

Qualitative characteristics of collectible forms *Citrus reticulata* Blan. var. *unchiu* Tan.

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Abstract. The article discusses the key characteristics of the quality of mandarin fruits (*Citrus reticulata* Blan. var. *unchiu* Tan.) from the collection of FRC SSC RAS. The objects of the study were 12 unique and most valuable varieties and hybrids of domestic and foreign breeding. The results of mechanical analysis of fruits are given. The study of the chemical composition of fruits showed that they are rich in vitamins, sugars, acids. The quantitative ratio is dominated by sucrose, more than 70 % of sucrose is noted in the varieties 'Pioner 80', 'Sochinskij 23', 'Krasnodarskij 83', 'Iverija'. The greatest amount of fructose was isolated in clones and hybrids from 20.1 – 21.6 %. Organic acids (citric, malic, succinic, acetic, lactic, oxalic, ascorbic), vitamin C (ascorbic) were determined, the high content of which was noted in clones 22 and 33. Among the main organic acids, citric acid dominates – 90-96 %, the leader appear to be 'Kowano Wase', the least amount is in 'Sochinskij 23'. The high content of succinic acid was noted in the varieties 'Millennium 1' (37.34 mg/100g) and 'Pioner 80' (35.06 mg/100g). Fruits of the variety 'Jubilejnyj', 'Pioner 80' and Hybrid No. 10 contain the largest amount of tartaric acid, which ranges from 51.44 to 59.71 mg/100g. The highest sugar–acid index was noted in the early ripening varieties 'Millenium 1' (9.3 units) and 'Kowano Wase' (8.5 units), hybrid No. 10 (8.0 units), which indicates good taste indicators of these samples.

1 Introduction

Citrus fruits are the most important fruit crops of frost-free subtropical and tropical regions. Currently, citrus cultivation is carried out in 90 countries of the world. The widespread distribution and cultivation of different types of citrus fruits is associated with the nutritional and dietary value of the fruits [8;3]. Citrus cultivation in Russia is possible in the humid subtropics of the Krasnodar Territory, but it is associated with great difficulties due to the geographical location and the harsh climatic conditions inherent in this zone [2]. In addition, varietal characteristics, maturation periods and stressful growing conditions affect the biochemical composition of fruits. In addition to sugars, vitamins, they contain organic acids, as well as calcium, phosphorus, iron salts necessary for the human body, etc., they are rich in bio elements [5; 6].

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The objective of our research is to study the qualitative and quantitative indicators of fruits of varieties and hybrids of the tangerine group from the collection of the FRC SSC RAS, for a more complete characterization of samples.

2 Materials and methods

The bioresource collection of the mandarin group of the Center includes 48 cultivars, of which 7 varieties of Russian, 14 of foreign selection, 5 relatives of mandarin, as well as 22 original interspecific and intergenerational hybrids, clones and nucellar seedlings obtained as a result of the breeding process. The pomological and biochemical characteristics of 12 unique mandarin samples are given. The fruits for analysis were selected at removable maturity. During the pomological characterization, the mass of the fruit and its components (the mass of the peel, the mass of the fruit body, the yield of dry matter) were measured [1].

The determination of chemical parameters was carried out in the Laboratory of Plant Physiology and biochemistry of the Center. The studies were carried out using classical methods for determining biochemical parameters: the content of soluble solids (RSV); acidity; the content of ascorbic acid in fruits - by the iodometric method. The content of mono- and disaccharides, as well as organic acids, was carried out using the capillary electrophoresis system «Capel 105-M». Biochemical studies were performed by a three-time repetition.

3 Results and discussions

The taste qualities of mandarin fruits are mainly due to the level of carbohydrates and organic acids [6;4;9]. The dominant form of carbohydrates are sugars (sucrose, glucose and fructose), with the leading disaccharide sucrose. Sucrose, glucose and fructose in a total ratio of 2:1:1 are the main components of carbohydrates of tangerine fruits and are the key to the sweetness of juice.

