

UTILISATION OF DAMANI WOOL IN CARPET MANUFACTURE

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Studies have been made on length, diameter, medullation, strength, resilience, lustre and colour of Damani wool fibres. These characteristics were compared with those of ideal carpet wool reported from abroad and also with those of local wools already considered by different workers to be of good quality for carpet pile yarn. The results show that Damani wool is almost ideally suited for manufacture of wool carpets.

Wools used in the manufacture of carpets and rugs are mostly produced in Asia Minor, South America, Iran, Afghanistan, India, Pakistan and other countries where the native sheep possess coarse, wiry tough fleece.¹ A carpet wool sample usually consists of four different types of fibres viz. true, heterotypical, medullated and kemp, its length usually ranges from 1 to 10 in and its dia from 20 to 70 μ . Such wools are also usually associated with a wide range of lustre, strength, crimp and resilience characteristics. In Pakistan, the majority of sheep breeds produce carpet wool; exports in 1967-68 were at Rs.38,919,000 for raw carpet wool and Rs. 30,483,000 for traditional handmade carpets. The rest of the wool is utilised, within the country, in manufacturing low to medium type woollen cloth, and hand as well as machine-made carpets.

Burns, Johnston and Chen³ in trying to characterise an ideal carpet wool type, made a study of five samples of Chinese wool and compared them with vicane and Aleppo wools, which were considered by the industrialists to be the ideal types of carpet wool.

In Pakistan, investigations on the utilisation of raw Pakistani wool and hair were first made by Haq⁴ who furnished data on the fineness of fifteen varieties of Pakistani wool. Next Ishaq and Ali⁵ reported data on the percentage of nonmedullated and medullated fibres. This was followed by a number of investigations⁶⁻¹⁰ concerning different physical characteristics of Pakistani wool and their utilisation in carpet manufacture.

The present work deals with physical characteristics of Damani wool i.e. its length, diameter, medullation, strength, resilience, lustre and colour. The suitability for carpet pile yarn has been assessed by comparison with an ideal carpet wool and with other indigenous carpet wools.

Material and Methods

Damani wool samples were collected in spring (March-April, 1968) shearing season from D.I. Khan Distt, the home-tract of the breed. Samples were also collected from some parts

of Peshawar and Bannu District where it is found in a less pure form. The samples were collected from some 50 flocks.

Scouring.—Samples were dusted before scouring which was carried out in bags made of "malmal", a local fine cotton cloth. In order to avoid felting, the powder detergent "Surf" was employed (two tablespoons of detergent in 6 l of water) during the scouring operation, keeping the temperature of the scouring solution at 45°C. All the samples in bags were then washed with water, rinsed in a scouring machine with squeeze rollers and air dried in sun-light.

Medullation.—Representative samples were tested for medullation. The three types of wool i.e. true, heterotypical and medullated were separated with the help of the benzene test.¹¹ Each sample of 0.06 g was sorted and counted for different types of fibres and the percentages calculated.

Diameter.—The diameter was measured with a "Lanometer" at a magnification of $\times 500$. Out of the fibres sorted as above, 20-25 fibres of each type were withdrawn at random, aligned on slides and covered by cover slips using Canada balsam. Each whole fibre was divided into five places and the average of each of five readings of five places along the length of each fibres was calculated.

Strength.—Tensile strength was measured with the help of a dynamometer.¹² The machine was hydraulically operated and the water flow was maintained in such a way that the time to break the fibres was 20 sec, the length of the fibre between the two clamps being set accordingly. Twenty to twenty-five fibres from each type of fibres of all the wool samples were tested.

Resilience.—0.5 g of scoured wool was loaded into a cylinder,¹³ 1 in dia 2 in length and with a bore of 1/2 in dia. To perform the test, the small piston was inserted into one side of the cylinder having the wool samples, while the large piston was inserted into the other side of the cylinder. The wool assembly was placed in a hydraulic press and a load of 3,000 lb/in² was applied. Before applying pressure, a load of 10 g was placed on the top of the piston and the length of the wool pellet measured. After applying pressure, the wool 'pellet' was pulled out by a specially devised puller.

The instant percentage length recovery of the wool pellet and the recovery after 5, 10, 15, 20, 25, 30 min, and 1 and 24 hr was measured. The percentage recovery was defined as:

$$\text{Percentage recovery} = \frac{\text{Height of pellet after release of pressure at different intervals}}{\text{Original height of pellet under 10 gwt}} \times 100$$

Length.—For measuring length, the fibres were stretched out along a meter rod and the distance between the two ends was noted. The length of twenty-five fibres of each fibre type was determined in each of the 50 samples and the average calculated.

