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BIOCHEMICAL AND POMOLOGICAL CHARACTERISTICS OF FRUIT OF SOME COMMERCIAL MEDLAR CULTIVARS (*Mespilus germanica L*) GROWN IN BIJELO POLJE

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Abstract: *This study described some biochemical and pomological parameters of fruits in 4 commercial medlar cultivars ('Domestic medlar', 'Plovdivska'; 'Royal medlar'; 'Rasna') grown in ecological conditions of Bijelo Polje (Montenegro) in the period from 2010 to 2012. Recording of biochemical parameters such as dry matter, total soluble solids, total acidity and pH was the most important segment of this research. The study also focused on comprised pomological traits such as fruit weight (g), fruit size (mm) and length (mm) and petiole length (mm). The values for fruit dry mater ranged from 26.2% to 28.8%, total soluble solid contents ranged from 20.45% to 22.25%, titrable acid contents ranged from 1.9% to 2.28%. The values for fruit weights ranged from 21.4g to 25.5g, fruit length ranged from 34.5mm to 38.4mm, fruit widths ranged from 31.5mm to 36.2mm, and petiole length ranged from 19.8mm to 23.2mm. Over the years of study, all researched cultivars had yields in the agroecological conditions of Bijelo Polje. The 'Royal medlar' cultivar is the cultivar we would recommend to producers, due to its fruit dry matter content of 28.2%, the total soluble solid contents of 22.25%, and the total titrable acid content of 2.28%. Moreover, the fruit mass was the highest for the 'Royal medlar' cultivar (25.5g). The length and width of the fruit in the same cultivar had also maximum values (38.4mm and 36.2mm, respectively), as compared to other researched cultivars.*

Keywords: *'Royal medlar', dry mater, soluble solid contents, titrable acid contents, fruit weights.*

1. Introduction

The medlar (*Mespilus germanica L.*) is a member of the *Rosaceae* family and is native to the eastern Mediterranean area. It was already cultivated about three thousand years ago in the Caspian Sea region of northern Iran [1]. Medlar (*Mespilus germanica L.*) belongs to *Rosaceae* family, and it is called 'Döngel' or 'Beşbıyık' in Turkey, 'Ezgil' in Azerbaijan, 'Bushmala' in Georgia and 'German' or 'Germanic Medlar' in the most of European countries. Until the seventeenth century, the medlar was the most important fruit crop. However, interest in it gradually faded away, and later it was replaced by other, more productive and undemanding crops. Currently, medlar is grown quite rarely and, mainly, in botanical gardens or in small farms. *Mespilus germanica* is indigenous to southwest Asia and possibly also southeastern Europe – from

northern Turkey (some occurrence in Greece and on the Crimea) to the Caucasus and Transcaucasus and the north-eastern part of Iran.

Its tree is generally 3-5 m tall, but it may reach nearly 8 meters. It is self-fertile and long-lived tree. It lives approximately 30-50 years. There are 100 year old trees in UK as well. The flowers are white-pink and hermaphrodite. Flower buds are formed in May-June, and each bud has one flower. Fruit shape may be variable. Fruits are inedible during tree maturity stage because of tannin content. It becomes edible when the skin color becomes chocolate brown. Medlar contains organic acids, sugars, pectin, vitamin C, and small amounts of vitamin A [2]. Medlar is a climacteric fruit, and as such, important biochemical changes occur during the respiratory climacteric, just before the full maturation stage [1] .The medlar shows better pest and climate resistance than most other fruit species of landscaping importance.

Very large number of researchers in Europe studied the biochemical and pomological characteristics of medlar cultivars [1-5].

The data for medlar trees in the territory of Bijelo Polje (Montenegro) are not statistically processed, which refers to the fact that the cultivation of this fruit cultivar is very low. We certainly wanted to make the existing situation less severe by presenting data for the quality of the fruits of certain medlar cultivars, which are grown in smaller family orchards in the territory of Bijelo Polje municipality.

