

EXAMINATION OF THE POMOLOGICAL CHARACTERISTICS AND THE PRESENCE OF HEAVY METALS IN THE PEACH CULTIVAR “CRESTHAVEN” FROM REPUBLIC OF MACEDONIA

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Abstract

The pomological characteristics are very important for each type of fruit. The different types of fruits are being classified according to their shape, size, dimensions and the other features. The purpose of this paper is to examine the pomological characteristics of the peach fruits from “Cresthaven” cultivar, from Rosoman, Republic of Macedonia. The fruits are being collected in full technological maturity. The following characteristics have been determined: height, width and thickness of the fruit (using a caliper with an accuracy of 0.01 mm), weight of the fruit and weight of the mesocarp and pit (using an analytical balance with an accuracy of 0.001 g), and the yield is also mathematically calculated. Also, during the research have been conducted an analysis for the presence of heavy metals (Pb, As and Cd) in the fruits (using atomic absorption spectrometer). The research was repeated three times, in a period of three years (2011, 2012, 2013). In the three-year period of examinations, from a statistical point of view, between the calculated values of the examined parameters of the peach fruits there are no statistically significant differences, with the exception of the pit weight and the yield, for which statistically significant differences have been determined. The contents of Pb, As and Cd in the fruits in three-year testing period are in accordance with the applicable rules and prescribed norms for food safety in the Republic of Macedonia.

Key words: peach, pomological characteristics, heavy metals.

INTRODUCTION

The peach is one of the most widespread fruits in the world because of its specific pleasant taste, juiciness and nutritional values. The peach, along with the cherries, sour cherries, plums and apricots, belongs to the group of stone fruits (Kantoci, 2008; Jašić, 2007). Peach originates from China, and today is being cultivated in warm temperate regions of Europe, Asia, North America, parts of Africa and Australia. Peach fruits can be consumed fresh and processed in different ways (Mratinić, 2000).

According to the systematic classification, the peach fruit belongs to the family *Rosaceae*, subfamily *Prunoideae*, genus *Prunus*, with a greater number of species (Bulatović-Danić, 2007). Known varieties:

‘Springtime’, ‘Suncrest’, ‘Springold’,
‘Sprincrest’, ‘Redtop’, ‘Redhaven’,
‘Cresthaven’ and other (Kantoci, 2008).

The fruit of the peach is big, usually with a round shape, juicy, with a pleasant sweet-sour taste and specific aroma. From the total weight of the fruit, which ranges from 80 to 250 g (sometimes more), the part that can be consumed amounts 93 to 98% (Mratinić, 2000). It is known that the peach fruit contains carbohydrates, organic acids, pigments, phenolic compounds, antioxidants and traces of proteins and lipids. It is a rich source of potassium, iron, fiber, vitamin A, vitamin C and other vitamins (Crisosto and Valero, 2008; Hajilou et al., 2013).

The natural conditions for the cultivation of peaches in Macedonia are very favorable. With the construction of more factories for fruit

processing, peach became much demanded raw material. The increased interest in this fruit affected the increasing number of peach trees. Thus, from 327.000 in 1970 their number increased in 2010 up to 505.000, and the output was 10.200 tons. The cultivation of peaches is most widespread in the Tikves region, then in the regions of Skopje, Strumica, Radovis, Gevgelija and Kumanovo (Stojmilov and Apostolovska-Toševska, 2016). Different varieties have been cultivated, and one of the most known is the 'Cresthaven' peach cultivar from the region of Rosoman.

The features of the fruits of peach cultivar 'Cresthaven' have been presented by many authors (Mratinić, 2000; Bulatović-Danilović, 2007; Nenadović-Mratinić et al., 2003). This variety has been obtained by complex hybridization. Peach ripens from mid to late August. The fruit is round in shape, firm and belongs to the group of large fruits from 250 g. It features with an average weight of 184 g, length of 6.75 cm, width of 7.41 cm and thickness of 7.56 cm. The main color of the exocarp which is yellow is complemented with red color, which covers most of the surface of the fruit (50-60%). The mesocarp is yellow, juicy, firm, tasty and of high quality. The pit can be easily removed from the fruit's flesh. Peaches can handle transportation. Fruit fresh include: 13.12% soluble dry matter, total sugars 10.43% and 0.60% total acids.

The quality of the fruits expressed by their size, appearance and taste, is very important prerequisite for their sale. A review of the fruits should include mechanical, sensorial, chemical and microbiological control, as well as remarks for the variety.

