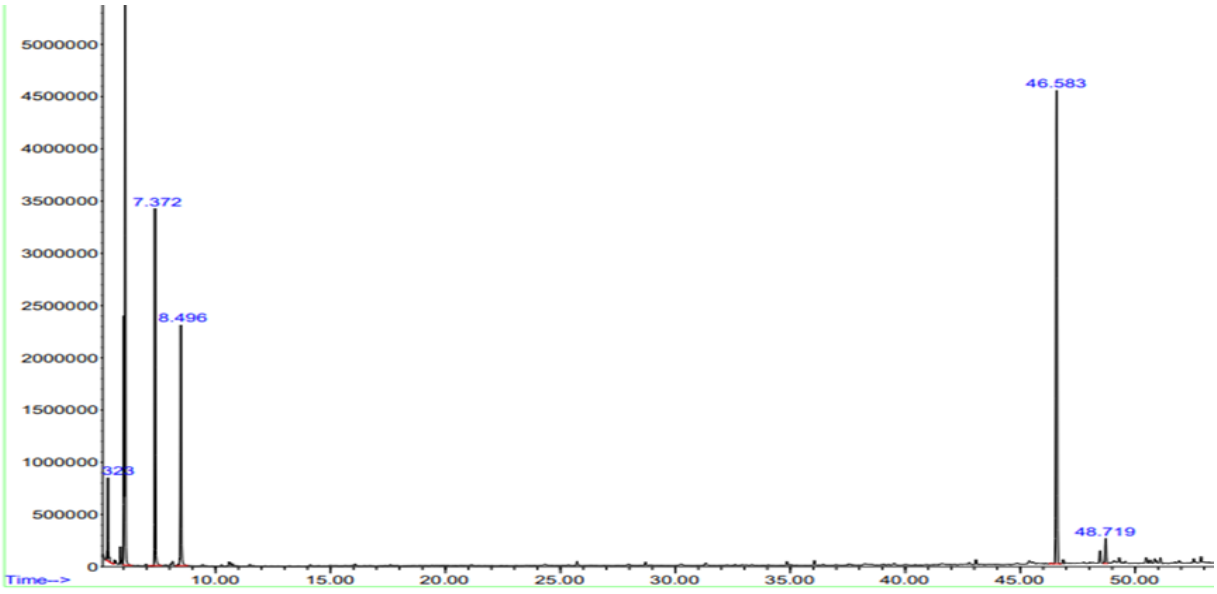
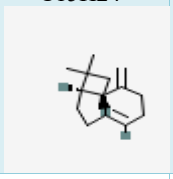
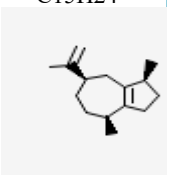


Figure (3): GC-MS analysis of the hot aqueous extract

Table (3) : Active compounds in basil seed extract petroleum ether GC-MS Abundanc

Compound name	MW	MF	Top area	Uses
D-limemonene Monoterpen	136.23	C10H16	0.56	Dietary supplement, anti-tumor, may inhibit tumor growth and stop cell cycle, antioxidant, antibacterial [20].
Geraniol Monoterpen	154.25	C10H18	0.76	Used in flavors, anti-tumor, anti-inflammatory, antibacterial, nerve calming, antidiabetic [21]
Citronellol Oxygenated Monoterpen	156.26	C10H20O	4.30	It is used as a flavouring agent, in rose and floral compositions, and in insecticides and is responsible for its insect repellent and anti-fungal properties [19].
Caryophelene Sesquiterpene	204.35	C15H24 	1.36	Cardioprotective, Kidney-protective, Antioxidant, Anti-inflammatory, Immune-boosting, Kidney-protective [22].
alpha.-Guaiene	204.35	C15H24 	0.54	Skin care products [23].
Hexadecano palmitic acid saturated fatty acid	256.42	C16H32O2	2.24	Anti-diabetic and anti-inflammatory [24]
Octadecano acid stearic acid	284.5	C18H36O2	1.83	It is used in the pharmaceutical industry and in the manufacture of personal care products [25]
9,12Octadecadenoic acid linoleic acid	276.4	C18H28O2	2.57	Regulate neuronal growth, improve gut microbiota [22]
9,12,15-ctadecadenoic acid α- linolenic	278.4	C18H30O2	9.97	Reduces the risk of cardiovascular and coronary diseases. Reduces the incidence of cancer (breast cancer). Modifies dietary fats in the body [14], [26].