2. Matherials and methods

Bijelo Polje is situated between 43° and 43°5′ north latitude and 19°40′ and 19°50′ east longitude. The municipality of Bijelo Polje is situated at the altitude from 520m (estuary of the River Kanjska to River Lim) to the altitude of 2017m (Komovi Mountain). The terrain of Bijelo Polje municipality is following the direction of River Lim flow, i.e. the north and northwest direction. Larger and better-quality agricultural land is located on the near proximity of the River Lim, and its tributaries [6].

The municipality of Bijelo Polje has average annual temperature of 8.9°C. The warmest period is during the months of June, July and August, with an average temperature from 16.3°C to 18.1°C. The coldest period is during the months of December and January, with an average temperature from 0.1°C to -1.6°C. The lowest daily temperatures on annual level are around -3°C. The winter period is characterized with intense negative temperatures, which can reach up to -27.6°C. The spring period is characterized with low temperatures, which can be more than critical when it comes to fruit production (late spring frosts). Namely, the month of April was recorded in some years with the lowest temperature of up to -8°C. The average minimal temperature during April is -2.8°C for the Bijelo Polje territory.

The annual precipitation level in Bijelo Polje municipality is 893.7 mm/m2. The maximum precipitation is occurring during the period of October - December, while the period with the lowest precipitation is from June - August. The dominance of the cold and rainy period over the warm and dry one is expressed in relation of 54% vs. 46%.

The materials of this study were commercial cultivars of medlar: ʿDomestic medlar', ʿPlovdivska', ʿRoyal medlar' (Fig. 1.) and ʿRasna' grown in ecological conditions of Bijelo Polje (Montenegro) in the period from 2010 to 2012.

Fig. 1. Royal medlar tree

Fig. 2. Royal medlar fruit

These researches were conducted on a larger number of private production orchards, which are in near proximity one from another and are all situated within the territory of Bijelo Polje. All cultivars were grafted on the vegetative rootstocks quince Ba-29.The orchards were of mixed type, and the trees of researched cultivars were with average age of 7-10 years, and were in the fruiting period. When it comes to agro-technical measures, winter cutting and winter spraying were applied.

The study focused on few segments. The first one included recording of biochemical traits - dry matter, total soluble solids, pH, and total acidity. The second segment comprised pomological traits [fruit weight (g), fruit diameter (mm), fruit length (mm), petiole length (mm)]. The dry mater was determined by drying at 105°C. The total soluble solid content was determined by refractometer. The acidity was measured by titration with 0.1 N NaOH. The fruit weight was determined by measuring by the electric scale Metler 1200. The result was shown in grams with the accuracy of 0.01g. Fruit dimensions - length and width were measured by Vernier scale.

3. Results and discussion

The results of biochemical and morphological characteristics of fruits of researched medlar cultivars are shown in Table 1 and Table 2. Fruit dry mater, total soluble solids, pH and titrable acid content of four medlar cultivars are shown in Table 1.

Table 1.

Biochemical characteristics of fruit of some commercial medlar cultivars (average 2010-2012)

Medlar cultivar	Fruit dry mater (%)	Total soluble solids(%)(TSS)	pH (0 -14)	total acidity(%)(TA)
Domestic medlar	26.20	20.45	3.59	2.20
Plovdivska	27.80	21.82	3.40	2.26
Royal medlar	28.80	22.25	3.86	2.28
Rasna	27.25	21.60	3.57	1.90
LSD 0.05	1.09	1.01	0.28	0.18
LSD 0.01	1.70	1.28	0.37	0.29

The values for fruit dry mater ranged from 26.2% (Cv.'Domestic medlar') to 28.8% (Cv.'Royal medlar'); total soluble solid contents ranged from 20.45% (Cv.'Domestic medlar') to 22.25% (Cv.'Royal medlar'); pH ranged from 3.40 (Cv.'Plovdivska') to 3.86 (Cv.'Royal medlar'); titrable acid contents ranged from 1.90% (Cv.'Plovdivska') to 2.28% (Cv.'Royal medlar').

The results of our research, related to the parameter of dry matter for the cultivars 'Domestic medlar', 'Plovdivska', 'Royal medlar', and 'Rasna', showed significantly lower values in comparison to data of 11 medlar genotypes, selected from Tokat province. In the research of genotypes from Tokat province, total dry matter was determined between 27.34% - 44.11% [2].

