STUDIES ON SOME OF THE PHYSICAL CHARACTERISTICS OF WOOL FIBRES IN DIFFERENT PARTS OF THE FLEECE OF HASHTNAGRI SHEEP

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(Received June 12, 1963, revised October 22, 1963)

Variations of the percentages of true, heterotypical, and medullated fibres in eleven different parts of the fleece of Hashtnagri sheep were studied and tensile strength, extension at the breaking point, diameter, and length of the fibres were determined. It was found that "shoulder wool" contained the maximum number of true fibres while heterotypical and medullated fibres were in excess in the "belly wool". The tensile strength of the true fibres was greatest in the "stained wool" while that of heterotypical and medullated was maximum in "fleece wool" and "brisket wool", respectively. "Britch wool", "belly wool", and "back wool" had maximum fibre length. In certain cases extension at the breaking point exceeds 30% elongation. The tensile strength and the respective diameters of the fibres of the different parts were not related

Introduction

West Pakistan has 6,000,000 sheep with 13 major types of breeds.[1] They are heterogeneous with wide variations in physical characteristics including body size and wool production. Wool produced in the different parts of the body of the sheep has true heterotypical, and medullated fibres in varying amounts and having different physical characteristics which may be due to differences in the physiological conditions of the different parts of the body. This difference in medullation and in other physical characteristics such as fibre-length percentage elongation at break and tensile strength indicate the characteristics of the wool furnished by different parts.

A scheme has been undertaken to survey different areas of West Pakistan and to collect wool samples from each of eleven parts of the fleece of different types of breeds of sheep, to assess the percentages of different types of fibre distributed in the fleece and to determine the variation in their respective tensile strength, percentage elongation, diameter, and fibre length.

For this purpose a general survey of Charsadda, Peshawar, and Nowshera, the home-tracts of Hashtnagri breed, has been made. The wool samples were collected from eleven different parts of the 60 Hashtnagri sheep found in various villages of these Tehsils and were tested accordingly.

Sampling.—1 or 2 sheep in each flock was selected and staples from each of the eleven parts were taken and kept separately. Similarly, 60 sheep in different flocks at various villages were selected and wool staples were taken accordingly.

Experimental

Medullation.—The samples were collected in the autumn season of 1962 and the staples of wool were shorn as close to the skin as possible. In order to determine the medullation, these samples were dusted and 0.06 gm. of each sample was sorted for true heterotypical and medullated fibres by the benzene method.[2] The percentage of each type of fibre was thus determined.

Length Measurement.—For measuring length, the fibre was stretched out along a metre-rod and the distance between the two ends was noted. The length of 20-25 fibres from each type of fibre were determined.

Dynamometric Measurement.—Tensile strength and breaking strength along with extension at break, were found by means of a single fibre testing machine, that recorded breaking force and elongation simultaneously. The machine was hydraulically operated and the water flow was maintained in such a way that the time to break the fibre was 20 seconds; the length of the fibre between the two clamps was set accordingly. To promote accuracy with each type of fibre, different additional weights were used. 20-25 fibres from each type of all the wool samples were tested.

Diametric Measurement.—To determine the diameter, the strength of tested fibres were aligned on clean glass slides after being cut dissectionally and secured by the cover-slip using glycerine. These slides were then inserted into a projectional microscope (Lanameter) and the diameter of the fibres was determined at a magnification of $\times 500$. An attempt was made to find the diameter at the centre and at least 100 readings were taken.

