N.A. Pogorelova et al /J. Pharm. Sci. & Res. Vol. 9(10), 2017, 1705-1710

ISSN:0975-1459
Journal of Pharmaceutical Sciences and Research
www.jpsr.pharmainfo.in

Defining Qualitative Indicators of the Pumpkin Semi-Finished Product Included in the Confectionary Technology in Terms of Competitiveness

N.A. Pogorelova, E.A. Moliboga
Federal State Budgetary Educational Institution of Higher Education
"Omsk State Agrarian University named after P.A. Stolypin",
644008, Russia, Omsk, Institute Square St., 2

Abstract.

The development and implementation of the latest technologies on producing flour confectionary goods by using functional ingredients contributes to the improvement of the nutritional content of ready products. The work defines chemical indicators of the pumpkin semi-finished product used as an additional raw material for producing oatmeal cookies. Citric acid added when making the pumpkin puree improves the integrity of bioactive substances, such as Vitamin C, reducing sugars, and amine nitrogen. The pumpkin puree is a non-traditional material in the candy manufacture. It contains dietary fibers, vitamins, micro- and macroelements. Pumpkin is characterized by a low content of fiber that is well boiled, soft, non-fibrous, and is well digested as a puree. This scientific article considers the technology of making a pumpkin puree with a citric acid. An increase in the content of the soluble pectin in the pumpkin semi-finished product comes with a decrease in the protopectin. Besides, as compared to the initial raw materials, the content of solids in this semi-finished product increases by 24.6%. The technology of producing oatmeal cookies with the pumpkin semi-finished product was developed. The main qualitative indicators of the ready product were defined. Greater preservation of Vitamin C in the sample with the maximum content of the pumpkin puree in the oatmeal cookies was defined. The quantity of Vitamin C in this sample was 15.75 mg/100 g.

Keywords: pumpkin, pumpkin puree, soluble pectin, protopectin, pectin substances, pastry with functional properties, pumpkin puree in the flour confectionary industry, oatmeal cookies with functional properties.

INTRODUCTION

Goal of the research is to define physical and chemical indicators of the pumpkin semi-finished product made by using different methods, and to develop a technology of producing oatmeal cookies with functional properties.

The Institute of Nutrition of the Russian Academy of Medical Sciences (RAMS) had made the researches that said about the non-balanced nutrition of the majority of the national population, deficit of vitamins (A, B, E, C groups), and the lack of microelements in the food [1, 2]. Due to this, there is a need to expand the range of biologically full and energetically valuable food at the expense of new materials [3]. One of the ways to solve the problem on expanding the raw materials' base for the food industry is to use the local fresh and processed raw materials. This contributes to improving the qualitative content and organoleptic characteristics of the food, and enriches the person's diet with the deficient food and biologically active substances [4, 5].

The Russian confectionary industry produces a rather wide range of goods that includes above 3,000 units. The use of these products as the object of enrichment creates real conditions that ensure the regular consumption of sources of deficient micronutrients by all categories of the population [6].

The main direction in this area is to enrich confectionary goods with fruit-based purees, wheat bran, and products of processing wild berries, pine nuts, and oil cakes [7]. However, the assortment of fruits and berries is not wide. That is why there is the need in the local standard vegetable crops which will allow decreasing the expenses related to transporting and storing raw materials.

New technologies of flour confectionary production based on using vegetables in the form of semi-finished products as additional raw materials allow minimizing expenses for expanding the range of products with the set functional properties that take into account constantly changing requirements of the market depending not only on the price factor but also on a certain region.

Due to this, it is interesting to consider issues on developing the technology of flour confectionary production by using a pumpkin semi-finished product. At the same time the change of the chemical content of food products by using a new plant raw material means the penetration into a traditional technology that must be researched to obtain the necessary technological and consumer characteristics, as well as functional properties of the products [7]. Besides, the raw materials that contain pectin and are added in the dough have an impact on biological, colloid and microbiological processes that take place in the dough.

