The Effect of Olive Varieties on Fatty Acid Composition and Tocopherol Contents of Cold Pressed Virgin Olive Oils

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Abstract: In this study, fatty acid composition and tocopherol contents of cold pressed olive oils belonged to Ayvalık, Gemlik, Domat, Çilli, Çöpaşı and Söbüaşı varieties were determined. The fatty acid composition of the olive oils showed differences depending on the olive variety. The major fatty acids such as oleic, linoleic and palmitic acids were found as 62.49-68.53%; 8.30-17.93%; 14.39-19.47%, respectively. The highest oleic, linoleic and palmitic acid contents were determined in the varieties of Çilli (68.53%), Söbüaşı (17.93%) and Gemlik (19.47%), respectively. Palmitic, oleic and linoleic fatty acids of the local varieties such as Çilli, Çöpaşı, Söbüaşı were similar to those of Ayvalık and Gemlik varieties. The most abundant isomer of tocopherol in olive oils was α-tocopherol (18.22-36.02 mg/100g). The highest α- and γ- tocopherols were observed in olive oils of Söbüaşı variety (36.02 mg/100g) and Gemlik variety (8.12 mg/100g), respectively. It is concluded that the olive variety is an important factor on the fatty acid composition and tocopherol content of the olive oil.

Key words: olive, varieties, cold press, oil, fatty acids, tocopherols, GC, HPLC

1 INTRODUCTION

Olea europaea is one of the most important and widespread fruit trees in the Mediterranean basin. Virgin olive oil is a quite valuable oil extracted from olives using cold press, which is the best practise for minimizing the loss of bioactive constituents¹–⁴. The major component of olive oil is triacylglycerols, which form by esterification of fatty acids and glycerol and also comprise more than 98% of total compounds, phytochemicals are significant minor components of olive oil². This chemical composition ensures that olive oil is beneficial for health and has nutritional value⁵. Oils belonged to local olive varieties of the Mediterranean area have drawn attention because of physicochemical properties, stability and fatty acid composition⁶. The high contents of phenolic compounds, monounsaturated fatty acid, especially oleic acid, and α-tocopherol amounts of virgin olive oil protect the oil to oxidation⁷. The high content of oleic acid is responsible for regulation of the low density lipoprotein and high density lipoprotein ratios⁸. In addition, virgin olive oil protects against atherosclerosis, obesity, metabolic syndrome, type II diabetes, hypertension, several cancer types and also has significant influence on lipid metabolism, some age-related processes and chronic inflammatory disorders⁹. The physicochemical properties of virgin olive oil can show differences according to climate, geographic area, variety, maturity level and agricultural practices (irrigation, fertilization)⁷. This study focused on determining the effect of local olive varieties on fatty acid composition and tocopherol content of cold press virgin olive oil.

2 MATERIAL AND METHODS

2.1 Materials

The olive samples belonged to Ayvalık, Gemlik, Domat, Çilli, Çöpaşı and Söbüaşı varieties were harvested from Mersin (Mut) in Turkey in December 2018. Olives were brought to the laboratory in plastic crates and foreign matters as leaves and stones, etc. were cleaned.
2.2 Methods

2.2.1 Extraction of virgin olive oil

Olive fruits were pressed using cold press and centrifuged to obtain the olive oil.

2.2.2 Fatty acid composition

Olive oils were esterified according to ISO-5509 method with some modifications. Fatty acid methyl esters of samples were analyzed gas chromatography (Shimadzu GC-2010) equipped with flame-ionization detector (FID) and capillary column (Tecnocroma TR-CN100, 60 m × 0.25 mm, film thickness: 0.30 μm). The temperature of injection block and detector was 260°C. Mobile phase was nitrogen with 1.51 ml/min flow rate. Total flow rate was 80 ml/min and split rate was also 1/40. Column temperature was programmed 120°C for 5 minutes and increased 240°C at 4°C/min and held 25 minutes at 240°C.

2.3 Statistical Analysis

All analytical measurements were carried out in triplicate. The obtained data were analyzed using analysis of variance. The results were expressed as means ± standard deviation of independent olive oil samples.