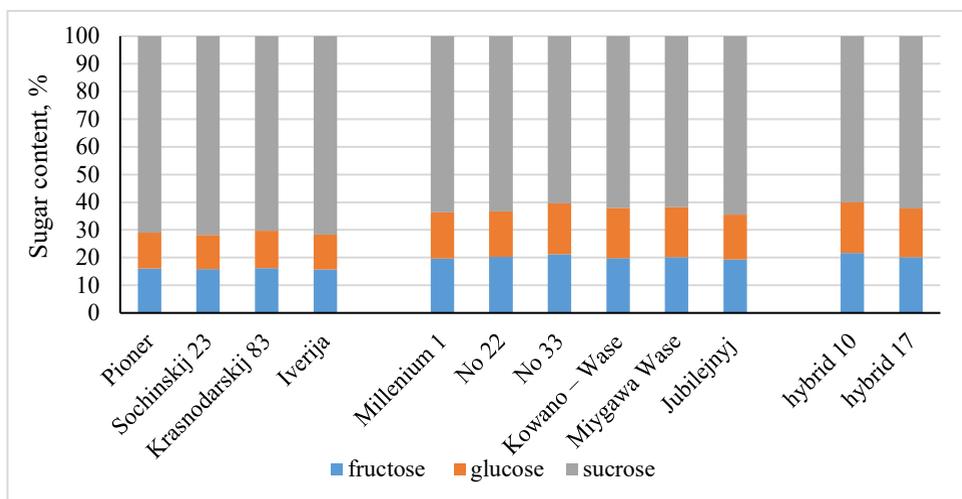


Fig. 1. Sugar content in fruits, %.

The content of sucrose to other reducing sugars tends to fluctuate depending on varietal characteristics, maturation dates, maturation stage and shelf life. Of the total amount of sugars, more than 70 % of sucrose was observed in the varieties 'Pioner 80', 'Sochinskij 23', 'Krasnodarskij 83', 'Iverija'. The largest amount of fructose was isolated from clones and

hybrids from 20.1 – 21.6 %. Fructose in the fruits of early ripening varieties ('Millennium 1', 'Jubilejnij', 'Kowano Wase' and 'Miygawa Wase') occupies 19.7 - 19.8 % of the total amount of sugars. A high glucose content was noted inherent in the fruits of hybrid No. 10, clone No. 33 and varieties 'Kowano Wase' and 'Miygawa Wase' – 18.0 - 18.5 % of the total (Fig. 1).

Mandarin fruits contain the most important water-soluble vitamin - C (ascorbic acid). The main amount (up to 70 %) of vitamin C in plants is represented in the form of ascorbate, which is a related form of ascorbic acid [7; 10].

