EURASIAN JOURNAL OF FOOD SCIENCE AND TECHNOLOGY

Determination of Fatty Acid Composition of Iranian Extra Virgin Olive Oils with Respect to Cultivar and Geographic Origin

Esmaeil Ghanbari SHENDI

Hacettepe University, Department of Food Engineering, Ankara 06-800, Turkey;

Email: esi.1361@gmail.com

Abstract

In this research, 12 Extra Virgin Olive Oil (EVOO) were collected from Iran's northern and southern provinces including Zard, Roghani, Dezful, and Mari cultivars were studied. Free fatty acid content (%), Peroxide value (meq O2/kg sample), and fatty acid composition of Extra Virgin Olive Oil (EVOO) were analyzed. Results showed that Iran's northern EVOOs have more unsaturated fatty acid (Oleic, Linoleic, Linolenic acids) than southern in general. On the other hand, saturated fatty acids content (Palmitic, and Stearic acids) were higher in southern EVOOs. But free fatty acid content (%) and Peroxide value (meq O2/kg sample) showed that oxidation stability of southern EVOOs was higher than northern.

Key words: Iran's Olive oil, Fatty acid composition, Free fatty acid content (%), Peroxide value.

INTRODUCTION

Iran is one of the olive oil producer country in the world. Although, it is not famous in Olive oil producing, but there are many attempts for development of olive trees in this country. Fatty acid composition is an important feature of virgin olive oil. The fatty acid composition affects the taste of virgin olive oil and it is largely responsible for the taste and healthful effects of the people's diet. It is well known that the fatty acid composition of olive oil is quantitatively affected by two main factors: the olive variety used in the production of the oil and the ripening stage at which the olives are harvested. There are only a few types of fatty acids in olive oil, but the proportions of each strongly influence the characteristics and nutritive value of the oil. Palmitic, oleic, and linoleic acids are the main fatty acids commonly found in virgin olive oil, other fatty acids are present in small amounts. Oleic acid is the most important fatty acid in composition of olive oil (55-88%). Oleic acid is a common monounsaturated fat in human diet. Monounsaturated fat consumption has been associated with decreased low-density lipoprotein (LDL) and possibly increased high-density lipoprotein (HDL) resulting in reduced cholesterol level. Apart from oleic acid, the particular minor components present in olive oil, such as polyphenols, hydrocarbons, tocopherols, fatty alcohols and triterpenic compounds and, some of which are known to be anti-inflammatory, make it the quintessential functional food (Boskou, 2006).

Olive fruit are harvested during October to December in Iran. The quality of the virgin olive oil is important factor in determination of its price and is a function of weather during the growing season. Environmental factors, affect olive oil fatty acid composition (Bucci et al., 2002) Due to a high demand for olive oil around the world, not only in the Mediterranean countries, Iranian farmers have been motivated to grow olive trees, therefore olive trees are widely distributed in the northern and southern regions of Iran.

Olive oil fatty acid composition changes may be associated with the zone of production, the latitude, the climate, the variety, and the stage of maturity of the fruit (Ballabio et al.,2006; Lopez-Feria et al., 2008; Di bella et al., 2007; Galtier et al., 2007; Rui Alves et al., 2005; Haddada et al., 2007). Studies showed that Greek, Italian, and Spanish olive oils have low content linoleic and palmitic acids and high content of oleic acid. Tunisian olive oils are high in linoleic and palmitic acids and low in oleic acid. It is not much information on its chemical composition of Iranian Virgin Olive Oil in the literature to date. The aim of this study was to determine fatty acids composition of some Iranian olive oils extracted from different cultivars and geographic origins. Present study tried to investigate fatty acids profile of Iranian Zard, Roghani, Dezful, and Mari olive oils in 2016 season.

MATERIAL AND METHODS

In this research 12 olive oil samples were extracted from the olives including Zard, Roghani, Dezful, and Mari cultivars harvested from different locations of Iran at early stages of maturation in 2016 season. Zard, Roghani, and Mari cultivars were belonged to northern provinces and Dezful cultivar was belonged southern provinces of Iran.

Determination of Free Fatty Acid Content

Total free fatty acids (FFA) of the samples were measured by titrating 1 g sample dissolved in 95% ethanol against phenolphthalein indicator according to American Oil Chemists' Society (AOCS) method Ca 5a-40, and results are given as percent of oleic acid (Ogutcu and Yilmaz 2009).

