Nutrition Plus

IN THIS ISSUE:

UREA SUPPLEMENTATION: IF A LITTLE IS GOOD, IS A LOT BETTER?

A team of researchers at the University of New Hampshire is working to fine-tune one aspect of dairy nutrition, by examining the relationship between ruminal ammonia nitrogen (N) concentration and ruminal fermentation in lactating cows. The effort is being led by animal science professor Dr. Chuck Schwab and graduate student Sarah Boucher. In their work, the researchers have examined whether supplemental urea could positively influence rumen fermentation and microbial protein synthesis in lactating cows fed a conventional, corn-silage-based diet, and, if so, at what level.

WEST CENTRAL SUPPORTS INTESTINAL DIGESTIBILITY STUDY

West Central has partially funded research by University of New Hampshire researchers Dr. Chuck Schwab and Sarah Boucher, as part of an ongoing commitment to discovering future improvements in dairy nutrition. “We were intrigued by the very specific evaluation planned by these researchers, and felt it was important to support their interest in evaluating this aspect of dairy nutrition,” says West Central Director of Research Dr. Jesse Goff. “Their conclusions could have tremendous value to the entire U.S. dairy industry.”

“To our knowledge, no one has previously researched the optimal ruminal ammonia N concentration required to maximize synthesis of microbial protein or to maximize ruminal digestion of organic matter (OM) in lactating cows fed conventional diets supplemented with urea,” says Schwab. In the study, four Holstein cows were fitted with ruminal and duodenal cannulae for sampling purposes. Results of various levels of urea supplementation were evaluated using a 4 X 4 Latin square design. Dietary treatments included supplementation of the TMR with 0, 0.3, 0.6 and 0.9% urea in diet dry matter (DM). The average amounts of urea that were fed for the 0, 0.3, 0.6 and 0.9% urea diets were 0, 63, 127, and 192 g/d, respectively.

Urea was added to the diet at the described levels to determine: (1) the optimum ruminal ammonia N concentration needed for maximum flow of microbial protein to the duodenum; (2) ruminal digestibility of diet organic matter (OM); and (3) ruminal degradability of the primary forage, energy and protein feeds in the diet. The basal diet contained (DM basis) 52% forage

(with 61% of forage provided as corn silage) and 48% concentrate ingredients, and was formulated to meet NRC requirements for energy and all nutrients except rumen degradable protein (RDP).

Schwab says a deficit of RDP was planned, so that ruminal ammonia N concentrations would be less than optimal, and the concentration of ammonia N required for maximum synthesis of microbial protein and ruminal OM digestion could be determined.

The researchers found that there was no effect of treatment on intake or ruminal digestibility of diet DM, OM, starch, carbohydrate, ADF or NDF. There also was no effect of urea treatment on ruminal pH or total free amino acid concentrations in ruminal fluid. Ruminal ammonia N concentrations did increase quadratically with increasing urea supplementation, as shown in Table 1.

Microbial protein synthesis was maximized at an average ruminal ammonia N concentration of 12.8 mg/dL when urea was added at 0.6% of diet DM, and efficiency of microbial protein synthesis was maximized at an average ruminal ammonia N concentration of 11.9 mg/dL when urea was added at 0.3% of diet DM. “Based on these observations, we determined that the optimal ruminal ammonia N concentration was around 11 to 13 mg/dL,” says Schwab. “These concentrations were achieved when dietary RDP concentrations were 10.0 and 10.8% of diet DM. Urea supplementation exceeding 110% of NRC (2001) RDP requirements resulted in a high increase in ruminal ammonia N concentrations and had negative effects on synthesis of microbial protein.”

The team also noted that, without supplemental urea, ruminal ammonia N concentrations limited microbial protein synthesis, but did not appear to limit diet digestibility. They suggest that the optimum ruminal ammonia N concentration required to support maximum ruminal digestibility of diet OM or effective degradability of DM of feedstuffs may be lower than the ruminal ammonia N concentration required to support maximum synthesis of microbial protein.

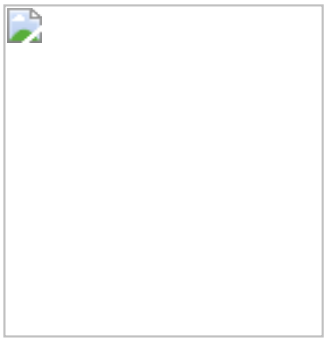
The researchers concluded that urea supplementation to a corn-silage-based diet is beneficial to support maximum synthesis of microbial protein. However, supplementing urea above 0.6% of diet DM may depress synthesis of microbial protein in diets high in corn silage.

CONSULTANT'S CORNER

INTESTINAL DIGESTIBILITY OF LYSINE IN RUMEN UNDEGRADED PROTEIN

By Sarah Boucher, MS, graduate student, University of New Hampshire, Durham, N.H.

In our initial urea study, our goal was to identify the urea supplementation level required to support maximum synthesis of



microbial protein in a corn-silage-based diet. However, in addition to providing dairy cows with adequate rumen degradable protein, it is also important to provide lactating cows with high-quality sources of rumen undegraded protein (RUP) to meet the metabolizable protein (MP) requirements of the animal.

