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TECHNOLOGY OF DRINKING PORRIDGE BASED ON RYAZHANKA WITH CHIA SEEDS

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Abstract. This study is devoted to the development of a functional fermented milk product—drinking porridge based on ryazhanka with chia seeds. The aim of the study was to determine the optimal method for producing drinking porridge based on ryazhanka, to establish the rational amount of chia seeds, to develop the technology, and to analyze the nutritional and energy value of the final product. Standard and specialized research methods were used to determine the quality parameters of raw materials and finished products. The control sample was a fermented milk drink (ryazhanka) obtained from baked milk using a dry bacterial starter culture. The study was conducted using pilot production of ryazhanka according to calculated formulations with the addition of whole and ground chia seeds. Ryazhanka is a popular fermented milk drink in Ukraine, which has a high nutritional and biological value, balanced in essential nutrients. Enrichment of ryazhanka with an additional source of plant protein and dietary fiber is relevant and promising for expanding the range of fermented milk products. Analysis of the effect of different concentrations and degrees of grinding of chia seeds on the organoleptic and physicochemical quality indicators of drinking porridge based on ryazhenka makes it possible to determine the optimal amount and form of adding chia seeds. Investigation of the technology of drinking porridge with the addition of chia seeds before fermentation and after fermentation made it possible to determine the method of introducing a plant additive, technological regimes and develop the technology of drinking porridge with chia seeds. Analysis of the nutritional composition of the resulting product after the addition of 2% chia seeds showed that the energy value of the drinking porridge increased by 17.4% compared to the control sample.

Keywords: dairy industry, fermented milk drinks, drinking porridge, ryazhanka, starter culture, chia seeds, dietary fibers, functional products, fermentation

Introduction. Formulation of the problem

The dairy industry is one of the key sectors of the agro-industrial complex of Ukraine. Its importance is determined by the characteristics of its main product – milk, a nutritionally complete food product that meets the population’s requirements for nutrients. Fermented milk drinks are also in high demand among different population groups, from children to the elderly, as nutrients in such products are more readily absorbed by the human body.

Current environmental challenges necessitate improving the structure of the population’s diet by increasing the biological value and sensory characteristics of food products. One of the promising approaches to food fortification is the incorporation of

biologically active ingredients that contain dietary fiber, proteins, mineral elements, etc. In view of this, it is advisable to use ryazhanka – a Slavic fermented milk product obtained from baked milk fermented with lactic acid bacteria – as the basis of the food product.

Dietary fiber contained in plant raw materials performs an important function in the human body, namely, it contributes to detoxification processes and the normalization of gastrointestinal motility. In turn, fermented milk drinks, including ryazhanka, traditionally occupy an important place in the diet due to established consumption patterns and affordability. That is why the enrichment of ryazhanka with an additional source of plant protein and dietary fiber and, accordingly, the expansion of the range of functional fermented milk products is relevant and promising.

Analysis of recent research and publications

An important direction in the development of the food industry in Ukraine and worldwide is the development and implementation of functional products. In particular, this applies to fermented milk drinks [1–6].

To date, the scientific literature contains a limited number of publications on the manufacture of functional products based on ryazhanka. However, studies on the influence of plant raw materials on the production process and quality indicators of the resulting product have been conducted.

Thus, the possibility of adding a plant component in the form of pumpkin seed flour to the milk base of fermented baked milk in an amount of 1–5% of the total mass of the product was investigated. The results indicate a significant increase in the mass fraction of Calcium in the finished product [3].

The effect of adding soy protein isolates, pea protein, wheat gluten, and rice protein on the quality indicators and biological value of ryazhanka was also investigated. It was established that the addition of these components improves the organoleptic and physicochemical quality indicators, increasing the biological value due to a higher content of amino acids, including essential ones (lysine, leucine, isoleucine, methionine, and threonine). It was noted that ryazhanka acquires a distinctive and harmonious taste due to the addition of nut protein isolate [4].

