THE EFFECT OF SODIUM BENTONITE OR ZEOLITE ON WOOL GROWTH OF SHEEP FED EITHER MULGA (ACACIA ANEURA) OR LUCERNE (MEDICAGO SATIVA)

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SUMMARY

Sheep consuming mulga and minerals (nitrogen, phosphorus and sulphur) *were* supplemented with bentonite or zeolite (60 g/d) or polyethylene glycol (PEG) (3 g/d). Sheep 'in the control group gained weight at a faster rate (27.7 versus 1.5 g/d, $P<0.05$) than sheep supplemented with bentonite. Sheep receiving bentonite or PEG produced more wool (0.613 and 0.625 versus 0.553 $mg/cm^2/d$, $P<0.05$) than those receiving zeolite, but not more than those receiving minerals alone. In a second experiment sheep consuming lucerne received no supplement, were supplemented with bentonite (30 g/d) mixed dry or given as a drench with 600 ml of water, or zeolite (30 g/d) with 40 ml of water. Sheep receiving dry bentonite and zeolite gained weight at a faster rate (40.7 and 43.4 versus 14.9 g/d, $P<0.05$) than the control sheep. There was no wool growth response to bentonite or zeolite. The effect of bentonite and zeolite was inconsistent across diets, making it difficult to predict the response to these supplements for any given dietary regime.

INTRODUCTION

Studies with bentonite and zeolite have suggested that these materials may have a role to play in improving the efficiency of ammonia utilisation in the rumen (Martin et *al.* 1969; Mumpton and Fishman 1977) and in the protection of protein from ruminal fermentation (Leng 1983). In south west Queensland sheep are regularly fed mulga with a non-protein nitrogen, phosphorus and sulphur supplement. The aim of the first experiment was to investigate the effect of bentonite or zeolite supplementation on the production of mulga fed sheep. A PEG treatment was also included in this experiment as this tannin binding compound has given significant improvements in the wool growth of mulga fed sheep (Pritchard *et al.* 1988). The second experiment was to evaluate bentonite and zeolite as supplements for sheep consuming a diet high in true protein.

MATERIALS AND METHODS

Experiment 1

Sheep were held as groups in pens at Charleville, south-western Queensland. Sixty-eight two-year-old Merino wethers were provided with *ad libitum* quantities of freshly lopped mulga *(Acacia aneura)* each day plus 20 g/head/d of mineral mix (50.4% coarse salt, 20.2% sulphate of ammonia, 20.2% monophos, 1.6% urea and 7.6% molasses). These animals had been grazing a predominantly mulga diet prior to the experiment. The sheep were maintained on the basal diet for a pre-experimental period of four weeks during which time wool growth was measured.

Treatments were replicated with the sheep being allocated to four groups of eight sheep, and four groups of nine sheep, by stratified randomisation based on pre-experimental wool growth. Each group received one of four treatments which *were* incorporated with the minerals as a dry mix: (1) nil treatment; (2) bentonite (60 g/head/d); (3) PEG (3 g/head/d); and (4) zeolite (60 g/head/d), The treatments commenced on 16 August 1988, and continued until 7 October 1988. Wool growth was measured over 41 days commencing on 26 August 1988. Seven days

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prior to the commencement of the mineral supplement the sheep were fed coarse salt to alleviate any sodium deficiency that may have caused them to consume toxic amounts of the supplement.

Live weights were recorded at the beginning and end of the pre-experimental period. During the experimental period, live weights were measured every two weeks and at completion of the experiment. Wool growth was measured during the pre-experimental and experimental periods using the clipped patch technique. Supplements were provided twice weekly and residues were measured to give mean daily intake of supplement. Supplement acceptance by individual sheep was checked by surrounding the troughs with hessian soaked in branding paint.

Experiment 2

Sheep were housed individually at the Charleville Pastoral Laboratory. Thirty-six two-year-old Merino wethers were offered a daily ration of 700 g of lucerne pellets (approximately 28 g nitrogen/kg dry matter). The sheep were maintained on the basal diet for a pre-experimental period of four weeks during which time wool growth was measured. The sheep were allocated to one of the four following treatments by stratified randomisation based on pre-experimental wool growth. Each sheep received one of the following treatments daily: (1) nil treatment; (2) bentonite dry - 30 g of sodium bentonite mixed with feed; (3) bentonite drench - 30 g of sodium bentonite mixed with 600 ml of water, administered via a drenching gun within 30 minutes of feeding; and (4) zeolite drench - 30 g of zeolite mixed with 40 ml of water and administered via a drench gun within 30 minutes of feeding. The experimental period commenced on 21 July 1988 and continued until 13 September 1988. Wool growth was measured over 43 days commencing on 2 August 1988.

