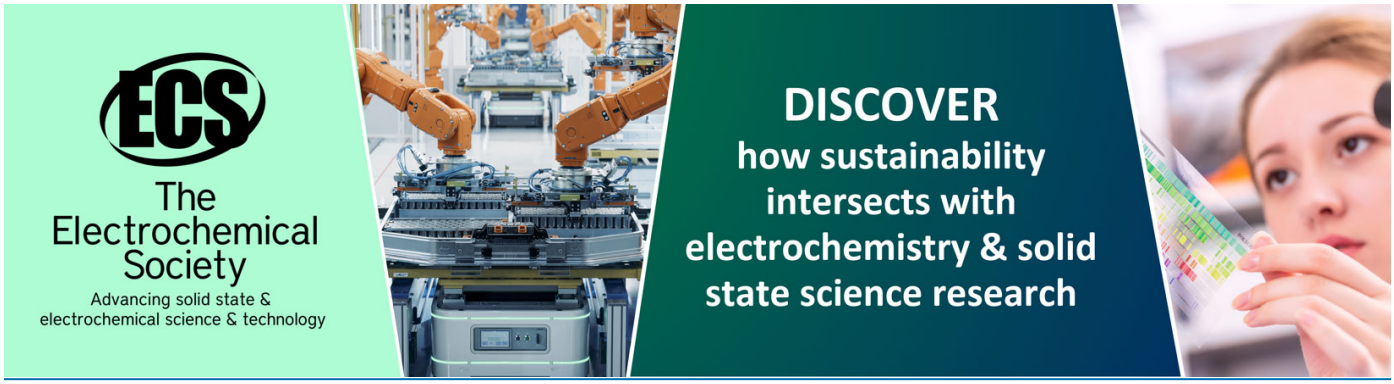
Solving the Problem of Food Security of the Amur Region by Developing Functional Food Products Using Local Raw Materials



Solving the Problem of Food Security of the Amur Region by Developing Functional Food Products Using Local Raw Materials

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Abstract. One of the main tasks of the state is to ensure food independence and security. Achieving food security in a particular region is possible, among other things, through the production of healthy food based on local agricultural and wild-growing raw materials. The agricultural sector of the Amur Region is characterized by large volumes of production of non-genetically modified soybeans, and wild berries grow on the territory of the region. These raw materials can be used for the production of functional foods. One of the promising objects for enriching the chemical composition and imparting the properties of a functional food product are jelly desserts. The article investigates the possibility of obtaining gelatinous soy-based desserts using wild berries, a sweetener and a structurant. The inclusion of these components in the recipe allows you to get desserts enriched with vegetable proteins, fats, carbohydrates, minerals and vitamins. Protein gelled desserts prepared according to the developed technology and recipes were highly appreciated in terms of organoleptic characteristics, they have a pleasant appearance and color, strong jelly-like consistency, light fruity aroma, moderately pronounced natural sweet taste and pleasant aftertaste.

1. Introduction

Food security is an integral part of the economic security and independence of any state. One of the most important conditions for ensuring the food security of the Russian Federation is improving the quality and reducing the cost of food products through the use of domestic agricultural raw materials [1, 2]. At the same time, the food security of the region is the main tool for the development of socio-economic processes in the region.

The main strategic goals and objectives of ensuring food security, reflected in the Food Security Doctrine of the Russian Federation, are physical availability of food, that is, the possibility of consumers purchasing safe and high-quality food products, as well as expanding the range of healthy food products (mass consumption products with a reduced fat content, salt and sugar, with a high-quality chemical composition) [3, 4]. Given the limited shelf life of some types of food and the associated transportation difficulties, it is necessary to ensure the production of food directly in the region, using local raw materials.

Today in the Amur Region there has been an active growth in industrial production and the development of the agricultural sector. This entails an increase in the population's demand for food products, including functional purposes. Considering the fact that more than 40% of Russian soybeans

are produced in the region, as well as a significant amount of wild-growing raw materials, in the Amur Region, it is possible to establish the production of healthy foods rich in protein, minerals and vitamins [5, 6].

The production of functional food products is based, first of all, on the exclusion of ingredients that are harmful to health from the composition of mass consumption products, or their replacement with components containing nutrients useful for the human body.

Some of the most promising for enrichment are sweet dishes, which have always been in demand by consumers due to their taste characteristics. A large assortment group of sweet dishes is represented by jelly-like dishes, which, when cooled, have a persistent jelly-like, delicate texture and pleasant taste [7-11]. For the preparation of gellied desserts, gelling agents are used - gelatine or agar. The possibility of creating useful and affordable gellified desserts consists in using high-grade raw materials and introducing safe food additives into the composition [11].

