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Araştırma Makalesi (Research Article)

**Determination of Some Pomological Features of Bilberries (*Vaccinium myrtillus* L.)
Native to Sarıkamış (Kars), Turkey**

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Abstract: This study was carried out to evaluate some physical and chemical properties of wild bilberry fruits collected from Sarıkamış forest of Kars province in Eastern Anatolia Region of Turkey. For this purpose, berry width, berry length, berry weight, pH, titratable acidity content (TAC), soluble solid content (SSC), taste, aroma, L*, a*, and b* color values were measured based on 4 replications of 20 fruit samples each from 20 plant genotypes. The results were interpreted on average values. Average values for width, length, weight, pH, TAC, SSC, taste, aroma and L*, a*, b* color values of berries were found as: 9.12 mm, 8.02 mm, 5.08 g, 2.22, 2.70%, 7.41%, 2.95, 3.00, 14.88, 1.72 and 0.06, respectively. Range values for the corresponding characteristics were determined as: 7.55 to 10.37 mm, 6.95 to 9.80 mm, 3.00 to 7.00 g, 2.04 to 2.60 %, 2.40 to 3.00 %, 6.00 to 8.50, 2.00 to 4.00, 13.24 to 16.30, 1.004 to 3.04 and -1.98 to 3.87, respectively (There is no aroma interval between these values). The current research is a preliminary evaluation for some physical and chemical characteristics of wild bilberries native to Sarıkamış district. Consequently, more detailed studies should be conducted on further physical and chemical characteristics of bilberries for breeding purposes and to gain baseline knowledge on the flora of Turkey.

**Türkiye'nin Sarıkamış (Kars) Bölgesinde Doğal Olarak Yetişen Çobanüzümlerinin
(*Vaccinium myrtillus* L.) Bazı Meyve Özelliklerinin Belirlenmesi**

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Anahtar kelimeler

Çoban üzümü,
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Öz: Bu çalışmanın amacı, Türkiye'nin Doğu Anadolu Bölgesindeki Kars-Sarıkamış ormanlarında yetişen çoban üzümü meyvelerinin bazı fiziksel ve kimyasal özelliklerinin belirlenmesidir. Bu amaçla meyve ağırlığı, genişliği, uzunluğu, pH, titre edilebilir asit miktarı, suda çözünebilir kuru madde miktarı, tat, aroma, L, a ve b değerleri, 20 farklı bitkiden elde edilen 20'şer adet meyvede, 4'er tekerrürlü olarak yapılmıştır. Sonuçlar ortalama değerler üzerinden yorumlanmıştır. Meyve genişliği, uzunluğu, ağırlığı, pH, titre edilebilir asit miktarı, suda çözünebilir kuru madde miktarı, tat, aroma ile L*, a* ve b* renk değerleri sırasıyla: 9.12 mm, 8.02 mm, 5.08 g, 2.22, 2.70%, 7.41 %, 2.95, 3.00, 14.884, 1.72 ve 0.065 olarak bulunmuştur. Sözü geçen bu parametrelerin aralıkları ise sırasıyla: 7.55-10.37 mm, 6.95-9.80 mm, 3.00-7.00 g, 2.04-2.60, 2.40-3.00 %, 6.00-8.50 %, 2.00-4.00, 13.24-16.30, 1.004-3.04 ve -1.98-3.87'dir (Aroma için aralık değer tespit edilmemiştir). Elde edilen bu sonuçlar, Sarıkamış bölgesinde yetişen çoban üzümünün bazı fiziksel ve kimyasal özelliklerinin belirlenmesi açısından bir ön çalışma niteliğindedir. Türkiye florası hakkında bilgi edinmek ve ıslah amaçlı kullanımlar için çoban üzümünün fiziksel ve kimyasal özellikleri üzerine daha kapsamlı araştırmalar yapılmalıdır.

