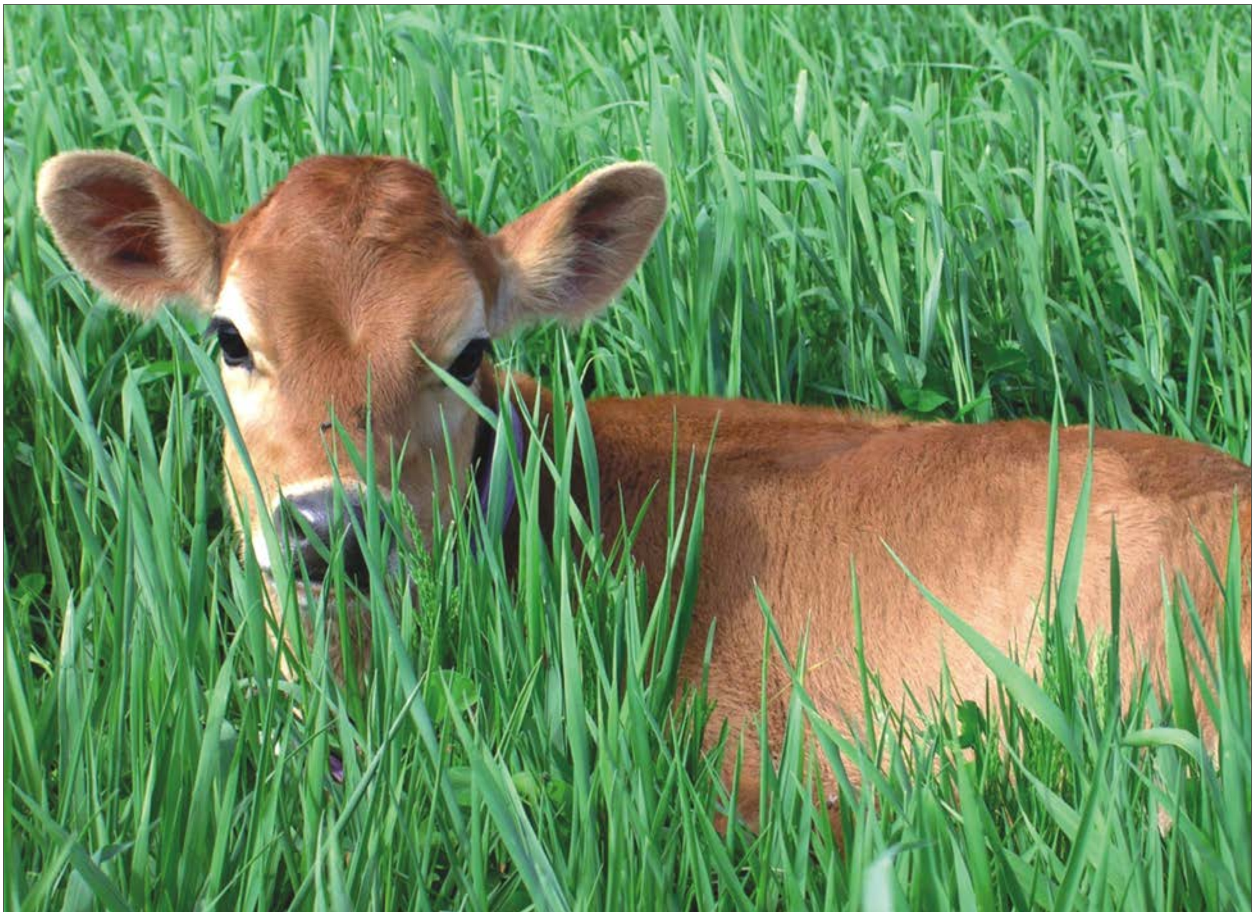

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Research Article

Effect of Different Factors on Consumer Properties of Fermented Milk Products with a Functional Orientation

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Abstract

Background and Objective: The consistency and taste of fermented milk products are complex organoleptic parameters that have a significant impact on the consumer's choice. In this paper, the factors affecting the consumer properties of fermented milk drinks are studied. **Materials and Methods:** For this purpose, the organoleptic characteristics of milk and dairy products, heat resistance of milk, titratable acidity, the density of milk and fermented milk products, the viscosity of the fermented milk product in terms of expiration time, the mass fraction of calcium was established by the complex metric method. The content of vitamin C in dairy products was also observed. **Results:** The introduction of dry mare milk into cow milk allows you to get yoghurt with a viscous homogeneous consistency and a pure fermented milk taste. The addition of pumpkin seed flour to it increases the content of Ca^{2+} and vitamin C. The pasteurization temperature of 76$\pm$2°C and the starter culture YF-L904 were the best for obtaining a product from goat milk with a pleasant, mild taste and velvety consistency. **Conclusion:** The experimental data we obtained showed that the consistency and taste are formed during the entire technological process of fermented milk products. These organoleptic parameters depend on the composition and origin of milk, the homogenization mode, the nature of the starter culture and the plant component based on all of the above factors.

