

# Meat Productivity of Kazakh and Tuva Horses

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**Abstract:** The research aims to study the meat productivity of Kazakh and Tuva horses in a comparative age aspect. The objects of the research are the local populations of horses of the Kazakh breed in the Republic of Kazakhstan and the Tuva native breed in the Republic of Tyva of the Russian Federation. All animals were clinically healthy. It has been established that in Kazakh foals, the pre-slaughter weight at 6 months of age was 195.5 kg, at 12 months 268.6 kg, 18 months 319.0 kg, 24 months 327.5 kg, 30 months 388.3 kg, and the Tuva breed 174-210-290-310 and 342 kg, respectively. The relative weight of the organs of the digestive tract from the pre-slaughter weight of animals in Kazakh colts of 6-month age is minimal, taking 6.4%, at 12 months 7.09%, 18 months 6.72%, 24 months 6.76% and 30 months 5.85%. The research results showed that in Kazakh colts, although the internal vital organs grow and develop in absolute terms with the age of the animals, in a comparative aspect with the pre-slaughter live weight, their percentage decreases. Thus, the liver of a 6-month old Kazakh colt weighs 4.0 kg, which is 2.0% of the pre-slaughter weight, at 12 months 5.5 kg (2.1%), at 18 months 5.7 kg (1.81%), at 24 months 5.8 kg (1.79%), and 30 months 5.8 kg (1.52%). A similar picture is observed for the lungs, heart, and kidneys. It was found that in Tuva colts from 6 to 24 months of age, the coefficient of meatiness varied from 6.0 to 6.3.

**Keywords:** Kazakh Horse, Tuva Horse, Slaughter Yield, Offal, Meatiness Coefficient

## Introduction

The Republic of Kazakhstan and the Republic of Tyva of the Russian Federation have significant pasture resources for the development of productive horse breeding. Huge areas of natural pastures can significantly increase the population of horses. The reserves for increasing the production of horse meat and koumiss are the use of the genetic potential of productive horses, the intensification of the production of horse meat and koumiss, the improvement of traditional technologies for keeping and feeding, as well as their breeding (Zaycev and Koveshnikov, 2021).

Herd horse breeding is a historically established, priority direction of pasture animal husbandry. Kazakh and Tuva native horses are well adapted to the conditions

of year-round grazing, are resistant to diseases, and require minimal costs in the production of meat and meat products (Mongush *et al.*, 2020).

In productive meat horse breeding, horse breeds in demand are Kazakh, Kazakh horse of the JABE type, Bashkir, Altai, Novoaltay, Buryat, Tuvan, Yakut, Kushum, Novokirghiz, as well as their crossbreeds with factory breeds of horses, especially with heavy ones (Oorzhak, 2015).

Of fundamental importance when using animals for meat is the growth rate of each individual, their ability to deposit fat, and obtaining an economically beneficial full-fledged carcass at a young age. Within a species or breed, not all animals are equal in precocity. In herd horse breeding, it is advisable to select animals that have a hereditary ability to

effectively use pasture forage to transform it into muscle, bone, and adipose tissue. This is primarily because, under the conditions of market relations, the role of natural and artificial pastures increases, contributing to the optimal supply of horses with feed and allowing them to more fully realize the genetic potential of precocity and meatiness of animals (Lefler *et al.*, 2016).

In the analytical review (Dobranic *et al.*, 2009) reported that "Horse meat has a high content of water, protein, glycogen, iron and water-soluble vitamins, as well as a lower content of lipids and fat-soluble vitamins, which makes it specific compared to ruminant meat. The high content of muscle fibers ( $\approx 70\%$ ) and a lower content of adipose tissue gives horse meat a special dietary feature. The proportion of fat in horse meat is from 0.5% to 3.0% and an important fact is that unsaturated fatty acids account for a larger proportion (55.67-60.33%) than saturated fatty acids (39.67-44.33%). First of all, this applies to linoleic, linolenic, palmitic, and oleic fatty acids (Dobranic *et al.*, 2009).

Slaughter yield is the percentage of a horse's carcass weight to its pre-slaughter weight after 24 h of fasting. The slaughter yield depends on the sex, age, and fatness of the animals and their breed. With average fatness, it ranges from 48 to 54%, with the highest-from 58 to 62% and with non-standard fatness, it does not exceed 44-48%. The total yield of horse meat and horse fat (fat) in a horse carcass is 80-82%, bones contain an average of about 18% with fluctuations from 14 to 23% (Bydantseva and Mikryukova, 2018).

