Innovative: International Multi-disciplinary Journal of Applied Technology
(ISSN 2995-486X) VOLUME 03 ISSUE 12, 2025

ANALYSIS OF LOCAL WOOL PRODUCTION STATUS AND MAIN PHYSICAL AND MECHANICAL CHARACTERISTICS OF LOCAL WOOL

Nosirov Muxammadali Ismoiljon o‘g‘li
Fergana State Technical University
m.i.nosirov@ferpi.uz

Abstract:

The increasing need for natural textile fibers has reignited interest in wool production in the Republic of Uzbekistan, where today, Karakul, Jaidari, Hisar and Edilbay sheep are the main sources of raw wool. These breeds and their origin and distribution have been well documented, though there are few data on the physico-mechanical properties of their fibre effective factors including the environmental and processing factors to wool quality. This work fills this gap by investigating local wool post primary processing with respect to structure, dimensions, contaminant levels and technological performance. In spring and autumn, wool samples were taken from Karakul and Jaidari sheep and investigated under controlled conditions of shearing, moisture, drying and sorting. Results reveal significant differences of plant residues, mineral impurities and oil-sweat among breeds and over seasons. They showed that the total waste in spring wool was about 19–20%, with higher levels of mineral impurities in Jaidari wool (coarser structure of wool) and higher content of plant residues in Karakul wool (a larger content of fine tivit fibers). Contamination was generally lower during autumn shearing. The implication is that wool cleanness and yield are dramatically influenced by breed characteristics, feeding conditions and the timing of shearing. Findings emphasize the need to adopt optimized shearing schedules; finer sorting and combing technologies; and more efficient breeding management practices to maximize the clean, high-quality wool yield for textiles in Uzbekistan.

Keywords: Endemic Sheep, Karakol, Twisting, Dead Fiber, Dead Fiber, Intermediate Fiber, Pesiga, Fuzz, Shearing, Plant Residues, Mineral Residues

1. Introduction

Uzbekistan with having no exception has almost the same trend globaly as well because the demand of textile raw materials are persistently growing around the world. With the increase in demand for textile, manufacturers depend largely on artificial fibers to meet output capacity [1]. Nevertheless, the anxieties regarding the adverse hygienic and physio-pathological impact of synthetic fibers on human body have intensified the interest in nature-based substitutes. Wool, one of the most sought-after commodity natural fibers, is known for its unique properties of highly low weight, high strength, moisture retention, high insulation, and high dyeability that makes wool a key element of both traditional and modern textiles [2].

Sheep breeding has been developed for a long time in Uzbekistan and the country is still one of the major countries of wool. The wool obtained mostly from sheep breeds Karakul, Jaidari, Hisar and Edilbay amounted to over 20,600 tons in 2022, according to the State Statistics Committee. Wool production, fiber type, and quality vary widely between these breeds [3]. Karakul and Jaidari are the only two breeds that together account for more than 87 percent of the national flock and, therefore, a critical link in the domestic textile supply chain. The existing literature has mainly described the origin, breeding history, and geographic spread of these breeds; little has been published on their comparative fibre characteristics and suitability for various textile processes.

Wool fibers being non-uniform, are classified in the scientific literature as down, intermediate, coarse hair, dead, and special covering fibers [4]. These types of fibers have specific factors like morphology, mechanical strength, diameter, crimp, and dyeing properties; which directly influence the yarn quality, spinning performance, and end-use applications of fibers, as discussed in the article. Although there are references to fiber classification, structural differences, and technological ramifications in international investigations, little empirical investigation relative to the physico-mechanical properties of wool of sheep (major breeds in Uzbekistan) has been done. However, this knowledge gap does not prevent the optimization of local wool processing technologies and the development of high value textiles [5].

The main goal of this study is to investigate the thickness, structure of the fiber, and functional characteristics of wool products created in Uzbekistan after the first, physical procedure. The research systematically compares wool groups of soft, semi-soft, semi-coarse and coarse wool groups using standardized laboratory methods for wool separation, washing, drying and fiber measurement. The analysis focuses on technology characteristics like diameter, length, tensile properties and other undesirable types like dead or dry hair [6]. These results should clarify their contribution to wool quality and industrial property differences among breeds and fiber types.

