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Adaptation of Crossbred Young Sheep of Kazakh Meat-Wool Half-Fine Breed to Conditions of Chu-Ili's Low Mountains and Moin-Kum's Sands

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Abstract

The article provides results of the study of the adaptation of the Kazakh crossbred female lambs of meat-wool half-fine breed obtained using cryopreserved sperm of Poll Dorset and Texel sheep compared with purebred female lambs of the same age. Indicators of hematological studies, heart rate, breathing, and body temperature of crossbred and purebred ewe lambs in the breeding conditions were within the physiological norms, with minor deviations, which indicate quite good adaptation properties of the studied animals.

Keywords

Kazakh meat-wool half-fine sheep (KMW); Texel; Poll Dorset

Introduction

Adaptation of animals to the life (or breeding) environment can be judged by their internal indicators, which in turn determine and characterize productive and biological qualities [1]. In this regard, of a great practical interest is to study the patterns of change in indicators of the blood of animals and their physiological state during the growth, development, and formation of productive qualities. As is known, the physiological functions of animals undergo certain changes with age, sex, and breed, which affect productivity and other factors [2]. The ability to adapt to the new conditions of keeping and breeding is an important characteristic in all livestock production systems, in particular when the habitat is characterized by abrupt climate changes [3]. Well-adapted animals have the best results of productivity, compared with nonadapted animals.

In this aspect, the crossbred lambs of Kazakh meat-wool half-fine sheep with the blood of Texel and Poll Dorset breeds face certain problems in adaptation to the new environment [4,5]. Adapting to the new conditions of keeping involves functional changes of every organ and system in the body that undergoes a series of metabolic and anatomical changes [6]. Different types and breeds may differ significantly by the level of adaptation to new conditions, which affects the bodies of youngsters, some of which cannot cope with climate change due to the inability to maintain physiological state [7]. Live birth weight is an important factor that plays a key role in maintaining body temperature, homeostasis, and growth of the body as a whole. It is known that newborn lambs with light weight (4.1 kg) have a reduced ability to maintain body temperature in comparison with heavier (5.2 kg) lambs [8].

Sheep of Texel and Poll Dorset breeds had a significant impact on the development of fast-gaining meat-wool half-fine sheep breeding in many countries, where they were used both for pure breeding and for crossbreeding with local sheep to create new fast-gaining breeds and types [9]. This fact proves that these sheep breeds are more resistant to various climatic conditions and have a plastic genotype, and it also determines the interest to study their adaptation capabilities in the regions of south and south-eastern Kazakhstan, particularly in hot climates of Chu-Ili's low mountains and Moin-Kum's sands.

The purpose of this work was to study the properties of adaptation by comparing the physiological and hematological characteristics of the offspring of the Kazakh meat-wool half-fine sheep breed obtained by interbreeding using the frozen sperm of sheep of Texel and Poll Dorset breeds, in different periods of growth and development of hybrid female lambs.

Materials and Methods

Field of study and characteristics of the animals

These studies were conducted in the sheep-breeding farm of "Batay-Chu" LLP, located in the area of Chu-Ili's low mountains and Moin-Kum's sands in the Zhambyl region of Kazakhstan (Lat. 43°35′54″N, Long. 73°45′41″E). The climatic conditions of the region are as follows: the average annual precipitation ranges within 250-300 mm, the average annual temperature in the semi-desert zone is î15°C, which is −6°C in the foothill and mountain areas.

Kazakh meat-wool half-fine sheep are characterized by strong constitution, regular body shape, well-developed skeleton, strong and well-defined limbs, and a dense hoof horn, which contributes to long travel to distant pastures [10]. Coat length is 13-14 cm, and fineness is 29.1-25.1 μm. Adult sheep have an average body weight of 101-118 kg and wool clip of 8.0-11.6 kg in the original or 5.0-7.3 kg in pure fiber; ewes have an average body weight of 55-65 kg and wool clip of 3.5-4.6 kg in the original, and fertility per hundred ewes is 115-125% [11]. To get crossbred female sheep from Texel and Poll Dorset, cryopreserved semen doses of the above breeds were used for intrauterine laparoscopic insemination. Cryopreserved sperm of Poll Dorset and Texel sheep was imported from New Zealand (Animal Breeding Services Ltd).

