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PROSPECTS FOR USING CAMEL MILK AS AN ALTERNATIVE TO COW AND GOAT MILK

ANNOTATION

According to data from the official website of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan and the National Bureau of Statistics (https://stat.gov.kz/), the number of camels for last year and 5 last year increased by 15,662 and 50,241 respectively. However, the population of camels in Kazakhstan is still relatively low in comparison to cows and goats. The low level of self-sufficiency in milk and dairy products of the population of Kazakhstan due to camel milk was calculated (0.3%) based on the volume of camel milk produced in 2022 in the country. In this research, Kazakh Bactrian, Arvana, and inter-species camels produced samples of camel milk to investigate organoleptic and physico-chemical indicators of camel milk to compare with cow and goat milk. Evaluation of the organoleptic properties of samples showed that camel milk is a promising alternative resource to cow and goat milk in Kazakhstan.

Based on data from physico-chemical indicators of various types of milk was approved that camel milk has high nutritional value due to a higher concentration of dry matter compared to cow and goat milk with a difference of 2.3% and 3%, respectively. Camel milk has a higher level of energy value as contains 85.22 kcal per 100 g product, which is 16.92 kcal more than cow milk and 14.79 kcal more than goat milk. Its density is also higher, with 4 kg/cm3 and 8 kg/cm3 more than cow and goat milk, respectively. Based on RNSS 55577-2013 and obtained results milk of various types of farm animals can be considered as a source of protein, as 23.33; 16.56, and 17.72 % of the energy value is provided by protein in camel, cow, and goat milk, respectively. However, only camel milk is a product with a high protein content, as it contains more than 20% of the energy value of the product provided by protein. This advantage of camel milk can be used in the production of specialized food products, where proteins are given a special role as an essential component of the diets of various population groups.

Key words: *camel husbandry, camel milk, cow milk, goat milk, physical and chemical properties.*

Introduction. The creation of agro-industrial complexes is of paramount importance to Kazakhstan's economic diversification and guaranteeing food security. As the country transitions towards a market economy, it has identified fresh priorities for industrial development. The utilization of superior livestock products is especially crucial in supplying the populace with food that is both safe and affordable [1].

For centuries, milk and milk products have been valued for their medicinal and nutritional benefits, making them a crucial component of human diets. These products possess both bacteriostatic and bactericidal properties, thanks to the antibiotic substances they contain, which can help combat harmful microflora in the gut. Most countries rely on cow's and goat's milk as their primary source for these goods. Similarly, in our country, roughly 95% of milk consumption is derived from these two sources. This is essential in our quest to provide our citizens with safe, affordable food, particularly as we focus on developing our agro-industrial complexes to achieve economic diversification and food security [2,3].

The practice of camel breeding, which includes competitive breeding, is a longstanding tradition in animal husbandry. Following our country's independence and shift to a market economy, the production of camel milk and milk products has notably increased. The people of our country have been fascinated by the many nutritional and healing benefits of camel milk for quite some time. To this end, researchers at the National Academy of Sciences of the Republic of Kazakhstan, including M.Kh. Shygaeva, J.K. Tolemisova, and Professor G.N. Dudikova have delved into the healing properties of camel milk and the microflora of fermented milk products [4,5]. T.Sh. Sharmanov and his team have also demonstrated the efficacy of camel milk in treating stomach ulcers and hepatitis [6,7].

Numerous nations utilize camel milk to enhance human health, given its medicinal and dietary benefits. This milk includes various antimicrobial agents, such as lactoferrin, lysozyme, immunoglobulin, lactoperoxidase, and bacteriocins. Despite the rising population of camels, the demand for camel milk remains low due to its elevated market value and organoleptic indicators, along with its high acidity. Nonetheless, camel milk surpasses cow's and goat's milk in nutritional value, with decreased fat and lactose levels and elevated levels of potassium, iron, and vitamin C [8,9].

A. Baymukanov [10] has stated that camel meat and milk are highly important and affordable products in Central Asia. They are mainly obtained from regions where camels are bred, which makes camel farming a crucial economic activity for farms located in arid and desert regions of the country. The demand for camel products is constant, both domestically and internationally.

