Functional milk-containing products

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Abstract. Many developments are currently underway to create products that not only support human life, but also are safe and ensure maximum usefulness. The studies on use of protective cultures “GoldenLineProfiline PC 27.50” and wheat dietary fiber NUTRIOSA FB 06 in the technology of milk-containing products were conducted at the department of technology of food of animal origin of the Federal State Budget Educational Institution of Higher Education “Voronezh State University of Engineering Technologies” (FSBEI HE “VSUET”). Protective cultures are antagonistic microorganisms that inhibit the growth of pathogenic and other undesirable microflora without affecting the organoleptic properties and quality of the product. The use of protective cultures in the technology of milk-containing products of sour cream type allows one to increase storage stability by 30%. According to medical and biological knowledge, the value of dietary fiber (DF) in human nutrition is inestimable. It binds and excretes cholesterol, bile acids, radionuclides and other harmful substances from the body, thereby preventing “diseases of civilization” – obesity, atherosclerosis, pancreatic diabetes, etc. Introduction of soluble dietary fiber into the formula of a milk-containing fermented milk product produced according to yogurt technology allows one to increase the shelf life and increase the functionality of the product.

1. Introduction
Currently, considerable attention is paid to the development of functional dairy products [1, 2]. As a rule, such products have improved quality indicators compared to analogues.

The department of technology of food of animal origin conducts studies on use of various non-traditional raw materials and modern additional components in technologies of functional products. The study of use of protective cultures and dietary fiber in this technology is of great interest.

Russian producers have a long-overdue need to improve microbiological safety of dairy products. The use of chemical preservatives is not always justified, since today the consumer pays greater attention to the label, studying the composition and preferring healthy and high-quality products. That is why there is a need to develop additives of natural origin that are effective against pathogenic microorganisms. Advances in studies and technologies have made it possible to create alternatives to artificial ingredients, such as protective cultures.

Protective cultures are antagonistic microorganisms that inhibit the growth of pathogenic and other undesirable microflora without affecting the organoleptic properties and quality of the product. The use of cultures allows one to keep dairy products fresh for longer without compromising food safety. The development of biological methods for preventing microbiological spoilage is based
on the principle of using lactic acid microorganisms that are part of fermented dairy products and are their natural microflora.

The main functions of protective cultures: improving safety of dairy products; maintaining quality performance; reducing the amount of waste and spoilage; increasing the shelf life; excluding the use of preservatives [3, 4].

Recently, the importance of ballast substances in human nutrition is of great interest. Some time ago, functional products were created by removing plant fiber from them. But absence or lack of dietary fiber in food began to lead to a decrease in the human body’s resistance to various negative factors, both nutrition and the environment as a whole.

According to medical and biological knowledge, the value of dietary fiber (DF) in human nutrition is inestimable. It binds and excretes cholesterol, bile acids, radionuclides and other harmful substances from the body, thereby preventing “diseases of civilization” – obesity, atherosclerosis, pancreatic diabetes, etc. [5].

2. The purpose of the study
“GoldenLineProfiline PC 27.50” – an additional culture, which is introduced together with the main starter culture in order to solve microbiological problems. Protective culture is particularly effective against yeast, mold, Escherichia coli, and makes it possible to create a safe product.

Wheat dietary fiber NUTRIOSA FB 06 is a soluble dietary fiber developed and manufactured by Roquette company (France). They do not split in the upper part of the digestive tract and enter the large intestine almost unchanged, improving its motility. This property of dietary fiber is very important in functional products.

The purpose of the study is to consider the possibility of using wheat dietary fiber NUTRIOSA FB 06 in the technology of the milk-containing fermented milk drink developed according to yogurt technology, and to increase the shelf life of the milk-containing product of sour cream type due to the use of protective cultures.

3. The object of the study
The objects of the study are the samples of the milk-containing product produced according to sour cream technology without the use of a protective culture (control sample); and the milk-containing product produced according to sour cream technology using a protective culture (experimental sample); and the samples of the milk-containing fermented milk product produced according to yogurt technology (control sample); and the milk-containing fermented milk product produced according to yogurt technology with introduction of wheat dietary fiber NUTRIOSA FB 06 into the formula (experimental sample).

