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ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
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ВЕСТНИК

НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК
РЕСПУБЛИКИ КАЗАХСТАН

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NAS RK is pleased to announce that Bulletin of NAS RK scientific journal has been accepted for indexing in the Emerging Sources Citation Index, a new edition of Web of Science. Content in this index is under consideration by Clarivate Analytics to be accepted in the Science Citation Index Expanded, the Social Sciences Citation Index, and the Arts & Humanities Citation Index. The quality and depth of content Web of Science offers to researchers, authors, publishers, and institutions sets it apart from other research databases. The inclusion of Bulletin of NAS RK in the Emerging Sources Citation Index demonstrates our dedication to providing the most relevant and influential multidiscipline content to our community.

Қазақстан Республикасы Ұлттық ғылым академиясы "ҚР ҰҒА Хабаршысы" ғылыми журналының Web of Science-тің жаңаланған нұсқасы Emerging Sources Citation Index-те индекстелуге қабылданғанын хабарлайды. Бұл индекстелу барысында Clarivate Analytics компаниясы журналды одан әрі the Science Citation Index Expanded, the Social Sciences Citation Index және the Arts & Humanities Citation Index-ке қабылдау мәселесін қарастыруда. Web of Science зерттеушілер, авторлар, баспашылар мен мекемелерге контент тереңдігі мен сапасын ұсынады. ҚР ҰҒА Хабаршысының Emerging Sources Citation Index-ке енуі біздің қоғамдастық үшін ең өзекті және беделді мультидисциплинарлы контентке адалдығымызды білдіреді.

НАН РК сообщает, что научный журнал «Вестник НАН РК» был принят для индексирования в Emerging Sources Citation Index, обновленной версии Web of Science. Содержание в этом индексировании находится в стадии рассмотрения компанией Clarivate Analytics для дальнейшего принятия журнала в the Science Citation Index Expanded, the Social Sciences Citation Index и the Arts & Humanities Citation Index. Web of Science предлагает качество и глубину контента для исследователей, авторов, издателей и учреждений. Включение Вестника НАН РК в Emerging Sources Citation Index демонстрирует нашу приверженность к наиболее актуальному и влиятельному мультидисциплинарному контенту для нашего сообщества.

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ESTIMATION OF COMPOSITION, TECHNOLOGICAL PROPERTIES, AND FACTOR OF ALLERGENICITY OF COW'S, GOAT'S AND CAMEL'S MILK

Abstract. The article provides information on the basis of data obtained by different authors that camel's milk differs significantly from cow's and goat's milk due to the insignificant content of one of the allergenic factors - milk protein β - lactoglobulin. On the basis of the research, the article showed that the content of the main components of milk - the mass fraction of dry matter, fat, protein, and one of the most important mineral substances - calcium, in camel's milk these indicators are significantly higher than in cow's and goat's milk. Indicators of density, titratable acidity, and energy value of camel's milk are also higher than those of cow's and goat's milk.

It was established that the content of monounsaturated and polyunsaturated fatty acids, including omega - 3 and omega - 6 acids, is much higher in camel's milk than in cow's and goat's milk.

The difference in the protein structure of camel's, cow's and goat's milk was revealed. Camel's milk contains more α-lactalbumin, lactoferrin, immunoglobulins than cow's and goat's milk, but most importantly, unlike cow's and goat's milk, there is practically no β-lactoglobulin in camel's milk.

Sour milk produced on the basis of camel's, cow's and goat's milk using different starter culture: lactate lactococcus (sour milk ordinary), acidophilus bacillus (sour milk acidophilus) and Lactobacillus bulgaricus (Bulgarian sour milk) differs in their properties.

All samples of sour milk of camel's milk, unlike sour milk from goat's and cow's milk, prepared with the same technology, showed noticeable foot of fat and this requires additional development of technological processes in the production using camel's milk. The established difference in the chemical composition of the analyzed sour milk samples is mainly due to the composition of the raw milk from which the products are prepared.

β-lactoglobulin is not identified in sour milk from camel's milk, which confirms the data on its absence in camel's milk.

Keywords: cow's milk, goat's milk, camel's milk, allergens, protein fractions, intolerance, hypoallergenicity, lactoferrin, protein profile, sour milk.

Relevance of the topic. In most countries of the world, cow's milk is the most common type of milk. Despite the availability and useful properties of cow's milk, not everyone can eat it because of the presence of substances that cause allergies. One of the most likely causes of allergy to milk proteins is the presence in the cow's milk, as well as in the milk of other ruminants, of the protein fraction - β-lactoglobulin, which is practically absent in breast milk.

Goat's milk is traditionally considered to be less allergenic compared to cow's milk, which is associated with a lower content of αs1 - casein. However, in goat's milk, as in cow's, there is a protein fraction of β-lactoglobulin, although in smaller quantities than in cow's milk. According to a number of authors [1], camel's milk has significantly less αs1-casein fraction and β-lactoglobulin than cow's milk, which is of interest from the point of view of allergenicity of camel's milk and milk products manufactured from it. Along with this, there is a high nutritional and biological value of fermented milk products

from camel's milk, which depends on the composition and properties of the raw milk and the activity of probiotic cultures of lactic acid bacteria.

