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PHYSICAL AND CHEMICAL CHARACTERISTICS OF EGYPTIAN OLIVE OIL AND ITS BLEND WITH SOME VEGETABLE OILS.

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ABSTRACT

Physical and chemical indices of local virgin olive oil versus refined olive oil were estimated. Moreover,some consumer-available vegetable oils of sunflower and corn seeds, individually and their blended oils with olive oil were investigated. Data were compared with the recommendation of standard methods for olive analysis given by FAO/WHO Food Programmer and Codex Alimentarius Commission. Data indicated that the crude oil content was 59% in the local olive fruit (on dry basis). The virgin oil have exhibited higher free fatty acids (FFA) and relatively lower oleic acid, However, linoleic acid was found to be higher than expected and the total of oleic and linoleici acids was more than 75% in the fraction of neutral lipids.

The total saturated and unsaturated fatty acids in virgin olive oil were about 20 and 80%, respectively. The quality characteristics of refined olive oil and sunflower oil were found to cope with the ranges of FAO/WHO Codex limits, while corn oil possessed lower iodine value and higher FFA and peroxide value than the recorded values of FAO/WHO Codex. Palmitic, stearic, oleic and linoleic acids were found to be the major fatty acids in all oil samples. Figures of fatty acid composition in tested oils agreed with those reported by FAO/WHO Codex ranges. When the blends of these oils were prepared, the identity characteristics were completely changed. Remarkable peculiarities were observed regarding acid distribution in all blends of olive oil samples, were the saturated level in all blends was increased.

INTRODUCTION

Olive oil, one of the most important and ancient oils, is obtained from the fruits of the evergreen trace, *Olea europea*. The virgin olive oil is the unique vegetable mentioned in Holy Kouraan .

The olive tree thrives best in the subtropical climates of the countries bordering the Mediterranean Sea and North Africa. Olive oil cultivations originated in Asia Minor and has spread to Greece. Italy, Spain and North Africa. Recently it also was extended in other countries with temperature climate like France (Antonio, *et al., 2000*). The olive fruit may contain 35-70% of oil (dry basis) and may be as high as 75% in the pulp (Samir and Ahmed, 1981).

Virgin olive oil requires a different approach form other oils because it is extracted from the fruit of the olive tree without any subsequent refining. It has a complex flavour, which is appreciated internationally by gourmets and cherished by native consumers. Olive oil sensory quality is so important that

the relevant European Communities "OCECR" (1991) regulations include sensory evaluation (Aparicio *et al.,* 1996).

The International Olive Oil Council defines olive oil categories as follows: virgin olive oil is the oil obtained from the fruit of the olive tree by mechanical or other physical means under conditions that do not lead to alteration of the oil. The oil has not undergone any treatment other than washing, decantation, centrifugation and filtration (Giorgio, *et al., 1994*).

Several studies indicated that olive oil may contribute to the prevention and control cardiovascular and other diseases (Charbonnier, 1985; Laval-Jeantent *et al.,* 1985; Rubba *et al.*, 1985 Viola and Audisio, 1987). Virgin olive oil is also rich in natural antioxidants (Phenols and tocopherals) and in aromatic compounds (Ranalli *et al.*, 1999). Biophenolic minor components (Angerosa, *et al*, 1995 Bianco, *et al.*, 1997; Vakey, *et al.*, 1997;), found that olive fruits, have shown their relevance in the production of table olives (Marsilio, *et al.,* 1996) and olive oil, (Bianco, *et al.*, 1998) typical foods of the Mediterranean culture. Because of their bioactive contribution to sensory characteristics (Montedoro, *et al.,* 1993; Bianco, *et al.*, 1997;), to stability toward autoxidation and to human health beneficial effects (Bianco *et al.*, 1999).

Vazquez, *et al.*, (1976) reported that the polyphenol content of olive oil depends on the cultivation procedures, environmental factors, harvesting stage, storage conditions of the fruits and extraction procedures. Flavonoids and other plant phenolics have been reported to have multiple biological effects such as antioxidant activity (Bors and Saran, 1987), anti-inflammatory action, inhibition of platelet aggregation and anti-microbial activities (Pratt and Hudson, 1990).

