Physico-Chemical Properties, Fatty Acids Content, Oxidative Stability and Antioxidant Activity of some Virgin Olive Oil Cultivars

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Abstract:

The present study was carried out on virgin olive oil extracted from four olive cultivars namely: Chemlali, Kronaki, Frantoio and Pecual in an attempt to shed light upon physical and chemical properties of olive oils, assessment of fatty acids composition, oxidative stability of extracted oils, antioxidant activity, as well as fractionation of unsaponifiable matter by gas liquid chromatography.

The main results revealed that:

1- Chemlali fruits had the highest oil content (47.20%). Meanwhile, Pecual fruits recorded the lowest oil content (35.4%).
2- Chemlali oil recorded low acid value (0.738%). Meanwhile, Kronaki, Frantoio and Pecual samples recorded the highest values (0.845, 0.828 and 0.860%; respectively).
3- Iodine value of studied samples ranged from 82.5 to 86.5 for Chemlali and Kronaki cultivars; respectively.
4- Chemlali oil recorded the highest value of peroxide value (10.98 meq/kg). Meanwhile, the lowest value was was recorded Frantoio oils (8.77 meq/kg).
5- Kronkai oil recorded the highest percentage of unsaponifiable matter (1.84%), the lowest value was recorded for Pecual oil (1.36%).
6- Kronaki cultivar oil recorded the highest oxidative stability (26.20 hr.), followed by Chemlali, Frantoio and Pecual (23.80, 21.60 and 19.40 hr.; respectively).
7- Oleic acid was the most predominant unsaturated fatty acid in all studied samples, followed by linoleic acid. Meanwhile, palmitic acid was the major saturated fatty acid.
8- The studied virgin olive oils recorded the highest value of antioxidant activity in sunflower oil in comparison with synthetic antioxidant (BHT).
9- Sterol fraction represented about 29.60, 29.84, 29.45 and 29.05% of the total unsaponifiable matters of Chemlali, Kronaki, Frantoio and Pecual olive cultivar oils; respectively. Among the sterol components, β-sitosterol was the predominant component in all studied samples.

Keywords: Virgin olive oil, oxidative stability, antioxidant activity, fatty acids.

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Introduction:

Virgin olive (*Olea europaea* L.) oil is recognized as one of the best vegetable oils given its nutritional benefits in the human diet (Visioli and Galli, 1998).

Virgin olive oil is also more stable oil than other edible oils because of its high content of phenolic compounds, α-tocopherol, carotenoids and monounsaturated fatty acids.

Virgin olive oil is one of the most used dressings and cooking fats is Mediterranean countries, and is a central component of the diet in this region (Bendini *et al*., 2007). One of the most important characteristics of olive oils is the presence of a high content of oleic acid which accounts for 60-80% of the total fatty acids (FA) and for approximately 90% of the mono-unsaturated fatty acids (MUFA) (Uceda & Hermoso, 1998).

Polyunsaturated fatty acids (PUFA), namely linoleic and linolenic acids, account for 5-8% of total fatty acids and together with MUFA are considered to be nutritionally favourable (FAO, 1978). Virgin olive oil is an excellent oil for high temperature cooking being rich in MUFA and low in PUFA, particularly in linolenic acid, and in addition it is free of trans fatty acids, thus fulfilling all major criteria of the stable frying fats (Gomez-Alonso *et al.*, 2003).

The high nutritional value of extra virgin olive oils is related to the presence of many components with interesting chemical and nutritional properties, including antioxidants and sterols. These compounds, together with other minor components, contribute to the oxidative stability of the oil. In olive oil, there are series of compounds with asserted antioxidant power, such as polyphenols, carotenoids and tocopherols (Baldioli *et al*., 1996 and Aparicio *et al*., 1999).

Oxidative stability is an important parameter in evaluating the quality of oils and fats, as it gives a good estimation of their susceptibility to oxidative degeneration, the main cause of their alteration. The greater or lesser stability of an oil means the conservation or not of the so-called dynamic parameters during the useful life of the product (Aparicio *et al*., 1999).

