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THE ELEMENTAL COMPOSITION AND MICROSTRUCTURE FEATURES OF SHEEP'S WOOL IN CONDITION OF INSUFFICIENT MINERAL NUTRITION

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Summary. The article presents data on the elemental composition and microstructure features of sheep's wool of the Precos and Hissar breeds under conditions of insufficient mineral nutrition using scanning electron microscope with the function of X-ray energy of the dispersion micro-analysis REM-106I (SELMI, Ukraine). The content of the main mineral substances of wool (S, K, Ca) was investigated and it was established that due to the lack of mineral substances in feed, their content in the wool remains within the limits close to the norm, but varies among representatives of different breeds. Thus, in sheep's wool of Precos breed the content of the Sulfur was in 1.23 times ($p \geq 0.05$) higher than that in sheep's wool of Hissar breed, Potassium and Calcium contents were in 40 and 1.93 times ($p \geq 0, 05$) less respectively. The data obtained from the research we associate with the ability of the sheep's body to use the mineral resources of the body. But it should be noted that the imbalance of the mineral nutrition has negatively affected the density of the adherence of scales to the surface of the hair, which gives the hair more brittle and «shaggy» and worsens the technical properties of wool as a whole.

Keywords: *sheep, wool, mineral nutrition, Sulfur, Potassium, Calcium.*

Formulation of the problem. One of the main prerequisites for improving the productivity of farm animals is their full-fledged mineral nutrition. The absence or lack of certain mineral elements and the violation of their amount in the diet leads to a reduction in the efficiency of nutrients in the feed and, as a result, reduces the cattle productivity.

Mineral elements included in the animal's organism, mainly as structural material, are involved in the digestion of feed nutrients, their absorption, synthesis, decomposition and separation of metabolic products from the body. They create the necessary conditions for the normal functioning of enzymes, hormones, vitamins, they stabilize the acid-base balance and osmotic pressure [1].

The animal's body includes about 84 chemical elements. More than 50 of them are constant components of them, determined quantitatively. The metabolic processes in the body take place in the form of the chemical and biological reactions, which result in the proteins, fats and carbohydrates synthesis. Their participation involves the growth and development of the organism – the higher the animals' productivity, the more intense is the metabolism [2, 3].

Underestimation of the mineral elements role in animal nutrition leads to economic losses in livestock production. The relative content of mineral elements in the animals' body is 4-6 % of their weight, depending on the age and food nature [4].

Mineral elements are important for the normal life of the organism. They participate in the supporting tissues construction, maintain homeostasis, activate biochemical reactions, affect enzymatic systems, directly or indirectly related to the functions of the endocrine glands, they enhance the activity of the gastrointestinal tract microflora [5].

The most active role of the mineral elements is in the processes of respiration, hematopoiesis, digestion, absorption, synthesis and allocation of

metabolic products in the body. They create the necessary conditions for the normal functions of vitamins, enzymes, hormones, maintaining the colloid state of proteins, acid-base balance, osmotic pressure at the required level and protection of the body's functions. Mineral elements are involved in the processes of neutralizing toxic substances and synthesizing antibodies [6].

Analysis of research and publications. As a rule, the diet of rations in its composition does not meet the needs of animals in mineral elements. Often there is an excess of some elements and a lack of the others. Due to the lack of minerals in animal rations, mineral metabolism is disturbed, food ingestion and digestion deteriorate, gains and milk productivity decrease, fertility is disturbed, diseases develop [2, 1].

The chemical composition of the animals' organism should be evaluated in close connection with plants, as the main source of its nutrition. It should also be remembered that the soil, plant and animals' organism are inextricably linkedas a single migration circle [7].

Some researchers have identified the mineral composition of the wool fiber and found that the sheep's body is particularly sensitive to Sulfur imbalances, an extremely necessary element for the wool production, in which its content is 3-5 %, although, of course, other elements are also important in wool formation, in particular Calcium, Phosphorus, Copper, Cobalt, Zinc, Iodine, Selenium, Silicon. In this regard, it is appropriate to note that the hair is considered to be one of the main indicators of the state of sheep's mineral support [8-10].

