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РАЗРАБОТКА РЕЦЕПТУРЫ И ТЕХНОЛОГИЯ ПРИГОТОВЛЕНИЯ МЯГКОГО СЫРА С ПРИМЕНЕНИЕМ ОВОЩНОГО СЫРЬЯ

RECIPE DEVELOPMENT AND TECHNOLOGY FOR PREPARING SOFT CHEESE WITH APPLICATION OF VEGETABLE RAW MATERIALS

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Аннотация. *В связи с большим содержанием жиров, влаги и довольно интенсивным распадом белков мягкие сыры имеют нежно-сливочную или творожистую консистенцию. Производство таких сыров с применением различных овощных добавок позволяет сделать продукт более пикантным и обладающим повышенной пищевой ценностью.*

Материалы и методы. *В качестве овощного сырья были выбраны морковь, свекла и хрен. Данные овощи исследовались по следующим показателям: содержание сухих веществ, витамина С, клетчатки, также было проведено определение кислотности и флавоноидов.*

Результаты. *По полученным результатам исследований было выявлено, что наиболее целесообразной и перспективной овощной добавкой при производстве мягких сыров будет выступать хрен и продукты его переработки, так как он обладает наилучшими химическими и физико-химическими показателями по сравнению с морковью и свеклой.*

Заключение. *Добавление овощного сырья в сыр при его производстве позволяет обогатить получаемый продукт витамином С, клетчаткой, а также флавоноидами, повышая таким образом не только пищевую ценность сыра, но и делая его более усвояемым и полезным для организма человека.*

Ключевые слова: сыр, мягкий сыр, овощное сырье, сыропроизводство.

Abstract. *Due to the high content of fats, moisture and fairly intense breakdown of proteins, soft cheeses have a creamy or curdled consistency. The production of such cheeses with the use of various vegetable additives allows you to make the product more piquant and possessing high nutritional value.*

Materials and methods. *As vegetable raw materials were chosen carrots, beets and horseradish. These vegetables were investigated by the following indicators: solids content, vitamin C, fiber, and acidity and flavonoids were also determined.*

Results. *According to the research results, it was found that the most appropriate and promising vegetable supplement in the production of soft cheeses will be horseradish and its processed products, since it has the best chemical and physico-chemical characteristics compared to carrots and beets.*

Conclusion. *Adding vegetable raw materials to cheese during its production allows to enrich the resulting product with vitamin C, fiber, and flavonoids, thus increasing not only the nutritional value of cheese, but also making it more digestible and useful for the human body.*

Key words: cheese, soft cheese, vegetable raw materials, cheese production.

Introduction. The problem of maintaining health by improving the quality of one's nutrition is becoming more and more urgent every year. Especially recently, in view of the constantly growing trend for healthy eating all over the world and, in particular, in our country, as a whole, increased attention of people to what they eat. One of the most common ways to improve your diet is to consume functional foods.

According to GOST R 52349-2005: “A functional food product is a special food product intended for systematic use in the composition of food diets by all age groups of a healthy population, which has scientifically substantiated and confirmed properties, reduces the risk of developing nutrition-related diseases, prevents deficiency or "replenishing the deficiency of nutrients in the human body, preserving and improving health due to the presence of physiologically functional food ingredients in its composition." From this definition, we can conclude that the systematic consumption of these products can not only support or make up for the missing amount of substances useful to the body and, as a result, the general level of human health, but also improve it.

Functional food products are created by reducing unhealthy components in traditional products as a result of their enrichment with functional food ingredients. Functional products can be natural, natural food sources (first category) or specially created products (second category). Of these two categories, the products from the first category are most trusted by consumers. the mere fact of natural origin is more credible. By analogy with functional products, functional food ingredients introduced into the product are divided into the first and second categories [1].