The use of pumpkin semi-finished products in confectionary recipes is stipulated by dietary and medical properties of the pumpkin. The pumpkin contains vitamins K, E, PP, thiamin, riboflavin, β-carotin and other carotenoid pigments of the pumpkin, as well as mineral substances – potassium, calcium, ferrum, and magnesium. Dietary fibers of the pumpkin flesh (fibers, pectins) have prebiotic, detoxicant and laxative effect [8, 9].

Physical and chemical properties of pectins of raw materials make pastries look attractive, flavor pleasantly, taste well, and prolong the storage time. That is why the use of pumpkin semi-finished products in confectionary production, the main raw materials of which include sugar and fats, is promising. The most optimal way to get a

pumpkin semi-finished product and preserve biologically active substances from the initial raw materials is to process it in the form of puree.

MATERIALS AND METHODS.

The pumpkin grown in the Omsk Region was researched. The standard method of cooking boiled pumpkin puree was taken as the control sample. According to it, the prepared raw materials are boiled to the state required for making a puree. The second method of cooking puree was offered by a number of authors (M.I. Beliaeva, A.A. Dubinina, V.I. Anokhina, etc.). It is recommended for full integrity of bioactive substances. The method provides adding citric acid in the dressing before heating of pumpkin flesh (pumpkin, water, and citric acid as correlated, mass: 1:0.4:0.0012).

The moisture of the pumpkin puree was defined by the gravity method in accordance with GOST 28561-90 [10]. The method of defining vitamin C according to GOST 24556-89 is based on titration with the iodine solution of the extract from the plant raw materials [11].

Amino nitrogens were defined by the copper method [12]. The Cu_3PO_4 suspension was poured in the extract of the plant raw materials, and KJ was added to the acid environment. The produced J_2 was titrated with starch $Na_2S_2O_3$.

The reducing sugars were defined by the iodometric method according to GOST 12575-2001 [13]. The method is based on recovering copper ions to Cu_2O when heating in the Offner basic solution with reducing substances, and the flock moved to the solution with an excess amount of iodine solution. The iodine excess was titrated with sodium thiosulphate. The quantity of reducing sugars is defined by the diversity of the amount of $Na_2S_2O_3$ used for titrating the control and test samples.

Pectin substances were defined by the calcium and pectant method. Pectic acids were settled as calcium salts. This is one of the most accurate methods [14]. At the first stage of defining, pectin substances were extracted from the plant raw materials and transformed into the dilution. The obtained extract of hydrated pectins was used for defining the soluble pectin. At the second stage the flock of protopectin was hydrated with the chlorohydric acid, transforming it into the soluble state. The obtain solution was used to define the content of protopectin. Pectin substances were flocked by $CaCO_3$, and the content of the pectin acid was calculated.

The receipt of the oatmeal cookies with functional properties was developed in the laboratory of the Food and Food Biotechnology Department, and the Central Agrarian and Technological Research Laboratory of the Omsk State Agrarian University Federal State Budgetary Educational Institution of Higher Education.

The quality of oatmeal cookies with different dozes of the pumpkin puree was researched, and organoleptic and physical and chemical indicators were studied. Oatmeal cookies cooked by using the standard recipe were used as the control sample (Table 1). The recipe included the following ingredients: extra wheat flour, oatmeal flocks, sugar, margarine, soda, and salt. The technological process of producing oatmeal cookies used the generally accepted technology.

In order to make the comparative estimation, the method of adding different dozes of the pumpkin puree was used at the stage of making dough - 10%, 20%, 30%, and 40% were added to the flour of the standard recipe.

At the first stage the pumpkin semi-finished product was made.

At the second stage after doughing and forming (Fig. 1), cookies were baked at the temperature of 150°C during 15 minutes, and then after cooling the estimation was made according to physical and chemical, and organoleptic indicators.

