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ТҮЙІН

Соңғы жылдары Қазақстанда еділбай тұқымынан алынған бағыландарға үлкен қызығушылық танытылуда, оның бір себебі өсіруде аз шығын жұмсалады. Осы жағдайды ескере отырып, еділбай тұқымының төлдеріне Батыс Қазақстан облысы, Жанғала ауданындағы бағыландарының еттік қасиеттеріне зерттеу жүргізілді. Зерттеулер көрсеткендей, еркек қозылар туылғанда салмағы 5,64 кг, ал 4 айлығында тірілей салмағы 8,20 есе өсіп, 46,27 кг-ға жетеді, майлы құйрық ұшасымнг бірге 7 айлығында сәйкесінше 21,06 кг (майлы құйрық салмағы - 2,48 кг) құрады. 62,48 кг және 28,09 кг (майлы құйрықтың салмағы - 5,87 кг). 4 және 7 айлығында олардың етінде ақуыз мөлшері 18,36% және 17,61%, май мөлшері 16,97% және 19,63% болды.

Бағылан етіне жүргізілген биохимиялық талдаулар 4 және 7 айлығында белок деңгейі сәйкесінше 18,36% және 17,61%, май мөлшері 16,97% және 19,63% деңгейінде болғанын көрсетті. Осылайша, 4 айлық бағыландарда ақуыз-май қатынасы 0,92, ал 7 айлықтарда 1,11 болды. Бұл еділбай қойының тұқымдық ерекшеліктерінде; олардың өмір сүру барысында жастарының еттерінде ылғалдылығы төмен, ал майлылығы, керісінше, жоғары. Бағыландарының етінің майында ересек қой етіне қарағанда қаныққан және қанықпаған май қышқылдары аз, сондықтан оның құндылығы жоғары екенін дәлелденді.

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Beishova I.S., Doctor of Biological Sciences, Associate Professor, <https://orcid.org/0000-0001-5293-2190>

NCJSC «Zhangir Khan West Kazakhstan Agrarian Technical University», Uralsk, Zhangir Khan street, 51, 090009, Kazakhstan, indira_bei@mail.ru

Shamshidin A.S., Candidate of Agricultural Sciences, <https://orcid.org/0000-0001-5457-1720>

NJSC «West Kazakhstan Agrarian and Technical University named after Zhangir khan», Uralsk, st. Zhangir khan 51, 090009, Kazakhstan, 270180@mail.ru

Muhatai Geminggul I., PhD, <https://orcid.org/0009-0000-3208-4403>

Tarim University, Alar, Xinjiang 843301, China, gmuhatat@bk.ru

Kuzhebayeva U.Zh., Master of Veterinary Sciences, <https://orcid.org/0000-0002-7887-3376>, NCJSC «Zhangir Khan West Kazakhstan Agrarian Technical University», Uralsk, Zhangir Khan street, 51, 090009, Kazakhstan, usya_999@mail.ru

Bekova G.S., doctoral student, <https://orcid.org/0000-0003-0230-1352>

NJSC «West Kazakhstan Agrarian and Technical University named after Zhangir khan», Uralsk, Zhangir Khan st. 51, 090009, Kazakhstan, bek_gulmira@mail.ru

Salimova D.K., doctoral student, <https://orcid.org/0000-0003-3197-6586>

NJSC «West Kazakhstan Agrarian and Technical University named after Zhangir khan», Uralsk, Zhangir Khan st. 51, 090009, Kazakhstan, salimova.dinara98@gmail.com

Бейшова И.С., д.б.н., ассоциированный профессор, <https://orcid.org/0000-0001-5293-2190>
НАО «Западно-Казахстанский аграрно-технический университет имени Жангир хана», г. Уральск, ул. Жангир хана, 51, 090009, Казахстан, indira_bei@mail.ru

Шәмшідін Ә.С., доктор сельскохозяйственных наук, <https://orcid.org/0000-0001-5457-1720>
НАО «Западно-Казахстанский аграрно-технический университет имени Жангир хана», г. Уральск, ул. Жангир хана 51, 090009, Республика Казахстан, 270180@mail.ru

Muhatai Geminggul I., PhD, <https://orcid.org/0009-0000-3208-4403>
Таримский университет, Алар, 843301, Китай, gmuhatai@bk.ru