Soybean grains can be a high quality raw material for making sweet dishes. It contains valuable protein substances with an almost complete amino acid composition, a significant amount of fat with a high-quality composition of fatty acids, carbohydrates, including dietary fiber, a large amount of minerals and vitamins [12-14].

The health benefits of lingonberry berries are in its immunostimulating, anti-inflammatory, diuretic effect on the human body, since lingonberry contains a significant amount of organic acids, vitamins (C, E, group B, carotenoids), minerals (sodium, potassium, calcium, phosphorus, iron and others) and tannins [15].

At the same time, bog whortleberry are a valuable source of many biologically active substances (bioflavonoids, organic acids, pectin substances, vitamins (C, B_1, PP, P, carotene), minerals (sodium, potassium, calcium, magnesium, phosphorus and iron). The chemical composition has an antitumor effect and makes it possible to recommend bog whortleberry for atherosclerosis, hypertension, rheumatism, sore throat, anemia, blood diseases, etc. [16].

Using soy grains, wild berries as a source of vitamins and minerals, a sweetener and a gelling agent, you can get high-quality protein gelling desserts for functional nutrition.

2. Materials and methods

2.1 Materials

The objects of research were the main types of raw materials used: soybean grain of the Amur selection Kruzhevnitsa (GOST 17109, TR TS 015/2011) grown in the Tambov district of the Amur region, wild berries of lingonberries, bog whortleberry, collected in the Zeysky district of the Amur region, food additive E 955 - the sweetener sucralose (GOST R 53904), the food additive E 406 - the structure-forming agent agar-agar Grasar (manufactured by OOO BARGUS production, Russia), as well as gelled desserts prepared with their use.

2.2 Methods

When performing the research, standard and special methods were used. Physicochemical and organoleptic indicators were studied according to standard methods: GOST 55462, GOST 34551, GOST 31902, GOST 55624, GOST 24556, GOST R 54634, GOST R 54058. The chemical composition of raw materials and finished products was investigated by spectrometry in the near infrared region on IR- scanner "FOSSNIRSystem 5000". Mass fraction of fat by infusion with a solvent. Acidity by titration with alkali, pH by potentiometric method. Content of vitamin C, carotenoids by titrimetric method with potentiometric titration, mass fraction of vitamin E using high-performance liquid chromatography, total amount of vitamin PP by colorimetry. The energy value of the obtained products was determined using the Rubner coefficients. To assess organoleptic indicators, five-point scales were developed with an accurate description of the evaluated indicators. Evaluation was made at tasting meetings.

3. Results and discussion

In the process of experimental studies, soy protein suspension - soy "milk", which was obtained as follows, was taken as the main component of the recipe for gelled desserts. Soy grains were soaked in water for swelling, then washed and a suspension was prepared from it by grinding in water with heating, filtration to separate insoluble substances – okara [17-19].

Berry puree were made from berries – lingonberries and bog whortleberry. For this, the berries were washed, crushed and rubbed until a homogeneous puree-like mass was obtained.

To prepare the dessert, puree from berries was added to the prepared soy suspension. The presence of organic acids in the berry puree ensures the coagulation of protein and other substances in the soy protein suspension. In the process of coagulation, flocculent particles are formed, which agglomerate and form a dense sediment - a soy-berry protein clot. The resulting bunches were brought to a moisture content of no more than 50% by pressing [17]. Soy-berry protein clot bunches have a pronounced berry taste, color and aroma [18, 19].

Based on the analysis and exploratory experiments, it has been established that the quality of the soybean-berry protein clot (X_1, C, points) in the process of its structure formation is significantly influenced by such factors as the mass fraction of berry puree (X_2, M,%); temperature of thermoacid coagulation (t, ºC) and duration of coagulation (X_3, τ, min) (table 1).

Table 1. Factors and levels of their variation.

Levels	Symbol	Factors		
		M – mass fraction of berry puree, %, X_1	t – temperature of thermoacid coagulation, ºC, X_2	τ – duration of coagulation, min, X_3
Variation interval	E	10	10	1
Top level	+1	40	80	6
Main level	0	30	70	5
Lower level	-1	20	60	4

In this regard, it was necessary to identify the dependence, first of all, of the organoleptic indicators on these factors and to establish their optimal values.