Key words: Cow milk, goat milk, mare milk, homogenization, pasteurization, starter cultures, pectin's, organoleptic, physicochemical

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

It is no secret that nutrition for a person is the satisfaction of the body’s physiological needs for nutrients and the restoration of vitality, it is a pleasure that brings peace of mind and joy, it is a source of inspiration, health and beauty[1].

Functional foods occupy the central place with beneficial properties, which allows you to avoid or prevent diseases caused by an unhealthy diet or negative environmental influences (for example, foods fortified with iodine and selenium). Fermented milk products have a therapeutic and prophylactic effect, have a general strengthening, prophylactic, adaptogenic effect and are used in the complex treatment of certain diseases[2-4].

These include fermented milk products that have a therapeutic and preventive effect, have a restorative, preventive, adaptogenic effect and are used in the complex treatment of certain diseases[5,6]. The most complex organoleptic indicators of fermented milk drinks, which influence the consumer's choice, are consistency and taste.

There are many studies devoted to the issues of obtaining fermented milk products with certain desired properties. However, each of them is devoted to studying the influence of only one specific factor on the product quality as a whole[7-9].

The purpose of this work was to study the factors affecting the consumer properties of fermented milk drinks. For this, the following tasks were set: To study the possibility of obtaining a combined fermented milk product based on cow’s milk with the addition of dry mare milk, to study the influence of the pasteurization regime on the organoleptic and physicochemical properties of a fermented milk drink made from the milk of Saanen goats, to study the influence of the nature of fermented milk starter culture on the milk fermentation process and the organoleptic and physicochemical properties of fermented milk drinks from the milk of Saanen goats, to study the influence of the plant component on the structural and mechanical properties of yoghurt made from cow’s milk with the addition of powdered mare milk.

MATERIALS AND METHODS

Study area: This study was conducted at the Department of Meat, Dairy Products and Chemistry of the Bashkir State Agrarian University from October, 2019-March, 2021.

Materials: The study focuses on fermented milk drinks prepared from cow, goat and mare milk. The starter cultures were (1) YF-L904 (YoFlex®, Thermophilic Yogurt Culture), (2)-AiBi® series LbS 22.11A (*Lactobacillus acidophilus*, *Streptococcus thermophilus*) and (3) AiBi® series LcLSY 40.44 (kefir fungi). A functional additive (pumpkin seed flour) was of herbal origin.

Research protocol: The work used the milk of goats of the Saanen breed, dry mare milk, produced at the stud farm of the sanatorium “Yumatovo” (Bashkortostan), cow milk. According to the scheme, fermented milk drinks were obtained: First, milk was heated to pasteurization temperature. After cooling to the fermentation temperature with constant stirring, the starter was added for 15 min. It was placed in a thermostat with a set temperature and kept until the titratable acidity was established at 75-140°T.

Measurement of parameters: Organoleptic indicators of milk and dairy products were carried out following State Standard R ISO 22935-2-2011. The thermal stability of milk was determined using State Standard 25228-82. Titratable acidity was determined by titration with phenolphthalein (State Standard R 54669-2011). The density of milk and fermented milk products was determined according to State Standard R 54758-2011 and the viscosity of the fermented milk product was determined according to the expiration time according to State Standard 9070-75. The mass fraction of calcium in milk was determined by the complexometric method. Determination of vitamin C in dairy products was carried out according to the well-known method described in State Standard 30627.2-98 (https://www.belaruslaws.com/p-56976-gost-306272-98.aspx).