The predominant phenolic compounds of virgin olive oil have an antioxidant effect. The phenolic compounds exhibited antioxidant activity which increased in the order tyrosol < caffic acid < oleuropein < hydroxytyrosol (Chimi *et al*., 1991). Virgin olive oil stability to oxidation is mainly due to phenolic compounds naturally occurring in it or arising from the glycated precursors present in the olive fruit before extraction. The stability to oxidation had been correlated to the total amount of phenolic compounds as well as to the o-diphenols and to selected simple phenol compounds (Papadopoulos and Boskou, 1991 and Gennaro *et al*., 1998).

The present investigation was carried out on virgin olive oil of four olive cultivars namely; Chemlali, Kronaki, Frantoio and Pecual in an attempt to shed light upon physical and chemical properties of olive oil, assessment of fatty acid, composition of olive oil by Gas liquid chromatography, oxidative stability of extracted oil, as well as antioxidant activity of virgin olive oils.

Materials and Methods:

Materials:

Source of olive fruits:

Four varieties of olive fruits (*Olea europea* L.) namely; Chemlalai, Kronkai, Frantoio and Peucal were obtained from Mersa Matroh during 2010/2011 season.

Methods:

Analytical Methods:

Extraction of oils:

Oil was extracted from all studied samples as described by Folch *et al*. (1957).

Oil content, moisture content refractive index, Thiobarbituric acid (TBA), unsaponifiable matter %, Acidity (as oleic acid), peroxide value (as milliequiv. Peroxides/kg oil) and iodine value (Hanus) were determined as outlined in AOAC (2005).

Diene and triene determination:

The ultraviolet absorbance at 232 nm (conjugated dienes) and 268 nm (conjugated trienes) of oil was measured on a UV-spectrophotometer (UV-160 IPC UV-visble spectrophotometer (SHIMADZU), according to the method described by Danopoulas and Ninni (1972).

About 0.1 mg of the oil was accurately weighed, dissolved in petroleum ether (b.p. 40-60°C) and transferred quantitatively to a 10 mL glass-stoppered volumetric flask. Absorbance readings were taken by diluting the original solution so that the observed absorbance was always between 0.1 and 0.5. The absorbance was corrected to calculate $E_{1cm}^{1\%}$ at 232 and 268 nm using the following formula:

Where: $E_{1cm}^{1\%} = A/CxD$

A is the absorbance of the solution at the specified wavelength.
C is the concentration of the oil in g/100 mL of the solution.
D is the length of the cell in cm.

Fatty acids composition:

Preparation of the fatty acid methyl esters:

About 0.1 g of oil was dissolved in 2 mL hexan and then 0.4 mL KOH in an hydrous methanol was added as reported by IVOOC (1991). Mixture was transesterfied with cold phenolic solution of potassium hydroxide. After 3 min, 3 mL water was added. The organic layer, separated by centrifugation, was dried by anhydrous sodium sulfate, and concentrated with N_2 stream to around 0.5 mL GC analysis of fatty acid methyl esters (FAME) at Agric. Res. Center, Giza.

Identification and determination of fatty acid methylesters:

Fatty acid methyl esters were directly injected into Agilent 6890 Series GC apparatus provided with a BD-23 colum (60 m x 0.32 mm x 25 µm). Carrier gas was N_2 with flow rate 2.2 ml/min, splitting ratio of 1:50 the injector temperature was 250°C and that FID detector was 270°C. The temperature setting was as follows 150°C to 225°C at 5°C/min, and then held at 225°C for 20 min.

Peaks identification were established by comparing the retention times obtained with standard methyl esters.

Measurement of oils stability by Rancimat:

Oxidative stability was evaluated by Rancimat method since it is a fast and reliable analytical procedure (Gutierrez, 1989) at Agric. Res. Center, Giza.

The stability of oils was measured using 679 Rancimat (Metrohm Ltd., Ch.9100 Herisau, Switzerland). The 679 Rancimat comprises of control unit and wet section containing six-reaction vessel. In the wet section, the oil samples (5g) were exposed to a stream of atmospheric oxygen (20 L/h) at 100±2°C. The volatile decomposition products (mainly organic acid) are trapped a measuring detected with distilled water (60 mL) and continuously detected with a conductivity cell (conductivity range 25-200 US/cm).

Conductivity curves and results are output on a built-in printer of the control unit. The induction time is the time needed to reach the break point of this curve (point of greatest curvature). The break point is designated as the intersection point of the two extrapolated straight parts of the curve. The induction time was then designated, i.e., the time of the start of the experiment and the intersection point.

