

THE EFFECT OF UREA TREATMENT OF STRAW AND LUPIN SUPPLEMENTATION  
ON INTAKE, LIVEWEIGHT CHANGES AND WOOL GROWTH IN SHEEP

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Summary

Chaffed wheat straw was treated with a seven per cent solution of urea and sealed for three weeks before feeding to sheep. Mature wethers received either this urea-treated straw or straw that had received an equivalent amount of urea mixed in with it at feeding. Both straws were fed either with or without lupins at 200 g/hd/d for seven weeks. DM intake was increased both by the urea treatment and by lupin supplementation compared with the urea-supplemented straw, but animals on all treatments lost weight throughout the experiment. Urea treatment had no significant effect on either liveweight change or wool growth compared with the control animals. Lupin supplementation decreased the rate of liveweight loss by 93 g/hd/d, and also increased wool growth by 18% (+ 0.51 g clean wool/hd/d) on both basal diets.

Key words: straw, urea, lupins, sheep

## INTRODUCTION

Many farms in Western Australia are mixed sheep/cereals enterprises, and farmers commonly graze sheep on the cereal stubble residues during summer and autumn. The nutritional value of cereal stubbles can be very low, particularly after extended grazing and some form of supplementary feeding is normally required to prevent excessive losses of weight and body condition. The most common form of supplementation is that of feeding out grain, particularly oats, although lupin feeding is becoming increasingly important. An alternative strategy is to conserve the cereal straw in baled form, and to improve its nutritional value by alkali treatment before feeding out to stock. A solution of urea can be used as a source of ammonia/ammonium hydroxide, as hydrolysis occurs rapidly in the damp straw and this treatment has the additional benefit of supplying extra nitrogen to the feed. Previous experiments have shown that levels of urea inclusion of over five per cent of the straw dry matter are necessary to bring about significant improvements to the digestibility. However, even with the improved digestibility, intake of the straw in long form can still be very low, resulting in significant liveweight losses of animals receiving the urea-treated straw (Aitchison et al. 1986; Aitchison, Rix and Rowe, unpublished data). Chaffing of poor quality roughages can improve intake (Alwash and Thomas 1974). The experiment reported here investigated the effect on performance of mature Merino wethers of straw treated and fed in the chaffed form. Supplementation with lupins has been shown to be effective in preventing excessive liveweight losses in animals grazings, tubbles and in pen feeding experiments (Rowe and Ferguson 1986; Aitchison et al. 1986). A second objective of this experiment was to compare the effect of urea treatment of straw with lupin supplementation.

## MATERIALS AND METHODS

Preparation of diets The basal straw used was wheat straw that had been baled in January 1987 following harvest in early December at Wongan Hills Research Station. It was chaffed to 20-40 mm prior to preparation of the two treatment diets as follows:

- (i) Urea treated straw: 1.4 kg urea + 140 g ammonium sulphate were dissolved in 10 L water, then combined with 20 kg of chaffed straw in a large black plastic bag, sealed and left for three weeks prior to being opened and the straw fed out.
- (ii) Urea-supplemented straw: The same quantities of urea and ammonium sulphate (70 g urea and 7 g ammonium sulphate/kg straw) were mixed in with the chaffed straw in dry form immediately before feeding.

Treatments and experimental design Mature Merino wethers, mean liveweight 56.5 kg (SE 0.04 kg) were selected from a flock grazing cereal stubbles and allocated to 16 pens in a covered shed, with 10 animals in each pen. Animals were adapted to the pens and the straw diets for two weeks, with all sheep fed the chaffed wheat straw ad libitum, plus 100 g lupins/hd per day. After this period of adaptation, four pens of sheep were allocated at random to each of the following treatments:

- a) Urea-supplemented straw
- b) Urea-supplemented straw + lupins (200 g/hd/d)
- c) Urea-treated straw
- d) Urea-treated straw + lupins (200 g/hd/d)

Straw was offered ad libitum, and measurements of straw intake were made weekly over a period of seven weeks. Animals were weighed weekly. Samples of rumen fluid were taken using a stomach tube immediately prior to feeding the lupins, during the 5th week of the experiment for measurement of pH, ammonia and volatile fatty acids (VFA). Only four samples/pen were analysed for VFA. Weekly samples of the straw-based diets were analysed for N and in vitro digestibility (McLeod and Minson 1978). Total N and ammonia (NH<sub>3</sub>) were measured by a semi-micro Kjeldahl technique, and VFA by gas chromatography. Wool growth was measured by close clipping an area of skin on the midside of each animal 11600 mm<sup>2</sup> (SE 150) at the start and end of the experiment.

## RESULTS

The basal straw had a N content of 6.1 g/kg DM. Urea supplementation provided a further 32 g N/kg, and the in vitro DM digestibility of this straw was 49.9%. The corresponding values for the urea treated straw were 25.6 g N/kg DM and an in vitro DM digestibility of 55.1%.