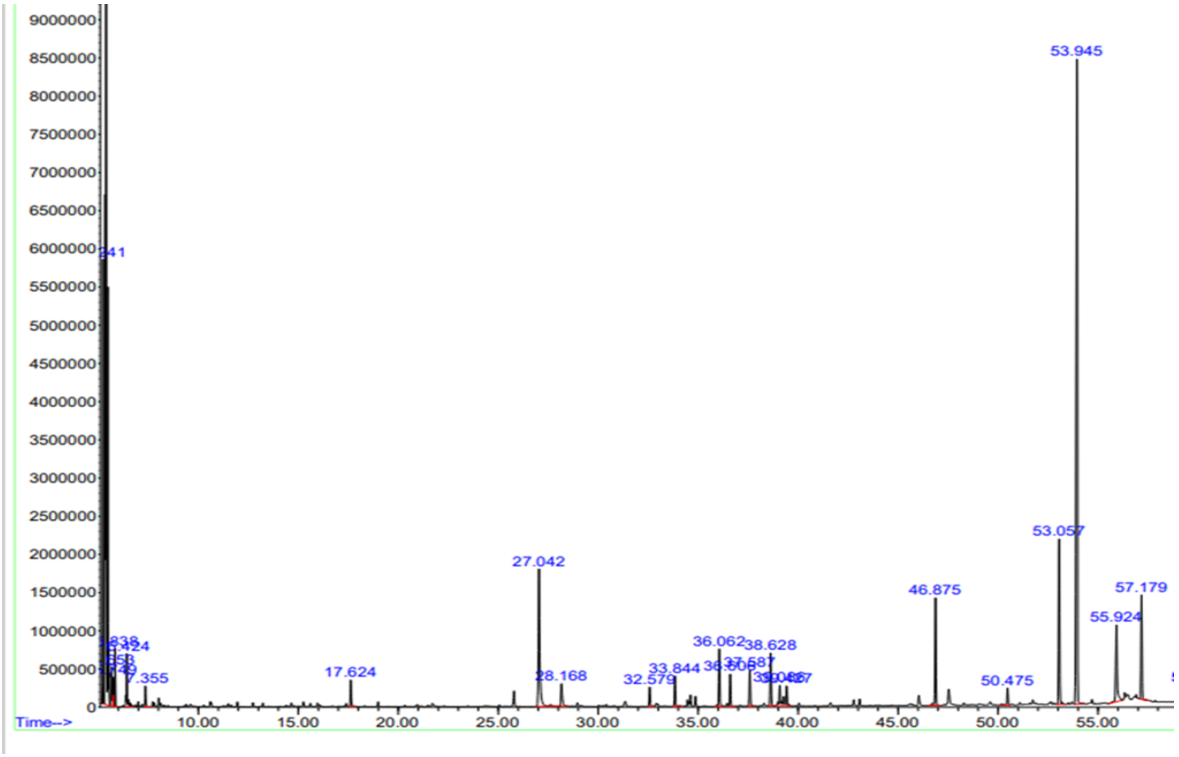


Figure (4): GC-MS analysis of petroleum ether extract

Table (4): Active compounds in methanolic basil seed extract GC-MS Abundanc

Compound name	MW	MF	Top area	Uses
Hexadecanoic acid palmitic acid saturated fatty acid	256.42	C16H32O2	11.42	Anti-diabetic and anti-inflammatory [24].
Trtradecanoic acid Myristic acid Saturated fatty acid	228.37	C14H28O2	1.32	Anti-cancer and anti-inflammatory [17].
Octadecanoic acid Stearic acid	284.5	C18H36O2	6.55	It is used in the pharmaceutical industry in the manufacture of personal care products [25].