It is common knowledge that the skin of mammals is covered with hair, which can be an indicator of body health. Hair consists of three layers – core, pebbles and cuticles. The superficial layer of hair – the cuticle – consists of one series of horny scales, which tile-like cover the cortical substance [11].

The purpose of the article.The purpose of the work was to investigate the surface microstructure and the elemental composition of sheep's wool under the condition of insufficient mineral nutrition, namely in winter period.

Materials and methods.The research was carried out in the laboratory of electron microscopy faculty of veterinary medicine of the Sumy National Agrarian University using a scanning electron microscope with the function of X-ray energy-dispersive micro-analysis REM-106I (SELMI, Ukraine).

For the study, samples of sheep's wool of 2-3 years old breeds of Precos (4 heads) and Hissar (4 heads) were selected. Experiments were conducted in winter. Preparation of samples included the following steps [12]: selection of biological material; degreasing (96 % alcohol); drawing samples on the objective table; silver spray to provide electrical conductivity.

The hair surface microstructure was studied by scanning electron microscopy in the mode of secondary electrons.

The mass fraction of elements in the local sample sections and averaged from the field of view were determined by X-ray microanalysis by the values of the energies of the characteristic X-ray peaks of the chemical elements in the range Na-U.

Results of researches.

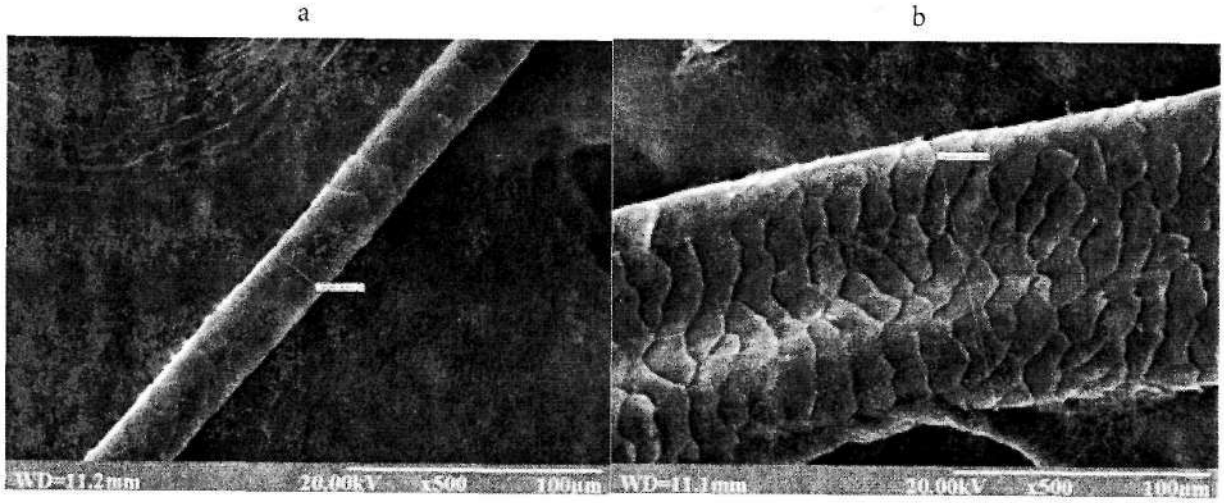

Fig. 1. Sheep's wool of Hissar breed:
a - downy hair (d = 26,4μm), b - guard hair (d = 110,2 μm).

The sheep's wool of the Hissar breed has composition and structure features (Fig. 1). It consists of downy and guard hair. Guard hair diameter is 110.2 microns, which is in 4.17 times larger than the downy (about 26.4 microns). Downy hair has a cylindrical shape, and the guard – flat one. The scales on the downy hair surface are approximately the same size, with sharpened and even edges and tightly adhere to the wool surface. The scales on the guard hair surface have different shape, almost the same size, with sharp edges and even edges and loosely adhere to the hair surface.

