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Research Article

Morphological Characteristics of Local Grape (*Vitis vinifera* L.) Cultivars

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Abstract

Objectives: In this study, it was aimed to determine the morphological characteristics of 6 grape varieties grown commercially in Manisa region. In this context, pomological and biochemical properties of grape samples were investigated by collecting Antep Karası grape, Trakya İlkeren grape, Michaeli Paliere grape, Red Globe grape, Crimson Seedless and Sultani Seedless grapes according to harvest time.

Methodology: From the pomological properties of grapes; berry size (mm), berry width (mm), berry thickness (mm), geometric mean diameter (Dg, mm), sphericity (ø), roundness (%, Ro), number of kernels in the berry, berry weight, 100 berry weight properties, physicochemical properties; pH, acidity, water-soluble dry matter (WSDM) and maturity index properties were determined. In addition, the color difference and intensity (L*, a*, b*, h°, C*) values as well as the berry skin color were determined in the grape samples.

Results: The lowest 100 berry weight was determined in Sultani Seedless, the highest in Michael Paliere. Within the scope of the study, Sultani and Crimson grape varieties are seedless, and it was determined that the grape with the highest number of seeds among other grape varieties was Red Globe. It was noted that Antep Karası, Michael Paliere and Sultani Seedless grapes had longer berry lengths, while Michael Paliere and Trakya İlkeren grape varieties had the highest width.

Conclusions: It is thought that the findings obtained in the region, which has an important export potential in table and dried grapes, can be used as basic data in future studies on technical issues such as machine harvesting, storage, transportation and production, taking into account the morphological, physical and chemical properties of grape berries of these varieties.

Keywords: Grape (*Vitis vinifera* L.); Morphological; Local

Introduction

Grape (*Vitis vinifera* L.) is accepted as a functional food cultivated in a wide area of the world and its parts such as leaves, seeds, skins, and pulp contain a significant amount of antioxidants related to their bioactive properties. Turkey is one of the leading countries in the world with different regions where viticulture is made, climatic conditions, grape varieties and cultivation methods. Turkey is among the countries with the greatest potential in terms of viticulture and meets 5% of the world's grape production [1]. Our country has a history of viticulture of about 6000 years and there is rich vine biodiversity as a wild vine (*Vitis vinifera* L. subsp. *sylvestris*) and cultivated vine (*Vitis vinifera* L. subsp. *sativa*) [2].

30% of the production in Turkey consists of the Aegean and more commonly seedless grape varieties. However, other regions such as Marmara and Mediterranean produce more table grapes.

The grape, one of the most cultivated fruits in the world, is not very selective in terms of climate and soil, and propagation methods are easy, which is why it is produced on a wide scale and has a high economic value [2,3]. With its suitable vineyard ecology, rich vine biodiversity, historical culture and high viticulture experience of its society, The Aegean Region is the area where vineyard cultivation is carried out in the widest area in our country, and almost half of the country's vineyard areas are located in this region. Manisa is the leading producer of dried grapes in Turkey, accounting for 89.7% of the country's dried grape production and 58.7% of the country's table grape production. The vineyard area in Manisa accounts for 36.95% of the total area of fruit orchards [4]. In Manisa, where modern viticulture systems are used, grapes take their place on the tables as fresh and dry, while the production of brine leaves, grape preserves, jam, must, molasses, pulp, wine, confectionery and similar products obtained from grapes is also in terms of the potential of grapes and products obtained from grapes, occupies an important place [5].

Grape (*Vitis vinifera* L.) is an important fruit crop with a their bioactive content, is recognized as a nutraceutical food, and also plays an important role in human metabolism due to its nutrient content. Grape is a food known for its components that protect the body against infections, strengthen the immune and nervous systems against diseases such as cancer, obesity, diabetes, and various joint disorders, and delay the effects of aging [6-9].

Grape berry consists of berry skin, fruit flesh, and seeds, and 5-12% of a mature fruit consists of the husk [10-12]. While the fleshy part of the grain constitutes 80-90% of the grape berry weight, the shape and size of the berries vary according to the grape variety. The main shapes are round, flat, oval, cylindrical, inverted oval, pointed oval, sickle, as well as in many intermediate forms. The average diameter of wild grapes starts from 4 mm and the diameter length can reach 30-35 mm depending on the cultivars, and the number of seeds per berry varies between 0-4 and can reach up to 6 seeds. Grape skin determines the color of the grape variety and there are grape varieties in white, yellow, green-yellow, red, blue-violet and red-black colors [11,13-20].

