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Original Article

Enhancing lamb growth and meat quality: analysis of kazakh fat-tailed and crossbred in central Kazakhstan's sharply continental climate

Melhorando o crescimento e a qualidade da carne ovina: uma análise de ovelhas cazaques de cauda gorda e mestiças no clima continental acentuado do Cazaquistão central

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Abstract

The article presents the results of scientific research on the production of lamb in the conditions of the Akmola region. The experiment was conducted on purebred Kazakh short-tailed rough-haired and cross-bred sheep obtained from industrial crossing of Kazakh short-tailed rough-haired queens with sheep- producers of the hampshire breed. Further, the article presents the results of feeding and fattening, as well as the morphological composition of the carcass of sheep of the Kazakh coarse-haired sheep breed of different ages. The object of the study for feeding and fattening were three groups of experimental sheep of the above-mentioned breed, where compound feed was included in the diet of the I experimental group in the form of top dressing, in the II experimental group, grain waste was also used for top dressing, and the control group was kept in the feed without top dressing. Based on the study of the feeding of experimental sheep, it was found that the absolute increase during the feeding period in experimental sheep who received fertilization in the form of compound feed is higher than in their peers, respectively, by 0.2 and 1.49 kg. In terms of morphological and varietal composition, in particular, the number of cuts of grade 1, there was also an advantage of experimental sheep that received fertilization in the form of compound feed compared to their peers, respectively, by 2.3-8.3%. In general, the results of a study on the growth, development and slaughter qualities of experimental sheep, i.e. purebred Kazakh short-tailed rough-haired and crossbred, obtained from crossing with sheep producers of the precocious breed "hampshire" showed that from the moment of birth to 2 and 4 months. For example, crossbred sheep were slightly superior to purebred peers in terms of the studied indicators. In particular, the results of feeding sheep of the Kazakh coarse-haired broad-tailed breed from 4 to 6 months, depending on the top dressing.

Keywords: industrial crossing, feeding, compound feed, lamb, average daily increase.

Resumo

Este artigo apresenta os resultados de pesquisas científicas sobre a ovinocultura nas condições da região de Aqmola. O experimento foi conduzido em ovinos cazaques raça pura de cauda curta e lã grossa, em comparação com ovinos mestiços obtidos a partir do cruzamento industrial de fêmeas cazaques de cauda curta e lã grossa com ovinos da raça Hampshire. Ademais, o presente artigo apresenta os resultados da alimentação e engorda, bem como a composição morfológica da carcaça de ovelhas cazaques da raça de lã grossa de diferentes idades. O objeto deste estudo relativo à alimentação e engorda se resumiu a três grupos experimentais de ovinos da raça supramencionada, onde alimentos compostos foram incluídos na dieta do Grupo Experimental I sob a forma de cobertura, enquanto no Grupo Experimental II foram também utilizados resíduos de cereais para a forragem e o Grupo de Controle foi mantido em um regime de alimentação sem cobertura. Com base no estudo da alimentação de ovinos experimentais, verificou-se que o crescimento absoluto durante o período de alimentação em ovinos experimentais que receberam fertilização sob a forma de alimentos compostos é superior aos seus pares em 0,2 e 1,49 kg, respectivamente. Em termos de composição morfológica e varietal, particularmente quanto ao número de cortes superiores, observou-se também uma vantagem de ovinos experimentais que receberam fertilização sob a forma de alimentos compostos em comparação com seus pares em 2,3-8,3%, respectivamente. Em geral, os resultados do estudo sobre as características de crescimento, desenvolvimento e abate de ovinos experimentais, ou seja, tanto da raça pura cazaque de cauda curta e lã grossa quanto da raça mestiça obtida a partir do cruzamento

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com produtores de ovinos precoces da raça Hampshire, obtiveram estes resultados desde o momento do nascimento até o segundo e quarto mês de vida. Por exemplo, os resultados dos ovinos mestiços foram ligeiramente superiores quando comparados aos seus pares de raça pura em relação aos indicadores aqui estudados. Especificamente a respeito dos resultados da alimentação de ovelhas cazaques de lã grossa e cauda larga de 4 a 6 meses, de acordo com a cobertura utilizada.

Palavras-chave: cruzamento industrial, alimentação, alimentos compostos para animais, ovinos, média de crescimento diário.

1. Introduction

Sheep farming in Kazakhstan is a traditional, historically established branch of animal husbandry, the development of which is favored by the presence of extensive natural pastures, which make up more than 65% of all forage agricultural land (Ombaev et al., 2013; Temirzhanova, 2010).

The profitability of sheep farming largely depends on the quantity and quality of meat products. Currently, the researchers note, the practical breeding of the industry is aimed at breeding sheep of meat productivity (Aguayo-Ulloa et al., 2013; Shauenov et al., 2015; Badee and Hidaka, 2014).

The intensive development of meat and fat sheep breeding contributes to the production of high-quality and competitive domestic products in full, satisfying rational consumption standards, meeting modern requirements of a healthy diet (Shauenov et al., 2016).

Intensive mutton production technology is a system of measures aimed at increasing production, mainly of young mutton (lamb), in combination with obtaining high-quality wool and fur-fur raw materials with minimal manual labor and material resources (Carrasco et al., 2009).

According to the UN Food Commission, currently sheep farming as a raw material of the meat industry occupies the 4th place, after cattle breeding, pig farming, poultry farming in the world (Dankvert et al., 2011).

Lamb by its taste qualities belongs to the best types of meat. It is known that the quality of meat is the best if sheep are slaughtered under the age of one year (Nikitichenko and Nikitichenko, 2008). Lamb meat, in addition to other characteristics such as a high concentration of linolenic acid, is more easily digestible compared to meat from other ruminants, since the amino acid profile of sheep myofibrillary protein provides its greater digestibility, which is approximately 99%, while bovine serum albumin has an amino acid digestibility of 93% (Badee and Hidaka, 2014).