The possibility of adding a calcium-containing fortifier (eggshell powder) to fermented milk products has also been studied. This addition had a positive effect on increasing product stability during storage, improving nutritional value, and preventing spoilage [*Pat. 11504201 JPN Dairy products fortified with cruhed eggshell*].

The possibility of optimizing and accelerating the fermentation process of ryazhanka by adding the biologically active additive “Lyucevita” (alfalfa extract) was investigated. The results showed improved nutritional value and organoleptic properties [5].

There are also patents describing the production ryazhanka with herbal additives (chicory extract, carrot, viburnum, cranberry juices), [*Pat 56317 UA Method for producing a fermented milk product of the type of fermented baked milk with chicory extract; Pat 10483 UA Method of production of fermented baked milk with plant additives*] which report the acceleration of the technological process and enrichment of the final product with nutrients.

Analysis of functional ingredients used in the food industry in Ukraine and worldwide shows that chia seeds are among the most promising. Today, they are widely used in the production of protein shakes and snacks for athletes and physically active individuals [*Pat 9131726 USA Chia seed composition / Nutraceuticals*], as well as in bakery and confectionery products [6,18].

Chia (*Salvia hispanica* L.) belongs to the Lamiaceae family and is an annual herbaceous flowering plant native to Central America. For many centuries, it has been cultivated by indigenous civilizations such as the Incas and Aztecs as a valuable high-protein crop.

In Europe, chia has attracted significant attention from nutritionists and consumers seeking a balanced diet since the early 21st century. Scientists [6-21] recognize chia seeds as one of the richest sources of plant protein, polyunsaturated fatty acids (omega-3, omega-6, omega-9), calcium, magnesium, and dietary fiber.

Chia seeds contain a significant amount of protein, including essential and non-essential amino acids, as well as fats and carbohydrates (Table 1) [18].

Table 1 – Content of essential nutrients in chia seeds

Substance	Content, %
Proteins:	21,8±0,9
non-essential amino acids	14,15±0,25
essential amino acids	7,65±0,25
Fats	33,2±1,7
Carbohydrates:	41,0±0,5
including mono- and disaccharides	14,8±0,5
non-starch polysaccharides:	26,2±0,4
including water-insoluble (dietary fiber)	21,2±0,3
water-soluble	5,0±0,2

Carbohydrates of chia seeds consist of 64% non-starch polysaccharides. Dietary fiber is the only physiologically active complex that provides important functions in the human body related to digestion and metabolism.

Dietary fiber of chia seeds consists of cellulose, lignin and part of hemicelluloses, normalizes the activity of beneficial intestinal microflora, improves its peristalsis, acts as enterosorbents, etc. Soluble non-starch polysaccharides include: part of hemicelluloses, pectin and mucous substances, which affect the reduction of cholesterol levels in the blood, contribute to the binding and excretion of heavy metals, radionuclides and other xenobiotics from the human body.

The high content of protein substances in chia seeds characterizes the biological value of the product. The higher the biological value of food protein, the better it is used for the synthesis of its own proteins and the functioning of the body. The biological value of a protein depends on its proximity to the “ideal protein,” namely, the ratio of essential and nonessential amino acids and the amino acid score. The ratio of the sum of essential amino acids to the sum of essential amino acids should not be lower than 0.4. For chia seeds, the value of this indicator is 0.54, so according to the amino acid score (Table 2), chia seed proteins can be classified as biologically valuable [18].

In particular, the amino acid scores of chia seed proteins for valine, leucine, isoleucine, tyrosine,

methionine and tryptophan are close to 100 or significantly exceed this limit. The limiting amino acids for protein are lysine and threonine, and in chia seeds they have quite high amino acid score values — 90.51% and 90.98%, respectively.

