DOI 10.7251/VETJEN1902290M **UDK 637.62:636.32/.38**

Original scientific paper

MICROSCOPIC EXAMINATION OF WOOL FIBERS IN PRAMENKA FOR THE QUALITY CLASSIFICATION OF RAW WOOL

Nadžida MLAĆO[1], Amela KATICA[1], Velija KATICA[2], Almira SOFTIĆ[2], Vedad ŠAKIĆ[2], Velida ĆUTAHIJA[1]*, Pamela BEJDIĆ[1], Nedžad HADŽIOMEROVIĆ[1], Jasmin KATICA[3]

[1] Veterinary Faculty University of Sarajevo, Department of Anatomy, Histology and Embryology, Zmaja od Bosne 90, 71000 Sarajevo, Bosnia and Herzegovina
[2]Veterinary Faculty, University of Sarajevo, Department of Animal Science, Zmaja od Bosne 90, 71000 Sarajevo, Bosnia and Herzegovina
[3]Veterinary Faculty, University of Sarajevo, Department of Food and Nutrition of Domestic Animals, Zmaja od Bosne 90, 7100 Sarajevo, Bosnia and Herzegovina
*Corresponding author: nadzida.mlaco@yahoo.com

Abstract: In Bosnia and Herzegovina, Montenegro, as well as in most Balkan countries, wool is a major environmental problem. After sheep shearing, farmers usually leave the wool at the shear sites, providing poorly degradable organic waste. The purchase price of such untreated wool is as low as its quality. By this research, we have tried to draw attention, from another aspect, to the quality of wool fibers of certain parts of the body, which is ultimately very important in the textile industry and in the selection of wool for further processing. The cuticle is made from cornfied cells, flakes, located on the surface of wool fibers. One of the significant roles of the cuticle is the protective. Namely, the cuticle protects the wool fibers from various external factors, whether mechanical or physic-chemical (such as ammonia evaporation in poorly maintained facilities, etc.), which can damage the fleece and thus make it less quality. We have found some differences in the flakes position and shape in the wool fibers we investigated, depending on part of the body from which they were sampled. However, by microscopic analyses of samples taken from the root of the tail, we have found that the flakes were much smaller and finer in structure than the arrangement and appearance of the cornified flakes from the rump. In this study, we have compared the appearance and arrangement of flakes of cuticle, which is very important in assessing the quality of wool and its further use as a raw material.

Key words: Dubska and Pivska pramenka, industry, wool fiber, cuticle

INTRODUCTION

In the last twenty years, production of wool has almost no economic significance in Bosnia and Herzegovina, Montenegro and most Balkan countries. Wool is by-product, which has been causing problems lately, since it is almost imossible to sell low quality wool which than becomes environmental problem.

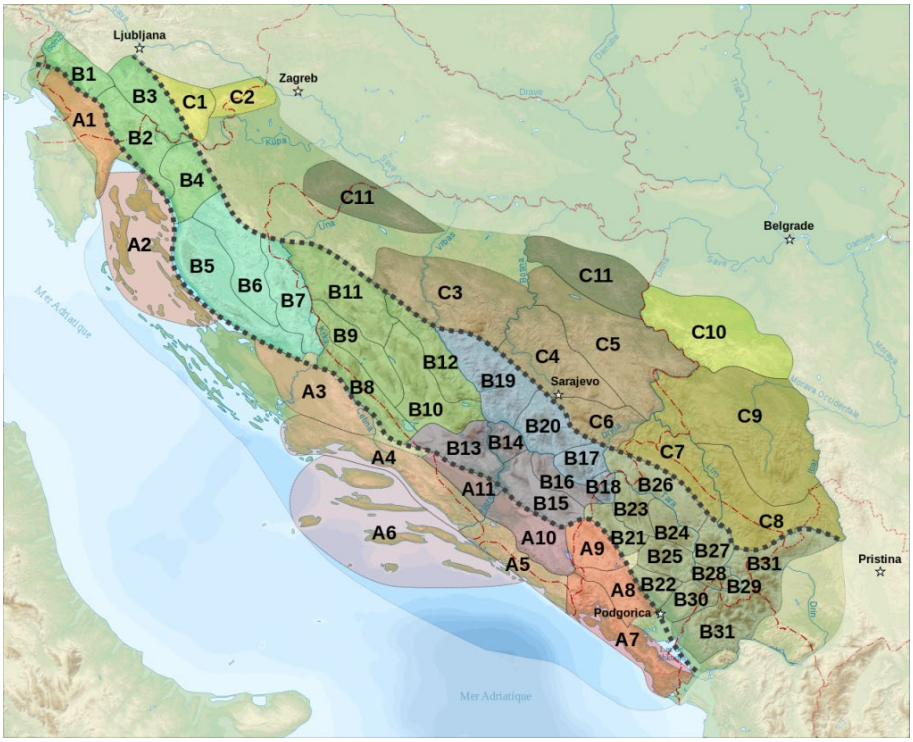
Most represented sheep breeds in Bosnia and Herzegovina and Montenegro are autochthoneus, mainly characterized by wool low production per animal. Wool is of poor and uneven quality, with poor elasticity and undulation that have no guaranteed prices or known and safe buyer. Furthermore, sheep are not prepared for shearing, while the sorting of wool by quality is not carried out. Due to poor and uneven quality, most of produced wool cannot be considered suitable for the textile industry, but can be considered as adequate for other productions (blankets, mattresses, carpets, pillows, souvenirs, insulation materials, etc.).

