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Characterization of fatty acids composition in Iranian Phishomi extra-virgin olive oil

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Abstract

In this test, fatty acid composition of olive oil obtained from Iranian Phishomi olive cultivar grown in the northern part of country, Gilan province, was determined using a gas chromatography fitted with a flame ionization detector. A total of 12 fatty acids entailing myristic, palmitic, palmitoleic, margaric, margoleic, stearic, oleic, linoleic, arachidic, linolenic, gadoleic and behenic acids were detected. From them, oleic acid was the most prevailing fatty acid, representing the highest content (63.65 %) in the sample, followed by linoleic acid (16.93 %), palmitic acid (14.14 %) and stearic acid (2.73 %); the amount of the rest of the fatty acids detected in trace amounts. Fatty acid composition might vary between olive oils obtained from different cultivars. However, our finding was agreed to the range of those disclosed by the International Olive Oil Council and Codex Alimentarius with elevated resemblance. Apart from fatty acid compositions, percentage of saturated fatty acids (17.48 %), monounsaturated fatty acids (64.82 %), polyunsaturated fatty acids (17.71 %) and the ratios of PUFA to SFA (3.66 %) and oleic to linoleic acids (3.76 %) were also evaluated in oils. Oleic to linoleic acid ratio in studied oils was similar to Greek Throumbolia (2.91–3.19 %) oil.

Keywords: Extra-virgin olive oil, Fatty acids composition, Phishomi olive variety

INTRODUCTION

Olive oil, one of the ancient well-known vegetable oils of the Mediterranean zone elaborated from the fruits of olive (*Olea europaea*), is said to protect against cardiovascular illness and cancer hazard because of its bioactive compositions (Amanpour et al., 2016). Moreover, it prohibits the oxidative stress, which is one of the main causes of aging, for the sake of its balanced fatty acid composition and presence of numerous minor compounds with biological attributes containing phenolic compounds, tocopherols, sterols etc (Kharazi et al., 2012). Also, olive trees are cultivated in a few regions around the world such as USA, Australia and Iran with the similar Mediterranean climate (Homapour et al., 2014).

Among oils, virgin olive oil, a unique crop owing to its elevated nutritional value and sensory properties, is formed by mechanical tools directly from olive fruits in crude form without any other refining processes with regard to further vegetable oils. The request for olive oils has promoted quickly in the last decade, both in oil-producing countries and among

those who are not such as Canada, Japan, Germany, the United Kingdom, and the United States. Iran with more than 22,000 hectares area harvested and 36,000 tons olive production ranked 11th among 43 olive-producing countries in 2013. It is guesstimated that the harvested area will enhance to 40,400 hectares with 121,200 tons production in 2026. More than 80 % of olive cultivation is connected to the northern part of country, Gilan province. The olive oil production of Iran amounted to 4,504 tons in 2011 (Amanpour et al., 2016).

In addition to its health and organoleptic properties, the oxidative stability of virgin olive oil is high because of the high amount of oleic acid, low amounts of linoleic and linolenic acids, and also the presence of biophenols and tocopherols. Thus, the quality and beneficial effects of virgin olive oil intensively belong to its acidic profile and the amount of the minor compounds (Kharazi et al., 2012). Subsequently, quantity and quality of fatty acids composition existing in the virgin olive oil is influenced by different parameters involving the kind of the olive variety, climatic conditions, ripening phase, irrigation management and the isolation techniques. Among these parameters, the variety is one of the most substantial parameters, as each variety has a unique attribute (Hashempour et al., 2010).

Iran is placed in the eastern Mediterranean basin. The history of olive cultivation in Roodbar, the principle olive growing zone of Iran, has been registered for more than nine hundred years. Roodbar is placed in a mountainous area of Iran at 36490N latitude, and 49350E longitude with the same Mediterranean climatic conditions. Phishomi is one of the major olive oil producing cultivar in Iran. In last years, studying in the olive oil composition, as a reliable scale for certified quality and authenticity of virgin olive oil, is of great scientific interest (Kharazi et al., 2012). However, there are limited studies about quality and composition of Iranian virgin olive oils in the Roodbar area. Therefore, due to the importance of fatty acid profile on the oil quality, the present study aims to investigate the composition of the fatty acids, percentage of saturated fatty acids (SFA), monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA) as well as the ratio of oleic acid to linoleic acid and MUFA to PUFA in the extra-virgin olive oil obtained from the Iranian Phisomi olive cultivar.

