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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:

$$Pi = N * 301 \quad (1)$$

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.

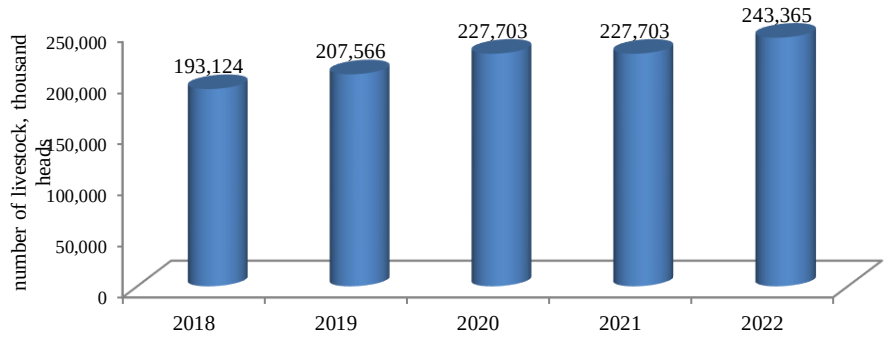

Figure 1– Growth dynamics of camel population in 2018-2022

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)

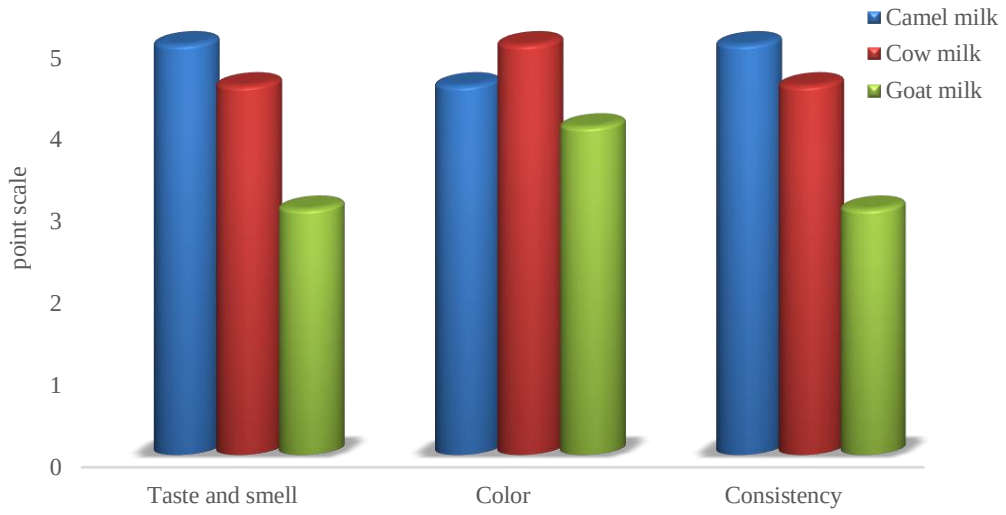

Figure 2– Organoleptic indicators of camel, cow, and goat milk

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.

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THE INFLUENCE OF BREEDING METHODS ON THE PRESERVATION AND IMPROVEMENT OF THE HORSES OF THE KUSTANAY BREED

ANNOTATION

The success of horse breeding is directly related to the organization of breeding. The article presents an analysis on improvement of breeding and sports features of horses of Kustanay breed in the process of development of breed from the moment of approbation. The aim was to determine the impact of the existing plant lines on the preservation and improvement of Artisanal horses. The estimation of stallions-producers on the quality of progeny was carried out and the applicants were determined as ancestors of new lines. To conduct research at the farm, three groups of young of different genotypes have been formed: I group of stallion-manufacturer Nauryztoy 9 (line 464 Neon), II group of stallion-manufacturer - stallion Preferans 5 (line 494 Forts) and III group - control (other lines). It has been found that the modern stock of horses of Artisanal breeds is characterized by superiority in the complex of features in the section of factory lines 464 Neon and 494 Forts over the peers of the control group - both on tribal and sports qualities. In this connection, stallions-makers: Nauryta 9 (512 Nag - 2146 Torquay 8) and Preferans 5 (525 Pegasus - 2101 Safari) on the assessment

of the quality of the offspring correspond to the status of improving and can be assigned to lay two new lines in the bush horse breed.

The research was carried out within the framework of the scientific and technical program BR 10764999 “Development of technologies for effective management of the breeding process and conservation of the gene pool in horse breeding” 2021-2023 of the Ministry of Agriculture of the Republic of Kazakhstan.

Key words: *breeding, breeding methods, stallion manufacturer, type, exterior, performance, sports qualities*

Introduction. The success of the development of tribal horse breeding and sports horse breeding is directly related to the organization of skillful purposeful tribal breeding work, which will ensure the normal sale of products in an economic sense and, equally important, the conduct of effective breeding, which is significantly more complex in comparison with the breeding of other types of farm animals, and therefore more attention should be paid to the application of effective methods for improving horse breeds [1].

In recent years, the need for imported horse breeds has been increasing in Kazakhstan equestrian sports, and domestic breeds with prospects in this direction are experiencing a reduction in the number of breeding composition, a decrease in demand and interest in them. One of such valuable domestic breeds is the Kustanay, which is on the verge of extinction. The issue of increasing the number of horses is acute, and it must be solved in the shortest possible time, without delay, using the rich, centuries-old experience of tribal breeding methods and improvement [2].

Due to the historical peculiaritiesof the way of sports horse breeding, the following performance qualities are taken into account: agility, endurance, strong constitution, ability to quickly restore strength [3].

For a long time, after approbation in 1951, the Kustanay harness horse was widely used both for riding and in harness in agriculture, and more attention was paid to its use in equestrian sports. Thanks to many years of competent selection and tribal breeding work of specialists at the end of the fourth decade of the XX century at the leading Kustanay stud farm (now "Kazakh Tulpary" LLP), horses of the Kustanay breed fully satisfied the requirements for professional sports, as they had the correct exterior, strong constitution, endurance, efficiency, unpretentiousness with a balanced, calm temperament. The improvement of important features of the Kustanay breed in Soviet times was a success, but the period of independence of the Republic of Kazakhstan negatively affected the fate of the modern Kustanay horse. In the last decades of the 21st century, there has been a sharp reduction in the number of horses, which threatens the extinction of the breed as a breeding stock and the loss of one of the most valuable gene pool for the domestic horse breeding.

Taking into account the small number of members of the Kustanay breed, it is important to use every opportunity to preserve, increase the number and popularity of a unique, ancient domesticbreed. Of course, it cannot be said that nothing is being done to revive the breed. In 2021, for the restoration, preservation and further improvement of the domestic harness horse breed, a "Road Map" for 2022-2027 has been developed and approved, which will draw additional attention to the domestic Kustanay horse breed and will contribute to the popularization of national equestrian sports.

One of the methods for preserving and further improving horses of the Kustanay breed is selection. A logical continuation of selection is selecting to correct undesirable characteristics of parents, combine valuable hereditary characteristics and their manifestation in future offspring. Selection and choice together constitute a breeding system, the practical methods of which shall be based on the general patterns of development of the optimal linear structure of the breed [4, 5, 6].

From the history of breeding and selection of farm animals, it should be noted that there are various forms of selection, such as mass and individual, unconscious and methodical, directional and stabilizing, direct and indirect, tandem, index, at independent levels, by individual characteristics, and others. Depending on the tribal breeding value of the mated individuals, improving and equalizing selection is distinguished, from similarities and differences between the mated individuals: homogeneous and heterogeneous, taking into account kinship – related and unrelated selection [4, 5, 7].

Working with the breed of farm animals of different species, it is necessary to purposefully use selection and choice. Since the basis for the selection of a breeding animal is the essence of the best parental genotypes. And the result of the genotype of the offspring, as a breeding animal, is revealed to one degree or another only by the end of its breeding use or even after its disposal. Therefore, according to many experts - leading breeders in horse breeding, it is possible not to wait for a direct assessment of the genotype, but to use for these purposes indirect, and hence to varying degrees probable methods of assessing breeding merits [8, 9, 10, 11].

At the moment, specialists and scientists of "Kazak Tulpary" LLP are actively involved in the development and implementation of a set of measures aimed at increasing the number of horses, increasing the intensity of tribal breeding, ensuring that the values of genetic (hereditary) shift of breeding traits for many generations to come are obtained at an early stage of growth and development of a horse. At the same time, special attention, as a factor influencing the effect of breeding in horse breeding, is paid to the combination of directional and stabilizing selection according to a set of traits due to the genotype: origin, type, measurements, exterior, performance [12].

In accordance with this, the goal was set to determine the impact of the established breeding lines on the preservation and improvement of the horses of the Kustanay breed. To solve the problem, the following tasks were set: to analyze the dynamics of breeding and sporting characteristics of horses of the Kustanay breed in the course of the evolution of the breed and to evaluate breeding stallions by the quality of offspring; to identify effective forms of selection and choice of the best breeding stallions as candidates for the formation of lines.

Research materials and methods. Research was carried out in the period of 2021-2023 on the basis of"Kazakh Tulpary" LLP.

The objects of the study were the horses of the Kustanai breed for the entire period of the breed's development.

The materials of tribal breeding books for the entire period of improvement of the breed has been analyzed, including the main measurements: height at the withers, oblique length of the body, chest girth and pastern girth, as well as data on the working capacity and breeding use of horses of the Kustanay breed in the context of lines.

The main indicators of the expression of breeding and sporting characteristics were determined in the modern horse breed in the context of lines based on the results of assessing stud stallions for the quality of their offspring [13].

The assessment of sporting qualities was carried out on the basis of recommendations for the breeding and sports training of riding horses [14] and according to the instructions for the bonitation of tribal horses of breeding lines [15].

To track the results of the evaluation of stud stallions by the quality of offspring, three groups of young stock of different genotypes were formed: Group I of the stud stallion Nauryztoy 9 (line 464 Neon), group II of the breeding stallion Preferance 5 (line 494 Fort) and Group III – control group (other lines).

The research results were processed by the biometric method according to Merkuryeva E.K. [16] using the Microsoft Office Excel program.

Results and their discussion. During the period of improvement of the horses of the Kustanay breed from the moment of approbation in in 1951 of the last century to the present time, there has been the use of these horses in such directions as breeding, sports and productive use. Throughout the studied period the requirements for animals, the level of development and equestrian sports, the scale of its spread changed, which impacted the methods of tribal breeding work in the leading stud farm of the country. During the selection and choice of horses in the producing stock, more attention was paid to such parameters as origin; type, measurements, exterior:elegance, size; endurance; performance: agility, jumping, correct movements at all paces, balance, endurance and good manners.

The most difficult period during the improvement of the Kustanay breed horses should be considered the last fifteen years: during this time, the number of total livestock of horses, as well as the participation of horses in equestrian sports, has significantly decreased. The structure of the breed composition also changed. This is due both to the loss of popularity of the Kustanay breed of horses among horse owners (due to the appearance of other breeds), and to the change in the number of the tribal breeding stock.

In order to determine the dynamics of the use of selection and choice based on a set of traits, characterizing the breeding and sporting qualities of horses of the Kustanay breed, we analyzed data for the period of testing and development of the breed at the present stage.

There were five main lines in the Kustanay breed – 30 Burelom, 45 Zaboy, 84 Zevs, 56 Diktor and 162 Torstnik. The line of 84 Zevs (main type) was the most widespread, 23% of the stock belonged to it; it was followed by the Zaboy line with an indicator of 15%; representatives of the lines of 30 Burelom (riding type), 162 Torstnik (main type) and 56 Diktor (riding type) had 7.8 and 9%, respectively. In 60-70, the Zaboy line became the leading one (33%), in 80-90. there is a change in the situation – the line 30 Burelomalmost doubles its representation (from 7-11% to 23%), the influence of the lines 75 Zaboy and 84 Zevs drops sharply (to 5-12%), the lines 56 Diktor and 162 Trostnik retained the middle positions.

