

Original Research Paper

# Selective and Genetic Aspects of Increasing Dairy Productivity of the Kazakh Bactrian Camels (*Camelus bactrianus*)

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**Abstract:** The aim of the research work was, firstly, to increase the genetic potential of the productivity of camels of the Kazakh Bactrian breed and of methods for its implementation based on selection; secondly, to determine the selective and genetic parameters of dairy products and the optimal ways of conducting breeding work with Kazakh Bactrians of dairy direction. In the conditions of deserts and semi-deserts, the development of dairy cattle breeding is impossible due to the scarcity of food resources, except for productive camel breeding. It is the branch of productive animal husbandry that will allow involving more than 100 million hectares of desert and semi-desert lands into economic activity with the subsequent development of social infrastructure with all the attributes of a competitive market economy. The conducted research indicates that the organization of selection and breeding work in dairy camel breeding should be based on selection and genetic parameters. The obtained values of the milk yield heritability coefficients ( $h^2 = 0.353$ ) are due to polygenes, which complicate the selection process. When organizing breeding work with camels of the Kazakh Bactrian breed of dairy products, we recommend that you analyze the selective and genetic parameters, this will allow you to reasonably select camels of linear origin and improve the productivity of the main herd.

**Keywords:** Camels, *Camelus bactrianus*, Kazakh Bactrian, Milk Production, Genetic Potential

## Introduction

Dairy camel breeding is a significant productive direction of the industry in the Republic of Kazakhstan (Baimukanov *et al.*, 2020a; Alibayev *et al.*, 2021).

In the conditions of deserts and semi-deserts, the development of dairy cattle breeding is impossible due to the scarcity of food resources, except for productive camel breeding. It is the branch of productive animal husbandry that will allow involving more than 100 million hectares of desert and semi-desert lands in economic activity with the subsequent development of social infrastructure with all the attributes of a competitive market economy (Alibayev *et al.*, 2020).

Serious tasks have been set for domestic camel breeders to increase the production of camel milk and improve the technological qualities for primary processing.

Achieving the goals is possible only with a significant increase in the productive and breeding qualities of purebred camels based on modern resource-saving technologies, the latest scientific developments, effective breeding methods that can rapidly improve the existing genotypes of dairy camels in the direction of productivity that meet modern industrial production requirements (Baimukanov *et al.*, 2019).

The camel breeds should have high productivity, adaptive qualities, good health, disease resistance, productive longevity, and reproductive ability (Bahbahani *et al.*, 2019; Atigui *et al.*, 2021).

In the Republic of Kazakhstan, in the work on improving the purebred camels of the Kazakh Bactrian dairy productivity direction, the use of domestic genetic resources, in particular, factory types and lines of camels of the Kazakh Bactrian breed of the Aral intrabreed type (Baimukanov *et al.*, 2019).

The choice of camels as an improvement is based on high productivity, manufacturability, economic efficiency, and adaptive qualities (Sagala *et al.*, 2021; Faraz *et al.*, 2021).

According to the FAO, in 2009 the number of camels in the world was 23 million animals, the gene pool of which is represented by 50 dromedary breeds and 7 Bactrian breeds. According to the statistics committee of the Republic of Kazakhstan Ministry of national economy of the Republic of Kazakhstan, the number of camels in 2020 amounted to 236 thousand animals, which are mainly concentrated in the southwestern region of the republic and 11% of them are breeding animals. According to the FAO, in 2009 in the Republic of Kazakhstan the camel gene pool was represented by 1 breed of Bactrians (Kazakh, with 3 types and 2 populations), 2 breeds of dromedaries (Arvana, Aruana, or Kazakh Nar) (Baimukanov *et al.*, 2020a).

Highly productive herds of Kazakh Bactrian camels are characterized by a certain genealogical structure and have their own distinctive features both in terms of phenotype and genetic content (Baimukanov *et al.*, 2020b).

Camel milk is in demand in the dairy industry and is highly in demand among consumers of natural milk (Shuvarikov *et al.*, 2019).

In dairy camel breeding, line breeding remains one of the most effective methods. As you know, in individual lines, various advantages of the breed accumulate, giving the plasticity necessary for its further improvement. Belonging to a certain line affects the growth and development of any breed of camel, dairy productivity, its quantitative and qualitative characteristics, and the reproductive ability of camels.

