Product properties and histostructure of young sheepskin of the Dorper Breed

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Abstract. The aim of the study is to analyze the commodity properties of sheepskin and the histostructure of the skin of rams of Kalmyk fat tail breed and crosses (1/2 Kalmyk fat tail × 1/2 Dorper). The uterus of group I was covered with sheep of the Kalmyk fat tail breed, and the ewes of group II with sheep of the Dorper breed (experimental group). The study revealed, the mass of paired sheepskins of young group I was greater than that of peers of group II by 1.0 kg or 34.5 % (P> 0.999). A large live weight affected the large area of the skin of the second group of young animals, and the length of the hair of the experimental group, which turned out to be shorter, affected the smaller weight of the sheepskin. Pets have the best quality indicators of sheepskin and the best histological structure of the skin. Cross-breed animals have 14.52 % of more elastic, stronger and less thick skin, due to a greater epidermis thickness of 27.7 % and a denser reticular layer of 13.7 %. Wool cover (the ratio of primary follicle on the secondary) in cross-breeding sheep is 10.47 % thicker, compared to peers of white color, which corresponds to the technological requirements for the production of high-quality sheepskins.

1. Introduction

There are well-known breeding plants of fine-fleece sheep in the Republic of Kalmykia, as well as meat-producing sheep, including fat-tail and their cross-breeds. The quality of sheep products of these breeds has not been fully studied yet, and there is no research at the microstructural level. Although sheep breeding in this regard plays a decisive role in providing the population of certain regions with lamb of good quality, it is also able to provide valuable raw materials for the fur industry. Issues of expanding the assortment of fur semi-finished products of a higher quality level must be addressed in conjunction with the problems of improving the quality of raw materials [1–3].

The economic condition, economic importance and prospects for the development of sheep husbandry in our country directly depend on the meat productivity of sheep. In this regard, one should improve the meat productivity of sheep through the use of the available gene pool of meat breeds of sheep, the creation of new, more productive, well adaptive to local natural and technological conditions for their breeding [4–6]. Therefore, it is necessary to improve the genetic resources of sheep with early maturity and high meat productivity. In this regard, the meat breed Dorper became popular [7–9].

The Dorper breed sheep were introduced into the Republic of Kalmykia in 2016. In the Russian Federation, this breed is new and there is only few information on its crossing with other breeds.
In this regard, it is relevant to study the productivity and interior performance of cross-breeding sheep derived from the Dorper breed using microstructural morphometric research methods.

The aim of the research is to study the qualitative indicators of sheepskin and the histological structure of the skin of rams of the Kalmyk fat tail breed and crossbreeds obtained by crossing ewes of the Kalmyk fat tail breed with sheep of the Dorper breed.

2. Methods and materials
Scientific and industrial experiments were held in “Agrofirma Aduchi” LLC in 2018–2019 according to the scheme presented in Table 1.

| Table 1. Scheme of experiment |
|-------------------------------|
| **Group** | **Ewe Breed** | **Sheep Breed** |
| Control group I | Fat-tailed sheep | Fat-tailed sheep |
| Experiment group II | Fat-tailed sheep | Dorper |

For the experiment, two groups with ewes of the Kalmyk fat-tail breed were formed according to the principle of pairs of analogues (40 animals each). The uterus of group I was covered with sheep of the Kalmyk fat-tail breed, and the ewes of group II with sheep of the Dorper breed (experimental group).

There was a control slaughter of experimental at 8 months of age. Three sheep were killed from each group. The process of slaughter revealed the mass of sheepskins and its area. In addition, to study the histological parameters of the skin, skin samples were taken on the right side of the animal (3 heads in a group), at a distance from the palm of the back and shoulder blade, in the place that serves to assess the quality of the coat when scoring. Previously, in this area, the hair was cut in the size of a square of 10 × 10 cm, then on the cleaned area with the fingers of the left hand, without tightly squeezing, a skin fold was fixed with a diameter of about 2–2.5 cm and a piece of skin was carefully cut with Cooper's scissors. The cut was made to the muscle tissue. Sampling was carried out at the bottom. As fixatives for histological studies of the skin, 10 % neutral formalin was used, which after 24 hours was diluted 2 times to 5 % concentration.