Camel milk is also believed to have a health-promoting effect on diseases such as tuberculosis, asthma, diabetes, autism [2, 3]. The reduced allergenicity of fermented milk products based on camel's milk is caused by the absence of β-lactoglobulin in it.

In this regard, it is relevant to study and practically justify the use of camel's milk as a raw material for the production of dairy products for people with food allergies to cow's milk proteins.

Based on the above, the aim of our research was to analyze the composition and technological properties of cow's, goat's and camel's milk, taking into account their protein profiles, as an allergenicity factor.

In connection with the aim, the objectives of the research included:

– to study the composition, organoleptic and physicochemical characteristics of the milk of animals of different species: cow, goat, camel;

– to investigate the composition of the fatty phase of raw milk, determine its protein profile and the content of β-lactoglobulin in it;

– to produce fermented milk products from different raw milk;

– to study the organoleptic, physicochemical indicators, nutritional, biological and energy values of dairy products produced from the milk of animals of three species.

The scientific novelty and practical significance of the work lies in the fact that camel's milk was compared for the first time with cow's and goat's milk, with a set of indicators determined in milk, its technological properties in the production of different types of sour milk and taking into account the allergenicity factor in the obtained product, which significantly complements the data of other authors who done research on camel's milk [1-3].

The results can be taken into account and used in farms and enterprises engaged in the production of animal milk of different species and its possible targeted processing into products for different categories of consumers, for example, camel and goat milk - for baby food.

The studies were carried out in accordance with the program of international cooperation of agricultural scientists of the EAEU countries for 2018-2020, as well as by order of the Ministry of Agriculture of the Republic of Kazakhstan for 2018 - 2020. URN: BR06249249-OT-18 Development of a complex system of enhancing productivity and improving the breeding qualities of farm animals, by the example of Bayserke-Agro LLP.

Methods of research. The experimental part of the research was performed in accredited laboratories of techno-chemical control and microbiology of the All-Russian Research Institute of Dairy Industry (ARRIDI), as well as in the laboratory of the Department of technology of storage and processing of animal products of the Russian State Agrarian University - Moscow Agricultural Academy named after K.A. Timiryazev in 2014 - 2015

Ferments of pure cultures of lactate microorganisms for the production of fermented milk products were provided by the Laboratory for Microbiology of the ARRIDI. The production of dairy products was carried out in 3 repetitions.

Cow's milk was received at the Zoo station of RSAU - MAA named after K.A. Timiryazev from Black-and-motley cows. Goat's milk of Zaanensky breed of goats was received on a subsidiary farm, Shelepanovo village, Solnechnogorsky district of the Moscow region.

Camel's milk from Bactrian camels was obtained on the farm LAIDOYA located in the Republic of Tatarstan, the Laishevsky district, the Kirbinsky rural settlement, the village of Travkino (figures 1, 2). Camel farm was founded in March 2013. At the time of the experiment, the population of camels was 90 animals.

Camel's milk was delivered to Moscow from Kazan by train storing in refrigerator. (4 °C).

The chemical composition of the camel's milk of the Kazakh Bactrian breed was carried out in the Educational Research and Production Center "Bayserke-Agro" LLP of the Talgar district, Almaty region. The studied milk has been taken from milk camels during the third month of lactation.

The research of all indicators of milk and dairy products was performed in accordance with common standardized and certified methods [4-12].

Figure 1 – Camels on the LAIDOYA farm in winter

Figure 2 – Milking of camels on the LAIDOYA farm

To measure contents of moisture and dry substances in dairy products, a gravimetric method was used (drying up to constant weight at a temperature of 102±2 °C) according to GOST 3626-73.

Analysis of the mass fraction of fat in raw milk and dairy products was carried out using the Gerber acid-butyrometric method according to GOST 5867-90. Determination of total nitrogen and calculation of the protein mass fraction in raw milk and dairy products were conducted according to the Kjeldahl method in accordance with GOST 23327-98, the determination of whey proteins - in accordance with GOST R 54756-2011. The mass fraction of lactose was determined by the accelerated polarimetric method according to GOST R 54667-2011.

The study of the fatty phase was performed by gas chromatography using a Crystallux 4000M chromatograph. Supelco 37, Component FAME Mix was used as an identification mixture; chromatograms were recorded and processed using the NetChrom software program.

The protein composition was determined according to GOST R 53761-2009. A monochromatic blue marker of 10–250 kDa was used as a protein molecular weight marker.

The density in raw milk was determined by the areometric method according to GOST R 54758-2011, the titratable acidity - according to GOST R 54669-2011. Active acidity in pH units was measured according to GOST R 53359-2009.

An expert commission of five people conducted an organoleptic evaluation of milk and dairy products. Statistical data processing was carried out using the Microsoft Excel program.