During the fattening, the increase in live weight was 47.3 kg in 6 month old stallions, 45.8 kg in 12 month old stallions, 40.7 kg in 18 month olds, 41.6 kg in 24 month olds, 5 kg in 30 month olds. Slaughter yield in 12 and 24 months old horses at feeding were 54.6-53.2%, and at fattening, respectively, 55.3-53.8%. In the 6, 18, 30 months old stallions, during the autumn feeding, the slaughter yield was 56.7, 53.6, and 52.3% and during the winter fattening it was 56.9, 53.8, and 52.7%, respectively. When studying the morphological composition of carcasses in stallions of different ages, it was established that 6, 12 and 18 month old foals have a relative bone content higher than in 24 and 30 month old foals, the content of pulp in the carcasses of 165.8 and 162.9 kg; the advantage is for 30 month old colts. The content of connective tissue is higher in younger stallions from 3.3 to 3.8% compared to 24 and 30 month-old animals of 2.5-2.7%. In terms of the class ratio of carcass parts in stallions of all ages from 43.3 to 46.5% fall in Class I, from 34.3 to 36.4% in Class II, from 15.0 to 28.3% on "out of class" (kazy and zhal) and from 6.1 to 7.4% go to Class III. According to chemical composition, the meat of 24 and 30 month old stallions differs from the meat

of 6, 12 and 18 month old animals with a lower fat content and is more high-caloric. 1 kg of meat contains 2098-2398 k. The meat of young colts contains more protein 19.27-19.07% than fat 9.01-10.07% and is an easily digestible dietary product (Richardovich *et al.*, 2019).

Local horse breeds are of particular interest for the development of herd horse breeding. The conducted studies of stallions-producers of the Kyrgyz aboriginal breed by phenogenetic indicators confirm the belonging of these individuals to the aboriginal Kyrgyz horse, as well as the relative identity (Toktosunov *et al.*, 2022a).

In Kyrgyz horses, sexual differentiation is presented: Stallions are taller and superior in oblique body length, but do not differ from mares in terms of massiveness and development of the skeleton. Stallions differ in size, structure and shape of the head, are characterized by short head, relatively narrow head, somewhat short head and less head depth. It has been established that the body indexes of the format, massiveness, compactness and bonyness in stallions were 103.4, 116.2, 112.4, 13.7%, in mares 104.7, 118.7, 113.3, 13.9% (Baimukanov *et al.*, 2022).

Kyrgyz horses are productive animals. To obtain horse meat with a high protein content in the conditions of herd horse breeding in the country, it is advisable to use the slaughter of horses over the age of 3 years with a live weight of  $399.6 \pm 8.6$  kg (Toktosunov *et al.*, 2022b).

Thus, based on the foregoing, we believe that the task of meat herd horse breeding is the production of high-quality horse meat with the lowest labor and cost.

### *The Aim of the Study*

The research aims to study the meat productivity of Kazakh and Tuva horses in a comparative age aspect.

## **Materials and Methods**

The studies were carried out in the Republic of Kazakhstan and the Republic of Tyva of the Russian Federation. The object of research in the peasant farm Bektobe of the Zhambyl district, Zhambyl region of the Republic of Kazakhstan was the local population of horses of the Kazakh breed, in the State Unitary Enterprise "Choduraa" of the Tes-Khem district (southern steppe zone) and the APF "Seserlig" of the Piy-Khem district (central mountain zone) of the Republic Tyva served as a Tuva native breed. All studied animals were clinically healthy.

Meat productivity was studied at the slaughter unit of the farm according to the method of the All-Russian research institute of horse breeding, following the technological instructions adopted in the meat industry (MDMPH, 1974).

The feeding qualities were assessed by the gain in live weight of the colts selected for the study up to 30 months of

age. Animals during fattening are watered 3 times a day (Svechin *et al.*, 1967).