Camel milk has been gaining popularity as an alternative to cow and goat milk. It has a unique taste and is packed with nutrients, making it an excellent choice for those who are lactose intolerant or have allergies to cow or goat milk. In addition, camel milk has been found to have a higher protein and fat content than cow's milk, making it healthier. Overall, the prospects for using camel milk as an alternative to cow and goat milk are promising, and it is likely to become an increasingly popular choice in the coming years.

Research materials and methods. Camel, cow, and goat milk were taken as a research object by the following regulatory and technical documents:

- National Standard of the Republic of Kazakhstan (NSRK) 166-2015«Camel milk for production. Camel milk according to technical conditions» [11];
- Russian National State Standard (RNSS)31449-2013«Cow's milk raw material. Raw cow's milk according to Technical conditions» [12];
- RNSS 32259-2013«Goat milk raw material. Goat's milk according to Technical conditions» [13].
- RNSS 55577-2013 «Functional Food Products Information on Distinctive Characteristics and Effectiveness»[14].

Organoleptic and physico-chemical indicators. Samples were dried and prepared for analysis according to RNSS 13928-84 [15]. Determination of color, taste, smell, and consistency of milk was carried out by organoleptic assessment. Determination of taste and smell was carried out according to RNSS 28283-2015 [16].

By the national standards of the Republic of Kazakhstan and international standards, the determination of the physicochemical properties of camel, cow, and goat milk is carried out according to generally accepted research methods:

- Determination of acidity according to RNSS 3624-92 [17];
- Determining the mass fraction of protein according to RNSS 23327-98 [18];
- Determining the mass fraction of fat according to RNSS 5867-90 [19];
- Determination of density according to RNSS 3625-84 [20];
- Determination of dry substances according to RNSS 3626-73 [21];
- Determination of temperature according to RNSS 26754-85 [22].

The statistical data was sourced from multiple credible outlets, including the Republic of Kazakhstan's Agency for Strategic Planning and Reforms official website, the National Bureau of Statistics https://stat.gov.kz/ [23], as well as scientific articles written by experts in this field and http://www.intelmeal.ru/[24].

Mathematical calculations. The need for milk and dairy products is calculated according to the following formula:

$$Pi = \mathrm{N} * 301 \quad (1)$$

where, N is population, million/people;

301 - effective milk (dairy products) consumption rate per capita, kg/year.

The level of self-sufficiency in dairy products (R, %) is calculated using the following formula:

$$R = k * \frac{100}{Pi} \quad (2)$$

where, k is the amount of milk produced per year, kg;
100 - self-sufficiency ratio, %;
Pi - need for dairy products, kg

The evaluation of the energy value of milk of various types of farm animals is calculated according to the following coefficients (Table 1):

Table 1– Coefficients of energy value of food macronutrients

Macro-nutrients	Energy value, kcal/1g
Proteins	3.9
Fats	8.9
Carbohydrates	3.9

When calculating the energy value of milk from different farm animals, it's important to take into account a variety of coefficients. These coefficients can vary depending on the type of animal and their specific milk production. It's essential to accurately evaluate the energy value of milk to ensure that it's safe and nutritious for consumption.

Research results. According to statistics from the National Bureau, Mangistau, Kyzylorda, Turkestan, and Atyrau have recorded a significant number of camels, while the urban regions of Astana, Almaty, and Shymkent have relatively low counts due to their urbanized nature. Nevertheless, the data indicates a steady increase in the nationwide camel population over the past five years, as illustrated in Figure 1.

