Sensory Analysis of some Egyptian Olive Oils in Relation to their Volatile Compounds and Chemical Composition.

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ABSTRACT

The objectives of the present study were to characterize the sensorial properties of the virgin olive oils, that produced in the year crop 2009/2010 in two different areas of Egypt, Siwa oasis and Giza, and their relations to the volatile compounds and chemical composition. Results revealed that the free fatty acid content of all cultivars olive oils was below 1, except for VOO of Maraqi cultivar was 1.20%(as Oleic acid). Whereas, peroxide value was lower than 2.76 meq O_2/kg for studied olive oils. Data showed that the values recorded at 232 and 270 nm and ΔK for all samples studied complied with IOC limits for extra virgin olive oil. Also data showed that all studied VOO, the oleic acid was always the most abundant fatty acid (monounsaturated), representing the 67 % of the total fatty acid composition at least, except for VOO of Arbequina where was only 44 %.The VOO of Maraqi and Wattagen showed the lowest total SFA (14.83 and 14.81, respectively) and, hence, the highest total USFA (85.08 and 85.12, respectively), while that of Arbequina showed the highest total SFA (23.28%) and the lowest total USFA (76.58%) as compared to the other VOOs. Furthermore, VOO of Coratina had the highest content of total tocopherols (798.649 mg/kg) and VOO of Wattagen had the lowest content of total tocopherols (559.089 mg/kg). Voo of Maraqi and Arbequina contained 3-nonen-1-ol (Z) as the most abundant volatile compound (2675.594, 2192.071 ppm ,respectively). Data showed that VOO of Wattagen contained 1-undecanol and 1,10 decanediol as the most prevalent volatile compounds (7150.116 and 7150.107 ppm, respectively). Results also revealed that VOO of Koroneiki contained 2-nonen-1-ol (z) as the most abundant volatile compound (2799.950 ppm), On the other hand, VOO of Coratina showed the lowest number of detectable volatile compounds (only 5 compounds), 1,9- nonanediol being the most abundant (632.055 ppm). Sensory data showed that The highest median of fruity , bitter and pungent (7,4 and 5 , respectively) were found for Coratina olive oil. Finally, data showed that no defects in all studied VOOs. Sensory properties of detected volatile compounds of Maraqi olive oil were Fresh, green, fruity, floral, rose, fatty, nutty, coconut, herbal and sweet.. Sensory properties of detected volatile compounds of Wattagen olive oil were Fruity, green, floral, tomato, nutty, fatty, waxy, citrus, sweet and herbal. Octanal , heptanal and other detected compounds were responsible about pungent and bitter for Maraqi and Wattagen olive oils. These data agreed with the results of sensory analysis of Maraqi and Wattagen olive oils. Also, sensory properties of detected volatile compounds of Arbequina, Koroneiki, Coratina olive oils agreed with the results of sensory analysis .

Keywords: Sensory analysis, Egyptian olive oil, Maraqi, Wattagen, Arbequina, Koroneiki, Coratina, Volatile compounds and Chemical composition, Virgin Olive Oil (VOO).

INTRODUCTION

Virgin olive oil (VOO), an excellent natural food, is obtained from olive fruit by mechanical or physical procedures. Its composition varies widely, depending on fruit variety, degree of fruit ripeness, environmental conditions, grown region, and techniques of processing and storage (Barranco *et al.*, 1996). VOO has a high resistance to oxidative deterioration due to its fatty acid composition and its phenolic content.

The chemical composition of VOO shows several compounds such as hydrophilic phenols, that affecting its sensorial and healthy properties, differentiate VOO from all the other vegetable oils used by humans. Chemical composition of VOO consists of major and minor components. The major components, that include triacylglycerols, represent more than 98% of the total oil weight. Minor components, that are present in very low amount (about 2% of oil weight), include more than 230 chemical compounds such as aliphatic and triterpenic alcohols, sterols, hydrocarbons, volatile compounds and antioxidants (Servili *et al.*, 2004).

The nutritional value of olive oil arises from high level of oleic acid and minor components, such as phenol compounds (De Nino A. *et al.*, 2000), whereas the aroma is strongly influenced by volatile compounds (Kiritsakis, 1998; Angerosa, 2002). Nutritional value and pleasant flavour have contributed to an increase in consumption of olive oil which has fostered cultivation of olives outsides the traditional olive oil producing region of the Mediterranean and into newer areas where cultivars adaptability, different climatic conditions and different agronomic practices may alter olive quality (Patumi *et al.*, 2002). Olive oil quality may be defined from commercial, nutritional or sensorial perspectives (Duran, 1990).

Recently, extra virgin olive oil (EVOO) has been in great demand by the consumers due to its nutritional, sensorial and functional properties. The desired aroma characteristics of EVOO are the result of the phenolic and volatile contents of the olive oil (Morales *et al.*, 1997). Factors such as cultivar, environment and cultural practices determine the quality and uniqueness of specific EVOOs (Cosio *et al.*, 2006). The geographical origin of olive oil is one of the most significant factors affecting the aroma profile of olive oil (Araghipour *et al.*, 2008). The detection of the aromatic volatiles is important in EVOO quality control (Morales *et al.*, 1997). The conventional analytical methods that include GC (Angerosa *et al.*, 2000), and GC/MS (Tura *et al.*,2004) and sensory analysis(Angerosa *et al.*, 2000,

Caporale *et al.*, 2006 and Cimato *et al.*, 2006) have been used for the geographical differentiation of EVOO.

The world production of olive oil is 2881,5 thousand tons (2009/2010), with approximately 2148,5 thousand tons 74.56 % coming from the European Community (EC) (IOC, 2010) . According to the recent International olive council (IOC) report (IOC, 2010), Egypt produced 2000 tons (approximately 0.07 %) of the world olive oil production over that time. Egypt consumption is 5000 tons of olive oil and imported 3000 tons of olive oil at season 2009/2010 (IOC, 2010).

The International Olive Council (IOC, 2006) and the European Commission (EEC, 1991) have defined the quality of olive oil, based on parameters that include free fatty acid (FFA) content, peroxide value (PV), UV specific extinction coefficients (K_{232} and K_{270}) and sensory score. In particular, the quantity of FFA is an important factor for classifying olive oil into commercial grades (Boskou, 1996; Rossell, 1986). The general classification of olive oils into the different commercial grades is based on FFA and sensory characteristics (taste and aroma). The commercial grades separate oil obtained from the olive fruit solely by mechanical or physical means (virgin) from the other oils that contain refined oils (Kalua *et al.*, 2007).