Histological studies of the skin were held according to generally accepted methods in the laboratory of morphology and product quality North Caucasian Federal Scientific Agrarian Center – a branch of the Federal State Budget Scientific Institution "North Caucasian FNATs" [10].

The data obtained were processed by the method of variation statistics.

3. Results
Sheepskin is a single system of two basic elements of leather and wool. The parameters of the crossbreeding sheepskin are presented in Table 2.

| Table 2. Sheepskin parameters |
|-------------------------------|
| **Groups** | **Biometric indicator** | **Body weight before slaughter, kg** | **Sheepskin weight, kg** | **Sheepskin square, dm²** |
| I | M±m | 39.44±0.26 | 3.90±0.10 | 91.73±1.16 |
| | σ | 0.37 | 0.14 | 1.64 |
| | Cv | 0.94 | 3.72 | 1.79 |
| II | M±m | 45.47±0.64 | 2.90±0.05 | 99.09±0.11 |
| | σ | 0.90 | 0.07 | 0.15 |
| | Cv | 1.98 | 2.50 | 0.16 |
The mass of paired sheepskins of young group I was superior to peers of group II by 1.0 kg or 34.5 % (P > 0.999). By the area of the pair sheepskin, the opposite picture is observed for animals of group II in this indicator exceeded peers of group I by 7.36 dm², or 8.0 % (P > 0.99).

A large live weight affected the large area of the skin of the second group of young animals, and the length of the hair of the experimental group turned out to be shorter. It affected the smaller weight of the sheepskin.

The skin is the outer cover of the body and serves as a mediator between the external environment and the body of the animal.

When examining the histological parameters of the skin (Table 3), it was revealed that the skin of group I rams is 352.57 microns thicker (14.52 %) compared with peers of group II. Moreover, the layer thickness of the total skin thickness in animals of group I occupies: the epidermis – 0.8 %, pilar – 69.8 %, reticular – 29.4 %; Group II – epidermis – 1.2 %, pilar – 60.5 %, reticular – 38.3 %.

| Indicator                      | Group I               | Group II              |
|--------------------------------|-----------------------|-----------------------|
| Gross thickness of skin, μm     | 2780.44±78.84         | 2427.87±108.97        |
| epidermis                      | 22.12±1.22            | 28.24±2.48            |
| pilar                          | 1940.22±52.13         | 1469.29±87.62         |
| reticular                      | 818.10±49.23          | 930.34±50.64          |
| The ratio of the pilar and reticular layers | 2.4±0.153            | 1.6±0.033             |

The epidermis is a layer of epithelial tissue, its thickness encounnts 2–3 % of the skin gross thickness. It consists of a stratified squamous epithelium and protects the skin and the whole body from the adverse effects of the external environment.

The thickness of the epidermis affects the strength of the sheepskin. The densest epidermis was detected in crossbreeds of group II. Their superiority in this indicator over peers of the control group was 6.12 μm or 27.7 %. This is explained by the fact that the epidermal part in animals of meat direction (mezdra) is thicker.

In the dermis – the skin itself, which consists of connective tissue, distinguish between the pilar (papillary) and reticular (mesh) layers. The most massive layer is considered to be the pilar layer, as it accounts for 60–70 % of the skin. The reticular layer is the dense part of the skin, which is its foundation. The main part of the reticular layer is bundles of collagen fibers.

The pilar layer was 470.93 μm or 35.05 % thicker in the rams of the control group than in the experimental group (P > 0.99).

An indicator of skin strength is the ratio of the pilar and reticular layers, the smaller it is, the stronger the skin. In our experiment, the difference was 0.8 in favor of crossbred sheeps of the second group.

The reticular layer is an important part of the skin. Its structure (i.e. the thickness of the collagen fibers and the nature of their bond) determines the quality of the sheepskin. The study of the reticular layer of the skin of the rams revealed the collagen bundles located mainly horizontally. They intertwine with each other, forming oval cells with transverse fibers (Fig. 1).