Antioxidant activity:

Antioxidant activities of the studied virgin olive oil cultivars compared with synthetic antioxidant (BHT) were determined with a Rancimat apparatus (Metrohm, Herisan, Switzerland) by measuring the induction period of oils containing individually the antioxidant (200 ppm BHT) as well as 400 ppm of each virgin olive oil cultivars, according to the method described by Hasenhuettl and Wan (1992). The antioxidant index was calculated as:

$$\text{Antioxidant index} = \frac{\text{Induction period of oil with extract}}{\text{Induction period of oil alone}}$$

Fractionation of unsaponifiable matters by GLC:

Gas liquid chromatography apparatus (Agric. Res., Center, Giza) equipped with flame iodization detector was used in the identification of unsaponifiable matter under following conditions; the chromatograph was fitted with a stainless steel column 1.5 m x 4 mm outer diameter packed with acid-alkali washed and silanized diatomite (coated with 1% OV-17). The operation was carried out isothermally and the temperatures of injector, column and detector were 300°, 270° and 300°C, respectively. Gas flow rates were 30, 33, 300 ml/min for nitrogen, hydrogen and air; respectively. The chart spead was 2 ml/min and the attention was $32x10^{-2}$.

The peaks were identified by comparing their retention time with those of standards under the same conditions as reported by Farag *et al*. (1982).

Results and Discussion:

The physico-chemical properties of virgin olive oils:

Some physical and chemical properties of virgin olive oils extracted from four olive cultivars namely: Chemlali, Kronaki, Frantoio and Pecual were studied, and the results are tabulated in Table (1).

The obtained results showed that Chemlali fruits had the highest oil content (47.20%) on dry weight basis. Meanwhile, Pecual fruits recorded the lowest oil content with percentage of 35.40% on dry weight basis. Results showed that the refractive index of studied samples were 1.467, 1.467, 1.471 and 1.468 for Chemlali, Kronaki, Frantoio and Pecual; respectively.

Virgin olive oil characterized by less linoleic acid percentage compared to other plant oils which contained substantially higher percentages of linoleic acid ($C_{18:2}$). These results coincide with Ismael (1989); Mohamed (1999); Ahmed

(2004) and Abd El-Fattah (2007). It is obvious that there is a direct proportional relationship between percentages of $C_{18:2}$ and refractive index. The more the increase in refractive index, the highly the degree of unsaturation, especially dienoic fatty acid in the oil.

The obtained results agree with the limits for edible olive oil as reported in Codex Alimentarius Standard (2003); and Egyptian Standards (2005), in which virgin olive oils show refractive index at 20°C ranged between 1.4677-1.4705.

Concerning the acidity of tested samples measured as oleic acid the tabulated results showed that Chemlali cultivar recorded low acid value (0.738%). Meanwhile, Kronaki, Frantoio and Pecual samples recorded the highest values (0.845, 0.828 and 0.860%; respectively).

Table (1): Physical and chemical properties of virgin olive oils.

Properties	Olive cultivars			
	Chemlali	Kronaki	Frantoio	Pecual
% oil content	47.20	45.09	42.74	35.40
Refractive index	1.467	1.467	1.471	1.468
Acid value (% oleic acid)	0.738	0.845	0.828	0.860
Iodine value	82.50	86.50	85.85	86.00
Peroxide value (meq/kg oil)	10.98	8.80	8.77	9.68
TBA (538 nm)	0.604	0.572	0.588	0.615
Diene (232 nm)	0.288	0.183	0.181	0.227
Triene (268 nm)	0.157	0.103	0.095	0.145
Unsaponifiable matter %	1.62	1.84	1.49	1.36

The acid value or the free acidity had been frequently used as important parameters to monitor the quality of oils and to show the case of hydrolysis induced in the oil. These results agree with those reported by Codex Alimentarius Standard (2003); Egyptian Standards (2005) and IOOC (2008), in which the free acidity of extra virgin olive oil ≤ 0.8.

The iodine value represents one of the parameters that could differentiate between the qualities of oils. The iodine value is used to indicate the degree of unsaturation of oil fatty acids or for measuring the number of double bonds present in the oil.

The tabulated data indicated that the iodine value of studied samples was ranged from 82.50 to 86.50. These results are in good agreement with Codex Alimentarius Standard (2003); Shehata *et al*. (2004) and Egyptian Standards (2005) findings.