Кужебаева У.Ж., магистр вет. наук, <https://orcid.org/0000-0002-7887-3376>
НАО «Западно-Казахстанский аграрно-технический университет имени Жангир хана», г. Уральск, ул. Жангир хана 51, 090009, Казахстан, usya_999@mail.ru

Бекова Г.С., PhD докторант, <https://orcid.org/0000-0003-0230-1352>
НАО «Западно-Казахстанский аграрно-технический университет имени Жангир хана», г. Уральск, ул. Жангир хана 51, 090009, Казахстан, bek_gulmira@mail.ru

Салимова Д.К., PhD докторант, <https://orcid.org/0000-0003-3197-6586>
НАО «Западно-Казахстанский аграрно-технический университет имени Жангир хана», г. Уральск, ул. Жангир хана 51, 090009, Казахстан, salimova.dinara98@gmail.com

MORPHOLOGICAL AND GENETIC DIVERSITY OF KAZAKH HORSE BREEDS: FUNDAMENTALS FOR SELECTION AND CONSERVATION OF BIOLOGICAL RESOURCES

МОРФОЛОГИЧЕСКОЕ И ГЕНЕТИЧЕСКОЕ РАЗНООБРАЗИЕ КАЗАХСТАНСКИХ ПОРОД ЛОШАДЕЙ: ОСНОВЫ ДЛЯ СЕЛЕКЦИИ И СОХРАНЕНИЯ БИОРЕСУРСОВ

ANNOTATION

The study is dedicated to the study of domestic horse breeds of Kazakhstan (Kushum, Mugalzhar, Adai, Jabe) in order to identify their morphological and genetic characteristics to improve breeding programs. The paper presents the results of the bonitation work, including the analysis of body weight, measurements (height at the withers, chest circumference, oblique body length) and age and gender characteristics. It has been established that the Kushum breed shows the biggest mass (stallions - up to 650 kg, mares - up to 530 kg) and pronounced sexual dimorphism, while the Mugalzhar breed is characterized by uniformity of measurements (height at the withers – 147-148 cm) and high meat productivity. The Adai and Jabe breeds are compact in size (140-144 cm at the withers) and adaptable to harsh conditions.

The methodology included the collection of biological material and data from farms in Kazakhstan, as well as preparation for genome-wide sequencing to analyze genetic variations. The results showed that the selected individuals (Jabe, Mugalzhar, and Adai stallions) have the best phenotypic characteristics, which makes them valuable for preserving genetic diversity.

The conclusions emphasize the importance of studying local breeds for the development of meat and dairy horse breeding in Kazakhstan. The data obtained opens up prospects for breeding aimed at enhancing productive qualities and resilience to environmental challenges. The work contributes to the conservation of unique genetic resources and the optimization of breeding programs.

Аннотация

Исследование посвящено изучению отечественных пород лошадей Казахстана (кушумская, мугалжарская, адайская, джабе) с целью выявления их морфологических и

генетических особенностей для совершенствования селекционных программ. В работе представлены результаты бонитировочных работ, включая анализ живой массы, промеров (высота в холке, обхват груди, косая длина туловища) и половозрастных характеристик. Установлено, что кушумская порода демонстрирует наибольшую массу (жеребцы - до 650 кг, кобылы - до 530 кг) и выраженный половой диморфизм, тогда как мугалжарская порода отличается однородностью промеров (высота в холке – 147-148 см) и высокой мясной продуктивностью. Адайская порода и джабе обладают компактными размерами (высота в холке 140–144 см) и адаптивностью к суровым условиям содержания.

Методология включала сбор биологического материала и данных в хозяйствах Казахстана, а также подготовку к полногеномному ресеквенированию для анализа генетических вариаций. Результаты показали, что отобранные особи (жеребцы пород джабе, мугалжар, адай) обладают наилучшими фенотипическими показателями, что делает их ценными для сохранения генетического разнообразия.

Выводы подчеркивают важность изучения локальных пород для развития мясомолочного коневодства в Казахстане. Полученные данные открывают перспективы для селекции, направленной на усиление продуктивных качеств и устойчивости к экологическим вызовам. Работа вносит вклад в сохранение уникальных генетических ресурсов и оптимизацию программ разведения.