The dough moisture in five samples of cookies was the same and made up 18%. According to GOST 25901-2014, the ready samples were used to define water absorption, weight of moisture, alcali content, and content of vitamin C, and amount of reducing sugars. The weight of moisture was defined by the gravimetric method. The alcali content was defined by titrating with the sulphuric acid and bromothymol blue. The method to define the content of vitamin C is based on titrating with the solution of iodine of the extract from raw materials. The reducing sugars were defined by the iodometric method. The method is based on recovering ions of cuprum to Cu_2O when heating in the Offner basic solution with reducing substances, and further transfer of the flock into the solution with the excess iodine solution. The iodine excess was titrated with sodium thiosulphate.

***Table 1*. Standard Recipe of Oatmeal Cookies (Control Sample)**

Raw materials	Content of solids, %	Raw materials per 1,000 kg		Raw materials per 500 g	
		in kind, kg	in solids, kg	in kind, kg	in solids, kg
Wheat flour, extra	85.50	391.00	334.30	195.50	167.15
Oatmeal flocks	85.50	161.00	137.65	80.50	68.83
Sugar	99.85	321.00	320.52	160.50	160.25
Margarine	84.00	164.00	137.76	82.00	68.88
Soda	50.00	7.00	3.50	3.50	1.75
Salt	96.50	4.00	3.86	2.00	1.93
In total:		1,112.00	978.57	556.00	490.55
Output:	94.50	1,000.00	945.00	500.00	472.50

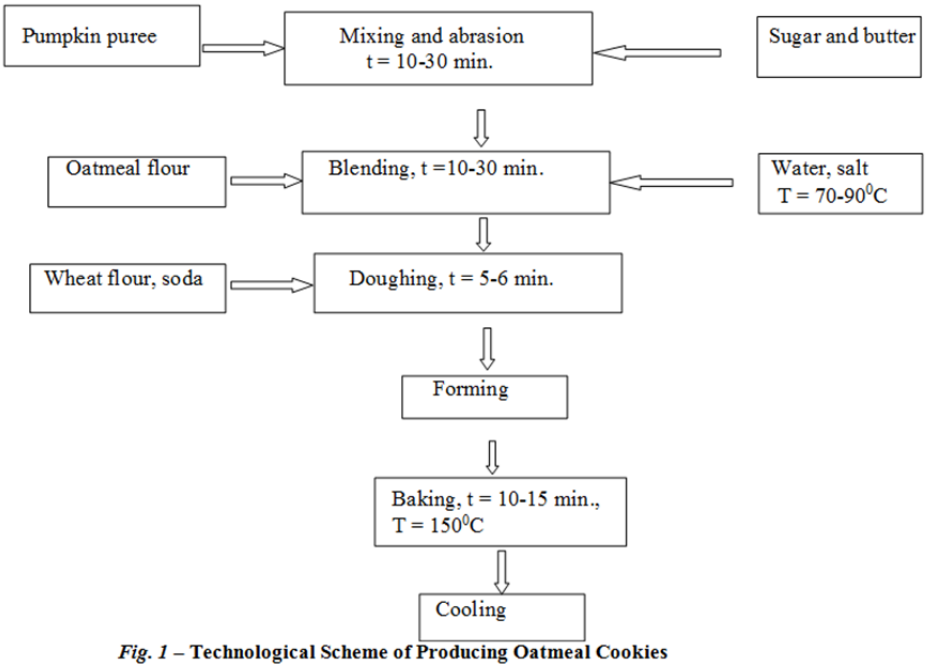

***Fig. 1* – Technological Scheme of Producing Oatmeal Cookies**

RESULTS AND DISCUSSION

The content of solids in pumpkin semi-finished products has increased in comparison with the initial raw material (Fig. 2). The greater amount has been determined for pumpkin puree with citric acid — 7.1%, which is higher than the content of solids by 24.6%, if compared to the initial raw material, and by 7.6% in the puree prepared by the standard method.