The fruit soluble solid contents increased in the ripening period for all of the researched medlar cultivars (Table 1). The fruit soluble solid contents were measured between 20.45% and 22.25% at the time of harvest. The highest fruit pH value was found in Cv. 'Royal medlar'(3.86).

Previous similar researches show that the total soluble solids (TSS) and pH values of medlar fruits grown in different agro climatic regions of Turkey (Kocaeli province) are between 16.4% - 22.2% and 3.68% - 4.02%, respectively [7]).The soluble solid contents varied between 17.0% and 24.0% in selected types of wild medlars in earlier studies in Turkey (Tonya District of Trabzon Province) [8]. Our findings regarding total soluble solids (TSS), and pH values showed results that were similar to these studies. The recorded variations of total soluble solids and pH in medlar fruits could be the result of different genetically based characteristics and the effect of the different agro ecological conditions, where the cultivars are grown.

Significant variation in chemical and morphological characteristics of fruit were recorded among cultivars of different fruit species, such as apple [9],plum [10], pear [11-12] and sour cherry [13], which were all grown in conditions of Bijelo Polje (Montenegro) as well.

The above listed biochemical characteristics of fruit dry mater and total soluble solids for all the researched medlar cultivars can be compared with the data for the same biochemical characteristics for commercial cultivars of pear from the same territory (Bijelo Polje, Montenegro). In the commercial pear cultivars, the values for fruit dry mater ranged from 16.6% ± 0.39 to 18.08% ± 0.32, total soluble solid contents ranged from 11.99% ± 0.25 to 15.66% ± 0.42. [11]. Our comparative analysis between the fruits of researched medlar cultivars and the fruits of researched pear cultivars showed that the level of the aforementioned biochemical parameters for medlar cultivars is significantly higher compared to parallel data in commercial pears from the same area. Having this in mind, we believe that the medlar is an unjustifiably neglected fruit species for cultivation in this area. Also, the experience has showed us that there is a large demand for all types of products from the fruits of medlar, whereas the supply is on an extremely low level. In order to confirm abovementioned, we can emphasize the exceptional quality and taste of medlar fruit liqueur (Fig. 3.), produced by the original recipe in the monastery of Gračanica, Kosovo and Metohija (Serbia).

Fig. 3. Medlar fruit liqueur

Fruit weight, length, width and petiole length are given in Table 2. The results of our research, as show in Table 2, indicated that the values for fruit weights ranged from 21.4 g (Cv.'Domestic medlar') to 25.5g (Cv.'Royal medlar'), fruit length ranged from 34.5mm (Cv.'Domestic medlar') to 38.4 mm (Cv.'Royal medlar'), fruit widths ranged from 31.5 mm (Cv.'Domestic medlar') to 36.2 mm (Cv.'Royal medlar'), and petiole length ranged from 19.8mm (Cv.'Domestic medlar') to 23.2 mm (Cv.'Plovdivska').
The scientific works that were also concerned with the study of the morphological properties of medlar genotypes indicate a wide divergence in terms of fruit weight, fruit width, fruit length and petiole length. We compared our data with researches conducted in Serbia and Turkey.

Table 2.
Morphological characteristics of fruit of some commercial pear cultivars (average 2010-2012)

Cultivar	fruit weight (g)	fruit length (mm)	fruit widths (mm)	petiole length (mm)
Domestic medlar	21.4	34.5	31.5	19.8
Plovdivska	23.3	35.9	34.2	23.2
Royal medlar	25.5	38.4	36.2	22.1
Rasna	22.8	35.5	35.1	22.0
LSD 0.05	0.28	0.08	0.08	0.25
LSD 0.01	0.37	0.11	0.10	0.33

