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Comparative characteristics of goat milk products in farms of Akmola and North Kazakhstan regions

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ABSTRACT

Providing the population with high-quality products is a priority intention of the government. North Kazakhstan and Akmola regions are the most promising in developing the country's dairy cattle breeding and milk processing. An assessment of the qualitative indicators of milk production and processing in these areas would allow us to assess the dynamics of the development of the country's dairy industry and identify the main problems, so research on this issue is relevant. The study aimed to analyze the qualitative indicators of milk production and processing at the enterprises of the North Kazakhstan and Akmola regions, the factors affecting the quality of dairy products, and the prospects for expanding the range of enterprises. In the study, an InfraXact infrared analyzer was used to determine the quality of haylage in the diet of goats and for goat milk - the CombiFoss FT + analyzer. Generally, the quality of milk on the goat farms "Zeren" and "Tamasha-2050" in terms of fat, protein, lactose, fatty acid composition of milk fat, and somatic cells meets the regulatory requirements. The specificity of the goat farm "Tamasha-2050" is the production of various hard and soft cheese types. Farm "Zeren" is focused on the production scale and a wide range of products (drinking milk, yogurt, kefir, and ice cream). It was concluded that there is a wide choice for the consumer of high-quality dairy products from goat milk in enterprises.

Keywords: goat milk, dairy product, quality, goat farm, Kazakhstan

INTRODUCTION

Recently, there has been a positive trend in dairy goat breeding in Kazakhstan, a profitable segment of the Kazakhstan market. Analyzing the changes that have taken place in the industry, it should be noted that according to the statistics agency of the Republic of Kazakhstan, the number of goats amounted to more than 400 thousand heads. According to statistics, the total number of sheep and goats in all categories of farms as of June 1, 2022, was 28,023.7 thousand heads. Compared to 2021, the increase was already 3.18%, as shown in Table 1.
The livestock of goats by category of agriculture includes large private farms (approximately 70%), agricultural organizations (1%), and peasant farms (29%).

As part of the project for developing the agro-industrial complex of the Kazakhstan Republic for 2021-2025, the volume of state support for the agro-industrial complex in 2022 is 48.1 billion tenges. Support for the development of animal husbandry is carried out in the given areas: to increase the productivity and quality of livestock products and subsidize farm animals. So, for example, funding for the development of animal husbandry is 6.5 billion tenges. Investments and subsidization of processing – 17.2 billion tenges (investments – 16,544.4 million tenges, for subsidizing the costs of processing enterprises – 697.8 million tenges) [1].

Table 1 Number of sheep and goats, thousand heads.

Region	2018	2019	2020	2021	2022 (on June 1)
Akmola	524.2	527.8	537.4	741.0	767.2
North Kazakhstan	384.4	402.7	416.9	615.4	634.9
Aktobe	1,206.1	1,216.9	1,265.1	1,578.6	1,636.9
Almaty	3,798.8	3,847.8	3,926.0	5,121.1	5,392.9
Atyrau	574.1	588.3	598.9	787.1	789.5
West Kazakhstan	1,291.0	1,219.9	1,254.9	1,734.6	1,815.7
Zhambyl	2,837.3	2,922.9	3,091.4	3,881.8	4,080.8
Karaganda	925.0	918.6	943.7	1,441.4	1,500.8
Kostanay	466.0	479.3	490.2	551.3	524.4
Kyzylorda	627.4	689.0	747.0	895.2	926.8
Mangist	399.1	394.7	424.9	610.7	561.5
Pavlodar	537.5	551.2	575.6	752.2	827.6
Turkestan	4,013.6	4,217.6	4,447.6	5,981.2	6,087.9
East Kazakhstan	1,809.7	1,784.1	1,769.8	2,370.7	2,401.9
Nur-Sultan	1.6	1.4	1.0	1.0	1.1
Almaty city	2.4	2.2	1.8	1.9	1.8
Shymkent	102.3	106.3	99.6	93.4	71.8
The Republic of Kazakhstan	19,500.4	19,870.7	20,592.0	27,158.6	28,023.7

Note: Compiled by the authors.

Figure 1 Map of agro-industrial projects in Kazakhstan.

According to the data in Figure 1, the agro-industrial map highlighted areas in which the development investments were made. Thus, in the Akmola region, from 2018 to 2021, the following projects were launched: processing of 1000 tons of oilseeds per day, production of 20 thousand tons of products per year (canned food, steaks, meat delicacies, etc.), the output of 500 tons of trout per year (live/chilled); in the Kostanay region from 2019 to 2020, a project is being implemented to produce 20 thousand tons of meat products per year; in the Almaty region from 2018 to 2021, the production of 60 thousand tons of extruded feed, the storage of grain – 15.0 thousand tons, the output of 1.2 thousand tons of dairy products per year are being implemented. More than 90 farms (29 modern dairy complexes) are in milk production in the North-Kazakhstan region. To increase the available livestock, about 1549 heads of breeding young cattle from Russia and European countries were imported this year. 34 projects worth 48 billion tenges are being implemented in the North Kazakhstan region. 16 dairy farms for 9 thousand heads and two feedlots for 13 thousand places are being built in the region **[2]**.