Results and Discussion

Length, strength, medullation,¹⁴ diameter, resilience, colour and lustre are the main characteristics of wool to be taken into consideration for carpet pile yarn. The length of fibres play an important part in processing¹⁵ and accordingly

combing and clothing wools are classified according to their length. Similarly a minimum fibre length is necessary for woollen yarn used in carpet manufacture in order to make up an irregular fibre bunch which will not collapse when compressed. It is necessary that woollen yarn used in carpet manufacture should have sufficient strength to withstand the impact stresses of short duration,¹⁶ caused by walking on the carpet, and constant stresses of long duration caused by furniture. A certain degree of medullation, due to the presence of heterotypical and medullated fibres, is necessary for carpet yarn since coarse fibres are more springy in nature and have more ability than fine fibres to restore their original position after being compressed. The coarse fibres offer more resistance to compression and exhibit a stronger tendency to regain the original state than do the fine fibres.¹⁷ The value of woollen carpets would thus seem to lie largely in their resilience characteristics. Further, in order to obtain uniform dyeing, it is necessary that the wool should be white. Similarly lustre could also be considered important in carpet

TABLE 1.—PERCENTAGES OF EACH FIBRE TYPE OF DAMANI WOOL DETERMINED BY COUNTING AND WEIGHING.

	True		Heterotypical		Medullated	
	Count	Wt	Count	Wt	Count	Wt
	60.5	66.2	14.3	23.6	17.8	15.2
	60.2	64.1	13.9	33.3	18.3	13.1
	52.5	59.7	12.5	30.5	19.0	12.8
	54.7	60.8	14.6	20.3	16.9	15.2
	80.2	44.5	15.3	18.0	17.8	8.6
	80.0	49.0	19.1	35.5	25.2	8.6
	54.0	61.2	17.1	25.8	22.8	12.0
	55.6	50.5	16.0	28.4	23.9	11.9
	56.0	57.2	15.6	20.0	21.0	18.8
	75.3	55.4	13.8	30.1	22.3	17.5
Mean	64.8	56.9	15.2	26.2	20.0	13.3

TABLE 2.—PERCENTAGES OF EACH FIBRE TYPE IN LEADING CARPET WOOLS DETERMINED BY COUNTING AND WEIGHING AND COMPARISON WITH DAMANI WOOL.

Types	True		Heterotypical		Kemp or medullated		Coloured	
	Count	Wt	Count	Wt	Count	Wt	Count	Wt
Romney	100.00	100.00	—	—	—	—	—	—
Lanchow	91.03	74.49	5.89	13.18	3.08	12.33	0.00	0.00
Tree sining	88.65	42.84	9.14	46.19	0.12	0.23	2.09	10.74
Szechwan	87.12	57.65	5.80	27.85	7.08	14.50	0.00	0.00
Mixed sining	84.66	61.51	3.93	16.42	11.35	22.02	0.06	0.05
Woosung	83.72	55.56	0.00	0.00	16.27	44.37	0.01	0.07
Aleppo	74.69	43.82	18.87	52.30	2.86	3.15	3.58	0.73
Vicanere	59.22	23.23	40.67	76.67	0.11	0.14	0.00	0.00
Damani	64.8	56.9	15.2	26.5	20.0	13.3	—	—

manufacture, as it influences the beauty and vividness of colour and appearance of the carpet.

Table 1 shows percentages of each fibre type in Damani wool determined by counting and weighing. Table 2 gives percentages of each fibre type in leading carpet wools in comparison with average values for Damani wool. Table 3 gives an assessment of the suitability of Damani wool for carpet manufacture by comparison of length, diameter and medullation with the tentative standards given by Burns, Johnston and Chen.¹⁷ True, heterotypical and medullated fibres of Damani type are 1.20 in, 2.70 in, and 2.04 in long for 6 months growth with a coefficient of variation of 16.68%, 11.91% and 10.85% respectively. An

ideal true wool should have an average length of at least 4 in for normal growth (12 months) and the variation in fibre length should not exceed 25%. Similarly, an ideal heterotypical wool should have at least 4 in length for normal growth (12 months) and the variability of fibre length should be less than 20%. The diameter of the true, heterotypical and medullated wool fibres is 26.1 μ , 35.4 μ and 88.0 μ , with a coefficient of variation of 13.5%, 13.6% and 19.8% respectively. As against this, ideal true wool fibres should have an average thickness of 25.4 μ and the variation in fibre thickness should not exceed 25%. Heterotypical fibres of an ideal carpet wool should have an average thickness of 30 μ and the fineness should not vary

TABLE 3.—ASSESSING SUITABILITY OF DAMANI WOOL FOR CARPET MANUFACTURE BY COMPARISON OF LENGTH, DIAMETER AND MEDULLATION WITH TENTATIVE GUIDE ESTABLISHED BY BURNS-JHONSTON-CHEN.