At the end of September 2019, the Prime Minister of the Russian Federation signed an order on the preparation of the transition of the population of the Russian Federation in 2021 to a new consumer basket. This bill was introduced at the beginning of 2018. According to him, in the new consumer basket there will be more meat (instead of 58, 73 kg

are planned), dairy products (instead of 290, 325 kg are planned) and less cereals and flour products (96 kg is planned instead of 126) [2–4].

Having studied the new consumer basket, we came to the conclusion that, taking into account future changes, it is necessary to develop a new functional product based on dairy products, in view of the fact that their consumption by the population, as described in the previous paragraph, should increase much more than meat products groups.

As a result, it was decided to develop a functional dairy product, namely a soft cheese with the addition of a natural functional ingredient. The choice of this dairy product is not accidental. This is primarily due to the fact that cheeses occupy a special place in the diet of a healthy diet, since they are a valuable source of complete digestible proteins, fats, products of their fermentation, as well as minerals, organic acids, and certain groups of vitamins. The world nutrition science recognizes cheese as a highly nutritious, biologically complete, easily digestible product. It is an indispensable and indispensable component of the human diet. The high biological value of soft cheeses is due to the fact that they are distinguished by a high content of soluble protein and amino acids, which gives them the properties of dietary products and allows you to satisfy the needs of the body.

Soft cheeses are extremely diverse both in organoleptic evaluations and physico-chemical parameters, and in the way of production. A wide range of different functional, aromatic and flavoring ingredients can be used in the production of soft cheeses. It is in the technology of soft cheeses that there is a huge selection of technological operations and introduced components aimed at obtaining new functional cheeses enriched with useful substances [5–8].

In addition, a large group of cheeses are the so-called "soft" cheeses. Among the wide variety of cheeses produced in the world, soft cheeses occupy a special place. Their production is widespread in many countries with developed cheese making (France, Italy, Germany, the USA, etc.), accounting for up to 25–35% of the total cheese production. It is known that soft cheeses are in steady demand among Russians, their preparation is cost-effective and, therefore, very attractive for the dairy industry. The advantage of soft cheeses is the most efficient use of raw materials in production, the possibility of faster implementation, since they have a shorter ripening time compared to hard cheeses, as well as high nutritional and biological value of the product. Also, some types of these cheeses can be realized without ripening at all [9–12].

The functional ingredient, it was decided to choose from three products of the vegetable group - carrots, beets and horseradish root. The following briefly describes the beneficial properties of the above vegetables, which determine their functional use.

Carrots. The main vitamin of carrots is β-carotene, which is contained in it in large quantities. β-carotene normalizes metabolism, affects the physical and mental development of the body, increases its resistance to infections, normalizes the functions of the organs of vision. In addition, it contains vitamins B4 and C in sufficient quantities. These vitamins improve appetite, increase the body's resistance to infections, ulcers and cancers, and effectively improve the functioning of the pancreas. For example, mashed baked carrots are used to produce a functional curd product. There are several reasons for this:

– mashed baked carrots is a source of vitamin A;

– this type of raw material is affordable, as carrots are grown in almost all regions of the Russian Federation, which allows purchasing it in the immediate vicinity of production, and the cost of the selected raw material is much lower than foreign vegetable fillers;

– in addition to the availability of carrots as a raw material for the filler, mashed baked carrots has a relatively low energy value, therefore, it is possible to reduce the calorie content of a new functional product [10].

In addition, powder compositions from carrots and pumpkins have found their application in the production of functional biscuits. In addition to saturation of the product with β-carotene, this composition saturated the product with pectin almost 2 times in comparison with the control sample. Fiber content increased by 75%, and the content of β-carotene is more than 30% of the daily needs of the human body, which justified recommending these biscuits for functional nutrition. When a 7% mixture of finely divided pumpkin and carrot powders is added, the content of macronutrients such as calcium increases in biscuits. Based on the studies, a significant effect of the composition of finely divided pumpkin and carrot powders on the organoleptic and physico-chemical parameters of biscuits was found. Significantly increased their nutritional value. All this made it possible to recommend this product as functional [11].

