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Chemical Composition of Fixed Oil of *Olea europaea* Drupes from Iraq

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Abstract: The present study was aimed to describe the fatty acid composition, stability and nutritional characteristics of fixed oil of *Olea europaea* drupes from Iraq, locally known as *Zaytoon*. The oil is commonly known as olive oil and is used throughout the world and is believed to have an important role in human health and nutrition. It is considered as one among newer source of edible oil. The oil is classified as generally regarded as safe (GRAS). The fact that there are few reports of analysis of olive oil from Iraq in comparison to other parts of the world also lured us to examine chemically. Fatty acid composition of the olive oil was determined by capillary GC-FID. Thirty fatty acids (95.88%) were identified in the oil. The major fatty acids of the oil were oleic acid (68.07±1.089%), palmitic acid (12.12±0.162%), arachidic acid (9.78±0.155%), docosahexaenoic acid DHA (2.65±0.041%) and eicosapentaenoic acid EPA (0.53±0.01). The DHA and EPA are highly valued polyunsaturated fatty acid (PUFA) and part of several health foods and nutraceuticals. Peroxidizability index calculated for the oil was 27.37% and unsaturated/saturated ratio was 3.25. High unsaturated fatty acid content signified its potential as a health promoter. Moreover, it can be expected to offer considerable resistance to oxidative rancidity during storage.

Key words: Olive oil, fatty acid composition, docosahexaenoic acid (DHA), eicosapentaenoic acid (EPA), polyunsaturated fatty acid (PUFA)

INTRODUCTION

Olea europaea (syn. Olive, *Zaytoon*) belonging to the family Oleaceae is an important medicinal plant which is used all over the world. It is a traditional tree crop of the Mediterranean Basin. The wild olive tree originated in Asia Minor and spread from there as far as southern Africa, Australia, Japan and China (Kiritikar and Basu, 1999). Its fruit oil is commonly known as olive oil and is used throughout the world, but especially in the Mediterranean (Tyler *et al.*, 1988). Olive oil is obtained from ripe fruits by expression and is a non-drying oil varying in colour from pale yellow to greenish yellow (Duke, 2002). The oil is classified as generally regarded as safe (GRAS) by Food and Drug Administration (Burdock, 1997). Olive oil represents an important component of the Mediterranean diet whose intake is greatly growing in developed and developing countries for its known healing effects. It is commonly used in cooking, cosmetics, pharmaceuticals and soaps (Evans, 1997).

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It is the integral part of the traditional Iraqi or Mesopotamian cuisine especially Masgouf and Mezzeh. The fruit is a one-seeded drupe, smooth, oblong or oval, 2-3 cm long, greenish at first, but shiny purplish black when ripe; it is oily and when fresh, extremely bitter. It has been proved effective in the treatment of diabetes, cardiovascular disorders, viral and microbial infections (Khan *et al*., 2007).

Owing to high use of olive or its oil in diet and traditional medicine, it was thought worthwhile to study composition of olive oil from Iraq. Moreover, the fact that there are few reports of analysis of fixed oil of *O. europaea* grown in Iraq in comparison to other parts of the world also lured us to examine its fixed oil. The aim of this study was to describe the detailed fatty acid composition along with stability and nutritional characteristics of the oil.

MATERIALS AND METHODS

Materials

Fully ripe drupes were collected from *O. europaea* growing in natural habitat in Mosul, Iraq, in October, 2008. The specimen was authenticated by Taxonomist and a voucher specimen (No. OED/10/08) was retained for further reference.

Methods

Extraction of Fixed Oil

Three batches of drupes (1.5 kg each) were cleaned and milled using a laboratory-type hydraulic press using a pressure of 11 kg cm^{-2} for one hour to obtain the oil. It was filtered through a glass funnel plugged with cotton. The extracted oil was stored at 4°C in the dark. For analysis of fatty acids, the extracted oils were esterified with 2 M KOH in MeOH at room temperature as described by AOAC (1990).

GC-FID Analysis

The GC analysis of olive oil was performed on Perkin-Elmer Clarus 500 equipped with auto-sampler using Supelcowax 10 column (30 m×0.25 mm; film thickness 0.25 µm). The carrier gas used was hydrogen at 10 psi flow pressure; oven temperature was programmed from 130°C, held for 5 min and raised at 4°C min^{-1} to a final temperature of 240°C and held for 12.5 min. The injector temperature was 260°C and injection volume was 1.5 µL. Detector used was Flame Ionization Detector (FID) and detector temperature was 290°C.

