Edible honeysuckle as a source of fruits promising for new functional food products development

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Abstract. The possibilities of introducing honeysuckle berries into the plant-based functional product being developed as a component that enriches its composition are discussed basing on initial results of an experimental evaluation of the introduction of original lozenges based into the diet of laboratory animals (rats). The lozenges were prepared using apple pulp with the addition of mixed berries of five honeysuckle varieties (Berel, Sinichka, Moskovskaya M103 (L. caerulea varieties), Kamchadalka and Chelyabinka (L. kamtschatica varieties). The most variable for used berries was the sugar content in the juice (from 8 to 11%), somewhat less the content of the ash component and the amount of phenolic compounds differed, but dry matter content (about 12% for all varieties) was similar. The highest polyphenols accumulation was detected for Sinichka variety (8.3 mg/g fresh fruit weight). The two-month consumption of functional lozenges with honeysuckle in a volume of 50% of the daily diet led to a decrease in systolic pressure in the experimental group of rats by 19% compared to the control. Also this diet resulted in less weight gain in experimental animals, their body weight was 30% less than that of control rats after a two-month exposure.

1 Introduction

The so-called edible honeysuckle that gives tasty fruits is relatively young cultivated plant, although the local population of the Far East and Siberia has traditionally harvested wild honeysuckle (edible, blue, Kamchatka species). For the first time it was introduced into cultivation as a berry plant in 1884 in Nerchinsk city [1]. The creation of honeysuckle varieties has begun from the 1940s to the 1960s in the leading breeding centers of our country [2]. Until the 21st century, honeysuckle was assessed as a crop for amateur gardening with the earliest berries ripening. At that time the leading directions of its selection were the achievement of dessert taste and large-fruitedness [3]. In recent years, the honeysuckle culture has been spreading to more southern regions, for which it is important to prevent fruit fall and secondary (autumn) flowering. During industrial cultivation, it is desirable to acquire varieties characteristics that facilitate mechanized harvesting [4]. For a long time, honeysuckle remained mainly a “Russian” crop, later Japan joined its selection and

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cultivation, and in the last years - Canada and the USA [5-9]. The growing interest in honeysuckle fruits is associated with their unique composition, including the presence of record high concentrations of ascorbic acid and bioflavonoids.

The beneficial effect of phytooxidants with various molecular structures, including flavonoids, on the human body has been widely confirmed. This attracts plant breeders and specialists involved in the development of new forms of food products to plants that are sources of bioflavonoids. The berries in the broad sense of the word, used both fresh and in various forms of processing, are the richest source of phytoantioxidants, but many of these fruits have a delicate texture, do not tolerate storage and transportation well, and easily spoil due to their high water content [10]. The development of functional food products with berry additives is highly promising; they can be whole berries and substances extracted from them [11]. The collective name “edible honeysuckle” essentially unites several botanical species (Lonicera edulis Turcz. ex Freyn., L. caerulea L., L. kamtschatica Pojark.). In the Botanical Garden of Samara University, the formation of a collection of honeysuckles began in 1945. Currently, the collection of edible honeysuckles includes 20 taxa: 1 species, 1 subspecies and 18 varieties; There are 5 new varieties at the nursery, they will join the collection in the spring of 2024. The height of the honeysuckle bushes in our collection is is 0.8-1.3 m what is less than those growing in more humid areas. The honeysuckles presented in the collection are absolutely resistant to winter frosts, temperature changes in winter, and early and late spring frosts. They bloom profusely every year and produce high yields. In dry years, which are becoming more common, additional watering of the plants is necessary 3-4 times per season. Pests and diseases are not observed. Honeysuckle fruits ripen in the Samara region earlier than other fruits and berries. It blooms on average in the first ten days of May and ends flowering in the middle of the second ten days of May. In favorable weather conditions, the fruits of some varieties are ready for consumption at the end of May. The taste qualities of the fruits presented in the collection of varieties are very high. In the last decade, this culture has been spreading very quickly throughout summer cottages and private household plots.

The article presents the initial results of an experimental evaluation of the introduction of original lozenges based on apple pulp with the addition of honeysuckle berries into the diet of laboratory animals (rats).

2 Research methodology

The goal of the work was to identify the possibilities of introducing honeysuckle berries into the plant-based functional product being developed as a component that enriches its composition. The objectives of the study included: preliminary estimation of dry matter, soluble phenolic compounds, sugars and ash total content in berries; preparation of a food product in the form of lozenges based on plant components; the use of fruit lozenges as an experimental additive to the diet of laboratory animals (rats); assessment of the effect of additives on the weight and blood pressure of animals.

Materials and methods.

The following honeysuckle fruits were used in the work: Berel, Sinichka, Moskovskaya M103 (L. caerulea varieties), Kamchadalka and Chelyabinka (L. kamtschatica varieties)

Determination of dry matter content in fruits was carried out by the method of repeated weighing, soluble phenols - by the Swain-Hillis method with the Folin-Ciocalteu reagent in a dropwise modification, sugars - by refractometry, the ash component - by the gravimetric method using dry ashing in a muffle furnace.

After a preliminary assessment of a number of indicators of honeysuckle berries, they were used (without sorting by varieties) to prepare an experimental functional product based on locally produced apple pulp (Kuibyshevskoye variety) using food agar (Pudov company)
as a binding agent. The product intended for experiments on animals was prepared according to the basic method for strawberry marshmallow by drying from a mixture of ground apple pulp and agar (30:1) (placebo option), as well as apple pulp ground in a mortar to form a paste of edible honeysuckle berries and agar (20:10:1) (experimental product).

