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Original article

Quality, Sensory and Oxidative Stability Characteristics of Olive Oils Obtained by Crossing of Ascolana with Karamürselsu, Tavşanyuregi and Uslu Cultivars

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Abstract

This research is aimed to determine the quality, sensory and oxidative stability characters of olive oils of 5 cultivar candidates obtained by cross breeding of Ascolana with Karamürselsu, Tavşanyuregi and Uslu cultivars. All olive trees were cultivated with the same agricultural practices in the same orchard (Yalova, Turkey). Free fatty acid content, peroxide value, specific ultraviolet absorbance, oxidative stability and sensory characters were evaluated. As a result, it has been determined that all of olive oils suitable for entering the class of extra virgin olive oil. AT056 has more favorable free fatty acids content and peroxide value but unfortunately has lower sensory scores. AU016 and AU019 have higher induction time and sensory scores with other favorable free fatty acids and peroxide value. So that AU016 and AU019 were determined as outstanding cultivars for analyzed olive oil characters.

Keywords: Shelf life, oxidation resistance, bitterness, free fatty acid.

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INTRODUCTION

Cross breeding project are widely used to increase the genetic variability of olives. Some new olive genotypes have remarkable characters to increase profit and or reduce cost of cultivation practices. For this reason, breeding programs were carried out in most olive-producing countries (Israel, Italy, Spain, Turkey, Morocco, Iran and Egypt) to select new cultivars better than the main cultivars in their respective countries (Laaribi et al., 2014; Bellini et al., 2008). Characters and compositional variations of olive oils are highly effected by every step of cultivar sellection, cultivation, processing and storages. Choice of olive cultivar highly effects quality, sensory, stability and functionality characteristics of olive oils (Serrano et al., 2020; Yu et al., 2020). Positive effect on olive oils are expected from registered new olive cultivars. Significant differences were reported in physicochemical properties, fatty acid profile, minor component contents (such as phenolic, tocopherols, volatile compounds etc.) and oxidative stability between different varieties of olive oils (Yu et al., 2020; Reboredo-Rodríguez et al 2016).

Olive cross breeding studies have been carried out since 1990 at Atatürk Horticultural Central Research Institute (Yalova, Turkey). In this project, significant differences were reported among chemical and physical characteristics of olives and olive oils. These reported variabilities represent a promising idea to obtain new olive cultivars. So that this research is aimed to determine free fatty acid, peroxide and specific ultraviolet absorbance values, sensory scores and oxidative stability of olive oils. Olive oils from olive of 5 cultivar candidates were used as material which are cross breeding of Ascolana (foreign pollinator) with Karamürselsu, Tavşanyuregi and Uslu (local cultivar) cultivars.

MATERIAL and METHOD

Sample were collected from olive trees that were planted with 1,5 m x 3 m distance at the olive genotype observation orchard of Ataturk Horticultural Central Research Institute in Yalova province of Turkey (40°39'42.1"N 29°17'24.5"E). Parents of olive cultivar candidates and genotype codes were given in Table 1.

Table 1. Parents of olive cultivar candidates

Genotype code	Parents	Maturation index
AK001	Ascolana X Karamürselsu	4,4
AT007	Ascolana X Tavşanyüreği	4,7
AT056	Ascolana X Tavşanyüreği	5,1
AU016	Ascolana X Uslu	4,6
AU019	Ascolana X Uslu	5,2

These genotypes were chosen on the basis of their high productivity, resistance to diseases, low periodicity and high oil (18 % < at fresh weight) content. Olives were hand-picked at 4,4-5,2 maturation

index, which provide optimum oil yield and quality (Kiritsakis, 1998; Boskou, 2006) in harvest seasons of 2011/2012, 2012/2013 and 2014/2015.

Olive Oil Production Method

Olives were washed without delay and damaged or diseased olives were removed. Then olives were turned into paste by laboratory scale hammer (100 rev / min) and kneader (45 minutes) after that crushed olives were pressed with manuel press. Mix of oil and fruit water (discharged fuild) were collected from discharge of press. Oil collected from upper side of discharged fluid. Finally, olive oils were centrifuged two remove residual particles and water. Olive oils were filled as a full in dark glass bottle without air head space and storage 20^{o}C until analysis.

