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Study of Fermentation Processes of Farm Animal's Milk by Microscopy Method

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***Abstract*— Researches are conducted within the scientific project "Development and Deployment of Innovative Technologies for Deep Processing of Milk of Agricultural Animals (Cow's, Goat, Mare's, Camel, Sheep Milk)" financed by the Ministry of Education and Science of RK (The project manager - Kulazhanov K.S., the executive - Alimardanova M. K.).In recent years, moderately increases of farm animals and as a consequence increase the production of milk in the Republic Kazakhstan. The volumes of yields of camel and goat milk increase in the Republic Kazakhstan. The structure and properties of camel and goat milk are different from cow milk. In camel and goat milk content of fat, serum proteins and mineral substances is higher. The amount of essential amino acids, vitamins and fatty acid composition of camel's milk is superior to the nutrition value of cow's milk. However, camel and goat milk has a specific organoleptic properties, which requires the use of alternative treatment methods to reduce these symptoms in order to use camel and goat milk on an industrial scale to produce not only shubat, but other dairy products.**

***Index Terms*—Camel's Milk, Cow's Milk, Goat's Milk, Laser Technology, Microscopy.**

I. INTRODUCTION

As an alternative to thermal treatment for milk processing there was used a laser technology method.

For development of technological modes of production of fermented milk products from cow, camel milk and their mixes it is necessary to know the biochemical changes occurring in the protein phase of the milk production process. In this connection it is interesting to study the microstructure of clusters obtained by rennet coagulation of cow, camel, goat's milk, processed by laser technology.

The work purpose is a research of processes of a milk fermentation processed by a method of laser technology. Studies are conducted by the following options:

- The cow milk processed by the laser option A;
- The cow milk processed by the laser option B;
- The camel milk processed by the laser option A;
- The camel milk processed by the laser option B;
- The goat milk processed by the laser option A;
- The goat milk processed by the laser option B.

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II. MATERIALS AND METHODS

Studying of a microstructure carried out on a raster electronic microscope of JSM-6490 LA of Jeol firm (Japan). In milk samples was brought a 5 % of bacterial starter and rennet considering the coagulation time of milk and getting a clot for 25-30 minutes.

Microscopic preparations were prepared and microscopy samples were investigated.

Traditional standard methods are used to definite of physical and chemical, biochemical properties of quality and safety of raw materials and production.

III. RESULTS AND DISCUSSION

Species composition and the dose of bacterial starter have a significant impact on the process of fermentation of milk and formation of clot acid in the production of fermented milk products.

It is particularly important to study the process of acid coagulation of camel and goat's milk, which has a distinctive flavor and aroma not typical for cow's milk, and therefore not attractive to a wide range of customers, i.e. to create a clean dairy flavor and smell for dairy products from camel and goat milk [1].

Besides, it must be kept in mind that clots obtained from camel and goat milk are less dense, flaked, poorly holding serum. Compounding a mixture from camel and cow's milk in a 1:2 ratio, and a mixture of goat and cow milk at a ratio of 1:1, with the introduction of 5 % of bacterial starter has a very important goal – to reduce the cost of dairy products, as the market price of 1 liter of camel and goat milk is 4—5 USD, which affects the final retail value [1,2].

For identification of an optimum dose of bacterial ferment, structure of Lactococcus thermophilus, Lactobacillus delbrueckii including types bulgaricus, Lactobacillus acidophilus, Bifidobacterium lactis brought in camel milk and dairy mixes, there were conducted researches on the following options:

- Fermented camel milk product with the introduction of 1-3 % of bacterial starter;
- Fermented camel milk product with the introduction of 4-5 % of bacterial starter;
- Fermented camel milk product with the introduction of 6-7 % of bacterial starter.

Fermentation temperature and milk coagulation is optimal for the selected type of bacterial starter and was 38-40 ºC. The results of the experiment are shown in the table 1.

The increase in amount of ferment to 7 % reduced fermentation time to 2,5–3 h, led to fast increase of acidity

that doesn't promote formation of protein structure of a clot in full volume and will lead further to serum separation at storage of a fermented milk product [3].

