Physical and Technical Wool Traits of Mazekh Sheep Breed

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Abstract
Mazekh sheep are raised in different regions of the Republic of Armenia, including farms in Qanaqeravan (Kotayk region, at 1250 m above sea level) and Koghb (Tavush region, at 750 m above sea level). Their wool is coarse and composed of different fibre fractions, including fluff, awn, and dead hair. The annual greasy fleece weight of rams ranged from 1.8 to 3.0 kg, while selective breeding increased ewe fleece weight up to 3.0 kg. The yield of washed wool varied from 56.77% to 76.84% across sex and age groups. The fractional composition of fleece showed variability, with fluff, awn, and dead hair accounting for approximately 26.5–33.1%, 32.3–39.5%, and 28.6–50.0%, respectively. Wool fibre diameter ranged from 24.7 to 51.6 µm depending on fibre type and sex group. Wool fibre strength was below the optimal level for coarse-wool breeds, with breaking length values of 8.84–8.94 km. Overall, Mazekh sheep retain the characteristics of a coarse-wool, fat-tailed local breed; however, changes in wool structure are observed, including variation in fibre composition, reduced fibre strength, and moderate fleece productivity. These changes are likely associated with long-term crossbreeding and environmental influences, indicating the need for targeted selection and improved management practices.

Keywords: Mazekh sheep breed; wool fineness; wool strength; fleece composition; clean wool yield

1. Introduction

Analysing wool characteristics is a useful way to evaluate and distinguish its quality. Understanding these traits supports decision-making about product application, enhances user comfort, and guides the level of processing required [1]. Wool's value is inherently connected to its qualities and how well it meets established commercial standards [2, 3, 4, 5]. Armenia is a mountainous country located in the Armenian Highland. The climate is subtropical, animal husbandry, including sheep and goat breeding is very important in the agriculture field. Sheep breeding is one of the main branches of animal husbandry in the Republic of Armenia and plays an important role in the agricultural economy, especially in the mountainous regions of the country.

According to the statistical data of the Republic of Armenia, as of 01.01.2018, the number of sheep was 660.1 thousand; in 2019 it was 615.7 thousand; and as of 01.01.2025, it reached 668.4 thousand. Compared to 2019, the population increased by 1.24% by 2025 [6]. It should be noted that several coarse-wool breeds of sheep are bred in the Republic of Armenia, yet the most common is the Mazekh breed (Figure 1, Figure 2). They are bred in Armavir region - 139 thousand, in Ararat region - 112 thousand, in the village of Koghb of Tavush region - 5 thousand. However, the specified areas are more specialized in plant cultivation rather than in animal husbandry. In the Kotayk region (Qanaqeravan village) where

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research on sheep breeding is also being conducted as of 10.01.2024 their population is 36669 with goats growing up only 3.1%. Since 2000, the attitude towards local breeds has also changed in the country [7]. The coarse-wool fat-tailed Mazekh sheep is well adapted to the conditions of Armenia [8].

Due to the fat tail, Mazekh sheep can easily adapt to the unfavourable feeding conditions during winter period. In summer, they compensate for seasonal deficits by increasing their body weight by 20-25%. The above allows us to assert that the loss of the gene pool of local sheep, which has high meat and milk productivity in the specific conditions of the industry's development would be incorrect as the gene pool of animals are a national treasure too.

The issue of recovering the gene pool of local sheep breeds (Balbas, Bozakh, Karabakh) is disturbing since in the past they were crossed with rams of velvet-wool and semi-velvet-wool breeds. The work is underway in the Republic of Armenia to recover and improve local sheep breeds. A particular attention should be paid for increasing the number of local sheep of the Mazekh and Balbas breeds, whose number of populations is high in Armenia.

Figure 1. Lambs of Mazekh breed in the village of Qanaqeravan

Currently, one of priority tasks in the country's sheep breeding should be the recovery and improvement of the local sheep population especially in the direction of increasing milk and meat productivity, where there are large and still unused genetic, economic and technological reserves.

Figure 2. Ram of Mazekh breed

Light-brown, brown and dark-brown colours are common for sheep. Sometimes, the appearance of a white colour of wool of Mazekh sheep is accidental and premeditated by cross-breeding with the Balbas breed.

In addition, the Mazekh breed of sheep has also served as the basis for the production of crossbreed velvet and semi-velvet wool sheep, when they are crossed with velvet wool breeds, mainly Caucasian and Soviet Merino rams.

