Brazilian Journal of Biology®

ISSN 1519-6984 (Print)
ISSN 1678-4375 (Online)

Original Article

Increasing the milk productivity of Kazakh jabe horses

Aumento da produtividade de leite de cavalos kazakh jabe

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Abstract

The purpose of the study was to determine the milk productivity and chemical composition of the milk of mares of the Kazakh breed of the jabe type (KJ) and the Novoaltay-Kazakh crossbreeds of the 1st generation (NA x KJ) in the conditions of herd keeping. To determine the milk productivity of mares, 2 experimental groups were formed with a total of 30 mares, 15 individuals were selected in each group. The studied animals were formed according to the principle of pairs of analogues in the context of full-age groups from 5 to 11 years. Kazakh horses of the jabe type in the group of experimental mares in milk have an average live weight of 433.5 kg, and are significantly inferior to the Novoaltay-Kazakh crosses (515.3 kg). The body measurements were 142.0-149.0-174.9-18.2 cm in Kazakh horses of the jabe type, and 150.1-157.1-186.7-20.02 cm, respectively, in Novoaltay-Kazakh crossbreeds. According to the results of studies, the milkiness of mares of the Novoaltay-Kazakh crosses for 105 days of lactation averaged 1932 liters or higher by 25.2% (487.2 liters) than the milkiness of mares of the Kazakh breed of the jabe type. As a result of studies on the composition of milk of mares of different genotypes, it was found that in mares of Kazakh jabe, on average, protein and fat indicators compared to Novoaltay-Kazakh crossbreeds were higher by 0.07% and 0.05%. In the course of determining the live weight of mares among the experimental groups, it was found that the Novoaltay-Kazakh crossbreeds, on average, had a higher live weight of 515.3 kg or higher compared to the Kazakh jabe by 81.8 kg (15.8%). Thus, the studies have proved the prospects of using stallions of the Novoaltay breed to increase the milkiness of local Kazakh horses of the jabe type in herd and pasture conditions.

Keywords: herd horse breeding, Kazakh horse of the jabe type, Novoaltay breed, Novoaltay-Kazakh crossbreed, milkiness, udder forms.

Resumo

O objetivo deste estudo foi determinar a produtividade do leite e a composição química do leite de éguas da raça Cazaque do tipo Jabe (KJ) e dos cruzamentos Novoaltay-Cazaque de 1ª geração (NA x KJ) nas condições de rebanho guardando. Para determinar a produtividade leiteira das éguas foram formados 2 grupos experimentais com um total de 30 éguas e 15 indivíduos foram selecionados em cada grupo. Os animais estudados foram formados segundo o princípio de pares de análogos no contexto de grupos de idade completa de 5 a 11 anos. Os cavalos cazaques do tipo jabe no grupo de éguas experimentais em leite apresentaram peso vivo médio de 433,5 kg e são significativamente inferiores aos cruzamentos Novoaltay-Cazaque (515,3 kg). As medidas corporais foram 142,0-149,0-174,9-18,2 cm em cavalos cazaques do tipo jabe e 150,1-157,1-186,7-20,02 cm, respectivamente, em mestiços Novoaltay-Cazaque. De acordo com os resultados dos estudos, a leiteira das éguas dos cruzamentos Novoaltay-Cazaque durante 105 dias de lactação foi em média 1.932 litros ou superior em 25,2% (487,2 litros) do que a leiteira das éguas da raça cazaque do tipo jabe. Como resultado de estudos sobre a composição do leite de éguas de diferentes genótipos, constatou-se que nas éguas do jabe cazaque, em média, os indicadores de proteína e gordura em comparação com os cruzamentos Novoaltay-Cazaque foram superiores em 0,07% e 0,05%. No decorrer da determinação do peso vivo das éguas entre os grupos experimentais, constatou-se que os mestiços Novoaltay-Cazaque, em média, apresentavam peso vivo superior em 515,3 kg ou superior em comparação com o jabe cazaque em 81,8 kg (15,8%). Assim, os estudos comprovaram as perspectivas de utilização de garanhões da raça Novoaltay para aumentar a capacidade leiteira de cavalos cazaques locais do tipo jabe em condições de rebanho e pasto.

