

Phenological, morphological and physicochemical characteristics of some local olive varieties grown in Mardin (Derik)

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Abstract

This study was carried out between 2016–2017 to identify local olive varieties grown in the Derik district of Mardin province and their distinguishing characteristics. In the study the growing strength of the trees of eight local olive species, pomological characteristics of their leaves, inflorescence, fruit, and seeds, phenological development periods, total oil content, fatty acid composition, and sensory characteristics of their oils were examined. It was found that the “Mavi” variety had the highest values for fruit weight, width, and flesh ratio among the varieties examined. The variety with the highest fruit oil content (30.0%) was “Derik Halhalı”, followed by the “Melkabazi” variety with oil content of 26.0%. The most abundant fatty acid in the oils of local olive varieties was cis-Oleic acid (57.60–73.51%), followed by Palmitic acid (12.90–18.57%), cis-Linoleic acid (7.97–17.76%), and Stearic acid (2.48–3.30%). It has been determined that growing “Derik Halhalı” and “Melkabazi” as oil genotype is suitable, while growing “Zoncuk”, “Mavi”, “Kejik”, “Belluti”, “Hursiki” and “Gulleki” as table genotype is suitable

Keywords: *Olea europaea* L., Morphology, Fatty acids, Sensory analysis, Mardin

INTRODUCTION

Olive is a cultivated plant dating back to 4000 BC (Özkaya et al., 2006). The homeland of olive (*Olea europaea* L.), a member of the family Oleaceae, includes South Asia Minor and Upper Mesopotamia, including the South-eastern Anatolia region of Turkey (Sakar, 2015). Olive is accepted to have spread from its homeland to the whole world through three routes, the first of which is Tunisia and Morocco via Egypt, the second of which is the Aegean islands, Greece, Italy, and Spain along Anatolia, and the third of which are Pakistan and China via Iran (Özkaya et al., 2010). It is considered that the Sami cultivated the olive and carried out the first breeding studies (Kaplan and Arihan, 2012). The presence of the lowest species of the olive tree in Mardin, Kahramanmaraş and Hatay in recent studies supports this judgement. However, there are also sub-varieties of olive species and wide biodiversity in this region (Sakar et al., 2017).

Since the early ages, people have not only considered the olive plant as an essential foodstuff but also made use of its oil in the treatment of internal diseases and wounds (Kaplan and Arihan, 2012). The olive tree has symbolised peace and prosperity throughout history due to its abundant crop and easy growth in suitable climatic conditions. This has led the olive to be one of the plants frequently mentioned in sacred scriptures (Eskiyörük, 2016).

Mardin, one of the ancient cities established in Mesopotamia between the Euphrates and Tigris rivers, is a region where both table and oil olives have been

grown for many years (Acar, 2016). As of 2022, a total of 4620 tonnes of olives are produced in an area of 20123 da in Mardin province. Table olives constitute 4278 tonnes of this production. Although olive cultivation in Mardin province is concentrated in Derik, Kızıltepe and Artuklu districts, Derik district accounts for 59% of the olive production in the province with a total olive grove of 11661 da and an annual olive production of 2727 tonnes (TÜİK, 2023). Derik district is protected from cold north winds by its location on the south-facing slopes of the Mardin Threshold Mountains and is exposed to hot winds blowing from the south and southwest directions. Nevertheless, the alluvial soils with high limestone content make this region favourable area for olive cultivation (Doran et al., 2008). Today, Derik Halhalı, Zoncuk, Melkabazi, Belluti, Hursiki, Mavi, Kejik and Gulleki local olive varieties cultivated in the Derik district hold an important share in the olive production of the region. Besides, these varieties were protected by the first selection study carried out by the Olive Research Institute in 1968 and are the olive species in the National Collection (Özkaya et al., 2006).

When the structure of olive cultivation in Turkey is analysed, it is observed that although there was a significant rise in the olive grove and the number of trees between 2004 and 2022, the same is not observed in the yield per tree (TÜİK, 2023). The main reasons why Turkey has not been able to achieve the output growth that other countries with which Turkey competes in olive cultivation have achieved in recent years are low productivity and unfavourable climatic factors that increase the tendency of periodicity (Bayramer, 2015; Şahin and Aydoğdu, 2021). Also, harvesting every 2-3 years due to the harsh periodicity of local varieties in the South-eastern and Mediterranean regions causes the olive groves in those regions to be abandoned to their own fate for a long period of time. Although it varies according to the provinces, the drying problem causes greater economic losses in olive groves that are not fertilised, are not pruned, or deprived of soil cultivation and are subjected to agricultural control (Tüzün, 2003). Also, the variety confusion in olive cultivation in Turkey and the recognition of a variety with different names in different regions and even in the same region are observed in the South-eastern Anatolia Region (Dölek, 2003; Sakar, 2015). Despite having large lands that can be utilised for olive cultivation, the climatic characteristics (high summer temperatures and insufficient rainfall) of the South-eastern Anatolia Region limit the expansion of olive cultivation in the region (Akıllıoğlu et al., 2000; Sakar, 2015). The climatic disadvantage of the region can be partially eliminated, and olive cultivation can be expanded in the region by identifying the potential of local olive varieties that are naturally distributed in the region and promising varieties among them.