Analysis Methods

The free fatty acid, peroxide value and specific ultraviolet absorbance K232 and K270 were determined according to the official methods described in Turkish Food Codex Olive Oil and Olive Oil Analysis Methods Communiqué (Communiqué No: 2014/53).

The oxidation stability characteristics of the oil samples were made according to AOCS Standard Method (2013) using a rancimat device (Rancimat 743 Metrohm) at a temperature of 110, 120 and 130°C. Induction periods and shelf lives of olive oils calculated by this rancimat device.

Sensory scores of olive oils were determined with taste descriptors (fruitness bitterness, pungency) by using a ten-point intensity ordinal rating scale from 0 (no perception) to 10 (extreme) according to the panel test method specified in Turkish Food Codex Olive Oil and Olive Oil Analysis Methods Communiqué. Sensory analysis were done in olive oil tasting laboratory of Tariş Olive And Olive Oil Agriculture Sales Cooperatives Association accordance with the standards of the International Olive Oil Council. Results were expressed as a median of eight assessments (Communiqué No: 2014/53).

Statistical Analysis

The trial plan was created according to the "Random Plot Trial Pattern" and was carried out with 3 replications. Variance analysis was performed on the data obtained by taking samples for 3 years, and it was examined whether there was a significant difference between the characteristics of the samples. Analyzes were done using the SAS statistical package program.

RESULT and DISCUSSION

Olive oil is actually a name of oil group which have six subgroups. Extra virgin olive oil subgroup is representing the highest quality. Free fatty acid content is a well-known parameter for olive oil classification by consumers. Actually, more than twenty parameters are analyzed for classifying olive oils as extra virgin olive oil, virgin olive oils or as other subgroups (Aristoil 2020, Communique No:

2017/26). After free fatty acid content peroxide value and specific ultraviolet absorbance are other well know parameters. Free fatty acid content, peroxide value and specific ultraviolet absorbance of olive oil samples are given in Table 2. In this study free fatty acid and peroxide content of samples were determined between 0,35-0,66 % and 5,22-6,30 meq O_2/kg. For extra virgin olive oil classification, allowed highest free fatty acid content and peroxide values are 0,8% and 20 meq O_2/kg. Specific ultraviolet absorbance of olive oil samples at 232 and 270 nm are 2,07-2,61 and 0,11-0,20. For extra virgin olive oil classification allowed highest specific absorbance values (K_{232} and K_{270}) are 2,50 and 0,22 (Aristoil 2020, Communique No: 2017/26).

Free fatty acid content and peroxide value of mono cultivar olive oil samples were reported between 0,2-0,4 % and 12,24-16,58 meq O_2/kg. These results are lower for free fatty acid content and higher for peroxide value compare to results that we got in this study.

Table 2. Free fatty acid content, peroxide value and specific ultraviolet absorbance of olive oil samples

Olive oil	Free fatty acid content (% oleic acid)	Peroxide value	Specific UV absorbance	
			K_{232}	K_{270}
AK001	0,43b	6,28a	2,25b	0,13c
AT007	0,66a	5,22c	2,11b	0,11c
AT056	0,35c	5,36c	2,07b	0,20a
AU016	0,40b	5,72b	2,61a	0,16b
AU019	0,62a	6,30a	2,18b	0,17b

The fatty acids composition and the presence of antioxidants mainly phenols and tocopherols are established key factors for the resistance of the oil to autoxidation. Thus extra virgin olive oil is stable oil and its shelf life is longer than the other edible oils (Roodaki et al., 2018). Induction time and calculated shelf life of olive oils were given in Table 3. The highest values of stability were reported at 120°C for Drobnica olive oil (6,66 and 6,89 h) and Lastovka olive oil (10,79 and 9,98 h) oils which resulted the longest induction period, while the shortest induction period (7,71 h) was reported for Oblica olive oil (Bilušić et al., 2018). Another study reported the induction time on mono cultivar olive oils between 7,1-13,6 h for same temperature (120°C) (Veloso et al., 2020). These values are higher than result of this study.