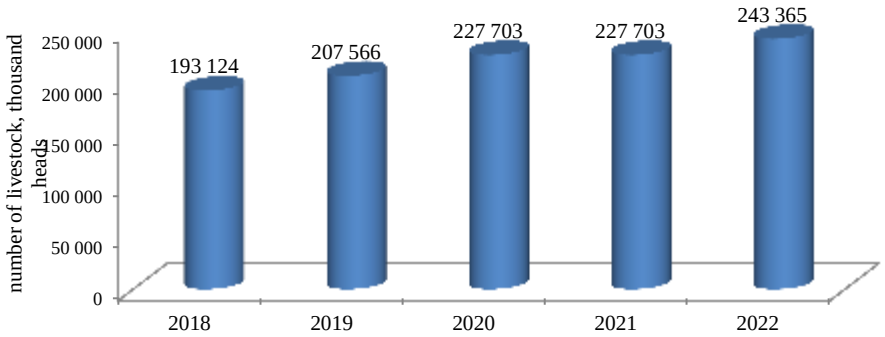

Figure 1– Growth dynamics of camel population in 2018-2022

According to data from the official website of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan and the National Bureau of Statistics (https://stat.gov.kz/) [23], the population of camels in Kazakhstan is relatively low in comparison to cows and goats. Nonetheless, there was a notable increase of 15.662 in the number of camels last year. This growth rate falls short of what is necessary for the production of camel milk products within Kazakhstan and export. It is crucial to raise their numbers, enhance the quality of their products, and increase the production of meat, milk, and wool, to maintain the important role that camels hold within Kazakhstan's economy.

The assessment of the self-sufficiency of the population of Kazakhstan with basic food products was carried out by calculating the volume of camel milk produced in 2022. The obtained data are presented in Table 2.

Table 2– Camel milk self-sufficiency level by regions of Kazakhstan, thousand

Republic of Kazakhstan and regions	All categories of farms, kg	Demand for milk and dairy products, kg (Pi)	Level of self-sufficiency in milk and dairy products, % (R)
Republic of Kazakhstan	17234.1	5 934 269.7	0.3
Akmola region	2.1	236 830.7	0.001
Aktobe region	960.2	278 685.0	0.3

Almaty region	2394.0	451 441.6	0.5
Atyrau region	1 728.7	207 916.0	0.8
West Kazakhstan region	7.4	206 788.2	0.004
Zhambyl region	218.2	366 087.0	0.06
Karaganda region	32.9	341 409.5	0.01
Kostanay region	6.7	250 515.3	0.003
Kyzylorda region	4 793.4	250 357.6	1.9
Mangistau region	5 623.6	228 130.3	2.5
Turkestan region	1 462.3	636 133.7	0.2
East Kazakhstan region	4.6	219 910.2	0.002

The Mangistau region of Kazakhstan boasts the highest rate of camel milk processing across all farm types, while other regions such as Kyzylorda, Almaty, and Atyrau also show promising results. Unfortunately, camel breeding and milk processing are not being fully utilized in other parts of the country. Camel milk, which boasts superior quality compared to regular cow's milk, presents an opportunity to provide a high-quality product to the population. However, self-sufficiency levels for camel milk and its products in Kazakhstan are quite low, at just 0.3% according to estimates. To address this issue, promoting camel farming with supportive state regulation is necessary to bolster agricultural development.

The organoleptic method is a sensory-based approach for evaluating food quality, aesthetic appeal, and certain ergonomic factors. This technique draws on our senses of sight, hearing, smell, touch, and taste to assess these qualities. One of its key advantages is its accessibility and speed, as it doesn't require costly measurement equipment. Additionally, most individuals possess sufficient sensory capabilities to evaluate appearance, taste, smell, and texture. Table 3 outlines the organoleptic indicators of raw milk.

Table 3– Organoleptic indicators of camel, cow, and goat milk

Indicators	Camel milk	Cow milk	Goat milk
Taste and smell	Pure, sweet, fresh milk-free aftertaste, milky smell, milky-creamy, without foreign smell	The taste is pleasant, sweet	Opaque liquid without excess impurities
Color	White to light yellow	White to pale cream	White to off-white
Consistency	Clear liquid, small amount of flakes	Homogeneous structure	

