



Breeding Methods and Results of Creating “Mamyr-Aktobe” Intra-breed Type of Meat and Dairy Productivity of Kushum Horse Breed of Aktobe Population

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ABSTRACT

The Kushum horse breed is very popular in Kazakhstan due to its adaptability to local conditions and high meat and dairy qualities. Obtaining new intra-breed types of this breed is necessary to improve the genetic potential and achieve high indicators of meat and dairy productivity. The purpose of this study was to develop a new intra-breed type “Mamyr-Aktobe”. Breeding work was carried out with the following livestock of the producing composition n=318, including stallions 18 animal units, mares – 300 units. The genealogical structure of promising branches of breeding lines of Kushum horses has been analysed, and their meat and milk parameters were evaluated. Adult stallions of the new intra-breed type have high measurements and live weight: the average height at the withers is 157.9cm, the oblique length of the trunk is 163.5cm, the chest and pastern girth are 205.2 and 22cm, respectively, the live weight is 656.2kg, and the massiveness index is 149.3%. For mares, the average height at the withers is 152.5cm, the indicator of the oblique length of the trunk is 160.2cm. The circumference of the chest and pastern is 188.7 and 20cm, respectively. On average, mares of the new intra-breed type weigh 529kg, and their massiveness index is 139%. Based on these characteristics, the new intra-breed type “Mamyr-Aktobe” can be used to improve the breeding qualities of the Kushum horse breed, as well as in meat and dairy farming.

Key words: Horse breeding; Live weight; Massiveness index; Dairy productivity; Pasture-wintering management

INTRODUCTION

The increasing demand for high-quality horse meat in Europe and Asia is driving the global market. To meet the demand for low-energy, cost-effective, and environmentally friendly livestock products, herd horse breeding is crucial (Shahini et al. 2023). Horse meat and koumiss, products of this breeding, are highly nutritious and biologically active (Kargayeva et al. 2020). With growing demand for dairy and meat products, there is a need to manage genetic resources effectively. Local horse breeds, well-suited to their natural, climatic, and feeding conditions, are gaining importance (Abilmazhinova et al. 2020). The Kushum horse breed, ranking third in number after the Kazakh and Mugalzhar breeds in the Aktobe region, was established in the mid-20th century through

complex reproductive crossing. These horses exhibit endurance and resistance to harsh climates and diseases like pyroplasmiasis, necrobacillosis, and brucellosis, making them attractive for meat and dairy farming (Rzabayev et al. 2022).

Breeding efforts in the Aktobe region focus on enhancing the regional Kushum horse breed and developing new meat-producing animal lines capable of thriving in changing climates. Kargayeva et al. (2020) noted some drawbacks in the Kushum breed but highlighted methodological solutions developed through its breeding. Rzabayev et al. (2022) emphasized increasing the number of productive horses, particularly breeds like Kushum, Mugalzhar, and Kazakh, as a key area of development in productive horse breeding. Pozharskiy et al. (2023) identified genetic markers linked to increased

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measurements and weight in Kushum horses, which could expedite breeding and enhance product quality. Nguyen et al. (2020) and Nguyen and Pham (2021) discovered genetic traits associated with high breeding parameters and body constitution in Kushum horses, respectively. Borisov (1970) highlighted the resilience of Kushum horses in harsh subarctic climates and their impressive meat and dairy productivity.

Thus, in order to improve the characteristics of Kushum horses, it is necessary to select animals with a massive physique and create new breeding lines and intra-breed types that are characterised by high productivity. Based on this, the purpose of this study was to obtain a new highly productive type of Kushum horses by breeding methods.

MATERIALS AND METHODS

The study involved 300 mares and 18 breeding stallions in Aktobe's suburban area, Kobdinsky district, Aktobe region. All procedures performed using animals were revised and approved by the Scientific Committee of Ethics of the Toraighyrov University, Pavlodar, Republic of Kazakhstan. Authorization N°88-23.

Over a decade, continuous efforts were made to evaluate and select the best individuals among both the breeding and young stock. These assessments followed guidelines for local breed valuation, considering factors like live weight and other characteristics. The selection criteria for breeding stallions and mares involved surpassing breed standards by 5-10% in weight. Enhancing breed qualities included the study of various selection methods and key horse measurements, encompassing exterior, adaptability to year-round herd-breeding conditions, reproductive, and productive traits. Additionally, genealogical connections were established through pedigree analysis.