Given the said reasons, this study, which was carried out

between 2016–2017, aimed to reveal the current situation of these varieties in the region and their potential by examining their morphological, phenological, and pomological characteristics, fatty acid composition in oils, and sensory qualities of local olive varieties grown in Derik district of Mardin province.

MATERIALS AND METHODS

Material

The first stage of this study included the identification of local olive varieties and species grown in the olive groves of the Derik district of Mardin province, among which eight local varieties with production potential in the region were selected to be utilised herein. The olive trees of the previously identified local olive varieties (Mavi, Belluti, Derik Halhalı, Zoncuk, Kejik, Hursiki, Melkabazi, and Gulleki) in the same grove and age were used as the plant material of the study between 2016–2017.

Method

The olive trees used in the study were of productive age, free from diseases and pests, and exhibited similar characteristics for development. For each variety examined, a total of eight trees were identified, and samples were taken from those trees for further examination and analysis. To identify the morphological and pomological characteristics of leaves, fruits, and flowers of olive varieties, each tree was randomly selected from different parts of the tree to represent the tree, and 50 samples were collected from each tree. Fruit samples which had been taken from each olive variety at harvest time were transported to the Postharvest Physiology Laboratory of the Faculty of Agriculture, Harran University to determine fruit and seed characteristics. Pomological and morphological characteristics of olive samples were identified following the methods and scales reported by Barranco et al., (2000), Şeker et al., (2012) and Sakar et al., (2017). Leaf samples were morphologically characterised using the methods and scales reported by Kaymak (2011) and Sakar (2015). The inflorescence of the examined olive varieties was characterised using the method and scale of Ulaş (2001). Soxhlet extraction using n-hexane solvent was used to determine the total oil content of olives (Kadaster, 1960). The fatty acid composition of olive oils was determined by gas chromatography at the Food Technologies Laboratory of the Olive Research Institute (Önal et al., 2006). Sensory analyses (fruitiness, bitterness, and pungency) of the olive oils extracted from the studied varieties were done by the IOC method (COI/T.20/Doc.No 15/2007) at the Olive Research Institute.

RESULTS AND DISCUSSION

Morphological Characteristics

Tree characteristics

During the garden observations in July-August, the trees belonging to the olive varieties analysed hereunder were

evaluated. In general, it was determined that the growth strength of the trees belonging to the varieties examined was "strong". However, the growth strength of olive trees does not only depend on the genotypic character of the variety. The growth strength may vary depending on the genotypic character as well as the climatic characteristics of the cultivation region and the nature of the cultivation practices applied to the grove (Baktır et al., 1995; Sakar et al., 2013; Sakar, 2015; Sakar et al., 2017).

The observations revealed that the crown structure of the trees differed according to the olive varieties analysed hereunder and varied between "upright", "semi-upright", and "spreading". The varieties with "upright" crown structures were Melkabazi, Belluti, Mavi and Zoncuk; whereas, the varieties with "semi-upright" crown structures were Gulleki, Hursiki, Derik Halhalı and the variety with "spreading" crown structures was Kejik.

Turanoğlu (2015) found that branching was sparse and leaf density was low in trees of Ayvalık olive variety. Ulaş (2001) reported that Adana Topağı, Mavi, Sarı Ulak (Adana), Silifke oil, Halhalı and Kargaburnu varieties had "dense" crown density and Edremit oil, Gemlik, Yerli, Kilis oil, Nizip oil, San Ulak (İçel) and Küncülü varieties had "moderate" crown density.

Leaf characteristics

Table 1 shows the leaf characteristics of local olive varieties grown in Mardin (Derik). The leaves of the varieties examined were generally found to be of medium length; however, the "Zoncuk" variety had longer leaves than the other varieties. Also, the width of the leaves of this variety was narrower, and the leaf length/width ratio was high compared to the other varieties. It is relatively easy to distinguish the variety "Zoncuk" from the others analysed even by considering only the leaf structure (Figure 1). The leaf shape of the varieties "Derik Halhalı", "Kejik," and "Gulleki" was elliptical long, while the leaf shape of the variety "Zoncuk" was long, and the leaf shape of the other varieties was elliptical.

