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# CHEMICAL AND TECHNOLOGICAL CHARACTERISTIC OF PLUM CULTIVARS OF *Prunus domestica* L.

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## Abstract

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During the period 2015-2016 the chemical composition was investigated and some biometric parameters were studied in fresh fruit of 8 plum cultivars in an experimental plantation of RIMSA, in the vicinity of the town of Dryanovo. 'Stanley' cultivar was used as a standard. The other cultivars included in this study are: 'Malvazinka', 'Green Renclode', 'Tegera', 'Hanita', 'Jojo', 'Čačanska Najbolja' and 'Čačanska rodna'. 'Malvazinka' is distinguished by the largest and most beautiful fruits – 48.88 g (2015), while the smallest fruit is found in 'Čačanska rodna' (16.06 g – 2015). For most cultivars, the relative share of the stone from the full weight of the fruit is higher in 2016, which we believe is due to the soil and climate conditions in the area. For 'Hanita' and 'Stanley' the stone is over 6% of the weight of the fruit. The fruits of the early cultivar 'Tegera' are distinguished with high content of dry matter – 24.3%/ 2015/, followed by 'Jojo' – 23.9%. The highest total sum of sugars is found in 'Stanley' (14.46%), followed by 'Tegera' – 14.01%. Regarding the content of organic acids, the fruits of 'Stanley' have the lowest content in both years. Tanning substance content ranges from 0.093% for 'Malvasinka to 0.451% for 'Stanley'.

'Stanley' cultivar shows the best chemical and technological indicators of fresh fruit in the conditions of Dryanovo, followed by 'Tegera'.

*Key words*: Prunus domestica; fresh fruits; chemical composition

## Introduction

The economic importance of plums of genus Prunus is great due to the wide use of their fruits in the food industry. The greatest economic significance has cultivars of Prunus domestica L. – home plum (Zhuvinov et al., 2012). They are used for fresh consumption, for drying and processing in compotes, nectars, jams, preserves, for baby foods; for freezing, etc. (Velkov et al., 1970; Zhuvinov et al., 2012; Iliev 1988)

The chemical composition of fresh plums determines to a great extent their taste and technological qualities. It changes and depends on the conditions of the environment, the cultivar characteristics and the soil and climate conditions (Velkov et al., 1970; Frayman et al., 1969). Plum fruits have a dry matter content of 9.6% to 31%. The total amount of sugar in plums grown in Moldova is on average about 11% and the content of acids, mainly malic, ranges from 0.50% to 1.43% (Frayman et al. 1969).

It is found from our previous research (Dimkova, 1996; 2003 and Vitanova et al., 2010) conducted in Dryanovo with other plum cultivars, that 'Mirabelle de Nancy' contains the highest dry matter (23.13%) and the highest total sugar content (15.36%). Iliev and Shtarkova (1995) studied 25 plum cultivars and found that the dry matter was in the range of 15.76% ('Opal') to 24.50% ('Izobilie'). 'Green Renclode' cultivar showed the following results: dry matter – 23.79%; organic acids – 0.97% and total sugars – 12.91%. Stefanova (2010), has found a high content of organic acids in 'Hanita' and 'Jojo'

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cultivars. These cultivars have been included in this study to establish the chemical composition of fresh fruit under the conditions of Dryanovo.

Regarding the possibilities for processing of plums, Velkov et al., (1970) consider that the cultivars with high-quality fresh fruits have also good quality processed products. The most suitable for processing into dried fruit are cultivars with high content of dry matter and high sugar content. An important indicator of cultivars for processing is the colour of fresh fruit, as fruits with dark blue color are preferred. Also, the degree of technological maturity of the fruit has its influence in processing as plums are not harvested in full maturity, but in technological – for processing in compotes and jam. Iliev (1988) found that the best fruit-filled compotes are obtained from 'Stanley', 'Green Renclode', and 'Pozhegacha' cultivars under the conditions of the Dryanovo region.

The purpose of the present study is to compare some biometric indicators of 8 plum fruit cultivars and to study their content of dry matter, sugars, acids and tanning substances under the conditions of the Fore-Balkan as a guide for the direction of their use.

## Material and Methods

The surveys were conducted in the period 2015-2016 in the Branch of the Research Institute of Mountain Stockbreeding and Agriculture in the town of Dryanovo, at an altitude of 308 m. The experimental trees were planted in the spring of 2008 on pseudopodzolic gray forest soil, at distances of 5x4 m and rootstock of yellow cherry plum in 4 replications. The plantation is grown under non-irrigating conditions.