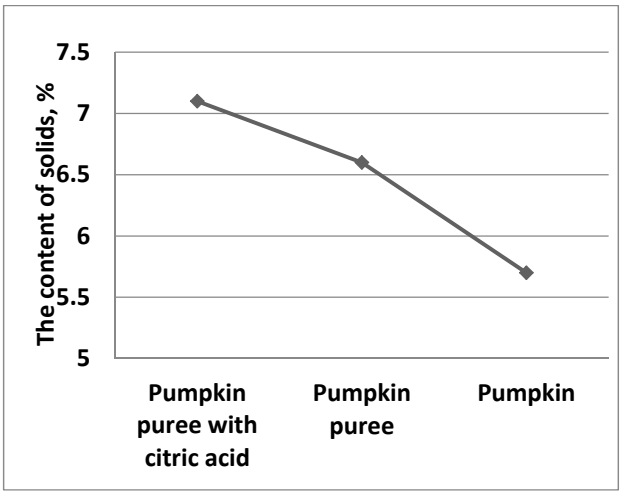

***Fig. 2* – Content of Solids in Pumpkin Puree**

The chemical analysis of pumpkin puree obtained by two methods is shown in Table 2. Amino nitrogen is found in plant raw materials as amino acids, peptides and proteins; its content affects the solubility of plant protein and may influence the intensity of melanoid in formation processes.

The amount of amino nitrogen in pumpkin puree obtained by the standard method was more by 70.0%, if compared to the initial raw material, and in pumpkin puree with addition of citric acid — more by 120.0%. During the thermal treatment of plant raw materials, protein proteolysis and solubility increase, and consequently, the amount of amino nitrogen in the pumpkin puree shall increase too.

The determination of vitamin C has allowed establishing its greater preservation in pumpkin puree with citric acid. Although the content of vitamin C significantly decreased during the mashing after heat treatment with addition of citric acid by 32.8%, if compared to the initial raw material, its amount was more than that in the puree obtained by the standard method by 12.8%. The use of citric acid for manufacturing vegetable semi-finished products prevents the oxidation of ascorbic acid to dehydroascorbic acid (ketone form), which is labile and easily decomposed in plant raw materials.

The content of reducing sugars in pumpkin puree obtained by the standard method did not differ from the initial raw material, and in the pumpkin puree with citric acid the amount of reducing sugars increased by 12%. Such an increase is possible because of hydrolysis of pumpkin polysaccharides to reducing carbohydrates in acidic medium and at a greater temperature while mashing the plant raw material.

While determining the pectin substances, an increase in soluble pectin in pumpkin puree with the simultaneous decrease in protopectin was determined. These changes were more significant for a sample of pumpkin puree with citric acid. An increase in the content of soluble pectin in pumpkin puree may affect the technological properties of both confectionery semi-finished or finished products. Pectin substances interact with functional groups of proteins and flour starch, thus forming heat-resistant protein-polysaccharide complexes, which have an increased hydrophilic ability [15], which may affect the amount of bound moisture and preservation of finished flour confectionery products.

Table 2. **Chemical Composition of Pumpkin Puree**

Indicators	Amino nitrogens, mg/100g	Vitamin C, mg/100g	Reducing sugars, %	Soluble pectin, %	Protopectin, %
Pumpkin	28.0 ± 0.2	5.7 ± 0.3	3.3 ± 0.2	0.479 ± 0.005	0.525 ± 0.005
Pumpkin puree	47.6 ± 0.3	3.9 ± 0.3	3.3 ± 0.2	0.515 ± 0.006	0.498 ± 0.008
Pumpkin puree with citric acid	61.6 ± 0.2	4.4 ± 0.4	3.7 ± 0.1	0.677 ± 0.006	0.463 ± 0.007

Table 4. **Physical and Chemical Indicators of Oatmeal Cookies**

Indicators	Moisture, %	Water absorption, %	Alcali content, %
Control	4.65	180.0	1.8
Sample 1	6.21	200.0	1.6
Sample 2	6.66	216.0	1.5
Sample 3	6.75	218.0	1.4
Sample 4	8.35	244.0	1.4

Thus, the method of mashing pumpkin with citric acid is most preferable while manufacturing semi-finished products. Further studies have been performed as to the quality of oatmeal cookies with a different dosage of this pumpkin semi-finished product.