Consequently, the production of mutton is of particular interest to commodity producers, in particular, the heads of farms where sheep of the meat-sucking direction are bred. The level and norms of feeding play an important role in improving animal productivity and reducing feed costs, which range from 50% to 70% of the total cost in the livestock industry (Verbeke et al., 2015). When developing feeding systems, it is necessary to take into account the peculiarities of production systems (Zervas and Tsiplakou, 2011). The production of sheep products on pasture lands requires lower levels of external resources, and it preserves traditional lamb production in many countries (Aguayo-Ulloa et al., 2013), as well as ensures a high level of animal welfare (McGlone, 2001). Lamb meat production in some countries is based on extensive feeding systems, which may include irrigated, arid and green pastures (Ponnampalam et al., 2002), but animals raised in these systems may have slower growth rates, which affects production efficiency (Carrasco et al., 2009) and the ability to reach the target live weight within a certain period. Often, in such systems, it is necessary to provide additional feed as an additive in order to improve the energy and protein balance and thereby meet nutritional needs for optimal growth of lambs and lamb production (Turner et al., 2014).

Feeding sheep, especially young ones, is economically feasible, because during the feeding period, the increase in live weight of sheep is carried out on natural grasslands of various grasses. When feeding on mixed-grass pastures, animals are provided not only with energy feed, but also with all nutrients for growth, development and feeding (Shauenov, 2019; Omarova et al., 2018).

In this regard, for the production of young mutton, we have carried out industrial crossing and feeding of young sheep (sheep). The object of the study were sheep of the Kazakh coarse-haired broad-tailed breed, sheep-producers of the HAMPSHIRE breed, sheep aged 2-4 and 4-6 months, Kazakh coarse-haired broad-tailed breed and their crossbreeds bred in the conditions of the Akmola region.

2. Material and Methods

The field of research and characteristics of animals. The research was conducted in the farm "Tabys" of the Akmola region of the Republic of Kazakhstan, which is engaged in breeding the Kazakh short-tailed rough-haired breed, well adapted to the conditions of year-round pasture and pasture-stable maintenance in the Northern region of Kazakhstan, where the climate is continental, the winter is cold, lasting about 5 months, with an average temperature of January - 17 °C and July 20 °C.

Kazakh short-tailed rough-haired sheep were distinguished by a fairly high precocity, especially during the dairy period and during the period of feeding and fattening. By the time of weaning from queens at the age of 4-4.5 months, sheep reached an average of 36.1%, bright – 53.7%, 1.5 years old, respectively, 73.6 and 84.9% of the weight of adult animals. The live weight of rams was in the range of 90-102 kg, queens – 60-65 kg, rams to chop – 35-37 kg, eggs – 33-35 kg. Shearing of sheep wool was 2.8-3.2 kg, queens – 1.7-2.0 kg. The slaughter yield of 4-5 month–old sheep is 50-52%, the yield of pulp in the carcass is 79-80%. The fertility of Kazakh short-tailed rough-haired sheep was in the range of 108-110%.

The sheep – producers of the precocious meat breed "HAMPSHIRE", which were used for industrial crossing,

were imported from the breeding farm "Manzor" and were breeding. Their live weight and shearing of wool is 65 and 5.3 kg.

In order to study the technology of lamb production during the experiment period, purebred breeding of Kazakh short-tailed rough-haired sheep and industrial crossing of Kazakh short-tailed rough-haired queens with sheep-producers of the HAMPSHIRE breed, as well as feeding of purebred sheep, were investigated and carried out. Before the start of the experiment, two groups of sheep of the Kazakh short-tailed rough-haired breed were formed for industrial crossing on the principle of analogues. Sheep of the first group were inseminated with sheep of the purebred Kazakh short-tailed coarse-haired breed, and sheep of the second group used sheep - producers of precocious meat breeds "HAMPSHIRE"

To study the feeding and meat qualities of the rams after weaning them from the queens, three groups of rams were formed, which were analogous in age, live weight and quantity. The conditions of grazing and their maintenance in the period from 4 to 6 months were the same, however, they differed in the types of top dressing after daily grazing. In particular, compound feed was included in the diet of the I experimental group of sheep, grain waste was included in the diet of the II experimental group of sheep, and the sheep of the control group did not receive top dressing for pasture feed.

Before the feeding, a preliminary plan was drawn up, which took into account the required number and sequence of use of grazing, the timing of feeding (60 days), the number of gains per day and during feeding.

The dynamics of live weight gain was taken into account based on the results of weighing experimental and control groups of suckling lambs and during the feeding period. Electronic scales TV-S(M)-150.2-A1 were used to determine the live weight of experimental lambs. During the experiment, the interstate standards GOST 31777 – 2012 (GOST Standards, 2012) "Sheep and goats for slaughter, mutton, lamb and goat meat in carcasses" and GOST 32605-2013 (GOST Standards, 2013) "Mutton. Carcasses and cuts. Delivery requirements and quality control".

Meat productivity, in particular, slaughter indicators were studied using the VIZ method. During the slaughter of sheep, the slaughter was carried out between the second and third cervical vertebrae. The following cuts were separated according to anatomical boundaries: the cervical and shoulder-scapular cut - included the anterior border along the line of incision separation, the posterior one between the tenth and eleventh ribs perpendicular to the spine and the lower one over the shoulder-the elbow joint. The cut included: five cervical vertebrae, a scapula and humerus, ten thoracic vertebrae with their corresponding ribs and a thoracic bone with cartilage. Lumbar cut: anterior border along the line of the dorsal rib and posterior between the fifth and sixth lumbar vertebrae perpendicular to the spine. Hip cut: anterior border along the line of separation of the lumbar cut and posterior through the middle of the tibia. The obtained data were biometrically processed according to Plokhinsky using the Microsoft Excel program (Plokhinsky, 1969).

