Seasonal Changes in Coat Characters in Cattle

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Summary

Evidence is presented to show that marked seasonal alteration in the appearance of the coat in cattle is due to morphological variation in fibre characters. The profound influence that seasonal coat changes may have on body temperature regulation is discussed.

Introduction

Cattle go through a regular seasonal cycle of hair growth and shedding, which is presumably adapted to the climate prevailing in their habitat, and which has been shown by Yeates (1955) to be influenced by light in Shorthorns. There is reason to believe that the process of shedding can also be influenced by other things such as the nature of the food supply and the condition of the animal. Hammond (1949) reports distinctive breed differences in cattle coats and within breeds the hair coat differs in appearance according to the seasonal change.

Differences in appearance of the coat are due to changes in the hair fibres of which it is composed, but no accurate objective measurements of the variation of hair fibre characters with season have been published. Reported work refers to the coat covering in more general subjective terms. Observations were therefore collected on the way coat characters vary in Bos indicus and Bos taurus species of cattle under different circumstances.

Material and Methods

(i) Animals.-Cattle of both beef and dairy breeds in both temperate and tropical zones were examined. Particulars of the animals will be inserted in the text.

(ii) Measurement techniques.-Hair samples were clipped from specific areas (Dowling 1955a) and dried and weighed. The clipped area was measured with calipers. Samples were conditioned for 2 days at 70°F, 65 per cent. R.H. prior to weighing. The weight of hair per unit area was calculated.

Estimates of the average length and diameter of the hair fibres and of the average diameter of the medulla were obtained in the following manner. A sample of approximately 250 fibres was taken from each animal. The length of individual fibres was measured with forceps against a rule to the nearest 0.2cm. The fibres were then mounted in euparal on a slide, and the diameter of the fibre and the diameter of its medulla were measured to the nearest 8 microns by projection. The degree of medullation was estimated from the percentage of the hair fibres medullated, and from the ratio of the diameter of the medulla to the diameter of the whole in a continuously medullated hair fibre.

(iii) Felting test.—Bonsma’s test (1949) of moistening a hair sample and rubbing fibres together in the palm of the hand to determine whether or not the fibres felt into a ball was applied to all samples collected. The felting grade 0 represents a complete lack of felting, grade 5 represents maximum felting.

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RESULTS

Table I shows the characteristics of the hairs of 30 Herefords sampled in summer and winter. The cattle were born at Talbingo, southern N.S.W. between 2.ix.48 and 31.x.48. The hair samples were collected in January and July 1950. At the first sampling the beasts were 15-16 months old and averaged 773 ± 12.7 lb in weight. At the second sampling when they were 21-22 months old the average weight was 1000.7 ± 19.6 lb. The table shows the difference resulting from the change of coat which took place between summer and winter as a result of the growing of a winter coat. The weight of coat increased in the winter nearly threefold, diameter was almost unchanged but length was increased almost threefold whilst medullation was much reduced (Fig. 1). Note that the summer coat did not felt at all whereas in winter all coats felted to the maximum amount.

Fig. 1-The type of medullation present in winter and summer samples from Hereford yearling steers, at Talbingo, N.S.W. The histogram shows diagrammatically the type of medullation. The illustration is not drawn to scale and does not show the variation in the summer and winter samples in the degree of medullation.
Similarly in a tropical zone at "Rainsby", in Queensland it was found that felting grade varied from 0 to 5 each year in a herd of 300 Shorthorns. Under adequate nutritive conditions age was

<table>
<thead>
<tr>
<th>Season</th>
<th>No. of animals</th>
<th>Mean weight (mg/cm²)</th>
<th>Mean Diam. (μ) (micron)</th>
<th>Mean length (cm)</th>
<th>Continuous fibres %</th>
<th>Discontinuous fibres %</th>
<th>Felt- ing Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>30</td>
<td>16.65</td>
<td>38.5</td>
<td>0.8</td>
<td>45</td>
<td>42</td>
<td>0</td>
</tr>
<tr>
<td>Winter</td>
<td>30</td>
<td>48.6</td>
<td>43.6</td>
<td>2.04</td>
<td>15.2</td>
<td>8.4</td>
<td>5</td>
</tr>
</tbody>
</table>

FIGURE 2A.
not associated with felting. Summer samples were collected from calves less than one week old with coats of 0 felting grade. Under adequate nutritive conditions sex was also not a cause of variation in seasonal felting in this herd.