Olive oil is a fundamental component of the Mediterranean area diet, and it is widely used as a condiment, cooking medium, emulsion component, and in the storage of vegetable and animal foods. A great deal of data in literature exist regarding physical and chemical characteristics of different types of olive oils (Sonntag, 1979 and Ismail, *et al*, 2001). However, because of the incomplete knowledge of olive oil characteristics, in the past, serious obstacles have arisen in fixing acceptable limits for these characteristics. To overcome this difficulty, a joint FAO/WHO Food Programme Codex Alimentarius Commission has recommended standard methods for olive oil analysis by giving ranges of characteristics values of different olive oils (FAO/WHO, 1970). Hilditch and Williams (1962) and Boskou (1996) on the basis of their classical work on the constitution of natural fats, noted two types of olive oils one is composed of the oils of low linoleic content, with correspondingly low content of palmitic acid, and a high oleic acid content, the second is characterized by a relatively high linoleic and palmitic acid content with lower percentage of oleic acid. These differences in composition are reflected relatively little in the iodine value. In Egypt, many regions of Matrouh (Western), Sinai (Eastern) and Kena (Southern) are the important regions for olive crop production with considerable amounts.

The consumption of oils rich in oleic and lenoleic acids is increasing gradually. The share of oleic acid has risen from 13 to 17% and of linoelic acid from 3 to 6% in last 20 years time (Rizek *et al.,* 1974 and Ismail ,1989) .

In view of nutritional and healthier values, olive oil has been considered as a major vegetable oil preferred as a fat in diet of many peoples. However, its limiting consumption is mostly related to its highest price as compared with other vegetable oils on the international markets. Therefore, there is an urgent need to produce various blends of olive oil with some other cheeper and available vegetable oils.

Considering the previous mentioned factors, this work was undertaken with the main two aims (1) Study the physical, chemical and fatty acid characteristics of Egyptian virgin olive oil, and (2) Investigation the characteristics and composition of various blends of olive oil with some other cheeper vegetable oils namely sunflower and corn oils.

MATERIALS AND METHODS

Materials :

1- Fifteen kg of Wetaukin mature olive fruits (*Olea e rupea*) was collected from Sewa Oasis, Matrough Governorate. The commercial virgin oil was extracted by mechanical pressing plant located at Sewa.

2-The refined olive oil was obtained from El-Safy Company, Siewa, Egypt. Two different oils were kindly secured from extracted oils and derivative Company, Alexandria, Egypt.

Methods :

1- Blending treatments:

Treatment	Olive oil	Corn oil	Sunflower oil
1	2	1	1
2	1	1	1
3	1	-	3
1	3	3	-

3- Physiochemical properties :

The specific gravity, refractive index, unsaponifiable matter, viscosity, acid value, iodine value, saponification value, Reichert Meissl value and Polenske value were determined according to the Official and Tentative Methods of AOCS (1985). The free fatty acids (FFA) were determined by the methods of Doris (1964). The thiobarbituric acid (TBA) was determined spectrophotometrically at 532 nm using a Beckman Spectrophotometer Model 26 (Tarladgis , *et al* 1960). All determination were carried out in triplicates .

4- Fatty acid composition :

Fatty acid composition was determined by conversion of the triglycerides to fatty acids methyl ester (FAME) using boron triflioride (BF_3) methanol reagent according to International Organization for Standardisation (ISO) Method (1978), the resultant FAMEs were analysed by GLC under the following conditions:

Gas chromatography : Perkin Elmer 4800 fitted with a flame ionisation detector.

Column and Packing materials: Nukol silica capillary column, 15 m x 0.53 min i.d. 0.5 Um.
Column temperature : 220°C.
Injector and detector temperature : 300°C
Helium as carrier gas at a flow rate : 13 ml/min.

RESULTS AND DISCUSSION

1st-The characteristics of local virgin olive oil.

1- **Physicochemical properties:**

The results in Table (1) were similar to information recorded by Gracian (1968) and Sonntag (1979), for olive oil from other areas, except for high level of FFA (4.4%) and unsaponifiable matter (up to 1.5%). According to Gracian (1963), the average physical and chemial properties of virgin olive oil are Density at 20°C, 1.4680-1.4705; viscosity at 20°C, 62-83 (cp); saponification value, 184-195; iodine value, 75-93; Reichert-Meissl value, 0.2-0.5; and polenske value, 0.9-2.1. The Codex Alimentarius and FAO/WHO (1970) has recommended International Standards for olive oil which are also within the limits just given, including maximum Codex limits fro unsaponifiable matter, 1.5%, FFA 3.6%, and peroxide value, 20 meq O_2/kg oil. The unsaponifiable matter in local olive oil exceeded the limits set by Codex. This may be a result of high contents of squalene in the virgin oil. Also high content of unsaponifiable matter (1.75%) have been found in Libyan virgin oil (Samir and Ahmed, 1981). A characteristic feature of the unsaponifiable matter in olive oil is often due to its squalene content, which is higher than that of the other vegetable oils (FAO/WHO, 1970).

