THE DISTRIBUTION AND THE MEASUREMENTS OF MEDULLATION OF KAGHANI WOOL FIBRES

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Study has been made in the variations of the percentage length, volume and the cross sectional area of the fragmental, interrupted and continuous medullated fibres which influence, to a great extent, the spinning and dyeing properties of wool fibres.

Introduction

In estimating the value and suitability of the Kaghani wool fibres for manufacturing purposes, it is considered desirable to have it free from medullation or hairiness as much as possible. The presence of medullation in Kaghani wool fibres which is of better quality comparing to other Pakistani wools is detrimental from the standpoint of the manufacturer and may have a pronounced effect on the buyer's assignment of its value. A comparative study of the Kaghani wool fibres was undertaken, and the measurements have been confined to 48 wool samples taken from the sides of indigenous Kaghani sheep body. Tests were carried out mostly on those samples which have a greater percentage of medullated fibres, while some samples of the improved cross breed varieties have been omitted. The percentage of true,[1] heterotypical, medullated and kempy fibres in 0.6 g. sample has been found. The percentage of kempy fibres was of negligible amount, and therefore, it has not been taken into consideration. Study has been confined only to the fragmental, interrupted and continuous medullated fibres in order to determine the degree of medullation which is an important factor to be considered by the sheep breeders,[2] spinners, and dyers.

Experimental

The sorting and separation of medullated and non-medullated fibres was effected with the help of benzene method. Staples of wool from different varieties of Kaghani wool were taken one by one and tested. All the three types of wool fibres contained in the staple, i.e., medullated, heterotypical and true, were separated and counted.

Slides were made, each one containing from 6 to 8 fibres (medullated or heterotypical). Each slide was then tested on a projected microscope (lanameter), and observations were made. In the case of fibres containing continuous medulla, the diameter of the fibres and that of medulla were observed at eight different points, and the readings were taken. The means of all eight readings gave the average diameters of the continuous medulla. For the fibres containing interrupted medulla observations were taken at the ends of interruption, and in this manner eight observations were made. Similarly, diameters of readings were taken at eight more ends other than the ends of interruptions. Finally, fibres containing fragmental medulla were observed and readings were taken in similar manner, but account was also taken of the length of fragments. Lengths of 10 or 12 fragments in a single medullated fibres were noted down and the mean of these readings was taken as the average length of the fragments.

In this way some twenty to twenty-five fibres were tested (from medullated and heterotypical each) from each sample of Kaghani wool.

Calculations

The percentage of hairiness in different samples was estimated from the number of medullated fibres and the total number of fibres in a single staple. Percentages of the different varieties of fibres, i.e. medullated, heterotypical and true, were estimated separately.

There are four factors[3] which determine the medullation quality of wool fibres: (1) the percentage of medullated fibres, (2) the average length of the medulla, (3) mean cross-sectional area of the medulla, and (4) mean cross-sectional area of the fibre.

Factors 1 and 2 can be combined together and the resulting factor may be named as the percentage length of medulla. Furthermore, the combination of all the four factors gives us the useful value of the percentage volume of the medulla. The equation regarding these can be expressed as follows:—

$$\text{Percentage volume of the medulla} = I_m \times \frac{\Pi r^2}{\Pi R^2}$$

where I_m = percentage length of the medullated fibres, Πr^2 = mean cross-sectional area of the medulla, and ΠR^2 = mean cross-sectional area of the fibre.

For the determination of mean cross-sectional area of the fibre and the medulla, the diameters of the fibres and the medulla were measured at least at 15 different points covering the whole of the fibre length. The mean radii of the fibre and the medulla were thus calculated, and the mean cross-sectional areas were found out with the help of the general formula Πr^2. Percentage length[3] of the medullated fibres (I_m) = $N_m/N_w \times 100$, where N_m = number of medullated fibres and N_w = total number of all fibres in the same samples.

Different types of fibres were sorted out and counted, then cut into small pieces ranging from $\frac{1}{2}$ to 1 mm. in length and were then examined for the determination of percentage volume.

Results and Discussion

The range of the medullated fibres is the widest[3] while that of true fibres is the least wide. The

TABLE 1.—PERCENTAGE OF MEDULLATED AND NON-MEDULLATED FIBRES IN KAGHANI MEDULLATED WOOL SAMPLES.