Fibers with finer diameter and greater crimp, especially the tivit (soft undercoat), are predicted to spin and create higher value textiles. On the contrary, wool with a great amount of dead or raised fibers is anticipated to have a low potential for dyeing and mechanical strength [7]. Spotting these patterns, the study provides useful information for breeders, processors and textile manufacturers. These outcomes could inform selective breeding, increase the accuracy of raw wool sorting, and facilitate the transition of Uzbekistan's natural-fiber products to be higher quality and internationally competitive.

2. Methodology

The research in this paper used a systematic method to assess the determinants of wool quality in Uzbekistan. The first step centered on the identification of potential breeds producing quality wool and an evaluation of their feeding and nutritional status, since wool quality is closely related to the type of the diet and the general health of animals [8]. The shearing practices were that soft and semi-soft wool was taken once a year, while coarse and semi-coarse wool was subject to twice yearly shearing. We took into consideration seasonal shearing periods in Uzbekistan in spring (April) and in autumn (September to October) and factors related to weather conditions.

Wool samples were taken at various times during shearing to ascertain the effects of time delays between fleeces on the level of impurity, oil build-up and overall cleanliness of fibers. Standard measurement tools were used to assess the most important quality indicators of each sample, including fiber fineness and staple length [9]. Crimping of the wool blanket for acceptance-level assessment was performed manually and a drop test was performed to observe its physical behavior and integrity. During the processing, wool with similar fibers had a moisture content of between 9 and 17 percent and between 7 and 15 percent for mixed fiber types. Drying processes were performed at varying temperatures of 90–105 °C. Skip tried to sort wool types based on wool batches to avoid mixing and combing out of coarse fibers, lint, and plant impurities, thereby improving the efficiency of cleaning [10]. The last step was industrial wool classing to sorts that separates types of wool ranging from low grade mixed coarse wool into higher-grade fine wool. All procedures were carried out in compliance with national processing protocols and the standard procedures used at wool plants.

3. Results and Discussion

The following data on the results of the research conducted to determine the number of plant residues in the wool sheared from sheep is: 0.5-22% and 4-30% and 2-43%, respectively. That is the amount of mineral things content material relies upon upon on the fats-sweat matters that they exude from the pores and skin layer of the sheep. Particles of dust and dirt are mixed with the wool and get stuck on the wool surface more firmly [11]. This is separated from the raw material wool by washing and combing. In the wool of sheep, this kind of waste lies in the range of 4–43%. A sparse fibrous structure (3-7 fibers per 1·10-6m^2 surface) of coarse and semi-coarse wool is one of the primary reasons for its low amounts of waste.

Oily-watery susbtances are outmixed and accumulate in the fleece and in particular in the fibers [12]. It is secreted from sebaceous gland and sweat glands.

Washing removes most of the percentage of waste in wool. Washing temperature (35-580C), detergents dispersion, module and processing time (3-20 minutes), parts movements of the unit.

The above waste percentage differs from the type and percentage of waste in our land wool fiber in other breeds of low climatic condition sheep [13]. The operating modes of wool pre-cleaning and combing enterprises are chosen depending on the fraction of the waste and vegetable impurities of wool.

Wool harvested from sheep depends on the type of breeders. As the character of the wool is very affected by the conditions where the sheep are kept, the feed they are given and so on [14]. Wool fibers naturally contain fats that must be stored considering different climatic conditions. It is necessary to effectively use the raw wool received from different breeds of sheep raised in Uzbekistan in the production of cloths in textile industry [15].

The wool is combed before washing, in this procedure, within the fibers contained in a large quantity of vegetable residues is mixed, thus complicating the process. These include such plants as thistles and the thistleheads and some parts of smooth-stemmed plants. When dry, the wool adsorbs rapidly unto the fiber, its mass is 28.10^{-6} - 40.10^{-6} kg. Equals 8–10 times the fiber image source – Call thorn runs over 2–3 times as high fiber by weight, its outer layer will partly decrumble and mix into raw materials on external mechanical-loading [16]. These smooth-stemmed plants may not directly disrupt wool fiber, but their proliferation makes it harder to handle the wool.

The process of sorting wool raw materials is important, and it is necessary to divide each of the presented batches into types. It is necessary not to allow mixing of different types of wool. The organization of the initial processing of wool on the basis of regulations is related to the preparation of high-quality wool fiber [17]. The correct organization of the process of combing consists in separating the wool raw materials into pieces, as well as separating the coarse fibers and lint. Thus, the cleaning process should allow to increase the efficiency of cleaning from existing dirt and plant impurities in the wool.

