

THE DETERMINATION OF POMOLOGICAL AND TOTAL OIL PROPERTIES OF SOME OLIVE CULTIVARS GROWN IN ISPARTA, TURKEY

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Abstract

The aim of this study was to determine the physical characteristics of three olive cultivars' fruits at 3 different harvest time (skin green with pink spots, pulp white-skin black, skin black and pulp purple) growing in Mediterranean region of Turkey in Isparta/Sütçüler at the same garden and growing conditions. Ayvalık and Memecik olive cultivars are grown in large areas of Turkey. The third cultivar Topakaşı, is a local cultivar and is cultivated limitedly in the research area. Thus, in the study, the differences between the varieties adapted to the region's ecology and the varieties brought from different regions were investigated. According to mean values, the highest individual fruit weight was found in Memecik (4.99 g) followed by Topakaşı (3.49 g) and Ayvalık (3.48 g). Ayvalık had the lowest (0.65 g) kernel weight followed by Memecik (0.76 g) and Topakaşı (0.86 g). In terms of fruit / kernel ratio, the Memecik cultivar has the best result (84.77%). The highest amount of dry matter was found in Topakaşı (53.37 g/100 g), followed by Ayvalık (39.00 g/100 g) and Memecik (38.53 g/100 g). The total amount of oil was highest in Ayvalık (57.46 g/100 g), followed by the Memecik (54.19 g/100 g) and Topakaşı (53.84 %).

Key words: olive cultivars, physical characteristics, Ayvalık, Memecik, Topakaşı.

INTRODUCTION

The olive (*Olea europaea*) is a native to the coastal areas of the eastern Mediterranean Basin and it is estimated that the cultivation of olive trees began more than 7000 years ago (Ercişli et al., 2012). Olive production in the Mediterranean basin accounts for more than 95 % of world's olive production. Located on the northeastern coast of the Mediterranean Sea, Turkey is a major olive-producing country. Olives originated from the coast of Eastern Mediterranean Sea and, to date, more than 1250 cultivars have been recognized worldwide for olive production. Most of these cultivars are present in countries located in the Mediterranean basin. The presence of 87 local olive cultivars has been documented in Turkey (İpek et al., 2012).

The increasing health consciousness and more cosmopolitan society explains the rising consumption of olive oil around the world and hence the rapid growth of the olive industry.

The beneficial health properties of olive oil have been known for centuries, particularly in the Mediterranean region. Olives and olive oil are an inherent part of Mediterranean culture and diet, and hence the decreased incidence of cardiovascular disease in this area (being one of the lowest in the Western Hemisphere) has been attributed to their consumption (Ryan and Robards, 1998). The positive effects of olive oil on health are linked to the presence of monounsaturated fatty acids (oleic acid) and a high antioxidant source, as well as high vitamin (A, D, E, K) content (Oktar et. al., 1983; Ryan and Robards, 1998; Salvador et. al., 2003). It also contains leucine, aspartic acid and glutamic acid, among other essential amino acids. Olive oil is the only vegetable oil that can be consumed without being refined (raw) and has its own odor, color and texture. These properties of olive oil are determined by chemical constituents such as fatty acids, phenolic substances, tocopherols, carotenoids and chlorophyll (Servili and Montedoro, 2002;

Ayton et. al., 2006; Turaa et. al., 2007). The chemical composition of olive oil is highly influenced by genotype, geographical region and its ecological conditions, cultural processes, harvest time and oil extraction methods (Mousa et. al., 1996; Boskou, 2000; Ayton et. al., 2006; Selvili et al., 2007; Al-Maaitah, 2009; Keçeli, 2013). In this study, it was aimed to determine the physical characteristics and oil yield of three olive cultivars at 3 different harvest periods (Pink spots on green ground, pink-violet, purple-black) grown in the same orchard and maintenance conditions in Sütçüler/Isparta located in Mediterranean Region of Turkey. The two of the olive varieties investigated in this research (Ayvalık and Memecik) are the most grown varieties and are grown in large geographical areas in Turkey. The third (Topakaşı) is a local cultivar and grown only in the research area. Thus, in the study, the differences between the cultivars adapted to the region ecology and brought from different regions are also revealed.

