Effects of body covers on milk production by cows during winter, and on oxygen consumption by young calves.

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ABSTRACT

Two experiments were carried out to measure the effects of fitting polyethylene body covers on the winter milk production of mature cows, and oxygen consumption by calves. In the first experiment, the covers had no significant effects on the winter milk production or liveweight of lactating cows grazing on pasture supplemented with silage. In the second experiment, oxygen consumption by young calves exposed to an air temperature of 9°C, 8 km/hour wind and simulated rain was significantly reduced by the wearing of covers (by 40% during the period of rain). Covers offer an effective, low-cost method for reducing the adverse effect of cold wet weather on young calves reared out-of-doors.

Keywords: body covers, lactating cows, calves, calorimeter.

INTRODUCTION

Exposure of cattle to climatic conditions which are colder than their thermoneutral zone will cause increases in energy expenditure and decreases in productivity (Webster, 1976). Studies in New Zealand suggest that, under wet, windy conditions, the lower critical temperatures for young calves and older non-lactating cattle are between 10°C and 20°C (Holmes and McLean, 1975; Holmes *et al.*, 1978). In practice, dairy cattle are frequently exposed to temperatures lower than these critical levels, especially during windy, wet weather in winter and early spring.

The adverse effects of cold-exposure can be reduced by the provision of shelter (e.g. Holmes et al. 1978). An alternative approach is to protect the animal with a "body cover", which has been shown to reduce energy expenditure by sheep (Webster and Park 1967; Panaretto *et al.*, 1968), but there are no reports in the literature on the effects of covers on cattle production under New Zealand conditions. In comparison to the past, when only canvas or jute covers were manufactured, relatively cheap and durable covers made from woven polyethylene fabric are now available. The experiments described in this paper measured the effects of covers on milk production by cows grazing on pasture during winter, and the consumption of oxygen by young calves exposed to simulated wet, windy conditions in calorimeter chambers.

MATERIALS AND METHODS

Experiment 1: Cows

Two groups (n = 12 per group) of eight year old lactating cows from the Massey University winter milk herd were formed in late June. The groups were balanced for production at the June herd test. The experiment commenced on June 30, 1992 when the cows were weighed at 0830 h and their condition was assessed. The following day the cows were weighed again at the same time, and milk samples were taken from the evening milking for the standard Livestock Improvement Corporation (LIC) herd test. Polyethylene covers (Straightline Canvas, Palmerston North) were fitted to each of the cows in one group (COVER) after milk sampling on the morning of 2 July. The other group remained uncovered (CONTROL). Cows were individually herd tested at weekly intervals over a period of six weeks. This provided milk yield data and a milk sample that was analysed for fat and protein content using a 'Milk-o-Scan' meter. Cow liveweights were recorded during week 3 and on consecutive days at the end of the experiment. A final condition score was taken on the last day of the experiment. Farm staff kept a record of problems and benefits encountered with the cow covers. Ripped covers were replaced as soon as the damage became apparent.

Cows were grazed in the same herd on a pasture diet supplemented with grass silage equivalent to about 50% of the daily intake of dry matter during the experiment. An additional meal supplement of 2 kg/cow/day of barley meal was introduced following flooding of the farm during week 4 of the experiment. Meteorological data were recorded at the Ag Research station, located approximately 1 km from the farm.

Statistical analysis

Milk yield and composition data was subjected to repeated measures analysis to test for the temporal effects of treatment. The number of days in milk for each cow at the start of the experiment was fitted before the treatment effect in the

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model. Cow liveweights, averaged for the two weighings at the commencement and end of the experiment, and cow condition scores were analysed by Students's t-test.

Experiment 2 : Calves

Four Friesian x Jersey bull calves, two to four weeks of age, and mean liveweight 36 kg, were used in each of the two parts of this experiment (8 calves in total). They were given fresh milk twice daily, at a level estimated to produce a growth rate of approximately 0.6 kg/day.

In part I of the experiment, oxygen consumption was measured in two calorimeter chambers (Holmes and McLean, 1974) equipped with fans and water sprinklers designed to simulate wind (8 km/hr) and rain, and maintained at 9°C air temperature. Each calf remained in its calorimeter for 11 days; 3 for acclimatisation and 8 for experimental measurements. Calves fitted with or without a body cover for 24 hours were then exposed to rain or no rain from 0800 to 1600 h. Each calf was exposed to each treatment combination on two separate days. Oxygen consumption, calculated both over the whole period of about 23 hours, and over the period from 1400 to 1600 h (the final two hours of exposure to rain), was expressed per kg $LW^{0.75}$ per hour.

