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ИСПОЛЬЗОВАНИЕ ПЛОДОВ ШИПОВНИКА В ТЕХНОЛОГИИ ПИТЬЕВЫХ КИСЕЛЕЙ

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Представлены исследования по разработке рецептуры и технологии киселей питьевых, содержащих нативные биологически активные вещества за счет использования плодов шиповника. Проанализировано по пять вариантов новой продукции из свежих и сушеных плодов шиповника с добавлением сахара, картофельного крахмала, ксантановой камеди и лимонной кислоты. Установлено, что кисели питьевые, содержащие не менее 21,5% свежих или 5,37% сушеных плодов шиповника, были наиболее привлекательными. Использование механоакустического оборудования при изготовлении киселей приводит к физико-химическим изменениям сырья (частичной деструкции клеточных стенок, образованию новых красящих веществ и др.), что положительно влияет на формирование органолептической характеристики новой продукции, а также сокращает технологические операции производства и ингибирует микроорганизмы. Употребление 200 см^3 новой продукции обеспечивает организм человека не менее 62% от суточной потребности в аскорбиновой кислоте и не менее 66% – в β-каротине, а также пищевыми волокнами не менее 0,6 г и фенольными веществами – 11 мг. Установлен срок годности киселей питьевых шиповниковых – 12 мес в стеклянных банках при температуре 25° С и относительной влажности воздуха не выше 75% и в защищенном от прямых солнечных лучей месте. На основании проведенных исследований разработана нормативно-техническая документация на кисели питьевые шиповниковые.

Ключевые слова: шиповник, кисели питьевые, органолептические показатели, физико-химические показатели, биологически активные вещества, микробиологические показатели, срок годности

THE POSSIBILITIES OF USING ROSEHIP FRUITS IN THE POTABLE KISSELS TECHNOLOGY

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Research on the development of the recipe and technology of potable kissels containing native biologically active substances through the use of rosehip fruits is presented. Five variants of new products from fresh and dried rosehips with the addition of sugar, potato starch, xanthan gum and citric acid were analyzed. It was found that the potable kissels containing at least 21.5% fresh or 5.37% dried rosehip fruits were the most appealing. The use of mechanoacoustic equipment in the manufacture of kissels leads to physical and chemical changes in the raw materials (partial destruction of the cell walls, the formation of new coloring substances, etc.), which positively affects the formation of organoleptic characteristics of new products, as well as reduces the technological

operations of production and inhibits microorganisms. The consumption of 200 cm^3 of new products provides the human body with at least 62% of the daily requirement for ascorbic acid and at least 66% for β-carotene, as well as dietary fiber of at least 0.6 g and 11 mg of phenolic substances. The shelf life of rosehip potable kissels is 12 months in glass jars at 25 ° C and relative humidity of 75% or higher and in a place protected from direct sunlight. On the basis of this research, normative and technical documentation for potable rosehip kissels was developed.

Keywords: rosehip, potable kissels, organoleptic indicators, physico-chemical indicators, biologically active substances, microbiological indicators, shelf life

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Conflict of interest
The authors declare no conflict of interest.

INTRODUCTION

Specialists believe that rosehips are used in the creation of food products in a very small amount in spite of the fact that they contain valuable nutrients for the human body. The content of biologically active compounds providing physiological value of rosehips has a wide variability and depends on many factors (species, pomological variety, place of growth, time and harvesting conditions, etc.). [1-8].

Kissels, which belong to the original Russian cuisine, are currently being developed, studied, and produced either as food concentrates or as a sweet dish in the public catering system [9-14]. At the same time, there are virtually no works on the development and study of the characteristics of the quality of drinking kissels. In the system of the Federal Institute of Industrial Property, Federal Service for Intellectual Property, Patents and Trademarks only one patent of the Russian Federation № 2668338 for the method of production of collagen enriched drinking kissels for functional nutrition from fruits (actinidia, black chokeberry, honeysuckle, red ashberry) was registered. According to the "Unified Register of issued certificates of conformity and registered declarations of conformity", currently only six Russian companies in Moscow, St. Petersburg, Stavropol, Krasnoyarsk, Yekaterinburg and Rasskazov produce "drinking kissels". Rosehip kissels (according to the "Unified Register...") are produced in our country only as food concentrates by eight enterprises, which are located mainly in the Siberian Federal District (62.5%), and the rest in the Moscow, Chelyabinsk and Yaroslavl regions (12.5% each).

