Biochemical value of berries of promising edible honeysuckle varieties for the production of functional food products

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Abstract. *Lonicera edulis* L. occupies a special place among sparsely distributed garden crops in the middle horticulture zone of Russia. The main advantages of the culture are its long maturation period, long fruiting period, high plasticity, value of the biochemical composition of berries. The paper presents experimental data on the biochemical composition of honeysuckle berries of the new generation introduced under the conditions of the Central Chernozem Region. Varieties with high levels of soluble dry substances, sugars, ascorbic acid, flavonols are noted. Prospects of obtaining functional food products using fresh honeysuckle fruits are considered. “Honeysuckle” fruit drink and low-calorie jams with high antioxidant activity are obtained.

1. Introduction

The state of health of the population largely depends on good nutrition. Balanced nutrition provides the human body with food and biologically active substances (BAS), energy, and also contributes to the prevention of alimentary diseases [1-3].

Fruits and vegetables containing minerals, vitamins, dietary fibers, phenolic compounds are the main natural source of biological substances.

In recent decades, Russia has expanded the range of cultivated garden crops grown by large horticultural businesses and farmers, as well as amateur gardeners. Fruitful breeding work on the creation of new generation varieties with high levels of economic and valuable features that are in demand on the consumer market ensures the improvement of crop varieties. In the Central Chernozem Region the amateur gardeners and the farmer sector successfully grow such cultures as *Lonicera edulis* L., *Hippophaë rhamnoides* L., *Amelanchier*, *Vaccinium corymbosum*, *Aronia melanocarpa*, *Sorbus aucuparia*, *Crataegus laevigata*, *Actinidia kolomikta* [3, 4-6].

*Lonicera edulis* L. is widespread in the northern and middle gardening zones. The increasing demand for berry products and planting material is caused by high adaptive potential, curable ripening time of berries, their therapeutic and dietary qualities. Honeysuckle berries contain B vitamins (thiamine, riboflavin, folic acid), ascorbic acid, minerals (iron, potassium, copper, phosphorus, calcium, magnesium, manganese, silicon, zinc, iodine and others), polyphenols, tannins and pectins, dietary compounds – sorbitol and inositol [7, 8]. Fruits are used for food not only in their fresh form, but also for the preparation of a variety of processed products: compote, jam, juice, marmalade, candy fillings, food dye, frozen and dried berries.
According to the Strategy for the Development of the Food and Processing Industry of the Russian Federation, the population of the country should be provided with high-quality food products that ensure a balanced diet at the level of physiologically recommended consumption standards [9-11].

Regular consumption of fresh berries and functional products prepared from honeysuckle will allow developing the protective reactions necessary for the body and increasing immunity to various types of diseases.

The first varieties of honeysuckle had a mediocre taste due to bitterness. This restrained the introduction of Lonicera L. into industrial berry farming in the Central Chernozem Region, where the variety of garden crops with dessert fruits is quite diverse.

Currently, the main tasks of Lonicera L. breeding are high-yield, large-fruit varieties with dessert berries and rich biochemical composition. Targeted breeding of honeysuckle is currently being carried out in the Main Botanical Garden named after N.V. Tsitsin RAS, Krasnoyarsk Research Institute of Agriculture, South Ural Research Institute of Horticulture and Potato Production, Siberian Research Institute of Horticulture named after M.A. Lisavenko, Federal Research Center named after I.V. Michurin, All-Russian Research Institute of Horticulture named after N.I. Vavilov, Pavlovsk Experimental Station of the All-Russian Research Institute of Horticulture named after N.I. Vavilov.

The introduction of varieties into new soil and climatic conditions, the need to expand the diversity of functional food products based on honeysuckle berries for different age categories of the population make the studies quite relevant.

2. Materials and methods

The biochemical value of freshly harvested honeysuckle berries was assessed at the Center for Collective Use of High-Tech Equipment of the Michurinsk State Agrarian University according to the “Program and Methodology for the Study of Fruit Berry and Walnut Crops” [11].

Fruit drink and jam were prepared in accordance with GOST R 51398-99 “Preserves. Juices, nectars and juice-containing drinks. Terms and Definitions”.

The object of the study included introduced edible honeysuckle varieties: Lazurnaya (control), Malvina, Omega, Pushkinskaya, Slavyanka, Snegir. The originator of Omega, Pushkinskaya, Slavyanka, Snegir varieties is All-Russian Research Institute of Horticulture named after N.I. Vavilov, Malvina varieties – Pavlovsk Experimental Station of the All-Russian Research Institute of Horticulture named after N.I. Vavilov, Lazurnaya – Barnaul Siberian Research Institute of Horticulture.

3. Results and discussion

A collectible site of berry crops was created at the scientific and experimental center named after V.I. Budagovsky of Michurinsk State Agrarian University, where 6 introduced varieties of edible honeysuckle were cultivated.

It is important to determine the chemical characteristics of fruits when growing plants under new climatic conditions, selecting varieties with improved chemical composition and creating functional food products.

One of the reasons restraining the spread of the crop in industrial plantations is low yield and bitter taste of berries. In this regard, the priority direction in the study of this honeysuckle variety is the selection of large-fruit dessert forms.