RESULTS

Exploring the possibility of obtaining a combined fermented milk product based on cow milk with the addition of dry mare milk: The following parameters of milk were studied: Acidity, density and viscosity. The acidity of milk depends on its acidic salts composition and its protein content. Milk has both Titratable acidity and active acidity. Titratable acidity is expressed as Thörner degree (the number of mL of a 0.1 n decinormal alkali solution required to neutralize 100 mL of milk) The Titratable acidity of raw milk averages 16-18°T. Active acidity is expressed as the concentration of hydrogen ions or pH. Potential hydrogen is defined as the negative decimal logarithm of hydrogen ion concentration. The average pH of raw milk varies from 6.6-6.7 (potentiometric method). The density of milk is taken as the mass of milk at 20°C divided by its volume (kg m^{-3}). Viscosity denotes liquid's resistance to movement of neighbouring portions relative to one another. The viscosity of milk depends on its emulsified and colloid-soluble content. In other words, it is influenced by the concentration of fats and casein present in the milk, the size of fat globules and their size distribution, agglomerate composition and casein properties.

This study obtained a combined fermented milk product based on cow milk with powdered mare milk. Fermented milk products were obtained with different dry mare contents in the milk mixture (1-5%) to determine the optimal amount of dry cow milk. In the course of the study, it was found that the product containing milk powder in an amount of 2% of the mass of the normalized mixture was distinguished by a dense, homogeneous consistency, a pure fermented milk taste with a taste of dry cow milk. If the product contains herbal admixtures (such as pumpkin flour), it will display exhibit a less prominent decrease in viscosity with increasing acidity in Fig. 1. While the viscosity of the control yoghurt with an acidity value of 102 equals 120, the viscosity of the yoghurt with additives is higher-138, even though the acidity value is the same (Fig. 1). With an increase in acidity to 112, the gap between the two samples remained (95 vs 115, respectively). Thus, adding herbal components helps to maintain the viscosity value of more acidic yoghurt.

Powdered mare milk did not affect the microbiological parameters of yoghurt during its storage, they met the requirements of the technical regulations for milk and dairy products.

Influence of the pasteurization regime on the organoleptic and physicochemical properties of the goat milk product: The study of the effect of the pasteurization regime on the organoleptic and physicochemical properties of the fermented milk product was carried out using the example of milk from goats of the Saanen breed, which corresponded to State Standard 32940-2014 in terms of organoleptic and physicochemical indicators, except for the content of fat and SNF. For this, four pasteurization modes were chosen: I-65±2°C, 30 min, II-76±2°C, 20 min, III-87±2°C, 10-15 min, IV-92±2°C, 8 min. When experimenting, it turned out that the studied milk belongs to the 5th group in terms of thermal stability (State Standard 25228-82), therefore, at a temperature of 82±2°C, thermal coagulation of milk occurred and further study was carried out for samples with I and II pasteurization modes. Analysis of pasteurized milk showed that heat treatment influenced both the organoleptic and physicochemical properties of milk, pasteurized milk did not meet State Standard 32259-2013 in terms of protein and SNF content.

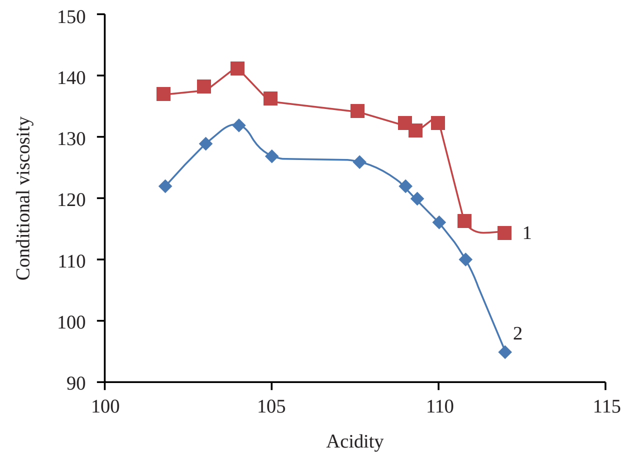

Fig. 1: Dependence between the acidity of the medium and conditional viscosity of yoghurt with no herbal additives (1) and with pumpkin flour (2)

Because of heat exposure, the water content in milk decreased 1.5 times (from 5-3.5 and 4.0 in groups 1 and 2, respectively, in Table 1, resulting in fluctuations in protein (0.1 increase compared with control, Table 1), lactose (0.1 increase compared with control, Table 1) and SNF (0.20-0.24 increase compared with control, Table 1) levels in both groups. The fat concentration in group 1 slightly decreased, while group 2 exhibited an increase in fat content. These changes are especially prominent at a pasteurization temperature of 76±2°C (group 2). In addition, the heat treatment of milk influenced the shelf life of milk.