Akmola region is one of the leading agricultural and industrial regions of the Republic of Kazakhstan **[3]**. As part of the development of dairy farming in 2021, 19 farms for 2.3 thousand heads were created in the Akmola region (Akkolsky – 1 farm for 40 heads, Arshalynsky – expansion of 1 existing farm for 108 heads, Astrakhan – 1 farm for 50 heads was created and expansion of 1 operating farm for 400 heads, Atbasarsky – 1 farm for 300 heads, Birzhan sal district – expansion of 2 existing farms for 210 heads, Bulandinsky – 1 farm for 50 heads, Burabaysky – 2 farms for 348 heads were created and development of 1 operating farm for 40 heads, Ereymentausky – 1 farm for 93 heads, Esilsky – 1 farm for 50 heads, Zhaksynsky – 1 farm for 50 heads, Zerenda – 1 farm for 90 heads, Korgalzhynsky – 1 farm for 50 heads, Sandyktausky – 1 farm for 100 heads, Tselinogradsky – expansion of 1 operating farm for 275 heads, Shortandinsky – expansion of 1 existing farm for 93 heads) **[1]**. The volume of processed milk production amounted to 41 thousand tons, a decrease of 21.4% compared to the same level in 2021, 759 tons of butter were produced with an increase of 3.3%, and cheese and cottage cheese – by 452 tons, a decrease of 42.4%, fermented milk products - 3.5 thousand tons with an increase of 6%. The workload of milk processing enterprises amounted to 59.9% (in 2021 – 76.2%) **[1]**.

Table 2 shows data on milk production in Kazakhstan over the past six years.

Table 2 Milk production in Kazakhstan in 2016-2021 (tons).

Index	2016	2017	2018	2019	2020	2021
Total production of milk	5341647.1	5 503418.3	5 686210.8	5 865087.6	6 051407.7	6 247202.3
cow's milk	5300014.2	5460451.4	5642283.0	5819317.2	6004364.4	6198842.0
mare's milk	25497.0	26600.8	27221.2	27565.3	28424.5	29025.2
goat milk	1486.4	1413.5	1398.3	1374.5	1381.6	1331.0
camel milk	14649.5	14952.6	15308.3	16827.6	17234.1	18022.0

As seen in Table 2, the production of all types of milk is increasing from year to year; at the same time, the production of mare and camel milk is growing, then the gross collection of goat milk remains at almost the same level.

According to the Ministry of Agriculture in Kazakhstan, there is an annual increase in prices for socially significant food products. Table 3 shows the average prices for dairy products as of 2021; for example, for the whole republic: unsalted butter was sold for 2720 per 1 kg, pasteurized milk (2.5%) – 256 per 1 liter, kefir (2.5 %) – 280 per 1 liter, cottage cheese – 1530 per 1 kg.

Table 3 Average prices for socially important food products as of 2021.

Region	Butter unsalted	Pasteurized milk 2.5%, liter	Kefir 2.5%, liter	Cottage cheese
Nur-Sultan	3 154	275	298	2 205
Almaty	3 207	271	321	1 838
Shymkent	2 332	231	244	1 849
Aktau	3 162	-	340	2 045
Aktobe	2 427	245	277	1 358
Atyrau	3 307	-	321	1 348
Zhezkazgan	2 774	297	280	1 822
Kokshetau	2 509	252	312	1 167
Karaganda	3 053	275	249	1 465
Kostanay	2 540	244	267	1 476
Kyzylorda	2 860	-	252	1 460
Uralsk	2 380	241	261	1 335
Ust-Kamenogorsk	2 759	274	352	1 406
Pavlodar	2 489	244	271	1 404
Petropavlovsk	2 433	-	229	1 173
Semei	2 450	274	263	1 504
Taldykorgan	2 767	209	216	1 092
Taraz	2 364	-	248	1 528
Turkestan	2 700	-	288	1 595

Note: Compiled by the authors. Source **[2]**.

Despite high production costs, milk production and processing remain an attractive economic niche. However, for the sustainable development of the dairy goat industry in Kazakhstan, it is necessary to modernize the material and technical base and goat milk processing technologies, create a forage base, and modern methods of storing dairy and processing secondary raw materials. This study aimed to confirm that goat farms in Akmola and North Kazakhstan produce good quality raw materials, which could be successfully used to create a wide range of dairy products from goat milk.

Given the development of dairy cattle breeding in the regions, it is necessary to accumulate statistical information on domestic experience in the production of goat milk and products from it.

Scientific Hypothesis

The feeding of goats must be optimized using additional feed additives to improve the quality component of raw milk. To reach this goal, we analyzed the quality of feed value of haylage included in the diet of goats and milk on two farms. Such feed's nutritional value provides goats with a maximum of 80% of the norm of feed units per day.

MATERIAL AND METHODOLOGY

This article is a comparative description of the production of goat milk and dairy products, compiled on the example of two goat farms in the Akmola and North Kazakhstan regions. The review includes statistical reports from the Department of Agriculture of Akmola and the North Kazakhstan regions. The analysis of the suitability of Akmola and North Kazakhstan goat milk as raw materials for cheese and dairy products was carried out. Links to studies on the production of dairy products from goat milk worldwide are given. Since product characteristics ultimately depend on milk quality, there is great interest in identifying the fundamental relationship of milk production factors that affect its composition **[3]**. The research aims to improve the quality of production and processing of goat's milk. An analysis of the qualitative indicators of milk and dairy products in the regions and the factors influencing these indicators is relevant for obtaining a general idea of the present state and further development of the dairy industry in the country.

