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Importance of the Joint Use of Goat and Cow Milk in the Production of Soft Cheeses

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Abstract

The paper presents the data on the physicochemical composition of cow and goat milk in different seasons of the year, as well as physicochemical data on mixed compositions of cow and goat milk in various proportions for the production of soft cheeses without ripening. The yield of soft cheese samples was calculated for a different combination of cow and goat milk, where a soft cheese sample with a milk raw material ratio of 50/50 and with the addition of extruded chickpea flour had a yield of 20.5%. Thus, it was found that the developed soft cheese formulation from a mixture of milk raw materials with chickpea flour allows the production of an environmentally friendly and biologically complete product.

Keywords: soft cheese, goat milk, cow milk, milk mixture, chickpeas, ecology

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1. Introduction

Today, one of the most acute problems for humans is environmental pollution. A person who displaces natural biogeocenoses and establishes agrobiocenoses thereby violates the stability of the entire biosphere through direct and indirect influences. It has an impact on all components of the ecosystem, while striving to obtain as much as possible production from soil areas. In particular, it affects the soil by applying a set of agrotechnical measures with the use of chemicalization, mechanization and melioration [1, 2].

Ecology is the sum total of knowledge related to the Economics of nature: the study of all animal relationships with organic and inorganic components of the environment [3].

Today in connection with the aggravated ecological situation there is a problem of health of the person. The solution to this problem is related to the protection of the environment, as well as the fact that enters the human body -- primarily food. The consumption of these foods should be guided by two principles: food safety and ensuring the nutritional, biological and energy value of the product. The main attention is paid to the vitamin, micronutrient and antioxidant activity of foods [4, 5]. According to

recent data, some food components may have prophylactic properties against cancer, neurodegenerative and other diseases [6, 7].

Since the beginning of the 2000s, the demand for goat milk and products from it has been growing, this is explained by the global interest in natural and environmentally friendly food [8]. Animal husbandry is traditionally the main branch of agricultural production, which is able to produce environmentally safe and biologically valuable products [8--10]. In this connection, the relevance of research and the possibility of using goat milk in the food industry, as well as a mixture of cow and goat milk, as a unique alternative source of raw milk are obvious.

Involvement in the production of special food products of sheep and goat breeding will increase production volumes, and will also diversify the range of this product category. It will provide a healthy diet for children with milk intolerance (a form of food allergy), as well as with various forms of tuberculosis, iron deficiency anemia and other diseases [11, 12].

Goats are unpretentious to the conditions of detention, are highly resistant to diseases (especially tuberculosis). They are relatively early ripening, multiple, well acclimatized in a variety of conditions [13, 14].

Recently [15] there has been a tendency to increase the number of studies on the development of innovative types of soft cheeses, most likely this is due to technical, economic and other properties compared to other types of cheeses. From which we can conclude that research on the development of soft acid and rennet cheeses is relevant.

2. Methods and Equipment

2.1. Materials

For the study, we used samples of soft cheese from cow's milk, from goat's milk, from mixed compositions of cow's and goat's milk in a ratio of 75/25, 50/50, 25/75, respectively, as well as from a mixture of cow's and goat's milk using chickpea flour. The control sample was soft cheese made from goat or cow dairy raw materials, which corresponded to the Russian national standard (2008) [16].

2.2. Methods

2.2.1. Cheese manufacture

Dairy raw materials (cow, goat raw milk) were obtained from the breeding plant of the Leningrad region. The soft cheese production process was carried out according to the traditional technology for the production of acid-rennet soft cheeses without ripening. Raw goat and cow milk and their mixed compositions were pasteurized at 72-75 °C for 20-25 seconds in a water bath, then cooled to 28-30 °C and subjected to acid rennet coagulation. Acid rennet coagulation of dairy raw materials was carried out using the following components: direct bacterial concentrate with a specific combination of *Lactococcus lactis subsp. lactis / cremoris* and *Lactococcus lactis subsp. diacetylactis* cultures in an amount of 2.0% of the mixture; rennet powder was added at a concentration of 0.002 g per 100 g^{-1} of milk; calcium chloride based on the addition of 40 g of anhydrous salt per 100 kg of the mixture. The milk mixture with the components was mixed and left for the coagulation process at a temperature of 35-40 °C for 360 minutes. After the formation of a cheese clot, they were cut into 1 x 1 cm cubes and left alone for 15 minutes. A plant component in the form of chickpea flour in an amount of 3-5% was introduced into the milk mixture after partial separation of whey (70%), after which the soft cheese was sent to molds and kept for independent pressing at 16--18 °C.

All product samples were tested in 5 parallel replicates. The obtained research results were presented as average values. As a control sample, soft cheese without chickpea flour based on cow's milk was used.

2.2.2. Determination of protein, fat, consistence

The measurement of total protein, fat and consistence in milk raw materials was carried out using a milk analyzer "Clever" (Ulicor). This equipment for the analysis of dairy raw materials "Clever" is used to carry out the content of fat, protein, lactose and density in milk and dairy products.

2.2.3. Cheese yield calculation

The yield was determined using the method of weighing soft cheese samples without ripening, and the results were calculated and shown as the difference (in the form of

percent). The calculation of the yield of soft cheese from dairy raw materials (YC) is presented by the formula 1:

$$YC = \frac{M_c \cdot 100}{Mm} \quad (1)$$

where: *YC* -- cheese output from dairy raw materials, g·100 g^{-1} milk; M_c -- mass of cheese, kg;

M_m -- mass of raw milk, kg.

