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The Cystine Content of Merino Wool in Relation to its Physical Attributes.

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Introduction.

The cystine content of Merino wool is approximately 12 per cent. and although several research workers have studied the source and formation of this constituent, the function of cystine in Merino wool production from nutritional and physiological aspects has not yet been defined. In the present contribution it is not intended to deal with this aspect of the problem but to discuss the results mainly with regard to the relationships between the physical attributes of wool and its cystine content. These physical attributes largely determine the uses to which Merino wool may be put and are valuable assets either during the processes of wool manufacture or in the finished fabric. Should the cystine content of Merino wool be a modifying factor in its physical attributes, quantitative variations in cystine would have important applications in methods of wool production.

In the present investigation a series of selected Merino wool samples which differ from one another in their physical attributes has been analysed. The cystine content is compared with such characteristics as Tensile Strength, Fibre Resilience, Fibre Fineness, Crimping, Scaliness, Percentage Extension and Whiteness.

Review of Literature.

Few figures are available on the correlations between the cystine content of Merino wool and its physical attributes. Several workers have analysed wool for sulphur content instead of cystine, but since it has been shown by Rimington (1929) and later by Barritt (1934) who allowed for the methionine content, that the sulphur content of wool can be converted into cystine, the relevant work dealing with the sulphur content of wool has a direct bearing on the present contribution.

Barker (1929) in discussing the ideal fabric and the manufacturing properties of wool asserted " that for an extensive series of wools of different types there is a significant variation in sulphur content, which is undoubtedly caused by biological, environmental and other influences, and which imparts to the fibre considerable variations in its response to textile processes ". After discussing the variations in the sulphur content of different wools Barker goes on to say that " it is significant that high sulphur content is accompanied by a lower regain of wool and it is certain that breed, environment and pathological condition of the animal play prominent parts in its development ". Also " a high sulphur content is desirable and it would seem to be the first difficulty in the production of our ideal fabric as to how to obtain it ".

Sidey (1931) analysed two classes of New Zealand wools for sulphur, the one lot being designated by the trade as a good processing wool and the other a fair processing lot. He found an insignificant difference between the two sets in their sulphur content.

Bonsma and Joubert (1934) working on Merino sheep found an insignificant correlation of 0·572 between the sulphur content and fibre fineness and there appeared to be no correlation between sulphur content and " quality " in Merino wool, apart from the fact that medullated fibres are inclined to be low in sulphur.

Van Wyk, Botha and Bekker (1935), while studying the effect of supplements of different forms of sulphur in the diet of Merino sheep, found that, when the animals were dosed such supplements as cystine, sulphates, KCNS and S, there was no response in their scoured fleece weights, mean fibre lengths, fibre thickness and mean fibre weights of shoulder samples. Subsequent work by Botha (unpublished) on the cystine content of the experimental wools showed no correlations between the groups, so that the abovementioned physical attributes did not appear to be correlated with the cystine content of the wools.

Smith and Harris (1936) oxidised wool artificially with hydrogen peroxide and as a result the cystine dropped from 11·6 to 8·4 per cent. They also found that " the oxidation alone showed no significant effect on the sulphur content, wet breaking strength, and resiliency of the wool ".

Swart (1936) when feeding sulphur to Merino sheep found that although the sulphur content of Merino wool was a variable quantity, no relationships could be established between sulphur content and staple length, diameter of fibre, extensibility, or crimps per inch.

McMahon and Speakman (1937) working on New Zealand Romney wool, found differences between the tips and roots of fibres in so far as their sulphur contents were concerned. They also found differences between the tips and roots of fibres in their relative degrees of " set " Their figures for variation in the sulphur content when converted into cystine content range from 11·8 to 12·6 per cent. and agree with those found in the present work.

METHODS.

Cystine was determined by the modified Sullivan method of Rossouw and Wilken-Jorden (1934). Approximately 1 gram of degreased and well-washed wool was freed of vegetable matter and sand by handpicking under distilled water with forceps in a large dish. The wool was collected on a G2 Jena fritted glass filter which was dried by suction and conditioned in the Constant Humidity chamber until constant weights were reached. The wools were then dissolved in ten times their weights of 6 N,HCl and placed in a controlled autoclave at 145° for 3 hours. It was shown that this was sufficient time for complete hydrolysis without apparent loss of cystine. The hydrolysate was filtered through G3 Jena fritted glass filters, washed and made up to suitable volume such that 5 ml. of the solution should provide approximately ·4 mg. of cystine. The colorimetric determination was carried out in the Constant Humidity Chamber at a constant temperature of 70° F. (It has been shown that a constant temperature is necessary in the colour development.) The cystine is expressed as a percentage of the clean dry wool.

In each case an average of three readings was taken for the sample, which system proved to be a reliable one. It was also shown statistically that there was a greater variation between groups constituting the average than there was within the groups, so that a real difference exists among Merino wools in their cystine contents.

Physical Attributes.

These were determined in the Constant Humidity Chamber at 70 per cent. Relative Humidity and 70° F. The methods employed and apparatus used at Onderstepoort have already been described (Bosman 1938) therefore only an outline of the methods used in this work are given here.

The tensile strength and percentage fibre extension were determined on the Doehner apparatus and the methods of sampling the wools used in the study are those described by Bosman, Waterston and van Wyk (1939).

The Fibre Resilience, expressed as the energy necessary to compress 5 grams of clean wool by 50 per cent. was determined by the Pendultex Apparatus devised by Henning. A detailed method of analysis is described by van Wyk (1939).

