PROTEIN SUPPLEMENTATION OF AMMONIATED WHEAT STRAW: EFFECT ON INTAKE AND DIGESTION IN BEEF STEERS[1]

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Summary

Sixteen ruminally fistulated steers (avg wt. = 998 lb) were used in a 30-day conventional digestion trial to examine the effects of protein supplementation on intake and digestion of ammoniated wheat straw. Steers were assigned to one of four protein supplementation programs: 1) Control (C) - no supplement, 2) Low Protein (LP) - 4.5 lb of a 10% crude protein (CP) supplement, 3) Medium Protein (MP) - 4.5 lb of a 20% CP supplement, or 4) High Protein (HP) - 4.5 of a lb 30% CP supplement. Supplements were mixtures of milo and soybean meal. Supplementation increased ($P < .05$) dry matter intake, tended ($P = .09$) to increase intake of digestible neutral detergent fiber (NDF), and increased ($P < .05$) intake of forage dry matter. Dry matter digestibility was higher ($P < .05$) for HP steers than C and LP steers, but no difference was detected between MP, and HP steers. Steers on HP, MP, and C treatments exhibited higher NDF digestibility than LP steers. Rumen pH, total volatile fatty acid concentration, and acetate to propionate ratio were unaffected by supplementation.

(Key Words: Ammoniation, Intake, Digestibility, Supplementation, Wheat Straw.)

Introduction

Wheat straw is abundant in Kansas but is of limited value because of its low digestibility. Ammoniation has been shown to increase its digestibility, intake, and crude protein content. Prior research has shown that natural protein is the major limiting nutrient in the utilization of ammoniated wheat straw by beef cows. This study was conducted to determine the effect of increasing levels of supplemental natural protein on intake, digestion, and rumen fermentation characteristics of cattle fed ammoniated wheat straw.

Experimental Procedures

Sixteen ruminally fistulated steers were randomly allotted by weight to a control treatment (no supplement) or 4.5 lb per day of a supplement formulated to contain 10, 20, or 30% crude protein. The straw was tub ground to pass through a 3-inch screen and fed ad libitum. The steers were fed in an open-fronted barn in individual pens. Feed offered and refused was measured daily to obtain intake; during the final 7 days steers were fitted with fecal bags for a total collection to measure digestibility. On day 29, rumen contents were manually removed, sampled, and immediately returned to the rumen at feeding and 4 hours postfeeding. On day 30, rumen fluid was collected at feeding and at 3, 6, 9, and 12 hours postfeeding to measure volatile fatty acid concentrations, pH, and a soluble marker, which was used to measure liquid dilution rate.

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Results and Discussion

After ammoniation, CP content of the straw averaged 10.5%. Actual CP contents of the supplements were: LP = 12.0%; MP = 21.7%; and HP = 31.7%. Forage dry matter (DM) intake and total DM intake were increased ($P < .01$) by supplementation, with a significant ($P < .01$) linear response to increasing levels of crude protein. Dry matter digestibility was increased by supplementation with 30% protein. NDF digestibility was depressed by feeding the LP supplement. Dry matter ruminal fill at 4 hours postfeeding (data not shown) was greater ($P < .05$) for supplemented steers than for controls, reflecting the increase in DM intake. Rumen pH, total volatile fatty acid concentrations, and acetate to propionate ratio were unaffected by supplementation.

This study helps explain the results of the associated cow feeding trial (see page xxx), in which cows fed the higher protein level gained slightly more than those on the LP treatment. The higher forage intake and higher NDF digestibility for the MP and HP treatments compared to the LP treatment resulted in greater intake of digestible energy.

Table 1. Intake, Digestibility and Fermentation Characteristics of Steers Consuming Ammoniated Wheat Straw and Supplements Varying in Protein Content

	Treatment			
Item	C	LP	MP	HP
Forage DM Intake[d]	1.56[a]	1.77[a]	1.92[ab]	2.24[b]
Total DM Intake[d]	1.61[a]	2.19[b]	2.34[b]	2.67[b]
DM Digest., %	52.9[ab]	51.7[a]	58.9[bc]	60.2[c]
NDF Digest., %	70.2[a]	63.5[b]	68.7[a]	70.4[a]
Rumen pH	6.17	6.31	6.13	6.33
VFA concentration[e]	103.6	96.5	100.1	107.1
Acetate:Propionate molar ratio	3.51	3.68	3.37	3.40

[abc]Means within a row with unlike superscripts differ ($P < .05$).

[d]Intake expressed as a % of body weight.

[e]Volatile fatty acid concentration expressed as millimoles per liter.