3 RESULTS AND DISCUSSION

The fatty acid composition of virgin olive oils extracted from different varieties of olives are presented in Table 1. The major fatty acids of olive oils were oleic, linoleic and palmitic acids, which ranged from 62.49 to 68.53%; from 8.30 to 17.93%; from 14.39 to 19.47%, respectively (Fig. 1). The highest oleic acid content was determined in olive oil belonged to Çilli variety (68.53%), followed by Ayvalık variety (67.50%) and Domat variety (67.09%). The essential fatty acids such as linoleic (17.93%) and linolenic (0.62%) acids were in maximum level for olive oil extracted from Söbüaşı variety. Additionally, olive oil of Gemlik variety (19.47%) had higher palmitic acid amount than other oils. It was observed statistically significant differences among fatty acid compositions of olive oils depending on varieties (p < 0.05). Dag et al. reported that the main fatty acids of olive oils were oleic acid (61.93% for Domat variety and 71.13% for Gemlik variety), palmitic acid (15.66% for Domat variety and 13.42% for Gemlik variety) and linoleic acid (15.27% for Domat variety and 8.83% for Gemlik variety). According to a study of Xiang et al., oleic, linoleic and palmitic acid contents were 66.09%, 13.41% and 12.69% for Barnea olive oil; 65.66%, 10.29% and 13.40% for Coratina olive oil; 74.93%, 5.37% and 13.23% for Koroni olive oil; 60.94%, 9.23% and 14.24% for Manzanilla olive oil, respectively. Draman informed that oleic acid contents of Memecik, Uslu, Domat, Ayvalık, Çelebi, Memeli, Erkence, Gemlik, Çakır, İzmir sofrahlık, Çekişte, Çilli olive oils were found as 77.12%, 75.34%, 70.16%, 76.93%, 65.95%, 79.50%, 71.87%, 74.84%, 75.95%, 78.18%, 82.10% and 75.30%, while the highest oleic acid and the lowest palmitic acid contents were 17.98% in Çelebi olive oil and 9.55% in Çilli olive oil. Fatty acid contents were found different from the values reported in literature and these variations can be attributed to differences in plant varieties.

The tocopherol contents of virgin olive oils extracted from different varieties of olives are presented in Table 2. The tocopherol contents of the olive oils varied depending on varieties. α-Tocopherol, ranged from 18.22 to 36.02 mg/100 g, was the major isomer in all of the olive oils, followed by γ-tocopherol (1.99-8.12 mg/100 g). The olive oil of Söbüaşı variety (36.02 mg/100 g) was a significant source of α-tocopherol as compared to other varieties. The highest

**Table 1** Fatty acid composition and tocopherol contents of virgin olive oils.

| Fatty acids (%) | Ayvalık | Domat | Gemlik | Çilli | Çopası | Söbüaşı |
|-----------------|---------|-------|--------|------|--------|---------|
| Palmitic        | 15.77 ± 0.04<sup>ab</sup> | 14.39 ± 0.08<sup>de</sup> | 19.47 ± 0.34<sup>d</sup> | 18.01 ± 0.20<sup>b</sup> | 15.35 ± 0.06<sup>c</sup> | 14.47 ± 0.34<sup>d</sup> |
| Stearic         | 2.04 ± 0.01<sup>bc</sup> | 2.63 ± 0.01<sup>c</sup> | 2.15 ± 0.01<sup>d</sup> | 2.18 ± 0.01<sup>c</sup> | 2.34 ± 0.00<sup>b</sup> | 2.16 ± 0.02<sup>d</sup> |
| Oleic           | 67.50 ± 0.00<sup>d</sup> | 67.09 ± 0.03<sup>d</sup> | 66.96 ± 0.25<sup>d</sup> | 68.53 ± 0.18<sup>a</sup> | 66.81 ± 0.05<sup>c</sup> | 62.49 ± 0.25<sup>d</sup> |
| Linoleic        | 11.41 ± 0.01<sup>c</sup> | 12.28 ± 0.02<sup>d</sup> | 8.49 ± 0.04<sup>d</sup> | 8.30 ± 0.03<sup>d</sup> | 12.24 ± 0.01<sup>c</sup> | 17.93 ± 0.07<sup>b</sup> |
| Arachidic       | 0.33 ± 0.01<sup>c</sup> | 0.41 ± 0.01<sup>c</sup> | 0.28 ± 0.01<sup>c</sup> | 0.32 ± 0.00<sup>d</sup> | 0.31 ± 0.00<sup>d</sup> | 0.34 ± 0.01<sup>b</sup> |
| Linolenic       | 0.42 ± 0.00<sup>d</sup> | 0.50 ± 0.00<sup>d</sup> | 0.37 ± 0.00<sup>d</sup> | 0.45 ± 0.00<sup>d</sup> | 0.48 ± 0.00<sup>c</sup> | 0.62 ± 0.00<sup>e</sup> |
| Behenic         | 0.09 ± 0.00<sup>d</sup> | 0.11 ± 0.00<sup>c</sup> | 0.07 ± 0.00<sup>d</sup> | 0.09 ± 0.00<sup>c</sup> | 0.09 ± 0.00<sup>c</sup> | 0.10 ± 0.00<sup>c</sup> |
| Arachidonic     | 0.42 ± 0.02<sup>e</sup> | 0.81 ± 0.02<sup>e</sup> | 0.40 ± 0.00<sup>de</sup> | 0.46 ± 0.01<sup>b</sup> | 0.41 ± 0.01<sup>d</sup> | 0.26 ± 0.00<sup>f</sup> |