The absence of a permanent leader indicated changes in the direction of breeding work, i.e. a change in priorities in determining the type of horse desirable for breeding leads to a change in the leadership of the lines in the breed. During the approbation of the Kustanay breed, the selected characteristics were horse-drawn qualities (including traction power), which were shown by representatives of the line 84 Zebs (main type), partially by 75 Zaboy, then after 70's only frolic received the prevailing direction. This led to a focus on the top–type line - 30 Burelom. During the same period, a new line was laid in the breed – 464 Neon, also of the riding type. In the 90s, the formation of another riding type line was carried out – the 494 Fort line.

In the 2000s, three lines - 56 Diktor, 162 Trostnik and 75 Zaboy practically ceased to exist. Line 30 Burelom became the leading group - 21%. Two genealogical lines formed in the 80s and 90s also retained their presence. - 486 Triumf and 494 Fort - 8% and 13%, respectively. Line 464 Neon had absolute numerical and qualitative superiority.

One of the important features in the breeding of horse breeds is the exterior of the horse, which has a great influence on performance. In the breeding structure of the Kustanay stud farmthroughout the studied years, there were and are currently a large number of fairly large and correct-lookingstallions and mares, which were widely used in breeding work to improve the breeding qualities of Kustanayhorses, representatives of different types, breeding lines and brood families. It should be noted that since the beginning of the breeding of the Kustanay breed, the assessment of the exterior and constitutional features of full-aged horses has changed markedly, as shown in the Table 1.

Table 1 – Dynamics of measurements and indices of body built of horses of the Kustanay breed during the control period

	Measurements, cm				Indices of body built, %			
Group of horses	Heightat theshoulder	Oblique Body Length	Heart-girth	Cannonbonegirth	Of format	Of bone	Of blockiness	Of heart-girth
1951(during approbation)								
Stallions	159,6	158,8	187	20,0	99,4	12,5	117,7	117,1
Mares	155,4	155,2	185,2	19,5	99,8	12,5	119,3	119,4
2000								
Stallions	160,2	159,6	187,4	20,4	99,6	12,7	-	-
Mares	157,4	156,1	185	19,5				
2022								
Stallions	163,3	162,5	188	20,6	99,5	12,6	111,6	121
Mares	160,3	158,8	185,6	20,1	99	12,5	116,8	115,7
Requirements for valuation instructions								
Stallions	160	-	186	20,5				
Mares	158	-	188	19,5				

So, according to Table 1 it follows that in comparison with the requirements of the valuation instructions (All-Russian Research Institute of Horse Breeding - 1991) [15], measurements of animals during recording periods exceed the breed standard.

Kustanay horses, due to their origin and due to the dramatic improvement in growing technology, training and testing, were distinguished by high endurance and speed. Kustanay horses are one of the fastest among half-blooded breeds and come second only to theThoroughbred breed [17].

Analyzing the data of Table 2, it follows that the Kustanay breed is considerably superior to its speed to such breeds as the Budyonny horse [18,19, 20] and Akhal-Teke [21] and at all distances has a clear advantage over these breeds, with the exception of the Budyonny - at a distance 3200 m (3.29) is 0.01 fractions of a second less for horses of the Kustanay breed (3.30), and at a distance of 1000 m, the record for Kustanay horses is 0.00.3 less than that of the Akhal-Teke breed (1.04.1) and amounted to 1.04.4.

Table 2 – Records of horses of the Kostanay breed in comparison with other horse breeds (speed min., sec)

Breed	Distance, m												
	1000	1200	1400	1500	1600	1800	2000	2400	2800	3000	3200	4000	7000
Kustanay	1,04,4	1,14,0	1,27,0	-	1,40,6	1,54,4	2,07,4	2,34,7	3,06,0	3,19	3,30	4,37,0	8,18,8
Budyonny	1,06,0	1,14,4	1,34,2	1,36	1,43	1,54,8	2,09,9	2,35,9	3,19,6	3,19	3,29	4,40,0	8,25,5
Akhal-Teke	1,04,1	1,16,7	1,28,5	1,40,2	-	-	-	-	3,09,6	-	-	-	-
Thoroughbred breed	0,58,0	1,11,4	1,25	-	1,37	1,49	2,02,0	2,27,2	2,57,0	3,11,0	3,22,2	4,22,0	8,11

Thus, in terms of speed at distances of 1200 m, 1400 m, 1600 m, 1800 m, 2000 m, 2400 m, 2800 m, 4000 m and 7000 m, the Kustanay breed is in second place after the Thoroughbred horse.

These horses went through the entire test cycle - from 2 years to older age and showed the best results in the speed class. Year after year, the results for the horses' speed at the main distances improved, and if we add to this the excellent locomotion system, endurance, calm character, noble lines, then we can claim that we have a world-class breed. That is why a modern Kustanay horse, with results-oriented systems of rearing, education and training, will not be inferior in working capacity to horses of other half-bred and roadster breeds, and will surpass them in a number of distances.

Currently, Kazakh Tulpary LLP is working to appoint stud stallions as successors to factory lines formed in 1980-1990, such lines as: line 464 Neon and line 494 Fort.

In connection with this, we carried out a selection of offspring in the context of lines for breeding and sports qualities, which is based on the assessment of stud stallions for the quality of the offspring by ranking the offspring scores by the sum of ranks for type and origin, body conformation, measurements and working capacity - based on the results of performances in flat racing, and during the training process - assessment of locomotory qualities.

The technique, accelerated by multifactor analysis, allows for the earliest possible assessment of young stud stallions not only by phenotype, but also by the level of development of sporting qualities in the offspring. In search of ways to solve this problem in a number of foreign countries (Germany, Poland), stallions and mares are tested not according to the results of racetrack tests, but according to the level of development of sports qualities identified during a short individual training at the age of 1.5-2 years [22, 23].

The ranking principle has significant advantages over the simple distribution of stallions by occupied places, since at the same time the assessment of a stallion depends on the severity of the trait in its offspring, and not on the number of assesable successors.

Table 3 presents an assessment of the offspring of the studied stud stallions from the lines: 464 Neon - stallion Nauryztoy 9 and 494 Fort - stallion Preferance 5 in terms of the quality of the offspring, which was carried out based on the results of valuation the offspring according to several selected traits, allocated to two groups: Group I includes the traits: assessment of type, torso, limbs, measurements. Group II includes an assessment of the severity of sports qualities, each of which was assessed on a 10-point scale.

Table 3 – Dynamics of the assessment of the phenotype of the offspring in the context of breeds according to the first group of assessed traits, score

Torso (body)					Limbs (base)		Score	Stallion category
Head	Neck	Chest	Sides	Crupper	Front	Rear		
Group I Offspring of stallion Nauryztoy 9								
9,5±0,5	9,5±0,4	10,0	9,5±1,5	9,5±2,7	9,5±0,1	9,5±,8	9,5	Improver
Group II Offspring of stallion Preference 5								
9,2±1,2	9,5±3,1	9,0±0,3	9,2±1,8	9,5±1,3	9,5±0,5	9,5±,8	9,0	Improver
Group IIIControl								
8,5±4,2	9,0±2,8	8,5±0,5	8,0±2,6	9,0±0,5	8,0±0,8	8,5±1,7	8,0	Neutral

Based on the information in Table 3 - I and II groups of young stallions of Nauryztoy 9 received 9.5 points, and the group of stallions Preferance 5 received 9.0 points. These indicators exceed the average level for young offsprings of other stallions taken into account in the control group III.

Table 4 continues the assessment of the studied offspring in terms of different genotypes by type and body conformation.

Table 4 – Dynamics of the intermediate assessment of the body conformation of the offspring in the context of lines according to the group I of assessed traits, score

Groups	Score for body conformation		
	M±m	δ	Cv
Group I classical distances (n=5)	7,5±0,13	0,52	6,92
Group II long distance (n=5)	7,5±0,16	0,52	7,01

From the data in Table 4 it can be seen that the young offsprings of group I trained for classical distances received an average score for body conformation (7.5±0.13), and for group II those trained for long distances (7.3±0.16), no significant difference was found between the compared groups.

Table 5 presents the summary results of the assessment of stud stallions for the quality of their offspring by type and body conformation.

Table 5 – Results of the final assessment by type and body conformation of the offspring in the context of lines according to the group I of evaluated traits

No.	Name	n=14	Score			Totalpoints	Rank
			Type	Body conformation	Measurements		
1	Nauryztoy 9	6	8	8	9	25	I
2	Preferance 5	8	8	8	9	25	I

Taking into account the obtained data of stud stallions based on the results of assessing the quality of the offspring by type and body conformation, according to the data in Table 6, it can be stated that the stud stallions occupy the following levels of excellence: The offspring of Nauryztoy 9 and Preference 5 are in the lead. During the assessment, the stallions received rank I - by category – improvers, elite class.

Table 6 presents the assessment of stud stallions based on the athletic performance of their offspring.

Table 6 – Results of assessment of the sports workingcapacity of the studied stud stallions, score

Group of horses Stallion name	Indicator						
	Locomotary characteristics						
	Number of steps per				Стильдвижения		Average score
	step	score	trot	score	Trot score	Gallop score	
Group I	32±2,5	9,3	17,4±1,8	7,5	4	4,5	6,3
Group II	30,5±2,4	9,0	18±3,5	6,5	4	4,6	6,0
Requirements for instructions	25-39	5-10	14-19	10-5	5	5	-

According to the data in Table 6, the offspring of stud stallions from the factory lines - 464 Neon and 494 Fort - meet these requirements for locomotary characteristics according to the instructions [15].

Conclusion.Throughout the course of the conducted research, it was established that in the process of assessing a set of traits based on zootechnical documentation, horses of the Kustanay breed for the entire period of its development were distinguished by the best breeding characteristics, not inferior to world breeds in terms of breeding and sporting qualities.

The results obtained by evaluating the breeding stallions in terms of the quality of offspring in the context of the factory lines 464 Neon and 494 Fort are superior over the peers of the control group - both in breeding and in the evaluation of the modern livestock in the context of the lines in terms of sporting qualities. In this connection, the breeding stallions: Nauryztoy 9 (512 Nag - 2146 Torki 8) and Preferance 5 (525 Pegasus – 2101 Safari) are being improvers according to the quality of offspring and can be used to lay two new lines in the Kustanay breed of horses.

Taking into account the positive dynamics based on research results, two competencies have been developed:

- to preserve the modern linear structure of the Kustanay breed both in the near and far future, to use purebred breeding as the main method of breeding in combination with an effective form of stabilizing selection and homogeneous selection, which will significantly affect the implementation of the set goal and objectives of this scientific work;

- the horses of the Kustanay breed should again become in demand on the market as sports, as well as among private horse owners, equestrian schools and clubs, as one of the priority ways of development, contributing to an increase in livestock and popularization.

Summing up, it should be concluded that raising the problem of preserving and developing the Kustanay horse breed is timely and extremely necessary in the development strategy of tribal horse breeding in Kazakhstan, and, therefore, an important part in supporting the entire livestock industry.

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ТҮЙІН

Жылқы шаруашылығын дамытудың жетістігі селекциялық және асыл тұқымды жұмыстарды ұйымдастырумен тікелей байланысты. Мақалада сынақтан өткен сәттен бастап тұқымды дамыту процесінде Қостанай тұқымды жылқылардың асыл тұқымды және спорттық белгілерін жетілдіру бойынша талдау ұсынылған. Қостанай тұқымды жылқыларды сақтау мен жетілдіруге қалыптасқан зауыттық желілердің әсерін анықтау мақсаты қойылды. Асыл тұқымды айғырларды ұрпақтарының сапасы бойынша бағалау жүргізілді және үміткерлер жаңа желілердің ата-бабалары ретінде анықталды. Шаруашылықта зерттеу жүргізу үшін әртүрлі генотипті жас жануарлардың үш тобы құрылды: Наурызтой өндіретін айғырдың I тобы 9

(неонның 464-желісі), преферанс айғырының II тобы 5 (Форттың 494 – желісі) және III топ – бақылау (басқа сызықтар). Қостанай тұқымды жылқылардың қазіргі заманғы Саны бақылау тобының құрдастарынан – асыл тұқымды және спорттық қасиеттері бойынша 464 неон мен 494 бекіністің зауыттық желілері бойынша белгілер кешені бойынша артықшылығымен сипатталатыны анықталды. Осыған байланысты, өндіруші айғырлар: Наурызой 9 (512 Наг-2146 Торки 8) және Преферанс 5 (525 Пегас – 2101 Сафари) ұрпақтарының сапасын бағалау бойынша жақсартушы мәртебесіне сәйкес келеді және қостанай жылқы тұқымына екі жаңа жол салу үшін тағайындалуы мүмкін.

