

Rational use of local wild plant raw materials in food industry

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Abstract. The paper presents main modern trends in the field of resource conservation and ensuring sustainable consumption and production models in food industry. On the example of burdock root, the possibility of the use of wild plants for ensuring above-mentioned models is studied. In the study, formulation and production technology of “Burdock root – Raspberry” drink were developed and substantiated. The raw material used for the drink was evaluated on microbiological indicators, and the results showed the safety of used ingredients. The optimal ratio of the main drink ingredients was determined by mathematical modeling using the MatLab software product. The obtained drink was evaluated on its sensory characteristics using expert assessment method. Evaluation of burdock influence on the quality of experimental drink sample showed that it had higher sensory characteristics compared to control sample because of its lower astringency. The use of burdock root as a food additive in drink production technology will expand the range of drinks and improve their nutritional value and consumer characteristics.

1 Introduction

Various resource-saving technologies, sustainable consumption and production models are developed and introduced into practical work of public catering enterprises worldwide. For example, about 1500 public catering enterprises in Russia serve drinks as takeaway production using cups, which belong to consumers, instead of disposable cups. For example, the “Vegan Day” restaurant in Kazan provides a 10% discount on a drink served in the consumer’s cup and offers metal drinking straws instead of plastic ones [1].

Some years ago, Dan Barber, American chef, launched a project called “WastED”. The purpose of the project is waste-free production in public catering enterprises. For example, beet wastes are used in the project for vegetarian burgers preparing [1].

Also, one of the approaches for sustainable consumption and production models in the food industry is the use of local raw materials. This allows raw materials cost reduction and enrichment of population diet with essential nutrients of non-synthetic origin.

In several regions of Russia gathering and preservation of medicinal plants and food forest resources is an important source of livelihood for local population. Today, there is a tendency to reorient Russian Federation economics towards agriculture development and import

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substitution. So, food forest resources can make a significant contribution in ensuring food security of the country [1].

Because of climate features in Western Siberian region, cultivation of several plant species can be difficult. Therefore, wild plants grown in the region are very valuable.

Herbaceous wild plants can be divided into salad and vegetable plants depending on their vegetative edible part (Fig. 1). The list of plants in each group is very wide. For example, in early spring, more than 10 types of plants can be used in Siberia for salads preparing. These plants can be wild garlic, plantain, chickweed, chicory, etc.

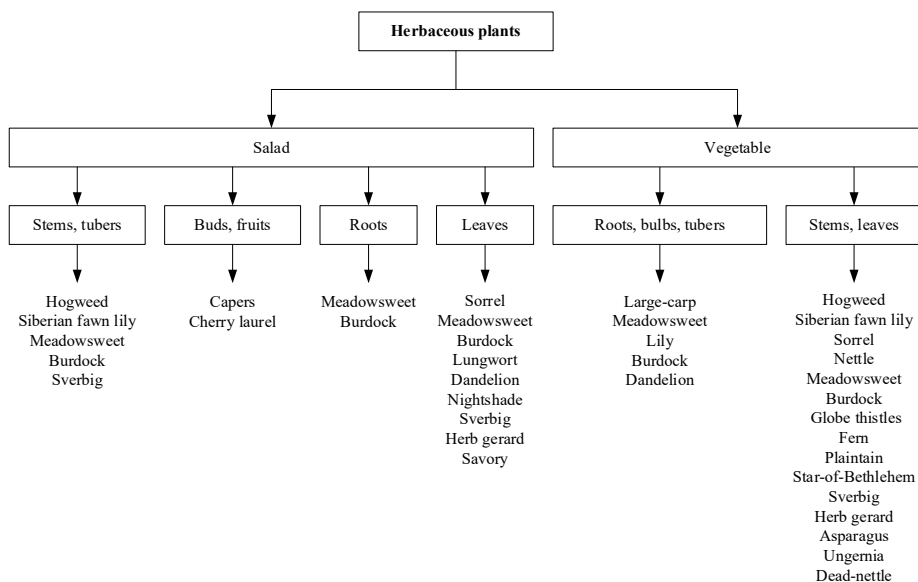


Fig. 1. Classification of herbaceous food plants

Mineral composition of the plants is quite diverse and is determined by their biological characteristics. So, the plants are used for nutraceuticals and biologically active food additives. The main advantage of the plants is that they contain microelements in the most accessible and digestible form common for living nature.

Wild plants are also used as a base for tea mixes and drinks. The basic principle of creating such drinks is the maximum use of extractive and biologically active substances of food plants (Table 1) [1, 3, 4].

Table 1. Vitamins content in herbal wild plant raw materials

Raw materials	Vitamins content, mg/100 g						
	B ₁	B ₂	B ₃	B ₆	PP	C	β-carotene
Ramson	0.02	0.14	0.01	0.20	28.00	120.0	4.0
Sorrel	0.01	0.02	0.01	0.07	21.00	147.0	2.5
Nettle	0.02	0,06	0.04	0.18	30.00	150.0	20.0
Oregano	0.03	0.03	1.00	1.04	40.00	160.0	1.0
Burdock petioles	0.11	0.22	0.08	0.91	0.22	48.0	1.8
Burdock root	0.01	0.03	0.30	0.24	0.30	3.0	0.2

In the paper, the possibility of the use of burdock root for the enrichment of coffee drinks is studied.

Burdock root is an official pharmaceutical raw material, which improves insulin secretion, so it is recommended to use for diabetes treatment. [5, 6]. It also has got high antioxidant activity [7–12].

2 Materials and Methods

The main of criteria for food products choice is sensory characteristics. The next criteria are chemical composition and nutritional value of the products. So, the ratio of drink ingredients was estimated on sensory evaluation of the product.