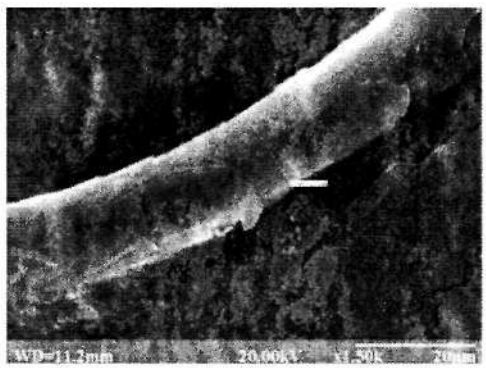

Fig. 2. Sheep's wool of Precos breed (d = 15,2μm).

Unlike the sheep's wool of the Hissar breed, the sheep's wool of Precos breed, is homogeneous and thin – 15.2 μm (Fig. 2). The scales are almost the same size, have sharpened edges with bushes and do not adhere tightly to the wool surface.

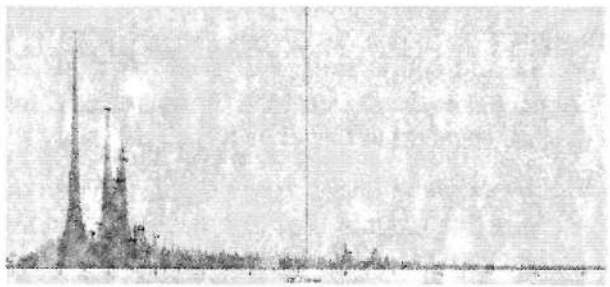

Fig. 3. Spectrogram of sheep's wool of Hissar breed and results of microanalysis.

As a result of the research, it was found that the following mineral substances – Sulfur, Potassium and Calcium – are determined in the keratin of the wool fiber (Fig. 3). The amount of Silver used to cover the samples was neglected in the calculations. The Sulfur content appeared to be the highest one among the studied elements (Table 1), since it is a member of the main sulfur-containing amino acids of wool – cystine, cysteine and methionine.

Table 1

Elemental composition of sheep's wool in conditionof insufficient mineral nutrition (M±m, %).

Element	Precos breed	Gissar breed
S	4,35±0,06	3,55±0,09
K	0,02±0,001	0,81±0,12
Ca	0,43±0,002	0,83±0,12

p≥0,05

In the wool fiber, obtained from sheep of Precos breed, the content of the Sulfur varied within the range of 2.53-5.56 % and was in 1.23 times ($p \geq 0.05$) higher than that of sheep's wool of Hissar breed (2.44-4.83 %). Such indicators are related to that fact that [13] the higher content of the Sulfur in the sheep of thin-fleece breed (Precos) increases its durability and gives it the best spinning properties.

Instead, in the sheep's wolf of the Hissar breed Potassium content was in 40 times higher –on the level of 0.42-1.22 % – compared to the sheep's wool of the Precos breed, which we associate with the less elasticity of the wool fibers of rough-woolsheep breeds (Hissar breed).

The Calcium content in the sheep's wool of Hissar breed was 0.40-1.30 %. In the sheep's wool of Precos breed, this figure varied within the range of 0.35-0.58 %, which is in 1.93 times ($p \geq 0.05$) less than that of Hissar breed sheep. The higher Calcium content in the wool fiber of rough-wool sheep breeds (Hissar breed) is due to their greater fragility, which causes bad spinning properties.

Conclusions. According to the results of the research it has been established that the elemental wool composition of the sheep Precos and Hissar breeds, in conditions of insufficient mineral nutrition, remains on average within the normal range, which may be due to the ability of the sheep's body to use the mineral resources of the body. But it should be noted that the imbalance of the mineral nutrition has negatively affected the density of the adherence of scales to the surface of the hair, which gives the hair more brittle and «shaggy» look and worsens the technical properties of wool as a whole.

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