The experiment was carried out on male rats fed a diet with honeysuckle and diets considered normal, with a predominance of cereals.

Twelve mature male rats weighing 260-300 g were divided into two groups - six individuals in each group. Animals were kept in separate cages in vivarium conditions, under natural light and had free access to food and water. Male animals in the control group received a diet according to traditional feed standards [12], with the addition of placebo lozenges (apple agar mass only), which the animals could freely consume along with the traditional diet (up to 30% of the total amount of food in caloric equivalent). For the animals of the experimental group, a diet was prepared in which “functional” lozenges (apple agar mass with the addition of honeysuckle berries) were used as additives in a volume of 50% of the daily diet (in caloric equivalent). After one and two months, the blood pressure and weight of the animals were measured.

The CODA Monitor device (Kent Scientific Corporation) was used to record hemodynamic parameters of systolic pressure (SD), diastolic pressure (DP), mean pressure (MAP), heart rate (HR), and minute blood volume (MBV). The animals were previously accustomed to being in an occlusive cuff to avoid additional stress. Due to the fact that the indicators of the cardiovascular system of rats are quite labile, the indicators in animals were recorded 6-8 times, then the mode of the indicator was calculated.

Statistical data processing was carried out using the SigmaPlot 12.5 program (SYSTAT Software). The normality of the distribution of data in the samples was determined using the Shapiro-Wilk test; the homogeneity of the distribution of samples was assessed using the Levene test. To compare samples, paired and unpaired t-tests, Mann–Whitney tests, and Wilcoxon tests were used. Differences with a level of p<0.05 were considered significant.

3 Results and discussion

3.1 Results

The content of some components of berries composition for 5 varieties of honeysuckle is presented in Figure 1. It can be noted that with a fairly similar dry matter content (about 12% for all varieties), the most variable was the sugar content in the juice (from 8 to 11%), somewhat less the content of the ash component and the amount of phenolic compounds differed. The highest accumulation of polyphenols was detected for the Sinichka variety (8.3 mg/g fresh fruit weight).

As can be seen from Figure 2, two-month consumption of functional lozenges with honeysuckle in a volume of 50% of the daily diet leads to a decrease in systolic pressure in the experimental group of rats by 19% compared to the control (p <0.05).

In addition, this diet resulted in less weight gain in experimental animals. After a two-month exposure, their body weight was 30% less than that of control rats (p<0.01).
Fig. 1. The content of some components in honeysuckle berries (harvest 2023, Samara city).

Fig. 2. Changes in systolic (Syst.) and diastolic (Diast.) pressure (in mm Hg), as well as body weight (g) in rats of the control and experimental groups. Legend: p<0.05; p<0.01.

Measurements of blood pressure and weight of male rats a month after the transition to the experimental diet did not show significant differences in these indicators. Thus, the effect we obtained is the result of long-term use of the experimental diet and is cumulative in nature.

3.2 Discussion

High blood pressure is a risk factor for many pathological conditions and diseases of the cardiovascular system. One of the significant factors in the development of arterial hypertension (AH) is poor nutrition [13,14]. The risk of hypertension increases in proportion to the salt and fat content of the diet, especially some saturated fatty acids; the decrease is associated with sufficient consumption of complex carbohydrates and fiber [15,16].
Studies fulfilled around the world as part of the Dietary Approaches to Stop Hypertension (DASH) program have shown: - a diet rich in fruits, vegetables and low-fat dairy products (combination diet) reduces BP: SBP - by 11.4 mm Hg. Art., DBP - by 5.5 mm Hg. Art. within 8 weeks; - the combination diet and reduction in sodium intake had the greatest effect on reducing blood pressure: SBP decreased by 8.9 mmHg. Art., DBP - 4.6 mm Hg. st.; - the combined diet significantly influenced lipid metabolism, reducing the level of total cholesterol, LDL and triglycerides; - consumption of calcium and potassium with food reduces blood pressure more than the inclusion of supplements of these mineral elements with medications in the diet [17].

When formulating nutritional recommendations for patients with arterial hypertension, it is advised to focus on the amount of total fat in the diet (mainly animal products containing cholesterol and saturated fatty acids) in favor of reducing it to 3-5 grams per day. It is recommended to additionally enrich the diet with dietary fiber and foods containing polyunsaturated fatty acids [17, 18].

Studies on the effects of adding fiber-rich foods to the diet have shown that fiber intake can lower blood pressure in rats. Moreover, certain fibers may improve blood pressure in patients with hypertension and prehypertension [19].

A meta-analysis shows that increasing fiber by approximately 17 g/day reduces systolic blood pressure by 1.15 mmHg. Art. and diastolic by 1.65 mm Hg. Art., and soluble fiber exhibits a stronger effect than insoluble fiber. One possible approach to increasing the amount of protein and fiber in the daily diet may be to include legumes, foods rich in protein and fiber [20].

4 Conclusions

Our research clearly demonstrates that a diet in which half of the daily ration is replaced with a product rich in plant fibers and polyphenolic compounds (ripe apple pulp enriched in fiber, to which honeysuckle berries are added as functional food components, containing anthocyanins, proanthocyanidins, catechins, flavonols, flavones, hydroxycinnamic acids, ascorbic acid, etc.), leads to a significant decrease in blood pressure and body weight in experimental animals compared to rats that consumed lozenges with apple plant fibers with free access to other foods. Our data are confirmed by literature sources. Thus, a product enriched with honeysuckle fruits can be considered functional and its use in the diets of people seeking to maintain physiological body weight and normalize blood pressure can be recommended.

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