Palavras-chave: criação de cavalos de rebanho, cavalo cazaque do tipo jabe, raça Novoaltay, mestiço Novoaltay-Cazaque, leitoso, formas de úbere.

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Received: August 25, 2023 – Accepted: October 6, 2023

1. Introduction

The study of economically useful traits of local Kazakh horses and their crosses, as well as the development of an effective technology for the production of mare's milk in the conditions of herd and winter-grazing content is of great scientific and practical importance.

The level of milk productivity and the content of the main components in milk are the most important breeding traits in in-milk herd, so studying the nature of their relationship is of great interest (Mongush and Yuldashbaev, 2019).

Kazakhstan is a center for the development of transhumance. Transhumance is represented by herd horse breeding and productive camel breeding. Therefore, it is necessary to observe the structure of the herd, that is, the quantitative and qualitative composition of the breeding stock, in order to obtain milk from mares and camels (Kargayeva et al., 2020a; Aubakirov et al., 2016; Kargayeva et al., 2020b).

The criteria for a reliable assessment of the selection of breeding stock in distant pastures for purposeful selection to increase milk productivity are breeding traits that affect the process of formation of milk yield (Kargayeva et al., 2020a).

After a harsh winter and scarce food supplies, a decrease in fertility is observed. When breeding for milk productivity, it is necessary to pay attention to targeted selection according to the shape of the udder (Baimukanov, 2019).

Mare's milk has been consumed for thousands of years in Central Asia and neighboring regions. Its composition is similar to breast milk, but different from cow's milk. Mare's milk has a wide range of therapeutic effects. Due to its composition (proteins, lipids, vitamins, carbohydrates, macro- and microelements, enzymes, hormones and a number of other important substances), fresh mare's milk has a high nutritional value and digestibility. Kondybayev et al. (2021) in a review article notes that in the countries of Central Asia it is more widely consumed fermented under the name koumiss. It is an acidic and low-alcohol drink fermented by lactic acid bacteria and yeast (Kondybayev et al., 2021).

According to Outram et al. (2009), the first domestication of horses and the consumption of mare's milk occurred in the modern Akmola region of Kazakhstan around 3500 BC (Outram et al., 2009). Currently, horses are mainly used as dairy animals in the countries of the former USSR, Mongolia and parts of China (Figure 1A) (Doreau and Boulot, 1989).

During the last decade, the consumption of mare's milk has become more popular in countries of Western Europe and North America (Claeys et al., 2014), especially among people suffering from intestinal problems, intolerance to cow's milk (Salimei and Fantuz, 2012) and skin diseases such as eczema and psoriasis. It is believed that the skin rash from these diseases disappears as a result of the use of mare's milk (Claeys et al., 2014; Salimei and Fantuz, 2012). However, these factors are not well understood by science, and the mode of action is unclear. In the last few years, interest in the use of mare's milk for human nutrition has increased, especially in France and Germany (Doreau and Martin-Rosset, 2011).

The use of mare's milk for direct consumption, which is currently sold in Europe mainly in the form of fresh or frozen raw milk (Naert et al., 2013), requires proper facilities, equipment and animal management to obtain dairy products with high sanitary and hygienic standards (Naert et al., 2013).

Herd horse breeding in Kazakhstan is one of the priority and profitable sectors of the agricultural sector. The peculiarity of herd horse breeding is the year-round maintenance of horses on natural pastures. Herd horse breeding makes it possible to effectively use hard-to-reach pasture areas of deserts, semi-deserts, mountain ranges and obtain cheap products.

In most countries of the world, with the exception of Central Asia, horses are not traditionally used as dairy animals (Salimei and Park, 2017).

Chirgin et al. (2019) believes that an objective criterion for assessing the development of glandular tissue and udder capacity is the daily and one-time milk yields of mares. After foaling for three weeks, the udder capacity of mares increased rapidly due to hypertrophy of the milk alveoli and the disappearance of puffiness and reached a maximum during this lactation. Then, during five to six months of lactation, the capacity of the udder changed little, but towards the end of lactation, approximately 1.5-2.0 months before the launch of the mares, due to the restructuring of the mammary glands, it began to decrease rapidly. The maximum capacity of the udder is determined mainly by the genotype of the animal (Baimukanov, 2020).