Determination of Peroxide Value

Peroxide value was determined according to the AOCS Cd 8-53 method . For performing of this analysis 5.00±0.05 g of sample was weighed into a 250-ml erlenmeyer flask with glass stopper and 30 ml of the 3:2 acetic acid-chloroform solution was added. The sample solution was shaked to dissolve. 0.5 ml of saturated KI solution was added. Solution was allowed to stand with occasional shaking for exactly 1 min, and then immediately 30 ml of distilled water was added. Solution must be titrated with 0.1N sodium thiosulfate, by adding it gradually and with constant agitation. Titration should be coutinued until the disappearing of yellow iodine color. 2 ml of starch solution was added and titration was continued with constant agitation, especially near the the end point, to liberate all of the iodine from the solvent layer. At the end part of assay, thiosulfate solution must be added dropwise until the blue color disapearing. PV was calculated with the following formula:

$$\text{POV (mEq/kg)} = (\text{S} - \text{B}) * \text{N} * 1000/ \text{ mass of sample}$$

B:volume of titrant, ml of blank
S:volume of titrant, ml of sample
N:normality of sodium thiosulfate solution

Fatty acid composition analysis

For the determination of fatty acid composition of the oils, fatty acid methyl esters were prepared from olive oil, using a cold transmethylation (Ogutcu and Yilmaz 2009). The fatty acids were converted to fatty acid methyl esters before analysis by shaking a solution of 0.2 g oil and 3

mL of hexane with 0.4 mL of 2 N methanolic potassium hydroxide. A Shimadzu (Kyoto, Japan) gas chromatograph, equipped with a flame ionization detector and a split/splitless injector, was employed. Separations were made on a Teknokroma TR-CN100 (Barcelona, Spain) fused-silica capillary column (60 m×0.25 mm i.d. 0.20 µm film thickness). The carrier gas was nitrogen, with a flow rate of 1 mL/min. The temperatures of the injector and the detector were held at 220 and 250 ◦C, respectively. The initial oven temperature of 90 ◦C was maintained for 7 min, raised to 240 ◦C at a rate of 5 ◦C/min, where it was maintained for 15 min. The injection volume was 1 µL. Peaks were identified by comparison of their retention times with those of authentic reference compounds (Sigma–Aldrich, St. Louis, MO, USA).

Statistical Analysis

Statistical analysis was performed by SPSS 17 (SPSS Inc.Chicago, IL) statistical software and using One-way Anova method. Differences among all groups were determined by Duncan test. All analyses were performed at least duplicate.

RESULTS AND DISCUSSIONS

Free fatty acid content:

Results of free fatty acid content (%) analysis showed that all olive samples were categorized in Extra Virgin Olive Oil class according to International Olive Council regulations (<0.8 %). Dezful Extra Virgin Olive Oil had the lowest content of free fatty acid content among all samples. It may be related to the ecologic condition of Khozestan province of Iran, that has low raining. Roghani cultivar had the highest amount of free fatty acid content, it is because of high raining in this region (Table 1).

Table 1. *Free fatty acid content (%) of Extra Virgin Olive samples*

Olive oil	Zard	Roghani	Dezful	Mari
Free fatty acid content (%)	0.3 ± 0.05^{b}	0.4 ± 0.03^{a}	0.2 ± 0.01^{c}	0.3 ± 0.02^{b}

Different superscript letters in the same column indicate significant difference between mean values ($P < 0.01$).

Peroxide Value:

Results of Peroxide Value assay showed that all olive oil samples were classified as Extra Virgin Olive Oil according to the International Olive Council regulations (PV<20). Roghani cultivar had the highest amounts of Peroxide value, and the lowest amount was belonged to Dezful cultivar. Ecologic conditions of olive cultivars led to increase or decrease of theirs' Peroxide values. The regions with high raining had high peroxide value because of oxidation rate increment (Table 2).

Table 2. *Peroxide value of Extra Virgin Olive Oil samples (meq O2/kg sample).*
Different superscript letters in the same column indicate significant difference between mean values ($P < 0.01$).

Olive oil	Zard	Roghani	Dezful	Mari
Peroxide value (meq O2/kg sample)	16.58 ± 0.021^{b}	18.20 ± 0.122^{a}	12.24 ± 0.035^{c}	16.50 ± 0.085^{b}

Fatty acids profile:

Results of fatty acid composition assay showed that all amounts were in the range of the International Olive Council limitations. Mari cultivar had the highest content of Oleic acid. The highest amount of Palmitic acid was belonged to Dezful cultivar. Zard cultivar had the most value of Palmitoleic acid. The most value of Stearic acid was belonged to the Zard cultivar. Linoleic and Linolenic acids are other important unsaturated fatty acids in extra virgin olive oil. Roghani cultivar had the highest amount of Linoleic acid. Zard and Roghani had the most value of Linolenic acid. The highest amount of Arachidic acid were belonged to the Zard and Roghani cultivars (Table 3). As other features, fatty acids compositions were affected by ecologic condition. The high temperature regions, had the most value of saturated fatty acids. On the other hand, regions with high raining had mono and poly unsaturated fatty acids. Unsaturated fatty acids have important role in decreasing of heart coronary diseases.