Зерттеулер Қазақстан Республикасы Ауыл шаруашылығы министрлігінің 2021-2023 ж.ж. BR 10764999 «Селекциялық процесті тиімді басқару және жылқы шаруашылығындағы генофондты сақтау технологияларын әзірлеу» ғылыми-техникалық бағдарламасы шеңберінде жүргізілді.

РЕЗЮМЕ

Успех развития коннозаводства напрямую связан с организацией селекционно-племенной работы. В статье представлен анализ по совершенствованию племенных и спортивных признаков лошадей Кустанайской породы в процессе развития породы с момента апробации. Была поставлена цель – определить влияние сложившихся заводских линий на сохранение и совершенствование лошадей кустанайской породы. Проведена оценка жеребцов-производителей по качеству потомства и определены претенденты, как родоначальники новых линий. Для проведения исследований в хозяйстве сформированы три группы молодняка разных генотипов: I группа жеребца-производителя Наурызтоя 9 (линия 464 Неона), II группа жеребца-производителя – жеребца Преферанс 5 (линия 494 Форта) и III группа – контрольная (прочие линии). Установлено, что современное поголовье лошадей кустанайской породы характеризуется превосходством по комплексу признако*в* в разрезе заводских линий 464 Неона и 494 Форта над сверстниками контрольной группы – как по племенным, так и по спортивным качествам. В связи с чем, жеребцы-производители: Наурызтой 9 (512 Наг – 2146 Торки 8) и Преферанс 5 (525 Пегас – 2101 Сафари) по оценке качества потомства соответствуют статусу – улучшателей и могут быть назначены для закладки двух новых линий в кустанайской породе лошадей.

Исследования проводились в рамках научно-технической программы BR 10764999 «Разработка технологий эффективного управления селекционным процессом и сохранения генофонда в коневодстве» 2021-2023 г.г. Министерства сельского хозяйства республики Казахстан.

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GENETIC DIVERSITY OF THE KOSTANAY HORSE BREED USING MICROSATELLITE MARKERS

ANNOTATION

The article presents the results of the analysis of genetic diversity of the Kostanay breed of 17 loci of DNA microsatellites, including AHT4, AHT5, ASB17, ASB2, ASB23, CA425, HMS1, HMS2, HMS3, HMS6, HMS7, HTG10, HTG4, HTG6, HTG7, LEX3, VHL20. Hair bulbs of 30 heads of horses of Kostanay breed (Kostanay city, Zarechny settlement) were used as biological material for research.

The aim of the work was to characterise the genetic diversity of horses of the Kostanay breed by microsatellite STR-loci.

Genotyping of animals was carried out by PCR, separation and detection of amplification products was carried out by capillary electrophoresis on an 8-capillary 3500 Genetic Analyzer (Applied Biosystems, USA). The results were interpreted in GeneMapper programme, and statistical processing was performed using Microsoft Excel 2010. The following parameters were calculated: allele frequencies, polymorphism level (Ae), degree of observed (Ho) and expected (He) heterozygosity, fixation index (Fis).

As a result of genotyping of the Kostanay breed of horses bred in Zarechny settlement of Kostanay district on the studied microsatellite loci, data characterising the polymorphism of each of the markers were obtained. On 17 microsatellite loci of DNA in horses of Kostanay breed 102 alleles were revealed. The number of alleles per locus varied from 4 to 10. The most informative for the group under study were loci with the highest number of alleles (ASB17, ASB2), the least informative - with the minimum (HMS1, HTG7). The highest observed heterozygosity was at the ASB2 locus (0.900) and the lowest at the HMS2 locus (0.367). The average expected heterozygosity was 0.696, observed heterozygosity was 0.681, and the mean fixation index had a value equal to 0.018.

Thus, characteristic features of polymorphism on all investigated indexes of the studied microsatellite loci of DNA of the Kostanay breed of horses were revealed.

***Key words**: horses, Kostanay breed, microsatellites, locus, DNA.*

Introduction. In 1887, for the first time 2 state stables were 20haracter – Torgay and Kostanay stables, and 3 years later – Orenburg stables. These stud farms purchased stallions-producers of Kalmyk, Don, purebred riding, Streletskaya breeds. In 1898 a breeding breeding centre was 20haracter, where local Kazakh horses began to breed in purity, selecting the best individuals for further selection work [1].

The best mares were crossed with stallions of Streletskaya and Don breed lines, and their offspring were infused with the blood of thoroughbred riding horses. The mixed breeds obtained in this way met the stated requirements – they had a massive body and strong limbs, and were 20haracterize20 by productive movements.

In 1920 the breeding ground was transformed into “Kostanay horse breeding farm”, where the breeding work was continued. Kostanay horse breed was registered in 1951 [2]. At present the work on breeding of the Kostanay breed of horses is continued by “Kazak tulpary” LLP, where the work on studying the genetic characteristics of the population and the development of a comprehensive breeding programme continues.

One of the most convenient and widely used markers for DNA-identification in animal genetics are microsatellites. This is a special class of DNA markers, which are DNA fragments with a large number of up to one hundred or more tandemly repeating identical “ motives” [3, 4]. A motif is a short sequence of several (from two to eight) pairs of nucleotides, usually called a “repeat” [5].

Depending on the repeat length, microsatellites are classified into loci with di-, tri-, tetra-, penta-, and hexanucleotide repeats [6]. Thus, a microsatellite, or microsatellite locus (STR locus, Short

Tandem Reapets), is a section of DNA located in a particular chromosome and containing short tandem repeats [7, 8].

In horses, the analysed STR loci constitute a standard panel of markers recommended by the International Society of Animal Genetics (ISAG): AHT4, AHT5, ASB17, ASB2, ASB23, CA425, HMS1, HMS2, HMS3, HMS6, HMS7, HTG10, HTG4, HTG6, HTG7, LEX3, VHL20.

In the scientific literature, the first description of microsatellite DNA in horses appeared in the early 1990s [9-13]. To date, more than 24 thousand microsatellite loci have been identified in the horse genome. Many of these loci have dozens of alleles that differ from each other in the number of tandem repeats [14-16].

Knowledge of differences in DNA structure is used in the assessment of intrapopulation diversity and identity of different breeds. A detailed study of the genetic characteristics of the population and the development of a comprehensive breeding programme are necessary for the conservation and further increase of the population [17, 18].

The aim of this study is to 21haracterize the genetic diversity of the Kostanay horse breed by microsatellite STR loci.

Materials and Methods. The researches were carried out on the basis of scientific research institute of applied biotechnology NLC "A.Baitursynov Kostanay regional university ". The object of research were horses of Kostanay breed (n=30), bred in "Kazak tulpary" LLP.

For DNA isolation from hair follicles we used a commercial kit "DNA-Extran-2" of "Syntol" company (Moscow). DNA amplification was carried out by PCR in multilocus format using a commercial kit "Cordis Horse" of the company "Gordiz" (Moscow) on the amplifier ProFlex PCR system (Applied Biosystems) according to the manufacturer's instructions. Amplification products were separated and detected by capillary electrophoresis in automatic mode on a 3500 Genetic Analyzer manufactured by Applied Biosystems. Interpretation of the analysis was performed using GeneMapper software. The final stage of the analysis of amplified fragments is the identification of alleles and establishment of genetic profiles of the studied DNA samples.

The following parameters were calculated during genetic-population analysis: allele frequencies, polymorphism level (Ae), degree of observed (Ho) and degree of observed (He) heterozygosity, fixation index (Fis) [19-21].

Research Results. The modern Kostanay horse breed reveals a high level of intra-breed genetic variability. In 17 STR-loci studied by us 102 alleles were identified. The number of alleles in each locus varied from 4 to 10 alleles per locus.

In a study of 30 horses of this breed, the following frequency of allele occurrence was found (Table 1).

Table 1 – Frequency of occurrence of alleles of microsatellite loci in the studied population of horses of Kostanay breed.

Locus	Alleles									
	B	C	D	F	G	L	H	I	J	K
1	2	3	4	5	6	7	8	9	10	11
AHT4							0,167	0,100	0,316	0,017
AHT5									0,200	0,267
ASB17				0,050	0,300		0,050	0,017		0,017
ASB2	0,100									0,183
ASB23						0,283		0,233	0,117	0,100
CA425						0,017		0,133	0,100	
HMS1						0,083		0,083	0,383	
HMS2						0,733	0,033	0,017		0,083
HMS3								0,267		
HMS6									0,033	0,033
HMS7						0,200			0,234	
HTG10						0,017		0,200		0,017

1	2	3	4	5	6	7	8	9	10	11
HTG4						0,017				0,201
HTG6					0,400				0,150	
HTG7										0,267
LEX3				0,067		0,233	0,100			
VHL20						0,033		0,417		

Locus	Alleles								
	M	N	O	P	Q	R	S	T	U
AHT4			0,350	0,017	0,033				
AHT5	0,217	0,250	0,033		0,033				
ASB17	0,033	0,267	0,133		0,050	0,083			
ASB2	0,033	0,050	0,067	0,167	0,183	0,217			
ASB23							0,217		0,050
CA425	0,200	0,483	0,067						
HMS1	0,451								
HMS2	0,134								
HMS3	0,117	0,033	0,200	0,350		0,033			
HMS6	0,317	0,017	0,033	0,567					
HMS7	0,133	0,333	0,100						
HTG10	0,400		0,232			0,117	0,017		
HTG4	0,750	0,017	0,017						
HTG6	0,067		0,350			0,033			
HTG7	0,117	0,150	0,466						
LEX3	0,083	0,134	0,200	0,183					
VHL20	0,133	0,317		0,100					

As can be seen from Table 1, there are 7 alleles in the locus AHT4. The most widespread was allele J, so, its frequency was 0.316. The lowest frequency was observed for alleles K and P, they occurred with the same frequency of 0.017.

In the locus AHT5 in horses of Kostanay breed 6 alleles were revealed, the highest frequency was observed for allele K (0,267); in the second place - allele N (0,250); the lowest frequency was observed for alleles O and Q (0,033).

The ASB17 locus is the most highly polymorphic in the studied group of horses. Thus, 10 alleles were identified in it. The highest frequency is noted for allele N (0.267); the second place is occupied by allele O (0.133). The lowest frequency is characterized by alleles I (0.017) and K (0.017).

The ASB2 locus contains 8 alleles. The most common allele was the R allele (0.217). Allele M in horses of Kostanay breed was less widespread, as its frequency was 0,033.

In the ASB23 locus, the L allele (0.283) is the most frequent, with the I allele (0.233) in second place. In the studied population of horses of Kostanay breed alleles K (0,100) and U (0,050) are among the rarest.

In locus CA425 in horses of Kostanay breed 6 alleles were revealed, the highest frequency was observed for allele N (0,483); in the second place - allele I (0,133); the lowest frequency was observed for allele L (0,017).

The locus HMS1 is the lowest polymorphic in the studied group of the Kostanay breed of horses. 4 alleles were detected in it. In descending order of frequency there are alleles: M (0,451), J (0,383), L (0,083) and I (0,083).

Five alleles were identified at the HMS2 locus. Thus, in the group of horses of the Kostanay breed, allele L (0.733) was found with the highest frequency, followed by allele M (0.134). Allele I is one of the rarest and its frequency is 0.017.

Six alleles were identified at the HMS3 locus. Allele I has the highest frequency (0.267), while alleles R and N are among the rarest, with a frequency of 0.033.

In the HMS6 locus, the following distribution of alleles is observed. In the studied population of horses of the Kostanay breed, the highest frequency is noted for the allele P (0.567), the lowest - for the allele N (0.017).

In the locus HMS7 in horses of Kostanay breed 5 alleles were revealed. The frequencies of alleles in the group in descending order were: N - 0.333, J - 0.234, L - 0.200, M - 0.133, O - 0.100.

