U. Ü. ZİRAAT FAKÜLTESİ DERGİSİ, 2013, Cilt 27, Sayı 1, 49-54
(Journal of Agricultural Faculty of Uludag University)

Effect of Different Growing Area on Triacylglycerol Composition of cv. Gemlik Olive Oil in Turkey

Didar SEVİM[1]*, Oya KÖSEOĞLU[1] and Ferişte ÖZTÜRK GÜNGÖR[1]

[1]Olive Research Station of Bornova Izmır/Turkey
**dcengeler@yahoo.com, Tel: 0(232) 4627073 Fax:0(232)4357042*

Geliş tarihi: 16.01.2013, Kabul tarihi:15.05.2013

Abstract: The origin of Gemlik olive cultivar is Gemlik, district of Bursa. This cultivar has spread rapidly during last years outside of its own origin and olive oil production of Gemlik cultivar, which is used as table olive, has increased dramatically in Turkey. In this research the effect of different growing areas on olive oil purity parameters were studied in the Marmara and Eagen region, during 2009/2010 crop season. To this end sample of Gemlik olive variety were collected from its own origin, Gemlik (Bursa), and tree different extensively growing districts, Akhisar (Manisa), Kemalpaşa (İzmir) and Kuyucak (Aydın). Fruits were processed into oil by using Abencor System. As purity parameters triacylglycerol composition in the oil samples was determined according to International Olive Council. The olive oil TAG (triacylglycerol) content (OOO (triolein) ranging from 33.05 % to 37.19 %, POO (palmitodiolein) 24.56 % to 25.52 %, LOO (diolelinolein) 11.3 % to 12.98 %) were determined. In all analyzed samples the content of trilinolein (LLL) did not exceed the maximum limit of 0.5 % determined by European Comission. Significant difference was determined on POO, LLL and ECN42 (HPLC value) content (P<0.05).

Key Words: Fatty acids, ECN 42, OOO, LOO, HPLC.

Türkiye'deki Gemlik Zeytini Yağlarının Trigliserid Kompozisyonu Üzerine Farklı Yetiştirme Alanlarına Etkisi

Özet: Gemlik zeytin çeşidinin orijini Bursa'nın Gemlik ilçesidir. Bu çeşit son yıllarda kendi doğal yöresi dışında hızlı bir yayılım göstermiştir ve ülkemizde sofralık zeytin olarak kullanılan Gemlik zeytin çeşidinden zeytinyağı üretimi önemli ölçüde artmıştır. Bu çalışmada Marmara ve Ege bölgelerinde farklı yetiştirme alanlarının zeytinyağı saflık parametrelerine etkisi, 2009/2010 hasat sezonunda araştırılmıştır. Bu amaçla Gemlik zeytin çeşidi örnekleri kendi orijin bölgesi, Gemlik (Bursa) ve yaygın olarak yetiştirildiği, Akhisar (Manisa), Kemalpaşa (İzmir) ve Kuyucak (Aydın) yörelerinden toplanmıştır ve Abencor Sistemi kullanılarak meyvelerden zeytinyağı elde edilmiştir. Zeytinyağlarında saflık parametresi olan triaçilgliserol kompozisyonu Uluslararası Zeytin Konseyinde belirtilen standarda göre tespit edilmiştir. Zeytinyağı TAG içeriği (OOO % 33.05 ile %37.19 arasında,

POO % 24.56 ile % 25.52 arasında, LOO % 11,3 ile % 12.98 arasında) saptanmıştır. Tüm zeytinyağı örneklerinin trilinolein (LLL) içeriği Avrupa Komisyonu tarafından belirlenen % 0.5 maksimum limitini aşmamıştır. Zeytinyağlarının POO, LLL ve ECN42 (HPLC değeri) içeriğinde önemli farklılıklar tespit edilmiştir ($p < 0.05$).

Anahtar Kelimeler: Yağ Asitleri, ECN 42, OOO, LOO, HPLC.