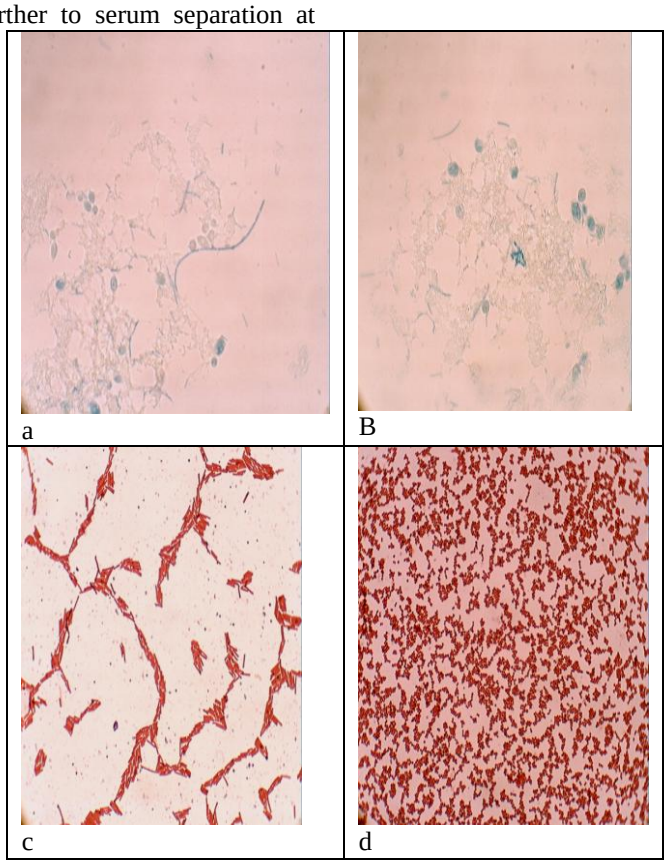


Figure 1 - Dynamics of coagulation of camel milk through a - 0, b-8, c-16, d-24 min

Table 1: The influence of the ferment amount on quality indicators of the fermented product

Product	**ferment dose, %**	**acidity, °T**	**organoleptic indicators**			**viscosity, Pa·s·10^{-3}**
			consistence	**taste and smell**	**scores**	
Option 1	3	81±0.5	not dense, slightly viscose, without separation of whey	fermented milk, poorly defined	4.5	3.1
Option 2	5	84±0.5	homogeneous, elastic, with a sligh separation of whey	fermented milk, defined	5	3.2
Option 3	7	86±0.5	homogeneous, elastic, with a separation of whey	fermented milk, strongly marked, too fermented	4.2	3.2

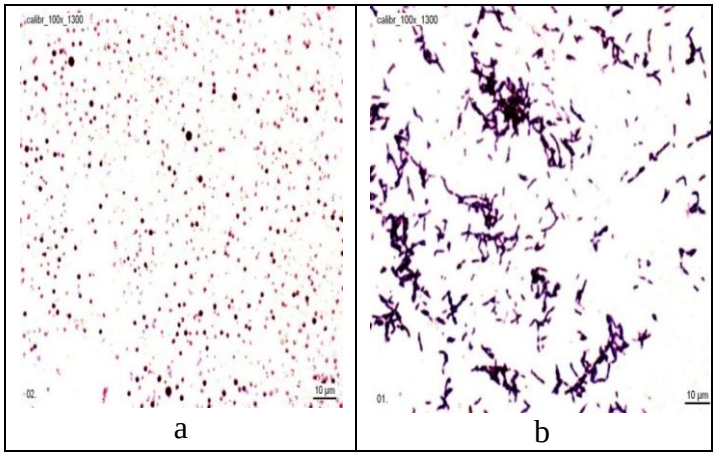


Figure 2 – Microscopic preparations: a – milk camel with ferment addition; b – fermented milk clot

The consistence of clots with use of 7 % of bacterial ferment was excessively viscous, with excessively fermented taste. Use of 3 % of bacterial ferment led to formation of a leaky clot with poorly expressed taste.

Therefore introduction of 5 % of bacterial ferment is chosen as the most optimum dose of bacterial ferment. The study of microscopic preparations of fermented milk products' samples allowed revealing the specific structure of the microflora of finished product. It is dominated by the active acid and aroma formation bacteria – Lactococcus, Streptococcus, Lactobacillus and Bulgarian bacillus.