Shuvarikov et al. (2019) in the conducted studies of milk from different types of farm animals note the need to comply with the general principles of quantitative (milk yield) and qualitative (chemical) analysis of milk (Shuvarikov et al., 2019).

In Kazakhstan, horses are used as both dairy and meat animals. This led to a steady increase in the number of horses in Kazakhstan. In fact, the number of horses has more than doubled since 1991 from 1.6 million to 3.1 million in 2021 (Figure 1).

The purpose of the scientific research work is to determine the milk productivity and chemical composition of the milk of mares of the Kazakh breed of the jabe type (KJ) and the Novoaltay-Kazakh crossbreeds of the I-generation (NA x KJ) in the conditions of the herd keeping of the Pavlodar region, the Republic of Kazakhstan.

2. Material and Research Methods

The studies were carried out in "Zhana-Aul" LLP farm of the Pavlodar region of the Republic of Kazakhstan. The research object was horses of the Kazakh breed of the jabe type (KJ) and Novoaltay-Kazakh crossbreeds of the 1st generation (NA x KJ). To determine the milk productivity of horses, 2 experimental groups were formed with a total of 30 mares, 15 individuals were selected in each group. The studied animals were formed according to the principle of pairs of analogs in the context of full-age groups from 5 to 11 years.

To ensure the nutritional value of the diet of mares in milk and foals, the animals were additionally fed with

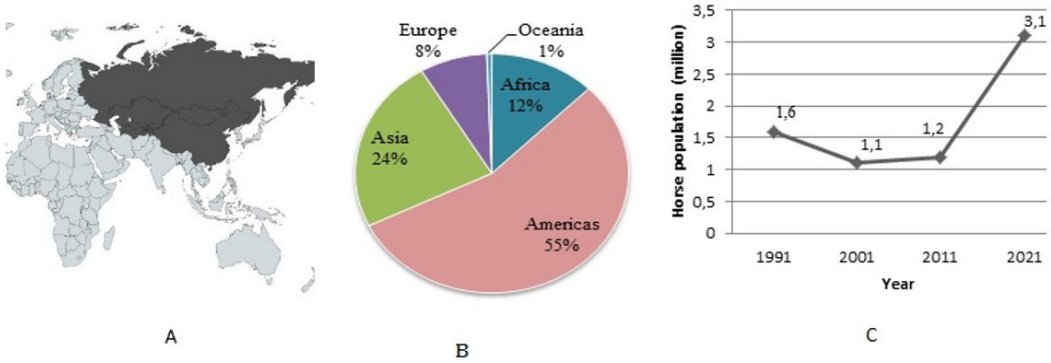


Figure 1. Horses as dairy animals and their population: (A) countries where horses are used as dairy animals (Doreau and Boulot, 1989); (B) share of the horse population by continent (FAOSTAT, 2019); (C) growth of the horse population in Kazakhstan between 1991 and 2021 (Bureau of National Statistics of Kazakhstan, 2021).

grass hay and extruded feed. Extruded feed is produced on the farm, which includes bone meal, wheat bran, and water. The chemical composition of the extruded feed was determined using the SPECTRAN-119M device (serial No. 579, serial number AB0082, manufactured in 2014, country of origin Ukraine), at the Testing Laboratory of the Research Institute of Agro-Innovation and Biotechnology of the Non-Commercial Joint-Stock Company "Toraigyrov University".

The chemical composition of grass hay was determined on the device FOSS NIRS DS2500, (Manufacturer "Foss Analytical A/S", Serial No. 91787137, part No. 60066162, 2016, country of manufacture Denmark), in the Testing Laboratory for the Analysis of Zootechnical Feed and Milk at the Faculty of Veterinary Medicine and Livestock Technology of the Non-Commercial Joint Stock Company "Kazakh Agrotechnical University named after S. Seifullin".

The assessment of Kazakh horses was carried out according to the requirements for the jabe type (Baimukanov et al., 2017).

The milking of the mares was carried out 5 times a day with an electric milking machine Model - DDU-2 (Manufacturer Melasty, country of origin Turkey), with a break between milking of 2 hours. This frequency of milking is associated with the anatomical and physiological features of the structure of the udder and milk secretion in mares.