Table 2 – Analysis of amino acid scores of seed proteins

No.	Amino acid	Amino acid score, %
1	Threonine	90,98
2	Valine	97,50
3	Methionine + cystine	145,91
4	Isoleucine	102,78
5	Leucine	100,51
6	Tyrosine + phenylalanine	135,05
7	Tryptophan	223,80
8	Lysine	90,51

Assessment of the fractional composition of chia seed proteins (Table 3) indicates a high content of water-soluble and salt-soluble fractions (albumins and globulins) [18].

Table 3 – Fractional composition of chia seed protein

No.	Protein fraction	Content, %
1	Albumins	16,8
2	Globulins	50,4
3	Prolamins	13,4
4	Glutenins	13,8
5	Insoluble protein	5,6

The nutritional and biological value of chia seeds is due to their fatty acid composition, namely the presence of fatty acids with two or more unsaturated bonds in the molecule. A feature of the fatty acid composition of chia seeds (Table 4) is the high content of polyunsaturated fatty acids (about 80% of all fats), including linolenic (ω -3) acid, which contains 63.3% [18].

These nutritional components are necessary for cell growth, normal skin condition, cholesterol metabolism and a large number of other processes occurring in the human body.

Of the micronutrients necessary for the human body, chia seeds contain such mineral elements as Potassium, Calcium, Magnesium, Copper, Zinc and Phosphorus, their content and percentage of the daily requirement of an adult are given in Table 5 [18].

Chia seeds contain a number of B vitamins, vitamins C, E and PP in significant amounts for the human body. In particular, 100 g of seeds contain about 20% of the daily requirement of vitamin E, more than 40% of thiamine, 10% of pyridoxine, 75% of folate and about 40% of niacin. The content of vitamins in the seeds is given in Table 6 [18].

Chia seeds are also a rich source of phytochemicals, especially polyphenols, which are characterized by high biological activity [19, 20]. The seeds contain significant concentrations of gallic,

caffeic, chlorogenic, ferulic and rosmarinic acids. Flavonoids, which are also present in chia seeds, are responsible for color, taste and prevent fat oxidation. Natural antioxidants – chlorogenic and caffeic acids and phytonutrients – myricetin, quercetin and kaempferol are useful for strengthening immunity and premature aging [22].

Table 4 – Fatty acid composition of chia seeds

Name of fatty acid	Content, %
Saturated fatty acids:	8,66
myristic (C14:0)	0,02
pentadecanoic (C15:0)	0,03
palmitic (C16:0)	5,98
margarine (C17:0)	0,05
stearic (C18:0)	2,26
behenic (C22:0)	0,08
tricosanic (C23:0)	0,03
lignoseric (C24:0)	0,21
Monounsaturated fatty acids:	11,97
myristoleic (C14:1)	0,02
palmitoleic (C16:1)	0,86
oleic (C18:1 – ω -9)	11,02
gadoleic (C20:1)	0,07
Polyunsaturated fatty acids:	79,37
linoleic (C18:2 – ω -6)	16,03
linolenic (C18:3 – ω -3)	63,3
eicosadienoic (C20:2)	0,02
eicosatrienoic (C20:3)	0,02

The analysis of the chemical composition of chia seeds and the possibility of its use in the production of functional products is also devoted to the work of scientists [21], which notes that 100 g of chia contains 94% of the daily norm of Magnesium, 63% – Calcium, 59% – Iron, as well as Manganese, Phosphorus, Copper, Selenium. These indicators differ somewhat from the data [18], which can be explained by varietal differences and the place of cultivation of chia.

Important qualities of chia seeds include the possession of prebiotic properties, due to the significant content of biologically active substances, including dietary fiber. Thus, there is a known study of the use of chia seeds in the composition of a herodietic smoothie [22].