Inflorescence characteristics

The inflorescence of the local olive varieties were collected at the end of April (during the inflorescence

period) and analysed. The results showed that the inflorescence length of the varieties varied between 16.73-29.54 mm (Table 2). The "Melkabazi" variety had the longest inflorescence length. On the other hand, the olive variety "Derik Halhalı" had a greater number of flowers per inflorescence than the other varieties (18.07 pcs/ inflorescence) among the varieties analysed in terms of the number of flowers per inflorescence. The number of flowers per inflorescence was generally low in the other varieties analysed.

The number of flowers on the inflorescence in olive trees may vary depending on the genetic characteristics of the variety, its susceptibility to periodicity, and the care procedures (fertilisation, irrigation, etc.) followed during cultivation (Sakar, 2015). However, it was also observed that there was no linear correlation between the inflorescence length and the number of flowers on the inflorescence of the olive varieties we analysed. Hence, the "Melkabazi" variety with a long straight inflorescence and the "Kejik" variety with a short compact inflorescence had similar numbers of flowers on their inflorescence (Table 2, Figure 2).

Pomological characteristics

Fruit characteristics

Table 3 presents the fruit characteristics of the local olive varieties analysed. Accordingly, the fruit weights of the analysed varieties varied between 1.33 and 7.10 g and the "Mavi" variety was identified as the olive variety with heavier fruits than the other varieties. When the varieties analysed by the fruit weight were classified based on the scale reported by Kaymak (2011), "Mavi" was classified as very heavy; "Belluti", "Melkabazi," and "Hursiki" as heavy; "Gulleki" and "Derik Halhalı" as moderate; and "Zoncuk" and "Kejik" as light. Fruit weight values are similar to the fruit weight values determined by Bolat and Güleriyüz (1995) in local olive varieties grown in Çoruh Valley and by Sevgin and Caner (2020) in olive genotypes grown in Şırnak and Mardin. The fruit flesh ratio of the varieties varied between 66.91 and 91.40%, and fruit weight and fruit flesh ratio were correlated. The "Mavi" variety with the heaviest fruits had the highest flesh ratio, and the "Kejik" variety with the lightest fruits had the lowest flesh

Table 1. Leaf characteristics of local olive varieties grown in Mardin (Derik)

Varieties	Leaf Length (mm)	Leaf Width (mm)	Leaf length/width Index	Leaf Shape
Derik Halhalı	66.29 Medium	12.27 Medium	5.40	Elliptical long
Zoncuk	71.51 Long	10.86 Medium	6.58	Long
Mavi	53.68 Medium	15.11 Wide	3.55	Elliptic
Kejik	63.82 Medium	12.04 Medium	5.30	Elliptical long
Belluti	65.94 Medium	18.03 Wide	3.65	Elliptic
Hursiki	56.61 Medium	18.83 Wide	3.00	Elliptic
Melkabazi	64.05 Medium	16.23 Wide	3.94	Elliptic
Gulleki	64.43 Medium	14.59 Medium	4.41	Elliptical long

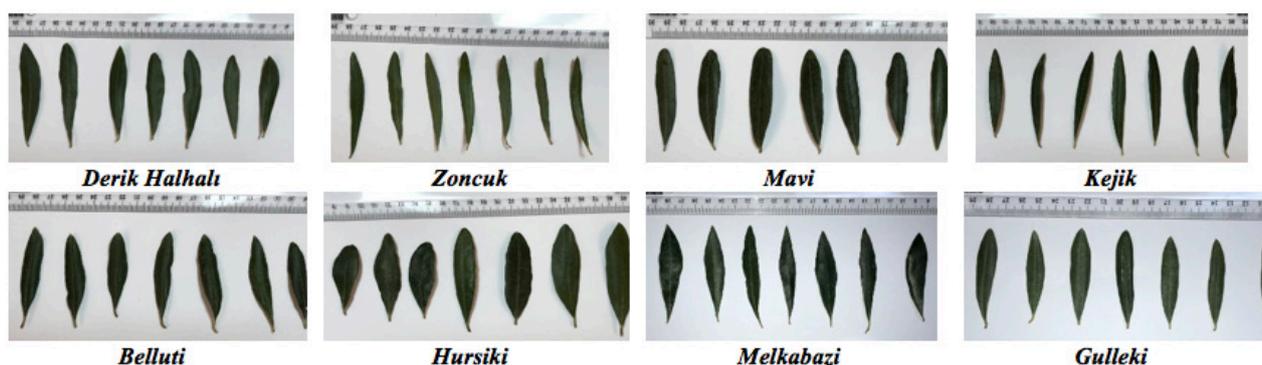


Figure 1. Leaves of local olive varieties grown in Mardin (Derik)

Table 2. Inflorescence characteristics of local olive varieties grown in Mardin (Derik)

