IMPROVING THE NUTRITIVE VALUE OF ROUND BALES OF OAT STRAW BY TREATMENT WITH UREA OR BY SUPPLEMENTATION WITH LUPINS

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SUMMARY

The treatment of large round bales of oat straw with a solution of urea, sucrose and minerals was compared with the use of lupin grain as a means of improving its nutritive value. Animal production from treated straw was assessed by measuring liveweight changes of ewes eating the treated straw and by measuring digestibility of the feed. Recovery of nitrogen applied to the bales as urea was 28–43%. All animals lost weight (-206 g/d) on the treated straw but not as rapidly as animals fed untreated straw (-240 g/d) ($P < 0.05$). There was no effect of treatment on DM or fibre digestibility. Supplementation of the untreated straw with 250 g lupins/day resulted in liveweight losses of -53 g/d and appeared to be a more effective method of improving sheep production from the straw diet.

(Keywords: straw, urea, lupins, ewes, liveweight)

INTRODUCTION

In W.A., over 6.5 million hectares are sown to cereals, and there is a great potential for the resulting cereal stubbles to provide a summer maintenance feed, following chemical treatment to improve digestibility. Feeding baled straw in confined areas has advantages in that it provides greater flexibility in the autumn cropping programme, it allows regrowth of autumn pastures and helps in the management of erosion. The alternative is to graze stubbles and provide supplementary nutrients through lick-blocks or grain feeding.

The nutritive value of low quality cereal straws for ruminants can be improved by chemical treatment. The advantages of using nitrogenous alkalis, such as ammonia, include the beneficial effects of the additional nitrogen supplied in the treatment process (Sundstøl et al. 1978), and their safer handling compared with caustic hydroxides. Urea may provide a source of ammonia following hydrolysis (Sundstøl and Coxworth 1984), and can be used as an alternative to anhydrous ammonia which in many parts of Australia is unavailable or expensive. The addition of a small amount of rapidly fermentable carbohydrate together with minerals may improve straw intake and digestibility, or may enhance fungal growth which could directly increase the digestibility of the straw (Stephenson et al. 1984).

This experiment investigated two ways of treating round bales of straw and compared these with the feeding of lupin grain as an alternative to straw treatment.

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MATERIALS AND METHODS

Oat straw conserved in large round bales, weighing 300–350 kg each, was used in the experiment. The treatment mixture applied to the bales comprised (%) : urea 74, ammonium sulphate 7.4, sucrose 17.4, mineral salts and vitamins 0.12. Bales were treated by spraying a solution of this treatment mix over the top of each bale, applied in 135 1 of water at 3% (w/w) of the straw. After the bales had been treated, they were either left uncovered for a period of 6–10 days before being fed out, or they were enclosed individually in plastic silage bags, and left for 4 weeks before being used.

Two experiments were conducted to assess the effectiveness of these methods of treating straw bales. Experiment 1 determined liveweight changes of sheep on the different dietary treatments. In Experiment 2 the in vivo digestibilities of the treatment diets were measured. The diets were the same in both experiments. These were:

(i) untreated straw;
(ii) untreated straw supplemented with 250 g lupins/head/d;
(iii) straw bales treated with the urea mix and left uncovered for 6–10 d; and
(iv) straw bales treated with the urea mix and covered for 4 weeks.

In Experiment 1, 120 mature ewes, aged 3-5 years, mean liveweight 47 kg, were penned in groups of five. Six pens were allocated at random to each of the four treatments. Each pen of sheep was offered an amount of straw estimated from the previous days refusals to be 15–20% in excess of the daily intake of the pen. Measurements of the daily straw refusals were not possible. Animals receiving lupins were fed this supplement once daily separately from the straw. Animals were weighed at intervals of 7 days over the experimental period of 6 weeks.

In Experiment 2, 24 mature ewes, mean liveweisht 46 kg, were housed in individual metabolism crates. Six sheep were allocated to each of the four treatments. Straw was offered to each animal at the rate of 700 9 air-dry weight per day. Animals were adjusted to the dietary treatments for 14 days prior to a 7 day collection period.