Fibre Fineness was determined on a Zeiss Lanameter. The crimping was measured as number of crimps per inch. Scaliness was determined by an apparatus designed after Speakman, the technique of sampling, mounting of slides and interpretation of readings being that described by Bosman and van Wyk (1939).

The degree of whiteness expressed as a percentage of standard white, was determined by the apparatus designed by Henning, where the white light is determined by the current set up in a photo-electric cell, care being taken that all the samples were cleansed of impurities by a standardised method.

Experimental Results.

The results of the analyses are summarised in Table 1, where it is shown that the cystine content varies from 10·86 to 12·75 per cent. with a mean of 12·02 and a coefficient of variability of 3·9 per cent. This variation is comparatively small when it is compared with that of the tensile strength (7·8 per cent.) or Resilience (22·3 per cent.) or the Fibre Fineness (11·0 per cent.) or Crimps per inch (12·9 per cent.) or scaliness (16·6 per cent.) or extension at break (13·6 per cent) or Whiteness (6·8 per cent.). It must, therefore, be concluded that the cystine content of Merino wool varies less than do the physical characteristics enumerated.

Table 1.

The Cystine Content of Merino Wool in Relation to Certain of its Physical Attributes.

Sample.	Cystine Content.	Tensile Strength Gms/ $CC^2 x 10^6$	Resilience Kg/cm.	Fibre Fineness (μ).	Crimping per Inch.	Scaliness.	Extension.	Whiteness.
	Per Cent.					Per Cent.	Per Cent.	Per Cent.
47.........	10·86	0·88	1·99	17·62	10–11	76·7	78·25	57·8
25.........	12·52	1·19	5·15	23·15	13–14	45·4	61·47	54·7
37.........	11·87	1·43	3·31	22·09	10–11	67·0	69·10	59·1
21.........	11·51	1·43	2·97	21·35	10–11	79·1	69·05	56·3
48.........	11·74	0·98	2·83	19·90	13–14	76·0	78·58	56·3
62.........	12·08	1·22	3·79	26·05	10–11	73·8	83·00	59·0
111.........	11·23	1·22	2·79	18·17	12–13	65·4	51·52	58·5
120.........	11·94	1·09	3·47	22·92	11–12	61·6	58·23	52·1
29.........	12·30	1·08	4·60	25·94	10–11	52·5	80·62	65·7
14.........	12·47	1·39	5·01	17·28	—	-	52·85	55·6
51.........	11·83	0·90	3·64	19·75	15–16	55·4	89·45	53·3
45.........	11·83	1·18	3·52	—	—	—	73·83	52·9
46.........	12·60	1·12	2·10	20·26	—	64·9	83·33	58·5
20.........	11·73	1·33	3·09	21·29	9–10	86·5	69·78	54·5
22.........	11·37	1·33	3·06	21·74	9–10	82·6	67·07	53·4
32.........	11·90	1·39	4·38	18·77	12–13	65·4	70·17	64·1
71.........	12·20	1·11	3·67	24·50	12–13	65·3	65·0	54·1
5.........	12·75	1·13	3·16	18·36	14–15	68·5	67·75	58·0
9	12·55	1·47	3·68	20·68	12	78·4	56·92	59·1
40	12·45	1·04	2·56	20·59	9–10	81·9	68·43	48·7
35.........	11·97	1·47	3·56	21·81	9–10	-	65·15	57·2
36.........	11·90	1·53	3·40	20·72	10	61·4	65·72	57·0
27.........	12·47	1·51	4·06	24·15	12	47·7	72·83	59·1
10.........	11·95	1·48	3·88	20·56	11–12	63·6	63·68	62·4
19.........	12·45	1·47	3·85	19·62	14–15	74·6	67·75	62·4
Means.......	12·02	1·25	3·50	21·14	11·66	67·9	69·18	57·2
S.D.........	·467	·976	·781	2·409	1·499	11·242	9·428	3·906
Coeff. of V...	3·9%	7·8%	22·3%	11·0%	12·9%	16·6%	13·6%	6·8%

A comparison of the coefficients of correlation between cystine and the physical attributes are given in Table 2.

TABLE 2.

Showing Coefficient of Correlation (r).

	Tensile Strength.	Resilience.	Fibre Fineness.	Crimping.	Scaliness.	Extension.	Whiteness.
Cystine.............	·1714	·4509	·2181	·3281	·2242	·0705	·1026
Degrees of Freedom..	23	23	22	20	20	23	23

According to Fisher's Table of r:—

	when P = ·05	when P = ·01
and when $n=23$ then $r=$	·3951	·4999
,, $n=20$ then $r=$	·4227	·5368

The only significant correlation (at P = ·05) is that between cystine and resilience with a value of ·4509. The characteristics of tensile strength, Fibre Fineness, Crimping, Scaliness, Extension and Whiteness bear no definite relationships to the cystine content.

SUMMARY AND CONCLUSIONS.

A series of selected Merino wool samples that differ markedly in their physical attributes were analysed for cystine.

The results show no significant correlations between the cystine content and Tensile Strength, Fibre Fineness, Crimping, Scaliness, Percentage Extension or Whiteness. This is contrary to the findings of certain other workers.

There is a certain significant correlation (at a 5 per cent. level) between cystine content and resilience. The value of this correlation is, however, not high.

It is concluded that the rôle of cystine in wool production is not an important one, and that the possibility of improving wool characteristics via the cystine content does not appear to be great.

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