When breeding Kazakh Bactrian camels for dairy productivity, effective methods of selection are used (Kazakhstan Patent, 2006; 2010a-c). Kazakh Bactrians in the conditions of the Almaty region are less studied in terms of breeding compared to representatives of *Camelus bactrianus* of the studied breed.

### *Aim of the Research*

The aim of the research work was, firstly, to increase the genetic potential of the productivity of camels of the Kazakh Bactrian breed and of methods for its implementation based on selection; secondly, to determine the selective and genetic parameters of dairy products and the optimal ways of conducting breeding work with Kazakh Bactrians of dairy direction.

In modern conditions, camel breeding is a low-cost branch of productive animal husbandry (Mayouf *et al.*, 2014; Dioli, 2022).

Evaluation, subsequent selection, and breeding in camel breeding allow you to get young animals with specified livestock parameters. Through purebred breeding of camels of the Kazakh Bactrian. It is

possible to create camel factory lines for producers and brood families. When breeding a particular camel breed, it is necessary to take into account the ever-changing market conditions in the domestic camel industry (Baimukanov *et al.*, 2020c).

Structure of the manuscript:

- Determination of dairy productivity of female ancestors of Kazakh Bactrian camels of the first colting
- Realization of the genetic potential of Kazakh Bactrian camels of the first colting
- Reproductive qualities of Kazakh Bactrian camels
- Heritability of traits of milk productivity in Kazakh Bactrian camels
- Correlation coefficients between indicators of milk productivity in Kazakh Bactrian Camels
- Repeatability of traits of dairy productivity in Kazakh Bactrian camels
- The efficiency of the selection of Kazakh Bactrian camels

### **Materials and Methods**

The studies were carried out in 2021-2023 in camel-breeding farm LLP "Training Research and Production Center Bayserke-Agro", ensuring the optimal level of feeding and good dynamics of selection work.

The studies involved 30 female camels aged 5-12 years and male producers from the Temir-BURA and Aport-BURA lines aged 6-10 years.

The selection of Kazakh Bactrian camels for dairy productivity was carried out at the request of Patent N. 22213 (Kazakhstan Patent, 2010d).

The dairy productivity of a milking herd of Kazakh Bactrian camels was studied with a monthly control milk yield, with the determination of the average daily milk yield, fat, and protein content in milk.

The predicted productivity of camels of the first colting (genetic potential) was determined based on the performance indicators of female ancestors. The Camel Parental Index (*CPI*) was calculated using the formula:

$$CPI = \frac{2 \times M + MM + MO}{4} \quad (1)$$

(Kazakhstan Patent, 2008).

where,

*CPI* = The camel parental index for milk yield (kg) or for *MJ* (%)

*M* = The productivity of the mother, kg or %

*MM* = The mother's mother productivity, kg or %

$MO$  = The productivity of the father's mother, kg or %  
2 and 4 are constant coefficients

The degree of the genetic potential realization was determined by the formula:

$$GPR = \frac{\text{actual productivity}}{\text{EXPECTED PRODUCTIVITY BY CPI}} \times 100\% \quad (2)$$

Accounting for the dairy productivity of first-colt females was carried out individually on the basis of control milkings and the chemical composition of milk (fat, protein content) on a monthly basis - using the milk quality analyzer "Klever-1M".

In pasture conditions, they were used with the help of the Baimukanov A. and Baimukanov D.A. methods for the determination of live weight in camels (Kazakhstan Patent, 2008).

The selection differential was calculated as the difference between the selected group and the group of animals, in which selection has not yet taken place.

The selection effect was calculated by multiplying the selection differential of a trait by the coefficient of heritability of this trait.

The coefficient of heritability of a trait is the main genetic parameter that assesses the share of the genetic component in the phenotypic variability of a trait. With increased coefficients of heritability of the trait, one can expect a fairly rapid genetic improvement in livestock during mass selection. At low values of heritability coefficients, selection based on the phenotypic manifestation of a trait is ineffective.

## Results

Insufficient development of the breeding base of meat and dairy and dairy camel breeding, the low potential of meat and dairy and dairy productivity of camels are the main factors of low economic efficiency of meat, milk, and wool production (Baimukanov, 2020).

