Effects of shearing method on the physiology and productivity of sheep

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ABSTRACT

Sheep shorn with a cover-comb were compared with conventionally shorn sheep in two experiments. In the first experiment, ewe and lamb performance and some aspects of ewe physiology were measured with 60 Romney ewes which were shorn before lambing. In the second experiment, oxygen consumption by 12 Romney hoggets was measured before and after shearing in calorimeters at 10°C.

In the first experiment, herbage intake by ewes in the 3 weeks post-shearing was not affected by shearing method. There were no treatment effects on the liveweight of ewes, birthweight and growth rate of lambs nor on ewe wool production during the 2 months post-shearing. However on days 1 and 3 after shearing the plasma concentrations of non-esterified fatty acids and of 3- hydroxybutyrate were higher in the ewes shorn with the conventional comb than in those shorn with the cover comb.

In the second experiment oxygen consumption was increased immediately after shearing, by 47% and 25% in the conventional- and cover-comb sheep respectively. The difference between the two groups, which remained significant until day 12 post-shearing, decreased with time until it disappeared on day 22.

The results show that sheep shorn with the cover-comb were significantly more resistant to cold conditions than those shorn with the conventional comb, particularly during the 3 days post-shearing. Use of the cover comb may offer a useful low cost method of reducing the effects of cold conditions after shearing, but its effects on mortality have not been demonstrated.

Keywords Shearing comb design, metabolism, oxygen consumption, shorn sheep.

INTRODUCTION

Pre-lamb shearing of ewes results in improved wool quality, a greater spread of seasonal labour requirements and more regular cashflow, and it may also improve lamb performance. The main disadvantages of pre-lamb shearing are a greater risk of ewe mortalities in cold weather, and an increase in the ewe's feed requirements (Livingston & Parker, 1985). These disadvantages may be reduced by shearing with cover combs, which leave a greater depth of stubble after shearing.

The experiments reported in this paper were designed to measure the effects of shearing with a cover comb, when compared with a conventional comb, on the performance of grazing ewes and their lambs, and on oxygen consumption by sheep in calorimeters.

MATERIALS AND METHODS

Experiment 1

Sixty pregnant Romney ewes were used, aged 2 to 6 years and with an average unfasted weight of 58 ± 0.9 kg at the beginning of the experiment. They were set-stocked at 10 ewes/ha on ryegrass/white clover pastures at the Ruminant Research Unit, Massey University. The ewes were mated between 10 March and 15 April 1989.

Treatments

At shearing, the sheep were divided at random into equal groups, and one group was shorn using a conventional comb (maximum depth of teeth 4 mm) while the other group was shorn using a cover comb (maximum depth of teeth 9 mm). Post-shearing stubble depths were 1 to 3mm, and 6 to 13mm respectively in the conventional and cover comb groups. The day of shearing (27 July 1989) is subsequently referred to as Day 0.

Measurements

Faecal output and feed intake

On Day 3, ten sheep from each group were given a controlled release capsule (CRC), containing chromium sesquioxide (Captec NZ Ltd, Auckland). Subsequently faeces were collected *per rectum* from each of these sheep on Days 4 to 6, 11 to 13 and 18 to 20 after shearing and analysed for chromium concentration.

Samples of herbage were plucked by hand from the paddocks grazed by the ewes on Days 8, 13 and 20. These were subjected to analyses for digestibility using the *in vitro* method of Roughan and Holland, 1977 and total nitrogen. Feed intake was then estimated from the values for faecal output and digestibility of feed eaten (Parker, *et al.*, 1989).

Blood Metabolites

Samples of blood were collected by venipuncture from each sheep, between 0800 to 0900 hours on Days -1 and -2 and after shearing on Days 1, 3, 7 and 14. Plasma was stored at -20°C prior to analyses for concentrations of glucose, non esterified fatty acids (NEFA), hydroxybutyrate, urea and creatinine on a Cobas Fara II autoanalyser following the manufacturer's recommendations.

Rectal temperature was measured for each sheep between 0730 and 0830 h on Days -1 and -2, and after shearing on Days 1, 3, 7 and 14. Liveweight was measured for each ewe on Day 0 and again 67 days later. The lambs were weighed at birth and again on Day 67 after shearing of the ewes. Herbage mass was

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estimated daily from Day -2 to Day 20 using a rising plate meter (Earle & McGowan, 1979) which was calibrated by cutting and weighing pasture herbage from measured quadrats. Meteorological measurements were recorded daily, either at the site, or at a site 2 km distant.