Description of the Experiment

Goat farms "Zeren" and "Tamasha-2050": The breeding farm "Zerenda" produces products from goat milk under the ZEREN trademark and is widely represented in stores in Astana (Nur-Sultan), Karaganda, and Kokshetau. It is the largest goat farm in the Kazakhstan Republic and has more than 1200 breeding goats of Zaanen, Alpine, and Angol-Nubian breeds. The breeding farm "Zerenda" has a complete production cycle, from fodder harvesting to the release of final products, allowing to control of product quality at each stage **[4]**. Farm "Tamasha-2050" – the farm specializes in breeding goats and producing dairy products. Farm "Tamasha-2050" was founded in 2020. Farm "Tamasha" breeds goats of the Saanen breed. At the Tamasha-2050 farm, cheeses are made from milk immediately after pasteurization; classic recipes are used. The cheese factory produces 36 products, including elite cheeses such as parmesan, asiago, cheddar, and montasio **[5]**.

Determination of feed quality: Feed quality was determined according to GOST 32040-2012 "Feedstuffs, compound feeds, feed raw materials. Method for determination of crude protein, crude fiber, crude fat and moisture using spectroscopy in the near-in-infrared region" on an InfraXact infrared analyzer (FOSS Electric, Denmark). It provides fast, accurate, and reliable analysis of feed, grain, and other components (protein, moisture, fat, crude fiber, ash, etc.) both in production and in the laboratory. The study was conducted based on the laboratory of the North Kazakhstan Research Institute of Agriculture LLP, Beskol, Kazakhstan **[6]**.

InfraXact is a spectrometer operating in the near-in-infrared region of the spectrum (NIR, 570-1848 nm); the analysis does not require reagents and solvents. The essence of the principle of operation of InfraXact spectrophotometers is based on comparing two light fluxes: full, taken as 100% reflection, and weakened when reflected from the sample under study. The spectrophotometers are assembled according to a single-beam scheme. The following main components are located in the device body: light source (halogen lamp); monochromator with a movable diffraction grating; focusing optical system; cuvette compartment for placing a cup with a test sample or solution; radiation receivers - a silicon photodiode for the wavelength range of 570-1098 nm and an InGaAs-based detector for the wavelength range of 1100-1848 nm, as well as a power supply system and a communication circuit with a control computer. Management of operating modes, all calibration operations, measurements, and saving results are performed by a specialized computer program "ISIScan," running in a Windows environment **[6]**.

Feed quality was determined according to GOST 32040-2012 Feedstuffs, compound feeds, and feed raw materials. Method for determination of crude protein, crude fiber, crude fat, and moisture using spectroscopy in the near-in-infrared region on an InfraXact infrared analyzer (FOSS Electric, Denmark). While preparing and carrying out measurements in the laboratory, the following conditions were met: ambient temperature – 27 °C, relative air humidity – 52%, supply voltage – 220V, AC frequency 50Hz. The crushed analyzed sample is transferred into a tightly closed container and, after it is cooled to room temperature, is used to take the spectrum. The mass of the laboratory sample was 250 g. Sampling is carried out according to ISO 6498:2012 Animal feeding stuffs-Guidelines for sample preparation, IDT **[7]**. The device is turned on and brought to the measurement mode following the operating instructions. Taking spectra is as follows: a carefully cleaned cuvette on a special stand included in the IR analyzer kit is tightly filled with a thoroughly mixed analyzed sample using a spatula. Avoid sudden movements and cuvette shaking. It is not allowed to pour the analyzed sample from the vessel, as this leads to gravitational separation of fractions and reduces the accuracy of the determination. Measurements are taken immediately after filling the cuvette. The measurement results are processed automatically. The content of the determined indicators is read from the display of the IR analyzer and can be printed. For the final result of the determination, the arithmetic mean of two parallel determinations is taken, with a confidence level of $p = 0.95$. The result is rounded to the first decimal place **[6]**.

Determination of milk quality: For the determination of milk quality the CombiFoss FT+ milk analyzer was used (North-Kazakhstan Research Institute of Agriculture LLP, Beskol, Kazakhstan). Fossomatic FC is based on flow cytometry technology. This approach is based on the enumeration and characterization of particles and cells. MilkoScan FT+ is based on Fourier IR spectroscopy (FTIR) analysis. It operates in the mid-IR range of 3-10 µm, corresponding to 1000-5000 cm^{-1}. The MilkoScan FT 6000 (Foss Electric) is based on Fourier transform infrared technology and provides a wide range of compositional parameters, including fat, protein, lactose, solids, CN, FFA, urea, and FP depression **[8]**. However, the laboratory is accredited to determine only 3 indicators: the mass fraction of fat and protein, and the content of somatic cells. The analyzed samples were checked for compliance with GOST 32940-2014 “Raw Goat Milk Technical conditions” **[9]**. Milk consumption for analysis: 5 mL. Sample temperature: 37-42 °C. VC (coefficient of variation) – standard (root mean square) deviation of CO, divided by the average value of the measured samples and multiplied by 100%, i.e. for milk with a fat content of 3%, the absolute accuracy will be ±0.03%.