Key words: *horse breeding, horse breeds, live weight, measurements, genetic diversity, Kazakhstan.*

Ключевые слова: *коневодство, породы лошадей, живая масса, промеры, генетическое разнообразие, Казахстан.*

Introduction. Kazakh horse breeding has been one of the most important livestock industries in the country for many centuries [1-3]. Horse breeding is rightly recognized as an industry capable to significantly improve the efficiency of public livestock farming in a number of regions of the country [4,5].

An active search for candidate genes associated with economically beneficial traits of horses, such as athletic performance, meat and dairy productivity, fertility, disease resistance and good adaptive qualities, can significantly improve the effectiveness of breeding programs [6].

In Kazakhstan, the breeding base of horse breeding is represented by five directions: riding, horse-drawn, trotting, heavy-duty, meat and dairy. Meat and dairy products occupy the largest share in the structure of the industry and account for more than 90 %. Representatives of these breeds and types are distinguished by their genetically and biologically determined adaptability to year-round pasture maintenance, have the ability to quickly bait in favorable (2-2.5 months) spring and autumn periods, are quite fertile, high-yielding and have a pronounced seasonal reproduction pattern [7].

Kushum, Mugalzhar, Kazakh Jabe type horses, and Adai type Kazakh horses are of great interest among domestic breeds. The genetic potential in live weight of Kazakh mares of the jabe type reaches 485 kg, and stallions 520 kg. These data show the potential for further improvement of their economically useful characteristics such as body weight [8]. The Kazakh Jabe horse is a specialized breed of herd horses capable of intensively increase live weight during the feeding period and produce high-quality meat, regardless of belonging to the population or offspring [9]. The live weight of Kushum stallions is 540 kg (the best - up to 711 kg), mares - 495 kg (the best - up to 645 kg), young animals up to 2.5 years - 430 kg (the best - up to 495 kg). The live weight of local horses in the area of distribution of Kushum horses (animals of other and, especially, factory breeds simply do not survive in these conditions) is: stallions 420-440 kg, mares - 370-390 kg, young animals 2.5 years 290-310 kg. The live weight of the crossbreeds (Kushum X local) is 50-70 kg more [10]. When breeding the Mugalzhar breed (1998), horses of breeding groups (the Emben intra-breed type of the Aktobe population) of Mugalzhar horses differed from

Kazakh horses of the Jabe type with a higher live weight and comparatively better measurements (stallions have an average height at the withers of 145.5 cm, an oblique body length of 159.1 cm, chest circumference of 185.8 cm, metacarpal circumference – 19.9 cm, live weight – 553 kg; mares, respectively: 145,1-155,6-180,6-19,0 cm and 481.2 kg), with high meat productivity (260-280 kg carcass weight) and good slaughter yield (56-58%) under pasture conditions [11]. Adai horses are well adapted to the harsh continental climatic conditions [12]. The Adai horse has good quality meat and has excellent fattening and feeding ability [13].

Advances in genome-wide sequencing have allowed for an in-depth analysis of the genetic variations present in horses. It is known that the history of horse domestication is approximately 5000-6000 years old, during this period the genetic diversity of domesticated animals is gradually changing due to breeding activities in populations [14]. It is worth noting that traditional breeding methods do not provide tangible breeding progress, in this regard, it is of interest to study the genetic profile of domestic horse breeds using new generation sequencing.

Materials and methods of research. The research was conducted on the basis of the Laboratory of biotechnology and diagnostics of infectious diseases of the NJSC "West Kazakhstan Agrarian and Technical University named after Zhangir Khan" and farms in various regions of Kazakhstan. A sample of domestic horse breeds (Mugalzhar, Kushum, Kazakh breed: Jabe and Adai type) was formed based on the collection of the following data: gender, age, body weight. The main measurements of the horses: height at the withers, oblique body length, chest circumference, metacarpal circumference were taken in accordance with the instructions for bonification [15].

The results and their discussion. In order to achieve our goals, we conducted visits to farms for bonification work and selection of biological material. Figure 1 shows the stallions of domestic horse breeds.



Figure 1 – Stallions of domestic horse breeds
(A – Jabe, Б – Mugalzhar, В – Adai, Г – Kushum)

Based on the results of the bonitation data, we selected the most typical representatives and formed a sample of domestic horse breeds (Table 1).

From the data in Table 1, it can be seen that the live weight of stallions varies from 420 kg (adai) to 650 kg (kushum), depending on the breed. The live weight of mares varies from 385 kg (Adai) to 580 kg (Mugalzhar) depending on the breed. Figure 2 shows a bar chart that represents live weight of horses of different breeds depending on gender.