In recent years, a number of publications have been presented related to the technology of fermentation of dairy raw materials with chia seeds. In this direction, studies have been conducted on the enrichment of yogurt mousse [7], kefir [8], yogurt [9-15] with chia seeds. In particular, a rational amount of chia seeds in the finished product and an increase in its nutritional and biological value have been established. When studying the effect of chia seeds on the quality of yogurt, an improvement in the organoleptic characteristics of the finished product was noted [11]. In addition, studies have been conducted on the effect of the gelling properties of chia seeds on the structure of low-fat yogurts [12], which showed positive results of its use as a natural stabilizer and emulsifier.

Table 5 – Mineral content of chia seeds

Mineral element	Daily dose, mg	Content in Chia Seeds, mg/100 g	% of Daily Value
Potassium	2000	420,8±0,4	21,04
Calcium	1000	594,0±0,4	59,4
Iron	15	7,1±0,1	47,3
Magnesium	400	296,4±0,4	74,1
Zinc	12	4,6±0,05	38,3
Phosphorus	800	720,0±0,4	90
Copper	1	1,09±0,04	109

Table 6 – Vitamin content in chia seeds

Vitamin Name	Daily dose, mg	Content, mg/100 g
B ₁ (thiamine)	1,1–1,9	0,48±0,02
B ₂ (riboflavin)	1,3–2,2	0,020±0,005
B ₆ (pyridoxine)	1,8–2,0	0,180±0,005
B ₉ (folate)	0,2	0,150±0,005
C (ascorbic acid)	75–90	3,20±0,05
E (tocopherol)	8–10	1,48±0,04
PP (niacin)	14–26	5,95±0,05

It was found that the introduction of a complex additive containing chia seeds in an amount of 1.4% significantly improves the stability of the lactic acid microflora of yogurt during 21 days of storage [13]. In addition, the introduction of chia seed extracts has a positive effect on the development of the microflora of the lactic acid product [14].

According to the authors' studies [15], enriching yogurt with chia oil in an amount of 2% leads to an increase in the amount of phytosterols and polyunsaturated fatty acids in yogurt, while maintaining the stability of its properties during four weeks of storage.

Summarizing the analyzed information, it can be stated that today it is advisable to expand the range of fermented milk products by using chia seeds. The development of a new type of fermented milk product, namely drinking types of porridge based on ryazhanka using chia seeds, is promising. This work is novel and relevant.

Purpose and objectives of the study. The purpose of the study is to develop a drinkable porridge based on fermented baked milk with the addition of chia seeds.

To achieve this objective, the following tasks were formulated:

1. To provide a scientific substantiation of the method for producing drinkable porridge based on ryazhanka with the addition of chia seeds.
2. To investigate the effects of different concentrations and particle sizes of chia seeds on the organoleptic and physicochemical properties of drinkable porridge based on ryazhanka.
3. To analyze changes in the nutrient composition of ryazhanka after the addition of chia seeds.
4. To determine the effect of the studied functional ingredient on the nutritional and energy value of the finished product.

Materials and methods.

Research on determining the quality indicators of raw materials and finished products was carried out using generally accepted standard and specialized methods. The raw materials used for the production of drinking porridge included cow's milk baked in accordance with DSTU 2661:2010. Baked milk. General specifications.

A dry bacterial starter culture of the Goodfood brand was used as a leavening agent in accordance with Technical Specifications TU 10.5-37392286-001:2019.

The starter culture contained the following bacterial strains: *Streptococcus thermophilus*, *Lactobacillus bulgaricus*, *Bifidobacterium bifidum*, *Bifidobacterium infantis*, *Bifidobacterium longum*, *Bifidobacterium breve*, *Bifidobacterium adolescentis*. The starter was added at a rate of 1 g per 1 kg of baked milk.

Whole and ground chia seeds were used as a source of micronutrients, complying with DSTU 2240-93. Seeds of agricultural crops. Varietal and sowing qualities. Technical specifications.

Grinding was performed using an LZMK-1 laboratory mill. The granulometric composition of the resulting powder was determined by sieving using an RL-1 laboratory sieve shaker (residue on sieve No. 067 was 2.5%).

