The nutritional composition and vitamin E of three Iraqi okra (Abelmoschus esculentus L.) seeds oil

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Abstract. This study aimed to determination the nutritional and vitamin E analysis of the three Iraqi cultivars of okra (Abelmoschus esculentus L.) seeds oil. The phenolic compound, chlorophyll, carotenoid and minerals (Fe, Zn, Ca, K, Mg, Na, P) were determined in okra seeds oil. The oil from A. esculentus seeds were extracted using Bligh and Dyer with chloroform: methanol (1:1). The mean values of total phenolic, the results of this study the husayniyah seeds oil contained the highest pheolic content (34.73mg Gallic acid/100g oil) and chlorophyll and caroteniod (2.295, 2.813mg/kg oil) in husayniyah respectively. Batera seed oil had the highest percentage of vitamin E (3861.347 ppm) when estimation vitamin HPLC. The results showed that petra seed oil had the highest Mg(321 ppm) while phosphorus was (382.799ppm) in husayniyah.

1. Introduction
The scientific name of the okra is Abelmoschus esculentus and is called in English okra which belongs to the Kingdom of Planate, Magnoliophyta section, Magnoliopsida type, Malvales degree, Malvaceae family, Abelmoschus gender and the kind is Esulentus, It is believed that Okra was first found in Ethiopia [1] and moved to North Africa, the Mediterranean, the Arabian Peninsula and India in the twelfth century [2]. Okra is plant it is similar to cotton and cacao and grows in fertile soils but can grow in a wide range of soils, at high temperatures and acidic function (5.5-8) [3; 4], okra has a high nutritional value because it contains important essential nutrients, as it contains the right amount of vitamins such as vitamin A, E, and vitamin C and many of the minerals elements necessary for the body including sodium, potassium, magnesium and calcium and a small percentage of trace elements such as zinc, iron and nickel [5;6]. The hard cover of the seed contains a high percentage of raw fiber and mature seeds with a high nutritional value for its essential nutrients. It is rich in quality protein compared to "protein sources of other plant crops, as well as its content of oil, carbohydrates, dietary fiber, vitamins and minerals. [6],While [7] confirmed that the seeds of the plant are most important because of their high nutritional value, high protein and oil content, as well as antioxidants, but they are not used to produce any protein or oil despite the presence of large quantities of seeds Which are unsuitable for agriculture, Oil is concentrated in seeds with a range of 40-20% [8; 9] Oil extraction from oilseeds is extracted from several extraction methods, including the mechanical screw press express method and the solvent extraction method, which is the most common method used in these times, Including the cold method, which is highly efficient in the extraction of oils and fats followed by [10].The seeds are rich in phenolic compounds, mainly flavonoids, Catechins and Oligomeric derivatives, which are the most important antioxidants [11 ; 12]. A number of studies have shown that
phenolic compounds, including chlorophyll and carotene, have many physiological and biological activities as antioxidants and anti-inflammatory. Which play a "vital and effective" role in promoting health and protecting against the negative effects of free radicals. Carotenoids are vital compounds of yellow, orange and red color and more than 600 species have been identified carotenoids are spread in vegetables and fruits and are bio-active "fat-soluble" compounds, including beta-carotene, lycopene, leutin and xanthophane [13],[14] found that there was a variation in the content of phenolic compounds between the fruits of the Okra the total phenolic content in Anamika was 167.62 mg / 100g ,112.27 mg / 100 g in the Sinnova type and Its quantity in Shagun was 106.26 mg / 100g, [15] showed that the fruits of the okra contained good chlorophyll levels of 0.141 mg / 100g in Anamika and 0.135 mg / 100g in the Sadahar type. Tocopherols are natural antioxidants and vitamin E is the most important ingredient in nutrition, with four pictures α and β, Y and δ, α-tocopherol consider the most important, It reduces fat adhesion into cell walls this reduces the amount of cholesterol in the blood and comes to its role by capturing the roots of peroxide in cell tissues. Most vegetable oils contain high levels of tocopherols such as palm oil, corn oil, soybean oil, wheat germ oil and rice bran oil [16].And tocopherols, which are oil compounds dissolved in fat are not affected by acid and resist high temperatures in the absence of oxygen, These compounds are highly sensitive to ultraviolet radiation and oxidizing agents and are one of the most widespread antioxidants "[17]. Okra seed oil can be compared to most oilseed crops. In addition, Okra seed oil has an effect on lowering hypocholesterolemic cholesterol [18]. Minerals are essential in human nutrition all stages of growth require many minerals. The human body needs 22 "metal" elements, Which can be provided by appropriate diet in varying amounts for healthy growth, health and body maintenance [19], Minerals are essential for mental and physical health in general and are important elements in building bones, teeth, tissues, muscles, blood and neurons [20]. It also helps maintain the acid-base balance and nerve response to physiological stimulation and blood clotting [21]. Okra contains potassium, sodium, magnesium and calcium, as well as rare elements such as iron, nickel, manganese and zinc and contains trace amounts of chloride [5]. [22] explained that the seeds contain 80 mg / g of zinc .Due to the nutritional importance of Okra seed oil because it contains some of the important and effective compounds vital for the production of locally and the lack of studies on oil this study was to highlight the most important nutritional components. There is no use for the seeds of these okra and limited information about the nutritional value of the oil to okra seeds. The objective of this work is to determine the total phenolic compounds, chlorophyll and carotene and the amount of vitamin E.

