Effect of Cold on the Thickness and Chemical Composition of the Skin in Sheep

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INTRODUCTION

Wodzicka (1958c) in New Zealand showed that skin increased in thickness after shearing (Figure 1). Since the sheep used in that experiment were on pasture, it was thought possible that this increase was due to nutrition, for there is evidence (Wodzicka 1958b; Lyne, personal communication) that skin thickness varies with the plane of nutrition, and it is considered that a sheep’s appetite increases after shearing. However, Lyne (personal communication) found that skin increased in thickness after shearing even in sheep on a sub-maintenance ration. A pilot trial of Wodzicka and Lyne (unpublished data) showed that skin of unshorn sheep increased in thickness in the cold. The investigations described in this paper were undertaken to examine the nature of this change.

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Figure 1.—Skin thickness after shearing, measured with the dermatometer on fresh biopsy samples.
EXPERIMENTAL

To find out whether the increase in skin thickness could be due to vaso-dilation or vaso-constriction, sheep were injected with acetyl choline and adrenaline. Skin thickness was measured before, and during the time of "blushing" and "blanching" respectively. Skin thickness did not change. Nor was it changed with short term local heating and cooling.

Six sheep (4 Merinos and 2 Southdowns) were then kept for 7 weeks at a temperature of 72°F. After this they were put into an environment of 33°F with an intermittent wind (12 m.p.h.) for 23 days. At the end of that period they were put back into the warm environment for a further 8 weeks. During the entire experimental period, they were on a fixed ration which kept their body weight constant in the warm environment. Skin samples were taken at intervals. Skin thickness was measured in 6 positions with constant-pressure calipers, with a dermatometer (Wodzicka 1958a) on fresh and fixed biopsy samples, and with a micro-projector used on histological sections. In addition, the fat, water, sodium, and potassium contents were determined. Rectal temperatures and heart rates were also measured.

Figure 2. Effect of a cold period on skin thickness measured in three ways, on the weight of biopsy samples taken with a standard trephine, and on the content of sodium and potassium.
RESULTS AND DISCUSSION

The sheep shivered constantly during the first few days in the cold when the wind was blowing, but stopped when the wind was turned off. During the last two weeks in the cold, their shivering in the wind was only intermittent. Rectal temperatures were normal, but heart rates were elevated during the first week. The mean skin temperature, measured on the areas clipped for the skin calipers, was about 25°F lower in the cold. Skin temperature of the lower leg was only about 50°F. Skin temperature was higher on the first day in the cold than at the end of this period. The sheep lost about two kg. body weight in the cold, but regained it rapidly in the warmth.

Skin thickness increased in the cold (Figures 2 and 3). The change in the mean fold thickness (caliper measurements) was evident within the first 2 hours of exposure to the cold. It reached a maximum after 2 weeks and stayed at this value until the sheep were put back into the warm environment when it declined. There was no change in skin thickness on the second day as measured by the dermatometer (on skin samples), but skin thickness had increased by the eighth day.

The weight of the trephine samples increased in the cold. The water content went up during the first week, but was back to normal at the end of the cold period. There was no change in fat content. There was no consistent change in the sodium content of the skin, but potassium declined in the cold period.

Detailed investigations of the histological changes in the skin are being made.

![Graph](image.png)

Figure 3.—Effect of a cold period on the thickness of fixed biopsy samples of skin, and on the fat-free residue of fresh samples.
From these experiments it seems that the increase in thickness after shearing is an effect of cold. This is not surprising because shearing is equivalent to a violent cold change in the sheep's proprio-climate. In this connection it is interesting to note that Lyne (personal communication) found that skin thickness increased greatly after shearing in the winter, but only slightly after a summer shearing. The full significance of the water-electrolyte shift will have to wait until histological examinations are complete. However, it is likely that the initial increase is related to a water change, but that later there is a change in skin histology.

These results will be reported fully elsewhere.

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REFERENCES


DISCUSSION

Dr. G. Alexander (Qld.) asked what was the effect of cold on cellular activity.

Answer.—Canadian work on rats showed a decrease in mitotic activity in the cold.

P. G. Schinckel (N.S.W.)—In rats this affected only the epidermis which forms only an insignificant portion of the skin of sheep. Was the change in sheep due to water change?

Answer.—Le Blanc's work on rats and goats in the cold showed that the dermis as well as the epidermis was increased in the cold. In this study the initial change was due to water content. Later the water content returned to normal though skin thickness increased. This suggested an increase in cell numbers or cell size.