Discussion

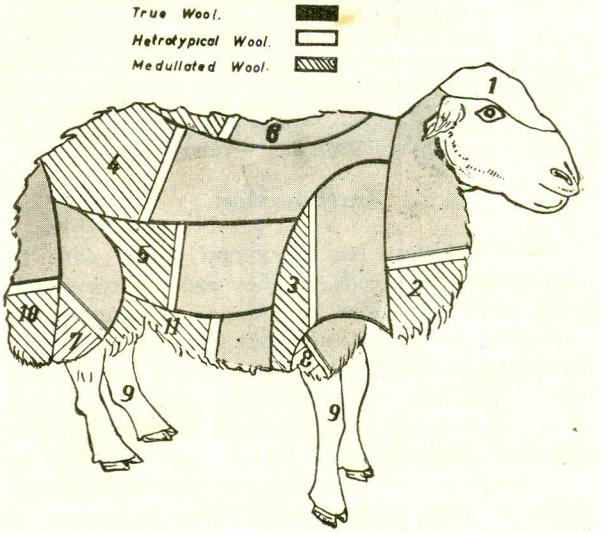
Smith,[5] in a study of Australian Merino sheep, has devised a fleece plan in which the fleece is divided into eleven distinct areas. This scheme has been applied in the present study to the fleece of Hashtnagri sheep. The wools grown at the "topknot" and "hairy shanks" (parts 1 and 9, respectively of Fig. 1) could not be tested for tensile strength owing to their short-staple length (less than 1 in.) and in the work described here, only strength tested fibres have been examined for diameter. In this latter connection, Meybeck and Gianola[4] have shown that wool fibres that have been stretched to the breaking point suffer a marked decrease in diameter.

To obtain a clear picture about the characteristics of wool furnished by different parts of the body, the following was established:

Topknot.—(Part 1 of Fig. 1). The growth at this part of the sheep body is very short and, therefore, has not been tested.

Neck Wool.—(Part 2). The fibres from this part occupy fourth place on the basis of distribution of different types of fibre (Table 1). With Australian Merino Sheep [5] this type of wool of regarded as one of inferior quality. This difference may be due to the absence of folds on the neck of Hashtnagri sheep and it is a general fact that the wool developed by the folds is coarse. The fibres are of medium strength (Table 3) Medullated fibres are shorter than the heterotypical fibres (Table 2).

Shoulder Wool.—(Part 3). The percentage of true fibres is at the maximum in this part of the body (Table 1). True fibres are comparatively coarser and the medullated fibres are finer than the true and medullated fibres obtained from other



1. Fig.—Showing different parts of the Hashtnagri Sheep Fleece and the various percentage of different types of fibres.

TABLE 1.—DISTRIBUTION OF DIFFERENT TYPES OF FIBRES IN DIFFERENT PARTS OF THE FLEECE

S. No.	Parts of the body	Percentage of True fibre	Heterotypical fibres	Medullated fibres
1.	Topknot ..	—	—	—
2.	Neck wool ..	63.2	9.1	27.7
3.	Shoulder wool ..	67.2	7.3	25.1
4.	Fleece wool ..	66.8	8.1	25.5
5.	Brisket wool ..	62.8	7.7	29.5
6.	Back wool ..	64.4	9.5	26.1
7.	Britch wool ..	62.4	7.7	29.9
8.	Arm piece wool ..	63.2	6.4	30.4
9.	Hairy shanks ..	—	—	—
10.	Stained wool ..	61.2	7.2	31.6
11.	Belly wool ..	29.6	11.9	58.5
	Mean ..	60.1	8.3	31.7
	Coefficient of variation ..	17.3%	12.5%	30.9%

TABLE 2.—VARIATION IN FIBRE LENGTH OF TRUE, HETEROTYPICAL AND MEDULLATED FIBRES FROM DIFFERENT PARTS OF THE FLEECE.