2. Materials and Methods
2.1 Materials
Okra seeds were brought from city of Maysan, three varieties were obtained (Petra, batera and husayniyan) it's been shifted to the laboratories of the Department of Food Science / College of Agriculture / University of Basra for the extraction of oil and conduct some examinations and tests analysis on it. Methods
The seeds were cleaned from the soil, the remains of the horns and the lingering dirt. After that, the seeds were broken by the ordinary mortar for each individual type to facilitate grinding process. Which was then made by using an electric mortar to get the very soft seeds powder and then the seed powder was dried at a temperature of 50 ° C for two hours to obtain the least amount of moisture and put the seed powder in the bags of polyethylene sealed and kept refrigerated at a temperature of 4-5° C until the tests.

2.2 Extraction of oil
100 g of seed powder was weighed to extract the oil under the method described in [10] with some modulation. 200 mL chloroform was added and homogenized with an electric mixer at 2000 rpm. The same quantity of methanol was added and mixed at the same speed For 30 seconds, after which the mixture was filtered by the Whatman No.1 filter papers. The solvent was evaporated by the rotary evaporator at a temperature of 40 ° C to obtain the crude oil which was placed in clean, dry,
dark, tight closed containers and preservation in cold place to prepare it for the study of nutritional qualities.

2.3 Determination of Total phenolic contents
The total phenolic content in the okra seed oil was estimated using the Folin-Ciocalteau method in [23] by mixing 1 g of oil in 46 ml of distilled water and adding 1 ml of Folin-Ciocalteau reagent, mix well. "After 3 minutes, add 3 ml of 2% sodium carbonate and leave the mixture for 2 hours with intermittent shakes then measure absorbance by a wavelength of 760 nm.

2.4 Determination of chlorophyll and carotenoid
Carotenoids and chlorophyll were estimated according to the method described previously [24] By dissolving 7.5 g oil in 25 mL of cyclohexane and measuring absorbance by wavelengths of 470 nm for carotene and 670 nm for chlorophyll. Chlorophyll was evaluated on the basis of compound \( \alpha \)-pheophytin and carotene based on the Lutein compound

\[
\text{Chlorophyll (mg / kg)} = \frac{(A670 \times 106)}{(613 \times 100 \times d)}
\]
\[
\text{Carotenoid (mg / kg)} = \frac{(A470 \times 106)}{(2000 \times 100 \times d)}
\]

613: Molecular Absorption (\( \varepsilon \)) of the compound \( \alpha \)-pheophytin
2000: Molecular Absorption (\( \varepsilon \)) of the Lutein compound
D: cell thickness 1 cm.