Regression analysis of the dependence $Y = f(X_1; X_2; X_3) \rightarrow max$ made it possible to obtain a mathematical model of the process of obtaining a soy-berry protein clot and assess its adequacy according to Fisher's criterion ($F_R > F_T = 8.05 > 4.77$).

$$C = -24.731 + 0.8509 \cdot M + 0.75115 \cdot t + 2.9250 \cdot \tau - 0.004625 \cdot M \cdot t - 0.03625 \cdot M \cdot \tau - 0.02625 \cdot t \cdot \tau - \\ - 0.0049062 \cdot M^2 - 0.0032127 \cdot t^2 \rightarrow \max$$

Optimal values were: mass fraction of berry puree 36-37%, temperature of thermoacid coagulation 74 ºC and duration of coagulation 4 minutes. With these values, the overall organoleptic assessment of soy-berry protein clot bunches is 24 points (out of 25 possible).

Achieving a sweet taste of desserts is achieved by introducing a sweetener - sucralose (E 955) into the recipe. Sucralose is a safe food supplement isolated from sugar that has a pleasant sweetness, no off-flavors, and a high degree of solubility. The sweetener sucralose is recommended for inclusion in dietary foods and beverages, since it does not affect carbohydrate metabolism and insulin production [20].

To obtain a dessert of a jelly-like consistency, a structurant, agar (E 406), was added to the soy-berry clot [21]. Grasar agar food supplement is a powder obtained from *Gracilaria algae*. Before adding agar to desserts, the powder was soaked in water for 15 minutes, then added to the mixture,

heated to boiling to completely dissolve the agar. The resulting dessert was poured into molds and cooled at room temperature and in the refrigerator for 2-3 hours until a jelly-like structure was obtained. Ready-made desserts were taken out of the molds and served for tasting.

The main objective of the experimental research was to develop a recipe for gelled desserts. When compiling the recipe, we were guided by the principles of forming harmonious organoleptic characteristics of the finished product (appearance, consistency, color, smell and taste). Based on the research results, 2 model recipes have been developed (table 2).

Table 2. Protein gellied dessert recipes.

The name of the ingredients	Quantity, g per 1000 g	
Soy protein suspension		
Soybean grain (soaked)	115.0	115.0
Water	885.0	885.0
Subtotal	1000.0	1000.0
Soy-berry clot		
Soy protein suspension	640.0	630.0
Lingonberry puree	360.0	-
Bog whortleberry puree	-	370.0
Subtotal	1000.0	1000.0
Protein gellied dessert		
Soy-berry clot	986.4	986.4
Sucralose	1.6	1.6
Agar agar	12.0	12.0
Subtotal	1000.0	1000.0

After preparation according to the developed recipes, the gelled desserts were evaluated by organoleptic and physicochemical indicators. Organoleptic evaluation was carried out according to the main indicators: appearance - a homogeneous gelled opaque mass; consistency - a strong jelly-like mass, without exfoliation of the liquid; color - pink-red for soy-lingonberry dessert and dark purple for soy-bog whortleberry jelly; natural smell, characteristic of the berries included in the composition, without foreign odors, with a light berry aroma; the taste is natural, pronounced, harmonious, characteristic of the taste of berries, moderately sweet with a slight sourness, without foreign aftertaste, with a pleasant aftertaste.

Table 3. Physicochemical parameters and nutritional value of protein gelatinized desserts.

Name of the indicator	The name of the dessert	
	soy-lingonberry	soy-bog whortleberry
Mass fraction of dry substances, %	50.0±2.0	
Mass fraction of protein, %	8.5±0.5	
Mass fraction of fat, %	4.5±0.2	
Mass fraction of carbohydrates,%	28.0±1.5	
Mass fraction of minerals,%	5.0±0.3	
Acidity, pH, no more	4.0	
Physiologically functional nutrients, including β-carotene, mg / 100 g	1.3±0.2	1.1±0.2
vitamin C, mg / 100 g	3.0±0.4	15.0±0.9
vitamin E, mg / 100 g	3.4±0.2	3.5±0.2
Energy value, kcal / 100 g	195.0±5.0	

The gellied desserts obtained by the developed technology are characterized by the presence in their composition of proteins, fats, carbohydrates, minerals and other physiologically functional ingredients (table 3).

Evaluation of physicochemical indicators of the quality of protein gelatinous desserts obtained by the developed technology and recipes indicates their high nutritional value and the presence of physiologically functional ingredients in their composition, which makes it possible to use desserts in functional nutrition.