To identify quantitative and qualitative composition of microflora of fermented milk products from milk formulas, processed by laser technology, there were studied microscopic preparations of the samples of dairy products of the following options:

– a mixture of camel and cow milk in the ratio 1:2, with introduction of 5 % of bacterial ferment;

– a mixture of goat and cow milk in the ratio 1:1, with introduction of 5 % of bacterial ferment;

– fermented milk products from a mixture of camel and cow milk in the ratio 1:2, with introduction of 5 % of bacterial ferment;

– fermented milk products from a mixture of goat and cow milk in the ratio 1:1, with introduction of 5 % of bacterial ferment;

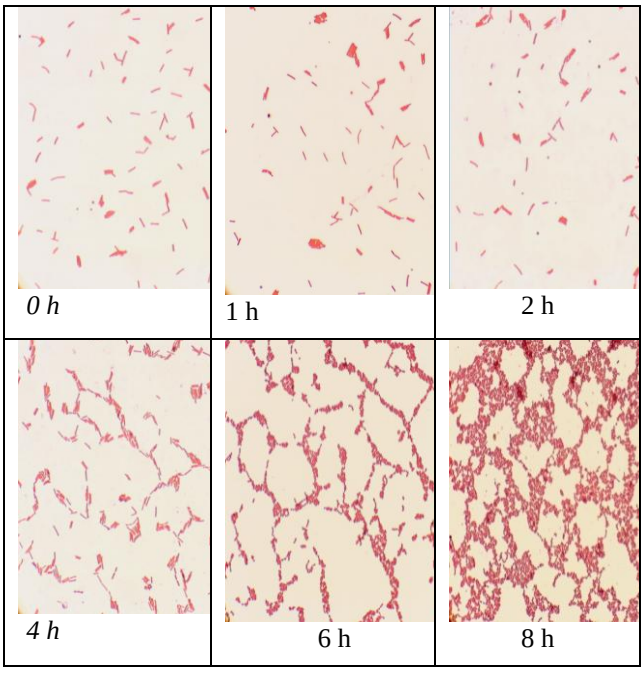
The studies of the microstructure of dairy products are shown in the pictures below.

At the first stage there was studied a process of fermentation of fresh camel's milk immediately after milking (saumal), fermented and coagulation of an acid clot during 24 h. At initial stage an insignificant quantity of lactic bacteria in 6 h, a formation of a continuous grid of a clot in 8–9 h, and a clot hardening in 12–14 h was observed.

In preparations of mixtures of camel and cow milk at a ratio of 1:1, with the introduction of 5 % of bacterial starter large fat globules that are uniformly distributed in the sample, two-, three chains of yeast cell of Torula type, present in the native camel milk, as well as individual chains of Streptococcus, Lactobacillus, Acidophilus bacillus, Bulgarian lactic acid bacillus are clearly visible, as the enzymatic process of microbial growth is at the initial stage.

In preparations of mixtures of goat and cow milk in the ratio of 1:1, with the introduction of 5 % of bacterial starter there are clearly visible small fat globules that are uniformly distributed in the sample, as well as separate chains of *Streptococcus, Lactobacillus, Bacillus acidophilus, Bulgarian lactic acid bacillus.*

In preparations of fermented milk products from the mixtures of camel and cow's milk in a ratio 1:2, with the introduction of 5 % of bacterial starter, there are clearly visible large fat globules that are uniformly distributed in the sample, two-, three types of yeast cell chains Torula, present in the native camel milk, as well as numerous chains of Streptococcus, Lactobacillus, Bacillus acidophilus, giving a streak tone to the general appearance of preparations, with a diameter of 1 micron, a length of 15 micron, and thicker, shorter in comparison with Lactobacillus acidophilus, the Bulgarian lactic bacilli. All the volume of a preparation is occupied with an extensive grid of proteinaceous flakes of a clot.