Heat treatment also affected the organoleptic properties of milk, especially in group 2 in Table 2. Milk in this group had a velvety appearance and a viscous structure, not seen in group 1 and raw milk. Its taste was milder compared to group 1 and control (raw milk, Table 2).

The acidity value of raw milk increased 2 times within 3 days compared with heated milk in groups 1 and 2 in Table 3. The day-one value of acidity in the second group was higher than in the first group by almost a unit (Table 3). By the third day, however, both groups evened out, with the second group reaching a bottom acidity value of 17.3 (Table 3). Within three days, the acidity of raw milk increased and no longer met State Standard 32940-2014 even on the 1st day of storage. The acidity of pasteurized milk practically did not change during the entire storage period.

The effect of pasteurization temperature on the properties of a fermented milk product was studied using the example of a fermented milk drink obtained by fermenting pasteurized milk using the YoFlex YF-L 904 fermentation tank method. Both groups displayed the same density values in

Table 1: Physical and chemical indicators of raw and pasteurized milk

Indicators	K raw milk	I 65±2°C (30 min)	II 76±2°C (20 sec)
Physical and chemical indicators			
Fat% from 2.8-5.6	2.99	2.94	3.04
Protein% no less than 3.0	2.9	2.98	2.99
Density A no less27	26.72	27.35	27.52
Distilled water	5.3	4.09	3.48
Lactose%	4.2	4.29	4.31
Salt%	0.66	0.68	0.68
Congeal point,°C	-0.4920	- 0.5	-0.5032
SNF% no less than 8.2	7.76	7.96	8.00

Table 4. Viscosity was slightly lower in group 2 (Table 4), which also had 0.07 units lower pH (Table 4).

Both groups had almost identical acidity values on day 1 and day 3 of storage (Table 4). Overall, no significant differences in examined properties were found between groups 1 and 2.

A fermented milk product with a homogeneous, velvety structure with a pleasant fermented milk smell and a mild fermented taste was obtained from milk pasteurized at a temperature of 76±2°C for 20 sec. Moreover, on the third day of storage, the acidity of this product changed by a smaller number of units than the fermented milk product obtained from milk with a lower pasteurization temperature.

Influence of the nature of the starter culture on the organoleptic and physicochemical properties of the goat milk product: The study of the influence of the nature of fermented milk culture on the fermentation process of milk and the organoleptic and physicochemical properties of fermented milk products was carried out using the example of goat milk of Saanen goats and starters: 1-YF-L904-Thermophilic Yoghurt Culture-YoFlex®, 2-AiBi series LbS 22.11A-Lactobacillus acidophilus, *Streptococcus thermophilus*, 3-AiBi series LcLSY 40.44 - starter culture on kefir fungi. The original goat milk corresponded to State Standard 32259-2013.

Using kinetic laws, studied the process of milk fermentation in the presence of various starter cultures. For this, after each hour, the titratable acidity and conditional viscosity of the samples under study were measured.

Groups 1 and 2 had similar values of titratable acidity after 4 and 6 hrs of fermentation (range, 78 to 80 units) in Fig. 2, while group 3 had a 0.5 times lower level of acidity (50 units, Figure 2).

The viscosity of milk in group 3 did not change during the 6 hrs of fermentation, while groups 1: 180 units and group 2: 50 units experienced an increase in viscosity by the end of treatment in Fig. 3. From the given figures, it can be seen that the most active fermentation process proceeded in the presence of starter culture 1, the least-in the presence of starter culture 3. Studies show that the starter culture affects the course of milk fermentation, which affects the organoleptic and physicochemical characteristics of finished fermented milk products.

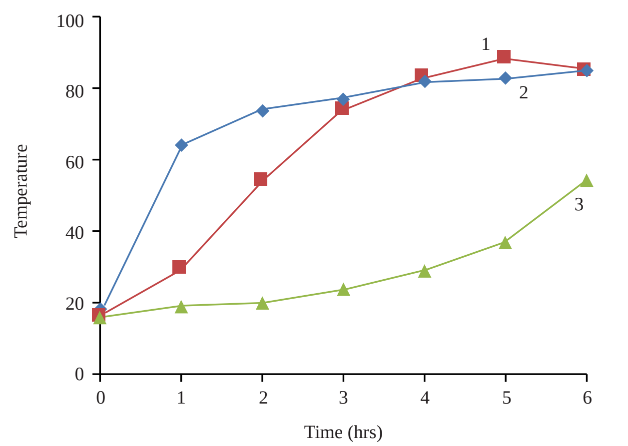

Fig. 2: Changes in the Titratable acidity of samples 1-3 during fermentation of milk with the appropriate starter cultures

