Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 25, Issue 1, 2025
PRINT ISSN 2284-7995, E-ISSN 2285-3952

ECONOMIC FEASIBILITY OF PRODUCING FUNCTIONAL PRODUCTS BASED ON GOAT'S MILK

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Abstract

The Strategy for Scientific and Technological Development of the Russian Federation provides for the achievement and formation of independence in critical areas of life support due to the high efficiency of scientific research and development aimed at popularizing safe and high-quality products, as well as the stimulation of the functional food market as one of the key priorities. The aim of the study is to analyze and evaluate the economic efficiency of production of functional food products based on goat milk. The study substantiates the advantages of goat milk, and also presents in detail the technological scheme of yoghurt production.In the production of yoghurts, a thermostatic method was used: pasteurization at 92±2 °C, fermentation at 38-42 °C with the addition of starter (lactic acid bacteria) and fillers (carob, cereals, raspberry jam). Based on the obtained products, calculations of the economic efficiency of producing yoghurts with different fillers were made using seven samples as an example. The high prospects of producing yoghurts in general were substantiated, with those samples that contain fillers and have high profitability being especially profitable. Directions for developing the functional food market based on stimulating the introduction of innovative production technologies and developing new recipes for yoghurts with different fillers in order to increase the competitiveness of manufactured products in the Russian and world markets were proposed.

Key words*: functional food products, dairy goat farming, technological process, market, innovation, strategy*

INTRODUCTION

According to the Decree of the President of the Russian Federation "On the Strategy for Scientific and Technological Development of the Russian Federation", approved on February 28, 2024, the development of safe and high-quality food products, including functional ones, is highlighted as one of the strategic guidelines and opportunities for scientific and technological development [6]. Experts note that about 80% of Russian residents, including children, experience a deficiency in micro- and macronutrients. At the same time, their diet is 40% dominated by sugar-containing and refined products with low nutritional value and a high glycemic index. This, in turn, can cause various diseases, such as osteoporosis, anemia, etc.

At the same time, natural functional products have high nutritional value and comply with the principles of healthy eating. These products can replenish the deficiency of essential nutrients in the diet and become an effective tool for the prevention of a number of diseases, as well as improve the quality and duration of life.

The formation of a number of new national projects in the field of healthy eating and improving the quality of life have determined the development of the functional food market. In this regard, the following target indicators have been established: an increase in the share of functional products in the total consumption volume to 30% by 2030, the creation of a register of certified natural functional products, the development of a program for the development of the natural

functional food market aimed at regulatory and informational and educational activities to stimulate both the production and consumption of such products [8].

Functional food products based on goat's milk are becoming essential components of diets and are as close as possible to the composition of human milk in terms of protein and fat fractions, which is why it is the basis of healthy nutrition for both infants and sick and elderly people [3,24]. And given the currently increasing demand for environmentally friendly products and the increased interest in alternative food sources, the popularization of these types of products has high socio-economic significance. Goat's milk contains a large number of macro- and microelements. It contains essential amino acids, polyunsaturated fatty acids, minerals, and vitamins [23,28,33]. Research by many scientists has proven its unique biological value, since many parameters have been found to be similar to human milk, which is why it is beneficially absorbed by children's bodies [19,20].Thus, the development of functional dairy products is becoming a major task for the dairy industry. And goat milk, in turn, is becoming an increasingly popular raw material due to its exceptional nutritional properties and ease of absorption by the human body [4].

