В останні роки відмічається дефіцит низки необхідних компонентів, йодна недостатність різного ступеня від легкої до важкої відноситься до найбільш розповсюдженого явища та спостерігається у 90 % населення України.

Дефіцит йоду є причиною багатьох хвороб: порушення функцій щитовидної залози, затримки розумового та фізичного розвитку дітей, глухонімоти, погіршення зору, неврологічного кретинізму. Тому одним із важливих завдань харчової промисловості є забезпечення населення продуктами, що містять йод у необхідних кількостях, та розширення асортименту йодовмісної продукції.

Для покращення якості сиру кисломолочного із козиного молока та збагачення його йодом, був використаний йодовмісний білковий препарат Йодказеїн.

Встановлено, що збагачення молока у Йодказеїном в кількості 0,01–0,025 мас., % при виробництві сиру кисломолочного із козиного молока, сприяє підвищенню його якості. Використання препарату, до складу якого входить комплекс органічного йоду, що пов'язаний з білком, у кількості від 0,01 до 0,025 % від маси молока, при виробництві дослідних партій продукту (Д.1, Д.2), сприяє збільшенню вологоутримувальної здатності сиру. Така властивість обумовлює підвищення масової частки вологи в продукті на 0,87 та 2,37 %. Це впливає на зменшення масової частки жиру в сирі на 0,5, та 1,74 %, порівняно з аналогічним показником в контролі. Утім, під дією вищевказаних доз препарату відбулося збільшення масової частки білка на 0,19 та 0,25 % та зменшення суми низькомолекулярних жирних кислот, відповідальних за прояв смаку і запаху жиропоту кіз, на 0,18 та 0,31 %, відповідно. Це свідчить про поліпшення органолептичних показників дослідних партій сиру кисломолочного, збагачених, визначеними експериментальним шляхом, раціональними дозами Йодказеїну та насичення його органічним йодом

Ключові слова: йодказеїн, козине молоко, аміно та жирні кислоти, козиний сир кисломолочний

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DEVELOPING A TECHNOLOGY FOR MAKING GOAT'S COTTAGE CHEESE USING THE PREPARATION YODKAZEINE

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1. Introduction

One of the ways to solve the task on providing people with high-quality dairy products is the use of a new type of raw milk – goat's milk. Processing goat's milk into a wide range of drinking milk and fermented milk products is hindered under industrial conditions by the difference between the technological properties of goat's milk and cow's milk. It is known that goat's milk is characterized by the taste and smell of goat's fat and sweat, by white color (regardless of its fat content). It is distinguished by a low indicator of titrated acidity, by the soft tender clot, formed under the influence of milk-coagulating enzyme preparations, which prevents or impedes its mechanical treatment [1].

Therefore, researchers proposed, in order to increase the density of clots in goat's milk, to acidify it with organic acids, and to introduce to the traditionally used ferments in the production of solid, soft and fermented products the unconventional types of ferments from the sour-milk acidophilic, Bulgarian sticks, and propionic acid bacteria. That is, from such kinds of ferments that were not previously used in the production of such a type of the fermented milk product as cottage cheese.

There is a biotechnology for the cottage cheese "Osoblyviy". In order to neutralize the flavor and smell of goat's fat and sweat in it, manufacturers used such fermenting combinations of the basic types of ferments as CMt – Lactococcus sp. and the auxiliary monocultures Propionibacterium sp. and Lb.acidophilus in the following ratios between lactococci, propionic acid bacteria, acidophilic lactic sticks

in the experimental samples of cottage cheese (E.1–E.4), respectively: E.1 – 50:30:20; E.2 – 60:30:10; E.3 – 60:25:15; E.4 – 55:25:20.

It was established that while achieving a significant reduction of specific features of goat's milk in all experimental batches of cottage cheese, they differed by the maximally possible or high levels of titrated acidity, some of them demonstrated a flaw – a metallic taste, which makes the product unfit for consumption [2].

The principal protein in goat's milk in terms of quantity and technological value is casein. Its content in milk varies from 2.3 to 2.9 %. The goat's milk proteins are an important source of the biologically active angiotensin converting enzyme (ACE), which inhibits the hypotensive peptides. They may provide immune protection and control over the microbial infection of diseases. In addition, the presence of a porous structure in casein and the high content of lysozyme made it possible to use the above preparation to accelerate the healing of wounds [3].

In order to replace the uncontrolled use of antibiotics, banned by the European Parliament and the Council of Europe, to combat pathogens and dysbacteriosis, pharmaceutical industry designed the antibacterial preparation "Fumagol". It is based on the natural goat's milk casein.

This preparation, in collaboration with the other two components (tatahurin and thymol), is effective for treating the nosematous disease in bees [4].

There is also the iodine-containing protein preparation called Yodkazeine, which is applied in the dairy industry in order to enrich the sterilized milk with iodine. Its main characteristics are: it is a powder of yellow to brown color. The content of iodine is 7–10 %. It is produced in 5-gram packets made from polymeric film materials; upon request from the consumer, in bundles packed in double plastic bags of 10; 20; 25 kg. Shelf life is 24 months. The preparation is soluble in water, in milk (at 50–60 °C) [5].