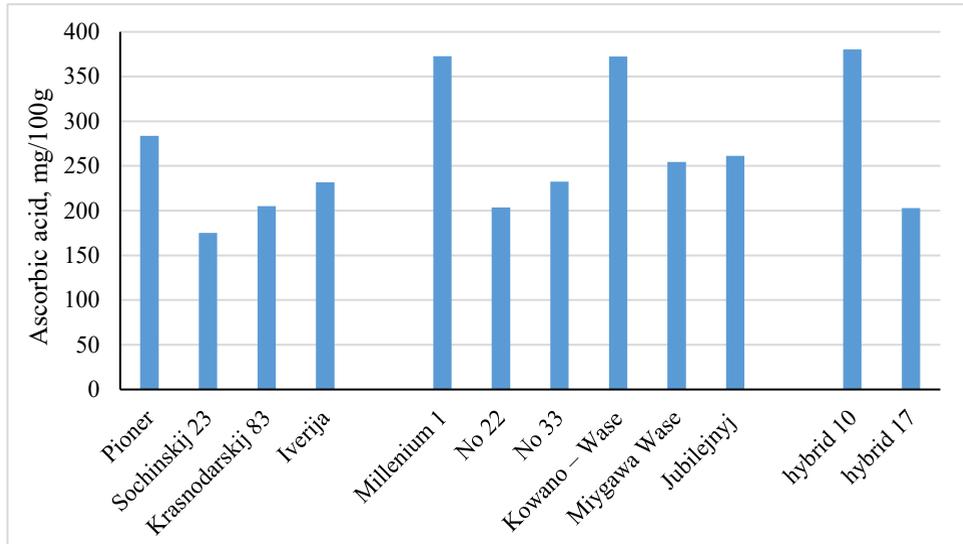


Fig. 2. Vitamin C content in fruits, mg/100 g.

It is noted that low – and medium-sized varieties and forms have a large amount of vitamin C, their crown is better illuminated by sunlight, the fruits of early ripening varieties ('Millennium 1'; 'Kowano Wase' and 'Miygawa Wase' and clones No. 22 and 33) accumulate more vitamin C compared to tall varieties later maturation period - 'Pioner 80', 'Sochinskij 23', 'Krasnodarskij 83', 'Iverija' (Fig.2).

The acidity of tangerine plays a key role in the criteria for evaluating the quality indicators of fruits and, together with the appropriate sugar level, provides a delicious taste. For mandarin, the dominant acid is citric and malic acid.

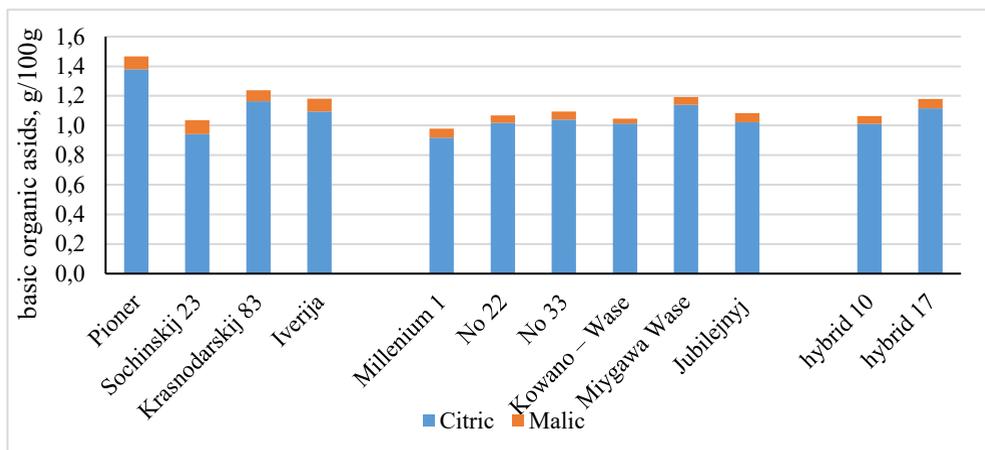


Fig. 3. Content of basic organic acids, g/100 g.

In the studied varieties and forms of mandarin, citric acid is dominant (90-96 %). No less significant acid is malic acid (5-10 %), (Fig. 3). The largest amount of citric acid was noted in the variety 'Kowano Wase', the smallest are the 'Sochinskij 23'. Followed by succinic, tartaric, lactic, oxalic, acetic, sorbic acid was showed at Figure 4.