This type is called normal ligature and indicates good skin strength. The reticular layer of crossbreeding young animals of the second group is 13.7 % better developed than the animals of the first group and occupies 38.3 % of the gross skin thickness, and 29.4 % in group I, which is 8.9 % less.

Zootechnical science distinguishes between hereditary and non-hereditary variability. Hereditary variability is associated with the genotype of animals, such variability is transmitted from parents to offspring. Non-hereditary variation is not related to the genotype of animals with their carriers of hereditary inclinations, therefore, cannot be transmitted to offspring during their reproduction.

The study considers hereditary variability with a genetic nature, so we tried to create identical optimal conditions for animals, for a more reliable manifestation of their genotype.
There are several methods for calculating the variability of traits, but it is most convenient to use the coefficient of variability in relative values, in percent.

The results of the study revealed that in cross-sectional animals, the coefficient of variation in the total skin thickness was high and amounted to 9.54 %, in the epidermis thickness – 15.20 %, in the thickness of the pilar layer – 10.33 %, which is more than in Kalmyk fat-tail breed at 4.63, 5.62, 5.68 abs. %. According to the thickness of the reticular layer, the difference between the groups was insignificant.

The data obtained indicate that in crossbreeds of the second group there are great opportunities for improving the qualitative characteristics of sheepskin based on breeding.

Thickness of the coat is a main attribute determining the sheepskin quality. The softest fur is made of black and white and white sheepskin. In hybrids of group II, the wool is mainly white, which meets the requirements of the processing industry for the manufacture of high-quality sheepskin coats.

The experimental cross-sectional young growth belongs to coarse-haired sheep breeds and has a wool fineness of 36.3 microns on average, i.e. 46 qualities, and 41.0 microns (40k) in control animals. Based on the standard of the sheep breed, the fineness values are consistent and meet the standard data.

There are two types of follicles: primary and secondary. Sheepskin contains hair follicles located in groups which consist of 2–3 primary follicles and a significantly larger number of secondary. The study of skin samples, namely the thickness of the skin tissue and its structure, as well as the thickness of the coat, is used in the practice of sheepskin production.

Studies of the histological structure of the skin (Table 4, Fig. 2) showed that the total density of hair follicles is small, which corresponds to the parameters of coarse-breed sheep. For the sheep of the first group – 27.57 pcs. per mm2 of skin, which is 3.12 % less than in the second group.

| Group | Primary | Secondary | Hair follicle thickness, pcs. Per mm² : Gross thickness | the ratio of secondary to primary follicles |
|-------|---------|-----------|--------------------------------------------------------|-------------------------------------------|
| I     | 3.38±0.05 | 24.19±0.63 | 27.57±0.58                                             | 7.16±0.28                                 |
| II    | 3.19±0.03 | 25.24±0.58 | 28.43±0.53                                             | 7.91±0.26                                 |

The most objective indicator of the skin thickness is the ratio of secondary to primary follicles. In cross-breed sheep of group II, this indicator was higher by 10.47 % than in peers of the control group.

Purebred animals of the first group had a greater coefficient of variation in thickness of primary hair follicles by 1.29 abs. %, And secondary follicles by 0.52 abs. %, compared with cross-breed sheep.

Also, in animals of the second group, the indicator of variability was lower than in sheep of the first group in terms of the ratio of secondary to primary follicles and amounted to 5.63 %.
Group I     Group II

Figure 2. Horizontal histological section of the sheepskin

4. Conclusion
The results of the studies give reason to conclude that cross-breeding animals obtained by crossing uterus of Kalmyk fat-tail breed with Dorper sheep have the best quality indicators and histological structure of the skin.

14.52 % of cross-breed animals have more elastic, stronger and less thick skin due to a greater epidermis thickness of 27.7 % and a denser reticular layer of 13.7 %. Wool cover (the ratio of secondary to primary follicles) in cross-breeding sheep is 10.47 % thicker than peers of white color, which corresponds to the technological requirements for the production of high-quality sheepskins.

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