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EVALUATION OF THE QUALITY OF AUTOCHTHONOUS PLUM CULTIVARS IN THE AREA OF BOSANSKI PETROVAC

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Abstract

History of our autochthonous fruit cultivars is very long. Balkan Peninsula is one of the most important and richest centers of genetic diversity of fruit species in Europe. In the process of domestication many fruit species came into contact with their wild relatives, intersecting different genetic material and adjusting to the given environmental conditions. In this way, there was enrichment of biodiversity with many landraces that now constitute our unique biological heritage. Autochthonous fruit varieties were suppressed by industrial and commercial varieties.

The objective of this study was to investigate main pomological characteristics as well as fruit quality of the selected autochthonous plum cultivars from the region of Bosanski Petrovac. The fruits of selected cultivars could be processed, particularly into plum brandy, or they could be used fresh or dried. Also, can be used both in breeding programmes and as rootstocks as well as in further disease related systematic studies under field and laboratory conditions. In our region conservation of indigenous varieties is a prerequisite for the preservation of biodiversity, and the recognizable quality of our national products that have preserved specificity of our natural and cultural heritage. Also the potential for branding our traditional food products could represent good strategy for future rural development.

Key words: *autochthonous plum cultivars, preservation, agrobiodiversity, organic production.*

Introduction

Bosnia and Herzegovina has a long plum growing and processing tradition as well as evident biological diversity in local plum (*Prunus domestica*) germplasm. Autochthonous or local (primitive, folk) plum cultivars (accessions) grown in Bosnia and Herzegovina belong to *Prunus domestica* L. and *Prunus insititia* L. (Milosevic & Milosevic, 2012). Considering the current tendency of consumers to select typical regional products, there is a need to define Bosnian autochthonous varieties and to characterize the specificity of related products. Data available are limited to an earlier work by Paunovic and Paunovic (1994) suggesting the existence of 92 autochthonous cultivars and noting a high variability in the main morphological, pomological and technological traits.

The fruit quality is a complex of features and specific characteristics, which besides other criteria is mostly in accordance to the market demand. It is recent trend to study possibilities of autochthonous fruit cultivars in order to enrich the food industry with highly valuable raw materials while preserving biodiversity and straightening rural development. Conservation and utilization of plant genetic resources in agricultural is one of the main trends

in development of sustainable food production. Old varieties and populations are mainly characterized with lower demands and higher adaptability to environmental factors. For this reason they are suitable for low input agriculture and organic production. The interest of individual farmers in maintaining autochthonous breeds and varieties is declining since there is no economic gain in preserving and exploiting agricultural diversity. This means that the heritage of species and varieties is at risk of genetic erosion and hence requires measures that will encourage conservation and provide incentives towards sustainable use of autochthonous genetic resources (Bertacchini, 2009). Although traditional varieties (synonym to landraces, e.g. Harlan 1975) are generally thought to have lower yield potential than modern ones, they offer many commercial advantages. They also have inherent potential for increased productivity, they are often better adapted to local climatic conditions, cultural practices, and pest and disease; provide resilience and stability under variable and difficult cropping conditions (Bellon 1995, Brush 1995). During the 1970s and 1980s the general opinion was that these varieties would rapidly disappear, but they have proved remarkably resilient (Thompson *et al.*, 2007). In former Yugoslavia, the plum tree was the most spread species, because of the good climate conditions, the fruit value (energetic, nourishing, dietetic etc.) and was further considered a traditional species (Mratinic, 2000). In remote rural areas in Bosnia there are still households that breed autochthonous fruit varieties. Bosnian plum production is characterized by extensive growing technology, low unstable yields, low quality fruits and problems with plum pox virus. Autochthonous plum cultivars are a limiting factor in improving plum production. Nevertheless, they can be used as an outstanding source of germplasm and as a genetic basis underlying breeding activities, principally the development of new cultivars, clonal selection (Ogasanovic *et al*., 1994; Milosevic, 2000), the development of new plum, apricot and peach rootstocks (Paunovic, 1988; Djuric *et al*., 1998), resistance to economically important diseases (Paunovic & Paunovic, 1994; Rodrigues *et al.,* 2009) or intensive cultivation (Mratinic, 2000).