Goat milk as a raw material has unique properties that give it significance among other food products of the population [11]. Hypoallergenicity is due to the low content of βs1-casein, which makes it safer for allergy sufferers [9]. The predominance of β-casein contributes to the formation of easily digestible clots in the stomach of children, ensuring comfortable digestion [13,16].Goat milk also has a high degree of fat dispersion, which promotes effective absorption of fatty components by the child's body [29, 30, 32]. It should also be taken into account that, despite the fact that goat's milk is often considered an optimal alternative to human breast milk, it has a number of specific characteristics, including changes in lipid composition [14]. The high amount of polyunsaturated fatty acids in milk, such as linoleic and linolenic acids, increases the body's immunity and normalizes cholesterol, and also has anti-inflammatory properties, promoting normal growth and metabolism [12]. Goat milk is also rich in useful elements, including phosphorus, cobalt and magnesium, which complement its nutritional value. Goat milk exceeds cow milk in vitamin A content by two times, β-carotene - almost three times, ascorbic acid (vitamin C) - one and a half times and nicotinic acid (vitamin PP) - three times. This abundance of vitamins can be explained by the fact that goats eat a variety of herbs. Their menu is much richer than that of cows, which gives milk a special taste. For example, scientists Monllor, P., Zemzmi, J., Muelas, R. et. al. It was reliably determined that the use of silage from artichoke by-products as a 40% supplement to dairy goat feed for a month showed that it is a good option not only for the rational use of agricultural and agro-industrial by-products in feeding ruminants, careful attitude to the environment, but also does not harm the physicochemical composition of milk, and, importantly, the health of animals [15, 18]. Goat milk is also used in the treatment of serious diseases, such as Graves' disease (goiter) and enlarged thyroid gland. It can serve as a preventive measure against cancer, and also has a positive effect on respiratory diseases, tuberculosis, allergies and eczema. It is important to note that any milk, including goat milk, helps to restore the body after exposure to radiation. Therefore, it is completely justified to call goats wet nurses and "home doctors" [31]. The production of fermented milk products with plant components is an area that is receiving increasing attention in the food industry. Adding plant ingredients to the recipe improves the nutritional value of the product and its effect on the body [17, 21].

Enrichment of fermented milk products with vitamins, minerals, organic acids and dietary fibres increases their beneficial properties and makes them more popular on the market [1]. The combination of animal and plant raw materials is also extremely important to

achieve a balance in the composition of the nutritional components of the products. Numerous studies confirm the positive effect of the use of plant components in fermented milk products on their quality and functional properties [5,10,27]. For example, in the work of Bartoń, M., Waraczewski, R., &Sołowiej, B. G., the properties of the obtained fermented organic drink from goat whey enriched with sea buckthorn or wild rosehip juice were studied [2]. Their research has shown that adding organic fruit juices, such as sea buckthorn or rosehip juice, improved the physicochemical and rheological properties of drinks(Fig.1).

Fig.1. Appearance of final fermented organic goat whey drink with labels.
Source: Own calculations based on data [2].

The results of this work show that the produced fermented goat whey drinks can potentially be used as new products that could provide pleasure from consumption and useful properties compared to conventional drinks.
The use of goat milk in food production is a promising direction, as its potential has not yet been fully realized. Increasing the range of products based on goat milk can satisfy the growing consumer interest in functional and healthy food products [26].
The aim of the study is to analyze and evaluate the economic efficiency of production of functional food products based on goat milk.

MATERIALS AND METHODS

The research is based on the synthesis of publications and analytical materials, regulatory documents.
The paper presents:
-The technological process for producing yoghurts with fillers including:
(i) the raw goat milk pasteurization,(ii)the starter culture of lactic bacteria, (iii)the fillers of various type, (iv)cooling, (v)fermentation, (vi) mixing, (vii) cooling, (viii) storage, (ix) sale.
-A number of 8 types of yoghurts were studied comparatively with the Control variant regarding their content in raw materials.
-The economic efficiency for each type of yoghurts was determined taking into account production cost, selling price, profit per package and profitability of production of yoghurts with various fillings.
The differences among the studied variants have been commented in order to establish which is more profitabile.

RESULTS AND DISCUSSIONS

Yoghurts are the most popular fermented milk drinks in the world, since many note their high consumer properties, variety of assortment and the presence of a huge number of probiotics and prebiotics in their composition, then it is undeniable that this type of functional food needs to be promoted among people who care about their health, as well as active advertising among young groups of the population. The technological scheme for the preparation of yogurts with carob powder and other flavor fillers is shown in Fig. 2.
The technological process of producing yoghurts with fillers was also carried out using a thermostatic method: goat milk was pasteurized at 92±2 °C for 2-8 minutes and cooled to a fermentation temperature of 38-

42 °C. A starter culture containing lactic acid bacteria *Streptococcus thermophilus, Lactobacillus delbrueckii* subsp. bulgaricus, *Lactobacillus casei* and fillers (carob with sugar, cereals with sugar or raspberry jam) was added to the milk mixture prepared for fermentation and fermented for 10 to 12 hours to an acidity of 93±2 ºT, after which simultaneous mixing was carried out until a homogeneous consistency was achieved, and cooled at a temperature of 2-6 °C.

