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Effect of different levels of supplemental N from urea on intake and utilization of wheat straw by Dohne Merino wethers

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Introduction

In crop-pasture farming systems, wheat straw is the pre-dominant energy source available to sheep during the dry summer and early autumn months. Wheat straw is, however, characterised by low levels of nitrogen (N) and available carbohydrates, a high cell wall content and poor digestibility (Dann & Coombe, 1987), rendering it unable to maintain body weight or meet the higher nutrient requirements of producing sheep (Aitchinson, 1988). Nitrogen is generally considered to be the first limiting dietary component for the utilization of low-quality forages. Therefore, supplementation of rumen degradable protein (RDP) and/or non-protein nitrogen (NPN) to ruminants grazing low quality roughages is seen as a useful practice. The availability of additional N to the rumen microbes may improve the energy status of grazing ruminants by promoting greater intake and/or digestion and possibly by improving the efficiency of the utilization of metabolisable energy. Because protein supplementation is expensive, it is important to determine the amount of RDP required to maximize digestible organic matter intake and duodenal protein flow. Since urea (NPN) is the cheapest N source available, it is important to identify the amount of NPN that can be substituted for RDP without sacrificing animal performance. This study was conducted to determine the impact of different levels of NPN inclusion in supplements on digestible organic matter intake, digestion and fermentation characteristics.

Material and Methods

Twenty-five Dohne Merino wethers fitted with ruminal and duodenal cannulas were used in a randomised block design to measure digestible organic matter intake (DOMI), site and extent of digestion and N flow to the duodenum. Animals had *ad libitum* access to wheat straw (3.8% CP, 75.5% NDF) and water, which was fed twice daily. All treatments provided the required amount of N (4.58 g N/kg $BW^{0.75}$) to maximize DOMI, as determined in a previous study. Treatments 1 to 5 respectively provided 0, 25, 50, 75 or 100% of the N from urea. The balance of the nitrogen was provided as RDP (calcium caseinate; 90% CP, 100% degradable), as determined by the method described by Roe *et al.* (1991). Supplements were divided into two equal portions, solubilized in 150 ml of water and administered intraruminally at 07h00 and 19h00. A salt-mineral mixture, formulated according to the mineral content of wheat straw, was administered intraruminally with the morning supplementation to prevent possible mineral deficiencies. In order to prevent urea toxicity, the 100% urea treatment was balanced to 40% CP with maize starch to provide a readily fermentable carbohydrate source. All the other treatments received the same amount of starch to prevent possible differences in digestion of the wheat straw because of the influence of the starch on the rumen microbes. The trial consisted of a 14-day adaptation period and a 6-day sampling period. Acid insoluble ash was used as the natural digestibility marker.

Results and Discussion

Digestible OM intake (DOMI) decreased non-significantly ($P > 0.05$) in a linear manner with the addition of increasing proportions of urea (Figure 1). A possible explanation for the decline in DOMI with increasing levels of urea inclusion is the decrease ($P > 0.05$) in NDF digestibility (Figure 1) observed at the higher urea levels, because a lower digestibility causes a longer retention time of the digesta in the rumen. From Figure 2 it is evident that microbial protein (MP) concentration was not significantly influenced by urea level ($P > 0.05$). However, MP concentration did increase between 25 and 50% urea inclusion, after which it reached a plateau, even though NH_3-N concentrations in both the rumen and duodenum kept increasing ($P > 0.05$). This corresponds well with the view that concentrations of 20 to 50 mg NH_3-N/l of rumen fluid are sufficient to allow maximum growth of rumen microbes (Slyter *et al.* 1979). Treatment had no effect on rumen pH, which varied between 6.6 and 6.8.

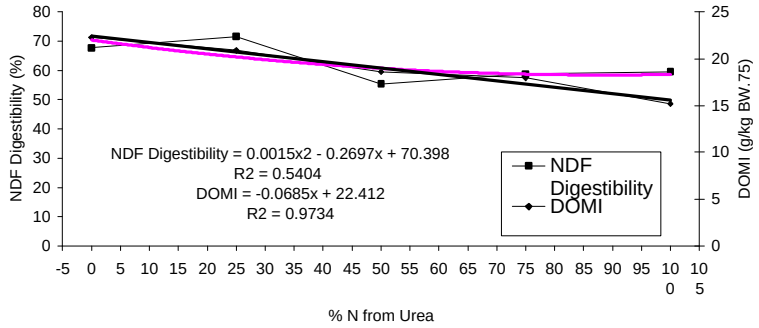

Figure 1 Digestible organic matter (DOM) and neutral detergent fibre (NDF) digestibility at different levels of urea inclusion in supplements for sheep fed low quality roughage.

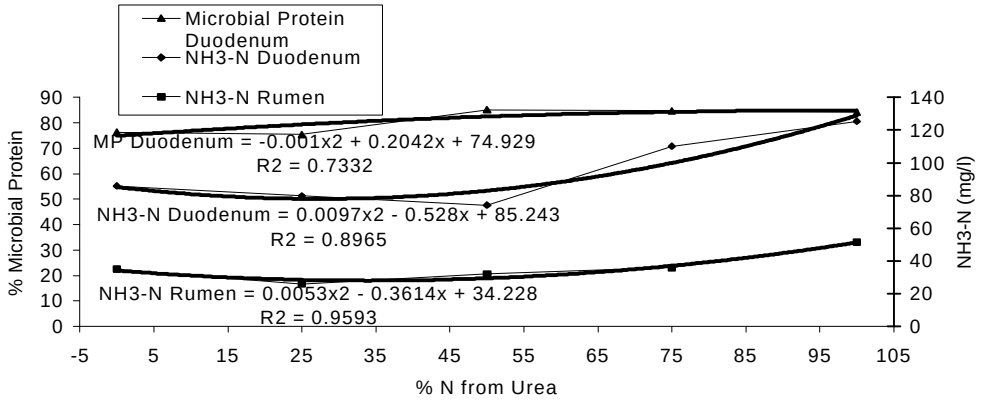

Figure 2 NH_3-N and microbial protein concentrations at different levels of urea inclusion in supplements for sheep fed low quality roughage.

Conclusion

These results suggest that isonitrogenous substitution of urea for RDP had no effect on DOMI of low quality forage or microbial protein concentrations in the duodenum when supplemental N was infused ruminally and provided in sufficient amounts to maximize DOMI (4.85 g N/kg $BW^{.75}$). However, even though non-significant, there was a trend for a decrease in DOMI with increasing urea levels. This implies that high substitution levels of urea for RDP in supplements are feasible, but at these high inclusion rates supplement palatability and animal performance must be taken into consideration.

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