Results and their discussion. Camel's milk obtained from Kazakh Bactrian dairy female camels during the third month of lactation is white, has a sweet-salty taste, thick homogeneous consistency when decantation foams strongly, it has a velvet of taste perception. Milk begins to boil at a temperature of + 100.3 °C, and freezes at -0.5 °C.

The fat content of the milk received by the proportions from Kazakh Bactrian camels varies in large ranges. The fat content of the first portions of milk yield ranges from 3.2% to 5%, of the main yield - from 5.5% to 6.5%, and of the milk yield - 8-12%.

The lactose content in milk of the Kazakh Bactrian female camels (4.5–5.5%, on average 5.0±0.03%) is more constant compared to the fat content (4.9 - 6.7%, on average 6.2±0.3%) and protein (3.1-4.0%, on average 3.8±0.2%).

On the basis of the conducted research, it was established that the composition and properties of camel's milk differ significantly from cow's and goat's milk.

The organoleptic parameters of raw milk of different species of animals are presented in table 1. The consistency of camel's milk was thicker, there was an increased fat content, which gave the taste to milk more like dairy cream.

There were no differences in smell between cow's and goat's milk. The smell of camel's milk was somewhat different from cow's and goat's milk. There were caught barely perceptible unusual shades in it.

Camel's milk was different from cow's and goat's milk in color. Beta-carotene gives yellowish color to goat's and cow's milk, vitamin A is dissolved in fat of the camel's milk in the form of retinol, and not carotenoid precursors, therefore the color of camel's milk is white.

Table 1 – Organoleptic parameters of raw milk

Parameters of milk	Raw milk		
	Cow's	Goat's	Camel's
Appearance	Opaque liquid, without impurities, without phase separation		
Colour	Uniform throughout the mass, white with a slight cream tint		Uniform throughout the mass, pure white
Taste	Pleasant, slightly sweetish	Pleasant, sweetish	Pleasant, sweetish - salty
Smell	Clean, pleasant, milky		
Consistency	Homogeneous, non-sticky, without fat lumps, liquid		Homogeneous, non-sticky, without fat lumps, thick

Goat's milk taste was the sweetest and fully complied with the requirements [13-16]. Both goat's and camel's milk had their own specific, different from cow's, but not too pronounced flavor.

In camel's milk, compared with cow's milk, the dry matter concentration was higher by 2.75% (abs.%) and higher related to the goat's milk – by 2.08% (table 2).

Table 2 – Physicochemical parameters of raw milk

Parameters of milk	Raw milk		
	Cow's	Goat's	Camel's
Content, %: - moisture	88.47±0.10	87.80±0.07	85.72±0.36
- dry matter	11.53±0.10	12.20±0.07	14.28±0.36
- nonfat milk solids	8.48±0.09	8.61±0.01	9.32±0.11
- fat	3.10±0.10	3.5±0.25	4.67±0.33
- total nitrogen	0.479±0.004	0.542±0.02	0.70±0.001
- nonprotein nitrogen	0.0311±0.0001	0.0413±0.01	0.0454±0.003
- protein	3.05±0.02	3.45±0.15	4.45±0.004
- whey proteins	0.79±0.01	0.99±0.03	1.44±0.09
- lactose	4.72±0.33	4.59±0.41	3.99±0.11
- ash	0.72±0.01	0.73±0.01	0.75±0.004
Ca content, mg/%	118.09±0.26	124.58±0.42	132.92±0.69
Calorific value, kcal / 100 g	60.67±2.34	65.11±1.32	78.03±3.22
Density, kg/m^3	1028.4±0.3	1028.7±0.25	1030.5 ±0.35
Active acidity, pH	6.58±0.20	6.67±0.01	6.38±0.05
Acidity, °T	15.4±0.04	16.5±0.03	22.0±0.60

Camel's milk is superior to cow's milk in the number of whey proteins by 0.66% and in fat content - by 1.57%. Protein was more by 1.4% relative to cow's milk and calcium content - by 14.84 mg/% (P>0.999). Camel's milk exceeds in calorific value by 17.36 kcal per 100 g of cow's milk and by 12.92 kcal - the goat's milk (P>0.95). Titratable acidity exceeded the acidity in cow's and goat's milk by more than 5 units (P>0.99). The density of camel's milk was 2.1 g/cm3 (P>0.95) higher than the density of cow's milk. The differences between the cow's and goat's milk in the same indicators were not so significant.

The content of unsaturated, physiologically important, essential fatty acids - linoleic, linolenic, arachidonic, in camel's milk was significantly higher than cow's and goat's milk (table 3).

The amount of polyunsaturated fatty acids in camel\s milk was 1.6% higher than in cow's milk, including 0.3% higher in the content of omega-3 acids and 1.3% higher in omega-6. Cow's milk contains the least polyunsaturated acids, goat's milk have them 0.8% more than cow's one.