Introduction

The olive tree (*Olea europaea* L.) is the most important crop in Mediterranean. Virgin olive oil, due to its use without refining, shows very well nutritional and sensorial properties, being one of the pillars of the so-called Mediterranean diet (Baccouri et al., 2008). Turkey is the world's sixth largest producer of olive oil (4.6 %) (IOC, 2011). Economically important Turkish olive cultivars are Memecik at 45 %, Ayvalık at 20 %, Gemlik at 11 %, Kilis Yağlık at 2.8 %, Domat at 1.4 % and Uslu at 1 % (Öztürk et al.., 2009). Gemlik olive cultivar is originated from Gemlik Gulf at Marmara region and it is the major olive variety of the Marmara and Eagean region. The fatty acid and triacylglycerol content of virgin olive oil differs considerably depending mainly on latitude, climate, variety and stage of maturity of olives (Velasco and Dobarganes, 2002). Olive oils consist predominantly of TAG that generally follow a unique and typical pattern in the glycerol molecule being chracteristic in the different oil seeds. Triacylglycerol composition is immensely useful for the characterization and discrimination, as well as authentication of olive oils or its geographical location (Galeano Diaz et al., 2005; Dıraman et al., 2011). North Aegean district contained higher levels of SOO, POS and ECN 50 when compared to South Aegean district whereas South Aegean district sampes demonstrated higher OOO contents (Gökçebağ et al., 2011).

The object of this study is to characterize of Gemlik c.v. olive oils from different growing areas in the Marmara and Eagen region by an official HPLC procedure based on triacylglyecerol (TAG) profile.

Material and Method

Samples

Olive fruits were harvested from four different growing area (Gemlik (Bursa), and Kermalpaşa (İzmir), Kuyucak (Aydın) and Akhisar (Manisa)) during crop season 2009/10. The analyses were carried out on 12 olive oil samples which were obtained from tree different olive orchard in each reagion. Orchards were accepted as repetition. Each sample was analyzed tree times.

Oil Extraction

Olives were harvested by hand and processed by an Abencor system. The olives were crushed with a hammer mill, the olive paste obtained was malaxated at 30 ± 1 ^{o}C for 30 min and the pulp was centrifuged. All oil samples were filtered and stored at 4 ^{o}C packaged in darkness using amber glass bottles without a head space until they were analyzed.

Method

TAG Composition Determination

The analysis of TAGs was performed according to the official liquid chromatographic method described in Regulation EEC/2568/91 of the European Union Comission (Anontmous, 1991). The chromatographic analysis was performed using an Instrument Agilent 1200 HPLC system consisted by a degasser, quaternary pump, manual six-way injection valve, refractometer detector, and Chemstation Software (3365) package for instrument control, data acquisition, and data analysis. A Superspher 100 RP-18 HPLC column (Merck, Germany) (250 x 4 mm i.d. x 4 µL, temperature 35 °C) was used. A loop of 100 µL capacity was used in which 0.5 µL sample was injected. Acetone (63.6 %)/acetonitrile (36.4 %) were mobile phases with a flow rate linear gradient (1.200 mL min^{-1}) under nebulizer gas pressure 2.00 bar for 45 min. The results were expressed in percentega of total TAG.

Statistical Analysis

All data were subjected to analysis JMP, Version 7. SAS Institute Inc., Cary, NC, 1989-2007.

Results and Discussion

The mean values and the standard deviation of the triacylglyecerol composition of "Gemlik" olive oil at Kuyucak, Gemlik, Kemalpasa, Akhisar are shown in Table 1. The main triacylglycerols were 1,2,3-trioleylglycerol (OOO), 2,3-dioleyl-1-palmitoylglycerol (POO) and 2,3-dioleyl-1-linoleylglycerol (LOO). In total, these accounted for more than 70 % of the total HPLC chromatogram peak area. Other minor triacylglyecerols were 2,3-dioleyl-1stearoylglycerol (SOO), 2-oleyl-3-palmitoyl-1-stearoylglycerol (SOP), 1-linolenoyl-2-oleyl-3-palmitoylglycerol (LnOP), 1,2-dilinoleyl-3-palmitoylglcerol (LLP), 1,3-dioleyl-2-linolenoylglcerol (OlnO), 1-linolenoyl-2-linoleyl-3-oleyglycerol (LnLO) and 1,2,3-trilinoleylglycerol (LLL).