The purpose of the work is to conduct research on the possibility of making drinking kissels from rosehips.

Research objectives:

- develop the recipe and technology of drinking rosehip fruit kissels;
- determine the shelf life of rosehip drinking kissels.

MATERIAL AND METHODS

The experimental studies were carried out in the laboratories of the Siberian Federal Scientific Center of Agro-BioTechnologies of the Russian Academy of Sciences.

When conducting research we used materials that by their qualitative characteristics meet the requirements of the current normative documentation: rosehip fruit to form technical characteristics of drinking kissels, white sugar, potato starch, citric acid to form the original odor, structure and taste of ready-to-eat products, xanthan gum to reduce moisture

loss during thermal processing and subsequent storage, as well as stabilize the consistency of the finished product.

The study of chemical composition indicators (mass fraction of dry matter, sugars, proteins, fats, free organic acids, dietary fiber, ash, ascorbic acid, β-carotene), microbiological safety (content of yeast, bacteria of *Proteus, Staphylococcus aureus, Salmonella* genera, coli group (coliform bacteria)) and organoleptic evaluation of drinking rosehip kissels was carried out in accordance with the methods set forth in the current regulatory documents; the total amount of phenolic compounds in terms of gallic acid - spectrophotometric method with Folin-Ciocalteu reagent [15]. Processing of experimental data was carried out by methods of mathematical statistics (validity of the results $p \leq 0.05$) using MS Excel program.

RESULTS AND DISCUSSION

Studies on approbation of different variants of drinking rosehip kissels have been carried out. Table 1 shows the best variants of recipes.

Fluctuations in the "color" score ranged from 4.2 to 4.8 points (max = 5) and depended mainly on the amount of raw fruit used. The type of fruit raw material (fresh or dried) had little effect on this organoleptic characteristic (the color of the entire mass was a uniform red-brown) (see Fig. 1).

The indicator "smell and taste" was influenced by the fruit raw materials and sugar contained in the composition of kissels (variants 1-5), the other options (6-10) - fruit raw materials, sugar and citric acid. The evaluation of the experimental samples ranged from 4.4 to 5.0 points (max = 5). According to organoleptic characteristics "smell and taste" the best samples of kissel of variants 3 and 8 were recognized: harmonious, sweet and sour, rich, with a characteristic taste of rosehip, without extraneous smell and aftertaste. In the smell and taste of the samples of variants 1, 2, 6, 7 rosehip was strongly felt, in tones and aftertaste of variants 1 and 6 the presence of potato starch was noted. The taste of kissel samples of variants 4 and 5 was excessively sweet, 9 and 10 - excessively sour.

For the indicator "appearance and consistency" the experimental samples received from 3.4 to 4.8 points (max = 5). In terms of appearance, all samples were a homogeneous, kisselike mass without undissolved lumps. As the content of xanthan gum increased and the potato starch decreased, the mass thickened.

Табл. 1. Варианты рецептуры питьевых киселей шиповниковых, г/100 г
Table 1. Recipe variants of potable rosehip kissels, g/100 g

Recipe option	Rosehip	White Sugar	Potato starch	Xanthan gum	Citric acid
Fresh fruit					
1	22,5	5,5	2,2	0,00	–
2	22,0	6,0	2,0	0,15	–
3	21,5	6,5	1,8	0,30	–
4	21,0	7,0	1,6	0,45	–
5	20,5	7,5	1,4	0,60	–
Dried fruit					
6	5,47	5,5	2,2	0,00	0,15
7	5,42	6,0	2,0	0,15	0,17
8	5,37	6,5	1,8	0,30	0,19
9	5,32	7,0	1,6	0,45	0,21
10	5,27	7,5	1,4	0,60	0,23

Note. Water is applied to the required volume - 100 cm^3.