Camel milk boasts a unique aroma that sets it apart from cow and goat milk. Its pristine white color contrasts with the yellow tint of cow and goat milk, which is attributed to beta-carotene. While assessing milk quality for consumers, it may not be imperative to discern every nuance of color, taste, or scent. Nonetheless, even slight differences in organoleptic quality indicators during expert evaluation hold great importance (Fig. 2)

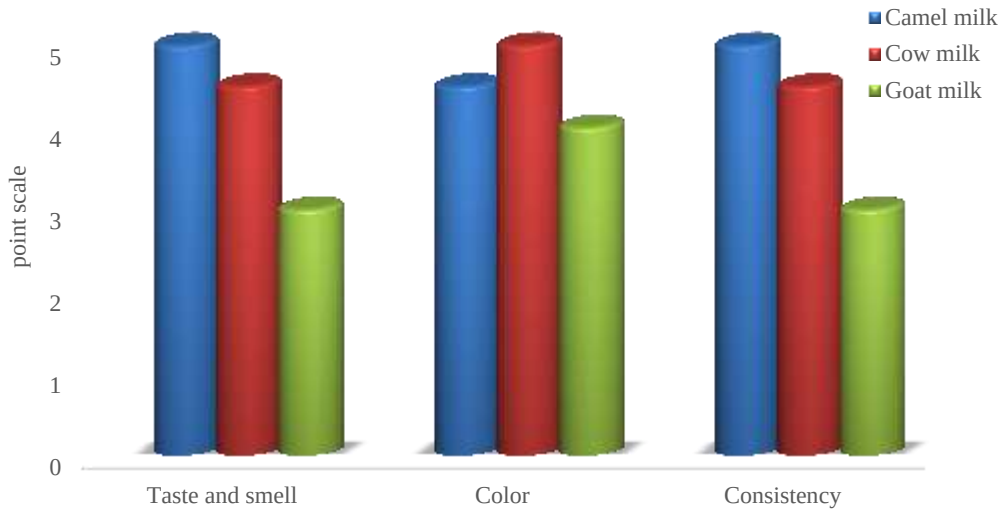

Figure 2– Organoleptic indicators of camel, cow, and goat milk

Upon thorough analysis of the milk samples, it was revealed that camel milk bears a striking resemblance to cow's milk in terms of sensory properties. Conversely, goat's milk was found to be undervalued during the taste assessment. Nonetheless, all milk samples were found to meet the established standards. These findings suggest that camel milk presents a promising option as an alternative to cow's milk.

Within the regional framework, traditional agriculture has shown great promise as a highly effective direction for the agro-industrial complex in Kazakhstan's desert and arid regions. In current times of productive camel husbandry, dairy products are taking the lead in production. Kazakhstan's camel farming boasts a variety of breeds, such as the Kazakh Bactrian, Arvana, and inter-species camels [25,26].

To produce exceptional camel milk and dairy products, it is imperative to prioritize the enhancement of camel husbandry and animal care. The crux of acquiring superior raw materials lies in the maintenance of optimal living conditions for the animals, as well as adherence to stringent sanitary and hygienic measures throughout the milking and early processing phases. By upholding these standards, we can confidently ensure the attainment of the highest caliber results in this industry [27].

To deliver exceptional dairy products that contribute to people's well-being, it is imperative to incorporate milk with high nutritional value into the final product. This underscores the importance of meticulously sourcing premium raw materials for milk-based products. Our research delves into a comprehensive comparative analysis of the physico-chemical properties of milk derived from diverse animal sources (Tab. 4).

Table 4– Physico-chemical indicators of milk of different types of farm animals [11,12,13]

Indicators	Normative indicators			Research results		
	for camel milk	for cow milk	for goat milk	camel milk	cow milk	goat milk
1	2	3	4	5	6	7
Acidity, no more than, °T	17.5	16-21	20	17.2±0.05	17±0.09	16.5±0.05
1	2	3	4	5	6	7
Mass fraction of protein, no lessthan, %	3.8	2.8	3.0	5.1±0.01	2.9±0.04	3.2±0.02
Mass fraction of fat, no lessthan, %	3.0	2.8	4.0	5.5±0.06	4.3±0.06	4.5±0.06
Density at 20 °C, no lessthan, kg/m^3	1032	1027	1027	1036±0.3	1032±0.3	1028±0.3
Dry matter, no lessthan, %	15	8.2	14.5	15.2±0.02	12.9±0.02	12.2±0.02

