

Characterization of Virgin Olive Oils Produced in Hatay

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In this study, physical and chemical characteristics and fatty acids compositions of virgin olive oils obtained from 36 different olive oil plant in Hatay province in 2001/2002 crop years were determined. The physical properties of oils were determined as follows; density 0.916-0.922 g/cm³, refractive index 1.4680-1.4699, viscosity at 20 °C, 68-78 cpu. The chemical properties of oils were determined as follows; free fatty acids 0.7-6.3 %, peroxide value 9.21-25.89 meqO₂/kg. Fatty acid compositions of the oils were found as follows; palmitic acid 10.84-15.81 %, palmitoleic acid 0.30-0.63 %, stearic acid 2.16-5.23 %, oleic acid 74.18-80.21 %, linoleic acid 4.12-7.40 % and linolenic acid 0.5-0.8 %.

Key Words: Olive oil, Hatay, Fatty acids composition.

INTRODUCTION

Turkey is the fourth biggest olive oil producer in the Mediterranean region after Italy, Spain and Greece¹. Hatay province, which is in the southern part of Turkey and borders the Mediterranean sea, has favourable climate and soil conditions for olive production. 90 % of the olives produced in this province are used for olive oil production and 10 % are for olives consumption².

The reason why the olives are processed into oil is to obtain virgin olive oil. Virgin olive oil is obtained only by mechanic or physical method and it shouldn't be exposed to heat and not treated except for washing, decantation, centrifuging and filtration. Virgin olive oil has a colour changing from green to yellow and a distinctive taste and besides it can be consumed as a food in its natural oil form³.

Olive oil is almost the only vegetable oil which can be consumed in its unrefined form, which is due to the distinctive features of the olive fruit⁴. Olive oil is preferred to other vegetable oils on account of its unique taste and smell and with its high digestibility and oxidation stability, olive oil is an important oil source⁵.

It can be stated that the kind and maturity degree of the olives, soil and climate conditions, harvesting method and period, oil extraction system and the storage conditions of the olive oil are among the most important

factors which affect the quality of the olive oil^{6,7}. High quality virgin olive oil is an important human nutrient on account of its chemical compounds and natural form⁸. Quality and classification of the olive oil is determined through chemical and physical analysis.

In the study, it is tried to determine the characteristics of the olive oil produced in Hatay province through chemical, physical and sensorial examinations.

EXPERIMENTAL

Virgin olive oil samples were taken from 36 different plant around Hatay in November (2001-2002 crop year). From each plant, 2 L of olive oil sample was taken and filled in 1 L amber glass bottles without head space. Oil samples, were kept in a cool (4 ± 1 °C) and darkness in the laboratory till the analysis.

All chemicals were reagents from Merck Chemical Co. (Darmstadt, Germany) and fatty acid standard were purchased from Sigma (St. Lois, MO, USA).

Determination of physico-chemical properties: The density (D), refractometer index (RI), free fatty acids, peroxide value⁹ were determined. In order to determine the viscosity (V) as cP, 150 g oil was put in a beaker and by applying R2 caliber spindle and 12 rpm speed in ST-DIGIT model viscosimeter¹⁰.

Determination of the fatty acid composition: For the determination of fatty acid composition, the methyl-esters were prepared by vigorous shaking of a solution of oil in hexane (0.2 g in 3 mL) with 0.4 mL of 2 N methanolic potash and analyzed by GC with a Hewlett-Packard (HP 6890) chromatography equipped with a FID detector. A fused silica capillary column BP \times 70 of 50 m length \times 0.25 mm i.d. and 0.25 μ m of film thickness (SGE, Australia). Helium was used as carrier gas and the oven temperature was maintained at 198 °C. The injector and detector temperatures were 220 and 250 °C, respectively. An injection volume of 1 μ L was used¹¹. The results were expressed as relative area percent of the total.

Statistical analysis: Data were subjected to analysis of variance by SPSS statistical program (SAS Institute, Version 10.0) and means were compared by Duncan's test at 0.05 significance levels.

RESULTS AND DISCUSSION

Average values pertaining to some physical and chemical features of the olive oil are given in Table-1. Density values of the samples were determined between 0.916-0.922, which are higher than the values determined in the other studies made in Hatay province¹².