The daily need for iodine by people in Ukraine is 100 200 μg/kg. Studies have shown that the samples of milk from animals held in the Kharkov oblast and AR Crimea, contain in the summer period the amount of iodine that meets the nutrition standards for the Ukrainian population, 102 and 209 μg/kg, respectively. The samples of milk from goats held in Lviv oblast revealed a low level of iodine, 47 μg/kg. Therefore, in Lviv oblast, it is recommended to add to goats feed the iodine-containing supplements. People there should consume milk and dairy products, enriched with iodine-containing preparations [6].

In today's world, cottage cheese from goat's milk fully meets the needs of the human body in nutrients, macro- and microelements. Goat's milk contains more such mineral substances as sodium, potassium, calcium, respectively, by 6.0, 10.4, 8.8 %, and magnesium by 1.3 % larger, than cow's milk. The content of iodine in goat's milk is two times higher than that in cow's milk.

Given the imbalanced diet of people, and the lack of iodine, it is a relevant task not only to produce cottage cheese, but also to enrich it with various substances, including microelements (iodine) [7].

2. Literature review and problem statement

The scientific task of this study is to develop a technology for making cottage cheese from goat's milk of dense consistency, devoid of the taste and smell of goat fat and sweat, with high food and biological value.

The existing technology of goat cottage cheese does not imply its iodization. Therefore, it is a relevant task to develop a technology for making goat cottage cheese, enriched with the iodine-containing preparation Yodkazeine.

At present, the iodine deficit in the nutrition of adults and children is a pressing issue around the world and in Ukraine. Based on the WHO estimate, about 1,600 million people live at the iodine-deficiency regions [8].

In Ukraine, the western Ukrainian oblasts have been traditionally considered to be the iodine-deficiency regions (Lviv, Ivano-Frankivsk, Chernivtsi, Ternopil, Zakarpattia, Rivne, Volyn). High social significance of this issue is reflected not only by the prevalence of iodine-deficiency conditions, but above all by their negative influence on the development and state of health of people [9, 10].

Bread and milk were identified as important sources of iodine in the Swiss diet, because they contributed to receiving iodine in the amounts of 58 and 29 μg/day, respectively. The contribution of all the major food groups to the consumption of iodine per capita was approximately 140 μg/day, which is slightly below the level accepted for adequate nutrition (150 μg/day) [11].

The intake of iodine with the iodized salt declines due to the efforts of public health organizations to reduce salt consumption. Thus, consumption of milk and dairy products could become a more important source of diet iodine in the future [12].

It was established that goat's milk contains, respectively, 50 and 80 % more vitamin B_1 and B_2, and the greater amount of iodine, by 0.017–0.249 μg/kg, compared with the similar indicators in cow's milk. This testifies to that goat's milk can be used to overcome the iodine deficit in the nutrition of Ukrainians [13].

The task of overcoming iodine deficit could be resolved through the use of milk obtained from farm animals whose feed included the iodine-containing supplements. In experiments involving dairy cows, the concentration of iodine in milk increased with an increase in the quantity of iodine supplements in the feed.

However, the grain and beans, as well as the products extracted from oil crops, are characterized by a low content of natural iodine, <9–43 micrograms of iodine/kg of dry matter (DM). Silage contained more iodine than concentrates. For the grass silage, the mean indicator was 173 μg of iodine/kg of DM.

Reducing the content of iodine in milk was due to that cows consumed rapeseed feed whose composition includes glucosinolates. These substances are antagonists to iodine. Thus, feed is a source of iodine for farm animals. Its level in milk depends on the content of a given element in the ration of their feeding [14].

Study has been conducted to determine the ratio of iodine consumed by lactating cows in the form of iodine-containing supplements and its concentration in milk. It was established that the amount and characteristics of the iodized supplement (organic or inorganic), which was added to the rations for feeding cows, affected the level of iodine in milk [15].

Results of the experiment on the prevention of iodine deficiency in children and adults revealed that taking Yodkazeine in the composition of drinking milk leads to the normalization of iodine in 6–8 weeks. Children's sleep and psycho-emotional state were improved. Adult persons experienced better sleep and elevated performance potential with

the highest possible efficiency in the mobilization of all reserves of the body; as well the actual performance, the level of which is always lower. At the same time, the use of the iodized salt almost did not change the level of secretion of natural iodine. Thus, consumption of Yodkazeine can be considered as an alternative and effective method of mass prophylaxis of iodine deficiency in the country's population [16, 17].

The bread making factories in Ukraine have produced bread, gingerbreads, and biscuits with the addition of Elamin. It is recommended for the enrichment of various meals and confectionery products with iodine, selenium, salts of alginic acid, microelements, and biologically active substances [18].

The iodine-containing preparation Elamin, which is produced industrially at the plant of lactic acid in the city of Kyiv [19]. It has been successfully used in the technology of kefir made from goat's milk. Due to the high level of protein, carbohydrates, minerals, including iodine, and thick consistency, the preparation contributed to an increase in kefir's viscosity and improved its consistency. As well as organoleptic indicators [20].

Cottage cheese technology is based on the process of syneresis – an intensive separation of whey from the clot until moisture content in the finished product (depending on the fat content) reaches 64 to 75, and 80 %. However, the specific features of Elamin (elevated viscosity) restrict its use for making cottage cheese.

Based on the above, it can be concluded that the most suitable for application in the technology for making cottage cheese is the iodine-containing preparation Yodkazeine.