Varieties	Inflorescence Length (mm)	Inflorescence Structure	Number of Flowers in the Inflorescence (pcs/ Inflorescence)
Derik Halhali	26.10	Long Straight	18.07 Medium
Zoncuk	26.01	Long Straight	14.64 Low
Mavi	25.23	Short Straight	13.20 Low
Kejik	21.40	Short Compact	14.38 Low
Belluti	17.92	Short Straight	5.84 Low
Hursiki	16.73	Short Compact	11.12 Low
Melkabazi	29.54	Long Straight	15.02 Low
Gulleki	21.26	Short Straight	11.92 Low

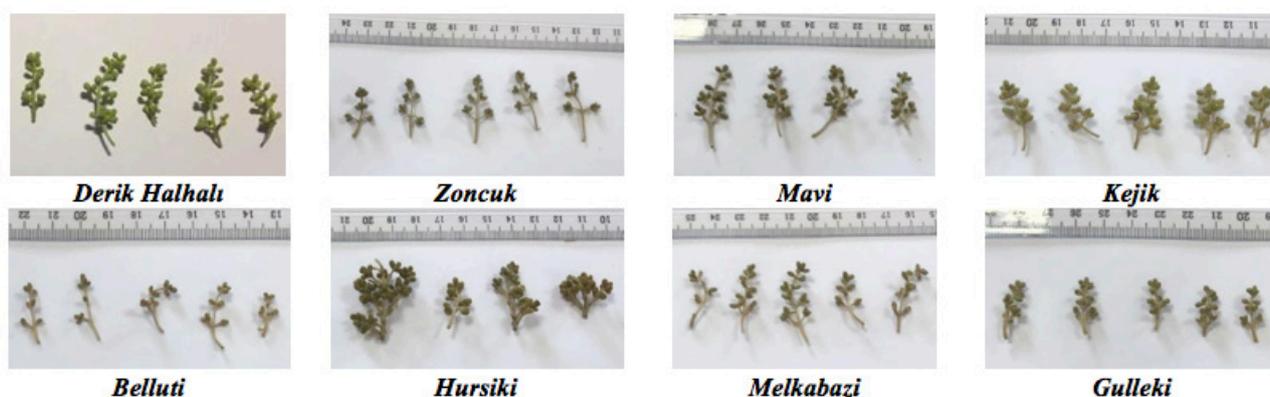


Figure 2. The inflorescence of local olive varieties grown in Mardin (Derik)

Table 3. Fruit characteristics of local olive varieties grown in Mardin (Derik)

Varieties	Fruit Length (mm)	Fruit Width (mm)	Fruit Shape Index	Fruit Weight (g)	Flesh Ratio (%)	Fruit Shape
Derik Halhali	20.69	15.52	1.33	2.80 Medium	82.50	Elliptic
Zoncuk	16.26	12.12	1.34	1.52 Low	67.10	Elliptic
Mavi	28.07	21.30	1.31	7.10 Very high	91.40	Elliptic
Kejik	16.71	10.91	1.53	1.33 Low	66.91	Sharp
Belluti	28.20	16.06	1.75	4.52 High	76.77	Sharp
Hursiki	22.35	18.55	1.20	3.69 High	77.24	Egg
Melkabazi	29.74	15.17	1.96	4.30 High	83.72	Sharp
Gulleki	19.43	16.19	1.20	3.42 Medium	83.92	Egg

ratio. Şeker et al., (2012) reported that the fruit-flesh ratio of olive varieties grown in the Eastern Black Sea Region varied between 74.86 and 77.86%. Biricik and Başıoğlu (2005) reported that the flesh ratio of olive varieties grown in the Marmara Region varied between 79.86 and 85.43%. Gündeşli and Küden (2020) reported that the flesh ratio of olive varieties grown in Çukurova (Adana) varied between 76.0 and 87.0%. Dağdelen (2008) found that the flesh ratio increased in parallel with ripening in "Ayvalık", "Domat," and "Gemlik" olive varieties grown under Edremit conditions.

Fruit length and fruit width varied between 16.26–29.74 mm and 10.91–21.30 mm, respectively, in local olive varieties. The longest fruits were found in the "Melkabazi" variety, and the widest fruits were found in the "Mavi" variety. On the other hand, the fruit shape index (fruit length/fruit width) varied between 1.20 and 1.96 in these varieties, while the highest shape index value was found in "Melkabazi" variety, the lowest shape index value was found in "Hursiki" and "Gulleki" varieties. Caner (2018) reported that olive varieties differed from each other in terms of fruit shape index. Indeed, the fruit shape index varied between 1.17 and 1.44 in the "Yamalak Sarısı" variety (Kaya and Tekintaş, 2006), 1.29 and 1.33 in the "Uslu" variety (Demir, 2018), and 1.34 and 1.53 in the "Erkence" variety (Tutar, 2010). Dölek (2003) reported that fruit widths varied between 15.10 and 18.19 mm, and Kaleci et al., (2016) reported that fruit widths varied between 20.78 and 35.07 mm in the olive varieties they analysed. Biricik and Başıoğlu (2005) reported that fruit length varied between 21.32 and 29.17 mm in the olive varieties they analysed. Gündeşli and Küden (2020) stated that fruit length varied between 13.10 and 34.83 mm, and Şahin and Şeker (2022) reported that fruit length varied between 13.70 and 23.37 mm. Findings on fruit size, shape index, weight, and flesh ratio in the present study appear to be similar to those in the literature. Also, findings of the present study showed that the local olive varieties grown in Derik are similar to the nationally recognised and extensively grown olive varieties and some local varieties are well suited to the production of