In this study, it was aimed to determine the same characteristics of 6 grape varieties grown in Manisa region with comparison of pomological, biochemical and color characteristics of Antep Karası grape, Trakya İlkeren grape, Michaeli Paliere grape, Red Globe grape, Crimson Seedless grape and Sultani Seedless grape.

Materials and Methods

The grapes varieties (Antep Karası grape, Trakya İlkeren grape, Michaeli Paliere grape, Red Globe grape, Crimson Seedless grape and Sultani Seedless grape), which are the experimental material, were collected from the vineyards in the Alasehir and Sarıgol districts of Manisa during the harvest time of the grape varieties (August-September-October) (Figure 1). The Turkish Standards Institute reports that according to the TS101 Table Grape Standard, the water-soluble dry matter (WSDM) should be at least 13% in seeded varieties. When the WSDM value is higher than 13% the grapes were harvested.

In this study pomological properties of the grapes varieties were determined. Berry size (mm), berry thickness (mm) and berry width (mm) were measured with caliper in the berries taken from different parts of the grape bunch samples (Figure 2). The berry weight (g) was recorded as the number of seeds in the grape berry (n) and the number of seeds in the grape berry samples on a precision balance. The water-soluble dry matter value (%, WSDM) was determined by refractometer in grape juice. Acidity was determined in grape samples by titration (using 0.1 N NaOH) method. pH value was measured with a pH meter [21]. Maturity index was expressed as the ratio of total water-soluble dry matter to acidity (WSDM/Acidity) [12]. Using the berry size, berry width and berry thickness values of grape samples, geometric mean diameter (Dg, mm), sphericity (Φ) and roundness (%, Ro) data were calculated according to equations 1.1., 1.2. and 1.3. [22].

$Dg = (L \times W \times T)^{1/3}$(1.1), $Ø = Dg/L$ (1.2), $Ro = W/L \times 100$ (1.3)

Grape berry skin color characteristics were performed in triplicate using chromometer (Konica Minolta Co., Osaka, Japan) in 2 different regions of 6 grapes in each replication. L*, a* and b* values were measured according to CIE Lab color system. On the color scale, the L* parameter ranges from 0 to 100 (brightness) from black to white, the a* axis shows a change from red (+a*) to green (-a*)

Figure 1: Grape varieties.

Figure 2: Size measurement of grape berry.

and while the b* axis from yellow (+b*) to blue (-b*). By the way hue is color tone angle, chroma is color intensity. According to the color coordinate system; 0° defines the color red-violet, 90° yellow, 180° blue-green, 270° blue [23]. Hue, equation 1.4. and the Chroma was determined in equation 1.5.

$h^o = \arctan(b^*/a^*)$ (1.4), $C^* = (a^{*2}+b^{*2})^{1/2}$ (1.5)

Results and Discussion

The grape berry properties of grapes shown in Table 1. The results showed some differences depending on the grape varieties. Average 100 grape berry weight (g), berry weight (g), berry length (mm), berry thickness (mm), berry width (mm) and number of seeds in berry (n) were 244.647-856.311 g, 2.74-12.80 g, 17.44-22.40 mm, 11.18-18.00 mm, 11.86-18.60 mm and 0-4 pieces respectively. The lowest 100 grape berry weight was determined in Sultani Seedless while the highest in Michael Paliere. Within the aim of the study, Sultani and Crimson grape varieties are seedless, and it was determined that the grape with the highest number of seeds among other grape varieties was Red Globe. It was noted that Antep Karası, Michael Paliere and Sultani Seedless grapes had longer berry lengths, and Michael Paliere and Trakya İlkeren grape varieties had the highest width. Aydin [24] determined the berry characteristics of 12 different table grape varieties and the berry width values were 18.46-24.08 mm; and the size was determined as 19.55-25.55 mm. They determined the highest berry width value in *Alphonse Lavallee* (ALFONS) (24.08 mm) variety, and the highest average berry length value in Trakya İlkeren (19.55 mm).