We assessed the life activity of probiotic microorganisms, added to the cottage cheese under simulated gastro-intestinal conditions for the release of potentially-antioxidant peptides and their antimicrobial action aimed at the suppression of monocitogen bacteria – *Listeria*.

To this end, we prepared three samples of cottage cheese, including control without adding the probiotics. In the experimental samples of cottage cheese, whose composition was given such probiotics as *Lactobacillus casei, Lactobacillus rhamnosus GG*, the commercially available mixture YO-MIX 205, the quantity of *L. monocytogenes* decreased approximately by one logarithmic cycle after 20 days of storage. The above-mentioned research results indicate that cottage cheese is a good means for the development of probiotic bacteria [21].

We estimated the growth potential (δ) of monocytogens *Listeria* in six samples of cottage cheese with the introduction of the probiotic preparations (*Lactobacillus acidophilus* and *Bifidobacterium lactis*). Using a cationite set-up, we replaced calcium in the fermented cottage cheese with sodium, potassium, and magnesium. The samples of sodium cottage cheese that contains either $NaCl_2$ in combination with KCl_2 and/or $MgCl_2$ were kept under different temperature conditions. We inoculated *L. monocytogenes* to the sodium cottage cheese samples (about 10^3 CFU/g) and kept them at 4 °C (I), 30 % of the shelf at 4 °C, and the remaining 70 % at 12 °C (II) and 12 °C (III) for 28 days. It was established that the growth potential (δ) was above 0.5 log CFU/g. That demonstrated that the preparation is capable of maintaining the growth of *L. monocytogenes*. The growth potential (δ) of *L. monocytogenes* at 4 °C (I) ranged from 0.5 to 0.8 log CFU/g. The higher potentials of growth (1.1–1.6 log CFU/g) were observed during storage of sour-milk cheese for 30 % of the shelf life at 4 °C with the further storage at 70 % at 12 °C (II). In experiment III (28 days at 12 °C). *L. monocytogenes* could grow only in compositions with 100 % $NaCl_2$ and without probiotics (F1) and in F2–F6 (probiotic preparations with various combinations of NaCl, KCl, $MgCl_2$) populations of this bacteria were below the level of quantification (<1 log CFU/g). That is, the probiotic cultures introduced to the composition of cottage cheese inhibited the growth of the specified pathogenic microflora. Regardless of the examined storage scenarios, strict conditions of hygiene during treatment and use of the raw materials with excellent microbiological properties are the key factors for ensuring the safety of this product since *L. monocytogenes* can grow at a low storage temperature [22].

Consumers search for products with functional characteristics that exceed their nutritional properties. Thus, the concept of the functional food has become a hot topic, making it possible to receive additional benefits to health, including the prevention of diseases. In this context, plants are recognized as sources of a wide spectrum of bioactive substances, including phenolic compounds. In our case, a water extract of rosemary was used as a functional ingredient for cottage cheese, thereby proving that it possesses both a high content of phenolic compounds and antioxidant activity. However, in seven days after the onset of storage we observed a reduction of bioactivity in the samples of cottage cheese, which had been enriched with extracts in a free form. Therefore, to preserve the antioxidant activity of cottage cheese, we introduced a microencapsulated water extract of rosemary to its composition. In general, the introduction of both the free and micro-capsulated extracts ensured the biological activity that was best maintained with the micro-encapsulated extracts without compromising the food value of cottage cheese [23].

Globally, there is a trend towards healthy food products, mainly including natural biologically active ingredients that substitute the synthetic supplements. Earlier screening study revealed that extracts from *Foeniculum vulgare Mill* (fennel) and *Matricaria recutita L.* (chamomile) retained the enriched properties and improved the anti-oxidant activity of cottage cheese. However, this effect was limited to 7 days. Therefore, the water extracts of these plants were microencapsulated in alginate and introduced to the cottage cheese to achieve their elevated biological activity. Regardless of the species of plants, the factor of "functional performance" did not affect changes in the parameters of product preparation. In addition, models that were functionalized by the microencapsulated extracts have shown the higher antioxidant activity after day 7 of storage. This indicates that the primary goal of that experimental work has been achieved [24].

It should be noted that experiments involving extracts of plant origin and their microencapsulation deserve attention. However, the process of obtaining extracts and their microencapsulation requires extra time and is labor-intensive.

The composition of extracts includes essential oils, a source of bactericidal substances. However, their physical-chemical composition is unstable. The absence of iodine reduces the possibility of a wider use of plant raw materials in the production process of sour-milk dairy products, including cottage cheese.

In the dairy industry, it is important to extend the range of products. Especially relevant is to provide dairy products with more useful properties. Enriching cottage cheese with ingredients that would improve its taste and functional properties will contribute to extending its product range. And stimulating consumer demand for sour-milk products.