Heptadecanoic Acid Margaric acid	270.5	C17H34O2	2.88	Anti-cancer [27].
9,12-Octadecadienoic acid linoleic acid	276.4	C18H28O2	9.04	Regulate neuronal growth, improve gut microbiota [22].
,12,15-Octadecatrienoic acid α- linolenic	276.4	C18H30O2	13.18	Reduces the risk of cardiovascular and nary diseases Reduces the risk of cancer (breast cancer), Modifies dietary fats in the body [14], [26].
9,12,15-Octadecatrienoic acid α- linolenic	276.4	C18H30O2	36.03	
9,12,15 Octadecatrienoic	276.4	C18H30O2	3.97	

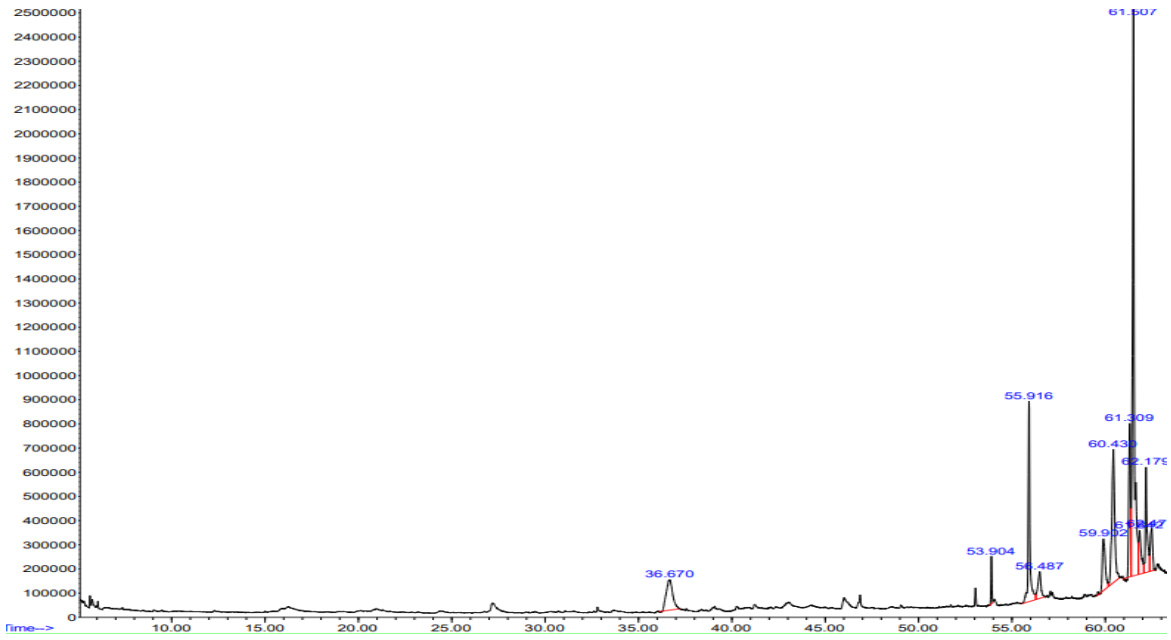


Figure (5): GC-MS analysis of the methanolic extract.