Statistical Analysis

Data for rectal temperature and plasma concentrations of metabolites were subjected to analyses of covariance, using the pre-shearing values as the covariate. Data for faecal output and lamb birthweight were subjected to analyses of variance with main effects of ewe liveweight, lambing date, shearing method and sex of lamb. Data for ewe liveweight on day 67 were subjected to analyses of covariance using liveweight on day 0 as the covariate and shearing method, pregnancy status and rearing rank as main effects.

Experiment 2

The experiment was carried out between August and November 1990, with twelve castrated male Romney sheep aged 10 to 12 months, with an average weight (shorn) of 33 kg (range 24 to 40). They were fed on chopped lucerne chaff at an estimated level of 0.5 MJ metabolisable energy per $kg^{0.75}$ daily, which was calculated to be approximately 1.1 times their maintenance requirement (ARC, 1980).

The sheep were housed individually in pens in the Animal Physiology Unit at Massey University, except during the measurements of oxygen consumption which were carried out in two identical calorimeter chambers, as described by Holmes (1973). Heat production was calculated as described by McLean (1972). Body insulation was calculated as:

$$\frac{(39°C - \text{measured air temperature})}{(\text{Daily heat production per } m^2 \text{ surface area})}$$

Oxygen consumption by each sheep was measured at an air temperature of 10°C, over four periods each of three days. The first period was immediately prior to shearing and the second period was immediately after shearing. The third and fourth periods began on Days 10 and 22 respectively after shearing. Each sheep had been kept in the calorimeter for several days before experimental measurements began.

Each sheep was weighed before and after each measurement period. The sheep were shorn by experienced New Zealand Wool Board instructors, using either a conventional comb or a cover comb. Details of the two combs are given above.

The two shearing treatments were applied randomly to the sheep within each pair of animals. Each sheep was allocated to one of the two calorimeter chambers, so that three sheep from each treatment were measured in each chamber.

Statistical Analysis

The data were subjected to analyses of covariance for repeated measurements with each animal, using the pre-shearing measurements as the covariates.

RESULTS

Experiment 1

Herbage mass on the paddocks grazed by the ewes was 600 to 900 kg DM/ha. The herbage dry matter contained 18 to 21% crude protein, and its digestibility was 70.5 to 72.6%.

Average values for climatic data recorded during Days 0 to 14 were wind run 7.5 km/h; rainfall 0 mm; minimum air temperature 4°C and maximum air temperature, 14°C. The values for days 0 to 67 were similar to those above, except that rainfall averaged 1.2 mm per day.

There were no significant differences between treatments in rectal temperatures, although daily mean values were slightly higher before shearing (39.1 to 39.3°C;) than after shearing (38.8 to 38.9°C).

There were no significant differences between shearing treatment in faecal output nor in dry matter intake. (Mean values for intake were conventional comb: 2.20 and 2.81 kg DM/day; cover comb: 2.46 and 2.16 kg DM/day for ewes rearing single and twin lambs respectively).

There were no differences in lamb birth weight, nor in lamb growth rate between treatments. (Mean values: birthweight 5.5 and 5.4 kg; growth rate 0.29 and 0.28 kg/day for conventional and cover combs respectively).

Unfasted ewe liveweight averaged 58 kg on Day 0 and 64 kg on Day 67, with no differences between treatments.

Repeated measures analyses revealed significant effects of time ($p<0.05$) on the concentrations of all measured metabolites; the concentration of NEFA, 3-OH-B, glucose and urea increased after shearing. On Days 1 and 3 the conventional comb ewes had significantly higher concentrations of NEFA and 3-OH-B than the cover comb ewes (Table 1).

There were no significant differences between treatments in concentrations of other metabolites.

Experiment 2

The mean values for oxygen consumption by both treatments in each of the four measurement periods are shown in Table 2.

During the 3 days immediately after shearing oxygen consumption increased in both groups, by 47% and 25% in the conventional and cover comb groups respectively ($p<0.01$) (rela-

TABLE 1 The mean values (±SE) for concentrations of nonesterified fatty acids (NEFA) (meg/L) and 3 ß hydroxybutyrate (3-OH-B) (mmol) in the plasma of ewes before and after shearing by the conventional or cover comb.