Physiological parameters

Studies were conducted in the period from April to August 2014. In total, 30 clinically healthy female sheep were used in the experiment, from birth to weaning from their mothers (120 days).

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Throughout the experiment, three groups of animals (KMW × KMW [$n = 10$], PD × KMW [$n = 10$], TX × KMW [$n = 10$]) were put in the same conditions of grazing and keeping in distant pastures. In the experiment, each group of female sheep was marked with special colored tags with individual numbers and digital tattoos on their ears and tail. The physiological parameters (heart rate and breathing, rectal temperature) of each female sheep were recorded with 10-day intervals at the same time of day (8:00 am). Body weight of female sheep was measured with electronic scales (VEU-150-50/100, Russia). Breathing rate was recorded visually using a stopwatch, for a certain period of time (10 min). Heart rate was measured by placing a finger on the femoral artery and using a stopwatch. Rectal temperature was measured with a digital veterinary thermometer (Hauptner and Herberholz, Germany).

Hematologic parameters

Blood samples were collected at the age of 3 months. For hematological study, blood was taken from the jugular vein with a syringe containing ethylenediaminotetraacetic acid anticoagulant (EDTA). Laboratory tests were conducted at the laboratory of S.Seifullin Kazakh Agro Technical University (Astana). Blood analyzer (HTI/Micro CC-18, USA) was used to determine the hematological parameters.

All results represent the mean value with standard deviation. The data obtained were analyzed using the statistical software SPSS Statistics 17.0.

Results and Discussion

Variability of body weight of the offspring during the study period was determined from birth to 120 days, that is, until the weaning from the ewe. At birth, the crossbred female sheep far exceeded purebred peers by body weight ($p < 0.05$) and averaged correspondingly by the breed and blood: KMW—4.2 ± 0.18; PD × KMW—4.6 ± 0.13; TX × KMW—4.9 ± 0.12 kg. According to the dynamics of body weight during the period of growth, there is also the superiority of crossbred female sheep; although at the age of 2 months, no significant differences were observed between the groups of purebred and crossbred female sheep from Poll Dorset (insignificant difference). During weaning from the ewes, among the three groups of female sheep, crossbred lambs from Texel were characterized by the highest rates of body weight, that is, they exceeded the control group of purebred female sheep by body weight by 9.5-12.0% ($p < 0.05$). The difference in body weight was observed with increasing age; this difference in the three groups at the age of 30 days was in the range from 8.7 to 12.8 kg and at the age of 120 days was from 26.7 to 33.5 kg (Figure 1A). The superiority of crossbred female sheep by body weight is due to the influence of heterosis effect; however, no magnificent manifestations of this genetic phenomenon were observed. Apparently, this is due to the common direction of productivity of the crossed breeds and at the same time due to the influence of paratypic environmental factors on maximum expression of genetic potential of import fast-gaining breeds. However, it should be noted that the crossbred female sheep were distinguished by significantly stronger bones and pronounced rounded meat-body forms, which is typical for youngster of the fast-gaining half-fine breeds. Consequently, gains of body weight as the female sheep grew significantly exceeded those of crossbred lambs from Texel and Dorset; that is, climate change of the south and south-eastern region of Kazakhstan does not affect the increase in body weight of crossbred female sheep. A linear regression model between the body weight and postnatal period before weaning from the ewes (4-4.5 months) shows a steady increase in body weight with increasing age of the animals.