GC-MS analysis of basil seed extracts revealed that they contain numerous biologically important chemical compounds, which are utilized in the food and pharmaceutical industries, as well as in flavour compounds and skin and body care The hot and cold aqueous extracts showed the presence of flavor compounds such as Acetic acid butyl ester, Acetic acid propyl ester, and Butyl alcohol, while the petroleum ether extract showed nine active compounds, which are Oxygenated monoterpene, monoterpene, Sesquiterpene, alkane, in addition to saturated and unsaturated fatty acids, where the percentages were as follows: D-limonene 0.56%, alpha.-Guaiene 0.54%, Caryophyllene 0.59%, Geraniol 0.76%, and the rate of the fatty acid Octadecadenoic acid 12.9 reached 2.57%, and the unsaturated fatty acid Octadecatrienoic acid 12.15,9 reached 9.97% and Hexadecanoic acid 2.24% and another study was close to the percentages of the peak area in the GC-MS examination of basil leaves, as the percentage of monoterpene was 1.32%, and oxygenated monoterpene 4.30%, Sesquiterpene 1.36% in the ether extract [28]. As for the methanolic extract of basil seeds, the results of the analysis of eight saturated and unsaturated fatty acids showed that the highest percentage was for α-linolenic fatty acid, 36%, followed by linoleic acid, 9.04%, then saturated fatty acid 11.42% and saturated fatty acid, Stearic acid, 6.55%.

From the above results, unsaturated fatty acids were the dominant acids in basil seeds, and their proportions were close to those of other basil seed varieties [16]. Many other studies also report that the proportion of beneficial unsaturated fatty acids was dominant in basil seeds [6]. Based on these results, basil seeds are considered a primary source of plant-based unsaturated fatty acids, and it is important to include them in the diet. In a study conducted by Martínez *et al.* [26] on basil seed oil, its bioavailability and its effects on some physiological parameters on laboratory animals (rats) using olive oil as a control factor, it was shown that basil seed oil has a high digestibility coefficient similar to olive oil, and basil seeds increased the concentration of α-linolenic and linoleic acids in plasma, liver and red blood cell membrane, which made the Environmental Protection Agency present it in the possibility of using it as a nutritional supplement or a new functional food or a component of nutritional formulas to treat various diseases. There are many factors that increase the variation in the fatty acid and essential oil content of basil seeds, including genetic patterns, geographical characteristics, and climatic factors. All of these factors affect the chemical composition of basil seeds [29]. The 3-2 High-performance liquid chromatography (HPLC) technology for separating and identifying vitamins in basil seeds:

The content of basil seeds of fat-soluble and water-soluble vitamins was estimated using HPLC with standard compounds, including fat-soluble vitamins (E, D3, A, K) and water-soluble vitamins (C, B1, B2), as shown in Table 5.

Table (5): Basil seeds' content of water-soluble and fat-soluble vitamins

percentage P.P.M	Water-soluble vitamins	P.P.M percentage	fat-soluble vitamins
0.11	C	21.52995	E
0.75904	B1	1.47822	D3
0.606347	B2	0.616092	A
		0.8667643	K

The results showed that basil seeds contain vitamins at parts per million, with vitamin E at the highest concentration of 21.52, followed by vitamin D3, then vitamins K and A. The water-soluble vitamins found in basil seeds that were detected were vitamin C, B1, and B2, which amounted to (0.11, 0.75, 0.60), respectively. Researchers in a study by Zamani Ghaleshahi *et al.* [30] found that basil seeds, compared to chia and flax seeds, gave the highest percentage of vitamin E, as its percentage in micrograms/kg of seed oil is (23.8 ± 0.30 micrograms/gram). Another study was conducted to develop innovative food products using mathematical equations, with basil seeds, chia seeds, flax seeds, and papaya seeds. The percentage of vitamin K (414.80 micrograms/100 grams) and vitamin E (0.8 micrograms/100 grams) in basil seeds was the highest among the nutrients [31]. Thus, the importance of basil seeds as a component with a high nutritional content appears, as basil seeds have recently been used to produce innovative food products that are comparable to chia seeds currently offered for consumption in the European Union.

The 3-3 High-performance liquid chromatography technology for separating and identifying amino acids in basil seeds: The amino acid content of basil seeds was estimated using HPLC technology, where standard amino acid compounds were used, and the results of the examination and diagnosis are shown in Table 6.