The effect of different concentrations of chia seeds on the quality indicators of the developed product was studied using the trial production method of the fermented milk product (ryazhanka) prepared according to calculated formulations with the addition of whole and ground chia seeds.

A sample of ryazhanka produced using the Goodfood starter culture was used as the control. Fermentation of all samples was carried out at a temperature of 38–40°C for 4 h using a Galaxy GL2690 yogurt maker (fermentation chamber capacity: 7 cups of

200 cm³ each) [23]. Organoleptic evaluation of the finished products was carried out in accordance with DSTU 4565:2006. Ryazhanka and varenets. Technical specifications.

The chemical composition and energy value of the developed products were calculated based on the formulation of the drinking porridge and the chemical composition of the raw materials.

The mass of each raw material component in 100 g of product was calculated using Formula (1):

$$m=100 \times (C/100), \quad (1)$$

where C is the mass fraction of the raw material in the product, %.

The contents of proteins, lipids, carbohydrates, minerals (Na, K, Ca, Mg, P, Fe) and vitamins in 100 g of product were determined using Formula (2):

$$G_{p/l/c} = m \times C_{p/l/c/m/v}, \quad (2)$$

where m is the mass of the raw material component in 100 g of product, g;

C is the content of the corresponding component in the raw material.

The energy value (EV) of the finished product was calculated using Formula (3):

$$EV = \sum m_i \times K_d \times Q_c, \quad (3)$$

where K_d is the digestibility coefficient (proteins – 0.71, lipids – 0.96, carbohydrates – 1.0);

Q_c is the calorific value, kJ/g (proteins – 23.64, lipids – 39.12, carbohydrates – 15.69);

m_i is the mass of proteins, lipids and carbohydrates in 100 g of product.

The mass fraction of dry matter in the finished products was determined using the accelerated method in accordance with DSTU 8552:2015. Milk and dairy products. Methods for determination of moisture and dry matter.

Titrate acidity was determined by the titrimetric method, while active acidity (pH) was measured by the potentiometric method using a pH-340 device, in accordance with DSTU 4565:2006.

The density of the samples was determined by the hydrometric method in accordance with DSTU 6082:2009. Milk and dairy products. Methods for determination of density.

Results of the research and their discussion

In order to develop a drinking porridge based on fermented milk, a technology of baked milk fermentation using dry bacterial starter and adding chia seeds at different technological stages was proposed. For production, fermented milk with a fat content of 2.6% was used, native and ground chia seeds. Seven samples of fermented baked milk were produced with the addition of whole and ground chia seeds in an amount of 0.5-3.0% before and after fermentation of fermented milk:

control – fermented baked milk with starter (without adding chia seeds);

sample 1 – with the addition of 0.5% to the mass of fermented milk of whole chia seeds before fermentation;

sample 2 – with the addition of 1.0% to the mass of fermented milk of whole chia seeds before fermentation;

sample 3 – with the addition of 2.0% to the mass of baked milk of whole chia seeds before fermentation;

sample 4 – with the addition of 3.0% to the mass of baked milk of whole chia seeds before fermentation;

sample 5 – with the addition of 3.0% to the mass of baked milk of whole chia seeds after fermentation;

sample 6 – with the addition of 3.0% of ground chia seeds to the mass of baked milk (after fermentation).

The results of the study of the physicochemical parameters of the manufactured samples are given in table 7. All experimental samples of drinking porridge are characterized by an increased content of dry matter (5.5-25.5% higher than the control) and a higher density (4.4-27.2% higher than the control), which is due to the presence of a large amount of dietary fiber in chia seeds. The high hygroscopicity of dietary fiber and the property of soluble non-starch polysaccharides to increase the viscosity of liquid systems influenced the increase in the density of the finished product.