The studied mares of the in-milk herd were divided into 2 groups according to the shape of the udder: cup-shaped and rounded. The actual and daily milk yield was determined.

The actual milk yield of mares was determined monthly during lactation by the method of control milk yield, twice a month on two adjacent days (Mongush and Yuldashbaev, 2019; Kargayeva et al., 2020a). You can see it in Figure 2.

The daily milk production of mares was calculated taking into account the milk sucked out at night by foals (Baimukanov et al., 2017).

The chemical composition of milk was determined on the device Laktan 1-4M version 700 (manufacturer "SibAgroPribor", manufactured in 2013, manufacturer No. 007150207, country of manufacture Russia), in the Testing Laboratory of the Research Institute of Agroinnovation and Biotechnology of the Non-Profit Joint-Stock Company "Toraigyrov University".

After milking, the mares were fed grass hay on average 3-4 kg and extruded feed 1.5-2 kg during the day, watering was carried out ad libitum. The suckling foals were also given grass hay 1-2 kg, extruded feed 0.5-1 kg and water ad libitum. The mares were milked only in the daytime, and at night they were kept together with the foals in the pasture.

Analysis of the research results was carried out using generally accepted methods of statistical data processing used in biological research (Baimukanov et al., 2016).

3. Research Results

Horse feeding. Feeding is a key component to the health, productivity and performance of horses. Horses have evolved as grazing animals adapted to high fiber diets, feeding continuously over long periods of time (Baimukanov et al., 2017).

Freestyle dry matter intake for fresh adult horses over many years has been estimated to average 2.3% of body weight (BW) (Harris et al., 2017). Voluntary dry matter intake is often the best way to increase milk production in lactating mares, which averages 2.8% dry matter (DM) of body weight but can be as high as 5% as recorded for herding ponies.

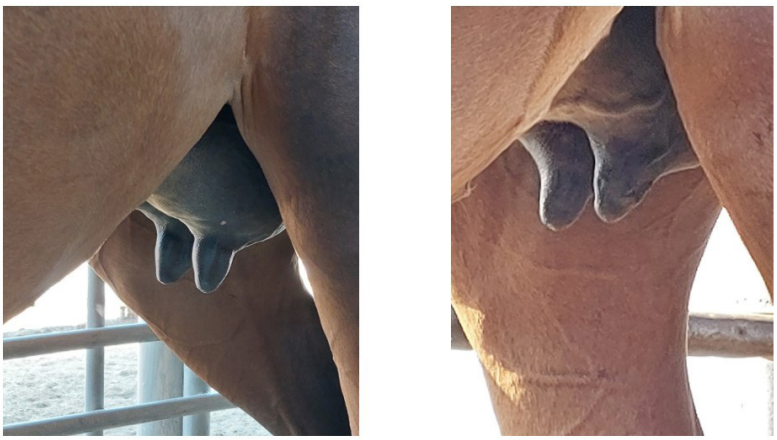
Experiments have established that herd horses on autumn pastures eat about 3.2 kg of grass dry matter per day per 100 kg of live weight. In summer, horses consume an average of 2.0 kg, in spring 3.9 kg, and in winter 4.4 kg of dry matter per 100 kg of live weight. The consumption of pasture vegetation by young animals, depending on age and body weight, is 20–30% less than that of adult animals (Akimbekov and Baimukanov, 2017). However, due to the fact that a sharply continental climate prevails in our republic and weather conditions can change dramatically, grazing dynamics can change in one direction or another, especially during critical periods of the year (Akimbekov et al., 2023).

It was found that the protein content in the hay was 12.3% and in extruded feed 14.0% (Table 1).

Protein is necessary for mares to recover body fatness, and for foals to grow. The fat content in the hay was 2.3%, in extruded feed it was 6.7%. Fats are essential for building cells, converting cholesterol, and forming prostaglandins. The content of calcium and phosphorus in the extruded feed was 3.0-0.9%, and in hay 0.48-0.07%, they are the most common elements in the horse's body. And therefore, it is very important to observe their mutual proportion in feeding.

Thus, the inclusion of hay and extruded feed in the diet of mares in milk and foals is one of the main sources of macro and micro elements to replenish the needs of the animal's body.