Separation of wool into varieties is called classification. Sorting (sorting) of wool is done on farms. According to the industry standard, the sorting process is carried out in wool processing plants [18]. Currently, industrial classification is used for wool sorting. This classification covers all types of wool sheared in the spring, from the low grades of mixed coarse wool to the high grades of fine wool (Table 1).

The classification is complex according to the method of construction, that is, it takes into account all the main signs and properties of wool, not just one of them, in order to comprehensively determine the technical properties of wool. The industrial classification is based on the thinness of the wool. According to this classification, the wool is divided into 13 classes according to the thinness (Table 2).

Table 1. Thinness index based on industrial classification of wool

Class	Average thinness in micrometers (μm)	Class	Average thinness in micrometers (μm)
80	14.5-18.0	48	31.1-34.0
70	18.1-20.5	46	34.1-37.0
64	20.6-23.0	44	37.1-40.0
60	23.1-25.0	42	40.1-43.0
58	25.1-27.0	35	43.1-55.0
56	27.1-29.0	32	55.1-67.0
50	29.1-31.0		

Table 2. Wool fiber is divided into 5 types. The description of wool according to the thickness of the fiber is as follows.

Sorts	High	1	2	3	4
Mean squared deviation	8,8-10,1 11,4-19,5	15,2-24,7	16,9-56,4	25,3-56,4	30,3-57,7
according to the average thickness	22-26 33 up to	33,1-37	37,1-43	43,1-49	49 and more

In the research, the wool of sheep raised in the conditions of the house and pasture in two seasons was studied. Karakol and Jaidari sheep wool were taken as samples. It was studied by separating the hard-to-separate, smooth-stemmed, and other parts of the plant into groups that are easy to separate. The results of the study are presented in the table.

Table 3. Amount of plant residues in wool.

A breed of sheep	On the pasture		At home		The output of fiber	
	Easy to detach	Difficult to separate	Easy to detach	Difficult to separate	Easy to detach	Difficult to separate
			Spring shearing, %			
Karakol	3,4	2,8	0,3	3,1	96,3	94,1
Endemic	3,1	2,3	0,2	2,7	96,7	95
			Autumn shearing, %			
Karakol	2,3	4,6	-	1,6	97,7	93,8
Endemic	1,9	2,6	-	1,4	98,1	96

As can be seen from the above table, the percentage of hard-to-separate plant residues in the spring sheared wool of pasture-fed sheep is relatively lower than that of home-fed sheep. It was found out that the autumn cuttings have fewer residues of this type compared to the spring cuttings. Degradable plant residues are present in the wool in both seasons, and are relatively less in domestic sheep. Both types of plant remains are less in wool sheared from Jaidari sheep compared to Karakol sheep [19]. Due to the large number of coarse fibers in the wool of the Jaidari breed, plant remains are covered in a small amount (Table 3). The abundance of tivit fibers in the composition of Karakol sheep wool, in turn, causes a lot of plant remains to stick to it. In addition, the amount of plant residues in the composition of sheep wool depends on agrotechnics of sheep feeding, climatic conditions, type of feed and other factors.

After the wool fiber is sheared from the sheep, it contains mineral and fat-sweat substances in addition to plant residues. They are characterized in different ways according to the degree of settling on the wool fiber. Samples were taken according to the given methodical instructions for determining waste in raw materials. The researches were carried out on spring shearing raw materials of Karakol and Jaidari sheep bred on the livestock farm. The results are presented in Table 4.

Table 4. The amount of waste in the wool of spring shear

Types of waste	Share of waste by sheep breeds, %	
	Karakul	**Endemic**
Waste of the forties	0,65±0,020	1,1±0,030
Plant remains	3,4±0,13	3,1±0,92
Mineral waste	4,3±0,197	4,8±0,210
Oil-sweat substances	11,0±0,681	11,3±0,768
Total waste	19,35	20,3
Amount of pure wool	80,65	79,7

The results show that spring wool fibers contain 0.65-1.1% of shearing waste, 3.1-3.4% of plant residues, 4.3-4.8% of minerals and oil. -ter is 11-11.3%.

The wool of Karakol and Jaidari sheep contains about 19-20% waste, and mineral waste is more in the wool of Jaidari sheep. For this reason, the wool of Jaidari sheep is coarser and has more fibers per 1 mm2 compared to Karakol sheep [20]. Coarse wool slices are somewhat sparse compared to fine wool, which makes it easier to add various objects (cotton, thread, film, paper, etc.) from the external environment to the raw material. Therefore, the impurity in Karakol and Jaidari sheep wool is around 0.65-1.1%.

