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Basic physico-chemical parameters of the fruits of some late sweet cherry cultivars, with sustainable cultivation technology

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Abstract

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The study was conducted in the period 2018-2020 in RIMSA Troyan. The experiment included 12 trees of the sweet cherry cultivars Regina, Kordia, Octavia, Sylvia, Lapins and Suite Hard. The aim is to determine and compare the physicochemical properties of fruits in order to assess their nutritional value. Octavia fruits (7 to 9 g; 22.50/18.13 mm) have been found to have the largest mass and largest, with Regina and Cordia having the smallest mass, but they have the highest content of total sugars. The high level of total polyphenols in cherries suggests that they may be sources of bioactive compounds that are important for human health. We have reason to recommend all analyzed sweet cherry cultivars as those with high nutritional qualities.

Keywords: sweet cherry, cultivars, fruit quality, correlation coefficients

Introduction

Sweet cherry is one of the most popular fruits of the temperate climate zone. In many areas, sweet cherries are the first fresh fruit of the season, consumed mostly fresh, untreated (Usenik, 2008; Hajagos, 2012). Fruit size and biologically active nutrient content affect consumer market demand. The taste is influenced by some chemical compounds such as sugars, organic acids, phenolic compounds, but depends primarily on the content of sugar and acids and more precisely the balance between them (Hajagos, 2012). Physico-chemical characteristics and organoleptic properties vary depending on the cultivar, environmental conditions and agricultural practices. Ouaabou (2020) observed significant differences ($p < 0.05$) in fruit weight (5.24–8.72 g), geometric mean diameter (14.22–16.36 mm), soluble solids content (17.70–24.50°Brix), total phenols (426, 44–485.69 mg GAE/100 g fresh weight (fw)) and total anthocyanins (194.53–267.67 mg cya-3-glu/100 g fw) in five cultivars. Some of these results correspond to our study. The polyphenolic composition of the fruit determines the antioxidant activity, in proportional dependence: samples richer in phenolic content (especially anthocyanins, phenols) show greater antioxidant activity Ouaabou (2020). Ballistreri et al. (2013) reported an anthocyanin content of 6.21 to 94.20 mg/100 g and a total phenol content of 84.96 to 162.21 mg/100 g gallic acid equivalents. According to them, the analysis of the absorption capacity of oxygen radicals (ORAC) shows that fruits of all genotypes have significant antioxidant activity. The high level of phenolic compounds and the antioxidant capacity of some sweet cherry fruits suggest that they may be sources of bioactive compounds that are important for human health.

The cultivars of cherries studied by us have medium and late ripening, suitable for mountain growing conditions, which makes it possible to extend the period of fresh fruit for the market.

The aim is to determine and compare the chemical composition of the fruits of six varieties of cherries to assess their nutritional value.

Material and Methods

The study was conducted in the period 2018-2020 in RIMSA Troyan. The experiment included 12 trees of the cultivars Silvia, Octavia, Kordia, Regina, Lapins, Sweet heart, refined on a seed rootstock Alkavo. The climatic conditions for the foothills are characterized by moderately cool winters and dry but not very hot summers. The altitude is 380 m, the terrain is inclined from 5 to 8°.

The trees are grown using sustainable technology and the corresponding plant protection adopted by the RIMSA Troyan, keeping the soil surface grassy, without irrigation, without additional fertilization. Each cultivar is a variant represented by an average sample of 30 fruits at harvest maturity.

The following indicators were registered:

1. Biometric (physical) characteristics of fruit (Nedev, 1979):
- Fruit weight (g);

Small – up to 4 (g), Average 4.0-5.5 (g), Large over 5.5 (g)

- Stone weight (g);
- Height (mm); • Diameter (mm); • Stalk length (mm);

2. Chemical composition of fresh plum fruit;
- Dry matter (DM) according to (refractometer) Re (%);
- Determination of sugars (total, invert and sucrose) and acid, according to the method of Schoorl (Donchev et al., 2001),
- Tanning substances according to the method of Leventa l (Donchev et al., 2000),
- Anthocyanins (mg /%) according to the method of Fuleki & Francis (1968),
- Total polyphenols (mg GAE/100g FW) – according to Singleton & Rossi (1965)

The experimental data were subjected to statistical analysis by Fisher's single-factors ANOVA. The significance of differences between the mean values of the factors and the interaction means was determined by LSD test at significance levels of $P \leq 0.05$.