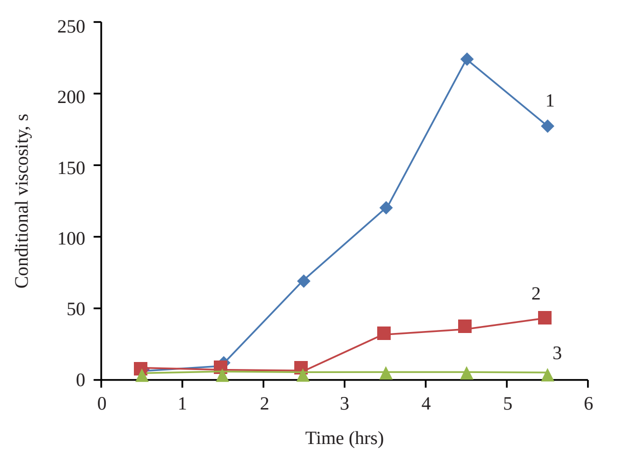

Fig. 3: Change in the conditional viscosity of samples 1-3 during milk fermentation with the appropriate starter cultures

Table 2: Organoleptic characteristics of raw, pasteurized milk and fermented milk drinks from goat milk

	Milk			Fermented milk drinks	
	Raw milk (in comparison with state standard 32940-2014)	Drinking milk (in comparison with state standard 32259-2013)			
		Pasteurization modes		Pasteurization modes	
Indicators		I	II	I	II
Appearance and consistency	Homogeneous liquid without sediment and protein flakes Grade 5	Drinking milk Opaque liquid, no sediment. Slight sediment of fat is allowed, disappearing with stirring, homogeneous, not viscous, without protein flakes and loose lumps of fat. Grade 5	Drinking milk Opaque liquid, no sediment Insignificant fat sludge is allowed, disappearing with stirring, homogeneous, not viscous, without protein flakes and knocked down lumps of fat Grade 5	The structure is homogeneous, viscous, fluid	The structure is homogeneous, velvety, viscous, fluid
Taste and smell	Clean, free of foreign odors and tastes that are not characteristic of fresh goat milk. A weakly pronounced fodder taste and smell, as well as a weak specific taste of goat milk, are allowed. Grade 4	Clean, a slight specific aftertaste of goat milk is allowed, with a slight aftertaste of boiling, for sterilized ones-a pronounced aftertaste of boiling Grade 5	Clean, a slight specific taste of goat milk is allowed, with a slight aftertaste of boiling, for sterilized ones-a pronounced aftertaste of boiling Grade 4	The smell is pleasant, of sour milk, the taste is sour and harsh	Pleasant smell, of sour milk, sour taste, softer
Colour	White to light cream. Grade 3	Milky white, uniform throughout the mass, for sterilisation-with a light cream shade. Grade 4	Milky white, uniform throughout the mass, for sterilisation-with a light cream shade. Grade 5	Milky colour	Milky colour

No significant differences in organoleptic properties were found between raw goat milk (control) and samples 1-3 in Table 5. Samples 1 and 2 did not taste like goat milk and sample 3 had a sourish flavour. Samples 2 and 3 had higher viscosity (+40-50 units) than samples 1 and control (Table 5). No significant differences in acidity were found between groups 1 and 2. Group 3, on the other hand, had an acidity value 10 units lower (Table 5). The acidity value of raw milk was 60 units lower compared to other groups (Table 5). Conditional viscosity values of raw milk and group 3 were comparable, while in groups 1 and 2, it was 7-9 times higher (Table 5).

Under the experiment conditions, the studied starter cultures showed a different effect on milk fermentation in the manufacture of fermented milk products from goat milk. YoFlex YF-L904 turned out to be the best in terms of milk fermentation rate, organoleptic and physicochemical characteristics fermented milk product. This product had a pleasant, mild taste without goat milk flavour with a smooth, velvety texture. And the starter culture AiBi series LcLSY 40.44 - the starter culture on kefir fungi under the conditions of the experiment did not show itself.

