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Use of Silk Berries and Sugar Beet Roots in the Production of Muffins

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ABSTRACT: Research methods were used traditional for the laboratories of confectionery factories. A concentrated paste with a dry matter content of $45.0 \pm 1.0\%$ was prepared from the fruits of mulberry and sugar beet, which was introduced into the dough in an amount of 20.0% by weight of flour. Calculation of the recipe for muffins with mulberry and sugar beet paste showed that the presence of their own sugars, fat and other dry substances in these additives can reduce the consumption of wheat flour, respectively, by 12.6 and 12.8%, sugar - by 9.9 and 10.1% per 1000 kg of finished products. The results of organoleptic and physicochemical quality indicators, changes in the storage process, the degree of satisfaction of the average daily need for nutrients and energy when using 100 g of the product are presented. It was found that the quality indicators of prototypes of muffins corresponded to the requirements of GOST 15052-2014 "Muffins. General technical conditions". The author considers it possible to use a concentrated paste from the fruits of white mulberry and root crops of sugar beet in the production of muffins while maintaining satisfactory organoleptic and physicochemical characteristics.

KEYWORDS: flour confectionery, muffins, pasta, mulberries, sugar beets, quality.

I. INTRODUCTION

Flour confectionery products (hereinafter - FCP), due to their consumer appeal and relatively low cost, are in significant demand among almost all age groups of the population. These products are made on the basis of refined raw materials, have an unbalanced chemical composition, high calorie content and do not meet the requirements of modern nutritional science. The composition of traditional confectionery products determines their position at the very top of the healthy eating pyramid, that is, among the products, the consumption of which should be limited. An analysis of the formulas and technologies of this type of product indicates the need for a significant correction of their chemical composition by increasing the content of healthy substances (dietary fiber, vitamins, minerals, etc.) while reducing the calorie content. Therefore, at present, developments on the enrichment of these products with physiologically significant and essential nutrients while maintaining the sensory-adequate traditional consumer characteristics of the products are especially relevant [1-4].

The key aspects of the development of new types of FCP are meeting the physiological needs of consumers for food and biologically active substances, ensuring favorable metabolic effects of functional ingredients included in the product, maintaining the traditional quality of the fortified product, adjusting its formulation in order to neutralize possible changes caused by the introduction of functional ingredients. Solving a set of issues that ensure high quality and safety of food products opens up new opportunities for multifactorial management of the development of alimentary-dependent diseases and improving the quality of life of people [5].

Muffins belong to the FCP group and are three-dimensional products prepared on the basis of flour, sugar, fat and egg products, which may include large or small additions (raisins, nuts, candied fruits, etc.), produced with a filling, with a surface finish or without it. The expansion of the assortment of muffins is achieved not only due to different ratios of raw materials, a variety of finishes, but also by giving the products a certain shape and weight. Sufficiently high consumption of muffins allows us to consider them important products in the diet of the population, especially children and youth [6].

One of the promising directions for solving this problem in relation to the production of flour products is the use of processed products of fruit, berry and vegetable raw materials. The uniqueness of this raw material is due to its biodiversity, availability, content of biologically active substances in the form of natural compounds in the form most assimilated by the body. The use of this raw material helps to reduce the consumption of basic raw materials, creates the preconditions for diversifying production, increasing resource efficiency, obtaining additional profits, expanding the segment of "healthy food" products [7-10].

In this context, relevant and promising are studies aimed at attracting non-traditional types of regional plant raw materials for the production of FCP with high consumer value and nutritional value.

II. MATERIALS AND METHODS

The aim of the study was to develop a recipe and technology for preparing muffins using paste from white mulberry and sugar beet root crops.

Research objects. The experimental part of the work was carried out in the laboratories of the food technology department of the Bukhara Engineering Technological Institute.

The following raw materials were used in the work: wheat flour of general purpose UzSSt 313-2009, melange GOST 30363-2013, granulated sugar GOST 31361-2008, margarine ROST R ISO 9001- 2015, baking soda GOST 2156-76, ammonium carbonate GOST 3770 -75, flavoring "Vanillin" GOST 16599-71.

The objects of the study were samples of ready-made muffins: a comparison sample - a cake "Prazdnichny" (Table 1), prototypes of muffins prepared with a concentrated paste of mulberries and sugar beets [11]. The dough was prepared with a corresponding correction of the recipe. The additives were added with partial replacement of sugar.

