Fermented goat milk product: Improvement of the production technology

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Abstract. To date, the population’s nutritional structure in the Russian Federation is defective and the nutritional status has considerable deviations from the balanced nutrition formula with respect to the consumption of micronutrients - vitamins and minerals, in particular, trace elements of many organic compounds of plant origin - and polyunsaturated fatty acids that are important in the regulation of the metabolism and functions of individual systems and organs, as evidenced by regular epidemiological studies conducted by the Institute of Nutrition of the Russian Academy of Sciences. In the Russian Federation and everywhere in the world, there is a decline in milk production, with the demand for dairy products increasing, so the dairy industry has a goal to stop the milk production drop. One of the possible ways to solve the problem is developing new technologies and improving available equipment, as well as implementation of milk from other animals, in particular, goats into the dairy industry and development of technology for goat milk products. The latter is investigated in our scientific work. One of the features of the goat milk is that it contains more fat than cow milk, but the goat milk fat is healthier, since it is represented mainly by polyunsaturated fatty acids that normalize cholesterol metabolism and help to increase immunity. This milk is hypoallergenic, contains considerably less lactose and is similar to human breast milk in terms of beta-casein content.

1. Introduction
An increase in the share of domestic products in the total resources of food products, milk, and dairy products to 90.2% is planned by the State Program on Agribusiness Development and Regulation of Farm Produce, Raw Materials, and Foodstuffs Markets.

Goat breeding is one of the promising branches of the animal husbandry due to many factors, one of them is that this direction is now actively developing in connection with new peasant farms, including in the Rostov region [1].

2. Problem statement
Raw material of plant origin as a source of minerals, vitamins, dietary fiber, and other biologically active compounds is promising in the production of combined fermented milk products.

At present, the range of products made from goat milk is poor. The goat milk as a raw material is not fully understood. The goat milk processing is promising due to an increase in the consumer demand, a
considerable shortage of cow's milk, and availability of existing equipment. In our investigation, a fermented goat milk product was enriched with lactulose syrup and sea buckthorn puree.

3. Research questions

3.1. **Features of goat milk**
Goat milk is hypoallergenic, contains substantially less lactose, and its beta-casein content is similar to the human breast milk.

3.2. **Sea buckthorn fruit**
Sea buckthorn fruit is a source of ascorbic acid and numerous compounds that are necessary for the human health, including choline, betaine, and tanning compounds.

3.3. **Lactulose syrup**
Disaccharide lactulose is an active bifidogenic factor in human milk. Lactulose needs to be added to optimize the formulation of milk-based baby food products. It has a wide and varied effect on metabolism. Lactulose is used in products as a highly soluble sweetener.

4. Purpose of the study
The purpose of the research was to improve the technology for manufacturing fermented goat milk drink.

The producibility of the fermented goat milk product needs to be theoretically and experimentally substantiated in order to increase the range of products from this raw material and improve sensory, physicochemical, and tasting characteristics. The expediency of the additives proposed for the recipe of a fermented milk product was planned to be substantiated based on the analysis of the chemical composition and study of the nutritional value of the product and functional, technological, and sensory characteristics of the raw material.

5. Research methods

5.1. **Material and research methods**
Experimental studies were performed in a laboratory of the Food Technology Department of the Don State Agrarian University, a regional veterinary laboratory, and a production laboratory of the individual entrepreneur Panchenko Yu.V. in the Rodionovo-Nesvetaysky district, the Rostov region.

To establish the proper dose of sea buckthorn puree added into the fermented milk product in laboratory conditions, using a thermostatic procedure, there were produced samples of fermented milk products, i.e. Control (no puree) and several Test samples with different doses of sea buckthorn (1.0%; 5.0%; and 10.0%); their sensory characteristics were assessed.

6. Findings

6.1. **The type of starter culture selected for the production of fermented milk drink**
Experimental studies were conducted in the laboratories of the Food Technology Department of the DSAU. The production tests of the finished product were carried out at the farm enterprise Panchenko Yu.V.

Raw goat milk was pasteurized at 92 °C with an exposure time of 3-5 minutes. Then the milk was cooled to 44-48 °C, and a pre-activated starter culture in the amount of 5% was added. The mixture was held in a thermostat at 44 °C until a clot appeared.

Three types of starter cultures were chosen for the experiment, namely, Starter culture I was Lactoferm YO-122; Starter culture II was Lactoferm YO-269; and Starter culture III was Danisko YO-MIX 401 LYO 50.
The product fermented with Starter culture III had a clear fermented milk smell and taste, so the goat milk product with this Starter culture had a more balanced combination of sensory characteristics. Starter culture III used in manufacturing the product enabled reducing the cost of electric or thermal energy due to reduced technological cycle [2].

Thus, the conducted study of sensory parameters and titratable acidity of fermented milk products with different types of ferments revealed that Starter culture III was optimal for fermenting the developed milk product.

6.2. Chemical composition and doses of sea buckthorn puree and lactulose syrup and the technological stage to add them

In order to improve the technology of a fermented goat milk product, sea buckthorn puree, lactulose syrup, and bacterial preparations were used.

The syrup added to the fermented milk product gave probiotic properties to it.

Sea buckthorn puree in manufacturing fermented milk products made it possible to obtain a functional high-quality enriched fermented milk product.

The experimental studies found that the appropriate sea buckthorn puree’s dose of 5.0% added into a fermented milk product favorably affected its sensory characteristics [3].

The optimal dose of lactulose syrup added to the fermented milk product was 0.5%.

