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Effect of protein supplementation on dormant, bluestem-range forage intake and digestion and protein flow to the small intestine in steers

Abstract

A digestion trial was conducted to determine dormant, bluestem-range forage intake, digestion, and protein flow to the small intestine in steers receiving different crude protein (CP) supplements. Dietary treatments were 1) control: no supplement; 2) low protein supplement (Low-CP): SBM + grain sorghum supplement containing 13% CP; 3) moderate protein supplement (Mod-CP): SBM + grain sorghum supplement containing 26% CP; and 4) dehydrated alfalfa pellets supplement (Dehy): supplement containing 17.5% CP. Forage intake increased an average of 36% in steers supplemented with Mod-CP and Dehy, compared to the forage intake of control steers. Forage intake of steers receiving Low-CP supplement was similar to that of control steers. Total tract digestion of forage fiber increased 8% when Mod-CP and Dehy supplements were fed compared to control treatment, whereas Low-CP supplement caused an 11% decrease in fiber digestion compared to control treatment. Crude protein flowing into the small intestine was greatest for steers fed the Mod-CP and Dehy supplements. In conclusion, the Dehy supplement was as effective as the Mod-CP supplement when fed to provide the same amount of CP per day; however, when a grain-based supplement was fed, increasing the CP concentration above 20% significantly improved intake and utilization of poor-quality range forage.

Keywords

Cattlemen's Day, 1990; Kansas Agricultural Experiment Station contribution; no. 90-361-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 592; Beef; Protein supplements; Intake; Crude protein flow; Winter range

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**EFFECT OF PROTEIN SUPPLEMENTATION ON DORMANT,
BLUESTEM-RANGE FORAGE INTAKE AND
DIGESTION AND PROTEIN FLOW TO
THE SMALL INTESTINE IN STEERS**

**S. M. Hannah, R. C. Cochran,
D. L. Harmon, and E. S. Vanzant**

Summary

A digestion trial was conducted to determine dormant, bluestem-range forage intake, digestion, and protein flow to the small intestine in steers receiving different crude protein (CP) supplements. Dietary treatments were 1) control: no supplement; 2) low protein supplement (Low-CP): SBM + grain sorghum supplement containing 13% CP; 3) moderate protein supplement (Mod-CP): SBM + grain sorghum supplement containing 26% CP; and 4) dehydrated alfalfa pellets supplement (Dehy): supplement containing 17.5% CP. Forage intake increased an average of 36% in steers supplemented with Mod-CP and Dehy, compared to the forage intake of control steers. Forage intake of steers receiving Low-CP supplement was similar to that of control steers.

Total tract digestion of forage fiber increased 8% when Mod-CP and Dehy supplements were fed compared to control treatment, whereas Low-CP supplement caused an 11% decrease in fiber digestion compared to control treatment. Crude protein flowing into the small intestine was greatest for steers fed the Mod-CP and Dehy supplements. In conclusion, the Dehy supplement was as effective as the Mod-CP supplement when fed to provide the same amount of CP per day; however, when a grain-based supplement was fed, increasing the CP concentration above 20% significantly improved intake and utilization of poor-quality range forage.

(Key Words: Protein Supplements, Intake, Crude Protein Flow, Winter Range.)

Introduction

Previous research at Kansas State University has shown that feeding cattle supplements containing moderate (26%) or high (39%) concentrations of crude protein (CP) increased their forage intake and utilization, whereas forage intake was not increased in cattle fed supplements containing a low (13%) CP concentration. DelCurto et al. (KAES Rep. of Prog. 539, p. 29) noted that forage intake and utilization were depressed when a grain-based supplement containing a low concentration of CP (11%) was fed at a level that provided the same amount of CP as a grain-based supplement containing a moderate concentration of CP (22%).

The protein:energy ratio in grain-based protein supplements appeared to have a major influence on forage intake and utilization. In contrast, Kansas State University research has also shown that cattle fed a fiber-based supplement (dehydrated alfalfa) showed similar performance to those receiving a grain-based supplement with a moderate CP concentration, when both were fed to provide equivalent amounts of CP. Although previous studies have examined the effect of protein supplementation on animal performance, information is limited regarding how such

supplements elicit their responses. The objectives of this study were to measure the amount of digestion in different segments of the intestinal tract and to monitor the protein flowing into the small intestine when different protein supplements were fed to steers consuming dormant, bluestem-range forage.