In the studied horse population 7 alleles were detected at the HTG10 locus. The highest frequency was observed for allele M (0.400); the second place was occupied by allele O (0.232); the lowest frequency was observed for alleles L, S and K (0.017).

Five alleles were detected in the HTG4 locus. In the group of horses of Kostanay breed with the highest frequency was allele M (0,750), followed by allele K (0,201). Alleles L, N and O are the least common, their frequency is the same and is 0.017.

In the HTG6 locus the following distribution of alleles is observed. In the group of horses of the Kostanay breed the greatest frequency is noted for alleles G (0,400), and O (0,350). Other alleles have a low frequency (from 0,033 to 0,150).

The HTG7 locus is one of the least polymorphic. Four alleles were identified in it. The O (0.466) and K (0.267) alleles have the highest frequency. The N (0.150) and M (0.117) alleles are the least common.

7 alleles were detected in the LEX3 locus. In horses of the Kostanay breed the most widespread was allele L (0,233). Alleles F (0.067) and M (0.083) were among the less common alleles.

Five alleles were identified at the VHL20 locus. Thus, in the group of Kostanay horses, allele I (0.417) was the most frequent, followed by allele N (0.317). The L allele is one of the rarest, and its frequency is 0.033.

Further we calculated the level of polymorphism, assessed heterozygosity, calculated the values of Wright fixation index (Table 2).

Than the lower the level of polymorphism, the lower the genetic diversity of the population. In our research the level of polymorphism varied from 1.657 in HTG4 locus to 6.250 in ASB2 locus. The average level of polymorphism was 3.758 (Table 2). In the group of Kostanay horses we studied, of the 17 identified STR loci, eight had allele counts greater than the average level of polymorphism and nine had allele counts less than the average level (from 1.657 to 3.719).

Heterozygosity is an important parameter in questions of population genetic dynamics. Heterozygosity serves as a measure of genetic variability of a population and is defined as the average frequency of heterozygous individuals at certain loci. An increase in homozygosity is accompanied by a decrease in genetic and phenotypic diversity and leads to an increase in the homogeneity of populations. In the studied group of the Kostanay breed, the observed and expected heterozygosity for all loci do not differ. The highest level of expected heterozygosity was at the ASB2 locus (0.840), and the lowest at the HTG4 locus (0.397). The average observed heterozygosity was 0.681 and expected heterozygosity was 0.696.

Table 2 – Genetic characterization of polymorphism of Kostanay horses by 17 DNA microsatellites (n=30)

Locus	Number of alleles	Level of polymorphism (AE)	Degree of heterozygosity		Fixation Index (Fis)
			Observed heterozygosity (Ho)	Expected heterozygosity (*He*)	
1	2	3	4	5	6
AHT4	7	3,814	0,733	0,738	0,007
AHT5	6	4,489	0,867	0,777	-0,116
ASB17	10	5,128	0,800	0,805	0,006
ASB2	8	6,250	0,900	0,840	-0,071
ASB23	6	4,813	0,867	0,792	-0,094
CA425	6	3,267	0,700	0,694	-0,009

1	2	3	4	5	6
HMS1	4	2,752	0,500	0,637	0,215
HMS2	5	1,773	0,367	0,436	0,158
HMS3	6	4,009	0,667	0,751	0,111
HMS6	6	2,353	0,667	0,575	-0,160
HMS7	5	4,286	0,800	0,767	-0,043
HTG10	7	3,719	0,667	0,731	0,088
HTG4	5	1,657	0,500	0,397	-0,261
HTG6	5	3,220	0,667	0,689	0,033
HTG7	4	3,077	0,567	0,675	0,160
LEX3	7	5,980	0,600	0,833	0,280
VHL20	5	3,303	0,700	0,697	-0,004
Average	**6**	**3,758**	**0,681**	**0,696**	**0,018**

For each locus, we calculated the values of the Wright fixation index. The Wright fixation index allows us to establish the deviation of heterozygous genotypes from the theoretically expected one. The index value can have both positive and negative values, in the first case it indicates the lack of heterozygotes, in the second case - their excess. For the studied Kostanay breed the shortage of heterozygotes was observed at loci AHT4, ASB17, HMS1, HMS2, HMS3, HTG10, HTG6, HTG7, LEX3; at the same time the index values were insignificant and were in the range from 0.006 to 0.280. An excess of heterozygotes was observed for the remaining loci, where the fixation index ranged from minus 0.004 at the VHL20 locus to minus 0.261 at the HTG4 locus. The mean value of Wright's fixation index showed 0.018.

Conclusion.

As a result of the study of 30 heads of horses of the Kostanay breed, we investigated and described 17 STR loci, in which 70 alleles were identified: from 4 to 10 alleles per locus. The maximum level of polymorphism was characterised by locus ASB2, and the lowest level - by locus HTG4. The studied group of the Kostanay breed was characterised by a high level of genetic diversity. The average level of observed heterozygosity was 0.681, expected heterozygosity - 0.696. In general, the average index of Fis fixation index (0.018) was determined for the group, which indicates the stability of the genetic structure of this population.

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ТҮЙІН

Мақалада ДНҚ микросателлиттерінің 17 локусы бойынша: AHT4, AHT5, ASB17, ASB2, ASB23, CA425, HMS1, HMS2, HMS3, HMS6, HMS7, HTG10, HTG4, , HTG7, LEX3, VHL20 Қостанай тұқымының генетикалық әртүрлілігін талдау нәтижелері келтірілген. Зерттеу үшін биологиялық материал ретінде Қостанай тұқымының 30 бас жылқысының (Қостанай қ.) шаш талдары пайдаланылды.

Жұмыстың мақсаты микросателлиттік STR-локустар бойынша Қостанай тұқымды жылқылардың генетикалық әртүрлірігін сипаттау болды.

Жануарлардың генотипін анықтау ПЦР әдісімен орындалды, күшейту өнімдерін бөлу және анықтау капиллярлық электрофорез арқылы 8 капиллярлы генетикалық анализатор 3500 Genetic Analyzer (Applied Biosystems, АҚШ) арқылы жүзеге асырылды. Нәтижелер GeneMapper бағдарламасының көмегімен түсіндірілді, статистикалық өңдеу Microsoft Excel 2010 бағдарламасы арқылы орындалды. Келесі параметрлер есептелді: аллель жиіліктері, полиморфизм деңгейі (Ae), байқалу дәрежесі (Ho) және теориялық есептелген (He) гетерозиготалық, фиксация индексі (Fis).

Қостанай облысы Заречное ауылында өсірілетін жылқылардың қостанай тұқымын генотиптеу нәтижесінде зерттелетін микросателлиттік локустар үшін маркерлердің әрқайсысының полиморфизмін сипаттайтын мәліметтер алынды. Қостанай тұқымды жылқылардағы 17 микросателлиттік ДНҚ локустары үшін 102 аллель анықталды. Бір локустағы аллельдердің саны 4-тен 10-ға дейін өзгерді. Зерттеу тобы үшін ең ақпаратты локустар аллельдердің ең көп саны бар локустар (ASB17, ASB2), ең аз ақпарат беретін локустар (HMS1, HTG7). Ең жоғары байқалған гетерозиготалық ASB2 локусында (0,900), ал ең төменгісі HMS2 локусында (0,367) болды. Күтілетін гетерозиготалықтың орташа деңгейі – 0,696, бақыланатын гетерозиготалық – 0,681, орташа фиксация индексі – 0,018.

Осылайша, Қостанай жылқы тұқымының зерттелетін микросателлиттік ДНҚ локустарының барлық зерттелген көрсеткіштері бойынша полиморфизмге тән белгілер анықталды.

РЕЗЮМЕ

В статье представлены результаты анализа генетического разнообразия костанайской породы 17-ти локусам микросателлитов ДНК, включая AHT4, AHT5, ASB17, ASB2, ASB23, CA425, HMS1, HMS2, HMS3, HMS6, HMS7, HTG10, HTG4, HTG6, HTG7, LEX3, VHL20. В качестве биологического материала для исследований использовались волосяные луковицы 30 голов лошадей костанайской породы (г. Костанай, п. Заречный).

Целью работы было охарактеризовать генетическое разнообразие лошадей костанайской породы по микросателлитным STR-локусам.

Генотипирование животных проводили методом ПЦР, разделение и детекцию продуктов амплификации осуществляли методом капиллярного электрофореза на 8-капиллярном генетическом анализаторе 3500 GeneticAnalyzer (AppliedBiosystems, США). Интерпретация результатов осуществлялась в программе GeneMapper, статистическую обработку проводили с использованием программы «Microsoft Excel 2010». Рассчитывали следующие параметры: частоты встречаемости аллелей, уровень полиморфности (A_e), степень наблюдаемой (*Ho*) и ожидаемой (H_e) гетерозиготности, индекс фиксации (*Fis*).

В результате генотипирования костанайской породы лошадей, разводимых в п. Заречное Костанайского района по изучаемым микросателлитным локусам были получены данные, характеризующие полиморфизм каждого из маркеров. По 17 микросателлитным локусам ДНК у лошадей костанайской породы было выявлено 102 аллеля. Число аллелей на локус варьировало от 4 до 10. Наиболее информативными для исследуемой группы явились локусы с наибольшим числом аллелей (ASB17, ASB2), наименее информативными - с минимальным (HMS1, HTG7). Наибольшая наблюдаемая гетерозиготность была в локусе ASB2 (0,900), а наименьшая – в локусе HMS2 (0,367). Средний уровень ожидаемой гетерозиготности составлял 0,696, наблюдаемой гетерозиготности – 0,681, средний индекс фиксации имел величину, равную 0,018.

Таким образом, выявлены характерные особенности полиморфизма по всем исследованным показателям изученных микросателлитных локусов ДНК костанайской породы лошадей.

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EXTERIOR AND MORPHOMETRIC INDICATORS OF BRED BREEDS OF HONEY BEES OF KAZAKHSTAN

ANNOTATION

The article presents the results of a study to determine the breed affiliation, exterior indicators, bred breeds of honey bees on the territory in the context of regions and zones of the Republic of

Kazakhstan. The study of wings by morphometric method covered 3000 samples of front, right wings from 40 beekeeping farms. It has been established that representatives of three subspecies of honey bees (*A. m. carnica, A.m. carpatica, A.m. mellifera*) are mainly bred on the territory of Kazakhstan, honey bees of breeds are distributed in all zones of the country. *A. m. carnica* and from 86 to 96% of honey bees in bee colonies belong to the C line, and *A.m. carpatica* belongs to 53.5 to 97.7% of bee colonies in apiaries. On the territory of Kazakhstan, 61.6% belongs to A.M. carnica, 29.4% to *A.m. carpatica* and 9% to *A.m. mellifera* and other breeds. As a result of the study to determine the exterior data, it was found that the bred breeds of honey bees by the length of the proboscis, by the size of tergites, sternites, wings fully meet the requirements of the standards for bees of the evolutionary line C, which includes the breeds *A.m. carnica* and *A.m. carpatica*, they are Kazakhstan populations of these subspecies.

Key words: *morphometry,exterior, cubital index, dumbbell index, discoidal displacement*

Introduction. According to the results of the work carried out on breed testing by scientists beekeepers of Kazakhstan from 1964 to 1971, three main breeds of honey bees were identified for zoning in Kazakhstan: *A.m. carnica, A.m. carpatica, A.m. mellifera.* During the breed testing, gray mountain Caucasian, Italian, Carpathian, Carniolan honey bee, and European dark breeds, which were crossbred with local bees, participated [1].

The methodology of identification of morphometric features of honey bees is promising for population control, breeding of new types, lines [2]. In the modern world, there are two scientific research schools in the field of beekeeping that evaluate the breed affiliation of bees by morphometric characteristics: Russian and German, differing in methodological approaches [3]. The essence of the difference in the studies of the two schools is the use by the European school in calculating the cubital index by determining the natural value, the ratio of the proximal segment of the main vein of the 3 cubital cell and the discoidal, and the Russian school adopted the opposite ratio with a percentage conversion. According to other indices, studies are conducted in the same way in two schools [4].