Table 1. Recipe for the "Prazdnichny" (Holiday) cake

Rawmaterials	Mass fraction of dry substances, %	Consumption of raw materials per 1000 kg of finished products, kg	
		actually	indrymatter
wheat flour of general purpose	85,50	337,00	288,14
Melange	27,00	471,00	127,17
Sugar	99,85	239,00	238,64
Margarine	84,00	176,00	147,84
Bakingsoda	-	2,50	-
Ammoniumcarbonate	-	2,50	-
Vanillin	-	0,30	-
Total		1228,30	801,79
Output	78,00	1000,00	780,00

The dough was prepared according to traditional technology in a laboratory. The dough preparation process included two stages: obtaining an emulsion and preparing the dough.

At the first stage, the melange with granulated sugar and margarine was whipped first at a low number of revolutions, gradually increasing the speed of the working body, at a temperature of 20° C for 15 minutes until a lush, cream-colored mass was obtained.

At the second stage, wheat flour of general purpose was added to the whipped mass in 2 - 3 doses M55-23, mixed with chemical baking powders (baking soda and ammonium salt), and stirred for no more than 15 seconds.

The finished dough with a moisture content of $30.0 \pm 1.0\%$ was poured into molds preliminarily greased. The molds were filled to 3/4 of the side height so that the dough would not spill out when it was lifted. Baking was carried out in a rotary oven at a temperature of 175 - 180° C for 16 - 20 minutes. The baked muffins were cooled at room temperature.

Experimental and control samples were prepared from the same batch of raw materials. All types of raw materials met the requirements of the relevant standards.

Dried mulberry paste was prepared by mixing them with water in a ratio of 1:1 (1:2), preheated to a temperature of 65 - 70° C. The mixture was kept at this temperature for 30 minutes, ground to a homogeneous structure, and then boiled to a dry matter content of $45.0 \pm 1.0\%$, cooled to 30° C and added to the dough.

Sugar beet paste was prepared according to the technology developed by M.G. Magomedov and etc. [12] and includes the following stages: raw material washing → cleaning → steam blanching for 15 - 20 minutes → homogenization → boiling → cooling. Mass fraction of dry substances $45.0 \pm 1.0\%$.

The quality of the pasta and finished products was assessed according to modern generally accepted organoleptic (sensory) and physicochemical (mass fraction of moisture, total sugar (for sucrose) and fat; alkalinity, density, specific volume) methods described in the manual [13, 14]. The content of minerals was investigated using a gas chromatograph "Crystal-Lux - 4000" (Russia) according to the instructions for the device. Changes in the storage process of muffins were recorded by weight loss.

The calculation of the nutritional and energy value of products was carried out in accordance with the methodology described in the manuals [15,16]. The degree of satisfaction with the daily average in nutrients and energy with muffins using processed products of mulberries and sugar beets with the use of a single serving of products



(100 g) was calculated according to the methodological recommendations MR 2.3.1.2432-08 Rational nutrition, in relation to the recommended daily requirement for nutrients and energy for labeling in accordance with TR CU 022/2011 "Food products in terms of their labeling."

Discussion. Analysis of the data on the level of consumption of confectionery products in Uzbekistan confirms that practically all groups of the population include FCP in their daily diet. Preferences are given to such products: cookies, gingerbread, waffles, muffins and rolls (Figure 1). Our sociological survey made it possible to determine the main criteria for respondents' choice of these products (Figure 2).

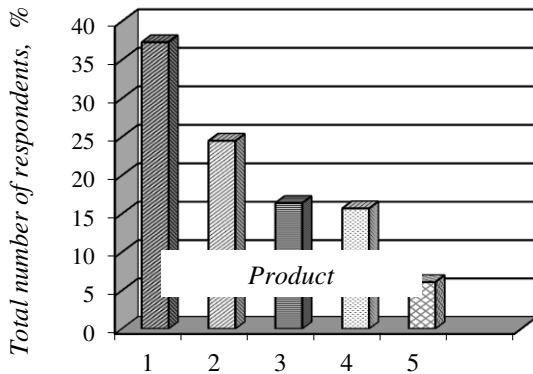


Fig. 1. Preferences by types of products, in % of the number of respondents:
1 - cookies; 2 - gingerbread; 3 - waffles;
4 - muffins; 5 - rolls