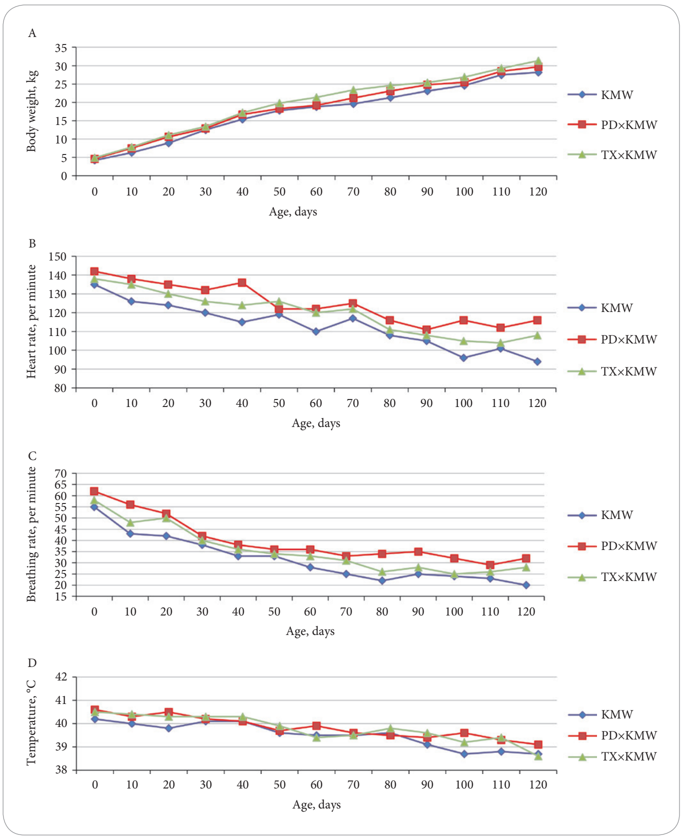

Figure 1: Mean physiological characteristics of female sheep: (A) body weight, (B) heart rate, (C) breathing rate, (D) body temperature

Heart rate at birth and during the growth of the body was high in crossbred female sheep from Poll Dorset ($p < 0.05$). Later, heart rate in all the experimental female sheep was uneven, and from birth to weaning average amounted to: KMW—135.5 ± 13.6 to 94.8 ± 8.2; PD × KMW—142.5 ± 12.7 to 116.0 ± 9.3; TX × KMW—138.5 ± 11.6 to 108.0 ± 7.2 beats per minute (Figure 1B). As is known, the pulse rate of the body as a physiological indicator is closely linked with the blood circulation and the feature of the body to maintain the physiological balance under external environmental factors. In view of the above, a slight increase in heart rate of female sheep with blood of Poll Dorset and Texel sheep breeds can be explained by the reaction of the body to high environmental factors and new habitat. However, it should be noted that the heart rate of the studied crossbred female sheep remained within the physiological norms, indicating good adaptation properties of the crossbred sheep youngster. We observed abnormal decrease in the heart rate during the period. However, the heart rate is directly dependent on physical condition and the milk process during feeding of the animal. Similarly, the heart rate also depends on the morning and noon times due to different ambient temperature peaks [12].

All experimental purebred and crossbred female sheep showed uneven value of breathing rate—initially with a decrease and then with an increase and vice versa. This physiological parameter was also observed in crossbred PD × KMW sheep, in which it was higher than in purebred peers ($p < 0.01$). The range of breathing rate of female sheep from birth to 120 days amounted to: KMW—55.0 ± 4.8 to 20.5 ± 6.2; PD × KMW—62.5 ± 8.1 to 29.0 ± 4.4; TX × KMW—58.5 ± 10.5 to 26.0 ± 3.6. At the age of 20 days, female sheep from

Parameters	KMW n = 10	PD × KMW n = 10	TX × KMW n = 10	Differences, %	
				PD × KMW	TX × KMW
RBC, million/mm^3	9.89 ± 0.34	9.75 ± 0.21	10.33 ± 0.15	−1.41	+4.45
WBC, thousand/mm^3	7.52 ± 0.18	6.95 ± 0.08	7.87 ± 0.32	−7.57	+4.65
Hemoglobin (Hb), g/%	10.20 ± 0.44	9.26 ± 0.26	9.08 ± 0.14	−9.22	−10.21
Hematocrit (HCT), g/%	35.40 ± 0.91	35.30 ± 0.63	34.71 ± 1.12	−0.28	−1.94
MCH (Hb = 1 × 10^{12}), pg	10.15 ± 0.31	9.86 ± 0.24	10.02 ± 0.43	−2.85	−1.28
MCV, mcm^3	37.36 ± 0.55	36.02 ± 0.78	36.84 ± 0.62	−3.58	−1.39
Mean corpuscular hemoglobin concentration in red blood cells, g/%	26.78 ± 0.54	26.02 ± 0.83	26.65 ± 0.35	−2.83	−0.48
Concentration of total protein in the serum, g/%	7.86 ± 0.14	7.08 ± 0.28	8.03 ± 0.32	−9.92	+2.16