Table 1 – Measurements and live weight of domestic horse breeds

Breed	Gender and age group	Color	Measurements, cm				Live weight, kg
			height at the withers	oblique body length	chest circumference	metacarpal girth	
Kushum	The mare, 9 years old	Brown	155	161	187	20	530
Kushum	The stallion, 11,5 years old	Dark bay	163	168	197	20	600
Kushum	The stallion, 8,5 years old	Bay	162	165	200	21	650
Kushum	The stallion, 10,5 years old	Dark bay	168	170	200	21	620
Mugalzhar	The mare, 7 years old	Savrasaya	148	154	183	20	530
Mugalzhar	The mare, 8 years old	Savrasaya	148	156	203	20,5	580
Mugalzhar	The mare, 8 years old	Savrasaya	147	158	197	20,0	560
Mugalzhar	The mare, 9 years old	Savrasaya	147	162	190	20,0	550
Mugalzhar	The stallion, 7 years old	Savrasaya	147	153	185	20	492
Mugalzhar	The stallion, 13 years old	Savrasaya	148	157	207	21,5	640
Mugalzhar	The stallion, 8 years old	Savrasaya	148	167	208	21,5	644
Adai	The mare, 9 years old	The chestnut	140	144	164	18	390
Adai	The mare, 9 years old	The Black Horse	142	146	173	18	385
Adai	The stallion, 12 years old	The chestnut	144	147	174	18	420
Jabe	The mare, 9 years old	The Black Horse	142	148	177	18	420
Jabe	The mare, 8 years old	The Black Horse	144	149	180	18	440
Jabe	The stallion, 8 years old	Savrasaya	144	151	205	20,5	560

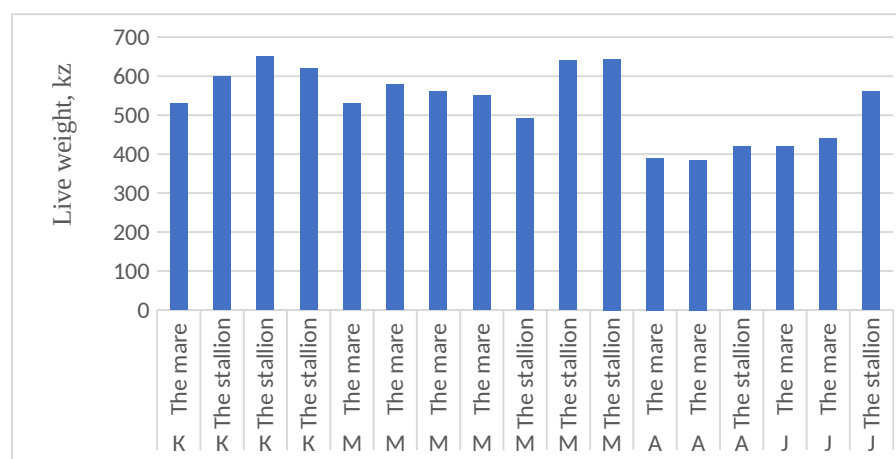


Figure 2 – Live weight (kg) of domestic horse breeds (K– kushum, M- mugalzhar, A- adai, J- jabe)

The Kushum horse breed has the largest body weight among all the breeds considered. Stallions reach a weight of 600-650 kg, and mares weigh about 530 kg. This makes them one of the largest and most powerful horses among the four breeds represented. The Mugalzhar breed is similar in its parameters to the Kushum breed. Stallions of this breed weigh from 640 to 644 kg, and mares can reach 530-580 kg. This weight also indicates good meat and dairy qualities and high productivity. The Adai breed, on the contrary, is the lightest of the listed. The average weight of stallions is about 420 kg, and mares weigh from 385 to 390 kg. Jabe occupy an intermediate position between Kushum and Mugalzhar horses that have a high body weight and Adai horses with a relatively small body weight. The weight of stallions of this breed reaches 560 kg, and mares weigh in the range of 420-440 kg. Thus, it can be concluded that the Kushum and Mugalzhar horses are much more massive than the Adai and Jabe horses. This is quite understandable in their meat and dairy direction, since larger sizes contribute to an increase in product output. At the same time, Jabe is a versatile option that combines moderate weight and good endurance.