The peroxide value is used as an index of the degree of oxidative rancidity of oils. The peroxide values of oils extracted from Chemlali, Kronaki, Frantoio and Pecual cultivars were 10.98, 8.80, 8.77 and 9.68 meq/kg of oil; respectively. In general, the peroxide value of studied samples was within the permissible limits for human consumption (20 meq/kg oil) for virgin olive oil according to IOOC (2003).

Concerning the thiobarbituric acid value of olive oil samples, the obtained results showed that the TBA values ranged between 0.572 to 0.615. The tabulated results indicated that lesser oxidation products were found in all studied samples. These results are in good agreement with those reported by Codex Alimentarius Standard (1999) and Egyptian Standards (2005).

The spectrophotometric measurement is one of the physical methods which is particularly useful in composition studies on fats and oils and in the analysis and identification of fatty materials. It had been employed for studying and following chemical reactions of fatty materials, especially isomerization, polymerization, oxidation and the determination of rancidity in oils.

In the case of non-conjugated and saturated oils, the absorption of light in the ultraviolet region of the spectrum is weak and cannot be used for analytical purposes. When linoleic and linolenic acids or more highly unsaturated fatty acids are oxidized to form hydroperoxides, the double bonds in the oils become conjugated. The hydroperoxides and the conjugated diene which may result from its decomposition show a strong, absorption band at about 232 nm, while conjugated triene and the secondary oxidation products, show an absorption band at 270 nm.

The obtained results in Table (1) revealed that conjugated diene had the values of 0.288, 0.183, 0.181 and 0.227 for Chemlali, Kronaki, Frantoio and Pecual olive oils; respectively. On the other hand, the values of triene recorded 0.157, 0.103, 0.095 and 0.145 for oils extracted from Chemlali, Kronaki, Frantoio and Peucal olive cultivars; respectively.

These results are in good accord with Codex Alimentarius Standard (2003) and IOOC (2008).

Kronaki oil recorded the highest percentage of unsaponifiable matter, it was 1.84%. Meanwhile, the lowest value was recorded for Pecual cultivar as it was 1.36%, followed by Frantoio and Chemlali oils (1.49 and 1.62; respectively). These results agree with those reported by Codex Alimentarius Standard (2003); Egyptian Standard (2005) and IOOC (2008) which had the range of 1.5% for olive oils.

Oxidative stability:

Results of oxidative stability of studied olive oil samples are presented in Table (2).

Table (2): Oxidative stability of oils extracted from olive cultivars.

Olive cultivars	Induction period (hr.)
Chemlali	23.80
Kronaki	26.20
Frantoio	21.60
Pecual	19.40

The obtained results showed that Kronaki cultivar oil recorded the highest stability (26.20 hr.), while the lowest value (19.40 hr.) was recorded by Pecual cultivar oil. On the other hand, it could be noticed that the oxidative stability of both Chemlali and Frantoio oils recorded 23.80 hr. and 21.60 hr.; respectively. These results are in harmony with those reported by Gennaro *et al*. (1998) and Ali (2008), who reported that the stability of olive oil samples correlated mainly with the total polyphenols content.

Oxidative stability, although not considered a standard parameter of quality, is useful to provide information about the hypothetical oil's shelf life. It is usually evaluated by the induction time, the time period until a critical point of oxi-

dation is reached, and is developed a sensorial degradation of the oil as a consequence of a sudden acceleration of the oxidative process.

The resistance to oxidative deterioration is usually attributed to two main reasons: (a) the fatty acid composition that, in the case of olive oil, is characterized by a high monounsaturated-to-polyunsaturated fatty acid ratio (Aparicio *et al*., 1999 and Salvador *et al*., 1999), and (b) the pool of minor compounds of powerful antioxidant activity which, in this case, is constituted mainly by tocopherols and polyphenols.

Fatty acid composition:

The fatty acids composition of olive cultivar oils were determined using gas liquid chromatography. The obtained results are presented in Table (3).