In this study are included the following eight cultivars of home plum: 'Stanley' (control), 'Malvazinka', 'Green Renclode', 'Tegera', 'Hanita', 'Jojo', 'Čačanska Najbolja', 'Čačanska rodna'. All trees are grown on the same agricultural background.

Average fresh fruit samples of 3kg for chemical analysis were randomized during the fruit's maturity.

The observation of the chemical composition of fresh fruits includes:

• dry matter, determined refracometrically;

• sugar content - according to the method of Bertran and Kolthoff (Stanchev et al., 1968);

• organic acids as malic, titrimetric method with 0.1 n NaOH;

• tanning and colouring substances – according to Neubauer – Löwenthal (Ermakov et al., 1972).

The biometric measurements of fruits are carried out according to the Methods for Studying Plant Resources in Fruit Orchard Cultivars (Nedev et al., 1979).

Statistical data processing was performed using the ANOVA program with LSD test at $\alpha = 0.05$.

## Results and Discussion

The climate conditions during the period of plum vegetation (from March to October), in different years, are presented in Fig. 1. Temperatures and precipitation have a significant impact on fruit growth, vegetative growth and the chemical composition of fruit. With regard to the monthly rainfall, it can be seen that they are unevenly distributed during vegetation, especially pronounced in 2016. The rainfall sum was over 130 l/m$^2$ in May 2016 and in July of the same year when the fruits were growing intensively, it was minimal – 7.4 l/m$^2$. In 2015, the rainfall amount per month is more evenly distributed, but there was the lowest rainfall amount in July – 34.7 l/m$^2$.

With regard to the average monthly temperatures, it can be seen from Fig. 1 that there are no significant differences in the two years of the survey. The highest temperatures in the region were found in July – 24.6°C (2015) and the lowest in March, when was the beginning of the vegetation – 5.9°C (2015).

We found significant differences in this study, between cultivars in terms of sizes and weight of fruit and stone. These differences are due to the cultivar peculiarities and the response of the trees to the growing conditions during the two years of the survey. The results of the biometric measurements of fresh fruit are presented in Table 1.

It is clear from data in Table 1 that 'Stanley' and 'Malvazinka' have the highest height of the fruit (44.05 mm) and 'Green Renclode' has the lowest height – 26.99 mm (2016). The fruit width varies from 28.38 mm (2015) for 'Čačanska rodna' to 43.46 mm for 'Malvazinka' (2016). The fruit thickness is more than 30 mm, as only 'Čačanska rodna' is below these parameters (2015). The largest thickness of fruit we found for 'Malvazinka' – 44.46 mm (2015).

As regards the fruit weight, the cultivars differ substantially. 'Malvazinka' is the cultivar with the largest fruit size (48.88 g - 2015). Next to it is 'Green Renclode' with 36.54 g, and 'Čačanska rodna' has the smallest fruit weight (Table 1).

The fruit stone weight is an important indicator, especially in the processing of plum fruits. In the studied cultivars, the highest stone mass – 1.86 g is found in Stanley, followed by 'Jojo' (1.69 g). Fruits of 'Čačanska rodna' has the smallest stone weight and in both years of the present study. Differences were demonstrated at $\alpha = 0.05$.

The relative share of the stone from the fruit weight is a

very important indicator in the processing of plums. According to Velkov et al. (1970) this share is from 2.36% to 5.79% for individual cultivars. In the present study we found that the share of the stone was over 6% in 'Hanita' and 'Stanley' (2016). The lowest share of the stone was found in 'Malvazinka' – 2.33% (2015).

The taste of plums and their technological qualities depend on the beneficial substances contained in them - sugars, acids, tannins and colouring substances, vitamins and others. The results of the chemical composition of fresh fruit in 8 cultivars are presented in Table 2.