Statistically significant differences were found the value of LLL, POO, ECN42, PLL/OLL and OOO/POO. In all analyzed olive oils the value of LLL didn't exceed the maximum limit of 0.5 % which was determined by the EC regulation. The values of LLL of oils are between 0.10 % and 0.20 % and the highest value of LLL is at Kuyucak area.

The values of POO of Kuyucak, Gemlik, Kemalpasa and Akhisar are 25.57 %, 24.56 %, 25.74 % and 25.52 %, respectively. Statistically significant differences were found between Gemlik and the other areas in the value of POO ($P<0.05$).

The ECN 42 values of samples are between 0.88 % and 0.49 %. Kuyucak showed the highest value for ECN 42. There is no differences were found between Gemlik, Kemalpasa and Akhisar.

Statistically important differences was found the value of PLL/OLL between Kuyucak, Kemalpasa and Gemlik, Akhisar reagion ($P<0.05$).

The values of OOO/POO of Kuyucak, Gemlik, Kemalpasa and Akhisar are 1.29 %, 1.51 %, 1.39 % and 1.46 %, repectively. Gemlik showed the highest value of OOO/POO.

LLL, POO, ECN 42, PLL/OLL and OOO/POO values played an important role in the characterization. For example, Kuyucak sample was identified with the value of LLL, ECN42 (HPLC value), PLL/OLL and OOO/POO. Gemlik sample was identified with the value of POO and OOO/POO.

In general Gemlik c.v. olive oil TAG content; OOO ranging from 33.05 % to 37.19 %, SOO 4.32 % to 4.59 %, POO 24.56 % to 25.52 %, PLO 6.20 % to 7.38 %, LOO 11.3 % to 12.98 %. Our results are in agreement with those of previous research (Dıraman et al., 2011; Gökçebağ et al., 2011; Yorulmaz, 2009; Saygın Gümüşkesen and Yemişçioğlu, 2007). İlyasoğlu and Özçelik (2011) has reported that content of OOO, POO and LOO of Memecik olive oil ranging from 63.50 % to 68.32 %, from 18.25 % to 25.82 % and from 6.01 % to 9.18 %, respectively. The value of Gemlik olive oil OOO is lower, POO and LOO is higher than Memecik olive oil. Aranda et al. (2004) has reported that the vaule of OOO, SOO, ECN 48 and ECN 50 of Cornicabra virgin olive oil was 51.7 %, 6.76 %, 74.7 % and 8.68 %, respectively. The vaule of OOO, SOO, ECN 48 and ECN 50 of Gemlik c.v. olive oil is lower than Cornicabra virgin olive oil but the value of POO, ECN 42 (HPLC value), ECN 44, ECN 46 of olive oil is higher than Cornicabra virgin olive oil. Ben Temime et al. (2006) has reported that TAG content of Chetoui which is second olive oil variety cultivated in Tunisia depending on pedoclimatic conditions and on the region of cultivation. The value of OOO, POO and LOO were ranging from 29.59 % to 37.38%, from 15.11 % to 18.02% and from 19.03 % to 24.74 %, respectively. The value of POO of Gemlik c.v. olive oil is higher, the value of LOO is lower than Chetoui c.v. olive oil.