Concerning the fatty acids composition of studied olive oils, it could be noticed that it contained palmitic acid as a major saturated fatty acid (22.676%, 15.724%, 19.796% and 15.198%), followed by stearic acid (2.721%, 2.434%, 2.590% and 2.977%) in Chemlali, Kronaki, Frantoio and Pecual olive oils; respectively. As for the unsaturated fatty acids, it is clear that oleic acid was the most predominant fatty acid among not only unsaturated ones, but also all over the fatty acids identified in studied olive cultivar oils. It amounted to 50.380%, 66.668%, 54.300% and 61.837% in Chemlali, Kronaki, Frantoio and Pecual olive oils; respectively.

On contrary, the least amount of fatty acids was linolenic acid which recorded 0.849%, 0.866%, 0.825% and 0.678% in Chemlali, Kronaki, Frantoio and Pecual olive oils; respectively.

On the other hand, linoleic acid was in a medium amount which recorded 19.920%, 11.891%, 19.267% and 17.370% for Chemlali, Kronaki, Frantoio and Pecualo olive oils; respectively. However, palmitoleic acid for the olive oil of four studied cultivars was found in small amounts which recorded 2.698, 1.595, 2.446 and 1.144% for Chemlali, Kronaki, Frantoio and Pecual olive oils; respectively.

Generally, there are two most important parameters related to fatty acid composition of any oil, one is the ratio of total saturated fatty acids/ total unsaturated fatty acids, which related to the oxidation stability of the oil, while the second is oleic/linoleic ratio, which has a positive effect on the taste of the oil (Ranalli *et al*., 2001). From the above data (Table 3), it could be noticed that oleic/linoleic ratio was higher in Kronaki olive oil (5.610) followed by Pecual, Frantoio and Chemlali, which recorded 3.560, 2.818 and 2.530; respectively.

Table (3):Fatty acid composition of olive cultivar oils (% of total fatty acids).

Fatty acids	Carbon chain	Olive cultivars			
		Chemlali	Kronaki	Frantoio	Pecual
Palmitic	$C_{16:0}$	22.676	15.724	19.796	15.198
Palmitoleic	$C_{16:1}$	2.698	1.595	2.446	1.144
Stearic	$C_{18:0}$	2.721	2.434	2.590	2.977
Oleic	$C_{18:1}$	50.380	66.668	54.300	61.837
Linoleic	$C_{18:2}$	19.920	11.891	19.267	17.370
Linolenic	$C_{18:3}$	0.849	0.866	0.825	0.678
Arachidic	$C_{20:0}$	0.466	0.408	0.447	0.434
	$C_{22:0}$	0.290	0.414	0.329	0.362
Total saturated fatty acids		26.153	18.980	23.162	18.971

Total unsaturated fatty acids	73.847	81.020	76.838	81.029
TSFA/TUFA	0.354	0.234	0.301	0.234
Oleic/Linoleic	2.530	5.610	2.818	3.560

Generally, Pecual and Kronaki oils, had higher content of total unsaturated fatty acids (81.029% and 81.020%) than Frantoio and Chemlali which recorded (76.838% and 73.847%); respectively. Such higher content of unsaturated fatty acids could be correlated with higher iodine value of Pecual and Kronaki oil cultivars which was previously measured (Table 1). The tabulated data showed that total saturated fatty acids was 26.153, 18.980, 23.162 and 18.971% in Chemlali, Kronaki, Frantoio and Pecual olive cultivars; respectively. The ratio of saturated fatty acids/unsaturated fatty acids was 0.354, 0.234, 0.301 and 0.234 for Chemlali, Kronaki, Frantoio and Pecual cultivar oils; respectively.

These results are in good accord with those reported by Codex Alimentarius Standard (2003); Egyptian Standards (2005); IOOC (2008) and Almoselhy (2010).

Results of fatty acids tabulated in Table (3) indicated that all determined fatty acids were in the limits required for standards. For example the limits required were (55.83%) for oleic acid, (7.5-20%) for palmitic, (3.5-21%) for linoleic acid and (0.5-5%) for stearic acid, which agree with the above-mentioned results.

Antioxidant activity of virgin olive oils:

Antioxidant activities of studied olive cultivar oils extracts are presented in Table (4). BHT was presented for comparison.

Refined sunflower oil was evaluated for oxidative stability based on Rancimat method technique. This method assigned the induction period for the onset of oxidative rancidity in sunflower oil at 100°C. Tabulated data showed that the highest induction period was shown for sunflower oil with 400 ppm polyphenols of Kronaki olive oil (15.56 hr and 1.87 antioxiant activity), followed by sunflower oil with 400 ppm polyphenols of Chemlali olive oil (14.80 hr and 1.779 antioxidant activity).