Mass fraction of lactose, %	-	-	-	4.2±0.05	4.8±0.05	4.59±0.05
Cryoscopic temperature, minus, no higherthan, °C	-	0.505	0.520	0.526	0.502	0.520

Camel milk has a higher concentration of dry matter compared to cow and goat milk with a difference of 2.3% and 3%, respectively. Moreover, camel milk contains 85.22 kcal per 100 g product, which is 16.92 kcal more than cow milk and 14.79 kcal more than goat milk. Its density is also higher, with 4 kg/cm^3 and 8 kg/cm^3 more than cow and goat milk, respectively. However, the benefits of camel milk go beyond its nutritional content. It's also recognized as a remedy for various ailments such as gastritis, diabetes, asthma, tuberculosis, skin diseases, urinary problems, and hepatitis. Researchers have found that it contains higher levels of monounsaturated and polyunsaturated fatty acids, omega-3, and omega-6 acids compared to cow and goat milk. Additionally, camel milk has a different protein structure, with more α-lactalbumin, lactoferrin, and immunoglobulins, and practically no β-lactoglobulin, unlike cow and goat milk.

It should be noted thatthe milk of farm animals includes all macronutrients (protein, fat, lactose). Based on macronutrient composition the evaluation of the energy value of milk of various types of farm animals was done (Table4). According to RNSS 55577-2013 «Functional Food Products Information on Distinctive Characteristics and Effectiveness» a food product is a source of protein only if at least 12% of the energy value of the food product is provided by protein, provided that the amount of protein per 100 g/cm^3 is not less than 5% of the daily requirement in protein.Camel milk is 2.2% more protein-rich than cow milk and 1.2% more fat-rich than goat milk. However, food product has a high protein content only if at least 20% of the energy value of the food product is provided by protein.

Table 5–Evaluation of the energy value of milk of various types of farm animals

Indicators	Milk of different types of farm animals		
	camel milk	cow milk	goat milk
Energy value of milk, kcal/100 g	85.22	68.3	70.43
Energy value of milk due to protein, kcal/100 g	19.89	11.31	12.48
Energy value of milk due to protein, %	**23.33**	16.56	17.72

Based on the information provided in RNSS 55577-2013 and the results of Table5milk of various types of farm animals can be considered asa source of protein, as 23.33; 16.56, and 17.72 % of the energy value is provided by protein in camel, cow and goat milk, respectively. However, only camel milk is a product with a high protein content, as it contains more than 20% of the energy value of the product provided by protein. This advantage of camel milk can be used in the production of specialized food products, where proteins are given a special role as an essential component of the diets of various population groups.

Conclusion. Based on information from the National Bureau of Statistics and obtained data of this research camel milk can be considered as a promising alternative resource to cow and goat milk in Kazakhstan. In the research was approved that camel milk is preferred raw material to compare with cow and goat milk in the production of specialized food because of camel milk has high protein content as 23.33% of the energy value is provided by protein. High nutritional value of camel milk as well as consumer properties can be attractive for producers of dairy foods in the country to provide enough level of self-sufficiency in milk products in different regions as well as in Kazakhstan in totally for the nearlist years. Moreover development of camel husbandry in the country can provide essential role to optimize Kazakhstan's economy.

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ТҮЙІН

ҚР Стратегиялық жоспарлау және реформалар агенттігі мен ұлттық статистика бюросының ресми сайтының деректері бойынша (https://stat.gov.kz/), өткен жылы және соңғы 5 жылда түйелердің саны сәйкесінше 15 662 және 50 241-ге өсті. Алайда, Қазақстанда түйе саны сиырлар мен ешкілермен салыстырғанда әлі де аз. Түйе сүтін өндіру көлеміне сүйене отырып, 2022 жылы елімізде түйе сүті есебінен Қазақстан халқының сүт және сүт өнімдерімен өзін-өзі қамтамасыз ету деңгейі (0,3%) есептелді.