The study involved comprehensive assessments and experiments to determine the key horse characteristics. High-quality young animals were carefully bred and selected, possessing the necessary traits for year-round pasture maintenance and ensuring high meat and milk production. Purposeful use of high-quality breeding stallions led to the creation of new breed groups with desirable characteristics. Genealogical structure development within the "Mamyr-Aktobe" intra-breed type of Kushum horses was analyzed through genealogical analysis, considering inbreeding coefficients, kinship among animals, and population dynamics. Productivity of young animals was investigated through control slaughter at ages 18-30 months, involving measurements of live weight before slaughter (after fasting), carcass weight, and slaughter yield.

Genealogical connections were analyzed to distinguish breeding lines and families, followed by an evaluation of their representatives based on economically valuable traits. This assessment considered typicality, alignment with the desired type, and individual exterior traits. Stallions were ranked based on the quality of their offspring. Mares' dairy productivity was determined using Saigin (1965) formula, which relies on controlled milking data. Reproductive qualities, including foalability, survival, and foal health, assessed mares' fertility. Meat parameters for adult stallions, mares and those aged 18 and 30 months were also

evaluated, with calculations of mean, standard deviation, and coefficient of variation for milk production and yield. Variational statistics and reliability criteria were applied to process digital data, yielding average and statistically reliable results as shown in the tables.

RESULTS

Genealogical structure of the intra-breed type "Mamyr-Aktobe"

As a result of the work, an intra-breed type was bred – "Mamyr-Aktobe", characterised by high adaptive and meat and dairy qualities. The resulting type has a structure consisting of three lines. These include the descendants of the stallion Krepysch 33-64, Samotsvet 77-73 and Grom 98-58, as well as 8 independent breeding families. At the moment, the 33-64 Krepysch line has reached the 5th generation. This line includes 3 branches, which are based on stud horses Kredit 76-71, Karbid 362-73 and Kremplin 352-76. Currently, they produce 1 great-grandson, 10 adult great-grandchildren, 2 young great-grandchildren and 1 3.5-year-old great-great-grandson of the highest class, who is a descendant of the stallion – Krepysch 33-64. This line includes the breeding families of mare No. 6, born in 1970, mare No. 54, born in 1972, and mare No. 3, born in 1974.

The stallion Grom 98-58 has three branches through such stallions as Granat 10-65, Gaz 67-71, and Gromoboy 20-72. Through the lines of the stallions Granat 10-65 and Gaz 67-71, the breeding line of Grom 98-58 reached the 5th generation, and through the Gromoboy 20-72 – the 6th generation. 2 great-great-grandchildren, 5 adult great-great-grandchildren, two 4.5-year-old great-great-grandchildren, and one 3.5-year-old descendant of the sixth generation of the Grom 98-58 breeding line are produced in the production structure of the basic farms. From the breeding stock of the Grom 98-58 breeding line, 2 breeding families are characterised by progressive development: bay mare No. 17, born in 1964 and bay mare No. 13, born in 1970. The Samotsvet 77-73 stallion line has 2 branches and has spread through Samal and Sayys stallions. In the producing composition of horses of the Kushum breed, 8 stallions – successors of this line are produced in basic farms, including: 1 grandson, 5 adult great-grandchildren, and 3 great-grandchildren (Samotsvet 77-73 line). The Samotsvet line developed through breeding families, 3 breeding families were formed.

In horse breeding, balancing genetic diversity and preserving breed resources is crucial. The choice of breeding lines and families plays a pivotal role in maintaining stability and productivity. An insufficient number of lines and families can reduce genetic diversity, leading to defects and diminished qualities. Conversely, excessive divisions can limit genetic potential. Striking the right balance ensures population stability, genetic diversity, and quality preservation. Elite animals and controlled selection are essential tools for achieving this balance.

Measurements and meat indicators of the "Mamyr-Aktobe" intra-breed type of Kushum horses

The indicators of adult elite horses of the "Mamyr-Aktobe" intra-breed type of Kushum horses are shown in Table 1.