The analysis of the breed zoning of camels in Kazakhstan for 1991-2020 shows that in 1991 the share of the camel breed composition as a percentage was: Kazakh Bactrian-90%, Arvana-3.0%, and hybrid, crossbred-7.0% and in 2020-Kazakh Bactrian-80.0%, Arvana-9.5% and hybrid, crossbred-10.5% (Alibayev *et al.*, 2020). In dairy camel breeding, selective and productive parameters are continuously improved (Faraz *et al.*, 2018).

The breeding program for milk production is based on the monitoring and analysis of productive parameters in a particular herd of camels (Oselu *et al.*, 2022).

Without taking into account the variability, heritability of traits, the relationship between them, and repeatability, it is impossible to properly organize work to improve the

economically useful qualities of purebred Kazakh Bactrian camels.

One of the most important factors that determine the value of camels is the genetic potential of animals, which is based on information about the productivity of maternal ancestors. The analysis of average indicators of productivity of mothers of camels of the first colting, mothers of fathers, and mothers of mothers was carried out, according to the records of productivity. It was established that the dairy productivity of mothers of fathers of camels of the first colting was at a fairly high level (Table 1).

Thus, the dairy productivity of mothers of camels of the Kazakh Bactrian breed was 780.4 kg for 210 days of lactation on average for the herd, mothers of mothers-690.5 kg, and mothers of fathers-1110.1 kg. The fat content of maternal ancestors was in the range of 5.5%. The mothers of fathers had the highest milk yield, this fact is due to that all the experimental animals are the daughters of the high-value Kazakh Bactrian servicing camels, tested for the quality of the offspring.

Milk productivity in mothers of Kazakh Bactrian camels of linear origin was 112.1-1250.3 kg, in mothers of mothers-830.7-959.1, in mothers of fathers-1490.2-1582.2 kg. Taking into account the linear affiliation of the camels of the first colting, we state that the highest dairy productivity of mothers was in the second and third groups, in comparison with the herd average, the difference was 140.2 and 268.6 kg, respectively.

When analyzing the milk fat content of maternal ancestors, it was found that it was the highest in mothers of fathers in the second and third groups (5.6%). The data obtained regarding the content of fat and protein in milk differ from (Faraz *et al.*, 2020) data, according to it, Bactrians have a fat content of 5.8% in milk and 3.7% of protein in milk (Faraz *et al.*, 2020).

There is evidence that the mass fraction of fat and protein in milk varies depending on the breed and the season of the year (El-Hanafy *et al.*, 2023). In our studies, significant fluctuations in the fat and protein contents in milk in spring, summer, and autumn were not revealed.

For a more complete evaluation of the potential capacity of animals for all indicators of female ancestors, we calculated the Female Camel Parental Index (FCPI), which shows the genetic capabilities of the animal and the degree of transmission of productive qualities to offspring (Table 2).

It was established that the FCPI indicator was on average at the level of 840.35-1228.37 kg for milk yield, 5.50-5.52% for fat content, and 3.80-4.00% for protein content. At the same time, all camels of the experimental (I, II) groups were superior in terms of productivity to the camels of the control group.

**Table 1:** Dairy productivity of female ancestors of Kazakh Bactrian camels of the first colting

Productive parameters	Unit Meas.	Mates, n = 15	Temir BURA, n = 15		Aport BURA, n = 15	
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<b>Mother</b>						
Milk yield, kg	kg	780.4±130.9	1250.3±80.7***	469.9	1112.1±71.5***	331.7
Fat, %	%	5.5±0.080	5.5±0.06	-	5.5±0.06	-
Protein	%	3.8±0.060	4.0±0.05*	0.2	4.0±0.04*	0.2
<b>Mother's mother</b>						
Milk yield, kg	kg	690.5±89.20	830.7±61.3**	140.2	959.1±110.2**	268.6
Fat, %	%	5.5±0.090	5.5±0.08	-	5.5±0.06	-
Protein	%	3.7±0.070	3.8±0.06	0.1	3.8±0.05	0.1
<b>Father's mother</b>						
Milk yield, kg	kg	1110.1±135.7	1582.2±90.1**	472.1	1490.2±82.5**	380.1
Fat, %	%	5.5±0.070	5.6±0.06*	0.1	5.6±0.09*	0.1
Protein	%	3.9±0.040	4.1±0.03*	0.2	4.2±0.04*	0.3