Identification of Fatty Acids

Most of the fatty acid methyl esters were identified by GC-FID by comparison of their retention times with those of reference standard available in the laboratory and analyzed under same conditions. The fatty acid composition was expressed as percentage of total fatty acid methyl ester in the oil. Results are mean of three observations. Peroxidizability Index (PI) was calculated according to equation of Song *et al*. (2000) as given below:

$$PI = (\%monoenoic \times 0.025) + (\%dienoic \times 1) + (\%trienoic \times 2) + (\%tetraenoic \times 4) + (\%pentaenoic \times 6) + (\%hexaenoic \times 8)$$

RESULTS AND DISCUSSION

The cold expression of *O. europaea* drupes yielded olive oil of yellowish green colour (yield 17.01±1.55 %, on fresh weight basis). Oil had a faint characteristic odour and a bland taste. The GC-FID analysis resulted in the identification of thirty fatty acids in the oil

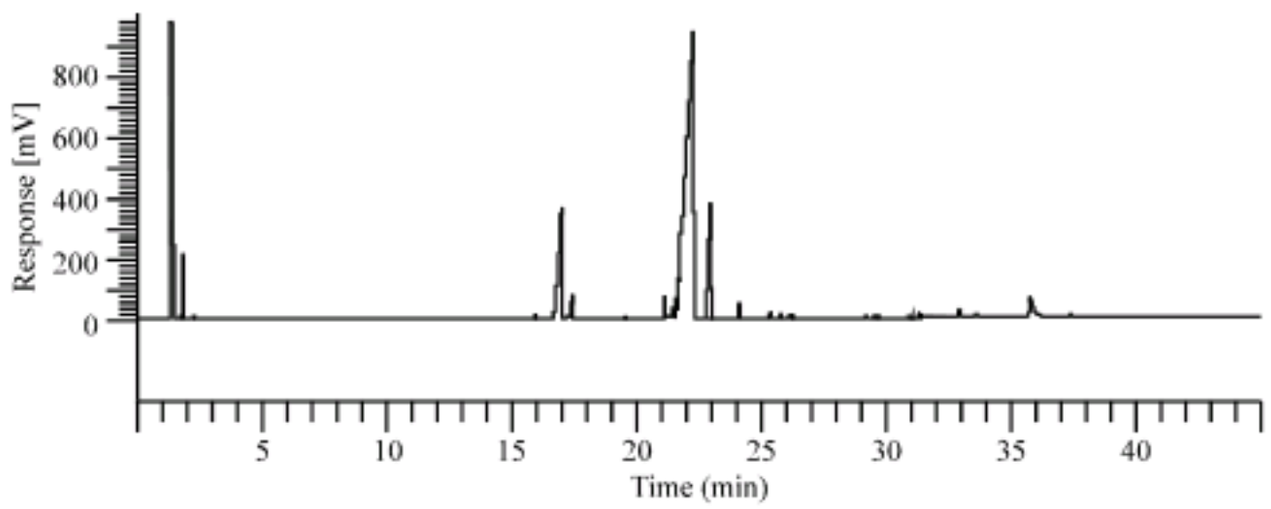

Fig. 1: GC-FID chromatogram of fixed oil from *O. europaea* drupes (olive oil)

Table 1: Fatty acid composition of the fixed oil of *Olea europaea* drupes (olive oil)