Moreover, sunflower oil with 400 ppm polyphenols of Frantoio and Pecual olive cultivar oils recorded 14.12 hr and 12.80 hr; respectively. On the other hand, the same data showed that the induction period of sunflower oil with BHT at 200 ppm recorded 13.60 hr and antioxidant activity 1.635.

Table (4): Antioxidant activities of virgin olive cultivar oils.

Treatment	Induction period (hr)	Antioxidant activity in SFO
Sunflower oil	8.32	--
SFO + BHT (200 ppm)	13.60	1.635
SFO + Chemlali (400 ppm)	14.80	1.779
SFO + Kronaki (400 ppm)	15.56	1.870
SFO + Frantoio (400 ppm)	14.12	1.697
SFO + Pecual (400 ppm)	12.80	1.538

Therefore, polyphenols of all studied olive cultivar oils had almost the same effect as an antioxidant agent that could prolong the induction period of sunflower oil to the same extent.

Generally, it could be concluded that, polyphenols extract from olive oils can react as antioxidant which delayed the oxidation. In addition, it is safe to use the natural antioxidants rather than the artificial ones BHT which are definitely harm to the human health (Tappel, 1995). In consumer friendly way of improving oxidative stability of frying oils is the addition of natural antioxidant components of plant origin. Several herbs, spices and leaf extracts had been used as sources of natural antioxidants for the enrichment of oils used for frying (Shyamala *et al*., 2005 and Seleim, 2010).

These results are in agreement with those reported by Kiralan *et al*. (2009), they found that the high total polyphenols content increased the antioxidant activity and there was a linear correlation between phenolic content and antioxidant activity.

Unsaponifiable matters composition:

Unsaponifiable matters of virgin olive cultivar oils were fractionated by gas liquid chromatography technique. The relative percentages of unsaponifiable matters were calculated and presented in Table (5). From the tabulated data, it could be observed that sterol fraction represented about 29.60, 29.84, 29.45 and 29.05% of the total unsaponifiable matters of Chemlali, Kronaki, Frantoio and Pecual olive cultivar oils; respectively. Whereas, hydrocarbon fraction represented about 70.40, 70.16, 70.55 and 70.55% of the total unsaponifiable matters of Chemlali, Kronaki, Frantoio and Pecual olive cultivar oils; respectively.

Among the sterol components, β-sitosterol was the predominant component in all studied samples. On the other hand, squalene was the predominant component of hydrocarbons in all studied samples.

In general, it could be concluded that β-sitosterol, stigmasterol, phytosterol and campasterol, were the major sterols in all studied olive cultivar oils. These sterols were found to have an antipolymerization effect which could protect oils against oxidation during prolonged heating at high temperatures (Gordon, 1989).

The tabulated data showed that the lowest percentage of squalene/total hydrocarbons ratio (sq/TH%) was recorded by Pecual olive oil (84.49%), while Chemlali olive oil had the highest value (86.47%), followed by Fantoio (86.18%) and Kronaki (86.02%). These results are in good accord with those recorded by Lanzon *et al*. (1994) and Badawy and Khalil (1996). Besides, the data showed that the studied olive cultivar oils had levels of the unsaponifiable matters in accordance with the limits reported in IOOC (2003).

Table (5): Unsaponifiable matters of virgin olive cultivar oils (% of total unsaponifable matters).

Unsaponifable matters	Virgin olive cultivars oils			
	Chemlali	Kronaki	Frantoio	Pecual
C14	0.04	0.06	0.04	0.04
C15	0.11	0.15	0.09	0.25
C17	0.70	0.82	0.66	0.50
C18	0.30	0.50	0.42	0.36
C19	0.20	0.32	0.22	0.18
C20	0.10	0.24	0.16	0.12
C21	0.21	0.24	0.11	0.12
C22	1.60	1.80	1.40	1.40
C24	2.41	1.68	2.73	2.82
C26	2.00	2.20	2.72	2.96
C28	1.50	1.80	1.20	1.90
Squalene	60.23	60.35	60.80	60.30
Unknown	0.49	0.42	0.46	0.42
Campasterol	0.52	0.65	0.68	0.66
Stigmasterol	0.81	0.76	0.72	0.75
β-sitosterol	27.04	27.19	26.93	26.62
Phytosterol	0.74	0.82	0.66	0.60
TH%	70.40	70.16	70.55	70.95
TS**	29.60	29.84	29.45	29.05
TH/TS	2.38	2.35	2.40	2.44
Sq/TH%	86.97	86.02	86.18	84.99

* TH = Total hydrocarbons.
** TS = Total sterols.