Note: \* -The difference between the indicators of daughters and their mothers is significant at  $p \geq 0.95$ , \*\* -The difference between the indicators of daughters and their mothers is significant at  $p \geq 0.99$ , \*\*\* -The difference between the indicators of daughters and their mothers is significant at  $p \geq 0.999$

**Table 2:** Realization of the genetic potential of Kazakh Bactrian camels of the first colting

Genetic options	Productive parameters	Population average	Temir BURA	Aport BURA
Camel Parental Index (CPI)	Milk yield, kg	840.35±127.9000	1228.37±78.1***	1168.37±84.3***
	Fat, %	5.50±000.0800	5.52±0.06	5.52±0.07
	Protein, %	3.80±000.0500	3.98±0.05	4.00±0.04*
Own productivity	Milk yield, kg	752.30±116.7000	1245.70±200.0**	1210.50±140.2**
	Fat, %	5.40±000.0700	5.44±0.05	5.48±0.07*
	Protein, %	3.70±000.0400	3.70±0.030	3.70±0.040
Realization of the Genetic Potential, (RGP) %	Milk yield, kg	89.52±200.1500	101.41±3.34***	103.60±4.25***
	Fat, %	98.18±200.7900	98.55±1.81*	99.27±2.95
	Protein, %	97.36±100.4700	92.96±1.38	92.50±2.16

Note: Hereinafter \* -The indicator is significant at  $p \geq 0.95$ ; \*\* - at  $p \geq 0.99$ ; \*\*\* - at  $p \geq 0.999$

In terms of milk yield, FCPI was the highest in the camels of the first lactation of the Temir BURA line (1228.37 kg), and in terms of quality indicators (fat, protein) -inmates of the group of the Aport BURA line (5.52-4.00%).

Realization of the Genetic Potential (RGP) for milk yield for 210 days of lactation was higher in group I (Aport BURA) at 101.43%, which is 15.91% more than the average for the population (Table 2).

In group II (Aport BURA line), the indicator of Realization of the Genetic Potential (RGP) for milk yield was 103.60%, which is higher than the average for the herd by 18.08%.

The realization of the Genetic Potential (RGP) for fat was higher in the second group compared to the average for the population by 1.09%. The realization of the genetic potential for the protein was lower in the first and second groups compared with the average population by 4.4-4.86%.

The results of a comparative analysis of the reproductive qualities of camels of different lineages showed that there are some differences between the studied groups. The age of the first colting in camels was the same, with slight fluctuations (Table 3).

The duration of the period between coltings in the analyzed lines was in the range of 792.8-799.9 days, which is lower than the average for the herd by 16.7-9.6 days.

In practice, the fertility index is recognized as an indicator of the reproductive ability of individual camels and breeds as a whole. This is a generalized indicator that takes into account the period between coltings and the age of the female camels at the first colting. With a camel fertility index of 48 or more, fertility is assessed as good, with an index of 41-47-medium and with an index of 40 or less-low. Female camels of the Temir BURA line-42.7 and Aport BURA-43.1 had a high fertility index in comparison with their mates on average for the population-41.9. The coefficient of reproductive capacity is an indicator that characterizes the fertility of the breeding stock of the Kazakh Bactrian camels, at the optimal level of fertility of camels it is equal to one and depends on the duration of the period between coltings. On herd average, the coefficient of reproductive capacity was the lowest-0.84. In the rest of the studied lines, the coefficient was at the level of 0.91-0.92, which indicates a satisfactory reproductive ability of the breeding stock of camels of the studied breed.

Selective and genetic parameters are statistical values, the skillful interpretation of which allows you to effectively plan selection and breeding work with camels of the studied breed. The main selective and genetic parameters are: The heritability of traits, the correlation between the main selection traits, the frequency of assessments, the selection differential, and the selection effect.