Medullated		Heterotypical		True	
No. of fibres	%	No. of fibres	%	No. of fibres	%
190	35.84	135	25.47	205	38.67
86	21.93	63	16.7	243	61.98
252	36.67	93	13.53	342	49.78
58	11.06	155	29.58	311	59.35
78	17.88	67	15.36	291	66.74
230	45.09	71	13.92	209	40.98
228	39.51	115	19.58	234	40.55
327	43.77	45	0.02	375	50.20
107	21.48	148	29.71	243	48.79
213	38.24	150	26.92	194	34.84

Mean percentage of medullated fibres	32.41
Mean percentage of heterotypical fibres	19.09
Mean percentage of kempy fibres	—
Mean percentage of true fibres	48.50

TABLE 2.—DISTRIBUTION OF PERCENTAGE LENGTH AND PERCENTAGE VOLUME IN FRAGMENTAL MEDULLA IN KAGHANI WOOL FIBRES.

No. of medullated fibres	No. of fibres with fragmental medulla	% length of the medulla	Mean cross-sectional area of the fibres	Mean cross-sectional area of the medulla	% volume of the medulla
154	56	40.0	866.0	28.28	3.2
149	103	25.0	3320.0	85.07	2.5
345	77	22.3	2954.0	506.90	17.1
213	46	34.5	2027.0	50.28	2.4
145	62	52.5	2059.0	85.07	4.1
301	80	29.4	1592.0	95.06	5.9
246	93	37.3	1975.0	55.31	2.7
343	128	29.8	1123.0	40.72	3.6
372	111	12.5	1158.0	45.38	3.9
255	32	42.4	1076.0	43.01	3.9
363	154	49.4	1334.0	47.75	3.5
325	130	42.0	1334.0	60.84	4.5

TABLE 3.—DISTRIBUTION OF PERCENTAGE LENGTH AND PERCENTAGE VOLUME IN THE KAGHANI WOOL FIBRES.

Total No. of fibres	No. of medullated fibres	% length of the medulla	Mean cross-sectional area of the fibres	Mean cross-sectional area of the medulla	% volume of the medulla
149	20	13.4	2207.0	124.7	5.6
345	53	15.0	2224.0	523.0	23.5
213	109	51.1	1542.0	181.6	11.7
145	47	32.4	2059.0	141.1	6.8
301	128	42.5	2412.0	132.7	5.5
343	13	3.7	1521.0	50.2	3.3
372	29	7.7	1750.0	66.5	3.8
255	50	1.9	1452.0	116.0	8.0
363	37	10.9	1365.0	199.0	14.5
325	39	12.0	2275.0	785.6	34.5

TABLE 4.—DISTRIBUTION OF PERCENTAGE LENGTH AND PERCENTAGE VOLUME IN THE CONTINUOUS MEDULLA IN KAGHANI WOOL FIBRES.

No. of medullated fibres	No. of fibres with continuous medulla	% length of the medulla	Mean cross-sectional area of the fibres	Mean cross-sectional area of the medulla	% volume of the medulla
154	98	47.3	2810.0	940.3	33.4
149	26	30.8	2158.0	259.1	12.0
345	215	25.9	2394.0	642.5	26.8
213	60	62.3	2754.0	487.6	17.6
145	18	12.9	2059.0	259.1	12.5
301	80	48.1	1975.0	204.1	10.3
246	153	15.2	2376.0	253.1	10.6
343	205	29.4	2175.0	607.1	27.9
372	232	59.8	1825.0	373.4	20.4
255	172	62.3	6506.0	3464.0	53.2
363	172	67.4	2773.0	539.4	19.4
325	154	47.3	2754.0	774.7	28.1

range of medullated fibres is from 34 to 138 μ. The percentage is high between 50 and 60 μ. After 60 μ, it decreases, and between 80 μ and 120 μ, it is quite negligible, i.e., about 5%. Percentage of true fibres ranges from 10 to 50 μ. It is highest between 20 to 30 μ, and after that it decreases gradually (Fig. 1).

The medulla diameter increases with fibre diameter. Continuous medulla cover a larger range, fibre diameter varies between 30 and 140 μ, while the medullary diameter rises as high as 120 μ. In fibres of larger diameter the medullary diameter is approximately the same as fibre diameter. In continuous medulla, the increase is gradual between 30 and 70 μ and afterwards rises abruptly, i.e., fibres whose diameter ranges from 30 and 70 μ are moderately medullated (Fig. 2).

Range of continuous medulla is from 44 to

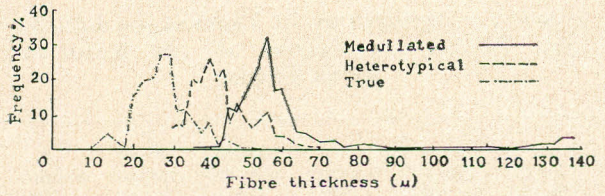

Fig. 1.—Distribution of Kaghani medullated and non-medullated wools according to the thickness.

