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У результаті проведених експериментальних досліджень встановлено, що для поліпшення консистенції при зберіганні кисломолочних напоїв, необхідно забезпечити зв'язування вільної вологи за рахунок застосування натуральних стабілізаторів, загущувачів та речовин, що виконують аналогічну функцію. Серед багатьох апробованих інгредієнтів цієї групи речовин, відібрано для впровадження та надано перевагу використанню стабілізуючих систем на основі природних складових рослинного та тваринного походження. Аналіз інформаційних джерел показує відсутність даних про використання пшеничних висівок у технологіях кисломолочних напоїв. Тому виникає об'єктивна необхідність створення нових видів кисломолочних напоїв, а саме кефірів з використанням пшеничних висівок. Споживання таких функціональних продуктів гарантує усунення недостатнього харчування, поповнення організму необхідними компонентами.

Вивчено вплив пшеничних висівок на якісні показники кисломолочного напою. Встановлено, що кисломолочний напій з пшеничними висівками з мчж 2,5 % за фізико-хімічними показниками відповідає вимогам діючого стандарту ДСТУ 4417:2005. Кефір. Технічні умови. При дослідженні органолептичних показників напою із використанням пшеничних висівок встановлено його чистий кисломолочний смак і запах. В напої з пшеничними висівками зростала загальна сума амінокислот – на 15,08 %, в тому числі незамінних – на 10,57 замінних – на 18,24 %, Виявлені зміни в амінокислотному складі напою з пшеничними висівками вказують на те, що використання пшеничних висівок при виготовленні кисломолочних напоїв дозволяє підвищити їх харчову та біологічну цінність білкової складової.

Додавання пшеничних висівок не тільки корегує харчову та біологічну цінність кисломолочного продукту, а й дозволяє підвищити його якісні характеристики за рахунок зв'язування вільгої вологи впродовж зберігання

Ключові слова: кисломолочні напої, добавки, пшеничні висівки, амінокислоти, органолептичні показники, фізико-хімічні показники

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INFLUENCE OF WHEAT BRAN ON QUALITY INDICATORS OF A SOUR MILK BEVERAGE

V. Nagovska
PhD, Associate Professor*
Y. Hachak
PhD, Associate Professor*
B. Gutyj
Doctor of Veterinary Science, Professor
Department of Pharmacology and Toxicology**
E-mail: bvh@ukr.net
O. Bilyk
PhD, Assistant*
N. Slyvka
PhD, Associate Professor*
*Department of Technology of milk and milk products**
**Stepan Gzhytskyi National University of Veterinary Medicine and Biotechologies Lviv
Pekarska str., 50, Lviv, Ukraine, 79010

1. Introduction

Modern severe environmental conditions create the urgent need to improve the structure of nutrition of the population by increasing biological and nutritional value of products and expanding their assortment [1]. Development of healthy eating became important for the development and enhancement of the structure of the food market [2]. That

is why production of functional and health care products increased to meet the significant demand of consumers [3]. The products, the formulation of which was developed with the aim of replenishing nutrients to increase the resistance of the organism under complex environmental conditions, enjoy especially great demand with population [4]. In many countries, the share of these products is quite significant and continues to grow each year. Consumption of functional products results not only in replenishing a human body with essential components [5], but also in the elimination of effects of toxins that are produced in the body itself or get inside it from the contaminated environment [6].

Preventive and medical and prophylactic products necessarily include natural micronutrients, due to which products receive such a name [7]. An increase in nutritional and biological value of foodstuff is carried out by additional supplementing of its formulation with such ingredients as vitamins, proteins, dietary fiber, biologically active additives, etc. [8, 9].

That is why it is relevant to develop the technology of a sour milk beverage using wheat bran, which is a ballast substance and will remove unwanted compounds from the body.

2. Literature review and problem statement

One of the main directions of the state policy in the field of healthy nutrition is development of the technology of products for functional purposes. These products are used to prevent diseases and strengthen protective functions of the organism. They are used to reduce the action of harmful substances, specifically for the population of environmentally unfavorable zones [10, 11].

The concept of functional (healthy) eating [12] originated in the early 1980s in Japan. Japanese researchers identified three main features of such products: nutritional value, taste properties, and physiological effect.