«For a more objective assessment of the marketability of meat, a butchering of horse carcasses was carried out according to the scheme adopted for the state trading network of the Republic of Kazakhstan. Each of the cuts has a specific purpose. For the manufacture of zhal using fatty neck comb from the first thoracic vertebra. The carbonate is used to produce kazy. The cutting from the outer back lumbar part is used for the manufacture of the suret products. The upper layer of muscle tissue with fat irrigation from the hip part is used for the manufacture of the zhaya products. The muscle and fatty parts of the remaining cuts after boning and trimming of horse carcasses can go for the production of chuzhuk. Simultaneously with the cutting and boning of the carcass, samples were taken for chemical analysis. For this purpose, the meat content of each class was passed through a meat grinder with a fine grating of 2 mm in diameter and after thoroughly mixing an average sample weighing 400 g of minced meat was taken. Then each minced meat sample was placed in previously dried porcelain cups and placed in a drying cabinet at 65°C for determination of initial moisture. Further chemical analysis of the meat was carried out according to generally accepted methods. The content of water, protein, fat, and ash was determined in the meat of each class. Calorific capacity was established by calculation method in kilocalories» (Richardovich *et al.*, 2019; Zaycev and Koveshnikov 2021).

## Results

Currently, the increasing demand for high-quality horse meat from the population and export necessitates obtaining carcasses with a large meat yield, an even distribution of fat between the muscles and inside the muscles, with a thick layer of abdominal fat for making kazy, a relatively small specific mass of bones and tendons in the carcass. Therefore, the study of morphological composition is an important qualitative indicator of the assessment of carcasses (Richardovich *et al.*, 2019).

The optimal age of colts for slaughter for meat is 2.5-3 years when their average live weight reaches its peak. Growing young animals up to 2.5 years of age are effective if the farm has good pasture land and reserve stocks of fodder.

The most objective indicator of assessing the quality of meat is to determine the ratio of the various tissues contained in it. A good carcass, as is known, consists of muscles penetrated by a moderate amount of fat, and has a low content of connective tissue and bones (Pankratov and Gogoleva, 2013).

It has been established that in Kazakh colts, the pre-slaughter weight at the age of 6 months was 195.5 kg, at 12

months 268.6 kg, 18 months 319.0 kg, 24 months 327.5 kg, at 30 months -388.3 kg and mates of the Tuva breed, respectively 174-210-290-310 and 342 kg (Table 1).

It is known that the older the animal, the more adipose tissue (internal fat) is deposited in its body, due to a decrease in the growth rate of colts. From the age of 2.5 years, reserve nutrients are deposited in the carcass of young animals in the form of fat (internal and subcutaneous fat) bones (Pankratov and Gogoleva, 2013).

According to the results of the study, it was found that in terms of pre-slaughter live weight, the Kazakh colts in all age groups exceeded their analogs of Tuva horses. By 6 months, their difference was 21.5 kg. The smallest increase in both experimental groups was recorded between 18-24 months. This figure for Tuva horses was 20 kg and for Kazakh colts 8.5 kg. At the age of 2.5 years, the pre-slaughter live weight corresponded to the age criteria and amounted to 388.3 and 342 kg. It should be noted that the weight of fat in both experimental groups at 6 months of age was the same with a difference of 0.1 kg (2.3-2.2 kg).

But in general, Tuva colts, when slaughtered at 12 and 18 months, slightly exceeded Kazakh horses of the same age in terms of fat mass. By the age of 24 months, the fat weight of Tuva horses was 8.9 kg, and that of Kazakh colts at the level 8.5 kg. Upon reaching 30 months of age, the difference was 2 kg in fat weight (18.3-16.3 kg). This fact can be explained by more severe climatic conditions in the Republic of Tyva.

When horses are slaughtered, offal is obtained (tongue, liver, kidneys, heart, brains, head, lungs), as well as valuable hides, horsehair, and hoof horn (Akimbekov *et al.*, 2018).

Horse offal is distinguished by good taste qualities. Horse meat contains high-grade proteins, fats, and vitamins. It is rich in iron, cobalt, iodine, copper, phosphorus, and calcium. In the meat of adult horses, there is more protein than in the meat of young animals, but the meat of mature horses contains more connective tissue, so it is coarser compared to young horse meat. The concentration of organic substances in horse meat depends on the age of the horses, their fatness, as well as part of the carcass (Svechin *et al.*, 1967).