Grape Varieties	100 Grape Berry Weight (g)	Berry Weight (g)	Berry Length (mm)	Berry Thickness (mm)	Berry Width (mm)	Number of seeds (n)
Antep Karası	519.317	6.00	22.28	15.23	15.29	2.5
Trakya İlkeren	530.280	5.32	17.56	17.32	17.56	3
Michael Paliere	856.311	10.26	22.40	18.00	18.60	3
Red Globe	741.153	12.80	18.85	16.18	16.80	4
Crimson Seedless	308.195	2.74	17.44	11.18	11.86	0
Sultani Seedless	244.687	2.93	22.28	13.22	13.44	0

Table 1: Berry properties of grape varieties**.**

The parameters studied showed partially differences depending on varieties. In the study, the highest geometric mean diameter was measured in Michael Paliere (19.57 mm), while the lowest geometric mean diameter value was determined in Crimson Seedless (13.22 mm). The highest sphericity was detected in Trakya İlkeren grape (0.995), and the lowest sphericity was determined in Sultani Seedless (0.710) grape. The roundness was recorded as 100.06% in Trakya İlkeren grape and 60.49% in Sultani Seedless grape in accordance with sphericity (Table 2).

The physicochemical properties of grape varieties are given in figure 3 and figure 4. It has been determined that the acidity values of grape varieties vary between 0.313-0.438% while the pH values between 3.90-4.35. The highest maturity index was determined in Sultani Seedless grape (58.82) and the lowest maturity index was determined in Antep Karası grape (34.61).

Cangi., *et al*. [25] in a study on the changes that occur during the ripening of some wine grapes grown in the Tokat region, they

Grape Varieties	Geometric Mean Diameter (Dg, mm)	Sphericity (Φ)	Ro (%)
Antep Karası	17.29	0.778	68.96
Trakya İlkeren	17.48	0.995	100.06
Michael Paliere	19.57	0.876	83.34
Red Globe	17.24	0.913	89.13
Crimson Seedless	13.22	0.757	68.08
Sultani Seedless	15.82	0.710	60.49

Table 2: Size measurements of grape berries**.**

stated that the pH value varies between 2.45-4.20 depending on ripening. Acidity, it has been stated by many researchers that the pH value increases as the grape ripening increases. This increase is explained by the decrease in organic acids, which are found in high levels in the composition of grapes during the ripening stages, due to ripening [25,26].

Keskin., *et al*. [27]. reported in their study that the pH values of ripe grapes vary between 3-4 values, and that the pH values of the grapes increase significantly during the ripening period, and this situation affects the flavor positively. Hayoglu., *et al*. [28] in their study, the pH value of Antep Karası grape variety 3.76; they determined the total acidity as 0.29 (g100 mL^{-1}) and 20% WSDM value.

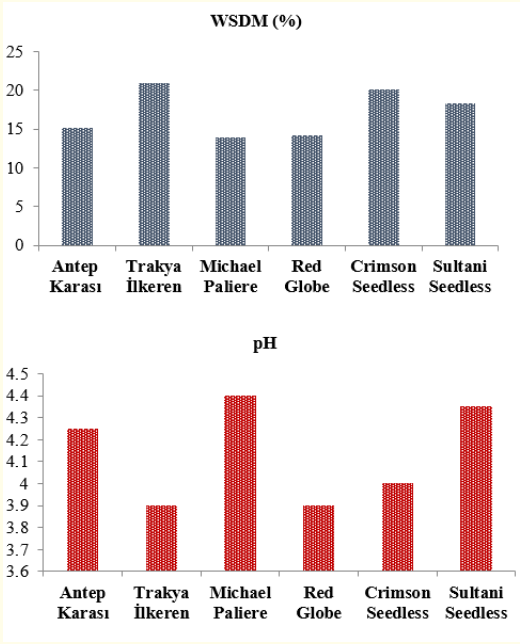

Figure 3: WSDM (%) and pH values of grape varieties.

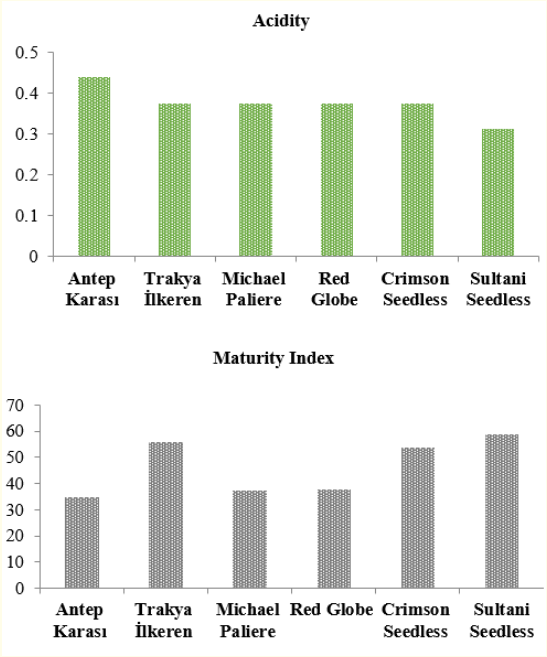

Figure 4: Acidity and maturity index values of grape varieties.