2.1. Characteristics of the feeds used in the experiment

The production of lamb from sheep of various breeds is mainly carried out by using the feeding of young animals after beating off the queens and fattening. In this experiment, where the feeding of young animals aged from 4 to 6 months was carried out, pastures with various grasses were used. In order to study the growth, development, absolute and average daily increase in live weight, as well as to obtain high-quality young lamb - lamb, lambs were fed on pasture without top dressing and using grain waste and compound feed concentrate NºOK-81-2.

The compound feed was made in the form of pellets, which facilitates transportation and use during feeding, i.e. it has a number of advantages over conventional feeds. The main ones are high digestibility (97-100%), uniformity of feed in physical composition, which makes it possible, as already noted above, to facilitate the transportation and distribution of feed.

The following components were included in the feed for lambs: crushed barley, wheat bran, sunflower meal, full-fat extruded soy, feed yeast, shell and monocalcium phosphate. Of the listed components, the largest proportion is barley - 56.1%, wheat bran - 20.0% and sunflower meal - 10.0% (Figure 1).

It is almost impossible to meet the need, especially for young sheep, for protein only at the expense of grain cereals, therefore, high-protein feed "soy" and "sunflower meal" were introduced into the feed, which contributed to the provision of protein.

To establish the chemical composition and nutritional value of the feed used in the laboratory "Feed quality assessment" of the department "Technology of production and processing of livestock products" of the Kazakh Agrotechnical University named after Saken Seifullin, laboratory tests were carried out on the express feed analyzer FOOS "NLRS DS 2500". The results of the study are shown in Table 1.

According to the results of the chemical composition of the feed, it can be seen that protein, fat and ash in the compound feed were 5.24 - 20.44, 1.28 - 6.12 and 3.71 - 0.53% higher than in grain waste and pasture grasses, and in terms of fiber composition, pasture grasses were slightly better than compound feed and grain waste, respectively, by 12.75 - 17.17%, which had a slightly better effect when feeding lambs during feeding. In general, in terms of composition and nutrition, compound feed and grain waste comply with the norms of the interstate standard GOST-10199-2017 (Gost Standards, 2017; Makangali et al., 2019; Tultabayeva et al., 2023; Tokysheva et al., 2023).

3. Results and Discussion

The dynamics of the live weight of purebred and crossbred lambs indicates that crossbred sheep had a significant advantage in live weight in all age periods.

In general, the live birth weight of the purebred and crossbred lambs ranged from 3.9 - 4.8 kg, in purebred experimental sheep this indicator was 4.1 kg, in crossbred lambs, 4.5 kg, respectively. (Table 2).

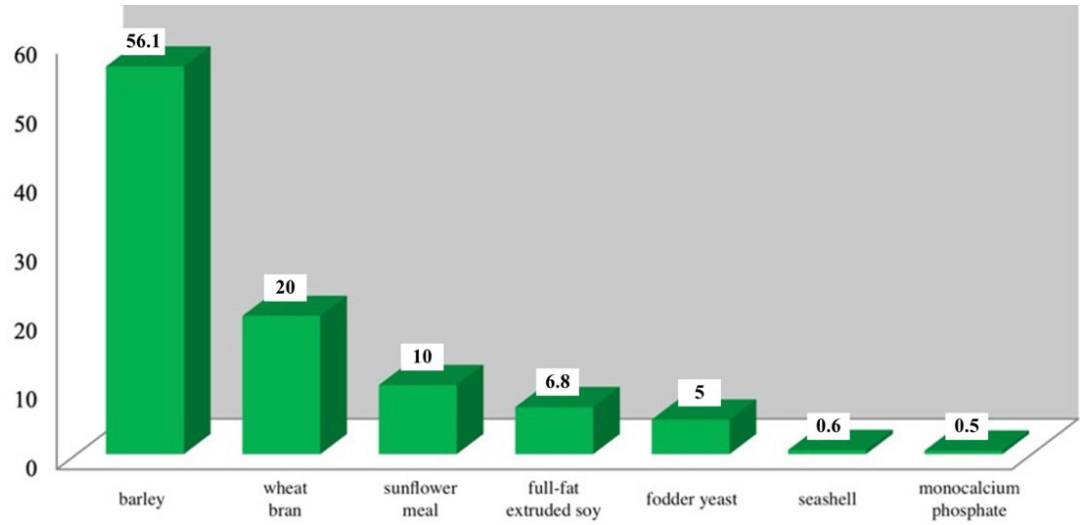

Figure 1. Composition of compound feed concentrate NºOK-81-2.

Table 1. Chemical composition of the feed used in the experiment.

Content	Types of feed		
	Pastures (mixed grasses)	Grain waste	Compound feed
Moisture	65.0	11.50	10.20
Protein	5.64	20.84	26.08
Fats	1.12	6.02	7.30
Fiber	21.29	4.12	8.54
Ash	5.56	2.38	6.09
Starch	1.39	55.14	41.79

Table 2. Live weight of sheep during the growing period.