1. Introduction

Blueberries are from family Ericaceae, genus *Vaccinium* represented by more than 200 species of sempervirent or deciduous shrubs and trees (Valentova et al. 2006; Riihinen et al, 2008). The most popular *Vaccinium* species are *V. angustifolium* (lowbush blueberry), *V. corymbosum* (highbush blueberry), *V. ashei* (rabbiteye blueberry) and *V. myrtillus* with the common name bilberry also recognized as European blueberry (Levi and Rowland 1997; Riihinen et al. 2008). Bilberries are also called blaeberry, heidelberry, huckleberry, hurtleberry and whortleberry in different parts of the world. Boreal forests are the common natural habitat of the perennial bilberry shrubs indigenous to North America together with northern and central parts of Europe (Kemper, 1999; Valentinova et al. 2006; Bao et al. 2008; Matsunaga et al. 2010). Bilberries are not very suitable for cultivation. Therefore, the ripe berries are harvested from the wild bilberry shrubs mainly spread on the herbaceous layers of the forests in Finland, Sweden, Norway, Belarus, Bulgaria, Poland, Russia and northern Turkey (Kemper 1999; Jaakola et al. 2001). Despite the increasing popularity of the European blueberry the cultivation is very limited and performed in small areas of North America, France, Holland, Germany, Poland and Spain (Diban et al. 2007). Bilberries are very rich source of phytochemicals with high antioxidant activity and potential benefits on health increasing their demand on the market (Jaakola 2001; Nakajima et al. 2004; Lyons et al. 2003; Mauray et al. 2012; Çolak (2018). The berries of *V. myrtillus* are blue-black or purple colored but different than the blueberry the flesh is purple not white (Valentinova et al. 2006). Bilberries are profound in anthocyanins, as observed from its dark colored flesh, and vitamins crucial in human diet (Kemper 1999; Kähkönen et al. 2003; Riihinen et al., 2008; Kalt and Dufour 1997; Cocetta et al. 2012; Hancock and Vinola 2005). The consumption demand for European blueberry is increasing due to its role in nutrition and health benefits (Ichiyanagi et al. 2004; Zhang et al. 2004; Kalt and Dufour 1997). *V. myrtillus* has potential healing effects on vision, inflammatory and vascular disorders (Kemper 1999; Morazzoni and Bombardelli 1996; Mink et al. 2007; Pizzorno and Murray 1987). Bilberries could be consumed fresh or utilized as juice, wines and jams (Primetta et al. 2013).

As the market demand for berries increases, the cultivation area also broadens thanks to the new varieties developed as a result of the breeding investigations (Koca and Karadeniz 2009). Fruit characteristics mainly depend on genotype and environmental factors (Koca and Karadeniz 2009; Scalzo et al. 2005). Although various studies were conducted on pomological features of blueberries (Kalt and McDonald 1996; Prior et al. 1998; Kalt et al. 2001; Taruscio et al. 2004; Remberg et al. 2006; Smolarz 2006; Castrejon et al. 2008; Sinelli et al. 2008; Çelik 2008; Çelik 2009; Giovanelli and Buratti 2009), the literature is scarce on bilberries indigenous to Turkey (Koca and Karadeniz 2009). Türkben et al. (2008) defined some fruit characteristics as weight, color, pH, titratable acidity and soluble solid content of bilberries from Uludağ mount of Bursa, Turkey.

To our best knowledge, this is the first research conducted on fruit features of bilberries growing naturally in Sarıkamış district of Kars province, Turkey. Therefore, the aim of this study was to obtain a baseline information on the fruit properties of wild bilberry population of Sarıkamış, Kars as a potential plant genetic resource for the future breeding programs.

2. Materials and Methods

2.1. Plant material

Ripe berries of wild *V. myrtillus* growing in Sarıkamış (Kars) located 2300 meters above sea level, at 40° 19' 39'' latitude and 42° 35' 13'' longitude, were used. Fruits were picked at dark-blue color in mid-August, 2009. The sample selection was made randomly from Sarıkamış forest. Measurements and weightings were performed based on 4 replications of 20 fruit samples each from 20 individual plants.

2.2. Determination of fruit characteristics

Weight, width, length, pH, titratable acid content (%), soluble solid content (%), taste, aroma and L*, a*, b* color values of sample berries were measured. Weight was measured for ten berries. pH and titratable acid content (TAC) were determined with a pH meter. Soluble solid content (SSC) was

defined with a refractometer. Aroma and taste were evaluated organoleptically with a rating range of 1-5. Berry color L^* , a^* , b^* color values were identified using a Minolta portable chromometer. Descriptive statistics for each trait were estimated based on 20 fruit samples with 4 replications of 20 plant genotypes (Table 1).