* The data show mean (n = 3) ± standard deviation.

** The different letters in the same column show statistically significant differences according to the Tukey test (p < 0.05).
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γ-tocopherol amount was determined in olive oil of Gemlik variety, with the value of 8.12 mg/100 g. The olive oil extracted from Çilli variety (6.93 mg/100 g) contained β-tocopherol, while this isomer is not detected in other olive oils. It could be concluded that fatty acid compositions and tocopherol contents of olive oils are significantly dependent on olive variety. It was observed statistically significant differences among tocopherol contents of olive oils depending on varieties ($p<0.05$). Dağdelen et al.\textsuperscript{14} observed that α-, β- and γ-tocopherol contents were 130.54 mg/kg, 1.23 mg/kg, 0.53 mg/kg in Ayvalık olive oil; 95.60 mg/kg, 0.49 mg/kg in Domat olive oil; 168.19 mg/kg, 2.10 mg/kg in Gemlik olive oil. In the study reported by Dag et al.\textsuperscript{12}, the major tocol isomer was α-tocopherol, with the values of 171.01 mg/kg for Domat olive oil and 200.38 mg/kg for Gemlik olive oil, while β- and γ-tocopherol amounts were 1.28 mg/kg and 1.22 mg/kg in Domat olive oil; 1.29 mg/kg and 3.93 mg/kg in Gemlik olive oil, respectively. Ayvalık, Domat and Gemlik olive oils contained 99.50 mg/kg, 118.50 mg/kg and 108.25 mg/kg α-tocopherol. γ-Tocopherol amount of Gemlik olive oil was determined as 0.50 mg/kg and also γ-tocopherol was not detected in Ayvalık and Domat varieties\textsuperscript{15}. Sarolic et al.\textsuperscript{16} reported that α-tocopherol contents of virgin olive oils extracted from Oblica, Lastovka and Levantinka varieties were 213.24 mg/kg, 177.82 mg/kg and 222.0 mg/kg, respectively. Our results showed partly differences compared with literature values made on tocopherol contents of several olive oils\textsuperscript{12, 16, 17}. These differences in tocopherol contents may be change depending on fruit varieties, harvest period, ripening stage of fruits or some environmental factors.

4 CONCLUSION

The compositional differences in fatty acids and tocopherols in different olive varieties can be attributed to difference in cultivation conditions, genetic variations among varieties, climatic characteristics, geographical effects, soil types, time of harvest and differences in analytical procedures applied. The current results reported in this study are beneficial as it contains important nutritional information about olive seed oil obtained by cold press which can contribute to establishing human health details. It was further reported that olive fruit obtained from different olive varieties are good source of oil which may have important applications as an edible oil for human nutrition.

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| Table 2  | Tocopherol contents of virgin olive oils. |
|---------|------------------------------------------------|
|          | Ayvalık | Domat | Gemlik | Çilli | Çöpaş | Söbüaş |
| α-Tocopherol | 24.47 ± 0.35* | 20.16 ± 0.04*** | 18.22 ± 0.07 | 25.86 ± 0.07* | 29.37 ± 0.08* | 36.02 ± 0.01* |
| β-Tocopherol | –*** | – | – | 6.93 ± 0.01 | – | – |
| γ-Tocopherol | 7.98 ± 0.15b | 6.66 ± 0.10c | 8.12 ± 0.03b | 1.99 ± 0.94c | 8.10 ± 0.17c | 2.00 ± 0.94c |
| δ-Tocopherol | – | – | – | – | – | – |

* The data show mean ($n=3$) ± standard deviation.
** The different letters in the same row show statistically significant differences according to the Tukey test ($p<0.05$).
***nonidentified

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