table olives.

The local olive varieties analysed hereunder varied in terms of fruit shape (Figure 3). The fruits of "Derik Halhali", "Zoncuk", and "Mavi" varieties were elliptical; the fruits of "Kejik", "Belluti", and "Melkabazi" varieties were sharp; and the fruits of "Hursiki" and "Gulleki" varieties were egg-shaped.

Seed characteristics

Table 4 presents the findings related to the seed characteristics of the local olive varieties analysed. The findings of the present study showed that the seed length varied between 12.35 and 23.36 mm and the seed width varied between 6.86 and 9.25 mm in the local olive varieties grown in Mardin (Derik). While the "Melkabazi" variety had the longest seeds, the "Hursiki" variety had the widest seeds. Besides, the seed shape index of the analysed varieties varied between 1.57 and 3.09. When assessing the potential of olive varieties in terms of cultivation, fruit flesh ratio is an important criterion as is fruit weight, which is directly affected by seed weight. The seed weights of the varieties analysed hereunder varied between 0.44 and 1.05 g. The "Belluti" variety had the heaviest seeds and the "Kejik" variety had the lightest seeds. Kaynaş et al., (1996) reported that seed weight varied depending on the olive variety analysed. Toplu et al., (2009) found that the seeds of the "Gemlik" olive variety were heavier in sufficiently irrigated trees compared to trees grown under water shortages. The seed weight was reported to vary between 0.38–0.72 g and 0.25–1.80 g in olive genotypes grown in Mardin and Şırnak by Sevgin and Caner (2020) and in Gaziantep province by Sakar (2015), respectively. The findings obtained here showed that the olive genotype was the direct and primary influential factor on seed characteristics. Moreover, it is consistent with the findings of previous researchers, who reported that the pomological characteristics of olive seeds varied according to the olive genotype studied.

The seed shapes of the local olive varieties in Mardin (Derik), which we analysed hereunder, differed as

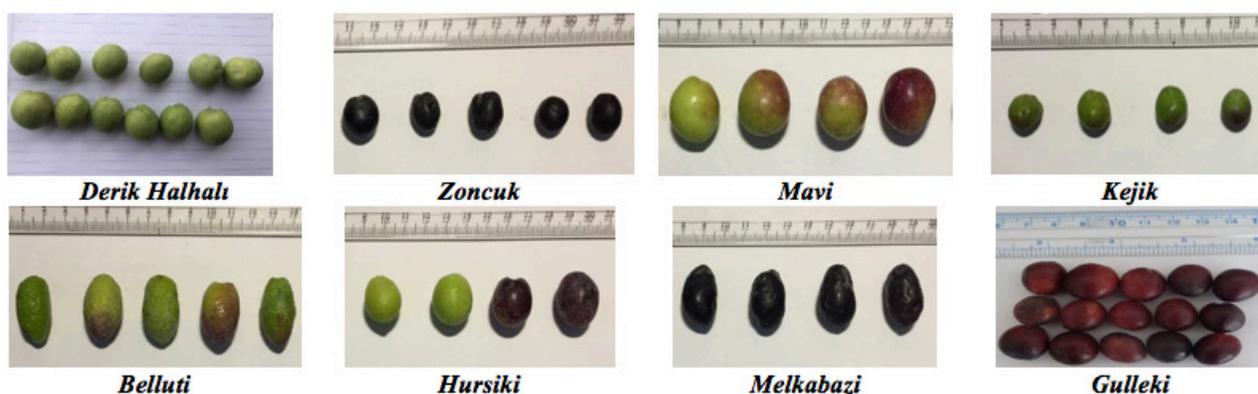
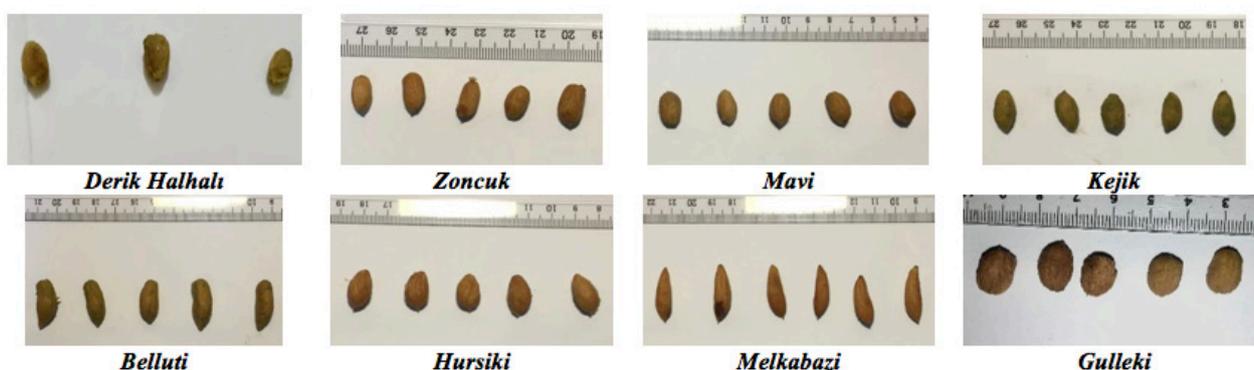