According to WTO data, given the diameter of the wool fibers, as well as their quality, wool is a widely used raw material, primarily in the textile, construction, agriculture, as fertilizer or material that inhibits weed growth and, in addition, retains moisture. The environmental insulation materials industry, both thermal and acoustic, use wool fibers in production of new heat resistant materials that have antistatic and anti-allergic properties.

The wool fibers in the sheep fleece represent quantitative but above all qualitative parameters in the production of wool and in determining its usability in further processing. The fibers are not of the same quality, both in chemical composition and technical characteristics, which largely depends on breed or strain type, breeding method, zoohygienic conditions, diet, climatic conditions, hormonal status, etc. (Savić et al., 2007, Savić et al., 2014). The aim of our study is to show to breeders the importance of climatic factors and age on the wool fibers quality of autochthonous Pramenka (Dubska and Pivska strains), which is likely to have an impact on the total production and usability of raw wool as a basic raw material in the demanding textile industry. With even more subtle microscopic investigations of the wool fibers of domestic sheep breeds, we have tried to draw attention to its different usability, from the textile industry (production of carpets, clothing, etc) to use in construction, as a thermal insulator.

MATERIAL AND METHODS

Samples for microscopic examinations of sheep wool fibers, both Dubska and Pivska pramenka, were taken from two different locations: Vlašić mountain - Bosnia and Herzegovina and Pivska mountain (Dubljevići and Kovači Orah) - Montenegro. Dinara Highlands have three zones: Littoral, the Central and the North-East, with several geographic areas within each. Pivska sheep are breeding in the Central region of Dinara Highlands, in the geographical areas of Durmitor and Sinjajevina (B23, 24). Dubska sheep are breeding in the North-East region of the Dinara Highlands in the geographic area of Vlašić (C3). (Picture 1).



Picture 1. Area of Pramenka breeding: Dinara Highlands and geographic areas of Pivska and Dubska pramenka breeding (*Source*: https://upload.wikimedia.org/wikipedia/commons/thumb/2/24/Dinaric_Alps_subdivisions fr.svg/1265px-Dinaric_Alps_subdivisions-fr.svg.png)

A total of 40 wool fibers were sampled (per twenty from each locality), 10 in the spring and 10 in the fall from each locality. The fleece for microscopic analyses was taken from different parts of the body: the root of the tail, the shoulder and the rump by cutting of the strands along the skin. Such samples, from both localities and at different time periods (spring and autumn) were placed in labeled plastic bags until microscopic analysis. Prior to microscopic analyses, the samples were washed with neutral soup to remove impurities, and then washed with water

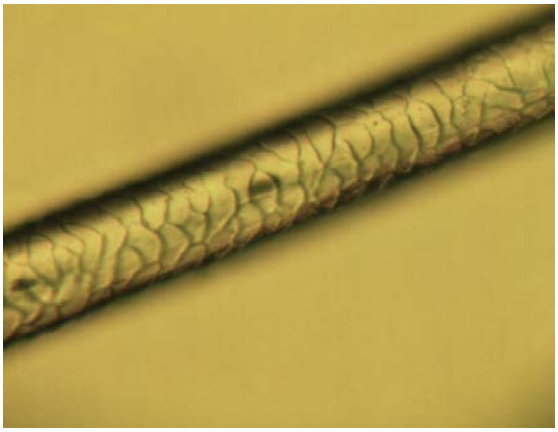
and again with distilled water. For microscopic analyses and transparency, the samples were placed in hydrogen peroxide (H_2O_2) for 24 hours and subsequently in xylolum for 48 hours. The samples were then washed again in distilled water, after which they were allowed to dry. The prepared sampled were placed on glass slides, embedded in glycerol drops, and then microscopically analyzed.