Fruits were determined at the laboratory of RIMSA Troyan.

Results and Discussion

The main biometric indicators of the cherry cultivars were measured: Silvia, Octavia, Kordia, Regina, Lapins, Sweet heart. For 2018 and 2020, the highest value for fruit weight was reported for the Octavia cv (8.81 g and 6.68 g), where the relative share of stone in relation to fruit flesh is the highest (0.30%). For the other cultivars, the average fruit weight for 2018 is (5.42 g), with the highest stone weight be-

Table 1. Biometric indicators of fruits by cultivars (2018-2020)

	Fruit weight, g	Stone weight, g	Relative share of stone, %	Height, mm	Diameter, mm	Fruit stalk length
2018						
Silvia	5.76	0.24	0.24	21.11	22.33/18.89	25.71
Octavia	8.81	0.29	0.30	20.38	22.50/18.13	43.29
Kordia	5.03	0.24	0.21	22.00	22.14/19.17	34.50
Regina	5.54	0.34	0.16	21.40	21.80/18.60	44.50
Lapins	5.45	0.30	0.18	21.11	18.70/21.11	43.33
Sweet heart	5.33	0.44	0.12	20.33	20.00/18.67	34.71
2019						
Silvia	7.26	0.40	0.18	22.36	20.55/23.96	27.15
Octavia	6.60	0.38	0.17	21.26	22.17/18.59	38.10
Kordia	6.40	0.33	0.19	22.70	22.98/19.56	36.32
Regina	5.90	0.40	0.15	21.28	21.72/19.18	43.98
Lapins	5.58	0.36	0.16	20.77	21.37/18.71	38.08
Sweet heart	7.70	0.44	0.18	22.21	25.00/21.30	28.79
2020						
Silvia	5.37	0.36	0.15	21.34	23.84/19.68	28.16
Octavia	6.68	0.41	0.16	21.55	24.33/20.13	45.13
Kordia	5.06	0.33	0.15	21.08	21.76/18.52	37.00
Regina	5.02	0.40	0.13	22.03	21.86/18.79	48.02
Lapins	5.58	0.45	0.12	21.14	23.05/19.46	48.05
Sweet heart	6.30	0.37	0.17	21.47	23.94/21.21	27.16
LSD=0.05	0.53	0.05		0.76	0.70	2.51

ing the Regina cultivar (0.34 g) and the smallest the Cordia and Sylvia (0.24 g). The percentage of stone is from 0.12% to 0.24%. This is one of the important characteristics of fresh cherry fruit. The average ratio determined by Ouaabou et al. (2020), varies between 11.08 and 21.59, for Turkish cultivars varies from 17.70 to 20.73. In our experiment, the values are in the widest range from 12 to 30 (0.12 to 0.30%) (Table 1).

In 2019, the largest weight of Sweet heart fruit is 7.70 g, followed by Sylvia 6.68 g. The average weight of the stones in all variants is higher compared to 2018, and the relative share of the stone is 0.16%. The cultivars Regina and Kordia have a lower fruit weight compared to the other studied cultivars and a respectively lower stone weight. The height of the fruit in the studied cultivars is in the range of 20.33 mm in Sweet heart to 22.00 mm in Kordia (2018). For 2019 it is in the range of 22.21 mm for Sweet heart to 22.36 mm for Sylvia. The fruits are smaller at cv Lapins (18.70/21.11 mm for 2018 and 21.37/18.71 mm for 2019), and larger at cultivar Sylvia (22.33/18.89) and cv Octavia (22.50/18.13 mm). For 2020, the fruits of the Kordia cultivar are smaller (21.76/18.52 mm) and the Octavia fruits are larger (24.33/20.13). A significant difference was observed in the length of the stalk, as for the three years of the study the smallest length was Sylvia cv (25.71 – 28.16 mm), the largest cv Regina (44.50 – 48.02 mm) (Table 1).