The aim of researchers was to theoretically substantiate the relevance and feasibility of using such a supplement in the technology for making cottage cheese as the date. It is known that dates are composed of sugars by 50 %, which makes them extremely nutrient. They are very quickly absorbed by the body; fructose relieves the nervous tension. During study, they produced three samples of a new food product, based on the production technology of cottage cheese. The pulp of dates was added in the amount of: 40 g, 30 g, 25 g, per 1,000 g of the finished product. In this case, they took into consideration the physiological need of human in carbohydrates and folic acid. By performing an organoleptic assessment, it was found that the taste and flavor of cottage cheese in sample No. 1 with the addition of pulp of dates are the best – sour milk, sweet with the taste of dates; the consistency is homogeneous, with a uniform distribution of particles of dates throughout the entire bulk; the color is inherent to cottage cheese with a creamy touch. Microbiological study to detect the total amount of microorganisms, bacteria Escherichia coli and Staphylococcus has shown that the finished product meets all the requirements of acting normative documents [25].

It should be noted that the conducted research aimed at the development of the technology of goat cottage cheese, with an elevated level of iodine, did not imply determining the antimicrobial properties of Yodkazeine. This drawback must be taken into consideration in the further studies.

Milk is used for the manufacture of sour-milk products, which have, in comparison with the original raw material, good dietary and medicinal properties.

Despite the high nutritional value of cottage cheese, it is a relevant task to diversify its assortment, including through the introduction to its composition of components that are useful for the human organism.

It is possible to improve the composition of cottage cheese by adding fresh apples. The chemical composition of apples varies widely and depends on the variety, farming, weather conditions, etc. The benefits of apples are the presence of various components, including vitamins, minerals. Apples contain almost all the vitamins and nutrients (carotene, sugar, mostly fructose), organic acids (mainly, malic acid), pectin substances, mineral substances (calcium, sodium, phosphorus, iron), fruit acids and fiber, required by the human body. Thus, apples can be a useful nutritional supplement to cottage cheese, as well as enriched it with vitamins, mineral, pectin substances. Scientists hope that the use of apples will not significantly affect the cost of cottage cheese [26].

Despite the benefits of supplements made from dates and apples, they changed the technological characteristics of cottage cheese. Specifically, the consistency of the product included the particles of the above-specified fruit. The availability of alternative foods, enriched with vitamin D, could help reduce the proportion of population that lack vitamin D. Cottage cheese was chosen because its manufacture makes it possible to add vitamin D to cream, and introduce the cream raw materials to a cottage cheese half-finished product, which prevents the loss of the vitamin with whey. Control was the cottage cheese without the addition of vitamin D. As expected, no losses of vitamin D with whey was observed in the production of the experimental batch of cottage cheese. It was established that in the examined sample of cottage cheese the concentration of vitamin D remained stable over 3 weeks of storage at 4 °C. Enriching the examined sample of cottage cheese with vitamin D, when compared with control sample of the product, did not affect changes in the physical-chemical composition and sensory characteristics. The above-specified product could become a new source of vitamin D or an alternative for the enriched drinking milk. However, when implementing a given technology, it is necessary to take into consideration the factors that contribute to its destruction. Thus, after adding vitamin D to cream, which are further used for the normalization of fat in cottage cheese, it is not recommended to expose cream to the pasteurization and homogenization [27].

The technology of cottage cheese, enriched with brown algae of the genus *Laminariaceae,* was developed. It was established that in order to obtain a product in accordance with the requirements of the normative and technical documentation, it is necessary to introduce Laminaria to cottage cheese in the amount of 1 % by weight of milk. In this case, adding more iodine-containing preparation, Laminaria (or otherwise) sea cabbage, to the above-specified product increases the titrated acidity and worsens the organoleptic characteristics. Over the entire period of storage, scientists noted a decreased contamination of the examined samples of the product. That points to the Laminaria's antibacterial properties. In addition, consumption of 100 g of cottage cheese, enriched with the above-indicated iodine-containing preparation, makes it possible to satisfy the daily need of an adult human in iodine for 60–70 %. However, under the influence of the above-specified iodine-containing preparation there occur the negative changes in the technological characteristics of cottage cheese. Thus, the white color of the product changes to white with inclusions of dark green or black color. Such deviations in the consistency parameters of cottage cheese, enriched with Laminaria, do not match the traditional ideas of consumers about this type of a sour-milk product. In addition, a product with the presence of impurities in its composition cannot be referred to a cottage cheese [28].

Thus, it follows from the above arguments that the enrichment of cottage cheese with organic iodine, improvement of the density of milk clots and its parameters, necessitates the selection of such an iodine-containing preparation that would not require any changes in the technological indicators of the product (taste, smell, color, and consistency).

3. The aim and objectives of the study

The aim of this work is to develop a technology for making goat cottage cheese using the preparation Yodkazeine.

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

– to increase the density of clots formed under the influence of milk-clotting enzyme preparations, specifically pepsin, and to reduce the loss of fat and protein of the milk clot with cheese whey during its mechanical treatment;

– to shorten the technological process of making cottage cheese to prevent its contamination by foreign microflora;

– to increase the population of useful fermenting microflora;

– to increase the level of essential amino acids and organic iodine;

– to improve the organoleptic indicators of cottage cheese made from goat's milk, in particular, to neutralize their taste and smell of goat fat and cheese by decreasing the amount of low-molecular fatty acids.

4. Materials and methods to study goat's milk as the raw material in the proposed technique and enriched with the preparation Yodkazeine

Sour-milk cheese. A protein sour-milk product containing mostly casein and whey proteins, it is produced by fermenting milk with the fermenting preparations using the techniques for acid or acid-rennet coagulation of protein.