The average weight of the fruit of the studied varieties in 2018-2020 ranged from 0.8 to 1.5 g. The large-fruited samples include Malvina, Pushkinskaya, Slavyanka, Snegir. Weather conditions in 2020 during the formation and ripening of berries led to higher weight of berries.

The Lonicera edulis L. varieties differ significantly in biochemical composition (Table). The amount of dry matter varied within 8.5 (Slavyanka) – 14.5% (Pushkinskaya). High indicators are characteristic of Lazurnaya, Omega and Pushkinskaya varieties. The content of dry matter is characterized by high ultrastability (V < 10%) and was slightly dependent on weather conditions during the growing season.
The taste qualities of honeysuckle fruits are caused by the quantitative ratio of the sum of sugars, organic acids, and bitter principles. The sum of sugars in the berries of the studied variety samples was 6.1-11.4%. The average accumulation (<9%) is characteristic of Lazurnaya, Malvina, Snegir, Slavyanka varieties, high – Omega, Pushkinskaya. Organic acids have a significant impact on the taste of both fresh berries and their processing products, as well as on the processing technology. Titratable acidity ranged from 2.21 to 3.42%. Slavyanka and Snegir varieties are characterized by the low level of titratable acids.

| Varieties      | Average fruit weight, g | Dry matter, % | Sum of sugars, % | Titratable acidity, % | Ascorbic acid, mg % | Flavonols, mg % |
|----------------|-------------------------|---------------|------------------|------------------------|---------------------|---------------|
| Lazurnaya (control) | 0.8                    | 13.0          | 8.1              | 2.71                   | 43                  | 280           |
| Malvina        | 1.1                    | 10.0          | 8.2              | 3.42                   | 50                  | 267           |
| Omega          | 0.9                    | 14.0          | 9.4              | 3.24                   | 34                  | 293           |
| Pushkinskaya   | 1.2                    | 14.5          | 11.4             | 2.90                   | 50                  | 324           |
| Slavyanka      | 1.4                    | 9.5           | 7.4              | 2.21                   | 107                 | 290           |
| Snegir         | 1.5                    | 10.1          | 8.5              | 2.39                   | 49                  | 270           |
| x±m            | 1.15±0.01              | 11.9±0.47     | 8.4±0.32         | 2.80±0.11              | 55.5±2.06           | 287±20.51     |
| Variation coefficient, % | -                      | 9.4           | 22.8             | 13.5                   | 24.5                | 28.8          |

The consumer market and the food industry pay special attention to the increased content of vitamins, polyphenols and antioxidant activity of vegetable raw materials. Vitamins are vital and essential substances for the human body that regulate the metabolism. Ascorbic acid, the source of which is plant products, is particularly important. The daily adult need for vitamin C is 70-100 mg. The limit of ascorbic acid accumulation in the fruits of the studied varieties was 34-107 mg%. The Omega variety lost ranked below the control variety Lazurnaya in this indicator. The Slavyanka variety should be distinguished as a source of vitamin C.

Bioflavonoids that prevent the formation of blood clots, the accumulation of cholesterol and the aging of the body have the anti-radiant effect. Honeysuckle berries have a dark blue, purple color. Biochemical assessment of flavonol content showed a variation of 270-324 mg%. The high level of accumulation of flavonols is characteristic of Slavyanka (290 mg%), Omega (293 mg%) and Pushkinskaya (324 mg%). A distinctive feature of Lonicera edulis L. berries is the ability to enhance the joint therapeutic effect of ascorbic acid and P-active substances (synergism).

In modern conditions, vegetable raw materials are widely used in the production of functional products. V.F. Vinnitskaya, O.V. Perfilova (2018) highlight an important role of vegetable raw materials of local flora, including using low-prevalence garden crops – sources of antioxidants, polyunsaturated fatty acids, prebiotics, dietary fibers [12, 13].

Michurinsk State Agrarian University is engaged in research on the development of recipes and the creation of functional food products for various groups of the population, primarily for people concerned with a healthy lifestyle, people with metabolic disorders and impairment of body functions. The products in this category also include soft drinks intended for daily consumption thus reducing the risk of diseases and improving health. Drinks enriched with biologically active components do not increase the energy value of nutrition.

Among global epidemics, the World Health Organization (WHO) highlights adult obesity and childhood overweight. The prototypes of “Honeysuckle” fruit drink and low-calorie jam (reduced amount of sugar) with increased content of ascorbic acid and flavonols were prepared from the berries of Slavyanka and Pushkinskaya varieties in the laboratory of functional food products. The obtained healthy food products have high organoleptic properties, attractive color, thirst-quenching properties.
4. Conclusion
The studied honeysuckle varieties are characterized by their coarseness and dessert taste of fruits.

The differences in the biochemical composition of freshly harvested honeysuckle berries were established. High content of titratable acids (2.21-3.42%), sufficient accumulation of sugars (7.4-11.4%), high content of ascorbic acid (34-107 mg%) and flavonols (270-304 mg%) are typical for the above fruits. Slavyanka and Pushkinskaya varieties have high levels of ascorbic acid and flavonols in the conditions of the Central Chernozem Region, which indicates their high nutritional value and functional orientation of honeysuckle berries as raw materials for the production of healthy foods.

The prototypes of “Honeysuckle” fruit drink and low-calorie jam from berries of Slavyanka and Pushkinskaya varieties have high antioxidant activity.

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