Sensory analysis has been defined as a scientific discipline which consists of a panel of trained or untrained panelists. Generally, it is used to discriminate olive oil with respect to its region of origin, variety, ripeness and extraction techniques (Cimato *et al.*, 2006). The sensory quality of a food points to its desirability and acceptability. Color, taste and aroma are the main variables for the definition of the quality of olive oils (Angerosa, 2000).

Sensory evaluation of olive oil is the main criterion for evaluating its quality. The organoleptic quality of olive oils depends on several factors, one of which is cultivars. The organoleptic quality of the oils was assessed in the light of the following parameters: aromas, total phenols, and phenol composition (Dhifi *et al.*, 2006). Volatile compounds have a significant role in determination of correlation between the olive oil quality and sensory appreciation (Cimato *et al.*, 2006).

Flavor is one of the most important qualities of foodstuffs and plays a major role in consumer acceptance. Sensory evaluation is generally

considered to be the ultimate method to measure flavor quality of foodstuffs, because chemical and instrumental procedures lack the acuity of the human senses and the ability to integrate perceptions. In recent years, however, many attempts have been made to obtain more objective results by using volatile compounds analysis and correlation between instrumental and sensory data (Jacobson *et al.*, 1989). Pilgrim and Schutz (1957), Noble *et al.*, (1987), and Kuentzel and Bahri (1991) tried successively to relate sensory perceptions with chemical components.

The main quality assays include organoleptic characteristics, free acidity, peroxide values and absorbance in the ultraviolet region.(Ceci and Carelli, 2007).In most cases quality parameters change by the time the oil reaches the consumer (Gutierrez and Fernandez, 2002). Olive oil is susceptible to both hydrolytic and oxidative reaction (Duran, 1990) that can adversely affect oil quality parameters. For instance, an increase in PV, K_{232} and K_{270} values and development or loss of certain volatile compounds is very common between extraction and consumption (Boskou, 1996; Gutierrez and Fernandez, 2002). The presence or absence of particular volatile compounds may also be a good indicator of olive oil quality changes.

Several factors are known to affect the quantitative profile of olive fruits. Among these factors, the degree of ripeness, the geographic origin and the nature of the cultivar are certainly those that have a pronounced influence on the composition. Some studies were already published concerning the influence of these factors on some French (Amiot *et al.*, 1986); Spanish (Botia *et al.*, 2001); Italian (Esti *et al.*, 1998; Romani *et al.*, 1999;), Portuguese (Vinha *et al.*, 2005) and Tunisian cultivars (Lazzez A., *et al.*, 2008).

Olive oil sensory quality is so important that the relevant European Communities (EC) regulation and International olive oil (IOC) include sensory analysis (EEC, 1991; IOC, 2007).

Because synergy and antagonism processes between volatile compounds contribute to the sensory evaluation of virgin olive oil, it is of great interest to ascertain the relationship between sensory attributes and volatiles responsible for them (Aparicio *et al.*, 1996).

Thus, the main objective of the present paper was to highlight the relation of sensory analysis of some Egyptian olive oils and its volatile compounds and chemical composition.

MATERIALS AND METHODS

SAMPLES

Olive oils of some Egyptian cultivars were obtained during season 2009/2010 from Agricultural Research center, Giza, Egypt. These olive oils were Maraqi and Wattagen cultivated in Siwa oasis (in the west of Egypt) and Coratina, Koroneiki and Arbequina cultivated in Giza (in the middle of Egypt). These oils were extracted using a two phase continuous extraction system (Toscana Enologica Mori, Italy). Olives were crushed by using a hammer mill, operating at 3000 rpm, malaxation of pastes was made in a mixer at 14 rpm and 30℃ for 1 h. Separation of the paste into oily must and pomace was performed by a tow phase centrifugal decanter working at 3500 rpm. Finally a horizontal centrifuge at 40℃, operating at 6500 rpm and fed with 1L tap water/ kg oily must, was used to remove the remaining solids from the must. All oil samples were filtered through anhydrous Na_2SO_4 and stored at -18℃ in dark glass bottles prior to analysis.

METHODS

Free fatty acids, peroxide value and UV light absorption (K_{232}, K_{270}, ΔK) were determined following the official analytical methods described in EC Regulation 2568/91 (EEC, 1991).

Fatty acids composition

The fatty acids composition was determined as methyl esters following the procedures described in the enclosures of the Commission Regulation EEC no. 2568/91: 0.15 g oil plus 1 mL hexane plus 0.1 mL 1 N KOH in methanol were shaken vigorously for 5 min. Subsequently 0.25 ml of the supernatant was taken, deposited in a vial and dissolved in 1.5 ml of the hexane.

GC-FID analysis

Hexane solution (1 µL) was injected into GC (Agilent 6890N) equipped with a capillary column SP-2340 (60 m x 0,25 mm i.d., 0.2 µm f.t., Supelco). The separation was carried out with a programmed temperature (110 ℃ for 5 min, increase of 3 ℃/min to 150 ℃ for 16.33 min, increase of 4 ℃/ min to 230 ℃ for 27 min) and FID detector at 260 ℃. The results are expressed in percentage of chromatographic areas (De Nino *et al.*, 2008).

Tocopherols analysis

Olive oil (0.6 g) was dissolved with hexane until 10 mL. This solution was filtered (PTFE filter 0.2 mm, 25 mm, Whatman) and 20 µL

were injected into HPLC (Agilent 1100) equipped with a zorbax NH_2 column (25 cm x 4.6 mm, i.d. 5 mm, Agilent) using an isocratic mobile phase hexane: ethyl acetate (80:20). The flow rate was 2 mL/min and the detector was a fluorescence spectrophotometer with a programmed wavelength (lex 295 nm and lem 325 nm). The results are expressed in mg of α (Fluka), or β (Supelco), or γ (Sigma) δ (Sigma) tocopherol per kilogram of oil (ppm) (De Nino *et al.*, 2008).

Volatile Compound

Olive oil (2 mL) was dissolved in a 10mL vials and added with a fixed quantity of internal standard (2-methyl-4-pentanol). The olive oil samples were directly analyzed by SPME-GC-MS using a Varian 4000 GC-MS mass spectrometer (Cavaliere *et al.*, 2007, Benincasa *et al.*, 2003). Particularly, a DVB/CARB/PDNS 70µm solid phase micro extraction fibre and a GC capillary column VF-5ms 60m x 0,25 mm i.d., 0,25 µm f.t. were used. Instrumental parameters were: split ratio 50/1; helium gas flow 1,2mL /min; Injection volume 1µL; column oven: T=50°C hold for ten minutes, then ramp to 180°C at 25°C/min; then ramp to 220°C at 10°C/min. Injection T 250°C; Transfer line T 270°C; Ion source T= 200°C. Pre-incubation time 20min at 40°C; adsorption time 5min; adsorption time 3min.