The addition of chia seeds (native and ground) to the finished fermented baked milk led to an increase in titrated acidity by 2-13% relative to the control and, at the same time, a slight decrease in the pH of the medium. The addition of chia seeds to fermented milk before fermentation led to a decrease in titrated acidity by 2.5-16.8% relative to the control. This is explained by the high content of natural antioxidants in chia seeds, such as caffeic and chlorogenic acids, myricetin, kaempferol and flavonols, as well as a decrease in the number of lactic acid bacteria in the test samples when chia seeds were added.

Adding 3% chia seeds after fermentation of baked milk leads to an increase in the dry matter content (by 3.2%), an increase in titrated acidity (by 22.4%) and practically does not affect the values of density and active acidity compared to adding the corresponding amount of seeds before fermentation.

Adding 3% ground chia seeds after fermentation leads to: an increase in the titrated acidity of the resulting porridge (by 11.6%), which is associated with the release of acids present in the seeds as a result of grinding; and a decrease in the dry matter content (by 2.24%) compared to adding the corresponding amount of native seeds.

Sensory analysis of the studied porridge samples included determination of taste, aroma, color and consistency. The results are presented in Table 8.

According to the results of the organoleptic evaluation, samples 1, 2, 3 of fermented baked milk with the addition of native chia seeds before fermentation were characterized by the best organoleptic indicators. Sample 4 was distinguished by a very thick consistency and a noticeable herbal smell of chia, which worsened the organoleptic properties.

Table 7 – Physicochemical quality parameters of the manufactured drinking porridge samples (n=3; P≥0.95)

Indicator	Control	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
Mass fraction of dry matter, %	10,99	11,55	12,66	13,17	13,65	14,10	13,79
Titrated acidity, °T	80,5	78,5	75,0	70,5	67,0	82,0	91,5
Active acidity, pH	4,64	4,65	4,67	4,69	4,71	4,62	4,60
Density, g/cm ³	1,060	1,107	1,173	1,257	1,348	1,349	1,330

Source: compiled by the authors

Table 8 – Organoleptic indicators of manufactured drinking porridge samples

Indicator	Control	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
Consistency	Homogeneous, dense	Non-uniform, thick texture with suspended hydrated chia seeds	Non-uniform, thick texture with suspended hydrated chia seeds	Non-uniform, thick texture with suspended hydrated chia seeds	Non-uniform, very thick texture with suspended hydrated chia seeds	Non-uniform, very thick texture with suspended hydrated chia seeds	Non-uniform, very thick texture with suspended hydrated chia seeds and the presence of chia seed lumps
Color	Creamy, homogeneous	Creamy with inclusions of chia grains	Creamy with inclusions of chia grains	Creamy with inclusions of chia grains	Creamy with inclusions of chia grains	Creamy with inclusions of chia grains	Creamy, heterogeneous, with a greenish tint
Aroma	Aroma of baked milk	Sour milky, light	Sour milky, light, barely noticeable smell of chia	Sour milky, light, barely noticeable smell of chia	Sour milky, light, noticeable smell of chia	Sour milky, noticeable smell of chia	Too pronounced sour milk, with a sharp smell of chia
Taste	Pleasant taste of baked milk	Pleasant taste of baked milk	Pleasant taste of baked milk with a faint chia aftertaste	Pleasant taste of baked milk with a faint chia aftertaste	Pleasant taste of baked milk with a faint chia aftertaste	Pleasant, of baked milk, with a chia flavor, there are hardened chia grains	Baked milk with a sharp bitter taste of chia

Source: compiled by the authors

When adding native chia seeds after fermentation (sample 5), rather hard grains remained in the finished product, which worsened the organoleptic indicators.

When adding ground chia seeds to fermented baked milk, the resulting porridge (sample 6) acquired an unpleasant, very sharp herbal smell of chia and, no less sharp, bitter aftertaste.

