THE EFFECT OF POLYETHYLENE GLYCOL (PEG) ON WOOL GROWTH AND LIVEWEIGHT OF SHEEP CONSUMING A MULGA (ACACIA ANEURA) DIET

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SUMMARY

Under pen conditions PEG was fed either alone or in conjunction with a mineral supplement (NPS) to sheep consuming a diet of mulga leaf. These supplements improved wool growth by up to 45% and liveweight gain by up to 33g/d compared with unsupplemented animals. It is likely that the improved productivity of PEG supplemented sheep is due to binding of mulga condensed tannins by PEG resulting in greater availability, digestion and absorption of protein and amino acids Keywords: Mulga, condensed tannins, wool growth, liveweight .

INTRODUCTION

Mulga (Acacia aneura,Benth) is widely distributed throughout inland Australia where it provides a valuable fodder for both sheep and cattle, particularly during drought. Despite a crude protein content of 10-14% it is regarded at best as only a maintenance ration.

McMeniman and Little (1974), Entwistle and Baird (1976) and McMeniman(1976) have shown that liveweight status and wool production of sheep fed mulga can be improved by supplementation with phosphorous and molasses. Hoey et al (1976) and Gartner and Niven (1978) demonstrated that a considerable proportion of the response was due to the sulphur component of molasses. Gartner and Hurwood (1976) suggested that although mulga contains adequate sulphur is was not available to the animal due to binding of protein by tannins present in mulga.

Subsequent studies (D.A. Pritchard, unpublished data) have shown that the tannins present in mulga are predominantly condensed tannins (CT) which are known to have anti-nutritional effects in ruminants (McLeod 1974). Pritchard et al (1985) investigated the effects of mulga condensed tannins on sheep productivity by drenching sheep fed mulga with 6g/d of polyethylene glycol (PEG; MW 4000). This resulted in modest improvements in intake and wool growth and a reduced rate of liveweight loss.

The present experiment was carried out to further investigate the effects of condensed tannins on the productivity of sheep consuming mulga under applied conditions.

MATERIALS AND METHODS

Sixty, adult medium woolled merino wethers were drenched with a broad spectrum anthelmintic (Albendazole)⁺, placed in large open-air group feeding pens at the Charleville Experimental Reserve (Burrows and Beale 1970). Freshly lopped mulga was offered ad lib. daily to the sheep throughout the experiment.

Queensland Department of Primary Industries, P.O. Box 282, Charleville, 4470. Queensland Department of Primary Industries, P.O. Box 46, Brisbane, 4001. Valbazen; Smith Kline Animal Health Products. Following a 2 week settling-in **period, clean** wool growth was measured over a one month period using the clipped patch technique of Morley et al. (1955). Sheep were then allocated to six groups by stratified randomisation on clean wool growth during this period.

The following mineral (NPS) and PEG supplements were then offered. Group 2, NPS (lick); Group 3, NPS + 12 g/hd/d PEG (lick); group 4, NPS + 24 g/hd/d PEG (lick); group 5, NPS (lick) + 24 g/hd/d PEG (water); group 6, 24 g/hd/d PEG (water). Group 1 received no supplement. The NPS lick consisted of coarse salt, sulphate of ammonia, mono ammonium phosphate, molasses and water mixed in the ratio of 2:1:1:1:0.3 w/w. This formulation was based on previous research findings at Charleville and is one of the mixtures fed commercially in the region (D.A. Pritchard unpublished data). The mix was offered 3 times weekly at the rate of 20 g/hd/d. For groups 3 and 4 PEG was added to the mix at the appropriate rate.

Water was available ad libitum to all groups in 80 litre containers. Water intakes were recorded **3** times weekly at which times the containers were emptied and **re-filled** with fresh water. For those groups (5 and **6**) receiving PEG in the water the appropriate amount of pre-dissolved PEG was added to the water depending on the average per head water intake over the previous 2 day period.

This supplementation regime was continued for a 12 week period during which two wool growth measurements were made. Live weights were recorded weekly throughout the experiment.

Data was analysed by analysis of variance with **pairwise** testing between treatments using the protected. L.S.D. procedure.

RESULTS

Wool growth rate was significantly (P<0.01) higher for all groups receiving PEG but here were no further differences within the groups receiving PEG, Although there was no difference in final live weight, differences in liveweight change were significant (P<0.01). The control group lost significantly (P<0.01) more weight than all other groups and groups receiving 24g/d PEG had significantly (P<0.01) higher rates of gain than other groups. The data are presented in Table 1.