Table (6): Basil seed content of essential and non-essential amino acids

percentage %	Non-essential amino acid	percentage %	essential amino acid
19.2	Glutamic acid	3.9	Tryptophan
1.7	Tyrosine	6.0	Luesine
3.0	Glysine	6.2	Histdine
2.1	Alanine	1.6	Theronine
2.9	Arginine	2.1	Isoleusine
7.9	Serine	11.5	Phenylalanine
6.1	Cysten		

The results showed that basil seeds contain 13 amino acids, 6 of which are essential amino acids such as phenylalanine, which gave the highest percentage of 11.5%, followed by the amino acids luesine, histdine, tryptophan, isoleusine, and threonine, which were respectively (6.0, 6.2, 1.6, 2.1, and 3.9%). And 7 non-essential amino acids, as glutamic acid gave the highest percentage of 19.2%, and Tyrosine, Glysine, and Alanine, which were respectively (1.7, 2.1, and 3.0%). The above results were close to the proportions reported in the study [32] for basil seeds, except for tryptophan, which was not present in that study. According to the above results, the Iraqi cultivar under study was characterized by the presence of tryptophan, while studies indicate a rate of 3.7 [33], a value close to what we obtained in our study.

In a study comparing the amino acid and protein content of basil seeds and wheat bran, the results showed that the isolated protein extracted from basil seeds and wheat bran contains essential and non-essential amino acids that the body needs [34].

3-4 Elemental analysis of basil seeds using XRF-Instrument:

The results of examining the mineral elements of basil seeds using the fluorescent device showed that it contains a group of important mineral elements such as calcium, silicon, magnesium, sodium and potassium, and a lower percentage of iron, as calcium gave the highest percentage, which is (3.07%), followed by silicon, magnesium, sodium, potassium and sulfur, where their percentages were (2.75, 1.62, 1.69, 1.97, 1.75%), and the percentage of iron was 13.0% and 0.0145%, as shown in Figure (6-A), with almost non-existent percentages of toxic elements such as cadmium and lead, which were (0.0002, 0.0006), as shown in Figure (6-B). This is consistent with [35] and the current study, including the proportions of magnesium (215 ppm) and iron (22.74 ppm) in basil seeds, and the presence of calcium (177 micrograms), magnesium (64 micrograms), and sodium (4 micrograms). In a study that indicated the high content of holy basil seeds of mineral elements when compared to chia seeds [36] it showed that it contains calcium, magnesium, iron and amino acids in a manner close to the proportions of chia seeds. Therefore, basil seeds can be used in the production of gluten-free bread with chia seeds, highlighting the nutritional value of basil seeds. Also, basil seeds are important in terms of their low economic cost and energy consumption during grinding with their high content of micronutrients, especially Fe, Mn, and Zn. As a result, it can support human nutritional intake with this organic mine [37].