A chemical analysis of fresh fruits of cherry cultivars was made: Sylvia, Octavia, Kordia, Regina, Lapins Sweet heart. In our study, largely the highest percentage of total sugars were reported in 2019, with Regina (10.9%) (Figure 1). In unison, Hajagos (2012) found the highest content of soluble solids (16.83%) and the content of reducing sugars (7.75% and 7.25% respectively) in Regina and Lapins cultivars, and that the sugar content in Regina fruit is significantly higher than that of Kordia, regardless of the rootstock.

In the cvs Sylvia, Regina, Lapins, Sweet heart, the total sugars are represented entirely by invert sugar, and the lack of sucrose (0%) defines them as a suitable food for diabetics. In 2018 and 2020, total sugars have low values. There is a difference of 7% between the lowest and the highest sugar

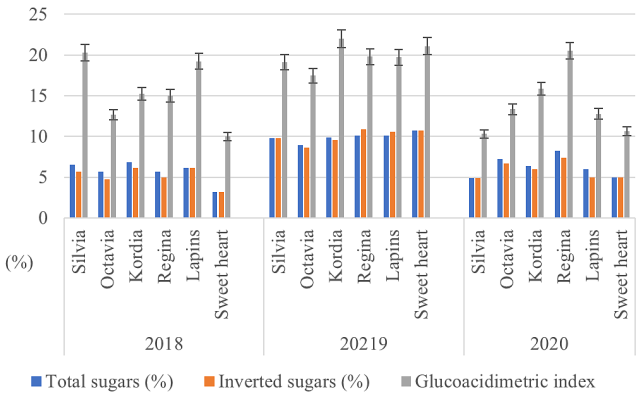

Fig. 1. Glycoacidimetric index of fresh fruits (2018-2020)

content in the fruit, which is due to both climatic factors and the genetic characteristics of the cultivars.

Usenik (2008) determines sucrose 3.57% for Sylvia, as low values, similar to our study, Sylvia cv has 0% sucrose in 2019 and 2020. A glycoacidimetric index (ratio between sugars and acids) was determined, the highest value of which was in the fruits of the Kordia cultivar (22.0%), followed by Sweet heart (21.1%) and Regina (19.7%) for 2019 (Figure 1). According to Stanchev (1968), in the case of stone fruits, values of glycosacity between 18 and 20% are considered to be a balanced fruit taste. The lowest index is in cv Octavia (17.5%). For the entire study period, the lowest values of the coefficient were found for Sweet heart (about 10%).

The highest percentage of dry matter, on average for the period (2018-2020) was reported for the varieties Regina and Lapins (16.83%). With Sweet heart the value of the indicator is the lowest (14.63%), with a confidence level of LSD 0.05 = 30.26

The amount of anthocyanins in our study varied on average over 3 years from 4.36 mg% in Sylvia cultivar to 6.86 mg% in Octavia (Table 2), while in Ballistreri et al. (2013) anthocyanins are in a very wide range from 6.21 to 94.20 mg%.

The total polyphenols in our country range from 140.85 mg/g in Octavia to 167.36 mg/g in Lapins (Table 2), Ballistreri et al. 2013 indicates (84.96 – 162.21 mg 100 g equiva-

Table 2. Biologically active substances (average 2018-2020)

	Soluble solids, %	Tanning substances, %	Anthocyanins, mg/%	Total polyphenols, mg/g
Silvia	15.83	0.06	4.36	162.39
Octavia	15.10	0.06	6.86	140.85
Kordia	15.33	0.07	6.29	161.34
Regina	16.83	0.09	6.53	166.96
Lapins	16.83	0.11	4.52	167.36
Sweet heart	14.63	0.07	5.08	152.68
LSD (p = 0.05)	30.26	0.03	3.42	34.32

lents of gallic acid FW), and Ouaabou et al. (2020) in Morocco from 426.44 to 485.69 mg GAE/100 g FW, probably due to the best possible fruit heating, depending on the geographical region.