Experimental Procedures

Four Holstein steers, ruminally and intestinally cannulated, with an average weight of 967 lb, were used in a 4x4 Latin square design digestibility experiment. The four dietary treatments examined were 1) control: no supplement; 2) low protein supplement (Low-CP): SBM + grain sorghum supplement containing 13% CP; 3) moderate protein supplement (Mod-CP): SBM + grain sorghum supplement containing 26% CP; and 4) dehydrated alfalfa pellets supplement (Dehy): supplement containing 17.5% CP. The Low-CP and Mod-CP supplements were fed at 4 lb/d, whereas Dehy was fed at 5.9 lb/d, so that the Dehy and Mod-CP supplements would provide the same amount of CP (1.04 lb CP/d). Dehydrated alfalfa pellets came from a third cutting of mid-bloom hay. The hay fed was dormant, bluestem-range forage with a CP concentration of 2.3%. The hay was fed at 130% of the previous day's consumption. At 8 A.M. and 8 P.M., steers were fed half of their daily allotment of supplement and forage. Each data collection period lasted 30 d. After each collection period, steers were switched to a different dietary treatment, until each steer had received each treatment.

Results and Discussion

Intake of dormant, bluestem-range forage was increased ($P < .01$) 42% by the Mod-CP supplement and 29% by the Dehy supplement, but was not increased by the Low-CP supplement (Table 30.1). Because of the addition of the supplements to the diet, total dietary dry matter (DM) intake was increased ($P < .01$) over control by 47, 89, and 100% for Low-CP, Mod-CP and Dehy supplements, respectively. Ruminal DM digestibility was increased ($P < .01$) 98% with Mod-CP and Dehy supplements compared with control and increased 59% compared with Low-CP supplement. Ruminal fiber digestion was not significantly affected by treatments but numerically averaged 22% lower for the Low-CP supplement than all other treatments. All supplements increased ($P < .05$) total dietary DM digestibility by an average of 28% over control.

In contrast to DM digestion, fiber digestion for the Low-CP supplement tended to be lower (11%; $P = .15$) than that for the control treatment and averaged 21% lower than the Mod-CP and Dehy supplement treatments. Fiber digestion was 8% greater for Mod-CP and Dehy supplements compared with the control. Forage intake and digestion results of this experiment agree with previous studies. Increased forage intake with the Mod-CP and Dehy treatments was closely associated with the amount of CP reaching the small intestine. Supplementation with Mod-CP and Dehy increased ($P < .01$) CP flow to the small intestine over the control treatment 116 and 129%, respectively, whereas the Low-CP supplement only increased CP flow by 61%.

Based upon the results from this trial and previous Kansas State research that evaluated the interaction of protein and energy levels in supplements, it appears that when grain-based supplements are fed, the crude protein concentration should be in the moderate to high range (greater than 20% CP on a dry matter basis). This approach should ensure optimal use of poor-quality range forage by supplemented cattle. In contrast, although the CP concentration in the fiber-based supplement (dehydrated alfalfa pellets) was lower than would be desirable for

Table 30.1. Effect of Supplemental Protein on DM Intake, DM and Fiber Digestibility, and CP Flow to the Small Intestine in Steers

Item	Control	Low-CP	Mod-CP	Dehy	SE ¹
DM intake, % BW ²					
Forage	.76 ^a	.75 ^a	1.08 ^b	.98 ^b	.05
Supplement	0	.37	.36	.54	
Total	.76 ^a	1.12 ^b	1.44 ^c	1.52 ^c	.04
Ruminal digestibility, %					
DM	19.72 ^a	24.53 ^a	38.96 ^b	39.07 ^b	2.85
Fiber ³	50.62	43.18	55.63	52.76	4.45
Total tract digestibility, %					
DM	43.56 ^d	53.81 ^e	59.06 ^e	54.26 ^e	2.90
Fiber ³	54.21 ^{fg}	48.50 ^f	59.68 ^g	57.70 ^g	3.06
CP flow to the small intestine, g/d	273.6 ^a	441.2 ^b	591.4 ^c	627.4 ^c	45.0

¹Standard error.

²BW = body weight.

³Neutral detergent fiber digestibility.

^{abc}Row means without a common superscript differ (P<.01).

^{de}Row means without a common superscript differ (P<.05).

^{fg}Row means without a common superscript differ (P=.15).

a grain-based supplement, the influence on forage use was similar to that of the Mod-CP supplement, as long as enough Dehy was fed to provide the same amount of CP per day.