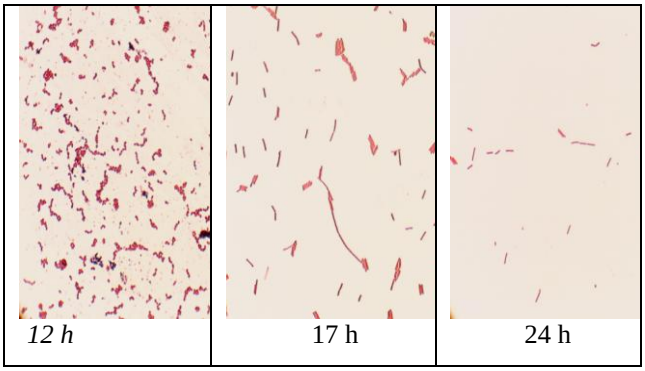


Figure 3 – The process of camel milk fermentation

In preparations of fermented milk products from mixes of goat and cow milk in the ratio 1:1, with introduction of 5 % of bacterial ferment, small fatty balls, and also numerous chains of Streptococcus, Lactobacillus, the acidophilic Bacillus giving to a general view of preparations a streak tone, with a diameter of 1 micron, about 15 microns long, and thicker, shorter in comparison with Lactobacillus acidophilus, the Bulgarian lactic bacillus. All the volume of a preparation is occupied with an extensive grid of proteinaceous flakes of a clot, more dense in comparison with production from the mixture of camel and cow milk [4].

A comparison of the microstructure of dairy products – control (product of a mixture of camel and cow milk at a ratio of 1:2, with the introduction of 5 % of the bacterial starter and a mixture of goat and cow milk at a ratio of 1:1, with the introduction of 5 % of bacterial starter) and prototypes - treated by laser, option A and B (the production of the same formula) – has showed that microstructural characteristics in the finished product are identical to the control, but the texture is more gentle, more is a distribution of fat globules with a diameter smaller than that in the control samples, as in the fermented milk products developed from a mixture of camel and cow milk, and also from mixes of goat and cow milk, which prevents their settling on the surface of the product during the storage.

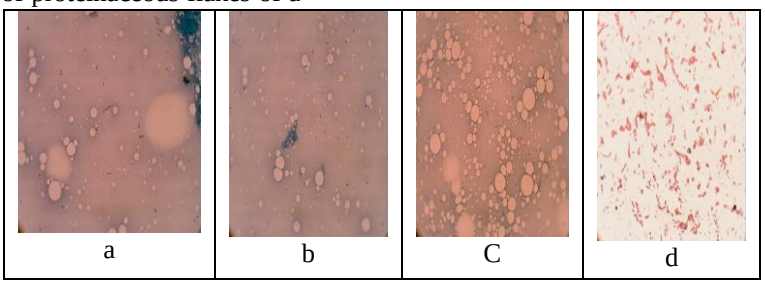


Figure 4 – The goat milk processed by laser activation (mode A) (a,b, c) and a fermented milk product from it (d).

In microscopic preparations are seen as numerous chains of *Lct.L.Streptococcus*, *Lactobacillus*, *acidophilic Bacillus*, giving a streak tone to the general appearance of preparations, with a diameter of 1 micron, a length of about 15 micron and thicker, shorter, compared with *Lactobacillus acidophilus*, *Bulgarian lactic bacillus*. All the volume of a preparation is occupied with an extensive continuous grid of proteinaceous flakes of the clot, allowing to create more gentle consistence and high viscous rates in a product.

Camel and goat milk differs from the cow's milk by its composition. Quantitative content of milk albumin fractions in camel and goat milk is much greater than the number of milk albumin fraction in cow's milk and is better absorbed by the human body. However, there is 2 times more milk albumin fraction in cow's milk than in a camel and goat milk. According to the content of immunoglobulin the difference is insignificant. It is known that rheological properties of clots depend on the ratio of casein/serum proteins [5].

Therefore a consistence of fermented milk products from camel and goat milk more gentle, flaked. The laser treatment can get the products with more uniform, coherent, delicate, pore structure, without the whey separation during the storage of the product, as well as improve qualitative characteristics and safety of finished fermented milk products, as well as contamination by a foreign microflora is minimized.

I. CONCLUSIONS

- Microscopic studies have confirmed that the most optimal mode of farm animal´s milk laser processing – option A;
- The optimal dose of bacterial starter is 5 %;
- Microscopic studies have shown the prevalence of Lactococcus L. Streptococcus, Lactobacillus, and Bulgarian acidophilus bacillus in fermented milk products made from the milk of farm animals and their mixtures;
- The use of laser technology allowed receiving fermented milk products with the best microbiological and rheological characteristics;
- The organoleptic assessment of the developed fermented milk products proved a high mark of finished fermented milk goods using laser processing of milk
- The researches allowed working out technological modes of the main processes – fermentation and coagulation of farm animal´s milk and their mixtures.

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