2.5 Estimate vitamin E (tocopherol) by High performance liquid chromatography (HPLC)
The amount of vitamin E in the Okra seed oil samples was estimated by high performance liquid chromatography in the laboratories of the Environment and Water Department / Ministry of Science and Technology / Republic of Iraq. By injecting 20 μl of standard solution 25 ppm of vitamin E and extracted oil samples from the three varieties by pushing the model by liquid phase (v / v, 95: 5) water / methanol at 1 ml / min at a wavelength of 294 nm where the amount of vitamin E for oil was calculated depending on the following mathematical formula:

\[
\text{Concentration of sample (Cu)} = \frac{\text{The topsize of the sample (Au) \times \text{Response factor}}}{\text{Thesurfacesize of thestandardmatterial(As) \times \text{The concentration of the standardmatterial(Cs)}}}
\]

2.6 Determination of mineral elements
The mineral content of Okra seed oil was estimated according to the method mentioned previously [25], by taking 5 g of oil per model and 500 m in the Muffle furnace then melted ash in a few milliliters of hydrochloric acid concentration of 6 M and completed the volume to 50 ml with water-free ions to the mark, mineral elements were estimated by atomic absorption, Absorption Spectrophotometer Atomic Flame, in the University of Basra / Agriculture College / Soil Department

3. Results and Discussion
3.1 Phenolic content of Okra seed oil
Shown in Figure (1) the total content of phenols in the oil seeds of okra varieties petra, batera and husayniyah, husayniyah had the highest content in phenolic compounds 34.736 mg of Gallic Acid / 100 g oil, Then petra and batera 33.433,31.630 mg Gallic acid /100 g oil respectively, The results of the statistical analysis showed significant differences in total phenol content at probability level (P <0.05). these results came close to what [26] in a study showed that the total content of phenols in okra seed powder ranged from 34.89 - 39.39 mg / 100g of seeds, this is due to the difference of varieties, which leads to a difference in phenolic content as well as the method of extraction influence and environmental conditions” on that, While [27] mentioned the total phenolic content of okra seed powder defatted 24.25 mg / kg, While the total phenolic content of non-defatted okra seed powder
25.24 mg/kg. As for [28] The total phenolic content of Okra fruits 10.75 mg/Gallic Acid / 100 g, while the total phenolic content of okra seeds was 142.48 mg/Gallic Acid / 100 g. And [29] showed the total content of phenols in okra seeds was 56.06 mg/ Gallic Acid / 100 g, while [30] indicated that okra seeds had a total phenolic content of 1460-185 mg / Gallic Acid / 100 g, when compared with the total phenolic content of the oil okra seeds with that found [31] on the total phenolic content of olive oil 168.53 mg / kg, Phenolic compounds play an important role in contributing to the smell and flavor of the oil and its effect on its stability and stability as antioxidants that protect the oils from the effects of oxidation side effects resulting which make them undesirable and affect the quality and quality of those oils [32], while [33] in the study of phenolic compounds in virgin olive oil that the high content of phenolic compounds act as natural antioxidants increase the resistance of oil for storage and higher temperatures In addition, phenols are the main contributor to the taste of olive oil as well as "its role in the prevention of many Of human diseases.

