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Research Article

Fleece Yield and Some Characteristics of Wool in Anatolian Merino Sheep

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ABSTRACT

In this study, greasy fleece yield and some wool characteristics and the effects of gender, age and live weight on these characteristics were investigated in 60 heads of Anatolian Merino sheep reared in Babayakup neighborhood of Polatlı District of Ankara. Least squares means of live weight before shearing, greasy fleece yield, fiber diameter, fiber length, breaking strength, fiber elasticity and clean fleece percentage were found to be 68±0.89 kg, 2.97±0.19 kg, 24.42±0.49 µm, 7.92±0.36 cm, 19.15±1.25 Cn/tex, 25.38±1.83 %, 48.16±2.17 %, respectively. The effects of gender ($p<0.001$) and age ($p<0.05$) on live weight before shearing, the effects of body weight group ($p<0.05$) on fiber diameter and the effects of gender ($p<0.05$) on fiber length were found to be significant. According to the findings, it was concluded that the fiber diameter value of the research material sheep is 60 sortiman, therefore it will be evaluated in the class of fine wool sheep and it is suitable for worsted fabric production.

1. Introduction

Merinoization studies were started for the first time in Turkey in 1841, and domestic Kıvırcık sheep and German Fleece-Meat Merino were crossbred in 1934 and merino conversion studies were carried out (Halıcı, 2009). Later, in the 1950s, as a result of crossbreeding of German fleece-meat merino (GFMM) and Akkaraman in Malya and Ulaş State breeding farms, a thin-long-tailed Anatolian Merino sheep with 75-80% Merino genotype was developed (Ertuğrul, 2012).

When the wool characteristics of Anatolian Merino sheep, which is a Merino crossbred, are examined, it is evaluated in the fabric industry by producing yarn from wool yarn or from wool-synthetic mixture due to the thin and moderately uniform nature of its fleeces.

Although the share of fleece in the product obtained from sheep has decreased today, wool yield and quality should be emphasized due to organic agriculture, protection and development of rural economy and significant changes in industrial production and consumer tendency in recent years. The healthier structure of natural fibers, and because animal fibers are 100 % biodegradable in nature, they are renewable. They have some properties that are not found in other animal and vegetable fibers such as coloration, curl, flexibility, felting, insulating, heat resistance, antimicrobial, dirt repellency, high comfort, and they are rare fiber that can meet many desired properties in technical applications (Dellal et al., 2010; Tüfekçi and Olfaz, 2014; Dellal et al., 2020).

In this study, some of the fleece yield and quality criteria of Anatolian Merino sheep were evaluated, up-to-date data on fleece were obtained, and it is aimed to contribute to the literature in a way that can guide breeding studies in this way, and to offer suggestions on improving the quality of wool by reviewing its suitability for fabric yarn production.

2. Materials and Methods

The animal material of the research consisted of 60 heads of Anatolian Merino sheep and their fleeces, which were raised in the Babayakup District of Ankara province, Polatlı county.

Anatolian Merino is a sheep with 75-80% GFMM genotype, which was developed as a result of cross-breeding the GFMM and the domestic sheep breed Akkaraman. Fleece-Meat is yield-oriented and generally spreads in the western parts of the Central Anatolia Region. They are generally white in color, have a large body, full thighs and meaty legs. The tail is lean and thin, and the fleece is of 60-64 sortiman quality.

Sheep were kept in barns under the conditions of peasant sheep management on days when the weather was not suitable in winter, and approximately one kg of concentrated feed and one kg of roughage were given

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per animal. They were grazed on the pasture under favorable weather conditions. Supplementary feeding was ensured at the return of pasture in the early spring and autumn periods. The sheep were kept in the pasture for about eight months and in the barn for four months, and stubble grazing was also done in the summer.