3. Results and Discussion

Natural and climatic conditions of habitat and breeding of different animal species caused significant differences in the composition of milk [17]. The chemical composition of dairy raw materials by season is presented in table 1. The chemical composition of milk varies depending on the period of lactation, breed, quality of feed, feeding conditions, content, age, health and other conditions. Even minor external influences and changes in the physiological state of the lactating animal affect the qualitative composition of milk. In further studies, the change in the fat, protein and density content in raw milk in different seasons of the year was studied, since the quantity and quality of milk raw materials depend on the season of the year and the diet of animals [18]. The studies of indicators were carried out in the spring, summer and autumn and winter periods of 2016-2017. The results of experimental studies are presented in table 1.

Table 1: Indicators of dairy raw materials for the seasons of the year.

Milk	Autumn	Winter	Spring	Summer	Average value
	Mass fraction of protein, %				
Cow	3.15±0.09	3.11±0.06	3.09±0.05	3.06±0.03	3.10±0.09
Goat	3.13±0.06	3.24±0.03	3.15±0.07	3.03±0.05	3.14±0.06
	Mass fraction of fat, %				
Cow	3.35±0.08	3.46±0.07	3.38±0.08	3,29±0,06	3.37±0.05
Goat	3.27±0.06	3.70±0.07	3.43±0.05	3.00±0.05	3.35±0.02
	Consistence, kg·m^{-3}				
Cow	1028.7±0.19	1028.88±0.20	1028.7±0.14	1028.55±0.15	1028.71±0.12
Goat	1027.43±0.15	1028.13±0.13	1027.4±0.12	1027.43±0.13	1027.6±0.16

The fluctuations in the main indicators of raw milk are associated with many factors. The mass fraction of fat of cow and goat milk in winter is slightly higher than in summer.

One of the tasks of the work was the preparation of mixed compositions of dairy raw materials for the production of a high quality product, as well as environmentally friendly with maximum yield. In connection with this task, various mixed compositions of cow and goat milk were compiled and the physicochemical composition of goat and cow milk, as well as their various compositions, was studied. Table 2 presents the results.

Table 2: Composition of the compositions of dairy raw materials.

The ratio of milk in the mixture (cow / goat)	Indicators		
	protein, %	fat, %	consistence, kg·m^{-3}
100/0	3.02±0.07	3.32±0.08	1028.87±0.17
75/25	3.03±0.08	4.03±0.07	1027.80±0.21
50/50	3.06±0.07	3.76±0.06	1028.13±0.19
25/75	3.04±0.06	4.04±0.08	1027.81±0.13
0/100	3.11±0.06	4.29±0.08	1027.56±0.18

According to the results of studies of the composition of mixed compositions of raw milk, it can be noted that with an increase in the addition of goat milk to the mixture, the content of the mass fraction of protein increases from 3.02% to 3.11%, as well as the fat content in the mixture, which must be taken into account when normalizing milk raw materials.

Heat treatment of milk (pasteurization) is carried out in the production of almost any dairy product. The appearance of new smaller peptides during the heat treatment of milk can serve as confirmation of an increase in its antioxidant activity under all studied pasteurization modes. Researchers found changes in antioxidant capacity in a wide range of values: 6.51-17.00 kCl · l and 5.12-12.84 kCl · l, respectively, for goat and cow milk [1, 18].

According to published data, for small peptides, antioxidant activity is higher than for peptides and proteins with a higher molecular weight [19]. An increase in the activity of a number of proteases during the heat treatment of milk can contribute to this [20]. In addition, by increasing the number and increasing the availability of sulfhydryl groups, denaturation and degradation of proteins can lead to an additional contribution to the increase in the antioxidant activity of cow and goat milk [20, 21]. As well as other side groups of amino acids that can play the role of traps for reactive oxygen species.

Samples of soft cheese without maturation were produced using previously developed technology [22]. In the course of research, the yield of soft cheese without ripening from various milk raw materials and its mixed compositions was determined, since the yield directly affects the rational use of raw materials, which means improving the environment. It is shown that the use of mixed compositions of cow and goat milk (50/50), as well as the introduction of flour of extruded chickpeas in an amount of 3-5% by weight of the milk mixture in a partially dehydrated clot, can improve not only organoleptic characteristics [22], and also increase the yield of soft cheese without ripening from a mixture of milk raw materials, which contributes to the rational use of milk raw materials.

Table 3: Yield of soft cheese without maturation from a mixture of raw milk.

The yield of soft cheese, %	The ratio of milk in the finished product (cow / goat)					
	100/0	75/25	50/50	25/75	0/100	50/50 with chickpea flour
	16.2±1.2	16.7±1.0	19.1±1.5	18.3±1.2	18.9±1.3	20.5±1.3

The increase in the yield of soft cheese from a mixture of milk raw materials with chickpea flour can be explained by the fact that the introduction of a plant component increased the water-holding properties of the cheese clot. This is due to the high water-holding ability of the extruded chickpea flour.

4. Conclusion

The high biological value of goat's milk allows us to consider it as promising alternative raw milk, which must be used to optimize the nutritional structure for various physiological conditions and diseases that cause an increased need for antioxidants, especially in today's adverse environmental conditions. Goat milk can also be used as a component in dairy mixes for the production of environmentally friendly products.

It should be noted that an increase in the yield of soft cheese from a mixture of dairy raw materials with a vegetable component compared to cheeses made from goat or cow milk allows to save dairy raw materials, increase the economic component of the product, and also allows us to state the conservation of ecology and rational nature management.

The awareness of the existing scientific and technological potential of goat milk processing and innovations in the resource system of the domestic dairy industry is an objective need for its innovative development and is capable of producing environmentally safe and biologically complete products with minimal labor and money.

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Conflict of Interest

The authors have no conflict of interest to declare.

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