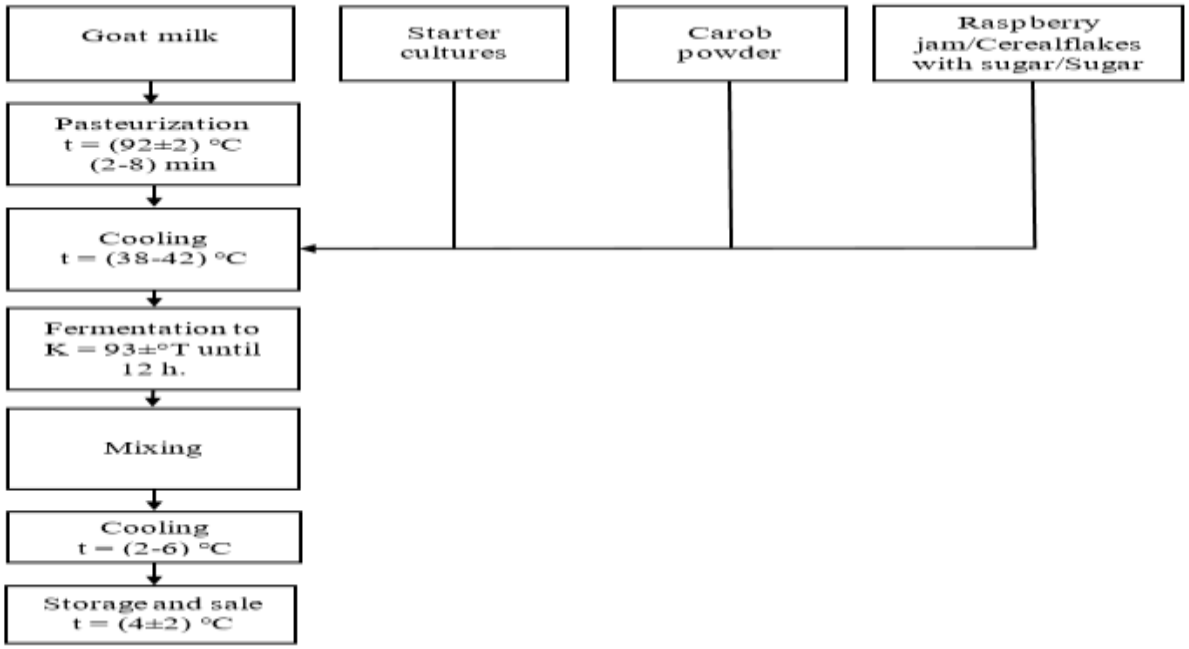

Fig.2. Technological scheme for making yogurts with carob and various flavors
Source: Own determination.

All necessary experiments related to the study of physical and chemical, sanitary and hygienic indicators of raw milk and yoghurts obtained from it, indicators allowing to evaluate the content of toxic elements and pesticides in fermented milk products, microbiological indicators of developed fermented milk products, as well as their nutritional and energy value, are reflected in early publications. The increase in the volume of production of fermented milk products is associated with the increased concern of end consumers about their health.

It is worth noting that the prospects for the production of such products also lie in the diversity and constant addition of their range. And given the fact that yoghurts obtained using various innovative methods, consisting in "enriching" them with valuable components based on plant materials in their physicochemical composition, their final cost will have a higher added value and demand among consumers. Based on the obtained products, calculations of the economic efficiency of producing yoghurts with different fillings were made and are presented in Table 1.

Analyzing Table 1, we can note, firstly, that the prospects for highly profitable production are traced in all experimental yoghurt samples. Secondly, the costs of producing all yoghurt samples are characterized by fairly low values.