**Table 3:** Reproductive qualities of Kazakh Bactrian camels

Productive parameters	Population average	Temir BURA	Aport BURA
Age of first fertilization, months	34.56±0.17	34.25±00.150	34.32±0.1200
Fruiting duration, days	444.50±2.200	432.70±03.100	425.10±4.6000
The period between coltings, days	809.50±21.30	792.80±11.600	799.90±14.800
Fertility index	41.90±0.620	42.70±00.150	43.10±0.3500
Reproductive capacity coefficient	0.87±0.08	0.92±00.040	0.91±0.0500

**Table 4:** Heritability of traits of milk productivity in Kazakh Bactrian camels

Group of camels	Heritability coefficient	
	High milk yield	Fat content of milk
Main herd	0.195	0.415
Temir BURA	0.491	0.381
Aport BURA	0.373	0.339
Average	0.353	0.379

**Table 5:** Correlation coefficients between indicators of milk productivity in Kazakh Bactrian camels

Group of camels	Correlation coefficient	
	Milk yield for 210 days of lactation, kg/mass fraction of milk fat, %	Milk yield for 210 days of lactation, kg/mass fraction of milk protein, %
Main herd	0.093	0.0090
Temir bura	0.011	-0.0070
Aport bura	0.014	-0.0005
Average	0.353	0.0030

**Table 6:** Repeatability of traits of dairy productivity in Kazakh Bactrian camels

Age of camels, lactation	Repeatability of milk yield for 210 days of lactation
2	0.78
3	0.85
4	0.86
5	0.79
6	0.74
7	0.56

Table 4 presents the values of the coefficients of heritability of traits of milk production.

The heritability of quantitative traits is rather low, due to the development of the studied traits under the influence of polygenic factors. It was found that the heritability coefficient of milk yield averaged 0.353, with extreme deviations from 0.195-0.491.

The heritability of milk fat is in the range of 0.339-0.415. Relatively high coefficients of heritability of traits in camels of linear origin are due to the intensive selection of camels.

The correlation coefficient makes it possible to assess the level of the relationship between features. The values of the correlation coefficient range from -1 to +1. The relationship between features is strong when the correlation coefficient is as close as possible to unity. The values of the correlation coefficients are presented in Table 5.

The relationship between milk yield for 210 days of lactation and milk fat content has not been established.

The results show the effectiveness of a targeted selection of camels that combine high milk yield with a mass fraction of fat in milk.

Between milk yield and protein content in milk, the values of the correlation coefficients are close to zero. The negative correlation between indicators of dairy productivity in camels of the Temir BURA and Atyrau BURA lines is due to an increase in the level of abundant milk production while reducing the content of fat and protein in milk.

In addition to the relationship between economic traits, it is necessary to take into account the repeatability of the trait, which makes it possible to predict the future productivity of camels based on evaluation indicators. When selecting camels for abundant milk production, it is necessary to take into account the repeatability coefficients of milk yield of the 1<sup>st</sup> and subsequent lactations. Table 6 shows the values of the repeatability coefficients of the main selection traits.

The frequency of milk yield for the 1<sup>st</sup> lactation with subsequent lactations has a curvilinear character, so the repeatability coefficients increase until the 4<sup>th</sup> lactation, then gradually decrease. In general, the milking repeatability coefficients are at the average level. The maximum values of the repeatability coefficient were obtained between the milk yield for the 1<sup>st</sup> and 4<sup>th</sup> lactations ( $r_w = 0.86$ ). Based on the evaluation and selection of camels of the first colting, the result allows to obtain the necessary result in full-aged camels.

**Table 7:** Efficiency of selection of Kazakh Bactrian camels

Group of camels	Index	Live weight, kg	Milk per lactation, kg	Fat content, %
First foal	Selection differential	35.0	150.0	0.20
	Selection effect	5.8	25.0	0.03
Temir BURA	Selection differential	50.0	425.0	0.30
	Selection effect	8.3	70.8	0.05
Aport BURA	Selection differential	60.0	398.0	0.30
	Selection effect	10.0	66.3	0.05

In addition, the use of the repeatability coefficient allows you to speed up the selection rate.

The selection differential is an important indicator characterizing the efficiency of camel selection (Table 7).

The selection differential shows the difference in productivity between the individuals of the selected group and the group, in which selection is not carried out. The selection of camels according to the level of dairy productivity is carried out according to the results of the completed 1<sup>st</sup> lactation, therefore, this group of camels was used to calculate the selection differential and the selection effect.