Figure 3. Grains of local olive varieties grown in Mardin (Derik)

Table 4. Seed characteristics of local olive varieties grown in Mardin (Derik)

Varieties	Seed Length (mm)	Seed Width (mm)	Seed Shape Index	Seed Weight (g)	Seed Shape
Derik Halhali	14.08	7.69	1.83	0.49 Heavy	Elliptic
Zoncuk	12.35	6.86	1.80	0.50 Heavy	Elliptic
Mavi	14.42	8.63	1.67	0.61 Heavy	Elliptic
Kejik	14.53	7.55	1.92	0.44 Medium	Elliptic
Belluti	21.90	9.04	2.42	1.05 Very heavy	Sharp
Hursiki	17.89	9.25	1.93	0.84 Very heavy	Elliptic
Melkabazi	23.36	7.55	3.09	0.70 Heavy	Sharp
Gulleki	12.44	7.89	1.57	0.55 Heavy	Elliptic

**Figure 4.** Seeds of local olive varieties grown in Mardin (Derik)

elliptical and sharp (Figure 4). The seeds of the “Belluti” and “Gulleki” varieties were sharp, while the seeds of the other varieties were elliptical.

Phenological Observations

The date when 5% of the flowers bloomed on the trees was accepted as the beginning of inflorescence in the olive varieties we analysed. Biagnami et al., (1993), who studied different varieties and ecologies, reported that the inflorescence dates of olive varieties changed when the temperature was 2°C higher, but there was no significant difference in the ripening time of the fruits. Canözer (1991) found that full inflorescence of olive varieties grown under Izmir conditions took place at the end of May. In the Derik district of Mardin province, the beginning of inflorescence of the olive varieties we analysed took place at the end of April due to the microclimate characteristics of the region. There was no difference between the varieties in terms of the beginning date of inflorescence. However, the determination of the full inflorescence date of the varieties was based on the date when 70% of the flowers bloomed on the trees. The observations revealed that full flowering took place in the middle of May for the eight local olive varieties grown in Mardin (Derik). Also, the period between the beginning of flowering and full blooming was determined to be 10 days in these varieties. The end of flowering was accepted as the date when all the flowers bloomed on the trees, and observations were made accordingly. The observations revealed that the end of inflorescence

was between the end of May and the beginning of June for the varieties analysed. No distinctive differences were found between the varieties in terms of both full blooming and end-of-flowering dates.

Chemical Analyses

The total oil content of the fruits of the local olive varieties analysed herein varied between 10.2 and 30.0% (Figure 5). The variety with the highest oil content was “Derik Halhali” and the variety with the lowest oil content was “Mavi”. Previous studies conducted by different researchers reported that the total oil content of olive fruits varied between 1.0 and 40.9% depending on the variety/genotype, growing conditions, and climatic conditions (Sakar, 2009; Tutar, 2010; Sakar et al., 2013; Karanfioğlu et al., 2017). Findings of the present study showed a distribution between the values of fruit oil content reported in the literature and, hence, were in parallel with the findings of previous researchers. The classification by the International Olive Council (IOOC) for oil olive varieties indicates that “Zoncuk”, and “Melkabazi” and “Derik Halhali”, the varieties analysed here, are classified as having low or high oil content and can be considered as oil olive varieties. On the other hand, it was concluded that “Mavi”, “Kejik”, “Belluti”, “Hursiki”, and “Gulleki” varieties would not be suitable to be considered as oil varieties.

