X. THE RELATION BETWEEN CYSTINE YIELD AND TOTAL SULPHUR IN KEMP AND OUTER-COAT ANIMAL FIBRES.

By CLAUDE RIMINGTON.

*From the Biochemical Department, Wool Industries Research Association,
Torridon, Headingley, Leeds.*

(Received December 13th, 1930.)

IN previous publications [Rimington, 1929, 1 and 2] it has been shown that practically the entire sulphur of purified wool and animal hair can be accounted for as cystine, the latter being determined colorimetrically and its quantity compared with the total sulphur of an aliquot portion of the hydrolysate. Several different varieties of wool and of hair were examined with identical results. It was noted, however, in the case of some animal hairs, more particularly of a sample of camel hair, examined, that the agreement between sulphur and cystine values was less close than in the case of true wool fibres. Such a difference might possibly be explained on the ground that the medullary cells of the hair shaft contain sulphur compounds other than cystine. Medulla is present in most animal hairs; it is absent however from true wool fibres.

In order to test this possibility and to complete the series of observations already reported, it was decided that an examination should be made of some typical kemp, of lambs' birth-coat, which is also medullated, and of further samples of camel hair. The investigation was rendered difficult by the necessity of sorting each sample by hand; in some cases it took several weeks to pick out sufficient material for analysis. In the case of camel hair, and Scotch blackface wool, one is also confronted by the difficulty of classification, nearly all gradations being met with between true wool and true kemp.

EXPERIMENTAL.

Each sample, after separation, was degreased in warm benzene and washed in the manner already described [Rimington, 1929, 1]. Samples of 1 g. were taken for hydrolysis. These were boiled for 5 hours with 20 cc. of 20 % hydrochloric acid. Two portions of 5 cc. each were then withdrawn for determination of total sulphur content, which was carried out by Rimington's [1930, 1] modification of the Benedict-Denis method for the determination of sulphur in urine. Another 5 cc. sample was measured into a 50 cc. graduated flask, diluted somewhat and brought to about *N*/10 acidity by cautious addition of 20 % sodium hydroxide solution. After filling to

50 cc. and filtering, this solution (2 cc.) was employed for the colorimetric determination of cystine, Folin and Marenzi's method as amended by Rimington [1930, 2] being employed.

Since, by Folin and Marenzi's [1929] technique it is now possible to obtain a reagent free from molybdenum compounds and giving no colour with pure tyrosine, this method is to be preferred to that of Sullivan [1926], which is technically somewhat difficult and which gives only a limited proportionality between colour intensity and cystine concentration. In the present study it was not considered necessary to employ Sullivan's method at all since earlier work [Rimington, 1929, 1] had shown the absence from hirsute structures of disulphide linkages other than those due to cystine. Where determinations were made of the total sulphur of the dry material, these were carried out as described in previous publications.

The results are recorded in Table I.

Table I. *Hydrolysis of 1 g. material by 20 cc. of 20 % HCl for 5 hours.*

Material	Total S % dry wt.	Cystine in hydrolysate by Folin-Marenzi- Rimington method	Total S of hydrolysate (as cystine)	Ratio*
		g.	g.	
Camel hair (kemp-free) I	3.25	0.1100	0.1169	+ 5.90
„ kemp I	—	0.1030	0.1134	+ 9.17
„ kemp II	—	0.1013	0.1055	+ 3.98
„ (mixed sample of 6 g.)	3.25	0.5510 (Sullivan)	0.5908	+ 6.73
Welsh Mountain wool	4.08	0.1260	0.1255	- 0.40
„ kemp	—	0.0975	0.0988	+ 1.32
„ birth-coat I	3.06	0.0957	0.0954	+ 0.31
„ birth-coat II	2.72	—	—	—
Scotch blackface kemp	—	0.0787	0.0811	+ 2.96

* $\frac{\text{Total S of hydrolysate as cystine} - \text{cystine (colorimetric)}}{\text{Total S as cystine}} \times 100.$

DISCUSSION.

Only in the case of camel hair can it be said, on reference to Table I, that there is any significant difference between the cystine content of kempy material (medullated fibres) as determined directly and by calculation from the total sulphur content. The differences noted in the case of Welsh mountain wool, kemp and birth-coat are well within experimental error.

The series is somewhat limited on account of the difficulty of obtaining sufficiently large quantities of kemp from normally fine-woolled sheep. It appears however that kemp, containing a large proportion of medullary cells, resembles non-medullated sheep's wool in containing no significant quantities of any sulphur-containing amino-acid other than cystine.

Camel hair, both inner and outer coat, as previously found shows evidence of non-cystine, sulphur-containing compounds. In this connection it should

be remembered that these fibres contain a dark, reddish-brown pigment and it is not improbable that this pigment itself contains sulphur.

The total sulphur content of Welsh mountain lambs' birth-coat is very considerably less than that of the wool of the same breed, just as the "puppy coat" of rats is less rich in cystine and sulphur than the corresponding hair of the adult [Lightbody and Lewis, 1929]. Rabbits' fur also increases in sulphur content with increase in the age of the animal [Düring, 1897]. It appears, in agreement with Barritt and King [1926], that the medullary cells are less rich in cystine than are the cortical cells of the fibre.

SUMMARY.

1. Samples of Scotch blackface kemp, Welsh mountain wool, kemp and lambs' birth-coat have been examined and in all cases practically the entire sulphur could be accounted for as cystine.

2. In the case of two separate samples of camel hair, both true hair (inner coat) and coarse outer-coat fibres contained more sulphur than could be accounted for as cystine. It is suggested that the brown-red pigment present in these samples may account, in part at any rate, for the discrepancy.

The author wishes to thank Mr A. T. King for his continued interest in the subject of this work, and Mr H. Rothera for valuable help in the preparation of the material.

REFERENCES.

- Barritt and King (1926). *J. Text. Inst.* **17**, 386 T.
Düring (1897). *Z. physiol. Chem.* **22**, 281.
Folin and Marenzi (1929). *J. Biol. Chem.* **83**, 103.
Lightbody and Lewis (1929). *J. Biol. Chem.* **82**, 485.
Rimington (1929, 1). *Biochem. J.* **23**, 41.
— (1929, 2). *Biochem. J.* **23**, 726.
— (1930, 1). *J. Soc. Chem. Ind.* **49**, 139 T.
— (1930, 2). *Biochem. J.* **24**, 1114.
Sullivan (1926). *U.S. Public Health Rep.* **41**, 1030.