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Effects of nonprotein nitrogen source in blocks on rumen parameters of steers fed prairie hay

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EFFECTS OF NONPROTEIN NITROGEN SOURCE IN BLOCKS ON RUMEN PARAMETERS OF STEERS FED PRAIRIE HAY

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Summary

Six ruminally cannulated steers (1012 lb) were fed prairie hay ad libitum supplemented with cooked molasses blocks that contained either 60% crude protein 83% of which came from urea (UREA block) or 60% crude protein with 42% from urea and 42% from biuret (UREA/BIURET block). Blocks were broken into small pieces to facilitate consumption and were fed once daily at .125% of body weight. Rumen samples were collected on days 3, 7, 14, and 21 at 0, 1, 2, 4, 6, 8, 12, and 16 hours after feeding blocks. Averaged over time, ruminal ammonia and total volatile fatty acid concentrations and plasma urea concentrations were lower ($P < .05$) for steers fed the UREA/BIURET block than for those fed the UREA block. Acetate and propionate concentrations followed patterns similar to those of total volatile fatty acids, whereas butyrate increased rapidly after block consumption. Release of ammonia from biuret was not demonstrated clearly. Ruminal ammonia concentrations were no greater with the UREA/BIURET block at times distant from feeding than with the UREA block.

(Key Words: Steers, Forages, Urea, Biuret.)

Introduction

Cattle consuming dormant range often are supplemented with crude protein as nonprotein nitrogen (NPN) or ruminal degradable protein. Although a common NPN source is urea, its release of nitrogen in the rumen is rather rapid and not well synchronized with the slower release of fermentable energy from forages. This rapid nitro-

gen release can result in toxic levels of ammonia. A more slowly released NPN source, such as biuret (a compound formed by thermal treatment of urea), might reduce the risk of ammonia toxicity and also improve synchronization of nitrogen release and carbohydrate fermentation. Our objective was to evaluate the effects of NPN source (urea or a urea/biuret combination) in cooked molasses blocks on ruminal parameters and plasma urea concentrations.

Experimental Procedures

Six ruminally cannulated steers (1012 lb initial body weight) were used in a completely randomized design. Steers were housed in individual tie-stalls where they had free access to fresh water. Each steer received 20 grams of plain salt daily and was offered coarsely chopped prairie hay at 120% of the average intake for the previous 5 days. Treatments were 1) a cooked molasses block that contained 60% crude protein, 83% of which came from urea (UREA block) and 2) a cooked molasses block that contained 60% crude protein with 42% from urea and 42% from biuret (UREA/BIURET block). The cooked molasses blocks were broken into small pieces and fed daily at 1.26 lb (.125% of initial body weight). On sampling days, steers were allowed 30 minutes to consume their block. Any unconsumed block was then placed directly into the rumen via rumen cannulae. The experiment lasted 21 days. Rumen contents were sampled via the rumen cannula on days 3, 7, 14, and 21 at 0, 1, 2, 4, 6, 8, 12, and 16 hours after blocks were fed. Jugular blood samples were collected on each of the sampling days at 5 hours after blocks were fed.

Results and Discussion

The prairie hay contained (dry basis) 5.5% crude protein and 69.5% neutral detergent fiber (NDF). Crude protein in both UREA and UREA/BIURRT blocks averaged 61.6% (dry basis), which was close to the expected values (60% as fed).

Ruminal parameters remained similar on the different sampling days (days 3, 7, 14, and 21), suggesting that adaptation to biuret was either rapid (within 3 days) or had not occurred before the end of the 21-day study. Rumen ammonia concentrations were similar with UREA and UREA/BIURET blocks at 1 hour postfeeding and at 12 hours or more postfeeding, but were lower for the UREA/BIURET block at 2, 4, and 8 hours after block feeding (Figure 1). As a result, ruminal ammonia concentrations, averaged over time, were lower ($P < .05$) for steers receiving the UREA/BIURET block (10.0 mM) than those receiving UREA block (15.1 mM). Furthermore, plasma urea concentrations averaged 3.14 mM for steers receiving the UREA/BIURET block vs. 4.12 mM for steers supplemented with a UREA block ($P < .05$). These differences may indicate that less ammonia was produced from microbial fermentation of blocks containing biuret. Because biuret is considered a slowly released source of ammonia, greater ruminal

ammonia concentrations at 8 hours or more postfeeding would have been expected if the total supplies of ammonia from the two blocks were similar.

For steers fed UREA blocks, ruminal pH was higher at 2 and 4 hours postfeeding, corresponding to higher ruminal ammonia concentrations. A lower pH at 16 hours may have been due to higher total VFA concentrations (Figure 1). Rumen total VFA concentrations averaged over time were 92.8 mM for the UREA block vs. 89.1 mM for the UREA/BIURET block ($P < .05$). Values were similar up to 6 hours after feeding, but differed thereafter. This may indicate a shift in ruminal fermentation from differences in nitrogen availability. Patterns of ruminal acetate and propionate concentrations were similar to those for total VFA concentrations. Ruminal butyrate concentrations increased rapidly after the feeding of either block because of the fermentation of sugars in the molasses component.

Steers fed UREA/BIURET blocks had lower rumen ammonia and plasma urea levels, indicating a reduced risk of ammonia toxicity. In fact, our data do not clearly demonstrate the release of ammonia from biuret. It is possible that reducing urea rather than replacing a portion with biuret would yield similar results.

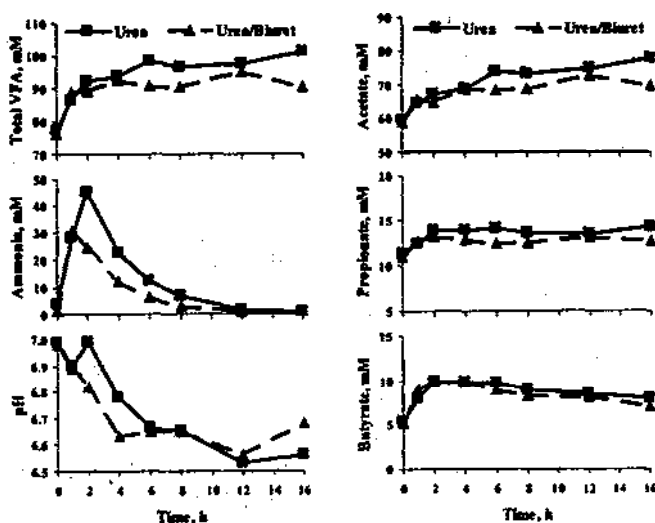


Figure 1. Effect of Supplementation on Ruminal Parameters of Steers