Pakistan J. Sci. Ind. Res., Vol. 14, No. 6, December 1971

INCIDENCE OF MEDULLATION IN CARPET WOOLS

Part 1.—Relationships of Medullation Characteristics with Diameter

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(Received March 11, 1971)

Percentage proportions of true, heterotypical, medullated and kempy fibres were evaluated in ten samples of Pakistani carpet wool. The diameters of the samples as well as of the assorted subsamples were determined and correlation coefficients for the various relationships estimated. It appears that, with increase in diameter, it is not only the number of medullated fibres that increases but that their diameter also increases significantly in comparison to that of true as well as heterotypical fibres.

Carpet wools are characterised, in general, by comprising partially of medullated fibres. Although medullation increases generally with increase in diameter, the relationship does not seem to hold good in the between-breed case, where wools of different types are being considered. Thus, carpet wools are conspicuously more medullated than other equally coarse wools, such as Lincoln.[1] In addition to the medullated fibres, the fibre population of a carpet wool consists of true, heterotypical (partially medullated), and often some kempy fibres.[2]

A survey of the carpet wools produced in Pakistan revealed that the 22 varieties comprised a wide range of fineness, the finest being 60's and the coarsest 32's and under.[3] Further, the extent of medullation among them showed extreme variation. On the basis of these important differences, these wools could differ appreciably in their processing behaviour. It may be recalled that although medullation is a nuisance in the worsted industry, it is a desirable quality for the purposes of carpet industry,[2] and may be easily tolerated (up to about 6%) in the woollen and knitting industries.[4,8]

Very little is, however, known about the various aspects of incidence of medullation in carpet wools. For instance, as far as we know, no data is available on the relationship between fineness and the percentage of different types of fibres, on that between fineness of the various types of fibres and the overall fineness, or on differentials among the fineness of the various types of fibres etc. Some work has earlier been done on the various aspects of quality of these wools[5] and it is now desirable to consider the incidence of medullation among them. The importance of this study is enhanced by a finding of Shah and Whiteley[6] that the substance of the carpet wools does not appreciably differ from other wools and, therefore, the cause for their specific end-use most probably lies in characteristics other than the substance.

The objectives of the present study were to examine the relationships between fineness of a carpet wool and the proportion of the various types of fibres in it, between the average fineness and the fineness of the various types of fibres and also fineness differentials in the various types of fibres.

Materials and Methods

Wool Samples.—The following ten samples of randomly selected breeds were employed: Swati, Kaghani, Terahi, Harnai, Lohi, Damani, Bibrik, Kooka, Hashtnagri, Michni. These samples were taken from the body wool (mid-side).

Mean Diameter.—Mean diameter of each sample was determined, employing a lanameter,[5] at a magnification of $\times 500$. Some 800 readings were taken in each case.

Medullation.—About 0.6 g of a randomly selected sub-sample were seperated into true, heterotypical, medullated and kempy fibres, employing the benzene test[7]. The percentage proportion of each type was calculated by count.

Diameter of the Various Types.—The diameters of true, heterotypical and medullated fibres were determined separately in the same way as for the mean diameter. In cases where the fibres available of a particular type were less than 50 in number, all the fibres were directly mounted on slides and their diameter measured at 15 different places at intervals of 0.2 cm, along a length of about 3 cm of each fibre. The diameters of kempy fibres were not determined, as their number was usually too small.

Results and Discussion

Percentage proportions of the true, heterotypical, medullated and kempy fibres are given in Table 1, which also includes the average fibre diameter for all the wools. The average diameter of these wools ranges approximately between 28μ and 45μ, the percentage of true fibres between 40% and 70%, that of heterotypical between 13% and 23% and medullated between 15% and 38%. The proportion of kempy fibres was usually less

than 2% and the maximum was 3.8%. The correlation coefficients for the relationships between fibre fineness and the percentages of the various types of fibres have been given in Table 3. The percentage of true fibres is negatively related to average diameter and the coefficient is significant at the 1% level. In comparison to this, the percentage of medullated fibres is positively related to diameter, the coefficient being also significant at the 1% level. Although the proportion of heterotypical fibres is positively related to the diameter, the relationship is nonsignificant. It becomes apparant that, with increase in diameter, although the percentage of true fibres decreases and that of medullated fibres increases, the proportion of heterotypical fibres does not show a definite trend.

Table 2 gives the diameters of the true, heterotypical and medullated fibres, together with their respective ranges. The mean diameter of true fibres varies approximately between 20μ and 27μ, that of heterotypical between 34μ and 42μ and that of medullated between 41μ and 76μ. The range of diameter of the various types of fibres was rather wide. There was, however, greater overlapping between heterotypical and medullated fibres in comparison to the case of the true and heterotypical types. It appears that, roughly speaking, fibres below 30μ are likely to be free from medullation and those above it would be partially or fully medullated. The transition from heterotypical to fully medullated stage will be the subject of investigation of a subsequent study. The correlation coefficients for the relationships between fibre diameter of the sample and those of the various types of fibres have been included in Table 3. The diameters of the three types of fibres are positively related to the sample diameter. The coefficient is, significant at the 5% level in the case of the true fibres, and at the 1% level in those of the heterotypical and medullated fibres. It can be seen from Table 2 that with increase in the sample diameter, the true and heterotypical fibres grows in diameter rather sluggishly: for an increase in the mean diameter of about 15μ, both true and heterotypical fibres increase only by about 7μ. However, as the increment in heterotypical fibres shows a more regular pattern, the corresponding coefficient is highly significant. In comparison to these cases of true and heterotypical

TABLE 1.—PERCENTAGE PROPORTION OF TRUE, HETROTYPICAL, MEDULLATED AND KEMPY FIBRES.