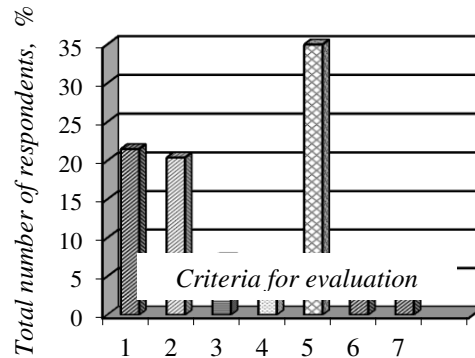


Fig. 2. Criteria for the choice of the FCP respondents:
1 - appearance; 2 - taste; 3 - packaging design;
4 - nutritional value; 5 - price; 6 - manufacturer;
7 - calorie content

Sociological survey data (Fig. 1) showed that the overwhelming majority of respondents prefer cookies (37.3%), followed by (in decreasing order) gingerbread (24.5%), waffles (16.4%), muffins (15.7%), rolls (6.1%). Moreover, among children and adolescents, muffins and cookies are in great demand. It was found that among the criteria for choosing FCP, first of all, attention is paid to the price (35.0%), then the appearance of the product (21.5%) and then taste (20.4%), packaging design (7.3%), manufacturer (6.4%), calorie content (4.8%), nutritional value (4.6%). It should be noted that the majority of respondents do not consider their nutritional value to be the determining factor in the choice of confectionery products, but are guided mainly by sensory indicators, price and manufacturer. This is especially dangerous for young children; therefore, when developing new types of confectionery products, it is necessary to focus, in addition to consumer factors, on the nutritional value of products, their calorie content and cost. This once again confirms the relevance of the development of recipes for these products for a healthy diet.

The development of modern technologies for modifying food products, including FCP, must be carried out taking into account modern medical recommendations [3], aimed mainly at reducing added sugar, saturated fat and trans fatty acid isomers (Figure 3).

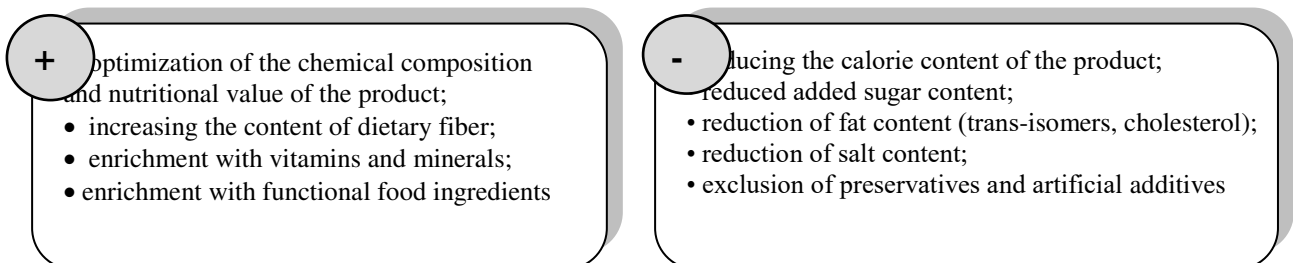


Fig. 3. The main directions of technological modification of food products (medical challenge of the food industry)

Technological modification and creation of new types of products, in our case, FCP involves the involvement of non-traditional natural raw materials in the production, the development of non-standard technological methods, including for reducing the unit costs of all types of resources and the introduction of R&D results (research and development work).



Analysis of the nutritional value of the main types of MCI shows that the fat content in them is from 2.0 to 30.0%, carbohydrates 62.0 - 77.0%, the bulk of which is sucrose (15.0 - 67.0%) and starch (10.0 - 54.0%), and a very insignificant amount of protein - from 2.8 to 8.5%. Energy value ranges from 346.0 - 542 kcal. Calculations show that 100 g of FCP provide 1.0 - 8.0% of a person's daily need for B vitamins, 1.0 - 5.0% - for potassium, calcium and magnesium, 5.0 - 11.0% - in phosphorus, 5.0 - 15.0% - in iron, at the same time their contribution to the total energy value of the diet at this level of consumption is 18.0 - 25.0%. In addition, leading experts in the field of nutrition indicate excessive consumption of sugar with confectionery [3, 17]

The solution to this problem is possible by modifying the FCP by using non-traditional, including processed products of natural and secondary fruit, berry and vegetable raw materials. This allows them to increase their nutritional value by enriching them with vitamins, mineral and pectin substances, to reduce the calorie content and consumption of fats, eggs, sugar without deteriorating the quality of the finished product.