Animal measurements give a definite idea of the type of physique of animals, but their isolated consideration without interrelation with each other less clearly characterizes its meat productivity (Baimukanov *et al.*, 2022; Oorzhak, 2015).

It has been established that the relative weight of the digestive tract organs from the pre-slaughter weight of animals in colts of Kazakh horses of 6 months of age is minimal and takes 6.4%, at 12 months 7.09%, 18 months 6.72%, 24 months 6.76% and 30 months 5.85% (Table 2).

**Table 1:** Meat productivity of Kazakh and Tuva horses in different age aspects

Age	Pre-slaughter live weight, kg.	Slaughter weight, kg.	Slaughter yield, %	Fat weight, kg	Hot carcass weight	Carcass yield, %
Kazakh horse ( <i>n</i> = 3, total 15 horses)						
6 months	195.5±1.7	110.8±00.90	55.50	2.3±0.45	108.5±1.2	54.3
12 months	268.6±4.1	143.0±01.20	52.62	2.6±0.15	140.4±0.4	51.6
18 months	319.0±1.5	173.0±01.10	53.50	6.0±0.30	167.0±0.8	51.6
24 months	327.5±2.1	176.5±01.70	53.00	8.5±0.50	168.0±1.4	50.3
30 months	388.3±2.4	213.3±02.50	54.70	16.3±0.80	197.0±1.6	50.4
Tuva horse ( <i>n</i> = 3, total 15 horses)						
6 months	174.0±1.6	95.4±00.79	54.80	2.2	93.2±0.79	53.6
12 months	210.0±1.4	111.7±01.10	53.20	3.1	108.6±1.1	52.2
18 months	290.0±1.5	150.5±00.80	51.90	5.3	145.2±0.8	51.9
24 months	310.0±2.1	160.0±00.90	51.60	8.9	153.5±0.9	51.1
30 months	342.0±1.9	178.2±01.70	51.60	18.3	165.9±1.7	49.8

**Table 2:** Mass and specific weight of the organs of the digestive tract of Kazakh horses in the age aspect

Animal age	Pre-slaughter weight		Stomach		Intestinal		Karta	
	kg	%	kg	%	kg	%	kg	%
6 months	195.5	100	6.8	3.57	3.0	1.57	2.50	1.31
12 months	268.6	100	10.0	3.84	4.8	1.84	3.80	1.41
18 months	319.0	100	11.5	3.67	5.6	1.78	4.00	1.27
24 months	327.5	100	12.0	3.70	5.8	1.79	4.10	1.27
30 months	388.3	100	12.3	3.23	5.9	1.55	4.10	1.07

**Table 3:** Mass and specific weight of the internal organs of Kazakh horses in the age aspect

Animal age	Pre-slaughter weight		Liver		Lungs		Heart		Kidneys	
	kg	%	kg	%	kg	%	kg	%	kg	%
6 months	195.5	100	4.0	2.00	2.7	1.42	2.0	1.00	0.57	0.30
12 months	268.6	100	5.5	2.11	3.5	1.34	2.8	1.07	0.70	0.26
18 months	319.0	100	5.7	1.80	3.8	1.21	2.9	0.92	0.80	0.25
24 months	327.5	100	5.8	1.79	3.9	1.20	3.0	0.93	0.90	0.28
30 months	388.3	100	5.8	1.52	3.9	1.02	3.0	0.79	1.00	0.26

**Table 4:** Morphological composition of the carcass of Tuva horses

Age, months	Number of animals	Carcass composition				Coefficient of meatiness
		Flesh		Bones		
		kg	%	kg	%	
6	3	82.3	86.3	13.1	13.7	6.3
12	3	96.1	86.0	15.6	14.0	6.1
18	3	129.1	85.8	21.4	14.2	6.0
24	3	135.1	84.4	24.9	15.6	5.4
3	03	150.8	84.6	27.4	15.4	9.7

**Table 5:** Chemical composition and calorific value of the 1<sup>st</sup> category offal of Kazakh and Tuva horses (*n* = 3)

