A NEW TECHNIQUE FOR ADDING NON PROTEIN NITROGEN TO OAT GRAIN

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SUMMARY

Two sources of non-protein nitrogen (ammonia gas compared with urea spray) were added to an oat grain ration to achieve four levels of crude protein. Together with an untreated (control) ration, these were used to study the voluntary feed intakes and growth responses of Merino weaner ewes under feedlot conditions.

Feed intakes increased linearly in response to increasing levels of non-protein nitrogen and there was no difference between the urea and the ammonia treatments. This was reflected in increasing growth rates in the ammonia treatments and the urea treatments except for the highest level of added urea (2.10 per cent urea, 15.5 per cent total crude protein) where a depressed growth rate occurred. The use of ammonia gas would appear to be a feasible alternative to urea spray with the advantage of being easier and less expensive to apply.

INTRODUCTION

Supplementary feeding of autumn lambing ewes and production feeding of lambs and shipping wethers are becoming increasingly common practices in the agricultural areas of Western Australia. Oat grain is the most commonly used feedstuff for these purposes. However variability in crude protein (CP) content of oat grain is often a problem.

Farmers usually add lupin grain (around 30 per cent CP) to oat grain which has insufficient crude protein for sheep production. However lupin supplies and prices in Western Australia vary markedly from year to year and the grain is sometimes contaminated with undesirable weed seeds. As a consequence, alternative (and cheaper) methods of fortification of low protein oats have been examined. Using the method of Orskov and Mehrez (1974), encouraging but limited responses have been obtained from urea applied as a spray (King, W.R., McDonald, C.L. and Rowe, J.B. unpublished data).

However, the urea spray method requires physical mixing of the grain while the spray is applied. Gassing of sealed silos with anhydrous ammonia would be a simple and inexpensive method of increasing nitrogen content of oat grain compared with spraying on a urea solution. The experiment reported here was designed to examine the feasibility of using anhydrous ammonia gas as a source of non-protein nitrogen for adding to oat grain and to compare production responses of weaner sheep in relation to the use of urea.

MATERIALS AND METHODS

Design

A factorial design was used consisting of two sources of non-protein nitrogen (NPN) - ammonia or urea, added to achieve four levels of C.P. and a control ration. There were two replicates per treatment and seven sheep per
replicate which were stocked at 0.65 m$^2$ per head on the slatted wooden floor of an indoor feedlot at Badgingarra Research Station, about 200 km north of Perth. Plots were laid out using a completely randomised design.

After a two week introduction to the experimental rations, feeding continued for eight weeks before termination.

**Ration preparation**

A base ration consisting of 85 per cent oats, 13 per cent hammermilled oaten hay and two per cent mineral/vitamin mix (Min/Vit) was treated with urea or anhydrous ammonia gas (NH3) to produce diets of five different crude protein levels for each of the two NPN sources (see Table 1).

<table>
<thead>
<tr>
<th>Anticipated CP (per cent)</th>
<th>NPN added (kg/tonne)</th>
<th>Oat Grain (kg/tonne)</th>
<th>Hay kg/tonne</th>
<th>Min/Vit (kg/tonne)</th>
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</thead>
<tbody>
<tr>
<td>9.4</td>
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<td>845.0</td>
<td>130</td>
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</tr>
<tr>
<td>10.9</td>
<td>NH$_3$ 3.0</td>
<td>841.8</td>
<td>130</td>
<td>2.5</td>
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<td>836.3</td>
<td>130</td>
<td>2.5</td>
</tr>
<tr>
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<td>NH$_3$ 9.0</td>
<td>835.3</td>
<td>130</td>
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<tr>
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<td>832.0</td>
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<td>Urea 21.0</td>
<td>823.0</td>
<td>130</td>
<td>2.5</td>
</tr>
</tbody>
</table>

* Sulphur/Nitrogen ratio about 1:9 for each ration

Urea was added to rations by spraying a concentrated solution (50/50 w/w) of urea in water onto the grain while it was being mixed in a tractor driven mixer (Jetstream All Bulk vertical mixer). The application of ammonia gas involved releasing the gas into 4,500 litre tanks through small networks of tubes from industrial gas canisters.

**Animals and feeding**

One hundred and twenty six Merino weaner ewes were selected from a line of 150 and allocated to the 18 pens (seven per pen) according to a stratified liveweight ranking. Sheep were introduced to the experimental ration by daily feeding of gradually increasing quantities of ration mixed with decreasing quantities of hay over a 14 day period. No evidence of grain poisoning was observed. After introduction, sheep were fed every second day at ad libitum levels and residues from previous feedings were weighed so that group intake could be calculated. Sheep were weighed fortnightly and on consecutive days at the beginning and end of the experiment.

**RESULTS AND DISCUSSION**

**Adding the ammonia**

No problems were encountered when treating the grain with the ammonia gas. The gas flowed freely and the loss of weight of the canister was used to
calculate the amount of ammonia added to the ration. At the highest level of addition, 21.6 kilograms of ammonia (equivalent to 28,461 litres of gas at standard temperature and pressure) was released into a 4500 litre tank during six hours without any deleterious pressure build up.

**Sheep performance**

Mean liveweight changes and group feed intakes (undried weights) for the eight week period after introduction to the experimental rations were analysed by analysis of variance.

![Fig. 1](image1.png)

Fig. 1 Effect of added NPN (urea or ammonia) on mean daily feed intake

- Urea
- Ammonia

![Fig. 2](image2.png)

Fig. 2 Effect of added NPN (urea or ammonia) on mean daily growth rate

- Urea
- NH₃

![Fig. 3](image3.png)

Fig. 3 Effect of added NPN (urea or ammonia) on ratio of feed eaten to liveweight gained (FCR)

- Urea
- NH₃
Mean feed intakes were not significantly different between the urea and ammonia rations at the same CP content and intake showed a significant linear increase ($P < 0.001$) in response to increased CP content (Fig. 1). Thus over the ranges of NPN used, no palatability problems were evident for either the urea or ammonia treatments.

For growth rates, there was a significant interaction ($P < 0.001$) between source of NPN and level of CP (Fig. 2). Whereas the growth rate response to increasing levels of CP obtained by adding urea was quadratic in shape (increasing to the 14 per cent level and then declining), the growth rates in response to ammonia increased linearly.

The diminishing growth response with higher levels of added urea is consistent with other work which showed little benefit from adding urea to diets which already contained around 12 per cent crude protein (e.g. King, W.R., McDonald, C.L. and Rowe, J.B.). However, the negative growth response to urea after the 14 per cent CP level is difficult to explain, especially in relation to the linear response of feed intake to added urea.

The better growth response from the higher levels of ammonia as compared with urea may be related to more efficient use of nitrogen through a possibly slower release in the rumen or to increased digestibility of the roughage portion of the ration due to alkali action of the ammonia. Further research is required to clarify this possibility and to understand the growth differences resulting from the urea and ammonia treatments used in this experiment.

Analysis of the ratios of feed eaten to liveweight gained for each of the different levels of added NPN is presented in Figure 3. For both the ammonia and urea treatments, NPN added to achieve 10.9 per cent CP significantly lowered feed conversion ratio, however no further significant change in feed conversion occurred when extra NPN was added to achieve 12.4, 14 and 15.5 per cent CP. (Fig. 3).

While this experiment should be regarded as a preliminary investigation showing encouraging results from anhydrous ammonia gas treatment of oats, the practicality of gassing larger silos and the responses of sheep under paddock conditions are yet to be tested.

ACKNOWLEDGEMENTS

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REFERENCE