3. Results and Discussion

Information regarding pomological characteristics of wild bilberries is very scarce in the literature (Türkben et al. 2008). This research provides preliminary examination of some fruit characteristics of the bilberry population native to Sarıkamış. Because pomology studies on bilberries are very scarce, findings from this study were discussed mainly with the researches done on the other *Vaccinium* species. General descriptive statistics for physical and chemical characteristics of wild bilberries collected from Sarıkamış forest of Kars province are provided in Table 1. The average and median values estimated for each of the investigated berry properties were found statistically very close to each other (Table 1). The means of berry width, length, weight, pH, TAC, SSC, taste, aroma and L^* , a^* , b^* color value were: 9.12 mm, 8.02 mm, 5.08 g, 2.22, 2.70 %, 7.41%, 2.95, 3.00, 14.88, 1.72 and 0.07, respectively. There is no interaction between these values: 7.55 to 10.37, 6.95 to 9.80, 3.00 to 7.00, 2.04 to 2.60, 2.40 to 3.00, 6.00 to 8.50, 2.00 to 4.00, 13.24 to 16.30, 1.00 to 3.04 and -1.98 to 3.87, respectively (Table 1). The average weight for ten berries was 5.08 g. Islam and Celik (2006) reported a range of 32.08-78.7 g for the weight of 100 blueberries cultivated in district of Trabzon province at the Blacksea Region of Turkey. Oblak (1977) found this range to be 78-21 g for blueberries grown in Slovenia. Çelik (2003) defined a range of 94-241 g for blueberries cultivated in Rize province of Eastern Black Sea Region of Turkey. The average pH value was 2.22 (Table 1). Türkben et al. (2008) found higher pH values for bilberries collected from Kirazlıyayla (pH 2.87), Sarıalan (pH 2.87), Çobankaya (pH 2.77), Bakacak (pH 2.87) and Alaçam (pH 2.95) locations of the mount Uludağ in Bursa province of Turkey. The difference in pH could be attributed to genotype and ecological conditions. The mean TAC was 2.70% (Table 1). Turkben et al. (2008) found lower acidity for Kirazlıyayla (1.02%), Sarıalan (1.19%), Çobankaya (1.23%), Bakacak (0.90%) and Alaçam (1.15%) locations. Kim et al. (2013) defined titratable acidity to range from 0.8% to 3.6% for blueberries grown in Korea.

The mean SSC was 7.40% (Table 1), which was lower than Turkben et al. (2008), who reported SSC values of 10.50%, 10.00%, 11.00%, 9.00% and 9.00% for bilberries collected from Kirazlıyayla, Sarıalan, Çobankaya, Bakacak and Alaçam locations, respectively. SSC averages for blueberries cultivated at different ecological conditions were determined as 11.4-14.1% by Oblak (1977), 7.5-13.5% by Islam and Celik (2006), and 10.38-11.06% by Celik (2003), which were higher than our findings. This variation could be mainly attributed to species difference and environmental conditions. Taste (2.95) and aroma (3.00) averages were similar (Table 1). The mean L^* was found 14.884 (Table 1). Turkben et al. (2008) reported lower average L^* value, except for Alacam area with L^* of 16.69. The mean a^* was 1.722 with a narrow range of 1.004-3.040 (Table 1), whereas broader range of 1.55-4.17 was stated by Turkben et al. (2008), mainly attributed to ecological variation. The current result (1.722) was in general lower than the values found by Turkben et al. (2008) for different locations in Uludağ mount. The average b^* value was 0.0650 with a broad range of - 1.980 to 3.87. Turkben et al. (2008) stated the mean b^* as: 0.34 (Cobankaya), 0.37 (Bakacak), 0.58 (Alacam), 0.61 (Sarıalan), and 0.93 (Kirazlıyayla) for different locations with narrow range of 0.34 to 0.93.

Table 1. Descriptive statistics of some physical and chemical characteristics of wild bilberry fruits.

Characteristics	Mean	SE	STDEV	MIN	Q1	Median	Q3	MAX
Berry Width (mm)	9.12	0.16	0.71	7.55	8.56	9.21	9.59	10.37
Berry Length (mm)	8.02	0.18	0.81	6.95	7.40	7.90	8.83	9.80
Berry Weight (g)	5.08	0.17	0.74	3.00	4.90	5.17	5.22	7.00
pH	2.22	0.03	0.15	2.04	2.09	2.18	2.29	2.60
TAC (%)	2.70	0.04	0.16	2.40	2.60	2.66	2.80	3.00
SSC (%)	7.41	0.14	0.62	6.00	7.12	7.51	7.78	8.50
Taste	2.95	0.11	0.51	2.00	3.00	3.00	3.00	4.00
Aroma	3.00	0.10	0.46	2.00	3.00	3.00	3.00	4.00
L*	14.88	0.26	1.14	13.24	13.60	14.96	16.07	16.30
a*	1.72	0.19	0.83	1.00	1.02	1.43	2.70	3.04
b*	0.07	0.54	2.41	-1.98	-1.92	-0.82	2.93	3.87

4. Conclusion

The current investigation is a preliminary assessment for some pomological characteristics of bilberries growing naturally in Sarıkamış, Kars area in Eastern Anatolia of Turkey. Further studies should be performed on the identification of physical and chemical characteristics of bilberry fruits for breeding purposes and to obtain baseline information on flora of Turkey. Besides, this genetic richness with potential medicinal properties needs to be preserved and reproduced.

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