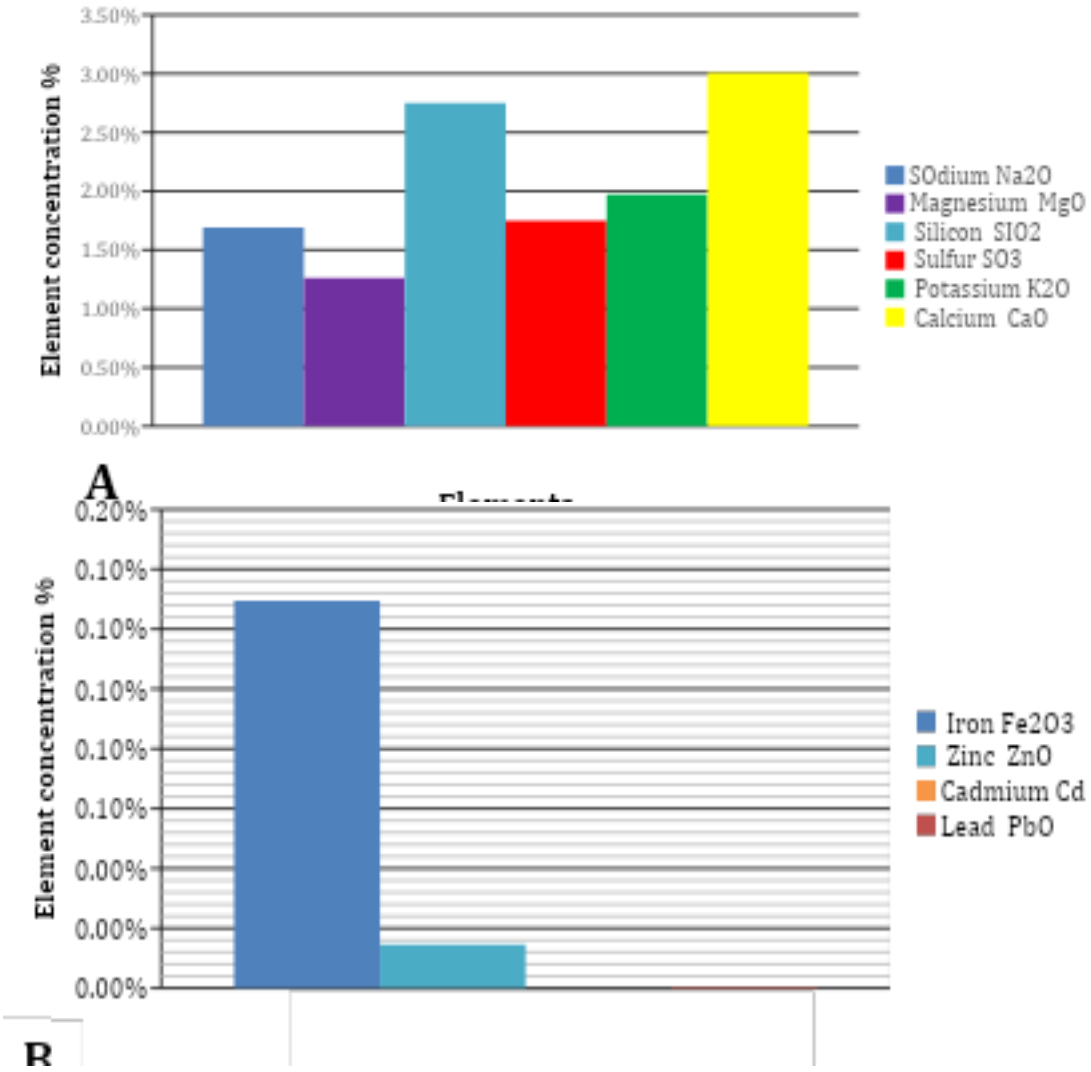


Figure (6): Concentrations of major and minor elements in basil seeds measured by X-ray spectrometry. (A) Represents the concentrations of major elements (sodium, magnesium, potassium, silica). (B) Represents the concentrations of minor elements (iron, zinc, cadmium, lead).

4. CONCLUSION

Basil seeds of the Iraqi cultivar showed in light of this study that they contain many very important nutritional elements and compounds to be a food source that can be used on a daily basis in addition to the possibility of benefiting from them as additives to food industries, in addition to the presence of effective compounds that can be adopted as antioxidants and very promising antibacterial, antifungal and anticancer agents, as shown below:

- Basil seeds contained a number of important compounds in food systems, and this was confirmed by the GC-mass examination, which contained alpha-linolenic and linoleic acids and terpenoids.
- HPLC analysis showed the presence of essential amino acids in basil seeds (Tryptophan, Leucine, Histidine, Threonine, Isoleucine, Phenylalanine) and non-essential amino acids (Glutamic Glycine, Tyrosine, Alanine, Arginine, Serine, Cystin) in addition to the presence of a group of vitamins E, D, K, A, C, B1, B2.
- Basil seeds were rich in minerals as the XRF device showed the presence of calcium, sodium, magnesium, potassium, silicon, and sulfur and the absence of toxic heavy elements.

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