Weekly samples of the treatment diets in both experiments, and of the faeces from Experiment 2, were analysed for DM, OM, total N (Kjeldahl) and NDF (Goering and Van Soest 1970). Statistical analysis of the mean liveweight and digestibility values was by analysis of variance.

RESULTS

The chemical compositions of the diets are shown in Table 1. The basal untreated straw had a nitrogen content of 4.6 g/kg. The urea mixture added to the straw at 10 9 N/kg straw increased the N content by 2.8 and 4.3 g/kg for the uncovered and covered bales respectively. The NDF content of the straw was not significantly affected by the urea treatment.

Table 1 Chemical composition of diets (g/kg DM)

	Untreated straw	Treated (uncovered)	Treated (covered)	Lupins
OM	956	963	970	977
Nitrogen	4.6	7.4	8.9	55.1
NDF	821	837	822	264

Table 2 Mean liveweight changes and intake of ewes, and digestibility of diets

	Untreated	Treated (uncovered)	Treated (covered)	Untreated + lupins	SED
Experiment 1:					
Liveweight changes (g/d)	-240	-209	-203	-53	14
Experiment 2:					
Straw DM intake (g/d)	434	366	486	482	27
Lupin DM intake (g/d)	-	-	-	216	
Digestibility (%) of					
DM	43.6	37.8	38.7	54.9	3.1
OM	42.3	37.9	39.5	55.5	3.0
NDF	46.5	44.6	43.9	47.3	3.3

All the animals lost weight on all the treatment diets (Table 2). Sheep fed lupins plus untreated straw lost less weight than those without lupins ($P < 0.001$). The rate of liveweight loss of animals eating both types of treated straw was also less than animals eating untreated straw ($P < 0.05$). There were no differences between the two methods of treating the straw in terms of liveweight change.

In Experiment 2, DM intake of the straw from uncovered treated bales was less ($P < 0.05$) than the straw intake on any of the other three treatments. DM digestibility for animals eating untreated straw plus lupins was higher ($P < 0.01$) than the DM digestibilities of the three treatments without lupin supplement. Digestibility of the fibre fraction of the diets, measured as NDF, was however not significantly different between any of the treatments.

DISCUSSION

There were considerable losses of the urea added to the straw. Of the 10 g N/kg straw from the urea, only 28% and 43% (in uncovered and covered bales respectively) was still present at the time of feeding. Similar low recoveries of N of 44 and 35% have also been reported by Hadjipanayiotou (1982) and Solaiman et al. (1979), when treating straw with urea and NH_4OH respectively. Loss of N after urea treatment is primarily as ammonia (Saadullah et al. 1981), and excess ammonia could have been lost from the uncovered bales, as well as from the covered bales after removal of the plastic sheeting. In contrast, Stephenson et al. (1984) reported a recovery of 89% of

the added urea in an experiment where round bales of stubble were treated by pumping a solution of urea into the centre of the bales using a spear technique. The method resulted in increased intake of DM and improved digestibility of the straw by weaner sheep. This suggests that the extent of penetration of urea into the bale and the subsequent retention of N by the straw may be major factors determining the potential improvement of straw by urea. For straw bales treated by spraying the urea solution over the top of the bale, the density of straw may influence the penetration of the treatment mix into the bale, and the use of wetting agents could be advantageous in achieving more complete coverage.

Although liveweight losses by the animals eating either of the two treated straw diets were less than those on untreated straw, they were still considerable. It was also clear that urea treatment had no significant effect on the digestibilities of the DM or NDF fraction of the straw. This indicates that either insufficient urea was used to achieve significant improvements in digestibility, or alternatively that the poor quality of straw used for this trial did not respond to ammonia treatment. The significant decrease in liveweight loss of sheep supplemented with lupins could principally be attributed to the additional metabolisable energy provided by the lupins since the supplement had no effect on digestibility of NDF. In this experiment supplementation of poor quality straw with lupins provided a more effective method of improving the utilization of the straw by sheep than treatment of the straw with urea.

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