The latter in their turn since 1964 served as a material for breeding of semi-velvet-wool sheep of meat-and-milk direction to the type of Corridel by crossing mixture with rams of meat-wool breeds of North Caucasian Mountain Corridel and the type of Lincoln.

2. Materials and methods

To achieve the objectives of the study, baseline productivity indicators were recorded for all age and sex groups of Mazekh sheep maintained in farms located in Qanaqeravan village (Kotayk region) and Koghb village (Tavush region), Armenia. The work was carried out under practical farm conditions as a field-based observational study. Data were collected over three production years (2021–2023), which allowed assessment of year-to-year variation in wool traits and productivity parameters.

The data were analysed using biometric statistical methods. The arithmetic mean (M), standard error of the mean (m), standard deviation (σ), coefficient of variation (Cv%), and confidence limits (Lim) were calculated [9]. One-way analysis of variance (ANOVA) was applied to evaluate differences between groups and years. Prior to comparative analysis, basic descriptive statistics including mean values, standard error,

standard deviation, and coefficient of variation were calculated for each trait. Differences were considered statistically significant at $p < 0.05$.

Fleece weight was determined by individual weighing of greasy fleeces immediately after shearing. Clean wool yield was estimated after laboratory washing of representative samples in hot water under standard conditions to remove impurities, grease, and suint, and was expressed as a percentage of greasy fleece weight. The proportion of fleece fractions (fluff, awn, and dead hair) was determined by manual separation and subsequent weighing of each component.

Fiber diameter was measured microscopically on 200 randomly selected fibres per sample using an ocular micrometre. Fiber length was determined on staple samples collected from standard body regions using a millimetre ruler. Wool strength was assessed as breaking length using a standard tensile testing procedure under controlled laboratory conditions.

Additional measurements were carried out in accordance with established methodological recommendations for wool evaluation [10].

Herd structure was monitored annually and showed a stable composition across the study period. Breeding ewes together with replacement females accounted for approximately 94–96% of the total flock. This reflects a production-oriented breeding system typical for the studied farms. Given that the annual culling rate of ewes reaches 17–20%, replacement with young stock was not always sufficient, indicating the need to increase the proportion of replacement females to maintain flock sustainability (Table 1).

3. Results and discussion

The wool of the Mazekh sheep is coarse and consists of various fractions: fluff, awn and dead hair. The wool yield of the rams-producers of the village of Koghb. depending on the year. ranges from 1.8 (2021) to 2.6.0 kg (2022). 2.5-2.9 0 kg and in 2023 - 1.8-2.4 kg. In village of Qanaqeravan, the wool yield was 2.11 kg in 2021 and increased to 3.0 kg in 2022. For comparison, according to the Armenian statistical committee, the average wool yield per sheep in the country is 2.2 kg [11]. Wool production is influenced by the age and sex of animals, and by reproduction in the ewe. Less wool is grown by young animals per unit of feed intake, presumably due to competition for nutrients between follicles and other tissues [12].

However. there is an increase in the shearing of ewes in 2022 by 1.88 kg of Koghb on average due to the selection carried out.

The three-year study (2021-2023) of wool shearing by age and sex groups by farms are presented in the following table (Table 2).

Table 1. Dynamics of sheep breed Mazekh in research farms for 2021-2023

Year	Village Koghb									
	n	%	n	%	n	%	n	%	n	%
2021	13	4.5	215	74.7	-	-	60	20.8	288	100
2022	10	3.0	250	76.9	5	1.5	60	18.6	325	100
2023	8	4.8	160	95.2	-	-	-	-	168	100
Year	Village Qanaqeravan									
	n	%	n	%	n	%	n	%	n	%
2021	9	3.6	183	73.2	6	2.4	52	20.8	250	100
2022	7	3.3	174	82.9	-	-	29	13.8	210	100
2023	6	3.8	153	96.2	-	-	-	-	159	100

The results which we have obtained are typical for Mazekh breed as evidenced by their comparison with the data available in the specialized literature [13].

The yield of washed fibre has been determined on wool samples only for the farm in the village of Qanaqeravan (Table 3). Large fluctuations in their values have been recorded and in general they are not typical for Mazekh wool with the exception of wool samples from ewes, which in our opinion may be the result of the influence of their crossing with velvet-wool and semi-velvet-wool rams.

A single dead and dry hair of the modern type of Mazekh sheep is very rarely encountered which is not taken into account.