Table 1: Characteristics of horses of the "Mamyr-Aktobe" intra-breed type

Indicator	Stallions			Mares			Statistical difference P-value
	Parameter value	Breed standard	Parameter increment	Parameter value	Breed standard	Parameter increment	
Animal units	18			184			
Height at the withers, cm	159.7±0.35	154	+5.7	155.2±0.1	150	+5.2	<0.05
Oblique length of the trunk, cm	165.3±0.24	156	+9.3	159.1±0.21	153	+6.1	<0.05
Chest circumference, cm	202.5±1.24	183	+19.5	187.8±0.28	178	+9.8	<0.05
Pastern girth, cm	21±0.1	20	+1	19.8±0.03	19	+0.8	<0.05
Live weight, kg	626.5±6.2	500	+126.5	531±1.81	460	+71	<0.05
Massiveness Index	153.8	136.9	+31.8	142	157.3	+7.9	<0.05

The "Mamyr-Aktobe" intra-breed type, both stallions and mares, exhibit higher measurements, live weight, and massiveness index compared to the Kushum breed standard. Notably, their live weight, an essential factor in meat animal husbandry, has significantly increased, highlighting their meat production potential. Moreover, the massiveness index of this new intra-breed type is significantly higher, indicating their superior economic efficiency. Offspring from this type, regardless of gender, display harmonious body composition, robust growth energy, improved meat parameters, elevated measurements, higher live weight, and an increased massiveness index. These horses are characterized by their increased body weight, fertility, deep chest, elongated trunk, robust limbs, and strong growth energy. They are well-suited for year-round pasture breeding and typically exhibit red, bay, or black coat colors.

Meat productivity of the intra-breed type "Mamyr-Aktobe" of the Kushum horse breed

"Slaughter yield" is the percentage of usable animal products obtained after slaughtering, compared to the animal's weight after 24-hour starvation prior to slaughter. It's a critical measure for assessing a horse's suitability as meat raw material, determining which parts are usable and which need to be discarded. Various factors like age, sex, breed, diet, living conditions, and slaughter methods can influence this yield. A high slaughter yield signifies good meat quality and animal productivity. The Kushum horse breed typically has a slaughter yield of about 50-55%, meaning a 500kg horse yields approximately 250-275kg of meat (Pozharskiy et al. 2023). Mares of the new "Mamyr-Aktobe" intra-breed type show higher live weight and slaughter yield, surpassing the Kushum breed average. Detailed meat productivity data for adult horses of this new type are presented in Table 2.

Table 2: Productivity indicators of adult mares of the "Mamyr-Aktobe" intra-breed type

Inventory number	Line	Live weight, kg	Weight before slaughter, kg (after fasting)	Carcass weight, kg	Slaughter yield, %
11-99	Krepysk	518	499	293	56.6
14-99	Krepysk	516	498.5	281.1	56.4
32-00	Grom	517	498.9	280.8	56.3
Average value		517±0.47	498.8±0.12	285±3.3	56.4±0.07

Table 3: Indicators of productivity of young animals of the "Mamyr-Aktobe" intra-breed type

Age	Line	Live weight, kg	Weight before slaughter, kg (after fasting)	Carcass weight, kg	Slaughter yield, %
18 months	Krepysk	356.5	338.5	187.9	55.5
	Grom	351.3	334.1	185.3	55.4
	Samotsvet	354.7	333.4	185.1	55.4
30 months	Krepysk	454	434.8	242.2	55.7
	Grom	451	431.7	240.4	55.7
	Samotsvet	449.2	430.5	239.8	55.7

Table 2 reveals that the mare with inventory number 11-99 from the Krepysk line exhibited the highest meat productivity. It's essential to consider the difference in meat productivity between adult and young animals, as it reflects variations in meat quality. Young animals tend to have tender but potentially fattier meat with less developed taste and aroma, while adults have tougher meat with superior culinary qualities. This distinction holds economic significance, as young animals are typically cheaper but yield less meat. Agricultural enterprises should account for this when planning their products and business management. Data on the meat productivity of young animals in the "Mamyr-Aktobe" type of the Kushum breed can be found in Table 3.

The data indicates that both 18-month-old and 30-month-old stallions of this new intra-breed type have high meat productivity, seen in their carcass weight and slaughter yield. Horses from the Krepysk line consistently demonstrate the highest rates at both ages, affirming the potential of year-round grazing for environmentally friendly meat production within the Aktobe population. This approach is highly effective for meat and dairy horse breeds, as it avoids significant investments in livestock facilities, feedstock purchases, and extensive labor resources.

Milk productivity of the "Mamyr-Aktobe" type of the Kushum breed

Data on the milk productivity of mares of the new intra-breed type are given in Table 4.

