

Full Length Research Paper

Some physico-chemical properties and mineral contents of sweet cherry (*Prunus avium* L.) type grown in Konya

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Accepted 21 May, 2009

In this research, several physico-chemical properties and mineral contents of one earliest (May 19) sweet cherry type grown in Konya region were determined. The results in terms of chemical properties were total soluble solids, 18.33 mg/100 g; pH, 3.86; color, S₄₁P₅₀E₄₁; texture, 0.25 kg/cm²; and juice yield, 66.28%. The evaluation of the total weighted rankit scores in terms of the fruit taste, aroma, adherence of pulp, appearance, bigness, preferable, yield, market preference were 7.33, 8.44, 7.44, 9.22, 8.44, 7.55, 8.22, 10.00 and 8.33, respectively. The results of physical properties were fruit mass, 2.76 g; flesh/seed ratio, length, 17.68 mm; width, 15.60 mm; thickness, 14.89 mm; sphericity, 90.46%; aspect ratio, 88.26%; and true density, 1024.63 kg/m³.

Key words: Sweet cherry, physico-chemical properties, nutritional properties.

INTRODUCTION

Many of the stone fruits like sweet cherry (*Prunus avium* L.) have been cultivated since ancient times (Naderiboldaji et al., 2008). Anatolia is the origin of sweet cherry, like many other fruits (Gümüő and Paylan, 2008). Cherries are members of the *Rosaceae* family, subfamily *Prunoideae*. They occupy the *Cerasus* subgenus within *Prunus*, being fairly distinct from their stone fruit relatives; plums, apricots, peaches and almonds. *Prunus avium* L. is the sweet cherry and *Prunus cerasus* L. the sour, pie, or tart cherry (Anonymous, 2009).

Turkey is the biggest sweet cherry producer in the world. 310.254 tones of sweet cherry fruit is produced per annum in Turkey. World's sweet cherry production is 1.872.000 tones (Anonymous, 2008). Fruits of these species are not only consumed fresh but also used to produce jam, jelly, stewed fruit, marmalade, syrup and several types of soft drinks. It is also used for medical purposes due to properties of stalk and fruits. The leaves and seed of these species are used in pharmaceuticals. The tree is also valuable for ornamentation as an ever-

green broadleaf plant (İslam, 2002).

Many studies have been reported on the physical, chemical, pomological and nutritional properties of fruits, such as sweet cherry (Naderiboldaji et al., 2008, Radicevic et al., 2008; Polat et al., 2008; Vursavuş et al., 2005), plum (Diaz-Mula et al., 2008, Ertekin et al., 2006), wild plum (Çalışır et al., 2005), Malatya apricot (Akın et al., 2008), cornelian cherry (Tural et al., 2008; Demir and Kalyoncu, 2003; Güleriyuz et al., 1998) oleaster (Akbolat et al., 2008), pomegranate (Al-Said et al., 2008), hazelnut (Oliveira et al., 2008; Köksal et al., 2006; Özdemir and Akıncı, 2004), orange (Topuz et al., 2004) and berries (Molina et al., 2008; Khazaei and Mann, 2004). No detailed study concerning physical, chemical, pomological and nutritional properties of sweet cherry have been performed up to now. The aim of this study was to determine some physical, chemical, pomological and nutritional properties of one earliest sweet cherry type.

MATERIALS AND METHODS

Sampling

10 fruits of each treatment were used for all analysis.

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Total soluble solids

The content of total soluble solids was determined using samples of fruit pulp with a hand refractometer, at room temperature (range from 18 to 23°C) (Cemeroğlu and Acar, 1986).

pH

10 g of samples were homogenized for pH measurements. A digital pH meter was employed at 25°C (Pekmezci, 1981).

Texture

For texture measurements, the fruits were peeled (very thin layer) in 2 different places in the equatorial region of the sweet cherries. The texture was measured in a handle penetrometer with crossheads of 0.8 cm of diameter. Texture was expressed by kg/cm².

Colour

The colour scale was employed for determination of the fruit juice colour (Küppers et al., 1987).