Alcali content is an important quality indicator that affects the organoleptic characteristics and shelf life of products [16]. When determining the alkali content in the test biscuit samples, it has been found that its value decreases with an increase in the number of pumpkin semi-finished products (Table 4), this change has positively influenced the organoleptic characteristics of the samples.

Humidity of confectionery products is one of the main indicators of commercial quality, which determines their ability to be stored for a long time, without deterioration, acidification and mold formation. Moreover, humidity is the factor that determines the yield of the finished product and its structural and mechanical properties. It is established that when pumpkin puree is added to the oatmeal cookie formulation, the humidity of the finished products increases (Table 4), which can be determined by increasing the amount of pectic substances of the pumpkin semi-finished product having high moisture-binding capacity. Thus, in a sample with a pumpkin semi-finished product content of 40% to the weight of flour of the standard formulation, the humidity is higher by 79.6% compared to the control. According to the study results, all samples of oatmeal cookies meet the standard requirements, which provide humidity of 10.5%. The increase in bound moisture in finished products positively influences the organoleptic properties of finished products.

Largely, the cookie quality depends on the ability to absorb water, while the intensity or speed of this process is of great importance.

Water absorption characterizes the porosity of flour confectionery products. This indicator is standardized depending on the grade of flour used and is not less than 150% [17]. The study results have shown that all samples meet the standard requirements, and increasing the amount of the puree added leads to an increase in the water absorption. Thus, adding 10%, 20%, 30% or 40% of pumpkin semi-finished products to the oatmeal formula shall improve the water absorption by 11.1%, 20.0%, 21.1% and 35.6%, respectively, if compared with the control. The increase in the water absorption values of oat cookie samples shall increase their volume and porosity.

Adding pumpkin puree to the dough of oatmeal cookies has influenced the structure and consistency of the finished products (Table 5). The use of pumpkin puree has led to the change in the color of the products from light straw to orange, which may be explained by the presence of β-carotene. The organoleptic results for all samples as to shape and fracture have been the same. Taste and odor have been more pronounced in samples3 and 4, the surface of these products has been smooth, not burned, without inclusions and crumbs.

Table 5. **Organoleptic Estimation of Products**

Indicators	Control	Sample 1, 10% added	Sample 2, 20% added	Sample 3, 30% added	Sample 4, 40% added
Taste and odor	Expressed, peculiar to the taste and odor of the ingredients included in the cookie recipes, without any foreign taste and odor			Slightly expressed taste and odor of pumpkin	Expressed taste and odor of pumpkin
Form	The form inherent in this kind of vagueness, without dents, blisters and damage to the edge				
Surface	Rough, with sinuous cracks, not scorched, without impregnations and crumbs, single inclusions of not completely dissolved sugar crystals on the surface			Smooth, not burnt, without inclusions and crumbs	
Color	Light straw	Straw	Light yellow	Yellow	Orange
Fracture	Baked, with a uniform porous structure, without voids and traces of undermixing				

The results of the organoleptic evaluation have shown that the sample with the dosage of pumpkin puree of 40% to the weight of flour has the best results and the highest score (Figure 3).