Considering the optimal physicochemical (titrated acidity and density) and organoleptic indicators, it is recommended to use native chia seeds in the technology of fermented milk drinking porridge based on fermented milk in an amount of 2% (to the mass of fermented milk) and to add it before fermentation (sample 3).

The nutritional value of the drinking porridge (sample 3) was obtained by the calculation method taking into account the chemical composition of the raw material components and their digestibility coefficient. First, the mass of fermented milk was calculated according to formula 1 (100 g of the product contains 97.9 g of milk, 2 g of chia seeds, and 0.1 g of starter

culture) then the masses of proteins, lipids, carbohydrates, corresponding minerals and vitamins in 100 g of the developed product according to formula 2. The changes in the composition of fermented milk during the fermentation process were not taken into account in the calculations.

Tables 9.1 and 9.2 present averaged literature data on the chemical composition of the main raw materials and the calculated composition of the proposed drinking porridge sample.

The results obtained showed that the addition of chia seeds in an amount of 2% of the mass of baked milk leads to an increase in the amount of proteins by 13.8%, lipids by 23.1%, carbohydrates by 12.5% compared to the control. At the same time, the amount of minerals increases (Potassium - by 3.8%, Calcium - by 7.6%, Iron - by 140.0%, Magnesium - by 40.0%, Zinc - by 20.0%, Phosphorus - by 13.7%, Copper - by 200%) and vitamins (B₁ - by 45%, B₆ - by 12%, B₉ - by 75%, C - by 20%, E - by 30%, PP - by 12.5%).

Table 9.1 – Chemical composition of the main raw materials and finished product

Raw materials/ finished product	Protein, lipid, carbohydrate content, g/mg per 100 g ± 5%									
	Proteins, g	Lipids, g	Carbohydrates, g	Minerals, mg						
				K	Ca	Fe	Mg	Zn	P	Cu
Baked milk	2,9	2,6	4,7	146	124	0,1	14	0,4	92	0,01
Chia seeds	23,0	33,0	33,5	420	594	7	296	4,6	720	1,09
Dry bacterial starter	2,0	0,0	93,0	-	-	-	-	-	-	-
Drinking porridge	3,3	3,2	5,4	151	133	0,2	20	0,5	104	0,03

Source: compiled by the authors

Table 9.2 – Chemical composition of the main raw materials and finished product

Raw materials/ finished product	Vitamin content, mg/100 g ± 5%					
	B ₁	B ₆	B ₉	C	E	PP
Baked milk	0,02	0,025	0,004	0,3	0,10	0,8
Chia seeds	0,48	0,180	0,150	3,2	1,48	5,9
Dry bacterial starter	-	-	-	-	-	-
Drinking porridge	0,03	0,028	0,007	0,4	0,13	0,9

Source: compiled by the authors

Energy value characterizes the share of energy that can be released from food products in the process of biological oxidation and used to ensure the physiological functions of the body. The energy value of the control sample of fermented baked milk and the resulting drinking porridge with a rational amount of chia seeds was calculated using formula (3).

$$EV_{\text{control}} = 208,79 \text{ kJ.} \quad EV_{\text{porridge}} = 245,13 \text{ kJ.}$$

Thus, adding chia seeds in an amount of 2% of the mass of baked milk leads to an increase in the energy value of drinking porridge by 17.4% compared to the control (fermented milk).

Determining the optimal concentration and method of adding chia seeds in the process of producing drinking porridge made it possible to propose the following technology for its production. Dry bacterial starter is added to baked milk with a fat content of 2.6%, the mixture is heated to a fermentation temperature of 37-42 °C, mixed for 15 minutes, after which pre-weighed chia seeds are added to the tank and the mixture is mixed again for 15 minutes. The fermentation duration is 4-6 hours to an acidity of 70-80 °T. Upon completion of maturation, before bottling, the porridge is mixed for 2-10 minutes and cooled to a temperature of 4 ± 2 °C, at which the porridge is packaged and stored in a refrigerator.