The first remark refers to the type and variety, degree of maturity, the average mass, the fruit size, the percentage of seed in the fruit, the stalk, the petals, husk, etc. Pomological characteristics of the agricultural products are parameters for determining the appropriate standards for assessment, transportation, processing and packaging (Karakasova and Babanovska-Milenkovska, 2012).

According to Crisosto et al. (2004) cited by Milošević and Milošević (2011), the size is a quantitative inherited factor for determination of the yield of fruit, the quality and the acceptability of the consumers.

The fruit is part of the daily diet, so it is very important to know the possible presence of heavy metals in it. The data indicate that heavy metals are pollutants of the fruit and such fruit consumed by humans may pose health risks (Sobukola et al., 2010; Elbagermi et al., 2012; Matei et al., 2013; Chandorkar and Deota, 2013). Lead, cadmium and arsenic are among the most widespread toxic elements present in the food and the environment. They have a long half-life after absorption in humans and animals, which can cause unpleasant effects such as damage of internal organs, nervous system, kidneys, liver and lungs (Ghazanfarirad et al., 2014).

Considering the previously mentioned, we consider that the data obtained in this examination will be of interest for the manufacturers, as well for the consumers, too. The obtained data will define the pomological characteristics of the peach fruits of the cultivar 'Cresthaven', available in the market, and at the same time will bring awareness for the presence of heavy metals in them, which is very important from a health point of view.

MATERIALS AND METHODS

The peach fruits of the cultivar 'Cresthaven', cultivated in Rosoman, Republic of Macedonia, have been used as a testing material. The fruits are collected in full technological maturity. For analysis have been taken 50 healthy fruits without major and average weight of the fruit, mesocarp and pit, using analytical balance with an accuracy of 0,001 g, average fruit sizes (height, width and thickness), using a caliper with an accuracy of 0,01 mm, have been determined. The fruits have been examined in the Laboratory for fruit and vegetables processing at the Faculty of Agricultural Sciences and Food in Skopje, Republic of Macedonia. The yield is mathematically calculated. The mass ratio between the useful part and the part that is not used, expressed as a percentage represents the yield (Karakasova, 2011). The contents of As, Pb and Cd have been determined at the Institute of Food at the Faculty of Veterinary Medicine - Skopje using atomic absorption spectrometry according SOP 392. The research was repeated three times, in a period of three years.

The results of the examination are presented, analyzed and statistically processed using the computer program Microsoft Excel and the statistical package SPSS Statistics Version 19.

RESULTS AND DISCUSSIONS

The results from the research of the pomological characteristics of fruits of peach cultivar ‘Cresthaven’ are presented in tables (Table 1) and graphics (Figure 2).

The results represent mean values obtained from analysis of the fruits used in each production year (2011, 2012, 2013).

Analyzed fruits of peach variety of ‘Cresthaven’ (Figure 1) are characterized with features inherent for the type and variety (Bulatović-Danilović, 2007).

The fruit is big, solid and round shape. The surface is yellow, complemented by red color. The mesocarp is yellow with redness around the pit, which can be easily split (Vuletić, 2016). The smell is pleasant and the taste is sweet.



Figure 1. Peach cultivar ‘Cresthaven’

In Table 1 are shown the obtained mean values for mass and dimensions for the peach fruits from the variety ‘Cresthaven’, and the obtained mean values for the mass of the mesocarp and of the pit and the yield calculated.

The mass of the fruit is one of the major pomological features, which largely affects the yield (Nikolić et al., 2013). Based on the obtained values for the average mass of the fruits in the three year period (from 169.08 ± 26.99 to 174.24 ± 44.39 g), it can be concluded that this variety is characterized with large fruits (150-200 g) (according to Mratinić, 2012 quoted Vuletić, 2016). The high standard deviation value of mass clears good selection of samples.