The prevalence of honey bees (*Apis mellifera*) throughout the globe was described by the world's leading beekeeping scientists based on the results of their research [5, 6, 7, 8, 9, 10, 11]. Initially, based on morphological analysis, all subspecies of the honey bee were grouped into four well–differentiated evolutionary branches, or lines that corresponded to the geographical origin of the subspecies: A - African line (subspecies); M – line "*Mellifera*" (subspecies of the western Mediterranean and Northwestern Europe), C – line "*Carnica*" (subspecies of Southeastern Europe and Eastern Mediterranean); O - line "Oriental" (subspecies of the Middle East and Western Asia) [5].

According to the modern classification, honey bees are divided into 30 subspecies belonging to six evolutionary lines. 11 subspecies of bees belong to the evolutionary line common in the African mainland, 9 subspecies that are common in eastern Europe and the Mediterranean belong to the C line, and 6 subspecies that are common in the Middle East are subject to the O line. On the territory of western and northern Europe, two subspecies from the M line are common, the remaining two subspecies of the two Z and Y lines are bred on the territory of Syria and Yemen [5, 6].

On the territory of eastern Europe and Belarus, 7 subspecies belonging to different evolutionary lines are often found: European dark bee (*A.m. mellifera*), Carpathian (*A.m. carpatica*), yellow Caucasian (*A.m.remipes Gerst*), Caucasian (*A.m. caucasica*), Carniolan honey bee (*A.m.carnica*), Italian *(A.m. ligustica*), Ukrainian steppe (*A.m. acervorum*) [12].

In Kazakhstan, the *A.m. carnica* subspecies is bred the most – currently, which make up about 61.6% of the number of bred honeybee breeds. Representatives of three breeds of honey bees are bred on the territory of our country: *A.m.carnica, A.m.carpatica, A.m. mellifera,* and there are also crossbred bees of representatives of different lines.

The purpose of the article was to present information material about the bred subspecies of honey bees in the territory of Kazakhstan.

Materials and methods. According to standard methods, 3000 samples of the front, right wings of the studied honey bees were selected from 40 apiaries from different regions of the country [13].

The samples were taken during the period of full activity of bees. They were fixed with ethyl medical alcohol and each batch was labeled indicating the numbers of the bee family [13].

The samples were taken according to the generally accepted method of Alpatov V. [14, 15, 16, 17], and the arrangement of lab preparation was carried out according to the method of Kartashov A. [18].

From the right front wing, legs, proboscis, hooks, sternite, tergite, the preparation was prepared by fixing on a transparent adhesive tape, scanned and received an electronic version according to the method of Kartashov A. [18]. They were scanned using an Epson V600 Photo scanner. The resolution of the images was 3200 dots per inch (image size: 5782x3946 pixels).

The exterior assessment of bees (proboscis length, number of hooks, tergite length and width, sternite length and width, wax mirror length and width, tarsal index of the right leg, length and width of the right wing) was carried out according to Alpatov's method in [14, 15, 16, 17] (figure 1).

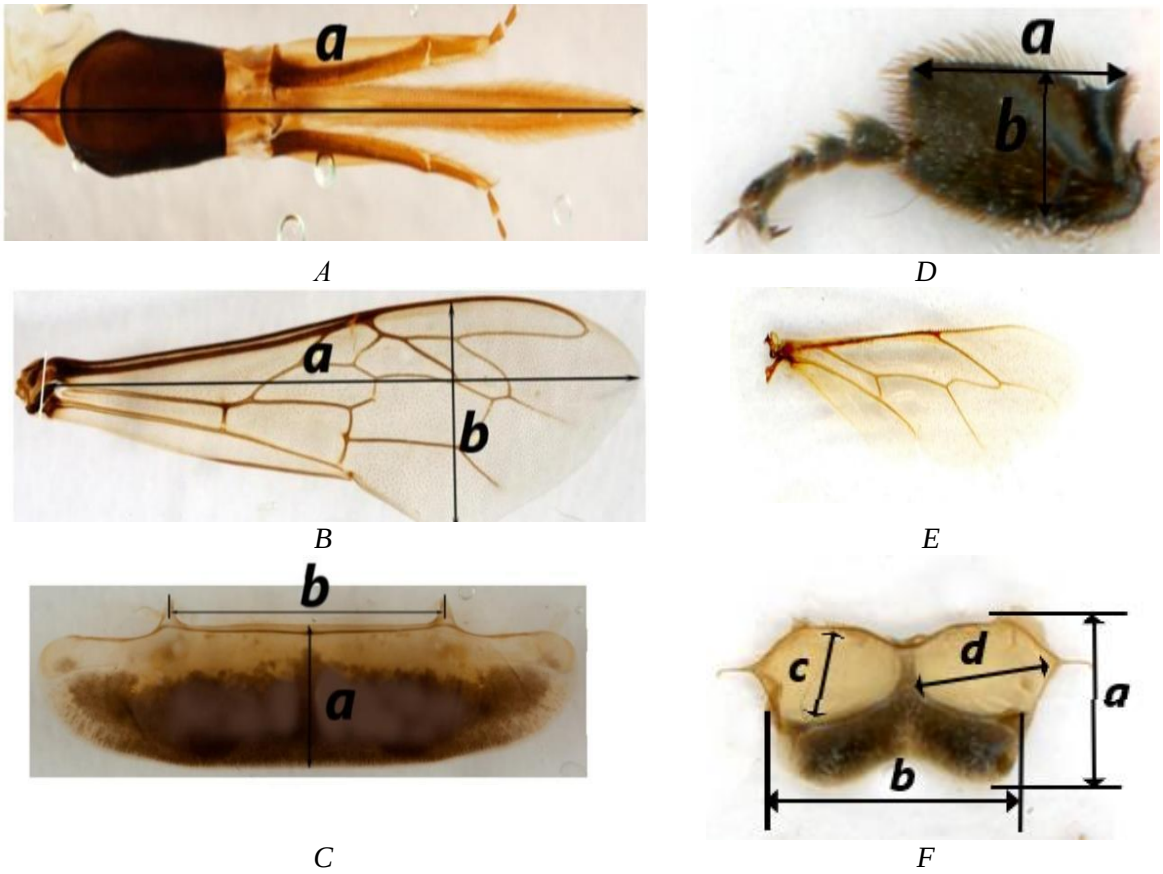

Figure 1 – A:proboscis length, B:front right wing: a – length, b- width,
C: tergite: a – length, b- width,
D: hind legs: a – length, b- width,E:small front wing (number of hooks),
F:sternite: a – length, b– width,wax mirror: c – length, d- width

The breed affiliation according to the index of the bee wing (cubital index, discoidal displacement, dumbbell index) was determined by the morphometric method according to A. Kartashov [18].

The obtained experimental material was processed according to the Microsoft Excel program based on the method of variational statistics according to the method of N.A. Plokhinsky [19].

Results. In the course of the study, the population of honey bees in Kazakhstan was studied by monitoring the number of apiaries, the presence of bred breeds, and the population of honey bees on the territory of Kazakhstan.

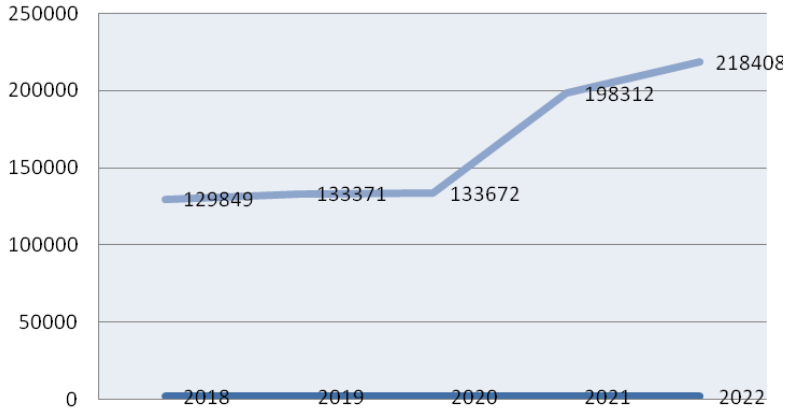

Figure 2 – Total number of families according to the Statistics Department of the Republic of Kazakhstan

Figure 3 shows the number of bee colonies in the context of the regions of Kazakhstan.

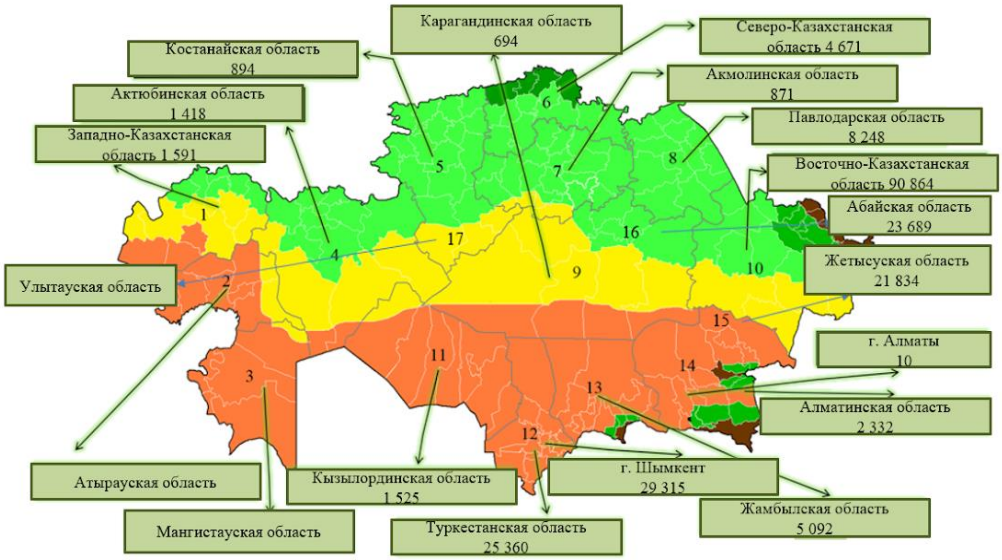

Figure 3 – Number of bee colonies in the context of natural and climatic zones of Kazakhstan

Currently, according to statistics, there are more than 218.4 thousand breeding families on the territory of our country [20]. 218408 bee families of Kazakhstan are located in the following order: the first place is occupied by the eastern region (East Kazakhstan, Abai region), where there are 114533 bee families or 52.45% of the total number. The second place is taken by the southern region (Zhambyl, Kyzylorda, Turkestan region, Shymkent), with 61292 bee families, which is 28.06%, the third place was taken by the south-eastern region (Zhetysu, Almaty) with the number of bee families 24176 or 11.07%, then the northern region (North Kazakhstan, Pavlodar, Kostanay) on the fourth (6.72%), the fifth – the Western region (West Kazakhstan, Aktobe) - 1.38% of bee colonies from the total number of bee colonies of the Republic of Kazakhstan. However, it should be noted that only in the territory of the East Kazakhstan region there are 90,864 bee colonies, which is 41.6% of all bee colonies in Kazakhstan.

Hence, it can be assumed that a large number of bee colonies and apiaries on the territory of eastern Kazakhstan are the result of the influence of the developed beekeeping of Altai and the early beginning (1786) of the development of beekeeping on the territory of present-day eastern Kazakhstan. The development of beekeeping in the south and south-east with a population of up to 85,468 bee colonies was apparently influenced by natural and climatic conditions and frequent importation of bee colonies from neighboring countries.

These indicators indicate the current state of the level of zoning of bred breeds: Carpathian, carnica, European dark bee, as well as unexplained populations of honey bees in Kazakhstan.

At the same time, it should be noted that bees are bred most of all on the territory of the republic in order to obtain honey products. Among the exemplary apiaries, the first place is occupied by the *A.m.carnica* breed with a population of 61.6% of the total number of bees, the second *A.m.carpatica* – 29.4%, and the remaining 9% is accounted for by other imported breeds and native local honey bees.

Studies were carried out to determine the breed affiliation and the percentage ratio of the number of studied cross bred bees in the context of breeds with the use of morphometric and molecular genetic modern methods.

In this regard, in the future, in order to establish an accurate, concrete picture of the number and abundance of breeds, populations, comprehensive studies will be conducted covering all bee apiaries, bee families in order to determine breeding areas in the context of breeds, ecotypes, intra-breeding lines of bees.

