STUDIES ON SOME OF THE CHEMICAL CHARACTERISTICS OF HASHTNAGRI WOOL FIBRES AND THEIR INTERRELATIONSHIP WITH FINENESS

ARJAMAND KHAN AND MUZAFFARUL HAQ

Wool Research Division, North Regional Laboratories, Pakistan Council of Scientific and Industrial Research, Peshawar

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Studies have been made on various samples of Hashtnagri wool, obtained from the home tract of the breed. Eight representative samples were analysed for moisture, ash, nitrogen, sulphur, wool wax, suint and scouring loss. The fineness or diameter of each representative sample was measured. The relationship was established between chemical constituents and fineness or diameter of the wool. It was found that wool with finer fibres contained higher percentages of sulphur, wool wax, suint and scouring loss but a smaller amount of ash than the wool with coarser fibres. In various samples, the moisture content was different whilst the nitrogen content was constant.

Introduction

Samples of Hashtnagri wool were collected from various parts of Charsadda and Mardan Tehsils. This wool is composed of the true, heterotypical, medullated and kempy types and is particularly used for carpet manufacture.

Ahmed[1] determined the vegetable matter of Pakistani wools. Rashid[2] studied the grease contents of various breeds of Pakistani wool and found an inverse relationship with the fineness and staple length. Burhanuddin and Ahmed[3] examined ash content and vegetable matter of Pakistani wool of different colours. Khan, Khan Wakil, and Haq[4] studied certain chemical characteristics of Kaghani wool and found direct relationship between ash content and diameter and an inverse relationship between sulphur content and diameter of the fibre. They also found an inverse relationship between wool wax content and diameter of the fibre.

In view of the fact that no systematic work has been done on the chemical characteristics of Hashtnagri wools, the present work was undertaken to study systematically their chemical characteristics and to correlate the results with their fineness or diameter.

Experimental

Diameter measurements were carried out on Hashtnagri wool fibres at room temperature, the relative humidity being 65 percent approximately. The wool used for the determination of moisture content was scoured by soap and alkali scouring process, whilst solvent-scoured wool was employed for ash, nitrogen and sulphur determination and for the measurement of diameter of individual types of wool fibres.

1. *Soap and Alkali Scouring of Raw Wool.*—The raw wool was scoured in a bath at pH, 10.6 containing 1 g. of detergent ("Surf") and 3 g. sodium carbonate per litre of distilled water. The wool was treated thrice for five minutes each with the prepared scouring solution at successive temperatures of 50°C., 40°C. and 30°C. After the third scouring the wool was rinsed repeatedly with distilled water as recommended by Von Bergen and Mauersberger.[5]

2. *Solvent Scouring of Raw Wool.*—The raw wool (10 g.) was scoured for five minutes thrice with fresh benzene 500 ml. at a time in a one-litre beaker. The wool was then air-dried and treated with warm water (50°C).[6]

3. *Diameter Measurements.*—Fibre diameter was measured by means of a projectional microscope at a magnification of × 500. Twenty fibres of each true, heterotypical and medullated wool were withdrawn from a representative sample. They were cut into pieces aligned on a microscope slide and covered by a coverslip which was secured by glycerine. The average diameters of the three types of fibres were found and recorded as in Table 1.

4. *Moisture Content.*—The moisture content was determined by means of the oven method. About 5-6 g. of the wool sample were heated at 105-110°C. for 5 hours to constant weight in an air oven. The moisture content was expressed as a percentage of the weight of the sample before drying.

5. *Ash.*—For the determination of ash percentage, the wool sample (4-5 g.) was first heated at 105°C. in a covered porcelain crucible over a burner until swelling ceased. The crucible was then heated in a muffle furnace at about 800°C. for about 4 hours until the ash attained a constant weight as shown by cooling the crucible in a desiccator and weighing. The ash content was calculated on the weight of the oven-dried sample.

6. *Nitrogen.*—The nitrogen content was determined by the microkjeldahl method recommended by A.O.A.C.[7]

TABLE 1.—PERCENTAGE CONTENT OF CONSTITUENTS OF HASHTNAGRI WOOL HAVING FIBRES OF DIFFERENT DIAMETERS.

Sample	Diameter μ	Moisture %	Ash %	Nitrogen %	Sulphur %	Wool wax %	suint %	Scouring loss%
				GROUP A				
1.	28.6	9.2	2.06	14.8	3.60	0.90	10.80	18.7
2.	31.1	9.8	2.25	14.8	3.55	0.82	10.80	18.0
3.	33.4	8.2	2.27	14.8	3.50	0.76	10.20	19.6
4.	35.2	9.6	2.34	14.9	3.50	0.63	8.00	18.1
Mean	32.07	9.2	2.23	14.3	3.54	0.78	9.95	18.6
				GROUP B				
5.	42.4	9.5	2.62	14.7	3.10	0.52	8.60	18.6
6.	44.8	9.7	2.72	14.5	2.74	0.48	7.40	14.8
7.	48.3	9.5	3.00	14.6	2.70	0.39	6.60	18.0
8.	54.5	7.7	3.21	14.6	2.62	0.20	4.40	15.8
Mean	47.50	9.1	2.89	14.6	2.79	0.39	6.75	16.8
Mean of all samples	39.78	9.15	2.56	14.7	3.16	0.58	8.35	17.7

7. *Sulphur.*—The sulphur in wool samples was determined according to the method recommended by Trotman and Trotman's modification of the Benedict and Denis procedure.[8,9]

8. *Wool Wax and Suint.*—Raw wool was first treated with warm (50°C.) water to remove suint and then with light petroleum (b.p. 50-70°C.) to remove wool wax. About 9-10 g. of raw wool sample were repeatedly stirred in three successive portions of 300 ml. of warm water for five minutes to remove suint. The wool was then dried for wool-wax determination. The suint solution was filtered and the filtrate evaporated to dryness and the residue weighed.