Table 2. Wool shearing by age and sex groups by farms, kg

Sex-age groups	Village Koghb					Village Qanaqeravan				
	n	Lim	M±m	σ	C	n	Lim	M±m	σ	C
					2021					
Rams	12	1.8-2.6	2.2±0.06	0.22	10	8	1.8-2.5	2.11±0.08	0.24	11.47
Ewes	220	0.6-2.6	1.45±0.03	0.57	39.3	180	0.6-2.6	1.44±0.04	0.58	50.5
1-2 years old sheep	53	0.6-1.5	0.92±0.03	0.25	27.2	43	0.4-1.5	0.75±0.04	0.27	37.5
					2022					
Rams	5	2.5-2.9	2.76±0.08	0.19	7.1	5	2.5-3.0	2.68±0.11	0.26	9.70
Ewes	238	1.3-2.9	1.88±0.02	0.45	25.3	182	0.7-2.6	1.32±0.04	0.60	46.15
1-2 years old sheep	60	0.8-1.8	1.44±0.03	0.29	25.4	52	0.6-2.3	1.22±0.07	0.50	41.6
					2023					
Rams	10	1.8-2.4	2.13±0.03	0.11	5.2	6	2.5-3.0	2.65±0.11	0.25	9.69
Ewes	150	0.6-2.4	1.33±0.02	0.36	27.1	153	0.6-2.4	1.32±0.02	0.35	26.9
1-2-year-old sheep	34	0.7-1.8	1.12±0.05	0.29	25.8	-	-	-	-	-

Table 3. Yield of washed wool of Mazekh sheep from Qanaqeravan village (%)

Sex-age groups	2021				2022			
	n	Physical weight of sample	Weight of wool after hot washing	Yield of washed wool, %	n	Physical weight of sample	Weight of wool after hot washing	Yield of washed wool, %
Rams	5	25.80	16.21	62.83	3	20.50	12.76	62.24
Ewes	5	11.52	7.45	64.67	4	17.72	10.06	56.77
1-2 years old sheep	5	7.05	5.17	73.33	3	18.35	14.10	76.84

It is easy to notice that in the wool of rams and ewes, the number of fibres of different fractions is almost the same. In their wool short awn is 11.3-11.8%. At the same time, the Mazekh sheep in the past were also quite heterogeneous in this regard.

It is sufficient to indicate the presence of fluff and awn hair types of animals with significant variations in the fibre composition of the wool (Table 4).

Table 4. Weight relationships of individual fractions of fleece of Mazekh sheep v. Koghb in 2022 (%)

Sex groups	Fluff			Dead hair			Awn		
	n	Lim	M	n	Lim	M	n	Lim	M
Rams	3	28.57-38.88	33.10	3	28.57-38.88	34.61	3	22.22-42.85	32.29
Ewes	7	11.12-37.50	26.50	7	37.50-50	39.53	7	12.50-50	33.97

The comparison with our data allows us to record in modern Mazekhs a significant change in the fractional composition of wool compared to the guard hair type in the direction of a significant increase in the content of fluff fibres and a decrease in awn fibres.

At the same time, the fluff type of the Mazekh sheep significantly exceeded the modern Mazekh in fluff content (66.9 versus 33.1%). As noted in the wool research methodology when determining the thickness of individual wool fractions, the diameter of 200 hairs in the sample was measured in each of them.

Fineness is one of the important systematic features in the evaluation and classification of sheep and wool [14]. Fineness of wool is determined by measuring the diameter of the cross-section of the wool fibre [15]. Wool grades are based mainly on the diameter of the fibre. Density is the major factor in determining the weight of the fleece. Length of fibre is also considered when grading wool Fiber diameter

refers to the average width of a single cross section of wool fibre [16].

Fiber diameter is widely acknowledged as the most important wool characteristics when assessing wool quality and value [17, 18].

From a genetic point of view, the main trait affecting wool quality and quantity is wool diameter and density, with high follicle density being associated with both low average fibre diameter (higher wool fineness) and high fleece weight (higher wool production). The great variability in wool diameter and length is usually the result of poor selection and a high degree of crossbreeding. Within different breeds, the rate of wool growth and wool uniformity is closely correlated with the nutritional status of the sheep [19].

The results of determining the fineness of various fractions of wool of rams and ewes in the village of Qanaqeravan and the village of Koghb are given in the following table (Table 5).