Table 1. Triacylglyecerol content (mean±SD, as %) of olive oil of Gemlik variety at different growing area in Turkey

Triglyceride	Area				p<
	Kuyucak	Gemlik	Kemalpasa	Akhisar	
LLL	0.20±0.05* A	0.15±0.06B	0.14±0.01B	0.10±0.02B	0.05
LOO	12.24±0.66	12.98±1.24	11.30±0.30	11.68±0.90	n.s
PLO	7.38±0.52	6.57±0.63	6.54±0.27	6.20±0.39	n.s
OOO	33.05±1.25	37.22±1.36	35.73±0.71	37.19±0.91	n.s
POO	25.57±0.67A	24.56±0.58B	25.74±0.13A	25.52±0.45A	0.05
SOO	4.56±0.29	4.40±0.12	4.32±0.26	4.59±0.35	n.s.
ECN42 (HPLC value)	0.88±0.34A	0.53±0.08B	0.64±0.03B	0.49±0.06B	0.05
ECN44	5.89±0.58	4.87±0.62	5.05±0.24	4.72±0.24	n.s
ECN46	24.16±1.38	23.43±1.34	22.72±0.81	22.32±1.23	n.s
ECN 48	63.10±1.86	65.42±2.02	65.81±0.66	66.61±1.15	n.s
ECN 50	6.05±0.31	5.73±0.14	5.69±0.38	5.87±0.40	n.s
PLO/OOO	0.22±0.02	0.18±0.02	0.18±0.01	0.17±0.01	n.s
LLL/ECN42	0.24±0.06	0.27±0.06	0.22±0.02	0.20±0.02	n.s
PLL/OLL	0.41±0.02A	0.33±0.02B	0.41±0.04A	0.37±0.03B	0.05
ECN48/ECN46	2.62±0.22	2.80±0.24	2.90±0.13	3.00±0.23	n.s
LOO/PLO	13.60±1.98	18.90±2.20	15.53±1.50	18.56±1.50	n.s
OOO/POO	1.29±0.02D	1.51±0.02A	1.39±0.02C	1.46±0.03B	0.05

*SD, standard deviation; P, palmitic; Po, palmitoleic; M, margaric; S, stearic; O, oleic; L, linoleic; Ln, inolenic; and A, arachidic acids. ECN_{42} (LLL+LOLn+POLL+PLLn); ECN 44 (OLL+OlnO+PLL+POLn); ECN 46 (LOO+PLnP+PoOO+PLO+SLL+PoOP+PLP); ECN 48 (OOO+SLO+POO+POP+PPP); ECN 50 (SOO+POS)

Mean values with different letters within the same row are statistically different ($p<0.05$).

Conclusions

The olive oil TAG content (OOO ranging from 33.05 % to 37.19 %, SOO 4.32 % to 4.59 %, POO 24.56 % to 25.52 %, PLO 6.20 % to 7.38 %, LOO 11.3 % to 12.98 %) were determined. In all analyzed samples the content of trilinolein (LLL) did not exceed the maximum limit of 0.5 % determined by European Comission Regulation. In the research, significant difference was determined on POO, LLL and ECN42 (HPLC value) content of olive oil (P<0.05). The data showed that LLL, POO, ECN 42 (HPLC value), PLL/OLL and OOO/POO content of olive oil played an important role in the characterization.