MATERIALS and METHODS

Olive Oil Sample. The monovarietal Phishomi olive oil (70 kg) was elaborated from an olive farming zone (five different olive trees) of Roudbar in the province of Gilan, in the North of Iran. Olive fruits were handpicked in the year 2016 and the relative oils were immediately acquired by cold press techniques (Amanpour et al., 2016). Samples were kept at 10 °C in darkness before analysis.

Fatty Acid Composition Analysis. Gas chromatographic analysis of the fatty acids was carried out applying a Schimadzu 14B GC (Tokyo, Japan) fitted with a flame ionization detector (FID) and a split injection system (split ratio 1:50). For the determination of fatty acid composition, the methyl esters were provided by cold transmethylation. Separation was performed with a DB23 (Agilent Inc., USA) capillary column (60 m × 0.25 mm id). Hydrogen was the carrier gas, and injector and detector temperatures were set to 250 and 300 °C, respectively.

Oven temperature was adjusted to 130 °C for 1 min, increased from 130 to 170 °C at 6.5 °C/min then was programmed to 215 °C at 2.75 °C/min for 12 min and then increased to 230 °C at 40 °C/min for 3 min. The injection volume was 1 µL. The identification of individual FA (myristic, palmitic, palmitoleic, margaric, margoleic, stearic, oleic, linoleic, arachidic, linolenic, gadoleic and behenic) was performed by checking with retention times of known standards and expressed as a percentage of the total (Amanpour et al., 2016).

RESULTS and DISCUSSION

Fatty Acid Composition of Olive Oil

The most conquering compounds in olive oil are fatty acids. Table 1 exhibited the fatty acid composition outcomes of Phishomi olive oil.

Table 1. Fatty acid composition of Iranian Phishomi olive oil

No.	Fatty acid composition	Olive Oil[a]	IOOC regulation[b]	Codex alimentarius[c]
1	Myristic acid (C14:0)	0.04±0.00	<0.05	0.0–0.05
2	Palmitic acid (C16:0)	14.14±0.03	7.5–20.0	7.5–20.0
3	Palmitoleic acid (C16:1)	0.86±0.02	0.3–3.5	0.3–3.5
4	Margaric acid (C17:0)	0.05±0.00	<0.3	0.0–0.3
5	Margoleic acid (C17:1)	0.06±0.00	<0.3	0.0–0.3
6	Stearic acid (C18:0)	2.73±0.01	0.5–5.0	0.5–5.0
7	Oleic acid (C18:1)	63.65±0.08	55.0–83.0	55.0–83.0
8	Linoleic acid (C18:2)	16.93±0.03	3.5–21.0	3.5–21.0
9	Arachidic acid (C20:0)	0.40±0.01	<0.6	0.0–0.6
10	Linolenic acid (C18:3)	0.78±0.00	<1.0	–
11	Gadoleic acid (C20:1)	0.25±0.00	0.24	0.0–0.4
12	Behenic acid (C22:0)	0.13±0.00	<0.2	0.0–0.2
	Saturated fatty acids	17.48±0.02	–	–
	Monounsaturated fatty acids (MUFA)	64.82±0.03		
	Polyunsaturated fatty acids (PUFA)	17.71±0.01		
	Oleic acid/linoleic acid	3.76±0.00		
	MUFA/PUFA	3.66±0.01		

[a]Results are expressed as mean ± standard deviation of relative percentages of the compounds
[b] (IOOC, 2001)
[c] (Codex Alimentarius Commission, 2003)

As can be indicated in Table 1, a total of 12 fatty acids were discovered under study. Findings revealed that the fatty acids existing in the oil samples were myristic acid (C14:0), palmitic acid (C16:0), palmitoleic acid (C16:1), margaric acid (C17:0), margoleic acid (C17:1), stearic acid (C18:0), oleic acid (C18:1), linoleic acid (C18:2), linolenic acid (C18:3), arachidic acid (C20:0), gadoleic acid (C20:1) and behenic acid (C22:0). Among these fatty acids, oleic acid (C18:1) was the most prevailing fatty acid, representing the highest content (63.65 %) in the sample, followed by linoleic acid (16.93 %), palmitic acid (14.14 %) and stearic acid (2.73 %); the amount of the rest of the fatty acids found in trace values are accessible in Table 1. Fatty acid composition may alter among oils from different olive cultivars. Nevertheless, our finding was agreed to those acquired in Racimilla, Bodocal, and Negral oils from Spain (Cerretani et al., 2006), in Gemlik, Ayvalik, and Memecik from Turkey (Kelebek et al., 2015) and in Throumbolia and Koroneiki from Greece (Vekiari et al., 2010) and Mari from Iran (Amanpour et al., 2016).