Table 5 shows the distribution of fatty acid composition in the oils of the local olive varieties analysed. The most

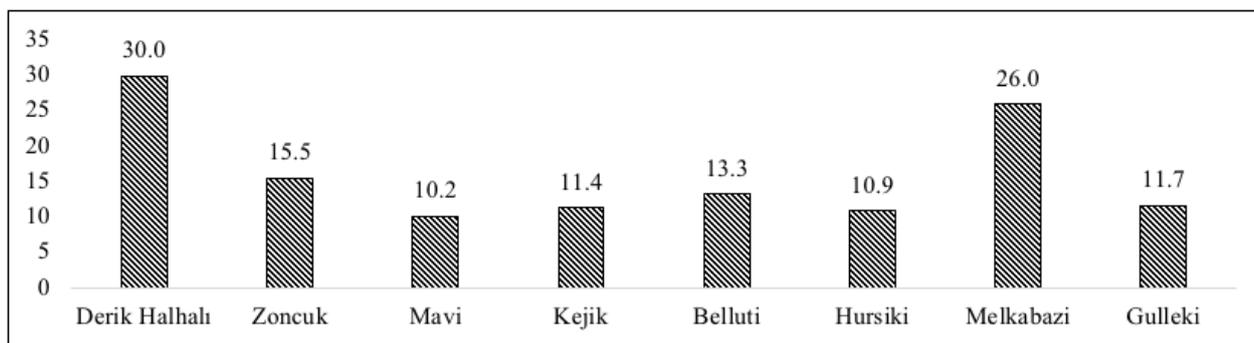


Figure 5. Total oil content (%) in the fruits of local olive varieties grown in Mardin (Derik)

Table 5. Fatty acid composition (%) of local olive varieties grown in Mardin (Derik)

	Derik Halhali	Zoncuk	Mavi	Kejik	Belluti	Hursiki	Melkabazi	Gulleki
C16:0	14.39	12.90	18.57	18.06	16.30	16.10	16.40	15.12
C16:1	1.23	0.53	1.22	0.84	1.03	1.14	1.06	1.14
C17:0	0.17	0.20	0.10	0.07	0.13	0.10	0.13	0.04
C17:1	0.25	0.27	0.13	0.08	0.17	0.14	0.18	0.04
C18:0	3.30	3.06	2.59	3.11	2.58	2.48	2.57	2.62
C18:1	69.04	73.51	57.60	62.10	63.41	64.93	63.08	70.90
C18:2	9.58	7.97	17.76	13.76	14.07	13.33	14.32	8.01
C18:3	0.96	0.72	1.00	0.87	1.21	0.84	1.19	0.95
C20:0	0.53	0.37	0.52	0.56	0.53	0.44	0.53	0.55
C20:1	0.30	0.24	0.29	0.29	0.32	0.32	0.31	0.32
C22:0	0.15	0.18	0.15	0.14	0.16	0.11	0.17	0.17
C24:0	0.10	0.05	0.07	0.12	0.09	0.07	0.06	0.14
ΣSFA	18.64	16.76	22.00	22.06	19.79	19.30	19.86	18.64
ΣMUFA	70.82	74.55	59.24	63.31	64.93	66.53	64.63	72.40
ΣPUFA	10.54	8.69	18.76	14.63	15.28	14.17	15.51	8.96

C14:0: Myristic acid, C16:0: Palmitic acid, C16:1: Palmitoleic acid, C17:0: Heptadecanoic acid, C17:1: *cis*-10 Heptadecanoic acid, C18:0: Stearic acid, C18:1: *cis*-Oleic acid, C18:2: *cis*-Linoleic acid, C18:3: *cis*-Linolenic acid, C20:0: Arachidic acid, C20:1: Gadoleic acid, C22: 0: Behenic acid, C24:0: Lignoceric acid

abundant fatty acid found in the olive oils of all analysed varieties was *cis*-Oleic acid, followed by Palmitic acid, *cis*-Linoleic acid and Stearic acid, respectively. This order was also reported by other researchers who analysed the oils of different olive varieties (Dağdelen, 2008; Kutlu and Şen, 2011; Sakar et al., 2017). Nevertheless, the varieties analysed in this study differed from each other with respect to palmitoleic acid and *cis*-linolenic acid content. Palmitoleic acid was higher in the oils of "Derik Halhali", "Mavi", "Hursiki" and "Gulleki" varieties, while *cis*-Linolenic acid was higher in the oils of "Zoncuk", "Kejik", "Belluti", and "Melkabazi" varieties. The olive variety containing the highest *cis*-Oleic acid (73.51%) in its oil was identified as "Zoncuk" and the variety containing the highest *cis*-Linoleic acid (17.76%) was identified as "Mavi".