Age, days	Purebred			Mixed breeds			t-test (p-value)
	X±m	σ	Variation variability between groups, Cv,%	X±m	σ	Variation variability between groups, Cv,%	
Live weight, kg							
At birth	4.1±0.28	0.52	12.6	4.5±0.41	0.41	9.10	2.55(0.02)
60 days	16.8±0.82	0.46	2.73	17.9±0.86	0.39	2.17	2.93 (0.01)
120 days	31.5±0.76	0.49	1.55	34.4±0.80	0.50	1.45	8.31 (<0.001)
Absolute increase, kg							
0 - 60	12.7±0.14	0.43	3.38	13.4±0.12	0.49	3.65	1.70 (0.10)
60 -120	14.7±0.17	0.50	3.40	16.5±0.13	0.56	3.39	3.92 (<0.001)
0 - 120	27.4±0.21	0.60	2.18	29.9±0.23	0.67	2.24	2.72 (0.01)
Average daily increase, g							
0 - 60	211.7±16.0	0.52	0.24	223.3±14.5	0.69	0.30	1.20 (<0.001)
60 - 120	245.2±17.5	0.44	0.17	275.0±16.4	0.55	0.20	2.66 (<0.001)
0 - 120	228.3±16.2	0.5	0.21	249.2±18.1	0.34	0.13	2.54 (<0.001)

As a result of the sufficiently high growth and development of lambs from birth to 4 months of age, the lambs reached a live weight of 31.5 and 34.4 kg. At the same time, the live weight of crossbred sheep of the experimental group exceeded the purebred peers of the control group by 2.9 kg or 9.2%, respectively. This advantage is explained by the phenomenon of heterosis, which is known to be more pronounced at a young age.

Studies of growth and development in purebred and crossbred sheep from the moment of birth to 2-4 months have shown that during the growing period there are differences in the magnitude of average daily and absolute

gains between the compared groups. In particular, the average daily increase in live weight in purebred and crossbred sheep up to 60 and 120 days was 211.7 - 245.2 and 223.3 - 275.0 grams, respectively, that is, the difference was observed in the range of 33.5 and 51.7 grams or 15.8 - 23.1% in favor of crossbred sheep.

During the study period, the absolute body weight gain of crossbred and purebred sheep during the dairy period was 27.4 and 29.9 kg, which is not a bad indicator.

To judge the true comparative growth rate of lambs of the groups during the dairy period, which have significant differences in terms of body weight, their relative growth rates were calculated. According to the indicators of the relative growth rate of the sheep, it was found that compared with the birth weight during the dairy period, the growth increased to 768.3 and 764.4%, respectively, i.e. there were no significant differences in relative growth, and from the moment of birth to 2 months of age, crossbred sheep had a slightly larger relative increase.

Lifetime assessment of the meat qualities of rams 2 - 4 months. it does not provide complete information about meat productivity. In this regard, a control slaughter of experimental sheep was carried out, where their carcass weight, slaughter weight and slaughter yield and other slaughter indicators were taken into account.

To study the development of meat production of young animals at 2 and 4 months of age, we carried out their slaughter of sheep (Table 3).

It can be seen from the data in Table 3 that there are minor differences in slaughter rates for 2 months. rams of the first and second groups. In particular, according to the pre-slaughter weight of the sheep, the difference was 1.10 kg in favor of crossbreeds, and accordingly, by carcass weight 0.9 kg, slaughter weight, also 0.9 kg and by slaughter yield, the difference was 2.0% in favor of crossbreeds.

The results of the control slaughter for 4 months. The rams showed that crossbred rams were superior to purebred rams in all slaughter parameters. In particular, the sheep of the Kazazkh short-tailed coarse-haired breed had a pre-slaughter mass lower than crossbred sheep by 3.0 kg., in terms of slaughter weight by 2.1 kg and, consequently, in terms of slaughter yield, the difference was 1.5% in favor of crossbred ones.

Carcasses of crossbred sheep had a rounded compact shape, insignificant subcutaneous fat covered a significant surface of the carcass with a uniform layer. Purebred had more fat deposits, which ranged from 0.3 – 0.7 kg, on average 0.4 kg, and crossbred sheep had a smaller amount of internal fat, within 0.3 – 0.8 kg, on average 0.4 kg.

The quality of the carcass is largely determined by the yield of more valuable cuts of the first grade, since the nutritional value of meat and the taste qualities of different parts of the carcass are different; a unit of meat deposited in the loin is equivalent in nutritional value to two units on the neck. The results of the varietal composition of carcasses are presented in Table 4.

The analysis of the data obtained shows that the carcasses of crossbred sheep are characterized by a higher yield of grade I cuts (93.30–93.15%) than those of purebred sheep, where the yield of grade I cuts was 92.50 - 92.10%, respectively, 0.8-1.05% more. At the same time, crossbred sheep outperformed purebred peers in the yield of Grade I cuts, on average, by 0.8% at 2 months of age and by 1.05% at 4 months of age. The advantage of crossbred animals in the yield of grade I cuts is noted in experimental sheep at 4 months of age.

Along with the varietal composition of carcasses, an important indicator of their quality is the meat content coefficient, characterized by the ratio of the fleshy part of the carcass to the mass of bones, expressed as a percentage. It was found that the yield of the pulp in sheep carcasses, depending on the breed and age, ranges from 65 to 85% of the mass of the entire carcass (Table 5).

Analysis of the results of the morphological composition of carcasses shows that crossbred sheep by the mass of pulp in cuts of grade 1 at 2 months of age exceeded purebred peers by 1.3 kg, at 4 months of age this indicator was 2.55 kg. The meat content coefficient in crossbred sheep at 2 months of age exceeded purebred by 1.64%, at 4 months of age, the meat content coefficient in purebred sheep was 3.5%, in crossbred, respectively, 4.84%.

In terms of the yield of pulp in the cut of grade 1, superiority was also observed in crossbred sheep, both at the age of 2 months and at 4 months, respectively, by 7.3 and 4.9%.

Getting high results of feeding depends not only on the type of feeding, but also on following the daily routine. During the experiment, the experimental groups of sheep began grazing at 600 in the morning and finished at 2100 in the evening. After grazing, the experimental sheep of groups I and II were fed, in the first 30 days, 200 g. and in the next 30 days 300 g. with compound feed and grain waste, and the sheep of the control group were not fed. The results of the sheep feeding are shown in Table 6.