4. Materials and methods
The organoleptic control was performed according to the following indicators: taste, smell, consistency, color; the physical and chemical control – active and titratable acidity, viscosity. The microbiological control included monitoring of such indicators as E. coli presence, determination of the number of lactic acid microorganisms, yeast and mold.

During the development of the milk-containing fermented milk product produced according to yogurt technology with introduction of wheat dietary fiber NUTRIOSA FB 06 (DF) into the formula, they studied the dynamics of fermentation of the samples with and without dietary fiber, the synergetic properties of the curd, the evaluated organoleptic characteristics (taste, smell, color, consistency), and the main physical and chemical parameters. In addition, the storage stability of the milk-containing fermented milk products developed according to yogurt technology was evaluated.

5. Discussion of the results
Production of safe dairy products of guaranteed quality is impossible without proper microbiological control over the entire production line, starting from raw materials and ending with the sale of the
finished product. One of the main criteria that reflects the microbiological quality of the product is the level of production sanitation, compliance with technological parameters.

The technological scheme of production of a milk-containing product of sour cream type with a protective culture does not differ from the traditional one. The protective culture is introduced along with the main one. The control of the quality indicators of the curd in the process of fermentation is of particular importance (tables 1, 2).

### Table 1. Characteristics of the curd in the process of fermentation of the control sample

| Name of starter culture | Duration of fermentation, h | Active acidity, pH | Titratable acidity, °T | Organoleptic indicators of curd |
|------------------------|-----------------------------|--------------------|------------------------|--------------------------------|
| ProfilineSC 30.01 Golden Line | 5                           | 4.89               | 40                     | the curd at the end of fermentation is dense, after mixing it is homogeneous and glossy, the color is white with a creamy tint, the smell and taste are pure, of fermented milk |
| 6                      |                             | 4.85               | 44                     |
| 7                      |                             | 4.69               | 50                     |
| 7.5                    |                             | 4.58               | 56                     |

### Table 2. Characteristics of the curd in the process of fermentation of the experimental sample

| Name of starter culture | Duration of fermentation, h | Active acidity, pH | Titratable acidity, °T | Organoleptic indicators of curd |
|------------------------|-----------------------------|--------------------|------------------------|--------------------------------|
| ProfilineSC 30.01 Golden Line + Profilineesc 27.50 Golden Line | 5                           | 5.16               | 28                     | the curd at the end of fermentation is dense, after mixing it is homogeneous and glossy, the color is white with a creamy tint, the smell and taste are pure, of fermented milk |
| 6                      |                             | 4.86               | 48                     |
| 7                      |                             | 5.7                | 52                     |
| 8                      |                             | 4.59               | 56                     |

From the data obtained, it can be concluded that the use of the protective culture in the production of the milk-containing product produced according to sour cream technology does not affect the duration of fermentation and organoleptic parameters of the curd.

In order to determine the shelf life, the milk-containing products were stored for 40 days at a temperature of 4±2 °C.

The organoleptic parameters of the experimental sample corresponded to the normative documentation on the 30th day: pure taste of fermented milk, homogeneous dense consistency, white color, uniform throughout the mass. On the 40th day, compared with the experimental sample, there was deterioration in the consistency and appearance of an acidic smell with elements of spoilage in the control sample.

The physical and chemical parameters of the experimental sample during its storage for 40 days corresponded to the established norms: titratable acidity not more than 100 °T, viscosity not more than 3900 MPa*s, whereas in the control sample, on the 30th day, titratable acidity was 101 °T, on the 40th – 140 °T. The product was considered spoiled.

Studying the microbiological parameters of the milk-containing products, we obtained the following results: in the control sample, yeast growth was observed on the 30th day, and yeast and
mold growth was observed on the 40\textsuperscript{th} day in the amount of more than 100 CFU/g of the product. In the experimental sample, there was observed no growth of pathogenic organisms during its storage.

It is proposed to use wheat dietary fiber NUTRIOSA FB 06 as an enricher. It is a white fiber powder with a neutral taste and smell. Dietary fiber is characterized by a high content of ballast substances (fiber). They are most often used to enrich cottage cheese products. They have a high water-holding capacity, they are soluble dietary fiber that are physiologically valuable food additives and contribute to improving human health due to their prebiotic effect.