Influence of the plant component on the organoleptic and structural-mechanical properties of a fermented milk drink: After several organoleptic studies, found the most optimal amount of herbal supplement in yoghurt, when adding flour from pumpkin seeds in an amount of 1%, the product had a pleasant taste and colour. The plant component leads to an increase in the content of calcium (from 91.01±0.19-95.06±0.15%) and vitamin C (from 0.90±0.03-1.08±0.09 mg kg^{-1}) and has a positive effect on the consistency of the fermented milk product.

This study obtaining a combined fermented milk product based on cow milk with powdered mare milk. Yoghurt and raw dairy products made from cow milk mixed with mare milk powder have different energy values in Table 6. As regards protein content, no significant differences were found between cow milk and yoghurt (0.06 units, Table 6). The protein content of mare milk powder exceeded that of yoghurt by 16 units.

The same picture was obtained for fats and carbohydrates. Powdered mare milk had a higher concentration of fats and carbohydrates compared to yoghurt with a difference of 12 and 52 units, respectively (Table 6). The energy content of mare milk powder is 7 times higher compared to cow milk and yoghurt (Table 6).

Table 3: Change in milk acidity during storage

Acidity of milk for the day of storage, °T	Pasteurization modes		
	K raw milk	I 65±2° C, 30 min	II 76±2° C, 20 s
0	17.6±0.5	-	-
1	22.0±1.0	17.6±0.5	18.5±0.5
2	27.0±1.0	17.6±0.5	17.3±0.5
3	35.3±0.5	17.3±0.5	17.0±1.0

Table 4: Physicochemical indicators of fermented milk drinks from goat milk

Indicators	I 65±2° C, 30 min	II 76±2° C, 20 s
Density, kg m^{-3}	1028±2	1028±1
Viscosity, s	28.1±0.3	27.0±1.5
pH	3.46±0.02	3.39±0.03
Acidity, °T		
1 day of storage	91.5±0.5	92±0.5
3 days of storage	93.5±0.5	93±0.5

Table 5: Organoleptic and physicochemical properties of fermented milk products from goat milk

Indicators	Goat milk	1 YF-L904	2 AiBi series LbS 22.11A	3 AiBi series LcLSY 40.44
Organoleptic properties of the original milk and fermented milk products				
Appearance	Opaque liquid, no sediment. The little residue of fat disappearing with stirring	Opaque liquid, no sediment	Opaque liquid, no sediment	Opaque liquid, no sediment Little fat sediment, disappearing with stirring
Consistency	Homogeneous, not viscous, without protein flakes and loose lumps of fat	Homogeneous, viscous, velvety, without protein flakes and loose lumps of fat	Homogeneous, viscous, without protein flakes and knocked down lumps of fat	Homogeneous, liquid, with flakes of protein and lumps of fat
Taste and smell	Clean, faint goat milk aftertaste	Soft, not sour, without the taste of goat milk	Soft, creamy, sourish, without the taste of goat milk	Sourish, unexpressed
Colour	Milky white	Milky white, matt	Milky white	Milky white
Physicochemical properties of fermented milk products				
Density, kg m^{-3}	1028.0±1.5	1077.0±1.3	1067.0±0.9	1031.0±0.8
Acidity, °T	18.0±1.0	85.0±0.8	88.0±0.7	78.0±0.9
Conditional viscosity s	5.0±0.5	48.0±0.7	34.0±0.9	7.0±0.6

Table 6: Energy values of raw materials and yoghurt made from cow milk with powdered mare milk

	Cow milk, 3,2% fat		Powdered mare milk		
Indicators	Quantity in 100 g of milk	Quantity in100 g of yoghurt	Quantity in 100 g of powdered mare milk	Quantity in 100 g of yoghurt	Content in 100 g of yoghurt
Proteins, g	2.9	2.84	16.76	0.33	3.17
Fats, g	3.2	3.14	12.5	0.25	3.39
Carbohydrates, g	4.7	4.61	53.17	1.06	5.67
Calorie content, kcal	59.2		392.22		65.87

It can be seen that the resulting fermented milk product is characterized by an increased content of protein and fat in comparison with the original cow milk comparing the chemical composition of cow milk, powdered mare milk and yoghurt.

DISCUSSION

The increase in the shelf life of milk and fermented milk product can be explained by a decrease in the pathogenic flora in milk[10]. It is possible to obtain a product with specific organoleptic and physicochemical properties using starter cultures with known biochemical activity. The nature of the starter culture influences the technological modes of production[11].

