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Effects of Pigmentation on Some Physical and Mechanical Properties in Merino Wool Fibers

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Abstract – In this study, fiber fineness (µm), fiber strength (cN) and elongation (%) values of white and pigmented wool samples taken from female Merino sheeps between the ages of 0-2 years were compared. The results showed that both the fiber strength (cN) and elongation (%) values were increased in the presence of melanin pigment which is responsible for the fiber color and forming the cortex layer of the fibers causing higher micron values of fiber fineness. However, the difference between the diameters of pigmented and white fibers were statistically insignificant. On the other hand, pigmentation had a statistically significant effect on the strength and elongation properties of the black and white fibers. On the other hand, age parameter was not found to be statistically significant. In general, it can be said that wools from elder sheep are coarser and stronger, but they have lower elongation value.
Keywords – *Merino sheep, wool, pigmentation, fineness, strength*

I. Introduction

Despite the fact that Turkey takes place near the top in terms of wool production, an important part of the wool obtained from sheep are not suitable for worsted fabric production from the point of quality aspects. Although crossing the native breeds with Merino sheep started in 1928 in order to meet the requirements of fine and uniform wool fibers in Turkey, until today no success has been gained due to many factors [1]. Karacabey Merino sheep, were first obtained in Karacabey, Bursa by crossbreeding of German Merino ram and local Kıvırcık sheep breeds, The fleece of this crossbreed is finer and consists only one type of fiber. Fibers are dense-curled. The other parts apart from the upper part of the legs, bottom of the abdomen and the face part of the head are covered with fleece [2].

As generally known, wool fibers have more or less yellow color due to the yellow colored products which are generated by the degradation of some amino acids forming macromolecules. However, some of the wool fibers are gray, brown or black. These colors, which are not desirable, grow out of the pigments in the cortex layer [3]. In protein fibers melanin pigment exists. Melanin is a natural protein pigment, produced by specialized cells called melanocytes [4].

The most important characteristics of wool fibers are their fineness, strength and elongation ability. There are numerous studies in the literature on the physical properties of the sheep wool from Merino and other species. However, it is not common to find studies, which are related with the effects of pigmentation on the physical properties of the fibers in sheep wool. In our previous study, we examined the fineness, length, strength and elongation values of white and pigmented samples taken from common goat and cashmere goat [5]. In this study, the fineness, strength and elongation values of two different colored samples which one of them was white and the other was black taken from female Merino sheep within the age range of 0-2 years were analyzed comparatively.

II. Materials and Method

In this study, two different colored fiber samples taken from female Karacabey Merino sheep between the ages of 0-2 years were examined. The fiber fineness, fiber strength and elongation values of two different colored samples were analyzed comparatively. Measurements of fiber fineness were carried out with optical fiber diameter analyzer (OFDA 2000) according to IWTO (International Wool Textile Organization) 47 standard [6]. The fiber strength and elongation at break were measured based on ASTM D3822 standard test method for tensile properties of single textile fibers [7] by using single fiber tensile tester (Prowhite).

III. Results and Discussion

The fiber fineness, fiber strength and elongation values of two different fiber samples taken from Merino sheep were given in Table 1.

Table 1: Average values of some physical and mechanical properties of the fibers and statistical results

	Diameter (µm)		**Strength (cN)**		**Elongation (%)**	
	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s
0-1	26,80	0,63	5,68	1,97	25,42	20,79
1-2	27,40	0,52	6,95	2,44	18,58	10,72
Black	27,30	0,67	7,10	2,34	28,15	19,69
White	26,90	0,57	5,44	1,92	15,17	8,84
Two Tailed Distribution-p level						
0-1 vs. 1-2	0,03		0,08		0,21	

Black vs. White	0,16	0,02	0,01

As the results were presented in Table 1, pigmented fibers (in this study black fibers) had higher micron values (which means fibers are coarser). As is known, the colors that pigmented fibers have are derived from colored pigments in the cortical cells forming the cortex layer [3]. This also leads to coarser fibers. However, the difference between the diameters of pigmented and white fibers were statistically insignificant (p=0.16). On the other hand, it was found that the age had a statistically significant effect on fiber diameter variable.

Both strength (cN) and elongation (%) values were increased in case of colored fibers containing melanin pigment. The strength values given here are breaking strengths, and it is natural that the strength to be higher in pigmented fibers which are coarser. On the other hand, the structure that plays an important role on the strength-elasticity behavior of protein fibers is disulfide bridges between macromolecules. Cystine amino acids are the most important among the 22 types of alpha-amino acids forming wool keratin due to the formation of covalent bonds (disulfide bridges) between fiber macromolecules. The distribution within the macromolecule, the distribution within the fibers, and the amount in the various fibers could be different for cystine aminoacid. It is possible to determine the amount of cystine by determining the amount of S in the fibers. Because a very large part of the Sulphur belongs to the cystine monomer. The remaining few belongs to other building blocks such as cysteine, methionine, lanthionine and cysteine acid [8]. In the previous study carried out by Gürkan Ünal and Atav [5], it was determined that in goat species, pigmented fibers have higher Sulphur content (%) and the higher strength-elongation properties of pigmented fibers were attributed to this phenomenon. Pigmentation had a statistically significant effect on the strength and elongation properties of the black and white fibers (p=0.02 and p=0.01 respectively). On the other hand, age parameter was not found to be statistically significant. In general, it can be said that wools from elder sheep are coarser and stronger, but they have lower elongation value.

IV. CONCLUSION

Studies have shown that both strength (cN) and elongation (%) values were increased in the presence of melanin pigment which gives color to the cortical cells forming the cortex layer of the fibers, whereas the fibers have higher micron values. On the other hand, it is noteworthy that as the age of sheep increases, its fiber becomes coarser and stronger. But the elongation value decreases. But it has to be kept in mind that these results were based on only a small group of a sample. In order to get a big picture, the sample size should be increased.

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