4. Conclusion

In order to increase the yield of relatively clean wool suitable for use in the textile industry, it is advisable for our cattle breeders to feed their sheep in pastures with low elasticity. When rearing at home, cleaning the barns from time to time, ensuring compliance with all agrotechnical rules during wool shearing is the reason for preparing high-quality wool. It is also recommended to store the sheared wool in a clean, tidy, dry place, protected from moisture and sunlight.

The analysis of existing researches on wool processing techniques and technology shows that the machines and equipment in the technological system are complex, require a lot of power, and are not very efficient. In particular, the technology and equipment for cleaning wool from plant impurities do not meet the requirements. It should be noted that most of the studies are focused on identifying technological regimes. In-depth scientific research on the creation of new working bodies and machines and the justification of their parameters in order to increase the resource and efficiency of wool cleaning machines from plant impurities has hardly been carried out. For this, it is important to analyze wool's specific properties and physical-mechanical characteristics in depth.

References

[1] Kuprashevich V. I., *General Technology of Wool Production*. Moscow: Light and Food Industry, 1981, 136 p.

[2] Korabelnikov R. V. and Khojimatov R. S., "Method for Cleaning Wool from Foreign Impurities," Patent DP No. 2356, Mar. 12, 1994.

[3] Yusupov S. A., *Improving the Technology of Processing Local Wool Fibers*. PhD Dissertation, Tashkent Institute of Textile and Light Industry, Tashkent, 2004.

[4] Korabelnikov O. M., "Characteristics of Karakul Wool and Its Rational Use," *Textile Industry*, no. 3, pp. 37–38, 1984.

[5] Alimova Kh. A., Qodirov Sh. A., and Yusupov S. A., "Possibilities of Producing Local Wool Fibers in Uzbekistan," *Silk*, 2000, no. 1.

[6] Gorbunova L. S., Rogachev N. V., Vasiliev L. G., and Koldoev V. M., *Primary Processing of Wool*. Moscow: Light and Food Industry, 1981, 352 p.

[7] Qayumov J. A., Ergashev J. S., Khojimatov R. S., and Dadaboyev F. M., Patent IAP 06781, "Device for Opening and Shaking Unwashed Wool."

[8] Rogachev N. V. and Fedorov V. A., *Primary Processing of Wool*. Moscow: Light Industry, 1967.

[9] Gusev V. E., *Raw Materials for Woolen and Nonwoven Products and Primary Processing of Wool*. Moscow: Light Industry, 1977.

[10] Nikolaev A. I., *Wool Commodity Science*. Tashkent: O'qituvchi Publishing, 1967.

[11] Korabelnikov R. V., *Mechanics of Ginning Fine-Fiber Cotton*. Tashkent: Fan Publishing, 1990.

[12] Kayumov J., Nazarova M., Obilov B., and Dadaboyev F., "Analysis of the Composition and Physical-Mechanical Properties of Raw Materials for Thermal Insulation Fabrics," *Engineering*, 2021.

[13] Dadaboyev F., Qayumov J., and Khojimatov R., "Study and Improvement of Designs of Preliminary Wool Cleaning Machines," in *Proceedings of the International Conference of NamMTI*, 2021.

[14] *Vegetable Matter in Australian Wool*, Australian Wool Testing Authority Ltd., Victoria, 1986.

[15] Korabelnikov R. V., Khojimatov R. S., Rakhmatullaev M. U., Ghoibnazarov E., and Khojiev A. A., "Method for Cleaning Wool from Foreign Impurities," Patent DP No. 2356, 1994.

[16] Dadaboyev F., Ergashev J., Qayumov J., and Ergashev J., "Improving Technologies of Primary Wool Processing," in *Proceedings of NamMTI International Conference*, 2021.

[17] The Woolmark Company, "Wool Fibre Information." Available: https://www.woolmark.com/fibre/

[18] Wikiwand, "Uzbekistan." Available: https://www.wikiwand.com/uz/

[19] Qomus, "Wool Industry." Available: https://qomus.info/encyclopedia/cat-j/jun-sanoati-uz/

[20] DoctorWool, "Interesting Facts About Merino Wool." Available: https://doctorwool.com/statii/interesnyie-faktyi-o-shersti-merinosov