SUPPLEMENTATION OF OATS OR CITRUS PULP WITH NON-PROTEIN NITROGEN OR ROUGHAGE

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SUMMARY

The voluntary intake and liveweight gain of young sheep fed oat grain (7-8% crude protein) were significantly increased by supplementation with pasture hay or lucerne chaff but equal benefits were obtained by supplementing with urea.

A similar response in terms of intake and liveweight gain of young sheep was achieved by supplementingcitrus pulp with urea but an additional and significant response occurred when supplements of roughage were offered. Pasture hay or straw were equally effective as the source of roughage.

INTRODUCTION

Grain feeding of sheep in Australia is confined to periods of drought and to lot feeding of light weight lambs during summer and autumn. Oat grain is often used in these situations andcitrus pulp has also been fed to sheep and cattle during droughts in northern Victoria. Practical feeding recommendations are that grain rations fed to young stock should contain a minimum of 30% roughage (Anon. 1972; Clarke 1977); the results of Hodge and Bogdanovic (1978) and Bogdanovic and Hodge (1978) show responses in animal production if oats (8% crude protein) and citrus pulp (6% crude protein) are supplemented with urea. This paper compares the performance of young sheep fed oats or citrus pulp supplemented with urea of roughage.

MATERIALS AND METHODS

Animals and management

Five experiments were carried out, four with 16-to 20-week-old ewe and wether lambs (Border Leicester x Merino ♀ x Poll Dorset ♂) and one with 1½-years-old wethers (Merino ♀ x Border Leicester ♂). The animals were offered rations based on oats or barley in the first three experiments and dried citrus pellets in the last two experiments (Table 1). The number of animals involved in each experiment and their initial weight are set out in Table 1.

In each of the experiments the animals were allotted by stratified' randomization on the basis of live weight and sex to their respective groups and, in the case of experiment 1 to one of four replications within each group. A total of 96 lambs (48 ♂ and 48 ♀) was available for experiment 1, 24 lambs (12 ♂ and 12 ♀) for experiment 2, 32 wether sheep for experiment 3 and 20 lambs (12 ♂ and 8 ♀) for experiment 4. At the end of experiment 4 six lambs were removed and the remainder re-randomized on the basis of live weight to one of two groups in experiment 5.

The animals which, apart from those in experiment 2, had been grazing dry residues of annual pasture were drenched with a broad spectrum anthelmintic, transferred to bare earth pens and offered the experimental rations ad *lib.* for periods of 56, 48, 49, 42 and 28 d respectively for experiments 1, 2, 3, 4 and 5. The lambs fed citrus pellets were injected with vitamins A, D and E. The lambs in experiment 2 had been born in a feedlot, weaned at six weeks of age and fed grain-based diets for a period of six weeks.

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Diets

The animals in experiments 1 and 3 were offered one of four diets; oats (8% crude protein), oats + roughage, oats + urea (1.7%), oats + urea (1.7%) + roughage. In experiment 1 the roughage consisted of pasture' hay (12% crude protein) which was offered ad libitum in separate hay racks. In experiment 3 the roughage was lucerne chaff (18% crude protein) which comprised 30% of the ration and was mixed with the oats before feeding. The diets for experiment 2 comprised whole oats or barley each supplemented with a separate barley/fishmeal pellet to provide 17% crude protein. One of the oat and barley rations was also supplemented with chaffed pasture hay (12% crude protein) which was offered in separate feeders at the rate of 100 g/h/d. The oats in all three experiments was also supplemented with 1.4% limestone, 0.5% salt and 0.1% of a trace element and vitamin pre-mix. In experiment 3 the minerals were offered in the form of a mineral-barley pellet which comprised 15% of the ration.

Dried citrus pulp pellets (6% crude protein) were provided in experiments 4 and 5. In experiment 4 the citrus pellets were supplemented with 2.0% urea or chaffed pasture hay (12% crude protein). The hay was offered at the rate of 200 g/h/d in separate feeders. In experiment 5 the citrus pellets were supplemented with urea (2.0%) and either pasture hay (12% crude protein) or straw (3% crude protein) at the rate of 150 g/h/d. The citrus pellets were also supplemented with 0.7% K_2SO_4 and 0.6% $Na\ H_2\ PO_4$.

For all five experiments the urea was dissolved in water and sprayed on the oats or citrus pellets to provide rations of 12% crude protein. All diets were offered daily in covered, galvanized troughs and residues were collected at weekly intervals.

Measurements

The live weights and group intakes of the animals were recorded at weekly intervals for all five experiments. In experiment 1, two animals from each of the four replications were selected at random and wool growth measured over a 37 d period from mid-side patches. The digestibility of the oats, oats + urea and pasture hay or lucerne chaff fed in experiments 1 and 3 was determined with 12 lambs or twelve 18-month-old sheep similar to those placed in the feedlot. At the end of the digestibility period for experiment 1 rumen fluid samples were obtained per stomach tube five hours after feeding and analysed for rumen ammonia. All liveweight data and the results for intake in experiment 1 were examined by analysis of variance.

RESULTS

The dry matter digestibilities (means and'standard errors) of the oats, oats plus urea and hay fed in experiment 1 were 67.0 ± 1.1, 66.3 ± 0.6 and 56.7 ± 1.2% respectively. The corresponding results for rumen ammonia concentrations were 1.6 ± 0.5, 9.5 ± 2.7 and 18.0 ± 0.9 mg/100 ml respectively. There were no significant differences in wool growth of the lambs in experiment 1; the mean values were 33.7 ± 2.4, 32.2 ± 2.3, 32.0 ± 2.4 and 31.2 ± 2.5 mg clean wool/cm^2 for the oats, oats plus hay, oats plus urea and oats plus urea plus hay diets respectively. The mean dry matter digestibilities of the oats, oats plus urea and lucerne chaff fed in experiment 3 were 69.0 ± 1.7, 70.0 ± 0.9 and 62.2 ± 0.6% respectively.