At the same time, it is worth considering the environmental friendliness and compliance with all regulatory requirements and regulations governing the quality and safety of fermented milk products, each ingredient used in the composition of our yoghurt samples.

The lowest costs were for the control sample - 22.3 rubles, since this sample did not include any fillers, but consisted exclusively of milk and a starter culture added to it containing lactic acid bacteria *Streptococcus thermophilus, Lactobacillus delbrueckii subsp., Bulgaricus and Lactobacillus casei*.

Table 1. Economic efficiency of production of yoghurts with various fillings based on goat milk

Indicator	Types of yoghurts studied								
	Control	№ 3	№ 3.1	№ 3.2	№ 3.3	№ 3.4	№ 3.5	№ 3.6	№ 3.7
Name of raw materials used, including:	-	-	-	-	-	-	-	-	-
Goatmilk, g	100	100	100	100	100	100	100	100	100
Sourdough, g	0.7	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Carob, g	-	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Cereal flakes, g	-	-	-	-	15	-	-	6	-
Sugar, g	-	-	-	-	10	-	-	10	10
Raspberry jam, g	-	-	15	-	-	10	-	-	-
Blackcurrant jam, g	-	-	-	15	-	-	10	-	-
Total raw materials	100.37	100.97	115.97	115.97	125.97	110.97	110.97	116.97	110.97
Cost of production of yogurt, rub.	22.3	24	31.8	39.3	29.2	29.2	29	26.5	24.7
Selling price, RUB	52	68	72	75	70	71	73	65	70
Profit per 1 package, RUB.	29.7	44	40.2	35.7	40.8	41.8	44	38.5	45.3
Profitability of production of yoghurts with different fillings, %	133.2	183.3	126.4	90.8	139.7	143.2	151.7	145.3	183.4

Source: Own calculations.

The highest level of costs was found in sample No. 3.2 - 39.3 rubles. On average, the cost of production of all types of yoghurts was 28.4 rubles. Selling prices were set based on the average price for similar types of fermented milk products. The control sample also had the lowest price – 52 rubles. The price for sample No. 3.2 was 75 rubles. The average selling price for experimental yoghurt samples was 68.4 rubles. This pricing policy seems moderate and optimal for target consumers according to research (what percentage of people are willing to pay a high price for yoghurts).

Among all types of manufactured products, sample No. 3.2 had the lowest profitability – 90.8%. Sample No. 3.7 had the highest – 183.4%. On average, the profitability of all types of experimental yoghurt samples was 144.1%.

Thus, we can focus on the high prospects of yoghurt production in general, with those samples that contain fillers and have high profitability, such as sample No. 3.7, being especially profitable.

The prices for the products are affordable for consumers. In addition, the required quality and safety standards were observed during the production of the samples under study. The shelf life of products that include natural and environmentally friendly components is limited. In this regard, the time of their delivery and sale to the end consumer should be minimized as much as possible due to the logistics of goods movement, covered by the percentage of high added value for these types of fermented milk products. Thus, the production of yoghurts based on goat milk with various fillers is a promising and highly profitable production.

By "incentives" we mean the use of innovative production technologies and the development of new recipes for yoghurts with different fillers for the functional nutrition of the population of our country [22]. Bringing new products to market allows for increased production volumes and the creation of new jobs [7, 25]. In addition, goat milk is an easily digestible product and has a low level of allergenicity. The production of goat milk-based yoghurts is a promising business and makes a positive contribution to the development of the industry and improving the quality of life of the population.

CONCLUSIONS

One of the priority areas of the Strategy for Scientific and Technological Development of the Russian Federation is the creation of safe and high-quality, including functional, food products.

Functional food products based on goat's milk are the basis of a healthy diet. Research by

many foreign and Russian scientists has proven its unique biological value, since many parameters have been found to be similar to breast milk, due to which it is beneficially absorbed by the body of children and is used to prevent various diseases.

Also, a number of foreign scientists have substantiated the improvement of the physicochemical and rheological properties of drinks by adding organic fruit juices, such as sea buckthorn or rosehip juice.

The study substantiates the advantages of goat milk and presents a detailed technological scheme for the production of yoghurts.