Cottage cheese must meet the requirements of the National standard of Ukraine DSTU 4554:2006 "Sour-milk cheese. Technical specifications" (as of January 1, 2007) and the Instructions for the production of cottage cheese, approved in the prescribed order.

Classification: sour-milk cheese, depending on the mass share of fat, is divided into:

– sour-milk cheese, low-fat;

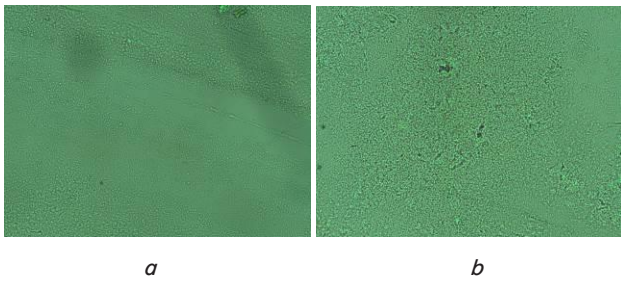
– sour-milk cheese with a mass fraction of fat over 2 % to 18 %.

Fig. 1 shows a photograph of the device Ekomilk at which we determined the physical-chemical indicators of goat's milk used for the manufacture of control and experimental batches of cottage cheese.

Fig. 1. Device Ekomilk for determining the physical-chemical composition of goat's milk

Images of the micropreparations were acquired at the interferential microscope MPI-5.

Fig. 2 shows the micropreparations of control and experimental samples of cottage cheese, enriched with the optimal dosage of Yodkazeine.



a *b*

Fig. 2. Micropreparations of control and experimental samples of cottage cheese, enriched with the optimal dosage of Yodkazeine: *a* — micropreparation of control sample (C) of cottage cheese made from goat's milk; *b* — micropreparation of the experimental sample (E.2) of cottage cheese, made from goat's milk, enriched with Yodkazeine in the amount of 0.025 % by weight

Fig. 2 shows that the application of the preparation in the optimum dosage of 0.01–0.025 % by weight ensures the formation in the experimental batch of cottage cheese (E.2) of the lactic acid microflora (from lactococci), useful for the human body, in the amount that is 2.6–2.8 times larger than that in control batch (C) of the product.

The materials and equipment that were used for studying the goat's milk as the raw material in the proposed technique and enriched with the preparation Yodkazeine, as well as the sampling of milk from lactating goats and methods of conducting physical-chemical and biochemical studies, and the sanitary-bacteriological research methods, are described in detail in paper [29].

5. Results of studying the physical-chemical, biochemical, and sanitary-bacteriological indicators of milk and cottage cheese made from goat's milk

Table 1 gives the physical-chemical indicators of the goat's milk used for making cottage cheese.

Table 1

Physical-chemical composition of goat's milk, used for making cottage cheese from goat's milk

Indicators	Research results
Mass fraction of dry substances, %	12.2
Mass fraction of protein, %	3.2
Mass fraction of fat, %	3.7
Titrated acidity, °T	15.0
Density, oA	28.5
Quantity of somatic cells, thousand/cm3	75.0±2.5

The data given in Table 1 show that the physical-chemical indicators of goat's milk meet the requirements of acting State standard of Ukraine to the harvested goat's milk (DSTU 7006:2009 "Goat's milk, raw material. Technical specifications").

We made control and experimental batches of goat cottage cheese (hereinafter cheese) in accordance with the requirements of the current regulatory and technical documentation. When manufacturing experimental batches of cottage cheese, we introduced to the milk, prepared for fermentation and souring, different dosage of the iodine-containing protein preparation Yodkazeine.

We determined the rational dosage of the preparation Yodkazeine (hereinafter referred to as "preparation"), aimed at improving the quality of cheese.

The physical-chemical parameters of control and experimental samples of cottage cheese made from goat's milk are given in Table 2.

The data from Table 2 show that the use of Yodkazeine in the amount of 0.01, 0.025, and 0.035 % by weight of milk in the production of experimental batches of cheese (E1, E2, and E3) contributes to an increase in its moisture-retaining capacity. This influenced the increase in the moisture content in the samples of cheese from three experimental (E1, E2 and E3) batches of the product, by 0.86, 2.37, and 2.83 %. Under the influence of the preparation, the mass share of fat in cheese decreased by 0.5 %, 1.74, and 1.65 %, as compared with control. However, under the influence of the above dosage of the preparation, the mass share of protein in the experimental

batches of cheese increased by 0.19, 0.25, and 0.2 7 %, as compared with control batch.

An increase in the dosage of the preparation by 0.01 % by weight in the composition of the sample from the experimental batch of cheese (E.3), compared with the similar indicators in the samples from the experimental batch (E.2), contributed to a small difference between the above-mentioned indicators. That testifies to the inappropriateness of applying a dosage of the preparation in the amount of 0.035 % by weight of milk, used to enrich experimental batch (E.3) with iodine. Therefore, according to the results of research into determining the effect of different dosage of the preparation on changes in the physical-chemical indicators of cottage cheese made from goat's milk, the rational dosage for using Yodkazeine is 0.01–0.025 % by weight. We determined the effect of different dosage of the preparation on the change in amino acid composition of cheese made from goat's milk (Fig. 3, 4).