Microscopic analyses of the cuticle of the root of the tail, shoulders and rumps from different localities were performed with a binocular light microscope (Motic 120M), zoomed 200 and 400 times.

RESULTS AND DISCUSSION

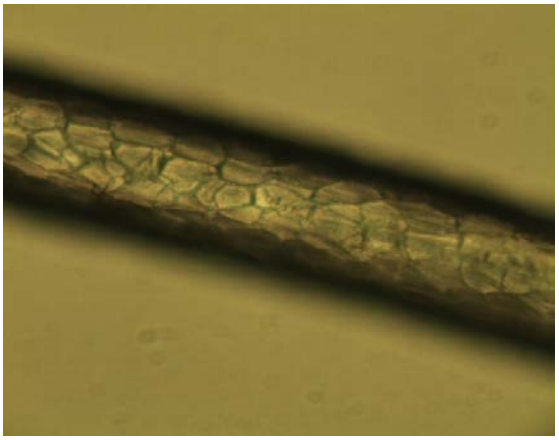
The wool fiber consists of three parts: the head (bulbus), the root and the tree (straight fibers, part of the fibers under the skin). The tree is the longest part of the fiber and forms the wool blanket of the sheep (Katica et al., 2010, Katica et al. 2015). Wool fiber is a cornified structure made up of two, sometimes three layers. Those are the epidermis (*cuticula, epidermis*), cortex or middle layer (*substratia corticalis*), medulla (*substratia medullaris*).

The cuticle is made of cornified cells, flakes, located on the surface of wool fibers. One of the most important roles of cuticle is the protective (Kozarić, 1997). Namely, the cuticle protects the wool fiber from various external insults, whether mechanical, physicochemical (such as ammonia evaporation in poorly maintained facilities, etc.), which can damage the fleece and make it less quality. We have found some differences in the flakes position and shape on the examined wool fibers samples, depending on the part of the body from which they were sampled, regardless of whether they were from Dubska or Pivska pramenka. Thus, on rumps (Picture 2), the cornified flakes stick over one another in continuity. They are irregular in shape and reminds on roof *tiles*. Usually, this cuticle appearance is associated with rough wool fibers. In contrast to this, on the samples taken from the rumps of Dubska and Pivska pramenka, it was expected that an even rougher structure in the cornified flakes arrangement would be at the root of the tail. However, by microscopic analyses of samples taken from the root of the tail, we found that the flakes are much smaller in size, finer in structure (Picture 3) compared to the arrangement and appearance of the cornified flakes on the rumps. On the edges of the fleece taken from the root of the tail, the funnel appearance of the cornified flakes lined circularly are seen (Picture 5). That is a feature of finer fleece with better quality. Samples of fleece taken from the shoulder indicate the so-called transitional cuticle shape (Picture 4). The cornified flakes are quite large, polygonal, and with distinct edges of the flakes that clearly bland into one another.

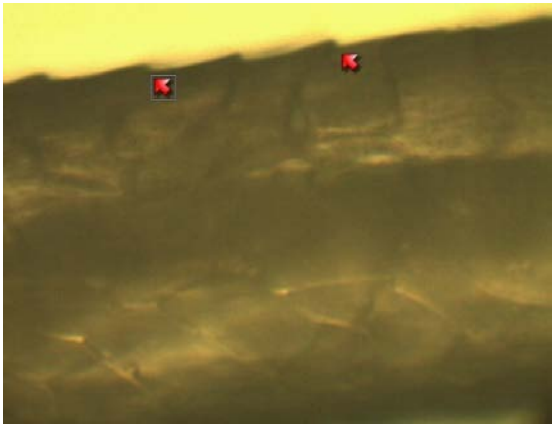


Picture 2. Native preparation; x 400; rumps

Picture 3. Native preparation; x 400; root of the tail



Picture 4. Native preparation; x 400; shoulder



Picture 5. Native preparation; immersion; flakes arrangement; root of the tail

Wool is the skin product and is a set of wool fibers with specific structure and physical properties that make it suitable for spinning (Mitić, 1984). The basic unit of wool is the wool fiber, i.e. the part above the skin surface that is economically used for the textile production, etc. All fiber are not equal in chemical composition, histological structure, or technological characteristics (Mioč et al., 2006). Wool fiber grows from the papillae located in the follicle. Fiber grow begins at the end of the second or at the beginning of the third month of intrauterine lamb development. The fibers comes out of the skin individually or in groups. The individual fibers connect into Y bundles, strands and fleece. After the first shear, the wool fibers are no longer pointed (Vegara, 1991).