The average height at the withers of the Kushum horse breed is 162 cm, which is significantly higher than other breeds. At the same time, the range of values in horses of the Kushum breed is maximum - from 155 cm in a 9-year-old female mare to 168 cm in a 10.5-year-old stallion. Such significant variability (standard deviation of 5 cm, coefficient of variation of 3.1%) indicates a wide range of growth characteristics within the breed. The pronounced age dynamics in stallions is particularly noteworthy: if an 8.5-year-old stallion has a height of 162 cm, then by the age of 10.5 this indicator increases to 168 cm, which corresponds to an annual increase of about 1.2 cm. Significant sexual dimorphism is also noteworthy - the difference between a mare (155 cm) and the average stallion (164.3 cm) is 9.3 cm, or 6% of the average (Figure 3).

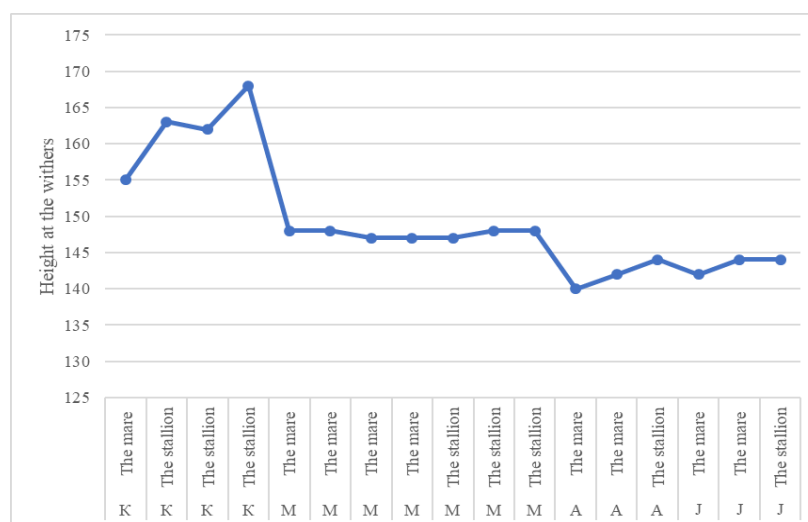


Figure 3 – Height at the withers (cm) of domestic horse breeds (K– kushum, M- mugalzhar, A- adai, J- jabe)

A completely different situation is observed in the Mugalzhar breed. These horses show an amazing uniformity of growth characteristics. The average height at the withers is 147.5 cm, with a minimum range of values from 147 to 148 cm. A standard deviation of only 0.5 cm with a coefficient of variation of 0.3% indicates the exceptional stability of this trait in the breed. It is noteworthy that there are practically no sex differences - the difference between the average values of mares (147.5 cm) and stallions (147.7 cm) is only 0.2 cm (0.1%). There is also no pronounced age dynamics.

The Adai breed and the Jabe show similar characteristics, although they have some differences. The average height at the withers of Adai horses is 142 cm (range from 140 to 144 cm), jabe - 143.3 cm (from 142 to 144 cm). Both breeds show moderate variability: a standard deviation of 2 cm (coefficient of variation of 1.4%) for Adai and 1.2 cm (0.8%) for Jabe. Sex differences expressed weakly: in Adai, the difference is 3 cm (2.1%), in Jabe, it is only 1 cm (0.7%). These breeds have similar growth characteristics.

Figure 4 shows examples of domestic horses depending on their gender. The analysis of measurements of horses of various breeds allows to reveal interesting patterns in their exterior features.