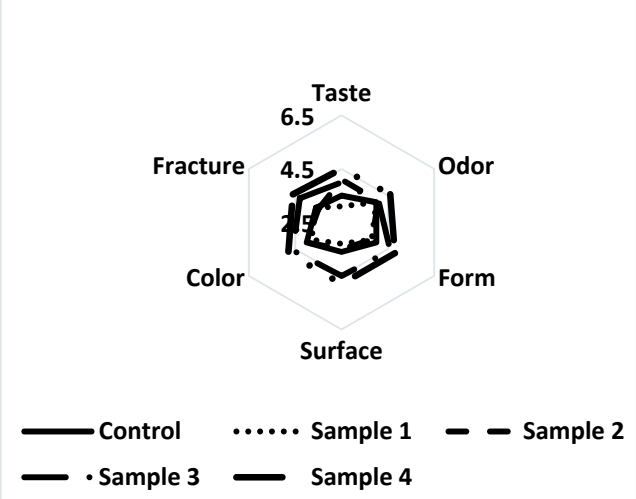

***Fig. 3*– Taste Panel Analysis**

Storage of oatmeal cookies for 5 days at a temperature of 23 ± 30 ^{0}C has shown that a positive effect of using pumpkin puree is a slowdown in the cookies staling (Figure 4). The decrease in moisture content in finished products is less pronounced for Samples 3 and 4, by the end of the fifth day of storage, the moisture loss amounts to 1.91% and 2.07% and is lower than that in the control sample by 50.9% and 55.2%, respectively. Adding pumpkin semi-finished product leads to an increase in the proportion of the most firmly bound moisture due to a greater amount of pectin substances.

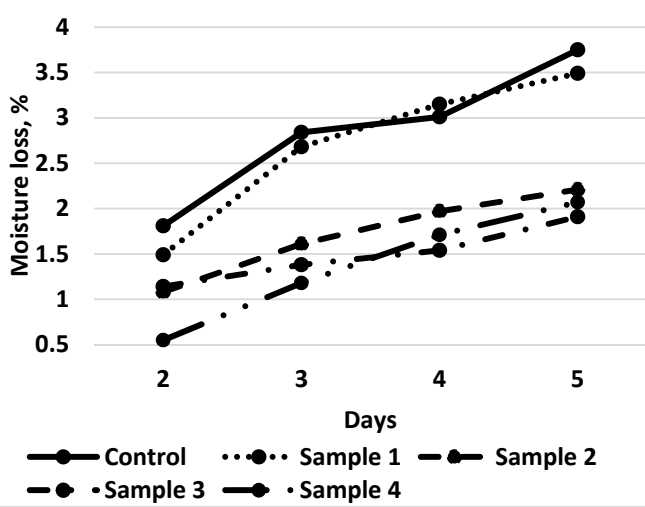

***Fig. 4* – Moisture Loss in Oatmeal Cookies**

A decrease in the content of reducing carbohydrates with an increase in the percentage of pumpkin puree has been determined (Fig. 5). The lowest level of reducing carbohydrates has been determined for the sample with a pumpkin puree content of 40% to the weight of flour, and it amounts to 1.2%, which is below the control by 31%. Such a decrease in reducing sugars is possible due to the greater intensity of melanoidin formation processes when baking cookies and reducing the share of sugar in finished products.

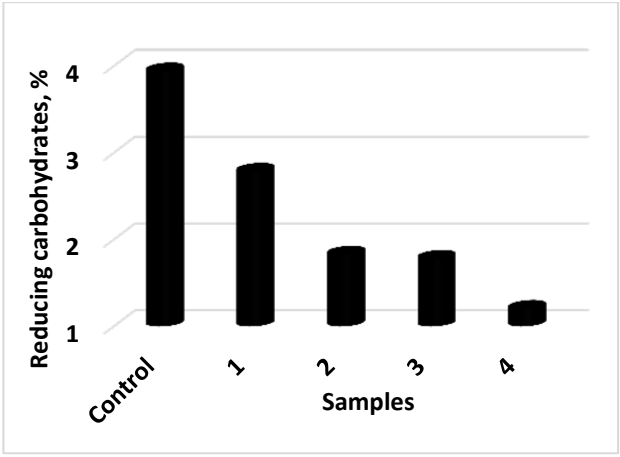

***Fig. 5* – Content of Reducing Carbohydrates in Oatmeal Cookies**

While manufacturing confectionery products, loss of vitamins is possible at the stage of obtaining pumpkin puree, at the stage of preparing the dough (when the mixture is saturated with air bubbles during batching), and during fermentation, proving and baking. Under the influence of air oxygen and temperature, vitamin C is destroyed. Its determination has allowed establishing the greater preservation thereof in the sample with the maximum content of pumpkin puree in the oatmeal cookie (Fig. 6). The amount of vitamin C in this sample equals to 15.75 mg/100 g, which is 450% higher than that of the control sample.