In the researches, it is stated that the phenological stages of the vine and the sugar concentration in the must are related to the climatic conditions and cultural practices in the region, and the amount of WSDM increases with the maturation of the grape varieties [29-33]. Otag [12] reported that the maturity index increased due to the increase in sugar concentration and the decrease in the total amount of acidity during ripening. It was stated that the maturity index varies between 1.14-1.60 in the verruk period, which is the beginning of ripening, between 27.46-43.92 in the ripening stage and between 48.54 and 73.30 in the over-ripe stage. Organic acids are taken into account together with sugars in determining the maturity status of grapes and are used in calculating the maturity index. Acidity, which is one of the quality characteristics of grapes, is expressed by the ratio of tartaric acid, which is the dominant organic acid in grapes. In addition, the pH value in grape juice, on the other hand, affects the color level of the grapes in connection with the acidity [8,34,35].

Appearance is an important quality parameter for economically produced grapes. Phenolic compounds affect the grapes especially hardness, softness, colour, taste, aroma etc. play a major role in their properties. In terms of color, grapes are generally divided into three main groups as white, red and black [16,18,19,36-38]. Anthocyanins are water-soluble natural colorants found in fruits, vegetables, flowers, leaves, roots and other plant storage organs that give a wide range of colors from pink, red, purple and blue [39-41]. Anthocyanin pigments are used in grapes and wines with their coloring and biological effects.They form an integral part of the sensory and therapeutic qualities. They show antioxidant and anti-inflammatory effects against DNA oxidative damage. The color of red and black grapes is composed of anthocyanidin group, and the color of white grapes is composed of flavone (quercetin) and flavonal (quercitrin) group yellow substances [8,42,43].

In table grape cultivation; factors such as the taste, aroma, shape, color and size of the grape berries and clusters are among the important factors that play a role in grape variety and are seen as an important factor in consumer demands [44-47]. In this study, it was determined that the berry skin color of Trakya İlkeren grapes was less bright compared to the *L** value, *+a** value, which indicates red color, was higher in Crimson Seedless, and *+b** value, which indicates yellow color, was at the highest level in Sultani Se-

Grape Varieties	L^*	a^*	b^*	h^o	C^*
Antep Karası	21.14	1.40	-0.48	18.92	1.48
Trakya İlkeren	20.38	1.41	-0.37	14.78	1.46
Michael Paliere	21.62	1.54	-0.56	19.98	1.64
Red Globe	31.94	8.90	3.16	19.55	9.44
Crimson Seedless	27.37	9.96	2.74	15.38	10.33
Sultani Seedless	36.94	-1.93	10.65	79.73	10.82

Table 3: Color properties of different grape varieties.

edless. Hue angle, which explains the hue angle, varied in the range of 14.78-79.73, while it was calculated the lowest in Trakya İlkeren grape and the highest in Sultani Seedless grape in accordance with the Chroma value (Table 3). When the color parameters of grape varieties are examined; It was determined that yellow color was dominant in Sultani Seedless grapes, blue-black color was dominant in Antep Karası, Trakya İlkeren and Michael Paliere grapes, and pink-red colors were dominant in Red Globe and Crimson Seedless grapes.

Conclusion

While there are many physiological and biochemical changes during the berry development in grapes, each developmental stage may vary according to the variety and environmental conditions. Due to its location, the Manisa region has an ideal geographical structure for viticulture in terms of climate and soil structure, and it is a province with favorable ecological conditions for the cultivation of table, dried, wine, and cider grape varieties. In this study, the data obtained by examining the pomological characteristics of the grape varieties most grown in the region were gained in the literature. It is thought that these results will be a guide for future studies. It is thought that the findings obtained in the region, which has important export potential in table and dried grapes, can be used as basic data in future studies on technical issues such as machine harvesting, storage, transportation and production, taking into account the physical and chemical properties of grape berries of these varieties.

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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