Table 6 shows the results of feeding experimental sheep. It should be noted that before the start of the feeding, the live weight of the sheep of the experimental groups was in the range of 29.0 – 29.5 kg, and at the end of the feeding, this indicator was in the range of 39.8-38.7 kg. At the same time, the absolute increase during the feeding period was 9.21 and 10.7 kg, the average daily increase was in the range of 178.3 and 153.5 grams. Consequently, the group of sheep that received top dressing with “compound feed” slightly exceeded the absolute and average daily live weight gain of peers who received top dressing in the form of grain waste by 0.2 kg and 3.3 g, and the indicators of sheep that did not receive top dressing, respectively, exceeded by 1.49 kg and 24.8 g ($p < 0.05$).

The morphological composition of the carcass is characterized by the ratio of its main parts: muscles, adipose tissue, bones. The ratio of these main parts of the carcass determines its nutritional value and depends on the breed, age, sex and fatness of the animals. The quality of animal meat, including sheep, is determined by the content of edible and inedible parts in their carcass. Thus, during the growth period of lambs, not only their live weight increases, but also their body composition changes. The edible part of the carcasses is mainly made up of bran of carcasses of the 1st grade. In this regard, we have established the morphological and varietal composition of the carcass of experimental sheep of the Kazakh short-tailed rough-haired breed (Table 7).

Table 3. Results of slaughter of sheep aged 2-4 months (n=5 heads).

Indicators, unit of measurement	Groups													
	2 month							4 month						
	I			II				I			II			
	Purebred			Mixed breeds			t-test (p-value)	Purebred			Mixed breeds			t-test (p-value)
	X±m	σ	Variation variability between groups, Cv,%	X±m	σ	Variation variability between groups, Cv,%		X±m	σ	Variation variability between groups, Cv,%	X±m	σ	Variation variability between groups, Cv,%	
Pre-slaughter live weight, kg	16.8±0.82	0.03	0.17	17.9±0.86	0.04	0.20	2.97 (0.001)	31.5±0.76	0.30	0.9	34.5±0.80	0.31	0.80	8.60 (<0.001)
Carcass weight, kg	8.1±0.95	0.02	0.24	9.0±0.80	0.01	0.10	2.29 (0.03)	15.8±1.12	0.19	1.20	18.0±1.04	0.21	1.10	4.55 (<0.001)
Weight of internal fat, kg	0.10±0.12	0.03	2.80	0.20±0.08	0.03	12.5	2.19 (0.04)	0.30±0.21	0.03	10.00	0.40±0.18	0.02	5.00	1.14 (0.27)
Body fat weight, kg	0.20±0.15	0.03	15.0	0.10±0.12	0.02	22.0	-1.65 (0.12)	0.40±0.24	0.03	7.50	0.20±0.21	0.031	15.5	-1.98 (0.06)
Slaughter weight, kg	8.40±0.43	0.22	2.60	9.30±0.45	0.26	2.70	4.57 (<0.001)	16.5±0.49	0.40	2.40	18.6±0.51	0.30	1.60	9.39 (<0.001)
Slaughter exit, %		50.0			52.0				52.40			53.90		

Table 4. Varietal composition of carcasses.

Indicators, units of measurement	Groups					
	2 month			4 month		
	I	II	t-test (p-value)	I	II	t-test (p-value)
	Purebred	Mixed breeds		Purebred	Mixed breeds	
Weight of chilled carcass, kg	8.10±1.75	9.00±1.80	1.13 (0.27)	15.80±1.95	18.00±2.05	2.45 (0.02)
σ	0.20	0.20		0.27	0.25	
Variation variability between groups, Cv,%	2.40	2.20		1.70	1.30	
Weight of cuts by grades, kg:						
I	7.49±1.01	8.40±1.96	1.30 (0.21)	14.55±0.85	16.77±0.95	5.50 (<0.001)
II	0.61±0.95	0.60±1.80	-0.01 (0.98)	1.25±0.70	1.23±0.90	-0.06 (0.95)
The yield of cuts by grade, % by weight is cooled, carcasses:						
I	92.50	93.30		92.10	93.15	
II	7.5	6.7		7.9	6.85	

Table 5. Morphological composition of carcasses.

Indicators, units of measurement	Groups					
	2 month			2 month		
	I	II	t-test (p-value)	I	II	t-test (p-value)
	Purebred	Mixed breeds		Purebred	Mixed breeds	
Cut of the 1st grade, kg.: σ	7.49±1.01	8.40±1.96	1.30 (0.21)	14.55±0.85	16.77±0.95	5.50 (<0.001)
Variation variability between groups, Cv,%	0.015	0.160		0.021	0.046	
flesh	0.002	0.019		0.002	0.003	
σ	5.60±0.55	6.90±0.60	5.05 (0.01)	11.35±0.70	13.9±0.75	7.86 (<0.001)
Variation variability between groups, Cv,%	0.15	0.26		0.06	0.44	
Bones	0.026	0.037		0.005	0.032	
σ	1.89±0.19	1.5±0.13	-5.35(0.01)	3.2±0.14	2.87±0.12	5.65 (<0.001)
Variation variability between groups, Cv,%	0.021	0.170		0.180	0.039	
	0.011	0.110		0.057	0.014	
Cut of the 1st grade, %:	100.0	100.0		100.0	100.0	
flesh	74.80	82.10		78.00	82.90	
Bones	25.20	17.90		22.00	17.10	
Meat ratio	2.96	4.60		3.50	4.84	
Pipes of 2 grades, kg.:	0.61±0.95	0.60±1.80	-0.02(0.98)	1.25±0.70	1.23±0.90	-0.06 (0.95)
σ	0.05	0.25		0.03	0.04	
Variation variability between groups, Cv,%	0.082	0.420		0.021	0.030	
flesh	0.21±0.05	0.21±0.03	0 (1.00)	0.44±0.09	0.43±0.95	-0.03 (0.97)
σ	0.047	0.034		0.024	0.027	
Variation variability between groups, Cv,%	0.22	0.16		55	0.062	
Bones	0.40±0.20	0.39±0.16	-0.12(0.90)	0.81±0.15	0.80±0.18	-0.13 (0.89)
σ	0.20	0.033		0.032	0.27	
Variation variability between groups, Cv,%	0.49	0.085		0.040	0.34	
Pipes of 2 grades, %	100.0	100.0		100.0	100.0	
flesh	34.4	35.0		35.2	35.0	
Bones	65.6	65.0		64.8	65.0	

Table 6. Results of feeding of experimental sheep.