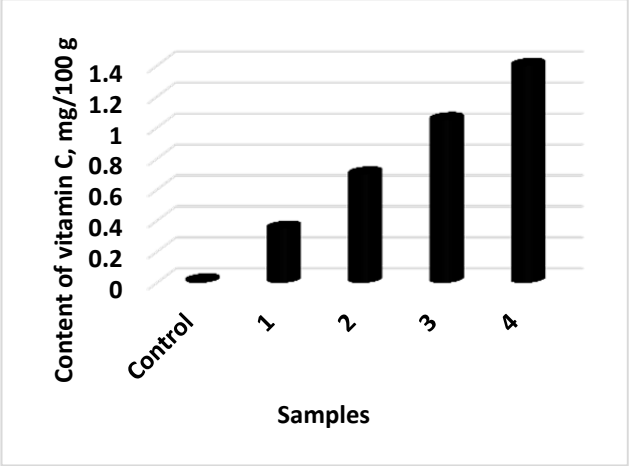

***Fig. 6* – Content of Vitamin C in Cookies**

CONCLUSION

The use of pumpkin semi-finished product with addition of citric acid shall increase the preservation of biologically active substances, such as vitamin C, reducing sugars and amino nitrogen. For mashing the plant raw materials, an increase in the content of soluble pectin and a decrease in protopectin in pumpkin puree have been determined, and it is more important for the pumpkin semi-finished product with citric acid. Moreover, the content of solids in pumpkin puree with citric acid has increased by

24.6%, as compared to the initial raw material. Thus, the method of mashing pumpkin with citric acid is most effective for confectionery production using the above as unconventional raw materials.

Oatmeal cookies with addition of pumpkin semi-finished products meet the requirements of GOST 24901-2014 and exceed the control sample for all the parameters. Adding pumpkin puree to the dough of oatmeal cookies has influenced the structure and consistency of the products. The application of mashed pumpkins has given the more expressed taste and aroma, the golden color, and stabilized the shape and the surface. The positive effect of the pumpkin semi-finished product on the preservation of freshness of finished products has also been found, which is of high importance in solving the problem of ensuring proper preservation. On the basis of the studies of the physicochemical and organoleptic properties of oatmeal cookies with pumpkin puree, it has been established that the best indicator is the sample containing 40% pumpkin puree to the weight of flour: humidity — 8.35%, alcali content — 1.4%, vitamin C content — 15.75 mg/100 g, reducing sugars — 1.2 mg/100 g, energy value — 446.29 kcal/100 g. Thus, it is advisable to use vegetables as raw materials for manufacturing confectionery products of increased nutritional value. Based on these data, the formulation of oatmeal cookies with addition of pumpkin puree has been developed.