Table 1. Recipe for fermented goat milk product (per 1000 kg of mixture, with no regard for losses).

| Raw material            | Amount, kg. |
|-------------------------|-------------|
| Goat milk               | 945.5       |
| Sea buckthorn puree     | 50.00       |
| Lactulose syrup         | 5.00        |
| Starter culture         | 0.5         |
| Total                   | 1000.00     |

Figure 1. Process flow diagram for manufacturing fermented goat milk product by the tank method.
7. Conclusion
The produced fermented milk products were evaluated in terms of sensory, physicochemical, and microbiological quality parameters.

7.1. Sensory evaluation of the fermented milk product developed
Sensory characteristics are shown in Table 2.

Table 2. Sensory characteristics of the fermented goat milk product.

| Parameters         | Characteristics                                                      |
|--------------------|----------------------------------------------------------------------|
| Appearance and consistency | Homogeneous consistency with a coherent clot                        |
| Taste and smell   | Pleasant fermented milk taste with sea buckthorn aroma               |
| Colour            | White, with an orange tint, uniform throughout the mass              |

The table shows that sea buckthorn and lactulose puree added to the fermented goat milk product improved its sensory characteristics and gave pleasant taste and aroma of sea buckthorn.

7.2. The physical and chemical characteristics of the fermented milk product under study
The optimized technology of the fermented milk product increased its nutritional energy value. The increased content of carbohydrates, in particular plant polysaccharides, contributed to the growth of lactic acid bacteria in a functional product. The low energy value of the developed fermented milk product suggested that the product can be recommended for special dietary uses [3].

Table 3. Nutritional and energy values of fermented milk products.

| Parameter                     | Conventional technology product, g/100 g | Optimized technology product, g/100 g |
|-------------------------------|------------------------------------------|--------------------------------------|
| Weight fraction of fat, g     | 3.8                                      | 3.8                                  |
| Weight fraction of protein, g | 3.0                                      | 3.2                                  |
| Weight fraction of carbohydrates, g | 4.1                                      | 5.1                                  |
| Weight fraction of ash, g     | 0.8                                      | 1.5                                  |
| Acidity, °T                    | 85                                       | 85                                   |
| Phosphatase                   | Not detected                             | Not detected                         |
| Temperature of the product before it leaves the from the enterprise, °C | 4±2°C                                   | 4±2°C                                |
| Energy value, kcal            | 58                                       | 62                                   |

The table indicates, that the optimized technology of a fermented goat milk product increased the nutritional value of the product developed. The high content of carbohydrates, including plant polysaccharides, promoted the growth of lactic acid bacteria in a functional product. The low energy value of the developed fermented milk product suggested that the product can be recommended for special dietary uses.

7.3. The microbiological indicators of the fermented milk product assessed
Table 4 shows the microbiological points of the fermented milk products [4].
Table 4. Microbiological points of fermented milk products.

| Parameter | Value according to TR CU 033/2013 | Actual value Conventional technology product | Optimized technology product |
|-----------|----------------------------------|-----------------------------------------------|-----------------------------|
| Lactic acid microorganisms, CFU/cm³ (g), not less than (at the end of the shelf life) | 1x10⁷ | 2·10⁷ | 4·10⁷ |
| Product weight cm³ (g), where microbes are not allowed | | | |
| Escherichia coli group bacteria (CGB) | | Not detected | Not detected |
| Staphylococcus S. aureus pathogenic (incl. Salmonella) | 1.0 | | |
| Yeast, CFU/cm³ (g), not more than | 50 | 14 | 10 |
| Mold, CFU / cm³ (g), not more than | 50 | 18 | 16 |

In the test samples, the number of yeast and mold cells were within the values prescribed by the Technical Regulations of the Customs Union “On the safety of milk and dairy products” for fermented milk products. Pathogens such as Staphylococcus aureus, E. coli bacteria, or Salmonella were not detected in the samples of fermented milk products.

Therefore, considering the assessed quality indices of fermented milk products, we can claim that the developed product has positive sensory characteristics and increased nutritional value and safety.

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References
[1] Serdyukova Ya P and Aleshin A A 2019 Objectives and perspectives of creating goat milk yoghurt Perspective agrarian and food innovations: Proceedings of the International scientific-practical conference ed I F Gorlov pp 132-4
[2] Kryuchkova V V, Belik S N, Gorlov I F, Slozhenkina M I and Serkova A E 2020 The influence of vegetable fillers on the quality and storage capacity of a fermented milk product Food Industry 1 50-5
[3] Kazarova I G and Serdyukova Ya P 2020 Prospects of plant components in the development of functional dairy products In: Theory and practice of modern agricultural science (Novosibirsk SAU) pp 388-90
[4] Shirokova N V, Skripin P V and Serdyukova Ya P 2019 Biotechnology and quality assessment of the fortified fermented milk product Scientific life 14 1141-9
[5] Kryuchkova V V and Khutsishvili M G 2019 Curd product with herbal ingredients Dairy industry 8 52-3
[6] Klimenko A I, Kryuchkova V V, Skripin P V, Drucker O V, Kontareva V Yu, Gorlov I F, Mosolova N I, Belik S N and Mishchenko A A 2019 Method for the production of fermented milk product enriched with phytocomponents and prebiotic Pat. of the Russian Federation No 2681291 appl. 15.12.2017, publ. 05.03.2019
[7] Kontareva V Yu, Kryuchkova V V, Skripin P V and Savitskaya T S 2019 Method for the production of yogurt with a prebiotic complex and plant components Pat. of the Russian Federation No 2681987 appl. 20.11.2017, publ. 03/14/2019