When fortifying food products, it is necessary to take into account that the content of physiologically functional ingredients in finished food products obtained using modern production technologies is significantly reduced or they are completely lost, especially vitamins. The success of vitamin fortification, for example, depends on their stability. Therefore, we studied the influence of various factors on the stability of vitamins [18].

The results are shown in Table 2.

Table 2. Technological factors affecting the stability of vitamins

Vitamin	Technological factors*				
	Light	Temperature	Humidity	Oxidants	Acid
A (retinol)	■	■	■	■	■
D (calciferols)	■	■	■	■	■
E (tocopherol)	■	■	■	■	■
K (phylloquinone)	■	■	■	■	■
B1 (thiamine)	■	■	■	■	■
B2 (riboflavin)	■	■	■	■	■
B6 (pyridoxine)	■	■	■	■	■
B12 (cyanocobalamin)	■	■	■	■	■
PP (niacin)	■	■	■	■	■
H (biotin)	■	■	■	■	■
C (ascorbic acid)	■	■	■	■	■

*Note: ■ - very sensitive; ■ - weakly sensitive; ■ - almost insensitive

The presented data allow us to assert that for the enrichment of confectionery products, it is most advisable to use supplements with vitamins B2, B6, B12, PP, H, A, D, E, K, as the most resistant to high temperatures.

There is evidence that the use of Jerusalem artichoke powder and bird cherry flour in the recipe for shortbread cookies in a ratio with premium wheat flour, respectively 20: 5: 75, will increase the mass fraction of organic acids relative to the reference sample (without additives) by 2, 0 times, flavonoids - 1.1 times, dietary fiber - 1.6 times, iron - 1.13 times, potassium - 1.3 times, manganese - 5.0 times, zinc - 2.0 times, copper - 3.0 times, vitamins of group B - 0.6 times; reduce the energy value by 54.0 kcal. The antioxidant activity of a cookie when added to its recipe bird cherry flour increases by 0.04 mg per 100 g of mass, bird cherry flour and Jerusalem artichoke powder - by 0.02 mg per 100 g of mass of a relative reference sample. Finished products are characterized by high quality indicators [19].

The possibility of using in the production of muffins a combination of oat flour, powdered leaves of bergénia crassifolia, seaweed, raspberries, coltsfoot (Tussilágófárfara), flowers and leaves of St.). This made it possible to enrich new products with essential amino acids, macro- and microelements and other biologically active substances, as well as to increase their storage stability and reduce their cost [20].

The introduction of Siberian wild pear powder into the production of muffins prepared with chemical leavening agents improves their consumer properties and increases the content of vitamins, microelements, and dietary fiber [21].

As new types of raw materials, flour is used from pumpkin seeds, flax and milk thistle, hawthorn as a source of vegetable protein, vitamin C; flour from seeds of watermelon, grapes and rose hips - as an additional fiber in the production of FCP to increase their nutritional value [22, 23].

To expand the range of functional shortbread and chocolate biscuits, low calorie content and increased biological value, the expediency of using rapeseed powder has been established [24].

As a source of an unconventional and promising biologically active plant polysaccharide, arabinogalactan from Siberian larch (*Lárixsibirica*) and tree gmelin (*Gmelinaarborea*) wood, which has biological activity, in the composition of biscuit semi-finished product, raw gingerbread and shortbread cookies has been studied. It is recommended as a prophylactic and technological additive allowing to reduce the proportion of prescription components (sugar, molasses and egg products) and the calorie content of flour products [25].

To increase the stability, dispersion of the confectionery emulsion and reduce the duration of its whipping, with the complete replacement of hard fats with native vegetable oil, it is recommended to use powders from pomace of red and black currant, pumpkin, tangerines obtained from secondary products of processing of fruit and vegetable raw materials that have fat-binding, fat-emulsifying and high water absorption capacity [26].