The results of the study of the protein profile of the raw milk obtained using disc electrophoresis in polyacrylamide gel are presented in figure 3.

Table 3 – Composition of the fatty phase of raw milk

Fatty acids (to the total content of fatty acids, %)	Raw milk		
	Cow's	Goat's	Camel's
Linoleic	2.4655±0.0435	2.8353±0.8060	3.1558±0.4472
Linolenic	0.2953±0.0553	0.6307±0.5675	0.9187±0.2139
Arachidonic	0.0263±0.0044	0.0069±0.0013	0.0299±0.0127
Amount of fatty acids: - unsaturated	67.8005±2.3161	69.6428±0.2885	61.7018±2.5735
- monounsaturated	28.6275±2.2282	25.9707±0.2723	32.9150±2.6181
- polyunsaturated, including:	3.5721±0.0882	4.3309±0.0953	5.1262±0.2700
- omega - 3	0.3042±0.0210	0.4452±0.3190	0.6067±0.0072
- omega - 6	3.2679±0.0672	3.8857±0.2237	4.5195±0.2637

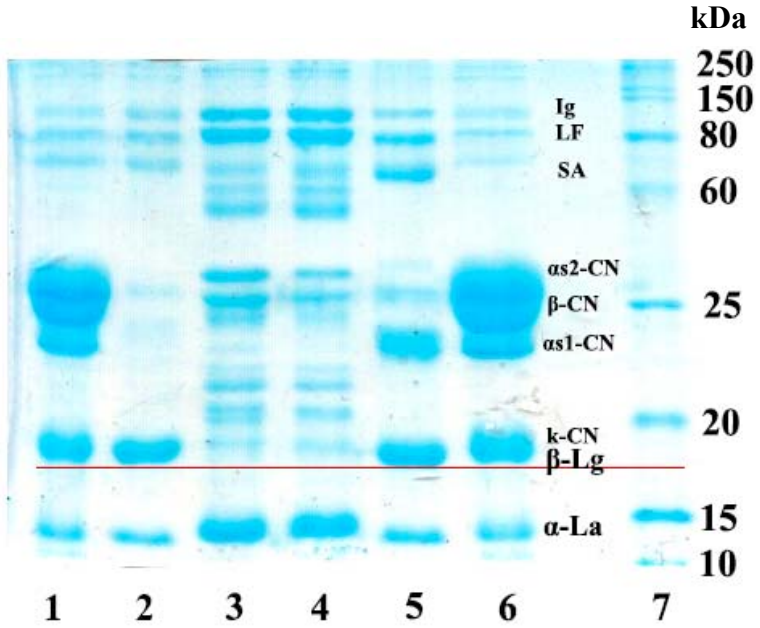

Figure 1 – Protein profile of raw milk:
1, 2 – cow's milk; 3, 4 – camel's milk; 5, 6 – goat's milk; 7 – molecular weight marker at 10-250 kDa;
α-La–α- lactalbumin; β-Lg–β- lactoglobulin; k-CN–k- casein; αs1-CN – αs1- casein; αs2-CN – αs2- casein;
β-CN – β- casein; SA – serum albumin; LF– lactoferrin; Ig – immunoglobulins

The protein profile of camel's milk differs significantly from cow's and goat's milk. Camel's milk contains more α-lactalbumin, lactoferrin, immunoglobulins, β - and αs2 - casein. But the most important thing is that β-lactoglobulin is almost absent in it.

When analyzing the organoleptic parameters of the products, it was established that the consistency of all samples of sour milk is equally dense (table 4). However, after mixing, the consistency of goat's and camel's milk products became less dense, and the consistency of cow's milk products remained thick. The obtained data to some extent vary from the studies of other authors [17-19].

In products from camel's milk, in contrast to sour milk from goat and cow milk, prepared using the same technology, a noticeable sludge of fat was observed. The consistency of camel milk products after mixing was liquid and resembled more kefir than sour milk, which requires additional technological processes in the production of camel milk products.

Goat's milk products had a thicker consistency compared to camel milk products, but were inferior in thickness to cow milk products. Sour milk from cow's milk had a rather thick consistency characteristic of this product.

Bulgarian sour milk produced from all types of milk was less dense than acidophilus and ordinary sour milk. Acidophilic sour milk, obtained from camel milk, surpassed the consistency of Bulgarian and ordinary sour milk (table 4).

