THE SKIN THICKNESS OF MEDIUM WOOL MERINO SHEEP AND ITS RELATIONSHIP TO WOOL PRODUCTION

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SUMMARY
The skin thickness of adult medium wool Merino sheep from 2 flocks, genetically different in capacity for clean wool production, was measured at the shoulder, midside and thigh. Skin at the shoulder and midside had similar average thickness, but that at the thigh was significantly thinner. The skin at the shoulder and midside of sheep from the high producing flock was thicker (1.66 v. 1.59 mm; \( P < 0.05 \)), but, at the thigh, it had a similar thickness to that from sheep in the low producing flock (1.37 v. 1.33 mm). Phenotypically, the average skin thickness was related to skin wrinkle, scored at the neck and trunk \((r = 0.163, P < 0.05)\). The average score was also greater in the high producing sheep (2.40 v. 1.96; \( P < 0.05 \)). Skin thickness was not related to either liveweight or body condition score. When sheep from these 2 flocks experienced a high or low level of nutrition in pens (6 per flock per nutritional level), skin thickness at the midside significantly decreased in the poorly fed sheep, but the average thickness of skin did not differ between the flocks.

Keywords = skin, thickness, wool production, Merino.

INTRODUCTION
The analogy has often been made that just as deep soils generally grow higher yielding crops, sheep with thick skins will produce heavier fleeces (Coy 1983). Gregory (1982a, 1982b) published results supporting this suggestion. Both skin thickness and clean fleece weight of strong wool Merinos had moderately high heritabilities and exhibited significantly positive genetic and phenotypic correlations. Hence, selective breeding for increased fleece weight should result in sheep with thicker skins. However, Coy (1983) suggests that selective breeding with emphasis on increased clean fleece weight results in sheep with thinner skins, due partly to the reduced grease yield evident in these sheep (Barlow 1974).

In this paper, we have compared the thickness of skin in 2 flocks of medium wool Merino sheep, which differed in their production of wool as a result of selective breeding with high or low clean fleece weight per head the selection criteria. Furthermore thick skinned sheep may be better able to withstand periods of dietary stress (Coy 1983). Therefore, we have observed the responses in thickness of skin of sheep from these 2 flocks to altered nutritional levels.

MATERIALS AND METHODS
Sheep
Williams et al. (1992) described the derivation of these flocks of Merino sheep with different genetic capacities for wool growth, resulting from selective breeding. Briefly, comparisons involved mature progeny from the mating of selected Fleece Plus (Fl+) or of Fleece Minus (Fl-) rams with a flock of medium wool Merino ewes. The Fl+ and Fl- flocks form part of a long term fleece selection experiment (Pattie and Barlow 1974), with replacement Fl+ and Fl- ewes and rams being selected on the basis of high or low clean fleece weight per head at 15-16 months of age respectively. The dams and the flocks of progeny grazed together throughout, any difference observed between progeny groups thus representing the average genetic difference due to the sire groups for that trait.

Measurements on 3-year-old grazing sheep
At 3 years of age the female (50 Fl+, 28 Fl-) and castrated male (46 Fl+, 48 Fl-) progeny were mustered. The skin thickness of each sheep was measured at the shoulder, midside and thigh (Williams 1970) after closely clipping the wool from these areas, using Oster clippers with fine (40) combs and cutters. Thickness of a double fold of skin was measured using dial gauge callipers exerting constant pressure of 1250 g/cm² (Lyne 1964). A double thickness of skin was grasped with the opposing jaws of the calliper in a anterior/posterior direction and then by grasping a double thickness at the same site in a dorso-ventral direction. As the orientation of the calliper did not influence the gauge reading, average thickness of skin was estimated by dividing the sum of these measurements by 4.

The sheep were also weighed and the ‘condition’ of the body scored essentially by the method described by Jefferies (1961), but with an expanded scale: 1 (very trim) to 10 (very fat). Two weeks
later, the sheep were shorn, fleeces weighed and midside samples collected for estimation of clean scoured yield. Following shearing, the degree of skin wrinkling at the neck and trunk was assessed, using a set of photographic standards (Turner et al. 1953).

The effect of nutrition of skin thickness

In the following year, 34 wethers (17 per flock) were individually fed a ration of 0.6 kg/day (oat grain, lucerne chaff 1: 1 by weight) in indoor pens for 4 weeks. Subsequently, 12 wethers/flock were randomly selected and divided between a high (H) or a low (L) dietary treatment. Each sheep on H was offered 1.25 kg/day of a high quality diet (2.3% nitrogen, and 72% digestible dry matter). Those on the L were each offered 0.72 kg/day of a low quality diet (1.6% N, and 65% digestible dry matter). The diets were described fully (Williams et al. 1990). The dietary treatments continued for 11 weeks and caused large differences in liveweight — an average 4 kg loss in the L group, and 5 kg gain in the H group with no flock difference (Williams et al. 1991).

At the completion of both the pre-experimental and the experimental feeding periods, the skin thickness of each sheep was measured with callipers as described previously. Additionally, duplicate skin samples were collected, using a trephine (10 mm), from the midside. These were placed in buffered formalin for 3-4 days for fixation. Each sample was then blotted dry and weighed after any projecting wool fibres and sub-dermal tissue were trimmed away.

The wool was clipped from areas (about 80 cm²) of midside skin 3 weeks after the dietary treatments commenced, and the areas of the patches measured. The greasy wool grown on these patches during the following 8 weeks was collected, weighed and a sample solvent scoured to determine yield. Wool production was then calculated as daily weight of wool fibre produced per unit area of skin, from the average of the right and left side.

