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Characteristics of Libyan Olive Oil

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ABSTRACT

The chemical and physical characteristics of Libyan olive oil were studied and compared with that of an imported one. The free fatty acids (FFA) were relatively higher in locally produced olive oil. The sample of local virgin and refined oil were low in oleic acid containing 44% and 47%, respectively. However, linoleic acid content was found to be higher and the total of oleic and linoleic acids is more than 75% in the fraction of neutral lipids. The total saturated fatty acids in both local and imported olive oils are about 20%.

INTRODUCTION

Olive oil is a very stable oil of excellent quality, widely used as a table and cooking oil especially in countries bordering the Mediterranean sea, and North Africa, where the olives are cultivated. The olive fruit may contain 35–70% of oil (on dry basis) and in pulp it may be as high as 75% (11).

Three distinct types of olive oil are found in the market: virgin, refined, and refined olive-residue oil. Virgin oil is the name given to the oil obtained from the healthy, mature olive fruits extracted by mechanical pressing. Pressing of the oil is commonly carried out in two stages with the first pressing yielding the highest grade, so called 'virgin' olive oil, and with each successive pressing yielding an oil of lower grade. Joint FAO/WHO, Food Program Alimentarius Commission, has recommended standard method for evaluation of each type of olive oil and gives ranges of characteristic value (6).

The olive oil is characterized by presence of a high percentage of oleic acid, as much as 93% in the neutral lipid fraction. According to Hilditch (5) there are 2 types of olive oils, one having a low content of both linoleic and palmitic, and a high oleic acid content; the second characterized by a relatively high linoleic and palmitic content and a lower percentage of oleic acid. This difference has little effect on the iodine value because the increase of a more unsaturated acid is compensated by the decrease of oleic and increase of palmitic.

Olive oil is one of the major edible oils which is produced in The Libyan Jamahiriya. There is very little data available regarding total production, uses, quality and composition. The present work was undertaken to study the physical and chemical characteristics of Libyan olive oil in comparison with imported oil from Spain.

MATERIALS AND METHODS

The local commercial virgin olive oil was obtained from a mechanical pressing plant located at Zawia (Libya). The refined oil was purchased from Tripoli market, a

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product of a 'Refining Plant for Olive Oils, Tripoli, Libya'. Imported olive oil was a product of Spain.

Physico-chemical properties of oil

The oil samples were stored under nitrogen cover. The specific gravity (density) 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 (1). The free fatty acids were determined by the method of Doris (3). The thiobarbituric acid (TBA) was determined spectrophotometrically at 538 nm, using a Beckman spectrophotometer model 26 (9).

Fatty acid composition

The separation of neutral fat was done on a silicic acid column and by thin layer chromatography as described by Stahl (10). One g of neutral fat separated on silicic acid column was dissolved in 10 ml chloroform and 0.2 ml aliquot of this solution was spotted on silica gel coated plate. The neutral lipids were developed first with diethyl ether benzene/ethanol/acetic acid (40:50:2:0.2) air dried and redeveloped in the same direction with n-hexanol/diethylether (96:4). The lipids were detected with iodine vapours. The resulting triglycerides were scraped from the plates and used for the preparation of methyl esters. These were prepared by transesterification using boron trifluoride (7). The methyl esters were assayed by gas chromatography (Pye-unicam model 104) equipped with flame ionization detectors. (Automatic temperature programing), and a 250 cm × 0.5 cm ID glass column containing 8% polyethylene glycol adipate (PEGA) was used. The column temperature was held constant at 170°C and injection temperature was 210°C. Samples were analyzed isothermally with a nitrogen flow rate of 50 ml/min. The fatty acids were identified on the basis of retention time with known standards.

RESULTS AND DISCUSSION

Most of the physical and chemical characteristics of Libyan olive oils (Table 1) were within usual limits reported elsewhere (2,4,11), with the exceptions of fairly high levels of FFA (4.4%) and unsaponifiable matter (up to 1.75%).

Table 1 The physical and chemical characteristics of local and imported olive oils.