Sugar beet (Latin *Beta vulgaris*) is a group of varieties of common beet, the Marevy family. The healing qualities of sugar beet are due to the presence in its roots of vitamins (A, E, C, group B, PP), minerals (magnesium, iodine, iron, calcium, copper, phosphorus, etc.). The use of this culture has a beneficial effect on the general immunity, metabolism, digestion, the activity of the cardiovascular system, the human reproductive system; possesses anticarcinogenic and antiseptic properties. It is recommended for anemia, atherosclerosis, leukemia, hypertension, neurological disorders, stress and depression. Sugar beet contains: gamma-aminobutyric acid, which stimulates metabolism in the brain; betaine is a material for the formation of choline, which prevents fatty degeneration of the liver; bioflavonoids (vitamin P), regulating hormonal levels, strengthening bone tissue, providing a capillary-strengthening effect. Protein substances of root crops, despite the fact that their content does not exceed 1.5%, are represented by a number of such essential amino acids as lysine, methionine, arginine [33].

Analysis of the ecological and toxicological safety of the raw materials under study, grown in Uzbekistan, proved that it is an environmentally "clean" product, as it meets the normative indicators of sanitary rules and norms of SanR&R №0366-19.

A concentrated paste was prepared from mulberry fruits and sugar beet roots, the organoleptic and physicochemical parameters of which are presented in Table 3.

Table 3. Organoleptic and physicochemical characteristics of the concentrated paste

Indicators	The value of the indicators of the quality of the paste	
	<i>Mulberryfruit</i>	<i>Sugarbeetrootvegetables</i>
Colour	Lightbrowntobrown	Cream
Smell	Inherent, mild	Nosugarbeetodor
Taste	Sweet	Sweet
Consistency	Homogeneous, viscous, lowspreading	
Mass fraction of dry substances,%	45,0±1,0%	45,0±1,0%
Mass fraction of reducing substances,%	21,50	19,90
Mass fraction of titratable acids (in terms of malic acid),%	0,83	0,59
Activeacidity, pH	3,30	3,80

Investigated the chemical composition and energy value of the paste (table 4).

Table 4. Chemical composition and energy value of the paste from the raw materials under study

Nutrients	Massfractionofnutrients,%	
	<i>Mulberryfruit</i>	<i>Sugarbeetrootvegetables</i>
Squirrels	1,61±0,04 / 2	1,83±0,05 / 1
Sahara	35,29±0,05 / 2	35,75±0,04 / 1
Starch	0,65±0,03 / 1	0,16±0,02 / 2
Pectin*	0,22±0,01 / 2	2,19±0,01 / 1
Fats	1,01±0,04 / 1	0,25±0,04 / 2
Organicacids	1,10±0,02 / 1	0,11±0,01 / 2
Alimentaryfiber	1,31±0,03 / 1	1,61±0,03 / 2



Minerals, including:	0,58±0,01 / 1	0,45±0,01 / 2
- potassium	0,35	0,27
- sodium	0,00	0,04
- calcium	0,08	0,01
- magnesium	0,04	0,07
- phosphorus	0,11	0,06
Other substances	0,23±0,03 / 2	0,65±0,03/ 1
Ca: P (1.0: 1.5)	1,0 :1,4/ 1	1,0 :6,0/ 2
Energyvalue, kcal	150,5±0,06 / 2	144,3±0,05 / 1
Totalrank, score	16	17

Note - in terms of galacturonic acid

As follows from the research results presented in table 4, a significant part of the dry matter of sugar-containing pastes falls on the carbohydrate complex. At the same time, the carbohydrates of the mulberry paste are represented mainly by fructose and glucose, and sugar beet - by sucrose. It is known that cellulose and pectin, which are included in the composition of sugar-containing pastes, being hydrophilic components, can have a positive effect on the rheological properties of the dough and are of certain importance for increasing the shelf life of finished products. In addition, fiber plays a significant role in the digestion process, and pectin substances are capable of removing heavy metals from the body. It should be especially noted that the ratio of Ca : P in both pastes is close to optimal, which increases the degree of assimilation of phosphorus.

Research was conducted on the use of mulberry and sugar beet paste in the production of muffins. The dough was prepared using chemical leavening agents. The paste was introduced in an amount of 20.0% by weight of flour with a partial replacement of the prescription amount of sugar, fat and high-quality wheat flour. The recalculation was carried out taking into account the dry matter content and the chemical composition of the paste. The dosage of the paste is determined by the recommendations of a number of researchers [34, 35] on the use of puree (12.0 - 20.0% of dry matter) from fruit, berry and vegetable raw materials in the production of flour products, no more than 30.0% by weight of flour, and the paste is more concentrated product (25.0 - 40.0% of dry substances and more), therefore, its dosage was adopted 20.0% to the mass of flour from the original recipe - 67.4 kg. The quality of the muffins was assessed 16 hours after baking. A product prepared without additives served as a control.