TABLE-1
PHYSICO-CHEMICAL PROPERTIES OF VIRGIN OLIVE OILS

Virgin olive oil	Density (g/cm ³)	Viscosity (Cp)	Refractive index (cP)	Free fatty acid (%)	Peroxide value (meq)
O1	0.917 ab	69.7 bc	1.4688 e-h	5.4 u	21.4 u
O2	0.918 b-d	71.7 d-g	1.4686 bc	4.1 p	13.9 g
O3	0.916 ab	74.0 j-l	1.4686 b	3.8 n	22.2 v
O4	0.919 c-e	73.3 h-k	1.4689 g-i	3.8 n	12.7 d
O5	0.916 ab	70.7 c-e	1.4688 e-g	5.5 u	25.8 w
O6	0.917a	74.0 j-l	1.4689 e-h	2.7 h	18.8 p
O7	0.916 ab	70.0 bc	1.4687 c-e	1.6 d	16.7 l
O8	0.919 c-e	72.0 e-h	1.4688 ef	3.4 k	16.1 k
O9	0.918 b-d	72.3 f-i	1.4686 bc	5.9 y	21.3 u
O10	0.917 ab	72.7 g-j	1.4687 b-d	3.5 l	19.9 r
O11	0.917 ab	70.0 bc	1.4691 j-l	2.7 h	16.7 l
O12	0.919 de	73.0 g-j	1.4686 bc	3.6 m	21.3 u
O13	0.917 a-c	74.3 k-m	1.4687 b-d	0.7 a	9.8 b
O14	0.918 b-d	72.3 f-i	1.4688 de	4.9 t	15.2 i
O15	0.919 c-e	73.7 i-k	1.4692 l	1.1 b	9.5 a
O16	0.919 de	75.7 lm	1.4689 e-h	4.8 s	17.2 m
O17	0.917 ab	72.3 f-i	1.4686 bc	5.7 v	23.3 z
O18	0.918 b-d	72.7 gh-j	1.4687 b-d	3.5 l	24.0 x
O19	0.918 c-e	78.0 n	1.4689 e-h	1.4 c	12.9 e
O20	0.918 b-d	75.3 lm	1.4691 i-k	4.1 o	22.4 vy
O21	0.919 c-e	72.0 e-h	1.4692 kl	3.2 j	17.3 m
O22	0.919 c-e	74.0 j-l	1.4680 a	5.7 v	22.5 y
O23	0.917 ab	68.0 a	1.4690 g-i	2.3 g	15.4 ij
O24	0.917 a-c	70.0 bc	1.4689 e-h	4.3 r	20.4 s
O25	0.920 e	70.3 b-d	1.4690 g-i	2.9 i	18.1 o
O26	0.918 b-d	69.0 ab	1.4690 hi	4.2 q	17.8 n
O27	0.919 c-e	70.7 c-e	1.4690 ij	3.2 j	19.1 q
O28	0.916 a	70.0 bc	1.4689 f-i	5.5 u	13.4 f
O29	0.917 a-c	72.0 e-h	1.4690 ij	4.8 s	20.6 t
O30	0.918 b-d	72.7 g-j	1.4689 f-i	1.9 e	13.5 f
O31	0.919 c-e	70.3 b-d	1.4699 m	2.4 f	15.6 j
O32	0.919 c-e	73.0 g-k	1.4686 b	2.7 h	11.4 c
O33	0.919 c-e	71.0 c-f	1.4686 bc	6.3 z	20.4 st
O34	0.922 f	72.3 f-i	1.4688 e-g	5.5 u	23.5 e
O35	0.917 ab	72.7 g-j	1.4698 m	3.6 m	16.8 l
O36	0.918 b-d	73.7 i-k	1.4689 e-h	4.3 qr	14.3 h

Means followed by the same letter are not significantly different at 5 %.

Refractive index values of the virgin olive oil under investigation were determined between 1.4680-1.4699. This index value is directly proportional to the degrees of the unsaturated fatty acids, the length of the chain and the presence of the conjugate double bond¹³. The refractive index value of the virgin olive oil was found high for Hatay region since the olive oil produced in the province has a high level of the unsaturated fatty acid.

Viscosity values of the virgin olive oil samples at 20 °C were determined between 68.0 cP-78.0 cP (average: 72.2 cP). Bernardini¹⁰ reported to have determined the same values between 77-83 cP, which are lower than the values (except O19) found in this study.

Free fatty acid contents (oleic acid %) of the olive oil samples were determined between 0.7-6.3 % (average 3.76 %). Stefanoudaki *et al.*¹⁴ determined the free fatty acids contents of the olive oil samples obtained from three different European countries between 0.22-0.31 %. The reason why the free fatty acid contents are high in the virgin olive oil produced in Hatay region is closely related to the characteristic features of the olives cultivated in the region, harvesting time and method and the various technological processes applied while extracting oil⁸. Furthermore, in the years when the olives are in abundance, acidity of the olives kept in sacks can increase with the hydrolysis of the oil due to some microbiological and enzymatic reasons.