Evaluation of the total weighted rankit scores

In order to determine the sweet cherry type character, the selection criteria used were, fruit taste, aroma, adherence of pulp, appearance, bigness, preferable, yield and market preference.

The modified weighted rankit (WR) method was used to determine the fresh consumption sweet cherry type (Demir and Kalyoncu, 2003; Ayfer et al., 1977). The relative score were multiplied by the each characteristic scores and summed to obtain WR scores for sweet cherry type.

Determination of mineral contents

About 0.5 g dried and ground sample was put into burning cup and 10 ml pure HNO₃ was added. The sample was incinerated in MARS 5 microwave oven under the 170 psi at 200°C temperature and solution diluted to the certain volume (25 ml) with water. Samples were filtered in filter paper and were determined with an ICP-AES (Skujins, 1998).

Working conditions of ICP-AES

Instrument: ICP-AES (Varian-Vista; Australia)
RF power: 0.7 - 1.5 kW (1.2 - 1.3 kW for axial)
Plazma gas flow rate (Ar): 10.5 - 15 L/min (radial), 15 L/min (axial)
Auxiliary gas flow rate (Ar): 1.5 L/min
Viewing height: 5 - 12 mm
Copy and reading time: 1 - 5 s (max. 60 s)
Copy time: 3 s (max. 100 s)

Determination of physical properties

The physical properties that were considered in this study are size, shape and true density.

Determination of size

From the samples, 10 fruits were selected at random for deter-

Table 1. Summary of some chemical properties of sweet cherry type with standard deviation.

Parameter	Values
Total soluble solids (mg/100 g)	18.33 ± 0.750
pH	3.86 ± 0.15
Color	S ₄₁ P ₅₀ E ₄₁
Juice yield (%)	66.28 ± 3.031
Texture (kg/cm ²)	0.25 ± 0.040

mining the physical characteristics. For each fruit, 3 linear dimensions were measured, that is (a) length, (b) width and (c) thickness, using a vernier caliper reading to 0.01 mm. Hence measurement of all size indices was replicated 10 times for sweet cherry fruit.

Determination of shape

The fruit and seed shape was expressed in terms of its sphericity index and aspect ratio. For the sphericity index Sc, the dimensions obtained for the 10 sweet cherry fruits were used to compute the index based on the recommendation of Mohsenin (1978) as $Sc = (a \times b \times c)^{1/3}/a \times 100$.

For the aspect ratio, 10 sweet cherry fruits were also selected at random for conducting the experiment. Measurements of all size and shape indices are replicated 10 times. The vernier caliper was also used for the measurements. The aspect ratio (Ra) was calculated as recommended by Maduako and Faborode (1990) as $Ra = b/a \times 100$.

Determination of fruit mass

The mass of individual fruit for sweet cherry type were determined by using an electronic balance to an accuracy of 0.001 g. Each measurement was replicated 10 times.

Determination of true density

The volume of fruit (V) and fruit density (Pt), were determined using the liquid displacement method. Toluene (C₇H₈) was used in place of water because it is absorbed by fruits to lesser extend. Also, its surface tension is low, so that it fills even shallow dips in a fruit and its dissolution power is low (Aydn, 2002; Demir et al., 2002).

RESULTS AND DISCUSSION

Some nutritional properties of sweet cherry type

Table 1 shows some chemical composition of sweet cherry variety, expressed as means with standard deviation. The total soluble solids, pH, texture, colour and juice yield were determined in sweet cherry fruits. Values of the total soluble solids, pH, texture, colour and juice yield were found to be 18.33 mg/100 g, 3.86, 0.25 kg/cm², S₄₁P₅₀E₄₁ and 66.28% respectively. Radicevic et al. (2008) reported that 9 sweet cherry cultivars originating from Canada: 'Lapins', 'early Van compact', 'summit', 'compact Lambert', 'compact Stella', 'Sunburst', 'new star',

Table 2. The scores of the characteristics and their relative values with standard deviation.

