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Physico-chemical characteristics of some Gilaburu (*Viburnum Opulus* L.) genotypes

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Abstract

Gilaburu is an important fruit species in terms of healthy effects, having potential for use as alternative medicine and suitable for industrial product processing. In this context, physico-chemical characteristics of three different gilaburu (*Viburnum opulus* L.) genotypes grown under the ecological conditions of Kayseri, Turkey were determined. In addition, correlations among the investigated characteristics were calculated and their potential to be handled together was revealed. According to results, Fruit width, fruit length and fruit weight characteristics varied between 7.40-7.95 mm, 7.65-8.81 mm and 0.30-0.37 g, respectively. Genotype 3 showed the highest values in terms of pomological characteristics, while the lowest values were obtained from Genotype 1. Among the chemical properties; pH, soluble solid content (SSC) and titratable acidity (TA) values ranged from 3.53 (Genotype 1) to 3.97 (Genotype 2), 10.46 (Genotype 1) to 12.72 (Genotype 2) and 1.56 (Genotype 2) to 2.16 (Genotype 1), respectively. A high level of positive correlation was found between fruit width and fruit length (r = 0.73 ***). Also, these properties have been found to increase fruit weight. While a highly negative correlation was found between titratable acidity and pH (r = -0.95 ***), it was determined that the increase in fruit size and weight decreased dry matter accumulation.

Keywords: European cranberrybush, Fruit, Selection, *Viburnum Opulus* L.

Introduction

Gilaburu (*Viburnum opulus* L.), is a fast-growing, bush-formed berry fruit belonging to the Adoxacea family and commonly grown in Europe and North Africa, while growing naturally in Turkey, especially in Kayseri, Bursa, Konya, Tokat, Ankara and Sakarya (Baytop 1999, Aksoy et al.2004, Sagdic et al.2006; Yıldız and Ekici, 2019). Gilaburu, which performs better in continental climate, has a plant height of 1.5-3.5 m and its fruits are long-living.

In recent years, with the increasing demand for natural products, studies on species with high nutritional value and health importance are increasing (Polat et al., 2018; Gündeşli et al., 2019; Güney, 2020; Okatan, 2020). Gilaburu is one of the remarkable species in this context.

When the studies are examined, it is observed that gilaburu fruits are rich in phenolic compounds such as caffeic acid, chlorogenic acid, ellagic acid, p-coumaric acid, gallic acid, protocatechuic acid, ferulic acid, rutin, syringic acid, quercetin, catechin, epicatechin, cyanidin-3-glucoside, pelargonidin 3-glucoside (Zarifikhosroshahi et al, 2018). Thanks to its rich and diverse biochemical content, it has been demonstrated with different studies that it has high antimicrobial, antioxidant, antimutagenic and pharmacological effects (Bolat and Özcan, 1995; Gerçekçioğlu, 1999; Burnaz et al., 2010; Murathan et al., 2018; Taşkın et al. , 2019; Yıldız and Ekici, 2019). It has been reported that its seeds also show the same effect (Güleşçi, 2019). In addition, within a study conducted on air pollution, it has been emphasized that the production of this

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fruit should increase in areas with heavy industrial production and highways due to its tolerance to sulfur dioxide among 72 species and it has been determined as a potential species that can be used in landscape areas in North America among 38 species (Mapeza, 1986).

It is very important to choose the genotypes that show superior features in gilaburu, which has a future in many different areas such as being consumed dried or fresh, used in the fruit juice industry, used in alternative medicine due to its rich and diverse biochemical content, preventing air pollution and used in landscaping. In this study, it was aimed to determine the pomological and chemical properties of gilaburu (*Viburnum opulus* L.) varieties growing in 3 different locations under ecological conditions of the province of Kayseri. In addition, as a result of the correlation analysis, the relationships between the examined features have also been revealed.

Material and Methods

Material

This study was conducted in 2016 and three different genotypes were used as material naturally grown in Akkışla (Genotype 1), Uluşağ (Genotype 2) and Kesdoğan (Genotype 3) of Kayseri, Turkey. Collected fruits were took into cold chain without losing time. All the analyses were performed in the pomology laboratory of the Isparta Applied Sciences University, Department of Horticulture.