Through correlation analysis in ANOVA McSoft Excel, we examined pairs of variables of the measured indicators to determine whether both variables tend to change simultaneously. A positive correlation with a Pearson's correlation coefficient (p-value <0.5) was found, between the dry matter content and invert sugar, at a coefficient r = 0.846968, corresponds to the function y = 0.5145x + 2.7444, with a coefficient of regression $R^2 = 0.7174$, which gives us an idea of the presumed invert sugars, relative to the dry matter measured refractometrically (Figure 2).

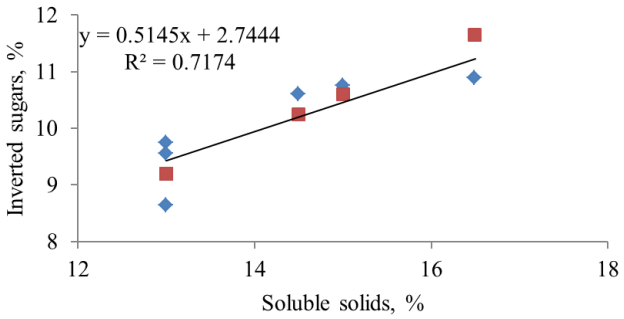

Fig. 2. Correlation dependence, among soluble solids content, and invert sugars

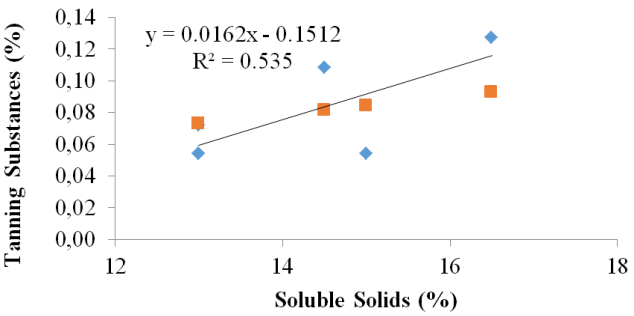

Fig. 3. Correlation dependence, among soluble solids content and tanning substances

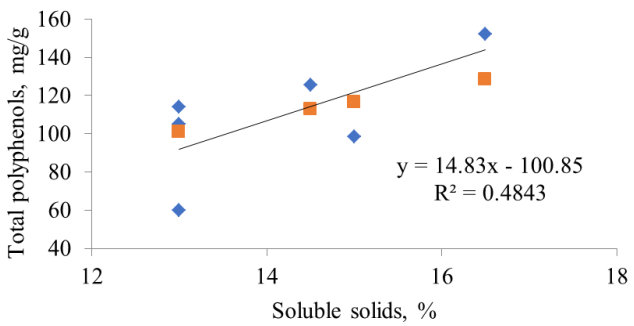

Fig. 4. Correlation dependence, among soluble solids content and Total polyphenols

Other similar links of practical importance are those between dry matter and tanning substans and between dry matter and total polyphenols. Figure 3 and Figure 4 show the mathematical model, and the functions by which the values of the variable can be determined.

Conclusions

Octavia fruits have the largest mass and the largest (7 to 9 g; 22.50/18.13 mm), Regina and Kordia have the smallest mass, and the Lapins cultivar is the smallest.

The fruits of the Regina and Kordia cultivars have the highest content of total sugars. Anthocyanins, tannins and total polyphenols vary by year, depending on varietal characteristics, climatic factors and care during the growing season.

The high level of total polyphenols in sweet cherry fruits suggests that they may be a source of bioactive compounds that are important for human health. The obtained results give us reason to recommend all analyzed cultivars as those with valuable nutritional qualities.

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