Dairy cultures, Thermophilic Yoghurt Culture, *Lactobacillus acidophilus* and *Streptococcus thermophilus* are characterized by homofermentative lactic acid fermentation in the formation of lactic acid. The main composition of kefir fungi is lactobacilli, acetic acid bacteria and milk yeast, which live in symbiosis, grow and multiply together. They are characterized by the flow of both lactic acid and alcoholic fermentation. During fermentation of milk, the Titratable acidity of the fermented milk product increases, which leads to acid coagulation of casein and gelation, which is essential for the formation of an ordered structure and contributes to the creation of a sure consistency of dairy products[12-15]. The kinetics of structure formation occurring during acid coagulation of casein includes three stages: The induction period, the stage of flocculation and metastable equilibrium. For fermented milk product 1, all three stages were recorded, for product 2, the induction period and the stage of flocculation were observed and for product 3, only the induction period (Fig. 3). Moreover, the relative viscosity of 1 product is much higher than others, since *Streptococcus thermophilus* and *Lactobacillus delbrueckii* bulgaricus, which are part of starter culture, belong to cultures that produce particular substances, Exopolysaccharides, which increase the viscosity and water-holding capacity of acid clots, i.e. are natural thickeners[14].

The previous work[8] shows the effect of milk composition on a fermented milk drink's structural and mechanical properties. Since the protein of mare milk (8.9% of dry matter) contains approximately the same amount of whey proteins (48%) and casein (52%), during fermentation, curd in the form of flakes (54°T) is formed. In cow milk (11.2% dry matter) and goat milk (11.6% dry matter), casein predominates, 81 and 80%, respectively, in this regard, a dense, glossy clot with a pure fermented milk taste (75°T) and from goat milk-a liquid friable with a specific taste (78°T). The addition of mare to cow milk (1:1) leads to the enrichment of milk protein in the composition of essential amino acids[7], a decrease in the content of dry matter (10.05%), a decrease in the Titratable acidity of the product (66°T) and the formation of a heterogeneous liquid clot with a taste of mare milk. So, because mare milk belongs to the milk of the albumin-new group, as a result of fermentation of a milk mixture consisting of cow's and mare milk, a heterogeneous liquid clot is formed that does not meet the wishes of consumers[16]. Adding dry mare milk allows you to increase the nutritional value of a fermented milk drink and obtain yoghurt with a dense homogeneous consistency and a pure fermented milk taste with a taste of dry mare milk. To create functional food products with a particular texture, raw materials of plant origin have recently begun to be used[17-20].

Pumpkin seed flour, rich in essential amino acids, is famous for its high content of natural, easily digestible zinc, a complex of vitamins B, vitamin C and dietary fibre. The use of flour leads to the normalization of metabolism, stimulation of immunity, improvement of the functioning of the main organs and systems of the human body, an increase in mental and physical performance[21].

In Cadesky *et al.*[22] the influence of homogenization parameters on forming the consistency of fermented milk products was studied. In the course of the study, it was found that with a change in the homogenization pressure, the product's structure, its acidity and viscosity change. With an increase in the homogenization pressure, the product's structure becomes more homogeneous. There is an even distribution of fat globules and gas bubbles throughout the volume of the fermented milk product[23].

Milk pasteurization, one of the stages of milk processing technology, is carried out to destroy pathogenic flora[24], increase the shelf life and ensure the safety of dairy products for consumers[25]. Nevertheless, exposure to high temperatures also affects the chemical composition of milk, leading to the formation of certain properties of dairy products. During heat treatment of milk, significant changes occur in the molecules of whey proteins associated with the destruction of the tertiary and secondary structure. As a result, the compactly folded molecule turns into a messy, disordered tangle. S-H groups are opened that can interact with each other, leading to the unification of denatured particles and complexes' formation k-casein (80-95°C). This process depends not so much on the heating temperature but the duration of the heat treatment. The authors of work[26], using one-dimensional electrophoresis, studied the effect of the most common modes of pasteurization on the polypeptide composition of cow and goat milk. With an increase in the pasteurization temperature, the content of whey proteins decreases and a slight increase in the mass fraction of casein is observed, associated with the aggregation of denatured whey proteins on its surface. This fact has a positive effect on forming a clot in the manufacture of fermented milk products[10]. The pasteurization temperature of 76±2°C was the best for obtaining a product from goat milk with a pleasant, mild taste and velvety consistency.