Shearing was done with a shearing machine at the end of May. During the shearing and the night before shearing, the animals were not fed and their live weights were determined by weighing with 100 g precision before shearing, and their ages were determined by looking at their teeth at the same time (as there were no records). Ethical approval was given by the Faculty of Veterinary Medicine ethical committee in Selcuk University (No:2021/133). The determined weight, age and gender were recorded at the same time and placed in a small nylon bag together with the fleece samples and kept under protection. As Ertuğrul (1996) reported, approximately 30 g of fleece samples were taken from the flank (rib) region of each animal. After shearing, the amount of fleece obtained by shearing from each animal was determined by weighing it with 10 g precision scale.

Analysis of physical properties such as Diameter (fiber/fiber diameter, µm), Strength (cN/tex), Elasticity (%), Clean fleece percentage (%) in fleece samples was performed at International Center for Livestock Research and Training General Directorate-the Department of Breeding and Genetics - Wool and Mohair Laboratory (Ankara) according to ASTM and IWTO standards. Fiber lenght was determined by taking the average lenght of 50 hairs randomly taken from each fleece sample. Each fiber (hair) was stretched from both ends and measured in mm, the average lengths were converted to cm.

Assuming that there is no significant interaction between the factors whose effects on wool yield characteristics were examined in statistical analysis, a computer package program developed by Harvey (1987) was used in the analysis of environmental factors. "Least Squares Variance Analysis " was used for fleece yield and properties, and the following mathematical model was used.

$Y_{ijkl} = \mu + a_i + b_j + c_k + e_{ijkl}$

Y_{ijkl} : *i.* age, *j.* the live weight group *k.* gender *l.* sheep's fleece yield and characteristics (greasy fleece yield, yield, diameter, length, elasticity and strength)

μ : overall mean,

$a_{i:\ i.}$ effect of sheep age, (i= ≤2, 3, 4, ≥5),

$b_{j:\ j.}$ effect of live weight [1.(35.00-55.50 kg), 2.(55.51-64.00 kg) and 3.(64.01-103.00 kg) group)],

$c_{k:}$ *k.* the effect of gender, k= 1, 2 (Erkek, Dişi),

$e_{ijkl:}$ random error.

The significance test of the differences between the groups was done with Duncan test (Düzgüneş et al., 1993).

3. Results and Discussion

In Babayakup District, the average live weight of 60 Anatolian Merino sheep in the hands of the breeder before shearing was found to be 68.54±0.895 kg. While the live weights of the sheep vary between 35 and 103 kg, the average live weight is 79.49±1.843 for males and 57.60±0.649 kg for females. The effects of gender ($p<0.001$) and age ($p<0.05$) on live weight before shearing were found to be significant. Four-year-old sheep had the highest body weight (71.53±13 kg), while the average body weight of one-aged sheep (65.30±1.91 kg) was the lowest. The means of the least squares of the greasy fleece yield, the thinness (fiber diameter), length (fiber length), strength, elasticity and clean fleece percentage properties of the fleece are given in Table 1.

As can be seen from Table 1, the mean of the least squares of the greasy fleece yield calculated in the herd is 2.972±0.199 kg. The 2.97 kg greasy fleece yield value obtained is similar to the value reported as 2.912 kg by Özsoy (1974) for the Merino sheep, and similar to the values reported as 2.84 and 2.87 kg by Dellal et al. (2000a) and Arık et al. (2002) for the Anatolian Merino. The greasy fleece weight is considerably higher than 2.398 kg reported by Tellioğlu (1975) for Merino, 2.7 and 2.4 kg reported by Koyuncu et al. (1996) for Kıvırcık and Türkgeldi sheep; higher than 1.91 and 2.42 kg reported by Tekin et al. (1999) for German Black-Headed and Hampshire Down sheep; and higher than 1.58 kg reported by Peşmen and Yardimci (2012) for the Menemen sheep, respectively. On the other hand, 3.7 and 3.5 kg reported by Yalçın et al. (1972) for Konya Merino yearling lamb and dams, 3.20 and 5.01 kg for German Meat Merino ewe and rams and 3.35 kg for Karacabey Merino reported by Akçapınar (1983), 3.35 kg reported by Oğan (1994) for Karacabey Merino, 3.2 kg reported by Koyuncu et al. (1996) for Merino sheep, 3.29 kg reported by Tekin et al. (1999) for Turkish Merino, 3.35 kg ve 3.79 kg reported by Ünal and Akçapınar (2001) for Central Anatolian Merino sheep and yearling lamb, 5.65 kg reported by Uzun (2008) for Karacabey Merino, 3.57 and 3.15 kg reported by Tuncer and Cengiz (2018) for Anatolian Merino and Ile de France x Anatolian Merino crossbred (F1) sheep are less than fleece yield value of all meat breeds x merino hybrid (F1) sheep studied by Şahan et al. (1995). Differences in greasy fleece yield value result from genetic and environmental factors.