Table 5. Microscopic determination of the thickness of wool fibres of Mazekh sheep (μm)

Year	Types of wool fibre	Rams				Ewes			
		n	M±m	σ	C	n	M±m	σ	C
		Village Qanaqeravan							
2022	Fluff	600	24.7±0.38	4.5	18.2	1000	25.08±0.63	4.12	16.40
	Dead hair	600	36.79±0.48	2.87	7.8	1000	36.27±0.35	3.30	9.00
	Awn	600	47.02±0.74	4.06	8.63	1000	51.64±0.41	3.79	7.30
		Village Koghb							
2023	Fluff	600	26.3±0.17	2.29	17.41	1400	25.02±0.19	4.72	31.70
	Dead hair	600	35.12±0.07	1.19	6.82	1400	34.20±0.36	3.96	26.22
	Awn	600	48.84±0.16	4.34	17.77	1400	47.7±0.16	4.07	17.05

*Significant correlation at $p<0.005$; ns, not significant at $p\geq0.005$.

The fineness of down fibres in rams is set at 24.7μm (Qanaqeravan settlement) and 26.3μm (Kokhp). dead hair and awn are 36.79. 35.12 and 47.02. 48.84 μm. respectively. In ewes. the thickness of down fibres across farms is 25.08 μm and 25.02 μm, dead hair - 36.27 and 30.20 μm and awn - 51.64 and 47.7 μm.

In general, no particularly noticeable difference in the thickness of the wool fractions between rams and ewes was found with the exception of the thickness between the awn fibres in rams and ewes in the village of Koghb. In ewes the thickness of this fraction was 4.62 μm greater.

When comparing the average fineness values of fractions of Mazekh sheep according to researchers a significant thinning of all fractions is noticeable in modern Mazekh sheep [7].

This change in the fineness of wool of all fractions is fully explained by the long-term transformation of Mazekh sheep by crossing them with rams of velvet-wool and subsequently semi-velvet-wool breeds, which took place over several decades beginning in the 1950.

A study of the quality of wool of modern Mazekh sheep showed that their fluff is white, dead hair is brown and awn hair is dark brown. The content of short guard hair in the fleece is 10-12% [7].

The strength of wool fibres (hardness) is the ability of wool fibre to withstand tearing force, which is of great practical importance, since the stronger the wool fibre the higher the wear resistance and service life of products made from it.

The wool of coarse-wool sheep is considered to be of normal strength if its breaking length is at least 10 km. It is also known that the strength of wool is determined by the fineness and histological structure of the fibres.

The strength of the wool of the Mazekh sheep breed, like other breeds, is affected by the health of the animals, their physiological condition, feeding and maintenance conditions.

Our studies of the wool strength of the sheep indicate that in all age groups this indicator is below 10 km of breaking length and fluctuates within 8.84-8.94 km/breaking length, which is explained by inadequate feeding of the animals, especially during the stalling period. Particularly low wool strength is observed in ewes (8.84 km/breaking length) which is apparently also associated with their pregnancy.

Wool extensibility is characterized by the ability of wool fibres to extend beyond their true length and then to restore their original length after the

stretching stops. As a rule, the extensibility of coarse wool sheep is 40-47 km.

The exception is the wool of the 2022 ewe lambs (6.28 km/breaking length). The strength of the wool of the Mazekh sheep also doesn't meet the requirements for coarse wool and doesn't reach the value of 10 km/breaking length. remaining within the ranges of 8.84 to 8.94 depending on the age and sex group (Table 6).

Table 6. Strength of wool of Mazekh sheep, Koghb village, 2022 (m/length)

Age and sex group	n	Lim	M ± m	σ	C
Rams	5	8.81-9.13	8.94 ± 0.07	0.17	1.90
Ewes	10	8.59-9.09	8.84 ± 0.05	0.16	1.81
Sex-age groups	10	8.69-9.07	8.93 ± 0.03	0.11	1.23

4. Conclusions

The Mazekh sheep breed shows moderate fleece productivity, with greasy fleece weight ranging from 1.8 to 3.0 kg in rams and reaching up to 3.0 kg in ewes, depending on farm conditions and year.

The yield of washed wool is relatively high (56.77–76.84%), although variation between age and sex groups suggests some inconsistency in fleece quality.

The fleece has a clearly heterogeneous structure and consists of fluff (26.5–33.1%), awn (32.3–39.5%), and dead hair (28.6–50.0%).

Fiber diameter varies considerably, from about 24.7 μm in fine fibres to 51.6 μm in coarse fibres, confirming the coarse and mixed nature of the wool.

Wool fibre strength remains below the desirable level for coarse-wool breeds, with breaking length values of 8.84–8.94 km, which is lower than the recommended standard of 10 km.

Overall, the results indicate that the Mazekh sheep gene pool requires further improvement under Armenian breeding conditions, with emphasis on selection for better fleece uniformity, higher strength, and improved wool quality.

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