The recipe for muffins with white mulberry paste and sugar beet root is shown in Table 5.

Table 5. Recipe for muffins with pasta from the raw materials under study

Rawmaterials	Mass fraction of dry substances, %	Consumption of raw materials per 1000 kg of finished products, kg			
		<i>Mulberryfruit</i>		<i>Sugarbeetrootvegetables</i>	
		actually	indrymatter	actually	indrymatter
Wheat flour for general use	85,50	294,40	251,71	293,90	251,28
Melange	27,00	471,00	127,17	471,00	127,17
Sugar	99,85	215,20	214,88	214,90	214,58
Margarine	84,00	175,30	147,25	175,80	147,67
Bakingsoda	-	2,50	-	2,50	-
Ammoniumcarbonate	-	2,50	-	2,50	-
Vanillin	-	-	-	0,30	-
Mulberrypaste	45,00	67,4	30,33	-	-
Sugarbeetpaste	45,00	-	-	67,4	30,33
Total		1228,30	771,34	1228,30	771,03
Outpu	78,00	1000,00	780,00	1000,00	780,00

Calculation of the recipe for muffins with a paste made from mulberries and sugar beets showed that the presence of their own sugars, fat and other dry substances in these additives can reduce the consumption of wheat flour, respectively, by 42.6 and 43.1 (12.6 and 12, 8%), sugar - by 23.8 and 24.1 (9.9 and 10.1%) kg per 1000 kg of finished products.

The muffins were evaluated by organoleptic (sensory) and physicochemical indicators for compliance with the requirements of GOST 15052-2014 "Muffins. General technical conditions". The results of the study of the quality of muffins are presented in table 6.

An analysis of the results obtained (Table 6) showed that the addition of mulberry paste will exclude flavorings (in this case, vanillin) from the recipe and provide the muffins with a pleasant fruity aroma. In the case of sugar beet paste, it is advisable to keep the flavors due to the mild odor. The established dosage of the paste provided the characteristic appearance, surface condition and porosity structure of the finished products. Products differed from control samples by more uniform and thin-walled porosity, tender and elastic crumb.

A decrease in the density of prototypes by an average of 8.5 - 13.5% and an increase in the specific volume by 1.7 - 4.6% relative to the control sample were established, which can be explained by an improvement in the gas-holding capacity of the dough due to the high stabilizing ability of dietary fiber additives.

Table 6. Quality indicators of muffins with mulberry and sugar beet paste

Indicatorname	RequirementsGOST 15052-2014	The value of muffin indicators		
		Controlsample	Withmulberrypaste	Withsugarbeetpaste
Tasteandsmell	Sweet taste and characteristic aroma of recipe ingredients, additives or flavors, without foreign tastes and smells	Sweet taste and vanilla aroma, without foreign tastes and smells	Smack and characteristic aroma of fruits, without foreign tastes and odors	Sweet taste and vanilla aroma, without foreign tastes and smells
Surface	With characteristic cracks, with the presence of a pronounced lateral surface, without voids, burns, tears and irregularities			
Brokenview	The product is baked without lumps, traces of impurities, with uniform porosity, without voids and hardening			
Structure	Soft, bound, loosened, porous, no voids or seals			
Theform	Correct, with a convex upper surface, without voids and shells			
Moisturecontent, %	12,0...24,0	21,4±0,2	21,8±0,2	21,6±0,2
Mass fraction of total sugar (for sucrose), %	13,0...25,0	24,2±0,3	24,0±0,1	24,1±0,1
Massfractionoffat, %	9,0...22,0	20,0±1,0	19,5±1,0	19,0±1,0
Alkalinity, hail	Не более 2,0	0,5±0,1	0,3±0,2	0,5±0,1
* Density, g / cm ³	Не более 0,55	0,59±0,2	0,51±0,3	0,54±0,3
Specificvolume, cm ³ / 100 g	-	174±5	177±4	182±4

* Note - for products weighing no more than 100 g

One of the indicators of the quality of muffins is their freshness during storage. The muffins were stored packed in a polypropylene film at a temperature of 20 ± 2 ° C and a relative humidity of no more than 75.0%. The degree of staleness was judged by the change in the moisture content of the cake crumb during storage. The change in quality indicators was determined every 5 days of storage for 30 days.