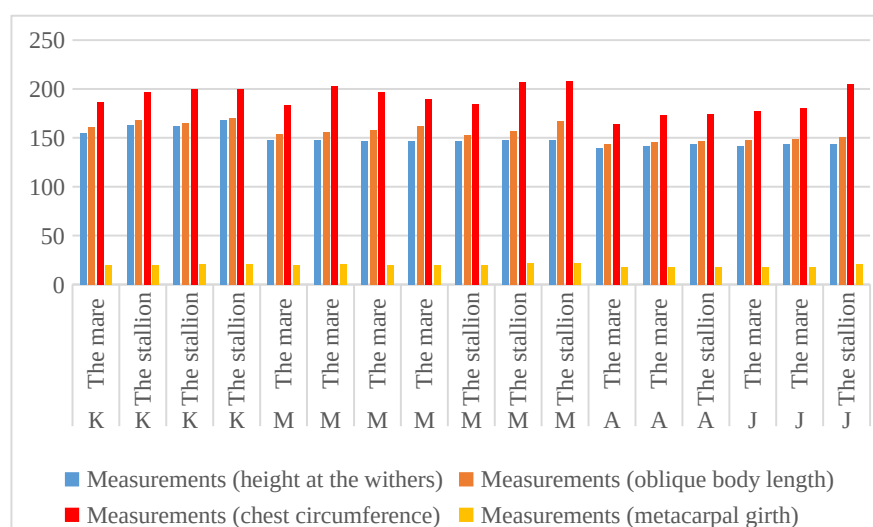


Figure 4 – Measurements of domestic horse breeds depending on gender (cm) (K– kushum, M- mugalzhar, A- adai, J- jabe)

The Kushum breed shows the most impressive size among all the presented breeds. The height at the withers of these horses varies from 155 cm in mares to 168 cm in stallions, which indicates a pronounced sexual dimorphism - the difference reaches 13 cm. The clear age dynamics is particularly noteworthy: if an 8.5-year-old stallion has a height of 162 cm, then by the age of 10.5 this indicator increases to 168 cm, showing an increase of about 3 cm per year. The large size is confirmed by other examples: the chest circumference ranges from 187 to 200 cm, and the metacarpal circumference is 20-21 cm, which indicates the powerful constitution of these animals.

The Mugalzhar horse breed impresses with its amazing uniformity of indicators. The difference between mares and stallions is minimal - less than 1 cm, which indicates a weakly expressed sexual dimorphism. However, a significant variation in chest circumference is noteworthy - from 183 to 208 cm, while the maximum values are recorded in stallions. The circumference of the pastern at 20-21.5 cm confirms the strong constitution characteristic of locally adapted breeds.

The Adai breed stands out for its most compact size. The height at the withers is only 140-144 cm, and the difference between mares and stallions does not exceed 4 cm. The chest circumference is small (164-174 cm), and the thin limbs (metacarpus circumference 18 cm) indicate adaptability to poor feeding conditions.

The Jabe breed is close to the Adai breed in basic measurements, but it has some interesting features. With a similar height at the withers (142-144 cm), stallions have an unexpectedly large chest circumference - up to 205 cm, which is significantly higher than mares (177-180 cm). The circumference of the pastern is 18-20.5 cm and occupies an intermediate position between the Adai and Mugalzhar breed.

Comparative analysis reveals a clear gradation of breeds according to dimensional characteristics. The Kushum breed is the absolute leader in height at the withers (up to 168 cm), while the Adai breed ranks last (140 cm). Curiously, the oblique length of the body is maximum in the Kushum breed (up to 170 cm), but in the Mugalzhar breed, individuals also show impressive indicators (up to 167 cm). The chest circumference shows the most paradoxical distribution: the absolute maximum belongs to the Mugalzhar breed (208 cm), although in other dimensions it is inferior to the Kushum breed.

The age dynamics is most pronounced in the Kushum breed, where in two years (from 8.5 to 10.5 years old) stallions add 6 cm at the withers. Other breeds do not have a similar pattern, which can be explained either by the early completion of growth or by insufficient data.

The analysis of gender differences deserves special attention. In the Kushum breed the difference between mares and stallions reaches 9.3 cm (6%), in the Mugalzhar breed it is minimal - only 0.3 cm (0.2%). The Adai and Mugalzhar breeds occupy an intermediate position with differences of 2-4 cm.

The prospects for further research include expanding the sample, especially by age group, studying the correlation between different measurements, as well as analyzing the relationship between exterior features and productive qualities. A detailed study of the unusually large chest circumference of several individuals of the Mugalzhar and Jabe breed is particularly interesting, which may open up new directions in breeding work.

Body measurements of the formed group of domestic horse breeds corresponded to breed standards. It should be noted that all horses met the standards in terms of their exterior characteristics.

Conclusion. In the course of our research, we selected and analyzed domestic horse breeds for genome-wide sequencing. The selection was carried out taking into account the bonus data and qualitative indicators of the extracted DNA. As a result of a thorough analysis, three stallions of the Jabe, Mugalzhar and Adai breeds were selected, which demonstrate the best genetic and phenotypic characteristics for further genome-wide research. These breeds represent valuable genetic resources with high adaptability and productivity, which makes them promising objects for breeding and preserving genetic diversity in the specific environment of Kazakhstan. The

results obtained open up new opportunities for improving and preserving domestic horse breeds, which is important for the development of horse breeding in the country.