The result of taking into account the number of bee apiaries and bred breeds in the context of the regions, it was found that the first place is occupied by the *A.m.carnica* breed, which is adapted to the conditions of all 6 natural and climatic zones (desert, semi-desert, steppe, forest-steppe, foothill, mountain).

Taking into account the biological and physiological features of the bred breeds of honey bees, the breeding was determined: A.M.carnica and A.M.carpatica, which are acclimatized to warmer, temperate climatic conditions, and the European dark breed of bees well adapted to cold conditions in the natural climatic zones of Kazakhstan with a relatively low temperature regime.

In Kazakhstan, the breeding area of the Carpathian and A.M.carnica bee breeds is expanding, which affects the increase in honey production, at the same time honey base plants for bees are improving, in this regard, natural and cultural honeybees, including oilseeds and fodder crops, have become widely used by bees. The necessary prerequisites are being created for the production of high-quality honey, which can successfully compete with the products of other countries.

According to the national statistics of the Republic of Kazakhstan, due to the state support for the development of beekeeping, there is an increase in the number of bee colonies, this was influenced by favorable natural and climatic conditions, relatively mild moderate temperature, wind speed and humidity in the summer period, as well as sufficient food supply for bees. Analyzing the data of the Department of Statistics of the Republic of Kazakhstan, the total number of hives in the regions over the past 3 years has increased by an average of 63.4%. However, beekeeping is poorly developed in the Mangistau and Atyrau regions. Compared to 2021, by the beginning of 2023, the number of bee colonies increased in the southern region by 36.8%, the remaining 4 regions, except for the central region, the number of 700 bee colonies in the western region increased to 2806 bee colonies in the eastern region, and in the central zone, the number of bee colonies decreased by 416 bee colonies.

To determine the presence of representatives of subspecies, 40 apiaries were studied, located in all natural and climatic zones, 12 regions of Kazakhstan, where 17967 bee colonies are bred. Of these, 14 bee apiaries are located in the steppe zone, 9 - in the forest-steppe zone, 4 - desert, 4 – semi-desert, 7 - foothill, 2 - mountain. The main directions of farms are honey and breeding. All farms in Kostanay and Pavlodar regions belong to the steppe zone, and in Almaty and East Kazakhstan regions apiaries are located in forest-steppe, steppe, mountain, foothill, desert, semi-desert zones. Of the 40 apiaries, 15 (37.5%) are stationary, where cultivated beekeepers are used for the further breeding of purebred families in the conditions of honey breeding farms. Table 1 shows the morphometric indicators of bees in the context of breeding zones.

Table 1 – Morphometric indicators of honey bees

Natural and climatic zone	Breed	Number of farms	Breed, %	Cubital index	Dumbbell index	Discoidal displacement	Tarsal index
1	2	3	4	5	6	7	8
Deserted	Carnica	2	92,6±2,59	2,785±0,06	1,08±0,01	3,91±0,25	57,09±0,565
	Carpathian	2	75,61±1,537	2,794±0,045	1,08±0,006	4,632±0,228	56,50±2,329
Semi - desert	Carnica	1	96,5±1,22	2,90±0,06	1,09±0,01	4,23±0,18	55,65±0,956
	different breeds	3		2,253 ±0,081	0,951±0,027	1,174±0,814	50,324 ±2,567

1	2	3	4	5	6	7	8
Steppe	Carnica	9	92,00±3,50	2,71±0,07	1,06±0,01	4,06±0,29	52,98±1,276
	Carpathian	3	97,70±1,476	2,946±0,104	1,11±0,012	4,650±0,259	57,33±0,663
Forest - steppe	Carnica	4	86,1±4,99	2,80±0,09	1,07±0,02	3,5±0,46	57,78±0,108
	Carpathian	2	58,6±2,45	2,4386±0,05	1,07±0,01	5,10±0,42	54,3±0,35
	Central Russian	2		2.274±0.018	1.06±0.033	3.574±1.209	59,08±1,893
Foothill	Carnica	5	92,90±1,49	2,66±0,04	1,08±0,01	3,84±0,16	57,52±0,55
	Carpathian	2	53,5±4,53	2,5088±0,49	1,061±0,01	4,00±0,21	55,6±0,38
Mountain	Carnica	1	95,10±1,82	2,78±0,05	1,08±0,01	3,71±0,14	58,77±0,57

The table shows the morphological characteristics of bees living in different natural and climatic conditions, showing variability depending on the latitude of the terrain and the vertical zoning of the regions.In this regard, it was necessary to study the morphological characteristics of bees in each region.

Bee samples for the study of morphological features were taken from bee colonies of the above localities and the following indices were measured with wings on the front right wings: cubital, dumbbell indices and discoidal displacement.

The difference in the cubital index of carnica between bees obtained in the forest-steppe zone with semi-desert was 0.10 (3.45%) and between steppe and semi-desert 0.19 (6.55%) and between foothill and semi-desert 0.24 (8.28%). Thus, the range of the cubital index of carnica, depending on the breeding zone, ranged from 0.10 to 0.24 and ranged from 2.66 to 2.90.

And for the Carpathian breed of bees, this indicator ranged from 2.438±0.05 to 2.946±0.104. The lowest values for the cubital index were noted for crossbred bees in semi-desert (2.253±0.081) and forest-steppe zones (2.274±0.0186).

In morphometric analysis, the dumbbell index of the wings of the studied farms ranges on average from 0.951 (semi-desert zone) to 1.109 (steppe zone). During the study of the dumbbell index by breed, the following met the standard: carnica (from 1.06± 0.01 to 1.09± 0.01), Carpathian (from 1.061±0.01 to 1.109±0.012), and in crossbreeds this indicator ranges from 0.951±0.027 to 1.060±0.033, which takes the index to the carnica breed index. In five zones, tarsal indices were the best for Ukrainian bees, only in the steppe zone they were better for Carpathians.

More contrasting interbreed differences are observed in the features of discoidal displacement. Purebred Carpathian bees have at least 80% of cases of positive bias. A high percentage of positive discoidal displacement in the Carpathian (4,00±0,21–5,10±0,42) bee breeds.

26 carnica, 9 Carpathian and 5 with different breeds were studied from the general beekeeping with breed affiliation. Of all the beekeeping farms studied, bees have a high similarity with the characteristics of the Carpathian breed *A.m. carpatica* in the steppe zone (97.700 ± 1.476), and in the semi-desert zone (96.5 ± 1.22), the characteristics *A.m.carnica* were determined. In semi-desert and forest-steppe zones, hybridization of bees is observed. At the same time, the high variability is shown by the breed of carnica bees.

The analysis of exterior signs was carried out in 40 apiaries from all regions of Kazakhstan for 11 main morphometric signs of worker bees: proboscis length, number of hooks, tergite length, tergite width, sternite length, sternite width, wax mirror length, wax mirror width, tarsal index of the right leg, right wing length, right wing width (Table 2).

According to the research results, it was found that the number of hooks that affect the adjustment of hovering in flight in all breeds was in the range of 19.43-21.96. At the same time, the A.M. carnica breed had the smallest number of leads in the mountain and forest-steppe zones of 19.4-19.9, which requires further study.

The length and width of the tergite worker bees in all zones were within the standard. Wax mirrors are one of the main vital structures of the body. The percentage ratio is 1/3 of the width of the length of the wings. The ratio of length to width according to tergite was in the range from 42 to 48%. The dimensions and the ratio of length to width of wax mirrors affect the volume of wax produced by

bees. According to tarsal indices, bees have a large value in desert (50,324 ± 2,567) and forest-steppe zones (59,084± 1,893), which affects long-term efficiency in the process of pollen collection.

The indicators of the average length of the proboscis, which is one of the main indicators for the bonitation of bees in the Carpathian breed ranges from 6,072 ± 0.084 to 6,462± 0.035, and in the carnica breed it ranges from 6,184 to 6,29 mm, regardless of their habitat zone, according to the tarsal index and the width of the right wing there are minor deviations in breeding zones, and there are no significant differences in other indicators. A.M.carnica in the steppe zone tarsal index was 9.84% lower than in the mountainous zone.

Conclusion. It was found that in six natural and climatic zones of 15 regions of Kazakhstan, only breeds of honey *bees A.m. carnica, A.m. carpatica* are common in desert, steppe, forest-steppe and foothill zones, and *A.m. mellifera* and native local bees are bred in farms located in semi-desert and forest-steppe zones.

Taking into account the peculiarities of the natural and climatic zones of Kazakhstan, it is proposed to breed breeds of the C line in the conditions that they are acclimatized, namely, in hot summer and warm temperate winter temperature conditions in zones, and more in cold temperature zones to breed European dark bee breeds and bees of the local population.

It has been established that the largest number of bees belongs to the A.M.carnica breed, which is bred by about 70% of farms, from all bee apiaries in Kazakhstan. There are cross bred representatives of the breed of the Ukrainian steppe, Caucasian, in scanty numbers. This indicates an unplanned and uncontrolled import of bees from different countries.

To carry out breeding, taking into account the selected directions, it is necessary to determine the level of purity and breeding value of the breeding group, queen bees and bee families.

As a result of the study to determine the exterior data, it was found that the bred breeds of honey bees by the length of the proboscis, by the size of tergites, sternites, wings fully meet the requirements of the standards for bees of the evolutionary line C, which includes the breeds *A.m. carnica and A.m. carpatica,* they are Kazakhstani populations of these subspecies. The average length of the proboscis of carnica was 6.22, were in the range from 6.18 to 6.29 mm, and the length of the proboscis of the Carpathians were a large range from 6.07 to 6.46 on average was 6.31mm. The bred populations of the European dark bee breed in the eastern and southeastern regions belong to the evolutionary line M. The results of the studies confirmed that the European dark bee belongs to this line. When determining the cubital index of honey bees, the carnica breed averaged 2.77 with a deviation range from 4 to 4.7% (from 2.66 to 2.90), taking into account the indicators of all natural and climatic zones.

Thus, it has been established that the Kazakh population of the A.M.carnica breed is mainly acclimatized in the southern, southeastern and western regions, where a temperate climate is maintained throughout the year. Currently, work is underway to determine the adaptive and resistant to cold climates of the Karnik and Carpathian breeds, the Central Russian breed, mainly acclimatized to the conditions of the forest-steppe, with cold winter weather temperature regimes.

The use of morphometric methods for determining the breed affiliation makes it possible to determine the effectiveness of honey bees in acclimatized zones and relative high productivity of a particular breed.

Currently, breeding and zoning of the *A.m. carnica, A.m. carpatica, A.m. mellifera* breeds is effective and contributes to the development of beekeeping in Kazakhstan.

The possibility of importing representatives of other managed breeds, the preservation of local populations require further research to determine the possibility of breeding other imported populations of honey bees on the territory of Kazakhstan.