The effect of gender, age and live weight group on greasy fleece yield was insignificant. In terms of greasy fleece yield, Özsoy (1974) reported the effect of age in Atatürk University Merino flock, Ünal and Akçapınar (2001) reported the effect of age in Central Anatolian Merino ewes sheep in yearling lambs, and Bağkesen and Koçak (2018) reported the effect of age on Ramlıç and Dağlıç sheep, significantly on the other hand, the effect of age was found to be insignificant by Yılmaz and Altın (2004) in Kıvırcık sheep and Dellal et al. (2000b) in various crossbreds. Şahan et al. (1995) found the effect of gender on meat breeds and Merino crossbred sheep (F1) significant; and Tekin et al. (1999) found the effect of age, gender and live weight on greasy fleece yield to be

significant in German Black-Headed meat sheep. The insignificant effect of age, gender and weight group in this study can be explained by the low variation due to the low number of sheep.

The diameter of the fibers and the uniformity are in the first place in determining the quality class of the fleece. The quality of the products made from quality yarn and quality fabric obtained from these yarns is directly related to the fineness of the fleece hair. In the study, the fineness value of fleece hair was determined as 24.423±0.495 µm. When this diameter is evaluated on the basis of the British Bradford system, the corresponding sortiman value is 60. In other words, the fleece of the sheep in the study is classified as thin fleece. The values of 24.1 µm reported by Koyuncu et al. (1996) for Türkgeldi sheep and 24.97 µm by Uzun (2008) for Karacabey Merino sheep are quite close to the values calculated in this study. On the other hand, this study fineness value is less than 25.77 µm reported by Tellioğlu (1975) for Merino sheep, 28.73 µm reported by Dellal et al. (2000a) for Anatolian Merino, 28.34 and 30.91 µm reported by Uzun (2008) and Peşmen and Yardimci (2018) for Menemen sheep, and again lower than 25.16 and 25.47 reported by Tuncer and Cengiz (2018) for Anatolian Merino and Ile de France x Anatolian Merino sheep. However, average diameter value of 24.423 µm calculated in this study is higher than fiber fineness averages of 22.3 and 22.4 µm reported by Yalçın et al. (1972) for Konya Merino female yearling lambs and dams, 23.19 µm reported by Özsoy (1974) for Merino sheep, 20.27 µm reported by Oğan (1994) for Karacabey Merino sheep, 20.4 µm reported by Koyuncu et al. (1996) for merino sheep, 21.32 µm reported by Tekin et al. (1999) for Turkish Merino, 22.19 and 22.37 µm reported by Ünal and Akçapınar (2001) for Central Anatolian merino sheep and yearling lambs, and again higher than 23.46 and 23.97 µm reported by Arık et al. (2003) for Anatolian Merino and Ile de France x Anatolian Merino crossbred sheep.

In this study, the effect of the live weight group, which was one of the factors whose effect on fleece diameter was examined, was found to be significant at $p<0.05$, while the effect of gender and age was insignificant. The finest fiber diameter average of 22.84 µm belongs to the 3rd age group (64.01-103.00 kg), and the highest fiber diameter average belongs to the 1st age group (35.00-55.50 kg) with 25.75 µm. Peşmen and Yardimci (2018) reported that the effect of age on the diameter was significant in Menemen sheep, while Tekin et al. (1999) reported that the effects of age, gender, and live weight were insignificant in Turkish Merino and German Black-Headed Meat sheep.