S. No.	Parts of the body	No. of samples	Fibre length (inches)		
			True fibres	Heterotypical fibres	Medullated fibres
1.	Topknot ..	—	—	—	—
2.	Neck wool ..	60	4.29	5.0	4.74
3.	Shoulder wool ..	60	4.26	3.98	5.28
4.	Fleece wool ..	60	3.78	4.38	4.50
5.	Brisket wool ..	60	4.00	4.30	4.58
6.	Back wool ..	60	4.34	4.62	5.17
7.	Britch wool ..	60	4.43	5.02	4.98
8.	Armpiece wool ..	60	3.81	4.57	5.41
9.	Hairy shanks ..	—	—	—	—
10.	Stained wool ..	60	4.18	4.63	5.00
11.	Belly wool ..	60	4.34	4.76	5.43
	Mean ..	60	4.16	4.45	5.01
	Coefficient of variation ..		.72%	.76%	.70%

TABLE 3.—VARIATION IN TENSILE STRENTH OF TRUE, HETEROTYPICAL AND MEDULLATFD FIBRES TAKEN FROM DIFFERENT PARTS OF THE FLEECE.

S. No.	Parts of the body	No. of samples	Tensile strength (Kg./Cm²)		
			True fibres	Heterotypical fibres	Medullated fibres
1.	Topknot ..	—	—	—	—
2.	Neck wool ..	60	2134	1426	906
3.	Shoulder wool ..	60	1889	1327	1035
4.	Fleece wool ..	60	2008	1889	868
5.	Brisket wool ..	60	2088	1493	1089
6.	Back wool ..	60	2234	1509	879
7.	Britch wool ..	60	1932	1010	677
8.	Armpiece wool ..	60	1672	784	680
9.	Hairy shanks ..	—	—	—	—
10.	Stained wool ..	60	2430	1548	865
11.	Belly wool ..	60	1826	1426	558
	Mean ..	60	2024	1401	840
	Coefficient of variation ..		10.57%	18.71%	19.9%

parts of the body. (Table 4). Heterotypical fibres occupy the lowest place as far as the fibre-length is concerned and they are also shorter than true fibres. (Table 2) Medullated fibres are comparatively stronger (Table 3).

Fleece Wool.—(Part 4). The heterotypical fibres are the strongest and finest. (Tables 3 & 4 while the fibre length of the true fibre is at the minimum (Table 2.)

Brisket Wool.—(Part 5). This wool approximates to the average but has the strongest medullated fibres (Table 3). Int his part one characteristic of the true fibres is their fineness (Table 4).

Back Wool.—(Part 6). This is an ideal average wool spread over the body of the sheep the medullation as well as other properties of the fibre approaching the mean (see all Tables). This wool

being open to the atmosphere is liable to suffer degradation as is evidenced by "tippy" dyeing.[6]

Britch Wool.—(Part 7). The fibre length of true and heterotypical fibres of this part is the highest recorded but the medullated fibres are shorter than the heterotypical fibres (Table 2).

Armpiece Wool.—(Part 8). The wool fibres in this part when compared with those of its counter part the "britch wool" are shorter in length for the true and heterotypical and longer for medullated fibres (Table 2).

Hairy Shanks.—(Part 9). This part extends over the lower legs and the feet (see Fig. 1). This wool has also not been tested because as its name denotes most of the fibres have a hair-like appearance.

TABLE 4.—VARIATION IN DIAMETER OF TRUE, HETEROTYPICAL AND MEDULLATED FIBRES OBTAINED FROM DIFFERENT PARTS OF THE FLEECE.

S. No.	Parts of the body	No. of samples	Diameter (u)		
			True fibres	Heterotypical fibres	Medullated fibres
1.	Topknot ..	—	—	—	—
2.	Neck wool ..	60	22.28	39.44	57.54
3.	Shoulder wool ..	60	23.94	34.23	53.41
4.	Fleece wool ..	60	23.03	37.34	55.40
5.	Brisket wool ..	60	20.89	35.84	60.08
6.	Back wool ..	60	21.82	41.32	64.86
7.	Britch wool ..	60	22.68	42.56	67.70
8.	Armpiece wool ..	60	23.18	47.40	63.55
9.	Hairy shanks ..	—	—	—	—
10.	Stained wool ..	60	22.32	31.97	65.19
11.	Belly wool ..	60	20.91	39.20	67.17
	Mean ..	60	23.30	38.14	61.70
	Coefficient of variation ..		4.3%	10.43%	8.00%

TABLE 5.—VARIATION IN PERCENTAGE ELONGATION OF TRUE, HETEROTYPICAL AND MEDULLATED FIBRES TAKEN FROM DIFFERENT PARTS OF THE FLEECE.

