

IN SITU DRY MATTER AND PROTEIN DISAPPEARANCE OF FEEDS IN BEEF COWS FED CONCENTRATE OR ROUGHAGE DIETS

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Story in Brief

The in situ technique was used to determine the effect of diet (80% concentrate vs roughage) on ruminal dry matter and protein degradability. Twelve feeds (3 cereal grains, 6 protein feeds and 3 roughage feeds) were ruminally incubated for 16 hours. Both dry matter and crude protein disappearance were lower for most feeds when incubated in the roughage-fed cow. The ranking of cereal grains and protein feeds was generally similar for both diets. For example, blood meal, feather meal and corn gluten meal had the lowest protein degradation of all protein feeds on both the concentrate and roughage diets. This study illustrates that the ruminal degradation of feeds is dependent on diet. Consequently, diet must be considered when formulating diets on the basis of ruminally degraded protein.

(Key Words: In Situ, Ruminal Degradable Protein, Concentrate, Roughage.)

Introduction

In addition to the total protein content of a feed, protein characteristics such as ruminal protein degradation are becoming more important. For example, range supplements must contain adequate quantities of ruminally degraded protein to stimulate fermentation of forage. If feeds high in bypass protein are used in range supplements, ruminal microbes may be starved for nitrogen. Under these conditions, forage fermentation and microbial protein synthesis may decline.

Ruminal degradation of feed protein varies widely among different feedstuffs. In addition, diet may alter ruminal protein degradation. Consequently, the objective of this study was to measure in situ dry matter and protein disappearance of selected feeds in beef cows fed concentrate or roughage diets.

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Materials and Methods

Two ruminally cannulated, mature crossbred beef cows were fed either a concentrate (Table 1) or a hay diet. The hay diet consisted of free choice, low quality native grass hay (4.5% CP) supplemented with 2 lb of a 40% CP supplement per day.

Feeds included cereal grains (wheat, corn, milo), protein feeds (soybean meal, cottonseed meal, whole cottonseeds, corn gluten meal, blood meal, feather meal) and roughage feeds (alfalfa hay, wheat midds, soybean hulls). Feeds were procured from the OSU Feedmill or from samples taken from various research projects. All feeds were ground through a 1-mm screen. Duplicate samples (.5 g) were placed in 2 x 4 inch dacron bags. These bags were tied in random order onto weighted strings. Bags were placed in the rumen of each cow for a 16 hour incubation period. Duplicate bags without sample were incubated in each cow. After incubation, the bags were removed and rinsed in lukewarm water. Bags then were washed by rotating between two large buckets of clean, lukewarm water until the wash water remained clear. The bags were removed from the strings, washed and dried at 105^o C for 24 hours. Kjeldahl protein content of the original feeds and of each bag was analyzed to calculate protein disappearance.

Feeds were grouped into classes of cereal grains, protein feeds and roughage feeds for statistical analysis. Data were subjected to least squares analysis of variance with feed class, diet and feed class x diet included in the model.

Table 1. Composition of concentrate diet.

Feed	% (as-is)
Sorghum grain, dry rolled	62.75
Cottonseed hulls	14.00
Soybean meal	10.00
Alfalfa, dehydrated	6.00
Cane molasses	5.00
Salt	.50
Limestone	.50
Dicalcium phosphate	.50
Aurofac-10	.15
Ammonium chloride	.50
Urea	.10

Results and Discussion

The protein content of the feeds used in this study (Table 2) generally was similar to reported values (NRC, 1982). The major discrepancy was noted for corn. The analyzed protein content of corn (8.86%) is typical of corn fed in Oklahoma during certain years.

In situ dry matter disappearance of two of three cereal grains, four of six protein feeds and two of four roughage feeds was higher for the cow fed the concentrate than the cow fed the roughage diet (Table 3). Ruminal microorganisms are probably more active on a concentrate diet and would be expected to ferment feeds more thoroughly. A significant feed class x diet interaction was observed, however, suggesting that the difference between diets was dependent on feed source. Within cereal grains, the difference due to diet was much greater for corn and sorghum grain compared to wheat. Both corn and sorghum grain contain protein that is known to be degraded less in the rumen than wheat protein. Perhaps protein shielding of starch granules was more limiting in corn and sorghum grain than in wheat. Within protein feeds, DM disappearance was lower on the roughage diet than on the concentrate except for whole cottonseed. Regardless of diet, feeds known to be slowly degraded in the rumen (blood meal, feather meal and corn gluten meal) were degraded to a lesser extent at 16 hours than feeds known to have greater ruminal degradation (soybean meal, cottonseed meal, whole cottonseeds).