4. Conclusion

Thus, we have developed the technology and formulations of new types of gelled desserts, enriched with vegetable proteins, fats, carbohydrates, vitamins and minerals, without sugar and animal products, suitable for functional nutrition.

Considering the high nutritional value of new types of gellied desserts, they can be classified as healthy food products, and taking into account the significant consumer interest in sweet jelly-like dishes, the resulting products can be recommended to preserve public health.

The recipe of the developed products provides for the use of plant raw materials that grow on the territory of the Amur Region. The use of local raw materials can contribute to solving the problem of food independence and security in a regional aspect.

5. References

[1] Sibiryaev A S, Zhiltsov S A and Sakhbieva A I 2017 Factor of innovative activity in ensuring food security of the Russian Federation *Bulletin of NGIEI* vol 2 (69) pp 117-124
[2] Timofeeva G V, Akmaeva R I and Aitpaeva A A 2017 Food security of the territory: innovative measurement technologies *Bulletin NSUEU* vol 4 pp 36-43
[3] Smirnov V V 2015 Food security of the regions of the Russian Federation *National interests: priorites and security* vol 3 (288) pp 29-42
[4] Mitrofanova I V, Pyankova S G and Ergunova O T 2020 Conditions and factors for ensuring food security in the region *Economics: Yesterday, Today and Tomorrow* Vol 10 pp 169-190
[5] Babiy N V, Loskutova E V 2015 Innovative approaches to the development of functional drinks Monograph (Blagoveshchensk)
[6] Skripko, O V, Litvinenko, O V and Pokotilo, O V 2016 Methodical recommendations on the use of new soybean varieties of the Far Eastern breeding for the production of functional food (Blagoveshchensk, ODEON)
[7] Gabrieljan D S and Grunskaja V A 2020 Gelatinized dessert products using fractional components of curd whey *Molochnohozjajstvennyj vestnik* vol 2(38) pp 156-168
[8] Rybalova T 2019 Milk desserts: tasty and healthy *Milk river* vol 3(75) pp 12-15
[9] Traksova N, Grin'kina T P 2011 Use of lemon juice in the production of jelly from whey *Success of modern natural knowledge* Vol 7 pp 219-220
[10] Kurbanova M G 2009 Biotechnological aspects of using buttermilk proteins for the production of whipped products *Bulletin of KrasGAU* vol 8(35) pp 138-141
[11] Macejchik I V, Lomovskij I O and Korpacheva S M 2014 Development of technology and formulations of functional gelled masses *Bulletin of KrasGAU* vol 7 pp 190-195
[12] Petibskaya V S 2012. Soybean: chemical composition and use Ed. V M Lukomets *Maikop, Polygraph-Yug.*
[13] Litvinenko O V et al. 2019 Prospects for the use of new soy varieties of selection of the All-Russian Research Institute of Soybeans in the production of a soy-chocolate drink *MSTU bulletin* T 22 vol 3 pp 413-420
[14] Skripko O V, Litvinenko O V and Isaycheva N Yu 2015 Study of biochemical composition of soybean seeds of the Amur selection for use in food industry *Storage and Processing of Farm Products* vol 8 pp 32–35

[15] Serba E M, Volkova G S, Sokolova E N, Fursova N A and Yuraskina T V 2018 Lingonberry fruits are a promising source of biologically active substances *HIPS* vol 4 pp 48-58
[16] Velichko N A, Berikashvili Z N 2016 Research of the chemical composition of blueberry berries and development of drink recipes on its basis *Bulletin of KrasGAU* vol 7 pp 128-131
[17] Skripko O V, Kostrykina S A 2019 Biotechnological aspects of obtaining coagulation structures for functional foods AGRITECH-II-2019 IOP Conf. Series: Earth and Environmental Science 421
[18] Skripko O V, Bodrug N S 2021 Development of Functional Food Technology for Food Security in the Regional Aspect *IOP* Conf. Series: Earth and Environmental Science 666
[19] Skripko O V 2021 The technology for producing a high-protein additive from soy and its use in the formulation of dry mix for baking muffins IOP Conf. Series: Earth and Environmental Science 640
[20] Baranov B A, Dyriva E V and Shishkina D I 2017 Algorithm for using the sugar substitute sucralose in the development of functional drinks *Problems of modern science and education* vol 15 (97) pp 18-22
[21] Pivovarov E P, Kondratjuk N V and Stepanova T M 2016 Features of low-calorie jelly technology development based on polysaccharides *Scientific result. Business and service technologies* vol 3 pp 45-49