S. No.	Parts of the body	No. of samples	Percentage elongation of		
			True fibres	Heterotypical fibres	Medullated fibres
1.	Topknot ..	—	—	—	—
2.	Neck wool ..	60	28.5	22.5	22.7
3.	Shoulder wool ..	60	35.8	27.3	25.4
4.	Fleece wool ..	60	34.8	24.4	23.0
5.	Brisket wool ..	60	27.8	29.7	23.0
6.	Back wool ..	60	29.4	30.0	24.0
7.	Britch wool ..	60	27.8	29.1	21.9
8.	Armpiece wool ..	60	25.8	23.2	23.1
9.	Hairy shanks ..	—	—	—	—
10.	Stained wool ..	60	29.9	30.4	23.7
11.	Belly wool ..	60	26.5	36.2	23.0
	Mean ..	60	29.6	28.1	23.3
	Coefficient of variation ..		11.1%	14%	3.9%

Stained Wool.—(Part 10). This wool is obtained from the back part and the rump of the sheep (see Fig. 1). True and heterotypical fibres of this part are very strong (Table 3).

Belly Wool.—(Part 11). This is a long wool hanging from the belly of the sheep. It contains the highest proportions of heterotypical an medullated fibres (Table I). It is observed that with "belly wool" there are greater differences in the percentages of different types of fibres than obtained with the rest of the parts of the sheep body excluding the head and foot areas the fibres of which were not tested (Table I). Otherwise all the other characteristics of different parts are more or less the same. This implies that the wool obtained from the same sheep is uniform but this fact is quite contradictory to fact, the wools of the two sheep from each flock are quite different.[7]

These studies have revealed a very important fact, viz. that the tensile strength of the fibres from different parts of the fleece varies irrespective of the diameter (Table 3 & 4). It is generally found that the smaller the diameter, the greater the tensile strength, but this finding is strictly applicable only to fibres from the same part of the fleece. In all the wool samples from the same part, this property is observed and the tensile strength is found to be a function of diameter. But a careful study of Tables 3 and 4, show that the diameter and tensile strength of the fibres of different parts are not related; the fibres of one part are found to be comparatively stronger than those of another part. This variation may be due to differences in physiological conditions. The secretion of grease varies in different parts of the fleece. Extraneous factors may also be responsible for this diversity. Some of the parts of the sheep come in close contact with ground when the sheep rests, some parts such as "brisket wool" constantly brush against the bushes while the sheep are grazing and some parts are more exposed to the atmosphere, e.g. "back wool". This wear and tear may produce a significant variation in the fibre properties. Consideration of kempy fibres has been omitted because very few of these fibres occured in the samples examined.

Conclusions

The above observations lead to the conclusion that in respect of medullation "shoulder wool" has the smallest and "belly wool" the greatest degree of medullation. As far as fibre length is concerned, the series true < heterotypical < medullated is obtained but there are certain anomalies, viz. (1) In "neck wool" medullated fibres are shorter than the heterotypical fibres. (2) In "shoulder wool" heterotypical fibres are shorter than the true fibres. (3) In "britch wool", medullated fibres are shorter than the heterotypical fibres.

The tensile strength of fibres from different parts of the fleece varies irrespective of diameter, probably owing to differences in physiological and extraneous factors that obtain with the various areas of the fleece.

Acknowledgement.—The authors are indebted to Dr. S.A. Warsi, Acting Director, North Regional Laboratories, Peshawar, for his guidance and are grateful to M/S Amir Mohammad, Ghulam Nabi and Abdul Rashid for their help in the calculations, etc.

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