Table 4 – Organoleptic parameters of fermented milk products

Types of sour milk		Type of milk		
		Cow's	Goat's	Camel's
Appearance	Acidophilic	dense, uniform clot, without serum separation		dense, uniform clot, with a foot of fat, without serum separation
	Ordinary	dense clot, with some serum		
	Bulgarian			
Colour	Acidophilic	uniform, cream	uniform, cream white	uniform, snow white
	Ordinary			
	Bulgarian			
Taste	Acidophilic	sour, pleasant	sour, with a not very pleasant tint	sour, pleasant, fat
	Ordinary	almost not sour, creamy, pleasant	almost not sour, pleasant, with an unusual tint	almost not sour, pleasant, milky, with a creamy tint
	Bulgarian	sour, pleasant	sour, with no tints	like acidified milk, with an unpleasant tint of bitterness
Smell	Acidophilic	Pleasant, typical	pleasant, a bit unusual	pleasant, milky, unusual
	Ordinary			pleasant, milky
	Bulgarian			with unpleasant tint
consistency	Acidophilic	thick, slightly viscous	like fatty kefir, a bit viscous	liquid, homogeneous, very viscous
	Ordinary	Thick with dense fractions	Like liquid sour cream, non-viscous	Homogeneous, liquid, non-viscous
	Bulgarian	Impure, liquid, non-viscous	Homogeneous, liquid, non-viscous	Homogeneous, very liquid, non-viscous

With the same terms of fermentation, the acidophilous bacteria were developed most actively in goat's milk (table 5).

Table 5 – Physicochemical indicators of sour milk

Indicator	Sour milk								
	Cow's milk			Goat's milk			Camel's milk		
	acid.	ordin.	Bul.	acid.	ordin.	Bul.	acid.	ordin.	Bul.
Content of, %: - dry matter	10.94 ±0.13	11.19 ±0.08	11.19 ±0.07	11.98 ±0.03	12.55 ±0.27	12.12 ±0.09	14.62 ±0.40	14.53 ±0.24	13.89 ±0.08
- moisture	89.06 ±0.13	88.81 ±0.08	88.81 ±0.07	88.02 ±0.03	87.45 ±0.27	87.88 ±0.09	85.38 ±0.40	85.47 ±0.24	86.11 ±0.08
- protein	3.07 ±0.01	3.06 ±0.04	3.11 ±0.06	3.34 ±0.01	3.29 ±0.07	3.35 ±0.04	4.43 ±0.03	4.43 ±0.04	4.39 ±0.04
- total nitrogen	0.481 ±0.003	0.479 ±0.006	0.488 ±0.009	0.524 ±0.003	0.516 ±0.009	0.525 ±0.006	0.695 ±0.004	0.695 ±0.006	0.689 ±0.006
- fat	3.00 ±0.1	2.20 ±0.1	2.60 ±0.1	3.30 ±0.1	3.30 ±0.3	3.30 ±0.1	5.00 ±0.1	4.90 ±0.1	5.00 ±0.07
- lactose	2.94 ±0.11	3.96 ±0.10	4.50 ±0.28	3.18 ±0.11	4.41 ±0.03	4.70 ±0.28	2.79 ±0.13	3.87 ±0.14	4.06 ±0.04
Calorific value, kcal/100 g	52.54 ±0.79	49.22 ±1.05	55.38 ±2.24	57.42 ±1.72	62.26 ±3.04	63.70 ±0.02	76.10 ±0.91	80.07 ±1.06	80.70 ±0.69
Active acidity, pH	3.62 ±0.10	4.40 ±0.03	4.48 ±0.04	3.59 ±0.13	4.45 ±0.07	3.74 ±0.06	3.64 ±0.06	4.56 ±0.08	4.12 ±0.03
Acidity, °T	167.84 ±1.19	68.80 ±1.27	60.64 ±2.14	185.44 ±0.79	61.60 ±2.36	150.40 ±1.26	151.84 ±0.93	77.92 ±1.30	109.60 ±1.27

Variations in the content of dry matter, fat, protein in all samples of sour milk relative to the raw milk were insignificant and unreliable. The titratable acidity of acidophilic sour milk from goat's milk was higher than the acidity of similar products of cow's milk by 17.7 °T and of camel's milk by 33.6 °T (P>0.99). The titratable acidity of sour milk obtained from camel milk was the highest. The highest acidity of Bulgarian sour milk was obtained by ripening goat milk. The not uniform increase in acidity of products from different raw milk should be taken into account when determining the terms of fermentation of products since the technological instructions for the production of fermented milk products are designed for cow's milk. Thus, in the case of acidophilic and Bulgarian sour milk from goat's milk, a reduction in the fermentation time is required in order to prevent an excessively sour taste of the product.

When comparing the fatty acid composition of the products, the difference in the level of essential linoleic, linolenic and arachidonic fatty acids was established between the samples of sour milk obtained from the milk of different animal species (table 6).

The content of linoleic acid in all three samples of sour milk from goat's milk was significantly higher (P>0.999) than in samples of yogurt from camel and cow milk. The level of linolenic acid in camel milk products significantly exceeded the indicators of this acid in samples of goat and cow milk products (P>0.95). In terms of arachidonic acid between product samples, a significant advantage has not been revealed.