Table 1 The effect of polyethylene glycol (PEG) and mineral (NPS) supplements on wool growth and live weight of sheep consuming a mulga diet

Live weight change (g/d)	Live weight (kg)	Wool growth (mg/cm ² /d)	Treatment
 -17 ^a	37.1	0.57 ^a	Control
– 2 ^b	39.2	0.60 ^a	NPS (lick)
2 ^b	40.8	0.76 ^b	NPS + 12g/d PEG lick
16 ^e	39.2	0.83 ^b	NPS + 24g/d PEG lick
			NPS (lick) + 24g/d PEG
12 ⁰	39.0	0.79 ^b	(water)
11 ^C	38.0	0.78 ^b	24g/d PEG (water)
5.5	3.82	0.076	LSD (P = 0.05)
 -17 ^a - 2 ^b 2 ^b 16 ^c 12 ^c 11 ^c 5.5	37.1 39.2 40.8 39.2 39.0 38.0 3.82	0.57 ^a 0.60 ^a 0.76 ^b 0.83 ^b 0.79 ^b 0.78 ^b 0.076	Control NPS (lick) NPS + 12g/d PEG lick NPS + 24g/d PEG lick NPS (lick) + 24g/d PEG (water) 24g/d PEG (water) LSD (P = 0.05)

^a Values within columns with different superscripts differ significantly (P<0.01).

DISCUSSION

Since PEG binds tannins (Jones and Mangan 1977), has no food value and is not digested by sheep (Sperber et al. 1953), the improved productivity of those sheep receiving the PEG supplement is indicative of the powerful anti-nutritional effects of condensed tannins present in mulga.

Although those sheep offered only the NPS supplement lost significantly less weight than control animals, the dominant role of PEG in improving both wool growth and rate of liveweight change is reflected by the similar responses obtained to either PEG (24 g/d) or PEG (24 g/d) + NPS. Because of the experimental design used and likely differences in supplement intake between sheep within groups it is not possible to rule out favourable interactions between PEG and NPS.

The lack of a wool growth response in those sheep receiving the NPS supplement is at variance with previous results obtained using the same formulation over a ten month period (D.A. Prtichard, unpublished data). An intake of 20 g/h/d of NPS provides **3.1**, **1.3**,0.9 and 1.0 g/h/d of sodium, nitrogen, phosphorous and sulphur respectively. Of these the most important are sulphur and phosphorous. the amounts supplied by the NPS lick are of the same order as those quantities previously shown to improve intake and wool growth of sheep fed mulga (Entwistle and Baird **1976**). The absence of a significant wool growth response to NPS in this experiment may simply reflect a large variation in supplement intake between animals.

Wool growth and liveweight responses to 12 and 24 g/d PEG were greater than those measured in a previous experiment when $6 \,\text{g/d}$ PEG was administered as a daily drench to sheep consuming mulga (Pritchard et al 1985). This suggests a decreasing level of CT activity with increasing levels of PEG supplementation.

In laboratory studies (D.C. Stocks unpublished data) it was found that a PEG:CT ratio of 2:1 prevented any binding of mulga protein by CT. However, the optimum PEG:CT ratio required to maximise productivity in mulga fed sheep remains to be determined.

While dry matter intake was not measured in the present experiment, other studies (D.A. Pritchard unpublished data) have shown that 24 g/d PEG increases intake of mulga by 40-50%. This response was accompanied by increases in both nitrogen and sulphur balance and a marked improvement in apparent nitrogen digestibility. Thus, the superior productivity of PEG supplemented sheep is likely to reflect both higher intake and improved nutrient availability of mulga. These findings support the contention of Gartner and Hurwood (1976) that responses to sulphur are not due to a deficiency of sulphur in mulga leaves but to the complexing of tannin and protein in vivo causing a decrease in available sulfur.

While PEG appears to improve nutrient availability in sheep eating mulga the location/s at which this occurs is less clear. Binding of CT by PEG in the rumen should increase protein availability, microbial activity and digestion of protein in the rumen. This should also improve the amount of microbial protein available for digestion in the small intestine. Alternatively the major role of PEG may be in binding free tannins in the abomasum and small intestine thereby negating their detrimental effects on protein digestion and absorption (McLeod 1974; Barry and Duncan 1984).

The finding that condensed tannins in mulga are depressing its nutritive value needs to be exploited under commercial grazing conditions. Unfortunately, the current cost of PEG rules against its use as a commercial supplement. Evaluation of analogues of PEG may provide an effective supplement with greater economic appeal.

Another option may lie in the use of micro-organisms with the ability to break down mulga condensed tannins in sheep. While this may be a long term prospect it probably offers the most efficient method of dealing with the problem.

A third possibility may **exist** in exploiting the regional, seasonal and between tree variation that occurs in CT content (2-11%) of mulga leaf.

Management and supplementation strategies could be developed which minimise the apparent anti-nutritional effects of condensed tannins in mulga thereby enhancing sheep productivity.

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