Many factors are known to affect the nutrient content of foods including variation due to differences in nutrient composition of foods below the level of species, i.e. subspecies, variety, cultivar or breed (Toledo & Burlingame, 2006). Until now over-exploitation of certain cultivars and varieties was driven by market demands. Nevertheless, recent studies have shown that human nutrition and dietary diversity within the traditional food system has to be enhanced not only with different fruit and vegetable species but also with varietal diversity in terms of fresh consumption and processing as well. It is generally thought that macronutrients vary only insignificantly within the same species (Greenfield & Southgate, 2003; Kuhnlein, 2003; Rodriguez-Amaya *et al*., 2008). However, Burlingame *et al.* (2009) show data that this is not always the case and that the compositional differences among varieties or cultivars can be very significant for macronutrients, micronutrients and bioactive non-nutrient. That is not a simple approach but a complex one, taking into account the diversity and quality of cultivars permanently improved and also having in view the nutrients which confer the fruit quality (Burzo *et al.,* 2005). Therefore, fruit chemical analysis recently received special attention, since it can provide information on fruit quality based on previously known adequate and critical nutrient levels and, therefore, prevents deficiencies and physiological disturbances in fruits (Marcelle, 1984; Suzuki & Argenta, 1994; Nachtigall & Freire, 1998; Ernani *et al*., 2002).

Action for Nutrition adopted at the 1992 International Conference on Nutrition (ICN, 1992). The declaration recommended the promotion of dietary diversity, and the use of locally available nutrient-rich indigenous and traditional foods as a vital strategy against food insecurity, malnutrition and disease.

Materials and methods

Investigations included *in situ* identification, marking and observation of autochthonous plum cultivars (accessions) in the area of Bosanski Petrovac. During 2012 recording of the phenological traits – first flowering, full flowering, end of flowering and harvest date was conducted on sample of five trees per each cultivar, as following: the beginning of flowering was recorded when at least 5% of the flowers bloomed; full flowering was accepted when at least 80% of the flowers bloomed, the end of flowering was determined when 90% of the flowers bloomed and corollas began to fall off, and harvest date was established when the fruits were sufficiently colored and soft to be eaten (Funt, 1998).

On 30 fruits, per sample, collected during full maturity, fruit weight, size, shape, color, firmness, stone weight, and stone general shape were measured. Randman, that represents percentage of fruit flesh in total fruit weight, was established calculating. All measurements were performed using hand caliper. Observation and recording of their phenological and pomological traits were performed using UPOV methodologies.

Analysis of the K, Ca and Mg content was conducted by wet burning of dried fruits with acid mixture (HNO3 + HClO4 + H2SO4) and concentration was determined in the AAS system (UNICAM, Model SP9).

Results and discussion

The phenological characteristics of autochthonous plum cultivars are given in Tab. 1. The data show that the onset of flowering was recorded in the second and third decade of April. Fruits of all examined plum cultivars averagely ripen in interval from 09th September up to 22nd September (Tab. 1).

Full flowering date of evaluated cultivars showed a high range (13 days), while the differences for harvest date were 13 days as well. These traits depend on environmental conditions (temperature, altitude etc.) and may change every year (Liverani *et al*. 2010). Cosmulescu *et al.* (2010) stated that "*flowering time duration*" is a feature which is influenced by climatic factor and genetic factor. In general, the earlier the flowering is developing, the shorter its time duration. The period between the beginning of flowering and the end of it vary from 14 to 17 days, and differences occur between cultivars. Similar data on the period and duration of flowering of autochthonous plum cultivars were reported by other authors (Jovancevic, 1977; Milosevic, 2010). Pozegaca ripens during the end of August and the beginning of September, but in higher altitudes even in October (Jacimovic *et al.* 2011).

Tab. 1. Phenological characteristics of autochthonous plum cultivars in Bosanski Petrovac

Cultivar (local name)	Flowering				Harvest date
	Onset	Full	End	Duration (days)	
Pozegaca	23.04.	03.05.	10.05.	17	22.09.
Durgulja	20.04.	27.04.	04.05.	14	12.09.
Bjelica sitna	11.04.	20.04.	28.04.	17	10.09.
Prskulja	10.04.	20.04.	27.04.	17	09.09.

All monitored autochthonous plum cultivars have extremely small fruit according to FAO plum descriptor. The average fruit weight of autochthonous plum cultivars ranged from 4,7 (Prskulja) g to 26,4 (Bjelica sitna), with significant differences comparing to average fruit weight of commercial plum cultivar Stanley (40,6 g). Comparing to measurements from previous years, average fruit weight of autochthonous plum cultivars in 2012 was significantly smaller due to the strong drought conditions during July and August. Also freeze

damage in the beginning of the vegetation strongly reduced fruit set affecting the yield in 2012. Fruit weight is in direct correlation with fruit size and other authors recorded statistically high differences in both, between different autochthonous plum cultivars (Jacimovic *et al.* 2011).