It is known thoroughly that the main monounsaturated fatty acid in olive oil is oleic acid. High amount of oleic acid in olive oil is of great significance owing to promoting the nutritional wealth by reducing the breast cancer hazard and diminishing the low density lipoprotein (LDL) cholesterol and triglycerides which decline blood pressure and cardiovascular illness as well as enhancing the oxidative stability (Benito et al., 2010). Therefore, as a consequence the high tolerance to oxidation in olive oil is especially because of the high amount in oleic acid. The content of oleic acid (63.65 %) shown in Table 1 is lower than the content disclosed in Coratina (79.70 %) from Pescara of Italy, Picual (78.20 %) from Sevilla of Spain (Luna & Aparicio, 2002) and Ayvalik (67.07 %) and Memecik (73.22 %) from Balikesir and Mugla of Turkey (Kelebek et al., 2015), and higher than the percentage

of Chemlali (ranging between 58.31 and 61.6 %) (Mraicha et al., 2010) as well as very similar to Throumbolia (ranging between 58.31 and 61.68 %) from Southern Greece (Vekiari et al., 2010). Linoleic acid is the second main fatty acid that comes right after the oleic acid as an unsaturated fatty acid with the content of 16.93 % in the total olive oil. The percentage of linoleic acid (16.93 %) in our study was higher than those reported in Coratina (5.80 %) from Pescara of Italy, Picual (4.60 %) from Sevilla of Spain, Koroneiki (4.60 %) from Crete of Greece (Luna & Aparicio, 2002), and lower than the percentage of Thrombolia (ranging between 20.97 to 19.68 %) from Southern Greece (Vekiari et al., 2010). Among saturated fatty acids, palmitic acid (C16:0) was the main compound with a 14.14 % content. As can be seen in Table 1, the percentages of the fatty acid compositions in our study were in the range of those reported and established by the IOOC (IOOC, 2001) and Codex Alimentarius (Codex Alimentarius Commission, 2003) with high similarity.

Apart from fatty acid compositions, the percentage of saturated fatty acids (SFA), monounsaturated fatty acids (MUFA), polyunsaturated fatty acids (PUFA) and the ratios of PUFA to SFA and oleic to linoleic acids were also assessed in our olive oil sample. The oleic to linoleic acid ratio is an important indicator of the oxidative stability in olive oil; thus, the higher value of this ratio, the less prone to oxidation (Cerretani et al., 2006). The percentage of this ratio was 3.76 % in studied olive oil which was similar to that obtained in Greek Throumbolia (2.91–3.19 %) (Vekiari et al., 2010), and lower than that reported in Spanish Bodocal (5.07 %) and Negral (8.04 %) oils (Cerretani et al., 2006), in Turkish Ayvalik (6.68 %) and Memecik (7.09 %) oil (Kelebek et al., 2015).

CONCLUSIONS

In this test, fatty acid composition of olive oil obtained from Iranian Phishomi olive cultivar grown in the northern part of country, Roudbar in the province of Gilan, was determined using a gas chromatography fitted with a flame ionization detector. A total of 12 fatty acids entailing myristic, palmitic, palmitoleic, margaric, margoleic, stearic, oleic, linoleic, arachidic, linolenic, gadoleic and behenic acids were detected. From them, oleic acid was the most prevailing fatty acid, representing the highest content (63.65 %) in the sample, followed by linoleic acid (16.93 %), palmitic acid (14.14 %) and stearic acid (2.73 %); the amount of the rest of the fatty acids detected in trace amounts. Fatty acid composition might vary between different olive oil cultivars. However, our finding was agreed to the range of those disclosed by the International Olive Oil Council and Codex Alimentarius with elevated resemblance. Apart from fatty acid composition, percentage of saturated fatty acids (17.48 %), monounsaturated fatty acids (64.82 %), polyunsaturated fatty acids (17.71 %) and the ratios of PUFA to SFA (3.66 %) and oleic to linoleic acids (3.76 %) were also evaluated in oils

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