The basis for the technologies of functional foods is a modification of the traditional products in order to improve the content of useful ingredients in them to the level that meets the physiological norms of consumption (10–50 % of the average daily needs) [13].

According to this concept, a functional food product is a product that is intended for regular use as a part of food rations by all age groups of healthy population. It reduces the risk of developing diseases associated with diet, maintains and improves health due to existence of physiologically functional food ingredients in its composition [1, 13].

An enriched food product is a functional food product, which is produced by adding one or more «physiologically functional food ingredient» to traditional foods in order to prevent the emergence of deficiency of nutrients or to eliminate the one that already exists in a human body.

Within a great number of groups of functional foods, the deserved popularity is enjoyed by sour milk beverages, i.e., cow milk, milk of sheep, goats, mares and other animals, soured by different kinds of lactic acid bacteria [14]. Kefir, yoghurt, ryazhenka, etc. are traditional for Ukrainians [15].

Kefir is one of the most popular sour milk drinks, it accounts for more than 2/3 of the entire production. In Ukraine, this product is very common, because it falls into the category of «first necessity» products. Useful properties of kefir are caused by its ability to stop the development of pathogenic bacteria in the intestine. Thus, the processes of decay are inhibited and the formation of toxic decay product is stopped [16].

The regulatory documentation on the production of a wide range of fermented sour milk drinks was designed, including vitamin enriched kefirs, both for mass nutrition and for special adult and children nutrition, specifically:

– TU U 15.5-19492247-005-2003 «Vitamin enriched kefirs and vitamin enriched kefir products»);

– TU U 15.8-21604587- 003-2003 «Products for special dietary consumption, children's nutrition. Vitamin enriched kefirs. Vitamin enriched kefir products») [17, 18].

Numerous authors propose a considerable list of milk products from plant components, the application of which provides obtaining products with an assigned structure and quality indicators [1, 19, 20]. The technology of kefir with the coarsely cut milk thistle was developed [21]. The composition of the coarsely cut milk thistle includes macro- and microelements (contents of Ca is 687 mg/100 gm), amino acids, polyunsaturated fatty acids, a record number of flavolignans, flavonoids, and fiber. Thus, there are 4 g of silymarin in 100.0 grams of coarsely cut milk thistle. Clinical studies of coarsely cut milk thistle showed the effectiveness of applying it in the integrated treatment of viral hepatitis B and C. The theoretical analysis and experimental research into manufacture of kefir with coarsely cut milk thistle revealed that this drink by its organoleptic and physical and chemical indicators meets the current standard DSTU 4417:2005. Kefir with coarsely cut milk thistle should be kept no more than 7 days at the temperature of 4±2 °C, because an increase in shelf life worsens its organoleptic and physical-chemical indicators [21].

The technology of kefirs with the use of Chia seeds was developed in [22]. The useful properties of Chia seeds have a wide range, so it started to be used as a food additive. Chia effectively helps in treatment of depression, epilepsy, sclerosis, at Alzheimer's disease and normalizes pressure. It is also an analog of the antibiotic, but natural, which positively affects the immunity improvement. Thanks to this fact, it contributes to prevention of colds. The seeds stimulate work of intestines and digestive system in general due to the high content of dietary fiber, preventing development of constipation and helping to remove harmful substances from the body. The feasibility of the use of Chia seeds in the production of kefir was proved. The optimal way of preparation and introduction of Chia seeds to the technology of kefir of the thermostatic method of production was found [22].

The conducted experimental research revealed that to improve consistency during the storage of kefirs, it is necessary to ensure binding of free moisture through the use of natural stabilizers, condensers and substances that perform a similar function. Among the many tested ingredients of this group of substances, the stabilizing systems based on natural components of vegetable and animal origin were selected for implementation and preferred for usage [21, 23]. The technological properties of herbal ingredients (moisture retaining ability, solubility) in water and serum, conditions of their addition to dairy whey for consistency regulation, giving the flavor completeness to beverages, including fermented, were studied [24].

The introduction of 6 % of wheat bran and 1 % of arabinogalactan into low-fat cheese contributes to obtaining a combined cheese product that possesses the organoleptic composition characteristic for cheese masses, balanced composition and functional properties, as well as allows the improvement of the technology of multicomponent thermized products based on combining dairy and grain raw material through the use of natural ingredients, which have the properties of the final product consistency stabilization [25].