Table 4 displays the average milk production data for 10 mares of the new intra-breed type. Daily milk yield, the amount of milk a horse produces in a day, is a critical criterion for assessing their effectiveness in milk production. It helps identify the most productive mares and informs decisions about feeding strategies and treatments to boost productivity. Typically, the Kushum breed yields 7-8 liters of milk per day. Results indicate that this new

Table 4: Milk yield and milk production of mares of the "Mamyr-Aktobe" intra-breed type

Month of lactation	Daily milk yield, l		Daily milk content, l		Total amount of milk, l	Statistical difference
	Value	C _v	Value	C _v	Value	P-value
June	7.6±0.1	4.3	18.2±0.25	4.3	547.2±7.51	<0.05
July	7.1±0.05	2.2	17±0.11	2.1	511.2±3.4	<0.05
August	6.5±0.05	2.6	15.6±0.13	2.6	468.6±3.8	<0.05
September	5.8±0.1	5.4	14±0.24	5.4	417.3±7.26	<0.05

Note: C_v – coefficient of variation.

intra-breed type exhibits similar daily milk yield characteristics. The highest milk production occurs in June and declines as autumn approaches.

Daily milk production, measuring the amount of milk an animal produces in 24 hours, is a key factor in evaluating the dairy productivity of horses. It's usually assessed at the start of lactation when milk levels are highest but holds value at various stages. This indicator aids in selecting high-yield animals for breeding and monitoring milk quantity and quality in husbandry. The peak daily milk production for mares occurs in June, declining as autumn nears. The total milk productivity over lactation aligns with the Aktobe population of the Kushum horse breed. The low coefficient of variation in daily milk yield and productivity indicates consistent milk production by experienced mares. Over the entire lactation period, these mares averaged 1944.3±24.2 liters of milk. Pasture quality at night significantly affects dairy productivity, as mares are calmer and can consume more nutrients during this time.

DISCUSSION

Genealogical analysis is a vital tool in horse breeding, enabling the assessment of kinship relationships among animals and their impact on genetic traits in offspring. This helps mitigate the risk of genetic defects and enhance desirable breed qualities (Bondarenko et al. 2023). Poyato-Bonilla et al. (2020) emphasize the use of inbreeding coefficients and kinship coefficients for such analysis, aiding in the selection of optimal pairs for breeding to preserve and improve desired genetic traits. Furthermore, genealogical analysis unveils hidden hereditary connections, revealing the breed's genetic potential, which is valuable in creating or enhancing breeds. This analysis informs breeding decisions, preserving and improving the genetic foundation, and boosting productivity. The presence of multiple horse lines from breeding stallions, some extending to the sixth generation, underscores the success of the pairing and breeding approach. This stability is further affirmed by the balanced meat and dairy indicators of the "Mamyr-Aktobe" intra-breed type.

Successful breed improvement relies on the intra-breeding selection of animals with strong pedigrees and consistent inheritance of productive traits. Selection occurs year-round in pasture conditions, with Raspa et al. (2020) recommending the pairing of horses based on genealogical connection and compatibility to ensure a rational mix of breed lines. In meat and dairy horse breeding, several factors are considered, including dairy and meat productivity, growth, body constitution, limb and hoof structure, and adaptability to local conditions. Razmaite et al. (2021) noted that a horse's sex can impact meat quality due to differences in muscle tissue structure and hormone concentration. Generally, mare meat is considered more

tender and less tough than stallion meat due to lower connective tissue, resulting in juicier, softer meat.

Significant progress has been made in breeding Kushum horses, evident when comparing the original population's size and weight characteristics with the new intra-breed type. Dyusegaliev (2022) measured parameters in the West Kazakhstan region's Kushum breed, allowing for a comparison with the new intra-breed type. Stallions of the "Mamyr-Aktobe" type outperform the initial West Kazakhstan Kushum breed in several aspects. Their oblique trunk length is 4.4cm longer, chest and pastern girths are 10.3cm and 0.1cm greater, respectively, and their average live weight is 86.5kg higher. The massiveness index for these stallions is 22.3% higher than the Kushum breed from the West Kazakhstan region. Similarly, mares of the new type surpass the West Kazakhstan Kushum breed in various parameters, including height at the withers (1.1cm), oblique trunk length (1.9cm), chest circumference (5.1cm), pastern circumference (0.5cm), live weight (39kg or 7.9%), and massiveness index (7%).