On the other hand, both in tropical and temperate environment some animals were found which did not completely shed the winter coat and carried it through into summer. Table 2 shows that animals judged not to have shed had coats of greater weight and length than those that were judged to have shed. Few of their fibres were medullated and their felting was complete. In fact they resembled closely a winter coat. Figure 2a and b and Figure 3a and b show the composition of the coats of two animals in winter and spring. Figure 2 is a scatter diagram of their fibres of an animal which was judged not to have shed completely and Figure 3 is one which shed. Notice the dramatic difference between spring and winter coats in Figure 3. In the winter coat few fibres are medullated. Only a small fraction of fibres are not medullated in the spring coat and the majority, whether medullated or not, are shorter than the winter fibres. It is clear that a complete or almost complete change over has been made in the fibre population. In Figure 2 the difference between spring and winter are less marked. It is suggested that most fibres particularly those over 0.5 cm are survivors of the winter coat. Figure 2c and 3c represent summer samples taken first week in January just before the phase of hair growth commences. The coat changes are relatively small during the 3 months before January. Note that most of the fibres in the summer coat of the animal shown to be heat tolerant (Dowling 1956a), are medullated whereas in Figure 2c they are not medullated.

![Figure 2a, b, c-Scatter diagrams to show the relation of the diameter to the length of medullated and unmedullated fibres in “woolly” coated Short-horns. (a) winter, (b) spring, (c) summer.](image-url)
Figure 3a.
Figure 3b.
Whereas in any year individual animals may have coats which did not shed completely, under certain conditions shedding was delayed in all animals. For example, on a low plane of nutrition the Shorthorns referred to grew a lighter coat and shedding was incomplete. 1952 was a drought year. The 1952 autumn, winter and summer hair samples felted in each season and weighed $21.6 \pm 4.2$, $25.2 \pm 3.6$ and $15.5 \pm 3.1 \text{mg/cm}^2$ respectively. Though these changes were less variable than normal an analysis of the results showed the differences in the weight of coat per unit area between seasons and between animals were significant at the 0.1 per cent. level. Similarly the stress of pregnancy or drain of lactation may inhibit the shedding phenomenon under inadequate feed conditions. It was observed that in the years 1951-1953 the lactating cows were readily distinguishable from dry cows and males by their unshed coats. Whereas in 1949-1950 under ideal green grass spring conditions they were not.
<table>
<thead>
<tr>
<th>Type of Coat</th>
<th>Breed</th>
<th>Weight of hair mg/cm²</th>
<th>Average length cm</th>
<th>Fibres No./cm²</th>
<th>Fibres Medullated</th>
<th>Felting Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer &quot;Smooth&quot; Shed</td>
<td>Shorthorn (Tropical)</td>
<td>4.2</td>
<td>0.36</td>
<td>780</td>
<td>Few fibres without some</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>medullation</td>
<td></td>
</tr>
<tr>
<td>Summer &quot;Rough&quot; Unshed</td>
<td>Shorthorn (Tropical)</td>
<td>12.5</td>
<td>1.87</td>
<td>860</td>
<td>Few fibres continuously</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>medullated</td>
<td></td>
</tr>
<tr>
<td>Summer &quot;Rough&quot; Unshed</td>
<td>Shorthorn (Temperate)</td>
<td>12.3</td>
<td>1.58</td>
<td>680</td>
<td>Only few coarse fibres</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>continuously medullated</td>
<td></td>
</tr>
<tr>
<td>Summer &quot;Smooth&quot; Shed</td>
<td>Shorthorn (Temperate)</td>
<td>6.7</td>
<td>0.64</td>
<td>610</td>
<td>Few fibres without some</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>medullation</td>
<td></td>
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</tbody>
</table>
TABLE III.
Variation in Coat Characters for Summer and Winter Coats in Zebu and A.I.S. Cattle.

<table>
<thead>
<tr>
<th>Season</th>
<th>Breed</th>
<th>Weight of hair mg/cm²</th>
<th>Average length cm</th>
<th>Fibres No./cm²</th>
<th>Fibres Medullated</th>
<th>Degree of Medullation Ratio Diameter Medulla:Diameter Fibre</th>
<th>Felting Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>Zebu</td>
<td>6.8</td>
<td>0.42</td>
<td>1290</td>
<td>All fibres medullated</td>
<td>0.60-0.76</td>
<td>0</td>
</tr>
<tr>
<td>Winter</td>
<td>Zebu</td>
<td>30.1</td>
<td>1.01</td>
<td>1234</td>
<td>All fibres medullated</td>
<td>0.56</td>
<td>0</td>
</tr>
<tr>
<td>Summer</td>
<td>A.I.S.</td>
<td>10.2</td>
<td>0.81</td>
<td>874</td>
<td>Most fibres medullated</td>
<td>0.40-0.62</td>
<td>0</td>
</tr>
<tr>
<td>Winter</td>
<td>A.I.S.</td>
<td>35.8</td>
<td>1.8</td>
<td>924</td>
<td>20% fibres medullated</td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>
In Table 3 comparison is made between Zebus and Australian Illawarra Shorthorns (A.I.S.) in Queensland in 1949 and 1950. The reason for collecting these results was to show the seasonal effect on the coat of two breeds one of which is highly heat adapted, the other partially so.