Peroxide value pertaining to the olive oil samples were determined between 9.51-25.89 meqO₂/kg (average: 17.89 meqO₂/kg). In Italy, Gutierrez *et al.*¹⁵ determined this value for two different olive oil samples between 8 and 3.6 meqO₂/kg.

Peroxide value is a qualitative indicator of the conservation condition of the oil. When oil is conserved in an inappropriate condition where it is exposed to oxygen, heat or light, this causes the oxidation and consequently the increase in the peroxide value¹⁶. Peroxide values of some virgin olive oil samples obtained from Hatay region were found high since the oil was packaged in pet bottles without vacuum and was exposed to oxygen during the extraction process.

Fatty acid compositions of the olive oil samples are given in Table-2. As can be seen in the Table-2, palmitic acid contents were determined between 10.8-15.8 % (O34 and O23), palmitoleic acid contents 0.30-0.63 % (O29 and O7), stearic acid contents 2.16-5.23 % (O8 and O29), oleic acid contents 74.18-80.21 (O23 and O27), linoleic acid contents 5.20-7.40 % (O13 and O6) and linolenic acid contents 0.6-0.8 %.

Stefanoudaki *et al.*¹⁴ determined the oleic acid contents of the virgin olive oil samples obtained from Italy (Coratina), Spain (Picual) and Greece (Koroneiki) between 75.1-80.8 %, palmitic acid contents 8.5-13.1 %, linoleic acid contents 5.3-5.8 %, stearic acid contents 2.3-2.6 % and linolenic acid contents 0.7-1.0%. In present study, palmitic (except O23), oleic, stearic

TABLE-2
FATTY ACID COMPOSITION OF VIRGIN OLIVE OILS

Virgin olive oil	C _{16:0}	C _{16:1}	C _{18:0}	C _{18:1}	C _{18:2}	C _{18:3}
O1	13.1	0.4	3.3	78.1	4.4	0.7
O2	13.2	0.4	3.2	77.0	6.0	0.6
O3	13.7	0.3	2.2	78.1	5.1	0.6
O4	14.0	0.3	3.1	77.2	5.1	0.5
O5	13.5	0.6	4.1	76.3	5.0	0.6
O6	11.2	0.5	2.5	75.9	7.4	0.6
O7	14.3	0.6	3.3	76.1	5.2	0.7
O8	13.2	0.4	2.2	78.3	5.2	0.6
O9	12.5	0.5	3.2	79.2	4.3	0.8
O10	12.1	0.3	3.3	78.5	5.2	0.7
O11	14.3	0.4	3.1	77.1	4.7	0.7
O12	13.8	0.3	3.1	78.0	4.5	0.8
O13	14.4	0.3	3.4	77.3	4.1	0.8
O14	13.4	0.4	3.5	77.6	4.6	0.7
O15	13.1	0.5	4.0	76.2	5.6	0.6
O16	11.3	0.5	3.5	79.1	4.7	0.7
O17	14.6	0.5	3.7	76.1	4.8	0.8
O18	14.3	0.4	3.2	77.2	4.6	0.7
O19	15.1	0.3	3.2	75.1	5.2	0.7
O20	14.7	0.4	3.3	75.6	5.4	0.6
O21	13.3	0.5	3.5	77.1	5.2	0.7
O22	14.2	0.4	3.3	76.2	5.6	0.6
O23	15.8	0.4	3.1	74.2	6.1	0.6
O24	14.5	0.3	3.6	76.4	5.3	0.6
O25	11.2	0.3	2.7	79.4	6.2	0.5
O26	14.1	0.4	3.4	77.2	4.7	0.7
O27	11.2	0.3	2.7	80.2	5.5	0.6
O28	13.2	0.6	3.2	77.4	5.2	0.7
O29	12.8	0.3	5.2	75.3	4.9	0.7
O30	14.6	0.4	3.7	75.5	5.3	0.6
O31	13.7	0.4	4.2	76.3	4.7	0.7
O32	12.3	0.5	2.5	79.7	4.6	0.6
O33	15.0	0.3	3.5	76.2	4.7	0.6
O34	10.8	0.5	2.6	80.1	5.7	0.6
O35	12.4	0.43	2.9	78.6	5.5	0.6
O36	11.2	0.32	2.2	79.2	6.3	0.5

(except O29), linoleic and linoleic acid contents were found in similar proportions.

In conclusion, average density, free fatty acids and peroxide values of the virgin olive oil produced in Hatay province were found higher than the values found in similar studies. As for the fatty acid composition, palmitic, stearic and oleic acid contents were found higher, but linoleic acid contents

were found lower. This situation is caused by different factors like geographic position, climate and soil structure, oil species and maturity level, harvesting time and method, oil processing technique and storage conditions.

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