The high economic efficiency of yoghurt production, especially samples with added fillers, is proven. The directions for the development of the functional food market on an innovative and investment basis are formulated in order to increase the competitiveness of manufactured products in the Russian and world markets.

REFERENCES

[1]Baniasadi, M., Azizkhani, M., Saris, P. E. J., Tooryan, F., 2022, Comparative antioxidant potential of kefir and yogurt of bovine and non-bovine origins, Journal of Food Science and Technology, Vol. 59(4): 1307-1316.

[2]Bartoń, M., Waraczewski, R., Sołowiej, B. G., 2025, Organic Sea Buckthorn or Rosehip Juices on the Physicochemical, Rheological, and Microbial Properties of Organic Goat or Cow Fermented Whey Beverages, Applied Sciences, Vol. 15(3): 1240.

[3]Borovik, T.E., Semenova, N.N., Lukoyanova, O.L. Zvonkova, N.G., Skvortsova, V.A., Zakharova, I.N., Stepanova, T.N., 2013, On the possibility of using goat milk and adapted mixtures based on it in baby food, Issues of modern pediatrics, Vol. 12 (1): 8-16.

[4]Canella, M. H. M., Prestes, A. A., Esmerino, E. A., Hernández, E., Cruz, A. G. d., Pimentel, T. C., Prudencio, E. S., 2024, Block Freeze Concentration Processes for Goat Milk Aiming at the Elaboration of an Innovative Functional Fermented Milk, Processes, Vol. 12(11): 2346.

[5]Chernopolskaya, N.L., 2019, Prospects for the production of specialized food products based on goat's milk, Food industry, Vol. 8: 44-47.

[6]Decree of the President of the Russian Federation dated 28.02.2024 No. 145. http://www.kremlin.ru/acts/bank/50358 Accessed on January 28, 2025.

[7]Derunova, E., Vasilchenko, M., Shabanov, V., Derunov, V., 2021, Mechanisms to stimulate the acceleration of innovative development in the agroindustrial complex, Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, Vol. 21(2):209–222.

[8]Development of the functional food market Source: https://tenchat.ru/media/2338261-razvitiye-rynka-funktsionalnogo-pitaniya Accessed on January 21, 2025.

[9]Fatikhov, A.G.,2016, Species features of the protein composition of goat's milk, Scientific notes of the Kazan State Academy of Veterinary Medicine named after N.E. Bauman, Vol. 225 (1): 152-156.

[10]Gavrilova, N.B, 2019, Goat milk – biologically complete raw material for specialized food products, Storage and processing of agricultural raw materials, Vol. 1: 66-75.

[11]Jakubowska, D., Dąbrowska, A. Z., Staniewska, K., Kiełczewska, K., Przybyłowicz, K. E., Żulewska, J., Łobacz, A., 2024, Health Benefits of Dairy Products' Consumption—Consumer Point of View, Foods, Vol. 13(23): 3925.

[12]Kasapidou, E., Karatzia, M.-A., Mitlianga, P., Basdagianni, Z., 2022, Effectsof Production Systems and Seasons on Retail-Goat-Milk Fatty-Acid Composition and Nutritional Indices in Greece, Animals, Vol. 12: 2204.

[13]La Torre, C., Caputo, P., Cione, E., Fazio, A., 2024, Comparing Nutritional Values and Bioactivity of Kefir from Different Types of Animal Milk, Molecules, Vol. 29(11): 2710.

[14]Liao, G., Wang, T., Li, X., Gu, J., Jia, Q., Wang, Z., Li, H., Qian, Y., Qiu, J., 2024, Comparison of the Lipid Composition of Milk Fat Globules in Goat (*Capra hircus*) Milk during Different Lactations and Human Milk, Foods, Vol. 13 (11): 1618.

[15]Monllor, P., Zemzmi, J., Muelas, R., Roca, A., Sendra, E., Romero, G., Díaz, J. R,2023, Long-term feeding of dairy goats with 40% artichoke by-product silage preserves milk yield, nutritional composition and animal health status, Animals, Vol.13(22): 3585.