Beet. It is useful as a prophylactic against the appearance of heart and vascular diseases, participates in the process of hematopoiesis, and prevents leukemia and anemia. Magnesium and iodine, found in abundance in beets, contribute to the treatment of atherosclerosis and hypertension, and also have an anti-inflammatory effect. Among beet vitamins in terms of quantitative content, vitamins C and B4 stand out, first of all. Just like carrots, beets found their application in the production of functional products.

Known technology for the use of finely divided carrot and beetroot powders to expand the range and increase the nutritional value of structured fish products (fish sticks). To this end, it was proposed to add regional vegetables (carrots and red beets) rich in biologically active substances to the minced Baltic bream obtained. The finished products were distinguished by high external and taste advantages - an analysis of the chemical composition of the fish-growing sticks showed that they are a high-protein natural product, functional in the content of 7 types of physiologically necessary ingredients: beta-carotene, vitamin A, vitamin PP, sodium, phosphorus, potassium and sulfur. When using beets as a herbal supplement, the color of the surface of the stick on the surface had a beetroot hue, and a light violet hue in the

section. The taste of the finished products had no extraneous flavors and aromas, was enriched with characteristic shades of added vegetables, and a moderate level of salinity [12].

There is also a technology for using beets, pumpkins and Jerusalem artichoke in the formulation of multicomponent caramel toppings. Beet pectin and inulin from Jerusalem artichoke root crops have a beneficial effect on the digestive system, increase immunity and have therapeutic and prophylactic properties. As a result of studies, it was found that the optimal ratio in a multicomponent filling consists of 70% beetroot and 30% pumpkin puree with an additional addition of 15% Jerusalem artichoke. The resulting product favorably affects the digestive system, enhances immunity and has therapeutic and prophylactic properties [13].

Horseradish root. It is called a natural antibiotic. This is one of the best sources of bactericidal phytoncides. It is useful in the treatment of colds, cough, runny nose, bronchitis, asthma and tuberculosis. Vitamin C is the main vitamin in horseradish. Like β-carotene in carrots, it is found in horseradish in large quantities. Vitamin C prevents damage to tissues and organs caused by oxidative stress. Vitamin B6 and B9 present in the plant help to lower blood homocysteine levels. A high concentration of this amino acid negatively affects the production of serotonin. Also in sufficient quantities in horseradish contains vitamin B4 contributing to the improvement of memory and central nervous system.

As a functional ingredient, horseradish root puree has found its application in the development of new recipes for sauces and dressings (low-calorie dressings on a berry, vegetable or milk basis with the addition of vegetable oil). Due to the content of natural antioxidants in horseradish, the shelf life of these dishes is increased, as well as enrich them with dietary fiber, minerals, vitamins, phenolic compounds and antioxidants, practically without increasing their energy value [14].

In addition, it is possible to use infusion from horseradish root as a spicy-aromatic raw material for the production of soft drinks, to enhance their aroma. As a result of the experiment, we obtained a drink with a more pronounced aromatic tone and with the manifestation of freshness and brightness of the citrus flavor perception in the organoleptic of the drink compared to a similar drink without infusion. This product is capable of exerting a positive influence both on the psychoemotional state of the consumer, and enriching his body with the necessary biologically active substances, and helping to maintain an equilibrium state in the body [15].

In accordance with the foregoing, the aim of this work is to develop the formulation of a functional dairy product, namely soft cheese with the addition of one of the three products of the vegetable group as a functional ingredient - carrots, beets, horseradish root. From these vegetables, one product that is most suitable for the role of a functional ingredient will be selected. The selection will be carried out according to several criteria: the content of the mass fraction of solids, the content of fiber, vitamin C and flavonoids, as well as titratable acidity (in terms of malic acid). The result of the work will be a discussion of the results and a conclusion on the work done.