	Content %					
	Kazakh horse				Calorific value, kcal	
	Moisture	Protein	Fat	Ash	Nutritional value, kcal	Energy value, kJ
Liver	71.10±00.270	24.10±00.41	4.9±00.13	1.5±00.02	144.38	6043.7
Kidneys	75.60±00.060	17.46±00.78	3.6±00.07	1.2±00.04	105.06	4397.8
Heart	67.88±00.370	22.80±00.80	8.8±00.15	1.0±00.08	175.32	7338.8
Tuva horse						
Liver	69.11±00.280	21.35±0.39	5.08±0.11	1.49±0.02	134.77	5641.4
Kidneys	72.08±00.080	19.39±0.66	4.09±0.08	1.43±0.02	117.50	4919.6
Heart	68.99±00.310	20.06±0.11	7.11±0.12	1.39±0.01	148.36	6210.4

Category 1 offal (liver, kidneys, heart) is also a source of protein. A high protein content is observed in the liver and heart, and a high-fat content is found in the heart (Pankratov and Gogoleva, 2013).

The results of the research showed that in Kazakh colts, although the internal vital organs grow and develop in absolute terms with the age of the animals, in a comparative aspect with the pre-slaughter live weight, their percentage decreases. Thus, the liver of a 6-month old Kazakh foal weighs 4.0 kg, which is 2.0% of the pre-slaughter weight, at 12 months 5.5 kg (2.1%), at 18 months -5.7 kg (1.81%), at 24 months 5.8 kg (1.79%), 30 months. 5.8 kg (1.52%). A similar picture is observed for the lungs, heart, and kidneys (Table 3).

For young local herd horses, a seasonal trend of growth and development is typical, which persists from year to year (Osipov *et al.*, 2018).

Studies have shown that in 6 month old Tuva foals, the carcass flesh averages 82.3 kg (86.3%), and the bone yield was 13.1 kg (13.7%). At the age of one year, the slaughter yield was 53.2%, including the weight of the carcass with fat was 111.7 kg, of which 96.1 kg was flesh and 15.6 kg of bones. In colts, when slaughtered at 1.5 years, the volume of the obtained flesh was 129.1 kg (85.8%) and the bone mass does not exceed 21.4 kg (14.2%). By 24 months, the flesh weight was 135.1 kg (84.4%). In 30-month old Tuva colts, the flesh weight reaches 150.8 kg (84.6%) and the bone tissue weight was 27.4 kg (15.4%) (Table 4).

When calculating the coefficient of the meatiness of Tuva horses, it was found that the highest coefficient of meatiness was recorded at the age of 30 months. The minimum indicator for the coefficient of meatiness was in colts at the age of two years. It was established that in colts of Tuva horses from 6 months to 24 months of age, the coefficient of meatiness varied from 6.0 to 6.3.

The analysis revealed that the nutritional value of the liver in the Kazakh horse was 144.38 kcal and this figure in the Tuva horse was 134.77 k (Table 5).

In both groups, compared with the rest of the offal, the content of protein and fat in the kidneys was inferior to the heart and liver. The calorific value in both groups of the heart was higher.

## Conclusion

The results of the research showed that, in comparison with Tuva horses, the Kazakh horses have a periodicity in the accumulation of live weight, this pattern in the dynamics of meat productivity is characterized by the intensity of development up to 18 months of age. In terms of nutritional value and energy value in relation to the heart, Tuva horses were inferior to their peers of the Kazakh breed. According to the content of fat and protein in kidneys, Kazakh horses were inferior to Tuva mates.

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## Author's Contributions

**Makpal Temirkhanovna Kargaeyeva:** Performed the experiments, analyzed the data, wrote the paper, and prepared tables, 20%.

**Khamit Ablgazinovich Aubakirov:** Giles conceived and designed the experiments, performed the experiments, analyzed the data, wrote the paper, and prepared tables, 20%.

**Sayana Darzhaevna Mongush:** Analyzed the data, and prepared tables, 15%.

**Kairat Zhaleluly Iskhan:** Conceived and designed the experiments, prepared tables, reviewed drafts of the paper, edited and commented on the manuscript, 15%.

**Ainur Malikovna Davletova:** Conceived and designed the experiments, prepared tables, reviewed draft of the paper, edited and commented on manuscript 10%.

**Aidar Dastanbekuly Baimukanov:** Harris conceived and designed the experiments, reviewed drafts of the paper, edited and commented on the manuscript, 20%.

## Ethics

When conducting the research work, all the principles of scientific ethics are observed. No conflict of interests.

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