It is emphasised that, though their genetical physiological limits may be narrower, marked seasonal coat changes may occur also in *Bos indicus* species of cattle. The changes are frequently not obvious from a casual inspection of the animal. The Zebu coat appears to be sparse and laid flat against the skin, because the longer hair fibres bend over laterally, whereas in actual fact the dense medullated fibres form a compact coat.

It appears that felting is associated with non-medullation rather than weight or length. When the fibres from the coats of the *Bos taurus* species of cattle were sorted into medullated and non-medullated fibres it was found that medullated fibres would not felt whereas the non-medullated ones did.

**DISCUSSION**

The study of the seasonal changes (Anon. 1951) shows that the coat in cattle varies from an insulating (winter) type of coat, with hair fibres which are longer but of more variable length and less medullated, to a non-insulating (summer) type of coat characterised by shorter medullated fibres. The important thermal property for the prevention of heat loss from the body is the capacity of the winter hair covering to stabilise an insulating layer of air, whereas the summer coat must allow heat loss which is the side of the balance upon which regulation is usually effected under hot conditions. An understanding of the significance of the variation in coat changes in body temperature regulation ends much of the confusion that marked the voluminous literature on heat tolerance in cattle.

For example *Bos indicus* species of cattle and relatively superior heat tolerant breeds of *Bos taurus* species of cattle have more medullated hair fibres, denser, more compact coats and better developed skin glands than the less tolerant breeds of *Bos taurus*, (Dowling, 1955a and b). Although the above mentioned breeds cannot grow winter coats comparable to the improved British beef breeds, even Zebus can grow a winter coat which is sufficiently insulating to allow the animals to withstand prolonged periods below zero. If Zebus in heavy winter coats were placed in a hot room at 105°F it is physically impossible for them to lose heat adequately from the skin surface and so under these circumstances Zebus would not be heat tolerant. Under these circumstances it is unlikely that they would record much better heat tolerance coefficients than the rabbit (Johnson and Brody, 1955).

Coat changes would explain the “surprising” seasonal differences in hot room tolerance tests reported by McDowell, Lee and Fohrman (1953). It would explain partially why animals of the same breed appear to become more heat tolerant in a warm climate than comparable groups in a cold climate (e.g. Louisiana and Washington, Brisbane and Missouri). It is a fact that cattle moved from a cooler region can be overheated and killed quickly if driven in the heat; whereas a portion of the mob, moved to the hotter region during winter and allowed to adapt itself and its coat covering, may be unaffected when driven with this other half of the group. Adaptation of both the coat and the sweat glands is necessary, but in cattle, coat changes are a precursor to effective sweat gland function (Dowling 1956a and b).

The marked environmental influence on hair growth and hair shedding indicates the difficulty of correlating heat tolerance and productivity factors with morphological coat characters unless the animals are kept under the same conditions. Coat changes explain
the futility of any test of heat tolerance, in a temperate climate, such as Bonsma's (1949) felting test or Yeates' (1955) hot room test, which cannot make allowance for coat changes.

Seasonal coat changes explain the inconsistencies of heat tolerance tests such as the Iberia heat tolerance test (Gaalaas 1947). Coat changes and different atmospheric conditions may account for otherwise inexplicable breed differences in response to this test. At Jeanerette, Louisiana, Phillips (1948) reported that the scale of heat tolerance for cattle as determined by the Iberia heat tolerance test was as follows: Zebu, 89; Santa Gertrudis 82; Jersey 79; Aberdeen-Angus 59. Whereas under similarly hot but less humid conditions it was found that the coefficients were 92 for Brown Swiss; 84 for Jersey and 76 for Holstein. Phillips contended that the high heat tolerance index for Brown Swiss cattle indicated that this breed may have special adaptability to hot climate that is not possessed by other breeds developed in the temperate zone. But at Fiji, Payne (1955) reported Iberia heat tolerance coefficients ranging from 60-88 in the Jersey, 45-91 in the Friesian, 54-82 in the Shorthorn and 70-84 in Zebu breed.

It is concluded that a morphological description of coat changes is needed for the eventual physiological interpretation of responses associated with the dissipation of heat.

REFERENCES


