EFFECTS OF PROTEIN SUPPLEMENTATION ON RUMINAL FERMENTATION OF LOW QUALITY NATIVE GRASS HAY IN STEERS

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Story in Brief

Three supplements supplying 0 (Control), .25 (Low) or .63 (High) lb of protein per day were fed to three ruminally cannulated steers consuming low quality native grass hay (4.9 percent crude protein). Feeding protein increased forage intake from 16.6 lb/day for the Control to 21.2 lb/day for the High group. Little change in intake was noted between the Control and the Low (.25 lb) protein levels. Ruminal pH decreased from 6.8 to 6.4 with supplement feeding. Ruminal ammonia concentrations were 2.3, 1.8 and 7.5 mg/dl for steers fed the Control, Low and High protein supplements, respectively. Disappearance of ground hay dry matter and fiber (ADF) from nylon bags was increased ($P<.0001$) by supplement feeding. The High protein level increased dry matter and fiber disappearance to a greater extent ($P< .05$) than the Low protein level. This study indicates that protein supplementation of low quality native grass hay stimulates ruminal fermentation through increased ammonia supply and increased fiber digestion.

Introduction

Wintering beef cows grazing native range in Central Oklahoma typically require protein supplementation to maintain adequate body condition. Protein supplementation of protein deficient forage increases forage intake, apparently due to increased forage digestibility. Ruminal bacteria require protein or the ammonia from protein to degrade fiber. The objective of this study was to evaluate the effect of protein supplementation on ruminal ammonia concentrations and disappearance of native grass hay from nylon bags suspended in the rumen of steers fed low quality native grass hay.

Materials and Methods

Three steers (1560 lb) fitted with large ruminal cannulae were allowed free access to coarsely chopped (1-inch screen) low quality native grass hay (4.9 percent crude protein, 48.7 percent ADF, 8.7 percent lignin). Each steer received either .18, .71 or 1.51 pounds of supplement each morning at 8 AM (Table 1). Supplements were formulated to provide 0 (Control), .25 (Low) or .63 (High) pounds of crude protein per day. Treatments (supplements) were applied in a 3 X 3 Latin square, with each period being seven days in length. Steers were adapted to their diets on days 1 through 4 and hay intakes and samples collected on days 5 through 7.

Nylon bags (2 X 4 inches) containing one gram of ground (20 mesh screen, Wiley mill) low quality native grass hay were suspended in the rumen to evaluate forage digestion. Duplicate bags were inserted for 6, 12, 18, 24, and 48-hour incubations. Bags were removed, washed, dried

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Table 1. Supplement composition (DM basis).

	Supplement Level		
	Control	Low	High
Soybean meal (lb/d)[a]	0	.53	1.33
Mineral mix (lb/d)[b]	.18	.18	.18
Crude protein intake (lb/d)	0	.25	.63

[a]47.6 % crude protein.
[b]Mineral mix; 43.0 % dicalcium phosphate, 17.6 % potassium chloride, 27.7 % trace mineralized salt, 11.1 % sodium sulfate, 14,000 IU Vitamin A/day.

and forage disappearance determined by difference. Bag contents were analyzed for acid detergent fiber (ADF) to evaluate fiber disappearance. Rumen samples were collected whenever nylon bags were inserted. Ruminal pH was measured after which samples were acidified, composited over time and frozen for later ammonia analysis.

Results and Discussion

Forage intake increased for steers receiving .63 lb of protein per day (Table 2). Feeding the Low (.25 lb) protein supplement, however, did not change ($P>.05$) forage intake. These observations on forage intake may be suspect because of the small number of experimental animals involved in this study. The trend for increased forage intake with supplemental protein is typical of low quality forage diets. Ruminal pH decreased with increased supplemental protein indicating enhanced fermentation (Table 2). Ruminal ammonia concentration was increased to 7.5 mg/dl when .63 lb of protein was fed. Feeding .25 lb of protein did not increase ruminal ammonia suggesting that inadequate ammonia may have limited microbial activity on the Control and Low supplements.