Indicators	Groups		
	Control	I	II
Number of rams, goal.	30	30	30
Live weight of sheep before feeding, kg	29.5±20[a*]	29.0±0.95 [a]	29.3±0.96 [a]
σ	1.24	1.54	1.31
Variation variability between groups, C_V, %	4.20	5.25	4.51
Live weight of sheep after feeding, kg	38.7±1.26 [a]	39.7±1.2 [a]	39.8±1.1 [a]
σ	0.52	1.0	0.68
Variation variability between groups, C_V, %	1.34	2.51	1.71
Absolute increase in body weight during the feeding period, kg	9.21±0.95 [a]	10.7±0.96 [b]	10.5±1.2 [b]
σ	3.35	5.58	1.17
Variation variability between groups, C_V, %	36.30	53.20	11.00
Average daily gain in body weight during the feeding period, g	153.5±0.9 [a]	178.3±0.98[c]	175.0±1.2 [b]
σ	3.64	1.29	3.17
Variation variability between groups, C_V, %	2.37	7.30	1.70

Table 7. Morphological and varietal composition of sheep carcasses.

Indicators	Groups		
	Control	I	II
Live weight of sheep before slaughter, kg	37.5±2.24[a*]	38.7±1.98 [b]	38.8±1.47 [b]
σ	0.63	0.47	0.40
Variation variability between groups, C_V, %	1.68	1.21	1.03
The mass of the carcass with a snub, kg	18.80±1.28 [a]	20.1±1.20 [b]	19.80±0.92 [b]
σ	0.29	0.05	0.31
Variation variability between groups, C_V, %	1.54	0.25	1.56
Carcass weight without a tailpiece, kg	17.49±1.16 [a]	18.63±1.05 [b]	18.37±0.65 [b]
σ	0.03	0.19	0.17
Variation variability between groups, C_V, %	0.17	1.01	0.92
Including cuts, kg: Grade 1	16.53±1.01 [a]	17.90±0.95 [b]	17.5±0.88 [b]
σ	0.04	0.06	0.07
Variation variability between groups, C_V, %	0.24	0.33	0.40
Grade 2	0.96±0.18 [b]	0.73±0.09 [a]	0.97±0.16 [b]
σ	0.04	0.09	0.03
Variation variability between groups, C_V, %	4.16	12.3	3.09
Yield of cuts, %: Grade 1	94.50	96.1	95.30
Grade 2	4.50	3.9	4.70
Weight, kg: pulp	13.30±0.54 [a]	14.80±0.60 [c]	14.40±0.47 [b]
σ	0.03	0.07	0.04
Variation variability between groups, C_V, %	0.22	0.47	0.27
bones	4.19±0.15 [c]	3.83±0.27 [a]	3.97±0.09 [b]
σ	0.30	0.03	0.06
Variation variability between groups, C_V, %	7.1	0.7	1.5
Yield, %: pulp	76.00	79.5	78.4
bones	24.00	20.5	21.6

Table 7 shows that the sheep that received top dressing by carcass weight, both with and without top dressing, outperformed their peers who did not receive top dressing by 5.3-6.9% and 5.6-7.1%, respectively. And also analyzing the data given in the table, it can be noted that the difference between the sheep that received top dressing in the form of grain waste and compound feed was 1.5 and 1.4%, respectively, in favor of the sheep that received compound feed, while the difference between them was not significant.

In terms of the proportion of grade 1 cuts in the carcass, the sheep that received top dressing in the form of compound feed outperformed their peers by 2.3 and 8.3%.

Consequently, the experimental sheep of groups I and II had higher fleshy parts of carcasses compared to peers of the control group by 11.3 and 8.2%. According to the ratio of the yield of the pulp and bones in the carcass, the experimental sheep were also characterized by a more optimal ratio. The carcass of the experimental sheep contained 79.5 and 78.4% of the pulp, which is 3.5 and 2.4% more than that of the control group of sheep.

The morphological and varietal composition of cuts, the ratio of individual tissues significantly affect the nutritional value of meat. When studying the varietal composition of sheep carcasses and determining cuts of grades I and II, it is possible to establish its market value and the direction of use of meat productivity. The morphological and varietal composition, biological and energy value of meat have significant differences in anatomical parts in the same carcass.

The best indicators of the meat content coefficient were possessed by the sheep that received top dressing in the form of compound feed - 4.11%, then the sheep that received grain waste - 3.87%.

When studying the slaughter and meat qualities of sheep after feeding, the composition of carcasses according to anatomical cuts was established for a more accurate idea of the commercial properties of young mutton.

From the data in Table 8, it should be noted that for all anatomical cuts, the experimental sheep had no significant advantages over the other two groups. However, in terms of the weight of the lumbar and hip parts, there was a slight superiority of the sheep that received top dressing over the control group in the range of 15.6 - 23.10% in the lumbar, 8.4 - 10.6% in the hip parts of the carcasses, and there were no differences between the comparative groups in the cervical bran.

In our experience, for the production of young mutton, we have formed 2 groups of rams at the age of 7 months. When they were put on fattening, the live weight was in the range of 38-39 kg. The fattening of the sheep was carried out with a diet made especially for them. In particular, grain waste and compound feed were used for the experimental sheep, to the main diet. The main diet of fattening sheep included: hay – 1.0 kg., straw – 0.5 kg., juicy feed – 1.5 kg. and 350 g of grain waste (group 1) and 350 g of compound feed (group 2), as well as 12-15 g of table salt. In general, the nutritional value of the diet was equal to 1.35-1.35 feed units. It should be noted that grain waste and feed by nutritional value, etc. The indicators corresponded to international GOST 101-99-2017 (Gost Standards, 2017).