Characteristic	Relative Scores (%)	Panel scores of the characteristics
Fruit taste	10	7.33 ± 0.00
Aroma	10	8.44 ± 0.96
Color	10	7.44 ± 0.19
Adherence of pulp	10	9.22 ± 0.50
Appearance	10	8.44 ± 0.50
bigness	15	7.55 ± 0.19
preferable	10	8.22 ± 0.38
Yield	15	10.00 ± 0.00
Market preference	10	8.33 ± 0.33

'Vega' and 'Vista'. The largest were in 'sunburst' (11.2 g) the highest and lowest soluble solids contents were in 'Vega' (18.2%) and 'new star' (13.5%), respectively. Radicevic et al. (2001) determined in another research, the best fruit quality with the highest content of soluble solids was registered in merchant, stark hardy giant, sunburst, summit, Durone Nero III and Lapins. The soluble solid content (18.333) obtained in our research was higher than those of Radicevic et al. (2008). Pırlak and Bolat (2001) determined the phenological and pomological properties of 5 sweet cherry cultivars (Kırdar, Akşehir Napolyonu, Salihli, Sapıkısa, Yerli) in Uzundere vicinity of Erzurum, Turkey, during 1996 - 1997. In these cultivars, total soluble solids were range between 12.10 - 16.90%. Voca et al. (2007) determined that Stella had 16.49% and Van had 16.60% soluble solid content. The result in terms of the soluble solid content in our study was lower than those of Voca et al. (2007).

pH value was reported as 4.20 for Nour De Guben, 4.10 for 0 - 900 Ziraat and 3.82 for Van sweet cherry cultivar in previous study by Vursavuş et al., 2005. In the present study, pH value (3.86) was lower than those of Nour De Guben and 0 - 900 Ziraat cultivar and the same value with Van cultivar the previous reports.

The juice yield was 66.28% in our study. The composition of sweet cherry juices was found to be similar to previously reported studies (Vursavuş et al., 2005, Gonçalves et al., 2004, Sütyemez, 2000, Girard and Kopp, 1998).

In sweet cherry fruit, firmness is one of the most important attributes and it is often used for fruit quality assessment (Esti et al., 2002). Late cultivars were found to be firm and early cultivar were generally much softer (Christensen, 1995). There are considerable genotypic differences in fruit firmness in sweet cherry (Christensen, 1995; Esti et al., 2002). Fruit texture value was 0.25 kg/cm² in our study. Blazkova et al. (2002) determined that fruit firmness Karesova sweet cherry cv. was decreased from approximately 2.5 N at the beginning of the period to approximately 1.5 N at its end. The data obtained in our research was higher than those of Blazkova

et al. (2002) at the harvest time.

Colour directly affects the appearance and the consumer acceptability of the fruits. As can be seen from Table 1, there was S₄₁P₅₀E₄₁. The results indicate that the fruit type used in this study has more different colour than those of the findings of Vursavuş et al. (2005), Bernalte et al. (2003) and Sütyemez (2000). These differences can be attributed to the environmental and cultivation conditions.

After the determination of the characteristics, scores of the sweet cherry type were evaluated and given in Table 2. The evaluation of the total weighted rankit scores in terms of the fruit taste, aroma, adherence of pulp, appearance, bigness, preferable, yield, market preference were 7.33, 8.44, 7.44, 9.22, 8.44, 7.55, 8.22, 10.00 and 8.33 respectively.

Pırlak and Bolat (2001) determined the phenological and pomological properties of 5 sweet cherry cultivars (Kırdar, Akşehir Napolyonu, Salihli, Sapıkısa, Yerli) in Uzundere vicinity of Erzurum, Turkey, during 1996 - 1997. In the sensory evaluation, Akşehir Napolyonu received the highest score of appearance, taste and aroma score while Yerli had the highest taste score. According to the results of their study, Akşehir Napolyonu could be more preferably owing to its fruit size, appearance, taste and aroma, its yield was also higher compared to the other cultivars. Radicevic et al. (2001) presents the results of a 2 year (1990 - 2000) study of the biological and pomological properties of 25 sweet cherry [*Prunus avium*] cultivars at the fruit and grape research centre, Cacak, Yugoslavia. Exceptional cropping was recorded with the cultivars Junska Rana, Van, sunburst, summit, Bianca di Verona, compact Stella and Lapins. In terms of fruit size, sunburst, Durone Nero III, summit, Vega and stark hardy giant were superior over the other cultivars. According to the general estimate concerning the properties of the cultivars studied under agroeco-logical conditions in Cacak, due note should be paid to the cultivars sunburst, early compact Van, Vega, stark hardy giant and Junska Rana, which are recommended for intensive growing. Another research 6 commercially grown

Table 3. Some nutritional properties of sweet cherry type.

