Livestock Efficiency

Effect of feeding range protein supplement on ruminal methylglyoxal production

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THE STORY IN BRIEF: When ruminants are consuming dormant range forage, the ruminal microbes may experience growth conditions where carbohydrate is supplied in excess of microbial needs and nitrogen is limiting to ruminal fermentation. To overcome dietary inadequacies, cattle are supplemented with protein supplements formulated to meet their nutrient requirement. These protein supplements may contain ruminally degradable protein, undegradable protein, or combinations of both. However, prediction of the effectiveness of the supplementation program, in regards to the degradable protein requirement of the microbial population, is based partially on animal performance and ammonia (NH_3) concentration in ruminal contents. Ammonia in the rumen is a pool of several inputs and outputs. Ammonia is derived from degradation of dietary protein and NPN, from the hydrolysis of urea recycled to the rumen, and from the degradation of microbial crude protein. Ammonia disappears from the rumen pool due to uptake by the microbes, absorption by the microbes, absorption through the rumen wall, and flushing to the omasum. Changes in any of these factors will alter NH_3 concentration in the rumen. Thus, NH_3 concentration is too dynamic to be a good indicator of the nitrogen status of the ruminal environment. The idea of using methylglyoxal as a marker for effectiveness of protein supplementation under a typical range supplementation protocol has not been investigated. Methylglyoxal is unique because it is produced by the rumen microbial population in response to unfavorable nutrient conditions in the rumen. The nutrient imbalance that is believed cause the rumen microbial population to produce methylglyoxal is limited nitrogen with carbohydrate loads that exceeds the needs of the microbial population. Therefore, methylglyoxal may hold the key to more efficient and cost effective supplementation strategies.

THE PROBLEM: **Protein supplementation to the cow herd represents a large cost to the producer. Often protein is overfed to compensate for our lack of ability to accurately assess the needs of the rumen microbial population. The protein produced by the microbial population accounts for the majority of nitrogen flowing to the small intestine for absorption and transport to body tissues. Therefore, a better balanced supply of nutrients to the microbial population would result in better animal performance with less inputs and lower costs. We currently do not have a method of assessing the effect of protein supplement strategies on the health of the rumen microbial population.**

OBJECTIVE: **An *in vivo* method has been developed to test the feasibility of detecting methyglyoxal under extreme nutrient limitations (Lodge-Ivey et al. 2002). However, the idea of using methylglyoxal as a marker for effectiveness of protein supplementation under a typical range supplementation protocol has not been investigated. Therefore, an experiment was conducted at the Corona Range and Livestock Research Center to determine the influence**

of protein supplementation on ruminal production of methylglyoxal, ammonia, pH and blood ketones by cows grazing dormant winter range.

DURATION: November 15, 2004 to February, 2005

APPROACH: Seven ruminally fistulated English crossbred cows (BW = 590 ± 15 kg) were used in a completely randomized design. Treatments consisted of two feeding regimes 1) a positive control (CON) representative of production practices in this region and 2) a strategic supplementation designed to vary with cow demands (VAR). The CON treatment (n=3) consisted of a 36% CP cottonseed meal based pelleted supplement delivered at 0.45 $kg \cdot cow^{-1} \cdot d^{-1}$, prorated to 3 times per week delivery. The VAR treatment (n=4) consisted of provision of the 36% supplement used in CON on an as needed basis. Need was determined by visual assessment of cow body condition change and forage conditions. Due to favorable weather and range conditions during the course of this experiment, animals on the VAR treatment did not receive supplement during the course of the experiment.

RESULTS: Mean levels of methlyglyoxal were (0.8 and 1.4 mM ± 0.83 SE) for CON and VAR, respectively. These values indicate that there was an imbalance in fermentable organic matter to ammonia nitrogen in the rumen and interestingly, both treatments had detectable methylglyoxal in the ruminal fluid by d 4 indicating that although the cows on CON treatment were receiving extra DIP it was not enough or was not in the most utilizable form to balance the nutrient content of the rumen. These data are preliminary but they support previous work in our laboratory that the ruminal microbes will produce detectable levels of methylglyoxal in response to nutrient imbalances in the rumen.

POTENTIAL APPLICATION: The results of this study support methylglyoxal concentrations in the rumen as being tool assess nitrogen status of the rumen. This is the first reported attempt to measure methylglyoxal in whole ruminal contents in cows under a commercial management setting. These results indicate that the ruminal microbial population experienced nutrient stress and responded by producing methylglyoxal. These data indicate that methylglyoxal may be a useful tool to assess ruminal nitrogen status.

REFERENCES:

S. L. Lodge-Ivey, R. L. Endecott, K. D. Richardson, and M. K. Petersen. 2005. Effect of feeding range protein supplement on ruminal methylglyoxal production. WSASAS proceedings, vol. 56, pp 445.