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Table 2 – Results of external indicators of worker bees in different climatic zones of Kazakhstan

Natural and climatic zone	Breed	n	Proboscis length	Number of leads	Tergite length	Tergite width	Sternite length	Width of sternite	Length of the wax mirror	The width of the wax mirror	Right wing length	Width of the right wing
Deserted	Carnica	2	6,184 ± 0,061	21,20±0,22	2,036±0,017	4,784±0,026	2,736±0,014	3,994±0,023	1,467±0,014	2,310±0,020	9,326±0,030	3,089±0,013
	Carpathian	2	6,072±0,084	21,33±1,202	2,703±0,078	4,768±0,058	3,267±0,131	4,319±0,133	1,761±0,067	2,717±0,074	9,142±0,035	3,723±0,182
Semi - desert	Carnica	1	6,195±0,049	20±2,0	2,008±0,029	4,812±0,028	2,772±0,089	4,023±0,110	1,446±0,004	2,252±0,092	9,2±0,164	2,992±0,028
	different breeds	3	6,086 ±0,201	20,250 ±0,590	2,559 ±0,019	5,727 ±0,051	3,358 ±0,054	5,318 ±0,140	1,334 ±0,030	2,456 ±0,082	10,025 ±0,186	3,514 ±0,086
Steppe	Carnica	9	6,199±0,057	21,667±0,182	2,197±0,017	4,849±0,056	2,729±0,012	4,225±0,023	1,484±0,009	2,322±0,019	9,305±0,029	3,158±0,030
	Carpathian	3	6,462±0,035	21,967±0,232	2,100±0,023	4,760±0,069	2,679±0,022	4,064±0,034	1,525±0,019	2,408±0,022	9,303±0,036	3,444±0,041
Forest - steppe	Carnica	4	6,231±0,077	19,933±0,230	2,049±0,062	4,267±0,089	2,715±0,041	4,180±0,026	1,407±0,051	2,235±0,024	9,792±0,054	3,566±0,031
	Carpathian	2	6,3±0,05	22±0,34	2,15±0,01	4,6±0,07	2,81±0,02	4,41±0,02	1,21±0,01	2,13±0,02	9,0±0,02	3,2±0,06
	Central Russian	2	6,455±0,046	20,333±0,221	2,148±0,020	4,662±0,028	2,724±0,013	4,058±0,027	1,499±0,008	2,365±0,015	9,549±0,042	3,448±0,042
Foothill	Carnica	5	6,29±0,02	20,50±0,42	2,20±0,01	4,79±0,02	2,83±0,03	4,65±0,03	1,27±0,01	2,28±0,02	9,14±0,04	3,24±0,02
	Carpathian	2	6,4±0,03	20±0,31	2,15±0,02	4,7±0,04	2,9±0,03	4,57±0,03	1,28±0,01	2,4±0,02	9,0±0,02	3,3±0,06
Mountain	Carnica	1	6,26±0,03	19,43±0,53	2,14±0,01	4,63±0,03	2,81±0,02	4,40±0,02	1,21±0,01	2,13±0,02	8,97±0,03	3,19±0,01

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ТҮЙІН

Мақалада Қазақстан Республикасының облыстары мен аймақтарында тұқымдық тиесілігін анықтау бойынша зерттеу нәтижелері, бал араларының өсірілетін тұқымдарының экстерьерлік көрсеткіштері келтірілген. Морфометриялық зерттеу әдістері бойынша 40 ара шаруашылығынан 3000 дана алдыңғы, оң қанат үлгілері зерттелді. Қазақстан аумағында негізінен бал араларының үш түрінің өкілдері өсірілетіні анықталды (*A.m.carnica, A.m. carpatica, A.m.mellifera*), еліміздің барлық аймақтарында *A.m.carnica* тұқымдарының бал

аралары таралған және ара колонияларындағы бал араларының 86-96%-ы С линиясына жатады, ал *A.m.carpatica* тұқымына өсірілетін ара шаруашылықтарының 53,5-тен 97,7%-на дейін тиесілі. Қазақстан аумағында 61,6% - *A.m.carnica,* 29,4% - *A. m. carpatica* және 9% - *A.m. mellifera* және басқа да тұқымдарға жатады. Экстерьерлік көрсеткіштерді зерттеу нәтижесінде бал араларының өсірілген тұқымдары тұмсығының ұзындығы, тергиттердің, стерниттердің, қанаттардың мөлшері бойынша *A.m.carnica* және *A.m.carpatica* тұқымдары жататын С эволюциялық линиясының аралары үшін стандарт талаптарына толық жауап беретіні анықталды, олар осы кіші түрлердің қазақстандық популяциялары болып табылады.

РЕЗЮМЕ

В статье приведены результаты исследования по определению породной принадлежности, экстерьерные показатели, разводимых пород медоносных пчел на территории в разрезе областей и зон Республики Казахстана. Были исследованы 3000 образцов передних, правых крыльев из 40 пчеловодных хозяйств по морфометрическим методам. Установлено, что на территории Казахстана в основном, разводится представители трех подвидов медоносных пчел (*A.m. carnica, A.m. carpatica, A.m. mellifera*), во всех зонах страны распространены медоносные пчелы пород *A.m.* carnica и от 86 до 96% медоносных пчел в пчелосемьях относится к линии С, а *A.m. carpatica* принадлежит от 53,5 до 97,7% пчелосемей разводимых хозяйствах по пчеловодству. На территории Казахстана 61,6% относится к *A.m. carnica,* 29,4% - A.*m. carpatica* и 9% *A.m. mellifera* и другим породам. В результате исследования по определению экстерьерных данных установлено, что разводимые породы медоносных пчел по длине хоботка, по размером тергитов, стернитов, крыльев полностью отвечают требованиям стандартов для пчел эволюционной линии С, куда относится породы *A.m. carnica* и *A.m. carpatica,* они являются Казахстанскими популяциями этих подвидов.

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THE INFLUENCE OF THE SLAUGHTER AGE ON THE MEAT PRODUCTIVITY OF KALMYK CATTLE

ANNOTATION

Meeting the growing demand of the population for meat is one of the priorities of modern animal husbandry. Particular attention is paid to the growth of cattle meat production, which occupies a leading position in the meat balance of the country.

The article deals with the study of the slaughter quality of meat of Calmyk bulls of different lines belonging to Seaman - 120541 and Stroy - 2520 at the age of 15-18 months and the change in the quality of slaughter depending on age. The morphological and chemical composition of the carcasses of bulls of different affiliations was studied, and the index and energy value of meat were determined. The chemical composition was examined at the National Accreditation Center of the Committee for Technical Regulation and Metrology of the Ministry of Trade and Integration of the Republic of Kazakhstan. According to the results of the study, the Sailor-120541 bulls were distinguished by high indicators. In the course of the work, the results of the chemical analysis of the average sample of meat showed that the chemical composition of meat varies depending on the age and genotype of each bull of different lines.

The research work was carried out within the framework of the scientific and technical program BR 10764981 "Development of technologies for effective management of the selection process for the conservation and improvement of genetic resources in meat husbandry" (2021-2023) by Moskovsky LLP in the farm where it grows the Kalmyk breed of meat.

Key words: *linear affiliation, slaughter quality, Kalmyk breed, carcass.*

Introduction. The formation of productive qualities in animals occurs as a result of all the changes in the body in the process of individual development. To the factors of formation of meat, productivity can be attributed feeding, age, sex, heredity, housing, acclimatization, and individual characteristics of cattle. According to the data of scientists A.V. Zarkeevich (1961); E. N. Dorotyuk (1981), in the winter period the skin of Kalmyk breeds significantly thickens under the influence of dermo and reticulum. In the cold season, the thickness of collagen fibers in the retinaculum (fibers tightly adhering to each other) increases approximately 2 times, which increases the ability of the skin to retain a large amount of heat. In connection with this, a powerful glandular apparatus appears on the skin of Kalmyk breeds, and sebaceous and sweat glands develop 2-3 times more than in other breeds. This makes the cattle more resistant to cold and serves as a cooling agent in the heat [1, 2]. Increasing the production of livestock products, including cattle meat, is a priority task of farms. It should be taken into account that in any farm the breed of beef cattle (structure) has defects of structure [3, 4]. In this regard, to systematize the production of cattle meat and improve the available breeds of LLP "Moskovsky" in 2012 imported bulls-producers of Kalmykian breeds from the Republic of Kalmykia.

Objective of the study. For a more detailed study of the meat productivity of imported beef cattle breeds for the Northern Territory and to identify differences in the slaughter age of animals, control slaughters at different age periods were carried out.

Materials and methods of research. The object of the study is bulls of the Kalmyk breed at the age of 15 and 18 months. The research work 2021-2023 was carried out in conditions of LLP "Moskovskiy" of the North-Kazakhstan region. Slaughter quality was studied at the slaughter of 3 heads from each group at the age of 15 and 18 months from descendants of factory lines Moryak - 120541, 3 heads of descendants of factory lines Stroyny - 2520 at the age of 15 and 18 months.

Figure 1 – 15-month old progeny of the bull breeder of the breeding line Sailor 120541 taken for research

In the course of the work, experiments were carried out by general scientific methods on the basis of comparative analysis and theoretical information generalizations, zootechnical, and anatomical data [5,6].

To estimate meat yield from each producer, 3 steers were taken by analogy to the controlled slaughter conducted at the slaughterhouse of the breeding farm according to the method of VNIIMS, VIZH (1977). The slaughter qualities were determined by live weight before slaughter, by the weight of the steamed carcass, weaner weight, slaughter weight, slaughter yield, and morphological composition of the carcass [7, 8]. For this purpose, after cooling for a day at a temperature from 0 to +4°C, the right half carcass was separated from the bone, and the relative composition of meat and fat, bones, tendons, and cartilage was determined, as well as the yield was determined meat tissues per 1 kg of bone (fleshiness index) [9]. Chemical parameters of meat and amino acids of the long muscle of bulls' backs were determined according to the general methodology (GOST 34132-2017) [10].

Results of the study. «One of the main problems in our country is to provide the population with meat, including beef. Human consumption of meat products is 86 kg per year according to scientifically based nutritional standards. 43-45% of this amount falls on beef [11].

Formation of meat productivity is realized as a result of morphological and physicochemical changes in the organism of animals in the process of growing and fattening. Factors influencing the formation of meat productivity include feeding, breed, sex, age, adaptability, housing conditions, and personal characteristics of animals.

The live value of animals is an additional indicator of meat productivity and can not fully reflect their meat qualities. A full assessment of meat productivity can be given on the basis of qualitative and quantitative indicators of meat productivity obtained from the results of slaughter [12].

The level of meat productivity of cattle is clearly determined by their live weight. However, we can fully assess the specificity of meat production and meat formation only through the number of meat products obtained as a result of animal slaughter.

According to the results of the control, the indicators of meat productivity of bulls are shown in Table 1.

Table 1 – Results of control slaughter of Kalmyk bulls of different ages and sires, (x ± Sx)

Indicators	Moryak- 120541		Strojny-2520	
	15 month	18 month	15 month	18 month
Live weight before slaughter, kg	364,7±3,55	414,3±9,12	354,1±9,89	407,7±10,5
Weight of fresh carcass, kg	195,6±0,9	223,2±5,68	189±4,8	218,9±5,84
Abdominal fat mass, kg	14±0,12	12,2±0,38	10,4±0,34	9,1±0,23
Slaughter weight, kg	209,6±0,62	235,4±1,0	199,4±0,72	228±1,15
Meats yield, %	53,3	53,8	53,3	53,7
Abdominal fat yield, %	2,5	2,9	2,9	3,4
Slaughter yield, %	57,5	56,8	56,3	55,9

Based on the results obtained, it can be concluded that meat productivity increases with age. During the study, the weight of steers Moryak-120541 was higher than the weight of steamed carcass of 15-month-old steers Stroiniy-2520 by 6.6 kg - 1.3%, and 18-month-old steers - by 4.3 kg - 1.01%. higher. In addition, the slaughter yield of steers slaughtered at 18 months of age is characterized by their development (taking into account grazing) [13].

It has been noticed that the performance of the bull producer Stroiny-2520 at 15 months of age is 3.6 kg or 1.3% less than that of the bull producer Moryak-12054 in terms of fat yield. Accordingly, 18-month-old bulls of Moryak -12054 had a higher index by 3.1 kg or 1.3%.

One of the important indicators characterizing the slaughter result is slaughter yield [14, 15]. According to the study, the slaughter yield of bulls of producer Moryak-12054 was higher than that of bulls of producer Stroiniy-2520 by 1.2 kg or 1.02% at 15 months and by 0.9 kg or 1.01% at 18 months. The highest slaughter yield was observed in 15-month-old steers of Moryak -12054 - 57.5%.

Figure 2 – Carcasses of Kalmyk bulls slaughtered at Karasu Et slaughterhouse

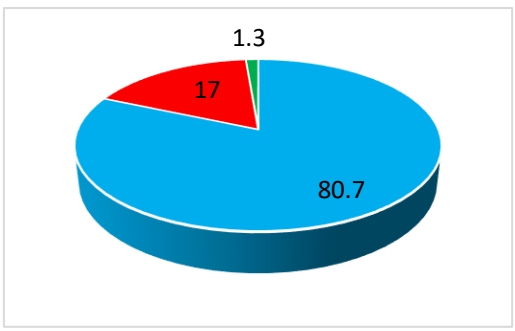
Carcasses of slaughtered bulls were cooled for a day and weighed by parts [17].

The morphological composition of carcasses was determined based on the results of cutting the right half of carcasses (Table 2).