Contents	Values[a]		
	Commercial virgin	Refined	Imported
Acid value	8.76 ± 0.047	8.55 ± 0.15	2.20 ± 0.016
Free fatty acids (%)	4.40 ± 0.55	4.30 ± 0.54	1.11 ± 0.38
Sponification value	191.98 ± 0.44	185.93 ± 0.90	191.04 ± 0.64
Unsaponifiable matter (%)	1.75 ± 0.01	1.64 ± 0.01	1.46 ± 0.02
Iodine value	82.91 ± 0.63	85.33 ± 0.53	87.43 ± 0.88
Peroxide value (meq O_2/kg)	5.04 ± 0.06	5.06 ± 0.09	4.59 ± 0.35
TBA number	1.162 ± 0.005	1.694 ± 0.004	2.31 ± 0.001
Reichert-Meissl value	1.29 ± 0.43	0.47 ± 0.038	0.66 ± 0.09
Polenske value	8.18 ± 1.29	0.72 ± 0.086	8.16 ± 1.29
Specific gravity at 25/25°C	0.912 ± 0.918	0.914 ± 0.0008	0.920 ± 0.0001
Refractive index (at 20°C)	1.4706 ± 0.0001	1.4740	1.4705
Viscosity (at 20°C in centipoises)	76.92 ± 0.43	84.49 ± 0.72	79.28 ± 0.55

[a] Each value is the mean of 3 replicates.

Table 2 Distribution of fatty acids in olive oils.

	Percentage weight[a]		
	Local		
Fatty acids	Virgin	Refined	Imported
C 16:0	17.5	17.0	14.2
C 16:1	2.5	2.0	1.2
C 17:0	0.1	0.1	0.1
C 17:1	0.1	0.6	0.2
C 18:0	2.2	3.2	4.7
C 18:1	44.0	47.0	56.5
C 18:2	32.3	29.2	22.4
C 18:3	0.8	0.7	0.9
C 20:0	0.4	0.5	0.8
C 20:1	0.2	0.2	0.5

[a] Each value is the mean of 3 replicates.

According to FAO/WHO, Codex Alimentarius Committee on Fats and Oils (6), the maximum limits are: unsaponifiable matter, 1.5%, FFA; 3.3%, and peroxide value; 20 meq O_2/kg. The unsaponifiable matter in local olive oil samples exceeded the limits set by Codex. This may be due to high contents of squalene in these samples. High percentage of unsaponifiable matter (1.95%) has also been found in Iranian olive oil (8).

A characteristic feature of the unsaponifiable matter in olive oil is its content of squalene, which is higher than that of the other vegetable oils. Another distinctive feature is that its sterols are composed of practically pure beta-sterol (up to 0.2%) of the oil (4).

The higher level of FFA in local virgin oil may be attributed to high moisture content in olive fruits, which is favorable to enzyme action. The FFA percentage in the local refined oil is also high (4.3%). This is perhaps due to poor refining conditions.

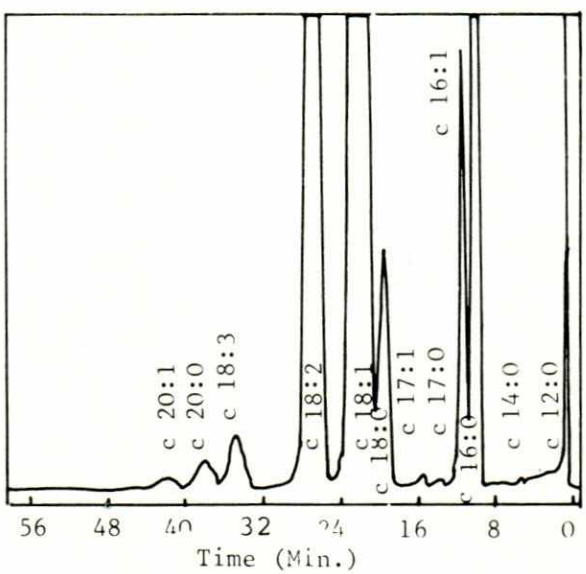

Fig. 1. Gas chromatogram of Libyan virgin olive oil.

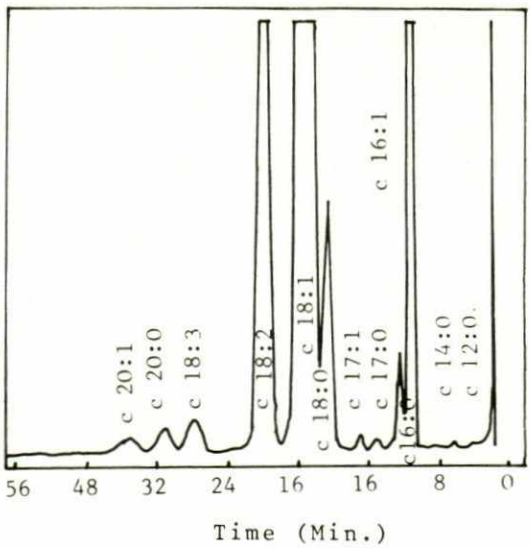

Fig. 2. Gas chromatogram of Libyan refined olive oil.