Materials and methods. The objects of research of this work: carrots, beets, horseradish root and soft cheese.

The determination of solids in the selected vegetable samples was carried out by the thermogravimetric method according to GOST 28561-90, the essence of which is to dry a product sample that is loosened or distributed over the absorbing surface at elevated temperature and atmospheric or reduced pressure.

The mass fraction of moisture (X) in the studied vegetables was calculated by the formula:

$$X = \frac{m_1 - m_2}{m_1 - m_3} \cdot K \cdot 100, \quad (1)$$

where m_1 – is the mass of the cup with a lid, a stick and sand or filter paper (or without them) and a sample before drying, g;

m_2 – the mass of the cup with a lid, a stick, sand or filter paper (or without them) and a sample after drying, g;

K – is the correction factor;

m_3 - the mass of the cup with a lid, a stick, sand or filter paper (or without them), g,

The mass fraction of solids (X_1) was calculated by the formula:

$$X_1 = 100 - X, \quad (2)$$

Vitamin C was determined by the titrometric method according to GOST 24556-89, based on the extraction of vitamin C with an acid solution (hydrochloric, metaphosphoric, or a mixture of acetic and metaphosphoric), followed by visual or potentiometric titration with a solution of sodium 2,6-dichlorophenolindophenolate until a light pink color was established.

Mass fraction of ascorbic acid (X) was calculated by the formula:

$$X = \frac{(V_1 - V_2) \cdot T \cdot V_3 \cdot 100}{V_4 \cdot m}, \quad (3)$$

where V_1 – is the volume of the solution of sodium 2,6-dichlorophenolindophenolate used for titration of the sample extract, cm^3;

T – titer of a solution of sodium 2,6-dichlorophenolindophenolate, g / cm^3;

V_3 – the volume of extract obtained by extraction of vitamin C from a sample of the product, cm^3;

V_4 – volume of extract used for titration, cm^3;

m – is the mass of the sample, g

To determine the content of crude fiber, the method of Genneberg and Shtoman was chosen, described in GOST 31675-2012, the essence of which is the sequential processing of a sample of the test sample with solutions of acid and alkali, ashing and quantitative determination of the organic residue by the weight method.

The mass fraction of crude fiber in the dry matter of the test samples (y) was calculated by the formula:

$$y = \frac{(m_1 - m_2)}{m_3} \cdot 100 \cdot \frac{100}{100 - m_4}, \quad (4)$$

where m_1 – is the mass of the nutsche filter with fiber after drying, g;

m_2 – mass of the nutsche filter after ashing, g;

m_3 – mass of sample;

m_4 – mass fraction of hygroscopic moisture,%;

$(100 - m_4)$ – mass fraction of dry matter,%.

The percentage of flavonoids in carrots, beets and horseradish was determined by the photometric method according to GOST R 55312-2012, by measuring the optical densities of the complexes formed by the interaction of flavonoids that are part of the studied vegetables with aluminum chloride at a wavelength of 408-420 nm.

The mass fraction of flavonoid compounds (in terms of catechin) (X_1) is calculated by the formula:

$$X_1 = C \cdot 100 \cdot 100 \cdot m \cdot 5, \quad (5)$$

where C – is the amount of catechin in 25 cm3, found from the calibration graph, mg;

100 – extract volume, cm^3;

100 – recalculation in percent,%;

m – is the mass of a sample of vegetables taken for analysis, g;

5 – volume of extract taken for analysis, cm^3.

The acidity was determined by potentiometric method according to GOST ISO 750-2013 by titration of the analyzed solution with sodium hydroxide solution in the presence of phenolphthalein indicator [1].