Analysis of information sources reveals the lack of data about the use of wheat bran in technologies of dairy drinks. That is why there appears an objective need for the creation of new types of sour milk drinks, specifically, using wheat bran. Consumption of such functional products guarantees the elimination of poor nutrition, replenishment of the body with the necessary components, as well as a relief of the toxic influence of the elements, which come from the polluted environment or are formed in the organism itself.

Based on the above, we can say that innovations in the technology of sour milk drinks, including kefirs with the use of wheat bran, are relevant. This approach, in turn, dictates the necessity of creation of the information field for scientific and technical creativity within the development of modern technology of sour milk drinks.

3. The aim and objectives of the study

The aim of this study was to examine the effect of wheat bran on quality indicators of a sour milk beverage.

To accomplish the aim, the following tasks have been set:

– to substantiate the appropriateness of the use of wheat bran in the technology of sour milk drinks;

– to explore the organoleptic indicators of a sour milk drink using wheat bran;

– to explore the main physical and chemical parameters of the drink with the use of wheat bran;

– to explore the biological value of a sour milk drink with the use of wheat bran.

4. Material and methods for studying the influence of wheat bran on quality indicators of sour milk beverages

The experimental part of the work was performed based on the ALC «Ivano-Frankivsk city dairy plant» and at the Department of Technology of Milk and Dairy Products of Lviv National University of Veterinary Medicine and Biotechnology named after S. Z. Hzhytskyi (Ukraine).

Kefir, made according to DSTU 4417:2005, and sour milk drink with wheat bran, manufactured according to our formulation, were used for research.

Two series of experiments were conducted. A dose of wheat bran, which was added to the drink during its cooling before maturation, was established in the first series.

The organoleptic, physical and chemical and microbiological indicators, as well as biological and nutritional value of the newly created sour milk beverage were established in the second series of the experiments.

Wheat bran according to DSTU 3016-95 was used for the research (Fig. 1).

Wheat bran should meet the following requirements:

– physical appearance – dry bulk product without solid lumps;

– the color is red-yellow with grayish tinge;

– the smell is peculiar for bran without any smell, not musty, not moldy;

– humidity is no more than 15 % (moisture content of wheat bran, obtained while grinding hard wheat into pasta flour is up to 16.5 %).

The material and the methods of research into the influence of raw materials on quality indicators of sour milk drinks are presented in paper [26].

Fig. 1. Kefir with wheat bran

5. Results of research into application of wheat bran in the technology of a sour milk drink

The experimental samples of the sour milk drink with bran were produced at Ivano-Frankivsk dairy plant. Kefir, manufactured by the reservoir method by the traditional technology, served a control sample. Wheat bran was added to the beverage during its cooling before maturation. The obtained samples were assessed, first of all, based on organoleptic indicators (Table 1).

Table 1

Organoleptic characteristic of the sour milk drink, depending on the dose of wheat bran

Dose of wheat bran, %	Flavor, smell	Consistency, physical appearance	Color
–	Sour milk, pure, mild with a pronounced smell of milk	Homogeneous, with a broken coagulum	White, homogeneous in the whole mass
1.0	Sour milk, pure with slight bran flavor	Homogeneous, with a broken coagulum	White, homogeneous with barely some bran
2.0	–//–	–//–	Creamy with bran impregnation
3.0	Sour milk, with a pronounced bran flavor	Homogeneous, thick, with a broken coagulum	Light brown with bran impregnation
5.0	Sour milk, with strongly pronounced bran flavor	Homogeneous, very viscous, with a broken coagulum	Intensively brown with pronounced barn

The drink, which contains 1 % and 2 % of wheat bran, was characterized by pure sour milk flavor and smell. It had a homogenous consistence with broken coagulum and was from white to creamy color with some bran. An increase in the dose of wheat bran to 3 % and 5 % led to the taste with sharply pronounced bran flavor and brown color with intense bran concentration. Based on the organoleptic parameters of a sour milk drink with wheat bran, we selected for further research kefir with 2 % of bran.