Sensory analysis

Sensory analysis of the samples was carried out by trained panellists according to the method described in International Olive Council (IOC/T.20/No 15-Rev.2) (IOC, 2007). The method involves, as a measuring instrument, a group of 8–12 persons suitably selected and trained to identify and evaluate the intensities of positive and negative sensory perceptions (Boskou , 2006). The oil samples (15 ml each) were randomly presented in covered blue glasses at 28±2ºC. The cover was removed and the sample was smelled and tasted by each panelist and panelists were requested to mark their perceptions on a profile sheet and to evaluate their intensity on an unstructured scale ranked from 0 to 10 (profile sheet) (Figure 1) (IOC, 2007).

Olive oil was classified (IOC, 2007):

* The extra virgin category when the median of the defects was equal to 0 and the median of the fruity attribute was more than 0.
* The virgin category when the median of the defects was more than 0 and less than or equal to 3.5 and the median of the fruity attribute was more than 0.

* The ordinary virgin category when the median of the defects was more than 3.5 and less than or equal to 6.0 or when the median of the defects was less than or equal to 3.5 and the median of the fruity attribute was equal to 0.
* The lampante virgin category when the median of the defects was more than 6.0.

INTENSITY OF PERCEPTION OF DEFECTS:

Fusty/ Muddy-sediment | **0** ——————————→ **10**

Musty-humid-earthy | ——————————→

Winey-vinegary - acid- sour | ——————————→

Metallic | ——————————→

Rancid | ——————————→

Others (specify) | ——————————→

INTENSITY OF PERCEPTION OF POSITIVE ATTRIBUTES:

Fruity | ——————————→

greenly □ ripely □

Bitter | ——————————→

Pungent | ——————————→

Name of taster:

Sample code: **Date:**

Comments:

Figure (1): PROFILE SHEET FOR VIRGIN OLIVE OIL

RESULTS AND DISCUSSION

Quality characteristics

Percentage of free fatty acids

Virgin olive oil contained about 98% neutral lipids, mainly triglycerides (96-97%) followed by small quantity of diglycerides (1-2%) and a variable quantity of free fatty acids which were used as marker of oil quality (Olias and Garcia, 1997). The quality indices of VOO in Table (1) revealed that the free fatty acid (FFA %) content of all cultivars was below 1%, except for VOO of Maraqi cultivar was 1.20%(as Oleic acid) and fell within the accepted values for extra-virgin olive oils and virgin olive oil as the standard FFA limit for extra-virgin olive oil and virgin olive oil were 0.8, 2.0 maximum, respectively (EEC, 1991 and IOC, 2006).

Table (1). Quality parameters of some Egyptian olive oils.

Characters	Maraqi	Wattagen	Arbequina	Koroneiki	Coratina
FFA %(as Oleic acid)	1.20	0.45	0.76	0.30	0.35
Peroxide value (meq O_2 / kg oil)	2.39	2.76	2.45	2.69	2.16
K_{232}	1.428	2.189	2.264	1.968	1.782
K_{270}	0.067	0.097	0.133	0.182	0.117
Δk	0.0005	-0.0005	-0.011	0.016	0

Peroxide value

The peroxide value (PV) is a measure of primary oxidation. Data in Table (1) revealed that the peroxide value (PV) of all studied VOOs was lower than 2.76 meq O_2/kg. None of the oil samples analyzed exceeded the maximum peroxide value for extra virgin olive oil (20 meq O_2/kg) (IOC, 2006). These results concur with those obtained for Coratina cultivar by (Clodoveo *et al.*, 2007).

Specific extinction coefficient at 232 nm, 270 nm and ΔK.

The K_{232} parameter is mainly indicative of the conjugation of trienes and also of the presence of carbonylic compounds. Data in Table (1) showed that the minimum and maximum values for the absorbance at 232 nm were recorded respectively for VOO of Maraqi) (1.428) and (VOO of Arbequina) (2.264). K232 values of Egyptian Koronaki and Arbequina olive oils is agreed with values obtained by Dabbou *et al.*,(2010) for the same cultivars in Tunisia .The absorbance at 270 nm was measured, the minimum value was recorded for (VOO of Maraqi) (0.067) and the maximum value for (VOO of Koroneiki) (0.182). This value of K270 Koronaki Egyptian olive oil was near to the same cultivar oil in Australia (Mailer *et al.*, 2010). The values recorded at 232 and 270 nm for all samples studied complied with IOC limits for extra virgin olive oil. Also, all the values for ΔK lie inside the limits specified for extra virgin olive oil in the standard (IOC, 2006).

Fatty acid composition

Fatty acid composition is an essential aspect of the qualitative assessment of olive oil. Monounsaturated fatty acids are of great importance because of their nutritional implications and effect on the oxidative stability of oils (Martinez de Victoria and Manas, 2001).

Fatty acid composition of VOO obtained from different olive oil cultivars is shown in Table (2).Data revealed that the identified fatty acids in all VOO were typically of olive oil and consisted of myristic acid ($C_{14:0}$); palmitic ($C_{16:0}$); palmotoleic ($C_{16:1}$) stearic ($C_{18:0}$); oleic ($C_{18:1}$); linoleic ($C_{18:2}$); linolenic ($C_{18:3}$) arachidic acid ($C_{20:0}$); eicosenic acid ($C_{20:1}$), behenic acid ($C_{22:0}$); and lignoceric acid ($C_{24:0}$). These fatty acids play an important part in the sensory characterization of olive oil (Ryan *et al.*, 1998).

Table (2). Fatty acid composition of virgin olive oils (%) extracted from different olive cultivars.