When the fatty acids in the oils of local olive varieties grown in Mardin (Derik) were classified according to their saturation levels and these classes were ranked according to their presence in the oil, the order of MUFA>SFA>PUFA

was achieved. The researchers have obtained the same order in previous studies conducted in different olive varieties and in different ecologies (Stefanoudaki et al., 1999; Dıraman and Dibekoğlu, 2009; Kritiotti et al., 2018; El Riachy et al., 2019). However, Toplu et al., (2009) found that SFA and PUFA increased and MUFA decreased with irrigation in the "Gemlik" olive variety, but fertilisation had no effect on the fatty acid composition. Future studies on the effects of irrigation, fertilisation, and similar cultural practices on the fatty acid composition of the olive varieties we analysed would contribute to the literature and help growers.

Sensory analyses

The sensory analyses of the olive oils revealed that the oils of the local olive varieties cultivated in Mardin (Derik) were dominated by spicy, walnut leaf, grapefruit peel, green banana, roasted terebinth seed, rocket, rosemary, green grass, green apple, green tomato, honey, pollen, forest fruits, green almond, and pistachio (fruit) odours

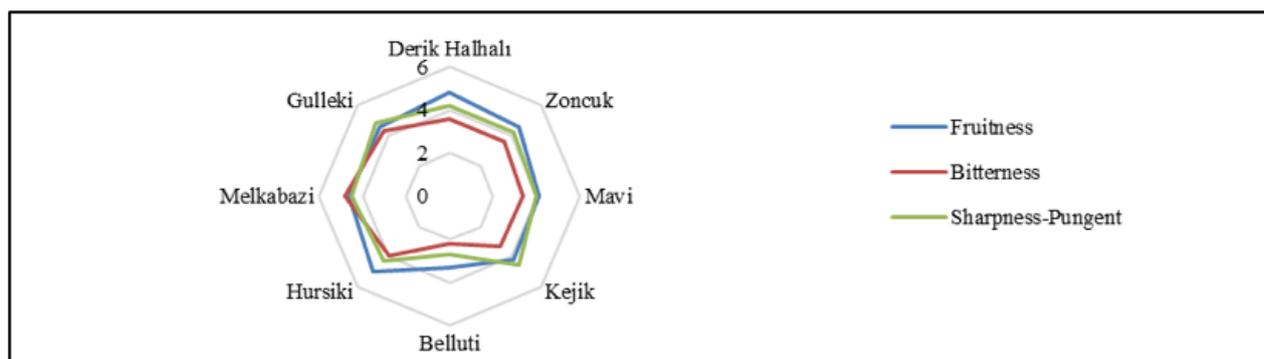


Figure 6. Tasting (sensory) analysis values of oils of local olive varieties grown in Mardin (Derik)

reflecting the characteristics of the region. The bitterness in the olive oils of the varieties analysed was felt with medium intensity and bitter almond, and green walnut inner shell bitterness was felt as particles popping on the back of the tongue. Also, the oils of these varieties were found to have a long-lasting pungent flavour. When the oils of the varieties were compared with each other, the highest fruitiness score was recorded in the oil of "Derik Halhali" variety, the highest bitterness score was recorded in the oil of "Melkabazi," variety and the highest sharpness-pungent score was recorded in the oil of the "Gulleki" variety (Figure 6).

CONCLUSION

This study, which aimed to identify the morphological, pomological, phenological, and physicochemical characteristics of the olive varieties grown in the Derik district of Mardin province, reveal the current conditions of the olive varieties in the region, and provided a preliminary evaluation of the cultivation potential of these varieties in ecologies similar to the region where they are currently grown. Although "Derik Halhali", one of the olive varieties analysed in this study, is a nationally recognised one due to its role in the cultivation of olives for oil in South-eastern Anatolia, the "Melkabazi" variety was also identified as a variety that can be evaluated for this purpose and can be adapted to the region in general. On the other hand, "Zoncuk", "Mavi", "Kejik", "Belluti", "Hursiki," and "Gulleki" varieties were found to be suitable for production of table olive.

New studies on the performance of the local olive varieties we analysed, both in their region and in different ecological and cultivation conditions, would contribute to improving the national and international recognition of these varieties and expanding their cultivation. Furthermore, different species of these varieties and clonal propagation of the superior genotypes under protection would also contribute to the agriculture of our country as a part of the conservation and dissemination of Turkey's olive genetic resources.

COMPLIANCE WITH ETHICAL STANDARDS

Conflict of interest

The authors declared that for this research article, they have no actual, potential or perceived conflict of interest.

Author contribution

The contribution of the authors to the present study is equal. All the authors read and approved the final manuscript. All the authors verify that the Text, Figures, and Tables are original and that they have not been published before.

Ethical approval

Ethics committee approval is not required.

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Data availability

Not applicable.

Consent for publication

Not applicable.

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