To assess a change in consistence of kefir with wheat bran during its storage, its viscosity and the diameter of flowing were determined (Fig. 2, 3).

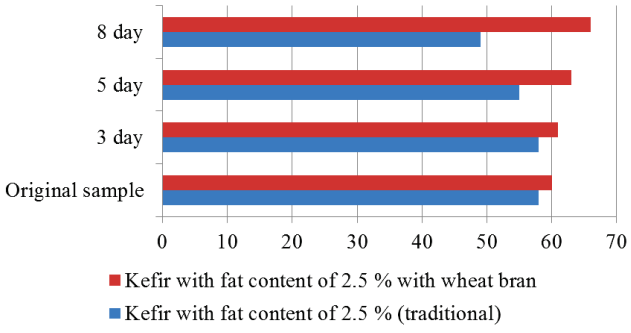

Fig. 2. A change in conditional viscosity of a sour milk beverage during storage

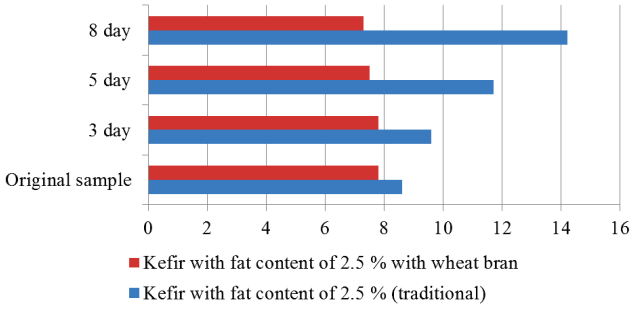

Fig. 3. A change in the diameter of flowing of sour milk beverage during storage, mm

It was found that the structure of products, and therefore consistence, change during storage. The viscosity of kefir with fat content of 2.5 % changes within seven days of storage, although it remains high enough on the eighth day, specifically, 49 s. This can be explained by existence of the acetic microflora in kefir, which is the cause of high viscosity even after the end of the shelf life.

An increase in viscosity of a sour milk drink with wheat bran is explained by the hygroscopic properties of bran, resulting in binding free moisture of the product. A change in the acidity of sour milk products during storage is an important characteristic for quality assessment.

An increase in titrated acidity of products during storage testifies to the intensification of the growth of lactic acid bacteria, although the acidity value is within the boundaries, specified by the standard, even after the expiration date. It is interesting that in the drink with wheat bran, an increase in acidity is somewhat more intensive in comparison with the traditional kefir and on day 8 of storage it was by 5° T is higher than in kefir (Fig. 4).

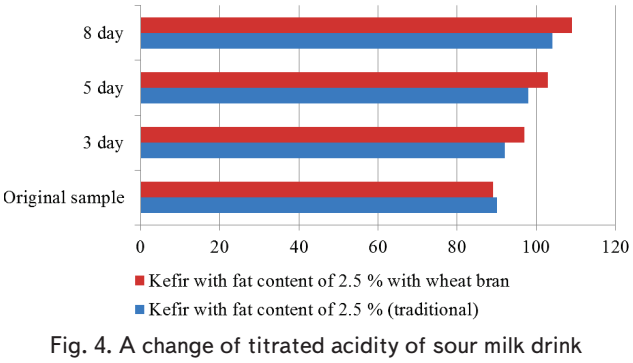

Fig. 4. A change of titrated acidity of sour milk drink during storage

Based on the data of the Table, it is possible to assume that wheat bran is the nutrient medium for the growth of lactic acid bacteria and the development is illustrated by the value of titrated acidity.

Microbiological research was conducted in order to clarify the shelf life of a sour milk drink from wheat bran.

The following indicators were selected as criteria of kefir safety: titer of bacteria of e. coli and MAFAM per 1 gram of the product. When establishing the shelf life of a new type of a sour milk drink, these indicators must not exceed the maximum permissible values, specified in the regulatory documentation (DSTU 4417:2005. Kefir. Technical specifications).

Microbiological indicators of the sour milk drink with wheat bran were explored immediately after its production and during storage at the temperature of (4±2) °C for 2, 4, 6, 8 and 10 days. The traditional kefir with fat content of 2.5 % was used for comparison as a control sample (Table 2).