Fiber length affects draft, twist, yarn structure, smoothness and yarn production method in yarn manufacturing (Sönmez, 1963). In industry, the length of the curl is taken as a basis, which is an important factor when evaluated according to the way of use. In this study, the fiber length was calculated as 7.923±0.362 cm. The 7.45 cm length value reported by Ünal and Akçapınar (2001) for the Central Anatolian Merino sheep in Konya Livestock Research Institute is close to the value calculated in this study. It is lower than the values of 9.96 cm and 9.22 cm (Dellal et al., 2000a, Ünal and Akçapınar 2001) reported for Anatolian Merino and Central Anatolian Merino yearling lambs, and than 10.49 and 9.83 cm, respectively, determined by Uzun (2008) in Karacabey Merino and Menemen dams. It is higher than the mean lengths of 4.78 and 4.79 cm, respectively, reported by Arık et al. (2003) for Anatolian Merino and Ile de France x Anatolian Merino (F1).

In this study, the effect of gender on fiber length was found to be significant ($p<0.01$), while the effect of age and live weight group was found to be insignificant. Peşmen and Yardimci (2012) and Bağkesen and Koçak (2018) reported opposite results regarding the effect of age on length.

Strength and durability in fleece are expressed as grams of the weight that the hairs that make up the fleece can withstand until they break. Durability is one of the important quality indicators of fleece. Raw materials with high strength are preferred in the textile industry (Kaymakçı, 2016). In the study, the average strength value of Anatolian Merino sheep was 19.153±1.252 cN/tex. This value is lower than 20.69 cN/tex reported by Peşmen and Yardimci (2012) for Menemen sheep. However, it is higher than the strength value reported by Dellal et al. (2000a) and Arık et al. (2003) for Anatolian Merino sheep. The fleece strength value was reported as 7.5, 8.2, 5.2, 10, 7.6, 15.2, 18.3, 4.05 and 5.53 g, respectively, by Yalçın (1972) for Konya Merino female yearling lambs and dams, by Şahan et al. (1995) for Merino female and male yearling lambs, by Koyuncu et al. (1996) for Merino, Kıvırcık and Türkgeldi sheep, and by Uzun (2008) for Karacabey Merino and Menemen sheep.

In this study, it was determined that the effects of the factors (gender, age and live weight group) whose effects on strength were examined were insignificant. Peşmen and Yardımcı (2012) found the effect of age on strength to be significant in Menemen sheep. Yalçın et al. (1972) reported that fluctuations in strength were not related to age.

Table 1
Least squares means (LSM) and standard errors (SE) of fleece yield and characteristics in Anatolian Merino sheep

		Greasy Fleece Yield (kg)	Fiber Diameter (µm)	Fiber Length (cm)	Breaking Strength (cN/tex)	Elasticity (%)	Clean Fleece Percentage (%)
	N	LSM±SE	LSM±SE	LSM±SE	LSM±SE	LSM±SE	LSM±SE
Overall	60	2.97±0.199	24.42±0.495	7.92±0.362	19.15±1.252	25.38±1.833	48.16±2.175
Gender		NS	NS	*	NS	NS	NS
Female	50	3.45±0.130	25.12±0.324	9.43±0.239[a]	17.93±0.818	22.82±1.198	52.58±1.418
Male	10	2.49±0.471	23.73±1.174	6.42±0.847[b]	20.37±2.969	27.95±4.342	43.75±5.139
Age		NS	NS	NS	NS	NS	NS
1	10	3.47±0.298	24.00±0.723	8.45±0.567	19.02±1.845	23.72±2.714	49.27±3.239
2	11	2.91±0.252	24.79±0.629	8.45±0.485	17.94±1.582	22.95±2.324	51.49±2.781
3	12	3.13±0.269	24.73±0.661	8.05±0.499	18.52±1.663	26.71±2.408	50.56±2.923
4	15	2.55±0.277	24.07±0.716	7.53±0.528	20.03±1.811	26.95±2.645	44.58±3.078
5+	12	2.79±0.307	24.52±0.767	7.14±0.540	20.25±1.916	26.60±2.814	44.92±3.289
Live Weight Group		NS	*	NS	NS	NS	NS
1. (35.00-55.50)	19	3.09±0.242	25.75±0.580[a]	8.83±0.462	15.83±1.445	24.48±2.197	52.87±2.611
2. (55.51-64.00)	21	3.04±0.280	24.69±0.691[b]	7.63±0.505	19.47±1.732	24.85±2.551	47.16±3.010
3.(64.01-103.00)	20	2.79±0.363	22.84±0.854[c]	7.31±0.664	22.15±2.208	26.82±3.314	44.46±3.889

*a,b,c: The differences between the averages shown with different letters in the same column are significant. *P<0.05; NS: Insignificant.