Thus, the production of young mutton through fattening was carried out by fattening purebred sheep of the Kazakh coarse-haired broad-tailed breed.

To control the absolute and average daily increase in live weight during the fattening period, control weighing of experimental sheep was carried out every 15 days. The results of fattening experimental sheep are shown in the following Table 9.

Table 9 shows that when fattening, the live weight of group I sheep, which were fed with grain waste, amounted to 39.0 kg, and group II, which were fed with compound feed, amounted to 38.5 kg. After fattening, it amounted to 49.2 and 50.0 kg, respectively. The average daily increase during the fattening period was 170.0 and 192.0, respectively. Consequently, the average daily increase in group II sheep by 22.0 grams or 12.9% was higher than that of group I sheep that were fed with grain waste.

In order to study the quantity and quality of young mutton, we established slaughter rates of fattened sheep at the age of 9 months. The live weight of fattened sheep turned out to be higher than that of sheep on feeding by 10.2-10.5 kg, i.e. fattened during 2 months amounted to 50.0 and 49.2 kg, respectively, and 49.0 and 48.2 kg before slaughter. The slaughter parameters of the sheep were within the following limits; carcass weight-25.2-23.6 kg or carcass yield – 51.43 - 48.96%. Consequently, the live weight of the sheep fed with the addition of compound feed was higher than that of the fattened sheep fed with grain waste by 0.8 kg or 1.6%. In general, the sheep fattened with compound feed had a slaughter weight of 27.17 kg, which is 1.77 kg higher than that of their peers fattened with grain feed.

The quality of meat is characterized by the morphological and varietal composition of carcasses. The edible part of the carcasses is made up of bran of the 1st grade. In this regard, we have established the morphological and varietal composition of the carcasses of experimental sheep (Table 10).

From the data in Table 10, it can be seen that sheep fed with compound feed, by carcass weight, both with and without a chicken, exceeded their peers fed with grain waste, respectively, by 1.6-1.4 kg or 6.8-6.3%. In terms of the specific weight of grade 1 cuts in the carcass, the sheep that received mixed feed also surpassed their peers who received grain waste by 2.15 kg. or 10.9%.

In general, the pulp weight of the sheep receiving compound feed was 18.6 kg or 79.10%, which is more than 1.9 kg or 3.5% of their peers.

As in the studies of feeding abilities of sheep at the age of 4-6 months, we also studied the composition of carcasses according to anatomical cuts of sheep of the Kazakh coarse-haired broad-tailed breed, slaughtered at the age of 9 months, i.e. after two months of fattening (Table 11).

Table 11 shows that the sheep fattened with the addition of compound feed to the diet had 23.5 kg of carcass weight, which is 1.4 kg higher than that of the sheep fattened with the addition of grain waste. At the same time, the mass of cuts of grade 1, respectively, amounted to 21.9 kg, and for

Table 8. Composition of sheep carcasses by anatomical cuts.

Indicators	Groups					
	Control		I		II	
	kg	%	kg	%	kg	%
Carcass weight without a tailpiece, kg	17.49±16[a*]		18.63±1.05[b]		18.37±0.65 [b]	
σ	0.03		0.19		0.17	
Variation variability between groups, C_v, %	0.17		1.01		0.92	
including cuts 1 grade	16.53±1.01[a]	100	17.90±0.95[b]	100	17.50±0.88[b]	100
σ	0.04		0.06		0.07	
Variation variability between groups, C_v, %	0.24		0.33		0.40	
Neck part, kg	1.10±0.16[a]	6.65	1.11±0.08[a]	6.20	1.06±0.09[a]	6.06
σ	0.12		0.16		0.1	
Variation variability between groups, C_v, %	10.9		14.4		9.43	
Shoulder shoulder blade, kg	5.20±0.33[a]	31.46	5.51±0.29[b]	30.78	5.35±0.36[ab]	30.57
σ	0.28		0.22		0.18	
Variation variability between groups, C_v, %	5.38		3.99		3.36	
Dorso-costal part, kg	2.90±0.21[a]	17.54	3.11±0.20[b]	17.37	3.00±0.22[ab]	17.14
σ	0.09		0.4		0.20	
Variation variability between groups, C_v, %	3.10		12.8		6.66	
Lumbar part, kg	1.60±0.18[a]	9.68	1.97±0.12[c]	11.00	1.85±0.10[b]	10.57
σ	0.29		0.10		0.11	
Variation variability between groups, C_v, %	18.10		5.00		5.94	
Hip part, kg	5.0±0.47[a]	30.25	5.53±0.35[b]	30.90	5.42±0.23[b]	30.97
σ	0.24		0.22		0.20	
Variation variability between groups, C_v, %	4.8		3.97		3.69	
Production losses	0.73±0.06[b]	4.42	0.67±0.06[a]	3.75	0.82±0.05[c]	4.69
σ	0.05		0.05		0.03	
Variation variability between groups, C_v, %	6.84		7.46		3.65	

Table 9. Dynamics of live weight of fattening sheep.