Cultivar / Fatty acid	Maraqi	Wattagen	Arbequina	Koroneiki	Coratina
$C_{14:0}$	0.02	0.02	0.01	0.04	0.01
$C_{16:0}$	11.69	11.98	21.36	14.93	14.36
$C_{16:1\ Isomer}$	0.07	0.06	0.08	0.05	0.05
$C_{16:1c}$	0.28	0.50	3.24	0.97	0.42
$C_{17:0}$	0.05	0.06	0.06	0.03	0.05
$C_{17:1}$	0.06	0.07	0.15	0.04	0.05
$C_{18:0}$	2.69	2.34	1.43	2.12	1.88
$C_{18:1}$	74.80	73.26	44.00	71.86	67.62
$C_{18:2}$	8.87	10.21	28.02	8.08	13.62
$C_{20:0}$	0.27	0.31	0.27	0.38	0.37
$C_{18:3}$	0.69	0.79	0.79	0.85	0.93
$C_{20:1}$	0.31	0.23	0.30	0.37	0.40
$C_{22:0}$	0.08	0.06	0.10	0.14	0.12
$C_{24:0}$	0.03	0.04	0.05	0.05	0.06
Σ SFA*	14.83	14.81	23.28	17.69	16.85
Σ USFA**	85.08	85.12	76.58	82.22	83.09
SFA/USFA	0.17	0.17	0.30	0.21	0.20
18:1/18:2	8.43	7.17	1.57	8.89	4.69
18:2/18:3	12.85	12.92	35.46	9.51	14.64
18:1/USFA	0.87	0.86	0.57	0.87	0.81

* SFA= saturated fatty acid **USFA= unsaturated fatty acid

Table (2) showed that in all VOO, the oleic acid was always the most abundant fatty acid (monounsaturated), representing the 67 % of the total fatty acid composition at least, except for VOO of Arbequina where was only 44 %. Palmitic acid was also the most dominant saturated fatty acid in all VOOs investigated. The content varied between 11.69 for Maraqi cultivar and 21.36 % for VOO of Arbequina. Linoleic acid is a di-unsaturated fatty acid. When present in notable quantities, it could contribute to the oxidation of olive oil during storage (Ryan *et al.*, 1998).The analytical results showed that the content of this acid varied between 8.08 and 28.08 %. These results agreed with those obtained by Manai *et al.*(2006) and Ceci and Carelli ,(2010). The fatty acids composition of the studied olive oils complies with the requirements of the IOC trade standard (IOC, 2006), except for Arbequina olive oil.

The VOO of Maraqi and Wattagen showed the lowest total SFA (14.83 and 14.81, respectively and, hence, the highest total USFA (85.08 and 85.12, respectively), while that of Arbequina showed the highest total SFA (23.28%) and the lowest total USFA (76.58%) as compared to the other VOOs.

The ratios between the total SFA to total USFA, again, confirmed the above results that the VOO from Maraqi and Wattagen cultivars had the lowest ratios (0.17), on the other hand, the VOO from Arbequina had the highest ratio (0.30).

Tocopherols

Tocopherols are particularly important functional components in foods. They have vitamin E properties and display antioxidant activity, which protect the body tissues against the damaging effects caused by the free radicals that result from many normal metabolic functions. Among all tocopherol homologues, α-tocopherol presents the highest biological potency (Perri *et al.*, 2000). It is the predominant representive of Vitamin E in virgin olive oil. The concentration of α-tocopherol, reported in the literature for good-quality VOO's, is usually in the range 100-300 mg/kg, β- and γ-tocopherols are found in smaller amounts, and δ-tocopherol only in traces (Boskou *et al.*2006 and Psomiadou *et al.*, 2000).

In general, the data of Table (3) showed the high values of Egyptian olive oils. As expected, the data showed the predominance of α-tocopherol in all olive oil samples studied, followed by γ, β-, and δ-tocopherol, respectively. These findings appear to agree with the results obtained by Speek *et al.* (1985) and Perrin (1992) in that good-quality oils generally have α-tocopherols concentration of more than 100 ppm, with α-tocopherols accounting for approximately 95% of that total.

The lowest α-tocopherols (mg/kg) were recorded for VOO of Wattagen (541.345 mg/kg) and the highest α-tocopherols were for VOO of Coratina. Results revealed that VOO of Koroneiki had the lowest content of β-tocopherols (3.016 mg/kg) and VOO of Wattagen had the highest content of β-tocopherols (6.534 mg/kg).

Data in Table (3) showed that VOO of Coratina had the highest content of γ- tocopherols (27.169 mg/kg) and VOO of Wattagen had the lowest content of γ- tocopherols (6.667mg/kg).

Finally, data in Table (3) showed that VOO of Coratina had the highest content of total tocopherols (798.649 mg/kg) and VOO of Wattagen had the lowest content of total tocopherols (559.089 mg/kg).

Table 3. Tocopherols of some Egyptian olive oils (mg/kg).

Cultivars	α-tocopherol	β-tocopherol	γ-tocopherol	δ-tocopherol	Total tocopherols
Maraqi	**691.745**	**6.390**	**11.807**	**1.297**	**711.238**
Wattagen	**541.345**	**6.534**	**6.667**	**4.543**	**559.089**
Arbequina	**634.341**	**5.939**	**16.620**	**0.788**	**657.687**
Koroneiki	**678.749**	**3.016**	**14.816**	**0.423**	**697.004**
Coratina	**765.995**	**3.569**	**27.169**	**1.916**	**798.649**

Volatiles compounds

VOO of Maraqi contained (Table 4) 3-nonen-1-ol (Z) as the most abundant volatile compound (2675.594 ppm). Results revealed that hexane 2,4 dimethyl was the second most dominant compound in VOO of Maraqi (396.318 ppm). Both octanal and 2-decenal-(Z) were also found at lower concentrations (ie. 213.336 and 192.944 ppm, respectively), both 10-undecenal and pentadecenoic acid ethyl ester were detected at 176.647 and 106.513, respectively. The concentrations of the other detected compounds (24 compounds) were less than 100 ppm.

Table 4. Volatiles compounds of Egyptian olive oils (ppm).

GC-MS ANALYSIS OF EGYPTIAN OLIVE OILS	Maraqi	Wattagen	Arbequina	Koroneiki	Coratina
1,10 decanediol	38.091	7150.107	n.d.	n.d.	n.d.
1,4 pentadecenoic acid	n.d.	n.d.	n.d.	n.d.	n.d.
1,9-nonanediol	n.d.	n.d.	n.d.	33.205	632.055
10-heneicosene	n.d.	3.671	n.d.	n.d.	n.d.
10-octadecenal	9.619	0.421	n.d.	n.d.	n.d.
10-undecenal	176.647	n.d.	830.330	264.624	n.d.
13-octadecenal (Z)	n.d.	n.d.	n.d.	n.d.	85.041
1-hexene 2,5 dimethyl	n.d.	n.d.	n.d.	n.d.	n.d.

