THE CHEMICAL COMPOSITION OF CATTLE HAIR. I. THE FAT, ASH AND NITROGEN CONTENT[1]

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Practically nothing is known about the composition of cattle hair although considerable use in identification and diagnosis apparently is made of chemical and microscopic analyses of hair from other species, including man. In connection with some detailed analysis to determine the melanin and mineral composition of cattle hair estimates were made on the amount of fat, ash, and total nitrogen.

EXPERIMENTAL PROCEDURE

Hair samples were cleaned before analysis by boiling for one-half hour in a 0.5 percent dreft solution followed by rinsing with hot water. The hair was then dried at 100°C and subsamples were used in the determination of ash and nitrogen. The determination of ash consisted of ashing a known amount of the cleaned hair for one hour in a muffle furnace at 540°C. Nitrogen determinations were made on a Kjeldahl apparatus.

The hair for the analysis of fat was treated in three different ways as indicated in table 1, *i.e.*, (1) washed in hot water followed by washing in 0.5 percent boiling dreft solution for ½ hour, rinsed and dried; (2) washed in boiling 0.5 percent dreft solution for ½ hour, rinsed and dried; and (3) rinsed in lukewarm water and dried. Method 2 was the method of choice in determining fat, ash, nitrogen and later melanin. Subsamples of hair for fat determination were extracted in petroleum ether for 96 hours using a Soxhlet extractor.

RESULTS AND DISCUSSION

The mean values for fat, ash and nitrogen are presented in table 1 along with the range for each set. The method of preparing the hair appears to have a significant effect on the values obtained for fat and indicates the importance of a standard procedure. The effect on ash and nitrogen would be similar. It can be noted that the nitrogen content of cattle hair is but slightly lower than the values for human hair given by Hawk *et al.* (1947).

In table 2 are summarized the values for means and standard errors for the ash content of cattle hair of different colors. Black hair, from cattle either carrying the recessive gene for red or those thought to be homozygous for its allele, was significantly higher in its ash content than hair from cattle that were brown (tan), red or white. The mean for black hair thus appears to be approximately 2.4 percent and of white, red or brown hair to be within the range of 1.4 to 1.6 percent. Further effort is being put forth to determine whether one or more specific elements are involved in this difference and also to ascertain whether or not there are elemental differences between hairs of other colors.

By spectographic analysis the following elements were identified: barium, boron, calcium, copper, iron, lead, potassium, magnesium, manganese, phosphorus, silicon, silver sodium and zinc. Potassium was the only element found in some samples that was not found in all. In some samples of white hair it was not identified. The ash of hair from Holsteins (both black and white), Guernseys and Shorthorn-Guernsey crossbreds was inspected.

The principal interest in the nitrogen content was in the melanin fraction. The preliminary melanin values ranged from 1.63 to 11.83 percent and definitely

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appeared to be associated with the color of the hair. An inspection of the data showed no relationships between the nitrogen and melanin values for hair (black, white and tan) from Holstein-Friesians, Angus and Guernseys. A further comparison of the melanin values of hair taken from the same cows from January to October showed considerable difference in some cows but not in others. Hair from identical twins tended to give similar values if taken on the same day and to vary similarly with seasonal changes. It was noted also that the melanin

TABLE 1

The fat, nitrogen and ash content of cattle hair

Constituent	No.	Mean	Range
		(gm/100)	(gm/100)
Fat	6	0.64	0.54– 0.77[1]
"	17	1.49	0.95– 1.90[2]
"	4	2.28	1.10– 3.10[3]
Ash	138	2.04	0.28– 3.08
N	12	13.46	12.40–14.40
"	Human Hair		14.60–15.80 (Hawk *et al., 1947*)

[1]Washed in hot water followed by washing with hot dreft solution (½%).

[2]Washed in dreft solution (½%).

[3]Rinsed in luke warm water.

TABLE 2

The ash content of different colored cattle hair

Color	No. of Samples	Ash Mean	S.E.
		(gm/100)	
White	24	1.408±	.0113
Red	22	1.662±	.1910
Brown	14	1.668±	.0365
Black (R.C.)	45	2.385±*	.0678
Black (x)	33	2.455±	.0748

*Difference highly significant ($P < .01$) from those preceding.

content varied, depending on the area of the body from which it was clipped with the hair from the head being the lowest. To a lesser extent that from the shoulders was the highest. Intermediate values were obtained for the rump, thigh, saddle and neck. Samples for subsequent analyses have been taken from the rump or thigh areas whenever possible. For melanin studies it was found also to be advantageous to brush the area well with a grooming brush before clipping.

SUMMARY AND CONCLUSIONS

An analysis of hair from 177 different cattle showed the average fat, ash, and nitrogen content to be 1.49, 2.04, and 13.46 percent, respectively when the hair was prepared for analysis according to a standard procedure. Hair from different cattle were used for the analysis of each of the three constituents. The washing

procedure prior to extraction with petroleum ether affected the value obtained for fat.

The ash content varied from 1.4 to approximately 2.4 percent, respectively for the mean value of white and black hair. The values for red and brown were intermediate but statistically indistinguishable from the white. Whether or not black cattle carried the gene for red appeared not to affect the ash content of the hair they produced.

From the ash the following elements were identified: boron, barium, calcium, copper, iron, lead, potassium, magnesium, manganese, phosphorus, silicon, silver, sodium and zinc. Potassium was not found in the ash from some of the samples of white hair.

The melanin content ranged from extremes of 1.63 to 11.83 percent as compared to 12.4 to 14.4 percent for total nitrogen, with no apparent relationship between these two constituents. Seasonal variations in the melanin content of hair from the same cattle sampled at different times appear to be affected both by environment and genotype. The area of body sampled also affected the melanin content.

The value of a standardized procedure in hair sampling is suggested.

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