Statistical analyses

The data from both the grazing sheep and those in pens were analysed by REG (Gilmour 1988). For the former data, the effects of flocks were compared after eliminating the effects of individual sires, type of birth (single or twin), sex and day of birth.

RESULTS

Skin thickness of grazing sheep

The thickness of the shoulder and midside skin was greater (P < 0.05) in the progeny of the Fl rams (Table 1). Skin was thinner at the thigh than at the other 2 positions which had similar thickness. The skin thickness at the thigh was similar in sheep from the 2 flocks. The progeny of the Fl rams produced significantly greater quantities of both greasy (5.6 v. 4.3 kg, s.e. = 0.1) and clean wool (4.3 v. 3.1 kg, s.e. = 0.1) at the shearing following measurement of skin thickness.

Table 1. Average thickness of skin (mm) of sheep sired by either Fleece Plus or Minus rams, measured at the shoulder, midside and thigh.

<table>
<thead>
<tr>
<th>Site</th>
<th>Fleece Plus</th>
<th>Sire</th>
<th>Fleece Minus</th>
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<tbody>
<tr>
<td>Shoulder</td>
<td>1.67</td>
<td>1.60</td>
<td></td>
</tr>
<tr>
<td>Midside</td>
<td>1.64</td>
<td>1.58</td>
<td></td>
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<tr>
<td>Thigh</td>
<td>1.37</td>
<td>1.33</td>
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</table>

Phenotypically, the average thickness of skin at the 3 positions was not related to either liveweight (mean, 43 kg) or to condition score (mean, 6.4), these 2 traits being similar for the progeny groups. The average skin thickness was correlated with the average neck and trunk wrinkle score (r = 0.163, P < 0.05). The progeny of Fl rams were also more wrinkled (2.4 v. 1.9, s.e. = 0.1).

The effect of nutritional level on skin thickness

The correlation, within flocks, between mean skin thickness and mean trephine weight measured at the midside of the 34 sheep at the end of the pre-experimental feeding was 0.87 (P < 0.01). Neither mean thickness (1.66 mm) nor mean weight (137 mg) differed between these samples from the 2 flocks.
The sire group and of diet on the measured thickness of skin, the weight of a fixed trephine sample, and rate of wool growth, all measured at the midside. The average pre-experimental values are in parentheses. Significant differences between diets and sire groups during the experimental period are indicated by a and b respectively.

<table>
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<tr>
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<td>Skin thickness (mm)</td>
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<td>Weight of trephine sample (mg)</td>
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<td>110 (132)</td>
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<td>High</td>
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<td>Wool production (mg/cm².day)</td>
<td>Low</td>
<td>0.74</td>
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<td></td>
<td></td>
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After 12 of the 24 sheep experienced the L regime for 11 weeks, both the measured thickness and the weight of the ‘fixed’ skin biopsied from the midside decreased (Table 2). The thickness and weight of the midside skin of those 12 sheep receiving the H diet were similar to the pre-experimental values. Significant differences between diets and sire groups during the experimental period are indicated by a and b respectively.

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DISCUSSION

In the initial comparisons of these sheep, the skin of the sheep from the Fl+ flock was significantly thicker, at the shoulder and midside positions, but not at the thigh. The difference was, however, small in relation to the c. 40% difference observed in the production of wool fibre. These results indicate that medium wool Merino sheep possibly have a positive genetic correlation between clean fleece weight and skin thickness, as Gregory (1982b) observed in the strong wool Merino. The greater average skin thickness of the sheep in high wool producing flock does not support the contention of Coy (1983) that selective breeding with emphasis on clean fleece weight leads to thin skinned sheep.

Skin thickness may reflect the liveweight and overall body condition (fatness) of the sheep, leading to positive phenotypic correlations between these traits. Our results do not support this hypothesis. The relationship between thickness and skin wrinkling, although significantly positive, was small. Gregory (1982b) observed a similarly small significant (0.14) phenotypic correlation between these 2 traits; a larger (0.22) genetic correlation was not significant.

Massey (1990) discussed the ability of ‘impact’ breeders of Merino sheep to recognise sheep with certain desirable skin characteristics. These included loose, well-nourished, supple and turgid-pink. Thickness was not specifically mentioned. Mitchell et al. (1984) examined some physical and chemical properties of ‘thick-mobile’ skins, considered to be productive and the non-productive ‘thin-tight’ skins. No differences were found between the 2 types of skin. We conclude that productive sheep will tend to have thicker skins as measured by callipers, but the difference is small.

The thickness of skin of sheep randomly selected from the 2 flocks for the nutritional experiment did not exhibit any significant difference between flocks, reflecting this small difference in thickness. Both skin thickness and the weight of the sample collected by trephine were sensitive to the imposed nutritional treatments. Hutchinson (1957) and Lyne (1964) also concluded that the nutritional environment influenced skin thickness. The reduced thickness of skin of sheep losing liveweight as a result of L dietary treatment, contrasts with the apparently stable skin thickness of those fed the H diet which resulted in a substantially increased liveweight. These results suggest the relationship between skin thickness and nutrition may be complex. The role of the skin (and its fleece cover) in thermo-regulation would be involved in this complex relationship as both Wodzicka (1958) and Lyne (1964) observed rapid increases in skin thickness after shearing. At the time of our experimental measurements, the sheep had 7 months wool, but the average temperatures in the shed were low (5-10°C). The result, however, most relevant to our study of skin thickness of sheep genetically different in wool production was that there were similar responses in thickness of the skin of sheep from the 2 flocks to altered nutritional levels.
REFERENCES