When selecting camels of linear origin, high requirements are placed on the productive qualities of females, so the selection differential was +425 and +398 kg for milk yield, +50 and +60 kg for live weight, and +0.05% for the fat content relative to camels of the first colting. Receiving replacement females from camels of linear origin, you can get the expected increase in abundant dairy productivity in the next generation by 66.3-70.8 kg of milk and in terms of milk fat content by 0.05%.

In the conditions of the "Baiserke-Agro TRPC, the Kazakh Bactrian camels realize their genetic potential at a high level, which is facilitated by optimal feeding conditions and an acceptable technology for keeping animals.

## Discussion

When organizing selection and breeding work to increase the dairy productivity of camels, it is recommended to take into account the obtained values of selection and genetic parameters. With high values of the coefficient of heritability of the trait, it is possible to quickly achieve an improvement in the selection trait by selecting individuals in accordance with the selection program. The low heritability of dairy productivity traits complicates the breeding process and makes it longer.

The calculation of the correlation coefficients between the breeding traits of the productivity of Kazakh Bactrian camels allows them to be effectively selected. High positive correlation coefficients between traits make it possible to improve two traits at the same time when selecting one trait. High repeatability values allow transferring the results of the first assessment to the subsequent productivity of camels, up to the 7<sup>th</sup> lactation, by selecting according to the results of the first lactation, to obtain a high selection effect in subsequent lactations.

At the same time, it is necessary to pay attention to the technological quality of camel milk production (Yirda *et al.*, 2020). Breeding and genetic parameters are auxiliary tools, the correct analysis of which will lead to an increase in the selection effect in dairy camel breeding and will accelerate the process of selection of Kazakh Bactrian camels.

## Conclusion

The conducted research indicates that the organization of selection and breeding work in dairy camel breeding should be based on selection and genetic parameters. The obtained values of the milk yield heritability coefficients ( $h^2 = 0.353$ ) are due to polygenes, which complicate the selection process. When organizing breeding work with camels of the Kazakh Bactrian breed of dairy products, we recommend that you analyze the selective and genetic parameters, this will allow you to reasonably select camels of linear origin and improve the productivity of the main herd.

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## Author's Contributions

**Dauren Maratovich Bekenov:** Head of the event generalization.

**Yusupzhan Artykovich Yuldashbayev:** Performer, analysis of research results.

**Makpal Temirkhanovna Kargayeva and Aidar Dastanbekuly Baimukanov:** Responsible executor, preparation of the manuscript.

## Ethics

When conducting research work, all the principles of scientific ethics are observed. There is no conflict of interest. When organizing breeding work to increase the high milk content and fat content of milk, it is recommended to take into account the obtained values of the heritability coefficients of the studied traits.