In Akbar *et al.*[27] the process of milk fermentation with various ferments and the rheological properties of the obtained fermented milk products were studied using the example of cow and goat milk. The starter cultures were with thermophilic streptococcus, Bulgarian bacillus (5 species), acidophilic bacillus, bifidumbacterin, mesophilic ferment, thermophilic streptococcus is not viscous. When fermented, goat milk produced a fine flocculent clot with a weakly expressed specific flavour of goat milk, whereas it was denser in the cow's curd. The authors of the work explain this phenomenon by the different fractional compositions of goat and cow milk proteins. Starter culture YF-L904 were the best for obtaining a product from goat milk with a pleasant, mild taste and velvety consistency.

In Ahmadi[11] formulations and technology for producing a curd product containing wheat bran, arabinogalactan and di-hydroquercetin were developed. The effect of functional additives on the organoleptic and physicochemical characteristics of the product has been studied. The addition of pumpkin seed flour to yoghurt with a viscous homogeneous consistency and a pure fermented milk taste increases the content of Ca^{2+} and vitamin C.

By changing the acidity of the product and the relative viscosity, studied the process of structure formation in yoghurt with a herbal supplement. At first, the viscosity increased slightly and then began to decrease. The regularities of changes in the relative viscosity of yoghurt with herbal supplements are repeated as in the control yoghurt, with only one difference, not all the changes are as apparent as in yoghurt without additives. Figure 1 shows how the conditional viscosity of the product changes during the fermentation process.

It is known that pumpkin flour contains pectin's-polysaccharides belonging to the group of polygalacturonase, which are structural components of plants. Pectins are widely used in food products as an excellent gelling agent, in addition, pectin's can bind toxic elements and radionuclides. Therefore pectins are a valuable additive in the production of food for therapeutic and prophylactic purposes. In an acidic environment, the dissociation of free carboxyl groups is suppressed, which prevents the electrostatic repulsion of the chains. In the presence of Ca^{2+} ions, calcium bridges are formed that connect pectin molecules[28]. Therefore, the product viscosity with the plant component became higher than the control sample and structure formation proceeded. Firstly, due to the destruction of the micellar casein structure, secondly, due to the formation of Exopolysaccharides as a result of the vital activity, in the third - lactic bacteria due to the formation of a spatial structure when the pectin chains approach and fourthly, as a result of the interaction of milk protein and polysaccharides[29].

A decrease in the viscosity of solutions in both products with an increase in the medium acidity was associated with the destruction of the yoghurt structure, caused by the appearance of positive charges in the casein molecule due to the protonation of free amino groups of lysine, guanidine groups of arginine and imidazole groups of histidine and a decrease in the synthesis of exopolysaccharides by starter cultures (the most optimal pH value is 6)[29].

CONCLUSION

From the analysis of literature and experimental data, it can be concluded that taste and consistency are the most complex organoleptic indicators formed during the entire technological process of making fermented milk products. These organoleptic parameters depend on the composition and origin of milk, the homogenization regime, the nature of the starter culture and the plant component, that is, on all the above factors in general. It must be taken into account when developing new fermented milk products. The given data can be helpful for specialists dealing with the issues of obtaining new fermented milk products from mare, goat, cow milk and a mixture of milk from different farm animals with given organoleptic characteristics, as well as when choosing the optimal recipes for preparing fermented milk drinks.

SIGNIFICANCE STATEMENT

This study discovered alternative processing options for dairy products (yoghurt) with mare milk powder and herbal additives. That can be beneficial for product taste and its shelf-life stability. This study is the first work to show how powdered mare milk could improve the viscosity and palatability of yoghurt. With herbal additives (pumpkin seeds), the calcium content of yoghurt increases, while the organoleptic and taste qualities of the product do not change. The key finding is that the optimal conditions for the production of high-quality yoghurt are the temperature of 74-78°C and the use of YF-L904 as a starter culture. For high-quality yoghurts produced in these conditions, the best additives would be the mare milk powder and herbal ingredients. This study will help the researchers to uncover the critical areas associated with the use of dairy and non-dairy ingredients in dairy product enhancement, which many researchers were not able to explore because of the relatively novel character of this field. Thus, a new theory on dairy product enhancement may be arrived, holding that incorporating herbal and other components will significantly change the quality of yoghurts and other dairy products.

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