1-octanol	17.749	122.116	34.596	n.d.	n.d.
1-propyl-cyclopentanol	16.748	n.d.	n.d.	n.d.	n.d.
1-undecanol	n.d.	7150.116	n.d.	n.d.	n.d.
2,4 decadienal (E,E)	21.066	141.503	n.d.	n.d.	n.d.
2,4 dodecadienal	n.d.	n.d.	80.870	n.d.	32.655
2,4 undecadienal (E,E)	n.d.	n.d.	n.d.	n.d.	n.d.
2-4-pentadien-1-ol-3-pentyl (Z,Z)	16.089	n.d.	n.d.	n.d.	n.d.
2-decanone	22.741	101.571	n.d.	n.d.	n.d.
2-decenal-(E)	n.d.	n.d.	686.045	65.580	n.d.
2-decenal-(Z)	192.944	n.d.	n.d.	243.769	60.158
2-hexanone-4-methyl	n.d.	15.434	n.d.	n.d.	n.d.
2H-pyran-2-one-tetrahydro-6-nonyl	4.334	n.d.	n.d.	n.d.	n.d.
2-isopropyl-5-methyl-1-heptanol	14.652	n.d.	n.d.	n.d.	n.d.
2-n-octylfuran	7.336	n.d.	n.d.	n.d.	n.d.
2-nonanone	18.699	111.689	n.d.	n.d.	n.d.
2-nonen-1-ol (Z)	n.d.	n.d.	n.d.	2799.950	n.d.
2-nonenal (E)	n.d.	38.294	n.d.	n.d.	n.d.
2-nonenal (Z)	n.d.	335.221	n.d.	n.d.	n.d.
2-octen-(Z)	n.d.	33.031	n.d.	n.d.	n.d.
2-undecenal	8.938	25.601	n.d.	n.d.	n.d.
3-hexen-1-ol	n.d.	n.d.	n.d.	n.d.	n.d.
3-nonen-1-ol	n.d.	n.d.	n.d.	n.d.	n.d.
3-nonen-1-ol (Z)	2675.594	n.d.	2192.071	n.d.	n.d.
4,4,6-trimethyl-cyclohex-2en-1-ol	n.d.	102.806	n.d.	n.d.	n.d.
4-hydroxy-4-methylhex-5-enoic-acid-tertbutyl-ester	n.d.	56.390	n.d.	n.d.	n.d.
4-nonenal (E)	38.336	245.082	n.d.	53.852	n.d.

5-isopropyl-6,6-dimethylhept-3-yne-2,5-diol	n.d.	14.379	n.d.	n.d.	n.d.
6-nonenal (Z)	23.895	n.d.	n.d.	n.d.	n.d.
7-tetradecenal (Z)	n.d.	545.701	n.d.	n.d.	n.d.
9-hexadecenoic acid methyl ester (Z)	30.851	n.d.	n.d.	n.d.	n.d.
butane-2-methyl	27.498	n.d.	n.d.	n.d.	n.d.
cyclohexanol 4-methyl-trans	n.d.	n.d.	n.d.	n.d.	n.d.
cyclohexanone 3,3,5,5 tetramethyl	n.d.	17.187	n.d.	n.d.	n.d.
cyclotridecanone	n.d.	41.320	n.d.	n.d.	n.d.
cyclpentanone 3-butyl	10.669	14.048	n.d.	n.d.	n.d.
E-2-methyl-tetradecen-1-olacetate	n.d.	n.d.	n.d.	3.493	n.d.
E-3-pentadecen-2-ol	n.d.	101.570	n.d.	9.666	n.d.
ethanol-2-(9-octadecenyloxy)-(Z)	n.d.	n.d.	n.d.	n.d.	n.d.
ethyl oleate	n.d.	n.d.	262.152	88.103	269.799
furan-2-pentyl	16.333	46.591	28.296	8.727	n.d.
Furanone	n.d.	n.d.	4.035	n.d.	n.d.
Heptanal	75.487	253.810	72.956	23.865	n.d.
heptane 2,4-dimethyl	n.d.	n.d.	n.d.	n.d.	n.d.
heptanoic acid	n.d.	n.d.	n.d.	n.d.	n.d.
hexadecanoic acid ethyl ester	n.d.	n.d.	n.d.	n.d.	n.d.
hexane 2,4 dimethyl	396.318	244.180	1.359	238.171	n.d.
hexane 3-methyl	47.688	76.930	102.111	13.955	n.d.
hexanoic acid	n.d.	92.379	n.d.	n.d.	n.d.
hexanoic acid	n.d.	57.172	n.d.	n.d.	n.d.

propyl ester					
nonanoic acid	26.107	677.163	41.336	197.348	n.d.
Nonanol	n.d.	n.d.	n.d.	n.d.	n.d.
Octanal	213.336	569.182	206.848	48.454	n.d.
Octane	n.d.	1690.011	n.d.	n.d.	n.d.
octanoic acid	n.d.	335.821	n.d.	n.d.	n.d.
oxiran-tetradecyl	n.d.	n.d.	n.d.	n.d.	n.d.
pentadecenoic acid ethyl ester	106.513	n.d.	n.d.	n.d.	n.d.
pentan-3-methyl	n.d.	n.d.	n.d.	n.d.	n.d.
pentane 2,3 dimethyl	n.d.	n.d.	n.d.	n.d.	n.d.
pentane-3-methyl	n.d.	n.d.	170.159	n.d.	n.d.
phenol 3,5-bis (1,1 dimethylethyl)	n.d.	n.d.	98.867	n.d.	n.d.
phenol-4-ethyl-2-methoxy	n.d.	n.d.	n.d.	n.d.	n.d.
phenylethyl alchol	n.d.	n.d.	n.d.	n.d.	n.d.
propanoic acid 2-hydroxy-2-methyl-ethyl ester	n.d.	2165.040	n.d.	n.d.	n.d.
tetranoic acid ethyl ester	n.d.	n.d.	n.d.	16.010	n.d.
valeric acid-4-tridecyl ester	10.711	n.d.	n.d.	n.d.	n.d.
Vinyl caprylate	16.681	n.d.	n.d.	n.d.	n.d.
Z-11-pentadecenol	n.d.	n.d.	n.d.	34.883	n.d.
Z-8-methyl-9-tetradecenoic acid	n.d.	23.412	n.d.	n.d.	n.d.
Z-9-pentadecenol	n.d.	40.882	n.d.	n.d.	n.d.
δ nonalactone	4.536	7.483	n.d.	n.d.	n.d.

* n.d.= not detected

Data of Table (4) showed that VOO of Wattagen contained 1-undecanol and 1,10 decanediol as the most prevalent volatile compounds (7150.116 and 7150.107 ppm, respectively), followed by propanoic acid 2-hydroxy-2-methyl-ethyl ester as the third most dominant volatile compounds (2165.040 ppm). Data also revealed that the VOO of Wattagen contained octane, nonanoic acid, octanal and 7-tetradecenal (Z) at concentrations of 1690.011, 667.163, 569.182 and 545.701 ppm, respectively. The oil also contained octanoic acid, 2-nonenal (Z), heptanal and 4-nonenal (E) at concentrations of 335.821, 335.221, 253.810 and 245.082 ppm, respectively. Both of hexane 2,4 dimethyl and 2,4 decadienal (E,E) were also found at concentrations (ie. 244.180 and 141.503 ppm, respectively), both 1-octanol and 2-nonanone were detected at 122.116 and 111.689 ppm, respectively. The concentrations of 4, 4, 6-trimethyl-cyclohex-2en-1-ol, 2-decanone and E-3-pentadecen-2-ol were around 102 ppm. The concentrations of the other detected compounds (18 compounds) were less than 100 ppm.