Seedless medlar genotype 'Pomoravka' was found in Pomoravlje, in the close vicinity of Svilajnac (Serbia), in 1994. It was grafted and transferred at three locations so as to be protected from deterioration. Apart from being used fresh, its fruit is very interesting for processing industry for making pastes, jelly, mash, liqueur etc. This genotype can be beneficial in the breeding aimed at development of seedless medlar cultivars of satisfactory fruit size. This genotype has a relatively small fruit (8.2g) but high stone flesh ratio (96.5%) and it is highly qualitative especially when it is overripe. Due to its high using values this genotype should be more propagated especially in view of the fact that the presence of

pathogen *Erwinia amylovora* has not been detected on any young tree of this medlar genotype [14]. Namely, the medlar genotype 'Pomoravka' has very small fruits (8.2g) and it is inferior in regards to fruit weight in comparison to all medlar cultivars we researched in our work, especially compared to 'Royal medlar'(Fig. 2.) cultivar, which average size was 25.5g. The fruit weight of the 'Royal medlar' cultivar is three times larger than the fruit weight of medlar genotype 'Pomoravka'. The Serbian research team must have researched the medlar genotype 'Pomoravka' for its resistance to the pathogen of *Erwinia amylovora*, and also because of the fact that there are no seeds within the fruit. The randman is 96.5% [14].

In Tokat province (Turkey), the average fruit weight of medlar's genotipes ranged between 17.71g - 32.46g in 2011, and 15.99g - 37.54g in 2012. Fruit diameter was determined around 21.07mm - 41.05mm in 2011, and 17.49 mm - 43.63mm in 2012. Fruit length was 18.25 mm-38.27 mm in 2011, and 14.96mm - 35.68 mm in 2012 [2]. The interesting fact is that some genotypes from Tokat province were with larger fruit weight even from cultivars from our research. This suggests that the work on selection of new cultivars can be continued, and that natural populations can produce cultivars of large fruits.

Morphological characterization continues to be the first step for germplasm description and classification [15- 16]. The existence of a large variability in fruits has been demonstrated in different species such as *Prunus persica (L.) Batsch* [17], *Prunus spp*. [18 - 20], *Malus sp.* [20], *Diospyros spp*. [22], *Castanea sativa Mill.* [23- 24], *Pseudocydonia sinensis* Schneid. [25], *Vitis vinifera L*. [26], *Ziziphusjujuba Mill.* [27], For the *Mespilus germanica* breeders or plant biologists, the description of the fruit morphology is of significant importance for phenomics studies.

4. Conclusion

Based on the obtained results in terms of morphological and biochemical characteristics of researched medlar cultivars ('Domestic medlar', 'Plovdivska', 'Rojal medlar', and 'Rasna'), the following conclusions can be drawn:

1. The values for fruit dry mater ranged from 26.2% (Cv.'Domestic medlar') to 28.8% (Cv.' Rojal medlar '); total soluble solid contents ranged from 20.45% (Cv. 'Domestic medlar') to 22.25% (Cv.'Rojal medlar'); pH ranged from 3.40 (Cv.'Plovdivska') to 3.86 (Cv.'Rojal medlar '); titrable acid contents ranged from 1.90 % (Cv.'Plovdivska') to 2.28% (Cv.'Rojal medlar ').

2. The results of our research indicate that the values for fruit weights ranged from 21.4 g (Cv.'Domestic medlar') to 25.5g (Cv.'Rojal medlar'), fruit length ranged from 34.5mm (Cv. 'Domestic medlar') to 38.4 mm (Cv. 'Rojal medlar'), fruit widths ranged from 31.5 mm (Cv. 'Domestic medlar') to 36.2 mm (Cv. 'Rojal medlar'), and petiole length ranged from 19.8 mm (Cv. 'Domestic medlar') to 23.2 mm (Cv.'Plovdivska').

3.The 'Royal medlar'(Fig. 1. and Fig. 2.) cultivar is the cultivar we would recommend to producers, due to its fruit dry matter content of 28.2%, the total soluble solid contents of 22.25%, and the total titrable acid content of 2.28%. Moreover, the fruit mass was the highest for the 'Royal medlar 'cultivar (25.5g). The length and width of the fruit in the same cultivar had also maximum values (38.4mm and 36.2mm), compared to other researched cultivars.

4. At the end of these studies, one general conclusion can be made, as an answer to set goals and the very task of our research:

agro-ecological conditions of Bijelo Polje and its surrounding environment fully correlate to the intensive medlar production; hence, the agro-biological characteristics of researched cultivars can be demonstrated economically.

5. References

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