Determination of pomological characteristics

Harvested fruits from the genotypes were immediately transferred to the laboratory. Fruit weight was determined using an electronic scale susceptible to 0.001 g (Vibra, AJH-42OCE) and digital calipers were used to measure fruit width and fruit length at 0.01 mm precision.

Determination of chemical characteristics

Fifty fruit belonging to each genotype were squeezed with a juice extractor and filtered with coarse filter paper to obtain their juices and these juices were used for phytochemical measurements. Soluble Solid Content (SSC) were measured by a digital refractometer (Hanna, HI 96801) and the results were given in percentile values (Karaçalı, 2012). For the determination of titratable acidity, the fruit juices were titrated with 0.1 N sodium hydroxyl solution using phenolphthalein as the indicator and the results were expressed as malic acid % by calculating the formula showed by Karaçalı (2012).

Statistical Analysis

The study was designed according to a randomized plot experimental design. Fifty fruit were used for pomological properties for each genotype. Fruit juices were used for the determination of chemical properties obtained from fifty fruit from each genotype. Results are expressed as mean ± standard deviation. Statistically significant differences among genotypes were determined by the one-way ANOVA procedure in the Minitab-17 program package. The Tukey multiple comparison test was used to reveal differences and correlation analysis was used to reveal the relations between the investigated features. (Zar, 2013).

Results and Discussion

Pomological results of the investigated genotypes in the study are given in Table 1. According to results, among the investigated properties, fruit width, fruit length and fruit weight varied between 7.40-7.95 mm, 7.65-8.81 mm, 0.30-0.37 g, respectively. The highest values in terms of these properties were obtained from Genotype 3, while the lowest values were measured in Genotype 1. While a stable ranking was not observed in terms of color values, the highest L*, C* and h^{o} values were determined as 49.38 (Genotype 1), 46.23 (Genotype 2) and 29.85 (Genotype 3), respectively. Titratable acidity, expressed as the sum of organic acids, was measured highest from Genotype 1 with 2.16% and lowest from Genotype 2 with 1.56%. As expected, contrary to titratable acidity, the highest pH was obtained from Genotype 2 and lowest from Genotype 1. Soluble solid content was determined in the range of 10.46% (Genotype 1) and 12.72% (Genotype 2).

Table 1. Physico-chemical characteristics of investigated gilaburu genotypes

	Genotype 1	Genotype 2	Genotype 3
Fruit length (mm)*	7,40±0,94^{b}	7,48±0,84^{ab}	7,95±0,76^{a}
Fruit width (mm)***	7,65±1,01^{b}	8,29±0,98^{a}	8,81±0,91^{a}
Berry weight (g)**	0,30±0,08^{b}	0,34±0,09^{ab}	0,37±0,09^{a}
L*	49,38±7,81^{a}	44,20±5,55^{b}	46,59±6,89^{ab}
C*	40,23±13,55^{ns}	46,23±10,41^{ns}	44,79±13,64^{ns}
h^{o}	28,39±5,02^{ns}	29,02±4,31^{ns}	29,85±5,73^{ns}
Ph***	3,53±0,04^{c}	3,97±0,04^{a}	3,94±0,04^{b}
TA (%)***	2,16±0,09^{a}	1,56±0,08^{c}	1,78±0,10^{b}
SSC (%)***	10,46±0,42^{c}	12,72±0,42^{a}	11,96±0,52^{b}

ns: non-significant, *,** and ***: significant at P<0.05, P<0.01 and P<0.001, respectively.

Previous studies conducted in different parts of Turkey indicated great variation on fruit weight, soluble solid content, titratable acidity and pH among gilaburu genotypes and were reported between 0.40 - 0.87 g, % 7.81 – 14.37, %1.49-2.85 and 2.13 – 3.90, respectively (Bolat and Ozcan, 1995; Karadeniz et al., 2003; Ozrenk et al., 2011; Gundogar, 2013; Ersoy et al., 2017; Ozrenk et al., 2020). In studies conducted with different gilaburu genotypes, change interval for fruit length was reported between 9.37-11.25 mm (Gündoğar, 2013); 11.83 mm - 12.55 mm (Kara ve ark., 1995; Karadeniz ve ark., 2003.