In the course of determining the live weight of mares of different genotypes, it was found that Novoaltay-Kazakh crossbreeds, on average, had a higher live weight of 515.3 kg or higher compared to Kazakh jabe by 81.8 kg (15.8%) (Table 2).



A B

Figure 2. (A) Cup-shaped udder; (B) rounded udder.

Table 1. The content of the chemical composition in feed for horses.

Feed	Protein, %	Fat, %	Cellulose, %	Ash, %	Sugar, %	Starch, %	Calcium, %	Phosphorus, %	Salt, %	Carotene, mg
Extruded feed	14.0	6.7	10.6	0.3	-	-	3.0	0.9	1.0	-
Hay	12.3	2.3	32.09	11.14	4.65	3.57	0.48	0.07	-	18.79

Table 2. Zootechnical characteristics of mares in milk in terms of live weight and main body measurements.

Indicator	Kazakh jabe		Novoaltay-Kazakh	
	M±m	Cv %	M±m	Cv %
Live weight, kg	433.5±4.70	4.1	515.3±5.72	4.2
Measurements, cm:				
Height at the withers	142.0±0.52	1.4	150.1±0.61	1.15
Oblique torso length	149.0±0.52	1.3	157.1±0.50	1.2
Heart girth	174.9±0.65	1.4	186.7±0.79	1.6
Pastern girth	18.2±0.05	1.1	20.02±0.09	1.6

Note: M - average value, m - error from the average value, Cv – coefficient of variability.

The body measurements were 142.0-149.0-174.9-18.2 cm in Kazakh horses of the jabe type, and 150.1-157.1-186.7-20.02 cm, respectively, in Novoaltay-Kazakh crossbreeds.

For a complete picture of the exterior of horses, we calculated body build indices, which represent the percentage of anatomically related measurements of horses.

It has been established that Kazakh horses of the jabe type have a format index of 104.93%, and Novoaltay-Kazakh crossbreeds 104.62%. No significant difference has been established in terms of broad-bodied, compactness indices. Kazakh horses of the jabe type are inferior to Novoaltay-Kazakh crossbreeds (13.44%) in terms of bonyness index (12.79%) (Table 3).

The format index characterizes the development of the trunk in length, and the compactness index gives an idea of the degree of development of the body, these indices are higher in horses of meat breeds. According to the broad-bodyness index, the conditions for growing young animals and the strength of their constitution are judged. The bonyness index indicates the development of the bone skeleton; it is highest in the heavy draft and meat and dairy breeds of horses (Baimukanov et al., 2021).

Baimukanov et al. (2021) consider that The cup-shaped shape of the udder is characterized by a large base (the circumference of the udder at the base is 70.3 cm), a symmetrical arrangement of both halves of the udder, with well-developed cylindrical dugs (the length of which is 4.0 cm and a girth of 13.1 cm), the dugs are widely spaced between the two udder lobes (the distance between the ends of the dugs is 7.2 cm). Mares with a rounded shape are characterized by conical and short dugs (length - 3.5 cm, girth - 11.4 cm) and a smaller udder volume (udder circumference at the base - 64.4 cm). Based on this, studies were carried out to study the influence of the shape of the udder on the milk productivity of mares. It has been established that the shape of the udder also affects the milk production of mares (Table 4).

Table 3. Body indexes of mares in milk.

Index, %	Kazakh jabe	Novoaltay-Kazakh
Format	104.93	104.62
Broad-bodyness	123.20	124.41
Compactness	117.41	118.91
Bonyness	12.79	13.44

From the data obtained, it can be seen that the mares of the Novoaltay-Kazakh crosses with a cup-shaped udder are superior in actual milk yield to mares with a rounded shape by 24%, however, they were inferior in protein and fat content by 0.49-1.81%. A similar picture is observed in the mares of the Kazakh jabe type, the difference in milk yield between the cup-shaped and rounded forms of the udder was 14%, in protein and fat content 1.08-1.73%.

According to Baimukanov et al. (2021) for four months of lactation from the mares of Kazakh jabe type with a cup-shaped udder, 1051 liters of marketable milk, rounded 823.6 liters were milked (Chirgin et al., 2019).