In part II of the experiment, oxygen consumption was measured in two calorimetric hoods (Holmes, 1971), with the calf's head and neck retained in a ventilated box, sealed with a flexible collar which fitted tightly around the neck. These were mounted in the calorimeter chamber used in Part I, and the same climatic conditions were imposed. Use of hoods rather than full calorimetric chambers made it possible to measure the changes in oxygen consumption over short periods of time. For each calf, oxygen consumption was measured over the period 0800 to 1600 h each day for 4 days, after the calf had become accustomed to the hood for 3 days. During the measurements the calves were exposed to 9°C air temperature and wind (8 km/hr); and to rain between 0800 and 1600 h. Calves were randomly allocated to two groups that either had their cover kept on throughout the measurements (covers) or removed at 1000 h (control). Oxygen consumption was measured for both treatments during the covariate period from 0900 to 1000 h, and during the treatment period, 1200 to 1600 h.

The data for oxygen consumption (expressed as $l/kg^{0.75}$ per hour) were subjected to analyses of variance for part I and analyses of covariance for part II.

Meteorological data

The data reported in Table 2 show that July and August were wetter, less sunny and less windy than average. July was slightly warmer, but August was slightly cooler than average.

RESULTS

Experiment 1

Cow liveweight and condition score

The initial liveweight of the cows did not differ significantly between the COVER and CONTROL groups (500 ± 15 vs 518 ± 17 kg), neither did condition score (4.51 ± 0.13 vs 4.35 ± 0.06 units). The COVER group had been lactating for 92 days (range 57 to 119 days) at the start of the trial compared with 107 days (80 to 128 days) for the CONTROL group. Cow liveweight decreased by 19.9 ± 4.0 kg in the COVER group over the six weeks of the experiment compared with 25.6 ± 3.9 kg in the CONTROL cows ($P>0.1$). The final condition score remained higher in the COVER cows than the CONTROL group (4.30 ± 0.25 *vs* 4.15 ± 0.13 units). Thus, the addition of covers did not significantly affect the change in liveweight or condition score of the cows over the six weeks of the experiment.

Milk yield and composition

The pattern and level of milk yields did not differ significantly between the COVER and CONTROL groups at any stage of the experiment (Table 1). However, uncovered cows had higher pre-treatment yields of fat and protein in the milk, which were maintained throughout the study. Milkfat and protein yields were not affected through time by the use of covers.

TABLE 1: Least square means for milk yield and milk components at each herd test (all treatment differences through time were non-significant).

	Herd Test						
	Initial[a]	Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Wk 6
Milk yield (*l*/d)							
CONTROL	15.8	15.6	16.2	14.5	12.5	12.7	13.6
COVER	13.7	14.5	15.1	13.8	11.7	11.4	11.3
Milkfat (kg/d)							
CONTROL	0.8	0.7	0.7	0.6	0.6	0.6	0.6
COVER	0.6	0.6	0.6	0.5	0.5	0.5	0.5
Milk protein (kg/d)							
CONTROL	0.5	0.5	0.5	0.5	0.4	0.4	0.44
COVER	0.4	0.4	0.4	0.4	0.3	0.4	0.3

[a]Measurements recorded on 1 and 2 July 1992.

Heavy rainfall during the fourth week of July resulted in 83% of the farm being flooded for 12 hours, and major damage to fences and races. Approximately 11% of the farm area was heavily silted and the pastures required reseeding. Thus, the pasture feed supply was sharply reduced from Week 4, and milk production in both groups declined to between 12 and 13 litres per cow (Table 1), despite the introduction of barley meal at 2 kg/cow/day.

Experiment 2

Part 1

The effects of the calf cover treatments were similar over both the afternoon and 23 hour periods (Table 3). Thus, rain caused a significant increase, and the covers caused a significant decrease in oxygen consumption. However, the interaction term was also significant because the effect of the cover was evident only during exposure to rain; it had no effect in dry conditions (alternatively the effect of rain was much larger without the cover than with the cover).

With rain, the size of the effect of the cover was larger during the last two hours of the exposure to rain (1400 to 1600 h) than for the whole 23 hours which included only 8 hours

TABLE 2: Weather conditions during the experimental period (data was collected by AgResearch Grasslands from a site adjacent to the No. 1 dairy farm).

Days	Rainfall (mm)		Wind run (km)		Air Temp (°C)				Sunshine (h)	
					July		Aug			
	July	Aug	July	Aug	Min	Max	Min	Max	July	Aug
1-7	28	18	287	298	6.3	13.5	4.2	11.9	12	23
8-14	28	46	225	266	6.0	10.8	7.3	13.0	15	5
15-21	23	22	128	188	3.9	12.5	5.5	12.5	18	26
22-28	49	11	342	160	4.0	11.7	2.5	11.3	18	22
29-31	13	3	134	137	9.3	13.8	1.4	10.2	5	11
Total	142	110							68	86
Average			252	222	5.4	12.2	4.4	12.0		
60-year average	89	89	270	270	4.0	11.9	5.0	13.1	104	102

TABLE 3: Mean (± SEM) values for oxygen consumption (litres/kg$^{0.75}$ per hour) measured at 9°C and 8 km/h over the whole 23 hours and over the period 1400 and 1600 h in part I of Experiment 2.