The quality of goat milk products: The physicochemical parameters of goat milk products were obtained according to the data from the official websites of the Zeren and Tamasha-2050 enterprises **[10]**, **[11]**. The energy value of goat milk products was determined according to formula 1:

$$\mathrm{EV} = 0.845 \times \mathrm{P} \times 4.0 + 0.94 \times \mathrm{F} \times 9.0 + 0.956 \times \mathrm{C} \times 4.0 + \mathrm{OA} \times 3.0 \quad (1)$$

Where:
P – proteins; F – fats; C – carbohydrates; OA – organic acids. Energy values are calculated per 100 g of food and are expressed in kilocalories and kilojoules **[12]**.

Statistical Analysis

The research materials were subjected to statistical processing using the methods of parametric and non-parametric analysis. Accumulation, correction, systematization of initial information, and visualization of the results were performed in Microsoft Office Excel 2016 spreadsheets. Statistical analysis was carried out using the program STATISTICA 13.3 (developer – StatSoft. Inc). In the case of describing quantitative indicators with a normal distribution, the obtained data were combined into variational series, in which the calculation of arithmetic means (M) and standard deviations (SD), boundaries of the 95% confidence interval (95% CI) was carried out.

RESULTS AND DISCUSSION

The diet of goats at the Zerenda farm includes haylage, pasture grass, alfalfa, barley, goat's rue, and rump. The fodder base of the enterprise is 400 hectares of irrigated fields. Since the quality and quantity of feed are of the most significant value for obtaining high-quality milk and other manufactured products, it is necessary to introduce biodiversity into the nutrition of goats. In turn, the Tamasha-2050 farm also grows forage grasses, oats, and barley for animal feed. The basis of food for goats at the farm "Tamasha" is hay, barley straw, barley, and oats. Goats on both farms are kept indoors; their feed consists of haylage (3 kg per animal). Also, for feeding highly productive goats, a grain mixture is used (corn, barley, and oats in equal proportions) **[13]**. The results of the experiment are shown in Table 4. Table 4 shows the nutritional value of haylage, which is the main part of the diet of goats on farms. According to the author **[13]**, goats should receive a nutritional value of 0.70 feed units per day during the grazing period. To ensure intensive development and necessary vital activity, the amount of digestible protein in the diet should be contained at 80 g.

As could be seen from Table 4, the nutritional value of feed LLP "Zeren" provides goats with 71.4% of the norm of feed units per day, while on the Tamasha-2050 farm – only 68.5% of the norm. The amount of digestible protein in the diet of the goats of the farm "Zeren" is – 75.5% of the norm, and the farm Tamasha-2050 – 61.8% of the norm. Thus, the goats of Zeren LLP consumed more haylage in terms of exchange energy than at the Tamasha-2050 farm by 2.93% and dry matter – by 1.54%, respectively.

Table 4 Feed value of haylage included in the diet of goats.

No.	Indicators	Zeren LLP		Tamasha-2050	
		In natural moisture of forage		In natural moisture of forage	
		content, g	content, g	content, %	content, %
1	Dry matter	863. 28	86.33	850.16	85.02
2	Organic matter	785.95	-	767.18	-
3	Humidity	136.72	13.67	149.84	14.98
4	Raw ash	77.34	7.73	82.98	8.30
5	Crude protein	112.41	11.24	92.10	9.21
6	including digestible Protein	60.43	6.04	49.51	4.95
7	Crude fat	25.18	2.52	25.68	2.57
8	Crude fiber	300.35	30.04	297.56	29.76
9	NFE, g incl.	348.01	34.80	351.84	35.18
10	Starch, %	1.10		1.00	
11	Sugar, %	6.70		6.42	
12	Carotene, mg	22.70		20.50	
13	Calcium %,	0.80		1.06	
14	Phosphorus, %	0.25		0.31	
	Nutritional value of forage:				
15	Exchange energy MJ	6.32		6.14	
16	Energy feed units (EFU)	0.63		0.61	
17	Feed unit	0.50		0.48	

Note: Compiled by the authors.

As could be seen from Table 4, the nutritional value of feed LLP "Zeren" provides goats with 71.4% of the norm of feed units per day, while on the Tamasha-2050 farm – only 68.5% of the norm. The amount of digestible protein in the diet of the goats of the farm "Zeren" is – 75.5% of the norm, and the farm Tamasha-2050 – 61.8% of the norm. Thus, the goats of Zeren LLP consumed more haylage in terms of exchange energy than at the Tamasha-2050 farm by 2.93% and dry matter – by 1.54%, respectively.

Goat milk quality

Table 5 presents goat milk's physical and chemical parameters on the farms "Zeren" and "Tamasha-2050".

Table 5 Physical and chemical indicators of goat milk on farms.

Name	Arithmetic mean (M):	Median (Me):	Standard deviation (σ):	The coefficient of variation (Cv), %:	The average error of the arithmetic mean (m):
			Zeren LLP		
Fat	3.76	3. 97	0.1	2.75	0.05
Protein	3.27	3.23	0.05	1.60	0.03
Casein	2.31	2.31	0.01	0.36	0.00
Lactose	3.93	3.93	0.01	0.21	0.00
TS	11.23	11.23	0.02	0 .18	0.01
Cells	137.40	138	2.19	1.59	1.10
MUFA	0.76	0.747	0.02	2.77	0.01
PUFA	0.29	0.285	0.01	3.48	0.01
Saturated FA	2.34	2.352	0.02	0.85	0.01
Total UFA	0.60	0.594	0.02	3.97	0.01

Table 5 Cont.