The fleece hairs can be extended a little by holding from both ends and stretching, and can regain their original form when released. However, if more tension is applied, the cortex layer is well stretched and the cells are separated from each other and the hair is broken (Sönmez, 1963). This property is called elasticity. When the extension ability of the hairs that make up the fleece shirt is bad, the fleece diminishes while being processed in the factory and thus the fleece yield decreases (Dellal et al, 2000a). The elasticity value was calculated as 25.384±1.833% for the research herd. This value is lower than the values 30.2% - 36.1% reported by Şahan et al. (1995) for meat sheep x Merino crossbred (F1) sheep, 32.5%, 39.3%, 41.5% reported by Koyuncu et al. (1996) for Merino, Kıvırcık and Türkgeldi sheep, 31.48%, 27.35 % reported by Dellal et al. (2000a) and Arik et al. (2003) for Anatolian Merino. On the other hand, it is higher than elasticity value of 21.1% and 23.3% reported by Yalçın (1972) for Konya Merino yearling lamb and dams, 23.69% reported by Arık et al. (2003) for Anatolian Merino x Ile de France crossbred, and than 24.45% reported by Uzun for Karacabey Merino.

The effects of gender, age and live weight group factors on elasticity were found to be statistically insignificant. Uzun (2008) found the effect of age on the elasticity of Karacabey and Menemen sheep to be statistically insignificant. On the other hand, Peşmen and Yardımcı (2012) reported the effect of age on elasticity in Menemen sheep to be significant.

The physical property that has the greatest effect on price is Clean Fleece Percentage. The Clean Fleece Percentage value calculated in this study is 48.165±2.175%. This result supports the knowledge that Anatolian Merino sheep are classified as fine wool sheep. This percentage value is lower than 53.72%, 51.91%, 59.13% reported by Dellal et al. (2000a), Arık et al. (2003), Tuncer and Cengiz (2018) for Anatolian Merino sheep, 60.92%, 51.3% reported by Tellioğlu (1975), Koyuncu et al. (1996) for Merino sheep, and 54-58%, 51.13% reported by Yalçın (1972) and Arık et al. (2003) for Konya Merino, Ile de France x Anatolian Merino. On the other hand, it is close to 47.9% and higher than 43.1%, calculated by Şahan et al. (1995) for Merino female yearling lambs and male yearling lambs, respectively. Wool grease is found more in fine wool sheep breeds than coarse wool sheep breeds, and because the grease of fabric type fleeces is higher, the yield is lower than carpet type fleeces.

It was determined that the effect of the environmental factors (gender, age, body weight group) examined on the Clean Fleece Percentage was insignificant. The effect of age on yield was found to be statistically significant in Menemen sheep (Peşmen and Yardımcı, 2012). Bağkesen and Koçak (2018), on the other hand, stated that the effect of age on the yield in Dağlıç sheep was significant, while it was insignificant in Ramlıç sheep. Uzun (2008) reported that when the values of different genders were examined in his study, the difference between gender groups was not statistically significant.

In this study, fleece yield and properties were investigated on a small sample of Anatolian Merino sheep raised by the public, and according to the results obtained, it was determined that Anatolian Merino wool had significant superior characteristics compared to the wool of domestic sheep. For this reason, it can be said that Anatolian Merino sheep can be an important source in the domestic supply of the fleece that the textile industry needs. To further improve the fleece yield and quality of Anatolian Merino sheep and to produce wool

suitable for the needs of the fabric industry, there is a need for increasing the current numbers and serious and planned selection to be applied in this direction.

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