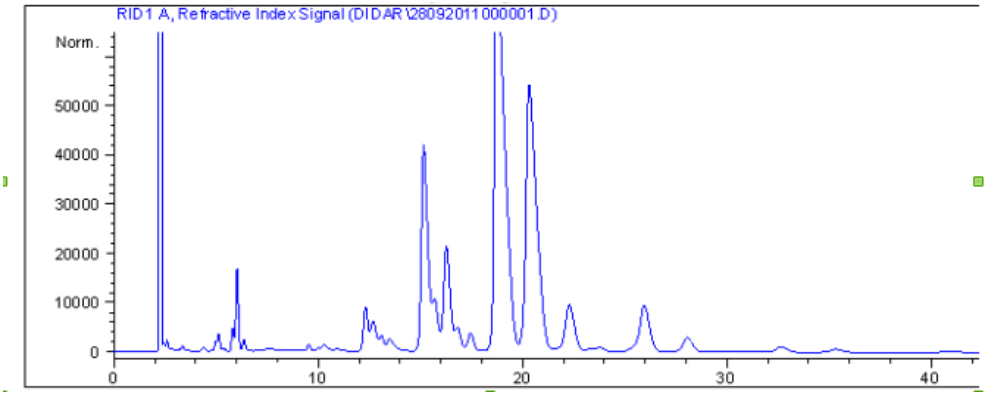

Figure 1. Triacylglyecerol peaks of Gemlik olive oil on HPLC

Acknowledgments

The authors would like to express their thanks to Mr. Mehmet HAKAN (Agric. Eng. Department of ISLAH, Ministry of Food, Agriculture and Livestock Directorship of Olive Research Station, Turkey.

Reference

Anonymous, 1991. European Economic Community, E.C. Regulation no 2568/91.Official Journal of European communities L 128/8 15/05/02 2002, Regulation no.796 of 6 May 2002 on cgange Bruxelles, Belgium.

Aranda, F., Gomez-Alonso, S., Rivera del Alamo, R.M., Salvador, M.D., Fregapanetemi, G., 2004. Triglyceride, total and 2-position fatty acid composition of Cornicabra virgin olive oil: Comparison with other Spanish cultivars, *Food Chemistry*, 86, 485-492.

Baccouri, B., Zarrouk, W., Baccouri, O., Guerfel, M., Nouairi, I., Krichene, D., Daoud D., Zarrouk D., 2008. Composition, quality and oxidative stability of virgin olive oils from some selected wild olives (Olea europaea L. subsp. Oleaster), *Grasas Y Aceites*, 59 (4),346-351.

Ben Temime, S., Wael, T., Bechir, B., Leila, A., Doua, D., Mokhtar, Z., 2006. Changes in olive quality of Chetoui variety according to origin of plantation, *J of Food Lipids*, 13, 88-99.

Dıraman, H., Saygı, Hülya, Özder, Y., 2011. Chemometric calssification of Turkish virgin olive oils from different geographical origins based on their triacylglycerol profiles, AOCS, World

Conference On Oilseed Processing, Fats & Oils Processing, Biofuels & Applications, 21-23 June 2011 Izmir, Turkey.

Galeano Diaz, T., Duran Meras, T., Sanchez Casas, J., Alexandre Franco, M., F., 2005. Characterization of virgin olive oils according to its triglycerides and sterols composition by chemometric methods, *Food Control*, 16, 339–347.

Gökçebağ M., Dıraman, H., Özdemir, D., 2011. Classification of virgin olive oils from Aegean region based on their triacylglycerol profiles by chemometrics, AOCS, World Conference On Oilseed Processing, Fats & Oils Processing, Biofuels & Applications, 21-23 June 2011 Izmir, Turkey.

IOC, 2011, http://www.internationaloliveoil.org/estaticos/view/131-world-olive-oil-figures.

İlyasoğlu, H. and Özçelik B., 2011, Memecik zeytinyağlarının biyokimyasal karakterizasyonu, Gıda, 36 (1), 33-41.

Öztürk, F., Yalçın, M., Dıraman, H., 2009. An overview on the olive oil economy of Turkey, *Electronic J Food Technol*, 12, 37-53.

Saygın Gümüşkesen, A. and Yemişçioğlu, F., 2007, Türkiye'deki zeytin çeşitlerinin ve zeytinyağlarının bölgesel karakterizasyonu, Ege Universitesi Gıda Müh., 141.

Velasco, J., Dobarganes, C., 2002. Oxidative stability of virgin olive oil *Eur. J. Lipid Sci. Technol.*, 104, 661–676.

Yorulmaz, A., 2009, Türk zeytinyağlarının fenolik, sterol ve trigliserit yapılarının belirlenmesi, FBE, Doktora Tezi, Ankara.