The quality of RUP supplements is generally evaluated by the amount of RUP in the feed and the digestibility of the RUP in the small intestine. The amount of RUP in a feed is most commonly determined by the in situ approach, and intestinal digestibility of RUP is most commonly determined using the mobile-bag technique or the three-step procedure of Calsamiglia and Stern (1995). The mobile-bag technique is an expensive, labor intensive procedure not practical for routine analysis. The three-step procedure is an in situ/in vitro procedure, which makes it more practical for routine analysis of RUP digestibility of feeds.

However, the three-step procedure only allows for measurement of RUP digestibility. It does not allow us to estimate the digestibility of individual amino acids in the RUP fraction of feeds (RUP-AA), nor does it allow us to distinguish between digestibility and absorbability of amino acids, particularly lysine. The lack of a valid method to estimate digestibility of individual amino acids is of particular concern for lysine in RUP (RUP-Lys) because lysine is especially susceptible to damage when feeds are heat processed due to its unique chemical structure. Also, lysine is a limiting amino acid for milk and milk protein production in North American dairy rations. Therefore, our overall research goal is to identify a valid in vitro method that can be used to accurately estimate digestibility of RUP-Lys.

However, in order to identify a method that can be used to accurately estimate RUP-Lys digestibility, in vivo measurements of RUP-Lys digestibility in individual feed samples are needed. Also, as part of our larger project, we wanted to investigate the effects of heat treatment on the intestinal digestibility of RUP-AA, with particular focus on RUP-Lys. So, to begin obtaining in vivo data and to assess the effects of heat treatments on RUP-Lys digestibility, we obtained three samples of soybean meal and three samples of SoyPlus® from the Feed Analysis Consortium, Inc. We heated one of the soybean meal samples and one of the SoyPlus® samples in our laboratory ovens at 150°C for 90 minutes. After this, we incubated the samples in situ in the rumen of four lactating Holstein cows for 16 hours. The in situ bags were then removed from the rumen and shaken in a methylcellulose solution to remove the bacteria. The rumen residue was then crop intubated to cecectomized roosters. The precision-fed cecectomized rooster assay has been reported in the literature to be an appropriate technique to estimate small intestinal digestibility of RUP-AA in cattle, and is a much simpler procedure than the mobile-bag technique.

The results of the rooster trial are presented in Fig. 1. The heat treatments that we applied to the samples significantly depressed digestibility of RUP-Lys and RUP-AA in both the soybean meal and SoyPlus® samples compared to the samples that were not heated. However, the depression in RUP-Lys digestibility was greater than the depression in RUP-AA digestibility. For example, the heated soybean meal sample (HSBM) had an RUP-Lys digestibility value of about 55% and an RUP-AA digestibility value of about 78%. The unheated soybean meal samples had RUP-Lys digestibility values of about 90% and RUP-AA digestibility values of about 94%. Of the samples that we did not heat in our lab, there were no differences in the digestibility of RUP-Lys or RUP-AA between the soybean meal and SoyPlus® samples.

These results, along with results that others have reported in the literature, emphasize the need to identify in vitro techniques that can rapidly and accurately estimate the digestibility of RUP-Lys. We are currently using the data presented in Fig. 1, along with data from other rooster trials—in which we fed the rumen residues of various samples of DDGS and fishmeal—to evaluate the efficacy of various in vitro procedures to estimate the digestibility or availability of RUP-Lys and other amino acids. Once an in vitro procedure has been established, feeds

can be routinely analyzed for content of digestible RUP-Lys. This will allow us to more selectively assess the quality of RUP supplements and more accurately predict the MP-Lys supply to the cow.

