Characteristics and Composition of Libyan Olive Oil

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ABSTRACT

Chemical and physical characteristics of local olive oil (both virgin and refined) were determined. The moisture levels in olive fruit, cake and oils were 11.77, 12.7 and 0.16%, respectively. The total crude fat on dry basis was: fruit, 39%; and cake, 7%. The free fatty acids (FFA) in both virgin and refined oils were high (4.4 and 4.3%). The samples of virgin as well as refined oil were found to have relatively low oleic acid contents (43.7 and 46.4%). However, linoleic acid was found to be higher than expected and the total of oleic and linoleic acids was more than 75% in the fraction of neutral lipids. The total saturated and unsaturated fatty acids in olive oil samples was ca. 20 and 80%, respectively.

INTRODUCTION

Olive oil, one of the most important and ancient oils, is obtained from the fruits of the evergreen tree, *Olea europa*. The olive tree thrives best in the subtropical climates of the countries bordering the Mediterranean Sea and North Africa. The olive fruit may contain 35–70% of oil (dry basis) and in the pulp it may be as high as 75% (1).

A great deal of data in literature exists on physical and chemical characteristics of different types of olive oils (1). 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 Alimentarius Commission has recommended standard methods for olive oil analysis by giving ranges of characteristic values of different olive oils (2). Olive oil is characterized by the presence of high percentages of oleic acid (up to 93%) in the neutral lipid fraction (3).

Hilditch and Williams (4), 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 and lower percentage of oleic acid. This difference in composition is reflected relatively little in the iodine value because the increase of a more unsaturated acid is compensated by the diminution of oleic and the increase of palmitic.

Despite the fact that Libyan Jamahiriya is one of the important olive crop producers, a considerable amount of foreign exchange is spent on the import of vegetable oils, including olive oil. Moreover, very little data is available on total production, uses and characteristics of Libyan olive oil.

This study is an effort to study the physical and chemical characteristics of Libyan olive oil.

MATERIAL AND METHODS

About 5 kg of mature olive fruits was collected from the University of Al-Fateh campus. The fruits were stored at room temperature until the oil, which was called "laboratory virgin oil," was extracted. The "commercial virgin olive oil" and cake was obtained from a mechanical pressing plant located at Zawia (Libya). The "commercial" refined oil was purchased from Tripoli (Libya) market.

Extraction of Oil

Oil was extracted from 20-g samples of oven-dried and fine ground fruits and cake using a Soxhlet apparatus for 6 hr separately with petroleum ether (bp 40–60 C) or chloroform/methanol (2:1, v/v). The extracts were centrifuged to remove insoluble material and evaporated to dryness on rotary evaporator.

Physicochemical Properties of Oil

The oil was stored under nitrogen at 4 C. 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 (5). The free fatty acids (FFA) were determined by the method of Doris (6). The thiobarbituric acid (TBA) was determined spectrophotometrically at 532 nm using a Beckman spectrophotometer Model 26 (7).

Fatty Acid Composition

The separation of neutral fats was done by silicic acid column and thin layer chromatography (TLC) as described by Stahl (8). One g of neutral fat fractioned on a silicic acid column was dissolved in 10 ml chloroform and a 0.2 ml aliquot of this solution was spotted on 20 x 20 cm silica gel coated (0.3 mm thick) plates. The neutral lipids were developed first with diethylether/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 vapors. The resulting triglycerides were scraped from the plates and methyl esters prepared by transesterification with boron trifluoride (9). The methyl esters were assayed by gas liquid chromatography (GLC) using a Pye Unicam Model 104 gas chromatograph equipped with flame ionization detectors. A 250 cm x 0.5 cm id glass column containing 8% polyethyleneglycol adipate (PEGA) was used. The column temperature was held constant at 170 C and the injection port temperature was 210 C with a nitrogen flow rate of 50 ml/min. The fatty acids were identified by comparison of retention time with known standards.