Day	NEFA			3-OH-B		
	Conventional comb	Cover comb	Level of Significance	Conventional comb	Cover comb	Level of Significance
-2	0.22 ± 0.02	0.25 ± 0.02	NS	1.16 ± 0.07	1.33 ± 0.07	NS
-1	0.20 ± 0.02	0.21 ± 0.02	NS	1.23 ± 0.07	1.33 ± 0.08	NS
1	0.39 ± 0.03	0.31 ± 0.03	**	1.52 ± 0.07	1.42 ± 0.07	**
3	0.35 ± 0.03	0.28 ± 0.02	*	1.38 ± 0.08	1.27 ± 0.05	*
7	0.33 ± 0.03	0.31 ± 0.03	NS	1.08 ± 0.07	1.03 ± 0.05	NS
14	0.32 ± 0.03	0.35 ± 0.03	NS	1.06 ± 0.04	1.09 ± 0.06	NS

** $P<0.01$; * $P<0.05$

TABLE 2 Mean values for daily oxygen consumption by the sheep in the two treatments, in the period before shearing and in the three periods after shearing (Litres O_2 per $kg^{0.75}$ daily)

Treatment Group	Before shearing	After shearing on Day 0		
		Days 1-3	Days 10-12	Days 22-24
Conventional Comb	25.4	37.3	29.2	25.0
Cover Comb	24.8	31.1	26.3	23.7
Standard error of difference between groups	± 0.6	± 1.0	± 0.7	± 0.6
Level of significance	N.S.	**	**	N.S.

** P<0.01

tive to pre-shearing levels). Oxygen consumption remained elevated during Days 10 to 12 after shearing, by 15 and 6% in the conventional and cover comb groups respectively (p<0.01). During days 22 to 24 after shearing oxygen consumption had returned to the levels which had been measured before shearing in both groups, and there was no difference between the groups. Daily heat production was increased by 3.4 and 1.8 MJ for the conventional and cover comb groups respectively, during the three days immediately after shearing.

Values for fleece depth post-shearing, and for body "insulation" are presented in Table 3. The differences in "insulation" between treatments, and the increases in insulation after shearing appeared to be associated with increases in stubble depth.

TABLE 3 Mean values body insulation and stubble depth

	Days after shearing	
	Days 1 to 3	Days 22 to 24
Insulation (°C per 1 MJ m^{-2} day^{-1})		
Conventional Comb	2.9	4.4
Cover Comb	3.6	4.6
Fleece stubble depth (mm)		
Conventional Comb	4[a]	14[b]
Cover Comb	9[a]	16[b]

[a] For 2 sheep in each group

[b] For 4 sheep in each group

DISCUSSION

Metabolic activity was increased after shearing in both treatment groups, in both the field and the calorimetry experiments, as evidenced by the increases in plasma metabolites and in oxygen consumption. Similar increases in oxygen consumption have been reported by Symonds *et al.*, (1986) and Davey & Holmes (1977), and in plasma metabolites by Symonds *et al.*, (1988) and Astrup & Nedkvitne (1988), and they indicate that body fat reserves are a primary source of energy for the increased rate of heat production.

In addition, significant differences between the two treatment groups occurred during the first three days post-shearing in oxygen consumption, with corresponding differences in concentrations of NEFA and 3-OH-B. These differences show that use of the cover comb caused increases in the sheep's body insulation, which were probably due to the increased post-shearing stubble depth on cover comb sheep. Similar conclusions can be derived from the differences in heart rate of sheep after shearing by a conventional comb or a snow comb (Hutchinson *et al.*, 1960).

The present values for insulation correspond closely to those which can be calculated from Blaxter (1977), for sheep of corresponding fleece depths. This suggests that the effect of the cover comb on heat production was due to its effect on post-shearing stubble depth. It also suggests that the decreases in oxygen consumption which took place in both groups during the 24 days after shearing can be explained by the regrowth of the fleece, and the resultant increase in insulation.

The increase in cold resistance caused by use of the cover comb is likely to confer two main advantages on the cover comb sheep:

(i) A reduced rate of mortality of sheep following shearing.

(ii) A reduced daily feed requirement, and/or a reduced requirement for mobilisation of body reserves.

The present data indicate that these advantages will persist for about 2 weeks after shearing but will be largest in Days 1 to 3 after shearing. The size and duration of these effects are likely to be increased by exposure to colder conditions than occurred in the present experiments. In Australia, 0.5 % of sheep (or 0.8 million sheep per year) died on farms in the 14 days after shearing (Hutchinson, 1968), although up to 8% mortality occurred in bad weather (Geytenbeek, 1962). In both studies mortality was highest in the first days after shearing, which is the period when the cover comb is likely to confer its largest benefits.

The reduced daily heat production by the cover comb sheep (1 to 2 MJ/day over days 1 to 12), would be equivalent to a decreased daily feed requirement of about 100 to 200 g DM from pasture, or to an additional 250 to 500 g liveweight over a period of 10 days following shearing. Differences of this magnitude would not have been detectable in Experiment 1. The absence of any treatment effects on either ewe liveweight or lamb growth rate (Experiment 1) is also consistent with the absence of any difference in feed intake between the treatments (Russell *et al.*, 1985).

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