Table 2

Microbiological indicators of sour milk beverages during storage at the temperature of 4±2 °C

Indicators	Shelf life, days					
	0	2	4	6	8	10
	Kefir traditional					
Bacteria of the group of e. coli (coli-forms), not found in the mass of the product, g	0,1	0,1				
	0,01	0,01	0,01	0,01		
	0,001	0,001	0,001	0,001	0,001	0,001
Pathogenic micro-organisms, including salmonella	not found					
Microscopic fungi, CFO/g	3	3	4	5	10	31
Yeasts, CFO/g	2	2	2	3	4	54
Sour milk beverage with wheat bran						
Bacteria of the e. coli group (coli-forms), not found in the mass of the product, g	0,1	0,1				
	0,01	0,01	0,01	0,01		
	0,001	0,001	0,001	0,001	0,001	0,001
Pathogenic micro-organisms, including salmonella	not found					
Microscopic fungi, CFO/g	2	3	3	4	13	49
Yeast, CFO/g	2	2	3	3	6	26

Analysis of microbiological indicators during storage of the drink with wheat bran makes it possible to make a conclusion on a satisfactory sanitary state of the new product and its safety for the consumer's health. Thus, when determining the titre of e. coli bacteria, three dilutions of the product (0.1, 0.01, and 0.001 g) were seeded on the Kessler medium. This indicator is more than 0.01 g in all samples of kefir during storage (temperature (4±2) °C for eight days. It should be noted that the value of the titer of e. coli bacteria for the drink with wheat bran was not different from the control values.

Since all the above analyses of the products do not give complete answers about biological and nutritional value, the research into amino acid composition of both wheat bran and the drink with wheat bran was carried out.

Proteins, composed of amino acids, are one of the most important components among nutrients of food products that determine the nutritional and biological value.

Research into amino acid composition of wheat bran (Table 3) showed that in comparison with kefir (Table 4), the total amount of amino acids in 100 g of wheat is by 4.75 times higher, the content of essential amino acids is by 3.61 times higher and of nonessential amino acids – by 5.55 times higher.

Table 3

Amino acid composition of wheat bran protein

Amino acids	g/100 g of barn	% of total content of amino acids
Essential amino acids		
Threonine	0.490	3.59
Valine	0.715	5.42
Methionine	0.225	1.65
Isoleucine	0.481	3.53
Leucine	0.911	6.68
Phenylalanine	0.588	4.31
Lysine	0.588	4.31
Tryptophan	0.274	2.01
Total	4.272	31.51
Non-essential amino acids		
Aspartic acid	1.107	8.12
Serine	0.666	4.88
Glutamate acid	2.813	20.63
Proline	0.862	6.32
Glycine	0.882	6.47
Alanine	0.755	5.54
Cysteine	0.362	2.65
Tyrosine	0.431	3.16
Histidine	0.421	3,09
Arginine	1.068	7.83
Total	9.367	68.49
Total	13.639	100.0

The content of lysine in the composition of essential amino acids in wheat bran was higher by 2.74 times, of isoleucine, methionine, leucine was higher by 2.99–3.23 times, of phenylalanine and threonine – by 4.17 and 4.34 times, of valine and tryptophan – by 5.38 and 6.23 times. Much greater difference was detected among the part of non-essential amino acids. Thus, the concentration of glycine, cysteine, arginine in wheat bran was higher than in kefir by 20.04; 16.45 and 10.07. Content of aspartic and glutamate acids and histidine in bran exceeded by 5.08–5.53 times, of alanine – by 7.26 times, of tyrosine, proline and serine – by 2.82–3.64 times.

The study of protein composition of the sour milk drink made with addition of wheat bran (Table 4) showed that in its composition, there was an increase in both the total amount (15.08 %), and in the amount of essential (10.57 %) and nonessential amino acids (18.24 %).

In the combined product, the concentration of all amino acids increased. Among essential amino acids, the content of tryptophan (22.73 %) and valine (18.04 %) increased most significantly, an increase in threonine (13.27 %) and phenylalanine (12.76 %) was slightly smaller, methionine (8.45 %), isoleucine (8.06 %) and leucine (8.86 %) increased even less, and the increase in lysine (6.72 %) was the smallest.