The technological scheme of production of the milk-containing fermented milk product produced according to yogurt technology with dietary fiber does not differ from the traditional one, by the tank method. Different studies were conducted to obtain a product by thermostat method, but with this method, the fermented product did not have a stable texture and separated into fractions. Introduction of dietary fiber occurs at the stage of introducing starter cultures.

At the first stage, the studies were conducted on selection of formula ingredients, including the dosage of introduction of dietary fiber into the milk-containing fermented milk product developed according to yogurt technology.

The studies were conducted to examine the dynamics of fermentation depending on the content of dietary fiber in the formula (table 3).

| Table 3. Dynamics of fermentation of samples depending on the content of dietary fiber |
|---------------------------------|------------------|------------------|------------------|
| Duration of fermentation, h     | Titratable acidity, °T | Percentage of dietary fiber introduction, % |          |
|                                | control sample | 1               | 2               | 3               |
|                                | experimental sample | 0.1             | 0.3             | 0.5             |
| 1                              | 48             | 48              | 49              | 50              |
| 2                              | 64             | 63              | 63              | 60              |
| 3                              | 75             | 75              | 74              | 72              |
| 4                              | 89             | 87              | 86              | 84              |

Table 3 demonstrates that introduction of wheat dietary fiber NUTRIOSA FB 06 into the formula does not significantly affect the duration and intensity of the product’s fermentation. All samples of the product, which have different contents of dietary fiber in their formula, reach necessary acidity for flavor bouquet of yogurt drink in 4 hours.

It is commonly known that dietary fiber is a substance that can retain moisture, thereby formally increasing storage stability of products. It is of practical interest to study synergetic characteristics of the curd depending on the amount of dietary fiber used in the formula (figure 4).

| Table 4. Synergetic characteristics of the curd depending on the content of dietary fiber used in the formula |
|---------------------------------|------------------|------------------|------------------|
| Duration of centrifugation, h   | Volume of received whey, ml | Percentage of dietary fiber introduction, % |          |
|                                | control sample | 1               | 2               | 3               |
|                                | experimental sample | 0.1             | 0.3             | 0.5             |
| 0.6                            | 7.1            | 6.7             | 6.6             | 6.4             |
| 0.4                            | 7.8            | 7.3             | 7.2             | 6.5             |
| 0.2                            | 7.9            | 7.5             | 7.4             | 6.5             |

According to the data given in table 4, it can be concluded that with an increase of introduction of dietary fiber into the formula, the moisture-holding capacity of the samples increases in proportion
to the dose of the additive.

It was found that the optimal organoleptic and physical-chemical parameters and stability of the product are provided by introduction of 0.3 % of wheat dietary fiber NUTRIOSA FB 06.

To study the storage stability and determine the shelf life of the finished product, we have studied changes in microbiological and physical-chemical parameters at a temperature of $t = (4 \pm 2) ^\circ C$. It was found that during 21 days of Coliform bacteria storage, yeast and mold were not detected. The dynamics of changes in titratable acidity (table 5) correlates with the data of the conducted microbiological analysis.

| Table 5. Dynamics of changes in titratable acidity |
|--------------------------------------------------|
| **Storage time, day** | 1 | 2 | 3 | 5 | 7 | 10 | 15 | 21 |
| Titratable acidity, $\% T$ (control sample) | 89 | 95 | 99 | 105 | 110 | 121 | 130 | 142 |
| Titratable acidity, $\% T$ (experimental sample No. 2) | 86 | 90 | 95 | 99 | 105 | 114 | 120 | 122 |

According to the results of the studies conducted, taking into account the required reserve ratio, there was established the shelf life of a yoghurt drink – 14 days at a temperature $t = (4 \pm 2) ^\circ C$, which guarantees the quality and safety of a milk-containing fermented milk product produced according to yogurt technology.

6. Conclusion

The use of protective cultures has a positive effect on the quality of a milk-containing product. Experimentally, there was established the shelf life of the milk-containing product produced according to sour cream technology with the use of a protective culture – 30 days (taking into account reserve ratio), which is 30% more compared to the control sample.

The use of wheat dietary fiber NUTRIOSA FB 06 in the technology of the milk-containing fermented milk product produced according to yogurt technology does not reduce the quality of organoleptic characteristics and, in turn, gives the product functionality. In addition, it was found that during the storage of the product with dietary fiber in the formula, a slower increase in titratable acidity occurs, so it can be assumed that the use of dietary fiber contributes to its storage stability.

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