Wool	Mean dia.	Percentage			
		True	Heterotypical	Medullated	Kempy
Swati	27.7	62.3	13.4	23.5	0.8
Kaghani	28.7	70.0	13.6	15.2	0.5
Terahi	33.9	52.5	22.8	23.4	1.3
Harnai	34.4	58.7	21.7	19.1	0.5
Lohi	37.3	49.8	15.8	32.3	2.1
Damani	38.8	52.3	15.2	29.9	2.6
Bibrik	39.5	53.1	13.4	29.7	3.8
Koka	41.3	41.0	22.0	34.5	2.5
Hashtanagri	41.6	51.7	17.0	29.6	1.6
Michni	44.5	47.4	12.6	38.2	1.8

TABLE 2.—DIAMETER OF TRUE, HETEROTYPICAL AND MEDULLATED FIBRES (μ).

Wool	Mean dia	True		Heterotypical		Medullated	
		Range	Mean	Range	Mean	Range	Mean
Swati	27.7	10–30	19.7	28–48	34.4	36–70	40.9
Kaghani	28.0	12–30	23.5	32–54	37.9	42–84	46.0
Terahi	33.9	14–32	25.1	32–56	38.2	44–176	49.1
Harnai	34.4	14–34	26.8	32–64	41.1	54–188	57.2
Lohi	37.3	12–32	25.2	32–54	39.3	56–144	61.3
Damani	38.8	14–32	24.6	32–56	36.5	56–110	63.4
Bibrik	39.5	16–36	25.0	34–56	42.4	50–106	61.5
Koka	41.3	16–36	26.3	36–46	40.0	56–128	62.7
Hashtangri	41.6	16–34	24.9	34–50	39.1	66–162	76.4
Michni	44.5	16–38	26.8	36–62	41.2	64–180	70.6

TABLE 3.—CORRELATION COEFFICIENTS FOR RELATIONSHIPS BETWEEN MEAN DIAMETER AND OTHER CHARACTERISTIC.

Characteristics	Coefficient
Percentage of true	—0.833 * *
Percentage of heterotypical	0.044
Percentage of medullated	0.845 **
Dia of true	0.719*
Dia of heterotypical	0.798**
Dia of medullated	0.923**

* Significant at the 5% level; * * Significant at the 1% level.

fibres, the diameter of the medullated fibres increases by about 25μ for the same range so that it may be concluded that it is not only the increase in the number of the medullated fibres but also that in their diameter which largely contributes to the coarseness of a relatively coarser carpet wool.

It may be noted, for practical purposes, that for an increase of a micron in the diameter of the sample, both true and heterotypical fibres increase only by about half a micron but medullated by two microns.

It may also be noted from Table 2 that the diameter of the true fibres is significantly finer than that of the sample, the former being about two-third of the latter. The heterotypical fibres have almost the same diameter as the mean, whereas the medullated fibres are about 1½ times coarser than the mean. These relationships can be of assistance in roughly indicating an estimate of diameter of a particular type of fibre on the basis of a knowledge of the mean diameter or diameter of one of the fibre types. These expectations have been summed up in Table 4.

These data may also be compared with the tentative guide for an ideal carpet wool as suggested by Burns, Johnston and Chen.[2] All these wools qualify the basic requirement for medullation viz the true wool fibres should not exceed the limit of 85%, and conversely, the heterotypical ones (partially and fully medullated fibres taken together) should be at least 15%. As for the fineness of the various types of fibres, however, it seems that their mean diameter tends to be slightly on the coarser side. Thus, as suggested by them, the mean diameter of the true type should not be above 25.4μ, but in the present study some of the samples exceed this limit by a micron or so, although the overall mean for all the samples comes out to be 24.8μ. It may be recalled that the work of Burns, Johnston and Chen was carried out some 30 years ago and their line of work does not seem to have been followed by further studies. It would be highly desirable if more objective tests are carried out, employing a large number of carpet samples, collected from widely differing origins, so that the concept of an ideal carpet wool can be more explicity and accurately defined.

TABLE 4.—INTERRELATIONSHIP OF THE VARIOUS DIAMETERS.

Description		Relationship with other diameters
Mean	"d"	$d \simeq 3/2\ t \simeq h \approx 2/3\ m$
True	"t"	$t \simeq 2/3\ d \simeq 2/3\ h \simeq 1/2\ m$
Heterotypical	"h"	$h \simeq\ d \approx 3/2\ t \simeq 2/3\ m$
Medullated	"m"	$m \simeq 3/2\ d \simeq 2\ t \simeq 3/2\ h$

* The diameter of medullated fibre in the case of wools coarser than about 40μ is even higher than twice of that of the true fibres.

Conclusion

The percentage of true fibres varies from 40 to 70 in the carpet wools studied. The remaining proportion is constituted of different proportions of heterotypical, medullated and kempy fibres.

With increase in diameter of a wool, the percentage of true fibres decreases and that of medullated increases but the proportion of heterotypical fibres does not follow any regular pattern.

With increase in diameter, the diameter of the various types of fibres also increases, in general, but the largest increment is in the case of fully medullated fibres. It becomes obvious, therefore, that the coarseness of a carpet wool is not only due to an increment in the number of medullated fibres but also in the diameter of such fibres.

The diameter of the true fibres is approximately two-third of the mean diameter, that of heterotypical is almost equivalent to the mean diameter and that of medullated is almost one and a half times of the mean diameter. On the basis of such relationships, the diameter of a certain type of fibre can be predicted, approximately, knowing the mean diameter or vice versa.

Acknowledgement.—The authors are thankful to Messrs Ataullah and Mohammed Raziq of these Laboratories for assistance in routine work.

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