MATERIALS AND METHODS

The study was carried out in Sütçüler / Isparta (37°29'40"N 30°58'54"E) located in Mediterranean Region of Turkey. Ayvalık, Memecik and Topakaşı, grown in the commercial orchard conditions where the same cultural practices were applied (irrigation, fertilization, pruning, etc.), were used as plant material. The trees are 10 year old and the planting spacing is 5x4 m. The altitude of the orchard is 250 m. Fruit samples were taken at 3 different stages of maturity according to the coloring of fruit peel and fruit flesh. These are; (1) Pink spots on green ground (Maturity index: 2-3), (2) pink-violet (maturity index: 4-5), and (3) purple-black (maturity index: 6-7). The fruits were harvested by hand. Samples were brought to the laboratory immediately after harvest on ice. Fruit weight (g), fruit width (mm), fruit length (mm), shape index, seed weight (g), seed length (mm) , seed width (mm) and seed/fruit flesh ratio (%) were measured. Dry matter and total oil ratios were determined in fruit samples as well. The measurements were made at each harvest period with 50 fruit samples in each triplicates.

Dry matter. The flesh of olive fruit samples were dried at 105°C in a vacuum oven until the weight reached to a constant weight. The amount of dry matter was calculated as %.

Total oil. 2 g of dried and milled fruit flesh sample was extracted with 200 ml of hexane for 4 hours in a Soxhlet apparatus and then evaporated (Guinda et al., 2003). The total crude oil was calculated as % dry sample.

RESULTS AND DISCUSSIONS

Cultivar and harvest period interactions were found statistically significant in terms of fruit weight (Table 1). As the maturity progressed, statistically significant increase was found in the fruit weight of Memecik. The highest fruit weight was determined in the second period of fruit harvest in Ayvalık.

Table 1. Some fruit characteristics of cultivars

Cultivars	Harvest Period I	Harvest Period II	Harvest Period III	Mean
Ayvalık	3.49bAB	3.66bA	3.30cB	3.48
Memecik	4.69aB	5.09aA	5.19aA	4.99
Topakaşı	3.40b	3.39b	3.67b	3.49
Mean	3.86	4.05	4.05	Lsd:0.3202
Fruit Height (mm)				
Ayvalık	19.17b	19.47b	18.57c	19.07
Memecik	25.45aB	27.19aA	26.59aAB	26.41
Topakaşı	19.94b	19.85b	20.33b	20.04
Mean	21.52	22.17	21.83	Lsd:1.513
Fruit Width (mm)				
Ayvalık	14.78b	14.89b	14.59b	14.76
Memecik	16.20aB	17.45aA	17.55aA	17.07
Topakaşı	14.11b	13.89b	14.40b	14.13
Mean	15.03	15.41	15.52	Lsd:1.125

Each value is expressed as mean ±standard deviation. Means followed by different capital letters (years) in the row are significantly different (p<0.05). Means followed by different small letters in the columns (cultivars) are significantly different (p<0.05).

The highest fruit weight for the Topakaşı was determined in the third period. However, the

differences between the harvest periods were not significant. Memecik had the biggest fruits (4.99 g) in all of the three harvest periods. The fruit sizes of Ayvalık and Topakaşı were similar. There was a significant difference in the fruit length and fruit width between the harvest periods only for Memecik. While the highest fruit length (27.19 mm) was detected in the second harvest period, the highest fruit width was found in the third harvest period (17.55 mm).

A significant difference was found between the cultivars in terms of seed weight. The highest average seed weight (0.86 g) was determined in the Topakaşı.