Moreover, the most abundant volatile compound (Table 4) in VOO of Arbequina was 3-nonen-1-ol (Z) (2192.071 ppm) like VOO of Maraqi. Data showed that the concentrations of 10-undecenal and 2-decenal-(E) were 830.330 and 686.045 ppm, respectively.The VOO of Arbequina also contained smaller concentrations of ethyl oleate (262.152 ppm), octanal (206.848 ppm), pentane-3-methyl (170.159 ppm) and hexane- 3- methyl (102.111 ppm). The concentrations of the other detected compounds (8 compounds) were less than 100 ppm.

Results in Table (4) revealed that VOO of Koroneiki contained 2-nonen-1-ol (z) as the most abundant volatile compound (2799.950 ppm), although detected only in this oil, followed by 10-undecenal and 2-decenal-(Z), 264.624 and 243.769 ppm, respectively. Data also showed that the concentrations of hexane 2, 4 dimethyl and nonanoic acid were 238.171 and 197.348 ppm, respectively. The concentrations of the other detected compounds (12 compounds) were less than 100 ppm.

On the other hand, VOO of Coratina showed the lowest number of detectable volatile compounds (only 5 compounds), 1,9- nonanediol being the most abundant (632.055 ppm). Results revealed that ethyl oleate was the second most dominant compound (269.799 ppm). The oil also contained smaller concentrations of 13-octadecenal, 2-decenal (z) and 2,4 dodecadienal (85.041, 60.158 and 32.655 ppm, respectively).

Sensory analysis:

Virgin olive oil flavour is usually characterized by pleasant sensory notes that are much appreciated by consumers (Aparicio *et al.*, 1996 and Aparicio *et al.*, 1997).These sensory characteristics, together with nutritional aspects, are the main reasons for the increment of virgin olive oil consumption in recent years (IOOC, 2003). The quality of olive oil is not the only criteria required by standards (Codex, 2003), but also the expectations of different consumer segments must be taken into account (Caporale *et al.*, 2006). Therefore, sensorial and consumer tests of olive oil quality have been gaining importance in addition to the common chemical and instrumental analyses. Olive oil is prized for its sensory attributes (Lipworth *et al.* 1997, Visioli and Galli., 1998, Wiseman *et al.*, 1996). Sensorial analysis was a critical parameter in this study as it was goal to determine virgin olive oil sensory attributes and relate them to their chemical composition and volatile compounds.

Results of sensory analysis of all studied Egyptian olive oils agree with values of free fatty acid, peroxide value and Specific extinction coefficient at 232 nm, 270 nm and ΔK as all studied Egyptian olive oils were extra virgin olive oil and virgin olive oil.

Sensory data in table (5) showed that positive attributes of VOOs, were perceived with a median intensity ranging between 5.5 - 7.0, 1.0 - 4.0, 1.3 - 5.0 for the attributes of fruity, bitterness and pungency, respectively. As expected, the VOO of Coratina cultivar showed the highest median values of bitterness and pungency. Also data showed that no defects in all studied VOOs.

Fruity and positive attributes of Maraqi olive oil were related to 3-nonen-1-ol (Z), hexane 2,4 dimethyl, octanal, 2-decenal-(Z),10-undecenal and other detected compounds as shown at Tables (5 and 6).

Fruity and positive attributes of Wattagen olive oil were due to 1-undecanol, 1,10 decanediol, octane, octanal, 7-tetradecenal (Z), 2-nonenal (Z), heptanal, 4-nonenal (E), hexane 2,4 dimethyl, 2,4 decadienal (E,E),1-octanol, 2-nonanone, 2-decanone and other detected compounds as shown at Tables (5 and 6).

Fruity and positive attributes of Arbequina olive oil were related to was 3-nonen-1-ol (Z), 10-undecenal, 2-decenal-(E), octanal, and other detected compounds as shown at Tables (5 and 6).

Fruity and positive attributes of Koroneiki olive oil were related to 2-nonen-1-ol (z), 10-undecenal, 2-decenal-(Z), tetranoic acid ethyl ester and other detected compounds as shown at Tables (5 and 6).

Finally, Fruity and positive attributes of Coratina olive oil were related to 1,9- nonanediol, 13-octadecenal, 2-decenal (z) and 2,4 dodecadienal as shown at Tables (5 and 6).

Data in Table (6) showed that sensory properties of detected volatile compounds of Maraqi olive oil were Fresh, green, fruity, floral, rose, fatty, nutty, coconut, herbal and sweet. These data agreed with the obtained results of sensory analysis for fruity attribute (Table: 5). Bitter and pungent attributes were related to octanal , heptanal and other detected compounds .

Data also in Table (6) revealed that sensory properties of detected volatile compounds of Wattagen olive oil were Fruity, green, floral, tomato, nutty, fatty, waxy, citrus, sweet and herbal. Green odor perception is the most remarkable, being produced mainly by C_6 aldehydes, alcohols and their corresponding esters (Olias *et al.*, 1993). Also octanal , heptanal and other detected compounds were responsible about pungent and bitter. These data agreed with the results of sensory analysis of Wattagen olive oil (Table: 5).

Data in Table(6) showed sensory properties of detected volatile compounds of Arbequina olive oil, these data agreed with the results of sensory analysis (Table: 5). Also, these results agreed with Aparicio *et al.*,(1996) that, volatile compounds (green- sweet) were esters and furanic compounds. Some nonadienes have been described sensorial as buttery (Evans *et al.*, 1971) and as sweet fruity green (Aparicio *et al.*,1996). Also, data in Table(6) showed sensory properties of detected volatile compounds of Koroneiki ,Coratina olive oils, these data agreed with the results of sensory analysis (Table: 5).

I concluded that studied Egyptian olive oil had different volatile compounds from other olive oils, might be degree of ripeness, the geographic origin, the nature of the cultivar, climate, soil,....etc. Also, this difference might be explained by the fact that sensory properties of volatile compounds can change with concentration and that new sensory properties can be achieved if other compounds are present, because of synergism, suppression and enhancement (Aparicio *et al.*,1996).