Period	Treatment				Significant effects		
	No rain		Rain				
	Cover	No cover	Cover	No cover	Rain	Cover	RxC
23 hours	1.46 ± 0.02	1.45 ± 0.03	1.54 ± 0.04	1.78 ± 0.06	**	*	**
1400 to 1600	1.36 ± 0.05	1.41 ± 0.06	1.46 ± 0.09	2.06 ± 0.17	**	**	**

of rain. Relative effects, expressed as the ratio: [(Oxygen consumption with cover): (Oxygen consumption without cover)], were 0.87 for the 23 hour period and 0.71 from 1400 to 1600 h.

Part II

In part II, the cover caused a significant decrease ($P<0.01$) in oxygen consumption; the actual values ($l O_2$/kg$^{0.75}$ per hour) were 1.44 ±0.06 and 1.77 ±0.10 for calves with and without covers, respectively. Thus, the value measured for calves with covers was almost identical to that measured in Part I (1.46, Table 3). However, the actual values measured without covers (1.77) were less than the corresponding values measured in Part I (2.06). This suggests that the flexible collar, required for the calorimeter hood in Part II, provided some protection against the effects of rain.

DISCUSSION

Experiment 1 : Cows

The cows adapted to the polyethylene covers within one to two days of fitting. A total of eight covers had to be replaced during the trial, mainly because of ripping against rails in the cow yard and due to tearing through trampling when the covers were blown over a cow's head during windy weather conditions. The loss of covers in this manner was of serious concern because it resulted in the affected cow "panicking" and upsetting the other cows in the herd. Damage to covers may be lower when fitted to non-lactating cows that are subjected to less pushing/shoving than cows herded twice daily for milking.

Weather conditions during July and August were wetter than the 60 year average, but less windy (Table 2). Air temperatures were warmer than average in July, but cooler in August. Total sunshine hours were well below the long-term average. Air temperatures reached a minimum of 3.9°C during July. The potential for chill conditions was also reduced by the lower than normal wind run.Thus, weather conditions were not favourable for animal, or pasture-production, because of almost continual wet ground conditions and dull, overcast days, rather than low temperatures. The relatively mild weather conditions would have contributed to the non-significant effect of covers on cow production.

The sustained period of wet ground conditions resulted in an outbreak of foot problems. Five and six cows in the CONTROL and COVER groups, respectively, required treatment during the six week trial period. Affected cows were removed from the main herd and grazed on paddocks within 100m of the milking shed until the hooves recovered. It was not possible to quantify the effects of these problems on milk production, although they would have undoubtedly contributed to less than optimal production.

Experiment 2 : Calves

The results of both parts of this experiment were consistent; the covers provided significant thermal protection against the effects of simulated rain, for the young calves exposed to a cool temperature and a gentle wind. Similar thermal protection has been reported for shorn sheep (Panaretto *et al.*, 1968) and fleeced sheep (Webster and Park, 1967) fitted with plastic or jute covers.

Exposure to the wind and showers of rain at 9°C, without the cover, caused oxygen consumption to increase by 15% (over 23 hours) and by 40% during the period of rain (Part I). The latter short-term effects may be important in relation to the incidence of mortality in young calves (Martin *et al.*, 1975), while the longer-term effects on energy expenditure would be expected to cause reduced growth rates or increased feed requirements. For example, the increase in daily oxygen consumption of 5.7 $l O_2$/kg$^{0.75}$ (without a cover in Part I), is

approximately equivalent to 1.7 MJ extra heat produced; the metabolizable energy in 0.3 *l* of milk, or the gross energy in 0.15 kg of body tissue. These effects would probably be larger in young Jersey calves, which are more susceptible to the effects of cool windy conditions because their lighter hair cover provides less thermal insultation (Holmes and McLean, 1975).

CONCLUSIONS

Fitting waterproof polyethylene covers to lactating cows supplying winter milk did not improve the daily yield of milk or milk components, and did not result in an improvement in cow liveweight or body condition over a six week period. Weather conditions during the trial, although wet and generally overcast, were relatively mild compared to those for a 'normal' Manawatu winter. The wet conditions contributed to lameness in the cows and resulted in lower than desired daily allowances of pasture for the herd. However, both groups were affected to a similar extent with respect to these factors. Wind blowing the covers over a cow's head was a serious practical problem and contributed to ripped covers (and an unacceptably high replacement rate) and to disturbance of the herd. An alternative strapping arrangement is required for covers that are to be used on short-tailed cows. The effect of covers on non-lactating cows during winter requires investigation. These animals dissipate less heat because of their lower level of daily intake than lactating cows. The use of cover on calves, however, provides an effective low-cost method to reduce the adverse effects of wet weather on calves raised on pasture.

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