Supplemental protein increased ($P<.0001$) the disappearance of ground hay dry matter from nylon bags (Figure 1). By 48 hours, only 18.9 percent of the ground hay dry matter had disappeared in the steers receiving no supplemental protein compared to 35.7 percent and 44.2 percent for the Low (.25 lb) and High (.63 lb) protein levels. In

Table 2. Effect of supplemental protein on forage intake and ruminal parameters.

	Supplement Level			
	Control	Low	High	SEM
Forage intake (lb DM/d)	16.6	16.4	21.2	3.1
Ruminal parameters:				
pH	6.8	6.5	6.4	---
Ammonia-N (mg/dl)	2.3[a]	1.8[a]	7.5[b]	.6

[ab]Means with different superscripts differ ($P<.05$).

addition, dry matter disappearance was greater (P<.05) for steers fed .63 lb of protein than for those recieving only .25 lb protein. Trends for fiber (ADF) disappearance were similar indicating that supplemental protein enhanced cellulose fermentation as well (Figure 1).

This study suggests that even a small amount of supplemental protein (.25 lb/day) can substantially increase forage digestion. Additional protein (.63 lb/day) appears to be necessary to raise ruminal ammonia concentrations above 5 mg/dl, the amount usually considered necessary for maximum fermentation of feedstuffs in the rumen. Total crude protein intake for the High protein steers was about 1.7 pounds per day (supplement plus hay) which is above the maintenance protein requirement listed by the National Research Council (N.R.C.). Protein digestibility of the grass hay used in this study, however, was probably low. Whether additional protein above these amounts would further stimulate rumen fermentation is unknown.

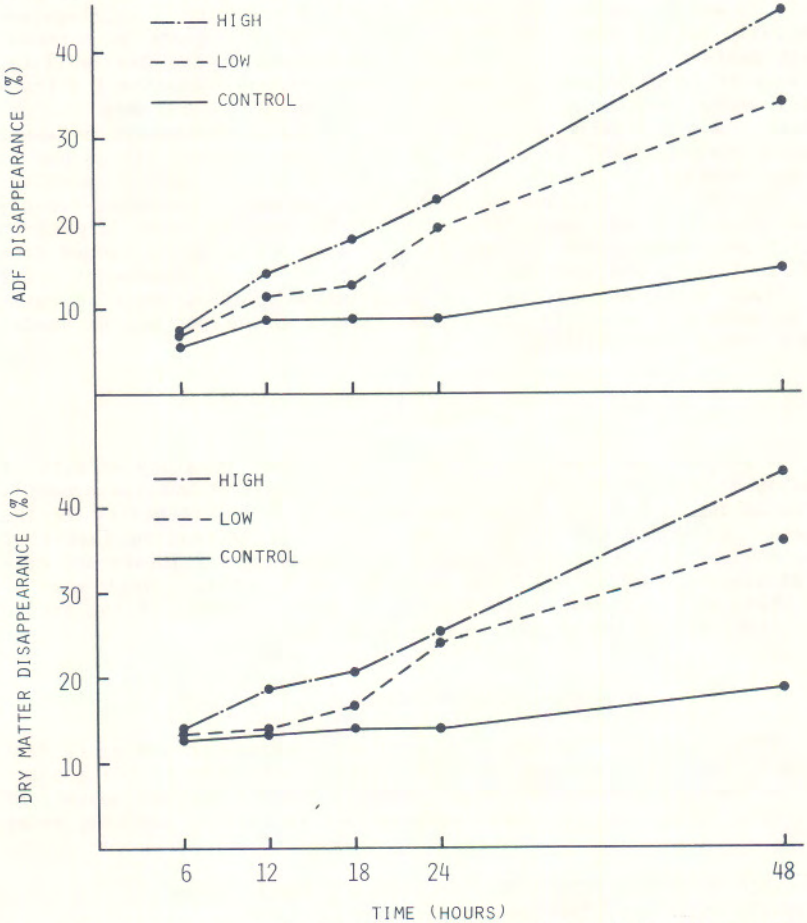

Figure 1. Dry matter and ADF disappearance of ground hay from nylon bags placed in the rumen of steers fed 0 (Control), .25 (Low) or .63 (High) pounds of supplemental crude protein per day.