In the manufacture of soft cheese such as "Slavyansky" was used cow's milk, with a mass fraction of fat of 3.2%. At the initial stage, milk was pasteurized at a temperature of 70 ° C for 10 minutes and then cooled to 34 ° C. In order to enrich milk with calcium during cooling, a solution of calcium chloride was added to milk at the rate of 30 g per 100 l of milk. A starter culture containing *Lactococcus lactis subsp. Was used in the production. Cremoris, L. lactis subsp. Diacetilactis, Streptococcus thermophilus, Bifidobacterim bifidum, B. longum, B. adolescentis* with an active acidity of 5.2 units. pH in an amount of 1% by volume of milk. The enzyme preparation Rennet, which promotes coagulation of milk, was introduced into the milk mixture after establishing a pH value of 6.42 units. pH Coagulation of the resulting milk mixture was carried out for 30 minutes while maintaining a constant temperature of 34 ° C. After the formation of a dense clot, the cheese grain was mixed until a dense elastic consistency was achieved, salting was carried out and its further self-pressing. In the process of cheese production, a preliminary heat treatment of horseradish and the production of vegetable puree were carried out. The resulting puree was introduced into the cheese in two ways: in whey and directly in the cheese grain itself.

Results and its discussion. According to literature data, most vegetables have a rather low percentage of solids. Typically, this indicator varies between 18-20%, but in certain types of vegetables may not exceed 3-5%. It is worth noting that the amount of solids is determined by physiologically active and nutrient elements - mineral salts, vitamins, carbohydrates, nitrogenous and aromatic substances [16].

As a result of physical and chemical studies, it was found that carrots, beets and horseradish have almost the same dry matter content in their composition: carrots - 14%, beets - 15%, horseradish - 16%. According to the results obtained, it can be concluded that horseradish, in contrast to beets and carrots, is richest in nutrients, minerals and trace elements.

As for fiber, this polysaccharide is one of the main components of the cell walls of fruits and vegetables. Carrots, beets and horseradish mainly contain insoluble fiber that does not interact with water and other substrates [17]. In these types of raw materials, dietary fiber is represented by hemicellulose, cellulose, pectin, and lignin. Fiber-rich foods are extremely beneficial for the digestive system, as well as significantly improve the body's metabolism. As the analysis showed, the percentage of fiber in horseradish is much higher than in beets and carrots: horseradish - 7%, beets - 3%, carrots - 2%. The increased content of dietary fiber in horseradish is due to the high content of cellulose microfibrils in cell membranes.

We also conducted a series of tests to determine vitamin C in the studied vegetables. Vitamin C, also known as ascorbic acid, is the most abundant vitamin in nature. This vitamin is actively involved in redox reactions that occur in the body. The insufficient intake of vitamin C with food contributes to the active development of vitamin deficiency. Ascorbic acid is necessary for the functional integration of sulfhydryl groups of enzymes, for the formation of collagen and intracellular structural substance, which is important for the formation of cartilage, bones, teeth and wound healing. It affects the formation of hemoglobin and the maturation of red blood cells [18].

According to various studies, horseradish contains five times more vitamin C than lemons and oranges. According to the content of ascorbic acid, this root crop is not inferior to red pepper and blackcurrant berries. This is confirmed by the results of chemical analysis that we obtained. So the percentage of ascorbic acid in horseradish was 45%, in carrots - 23%, and beets - 20%. According to the results, it is clear that the content of vitamin C in horseradish is several times greater than in beets and carrots. The flavonoid content in the studied vegetables was not determined randomly, since these compounds have powerful antioxidant activity and are not inferior to vitamins C and E, as well as β-carotene [19].

According to the reference data, horseradish contains the largest number of flavonoids, unlike other vegetables and root crops. According to our results, it is also seen that the mass fraction of flavonoids in horseradish is several times higher than their content in carrots and beets: carrots - 55%, beets - 51%, horseradish - 71%. All obtained research results are given in table. 1.

According to the results of chemical and physico-chemical tests, it was revealed that the most appropriate and promising vegetable additive in the production of soft cheese will be horseradish and its processed products.