Table 2. Protein content of feeds.

	Actual analysis	NRC (1982)
	-----% (DM basis)-----	
Cereal grains:		
Corn	8.86	10.9
Sorghum grain	12.24	12.4
Wheat	14.25	14.4
Protein feeds:		
Blood meal	94.14	93.3
Feather meal	87.86	91.3
Corn gluten meal	68.14	67.2
Soybean meal	48.80	49.9
Cottonseed meal	43.41	45.2
Whole cottonseeds	24.05	23.9
Roughage feeds:		
Alfalfa hay	21.77	19.0
Soybean hulls	14.40	12.1
Wheat midds	17.98	17.2

Table 3. Dry matter disappearance from dacron bags of selected feeds incubated in beef cows fed concentrate or roughage diets.

	Concentrate	Roughage
Cereal grains: ^a		
Corn ^b	84.8	38.8
Sorghum grain ^b	72.2	37.4
Wheat	89.8	86.6
Mean	82.3	54.3
Protein feeds: ^a		
Blood meal ^b	22.7	2.8
Feather meal	8.9	8.5
Corn gluten meal ^b	36.0	16.8
Soybean meal ^b	76.6	52.7
Cottonseed meal	50.5	48.4
Whole cottonseeds ^b	50.0	58.5
Mean	40.8	31.3
Roughage feeds: ^a		
Alfalfa hay ^b	51.1	55.9
Soybean hulls ^b	50.2	43.2
Wheat midds	72.2	70.8
Mean	57.8	56.6

^a Feed x diet interaction ($P < .05$).

^b Effect of diet ($P < .05$).

Protein disappearance from dacron bags was higher on the concentrate than roughage diet for all feeds except for whole cottonseed and alfalfa hay (Table 4). Within cereal grains, the rank in protein disappearance (wheat > corn > sorghum grain) was similar to DM disappearance. On the concentrate diet, blood meal, feather meal and corn gluten meal were degraded to a lesser extent than soybean meal and whole cottonseeds. On the roughage diet, rankings were similar although the protein degradation of soybean meal was extremely low (34%). Protein degradation of whole cottonseeds was increased on the roughage diet. Within roughage feeds, the roughage diet resulted in increased protein disappearance from alfalfa hay but it decreased protein disappearance from soybean hulls and wheat midds. The protein disappearance of all roughage feeds was extremely high on both diets suggesting that a major portion of their protein is degraded in the rumen.

Diet has an effect on ruminal dry matter and crude protein disappearance from feeds. These differences are important when formulating range supplements because feed selection will affect the quantity of ruminally degraded protein in a supplement which may affect ruminal fermentation of

Table 4. Protein disappearance from dacron bags of selected feeds incubated in beef cows fed concentrate or roughage diets.

	Concentrate	Roughage
Cereal grains: ^a		
Corn ^b	97.0	50.0
Sorghum grain ^b	74.1	36.7
Wheat ^b	104.5	84.0
Mean	91.9	56.9
Protein feeds: ^a		
Blood meal ^b	28.7	16.5
Feather meal	12.7	11.7
Corn gluten meal ^b	24.0	12.4
Soybean meal ^b	71.8	34.1
Cottonseed meal	57.1	50.4
Whole cottonseeds	88.6	93.4
Mean	47.1	36.4
Roughage feeds: ^a		
Alfalfa hay ^b	68.3	74.7
Soybean hulls ^b	75.3	65.4
Wheat midds ^b	98.1	84.0
Mean	79.9	74.7

^a Feed x diet interaction ($P < .05$).

^b Effect of diet ($P < .05$).

forage (Scott and Hibberd, 1990). In addition, including bypass proteins such as blood meal, feather meal and corn gluten meal in supplements may alter the quantity and quality of amino acid flow to the small intestine. This study suggests that the ruminal protein degradation of feeds should be determined with the diet that will be used.

Literature Cited

- NRC. 1982. United States-Canadian Tables of Feed Composition. National Academy Press, Washington, DC.
- Scott, R.R. and C.A. Hibberd. 1990. Incremental levels of supplemental ruminal degradable protein for beef cows fed low quality native grass hay. Okla. Agr. Exp. Sta. Res. Rep. MP-129:57.