In nonessential amino acids, the level of glycine (77.27 %) and cysteine (68.18 %) increased most noticeably. An increase in arginine (37.74 %) and alanine (26.92 %) was also significant, an increase in glutamate acid (18.07 %), serine (11.48 %), aspartic acid (16.06 %) was even smaller. An increase in the content of proline (9.22 %) and tyrosine (6.53 %) was the smallest. Therefore, we can conclude that in the technology of sour milk drinks, it is advisable to use wheat bran of 2 % of the normalized mixture weight in the drink when it is cooled and stirred before bottling.

Table 4

Amino acids concentration in kefir

Amino acids	Control sample		Experimental sample	
	g/100 g of kefir	% of total	g/100 g k/m of the drink	% of total
Essential amino acids				
Threonine	0.133	3.94	0.128	3.87
Valine	0.133	4.63	0.157	4.78
Methionine	0.071	2.47	0.077	2.30
Isoleucine	0.161	5.61	0.174	5.30
Leucine	0.282	9.82	0.307	9.29
Phenylalanine	0.141	4.91	0.159	4.81
Lysine	0.238	8.29	0.254	7.69
Tryptophan	0.044	1.53	0.054	1.63
Total	1.183	41.21	1,308	39.59
Non-essential amino acids				
Aspartic acid	0.218	7.59	0.253	7.66
Serine	0.183	6.37	0.204	6.17
Glutamate acid	0.509	17.73	0.601	18.19
Proline	0.271	9.44	0.292	8.96
Glycine	0.044	1.53	0.078	2.36
Alanine	0.104	3.62	0.132	3.99
Cysteine	0.022	0.77	0.037	1.12
Tyrosine	0.153	5.33	0.163	4.93
Histidine	0.078	2.71	0.091	2.75
Arginine	0.106	3.69	0.416	4.42
Total	1.688	58.79	1.996	60.41
Total	2.871	100.0	3,304	100.0

6. Discussion of results of using wheat bran in the technology of sour milk drinks

The drawback of using so-called «artificial» products and products, obtained with the use of «artificial» additives, is their low assimilability and negative impact on the health of the people. The representatives of modern food industry consider that an important factor in solving the problems of protection of the population from an increased content of heavy metals, radionuclides, and harmful wastes of production is creation of medical and prophylactic products [1, 2]. Almost all these products are complex systems with a single internal structure and, to a certain extent, with general physical and chemical properties.

As is known, the quality of food is determined by nutritional and biological value. Nutritional value of the consumed product depends on the content of proteins, lipids, carbohydrates, vitamins, minerals in it and assimilability by the body. Biological value implies the compliance of the composition of food products with the optimal needs of the human organism according to physiological norms.

One of the important ways to improve these parameters of human nutrition, as well as providing them with dietary and medical and prophylactic properties, is the creation of combined products by applying, in the first place, vegetable raw materials. That is why the dairy producing industry implements a number of technologies aimed at enhancing nutritional and biological value of dairy products by introducing specific additives. To create such combined products with improved composition, it is promising to use the products of recycling crops, such as bran.

Wheat bran is believed to be the most useful of the variety of bran. Bran has a 90 % concentration of biologically active substances of the wheat grain, such as proteins, carbohydrates, fats, minerals, and vitamins. Dietary fibers of bran are necessary for normal functioning of the intestine and the whole digestive system.

According to modern ideas, biological value implies a degree of nitrogen retention or the effectiveness of its utilization for maintaining the nitrogen balance in the human organism, dependent on the amino acid composition and structural characteristics of protein. Biological value of proteins depends on the balance of the composition, first of all, for essential amino acids.

To build a vast majority of proteins, the human organism needs all 20 amino acids, and at certain ratios. Moreover, sufficient amount of each amino acid is not as important as the ratio, which should be maximally close to the one in human proteins. Violation of the balance of the amino acid composition of food proteins leads to violation of synthesis of own proteins the body, shifts the dynamic equilibrium of protein metabolism towards disintegration of proteins in the organism. The lack of a certain essential amino acid limits the use of other amino acids in the synthesis of proteins in the organism.

Biological value of proteins is determined by comparing the amino acid composition of the protein with the reference scale of amino acids of a hypothetical perfect protein.