The research results are shown in Figure 4.

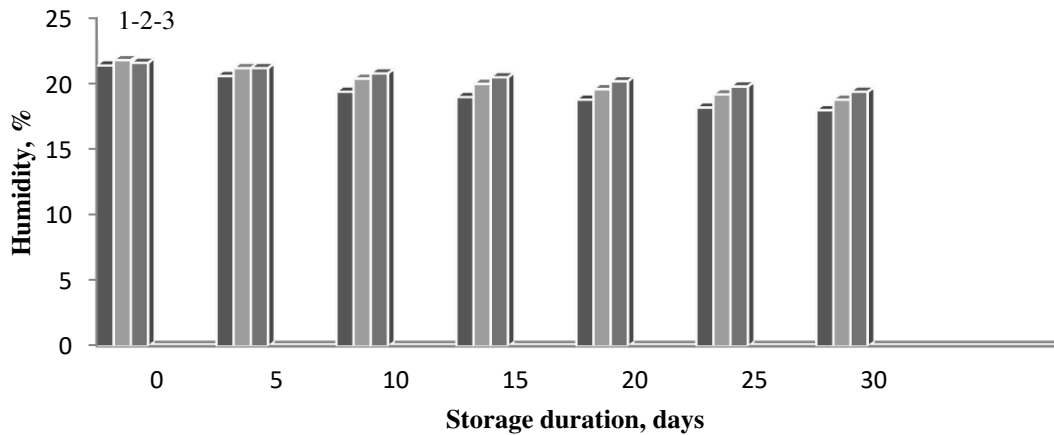


Fig. 3. Change in moisture content of muffins (%) during storage: 1-control; 2 - with mulberry paste; 3 - with sugar beet paste

When analyzing the data on the change in the moisture content of the test samples after 30 days of storage and comparing them with the control data, it was found that the experimental samples are characterized by lower rates of moisture loss, which is probably due to the presence in their composition of a certain amount of moisture-retaining substances (dietary fiber), as well as mono- and disaccharides, which stabilize the moisture content of confectionery products due to increased hygroscopicity. At the same time, as can be seen from Figure 3, the moisture content of all samples after 30 days of storage was within acceptable limits (12.0 - 24.0). At the same time, the samples with sugar beet paste looked fresher visually.

Determination of microbiological contamination of muffins after 30 days of storage was carried out using nutrient agar media. The substrates were incubated under conditions optimal for the growth of colonies of microorganisms, and then, by means of phase-contrast microscopy, the species and quantitative composition of the microflora of the investigated semi-finished products was determined (Table 7).

Table 7. Microbiological indicators of the quality of muffins

Index	The value of indicators			
	By ND *, no more	Control sample	With mulberry paste	With sugar beet paste
The number of mesophilic aerobic and facultative anaerobic microorganisms, CFU / g, no more	5×10^3	$6,4 \times 10^2$	$6,1 \times 10^2$	$7,2 \times 10^2$
Coliform Bacteria (coliforms), in 1 g	Not add.	Not found		
Staphylococcus aureus in 0.1 g	Not add.	Not found		
Pathogenic, including salmonella in 25 g	Not add.	Not found		
Yeast, CFU / g, no more	50	34	38	41
Molds, CFU / g, no more	50	24	27	29

Note: * ND - normative documentation

From the data in Table 7, it follows that the studied control and experimental samples of muffins after 30 days of storage in the package for microbiological indicators met the requirements of SanR&R No. 0366-19 (5.5.7. Muffins and rolls in sealed packaging) [36].

For a complete and healthy diet, a person needs amino acids, carbohydrates, fatty acids, dietary fiber, minerals, vitamins and other physiologically significant substances. Therefore, we investigated the nutritional and energy value, as well as the physiological significance of muffins with the studied additives.

The calculation of the chemical composition and energy value of the muffins was carried out according to the method developed by the All-Russian Scientific Research Institute of the Bakery Industry (ARSRIBI), the degree of satisfaction of the need for food substances - by means of a comparative analysis with the standard indicators of the calculation methods CM 2.3.1.2432-08. The calculated data are presented in tables 8, 9.