Name	Arithmetic mean (M):	Median (Me):	Standard deviation (σ):	The coefficient of variation (Cv), %:	The average error of the arithmetic mean (m):
			Tamasha-2050		
Fat	3.82	3.83	0.1	2.52	0.05
Protein	3.23	3.23	0.01	0.26	0.00
Casein	2.32	2.32	0.00	0.19	0.00
Lactose	3.94	3.94	0.00	0.00	0.00
TS	11.27	11.27	0.02	0.16	0.01
Cells	135.40	135	1.14	0.84	0.57
MUFA	0.770	0.775	0.01	1.81	0.01
PUFA	0.29	0.288	0.01	2.30	0.00
Saturated FA	2.33	2.342	0.05	1.94	0.02
Total UFA	0.61	0.618	0.01	1.60	0.00

Note: Saturated Fatty Acids (SFA); Monounsaturated Fatty Acids (MUFA); Polyunsaturated Fatty Acids (PUFA); Unsaturated Fatty Acids (UFA). Compiled by the authors.

Table 5 shows that the fat, protein and total unsaturated fatty acids content in goat milk samples did not vary significantly: fat (p = 0.424), protein (p = 0.224), total UFA (p = 0.35); for example, in the milk of the Tamasha-2050 farm, the fat content was, on average, 1.5% higher, while the protein content was less by 1.2%. Total lactose contents in milk samples ranged between 3.92% and 3.93%, p <0.01, casein – between 2.31% and 2.32% (p <0.01) and TS – between 11.23% and 11.27% (p <0.01). In general, the quality characteristics of goat milk in both farms met the requirements of GOST 32940-2014 "Raw Goat Milk Technical conditions" **[8]**.

Tables 6-7 provide data on the physical and chemical parameters of dairy products from goat milk, energy value, types of packaging, and prices for products on the farms "Zeren" and "Tamasha-2050".

Table 6 Physical and chemical parameters of assortment products in the goat farm “Zeren”.

Product’s name	Mass fraction of fat, %	Mass fraction of protein, %	Mass fraction of carbohydrates, %	Energy value, kcal	Package type	Shelf life, days	Weight (L)	Price (tenge)
Natural pasteurized goat milk	3.9-4.0	3.3	4.4	62 kcal/ 259 kJ	Plastic bottle	7	1	1 000
Goat milk	3.9-4.0	3.3	4.4	62 kcal/ 259 kJ	Plastic bottle	7	0.5	600
Yogurt drink 4%	3.9-4.0	3.3	4.3	59 kcal/ 247 kJ	Plastic bottle	14	0.3	750
Yogurt drink – Strawberry 4%	3.9-4.0	3.3	5.2	65 kcal/ 254 kJ	Plastic bottle	14	0.3	850
Yammi ice cream – ice cream	10	3.7	18.4	178 kcal/ 745 kJ	plastic bucket	6 months	0.25	1 200
Yammi ice cream – chocolate	10	3.7	18.4	178 kcal/ 745 kJ	plastic bucket	6 months	0.25	1 200
Kefir 2.5%	2.5	2.8	4.0	49.7 kcal/ 208 kJ	Plastic bottle	14	0.5	750
Kefir 1% (lite)	1	3.0	4.0	36 kcal/ 151 kJ	Plastic bottle	14	0.5	600

Table 6 Continue.

Product's name	Mass fraction of fat, %	Mass fraction of protein, %	Mass fraction of carbohydrates, %	Energy value, kcal	Package type	Shelf life, days	Weight (L)	Price (tenge)
Creamy ice cream	10	3.7	18.4	178 kcal/ 745 kJ	plastic bucket	6 months	0.7	2 550
Chocolate ice cream	10	3.7	18.4	178 kcal/ 745 kJ	plastic bucket	6 months	0.7	2 550
Cottage cheese	1.8	18	1.2	88 kcal/ 370 kJ	PET Packaging	7	0.2	750
Whole goat milk kurt	1	20	17	200 kcal/ 837 kJ	vacuum packaging	15	0.1	750
Homemade sour cream	58	2.5	3.3	556 kcal/ 2322 kJ	plastic cup	10	0.2	900
Butter goat	82.5	0.5	0.5	765 kcal/ 3 202 kJ	PET Packaging	15 to 30	0.1	900
Butter goat	82.5	0.5	0.5	765 kcal/ 3 202 kJ	PET Packaging	15 to 30	0.2	1700
Whey	0.05	0.8	3.5	18.1 kcal/ 76 kJ	Plastic bottle	7	1	450

Note: Compiled by the authors. Source **[10]**.

As could be seen from Table 6, the Zeren enterprise presents a wide range of products supplied on an industrial scale: drinking pasteurized milk (4.0%), kefir (1%, 2.5%), yogurts with and without filling (4%), cream and chocolate ice cream (10%), butter (82.5%), sour cream (58%), whey (0%).

Table 7 Physical and chemical parameters of assortment products in the goat farm Tamasha-2050.