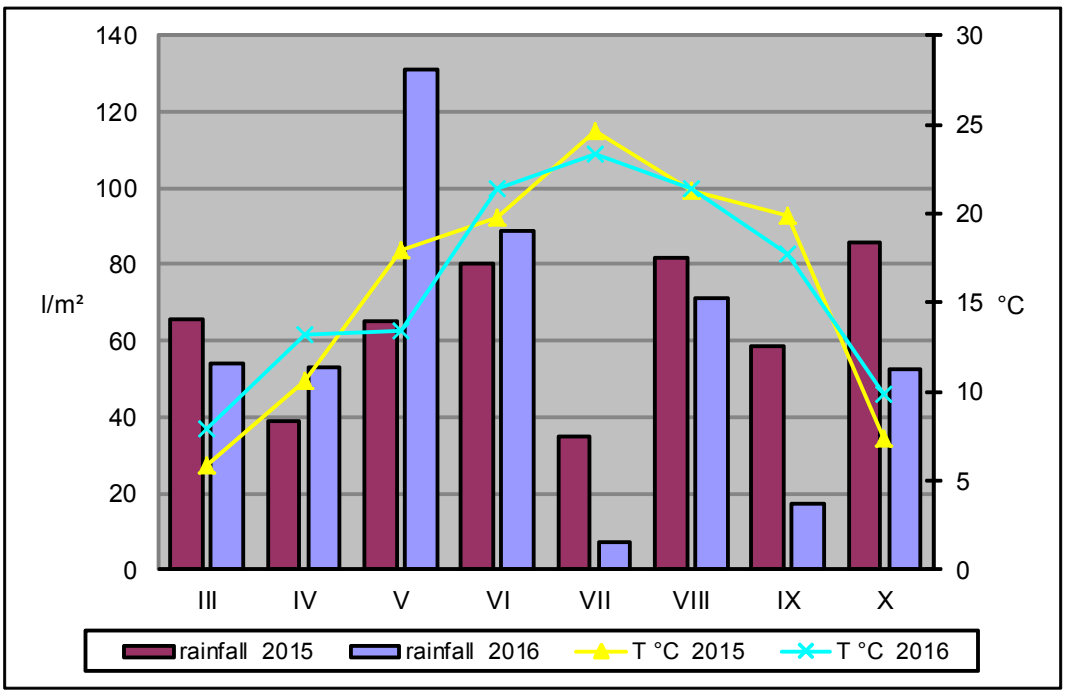


**Fig. 1 Meteorological data for the region of Dryanovo – 2015-2016**

It can be seen in Table. 2 that the dry matter of the cultivars tested is in the range of 18.9% for 'Čačanska Najbolja' (2016) up to 24.3% (2015) for 'Tegera'. 'Jojo', 'Čačanska rodna', 'Hanita', 'Malvazinka', 'Green Renclode' showed dry matter with more than 20%, which exceeded the control – 'Stanley'.

The content of total sugars (glucose, fructose and sucrose) is of great importance for the taste properties of the fruits. The high sugar content in plums is the basis for obtaining a higher yield, both in drying and in other types of processing. Table 2 shows that 'Stanley' ranks first according to this indicator (14.46%, 2016), followed by 'Tegera' – 14.01% (2015). During the two-year study, 'Čačanska Najbolja' and 'Čačanska rodna' are distinguished by low-sugar content (10.08%-10.48%). From the above results, it can be assumed that 'Stanley' and 'Tegera' will be suitable for the production of dried fruit.

The lowest content of organic acids, such as malic, in plum fruits was found for 'Stanley', followed by 'Green Renclode' (0.81% and 0.90%, respectively). It is generally known that the very high and very low acid content in plum fruits degrades the quality of their products. The highest acid content is found in 'Hanita' (1.63%), which confirms the results of Stefanova (2010).

Miloshevic et al. (2012) also found the highest content of soluble solids, titratable acids and sugars in fruits of 'Hanita', while the highest values of the ratio of total sugars and acidity were observed in 'Katinka'. From the results obtained, it can be assumed that 'Hanita' is not a suitable cultivar for dried fruit.

A very important indicator of the taste properties of the fruit is the ratio of total sugars to acids. This ratio ranges in plums from 3 to 35, and the average is about 12 -Velkov at all.