Calculation of the score, as a rule, is carried out based of calculation of the percentage ratio of the quantity of each essential amino acid in the studied protein to the amount of the same amino acid in the hypothetical protein with an ideal amino acid scale from the formula:

$$\text{Amino acid score} = \frac{\text{mg in 1 g of studied protein}}{\text{mg in 1 g of ideal protein}} \times 100\,\%.$$

An essential amino acid, the score of which is less than 100 %, is limiting.

Determining amino acid score of the proteins of wheat bran revealed a rather high biological value, integral (average) score of which was 113,73 % (Table 5).

Threonine (89.75 %), isoleucine (88.75 %) and lysine (79.64 %) were found to be limiting amino acids. The scores of leucine (95.43 %) and valine (108.4 %) were close to the reference protein, and of tryptophan (201.0 %), the sum of aromatic (124.5 %) and sulfur containing (122.8 %) of amino acids noticeably exceeded it.

The use of wheat bran during manufacturing sour milk drink did not influence noticeably the biological value of proteins of the combined product (Table 6). This is evidenced by the magnitudes by the average amino acid scores of the control (129.77 %) and experimental (127.55 %) samples of the drink.

An insignificant decrease in the scores of isoleucine, leucine, lysine, the sum of aromatic amino acids was balanced by an increase in the scores of sulfur containing amino acids, valine, and tryptophan. In general, the experimental sample of the drink was characterized by the balanced amino acid composition.

It was found that wheat bran is the nutrient medium for the growth of lactic acid bacteria and the development is illustrated by the value of titrated acidity.

Table 5

Biological value of proteins of wheat bran

Amino acids	Reference protein FAO/WHO g/100 g of protein	Wheat bran g/100 g of protein	Amino acid score, %
Isoleucine	4.0	3.53	88.25
Leucine	7.0	6.68	95.43
Sum of aromatic (phenylalanine + tyrosine)	6.0	7.47	124.50
Sum of sulfur containing (methionine + cysteine)	3.5	4.30	122.86
Threonine	4.0	3.58	89.75
Valine	5.0	5.42	108.40
Lysine	5.5	4.38	79.64
Tryptophan	1.0	2.01	201.0
Total			113.73

Sour milk drink with wheat bran is a medical and preventive product because it contains dietary fibers, which are a valuable energy additive.

Thus, the use of wheat bran in the technology of sour milk beverages allows enrichment with vitamins, minerals and dietary fibers.

In the production of the drink from wheat bran, it is not necessary to apply new expensive equipment. For this, it is possible to apply the equipment, existing at any plant that manufactures whole dairy products. To produce the sour milk drink with wheat bran under industrial conditions, the technological instructions of production was designed.

Summing up the above, we can state that the use of wheat bran in the production of kefir allows expansion of the range of sour milk drinks and to obtain the product of enhanced biological value.

The obtained results determined the tasks for subsequent research: establishment of the vitamin and mineral composition of the developed drinks; their industrial testing and determining economic efficiency of its introduction into production.

Table 6

Biological value of proteins of sour milk drink

Amino acids	Reference FAO/WHO	Control sample	Experimental sample	Control sample	Experimental sample
	g/100 g of protein			Amino acid score, %	
Isoleucine	4.0	5.61	5.30	140.25	132.50
Leucine	7.0	9.82	9.29	140.28	132.71
Sum of aromatic (phenylalanine + tyrosine)	6.0	10.24	9.74	170.66	162.33
Sum of sulfur-containing (methionine + cysteine)	3.5	3.22	3.42	92.2	97.71
Threonine	4.0	3.94	3.87	98.50	96.75
Valine	5.0	4.63	4.78	92.60	95.60
Lysine	5.5	8.29	7.69	150.73	139.82
Tryptophan	1.0	1.53	1.63	153.0	163.00
Total				129.77	127.55

7. Conclusions

1. Theoretical and analytical research resulted in the proposal to use wheat bran in the technology of sour milk drinks. Wheat bran contains proteins, carbohydrates, fats, minerals, and vitamins. Dietary fibers of bran are necessary for normal functioning of the intestine and the entire digestive system. The application of bran in the production of sour milk drinks allows creation of a product of enhanced biological value with excellent quality indicators.