Table 1

The results of studies of the chemical and physico-chemical parameters of vegetables

The determined indicator	Test vegetable		
	Carrot	Beetroot	Horseradish
Mass fraction of solids,%	14	15	16
Cellulose, %	2	3	7
Vitamin C, %	23	20	45
Flavonoids,%	55	51	70
Acidity (in terms of malic acid), ^{0}T	0,15	0,15	0,38

In the process of cheese production were carried out: preliminary heat treatment of horseradish and making mashed potatoes from it. The resulting puree was introduced into the cheese in two ways:

1. In the milk mixture before making the enzyme, in dosage:

Sample No. 1 - 8 g;

2. Directly in cheese grain, in dosage:

Sample No. 2 - 4 g;

Sample No. 3 - 8 g;

Sample No. 4 - 12 g.

The optimal dosage of added puree to the milk mixture was calculated on the basis that in one portion of the functional product (50 grams) should contain 15% of the functional ingredient, as a result of which the following calculations were obtained:

$$\begin{matrix} m_{\text{функц–го прод–та}} - 100\,\% \\ m_{\text{функц–го ингред–та}} - 15\,\%, \end{matrix} \quad (6)$$

where $m_{\text{функц–го прод–та}}$ – is the mass of one portion of the functional product, 50 g;

$m_{\text{функц–го ингред–та}}$ - weight of the applied dosage of the functional ingredient, g.

Since the mass of one portion was 50 g, the mass of the applied dosage was:

$$m_{\text{функц–го ингред–та}} = \frac{50 \cdot 15}{100} = 7{,}5 \approx 8\,\text{г} \quad (7)$$

According to the formula (6), in addition to the optimal one, the minimum and maximum dosages were calculated to introduce the functional ingredient into the cheese grain.

The minimum weight of the applied dosage was calculated from the ratio:

$$\begin{matrix} m_{\text{функц–го прод–та}} - 100\,\% \\ m_{\text{функц–го ингред–та}} - 7{,}5\,\%, \end{matrix} \quad (8)$$

where $m_{\text{функц–го прод–та}}$ – is the mass of one portion of the functional product, 50 g;

$m_{\text{функц–го ингред–та}}$ - weight of the applied dosage of the functional ingredient, g.

Similar to the calculations by formula (7), we obtain the minimum weight of the applied dosage:

$$m_{\text{функц–го ингред–та}} = \frac{50 \cdot 7{,}5}{100} = 3{,}75 \approx 4\,\text{г} \quad (9)$$

The maximum weight of the applied dosage was calculated from the ratio:

$$\begin{matrix} m_{\text{функц–го прод–та}} - 100\,\% \\ m_{\text{функц–го ингред–та}} - 23\,\%, \end{matrix} \quad (10)$$

where $m_{\text{функц–го прод–та}}$ – is the mass of one portion of the functional product, 50 g;

$m_{\text{функц–го ингред–та}}$ - weight of the applied dosage of the functional ingredient, g.

Similar to the calculations according to formula (7), we obtain the maximum weight of the applied dosage:

$$m_{\text{функц–го ингред–та}} = \frac{50 \cdot 23}{100} = 11{,}5 \approx 12 \text{ г} \quad (11)$$

The test for assessing organoleptic indicators was carried out on a 5-point scale, where 1 point meant the lowest level of acceptance and 5 points - the highest. In total, 4 tasters participated in the test. According to the results of the study, each taster filled out a tasting card. The arithmetic mean values of points for each indicator and the total amount of points for each sample were summarized in table 2.