Approbation of research results. The obtained research results can be implemented on small dairy farms in order to produce a functional, protein-enriched product that can be used for a wide range of people, in particular, in gerodietic nutrition.

Conclusion

1. The technology of drinking porridge based on fermented baked milk with the addition of chia seeds

was analyzed, scientifically substantiated and developed.

2. Analysis of the physicochemical parameters of the finished products showed that the addition of chia seeds at a concentration of 0.5-3% leads to an increase in the dry matter content by 5.5-25.5%; an increase in density by 4.4-27.2%; a decrease in titrated acidity by 2.5-16.8% when adding chia seeds to baked milk before fermentation and an increase in titrated acidity by 1.9-13.0% when adding chia seeds to the product after fermentation compared to the control (fermented milk).

3. Based on the results of physicochemical and organoleptic studies of the developed samples, it is proposed to use 2% of chia seeds from the amount of fermented milk in the technology of drinking porridge based on fermented milk and to introduce it into the normalized mixture before fermentation in its native form.

4. Calculation of the nutritional value of drinking porridge samples showed that adding chia seeds in an amount of 2% of the mass of fermented milk leads to an increase in the amount of proteins by 13.8%, lipids by 23.1%, carbohydrates by 12.5% compared to the control. At the same time, the content of minerals increases (Potassium – by 3.8%, Calcium – by 7.6%, Iron – by 140%, Magnesium – by 40%, Zinc – by 20%, Phosphorus – by 13.7%, Copper – by 200%) and vitamins (B₁ – by 45%, B₆ – by 12%, B₉ – by 75%, C – by 20%, E – by 30%, PP – by 12.5%).

5. According to the calculations, the energy value of drinking porridge with chia seeds in the amount of 2% of the mass of baked milk as a whole increases by 17.4% compared to the control sample.

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ТЕХНОЛОГІЯ ПИТНОЇ КАШІ НА ОСНОВІ РЯЖАНКИ З ВИКОРИСТАННЯМ НАСІННЯ ЧІА

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Анотація. Робота присвячена розробленню функціонального кисломолочного продукту – питної каші на основі ряжанки з використанням насіння чіа. Метою роботи було визначити оптимальний спосіб одержання питної каші на основі ряжанки, дослідити раціональну кількість додавання насіння чіа, розробити технологію, проаналізувати харчову та енергетичну цінність готового продукту. Використовувалися загальноприйняті і спеціальні методи досліджень з визначення показників якості сировини і готової продукції. Контролем слугував кисломолочний напій (ряжанка),

отриманий з пряженого молока з використанням сухої бактеріальної закваски. Дослідження проводили методом пробного виготовлення ряжанки за розрахованими рецептурами з додавкою насіння чіа – цілого й перемеленого. Ряжанка є популярним кисломолочним напоєм серед населення України, який має високу харчову та біологічну цінність, збалансовану за найбільш необхідними для організму людини речовинами. Збагачення ряжанки додатковим джерелом рослинного білка та харчових волокон є актуальним і перспективним для розширення асортименту кисломолочної продукції. Аналіз впливу різної концентрації та ступеня подрібнення насіння чіа на органолептичні та фізико-хімічні показники якості питної каші на основі ряжанки дає змогу визначити оптимальну кількість і форму додавання насіння чіа. Опрацювання технології питної каші з внесенням насіння чіа до сквашування і після сквашування дозволило визначити спосіб внесення рослинної добавки, технологічні режими та розробити технологію питної каші з насінням чіа. Аналіз нутрієнтного складу отриманого продукту після додавання насіння чіа у кількості 2 % показав, що енергетична цінність питної каші збільшилася на 17,4 % порівняно з контрольним зразком.

Ключові слова: молочна промисловість, кисломолочні напої, питна каша, ряжанка, стартова культура, насіння чіа, харчові волокна, функціональні продукти, ферментація

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