2. The found technological combinability of wheat bran and dairy basis provides the appropriate organoleptic indicators of sour acid drink. The finished product has pure sour milk flavor and smell, homogenous consistence with broken coagulum and the color from white to creamy with bran impregnation.

3. Based on the obtained data for organoleptic and structural-mechanical properties, we established a relationship between the consistence and effective viscosity of the product thanks to the hygroscopic properties of wheat bran, resulting in binding free moisture of the product. By physical and chemical indicators, the sour milk beverage with wheat bran with the weight fraction of fat of 2.5 % meets the acting standard DSTU 4417:2005. Kefir. Technical specifications.

4. The introduction of wheat bran during manufacturing the sour milk drink in the amount of 2.0 % of the weight of the normalized mixture increases the content of amino acids by 15.08 %, including essential amino acids – by 10.57 % compared to the same indicator in the control sample. Detected changes in the amino acid composition of the finished product indicate that the use of wheat bran in the technology of sour milk drinks allow increasing the nutritional and biological value of the protein component.

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Враховуючи сучасні вимоги до технологічних характеристик оздоблювальних напівфабрикатів, мікронутрієнтного складу, розроблено рецептуру кондитерського напівфабрикату. Основою його є помада цукрова, додатково внесено суміш масла вершкового, порошку банану і поверхнево активної речовини (ефіру лимонної кислоти, моно-, дигліцериду – поверхнево-активні речовини. Напівфабрикат є універсальним та призначений для виробництва широкого асортименту оздоблювальних напівфабрикатів (кремів, начинок, глазурі тощо).

Проведено дослідження впливу суміші масла вершкового, порошку банану і поверхнево-активних речовин (ПАР) на теплофізичні властивості і структуру кондитерського напівфабрикату для оздоблення борошняних кондитерських виробів.

Метою роботи було вивчення впливу обраних інгредієнтів на процес формування кристалічної фази помади цукрової, що є основою кондитерського напівфабрикату.

За результатами дослідження встановлено, що під час формування кристалічної фази напівфабрикату присутність компонентів порошку банану приводить до диференціації вуглеводів помади цукрової за температурами плавлення. Це дає можливість припустити, що при зберіганні збагаченої помадної маси процеси перекристалізації у порівнянні з контролем перебігатимуть з меншою інтенсивністю.

Внесення ПАР сприяє отриманню гомогенної поліфазної системи, що підтверджується однорідною пластичною структурою. Мікроструктурними дослідженнями показано, що кристали помади та часточки рослинного порошку оточуються жировою фазою масла, а набухлі часточки порошку не утворюють угрупувань.

За результатами мікроструктурного аналізу і диференційної скануючої калориметрії запропоновано механізм взаємодії частинок порошку банану з жировою фазою і пересиченим розчином сахарози.

Отримані результати обумовлюють агрегативну стійкість і термостабільність універсального кондитерського напівфабрикату при багатократному тепловому та механічному впливі, що має технологічне значення

Ключові слова: кондитерський напівфабрикат, порошок банану, теплофізичні властивості, кристалізація, ендотерма плавлення, фракціонування

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EFFECT OF BANANA POWDER AND BUTTER ON THE FORMATION OF THE CRYSTALLINE PHASE OF SUGAR FONDANT

M. Ianchyk
Postgraduate student*
A. Niemirich
PhD, Associate Professor,
Head of Department
Department technologies of
restaurant and ayurvedic products**
O. Vasheka
PhD, Associate Professor*
O. Petrusha
PhD, Associate Professor*
E-mail: petrushaoo@ukr.net
N. Pogozhikh
Doctor of Technical Science, Professor
Department of Physical-mathematical and
engineering-technical disciplines
Kharkiv State University
of Food Technology and Trade
Klochkivska str., 333, Kharkiv, Ukraine, 61051
*Department of Foodstuff Expertise**
**National University of Food Technologies
Volodymyrska str., 68, Kyiv, Ukraine, 01601

1. Introduction

According to data by WHO, in 2015, at the territory of Ukraine the mortality rate of the population aged 30–70 years due to chronic non-infectious diseases (CNID) amounted to 28.9 %, which exceeds the respective statistics of the economically developed countries by 2–4 times [1, 2]. In recent years, based on numerous studies by leading scientific