Fatty acid	Formula	RT	Percentage (Mean±SD)
Butyric acid	$C_{4:0}$	1.50	0.04±0.041
Caproic acid	$C_{6:0}$	1.67	0.01±0
Caprylic acid	$C_{8:0}$	2.23	0.02±0
Capric acid	$C_{10:0}$	3.68	0.01±0
Myristic acid	$C_{14:0}$	11.88	0.02±0
Myristoleic acid	$C_{14:1}$	12.75	0.01±0.005
Pentadecanoic acid	$C_{15:0}$	14.28	0.02±0
cis-10-Pentadecenoic acid	$C_{15:1}$	15.22	0.05±0.005
Palmitic acid	$C_{16:0}$	16.96	12.12±0.162
Palmitoleic acid	$C_{16:1}$	17.22	0.12±0.005
Margaric acid	$C_{17:0}$	18.99	0.06±0
Margaroleic acid	$C_{17:1}$	19.49	0.11±0.005
Stearic acid	$C_{18:0}$	21.20	0.08±0
Oleic acid	$C_{18:1}$	22.23	68.07±1.089
Linoleic acid	$C_{18:2}$	22.55	0.05±0.005
Arachidic acid	$C_{20:0}$	22.95	9.78±0.155
(-Linoleic acid	$C_{18:3}$	23.83	0.22±0.375
cis-11-Eicosenoic acid	$C_{20:1}$	25.34	0.35±0
Linolenic acid	$C_{18:3}$	25.74	0.26±0.115
Heneicosanoic acid	$C_{21:0}$	26.16	0.25±0.005
cis-11,14-Eicosadienoic acid	$C_{20:2}$	26.84	0.01±0.005
Behemic acid	$C_{22:0}$	28.78	0.02±0
Erucic acid	$C_{22:1}$	29.13	0.12±0
Arachidonic acid	$C_{20:4}$	29.49	0.04±0
Tricosanoic acid	$C_{23:0}$	29.70	0.08±0
cis-13,16-Docosadienoic acid	$C_{22:2}$	30.90	0.08±0
Lignoceric acid	$C_{24:0}$	32.70	0.05±0
cis-5,8,11,14,17-Eicosapentaenoic acid	$C_{20:5}$	32.89	0.53±0.01
Nervonic acid	$C_{24:1}$	33.09	0.02±0.046
Docosahexaenoic acid	$C_{22:6}$	35.20	2.65±0.041
Total saturated fatty acids (14)			22.56
Monoenoic fatty acids (8)			69.48
Bienoic fatty acids (3)			0.14
Trienoic fatty acids (2)			0.48
Tetraenoic fatty acids (1)			0.04
Pentaenoic fatty acids (1)			0.53
Hexaenoic fatty acids (1)			2.65
Total unsaturated fatty acid (16)			73.32
Total fatty acids (30)			95.88

Results are mean of three observations, SD: Standard deviation, RT: Retention time, Unsaturated/saturated ratio = 3.25, Peroxidizability index (PI): 27.37%

(Fig. 1), which represented 95.88 % of total fatty acid composition (Table 1). The oil consisted of fourteen saturated fatty acids (22.56%) and sixteen unsaturated fatty acids (73.32%). Oleic

acid (68.07±1.089%), palmitic acid (12.12±0.162%) and arachidic acid (9.78±0.155%) were the major components of the oil, as in most of the common edible oils. The fatty acid composition is in good agreement with the earlier reports (CSIR, 2007; IOOC, 2008). However, present study reports the presence of docosahexaenoic acid (22:6n-3; DHA) and eicosapentaenoic acid (20:5n-3; EPA) in the olive oil for the first time (2.65±0.041% and 0.53±0.01, respectively). The source of variability may be genetic (cultivar, variety) or due to fruit variables, quality, oil processing and accuracy of quantification technique.

DHA along with EPA is the predominant n-3 polyunsaturated fatty acid (PUFA) in fish oils. Consumption of fish oils is particularly associated with a low incidence of atherosclerosis and cardiovascular diseases and this prophylactic effect is attributed to n-3 PUFAs, such as EPA and DHA (Sekine *et al*., 2007). These are highly valued omega-3 fatty acid and are a part of several health foods and nutraceutical preparations. The role of DHA for the growth and functional development of the brain in infants and adults is well established. The inclusion of DHA in the diet improves learning ability, whereas deficiencies of DHA are associated with deficits in learning. DHA has a positive effect on diseases such as hypertension, arthritis, atherosclerosis, depression, adult-onset diabetes mellitus, myocardial infarction, thrombosis and some cancers (Horrocks and Yeo, 1999; Song *et al*., 2000). The PI for the oil was 27.37% and unsaturated/saturated ratio was 3.25. It indicated that the crude oil extracted by cold expression is stable to auto-oxidation rancidity during storage.

CONCLUSION

From these results it may be concluded that the olive oil from Iraq has high unsaturated fatty acid content including DHA and can be expected to offer considerable health benefits on consumption and resistance to oxidative rancidity on storage. The source of variability may be related to cultivar or variety, quality, oil processing and accuracy of quantification technique.

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