Characteristics	Damani wool			Tentative guide established by Burns-Jhonston-Chen.		
	True	Heterotypical	Medullated	True	Heterotypical	Kemp
Length (inches)	1.20 (6 months growth)	2.70 (6 months growth)	2.04	4.00 (12 months growth)	4.00 (12 months growth)	—
Variation (%)	16.68	11.91	10.85	25.00	20.00	—
Diameter (μ)	26.1	35.4	88.0	25.4	30.0	—
Variation (%)	13.5	13.6	19.8	25.0	15.0	—
Percentage medullation (by count)	64.8	15.2	20.2	85.0	15.0	2.0
Percentage Medullation (by wt)	51.7	25.0	10.5	65.0	35.0	4.0

TABLE 4.—COMPARISON OF DAMANI WOOL WITH OTHER PAKISTANI WOOLS FOR TENSILE STRENGTH AND GENERAL CHARACTERISTICS.

Type of breed	True		Heterotypical		Medullated		Uses
	Dia μ	Tensile strength kg/cm ²	Dia μ	Tensile strength kg/cm ²	Dia μ	Tensile strength kg/cm ²	
Hashtnagri	25.2	1590	40.2	1378	51.8	1057	Carpet, blanket and apparel
Terahi	20.2	2261	39.2	2500	79.2	849	do
Makrani	27.2	2462	33.5	2627	60.5	1182	Carpet and blankets. Carpet
Lohi	26.8	719	39.8	259	66.8	419	Could be used in carpet manufacture
Damani	26.4	1995	39.6	2139	88.0	558	

TABLE 5.—PERCENTAGE RECOVERY (RESILIENCE) AT DIFFERENT INTERVALS OF TIME OF DAMANI WOOL FIBRES.

Instant	0-5 min	5-10 min	10-15 min	15-20 min	20-30 min	30-60 min	24 hr
33.4	40.0	46.7	46.7	53.4	53.4	53.4	55.0
27.8	33.4	38.9	44.5	44.5	44.5	50.0	50.0
31.3	31.3	37.5	37.5	43.8	43.8	43.8	45.0
43.8	50.0	57.8	57.8	57.8	59.9	60.0	61.8
38.9	38.9	44.5	44.5	44.6	44.6	45.1	46.0
25.9	25.9	31.6	31.6	36.9	36.9	36.9	37.1
25.4	25.4	38.5	38.5	38.5	46.2	46.2	47.2
33.4	33.4	40.0	40.0	46.7	46.7	47.3	48.1
29.5	35.8	35.8	35.8	37.0	37.0	37.2	39.1
27.8	28.9	30.2	31.2	31.5	31.5	34.1	35.1
Mean:	31.7	34.3	40.2	40.8	43.5	44.5	46.4

more than 15%. The dimensional characteristics of kemp fibres are not so important. The percentage of true, heterotypical and medullated fibres in Damani wool is 64.8%, 15.2% and 20.2% respectively by count and 51.7%, 25.0% and 10.5% by weight, whereas an ideal carpet wool should not contain more than 85% by count or 65% by weight of true wool fibres. Similarly, an ideal carpet wool should contain at least 15% by count or 35% by weight of heterotypical fibres.

Table 4 shows tensile characteristics of different types of Pakistani wool and their general uses, especially in carpet manufacture. These measurements were reported by previous workers. From the table Damani wool appears to be of an average type.

Table 5 shows percentage recovery (resilience) at different intervals of time ranging from instant recovery up to 24 hr recovery. The average recovery of these samples ranges from 31.7% to 46.4% with an average percentage recovery of 40.8.

Damani wool fibres have a silky lustre and white colour and could be dyed easily with attractive shades.

Taking into consideration all the above characteristics of Damani wool and comparing these with other Pakistani wools already established as good types of wool for carpet production it seems that the wool could be categorised as almost ideal for carpet manufacture.

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