Table(1) : Physical and chemical charecteristics of Egyptian virgin olive oil with comparison with refined oil

Constant	Virgin	Refined
Refractive Index	1.4714	1.4091
Specific gravity (at25°C)	0.912	0.916
Viscosity (at25°C-centipoises)	76.4	82.2
Acid value	8.6	8.2
FFA(%as oleic acid)	4.4	0.41
Saponification value	194	181
Unsaponifiable matter (%)	109	0.97
Iodine value	81.9	86.1
Peroxide value (meq O2/kg oil)	5.8	4.7
TBA number	1.7	1.2
Reichert- Meissl value	1.4	0.4
Polenske value	8.4	0.6

Another distinctive feature is that its sterols are composed of practically pure B-sitosterol (up to 0.2% of the oil) (Gracian, 1968). The higher levels of FFA in local virgin oil may be related to high moisture content in olive fruits which is favourable to enzyme action. Also, the high FFA content in the refined is perhaps due to poor refining conditions. The limits for FFA according to

FAO/WHO and Codex (1970) are 3.6% for virgin oil and 0.3% for refined olive oil.

2- Fatty acid Composition :

The percentage of oleic acid in local virgin oil (Table 2) are obviously lower than reported from other areas and higher for linoleic and palmitic acids. Limits for oleic in the olive oil of different origin are : Italy, 63-86%, Greece, 57-93%, Spain, 65079%; Tunisa 55-70.6% and California 63-83% (Tsimidou and Karakostas ,1993 and Antonio, *et al.*, 2000). The limits for other fundamental acids of olive oils from the aforementioned sources are (%): linoleic (3.7-15); palmitoleic (1.3-4.7; palmitic, 5.5-19.7); stearic (0.3-3.4); and the total saturated acids are from 8.9 to 22, as reported by the previously literatures. Codex limits for major fatty acids in olive oil are (%): Oleic, 56-33; palmitic, 7-20 and linoleic, 3-20 (FAO/WHO, 1970). The proportion of oleic and linoelic acids in local virgin oil (Table 2) do not comply with those reported for olive oils from different regions (Gracian, 1968). This may be due to local climatic conditions, as reported by Sonntag (1979) and Richard, et al., (1993), that olive oil reflects the influence of climate and temperature like other vegetable oils. However, most of the other fatty acids are within limits of the data reported by Gracian (1968) , Sonntag (1979) and Badawy *et al.*, (2001). The total of these two main fatty acids of virgin olive oil is 76% in agreement with data reported by FAO/WHO (1970).

Tabel (2) : Fatty acid composition of localvirgin olive oil and refined olive (% weight)

Fatty acids/oils	Virgin	Refined
C16:0	16.7	15.0
C16:1	3.3	2.0
C18:0	2.5	3.4
C18:1	43.7	50.7
C18:2	32.6	26.8
C18:3	0.7	0.8
C20:0	0.4	0.9
C20:1	0.1	0.4

B: The blended oils:

1-Physiochemical properties of sunflower and corn oils and their blends with olive oils.

It could be observed (Table 3) that the values of olive oil and sunflower oil characteristics are within the ranges given by FAO/WHO and Codex Standards (1970), except slight deviations is found in corn oil under study. The FFA and peroxide value in corn oil are slightly higher than the Codex standards. Also, the refractively index of tested corn oil is 1.4764 (Table 3), this is higher than the range given by to Codex (1.465 : 1.458).

This slight deviations may be related to the corn oil become slightly rancid and there is a possibility of adulteration. The physical and chemical characteristics for four different blends prepared from the three oils are given

in (Table 4). As was expected, the identity characteristics of the mixture were completely changed.

Table (3): Physical and chemical characteristics of refined olive ,sunflower and corn oils

Constants / oils	Olive oil	Sunflower oil	Corn oil
Refractive Index	1.4091	1.4674	1.4764
Specific gravity (25°C)	0.916	0.922	0.931
Viscosity (25°C-centipoise)	82.2	62.0	78.4
Acid value	8.2	7.3	6.4
FFA(%as oleic acid)	0.41	0.29	0.24
Saponification value	181	187	186
Iodine value	86.1	119.8	94.9
Peroxide value (meq O_2/kg oil)	4.7	2.4	10.2
TBA number	1.26	1.72	0.80
Reichert-Meissl value	0.48	0.76	1.01
Polenske value	1.6	2.1	2.4

Tabel (4): Physical and chemical characteristics of blended oils

Constants	Blend 1	Blend 2	Blend 3	Blend 4
Refractive index	1.4646	1.4697	1.4492	1.4562
Specific gravity (25°C)	0.926	0.926	0.928	0.929
Viscosity(25°C-centipoise	68.8	66.6	73.3	72.9
Acid value	7.0	6.2	6.8	7.0
FFA(%as oleic)	0.31	0.28	0.30	0.30
Sapomification value	176	172	177	176
Iodine value	94.9	95.6	92.3	112.9
Peroxid value (meq02/kg)	6.8	7.2	8.2	5.6
TBA numer	0.82	1.16	0.96	1.12
Reichert-Meissl value	0.87	0.79	0.71	0.53
Polenske value	1.8	2.3	2.8	1.8

2-Fatty acid Composition in tested three oils and their blends.