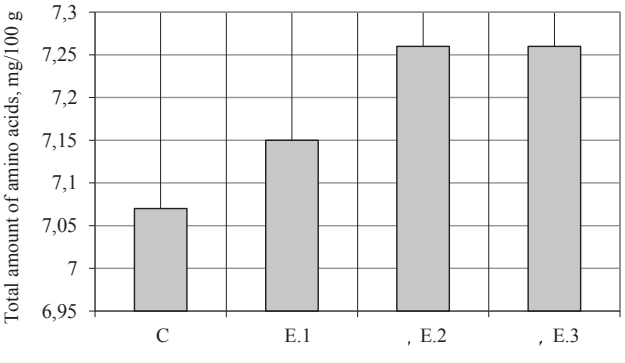


Fig. 3. Total amount of amino acids in control and experimental batches of cottage cheese made from goat's milk

Fig. 3, 4 show the graphs of change in the total amount of amino acids, and the total amount of essential amino acids, in the experimental batches of goat cottage cheese under the influence of different dosage of Yodkazeine.

Fig. 3 shows that under the influence of Yodkazeine in the amount of 0.01, 0.025, and 0.035 % by weight, the total amount of amino acids in the samples from experimental batches of cheese E.1, E.2, and E.3 increased by 0.08 and by 0.19 % in each sample.

Fig. 4 shows that the enrichment of the experimental batches of goat cheese (E.1, E.2, and E.3) with Yodkazein in the amount of 0.01, 0.025, and 0.035 % by weight, respectively, contributed to an increase in their amount of essential amino acids by 0.31, 0.66, and 0.79 %, compared with control. No reliable difference between the total amount of essential amino acids in the samples of cheese from the experimental batch (E.3) and the similar indicator in the samples from the experimental batch of the product (E.2) was found.

This indicates that the rational dosage for using Yodkazeine is 0.01–0.025 % by weight. We determined the effect of dosage of the preparation on changes in the low-molecular acids in the composition of experimental batches of goat cheese (Fig. 5).

Fig. 5 shows that the action of the above-specified dosage of the preparation leads to a positive phenomenon – reducing the total amount of low molecular fatty acids, responsible for the manifestation of the taste and smell of goat's fat and sweat, by 0.18, 0.31, and 0.34 %, respectively. This indicates the improvement of organoleptic indicators in the experimental batches of cottage cheese, enriched with Yodkazeine.

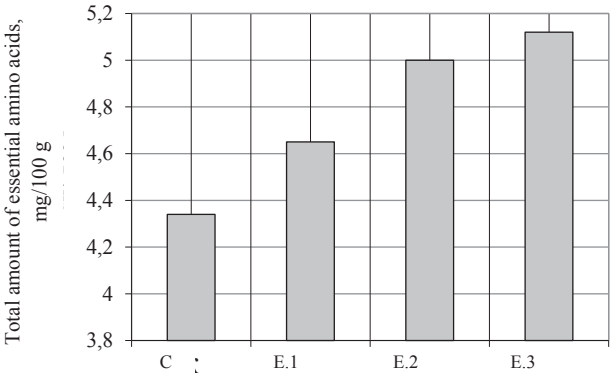


Fig. 4. Total amount of essential amino acids in control and experimental batches of cottage cheese made from goat's milk

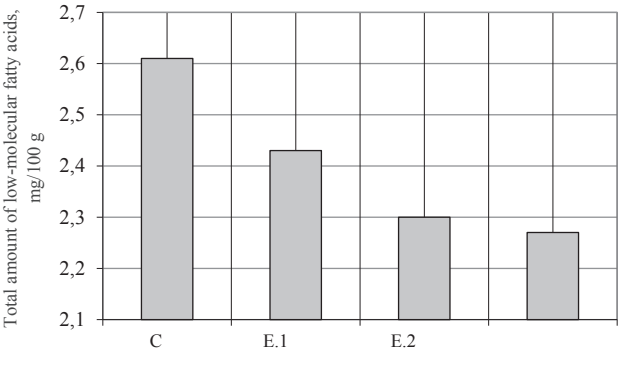


Fig. 5. The total amount of low molecular fatty acids in the control and experimental batches of cottage cheese from goat's milk

The graph in Fig. 5 shows a positive phenomenon, the reduction of the total amount of such low molecular fatty acids as: butyric, caproic, caprylic and lauric acids, whose content is 2.61 % in the control batch (C) of cheese, and is 2.43, 2.30 and 2.27 % in the experimental batches (E.1, E.2, and E.3) of the product. These fatty acids are responsible for the manifestation of the taste and smell of goat's fat and sweat. Under the action of the applied, in the manufacture of experimental batches of cheese (E.1, E.2, and E.3), dosage of Yodkazeine in the amount of 0.01, 0.25 and 0.35 % by weight, they decreased by 0.18, 0.31, and 0.34 %, compared with control. This indicates the improvement of organoleptic indicators of the product, enriched with Yodkazeine.

Table 3 gives results of the organoleptic estimation of control and experimental samples of cheese.

Data from Table 3 show that the use of the preparation Yodkazeine in the rational dosage of 0.01 to 0.025 % by weight of milk contributed, in the experimental samples of cheese with its use, to neutralizing the taste and smell of goat's fat and sweat and obtaining a dense clot.

However, increasing the dosage of applying the preparation to 0.035 % by weight was accompanied by a decrease in the density of the product's consistency. That requires the additional pressing of cheese to remove the excess amount of moisture from it, which is impractical.