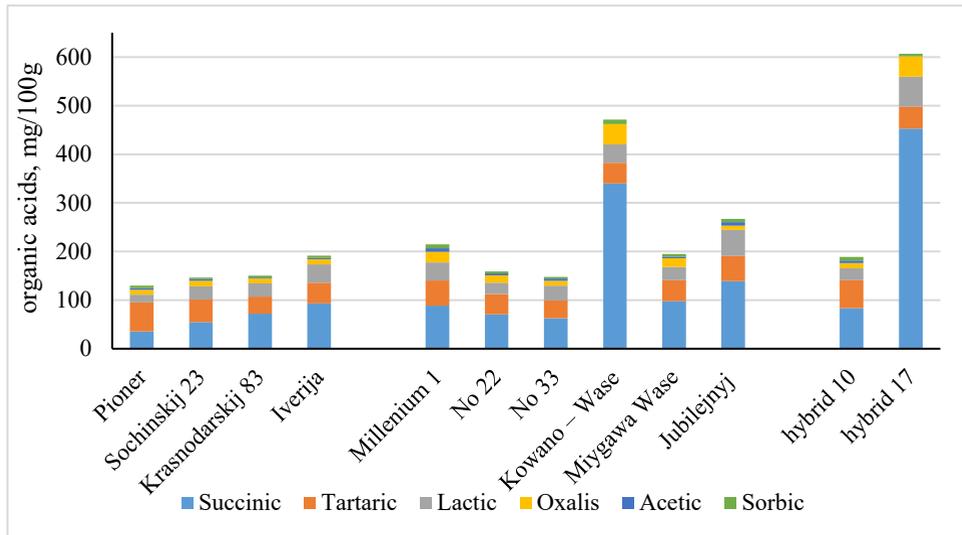


Fig. 4. The content of other organic acids in fruits, mg/100 g.

Succinic acid is a powerful antioxidant, the greatest amount of it was noted in the varieties 'Millennium 1' and 'Kowano Wase'. Tartaric acid is a natural antioxidant that affects the taste and aroma of fruits, prolongs the shelf life of fruits; the largest amount is contained in the fruits of the varieties 'Pioneer 80', 'Jubilee' and hybrid No. 10, ranging from 51, 44 to 59.71 mg / 100g. Lactic acid, the largest amount was noted in the varieties 'Iverija' and 'Sochinskij 23'. Oxalic acid is an important intermediate that binds together the transformations of carbohydrates and amino acids. Its content in mandarin fruits is low, ranging from 8.56 mg/100g ('Krasnodarskij 83') up to 12.56 mg/100g (hybrid No. 10). Acetic acid is found in many crop cultures (in fruits and parts of plants) and mandarin fruits are no exception. It affects the food taste value and is included in the aroma-forming complex. The largest number was noted in hybrid variety No. 17. Sorbic (hexadienic) acid has an antimicrobial effect, so its detection in citrus fruits is a positive fact, affects the taste of fruits, and also increases the immune qualities of the plant itself. Found in small amounts from 3.35mg/100g (Clone No. 33) to 7.53 mg/100g ('Millennium 1').

The harmonious taste of mandarin fruits is given by the ratio of acid and sugars (sugar-acid index). The highest index was noted in the early ripening varieties 'Millennium 1' (9.3) and 'Kowano Wase' (8.5), hybrid No. 10 (8.0), this indicates good taste indicators of these varieties/hybrid (Fig. 5). Table 1 shows the basic characteristics of the fruits relatively to the tangerine group.