The results carried out on milk productivity were not the same. So, on average, the mares of the Novoaltay-Kazakh crosses had a higher milk productivity under pasture conditions, where for 105 days of lactation the actual milk yield was 805 liters, while the Kazakh jabe had 602 liters. Thus, in groups of hybrids (NA x KJ), milk yield is higher by 33.7% or by 203 liters.

Chirgin et al. (2019) found that mares produce milk with a mass fraction of fat in milk of 1.96% and protein of 2.10% (Chirgin et al., 2019).

According to Musaev et al. (2021) mare's milk contains 1.21% fat and 2.14% protein (Musaev et al., 2021).

According to the results of the studies of the chemical composition of milk of mares of different genotypes, it was found that in Kazakh jabe, on average, protein indicators showed 2.21%, fat 1.85%, in comparison with the Novoaltay-Kazakh crossbreeds, protein is higher by 0.07%, fat 0.05%.

In dairy horse breeding, the amount of milk per 100 kg of live weight of a mare, called the index per unit of its mass, matters, the better it pays for feed. It is especially important to determine the index of milkiness on farms practicing stable and pasture maintenance of dairy mares, where there are certain costs for feeding and servicing animals.

To characterize the milk productivity of the experimental groups of mares in terms of their milk productivity per lactation and live weight, the milkiness indices were calculated, shown in Table 5.

Table 4. The influence of the udder shape on the milk yield of mares.

Indicators	Group			
	Kazakh jabe		Novoaltay-Kazakh	
	Cup-shaped	Rounded	Cup-shaped	Rounded
Number of animals	8	7	9	6
Actual milk yield per day, l	6.11±0.3	5.36±0.23	8.50±0.4	6.83±0.18
Milkiness per day, l	14.67±0.62	12.86±0.50	20.40±1.04	16.40±0.44
Milkiness for 105 days of lactation, l	1540±65.48	1350±57.24	2142±109.12	1722±46.01
Protein, %	2.20±0.01	2.22±0.01	2.13±0.01	2.15±0.01
Fat, %	1.83±0.01	1.86±0.01	1.78±0.01	1.82±0.01

Table 5. Milkiness index of mares for 105 days of lactation, n=15.

Group	Average live weight, kg	Average daily milkiness, l	Milkiness for 105 days, l	Average milkiness index, l
Kazakh jabe	435.5	13.8	1445	333.3
Novoaltay-Kazakh	515.3	18.4	1932	374.9

It has been established that the index of milkiness in crossbreeds is higher than that of jabe mares, in general, crossbreeds have a higher milkiness, which certainly affects the intensity of growth and development of crossbred young animals.

Milk productivity depends on many factors, one of the main ones is breed. In their studies, Medvedev and Yavorsky (1984), Assanbayev (2013) on the productivity of the mares of the Soviet, Russian, Lithuanian draft horses, and the Novoaltay breed of horses established a high milkiness of these animals. So, Russian draft horses have 525 liters of milk per 100 kg of live weight, Soviet draft horses - 540 liters, for 210 days of lactation. For 150 days of lactation in the Novoaltay breed - 474.6 liters of milk for every 100 kg of live weight.

All these facts mean that the Novoaltay breed, having a high genetic potential in its blood, of the above breeds, can be improvers of the Kazakh breed of horses in terms of milk productivity.

4. Conclusion

One of the effective ways to increase the milk productivity of Kazakh horses of the jabe type in the herd is interbreeding. For this reason, we recommend using the Novoaltay breed as an improver, as it most optimally combines the blood of Soviet, Russian and Lithuanian draft breeds, which has high milk productivity and excellent adaptive qualities for year-round herd keeping.

Thus, to create a dairy herd, mares with a cup-shaped udder should be selected, since they are distinguished by well-developed dugs, also elongated mounds and, accordingly, the milkiness of mares is higher than that of mares with a rounded udder, which is characterized by smaller sizes.

Acknowledgements

The authors are grateful to Professor S.K. Abdrakhmanov, Associate Professor S.K. Bostanova for their technical support. We express special gratitude to the owner of the horse farm "Zhana-Aul" LLP K.Kh. Ibrayev for the given opportunities to choose the object of research and set up experiments in a comparative aspect.

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