We have determined the microbiological indicators of control (C) batch of cheese made using known technology, and the experimental batches (E.1–E.3) of cheese, enriched with the preparation (Table 4). We also determined duration of the clot formation in the experimental batches of cheese, in hours.

Table 2

Changes in the physical-chemical indicators of goat cheese under the influence of different dosage of the preparation, %

Indicators	Results of studying the batches of cheese			
	Control (C)	Experimental, enriched with Yodkazeine mg/100 mg		
		(E.1)	(E.2)	(E.3)
		Dosage of preparation used to enrich the cheese		
		0.01	0.025	0.035
Mass fraction, %	–	–	–	–
Moisture	61.67	62.53	64.04	64.50
Fat	22.08	21.58	20.34	20.43
Protein	12.28	12.47	12.53	12.55

Table 3

Organoleptic indicators of control and experimental samples of cheese

Cheese sample name	Indicators		
	Taste and smell	Color	Consistency
Control (C)	Pure sour-milk, no extra taste and smell, not inherent for goat's milk (with a specific taste and smell of goat's fat and sweat, typical for goat's milk)	White	Not dense enough (soft). Not suitable for packing at the technological equipment and for processing into the cottage cheese products
Experimental (E.1)	Pure sour-milk, no any extra taste and smell, not inherent for goat's milk, with the neutralized taste and smell of goat's fat and sweat	White	Denser than control. Suitable for packing at the technological equipment and for processing to cottage cheese products
Experimental (E.2)	Pure sour-milk, no any extra taste and smell, not inherent to goat's milk, with the neutralized taste and smell of goat's fat and sweat	White	Dense. Suitable for packing at the technological equipment and for further processing to cottage cheese products
Experimental (E.3)	Pure sour-milk, no any extra taste and smell, not inherent to goat's milk, with the neutralized taste and smell of goat's fat and sweat	White	Dense enough. Recommend additional pressing to remove the excess amount of moisture to 0.5– 1.0 %

According to data from Table 4, the amount of lactic acid bacteria in the experimental batches of cottage cheese, under the influence of Yodkazeine in the amount of 0.01, 0.025, and 0.035 % by weight of milk, increased from 1.0×10^7 CFU per 1 cm^3 in control batch (C) of cheese to 2.6×10^7 CFU per 1 cm^3 in the experimental batch of cheese (E.1). In two other experimental batches (E.2 and E.3) of the product their amount increased to 2.8×10^7 CFU per 1 cm^3. That makes it possible to shorten the duration of clot formation in the cheese by 1.5–2 h, in comparison with the analogous indicator for the control batch of the product.

Table 4

Microbiological indicators of two samples of cheese

Indicator name	Batch of cheese		
	Control (C)	Experimental (E.1)	Experimental (E.2) and (E.3)
Bacteria of the group of intestinal sticks (coliform) per 0.01 g of cheese	Not detected		
Pathogenic microorganisms, including bacteria of the genus Salmonella, per 25 g of product	Not detected		
Staphylococcus aureus, per 1 g of cheese	1.0×102		
Listeria monocytogenes per 1 g of cheese	Not detected		
Amount of lactic acid bacteria, CFU per 1 cm^3, not less than	1.0×107	2.6×107	2.8×107

6. Discussion of results of studying the effect of using Yodkazeine in the technology of goat's cheese

Goat's milk is used as a raw material for the production of drinking milk and fermented dairy products, such as cottage cheese. The antibacterial preparation "Fumagol" was created using it as a base [4].

However, the drawback of the specified preparation is the absence in its composition of organic iodine, which is capable of solving the task on overcoming the iodine deficit in the nutrition of the Ukrainian population.

The research has found that the content of iodine in goat's milk depends on many factors: the season of the year, feeding rations, region where goats are kept. In Lviv oblast, the goat's milk revealed the lowest content of this element, 47 μg/kg. Therefore, it is recommended to include the iodine-containing supplements in this endemic area to the feed for goats. The people are recommended to consume milk and dairy products, enriched with iodine-containing preparations [6].

At present, it is a pressing issue around the world and in Ukraine to supplement the nutrition of people with high-quality dairy products that are high in protein and organic iodine [8–10]. The intake of iodine in the composition of iodized salt declines as a result of efforts by public health organizations [12].

Since goat's milk contains 0.017–0.249 μg/kg more iodine, compared with the similar indicators in cow's milk, this kind of milk raw material is more appropriate to use for overcoming iodine deficit than cow's milk [13].

Mineral substances in milk are in a small amount, however, they play an important role in the life activity of the body, as well as in the technologies for making dairy products. A source of iodine is the feed with which, from the animal organism, organic iodine enters milk. Its amount depends

on the type of feed, most of which do not provide the body of animals with the required volume of it and contributes to the formation of a low level of this microelement in milk. Thus, feeds are a source of iodine for farm animals. Its level in milk depends on the content of a given element in the feed for animals. Through the feed, organic iodine enters the human body. However, the low level of iodine in most existing feeds necessitates their enrichment with the iodine-containing supplements. In addition, the use of iodine-containing preparations to enrich milk and dairy products with iodine in many countries is mandatory [14].