Table 2

The results of organoleptic evaluation of soft cheese with horseradish puree

Index	Sample № 1	Sample № 2	Sample № 3	Sample № 4
Consistency	5,0	4,0	4,0	5,0
Taste	4,8	3,3	3,5	3,8
Smell	4,8	3,5	3,8	4,0
Colour	5,0	4,0	4,0	4,0
Total points	19,6	14,8	15,3	16,8

As can be seen from the data in Table 2, the cheese sample No. 1 scored the highest score, during the production of which 8 grams of horseradish puree was added to the whey (Figure 1).

a *b*

Fig. 1. An outer view of sample 1: *a* – top view; *b* – cross section

This sample has a good coherent and soft consistency, for which I received 5 points from tasters. In addition, three of the four tasters noted he had a pleasant pungent flavor of horseradish, complementing the milk taste of cheese, which is felt throughout the mass of the product and the same uniform aroma. One of the tasters felt that the taste and aroma of horseradish were not felt enough, for which he set 4 points for both indicators. In terms of color, all experts agreed that this is the most accurate and aesthetically pleasing pattern, because the surface of this sample was uniformly cream-colored without coarse large inclusions of horseradish on the surface, for which he received 5 points from everyone.

In second place was sample No. 4 (Figure 2).

a *b*

Fig. 2. An outer view of sample 4: *a* – top view; *b* – cross section

All tasters noted that he had a good consistency, like that of sample No. 1, and set 5 points. According to the "taste" indicator, opinions were divided - one of the tasters noted a too strong and harsh taste of horseradish, which did not allow to feel the milky taste of cheese, as a result of which they gave it 3 points. Three others did not find the horseradish taste too strong, but put 4 points for its unevenness throughout the product. According to the "smell" indicator, all tasters agreed that it is felt unevenly, for which the product received 4 points from all. In terms of color, all experts gave 4 points, considering that large inclusions of horseradish in places sharply contrast with the uniform cream color of the product.

The third place was taken by sample No. 3. According to the "consistency" indicator, the tasters put 4 points each, noting in places the insufficient density of the product, its excessive friability (Figure 3).

a *b*

Fig. 3. An outer view of sample 3: *a* – top view; *b* – cross section

According to the "taste" indicator, opinions were divided again - two tasters unanimously gave 4 points, considering the taste of the product as good as that of sample No. 1, but lowered the score for its unevenness, the other two put 3 points, considering the horseradish taste not strong enough, as well as uneven. The smell of this sample was also heterogeneous, for which he received 4 points from three experts and 3 points from one of the tasters, who considered the smell to be too weak and heterogeneous. The experts gave the indicator "color" 4 points each as well as sample No. 4, noting the unpleasant contrast between the uniform cream color of the product and the large inclusions of horseradish.

Outsider of this test was sample No. 2, which received the least points in comparison with other samples (Figure 4).

a *b*

Fig. 4. An outer view of sample 2: *a* – top view; *b* – cross section

Tasters noted insufficient consistency, as in sample No. 3, and set this parameter to 4 points. The main disadvantages of this sample were taste and smell. According to the "taste" indicator, two tasters put 4 points each, noting its unevenness. Another expert put 3 points, considering that the taste of horseradish is not very pronounced, as well as uneven. The last taster gave 2 points, noting the minimal signs of horseradish taste in this sample, which, in addition to being weakly expressed, was also uneven, which in some places made him feel like there was no horseradish at all. The "smell" indicator also received different estimates: two tasters gave 4 points each, two more tasters gave 3 points each, lowering two points for the same reason as the "taste" indicator - a mild horseradish smell, which was present only in places and accordingly was uneven. The color of this sample received 4 points from all tasters, for the same reason as for samples No. 3 and No. 4 - large inclusions of horseradish sharply contrast with the uniform cream color of the product.

Conclusion. According to the results of the studies, it can be concluded that the use of horseradish as a vegetable additive in the production of cheese not only contributes to its enrichment with vitamins, flavonoids and dietary fiber, but also improves its taste, giving the product an interesting piquant taste.

Also, having carried out an organoleptic and visual assessment of the cheeses obtained, it was found that the most appropriate would be the addition of horseradish directly to whey, and not to cheese grain.

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