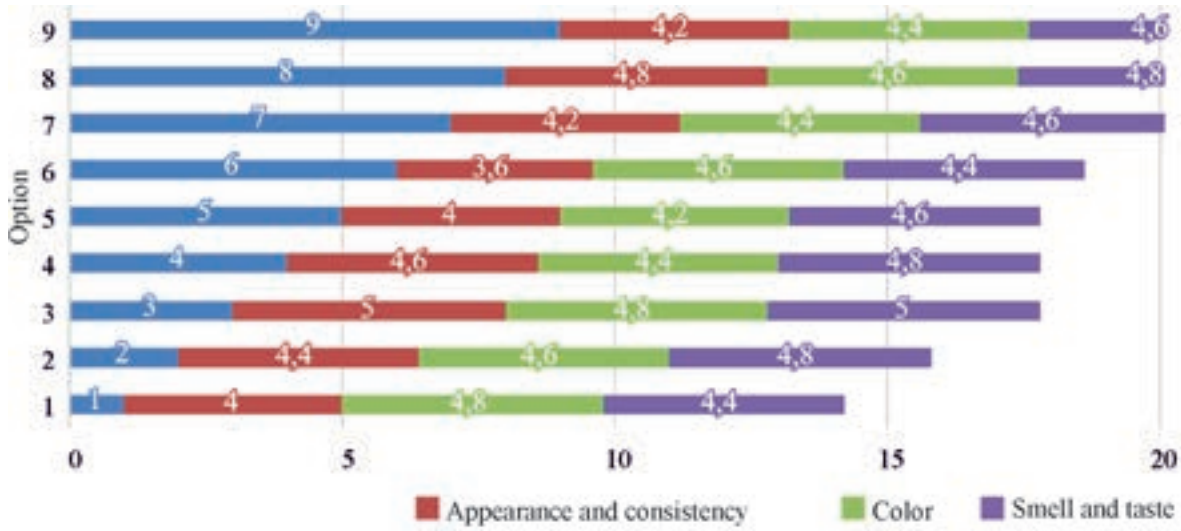

Рис. 1. Органолептическая оценка киселей питьевых шиповниковых, балл

Fig. 1. Organoleptic evaluation of rosehip potable kissels, point

The best variants in terms of "appearance and consistency" were recognized for samples of kissel 3 and 8 with xanthan gum (0.3%) and potato starch (1.8%).

Fig. 2 shows a basic technological scheme for obtaining rosehip drinking rosehip kissels. Hydroacoustic treatment of semi-finished product (mixture of fruit and water) in an apparatus equipped with a rotary-dispersing device creating an acoustic field with an intensity of 100-500 W/kg at 50-65 °C for 15-30 min resulted in physical and chemical changes in raw materials (partial destruction of cell walls, formation of new coloring substances, inactivation of enzymes, etc.).), which influenced the formation of organoleptic characteristics of new products and partial inhibition of microorganisms. Sterilization of the blend (semi-finished product and mixture consisting of white sugar, xanthan gum) in mechanoacoustic apparatus at the temperature of 95-97 °C for 20-60 sec completely inhibited microflora, which ensured later preservation of quality characteristics of the product.

Studies were carried out to determine the shelf life of the best options (3 and 8) of the drinking rosehip kissels. The kissels were poured into glass jars of type I with a crown

Табл. 2. Влияние продолжительности хранения киселей питьевых шиповниковых на органолептические показатели, балл (n = 5)

Table 2. Effect of potable rosehip kissels storage time on organoleptic characteristics, point (n = 5)

Storage time, months	Appearance and consistency	Color	Smell and taste
From fresh fruit (variant 3)			
6	5,0 ± 0,0	4,6 ± 0,5	4,8 ± 0,4
12	4,8 ± 0,4	4,4 ± 0,5	4,6 ± 0,5
14	4,6 ± 0,5	4,2 ± 0,4	4,2 ± 0,4
From dried fruit (variant 8)			
6	4,6 ± 0,5	4,4 ± 0,5	4,6 ± 0,5
12	4,4 ± 0,5	4,2 ± 0,4	4,4 ± 0,5
14	4,0 ± 0,0	4,0 ± 0,0	4,2 ± 0,4