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الخواص الطبيعية والكيميائية ، محتوي الأحماض الدهنية ، الثبات الأكسيدي والنشاط المضاد للأكسدة في زيوت بعض أصناف الزيتون

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أجريت الدراسة علي الزيوت المستخلصة من أربعة أصناف من ثمار الزيتون وهي الشملالي ، الكروناكي، الفرانتيو ، البيكوال. وقد تمت الدراسة لمقارنة الأصناف من حيث الخواص الطبيعية والكيميائية للزيوت البكر المستخلصة ، بالإضافة إلي تركيب الأحماض الدهنية باستخدام التحليل الكروماتوجرافي الغازي ، وكذلك دراسة الثبات الأكسيدي للزيوت المستخلصة باستخدام جهاز الرانسيمات، والنشاط المضاد للأكسدة مقارنة بمضادات الأكسدة الصناعية. بالإضافة إلي تركيب المواد غير المتصبنة باستخدام جهاز التحليل الكروماتوجرافي الغازي. وقد توصلت النتائج إلي ما يلي:

١- سجلت ثمار الشملالي أعلي نسبة من الزيت (٤٧,٢٠%)، بينما سجلت ثمار البيكوال أقل نسبة من الزيت (٣٥,٤٠%).

٢- سجلت ثمار الشملالي أقل نسبة من الحموضة (٠,٧٣٨%) بينما كانت نسبة الحموضة (٠,٨٤٥، ٠,٨٢٨ ، ٠,٨٦٠%) في أصناف الكروناكي ، الفرانتيو ، البيكوال، علي التوالي.

٣- كانت قيم الرقم اليودي تتراوح بين ٨٢,٥٠ للصنف الشملالي ، ٨٦,٥ للصنف الكروناكي.

٤- سجل الزيت المستخلص من الصنف الشملالي أعلي قيم لرقم البيروكسيد ١٠,٩٨ (ملي مكافئ/كجم زيت) ، بينما كان أقلها في الصنف الفرانتيو ٨,٧٧ (ملي مكافئ/كجم زيت).

٥- كانت أعلي نسبة للمواد غير المتصبنة في الزيت المستخلص من الصنف كروناكي (١,٨٤%)، بينما كانت أقل نسبة في الزيت المستخلص من الصنف بيكوال (١,٣٦%).

٦- سجل الزيت المستخلص من الصنف كروناكي أعلي قيمة للثبات الأكسيدي (٢٦,٢ ساعة) يليها كل من الشملالي ، الفرانتيو ، البيكوال حيث سجلت ٢٣,٨ ساعة ، ٢١,٦٠ ساعة ، ١٩,٤ ساعة، علي التوالي.

٧- استبان من نتائج تركيب الأحماض الدهنية أن حامض الأوليك هو الحامض الدهني غير المشبع السائد في جميع الأصناف المدروسة ويليه حامض اللينولييك. بينما كان حامض البالمتيك هو الحامض الدهني المشبع السائد في جميع الأصناف المدروسة.

٨- أوضحت النتائج أن الزيوت المستخلصة من ثمار الزيتون ذات نشاط مضاد للأكسدة مرتفعاً مقارنة بمضادات الأكسدة الصناعية وذلك لمحتواها المرتفع من المواد الفينولية.

٩- أوضحت نتائج التحليل الكروماتوجرافي الغازي للمواد غير المتصبنة احتواء زيوت الزيتون المستخلصة من الثمار المدروسة علي نسبة مرتفعة من الاستيرولات (٢٩,٦٠% ، ٢٩,٨٤% ، ٢٩,٤٥% ، ٢٩,٠٥%) في كل من أصناف الشملالي ، الكروناكي ، الفرانتيو ، البيكوال، علي التوالي. وكان مركب بيتا – سيتوستيرول هو المركب السائد في جميع العينات المدروسة.