UREA OR LUPINS AS SOURCES OF SUPPLEMENTARY NITROGEN

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SUMMARY

Two-tooth Merino wethers were fed diets based on hay and ensiled apple pomace, fortified with a range of levels of lupins and urea to provide a total of 2.4% nitrogen in the dry matter.

Performance declined above 1.74% urea in the dry matter and it was concluded that urea could be used to supply up to 34% of the dietary nitrogen without adversely affecting performance.

INTRODUCTION

Hodge and Bogdanovic (1980) reported improvements in intake and liveweight gain from supplementing oats and citrus pellets/hay with a single level of urea in diets for lambs and wethers. Mehrez and Orskov (1978) reported significant improvements in intake and liveweight gain by early weaned lambs of about 2 months age, from adding urea at a range of levels to diets based on barley without other sources of supplementary protein. No reports have been found of experiments directly comparing performance over a wide range of levels of substitution of urea for other sources of dietary nitrogen (N).

Apple pomace contains only about 0.7% N in the dry matter (Sprivulis, unpublished data) which as a feed for cattle or sheep is very low, but Crampton and Harris (1969) report a high ME content of 11.5 MJ/kg DM. It thus provides a useful substrate for comparing the extent to which different sources of dietary N can be effectively used in ruminant diets. Apple pomace is available annually as a low cost supplement in the SW of Western Australia in the autumn/winter when pasture growth is very limited.

The aim of this experiment was to determine the effects of replacing from 0 to 100% of the lupin N by urea N in diets for 2 tooth wethers.

METHOD

Thirty-six two-tooth Merino wethers of fat score l-2 and average liveweight of 31 kg were stratified by weight and allocated to heavy, intermediate and light blocks and to 6 treatments at random within blocks, i.e. 2 sheep of similar weight per plot. The 6 treatments were diets supplied ad libitum and consisting of apple pomace silage fortified by thoroughly mixing daily with minerals and lupins or urea and gypsum, as below:

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Treatment	1	2	3	4	5	6
	% Composition of diet (as is)					
Lupins	11.3	16.9	11.3	6.7	3.0	0
Apple pomace	88.2	82.7	88.0	92.2	95.6	98.5
Minerals*	0.45	0.45	0.45	0.40	0.40	0.40
Urea	0	0	0.33	0.6	0.84	1.0
Gypsum	0	0	0.08	0.15	0.21	0.25

* The mineral mixture consisted of salt 5 kg, ground limestone 4 kg, Acid Calcium Phosphate 4 kg, Manganese Sulphate 39 g and Zinc Oxide 50 g

Each sheep also received a daily ration of 330 g meadow hay. They were confined in pens measuring approximately 4 m^2, inoculated with a selenium-fortified pulpy kidney vaccine, treated with anthelmintic, and introduced to the diets over 14 days. Fortnightly liveweight, and daily feed intake (feed supplied less discarded residues) were recorded from day 14, for 49 days, after which the sheep were slaughtered and their carcase weights and "GR" measurements (tissue depth external to the 12th rib, 11 cm lateralto the midline) were recorded. The data were analysed initially as a randomized block design with liveweight after ration introduction as a covariate. After adjustment by covariance the block effects were negligible and the data were reanalysed as a completely randomized design with covariate using plot means as the experimental unit. A sample of the lupins was analysed for dry matter and N content and weekly samples of the ensiled apple pomace were analysed for dry matter, pH, N, reducing sugars, ethanol and acetic acid, using standard techniques.

RESULTS

The composition of the lupins was 91.3% dry matter and 5.0% N in dry matter (DM). The composition of the apple pomace silage varied during the experiment. Initially the results of the analysis were (as is): Dry matter 25.4%, nitrogen 0.2%, ethanol 0.3%, reducing sugar 0.9%, acetic acid 0.05%, and pH 3.9. Most of these changed progressively but had stabilized by about week 5. Values of 21.2, 0.14, 2.5, 0.6, 0.05% and pH 3.45 respectively were recorded by the end of the experiment.

The estimated composition of the 6 diets and performance of the sheep after introduction is shown in table 1.

Table 1 Estimated composition of dietary dry matter (DM) and performance of sheep over 49 days

Treatment	1	2	3	4	5	6	
Total N (% DM)	1.96	2.36	2.36	2.38	2.42	2.36	
Urea (% total DM)	0	0	0.84	1.74	2.59	3.19	
Urea N (% total N)	0	0	16	34	49	62	
Urea (% pomace DM)	0	0	1.1	2.25	3.4	4.5	LSD $p < 0.05$
Live gain (g/d)	197	210	211	238	179	124	49
Carcase wt (kg)	17.9	18.6	18.9	19.5	17.6	15.6	1.5
GR - see text (mm)	8.3	9.0	8.6	10.6	9.1	6.7	NS
Intake (g/d)	886	955	988	1039	953	776	169
Intake/gain	4.5	4.5	4.7	4.4	5.3	6.3	0.79
Urea intake (g/d)	0	0	8.3	18.1	24.7	24.8	

No symptoms of urea toxicity or any other metabolic disturbance were observed during the introductory or the experimental feeding periods.

DISCUSSION

The results showed that urea and gypsum could substitute satisfactorily for lupins as a source of supplementary nitrogen in diets based on hay and ensiled apple pomace, at up to 1.74% urea in the total dietary DM, or 2.25% of the fortified pomace dry matter, with no adverse effect upon performance or intake. Above that, liveweight gain and carcase weight were significantly and markedly reduced. Differences in DM intake followed the same pattern.

It is unlikely that these results were a consequence of supplying excess N (2.4% N in dry matter) because performance apparently (though not significantly) declined when less N (treatment 1) was provided. Orskov et al. (1976) also reported a large increase in liveweight gain in lambs of well over 28 kg liveweight by increasing the dietary N content from 1.92 to 3.2% in the dry matter.

The result reported here corresponds closely to that of Mehrez and Orskov (1978) whose lambs on a low protein barley diet showed increasing intake and liveweight gain up to but not beyond 1.6% urea in the diet (i.e. about 1.8% urea in DM).

Treatment effects upon GR measurement in our experiment showed a trend corresponding to the changes in liveweight gain and carcase weight but were not significant at $p < 0.05$.

Ensiled apple pomace was readily consumed in spite of its low pH and high ethanol content. Total feed intake (hay + fortified pomace) was high at around 1 kg DM/head/d and the feed was converted very efficiently, up to 2.25% urea in pomace DM (18 g urea intake/head/d). Above 2.25% urea content, intake of pomace and performance of the sheep declined and intake of urea appeared to be self-limiting at 25 g/head/d. We suggest that the decline was a consequence of unpalatability rather than toxicity of the pomace containing 3.4 or 4.5% urea in pomace DM.

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REFERENCES

CRAMPTON, E.W. and HARRIS, L.E. (1969). "Applied Animal Nutrition" 2nd Ed. (W.H. Freeman; San Francisco).

HODGE, R.W. and BOGDANOVIC, B. (1980). Proc. Aust. Soc. Anim. Prod. 13:277.

MEHREZ, A.Z. and ORSKOV, E.R. (1978). Br. J. Nutr. 40:337.

ORSKOV, E.R., McDONALD, I., GRUBB, D.A. and PENNIE, K. (1976). J. Agric. Sci. Camb. 86:411.