## References

- Alibayev, N. N., Ermakhanov, M. N., & Abuov, G. S. (2020). The concept of development of the camel breeding industry in the Republic of Kazakhstan for 2022-2026. *Bulletin of the Tuva State University. Natural and Agricultural Sciences*, 2(61), 60-71. <https://cyberleninka.ru/article/n/kontseptsiya-razvitiya-otrasli-verblyudovodstva-v-respublike-kazahstan-na-2022-2026-gody>
- Alibayev, N. N., Semenov, V. G., Baimukanov, A. B., Mongush, S. D., Ermakhanov, M. N., & Abuov, G. S. (2021). Increase of camel milk productivity biopotential. *Scientific Notes Kazan Bauman State Academy of Veterinary Medicine Kazan*, 247(3), 11-15. <https://doi.org/10.31588/2413-4201-1883-247-3-11-15>
- Atigui, M., Brahmi, M., Hammadi, I., Marnet, P. G., & Hammadi, M. (2021). Machine milkability of dromedary camels: Correlation between udder morphology and milk flow traits. *Animals*, 11(7), 2014. <https://doi.org/10.3390/ani11072014>
- Bahbahani, H., Musa, H. H., Wragg, D., Shuipe, E. S., Almathen, F., & Hanotte, O. (2019). Genome diversity and signatures of selection for production and performance traits in dromedary camels. *Frontiers in Genetics*, 10, 893. <https://doi.org/10.3389/fgene.2019.00893>
- Baimukanov, D. A., Ombayev, A. M., Baimukanov, A., Yuldashbayev, Yu. A., & Demin, V. A. (2019). Economically useful features of the aral intrabreed type of the Kazakh Bactrian camel. *Izvestiya of Timiryazev Agricultural Academy. Moscow. Publishing House of RSAU-MTAA*, 2, 72-87. <https://doi.org/10.34677/0021-342X-2019-2-72-87>
- Baimukanov, D. A. (2020). Regularities of development of colts of the Kazakh Bactrian breed. *Reports of NAS RK*. (3), 20-28. <https://journals.nauka-nanrk.kz/reports-science/article/view/797>
- Baimukanov, D. A., Semenov, V. G., Alibaev, N. N., Baimukanov, A. B., Karymsakov, T. N., Ermakhanov, M. N., & Iskhan, K. Z. (2020a). Technology to improve milk productivity of female camels of the Arvana breed and Kazakh bactrian. In *IOP Conference Series: Earth and Environmental Science* (Vol. 433, No. 1, p. 012027). IOP Publishing. <https://doi.org/10.1088/1755-1315/433/1/012027>
- Baimukanov, D. A., Yuldashbaev, Yu. A., Iskhan, K. Zh., & Demin, V. A. (2020b). The concept of development of productive and breeding camel breeding of the Republic of Kazakhstan for 2021-2030. *Agricultural Science*, (7-8), 52-60. <https://doi.org/10.32634/0869-8155-2020-340-7-52-60>
- Baimukanov, A., Alibayev, N., Semenov, V., Ermakhanov, M., & Abuov, G. (2020c, November). Monitoring productivity of Kazakh Bactrian and Arvana camels of Kazakhstan population. In *IOP Conference Series: Earth and Environmental Science* (Vol. 604, No. 1, p. 012027). IOP Publishing. <https://doi.org/10.1088/1755-1315/604/1/012027>
- Dioli, M. (2022). Observation on dromedary (*Camelus dromedarius*) welfare and husbandry practices among nomadic pastoralists. *Pastoralism*, 12(1), 1-23. <https://doi.org/10.1186/s13570-021-00221-5>
- El-Hanafy, A. A., Saad, Y. M., Alkarim, S. A., Almehdar, H. A., Alzahrani, F. M., Almatry, M. A., ... & Redwan, E. M. (2023). Yield and Composition Variations of the Milk from Different Camel Breeds in Saudi Arabia. *Sci*, 5(1), 2. <https://doi.org/10.3390/sci5010002>
- Faraz, A., Khan, N. U., Passantino, A., Pugliese, M., Eyduran, E., Pastrana, C. I., ... & Nabeel, M. S. (2021). Effect of Different Watering Regimes in Summer Season on Water Intake, Feed Intake and Milk Production of Marecha She-camel (*Camelus dromedarius*). *Animals*, 11(5), 1342. <https://doi.org/10.3390/ani11051342>
- Faraz, A., Waheed, A., Nazir, M. M., & Mirza, R. H. (2018). Milk production potential of Marecha dromedary camel in desert Thal Punjab. *Pakistan. J. Fish. Livest. Prod*, 6(3). <https://doi.org/10.4172/2332-2608.1000280>
- Faraz, A., Waheed, A., Tauqir, N. A., Mirza, R. H., Ishaq, H. M., & Nabeel, M. S. (2020). Characteristics and composition of camel (*Camelus dromedarius*) milk: The white gold of desert. *Adv. Anim. Vet. Sci*, 8(7), 766-770. <http://dx.doi.org/10.17582/journal.aavs/2020/8.7.766.770>