Mineral	Values (ppm)	Mineral	Values (ppm)
Al	13.482	Mg	1559.699
As	0.093	Mn	4.649
B	30.001	Na	293.970
Bi	4.347	Ni	0.507
Ca	1308.478	P	1448.181
Cr	1.632	Pb	5.113
Cu	5.797	S	953.926
Fe	23.218	Sr	12.395
K	5548.608	V	5.852
Li	2.311	Zn	8.340

sweet cherry (*Prunus avium* L.) cultivars were evaluated in a consumer sensory evaluation in Portland, Oregon on 18 July 2004 by Turner et al. (2008). 5 of the 6 cultivars were evaluated for taste - 'Regina', 'Sweet-heart', 'Skeena', 'Lapins' and 'Bing' - while 'Kordia' ('Attika') was included for visual evaluation only. A total of 192 participants were asked to visually examine 'Bing', 'Sweet-heart' and 'Regina' cherries for their preference in color. Cherry size preference was evaluated using 'Bing' fruit at 30, 25 and 21 mm and shape preference was evaluated using 'Kordia', 'Skeena' and 'Sweetheart'. In addition, participants tasted 5 cultivars and ranked them according to overall preference. The participants in this pilot evaluation preferred a cherry that was large in size (30 mm or larger) and dark in color ('Regina'). Sweet tasting cherries were preferred the most (65%) while cherries that lacked flavor or were too sour were preferred the least. 'Regina' rated the highest for overall taste preference.

Mineral contents of sweet cherry fruits are reported in Table 3. K (5548.608 ppm), Mg (1559.699 ppm), P (1448.181 ppm), Ca (1308.478 ppm) and S (953.926 ppm) were established as major minerals of the sweet cherry fruits. Others were determined at minor levels. The highest mineral was K followed by Mg, P, Ca and S. The minerals examined were thought to be important ones due to their abundance and perceived health effects. Mineral compositions are of interest due to their pro-oxidant activity and health benefits (Parcerisa et al., 1995). Many studies have been reported on the mineral compositions of stone fruits, such as apricot (Akin et al., 2008, Drogoudi et al., 2008), peach (Başar, 2006), cornelian cherry (Demir, 2002). All the studies indicated that the major minerals are N, K, Mg, P, Ca and S.

Some physical properties of sweet cherry type

Some physical properties of sweet cherry type were given in Table 4. The sweet cherry fruit mean length; width and thickness were found to be 17.68, 15.60, 14.89

mm, respectively. The seed of fruit mean length, width and thickness were found to be 9.52, 8.03, and 6.03 mm, respectively. Sütyemez (2000) reported the length, width and thickness values of 0 - 900 Ziraat variety to be 23.45, 20.85 and 20.45 mm, respectively. Vursavuş et al. (2005) reported the length, width and thickness values 23.97, 18.15 and 19.79 mm for Van, 21.04, 19.09 and 18.38 mm for Noir De Guben, 24.37, 22.53, 21.48 mm for 0 - 900 Ziraat sweet cherry cultivar, respectively. Naderiboldaji et al. (2008) determined the length, width and thickness values 20.18, 18.93, 17.04 mm for Mashad, 24.72, 22.87 and 17.04 mm for Siah Mashad sweet cherry cultivar, respectively. The values obtained from different types by Sütyemez (2000), Vursavuş et al. (2005) and Naderiboldaji (2008) were higher than those of ours, because of the genetical, environmental and growing conditions were different.