Indicators	Groups					
	I	σ	Variation variability between groups, C_v, %	II	σ	Variation variability between groups, C_v, %
The number of sheep, head	30			30		
Live weight before fattening, kg	39.0±0.95	0.24	0.006	38.5±0.96	0.10	0.003
Live weight after fattening, kg	49.2±1.20	0.08	0.002	50.0±1.10	0.43	0.009
Absolute gain during the fattening period, kg	10.2±0.96	0.09	0.003	11.5±1.20	0.04	0.004
Average daily increase during the fattening period, g	170.0±0.98	1.56	0.009	192.0±1.20	0.43	0.002

sheep fattened with the addition of grain waste, 19.75 kg, i.e. the difference was 2.15 kg in favor of sheep fattened with compound feed. There are also better indicators of the shoulder, lumbar and hip parts in sheep, also fattened with the addition of compound feed. In particular, the shoulder scapular, lumbar and hip parts of the rams of the compared groups were, respectively, 6.7; 2.39; 6.9 kg and 6.12; 2.27 and 6.04 kg. Consequently, according to the above indicators, the superiority was observed in favor of sheep fattened with the addition of compound feed to the diet.

Table 10. Morphological and varietal composition of fattened sheep carcasses.

Indicators	Groups					
	I			II		
	X±m	σ	Variation variability between groups, Cv, %	X±m	σ	Variation variability between groups, Cv, %
Live weight of sheep before slaughter, kg	48.20±0.089	0.27	0.006	49.00±0.42	1.26	0.026
The mass of the carcass with a snub, kg	23.60±0.068	0.20	0.009	25.20±0.1	0.32	0.013
Carcass weight without a tailpiece, kg	22.10±0.042	0.13	0.006	23.50±0.18	0.54	0.023
Including cuts, kg: Grade 1	19.75±0.027	0.08	0.004	21.90±0.12	0.348	0.016
Grade 2	2.35±0.031	0.09	0.039	1.60±0.044	0.132	0.082
Yield of cuts, %: Grade 1		89.40			93.20	
Grade 2		10.60			6.80	
Weight, kg: Pulp	16.70±0.05	0.15	0.009	18.60±0.065	0.19	0.01
Bones, kg	5.40±0.019	0.06	0.010	4.90±0.059	0.18	0.036
Yield, %: Pulp		75.60			79.10	
Bones		24.40			20.90	

Table 11. Composition of sheep carcasses by anatomical cuts of fattened sheep.

Indicators	Groups			
	I		II	
	kg	%	kg	%
Carcass weight without a tailpiece, kg	22.1±0.042		23.5±0.015	
σ	0.13		0.05	
Variation variability between groups, C_V, %	0.006		0.002	
including cuts Grade 1	19.75±0.012	100	21.9±0.018	100
σ	0.04		0.06	
Variation variability between groups, C_V, %	0.002		0.003	
Neck part, kg	1.27±0.0012	6.42	1.31±0.0053	6.01
σ	0.004		0.020	
Variation variability between groups, C_V, %	0.003		0.012	
Shoulder shoulder blade, kg	6.12±0.0033	31.00	6.7±0.0069	30.52
σ	0.01		0.02	
Variation variability between groups, C_V, %	0.002		0.003	
Dorso-costal part, kg	3.38±0.0042	17.10	3.7±0.0088	16.90
σ	0.01		0.03	
Variation variability between groups, C_V, %	0.004		0.007	
Lumbar part, kg	2.27±0.0029	11.50	2.39±0.0016	10.91
σ	0.01		0.01	
Variation variability between groups, C_V, %	0.004		0.002	
Hip part, kg	6.04±0.002	30.60	6.9±0.0073	31.47
σ	0.01		0.02	
Variation variability between groups, C_V, %	0.001		0.003	
Production losses	0.67±0.0037	3.38	0.9±0.0081	4.19
σ	0.01		0.02	
Variation variability between groups, C_V, %	0.017		0.027	

4. Conclusions

Based on the results obtained, it can be concluded that the average daily increase in live weight in purebred and crossbred sheep up to 2 and 4 months was 211.7 – 245.2 and 223 – 275.0 g, respectively, i.e. the difference was within 33.5 and 51.7 g or 15.8 – 23.1%, and the absolute increase in body weight of crossbred and purebred sheep, respectively, were in the range of 27.4 and 29.9 kg. or 9.1% in favor of crossbred sheep.

The results of the control slaughter for 2 months. sheep of the compared groups showed that in terms of pre-slaughter live weight, crossbred sheep outperformed purebred peers by 1.10 kg. and accordingly, they exceeded the carcass weight by 0.9 kg. and the slaughter yield by 2.0%, and at the age of 4 months. they also slightly outperformed purebred sheep in all of the above indicators.

Studies of the slaughter, morphological and varietal composition of the carcasses of experimental sheep after feeding showed that the sheep that received top dressing by carcass weight, both with and without top dressing, surpassed their peers who did not receive top dressing, respectively, by 5.3-6.9% and 5.6-7.1%, with no significant difference between the sheep that received top dressing in the form of grain waste and mixed feed, respectively 1.5 and 1.4% in favor of sheep that received mixed feed.

For all anatomical cuts, the experimental sheep that received compound feed did not have significant advantages in relation to other groups, with the exception of the lumbar and hip mass indices, where superiority was observed in the range of 0.25-0.37 kg or 15.6-23.1% lumbar and 0.42-0.53 kg or 8.4-10.6% hip carcasses.

The results of fattening of experimental sheep showed that the average daily increase in sheep fed with compound feed was 192.0 g, against 170.0 g. for sheep that received grain waste, i.e. the difference was 22.0 g. or 12.9% in favor of sheep that received compound feed. At the same time, it should be noted that the live weight of fattened sheep turned out to be higher than that of sheep on feeding by 10.2-10.5 kg. and amounted to 50.0 and 49.2 kg, respectively.

Studies of the morphological and varietal composition of carcasses of fattened sheep showed that the pulp weight of sheep fed with compound feed was 18.6 kg. or 79.1%, which is more than 1.9 kg. or 3.5% of their peers, and in terms of the specific weight of cuts of grade 1 in the carcass, also the sheep that received compound feed exceeded peers who received grain waste by 2.15 kg or 10.9%.

Thus, sheep, both purebred and mixed, can be used for the production of young mutton aged 2-4 and 9 months, as it is in demand by the population of the country.

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