NITROGEN SOURCE AND DIGESTION IN DAIRY COWS

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Story in Brief

Cannulated dairy cows were fed 55 percent concentrate diets at 90 percent of ad libitum intake with no supplemental nitrogen (basal diet; 11.1 percent crude protein) or diets supplemented with urea, casein or soybean meal to increase crude protein content to 15 percent. Ruminal organic matter digestion was not affected by diet. Disappearance of starch in the rumen tended to be lower for the soybean meal diet (54.5 vs 60.8, 63.8 and 62.9 percent for soybean meal, basal, urea and casein diets, respectively), while total tract acid detergent fiber digestion was lowest for the basal diet (26.3 vs 39.5, 38.8 and 40.5 percent for basal vs urea, casein and soybean meal-fed cows, respectively).

Key Words: Protein, Rumen Digestion, Fiber Digestion, Soybean Meal.

Introduction

In one previous trial, efficiency of microbial growth was increased from below 10 to over 15 g of microbial nitrogen per kg of organic fermented in the rumen when plant protein (soybean meal or cottonseed meal) was added to a 50 percent concentrate, 12 percent protein diet to increase the crude protein content to 17 percent (Goetsch et al., 1984). Such a change could be due to changes in the rumen population or in concentrations of specific nutrients for ruminal microbes. These include ammonia, peptides, amino acids, branched chain volatile fatty acids, certain minerals and B-vitamins. This trial was conducted to investigate the effect of source and level of dietary nitrogen on digestion and microbial efficiency in the rumen of dairy cows.

Materials and Methods

Four cannulated dairy cows (three Ayreshires and one Holstein; 1047 lb) in late lactation were fed diets (Table 1) twice daily and milked two times each day. The basal diet contained no supplemental nitrogen (11.1 percent crude protein). Urea, casein or soybean meal was substituted for corn starch in the basal diet to 15 percent crude protein levels. The soybean meal diet was fed in a 14 day preliminary period to determine ad libitum consumption. Intakes were restricted to 90 percent of this amount throughout the experiment.

Periods lasted 14 days with sampling on the last three days of each period. Feed, duodenal and fecal samples were obtained and subjected to all or part of the following analysis: dry matter, ash, nitrogen, acid detergent fiber, starch, chromium, nucleic acid-N and ammonia-N. Means were statistically contrasted.

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Table 1. Diet compositions, % of dry matter[a].

Ingredient	Diet			
	Basal	Urea	Casein	SBM
Corn starch	7.2	6.0	3.4	----
Urea	----	1.2	----	----
Casein	----	----	3.8	----
Soybean meal	----	----	----	7.2
Ground milo	43.5	43.5	43.5	43.5
Dehydrated alfalfa pellets	20.0	20.0	20.0	20.0
Chopped sorghum silage	25.0	25.0	25.0	25.0
Cane molasses	1.5	1.5	1.5	1.5
Dicalcium phosphate	1.5	1.5	1.5	1.5
Limestone	.5	.5	.5	.5
Trace mineralized salt	.5	.5	.5	.5
Chromic oxide	.3	.3	.3	.3

[a]Crude protein contents were 11.1, 15.0, 14.9 and 15.1%, respectively.

Results and Discussion

Ruminal and total tract digestion of organic matter were similar for all diets (Table 2) but lower than anticipated. Silage was cut at a late stage of maturity which may explain the low diet digestibility. Ruminal starch digestion was lower for the soybean meal than the urea diet. This may be due partially to the dietary level of corn starch. Postruminal starch digestion of the soybean meal diet compensated for depressed digestion of starch in the rumen. The acid detergent fiber content of the soybean meal diet was slightly greater than in other diets and ruminal acid detergent fiber digestion tended to be highest with this diet.

Table 2. Digestion measures.

Item	Diet			
	Basal	Urea	Casein	SBM
Organic matter digestion, % of intake				
Ruminal, true	44.9	45.6	46.1	42.9
Postruminal	9.5	12.3	11.4	12.7
Total	54.4	57.9	57.9	55.6
Starch digestion, % of intake				
Ruminal	60.8	63.8	62.9	54.5
Postruminal	3.3	1.6	2.3	15.6
Total	64.0	65.4	64.2	70.1
Total acid detergent fiber digestion, % of intake	26.3	39.5	38.8	40.5
Nitrogen disappearance, % of intake				
Ruminal (total)	3.0	22.0	6.0	6.0
Ruminal (non-microbial)	36.5	48.8	43.9	42.1
Total	42.1	58.2	59.3	55.6
Microbial efficiency, g microbial nitrogen/kg organic matter intake	15.0	15.2	15.5	15.3

Addition of protein to the diet increased (P<.05) fiber digestibility. Slower degradation of soybean meal than the other protein sources in the rumen would provide products of protein degradation more continually over the 12 hour feeding cycle which might increase fiber digestion.

Nonammonia nitrogen flow to the duodenum was equal to 97, 78, 94 and 94 percent of nitrogen intake for basal, urea, casein and soybean meal diets, respectively. Microbial efficiency (Table 2) was similar for all groups, contrasting with the earlier experiment in which intact protein supplementation of a 12 percent crude protein basal diet increased MOEFF from 10 to over 15 g N per kg organic matter truly fermentation in the rumen (Goetsch et al., 1984). In the previous trial, urea supplied 18 percent of the protein in the basal diet so protein byproducts may have been lower in that trial. Further, feed intake in the earlier experiment was slightly greater than in this trial which would elevate passage rate through the rumen. A faster ruminal passage rate may increase the effect of natural protein on microbial efficiency.

Assuming that urea and casein are totally degraded in the rumen, ruminal N disappearance with the basal diet was lower than anticipated. In most cases urea has not influenced escape of dietary protein, so it was surprising that ruminal escape of dietary N was increased by 10 percent with urea feeding in this trial. An increased rate of particle disintegration with urea supplementation would be expected to enhance passage rate of ruminal particles and decrease the extent of disappearance of basal dietary N, but ruminal OM digestibilities do not reflect such a change.

In summary, N level and source had little impact on site of digestion of nutrients with the exception of ADF. Total tract digestion of ADF was increased by N supplementation regardless of N source as has been observed previously (Kropp et al., 1977; Weakley et al., 1983). This may have been due to deficiency of ammonia-N in the rumen in this trial but not in the other trials. In this study, an ammonia deficiency would have been expected to reduce microbial efficiency based on in vitro studies but microbial efficiency values did not increase with added protein or non-protein nitrogen.

Literature Cited

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