Table 2. Some seed characteristics of cultivars

Cultivars	Harvest Period I	Harvest Period II	Harvest Period III	Mean
Seed Weight (g)				
Ayvalık	0.73	0.61	0.61	0.65b
Memecik	0.73	0.78	0.76	0.76ab
Topakaşı	0.89	0.84	0.86	0.86a
Mean	0.78	0.74	0.74	Lsd:0.1663
Seed Height (mm)				
Ayvalık	13.03c	12.33c	12.17c	12.51
Memecik	18.00aB	18.00aB	19.87aA	18.62
Topakaşı	14.80bB	14.13bB	17.07bA	15.33
Mean	15.28	14.82	16.37	Lsd:1.605
Seed Width (mm)				
Ayvalık	6.56ab	6.33ab	6.33b	6.41
Memecik	5.86bB	6.00bB	8.27aA	6.71
Topakaşı	6.83aB	6.83aB	8.73aA	7.47
Mean	6.42	6.39	7.78	Lsd:0.7267
Fruit flesh/seed ratio (%)				
Ayvalık	79.08	83.33	81.52	81.32
Memecik	84.43	84.68	85.36	84.77
Topakaşı	73.82	75.22	76.57	75.36
Mean	79.11	81.08	81.15	

Each value is expressed as mean \pm standard deviation. Means followed by different capital letters (years) in the row are significantly different ($p < 0.05$). Means followed by different small letters in the columns (cultivars) are significantly different ($p < 0.05$).

There was no significant relationship between seed weight and harvesting periods. While there was a significant increase in the third harvest period in the seed length and width parameters of Memecik and Topakaşı, a insignificant decrease was determined in Ayvalık.

While the longest seed size was determined in Memecik (18.62 mm), the largest seed width (7.47 mm) was found in Topakaşı. As the harvest progressed, the fruit flesh ratio increased.

The highest fruit flesh ratio was found in Memecik (84.77%) and lowest was in Topakaşı (75.36%) (Table 2). Significant differences were found between the cultivars in terms of leaf characteristics. The highest leaf area was determined in Topakaşı (Table 3).

Table 3. Leaf characteristics of cultivars

Cultivars	Leaf Length (mm)	Leaf Width (mm)	Leaf Area (mm ²)
Ayvalık	55.72b	15.02	470.80b
Memecik	55.21b	14.57	619.60ab
Topakaşı	66.50a	16.85	841.90a
Mean	59.14	15.48	644.10
LSD	6.083	2.207	313.5

The differences among the averages indicated with different letters in each column are statistically significant at the level of 5 %

Cultivar and harvest period interactions were found significant in terms of dry matter and total oil (Table 4).

The results of the study showed that the dry matter accumulation varies at different harvest periods according to the cultivars.

The amount of dry matter increased with increasing maturity in Memecik and the highest value was found in the third harvest period when the fruits were the most mature.

A fluctuation was found in Ayvalık and the highest amount of dry matter was determined at the first and third harvest periods and the values were close to each other.

According to the average values, Topakaşı had the highest (over 50%) dry matter content. The results of the research showed that Topakaşı had the ability to accumulate high dry matter in the early harvest period. The reason for this is

thought to be the result of more photosynthesis due to the higher leaf area of Topakaşı. It is observed that Ayvalık also completed the accumulation of dry matter in the early period. As expected, the total amount of oil increased in all of the three cultivars as the maturity progressed (Table 4).

Table 4. Some chemical characteristics of cultivars

Cultivars	Harvest Period I	Harvest Period II	Harvest Period III	Mean
Dry Matter (g/100 g)				
Ayvalık	40.93bA	36.89bB	39.20cA	39.00
Memecik	34.62cC	37.45bB	43.51bA	38.53
Topakaşı	54.85aA	52.56aB	52.72aAB	53.37
Mean	43.47	42.30	45.14	Lsd:2.183
Total Oil (g/100 g dry matter)				
Ayvalık	51.10aC	57.92aB	63.35aA	57.46
Memecik	46.50bC	53.80bB	62.26aA	54.19
Topakaşı	51.09aB	53.61bAB	56.81bA	53.84
Mean	49.57	55.11	60.81	Lsd:3.582

Each value is expressed as mean \pm standard deviation. Means followed by different capital letters (years) in the row are significantly different ($p < 0.05$). Means followed by different small letters in the columns (cultivars) are significantly different ($p < 0.05$).