Live weights were recorded at the beginning and end of the pre-experimental period. During the experimental period, live weights were measured every two weeks and at completion of the experiment. Wool growth was measured during the pre-experimental and experimental periods using the clipped patch technique.

RESULTS

Experiment 1

The initial mean live weight of the sheep was 31.2 kg. All sheep lost weight (33 g/head/d) during the pre-experimental period. This was reversed when supplementation commenced, with all groups increasing live weight over the experimental period (Table 1). During the experimental period, the only significant difference in rate of liveweight change was between the control group and the bentonite group, with the sheep in the control group gaining weight at a significantly faster rate ($P<0.05$) (Table 1). The sheep receiving the bentonite and those receiving PEG grew significantly more wool (11% and 13% respectively, $P<0.05$) than the sheep receiving zeolite. The bentonite and PEG treatments did not significantly increase wool growth over the control. All sheep showed paint marks indicating the acceptance rate of supplements was 100%. The groups receiving NPS alone consumed all of the supplement offered. The mean intake of supplement was 49.5 g/d bentonite, 43.5 g/d zeolite and 2.9 g/d PEG.

Table 1 Liveweight change and wool growth of sheep fed mulga and minerals and supplemented with bentonite, zeolite or PEG

Parameter	Treatment group				s.e. mean
	Control	Bentonite	PEG	Zeolite	
Liveweight change (g/head/d)	27.7[a]	1.5[b]	13.6[ab]	9.7[ab]	8.53
Clean wool growth ($mg/cm^2/d$)	0.599[ab]	0.613[b]	0.625[b]	0.553[a]	0.0170

Means within rows with different superscripts differ significantly (P<0.05).

Experiment 2

The initial mean live weight of the sheep was 44.5 kg. There were no significant differences in mean live weight between the groups. However, during the experimental period there were differences in rate of liveweight change (Table 2). Sheep receiving the dry bentonite and the zeolite supplements gained weight at a significantly faster rate ($P<0.05$) than the control sheep. Live weight change of the sheep receiving the bentonite drench was not significantly different from that of any of the other treatments. There was no wool growth response to the addition of bentonite or zeolite to the lucerne diet (Table 2).

Table 2 Liveweight change and wool growth of sheep fed lucerne and supplemented with bentonite or zeolite

Parameter	Treatment group				s.e. mean
	Control	Bentonite dry	PEG drench	Zeolite drench	
Liveweight change (g/head/d)	14.9[a]	40.7[b]	24.4[ab]	43.4[b]	7.16
Clean wool growth ($mg/cm^2/d$)	0.600	0.600	0.624	0.571	0.0191

Means within rows with different superscripts differ significantly (P<0.05).

DISCUSSION

Although there were some significant differences in liveweight change and wool growth between the treatments imposed on the mulga and mineral fed sheep, their production was not enhanced by the addition of bentonite, zeolite or PEG. The lack of response to the addition of PEG to the mulga and mineral diet is inconsistent with responses in earlier experiments (Pritchard *et al.* 1988; Eady *et al.* 1989). However, the tannin content of mulga does vary with season and between locations (D.A. Pritchard pers. comm.) and a possible variation in the PEG:tannin ratio may account for the lack of response,

Supplementation with dry bentonite or zeolite slurry gave some benefits in terms of liveweight gain for sheep consuming a good quality diet of lucerne. The lack of response to the bentonite slurry was inconsistent with this result, as the addition of water to the bentonite should not have interfered with its action in the rumen. It is unlikely that the responses seen in liveweight gain were due to an increase in the level of protected protein available for digestion because wool growth, a function sensitive to the availability of undegraded protein (Hemsley and Reis 1984), did not show the same pattern of response. An increase in microbial activity due to the possible ammonia sparing action of the bentonite *or* zeolite (Mumpton and Fishman 1977; Britton *et al.* 1978) could have resulted in an increased flow of microbial protein into the small intestine, giving rise to a greater quantity of protein but no improvement in quality.

The responses to bentonite and zeolite supplementation were inconsistent between the experiments. Where sheep were fed mulga, the differences between treatments in live weight change and wool growth were small and of little biological significance. On the pelleted lucerne diet liveweight gain was significantly improved by the addition of dry bentonite and zeolite, but wool growth was unchanged.

The general trend for bentonite supplementation to improve liveweight gain and nitrogen retention in sheep and cattle has been observed in situations where regular intake was ensured (Martin *et al.* 1969; Britton *et al.* 1978). In a commercial situation with grazing sheep, bentonite or zeolite would be fed in block or loose mix form since administration through the water would be difficult due to the insoluble nature of these substances. Hence intake would be variable and any possible response reduced. The present work provides no strong evidence for including bentonite or zeolite in supplements for sheep under paddock conditions.

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