Table (5): Sensory analysis of Egyptian olive oils .

Sensory attributes \ Cultivars		Maraqi	Wattagen	Arbequina	Koroneiki	Coratina
Defects (negative attributes)		Not detected	Not detected	Not detected	Not detected	Not detected
Positive attributes	Fruity	5.5 -Floral -Fruity olive mature - Almond flavors	6 -Fruity olive mature - Almond	6 -Floral -Fruity olive ripe - Pear - Banana flavors	6.5 - Aromatic herbs -Fruity olive ripe -Fruity green olive -Almond	7 - Aromatic herbs -Fruity olive ripe -Fruity green olive -Almond flavors
	Bitter	3.3	3.5	1	2	4
	Pungent	3.5	4	1.3	3.5	5

Table (6): Volatiles compounds and its sensory properties .

GC-MS ANALYSIS OF EGYPTIAN OLIVE OILS	Detected in *	Molecular Formula	Molecular Weight: (g/mol)	Sensory properties**
1,10 decanediol	W, M	$HO(CH_2)_{10}OH$	174.29	
1,9-nonanediol	C,K	$C_9H_{20}O_2$	160.25	
10-heneicosene	W			
10-octadecenal	M, W			Fatty
10-undecenal	A, K, M	$C_{11}H_{20}O$	168.27	Citrus, Fatty, oily and aldehydic with a mandarin, citrus nuance, waxy, and aldehydic with a green, soapy nuance, aldehydic rose.
13-octadecenal (Z)	C	$C_{18}H_{34}O$	266.46	
1-octanol	W, A, M	$C_8H_{18}O$	130.22	Waxy green orange aldehydic rose, citrus, aldehydic and floral with a sweet, fatty, coconut nuance, and aldehydic with a fruity nuance.
1-propyl-cyclopentanol	M	$C_8H_{16}O$	128.21	
1-undecanol	W	$CH_3(CH_2)_{10}OH$	172.31	Fresh, waxy, rose, soapy, clean clothes, floral, citrus. Sigma-Aldrich Inc
2,4 decadienal (E,E)	W, M	$CH_3(CH_2)_4CH=CHCH=CHCHO$	152.23	Fatty, oily, melon, citrus, pumpkin nut, coriander, aldehydic, green, Sigma-Aldrich Inc
2,4 dodecadienal	A, C	$C_{12}H_{20}O$	180.28	Fatty, grapefruit, orange, fatty, citrus
2-4-pentadien-1-ol-3-pentyl (Z,Z)	M			
2-decanone	W, M	$C_{10}H_{20}O$	156.26	Orange, floral, fatty, peach
2-decenal-(E)	A, K	$C_{10}H_{18}O$	154.24	Waxy, fatty, coriander, green, orange odor with floral top notes Very compatible with orris or citrus bases. Flavor: fatty ,fried ,citrus Adds dimension to peach flavors, as well as guava, strawberry, chocolate, tangerine, mandarin, grapefruit and coffee flavors., Diffusive orange odor, rose top note
2-decenal-(Z)	K, M, C	$CH_3(CH_2)_6CH=CHCHO$	154.25	Fatty, orange, rose, aldehydic floral, green.

2-hexanone-4-methyl	W	$C_7H_{14}O$	114.19	
2H-pyran-2-one-tetrahydro-6-nonyl	M	$C_{14}H_{26}O_2$	226.36	Waxy, creamy, oily, buttery, fatty, Soft ,creamy with sweet milky and dairy nuances Flavor: fatty For butter, milk, nut, and fruit flavors
2-isopropyl-5-methyl-1-heptanol	M	C11H24O	172.31	
2-n-octylfuran	M	$C_{12}H_{20}O$	180.28	
2-nonanone	W, M	$C_9H_{18}O$	142.23	Fresh, sweet ,green, weedy, herbal, Fruity, waxy, soapy, cheese, green herbaceous, coconut like, buttery, creamy, fatty, coconut; oily, floral Odor: RUE-LIKE Flavor: ROSE TEA-LIKE TASTE
2-nonen-1-ol (Z)	K	$C_9H_{18}O$	142.23	Slightly waxy, melon ,sweet green, fatty Used for melon, fatty, sweet notes. Flavor: green fatty Used in vegetable, melon and tropical flavors
2-nonenal (E)	W	$C_9H_{16}O$	140.22	Green, fatty, aldehydic citrus, aldehydic, fatty with a citrus nuance, soapy, Flavor: green Can be used in green apple, cantaloupe, vegetable, watermelon, orange, citrus and lime flavors. Odor: Fatty, Violet, powerful fried fatty odor with citrus-like Suggested Uses: Apricot, Cheese, Citrus Fruits, Coffee, Hard Fruits, Nut, Orange, Soft Fruits, Tea, Tomato
2-nonenal (Z)	W	$C_9H_{16}O$	140.22	Fatty, green, waxy and tomato nuance.
2-octen-(Z)	W			
2-undecenal	W, M	$C_{11}H_{20}O$	168.27	Fresh fruity, citrus, orange peel, Aldehydic, waxy, with a fatty green nuance Odor: fresh, fruity,

				citrus Can be used as a fresh, citrus note in many fragrances. Flavor: waxy aldehydic Found mostly in citrus flavors orange; herbaceous; fruity
3-nonen-1-ol (Z)	M, A	$C_9H_{18}O$	142.238620	Odor: fresh, waxy, green melon Used for fresh, tropical, melon notes. Flavor: waxy A fresh green melon
4,4,6-trimethyl-cyclohex-2en-1-ol	W			
4-hydroxy-4-methylhex-5-enoic-acid-tertbutyl-ester	W			
4-nonenal (E)	W, K, M	$C_9H_{16}O$	140.22	Fruity
5-isopropyl-6,6-dimethylhept-3-yne-2,5-diol	W			
6-nonenal (Z)	M	$C_9H_{16}O$	140.22	Melon, green, cantaloupe, waxy Odor: Powerful fresh citrus,
7-tetradecenal (Z)	W	C14 H26 O	210.35	Fruity, citrus
9-hexadecenoic acid methyl ester (Z)	M			
butane-2-methyl	M	$CH_3CH_2CH(CH_3)_2$	72.15	
cyclohexanone 3,3,5,5 tetramethyl	W			
cyclotridecanone	W	$C_{13}H_{24}O$	196.33	
cyclopentanone 3-butyl	W, M			Fruity, peach, apricot, jasmin, lactonic, herbal, lavender
E-2-methyl-tetradecen-1-olacetate	K			
E-3-pentadecen-2-ol	W			
Ethyl oleate (Oleic acid ethyl ester)	C, A, K	$C_{20}H_{38}O_2$	310.51	Floral, fatty, oily, dairy, milky, waxy Odor: Delicate fragrance with a faint, floral note.
furan-2-pentyl	W, A, M, K	$C_9H_{14}O$	138.20	Fruity, green, sweet, waxy
furanone	A	$C_4H_4O_2$	84.07	Sweet
heptanal	W, M, A, K	$C_7H_{14}O$	114.18	Fresh, aldehydic, fatty, green, herbal, harsh,