Product's name	Mass fraction of fat, %	Mass fraction of protein, %	Mass fraction of carbohydrates, %	Energy value, kcal	Package type	Shelf life, days	Weight (L)	Price (tenge)
Natural goat milk	3.9-4.3	4.4-4.5	4.2-4.5	68-70 kcal/ 284-294 kJ	Plastic bottle	7	1	700
Sour cream	24	2.9	3.7	247 kcal/ 1034 kJ	PET Packaging	10	0.1	1200
Butter	82	0.6	0.9	748 kcal/ 3131 kJ	PET Packaging	30	0.1	1400
Cottage cheese	9	8	3.5	84 kcal/ 351 kJ	PET Packaging	7	0.1	900
Kurt	0.05	20	16	200 kcal/ 837 kJ	PET Packaging	15	0.1	1000
Cheese candies	0.05	20	25	240 kcal/ 1000 kJ	PET Packaging	15	0.1	1000
Mold (Blue) Cheeses								
Camembert	24	22	0	304 kcal/ 1272 kJ	vacuum packaging	45	0.1	1000
Pouligny St Pierre	28	22	1	330 kcal/ 1381 kJ	vacuum packaging	to 120	0.1	650
Shaurs	30	18	0	342 kcal/ 1431 kJ	vacuum packaging	30	0.1	650
Bree	27	30	0	372 kcal/ 1557 kJ	vacuum packaging	15	0.1	650

Table 7 Continue

Product's name	Mass fraction of fat, %	Mass fraction of protein, %	Mass fraction of carbohydrates, %	Energy value, kcal	Package type	Shelf life, days	Weight (L)	Price (tenge)
Soft cheeses								
Feta	27	15	0	268 kcal/ 1122 kJ	Plastic boxes	15	0.1	650
Burrata	20	17	1.8	255 kcal/ 1060 kJ	plastic cup	4	0.1	900
Suluguni	24	17	0	290 kcal/ 1213 kJ	vacuum packaging	60-120	0.1	650
Brynza	19.8	18.2	0	251 kcal/ 1050 kJ	plastic cup	20	0.1	650
Adyghe	18	16	0	228 kcal/ 954 kJ	vacuum packaging	44	0.1	650
Ricotta	10	13	2.8	142 kcal/ 594 kJ	Plastic boxes	10	0.1	700
Hard cheeses								
Fracket	26	17	1.8	264.2 kcal/ 1105 kJ	vacuum packaging	15	0.1	550
Asiago	26.3	11	1.2	209 kcal/ 875 kJ	vacuum packaging	15	0.1	900
Belper Knolle	25	10	0.8	193.2 kcal/ 808 kJ	Plastic boxes	60	0.1	900
Cachotta	20	25	0	280 kcal/ 1172 kJ	vacuum packaging	90	0.1	900
Gouda	25	26	2	354 kcal/ 1482 kJ	vacuum packaging	30	0.1	900
Maasdam	26.3	26.8	0	342 kcal/ 1433 kJ	vacuum packaging	90	0.1	900
Cheddar	26.8	25.2	0	334 kcal/ 1398 kJ	vacuum packaging	15	0.1	900
Monterey Jack	26	23	0	326 kcal/ 1364 kJ	vacuum packaging	30	0.1	900
Parmesan	23	21	0	281 kcal/ 1176 kJ	vacuum packaging	90	0.1	900
Montasio	32	24	1	388 kcal/ 1642 kJ	vacuum packaging	7	0.1	900
Jarlsburg	28	26	0.3	364 kcal/ 1523 kJ	vacuum packaging	30	0.1	900
Canestarto	29	23	0	362 kcal/ 1115 kJ	vacuum packaging	15	0.1	900
Tilsiter	23.4	24.4	0	308 kcal/ 1281 kJ	vacuum packaging	30	0.1	900
Bulaevsky	25	26	2	354 kcal / 1482 kJ	vacuum packaging	30	0.1	900

Note: Compiled by the authors. Source **[11]**.

As could be seen from Table 7, the Tamasha-2050 enterprise mainly presents a wide range of different types of soft and hard cheeses, as well as blue cheeses.

Prices for goat milk products and raw materials in 2020 averaged: milk, pasteurized normalized (3.2%) 580 tons per 1 liter; sour cream (30%) – 3,125 tons per 1 kg; semi-fat cottage cheese (9%) – 2,679 tons per 1 kg; hard cheeses – 3,795 tons per 1 kg; milk – raw materials – 520 tons per 1 liter; butter – 8500 tons per 1 kg, whey – 300 tons per 1 liter; yogurt – 450 tons per 300 mL **[14]**.

In general, in 2022, all Zeren dairy products from goat milk increased in price, as shown in Table 5. Prices increased for milk (+34.61%), yogurt (+66.66%) and sour cream (+44 .0%), butter (+5.88%) and cottage cheese (+38.88%). The products of the Tamasha-2050 farm, represented mainly by cheeses of various types, similarly increased in price: milk (+34.61%), sour cream (+284%), butter (+64.7%), and cottage cheese (+233 %), as well as fresh and semi-hard cheeses (+ from 71.3 to 137%).

The production of cheese and butter is the most costly; as a result, the price of these types of products is higher and domestic enterprises, due to the high cost of production, are forced to either reduce their production or work for export. At the same time, the Republic of Kazakhstan subsidizes the costs of a dairy processing enterprise for the purchase of milk for the production of butter, hard cheese, and powdered milk (whole). It involves the reimbursement of the difference between the guaranteed purchase price and the purchase price of a unit of processed products, considering the final conversion factors given in the table of products for milk subsidy standards per unit of purchased agricultural products approved by akimats **[15]**.

The norm of subsidies per kg of purchased milk varies depending on the akimat and is for the production of: butter – from 12 to 16 tenges per liter; hard cheese – from 15 to 20 tenge per liter; powdered milk – 15 tenges per liter **[15]**.