Similar notifications were made in the range of for fruit width in 9.23 mm and 11.96 mm (Gündoğar, 2013).

When the results of different studies were examined, it was seen that the color values were evaluated using the weighted ranking method. In the study conducted by Gündoğar (2013), 12 and 31 genotypes were reported as light red and red, respectively. Similarly, Ersoy et al. (2017), reported 4 genotypes as light red, 2 genotypes as red and 4 genotypes as dark red.

Although differences in all investigated characteristics were thought to be mainly due to the differences in genotypes examined, differences in climate and soil characteristics, geographical status of the cultivation area, harvesting type and time, storage or processing of the crop, method or periodical differences of the applied cultural processes lead to significant differences in the final shape and content of the products (Li et al., 2012; Tiwari and Cummins, 2013; Mertoğlu et al., 2020; Büyüksolak et al., 2020).

Correlation coefficients between the investigated properties in the study are given in Table 2. A high level of positive correlation was found between fruit width and fruit length (0.73 ***). In plants, after fertilization, firstly an increase in the number of cell is observed then cell expansion is seen. Horizontal and vertical growth progress in parallel during the cell expansion phase and this explains the strong relationship between these two features. Volume increase in cells that make up the fruit, increases the weight also. In this context, a strong positive relationship was detected between fruit weight with fruit width and fruit length, respectively, at 0.87*** and 0.89***. A strong and positive relations between fruit physical characteristics have been reported in different species (Lo Bianco et al., 2010; Sarıdas et al., 2017).

Table 2. Correlation coefficients among the investigated characteristics

	FW	FL	BW	L*	C*	h°	SSC	Ph
FL	0,73***							
BW	0,87***	0,89***						
L*	-0,20ns	-0,25*	-0,17ns					
C*	0,15ns	0,20ns	0,11ns	-0,82***				
h°	0,23*	0,21*	0,16ns	-0,79***	0,92***			
SSC	-0,26*	-0,05ns	-0,22*	-0,21*	0,16ns	0,03ns		
Ph	-0,02ns	0,20ns	0,05ns	-0,24*	0,18ns	0,06ns	0,93***	
TA	0,19ns	-0,03ns	0,13ns	0,23*	-0,16ns	-0,01ns	-0,98***	-0,95***

FL: Fruit length, FW: Fruit width, BW: Berry weight, SSC: soluble solid content, TA: Titratable acidity,
ns: non-significant *P<0.05, **P<0.01, ***P<0.001

Intercellular spaces of the cells, increase with the increase of fruit volume and weight. As a result, soluble solid content accumulation per unit area decreases. Consequently, a negative and significant relationship was found between soluble solid content with fruit width and fruit weight, respectively, at -0.26* and -0.22* in the study. Similar results were reported by Eskimez et al. (2020).

A strong and negative relation (-0.95 ***) was found between the pH properties of TEA, which is the calculated form of total organic acids in terms of dominant acid. Negative relation between pH and TEA was similarly reported by Mertoğlu and Evrenosoğlu (2019) as -0.81*** and by Eskimez et al. (2020) as -0.78***.

Increase of color giving pigments in fruit, makes the fruit darker and dull at the same time. For this reason, it was found that L value were negatively correlated with C and H values and the correlation coefficients between them were -0.82*** and -0.79***, respectively. While there is a positive correlation between fruit sizes and weight with C* and h° values, L* value wasfound in a negative relationship with these characteristics. These relations may have resulted from the fact that color pigments are synthesized as a result during photosynthesis, which also improves the physical properties of the fruit.

Conclusion

In recent years, it has become very important to identify superior genotypes of species with high antioxidant effect, having potential for use as alternative medicine and suitable for industrial product processing. In this context, three different genotypes of gilaburu grown in different province of Kayseri (Akkışla, Uluşağ and Hastane) has potential and were characterized in this study in terms of their physico-chemical characteristics. According to the results, genotype-3 stood out in terms of pomological characteristics, while genotype-2 showed superior characteristics in terms of chemical properties.

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

Mehmet Polat designed the study and collected the data with İlknur Eskimez. Kerem Mertoğlu made the statistical analysis and wrote the original draft of the article. 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

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Data availability

Not applicable.

Consent for publication
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