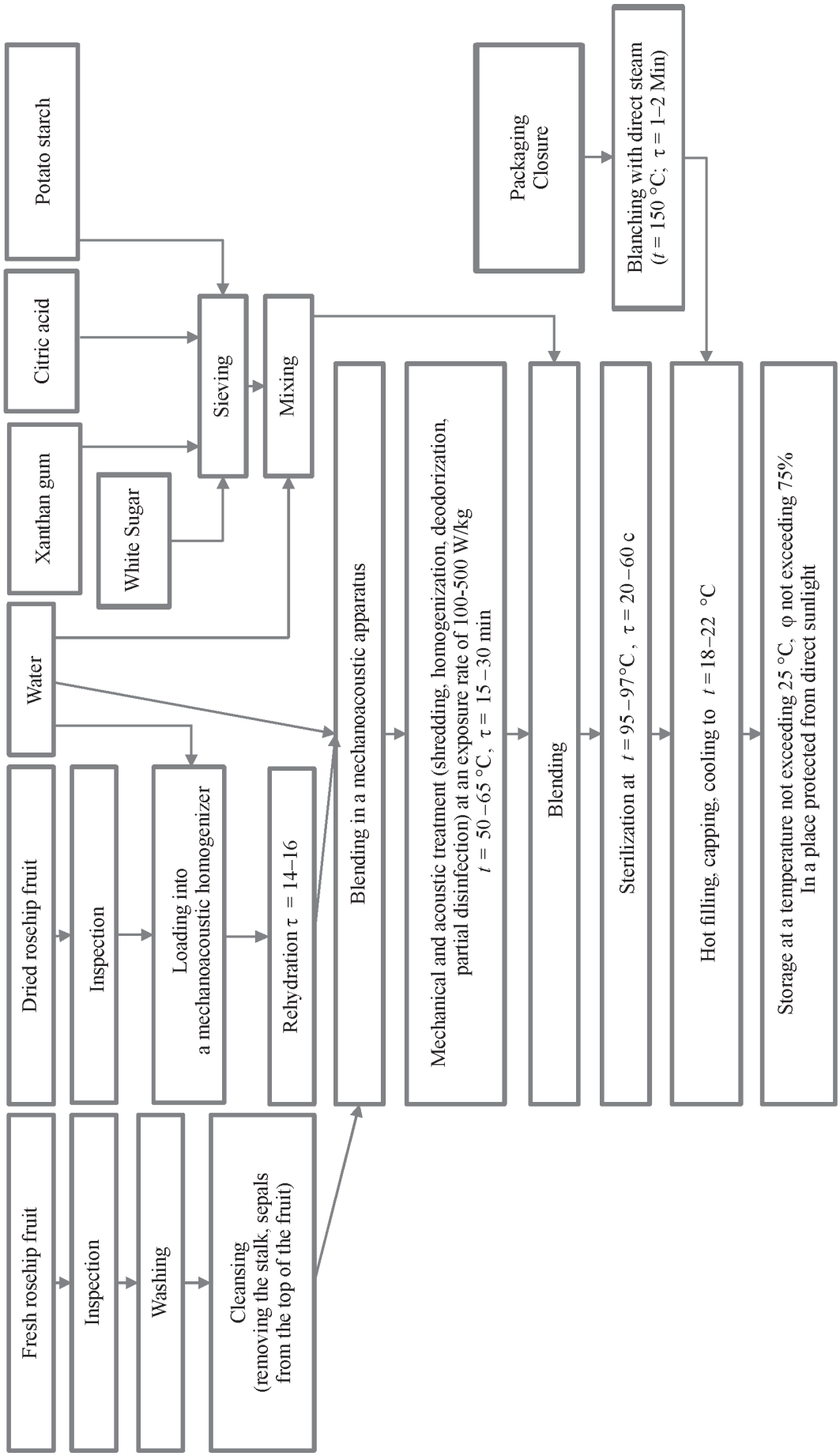

Рис. 2. Принципиальная технологическая схема производства киселей питьевых шиповниковых
Fig. 2. Principle technological scheme of production of rosehip potable kissels