Table 1. Pomological characteristics of fruits of peach cultivar ‘Cresthaven’ in 2011, 2012, 2013

Year	Analyzed parameters	n	\bar{x}	SD	<i>p</i> -value		
					2011	2012	2013
2011	Mass of the fruit (g)	50	174.24	44.39		0.586	0.489
	Height of the fruit (cm)	50	6.30	0.55		0.521	0.592
	Width of the fruit (cm)	50	6.87	0.60		0.942	0.686
	Thickness of the fruit (cm)	50	6.68	0.61		0.091	0.930
	Mass of the mesocarp (g)	50	166.24	42.79		0.456	0.413
	Mass of the pit (g)	50	5.68	1.73		0.001**	0.001**
	Yield (%)	50	95.35	0.46		0.000**	0.000**
2012	Mass of the fruit (g)	50	170.18	38.17	0.586		0.883
	Height of the fruit (cm)	50	6.36	0.44	0.521		0.915
	Width of the fruit (cm)	50	6.88	0.54	0.942		0.634
	Thickness of the fruit (cm)	50	6.87	0.59	0.091		0.109
	Mass of the mesocarp (g)	50	160.90	36.40	0.456		0.941
	Mass of the pit (g)	50	6.74	1.83	0.001**		0.940
	Yield (%)	50	94.52	0.30	0.000**		0.000**
2013	Mass of the fruit (g)	50	169.08	26.99	0.489	0.883	
	Height of the fruit (cm)	50	6.35	0.43	0.592	0.915	
	Width of the fruit (cm)	50	6.83	0.41	0.686	0.634	
	Thickness of the fruit (cm)	50	6.69	0.49	0.930	0.109	
	Mass of the mesocarp (g)	50	160.37	25.88	0.413	0.941	
	Mass of the pit (g)	50	6.76	1.22	0.001**	0.940	
	Yield (%)	50	94.83	0.33	0.000**	0.000**	

n - number of examined fruits; \bar{x} - average value; SD - standard deviation; p - statistical significance, * Significant differences at the significance level of 0.05 ($p < 0.05$); ** Significant differences at the significance level of 0.01 ($p < 0.01$).

Lower values for mass of the peach fruits from the cultivar ‘Cresthaven’, cultivated in different locations in Serbia in the period 2000-2003

were found by Zec et al. (2003). The authors found that the mass of the fruits of this variety cultivated at Padinska Skela has average values

ranged from 59.90 g to 110.60 g, and at Grocka location from 57.30 g to 126.00 g.

The following mean values expressed in cm for height, width and thickness of the fruit in each of the years vary from 6.30 ± 0.55 to 6.36 ± 0.44 , from 6.83 ± 0.41 to 6.88 ± 0.54 and from 6.68 ± 0.61 to 6.87 ± 0.59 . From Table 1 can also be determined that the mass of mesocarp is from 160.37 ± 25.88 to 166.24 ± 42.79 g, and the pit mass from 5.68 ± 1.73 to 6.76 ± 1.22 g. The calculated values of the yield are ranging from 94.52 ± 0.30 to $95.35 \pm 0.45\%$.

A comparison of the results from the examinations of the peach fruits from the cultivar ‘Cresthaven’, by years, indicates the existence of certain differences in the calculated values of the examined parameters. With statistical analysis it has been determined their significance (Table 1).

In terms of mass of fruits in each of the years under examination, it can be concluded that in 2012 and 2013 were obtained lower values (170.18 g and 169.08 g) compared to 2011 (174.24 g). With the statistical analysis of the data it has been determined that these differences are not statistically significant ($p > 0.05$).

In terms of height (6.30 cm, 6.36 cm, 6.35 cm) and width (6.87 cm, 6.88 cm, 6.83 cm) of fruits it was found that the differences between the values obtained for this period are not statistically significant ($p > 0.05$).

Small differences in the values obtained have been determined for the thickness of the fruit in 2011, 2012 and 2013 (6.68 cm, 6.87 cm, 6.69 cm), also confirmed by a statistical standpoint ($p > 0.05$). Also, there were identified some variabilities in values obtained for mass of mesocarp, which proved that there was no statistically significant difference ($p > 0.05$).

For pit mass of the fruits have been obtained approximations in 2012 and 2013 (6.74 g, and 6.76 g). The little difference which occurs in the values obtained for this parameter is not statistically significant ($p > 0.05$). In terms of pit mass of the fruits in 2011 it has been determined that it is smaller (5.68 g) than the mass of pit in 2012 and 2013. Statistical analysis of the data has shown that differences which occur between the values of pit mass in 2011 and 2012 and between 2011 and 2013 are statistically significant ($p < 0.01$).

The yield is closely connected with the mechanical composition of raw materials (Niketić-Aleksić, 1994). The differences which appeared in the pit mass of fruits affected the obtained values of the yield. Statistical analysis of the results for the yield of fruits has shown statistically significant differences ($p < 0.01$).