For sensory evaluation, a method of expert assessments – direct ranking method was used. During the evaluation, the experts were asked to rank randomly submitted coded drink samples in order of increasing or decreasing intensity of the assessed characteristics [11].

There was carried out the analysis of 3 drink samples with various ratios of incoming ingredients. The samples were evaluated by 15 experts according to 5 indicators: appearance, consistency, color, taste and smell.

For checking the experimentally obtained ratio of drink ingredients, a mathematical modeling method by the MatLab software product was used.

The following ingredients for the development of drink formulation were chosen: burdock root, roasted coffee, raspberry juice, sugar.

The ingredients were prepared according to the “Collection of Technological Standards for Public Catering Enterprises” and technological recommendations for imported raw materials. Russian national standard GOST 31987-2012 “Public catering. Technological instructions of products of catering. General requirements for lay out development and composition” was also used.

Production technology of the drink consisted of the following stages.

1 stage – preparing of ingredients: sugar sifting, raspberry juice straining, grinding of coffee beans and burdock root. Adjusting the grinding degree follows the rule: the finer the grind, the more pronounced are all the flavors contained in the raw material. The presence of pronounced bitterness in coffee beans becomes more pronounced with decrease of grinding. The sourness also becomes more pronounced as the grinding decreases. The main thing in the grind adjusting is to find balance and sweetness.

2 stage – brewing. The required amounts of prepared burdock root and coffee are put into a French press, filled with hot water at 96–98 °C and left for extraction for 3–5 min.

3 stage – portioning. The brewed drink is filtered directly into a coffee cup using a French press mesh filter. Raspberry juice and sugar are added to the drink and mixed. The drink is served hot.

Study of microbiological indicators is an important stage in quality and safety control of food raw materials and food products. Standard data for their monitoring are regulated in Customs Union Technical Regulations on safety of food products (CU TR 021/2011).

In ground roasted coffee and burdock root the quantity of mesophilic aerobic and facultative anaerobic microorganisms was determined as microbiological indicator. The determination method is based on the ability of the microorganisms to grow on nutrient media of a certain composition at 30 °C with the formation of colonies, which are visible at double magnification.

The samples were prepared using single dilution method. Then 1 ml of the sample was inoculated using the “deep method” into a nutrient medium of 2% agar. After the agar solidification, the plates with the inoculations were placed into a thermostat with bottom up and incubated at 30 °C for 72 h.

3 Results and Discussion

Within the study, the optimal ingredient ratios for “Burdock root – Raspberry” drink were determined: dried burdock root – 18 g, roasted coffee – 9 g, water – 380 g, raspberry juice – 10 g, sugar – 10 g.

Sensory evaluation of the drink showed that it has sweetish herbal taste and slight smell of nuts and coffee. It also has higher sensory characteristics compared to traditional coffee drink because of reducing its astringency.

In Table 2, the data information matrix for “Burdock root – Raspberry” drink formulation is presented.

Table 2. Data information matrix for “Burdock root – Raspberry” drink formulation.

Formulation ingredients	Index, X_i	Water soluble substances content, %	Magnesium content, mg/100 g	Inulin content, g/100 g
Roasted coffee	X_1	21.6	200	–
Dried burdock root	X_2	58	38	37.5
Raspberry juice	X_3	7.2	22	0.75

The required values of specific weight for each type of ingredients used for in the drink formulation were determined as X_1 , X_2 , X_3 .

The problem conditions were to find the required values of X_1 , X_2 , X_3 , when $F(x) = \max \{21.6 \cdot X_1 + 58 \cdot X_2 + 7.2 \cdot X_3\}$ subject to the following conditions:

- inulin content is not less than 1.25 g (15% from required daily intake):

$$37.5 \cdot X_2 + 0.00075 \cdot X_3 \geq 1.25;$$

- magnesium content is not less than 0.4 g: $0.2 \cdot X_1 + 0.038 \cdot X_2 + 0.022 \cdot X_3 \geq 0.4$;

- obtaining of production unit: $X_1 + X_2 + X_3 = 1$.

The given problem is a linear programming problem. Its solving allows to determine values of specific weight X_1 , X_2 , X_3 .

Based on the data from Table 1, a linear balance equations system was formed. Its solution has the following results: $X_1 = 0.320$; $X_2 = 0.625$; $X_3 = 0.055$.

The obtained results correspond to the developed formulation of “Burdock root – Raspberry” drink.

Study of microbiological indicators shows the safety of the ingredients used. Coffee sample had only 1 colony, which was round, flat and homogeneous. Burdock root sample had 34 colonies, which were evenly distributed, round and homogeneous. Quantity of colonies in burdock root is determined by the specifics of non-traditional plant raw materials. however, this indicator does not go beyond the value regulated by CU TR 021/2011 for dry plant materials mixtures used for hot non-alcoholic drinks preparation – $5.0 \cdot 10^5$ CFU/g.

4 Conclusion

During the study, the optimal ingredients ratio for “Burdock root – Raspberry” drink formulation was determined. These values were confirmed by mathematical modeling method using the MatLab software product.

Study of microbiological indicators of the ingredients used showed their safety, because all values did not exceed the values established by regulatory documentation.

In further research, it is planned to conduct studies on the safety of finished products, confirm quality indicators based on determining the inulin content using high-performance liquid chromatography, and confirm the functional properties of the developed drink formulation.

Development of new kinds of drinks based on wild food plants allows to expand the range of hot drinks, improve their nutritional and biological value due to using nutrient-rich

ingredients, decrease their energy value due to replacement of sugar with inulin, improve their consumer characteristics and prove the functionality of the developed drinks.

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