RESULTS AND DISCUSSION

The physical and chemical characteristics of Libyan olive oils (Table I) were similar to information reported in the literature (1,3), for olive oil from other areas, except for high levels of FFA (4.4%) and unsaponifiable matter (up to 1.5%).

The average physical and chemical characteristics of virgin olive oil, according to Gracian (3) 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 FAO/WHO Codex Alimentarius Committee on Fats and Oils (2) has recommended International Standards for olive oil which are also within the limits just given, including maximum Codex limits for unsaponifiable matter, 1.5%; FFA, 3.6%; and peroxide value, 20 meq O_2/kg. The unsaponifiable matter in local olive samples exceeded the limits set by Codex. This may be a result of high contents of squalene in these samples. High percentages of unsaponifiable matter (1.75%) also have been found in Iranian

commercial virgin olive oil (10).

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 (2). Another distinctive feature is that its sterols are composed of practically pure β-sitosterol (up to 0.2% of the oil) (3).

The higher levels of FFA in local virgin oil may be attributed to high moisture content in olive fruits which is favorable to enzyme action. The other cause for high FFA content may be the bruising of the olive fruits at harvest. The FFA percentage in the local refined oil is also high (4.3%). This is perhaps due to poor refining conditions. The limits for FFA according to FAO/WHO Codex (2) are 3.6% for virgin oil and 0.3% for refined olive oil.

The distribution of fatty acids in olive oil samples is shown in Table II. The percentages observed for oleic acid in all olive samples are significantly lower than reported in literature from other areas and higher for linoleic and palmitic acids.

According to the Hilditch and Williams (4) classification, Libyan olive oil is the type which is characterized by relatively low oleic and high linoleic and palmitic acids.

Limits for oleic in the olive oils of various origin are: Italy, 63-86%; Greece, 57-93.5%; Spain, 65-79%; Argentina, 54-79%; Tunisia, 55-70.6%; and California, 62-83% (3). 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 (3). Codex limits for principal fatty acids in olive oil are (%): oleic, 56-83; palmitic, 7-20; and linoleic 3-20 (2).

The proportions of oleic acid and linoleic both in local virgin and refined olive oils (Table II) do not comply with those reported in literature for olive oils of different origin. This may be due to local climatic conditions. It is now known that olive oil reflects the influence of climate and temperature like other vegetable oils (1). However, most of the other fatty acids are within limits of the data reported in the literature (1,3). The fact that the total of these two principal fatty acids of olive oils is ca. 75-76% (both in virgin and refined oils) is in agreement with data reported in the literature (2).

The oleic content in laboratory virgin olive oil is slightly higher than that of commercial virgin and refined olive oil samples.

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

TABLE I

Physical and Chemical Characteristics of Libyan Olive Oil Samples

Constants	Values[a]		
	Laboratory virgin	Commercial virgin	Refined
Acid value	6.1	8.8	8.5
Free fatty acids (% as oleic)	3.2	4.4	4.3
Saponification value	193	192	186
Unsaponfiable matter (%)	1.6	1.7	1.6
Iodine value	82	84.9	85.3
Peroxide value ($meq/O_2/kg$)	4.1	5.0	5.0
TBA number	1.0	1.2	1.7
Reichert-Meissl value	0.7	1.3	0.5
Polenske value	2.1	8.2	0.7
Specific gravity at 25 C	0.910	0.912	0.914
Refractive index	1.460	1.471	1.409
Viscosity (at 20 C in centipoises)	72.0	76.9	84.5

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

TABLE II

Distribution of Fatty Acids in Olive Oils

Fatty acids	Percentage weight[a]		
	Commercial		
	Virgin	Refined	Laboratory virgin
16:0	17.8	17.0	18.0
16:1	2.5	2.0	1.2
17:0	0.1	0.1	0.1
17:1	0.1	0.6	0.2
18:0	2.2	3.2	4.7
18:1	43.7	46.4	51.2
18:2	32.3	29.2	22.4
18:3	0.8	0.7	0.9
20:0	0.4	0.5	0.8
20:1	0.2	0.2	0.5

[a]Mean of 3 replicates.

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