The sphericity value was 90.46 in present study. Vursavuş et al. (2005) reported that both the Noir De Guben (92.29%) and 0 - 900 Ziraat (90.66%) varieties had more sphericity than the Van variety (85.27%). Naderiboldaji et al. (2008) determined that the maximum sphericity ratio found from Dorageh Karaj cultivar (94%), the minimum sphericity ratio found from Shabestar cultivar (91%).

The sample mass of the sweet cherry varieties was determined to have different means and these values varied from 5.61 to 8.43 g by Vursavuş et al. (2005). Also they determined that the 0 - 900 Ziraat variety had more weight than the other varieties. Radicevic et al. (2008) researched that 9 sweet cherry cultivars originating from Canada: 'Lapins', 'early Van compact', 'Summit', 'compact Lambert', 'compact Stella', 'Sunburst', 'New Star', 'Vega' and 'Vista'. And they determined that the the heaviest cultivar was 'Sunburst' (11.2 g). Sütyemez (2000) found lower mass values (5.52 g) for 0 - 900 Ziraat variety. Usenik et al. (2008) determined the highest average fruit weight was measured in Lapins and the lowest in Fer-prime which was the earliest cultivar in their study. Our results show a low fruit weight for the earliest sweet cherry type (2.76) compared to the results of Dever et al. (1996), Sütyemez (2000), Vursavuş et al. (2005), Radicevic et al. (2008). Fruit weight, beside cultivar genotype (Gonçalves et al., 2006) also depends on crop load.

The length of seed of the sweet cherry variety was found to be 9.52 in this research. Vursavuş et al. (2005) determined that the length of seed of the cherry varieties was found to be statistically significant at the 0.1% probability level, they found that this data to be 9.87 mm for Van, 9.78 mm for Noir De Guben, 11.03 mm for 0 - 900 Ziraat. But the variation between Van and Noir De Guben varieties was insignificant. The data obtained in our research was lower than those of Vursavuş et al. (2005). The width of seed of the sweet cherry variety was found to be 8.03 in this research. Vursavuş et al. (2005) determined that the width of seed of 0 - 900 Ziraat variety (9.50 mm) was significantly greater than that of the other

Table 4. Summary of some physical properties of sweet cherry type with standard deviation.

Property	Mean value (\pm standard deviation)	
	Fruit	Seed
Fruit mass, g	2.76 \pm 0.238	0.21 \pm 0.005
flesh/seed ratio	12.08 \pm 1.110	
Length, mm	17.68 \pm 0.264	9,52 \pm 0.244
Width, mm	15.60 \pm 0.486	8.03 \pm 0.665
Thickness, mm	14.89 \pm 0.509	6.03 \pm 0.145
Sphericity, %	90.46 \pm 2.159	81.61 \pm 2.266
Aspect ratio, %	88.26 \pm 4.049	84.91 \pm 6.666
True density, kg/m ³	1024.63 \pm 28.807	

fruits. The Van and Noir De Guben varieties had 9.24 and 7.83 mm width of seed, respectively. The data obtained in our research was lower than Van and 0 - 900 Ziraat variety, but higher than Noir De Guben variety. The weight of seed of the sweet cherry variety resulted to be 0.21 g in this study. Vursavuş et al. (2005) determined that the weight of seed of the cherry varieties resulted in different means varying from 0.27 to 0.39 g. The greatest seed weight was 0 - 900 Ziraat variety, followed by the Van and Noir de Guben varieties. The results in this study in terms of the seed weight was lower than the results of Vursavuş et al. (2005).

Average flesh/seed ratio was 12.08 in this research. Vursavuş et al. (2005) reported that average flesh/seed ratio was from 17.70 to 20.73. However, Sütyemez (2000) reported that flesh/seed ratio was between 9.03 and 11.91 for the different sweet cherry varieties grown at different environmental and cultivation conditions. The values obtained from different types by Sütyemez (2000) were lower than those of ours but the values obtained from different types by Vursavuş et al. (2005) were higher than those of ours. The true density of the sweet cherry variety was found to be 1024 kg/m³.

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