Table 6 – Composition of the fatty phase of sour milk (to the total content of fatty acids, %)

Fatty acids	Sour milk								
	Cow's			Goat's			Camel's		
	acid.	ordin.	Bul.	acid.	ordin.	Bul.	acid.	ordin.	Bul.
linoleic	2.372 ±0.093	2.434 ±0.003	2.323 ±0.026	3.238 ±0.013	3.187 ±0.012	3.193 ±0.026	2.761 ±0.001	2.848 ±0.163	2.610 ±0.001
linolenic	0.338 ±0.023	0.293 ±0.008	0.276 ±0.057	0.239 ±0.013	0.187 ±0.003	0.194 ±0.032	1.293 ±0.121	1.239 ±0.013	1.409 ±0.002
arachidonic	0.031 ±0.001	0.02 ±0.001	0.01 ±0.002	0.003 ±0.001	0.025 ±0.002	0.001 ±0.001	0.004 ±0.001	0.012 ±0.001	0.019 ±0.001
Sum of acids: unsaturated	66.387 ±0.723	66.260 ±0.224	65.918 ±0.351	68.805 ±0.168	68.988 ±0.008	68.745 ±0.063	63.402 ±0.170	64.904 ±0.050	65.684 ±0.306
monounsaturated	30.134 ±0.737	30.33 ±0.293	30.717 ±0.161	27.064 ±0.120	26.85 ±0.031	27.217 ±0.190	31.690 ±0.249	30.020 ±0.109	29.341 ±0.353
polyunsaturated.	3.479 ±0.008	3.412 ±0.063	3.366 ±0.189	4.131 ±0.039	4.161 ±0.023	4.038 ±0.126	4.908 ±0.086	5.076 ±0.059	4.975 ±0.051
including ω-3	0.274 ±0.002	0.216 ±0.044	0.273 ±0.100	0.267 ±0.001	0.330 ±0.003	0.222 ±0.051	0.345 ±0.050	0.461 ±0.211	0.575 ±0.052
including ω-6	3.205 ±0.010	3.197 ±0.019	3.093 ±0.089	3.864 ±0.039	3.832 ±0.021	3.816 ±0.074	4.563 ±0.136	4.615 ±0.152	4.400 ±0.001

The content of monounsaturated fatty acids in sour milk from camel milk, especially in acidophilic sour milk, was significantly higher than in sour milk from goat's milk (P>0.99), with a slight difference in the level of monounsaturated fatty acids contained in lapper milk from cow milk. The amount of polyunsaturated fatty acids, including omega-3 and omega-6, in sour milk from camel milk significantly exceeded the content of these fatty acids in samples of goat and cow's milk. As for a sum of monounsaturated and polyunsaturated fatty acids in the samples of sour milk obtained from one type of milk, no significant difference was revealed. The established variations in the composition of fatty acids in products are due to the characteristics of the fatty acid composition of raw milk.

The most stable starter microorganisms advanced in camel milk (table 7). In the development of acidophilous bacterium, Lactobacillus bulgaricus, dairy and creamy lactococci, there was neither increase in number nor dying within five days of research. Their number was invariably $2.5x10^8$ CFU/cm^3, which corresponds to the requirements for the number of living microorganisms in the finished dairy product by the end of the storage period - not less than $1.0x10^7$ CFU/cm^3. Lactobacillus bulgaricus in goat's milk developed poorly.

Just after fermentation, the number of microorganisms in sour milk was $2.5x10^7$CFU/cm^3, and already on the 3rd day, it decreased to $2.5x10^6$CFU/cm^3, which is less than the required $1.0x10^7$CFU/cm^3. The amount of lactic and creamy lactococci was consistently kept at the level of $2.5x10^8$CFU/cm^3 for 5 days. The number of acidophilous bacteria increased on the 3rd day from $2.5x10^{10}$ to $2.5x10^9$ CFU/cm^3, and on the 5th day, it slightly decreased and was equal to the initial value.

Table 7 – Microbiological testing of sour milk

Storage time	Sour milk								
	Cow's			Goat's			Camel's		
	acid.	ordin.	Bul.	acid.	ordin.	Bul.	acid.	ordin.	Bul.
Ground	$2.5x10^8$	$2.5x10^7$	$2.5x10^8$	$2.5x10^8$	$2.5x10^8$	$2.5x10^7$	$2.5x10^8$	$2.5x10^8$	$2.5x10^8$
3 day	$2.5x10^7$	$2.5x10^7$	$2.5x10^8$	$2.5x10^9$	$2.5x10^8$	$2.5x10^6$	$2.5x10^8$	$2.5x10^8$	$2.5x10^8$
5 day	$2.5x10^8$	$2.5x10^8$	$2.5x10^9$	$2.5x10^8$	$2.5x10^8$	$2.5x10^6$	$2.5x10^8$	$2.5x10^9$	$2.5x10^8$

The number of acidophilous bacteria in yogurt from cow's milk on the 3 day decreased to $2.5x10^7$ CFU/cm^3 compared with the ground, and then their number again increased to $2.5x10^8$ CFU/cm^3. The population of microorganisms of Lactobacillus bulgaricus in cow's sour milk by the 5 day even increased slightly and amounted to $2.5x10^9$ CFU/cm^3. Milk and creamy lactococci advanced well in cow's milk, their amount slightly increased during the study period, and on day 5, it was $2.5x10^8$ CFU/cm^3.