![Phenolic content](image)

**Figure 1.** Total content of Phenolic in Okra seed oil for studied varieties

R.L.S.D total Phenolic 1.303

### 3.2 Carotenoid and chlorophyll

The results in Figure(2) showed no significant differences in oil content of both Husayniyah and Petra in carotene 2.813 and 2.627mg /kg oil respectively. While the seed oil of the batera varied significantly "and the value of carotene has 2.222 mg / kg oil, when comparing the value of carotene in okra seed oil of the studied varieties with what [34] found, the okra seed content of carotene was 1.7 mg / kg oil, while [35] found that the percentage of carotene in okra seeds 4.9% , when comparing the carotene values of okra seeds oil with some vegetable oils , [36] said the highest beta-carotene content was possessed by red palm oil 542.09 ppm and the lowest was in corn oil 0.91 ppm. Carotenoids and their engineering isomers play an "effective" role in protecting plant cells from oxidation and the resulting damage [13].

While figure (3) shows the values of chlorophyll in the oil of husayniyah, Petra and batera. There were significant difference at the probability level of (P <0.05) between Husayniyah and other varieties 2.295, 1.667 and 1.277 respectively, highest value of chlorophyll in husayniyah oil was 2.295 mg / kg oil followed by Petra seed oil 1.669 mg / kg oil and then the batera was 1.277 mg / kg oil, chlorophyll values were lower for the studied seed varieties than [37] found 6.05 mg / kg oil. when comparing the chlorophyll value of the seed oil studied with what [38] found, the value of chlorophyll for the palm oil extracted by Bligh and Dyer was 1.67 mg / kg oil and approached that with the value
of chlorophyll for the seed oil of Petra. The differences in chlorophyll and carotene values may be due to the different types of okra and the extraction methods [39].

**Figure 2.** The content of the okra seed oil the Petra, batera and husayniyah of carotene

**Figure 3.** The content of the okra seed oil the petra, batera, husayniyah of chlorophyll
3.3 Determination vitamin E in okra seed oil

Fig. 4, 5, 6, and table 1 shows the content of okra seed oil of (petra, batera and husayniyah) varieties of vitamin E and standard vitamin E, seed oil is characterized by a high content of this vitamin reached 2462.497, 3861.347, 1022.123 ppm respectively, as petra seed oil was higher in the content of vitamin E, followed by batera seed oil and then husayniyah seed oil, and these results were higher than found in the study [40] for two varieties of Pakistani okra seed oil, Sabzpardi and Punjab-8, where their contents were 700.80, 656.08 ppm respectively, as well as higher than the result of [41]. The value of vitamin E for okra seed oil was 872.30 ppm, by comparing the vitamin E content of the studied varieties with the content of palm oil, the vitamin content of it ranges from 150-1500 ppm. [42], while [43] showed that the total content of tocopherols in corn oil was 1006 mg / kg oil. Vitamin E content for soybean oil, rapeseed oil, sunflower oil, olive oil 937, 654, 625 and 133 mg / kg oil respectively, all lower than the vitamin values of the studied seed oil, while [44] reported that soybean content of vitamin E 1549 mg / kg oil, vitamin E concentration in corn was 1423 mg / kg oil, and the importance of vitamin E is due to its antioxidant role in the protection of polyunsaturated fatty acids [45:46], explained that the presence of tocopherols can protect oils or reduce oxidation of oil as natural antioxidants, [47;48] noted that the most important role of vitamin E is to prevent low-density lipoprotein (LDL) oxidation, which oxidizes the coronary arteries, leading to atherosclerosis and heart attacks, also found that there is a relationship between the low rates of heart disease with increasing rates of vitamin E through its role of antioxidant and protect the cells from the effects of free radicals, as well as its role in the protection of a number of important substances such as vitamin A and C of oxidation and damage in tissues.