Table 3. Induction time and calculated shelf life of olive oils

Olive oil	Induction time at 110°C (h)	Induction time at 120°C (h)	Induction time at 130°C (h)	Self life (year)
AK001	4,89d	2,14d	0,92d	1,43d
AT007	11,26a	4,47a	1,17c	1,94b
AT056	7,27c	2,90c	1,44b	2,06b
AU016	6,45d	4,38a	2,14a	1,98b
AU019	9,12b	3,65b	1,36b	2,51a

The sensory analyses of mono varietal olive oils showed particular attributes of taste and aroma that is featured exclusively by olive cultivar. Sensory characteristics of the samples vary depending on the olive variety and have certain properties for each mono varietal olive oil (Bilušić et al., 2018). Sensory scores of olive oil samples were given in Table 4. Sensory analysis is one of the most important quality parameters. Both positive and negative attributes of olive oils must be evaluated (Fernandes et al., 2018). Median of fruitiness, bitterness and pungency scores were determined between 2,73-3,69, 2,10-3,25 and 1,92-3,65. Defects were not determined for all olive oil samples.

Bitterness and pungent results were reported less than 2 for Chetoui olive oils (Essid et al., 2016). On the other hand, average fruitiness scores reported as 5.1 and 5.8 for olive oils of Rebolã and Verdeal cultivar (Rodrigues et al., 2020). Fruitiness scores of this study is higher than Essid et al (2016) but lesser than Rodrigues et al. (2020). Bitterness scores were reported as 3 and 7 respectively for Galega Vulgar and Cobrançosa mono varietal olive oils (Peres et al., 2016). Pungent scores were reported as 3,25 and 3,50 for olive oils of Souidi and Zeletni cultivars. Reported pungent scores were slightly lesser but reported bitterness scores were higher than results of this study.

Table 4. Sensory scores of olive oil samples

Olive oil	Fruitiness	Bitterness	Pungency
AK001	2,73c	2,88b	2,15b
AT007	3,48b	2,57c	2,23b
AT056	2,77c	2,10d	1,92c
AU016	3,69a	2,82b	3,65a
AU019	3,43b	3,25a	2,28b

Phenolic compounds which responsible both for increased stability against oxidation and for pungency and bitterness scores of olive oils. In this study parallel results also were found between shelf life and sensory scores for olive oil samples. AU016 and AU019 had both higher sensory scores and oxidative stability values. Cultivar, fruit harvest maturity and process conditions were reported as effective factors on oxidative stability and sensory scores of olive oils (Di Lecce et al., 2020; Bilušić et al 2018). So that selection of new cultivar candidates and planting new cultivars which have remarkable olive oil characteristics will be beneficial for producers and consumers. Main reason of differences on olive oil characteristics between literature and this study probably caused by genetic, ecologic and cultivation differences.

Conclusion

In this study analyzed characters (free fatty acid content, peroxide value, specific absorbance, and sensory scores) for all olive oil samples were compatible with the limits of extra virgin olive oil which represents the highest quality olive oil subgroup. These is extremely important to be able to get a higher

selling prices for olive oils. More over as possible as lower fatty acid content and peroxide value and higher positive sensory scores (fruitiness, bitterness, pungency) are expected for higher prices and to be able attract consumers' attention.

Higher induction time and shelf life express higher resistance against oxidation which cause oxidative spoilage of olive oil during cooking and/or shelf life. Higher induction time also gives idea about resistance against unwanted loss of beneficial component such as phenols and polyunsaturated fatty acids.

In this study all olive trees were cultivated with same practices in same orchard. But as a result of genetic variations olive oils of these cultivars showed different properties. AT056 has lower free fatty acids content and peroxide value but also lower sensory scores. AU016 and AU019 have higher induction time and sensory scores with other favorable characteristics. So that AU016 and AU019 were determined as outstanding cultivars for the analyzed olive oil characters.

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