The percentages of major fatty acids in both sunflower and corn oils (Table 5) fall within the ranges tentatively adopted by the FAO/WHO and Codex on fats and oils (FAO/WHO, 1970).

The fatty acids composition of the different blends (Table 5) shows a remarkable peculiarities in olive oil blended samples. There is an obvious increase in the saturated fatty acids content and C 20:1 compared with the samples of corresponding individual oils were the fatty acids are in traces (Table 5). The key changes in the blends is the oleic acid distribution which is reduced while the linoleic acid was comparatively less affected. We can not introduce an explain for the increasing of saturated fatty acids, but we noted an elevation of new peak in fatty acid charts of the blends explained as C

17:0 which led to the increase of saturated fatty acids in blend samples. Therefore, our results suggest that further research work is needed on the fatty acid composition of olive oil blends with other vegetable oils.

The results obtained may be of use for all concerned with the industrial and nutrition uses of such olive oil blends. The production of such blends on commercial scale will depend upon the acceptance and taste of the consumers.

Table(5): Fatty acid composition of refined olive oil, sunflower oil and corn oil (%Weight).

Fatyacids	Olive oil	Sunflower oil	Corn oil
C16:0	15.0	11.8	12.2
C16:1	2.0	0.6	0.4
C17:0	Trace	Trace	Trace
C17:1	Trace	Trace	Trace
C18:0	3.4	7.5	3.1
C18:1	50.7	30.8	40.0
C18:2	26.8	47.9	43.0
C18:3	0.8	0.7	0.7
C20:0	0.9	0.5	0.5
C20:1	0.4	0.2	0.1

Tabel(6): Fatty acid composition of the blend oils (%Weight)

Fatty acids	Blend 1	Blend 2	Blend 3	Blend 4
C16:0	11.3	10.1	11.5	17.7
C16:1	0.6	0.2	0.2	0.4
C17:0	10.8	9.5	10.4	12.0
C18:0	2.2	2.6	1.7	1.9
C18:1	38.6	40.2	37.3	35.5
C18:2	25.3	27.2	26.9	24.6
C18:3	0.7	0.7	0.7	1.8
C20:0	1.2	1.0	1.0	1.0
C20:1	9.3	8.5	10.3	10.1

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الصفات الفيزيقية و الكيماوية لزيت الزيتون المصرى ومخاليطه مع بعض الزيوت النباتية

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درست الخواص التركيبية لزيت الزيتون البكر المحلى (الاحماض الدهنية والخواص الفيزيوكيماوية) وتم مقارنتها بالزيت المكرر كذلك تم دراسة خواص بعض الزيوت النباتية المتوفرة للمستهلك (زيت عباد الشمس و زيت الذرة) كل على حده بجانب مخلوطهما مع زيت الزيتون وتم مقارنة النتائج بالبيانات القياسية لمنظمة FAO/WHO،Codex . وقد اوضحت النتائج ان محتوى الزيت الخام (٥٩%) لثمار الزيتون المحلية (على اساس الوزن الجاف) وان محتوى الزيت البكر من الاحماض الدهنية الحره مرتفع فى حين كان حامض الاوليك منخفضا نسبيا ولكن حامض اللينوليك كان مرتفع عن المتوقع وكل من الاوليك و اللينوليك تمثل اكثر من ٧٥% من الليبيدات المتعادلة

الاحماض الدهنية المشبعة وغير المشبعة فى زيت الزيتون البكر كانت ٢٠% ، ٨٠% على التوالى . الخواص و المميزات للجودة لزيت الزيتون المكرر وزيت عباد الشمس كان فى الحدود الموصى بها لـFAO/WHO فى حين قيمة اليود لزيت الذره كانت منخفضة بينما قيمة البيروكسيد كانت اعلى لنفس الزيت مقارنة بـــ FAO/WHO ، Codex

احماض البالمتيك و الاستياريك و الاوليك واللينوليك كانت الاحماض الدهنية الرئيسية فى جميع عينات الزيت ويعتبر تركيب الاحماض الدهنية فى الزيوت المختبرة مشابها للحدود الموصى بها فى Codex ، FAO/WHO ولكن مخاليط الزيوت كانت غير متماثلة وغير مطابقة للمواصفات وكانت مميزة فقط لتوزيع الحامض فى جميع مخاليط زيت الزيتون فى حين مستوى التشبع لجميع المخاليط كان متزايد .