In the Republic of Kazakhstan, the share of the subsidy in the total direct costs incurred for purchasing machinery and equipment for a milk processing facility is 30%, and for buying a portable milking machine, 50% **[15]**.

According to Miller et al. (2019) **[16]**, the global goat population continues to grow and is now over one billion. Most of the world dairy goat production and consumption is in Asia, but most organized market for goat milk is found in Europe, especially in France. The European goat sector specializes in milk production, mostly for industrial cheese making, while supporting traditional on-farm manufacturing. Government involvement is significant in sanitary regulation, research, extension, support for local producer organizations, and markets, and ensures safety and quality **[16]**. The study **[17]** of goat farms demonstrated that the extension system suffers from limitations of financial and man-power resources. Farmers have minimal access to scientific advancement in the field of livestock production. Further, the meta-analysis **[17]** revealed that the farmers had knowledge of 47% of technologies that has the potential to mitigate the effects of climate change on goats. The health, feeding, breeding, and housing practices had an adoption level of 31%, 40%, 58% and 70% respectively **[17]**. The results **[18]** show that in Algeria three different farming systems: cluster 1 (pastoral system), cluster 2 (mixed crop-livestock system) and cluster 3 (small herds in zero grazing system).

According to Kisku et al. **[19]**, goat farming projects can be a considerably profitable business for small and marginal farmers. In long run, a farmer may increase flock size depending on market demand for more profit **[19]**. The study of fermented dairy products **[20]** demonstrated that they feature functions are immunomodulatory agents, anti-carcinogenic agents, hypocholesterolemic agents, antioxidants and hypotensive agents.

Caprine milk fat is a reward in short- and medium-chain fatty acids, particularly caprylic and decanoic (capric) acids **[21]**. The fatty acid profile of raw milk samples is shown in Table 4. Therefore Saturated Fatty Acids (SFA) were most prevalent in goat milk samples. A previous study of goat milk identified several aspects of using local milk raw materials in Kazakhstan is little known **[22]**.

Extensive research has shown that goat milk has been an essential part of human nutrition for millennia, partly because of the more remarkable similarity of goat milk to human milk, softer curd formation, a higher proportion of small milk fat globules, and different allergenic properties compared with cow milk. As a result, the need for higher-quality goat milk has increased in recent years. Goat milk and milk products are held to the same high standards for safety and quality that the known in the dairy industry. Furthermore, their compact size (compared with cows) makes them appealing from herd management and milking standpoint. Additionally, physiological differences render unique physical characteristics to goat milk in terms of flavor profile, fat globule size, coagulation properties, and allergenicity, making goat milk the dairy product of choice for many consumers **[23]**.

However, a study investigating advances in goat milk **[24]** offers additional research into methods to sustainably feed goats, responsibly improve productivity, ecologically manage effluents, and creatively utilize goat whey will be essential in managing the global dairy industry.

These experiments confirmed that the quality of raw milk and various types of dairy products from goat milk on the goat farms "Zeren" and "Tamasha-2050" meet regulatory requirements and are presented to the consumer in a wide range. The total solid content, dry matter, and proximate composition of goat milk and feedstuffs from the different farms were determined. The results were analyzed using principal component analysis, as seen in Tables 3-4. The total solid content of goat milk from the "Tamasha-2050" farm had the highest solid content ranging from 11.27% to 11.29%, compared to milk from farm "Zeren." Previous studies find that milk's quality and composition vary according to breed, diet and feeding practices, management system, lactation stage, parity, and animal health **[25]**, **[26]**. These results are consistent with data obtained in earlier studies **[27]**, which found that goat milk had a solid content ranging from 10.95% to 14.63%, milk fat ranging from 2.49% to 7.36%, and protein contents (4.34%). However, some researchers **[28]** investigated how can naturally increase omega-3 fatty acid content in goat milk using goat nutrition as one of the key factors. In this study, results showed that goat feed supplementation with linseed oil indeed positively changed fatty acid profile of goat milk by increasing α-linolenic acid content **[28]**.

It has been noted **[29]** that goat milk and its derived products have high nutritional value. The study **[30]** revealed that goat milk may be considered as the basis for the creation of a sour-milk product for special dietary consumption. Goat milk has a low content of αs1- αs2- and a high content of β-casein fractions of proteins compared to cow milk **[30]**. To increase their production, it is necessary to increase food safety, improve their flavor, and potentiate their functional value. Several researchers **[31]** attempted to find the advantages of goat milk, the necessary theoretical background, and some details about using prebiotics and/or probiotics in goat milk products. Sumarmono (2022) **[32]** demonstrated that goat milk utilization includes fluid milk for direct consumption; frozen fresh milk; dried or powdered milk; fermented milk products such as yogurt, kefir, including its derivatives such as cosmetics, concentrated yogurt, yogurt cheese, ice cream, shakes; cheeses such as fresh cottage-type cheese, acid-coagulated cheese and mozzarella.