The highest amount of oil was obtained at the stage of full ripeness (third harvest period, black purple fruit). The highest average oil ratio (57.46%) was found in Ayvalık. Memecik and Topakaşı had oil contents close to each other (Table 4).

Although the total oil content was highest as percentage in Ayvalık, the obtained dry matter content as above 50% on average in Topakaşı led to the conclusion that this cultivar had the higher oil yield (average 217 g / kg dry fruit flesh) than Ayvalık. In addition, the study results indicated that Topakaşı cultivar, which has completed its dry matter accumulation in the early period, can be harvested at early harvest period (second harvest period: pink-purple) without loss of excess oil yield. On the other hand, it has been concluded that harvesting of Ayvalık and Memecik at the full ripe stage (third period) should be more appropriate in terms of oil yield.

As in other fruit species, especially in table olives, the physical properties of the fruit can

vary depending on the cultivar, maturation status and environmental factors. It is possible to see the effects of these factors on olive varieties in previous studies. Likewise, Nas and Gökalp (1990) found the average fruit length, fruit width, fruit/flesh ratio, total dry matter content and total oil content between 17.33-20.62 mm, 12.57-16.09 mm, 61.20%-74.38%, 38.3%-73.0%, 6.0%-24.6%, respectively in a research conducted on some fruit characteristics of some table olive cultivars. Erbay et al. (2010) reported that the fruit width of green olives varied between 13.4 and 16.9 mm. Gümüšoğlu et al. (2006) found that fruit lengths of Domat and Gemlik olive varieties varied between 22.78-27.96 mm and 16.90-23.34 mm, respectively in a research on fruit characteristics of Domat and Gemlik. Kaya and Mutlu (2010) reported that the fruit width, fruit length, fruit/flesh ratio and total oil content were varied between 16.0-19.0 mm, 22.0-24.0 mm, 70%-80%, 6.10%-26.60%, respectively in a research conducted on olives grown in İznik. Özdemir et al. (2011) reported that the fruit/flesh ratio and total oil content were varied between 3.15%-4.87% and 17.53%-32.05%, respectively in a research that aimed to determine the physicochemical changes of olive fruits collected at the different ripening stages. Aşık and Özkan (2011) investigated the fruit characteristics of Memecik olive cultivar and found that the average fruit length, fruit width, seed weight, fruit weight and total oil ratio were 2.55 mm, 1.88 mm, 0.95 g, 5.98 g, 44.74%, respectively.

CONCLUSIONS

The aim of this study was to determine the physical characteristics and total oil of three olive cultivars' fruits at 3 different harvest maturity (skin green with pink spots, pulp white-skin black, skin black and pulp purple) which were grown in Mediterranean region of Turkey in Isparta/Sütçüler at the same garden and growing conditions.

According to mean values, the highest fruit weight was found in Memecik (4.99 g) followed by Topakaşı (3.49 g) and Ayvalık (3.48 g).

Ayvalık had the lowest (0.65 g) seed weight followed by Memecik (0.76 g) and Topakaşı (0.86 g).

In terms of fruit / seed ratio, Memecik has the best result (84.77%) according to mean values. The highest amount of dry matter was found in Topakaşı (53.37 g/100 g), followed by Ayvalık (39.00 g/100 g) and Memecik (38.53 g/100 g). The total amount of oil was highest in Ayvalık (57.46 g/100 g), followed by Memecik (54.19 g/100 g) and Topakaşı (53.84 %).

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