From Figure 2 it can be concluded that the average mass of the fruits from the cultivar ‘Cresthaven’ for the three year period is 171.17 g, height 6.34 cm, width 6.86 cm, and thickness of 6.75 cm. The average mass of the fleshy interior is 162.50 g, the average pit mass is 6.39 g, and the yield 94.90%.

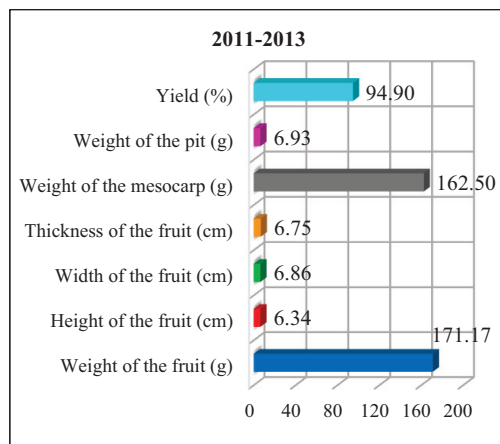


Figure 2. Pomological characteristics of fruits of peach cultivar ‘Cresthaven’ for all three years

Compared with the results obtained from our research, lower values for the same parameters are presented by Zec et al. (2003). Namely, the three-year research period of peach fruits from the cultivar ‘Cresthaven’ it has been determined that in average they are characterized by a mass of 92.8 g, a height of 5.41 cm, a width of 5.67 cm and a thickness of 5.37 cm. Higher average mass value (117.00 g) is determined by the same author in 2005 in a two-year examination of the peach fruits from the cultivar Cresthevn cultivated at the locations of Mislodzhin and Padinska Skela, but this average value is lower than the value obtained from our determinations.

Contrary to previous results Nenadović-Mratinić et al. (2003) for the tested parameters have evidenced slightly higher average values of the values obtained from our research. In seven years period of examining peach fruits

from the cultivar 'Cresthaven' they have concluded that this variety of peach fruits is featured with a mass of fruit of 184.00 g, a length of 6.75 cm, a width of 7.41 cm, thickness of 7.56 cm, mass of pit 8.09 g and yield of 95.60%.

Differences between the results obtained from the research and the previously mentioned bibliography data are expected, because, although it is a fruit of the same variety of peach, the conditions under which it has cultivated are different.

Heavy metals are defined as metals whose specific density is greater than 5 g/cm³. They affect human health through pollution of the environment and through the food, mainly through the fruits and vegetables cultivated in soil that has been contaminated. These include: arsenic, cadmium, chromium, copper, lead, nickel, zinc, molybdenum and vanadium (Islam, 2013).

During the research it has been conducted an analysis for the presence of Pb, As and Cd in the fruits of the cultivar 'Cresthaven'. The obtained results of the conducted analyzes in the three years of testing are shown in Table 2.

Table 2. Content of Pb, As and Cd in peach fruits of the cultivar 'Cresthaven' (2011, 2012, 2013)

Heavy metals	Pb mg/kg (L)	As mg/kg (L)	Cd mg/kg (L)
Year			
2011*	0.008	0.000	0.000
2012*	0.021	0.000	0.006
2013**	0.023	<0.001	0.002

*According to Regulation on general requirements for food safety (Official Gazette of RM No.118/2005).

** According to Regulation on the general requirements for food safety in relation to the maximum levels of certain contaminants (Official Gazette of RM No.102/2013).

From the submitted results it can be found that in the three years of examining the content of Pb, As and Cd in the peach fruits from the cultivar 'Cresthaven' is in accordance with the prescribed standards for food safety (Regulation on general requirements for food safety, Official Gazette of RM No.118/2005; Regulation on the general requirements for food safety in relation to the maximum levels of certain contaminants, Official Gazette of RM No.102/2013).

CONCLUSIONS

Based on three-year research period for the peach fruits of the cultivar 'Cresthaven' cultivated in Rosoman, Macedonia can be concluded that they were characterized by features inherent for their type and variety.

From a statistical point of view between the calculated values of the tested parameters there are statistically significant differences between the years of testing, in terms of pit mass and the yield.

From the calculated values for the content of Pb, As and Cd in fruits in the three years of testing it can be concluded that they are in accordance with the prescribed standards for food safety and are safe for consumption.

It is expected that the results obtained will find applications for the primary producers and direct consumers, which will increase the placement of this kind of fruit in the domestic and foreign market.

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