Through a comprehensive study of Dubska and Pivska pramenka fleece, sampled from different localities, ambient conditions and seasons, we tried to establish the quantitative, morphological-histological and qualitative features of fleece originated from these two strains.

Studies of the cuticle of the wool fibers have shown differences in the arrangement, shape and attachment of the flakes to one another, as well as their continuity from different parts of the body.

The cuticle of the Dubska and Pivska pramenka generally showed a softer structure in the spring than in the fall. In particular, the cuticle of the root of the tail was of uniform structure in samples taken from both localities in the both periods. Our results will help the breeders, as they will give them some guidance for sheep shearing which must include preparation in order to improve the fleece quality. The research is of particular interest to the textile industry, since the obtained results will enable classification of wool fibers. The roughest fleece can be used as eco-friendly construction material because of the extremely high values of the thickness of the wool fibers from individual body parts. Nowadays sheep wool should not be “environmental problem” but, on the contrary, valuable organic raw material, which will find its application on a wide market.

CONCLUSIONS

The appearance of the cuticle, the outer, protective sheath of wool fibers, varied depending on the region of the body in both Dubska and Pivska pramenka. The cornified flakes on the rumps of the both strains reminded on the roof *tiles* because they were correctly stacked over one another, which is a feature of rough wool fibers. However, the cuticle of the root of the tail was slightly finer in structure, the cornified flakes were smaller in size than those sampled from rumps, and ended at the apex with a funnel. On the shoulder, the so-called transitional cuticle shape was dominant, which was characterized by prominent, large and polygonal cornified flakes that were noticeable, large and polygonal with prominent edges that join together.

Microscopic examinations of the wool fiber cuticle have revealed differences in the microstructure and appearance of cornified flakes. In both strains, the cuticle of the root of the tail was unexpectedly finer in structure than the cuticle of the rumps or shoulders. The cornified flakes of the cuticle on the tail are smaller in size and are correctly folded over each other in the form of the funnel. The cuticle of the wool fibers on the rumps showed a rougher structure, while the transitional form was represented by the cuticle of the shoulders in both the Dubska and Pivska pramenka.

Based on the obtained results, we would like to draw attention to the fact that as early as during sheep shearing, breeders can initially sort out the wool, thus directing the raw material toward further production, purposefully.

REFERENCES

1. Katica A., Mlaćo N., Hasanbašić D., Hamzić E. (2010): *Osnove veterinarske histologije*. Univerzitet u Sarajevu, Veterinarski fakultet, Sarajevo.
2. Katica A., Mlaćo N., Šakić V., Šatrović E., Kovčić I. (2015): *Koža i derivati kože životinja*. Univerzitet u Sarajevu, Veterinarski fakultet, Sarajevo.
3. Kozarić Zvonimir (1997): *Veterinarska histologija*. Veterinarska izdanja, Naklada Karolina, Zagreb.
4. Mioč B., Sušić V., Pavić V., Barać Z., Prpić Z. (2006): *Priprema ovaca za strižu, striža i postupci sa vunom do transporta*. Stočarstvo, UDK 636.083.45, (129−141); Zagreb.
5. Mitić A.N. (1984): *Ovčarstvo*. Zavod za udžbenike i nastavna sredstva, Beograd.
6. Savić M., Dimitrijević V., Trailović R., Vegara M., Dimitrijević B., Bečkei Ž., Petrujkić B., Cojkić A. (2014): *Selekcijski kriterijumi u organskom stočarstvu*. Veterinarski glasnik 68 (5−6), Beograd.
7. Savić M., Jovanović S., Vegara M. (2007): *Stočarstvo*. Univerzitet u Beogradu, Norwegian University of Life Sciences, 1−304, Beograd.
8. Vegara M. (1991): *Razvoj vunskih folikula pramenke u dobi od šest do 26 mjeseci*. Doc. diss., Univerzitet u Sarajevu, Sarajevo.

Article received: 08.10.2019.
Article accepted: 01.12.2019.