O'Brien, Aryana, Prinyawiwatkul, Ordonez, and Boeneke (2016) cited that many health benefits are associated with traditionally produced kefir; for instance, the usually made kefir exhibited significantly higher counts of bacteria and yeast at each sampling of frozen storage **[33]**. In addition, Domagała, Wszolek, and Dudzińska (2012) reported that probiotic yogurts prepared from goat's milk concentrated via ultrafiltration have better sensory properties and maintain a good texture **[34]**. Goat's milk might also be utilized to produce ice cream with desirable textural properties, good sensory quality, and desirable melting characteristics: commercial raspberry and blackberry fruit sauces and fruit sauce prepared from frozen raspberry were used for the production of ice cream (Açu, Kinik, Yerlikaya, 2017) **[35]**. The sensory characteristics of goat yogurt could be greatly improved by integrating to a culture typical of yogurt starters, Streptococcus thermophilus, Lactobacillus delbrueckii spp. bulgaricus, with cultures of Leuconostoc lactis, as reported by De Santis et al. (2019) **[36]**. The results of this study indicated that adding L. lactis to the traditional yogurt starter improved the sensory characteristics of fermented goat milk. Hadjimbei et al**.** (2020) **[37]** found that goats' milk yogurt fortified with Pistacia atlantica resin extract alone or in combination with Saccharomyces boulardii were produced. Dual supplementation of yoghurt promoted the growth of LAB, enhanced the stability of resin phytochemicals and improved the organoleptic properties. El-Shafei et. al. (2020) **[38]** investigated the impact of supplementing goats' milk with quinoa extracts, in the range of 5, 10 and 15 g/100g on the milk fermentation. The supplementation of goats' milk with quinoa extracts, particularly permeate extract, reduced the fermentation time and enhanced the viability of lactic acid bacteria. Panellists highly accepted the yoghurt that contained quinoa permeate extract **[38].** The study of milk quality demonstrated that **[39]** it depends on chemical parameters (fat and protein content and absence of inhibitory substances), as well as microbial and somatic cells counts, and affects the price of milk.

There are results not only about an investigation of goat milk **[40]**, but also of cheese. The position of goat milk and its products may vary depending on factors such as season, feeding system and heat treatment. Total phenolic compounds concentrations were highest in unpasteurized samples from dry season compared to pasteurized and rainy season: 132.4 ±7.3, 76.5 ±0.77 mg of gallic acid equivalent (GAE)/L for unpasteurized milk and milk whey, respectively, and 363.21 ±2.97 mg GAE/Kg for cheese. Antioxidant capacity for dry season produce was significantly higher (p <0.05) than rainy season produce. Free-range grazing was a food option for producing a higher concentration of phenolic compounds and a higher antioxidant capacity **[40]**. For instance, Bennato et al. **[41]** determined that dietary integration with dried licorice root modified chemical and technological properties of goat cheeses, reducing lipid oxidation during ripening and inducing changes in texture that could improve consumer acceptability.

Results obtained by Vargas-Bello-Pérez et al. **[42]** for consumer attitudes found consumer preferences for small ruminant dairy products, between continents. Among consumers in Italy, Greece, Denmark, and Mexico, the most desirable was fresh cheese, and the preferred product in Spain and Chile was aged cheese. Another significant aspect was that consumption frequency was the highest in Italy, Spain, and Greece. In Chile and Mexico, consumption was limited to 2 to 3 times per month, whereas frequency in Bangladesh was 1 to 2 times per year, or as necessary due to sickness **[42]**.

This study confirms previous findings **[24]** about high production costs and correspondingly inflated prices for goat milk products. However, the development of goat breeding has economic and social significance for all areas of activity. In particular, the production and processing of products will create additional jobs and provide the population with high-quality meat, wool, and dairy products **[43]**. It should be noted that the fundamental condition for effective animal husbandry management is the need for organizational and economic reorganization of all parts of the technological process on new production and technical basis. The modernization of industries involves the creation of large goat-breeding complexes, specialized farms, and inter-farm enterprises, the introduction of advanced technologies; increasing the efficiency of selection and breeding work; improvement of the forage base; introduction of intensive rearing and fattening of young growth using resource-saving technologies **[43]**. In the future, it is necessary to pay serious attention to increasing the number of goats and creating conditions for maximizing their productivity, as well as the rational use of pastures by goats, observing pasture rotation and load **[43]**. This will increase the gross income of the country's agro-industrial complex and meet the growing demand for medical nutrition for people who cannot tolerate cow's milk, people with weakened immune systems, diseases of the gastrointestinal tract, and diabetics **[43]**. At the same time, some authors **[24]** point out the importance of other measures, such as professional management training and a well-thought-out goat farm management plan.

CONCLUSION

A brief analytical review of production projects launched in Akmola and North Kazakhstan regions, affecting the development of animal husbandry and dairy cattle breeding in the regions, was carried out. Although most goat milk producers are private farms, there are also large goat farms: in the Akmola region – Zerenda LLP, in the North Kazakhstan region – Tamasha-2050 LLP. The results showed a significant difference (p <0.05) on the lactose, caseimilk samples' ns and total solids contents in milk samplebetween the general, in 2022, all dairy products from goat milk from the Zeren farm went up, prices increased for milk (+34.61%), yogurt (+66.66%) and, sour cream (+44.0%), butter (+5.88%), and cottage cheese (+38.88%). The products of the Tamasha-2050 farm similarly increased in price: milk (+34.61%), sour cream (+284%), butter (+64.7%) and cottage cheese (+233%), as well as fresh and semi-hard cheeses (+71.3 to 137%). The diet of the animals complied with the norms; the considered physical and chemical parameters of milk meet the requirements of regulatory documents and, accordingly, could be used for the production of various types of dairy products.

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