**Table 1. Biometric measurements of fresh fruit in 2015 and 2016.**

| Sort / Year | Stanley | Malva zinka | Green Renclode | Tegera | Hanita | Jojo | Cacanska najbolja | Cacanska rodna | LSD α=0,05 |
|---|---|---|---|---|---|---|---|---|---|
| Height (mm) | | | | | | | | | |
| 2015 | 41.66 | 44.05 | 39.18 | 42.6 | 38.83 | 46.78 | 41.21 | 37.58 | 2.41 |
| 2016 | 44.05 | 41.86 | 26.99 | 40.75 | 38.18 | 42.98 | 42.56 | 40.96 | 1.97 |
| Width (mm) | | | | | | | | | |
| 2015 | 31.88 | 42.92 | 39.51 | 34.05 | 31.08 | 33.88 | 35.21 | 28.38 | 2.17 |
| 2016 | 35.37 | 43.46 | 29.77 | 32.56 | 32.46 | 35.32 | 38.25 | 32.07 | 2.02 |
| Thickness (mm) | | | | | | | | | |
| 2015 | 32.52 | 44.46 | 38.99 | 36.15 | 31.36 | 37.4 | 36.49 | 29.26 | 1.95 |
| 2016 | 34,64 | 40.27 | 30.64 | 31.18 | 30.67 | 33.07 | 35.54 | 31.49 | 2.01 |
| Fruit weight (g) | | | | | | | | | |
| 2015 | 24.43 | 48.88 | 36.42 | 27.64 | 21.88 | 33.16 | 33.06 | 16.06 | 3.79 |
| 2016 | 29.45 | 41.91 | 36.54 | 23.76 | 23.51 | 28.74 | 31.84 | 26.04 | 4,23 |
| Stone weight (g) | | | | | | | | | |
| 2015 | 1.34 | 1.14 | 1.45 | 1.46 | 1.2 | 1.69 | 1.23 | 0.86 | 0.14 |
| 2016 | 1,86 | 1.17 | 1.32 | 1.37 | 1.61 | 1.64 | 1.58 | 1.02 | 0.13 |
| Share of the stone (%) | | | | | | | | | |
| 2015 | 5.48 | 2.33 | 3.98 | 5.28 | 5.48 | 5.09 | 3.72 | 5.35 | |
| 2016 | 6.32 | 2.79 | 3.61 | 5.76 | 6.85 | 5.71 | 4.96 | 3.92 | |

**Table 2. Chemical composition of fresh fruits**

| Sort / Year | Stanley | Malva zinka | Green Ren- clode | Tegera | Hanita | Jojo | Cacanska najbolja | Cacanska rodna |
|---|---|---|---|---|---|---|---|---|
| Soluble solids (%) | | | | | | | | |
| 2015 | 19.7 | 21.2 | 19.3 | 24.3 | 19.8 | 23.9 | 19.5 | 22.3 |
| 2016 | 20.1 | 19.4 | 22.5 | 20.6 | 21.0 | 20.2 | 18.9 | 21.2 |
| Total sugar (%) | | | | | | | | |
| 2015 | 11.15 | 11.50 | 10.85 | 14.01 | 10.16 | 12.46 | 10.08 | 10.48 |
| 2016 | 14.46 | 10.80 | 13.44 | 13.80 | 12.10 | 11.83 | 11.18 | 10.56 |
| Organic acids (%) | | | | | | | | |
| 2015 | 0.81 | 1.14 | 1.05 | 1.03 | 1.63 | 1.16 | 1.05 | 1,38 |
| 2016 | 0.85 | 1.14 | 0.90 | 1.09 | 1.34 | 1.07 | 0.99 | 1.30 |
| Sugar-acid ratio | | | | | | | | |
| 2015 | 13.76 | 10.09 | 10.33 | 13.60 | 6.23 | 10.74 | 9.60 | 7.59 |
| 2016 | 17.01 | 9.47 | 14.93 | 12.66 | 9.03 | 11.06 | 11.29 | 8.12 |
| Tanning and colouring substances (%) | | | | | | | | |
| 2015 | 0.451 | 0.145 | 0.118 | 0.145 | 0.145 | 0.262 | 0.162 | 0.145 |
| 2016 | 0.440 | 0.093 | 0.104 | 0.158 | 0.118 | 0.207 | 0.138 | 0.135 |

(1970). In the present study, this indicator is first in 'Stanley', followed by the 'Green Renclode' and 'Tegera' (2016). For most cultivars, this ratio is lower in 2015 compared to 2016 (Table 2). The lowest sugar/acid ratio is found in 'Hanita' /6.23 – 9.03/.

Concerning the content of tannins and colouring substances, the results of Table 2 show that their highest content was in the case of 'Stanley' during both years of the study (0.440% - 0.451%) and at the second place was 'Jojo' (0.207% - 0.262%). The lowest results of that indicator are for 'Malvazinka' – 0.093%.

## Conclusions

From the study we can draw the following more important conclusions:

• The cv. 'Malvazinka' has the largest and most impressive fruits;

• The fruit weight in 'Čačanska rodna' is not satisfactory and is not suitable for processing into dried fruit;

• Cultivars with the best chemical composition are 'Stanley', 'Tagera' and 'Green Renclode', which have a good combination of sugars and acids;

• Fruits of cv. 'Hanita' have a high acid content in both years of the study, indicating that they will not be suitable for drying.

• Fruits of cv. 'Stanley', concerning their weight, dark color and a combination of sugars and acids is best suited for processing - drying and compote.

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