Table 8. Nutritional and energy value of muffins with mulberry paste and sugar beet

Componentname	Mass fraction of components in 100 g of muffins, g					
	Controlsample		Withmulberrypaste		Withsugarbeetpaste	
	g/100g	g/100 g	±Δ	g/100 g	±Δ	
Proteins	9,60	9,27	- 0,33	9,26	- 0,34	
Fats	20,3	20,2	- 0,10	20,2	- 0,10	
Sugar	24,3	24,0	- 0,30	24,1	- 0,20	
Starch	22,6	19,8	- 2,80	19,8	- 2,80	
Pectin	-	0,01	+ 0,01	0,64	+ 0,64	
Alimentaryfiber	0,02	0,35	+ 0,33	1,12	+ 1,10	
<i>Minerals, mg/100 g</i>						
- potassium	130	70	- 60	130	-	
- sodium	90	90	-	90	-	
- calcium	30	30	-	30	-	
- magnesium	20	20	-	20	-	
- phosphorus	130	130	-	120	- 10	
Ca: P (1.0: 1.5)	1,0 :4,3	1,0 :4,3		1,0 :4,0		
Energyvalue, kcal	405,0	390,0	- 15,0	390,4	- 14,6	

* Note: Δ is the change in the mass fraction of the components of the test samples of cakes relative to the control, in g / 100 g of product

Comparative analysis of the nutritional value of the control sample and muffins with pasta showed that in the experimental variants the mass fraction of the following components decreased: proteins - by 3.5 - 4.4%, sugar - by 0.4 - 1.2%, starch - by 12.4%. The energy value has decreased, on average, by 3.65%. At the same time, the content of dietary fiber increased 17.5 - 56.0 times. In the mineral composition of muffins, the Ca: P ratio is negative, equal to 1.0: 4.3 and 1.0: 4.0, with an optimal value of 1.0: 1.5, which reduces the degree of phosphorus absorption.

Determined the degree of satisfaction of the daily requirement for nutrients of the studied samples of muffins for the main components (table 9).

Table 9. The degree of satisfaction of the daily physiological need for nutrients and energy when eating 100 g of muffins

Componentname	Norms of physiological need for nutrients and energy (averaged for both sexes) by CM 2.3.1.2432-08	Mass fraction of components in muffins, %					
		Controlsample		Withmulberrypaste		Withsugarbeetpaste	
		%	rk	%	rk	%	rk
Proteins	66,5	14,40	1	14,00	2	13,90	3
Fats	74,0	27,40	2	27,30	1	27,30	1
Digestiblecarbohydrates (starch), including:	323,5	7,00	2	6,10	1	6,10	1
Sugar	50,0	48,60	3	48,00	1	48,20	2
Alimentaryfiber	20,0	0,10	3	1,75	2	5,60	1
Pectin	2,0	-	3	0,50	2	32,00	1
Minerals:							
- potassium	2500	5,20	1	2,80	2	5,20	1
- sodium	1300	6,90	1	6,90	1	6,90	1
- calcium	1000	3,00	1	3,00	1	3,00	1
- magnesium	400	5,00	1	5,00	1	5,00	1
- phosphorus	800	16,20	1	16,20	1	15,00	2
Energyvalue, kcal	2225	18,20	2	17,50	1	17,50	1
Totalrank, score	-	-	21	-	16	-	16

It was found that the degree of satisfaction of the daily requirement for nutrients due to the use of the investigated additives in the recipe for muffins increased by an average of 1.65 ... 5.50%. Products were enriched with



pectin. The total rank, as a complex indicator of the quality of products, was the same in the experimental samples (16 points), which indicates their almost identical nutritional value and exceeded the control value by 5 points.

It should be borne in mind that the calculated content of physiologically functional components in finished products differs significantly from the actual one, since their mass fraction can be significantly reduced during the production process.

III. CONCLUSION

Most food manufacturers do not sufficiently use reserves for processing local raw materials (berries, fruits and vegetables) and secondary raw materials from the processing industries of the food industry, the use of which in the production of confectionery products will reduce production costs and the dependence on suppliers of imported prescription ingredients.

The use of natural additives avoids the use of food additives of a non-nutritional nature and, therefore, increases the level of product safety.

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