For wool-wax determination, the sample, free from dirt and suint etc., was placed in a filter-paper thimble in a soxhlet apparatus and extracted by means of light petroleum for 5 hours, the petrol extract was filtered, the container rinsed repeatedly with light petroleum, and the solvent recovered by distillation. The wool wax so obtained was dried in an air oven for half-an-hour at 105±2°C. The flask was then placed in a desiccator, cooled, and weighed. The percentage of wool wax and suint was calculated on the basis of the weight of residual clean wool free from dirt, earth, vegetable matter, wool wax and suint.[10]

9. *Scouring Loss.*—Scouring loss was determined according to the method as recommended by Lomax.[11]

Results

Table 1 shows the results of analysis of the samples arranged according to the increasing order of diameter of fibres. The average values of eight experiments for diameter and each chemical constituent of individual representative samples have been recorded.

Discussion

The present investigation was undertaken to study systematically the chemical characteristics of Hashtnagri wool fibres and to relate the chemical properties with the fineness or diameter of the fibre. The method of Gore[12] is applied to the statistical analysis of the results.

From the results shown in Table 1, it is found that the moisture content in Hashtnagri wool samples ranges from 7.7 to 9.8 percent (average 9.15 percent). The moisture content is in no way related to the diameter of the wool fibre.

The average ash content of samples was found to be 2.56 percent varying from 2.06-3.21 percent. There is a marked relationship between ash content and diameter of the fibre (coefficient of correlation +0.993). The ash content increases directly with the diameter of the fibre (Fig. 1).

The nitrogen content of the various samples is almost constant (the limit being 14.5-14.9 percent) and does not vary with the diameter of the fibre.

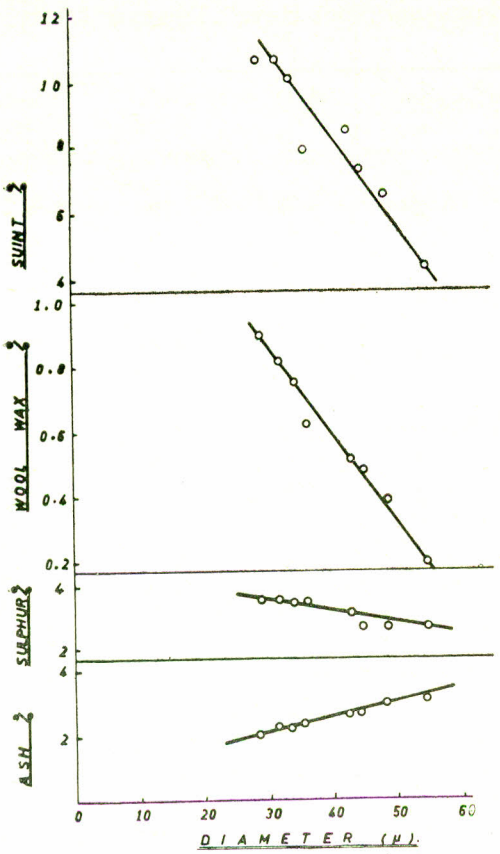

Fig. 1.—Relationship between the diameter (μ) and percentage of ash, sulphur, wool wax and suint in Hashtnagri wool fibres.

The sulphur content varies from 2.62-3.60 percent, the average being 3.16 percent. It is observed that the sulphur content increases with the decrease of diameter (Fig. 1).

The wool wax content has an average value of 0.58 percent (range 0.20-0.90 percent). There is a significant correlation between wool wax and diameter of the fibre (coefficient of correlation-0.990). The wool wax content increases with decrease in the diameter of the fibre (Fig. 1). The higher wool wax percentage of the finer fibres is possibly due to a larger number of sebaceous glands present per unit area of the skin. The suint content in Hashtnagri wool fibres ranges from 4.4-10.8 percent, the average being 8.35 percent. There is an intimate relationship between suint content and diameter of the fibre (coefficient of correlation-0.949). The suint content in Hashtnagri wool fibres increases as the diameter decreases (Fig. 1). The higher suint percentage of the finer fibres is considered to be due to larger number of wool fibres growing per unit skin area of the fibres per unit weight. Wool fibres in their natural state are associated with wool wax and suint in amounts depending on the quality of the wool.

The last characteristic is the scouring loss. The average scouring loss in the wool samples examined is 17.7 percent (range 14.8-19.6 percent). When the samples shown in Table 1 are split into two groups, A and B, of 4 samples in each group, it is then clear that the mean diameter of the group A is 32.07μ with an average scouring loss of 18.6 percent, whilst in group B the respective averages are 47.50μ and 16.8 percent. Thus the finer fibres show a higher scouring loss than the coarse fibres; this is to be expected from the higher contents of wax and suint in the finer fibres.

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