The protein profile of fermented milk products from different raw milk with different microbiological starters is shown in figure 4.

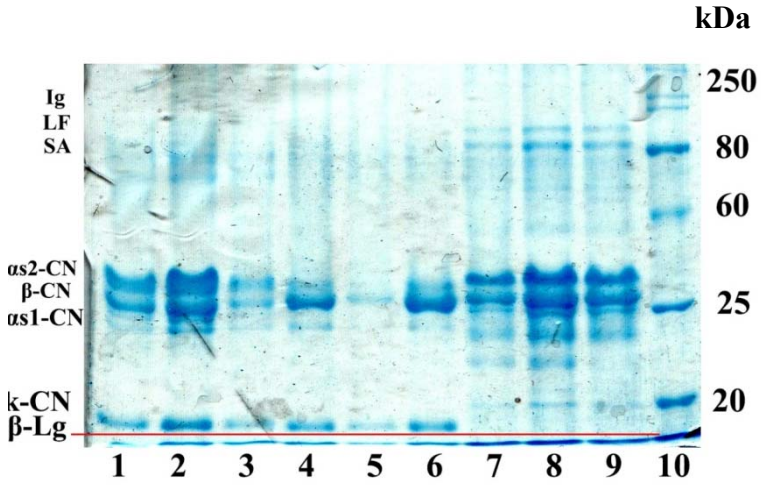

Figure 4 – Protein profile of fermented milk products:
1, 2, 3 – cow's milk (1 – ordinary sour milk, 2 – acidophilus sour milk, 3 – Bulgarian sour milk);
4, 5, 6 – goat's milk (4 – acidophilus sour milk, 5 – ordinary sour milk, 6 – Bulgarian sour milk);
7, 8, 9 – camel's milk (7 – Bulgarian sour milk, 8 – ordinary sour milk, 9 – acidophilus sour milk);
10 – molecular weight marker; α-La–α- lactalbumin; β-Lg–β- lactoglobulin; k-CN–k- casein; αs1-CN – αs1- casein;
αs2-CN – αs2- casein; β-CN – β- casein; SA – serum albumin; LF– lactoferrin;Ig – immunoglobulins

In fermented milk products of camel's milk, β-lactoglobulin is not identified, it confirms the data on its absence in camel milk.

Currently, camel milk products on the Russian market are positioned as medicinal, hypoallergenic, dietary, but not as mass-consumption products. However, the capacity of camel milk as raw milk is quite high due to its unique chemical composition. With an increase in the production of this type of milk, fermented milk products produced from it will be able to compete with other products from natural cow's milk [20].

Camel milk of the Kazakh Bactrian females can be kept fresh for a long time. Increased bactericidal properties of milk slow down the acidity growth. At + 100 °C in camel milk, the original acidity is kept

for 72 hours, while in cow's milk it increases continuously. At + 300 °C, camel milk is stored for 24 hours, and cow milk deteriorates after 5 hours.

Conclusions.

1. In a comparative assessment of the milk of different animal species, it was established that the physicochemical indicators of camel milk differ significantly from cow and goat milk.

2. Comparing with cow and goat's milk, In camel's milk, there are more polyunsaturated fatty acids, which have important physiological significance for the human body.

3. The study of the milk protein profile showed that in camel's milk there is no β-lactoglobulin - one of the main allergens of cow and goat milk. The protein profile of cow and goat milk has a similar pattern.

4. Camel milk can be used in manufacturing different types of sour milk up on the production technology of these products from cow and goat milk, but it is necessary, without fail, to include homogenization of milk, due to the sharp separation of the fat phase in the product, which does not occur in products from cow and goat milk.

5. The time of ripening of sour milk from cow, goat and camel milk varies, it should be considered when manufacturing these products.

6. In terms of organoleptic characteristics, all samples of the products were highly valued, except for the Bulgarian yogurt of camel milk, that is due to the uncharacteristic consistency and the presence of undesirable flavors in the yogurt.

7. Differences in the chemical composition of sour milk samples from cow, goat and camel milk are conditional upon the chemical composition of raw milk, rather than the influence of the type of starter culture.

8. Companies specializing in the dairy production for diverse groups of the population, including those with hypoallergenic products, are recommended to use camel's milk as a raw material, which does not contain an allergen β-lactoglobulin.