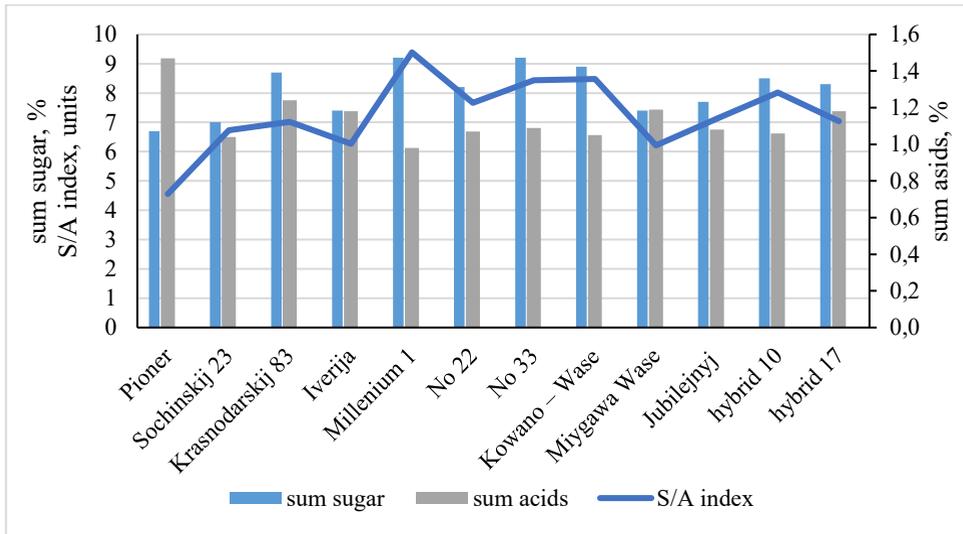


Fig. 5. Content of sum sugar, acids and sugar - acid index.

Table 1. General characteristics of the mechanical composition relatively to the varietal fruits of mandarin varieties.

Sample	Average weight of the fruit, g	Fraction of the total mass, %*		Dry matter content, %	
		peel	fruit body	peel	fruit body
A group of stunted, early-maturing					
Millennium-1	65,2±5,4	18,5	81,5	32,6±0,4	10,1±0,4
Jubilejnyj	56,6±7,5	19,3	80,7	26,0±0,1	9,5±0,1
Clone No.22	87,2±16,3	19,7	80,3	30,2±0,4	9,6±0,4
Clone No.33	72,2±15,9	18,0	82,0	27,8±0,3	10,7±0,3
Kowano Wase	57,3±13,3	18,6	81,4	34,9±0,1	10,7±0,1
Miagawa Wase	72,1±14,3	15,7	84,3	32,9±0,1	10,1±0,1
<i>Average value</i>	<i>68,4</i>	<i>18,3</i>	<i>81,7</i>	<i>30,7</i>	<i>10,2</i>
A group of tall, late-mature					
Sochinskij 23	73,2±8,8	25,8	74,2	26,2±0,3	8,4±0,3
Pioneer 80	68,6±13,9	21,0	79,0	29,4±0,1	8,7±0,1
Krasnodarskij 83	83,5±24,2	20,2	79,8	27,8±0,1	10,8±0,4
Iverija	86,3±11,0	25,0	75,0	28,3±0,5	9,4±0,5
<i>Average value</i>	<i>77,9</i>	<i>23,0</i>	<i>77,0</i>	<i>27,9</i>	<i>9,4</i>
Hybrids					
Hybrid No. 10	65,3±12,8	18,2	81,8	27,4±0,4	10,8±0,4
Hybrid No. 17	60,3±10,2	15,1	84,9	33,9±0,6	10,1±0,6

*Note: The calculation was carried out on 1 kg of fruit.

The highest indicator of the average fruit weight is expected to be observed in late-ripening varieties of mandarin, among which the largest fruit weight was the variety 'Krasnodarskij-83' and 'Iverija' – 107.7 and 97.3 g, respectively. Among the early-ripening varieties, clone No. 33 and clone No. 22 had the largest fruit mass – 88.1 and 103.5 g. This indicator is characterized by a fairly high variability, high yield under favorable conditions, contributes to the formation of fruits with a lower mass.

In early-ripening varieties, there is a smaller proportion of peel per total fruit weight, ranging from 15.7 to 19.7 %. In late-ripening varieties, this indicator varies from 20.2 to 25.8 %.

Hybrid forms are characterized by low indicators in their characteristics, they can be included in the first group of varieties.

All the samples under consideration are characterized by a fairly low dry matter content from 8.4 to 10.8 %, which indicates their high juiciness of the pulp, which is a valuable quality of the fruit.

4 Conclusion

This characteristic of the fruits of twelve varieties of the bioresource collection of mandarin; a biochemical analysis of the fruits was carried out: carbohydrates, organic acids (citric, malic, amber, acetic, lactic, oxalic, sorbic), vitamin C, as well as dry matter were determined. A mechanical analysis of the fruits was carried out.

Acknowledgements

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