[16] Muñoz-Salinas, F., Andrade-Montemayor, H. M., De la Torre-Carbot, K., Duarte-Vázquez, M. Á., Silva-Jarquin, J. C.,2022, Comparative analysis of the protein composition of goat milk from French Alpine, Nubian, and Creole breeds and Holstein Friesian cow milk: Implications for early infant nutrition, Animals, Vol. 12(17):2236.

[17]Paszczyk, B., Czarnowska-Kujawska, M., Klepacka, J., Tońska, E., 2023, Health-promoting ingredients in goat's milk and fermented goat's milk drinks, Animals, Vol. 13(5): 907.

[18]Popescu, A., 2014, Research on milk cost, cost, return and profitability in dairy farming, Scientific Papers Series "Management, Economic Engineering in Agriculture and Rural Development", Vol. 14 (2): 219-222

[19]Popescu, A., 2015, Research on the trends in milk production and consumption in Romania Scientific Papers Series "Management, Economic Engineering in Agriculture and Rural Development", Vol. 15 (1): 387-392.

[20]Popescu, A.,2014, Research on profit variation depending on marketed milk and production cost in dairy farming, Scientific Papers Series "Management, Economic Engineering in Agriculture and Rural Development", Vol.14 (2): 223-229
[21]Prapa, I., Pavlatou, C., Kompoura, V., Nikolaou, A., Stylianopoulou, E., Skavdis, G., Grigoriou, M.E., Kourkoutas, Y., 2025, A Novel Wild-TypeLacticaseibacillusparacasei Strain Suitable for the Production of Functional Yoghurt and Ayran Products, Fermentation, Vol. 11(1): 37.
[22]Preobrazhenskiy, Y ., Firsova, 2020, A Problem of forming balanced agroinnovation systems: empirical evidence from Russian regions. Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development. Vol. 20(4):437-444.
[23]Protasova, D.G., 2001, Properties of goat milk, Dairy industry, Vol. 8: 12-13.
[24]Ryumina, I.I., 2021, Goat's milk-based formulas when choosing artificial feeding for a newborn and a child of the first year of , Medical Council, Vol. 1: 30-36.
[25]Sandu, I.S., Nechaev V.I.,2023, Neoindustrialization of the agricultural sector of the economy as a necessary condition for innovative transformation of productive forces and achieving technological sovereignty. Scientific Papers Series «Management, Economic Engineering in Agriculture and Rural Development», Vol.23(3): 802-810.
[26]Shchetinina, E.M., 2020, Development of technology for fortified yogurt based on goat milk raw material, Polzunovsky Bulletin, Vol.2: 5-77.
[27]Shishkina, E.I.,2020, Analysis of foreign technologies for drinking yoghurt and drinking yoghurt for functional purposes, Colloquium-journal, Vol.1 (53): 13-15.
[28]Sorvacheva, T.N., 2022, Differentiated choice of standard milk formula: how to reduce the risk of artificial feeding, Issues of pediatric dietetics, Vol. 20 (1): P. 58-67.
[29]Trukhachev, V.I, Selionova, M.I., Aybazov, A.M.M., et al., 2022, Characteristics of correlation links between milk components of goats of dairy and combined productivity directions, Bulletin of the Timiryazev Agricultural Academy, Vol. 5: 108-119.
[30] Volkova, L.Yu, Nikitina, E.A., Orlova, S.V., 2023, Study of the feasibility of using a fortified product based on goat's milk in the nutrition of vulnerable groups of the population, Medical alphabet, Vol. 8:14-22.
[31]Zabelina, M.V., Belova, M. V., 2015, Production of a fermented milk product (yogurt) based on goat milk with the addition of quince syrup, Sheep, goats, wool business, Vol. 3: 20-22.
[32]Zasemchuk, I.V., Berdanova, M.V.,2019, Indicators of milk productivity of goats of different breeds, Bulletin of the Don State Agrarian University, Vol. 2-1 (32):16-21.
[33] Zhizhin, N.A., 2020, Evaluation of the fatty acid composition of cow's and goat's milk from the point of view of the functional impact on the human body, Actual issues of the dairy industry, intersectoral technologies and quality management systems, Vol. 1 (1):181-186.