There were no refusals of lupins throughout the experiment. Table 1 shows the mean daily intakes of the straw diets offered. Intake of the urea-supplemented straw was increased by 25% when lupins were included in the ration. DM intake was increased by 21% as a result of the urea treatment, and by 32% when lupins were fed as a supplement. All animals lost weight during the experiment, but there was no significant effect of urea treatment on liveweight changes. However, inclusion of lupins reduced the average rate of liveweight loss by 93 g/d ( $P < 0.001$ , mean effect over both types of straw diets).

Clean wool growth rate was significantly increased ( $P < 0.05$ , Table 1) when lupins were included in the diets, but urea treatment of the straw had no effect on wool growth.

Lupin supplementation significantly increased the total rumen VFA and NH<sub>3</sub> concentrations ( $P < 0.001$ , Table 2). Animals eating urea-treated straw had lower pH s ( $P < 0.01$ ) and higher rumen NH<sub>3</sub> levels ( $P < 0.05$ ) than those receiving urea-supplemented straw, but urea treatment had no effect on total VFA concentrations.

Table 1. Effect of urea treatment of straw and lupin supplementation on DM intake, liveweight change and wool growth of sheep

Treatment	Daily DM intake (g/d)		Liveweight change (g/d)	Clean wool growth (g/m <sup>2</sup> /d)
	straw	lupins		
Urea-supplemented straw	351		- 208	3.27
Urea-supplemented straw + lupins	440	184	- 100	3.78
Urea treated straw	425		- 198	2.96
Urea treated straw + lupins	465	184	- 119	3.55
SED	16		11	0.31

SED standard error of difference

Table 2. Effect of urea treatment of straw and lupin supplementation on rumen pH, volatile fatty acid (VFA) and ammonia (NH<sub>3</sub>) concentrations

Treatment	pH	Total VFA concentration (mmol/L)	NH <sub>3</sub> concentration (mg NH <sub>3</sub> -N/L)
Urea-supplemented straw	7.27	49	58
Urea-supplemented straw + lupins	7.27	65	148
Urea treated straw	7.20	53	110
Urea treated straw + lupins	7.11	64	178
SED (n)	0.039 (40)	5.5 (16)	22 (40)

SED~ standard error of difference, n~ number of animals in each treatment group

## DISCUSSION

The N content of the treated straw was 25.6 g/kg DM, indicating losses of N of approximately 33%, most likely as NH<sub>3</sub> after the bags had been opened, and after oven drying of the feed samples (Saadullah et al. 1981).

Urea treatment of the straw improved its in vitro digestibility by 10% compared with the urea-supplemented straw. Intake of the straw was increased by up to 32 per cent when lupins were included in the diet. However, despite these increases in the digestibility and intake of straw, none of the treatments provided a maintenance ration for these sheep; Animals receiving urea-treated straw lost slightly less weight than those receiving urea-supplemented straw ( $P < 0.10$  after 6 weeks); nevertheless they still lost over 9 kg during the seven weeks of the experiment. Low levels of lupin supplementation <(approximately 150 g/d) can be effective in preventing liveweight loss of animals grazing cereal stubbles (Rowe and Ferguson 1986). In the present experiment, inclusion of lupins at 200 g/hd/d decreased the rate of liveweight loss by 93 g/d, but animals were still losing around 100 g/d. Animals were able to preferentially select the lupins present in the straw/lupin mix; however, no measurements were made of the physical or chemical composition of the resulting straw residues. It appears however, that by harvesting and chaffing the straw the sheep have a reduced opportunity to select the more digestible parts of the stubble, and are therefore being fed a diet which is effectively of lower quality than they could obtain from the standing crop residue.

Wool growth rates were low in all groups and urea treatment of the straw resulted in no significant improvement. Lupin supplementation increased the total intake of digestible organic matter and the supply of dietary protein. Both of these factors may be directly related to the improved wool growth rate observed (Aldden 1979). Hynd et al. (1986) suggested that 6 weeks may be required for wool growth to truly reflect dietary changes. The increase in wool growth measured here could therefore be an underestimate of the true response to the lupin supplementation, because the sheep had previously been grazing stubble 'pastures with no supplementation, and this would also have resulted in only a low growth rate. Rumen NH<sub>3</sub> levels in animals receiving the urea-supplemented straw were close to the minimum levels of about 45 mg N/l observed by Boniface et al. (1986) below which fermentation rates are reduced. Since the feed residues were not analysed for N content, it is not possible to establish the amount of additional N provided as urea that was ingested. The high levels of urea may have inhibited straw DM intake, although the low levels of NH<sub>3</sub> recorded for animals on the urea-supplemented diet indicate that some selection against the urea may have occurred. Both urea treatment and lupin supplementation increased NH<sub>3</sub> levels by 90 and 255 % respectively, but VFA levels only increased significantly in lupin supplemented animals.

These results, and those from previous investigations (Aitchison et al. 1986) indicate that urea treatment of cereal straw is not effective in providing a maintenance ration for sheep, whereas lupin supplementation can improve both intake of the basal straw, reduce liveweight loss of the animal and increase wool growth.

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