Табл. 3. Влияние продолжительности хранения киселей питьевых шиповниковых на содержание основных пищевых веществ

Table 3. Effect of potable rosehip kissels storage time on the content of the main nutrients

Storage time, months	Mass fraction, %				
	sugar	protein	fat	organic acids (by malic acid)	ash
From fresh fruit (variant 3)					
0	9,1 ± 0,3	0,2 ± 0,1	0,09 ± 0,05	0,44 ± 0,03	0,29 ± 0,05
6	9,0 ± 0,2	0,2 ± 0,1	0,09 ± 0,05	0,43 ± 0,03	0,29 ± 0,05
12	8,8 ± 0,2	0,2 ± 0,1	0,09 ± 0,05	0,42 ± 0,02	0,28 ± 0,05
14	8,8 ± 0,3	0,2 ± 0,1	0,08 ± 0,04	0,41 ± 0,02	0,28 ± 0,04
From dried fruit (variant 8)					
0	9,9 ± 0,4	0,2 ± 0,1	0,07 ± 0,03	0,45 ± 0,03	0,15 ± 0,03
6	9,8 ± 0,3	0,2 ± 0,1	0,07 ± 0,03	0,44 ± 0,02	0,15 ± 0,03
12	9,6 ± 0,4	0,2 ± 0,1	0,07 ± 0,03	0,43 ± 0,02	0,14 ± 0,03
14	9,5 ± 0,5	0,2 ± 0,1	0,06 ± 0,02	0,42 ± 0,03	0,14 ± 0,02

Табл. 4. Влияние продолжительности хранения киселей питьевых шиповниковых на содержание биологически активных веществ

Table 4. Effect of potable rosehip kissels storage time on the content of biologically active substances

Storage time, months	Mass fraction			
	dietary fiber, %	ascorbic acid, mg/100 g	sums of phenolic substances, mg/100 g	β-carotene, mg/100 g
From fresh fruit (variant 3)				
0	0,80 ± 0,05	209 ± 14	181 ± 26	8,85 ± 0,81
6	0,79 ± 0,04	185 ± 16	168 ± 12	8,50 ± 0,76
12	0,79 ± 0,04	162 ± 12	157 ± 13	7,78 ± 0,75
14	0,78 ± 0,05	144 ± 11	152 ± 12	7,57 ± 0,80
From dried fruit (variant 8)				
0	0,37 ± 0,03	53 ± 11	16 ± 3	2,09 ± 0,26
6	0,37 ± 0,02	47 ± 10	15 ± 5	2,01 ± 0,20
12	0,37 ± 0,02	41 ± 10	14 ± 3	1,84 ± 0,19
14	0,36 ± 0,03	37 ± 9	13 ± 3	1,79 ± 0,22

number of 82 mm and a capacity of 500 cm3, sealed with lids of size 1-82-C, stored at a temperature of 25 °C, relative humidity of no more than 75% in a place protected from direct sunlight for 14 months with a reserve factor of 1.15 according to the methodological guidelines "Sanitary and epidemiological evaluation of the validity and storage conditions of food products" (2004).

During the storage of rosehip kissels there were changes in organoleptic parameters of the products (see Fig. 1, Table 2). By the indicators "appearance and consistency", "color" and "smell and taste" the decrease in scores by the end of the 12th month of storage was 7.3; 8.7 and 9.2%, in the 14th month - 12.6; 13.1 and 15.3%, respectively. By the end of the storage period under analysis, the appearance of the

Табл. 5. Влияние продолжительности хранения киселей питьевых шиповниковых на микробиологические показатели

Table 5. Effect of potable rosehip kissels storage time on microbiological parameters