Table 1. Okra seed oil content for studied varieties of vitamin E tocopherol

| Product      | Retention Time | Area     | Concentration of vitamin E (PPM) |
|--------------|----------------|----------|----------------------------------|
| Standard Model | 10.537         | 759.051  | 25                               |
| Petra        | 10.520         | 74766.443| 2462.497                         |
| batera       | 10.487         | 117238.393| 3861.347                         |
| husayniyah   | 10.503         | 31033.767| 1022.123                         |
**Figure 4.** Estimation of vitamin E standard with HPLC

**Figure 5.** Estimation of vitamin E in okra seed oil in petra by HPLC
Figure 6. Estimation of vitamin E in okra seed oil in batera by HPLC

Figure 7. Estimation of vitamin E in okra seed oil in husayniyah by HPLC
3.4 Mineral elements for okra seed oil batera, petra and husayniyah

The results in Table (2) indicate the content of okra seed oil from some mineral elements measured in ppm, Fe, Zn, Ca, K, Mg, Na and P. The results of the statistical analysis showed significant difference in mineral concentration at the probability level (P < 0.05) for the samples of the okra seed oil under study, noting that the iron element differed significantly among the three varieties, the highest concentration in Petra was 47.76 ppm. While zinc was not significantly different in its concentration, with the highest concentration in husayniyah 2.5 ppm. Husayniyah seed oil had the highest calcium concentration of 12.56 ppm followed by Petra with 7.126 ppm and its lowest concentration at batera with 2.29 ppm, but for K and Mg were the highest concentration in batera seed oil 171.33 and 362.76 ppm, respectively. The sodium component did not show a significant difference between the Petra and batera varieties. The concentration was 19.5 and 20.5 ppm respectively, while the husayniyah variety significantly differed from the previous two varieties with the highest concentration of 22.16 ppm and the superiority of batera seed oil with phosphorus content 393.47 ppm. For the rest of the other two categories, [49] found that okra seeds contain 14.04 ppm Fe, 4.95 ppm Zn, 23.45 ppm Na, 147.74 ppm K, 1007.16 ppm P, 81.77 ppm Ca, while [50] to the content of okra seeds of P 1450, Mg 3259.64, K 109.76, Ca 78.65, Na 54.78 mg /100 g. When comparing the content of okra seed oil with some vegetable oils, [51] found that the content of soybean oil from Fe, Zn and Na elements was 57.23, 7.863 and 59.567 ppm respectively, while the content of these elements in palm oil was 73.23, 11.928, 8.668 ppm and rice bran oil were 61.28, 8.271 and 31.080 ppm.

Table 2: The content of the Okra seed oil for the studied varieties of mineral elements

| Metal elements(PPm) | Samples | Petra | Batera | Husayniyah |
|---------------------|---------|-------|--------|------------|
| Iron                | 47.76   | 20.89 | 8.26   |
| Zinc                | 2.17    | 2.04  | 2.5    |
| Calcium             | 7.126   | 2.29  | 12.56  |
| Potassium           | 100     | 272   | 171.33 |
| Magnesium           | 321.33  | 362.67| 344.67 |
| Sodium              | 19.5    | 20.5  | 22.16  |
| Phosphorus          | 98.915  | 393.47| 382.799|

R.L.S.D Iron 12.633 R.L.S.D Calcium 4.833 R.L.S.D Potassium 71.333
R.L.S.D Phosphorus10.676 R.L.S.D Sodium1.656 R.L.S.D Magnesium 8.000

[52, 53] report that one of the most important quality standards in vegetable oils is their mineral content, and [54; 55] noted that minerals are essential in the human diet. While [56] said minerals have an important role in the physiological functions and metabolism of the body. However, knowledge of the structures and proportions of minerals in food is important and necessary, especially "trace minerals and their effect on flavor, oxidation and stability of oils, some minerals can catalyze the oxidation of fatty acid chains, resulting in a detrimental effect on shelf life and nutritional value [57; 58].

4. Conclusion

Okra (Abelmoschus esculentum L.) seeds oil as good sources of phenolic compounds, vitamin E and minerals such as potassium, phosphorus, magnesium, calcium and iron. Okra seeds oil have high contents of vitamin E its potential nutrition importance of okra seeds oil and its role in improved nutrition health, which considered as natural antioxidants. Scientific studies provide some evidence to support the potential beneficial effects of okra seeds oil compounds in lowering the risk of blood pressure, diabetes, chronic dysentery.
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