The limits for FFA, according FAO/WHO Codex (6), are for virgin oil 3.6% and for refined olive oil 0.3%.

The distribution of fatty acids in olive oil samples is shown in Table 2 and Figs 1, 2, and 3. The acids which have been identified in all samples of olive oil are: oleic, linoleic, palmitic, palmitoleic and stearic, which are usually referred to as 'fundamental acids'. The percentages observed for oleic are significantly lower and higher for linoleic acids and palmitic respectively in all olive oil samples including imported ones.

According to Hilditch's (5) classification, Libyan olive oil belongs to the type which is characterised by relatively low oleic and high linoleic and palmitic acids.

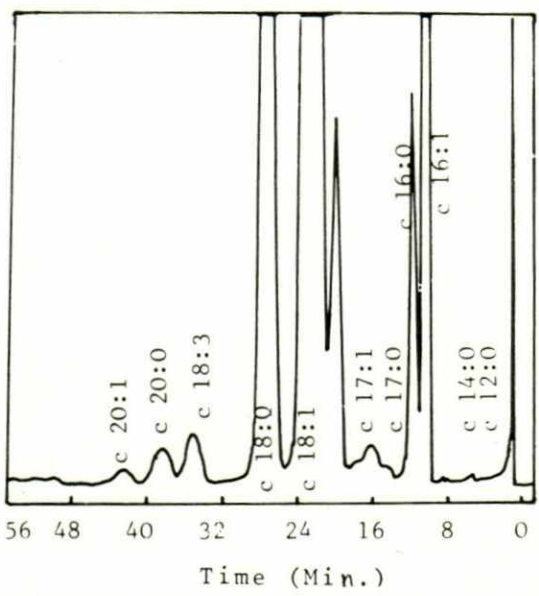

Fig. 3. Gas chromatogram of imported olive oil.

The limits for oleic in the olive oils of various origin are: Italy, 63–86%, Greek, 57–93%; Spain, 65–79%; Argentine 54%; Tunisia, 55–70.6%; California 62–83%. The limits for other fundamental acids of olive oils from above sources, are as follows: linoleic, 3.7–15%; palmitoleic, 1.3–4.7%; palmitic 5.5–19.7%; stearic 0.3–3.4%; and the total saturated acid are from 8.9 to 22%. (1). Codex limits for principal fatty acids in olive oil are: oleic, 56–83%; palmitic, 7–20%; linoleic 3–20% (6).

The proportions of oleic acid and linoleic, both in local virgin and refined olive oils (Table 3), do not comply with those reported in literature for olive oils of different origin. However, most of the other fatty acids are within limits of the data reported in literature (4,11). The total of these two principal fatty acids of olive oils is about 76% (both in virgin and refined oils), which is in agreement with data reported in literature (6).

The distribution of oleic and linoleic acid in the imported oil is also similar to that of local oils. However, the percentage of oleic acids is 56.5, which is lowest according to Codex limits.

It seems that in all olive oils under study there is shifting of oleic acid in linoleic acid. The causes for this phenomena are not understood. Nevertheless these results suggest further research works on the fatty acid composition of olive oil produced in The Libyan Jamahiriya.

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بعض صفات زيت الزيتون المنتج فى ليبيا

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المستخلص

تم دراسة الصفات الكيماوية و الفيزيائية لزيت الزيتون الناتج فى ليبيا مع مقارنة بمثيله المستورد من الخارج . وقد وجد أن الأحماض الدهنية الحرة أعلى فى المنتج المحلى من الزيت ـ كما كانت عينة الزيت المحلى الخام مثل عينة الزيت المكرر المحلى فى انخفاضهما فى نسبة حامض الاوليك حيث كانت ٤٤ ٪ ، ٤٧ ٪ على التوالى . ومع ذلك فقد كانت نسبة حامض اللينولينيك عاليه وكان مجموع تركيز حامض الاوليك و اللينولييك أعلى من ٧٥ ٪ من شق الليبدات المتعادلة . وقد تبين أيضا أن مجموع الاحماض الدهنية المشبعة فى كل من الزيت المحلى و المستورد فى حدود ٢٠ ٪ من وزن الزيت .