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СИЫР, ЕШКІ ЖӘНЕ ТҮЙЕ СҮТІНІҢ ҚҰРАМЫН, ТЕХНОЛОГИЯЛЫҚ ҚАСИЕТТЕРІН ЖӘНЕ АЛЛЕРГИЯЛЫҚ ФАКТОРЛАРЫН БАҒАЛАУ

Аннотация. Мақалада түйенің сүтінің негізгі физика-химиялық көрсеткіштері бойынша аллергиялық факторлардың бірі-β - лактоглобулиннің сүт ақуызының болмашы болуына байланысты сиыр және ешкі сүтінен айтарлықтай айырмашылығы бар. Мақалада жүргізілген зерттеулер негізінде сүттің негізгі компонент-терінің құрамы – құрғақ заттардың, майдың, ақуыздың және ең маңызды минералды заттардың бірі – кальций, түйе сүтінде бұл көрсеткіштерден сиыр және ешкі сүтінде айтарлықтай асып түсетіні көрсетілген. Түйе сүтінің тығыздық, титрленген қышқылдығы мен энергетикалық құндылығының көрсеткіштері сиыр және ешкі сүтінің ұқсас көрсеткіштерінен жоғары.

Моноқанықпаған, сондай – ақ полиқанықпаған май қышқылдарының, сондай – ақ омега-3 және омега-6 қышқылдарының құрамы түйе сүтінде сиыр және ешкі сүтіне қарағанда айтарлықтай көп екендігі анықталды.

Түйе сүтінде сиыр және ешкі сүтіне, α-лактальбуминге, лактоферринге, иммуноглобулиндерге қарағанда көп, бірақ ең бастысы сиыр және ешкі сүтіне қарағанда β-лактоглобилиннің болмауы.

Түйе, сиыр және ешкі сүті негізінде әртүрлі ұйытатын дақылдарды: сүт қышқылды лактококококтарды (қарапайым айран), ацидофильді таяқшаларды (ацидофильді айран) және болгар таяқшаларын (Болгар айран) пайдалана отырып жасалған айран өзінің қасиеттері бойынша ерекшеленді.

Түйе сүтінен жасалған айранның барлық үлгілерінде бірдей технологиямен дайындалған ешкі және сиыр сүтінен жасалған ұйытқышқа қарағанда майдың Елеулі тұнбасы байқалды және бұл түйе сүтінен өнім өндіру кезінде технологиялық процестерді қосымша өңдеуді талап етеді. ЗЗерттелетін айранның химиялық құрамындағы белгіленген айырмашылық негізінен өнімдер дайындалған сүт-шикізатының құрамына байланысты.

Түйе сүтінен шыққан айранда β-лактоглобулин сәйкестендірілмеген, бұл оның түйе сүтінде жоқ екенін растайды.

Түйін сөздер: сиыр сүті, ешкі сүті, түйе сүті, аллергендер, ақуыз фракциялары, төзбеушілік, гипоаллергендік, лактоферрин, ақуыз профилі, айран.

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ОЦЕНКА СОСТАВА, ТЕХНОЛОГИЧЕСКИХ СВОЙСТВ И ФАКТОРА АЛЛЕРГЕННОСТИ КОРОВЬЕГО, КОЗЬЕГО И ВЕРБЛЮЖЬЕГО МОЛОКА

Аннотация. В статье приводится информация на основе данных, полученных разными авторами, что верблюжье молоко по основным физико-химическим показателям существенно отличается от коровьего и козьего молока из-за незначительного содержания одного из аллергенных факторов – молочного белка β-лактоглобулина. В статье, на основании проведенных исследований, показано, что содержание основных компонентов молока – массовой доли сухих веществ, жира, белка, и одного из наиболее важных минеральных веществ – кальция, в верблюжьем молоке существенно превышает эти показатели в коровьем и козьем молоке. Показатели плотности, титруемой кислотности и энергетической ценности верблюжьего молока также выше аналогичных показателей коровьего и козьего молока.

Установлено, что содержание мононенасыщенных, так и полиненасыщенных жирных кислот, а также кислот омега-3 и омега-6, в верблюжьем молоке значительно больше, чем в коровьем и козьем молоке.

Выявлена разница в белковой структуре верблюжьего, коровьего и козьего молока. В верблюжьем молоке содержится больше, чем в коровьем и козьем молоке, α-лактальбумина, лактоферрина, иммуноглобулинов, но самое главное, в отличие от коровьего и козьего молока, практически отсутствие β-лактоглобилина.

Простокваша, выработанная на основе верблюжьего, коровьего и козьего молока с использованием разной заквасочной культуры: молочнокислых лактококков (простокваша обыкновенная), ацидофильной палочки (простокваша ацидофильная) и болгарской палочки (простокваша болгарская) различалась по своим свойствам.

У всех образцов простокваши из верблюжьего молока, в отличие от простокваши из козьего и коровьего молока, приготовленной по одинаковой технологии, наблюдался заметный отстой жира и это требует дополнительной отработки технологических процессов при производстве продукции из верблюжьего молока. Установленная разница в химическом составе исследуемых образцов простокваши обусловлена в основном составом молока-сырья из которого приготовлены продукты.

В простокваше из верблюжьего молока β-лактоглобулин не идентифицирован, что подтверждает данные о его отсутствии в верблюжьем молоке.

Ключевые слова: молоко коровье, молоко козье, молоко верблюжье, аллергены, фракции белка, непереносимость, гипоаллергенность, лактоферрин, белковый профиль, простокваша.

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