Table 1: Hematological parameters of purebred and crossbred female sheep (n = 30)

Texel saw a higher breathing rate than other experimental groups ($p < 0.05$), and at the age of 90 days, female sheep from Poll Dorset also saw an increase in breathing rate ($p < 0.05$) (Figure 1C). Somewhat high breathing rate in crossbred female sheep aged 20 and 90 days was due to the close correlation of the physiological parameters with the heart rate, and is associated with the beginning of the formation of the "plasticity" of the young body, that is, the body's ability to form a stable homeostasis in the new conditions of their breeding and raising.

The rectal temperature of the female sheep of three groups shows an uneven decline with the growth of animals' bodies ($p < 0.001$). Although all experimental groups of female sheep saw a little difference, at the end of the study, at the age of 100-110 days, crossbred female sheep saw higher body temperature than that of purebred peers ($p < 0.05$) (Figure 1D). The temperature difference among the groups of female sheep being compared was not statistically significant during the study period, indicating equal standards of reaction to changing environmental conditions within allowed limits, as well as a fairly high degree of adaptability of young Kazakh meat-wool half-fine sheep to hot conditions of Chu-Ili's low mountains and Moin-Kum's sands.

Hematologic parameters of purebred and crossbred lambs of Kazakh meat-wool half-fine breed are given in Table 1. According to the number of red blood cells, crossbred female sheep from Texel prevail over the control group of purebred female sheep ($p < 0.05$). By the content of hemoglobin in the blood, purebred female sheep significantly prevail over crossbred female sheep ($p < 0.01$). In terms of hematocrit, mean corpuscular hemoglobin concentration, average content of hemoglobin in red blood cells, and secondary cell concentration of hemoglobin in red blood cells, purebred female sheep were significantly higher than their crossbred peers ($p < 0.05$).

In this respect, it should be noted that hematological parameters characterize and ensure the functioning of the body as a whole and in conjunction with the organs individually [13]. Also, the level and concentration of hemoglobin, as a parameter, is closely linked with the transport of oxygen and blood circulation in the body and thus with the operation and growth of all organs, body tissues and the level of manifestation of the body genetics [14,15]. With this in mind, a high content of red blood cells in the blood of female sheep of Texel breed can be attributed to the better functioning of blood-forming organs and the more intense metabolism in the body of the female sheep from Texel. At the same time, it should be noted that hematology of the studied crossbred sheep was within physiological norms, indicating good adaptation properties of both purebred and crossbred youngster. The superiority of purebred female sheep in terms of hematocrit, mean corpuscular hemoglobin concentration, average content of hemoglobin in red blood cells, and secondary cell concentration of hemoglobin in red blood cells indicates their better adaptation to local conditions of breeding.

Conclusion

The results of studies of physiological and hematological parameters of purebred and crossbred female sheep of Kazakh meat-wool half-fine breed from birth to weaning (120 days) in hot climates of Chu-Ili's low mountains and Moin-Kum's sands showed a good level of adaptive features that indicate a high plasticity of the body of the obtained breeds, which corresponds to the fast-gaining sheep of this productivity direction. In particular, the parameters of the heart and breathing rate and body temperature of the studied crossbred sheep in different periods were within the physiological norms, with minor deviations. It should be noted that the hematological parameters of youngster of the studied groups were within the permissible norms, showing good properties of adaptation to the new conditions of raising. In the future, the crossbred female and male sheep from fast-gaining Poll Dorset and Texel breeds, with vigorous level of selection and matching, will be the basis for a new fast-gaining meat type of Kazakh meat-wool half-fine breed exceeding KMW breed standards for meat productivity by 10-15%.

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