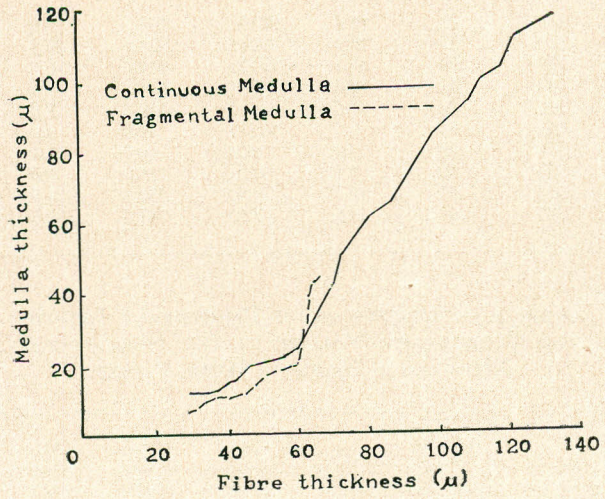

Fig. 2.—Relationship between the fibre thickness and the medulla thickness.

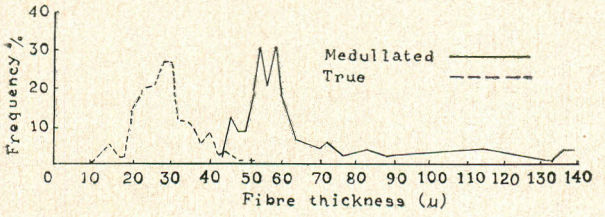

Fig. 3.—Distribution of Kaghani medullated fibres (containing continuous medulla) to the thickness.

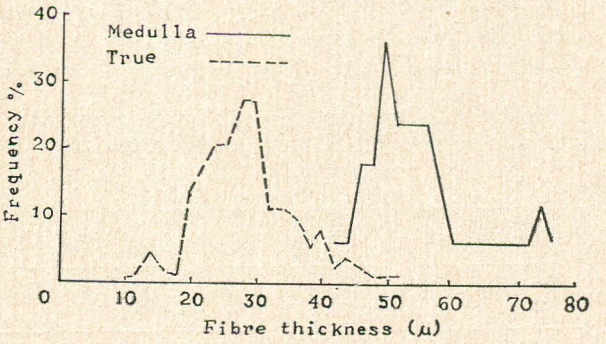

Fig. 4.— Distribution of Kaghani medullated fibres (containing fragmental medulla) according to the thickness.

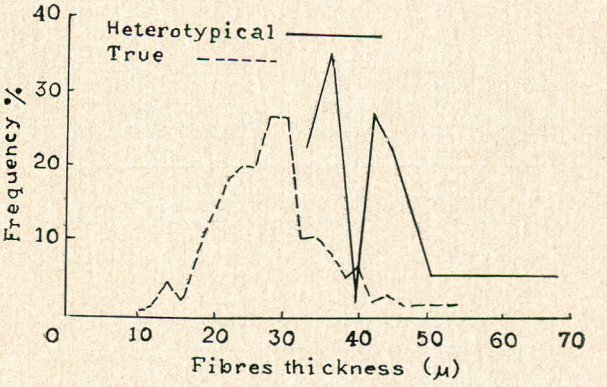

Fig. 5.—Distribution of Kaghani heterotypical fibres (containing continuous medulla) according to the thickness.

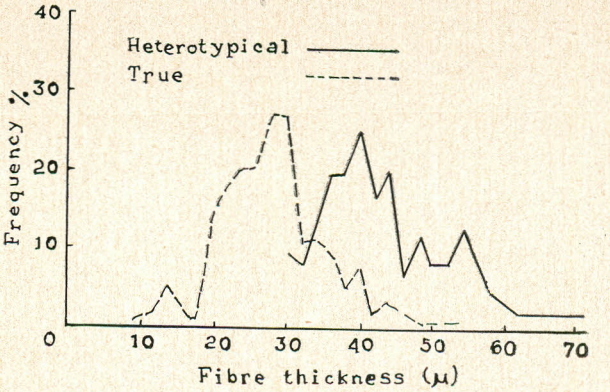

Fig. 6.—Distribution of Kaghani heterotypical wool fibres (containing continuous medulla) according to the thickness.

136μ (Fig. 3), while fragmental medulla is found only between 42 and 76 μ (Fig. 4). Originally the frequency of fibres containing fragmental medulla is not so high. The frequency shown is of limited number of fibres with fragmental medulla (Fig. 4). Frequency is high for a diameter range 50-60 μ.

The frequency of fibres containing continuous medulla is extremely irregular, because of their low percentage (Fig. 5). Frequency of fibres with fragmental medulla is in accordance with that of true fibres (Fig. 6). Frequency is high for fibres with diameter range of 30 μ to 40 μ.

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