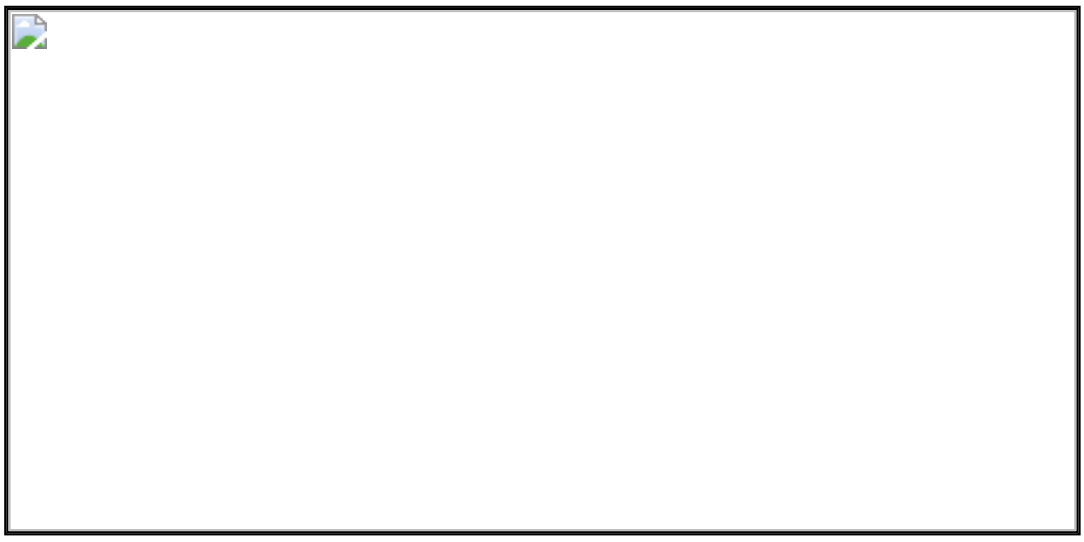


Figure 1. True intestinal digestibility of lysine and total amino acids (TAA) in the RUP fraction of various samples of SoyPlus® (SP) and soybean meal (SBM) determined in cecectimized roosters.

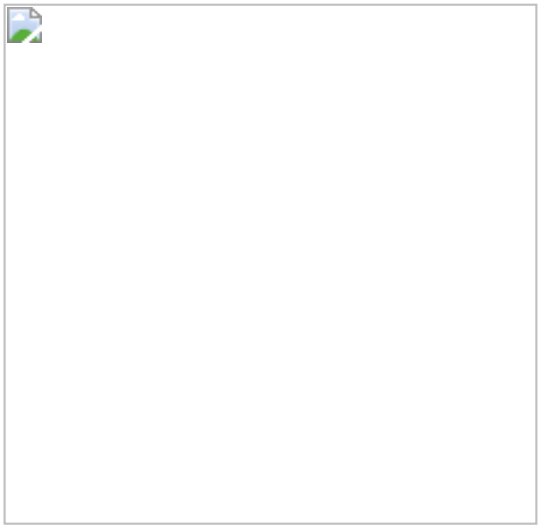
a, b, c Means between samples and within an amino acid category differ (P M 0.05).

Samples indicated by HSP and HSBM were heated in our over at 150 degrees C for 90 minutes.

NRC indicated the National Research Council (2001) RUP digestibility coefficient of solvent extracted soybean meal.

BEYOND BYPASS

ANIMAL BEHAVIOR INFLUENCES FEED CONSUMPTION



Even the most beautifully formulated ration is of little value if cows don't eat it. While the industry has long been aware of the importance of dry matter intake (DMI), the limited studies that have been conducted to evaluate the relationship between animal behavior and DMI have focused almost exclusively on individual-cow, tie-stall settings.

A team of researchers lead by Dr. Marina von Keyserlingk at the University of British Columbia Animal Welfare Program set out to evaluate the impact of various changes in feeding practices on cows in a group housing setting being fed a TMR.

Their studies and results included:

• **Feeding time** – This study was conducted to determine whether feeding at a time separate from milking could influence feeding behavior and intake. Forty-eight lactating Holstein cows were subjected to each of two treatments: (1) milking and feed delivery times coinciding; and (2) feed delivery at six hours post-milking. Shifting the time of feed delivery away from milking time resulted in increased daily feeding time by 12.5% and altered feeding and lying patterns. "These results indicate that the management practice of feed delivery acts as the primary

influence on the daily feeding pattern of lactating dairy cows and not, as previously thought, the time of day," says von Keyserlingk.

• **Feeding frequency** – In each of two experiments, 48 lactating Holstein cows, split into groups of 12, were subjected to each of two treatments (over 10-day periods) in a cross-over design. Study 1 evaluated (1) delivery of feed once per day versus (2) delivery of feed twice per day. Study 2 examined (1) delivery of feed twice per day versus (2) delivery of feed four times per day. They found that increased frequency of feed provision increased total daily feeding time by 10 and 14 minutes, respectively. Frequency of feed delivery had no effect on the daily lying time of the cows or aggressive interactions at the feedbunks. However, subordinate cows were not displaced as frequently when fed more often, indicating that these cows would have better access to feed, particularly fresh feed, when the frequency of feed delivery is high. Based on changes in NDF value throughout the day, the researchers found that TMR sorting was reduced when feeding frequency was increased from once to twice per day, but that no additional reduction of sorting was gained when the feed was delivered four times per day.

• **Bunk space allocation** – Twenty-four Holstein cows were subjected to two stocking densities: 0.5 meter and 1.0 meter of feed bunk space per cow. When cows had access to more bunk space there was at least 60% more space between animals (regardless of the number of cows at the feed bunk) and 57% fewer aggressive interactions while feeding. In addition, during the 90 minutes after fresh feed was provided, cows at the 1.0 m/cow stocking density increased their time at the feeder by 24%, and this effect was strongest in subordinate animals.

QUALITY CORNER

Between April 5 and August 8, 2007, 27 samples of SoyPLUS were submitted to a commercial lab (Eurofins) for analysis. Results are expressed as the mean + the standard error of the mean % on an "as fed" basis.

% Moisture	% Fat	% Fat
10.36	5.93	43.27
+0.12	+0.06	+0.11