The mean dry matter intakes and liveweight gain of the animals in all experiments are set out in Table 1. The analysis of results included the first 14 days but it can be seen from Table 1 that the mean growth rate of the animals

after adaptation to the diet was, in most cases, considerably higher than the overall mean. The provision of pasture hay or lucerne chaff to oats resulted in increased dry matter intakes and liveweight gain of the animals in experiments 1 and 3 but additional (experiment 1) or equal (experiment 3) benefits were obtained at lower dry matter intakes by supplementing with urea. No benefits were obtained by supplementing the oat/fishmeal or barley/fishmeal diets with pasture hay. The best liveweight gains recorded for the lambs in experiment 1 were low, and much less than those achieved by the lambs supplemented with fishmeal (experiment 2) or by the older and heavier sheep fed oats in experiment 3.

Supplementation of citrus pellets with pasture hay more than doubled the dry matter intake of the lambs in experiment 4 but again similar increases in dry matter intake and additional responses in terms of liveweight gain were achieved by adding urea only. Unlike the oat-based rations the beneficial effects of the hay and urea supplements were additive and the highest intakes and liveweight gains were obtained when the citrus pellets were supplemented with both urea and roughage, The beneficial effects of roughage were obtained with supplements of either pasture hay or straw (experiment 5).

TABLE 1 Mean intake and liveweight gain of young sheep offered oat grain or dried citrus pulp diets supplemented with urea or roughage

Experiment	Ration	Intake† (g DM/h/d)		Gain‡ (g/d)	
	Oats	468^{a}		8^{a}	(50)
1 n = 96	Oats + hay	592^{bc}	(115)	29^{b}	(55)
Initial wt = 25 kg	Oats + urea	542^{b}		58^{b}	(91)
	Oats + urea + hay	654^{c}	(156)	53^{b}	(92)
	Oats + fishmeal	526		137^{a}	
2 n = 24	Oats + fishmeal + hay	570	(80)	129^{a}	
Initial wt = 18 kg	Barley + fishmeal	1033		283^{b}	
	Barley + fishmeal + hay	1088	(60)	290^{b}	
	Oats	817		147^{a}	(141)
3 n = 32	Oats + lucerne chaff	1403		204^{ab}	(225)
Initial wt = 32 kg	Oats + urea	1142		222^{b}	(275)
	Oats + urea + lucerne chaff	1399		219^{b}	(270)
	Citrus pellets	267		-118^{a}	(-9)
4 n = 20	Citrus pellets + hay	651	(176)	15^{b}	(43)
Initial wt = 24 kg	Citrus pellets + urea	517		-31^{b}	(103)
	Citrus pellets + urea + hay	964	(176)	117^{c}	(172)
5 n = 14	Citrus pellets + urea + hay	1005	(129)	146^{a}	
Initial wt = 25 kg	Citrus pellets + urea + straw	961	(130)	136^{a}	

Figures in parentheses = intake of hay (†) or liveweight gain (‡) excluding the first 14 d.
Different superscripts within columns denote significance, ($P<0.01$) for experiments 1, 2 and 4; ($P<0.05$) for experiment 3.

DISCUSSION

The results of this study do not support recommendations that roughage should be included in oat or barley grain diets fed to young sheep. In none of the three experiments in which oats or barley was fed was there any indication that the inclusion of pasture hay or lucerne chaff increased intake or liveweight gains above those achieved by supplementing with urea or fishmeal. This result

is important because roughage, particularly good quality material, is likely to be expensive and in short supply during drought.

The very low rumen ammonia concentrations in the lambs fed oats alone in experiment 1 and the response obtained to supplements of urea indicate that the benefits obtained from the pasture hay and lucerne chaff were mainly due to their nitrogen content rather than any effect of roughage per se. However, this was not the case with the citrus pellet ration where supplements of hay increased dry matter intake and liveweight gains of the lambs independently of the effect achieved by urea. Furthermore the provision of hay during the first 14 days of feeding citrus pellets had a marked effect in reducing the weight loss observed when citrus pellets were fed alone. It was also observed, throughout the period of the experiment, that the lambs offered citrus pellets avidly consumed their supplement of hay or straw before eating any of the pellets. The same behaviour was not apparent with the lambs fed oats or barley in experiment 2, not all of the small supplement of hay (100 g/h/d) was eaten, particularly in the case of the lambs fed barley (Table 1).

The observation that quality of roughage supplement was not important in maintaining the performance of lambs fed citrus pellets suggests that the beneficial effects of roughage were associated with pH of the rumen fluid or other conditions within the rumen which promoted microbial fermentation, rather than with the provision of nutrients additional to that supplied by urea.

Even the best liveweight gains recorded for the lambs fed oats plus urea in experiment 1 were low, and the improved performance of the animals fed fishmeal in experiment 2 indicates the higher protein requirements of these lambs compared to the older and heavier sheep in experiment 3 where satisfactory performances were obtained with supplements of non-protein nitrogen only. On the other hand the better performance of the lambs fed barley confirms that the higher fibre content and lower digestibility of oats limits the intake and growth of young lambs (Ørksov et al. 1974).

We conclude that non-protein nitrogen (urea) is as effective as good quality roughage (pasture hay or lucerne chaff) in promoting liveweight gains of young sheep fed low protein oats (7-8% crude protein), but that both urea and roughage are required to maximize performance of lambs fed dried citrus pulp.

ACKNOWLEDGEMENTS

This work was carried out with funds provided by the Australian Wool Corporation. We thank Mr. R. Jardine, Biometrician, for the statistical analyses.

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