REFERENCES

1. Tutelyan V.A. and Alekseeva I.A. Vitaminy antioksidantnogo ryada: obespechennost naseleniya i znachenie v profilaktike hronicheskih zabolevaniy [Antioxidant Vitamins: Provision of Population and Importance in Preventing Chronic Illnesses]. Clinical Pharmacology and Therapy, 1995, 4 (1), 90–92.
2. Tutelyan V.A., Spirichev V.B. and Shatnyuk L.N. Korrektsiya mikronutrientnogo defitsita – vazhneyshiy aspekt kontseptsii zdorovogo pitaniya naseleniya Rossii [Correction of Micronutrient Deficit is the Most Important Aspect of the Russians' Healthy Nutrition Concept]. Issues on Nutrition, 1999, 1.
3. Shenderov, B. A. Sostoyanie i perspektivy kontseptsii "Funktsionalnoe pitanie" v Rossii: obschie i izbrannye razdely problemy [State and Perspectives of the "Functional Nutrition" Concept in Russia: General and Selected Parts of the Problem]. Pharmateca, 2006, 1, 41-47.
4. Kartashova, L. V. Tovarovedenie prodovolstvennyh tovarov rastitelnogo proishozhdeniya [Merchandise Knowledge of Vegetables-Originated Food]. Moscow: Business Literature Publishing house, 2004, pp. 816.
5. Salnikov, A. I. Plodoovoschnaya konservnaya promyshlennost – vchera, segodnya, zavtra [Fruits and Vegetables Canning Industry]. Non-Perishable Food, 2007, 1, 4-9.
6. Pushkareva E. A. Otsenka kachestva ovsyanogo pechenya s pektinovymi veschestvami drevesnoy zeleni sosny obyiknovennoy [Estimation of the Quality of Oatmeal Cookies with Pectin Substances of Wood Greenery from Scotch Pine]. Society, Science, and Innovations: Collection of Articles. Ufa, 2013, pp. 106-109.
7. Kuzminova E. V. Proizvodstvo pektinosoderzhaschih hlebobulochnyh i makaronnyh izdeliy [Production of Pectin-Containing Bread and Alimentary Products]. Theses of reports at the Ist All-Russian Research and Practice Technical Seminar-Meeting "Research and Practical Ways of Solving the Problem on Producing Pectin". Krasnodar, 1994, pp. 56–57.
8. Korostyleva, L.A. Dieticheskie i lechebno-profilakticheskie napitki na osnove tykvy [Pumpkin-Based Dietary, Treatment and Prevention Beverages]. Beer and Beverages, 2, 68.
9. Mamonov, E.V. Sortovoy katalog "Ovoschnyie kultury" ["Vegetables" Sorts' Catalogue]. Moscow: EKSMOpress, 2001, pp. 416–419.
10. GOST 28561-90 Produkty pererabotki plodov i ovoschey. Metody opredeleniya suhih veschestv ili vlagi [GOST 28561-90 Products of Processing Fruits and Vegetables. Method of Defining Solids or Moisture]. Moscow: Standartinform, 2011.
11. GOST 24556-89 Produkty pererabotki plodov i ovoschey. Metody opredeleniya vitamina C [GOST 24556-89 Products of Processing Fruits and Vegetables. Methods of Defining Vitamin C]. Moscow: IPK Publishing Standards, 2003.
12. Smotraeva I.V., Balanov P.E. Tehnologiya produktov iz rastitelnogo syrya [Technology of Production from Plant Raw Materials]: Manual. Saint-Ptersburg: NIU ITMO; IHiBT, 2014, pp. 78.
13. GOST 12575-2001 Sahar. Metody opredeleniya Redutsiruyuschih veschestv [GOST 12575-2001. Sugar. Methods of Defining Reducing Agents]. Moscow: Standartinform, 2012.
14. Averyanova, E.V. Pektin. Poluchenie i svoystva [Pectin. Production and Features]. Biysk: Altai State Technical University, 2006, pp. 44.
15. Sokol, N.V. Ispolzovanie bogatogo pektinom rastitelnogo syrya v hlebopekarnom proizvodstve [Use of Plant Raw Materials that are Rich in Pectin in Bakery]. Poly-Theme Online Research Bulletin of the Kuban State Agrarian University, 2005, 15.
16. GOST 5898-87. Izdeliya konditerskie. Metody opredeleniya kislotnosti i schelochnosti [GOST 5898-87. Confectionary. Methods of Defining Acidity and Alcali Content]. Moscow, 2015, pp. 26.
17. GOST 24901-2014 Pechenie. Obschie tehnicheskie usloviya [GOST 24901-2014. Cookies. General Technical Conditions]. Moscow, 2015, pp. 7