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ТҮЙІН

Зерттеу селекциялық бағдарламаларды жетілдіру үшін олардың морфологиялық және генетикалық ерекшеліктерін анықтау мақсатында Қазақстанның отандық жылқы тұқымдарын (көшім, мұғалжар, адай, жабы) зерттеуге арналған. Жұмыста бонитировка нәтижелері: тірі салмақ, дене өлшемдері (шоқтық биіктігі, кеуде айналымы, қиғаш дене ұзындығы) ұсынылып, жыныс-жас ерекшеліктерінің талдауы жасалды. Зерттеу нәтижелері көрсеткендей, көшім тұқымы ең жоғары салмақ көрсеткіштеріне (айғырлар – 650 кг-ға дейін, бие – 530 кг-ға дейін) ие және айқын жыныстық диморфизм байқалады. Мұғалжар тұқымы біркелкі өлшемдерімен (шоқтық биіктігі – 147-148 см) және жоғары ет өнімділігімен ерекшеленеді. Адай және жабы тұқымдары ықшам дене бітімімен (шоқтық биіктігі 140–144 см) және қатал табиғи жағдайларға бейімділігімен сипатталады.

Зерттеу әдістемесі Қазақстан шаруашылықтарында биологиялық материал мен деректер жинауды, сондай-ақ генетикалық вариацияларды талдау үшін толық геномдық қайта секвенирлеуге дайындықты қамтыды. Нәтижелер көрсеткендей, таңдап алынған тұқымдар (жабы, мұғалжар, адай тұқымдарының айғырлары) ең үздік фенотиптік көрсеткіштерге ие, бұл оларды генетикалық әртүрлілікті сақтау үшін құнды.

Қорытынды Қазақстанда ет-сүт жылқы шаруашылығын дамыту үшін жергілікті тұқымдарды зерттеудің маңыздылығын көрсетеді. Алынған мәліметтер өнімді қасиеттерді және экологиялық сын-қатерлерге төзімділікті арттыруға бағытталған селекция үшін мүмкіндіктерді ашады. Жұмыс бірегей генетикалық ресурстарды сақтауға және асылдандыру бағдарламаларын оңтайландыруға ықпал етеді.

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Каюмов Ф.Г., доктор сельскохозяйственных наук, профессор, <https://orcid.org/0000-0002-5155-4295>

ФГБНУ «Федеральный научный центр биологических систем и агротехнологий РАН», Оренбург, Россия, 9-Января,29, kserev_1976@mail.ru

Третьякова Р.Ф., кандидат биологических наук, <https://orcid.org/0000-0001-9241-9228>

ФГБНУ «Федеральный научный центр биологических систем и агротехнологий РАН», Оренбург, Россия, 9-Января,29, nazkalms@mail.ru

Ахметалиева А.Б., к.с.-х.н., доцент, <https://orcid.org/0000-0003-1788-8336>

НАО «Западно-Казахстанский аграрно-технический университет имени Жангир хана», г. Уральск, ул. Жангир хана, 51, 090009, Казахстан, akhmetalieva@mail.ru

Kayumov F.G., Doctor of Agricultural Sciences, Professor <https://orcid.org/0000-0002-5155-4295>

Federal Research Center for Biological Systems and Agrotechnologies of the Russian Academy of Sciences, Orenburg, Russia, January 9, 29, kserev_1976@mail.ru

Tretyakova R.F., Candidate of Biological Sciences <https://orcid.org/0000-0001-9241-9228>, nazkalms@mail.ru

Akhmetalieva A.B., Candidate of agricultural sciences, <https://orcid.org/0000-0003-1788-8336>

NJSC «West Kazakhstan Agrarian and Technical University named after Zhangir Khan», Uralsk, st. Zhangir khan 51,090009, Kazakhstan, akhmetalieva@mail.ru

КАЧЕСТВО ПОТОМСТВА ОТ БЫКОВ ТИПА АДУЧИ: ОЦЕНКА И АНАЛИЗ ПРОИЗВОДИТЕЛЕЙ