Tab. 2. Pomological and sensorial characteristics of autochthonous plum cultivars in the area of Bosanski Petrovac

Cultivar (local name)	Fruit weight (g)		Fruit Size[1]	Fruit Shape[2]	Flesh Color[3]	Flesh Firmness[4]	Stone weight (g)	Stone shape[5]	Share of flesh (%)
	2010	2012							
Pozegaca	20,7	15,5	1	2	3	7	0,5	1	96,78
Durgulja	17,3	11,1	3	5	3	3	0,9	3	91,90
Bjelica sitna	11.5	26,4	1	6	4	5	0,5	2	98,11
Prskulja	8,9	4,7	1	2	3	3	0,5	2	89,36
Stanley	39,8	40,6	5	2	3	7	1,9	1	99,53

[1] Fruit size: 1 = extremely small, 2 = very small; [2] Fruit shape: 2 = rounded, 3 = elliptical, 4 = ovate, 6 = oblong; [3] Flesh color: 2 = light green, 3 = yellow green; [4] Flesh firmness: 3 = soft, 5 = medium, 7 = firm; [5] Stone general shape in lateral view: 1 = narrow elliptic, 2 = elliptic, 3 = circular.

Stone weight of autochthonous cultivars was significantly smaller in relation to Stanley, and it ranged ranged from 0,5 g (Pozegaca, Bjelica sitna, Prskulja) to 0,9 g (Durgulja), which was in agreement with the results obtained by Milosevic *et al.* (2010), Paunovic (1988), Paunovic and Paunovic (1994) and Mratinic (2000).

All monitored autochthonous cultivars have high share of flesh ranging from 89,36 % (Prskulja) to 98,11 % (Bjelica sitna), but lower comparing to Stenley that is well known for high share of flesh in fruit's total weight.

Tab. 3. The mineral composition of selected essential macro minerals (K, Ca, Mg) in investigated plum cultivars from Bosanski Petrovac

Cultivar	K %	Ca %	Mg %
Stanley	1,16	0,02	0,04
Prskulja	1,40	0,06	0,05
Pozegaca	0,99	0,06	0,04
Bjelica	1,25	0,07	0,06
Durgulja	1,15	0,06	0,05

It has been proposed by several authors that different varieties as well as different cultivars should be examined for their nutritional value (Campeanu *et al.*, 2009; Imran *et al.*, 2007; Imran *et al.*, 2010; Jacimovic *et al.* 2011). The various mineral elements enter the maturing fruit at different rates (Valvi & Rathod, 2011). Among the macro-minerals (K, Ca, and Mg), the content of K varied from 0,99% (Pozegaca) to 1,40% (Prskulja). Cultivars Prkulja and Bjelica had higher K content comparing to Stenley. Chemical analysis showed that Stenley had lowest Ca content comparing to autochthonous cultivars. Ca contetnt ranged from 0,02% (Stenley) to 0,07% (Bjelica). The lowest Mg content was determined in Stanley and Pozegaca (0,04%) and the highest in Bjelica (0,06%).

Conclusion

Investigated autochthonous cultivars are fully adapted to the environmental conditions in the area of Bosanski Petrovac. The aim of these studies should be to provide information about the nutritional value of old varieties, in order to preserve autochthonous varieties and cultivars from genetic erosion.

In this study the autochthonous plums were classified as being extremely small in terms of fruit size. The obtained values, particularly those for fruit weight and fruit size, were lower than standard commercial cultivar.

Due to the various ways of propagation (both by cuttings and seedlings), plum populations are highly heterogeneous and show environmentally dependent traits. This implies that detailed evaluation and description of autochthonous cultivars should be preformed and that reliable estimation will be possible only through a multi-disciplinary approach by examining selected cultivars grown in a collection orchard as well as under field and laboratory conditions over the next five to ten years.

All the autochthonous fruits could be processed, and some could be dried or used fresh. The autochthonous (primitive, local) plum cultivars could serve as an outstanding genetic basis and a source of germplasm for plum breeding aimed at developing new cultivars and rootstocks. More effort and resources are needed to analyze and disseminate data on the nutrient composition of wild, underutilized, autochthonous varieties, and under-appreciated food biodiversity.

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