- Kazakhstan Patent. (2006). Database Patent of the Republic of Kazakhstan No 13739. The method of selecting camels of purebred Kazakh Bactrians for breeding. Published: 15.12.2006. Authors Baimukanov, D. A., Baimukanov, A., Tatibekov, A. IPC A01K 67/02. <https://kzpatents.com/3-13739-sposob-otbora-verblyudic-chistoporodnyh-kazahskih-baktrianov-dlya-selekcii.html>
- Kazakhstan Patent. (2008). Database Patent of the Republic of Kazakhstan No 15886. The method of Professor A. Baymukanov and D. A. Baimukanov determination of live weight in camels. Published 15.08.2008. Authors Baimukanov, D. A., Baimukanov, A. IPC: A01K 67/02. <https://kzpatents.com/3-15886-sposob-professora-bajjmukanova-a-i-bajjmukanova-da-opredeleniya-zhivojj-massy-u-verblyudov.html>
- Kazakhstan Patent. (2010a). Database Patent of the Republic of Kazakhstan No 16226. The method of selection of camels of the Kazakh Bactrian dairy direction. Published 15.01.2010. Authors Koshshan, B.L., Zholdybaev, T., Baimukanov, A., Imangazyev, Z., Baimukanov, D.A. IPC A01K 67/02. <https://kzpatents.com/3-16226-sposob-selekcii-verblyudov-kazahskogo-baktriana-molochnogo-napravleniya.html>
- Kazakhstan Patent. (2010b). Database. Patent of the Republic of Kazakhstan No 16357. Method for selection of Kazakh Bactrian camels for selection. Published 15.01.2010. Authors Sharipov, I. K., Baimukanov, D. A., Tatibekov, A., Zaitbekov, E. D., Alibaev, N., Baimukanov, A. IPC A01K 67/02. <https://kzpatents.com/3-16357-sposob-otbora-verblyudov-kazahskogo-baktriana-dlya-selekcii.html>
- Kazakhstan Patent. (2010c). Database. Patent of the Republic of Kazakhstan No 2366. The method of selection of purebred Kazakh Bactrians for breeding. Published 15.12.2010. Authors Alikhanov, O., Turumbetov, B. S., Zaitbekov, E. D., Baimukanov, A., Ermakhanov, M. N., Baimukanov, D. A. IPC A01K 67/02. <https://kzpatents.com/4-23606-sposob-otbora-chistoporodnyh-kazahskih-baktrianov-dlya-selekcii.html>
- Kazakhstan Patent. (2010d). Database Patent of the Republic of Kazakhstan No 22213. The method of selection of camels of the Kazakh Bactrian for milk production. Published 15.01.2010. Authors Alikhanov, O., Baimukanov, D. A., Turumbetov, B. S., Baimukanov, A. IPC A01K 67/02. <https://kzpatents.com/3-22213-sposob-otbora-verblyudov-kazahskogo-baktriana-pomolochnosti.html>
- Mayouf, R., Benaissa, M. H., Bentría, Y., Aoune, F. Z., & Halis, Y. (2014). Reproductive performance of *Camelus dromedarius* in the el-oued region, Algeria. *Online Journal of Animal and Feed Research*, 4(4), 102-106. <https://www.cabdirect.org/cabdirect/abstract/20143345046>
- Oselu, S., Ebere, R., & Arimi, J. M. (2022). Camels, camel milk and camel milk product situation in Kenya in relation to the world. *International Journal of Food Science*, 2022. <https://doi.org/10.1155/2022/1237423>
- Sagala, J. I., Gachuiiri, C. K., Kuria, S. G., & Wanyoike, M. M. (2021). Effects of supplementing lactating camels with *Acacia tortilis* pods and ‘Chalbi salt’ on milk yield and calf growth in the peri-urban area of Marsabit town, Kenya. *International Journal of Agricultural Research, Innovation and Technology*, 11(1), 117-122. <https://doi.org/10.3329/ijarit.v11i1.54474>
- Shuvarikov, A. S., Baimukanov, D. A., Dunin, I. M., Pastukh, O. N., Zhukova, Ye. V., Yuldashbayev, Yu. A., Yurova, E. A., Erokhin, A. I., & Karasev, E. A. (2019). Estimation of composition, technological properties and factor of allergenicity of cow's, goat's and camel's milk. *Scientific Journal "Bulletin of NAS RK"*, (6), 64-74. <https://journals.nauka-nanrk.kz/bulletin-science/article/view/1206>
- Yirda, A., Eshetu, M., & Babege, K. (2020). Current status of camel dairy processing and technologies: A review. *Open Journal of Animal Sciences*, 10(3), 362-377. <https://doi.org/10.4236/ojas.2020.103022>