Table 3. *Fatty acids compositions of Extra Virgin Olive Oil*

Olive oil	Palmitic	Palmitoleic	Stearic	Oleic	Linoleic	Linolenic	Arachidic
Zard	12.90±0.42^{c}	2.62±0.12^{a}	5.15±0.61^{a}	69.42±0.85^{b}	7.82±0.41^{b}	1.00±0.01^{a}	0.60±0.01^{a}
Roghani	11.42±0.12^{d}	0.86±0.03^{c}	4.32±0.23^{b}	69.96±0.52^{b}	11.62±0.21^{a}	1.00±0.02^{a}	0.60±0.02^{a}
Dezful	16.50±0.75^{a}	1.55±0.11^{b}	2.36±0.15^{d}	67.31±0.52^{c}	11.00±0.11^{a}	0.82±0.01^{b}	0.46±0.01^{b}
Mari	13.62±0.32^{b}	0.96±0.02^{c}	3.42±0.21^{c}	73.62±0.21^{a}	6.32±0.22^{c}	0.91±0.02^{b}	0.53±0.03^{a}

Different superscript letters in the same column indicate significant difference between mean values ($P < 0.01$).

CONCLUSION

Results of this research showed that Iran's northern EVOOs have more unsaturated fatty acid (Oleic, Linoleic, Linolenic acids) than southern in general. These fatty acids have important role in human diet. On the other hand, saturated fatty acids content (Palmitic, and Stearic acids) were higher in southern EVOOs. But free fatty acid content (%) and Peroxide value (meq O2/kg sample) showed that oxidation stability of southern EVOOs was higher than northern. Because of low data base on Iranian Olive Oil in literature, present study can help to better programming of agriculture plans in Iran.

REFERENCES

American Oil Chemists' Society (AOCS), 2003. Official Method for determining peroxide value Acetic Acid-Chloroform, Cd 8-53.

American Oil Chemists' Society (AOCS), 2017. Free Fatty Acids in Crude and Refined Fats and Oils, Method Ca 5a-40.

Boskou, D., 2006. Olive oil, chemistry and technology. AOCS Press, Champaign

Bucci, R., Margi, ´ A.L., Marini, D, Marini. F., 2002. Chemical authentication of extra virgin olive oil varieties by supervised chemometric procedures. *J Agric Food Chem* 50,413–418

Ballabio, D., Mauri, A., Todeschini, R., Buratti, S., 2006. Geographical classification of wine and olive oil by means of classification and influence matrix analysis (CAIMAN). *Anal Chim Acta* 570, 249–258.

Lopez-Feria, S., Cardenas, S., Garcıa-Mesa, J.A., Valcarcel, M., 2008. Classification of extra virgin olive oils according to the protected designation of origin, olive variety and geographical origin. *Talanta*, 75, 937–943.

Di bella, G., Maisano, R., Lapera, L., Loturco, V., Salvo, F., Dugo, G., 2007. Statistical characterization of sicilian olive oils from the Peloritana and Maghrebian zones according to the fatty acid profile. *J Agric Food Chem*, 55, 6568–6574.

Galtier, O., Dupuy, N., Le Dr0eau, Y., Ollivier, D., Pinatel, C., Kister, J., Artaud, J., 2007. Geographic origins and compositions of virgin olive oils determinated by chemometric analysis of NIR spectra. *Anal Chim Acta*, 595, 136–144.

Rui Alves, M., Cunha, S.C., Amaral, J.S., Pereira, J.A., Beatriz Oliveira, M., 2005. Important classification of PDO olive oils on the basis of their sterol composition by multivariate analysis. *Anal Chim Acta*, 549, 166–178.

Haddada, F.M., Manaı, H., Oueslati, I., Daoud, D., Sanchez, J., Osorio, E., Zarrouk, M., 2007. Fatty acid, triacylglycerol, and phytosterol composition in six Tunisian olive varieties. *J Agric Food Chem* 55, 10941–10946.

Ogutcu, M., Yilmaz, E., 2009. Comparison of The Virgin Olive Oils Produced in Different Regions of Turkey, *Journal of Sensory Studies*, 24**,** 332–353.