				pungent, oily, woody, fruity, nutty.
hexane 2,4 dimethyl	M, W, K, A	C8 H18	114.23	
hexane 3-methyl	A, W, M, K	C7 H16	100.20	
hexanoic acid	W	$C_6H_{12}O_2$	116.15	Sour, fatty Odor: Acidic, Burnt, Fatty, Fruity. Suggested Uses: Apple, Bakery, Cheese, Dairy Products, Savoury, Strawberry, Tropical Fruits, Vegetables.
hexanoic acid propyl ester	W	$C_9H_{18}O_2$	158.23	Sweet, fruity, juicy, pineapple, green and tropical.
nonanoic acid	W, K, A, M	$C_9H_{18}O_2$	158.23	Fatty, waxy and cheesy with a mild sweet creamy background
Octanal	W, M, A, K	$C_8H_{16}O$	128.21	Aldehydic waxy, citrus, orange peel ,green, fatty, harsh.
Octane	W	C_8H_{18}	114.23	
octanoic acid	W	$CH_3(CH_2)_6CO$ OH	144.21	Fatty, waxy, oily, vegetable, cheesy
pentadecenoic acid ethyl ester	M			
pentane-3-methyl	A	C_6H_{14}	86.17	
phenol 3,5-bis (1,1 dimethylethyl)	A	$C_{14}H_{22}O$	206.32	
propanoic acid 2-hydroxy-2-methyl-ethyl ester	W	$C_6H_{12}O_3$	132.16	
tetranoic acid ethyl ester	K	$C_6H_{12}O_2$	116.16	Fruity
valeric acid-4-tridecyl ester	M	$C_{18}H_{36}O_2$	284.48	
Vinyl caprylate	M	C10H18O2	170.25	
Z-11-pentadecenol	K			
Z-8-methyl-9-tetradecenoic acid	W			
Z-9-pentadecenol	W			
δ nonalactone	W, M	$C_9H_{16}O_2$	156.22	Apricot, butter, nutty, sweet,

* M= Maraqi, W= Wattagen, A= Arbequina, K= Koroneiki, C= Coratina virgin olive oils.

** Sigma-Aldrich,(2011) ; Merck .(2011), The good Scents Company, (2010) , and Aparicio *etal.*, (1996).

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الملخص العربي

التحليل الحسي لبعض زيوت الزيتون المصرية و علاقتها بمركباتها المتطايرة و تركيبها الكيماوى.

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اجريت هذه الدراسة بهدف دراسة التحليل الحسى لبعض زيوت الزيتون المصرية و علاقتها بمركباتها المتطايرة و تركيبها الكيماوى و كانت اصناف زيوت الزيتون البكر المستخدمة خلال محصول موسم 2010/2009 كالتالي من واحة سيوه (مراقى- وطيجن) و من الجيزة (معهد بحوث البساتين) (كوراتينا – كروناكى – اربيكينا) .

كانت النتائج المتحصل عليها :

*زيت زيتون صنف المراقي أوضح محتواه العالي من الأحماض الدهنية الحرة مقارنة بالاصناف الأخرى.

* رقم البيروكسيد لجميع زيوت الزيتون المستخدمه تتراوح بين 2.16- 2.76 ملى مكافىء اكسجين/ كجم زيت .

*كانت قيم الامتصاص عند 232 ، 270 nm, ΔK لجميع زيوت الزيتون التى تم دراستها فى الحدود التى حددها المجلس الدولى للزيتون لزيت الزيتون البكر اكسترا .

* زيت الزيتون لصنف اربيكينا احتوى على أعلى نسبة في الأحماض الدهنية المشبعة وأقلهم في نسبة الأحماض الدهنية الغير مشبعة وعلى الجانب الآخر زيت الزيتون لصنف الوطيجن احتوى على أقل نسبة في الأحماض الدهنية المشبعة وأعلاهم في نسبة الأحماض الدهنية الغير مشبعة .

* نسبة الأحماض الدهنية المشبعة / الأحماض الدهنية الغير مشبعة أعلى في زيوت أصناف الجيزة عن مثيلتها في الأصناف السيوية .

*أوضحت النتائج أن الأصناف المصرية لزيوت الزيتون و بالاخص لصنف كوراتينا ذات محتوى عالى من التوكوفيرولات و خاصة الفا توكوفيرول.

* تنوع المركبات المتطايرة فى زيوت الزيتون التى تم دراستها حيث كان المركب السائد لزيت صنف المراقى وصنف اربيكينا هو 3-nonen-1-ol (Z) و المركبان السائدان لزيت صنف الوطيجن هما 1- 1,10 decanediol،undecanol

* المركب السائد لزيت صنف كروناكى هو 2-nonen-1-ol (z) و اوضحت النتائج ايضا ان زيت صنف كوراتينا اقل الاصناف المدروسه فى عدد المركبات المتطايرة و المركب السائد هو 1,9- nonanediol .

* أوضحت نتائج التحليل الحسى للزيوت المدروسه ان قيم الوسيط للخواص الايجابيه تتراوح بين 5.5-7 ، 4-1 ، 5-1 لـ fruity, bitterness and pungency على الترتيب و ان زيت صنف كوراتينا اعلى قيمه وسيط لـ Fruity, bitterness and pungency .

* الخواص الحسية للمركبات المتطايرة لزيت زيتون صنف المراقى Fresh, green, fruity, floral, rose, fatty, nutty, coconut, herbal and sweet و هي متناسبة مع نتائج التحليل الحسي المتحصل عليها.

* الخواص الحسية للمركبات المتطايرة لزيت زيتون صنف الوطيجن Fruity, green, floral, tomato, nutty, fatty, waxy, citrus, sweet and herbal. و هي متناسبة مع نتائج التحليل الحسي المتحصل عليها.

*Octanal , Heptanal و المركبات المتطايرة المتحصل عليها هي المسئولة pungent and bitter لزيوت زيتون المراقى و الوطيجن.

* الخواص الحسية للمركبات المتطايرة لزيت زيتون أصناف اربيكينا و كروناكى و كوراتينا متناسبة مع نتائج التحليل الحسي المتحصل عليها.