Indicator	Storage time, months		
	0	12	14
From fresh fruit (variant 3)			
QMA&OAMO, CFU/g	9,54 × 10	9,09 × 10	8,64 × 10
Mould, CFU/g	No growth	No growth	No growth
Yeast, CFU/g	» »	» »	» »
CGB (coliforms)	Not detected	Not detected	Not detected
Bacteria of the genus *Salmonella*	» »	» »	» »
Staphylococcus	» »	» »	» »
Proteus	» »	» »	» »
From dried fruit (variant 8)			
QMA&OAMO, CFU/g	6,36 × 10	4,55 × 10	3,64 × 10
Mould, CFU/g	No growth	No growth	No growth
Yeast, CFU/g	» »	» »	» »
Bacteria of the genus *Salmonella*	Not detected	Not detected	Not detected
CGB (coliforms)	» »	» »	» »
Staphylococcus	» »	» »	» »
Proteus	» »	» »	» »

kissels became less attractive, the consistency became somewhat viscous, the smell and taste were less harmonious and weak. There was a slight darkening of the top layer.

During storage, there was a decrease in the content of the main nutrients in the drinking rosehip kissels regardless of whether the products were obtained from fresh or dried fruits (see Table 3). Thus, losses of sugars, proteins, fats, organic acids and ash by the end of 12 months of storage averaged 3.1; 12.5; 0.2; 6.5 and 4.2%, after 14 months. - 3.7; 16.7; 9.1; 9.0 and 5.1%, respectively.

The content of biologically active substances in the kissels decreased during storage (see Table 4). Ascorbic acid suffered great losses. Regardless of whether the fruit was fresh or dried, its loss after 12 months of storage averaged 69.0%, and after 14 months of storage - 77.5%. - 77,5%. Preservation of phenolic substances and β-carotene was comparable and averaged 87.0 and 88.0% after 12 months of storage, after 14 months - 84.0 and 86.0%, respectively. - 84.0 and 86.0%, respectively. Dietary fiber had the least losses during storage: after 12 months of storage losses averaged 0.9%, after 14 months - 14.5%. - 14,5%. Thus, the consumption of one portion of drinking rosehip kissels (200 cm^3) satisfied the daily requirement for ascorbic acid not less than 62%, β-carotene - not less than 66%.

To establish the shelf life of rosehip drinking kissels, studies of microbiological parameters were carried out (see Table 5).

The permissible number of cells of microorganisms in 1 g of the preserved product, which does not violate its microbiological stability during storage and does not pose a danger to humans, is up to 103 units. It is important that during storage the residual microflora

Табл. 6. Регламентируемые технические характеристики киселей питьевых шиповниковых
Table 6. Regulated technical characteristics of rosehip potable kissels

Indicator	Characteristic/norm
Appearance and consistency	Homogeneous, kisselike mass; no undissolved lumps
Color	Light brown, homogeneous throughout the mass
Smell and taste	Well pronounced, sweet and sour, typical of used rosehip berries, which have been heat-treated; no extraneous odors and flavors
Mass fraction of soluble solids, %	No less than 12
Mass fraction of the fruit part, %	No less than 20,0
Mass fraction of titratable acids (by malic acid), %	0,4–1,0
Impurities of plant origin (stalks, sepals, stems and other plant parts)	Are avoided
Extraneous impurities (not provided for in the recipe)	Are avoided

remain in a suppressed state. In the microbiota of samples of drinking rosehip kissels non-sporulating bacteria were not detected (see Table 5). Residual microflora was within the permissible values of TR CU 021/2011 "On food safety".

On the basis of this research, normative and technical documentation for rosehip drinking kissels was developed (see Table 6).

CONCLUSION

The recipes and technology of drinking kissels made of fresh or dried rose hips have been developed which allow expanding the assortment of new generation products containing biologically active substances. It has been established that the shelf-life of rosehip drinking jellies was 12 months when stored in glass jars of type I with a neck number of 82 mm and a capacity of 500 cm^3, sealed with lids of size 1-82-S, at a temperature and relative humidity of 25°C and 75% respectively and in a place protected from direct sunlight.

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