According to Rzabayev et al. (2020), the initial group of Aktobe population stallions had an average height at the withers of 156cm, oblique trunk length of 161.3cm, chest circumference of 182.3cm, pastern circumference of 20.6cm, live weight of 508.3kg, and a massiveness index of 123.5%. In contrast, the new stallions of this type have a 1.9cm taller withers, 2.2cm longer oblique trunk, and larger chest and pastern girths by 23.1cm and 1.4cm, respectively. They also weigh 147.9kg more on average, a 29.1% increase, and their massiveness index is 10.2% higher. Comparing the new mares with the original Aktobe population, the former have a 5.2cm taller withers and 3.1cm longer oblique trunk. Their chest circumference is on average 8.8cm larger, pastern circumference is 0.9cm larger, live weight is 58kg (12.3%) heavier, and massiveness index is 2% larger.

The live weight of meat horse breeds can vary significantly based on breed, housing conditions, and other factors. For instance, Beeckaert (2020) noted that European breeds like the Arden can surpass 1000kg, while Prochniak et al. (2021) found that German Holstein adult stallions can reach up to 800kg. In the USA, breeds like the Quarterhorse, as mentioned by Rodrigues et al. (2021), range from 400 to 600kg. Consequently, the live weight of the intra-breed "Mamyr-Aktobe" type of the Kushum breed is in line with global horse breed standards. Milk production in mares depends on various factors, including genetics, diet, and living conditions. Barreto et al. (2020) highlighted the role of genetics in establishing the baseline milk production level, which can be influenced by feeding and care conditions. Adequate nutrition supports milk production, while regular milking and inspections, as emphasized by Czyzak-Runowska et al. (2021), are crucial

for managing and improving dairy mare performance in breeding programs.

Oftedal et al. (1983) noted that during the summer, dairy mares significantly rely on nighttime pasture grazing for their nutrition. In contrast, Baimukanov et al. (2021) reported lower milk production in mares, with figures of 1051 and 823.6 liters in a four-month lactation period, compared to the "Mamyr-Aktobe" intra-breed type. Their study found the highest commercial milk productivity in dairy mares occurring during the 2nd and 3rd months of milking, reaching 7.2 and 6.9 liters daily. In contrast, the "Mamyr-Aktobe" type exhibited its highest daily milk yield during the first month of lactation. External factors, like grazing conditions, may account for these differences in data. However, the new intra-breed type's results exceeded the average values for the Kushum breed, which Nurmakhanbetov (2020) reported as 13-14 liters per day. Therefore, the "Mamyr-Aktobe" intra-breed type's mare performance was notably high, surpassing both the Kushum breed and other regional breeds.

The results obtained indicate the success of breeding work aimed at creating high-quality meat and dairy productivity of breeding lines and types of Kushum horses. The studies performed correspond to one of the main areas of applied scientific research aimed at developing a system for controlling the breeding process and strengthening it in the horse breeding industry.

Conclusions

In the course of the study, using breeding methods, a new intra-breed type "Mamyr-Aktobe" of the Aktobe population of Kushum breeding horses was obtained, which has increased indicators of meat and dairy productivity in comparison with the average values for the breed. Both stallions and mares of the new intra-breed type have increased parameters, such as the oblique length of the trunk, height at the withers, and indicators of chest girth and pastern. According to the data obtained, the average live weight of adult stallions of the "Mamyr-Aktobe" intra-breed type exceeds the breed standard by 161.2kg (32.5%). Similarly, elite adult mares have an excess of the breed standard by 69kg, which is 15.1%. There was also an increase in the massiveness index of adult stallions and mares by 15.6 and 5.8% compared to the standard characteristics of the breed, respectively. The slaughter yield of both adult animals and young animals aged 18 and 30 months is at a high level and amounts to 56.4, 55.4, and 55.7%, respectively. The "Mamyr-Aktobe" intra-breed type is characterised by high milk productivity. The maximum indicators of daily milk yield and daily milk production for mares of this type were 7.6 ± 0.1 and 18.2 ± 0.25 litres, respectively, which exceeds the corresponding values for the initial population. The total milk productivity for the entire lactation period was 1944.3 ± 24.2 litres. The obtained findings are of practical importance for horse breeding farms of the region and the republic, as they can help in improving the productivity and quality of local horse breeds used in breeding. Moreover, breeding horses of a new intra-breed type can serve to improve the gene pool on commercial meat and dairy farms in Kazakhstan and other countries of the region. It is necessary to conduct further study to maximise the dairy and meat productivity of the new "Mamyr-Aktobe" intra-

breed type in conditions of year-round grazing and wintering.

Author's contributions

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Tolybek Rzabayev, Nikolay Arsyutin and Serikbay Rzabayev. The first draft of the manuscript was written by Tolegen Assanbayev and Kalybek Rzabayev. All authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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