Бұл зерттеуде түйе сүтінің органолептикалық және физика-химиялық көрсеткіштерін зерттеу үшін сиыр және ешкі сүтімен салыстыру үшін түйе сүтін қазақ бактриан тұқымының түйесінен алды. Сүттің әртүрлі түрлерінің физика-химиялық көрсеткіштерінің деректеріне сүйене отырып, түйе сүтінің сиыр мен ешкі сүтімен салыстырғанда құрғақ заттардың жоғары концентрациясына байланысты тағамдық құндылығы жоғары, сәйкесінше 2,3% және 3% айырмашылығы бар екендігі расталды. Түйе сүтінің энергетикалық құндылығы жоғары, өйткені оның құрамында 100 г өнімге 85,22 ккал бар, бұл сиыр сүтінен 16,92 ккал және ешкі сүтінен 14,79 ккал артық. Оның тығыздығы сәйкесінше сиыр мен ешкі сүтіне қарағанда 4 кг/см3 және 8 кг/см3 жоғары. ГОСТ 55577-2013 және алынған нәтижелер негізінде ақуыздың көзі 23,33 есептеулерге сәйкес ауылшаруашылық жануарларының әртүрлі түрлерінің сүті деп санауға болады; сәйкесінше түйе, сиыр және ешкі сүтінің ақуыздары энергетикалық құндылықтың 16,56 және 17,72% қамтамасыз етеді. Алайда, тек түйе сүті ақуызға бай өнім болып табылады, өйткені оның құрамында ақуыз беретін өнімнің энергетикалық құндылығының 20% - дан астамы бар. Түйе сүтінің бұл артықшылығын арнайы тамақ өнімдерін өндіруде қолдануға болады, мұнда ақуыздар әртүрлі популяциялардың диетасының маңызды құрамдас бөлігі ретінде ерекше рөл атқарады.

РЕЗЮМЕ

По данным официального сайта Агентства стратегического планирования и реформ РК и Национального бюро статистики (https://stat.gov.kz/), поголовье верблюдов за прошлый год и за последние 5 лет увеличилось на 15 662 и 50 241 соответственно. Однако поголовье верблюдов в Казахстане по-прежнему относительно невелико по сравнению с коровами и козами. Исходяиз объема производства верблюжьего молока в 2022 году в стране был рассчитануровень самообеспеченности молоком и молочной продукцией населения Казахстана за счет верблюжьего молока(0,3%).

В данном исследованиидля изучения органолептических и физико-химических показателей верблюжьего молока для сравнения с коровьим и козьим молоком верблюжье молоко взяли от верблюдицы породы казахский бактриан. На основании данных физико-химических показателей различных видов молока подтверждено, что верблюжье молоко имеет высокую пищевую ценность за счет более высокой концентрации сухого вещества по сравнению с коровьим и козьим молоком с разницей в 2,3% и 3%, соответственно. Верблюжье молоко имеет более высокий уровень энергетической ценности, так как содержит 85,22 ккал на 100 г продукта, что на 16,92 ккал больше, чем у коровьего молока, и на 14,79 ккал больше, чем у козьего молока. Его плотность также выше на 4 кг/см^3 и 8 кг/см^3, чем в коровьем и козьем молоке, соответственно. На основании ГОСТ 55577-2013 и полученных результатов источником белка можно считать молоко различных видов сельскохозяйственных животных, согласно расчетам 23,33; 16,56 и 17,72% энергетической ценности обеспечивают белки верблюжьего, коровьего и козьего молока, соответственно. Однако

только верблюжье молоко является продуктом с высоким содержанием белка, так как в нем содержится более 20% энергетической ценности продукта, обеспечиваемой белком. Это преимущество верблюжьего молока может быть использовано при производстве специализированных пищевых продуктов, где белкам отводится особая роль как важнейшему компоненту рациона питания различных групп населения.