The type of an iodine-containing preparation, introduced to the farm animals feed affects the level of iodine in the dairy raw materials. For example, the introduction to the farm animals feed of organic iodine with Elamin contributes to the formation of a greater amount of iodine in milk than that when using the chemical compound potassium iodide whose composition includes inorganic iodine [15].

Yodkazeine has proved to be an effective means in preventing iodine deficiency in adolescents and adults. Within 6 weeks after starting consuming the iodized milk, the bodies of the examined pupils showed the normalization of iodine level, while the adults improved their sleep and increased their performance [16, 17].

Recently, there has been an increase in the production of the iodized bread. For this purpose, the iodine-containing preparation Elamin has been applied [11]. The composition of Elamin includes a complex of biologically active substances and organic iodine. Under its influence, consumers reveal the normalization of the iodine balance [18, 19].

However, it is known that milk and dairy products contain greater amounts of natural iodine than other food products. Therefore, the use of dairy products by people is a more effective means to eliminate the deficit of iodine. The biological value of milk and dairy products increases by orders of magnitude after their enrichment with iodine [13].

It was established that the application of Elamin is extremely limited. This preparation can be effectively used only when manufacturing products with a viscous consistency, such as kefir [20].

Cottage cheese contains more proteins, vitamins, and mineral substances in concentrated form than other dairy products. It is a popular food product among consumers.

Due to the lower density of the goat's clot, formed under the action of milk-clotting enzyme preparations on goat's milk, the standard losses of fat and protein with whey may be exceeded. In addition, under the influence of heat treatment, in the manufacture of cottage cheese from goat's milk, the flavor and smell of goat's fat and sweat increase [1]. That explains why cottage cheese from goat's milk is less popular than a similar product from cow's milk.

To solve the set tasks, aimed at eliminating the above-specified shortcomings of cottage cheese made from goat's milk, it was necessary to select among known iodine-containing preparations the one that meets the quality criteria of the above type of product.

We have chosen the iodine-containing preparation Yodkazeine, a rational dosage of which had to be established experimentally.

Our experiments have shown that the rational dosage of Yodkazeine in the manufacture of cottage cheese is 0.01 to 0.025 % by weight of milk.

The application of the preparation, which includes a complex of organic iodine, associated with the protein, in the amount of 0.01–0.025 % by weight of milk, when manufacturing experimental batches of product (E.1, E.2), contributes to an increase in the moisture-retaining capacity of cheese and to obtaining a greater moisture content in the experimental batches of the product, by 0.86 and 2.37 %, than in control.

There is a reduction of the mass share of fat in the cottage cheese, by 0.5 and 1.74 % compared with the similar indicator in control. However, under the influence of the above-specified dosage of the preparation, there occurs a positive phenomenon, increasing the mass fraction of protein by 0.19, 0.25 %, the total amount of essential amino acids and decreasing the content of low-molecular fatty acids, responsible for the manifestation of the taste and smell of goat's fat and sweat, by 0.18, 0.31 %, respectively, compared with control.

That attests to the improvement of the organoleptic indicators of experimental parameters of cottage cheese, enriched with the determined rational dosage of Yodkazeine.

Application of the preparation in a rational dosage of 0.01–0.025 % by weight ensures the formation of a denser clot and a larger, by 2.6–2.8 times, number of lactic acid microflora, useful for the human body, compared with the similar indicators for the control (C) batch of product. This makes it possible to shorten the duration of forming a clot in the cottage cheese by 1.5–2 hours, compared with the similar indicator for the control batch of product.

The benefits of this research, among others, are the right choice of the iodine-containing preparation Yodkazeine, applied to improve the quality of cottage cheese and to increase its food and biological value.

A given preparation, in contrast to other iodine-containing preparations (Elamin, Laminaria, Fumagol, etc.), does not change the traditional technological cottage cheese characteristics (taste, smell, color, and consistency).

At the same time, this work has not yet resolved some issues, namely:

– the antibacterial activity and antioxidant activity of Yodkazeine were not determined, compared with other types of iodine-containing preparations;

– we have not selected, among food additives, bacterial preparations, extracts or fatty acids, such ingredients that would contribute to an increase in the mass share of fat in cottage cheese.

7. Conclusions

Thus, our choice in favor of the iodine-containing preparation Yodkazeine and its application in the rational amount of 0.01–0.025 % by weight in the production of cottage cheese, when compared to control, contribute to:

1. An increase in the density of clots, formed under the influence of milk-clotting enzyme preparations, and to a decrease in the losses of fat and protein of milk clot under the cheesy whey during its mechanical processing (cutting the clot).

2. Shortening the duration of technological process of making cheese by 1.5–2 hours. This prevents infection of cheese with foreign microflora.

3. An increase in the population of beneficial fermenting microflora, by 2.6–2.8 times.

4. An increase in the biological value of cheese by increasing its level of essential amino acids by 0.31 and 0.66 % and enriching it with iodine.

5. Improvement of organoleptic indicators of the product made from goat's milk, in particular neutralizing the taste and smell of goat's fat and sweat. This is due to the decrease in the levels of low molecular fatty acids in cheese, by 0.18, 0.31 %.

Given the above, there is reason to believe that the enrichment of cottage cheese with the rational dosage of Yodkazeine makes it possible to obtain goat cheese with an elevated biological value, compared with a product made in accordance with the acting requirements from current regulatory and technical documentation.

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