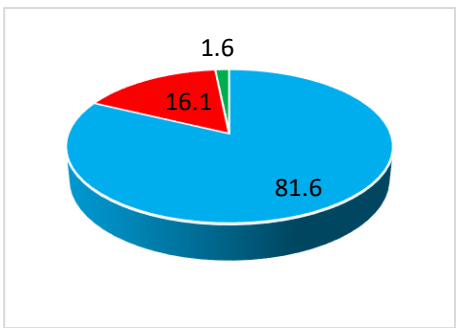
Table 2 – Morphological composition of the right half carcass of Kalmyk steers of different ages of different ages, (x ± Sx)

Indicators	Moryak- 120541		Strojny -2520	
	15 month	18 month	15 month	18 month
Weight of fresh carcass, kg	195,6±0,9	223,2±5,7	189 ±4,8	218,9±5,9
Weight of chilled carcass, kg	192,4±0,6	220,6±5,6	186,6±4,7	216,6±5,88
Half carcass weight, kg	94,6±0,5	109,1±2,9	92±2,4	107±2,95
Meat and fats, kg %	76,4±2,73 81,8	89,3±3,12 81,9	75,1±2,61 80,7	87,3±2,89 81,6
Bone yield,kg %	16,8±2,21 17,8	18,1±2,43 16,8	15,6±2,03 17	17,9±2,31 16,1
Tendon yield, kg %	1,3±0,14 1,4	1,6±0,17 1,5	1,2±0,12 1,3	1,7±0,17 1,6
Meat index, kg	4,5±0,1	4,9±0,16	4,8±0,13	4,9±0,16

The morphological composition of carcasses of bulls of different ages of each producer showed that meat quality indicators increased with age. In the experiment, bulls-producers Moryak -120541 of different ages differed from bulls-producers Stroiniy-2520 by a more effective ratio of meat and bone parts in the carcass. 18-month-old male bull Moryak -120541 had 81.9% absolute weight of pure meat part.



а. Strojny- *2520, 15* month



б. Strojny- *2520, 18* month

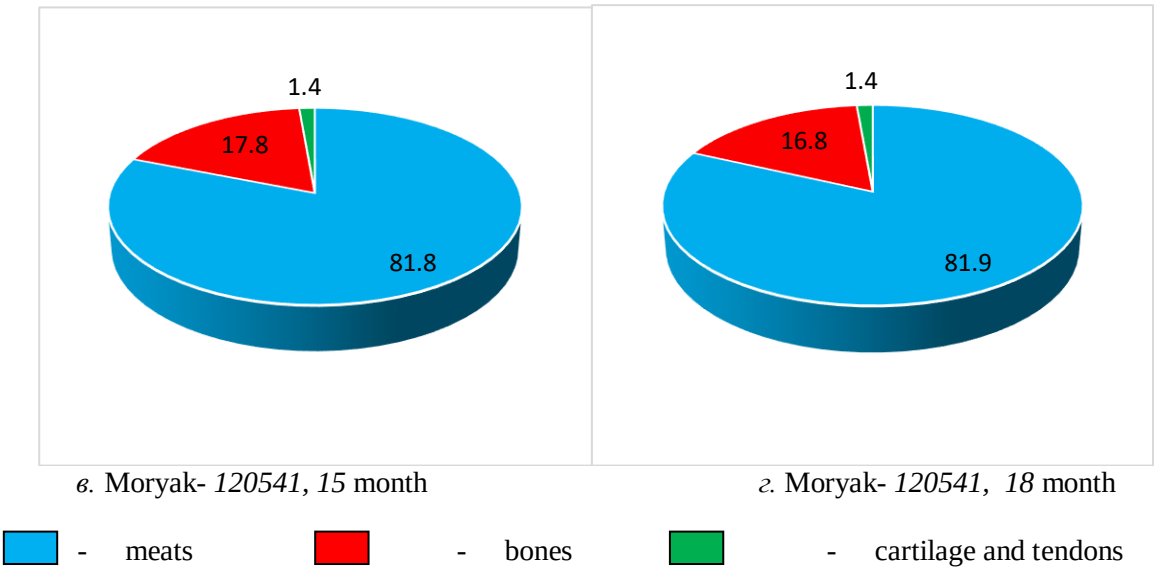


Figure 3 – Morphological composition of the right half carcass of experimental steers

The bone mass of 18-month-old bulls of producer Moryak-120541 is 0.7% less than that of bulls of producer Stroiny-2520.

The meat index of the cattle breeds in the beef direction is estimated as average (4.7-5.3) [16].

In terms of the productivity index, the performance of 18-month-old steers Sailor-120541 and Stroiny-2520 had the same result of 4.9 kg.

As a result of the research, the breeding lines of the Kalmyk breed reached these indices from the 15th month, which indicates that the Kalmyk breed retained its meat productivity due to the ability to quickly adapt to any situation, to acclimatize under extreme conditions [18,19].

An important indicator of meat productivity, along with slaughter productivity and morphological composition, is the chemical composition and caloric content of meat [20,21]. When evaluating meat, much attention is paid to the study of its quality (Table 3).

Table 3 – Chemical composition (%) and energy value (MJ) of meat, (x ± Sx)

Indicators	Moryak- 120541		Stroiny-2520	
	15 month	18 month	15 month	18 month
Dry matter	23,69±0,28	25,49 ±0,34	23,2 ±0,24	25,1 ±0,60
Moisture	76,31 ±3, 67	74,51 ± 3,37	76,8 ±3,58	74,9 ±3,41
Protein	20,01 ±1,53	20,6 ± 1,65	19,83 ±1,39	20,02±1,56
Fats	3,71 ±0,36	4,53 ± 1,3	3,16±0,23	4,03 ±0,7
Ash	0,83 ±0,10	0,88 ± 0,13	0,91±0,16	0,85 ±0,12
Nutritional value of meat, kcal	1165	1217,5	1106,9	1195,2
1 kg energy value, MJ	4,8	5,1	4,6	5,0

According to the data of chemical analysis of the average meat sample, there was no reliable difference in protein indices, and also the intensity of fat accumulation was higher in 15- and 18-month-old steers of the producer Moryak-120541 than in bulls of the producer Stroiny-2520. Due to their high-fat content, they are also high in calories [22].

According to the results of the chemical composition of the obtained meat, no significant interbreed differences in the content of dry matter and moisture in the meat were revealed.

Among 15-month-old experimental groups, meat moisture content of meat of bulls-producers of Stroiniy-2520 was 1% higher than that of bulls-producers of Moryak-120541, and meat moisture content of bulls-producers of Stroiniy-2520 was 1% higher among 18-month-old bulls-producers.

Compared to the experimental groups with higher meat fat content in 15- and 18-month-olds, 3.71-4.53% was also observed in Sailor-120541.

Conclusion. Meat productivity of Kalmyk breeds of cattle bred in the North-Kazakhstan region was characterized by satisfactory indicators. It should be noted that the slaughter yield of each bull producer was in the desired value from the point of view of meat productivity.

According to the conducted research, one of the most important indicators characterizing the result of slaughtering is slaughter yield. The highest slaughter yield was observed in 15-month-old bull producer Sailor-120541 - 57.5 %, it was higher than in 15-month-old bull producer Stroiny-2520 by 1.2 %, and in 18-month-old bull producer - by 1.6 %. This is an important factor determining the productivity of the Sailor-120541 bull, which is well adapted to local weather conditions and is effective for marketing meat. As was said above, the Kalmyk breed of cattle, introduced and bred in areas of Northern Kazakhstan, has high enough indicators of meat productivity. When evaluating the quality of meat for carcass completeness, the producer Sailor mark -120541 received a fairly high price. According to the energy composition of meat, calculated on the basis of the concentration of fat and protein in the meat, the indicators of 18-month-old steers-producers Sailor-120541 amounted to about 5.1 MJ. The results of the chemical analysis of the average meat sample showed that the chemical composition of meat varies depending on the age and genotype of each producer.

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ТҮЙІН

Халықтың етке өсіп келе жатқан сұранысын қанағаттандыру қазіргі заманғы мал шаруашылығының бірінші кезектегі міндеттерінің бірі болып табылады. Елдің ет балансында жетекші орын алатын ірі қара етін өндірудің өсуіне ерекше мән беріледі. Мақалада 15-18 айлық жастағы қалмақ тұқымының Моряк- 120541 және Стройный- 2520 аталық іздерінен тараған бұашықтардың сойыс сапасын зерттеу және жасына байланысты сойыс сапасының өзгеруі қарастырылған. Әр аталық із бұқашықтары ұшасының морфологиялық және химиялық құрамы зерттеліп, еттілік индексі мен энергетикалық құндылығы анықталды. Химиялық құрамы Қазақстан Республикасының сауда және интеграция министрлігінің техникалық реттеу және метрология комитетінің Ұлттық Аккредиттеу Орталығында сараптамадан өтті. Зерттеу нәтижесі бойынша Моряк - 120541 аталық із бұқашықтары жоғары көрсеткіштерімен ерекшеленді. Жұмыс барысында, орташа ет сынамасының химиялық талдау нәтижелері әр аталық із бұқашықтарының жасына және генотипіне байланысты еттің химиялық құрамы өзгеретінін көрсетті. Зерттеу жұмысы BR 10764981 "Етті мал шаруашылығындағы генетикалық ресурстарды сақтау мен жетілдірудің селекциялық процесін тиімді басқару технологияларын әзірлеу" (2021-2023 ж.) ғылыми-техникалық бағдарламасы шеңберінде «Московский»ЖШС етті бағыттағы қалмақ тұқымын өсіріп жатқан шаруашылықта жасалды.

РЕЗЮМЕ

Удовлетворение растущего спроса населения на мясо является одной из первоочередных задач современного животноводства. Особое внимание уделяется росту производства мяса крупного рогатого скота, занимающего лидирующие позиции в мясном балансе страны.

В статье рассматривается исследование убойного качества мяса бычков калмыцкой породы разной линейной принадлежности Моряк - 120541 и строй - 2520 в возрасте 15-18 месяцев и изменение качества убоя в зависимости от возраста.Был изучен морфологический и химический состав туш бычков разной принадлежности, определен индекс и энергетическая ценность мяса.Химический состав прошел экспертизу в Национальном аккредитационном центре Комитета технического регулирования и метрологии Министерства торговли и интеграции Республики Казахстан. По результатам исследования, бычки Моряк - 120541 отличались высокими показателями. В ходе работы результаты химического анализа

средней пробы мяса показали, что химический состав мяса меняется в зависимости от возраста и генотипа каждого бычка разных линии. Исследовательская работа выполнена в рамках научно-технической программы BR 10764981 "Разработка технологий эффективного управления селекционным процессом сохранения и совершенствования генетических ресурсов в мясном животноводстве" (2021-2023 гг.) ТОО «Московский» в хозяйстве, где выращивает калмыцкую породу мясного направления.

CONTENT

ANIMAL HUSBANDRY

Rules for authors on the design of an article for publication

Scientific and practical journal «Ğylymjänebilim» is a periodical of the West Kazakhstan Agrarian and Technical University named after Zhangir Khan K. The journal is published kuarterly and articles are published in Kazakh, Russian and English languages. The journal publishes scientific works on actual problems of fundamental and applied researches in the field of agricultural, veterinary, biological, technical, economic and socio-humanitarian sciences.Subscription to the collection can be arranged through the catalogues of newspapers and magazines «Kazpost» JSC (index 76316). Scientific, technical and industrial articles planned for publication in our journal undergo the procedure of unilateral blind review and approval by the editorial board. With a positive conclusion, the material is placed in the «portfolio» of the editorial board in the kueue for publication. The speed of publication depends on the relevance of the material and fullness of the «portfolio» of the editorial office on the given topic. In addition, due to the fact that according to the order of the Chairman of KKSON MES RK dated 12.06.2013 № 949 one of the conditions for inclusion of the journal in the list of editions recommended by the Committee for publication of the main results of scientific activity is the availability of publications in foreign languages, the right of extraordinary publication will be enjoyed by articles in English.

Articles for publication should be submitted through the online article submission and review system.

When preparing articles for the journal we recommend to follow the following rules:

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