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Influence of low-level fall protein supplementation on forage intake, diet digestion, and selection by beef steers grazing tallgrass-prairie range

Abstract

This study evaluated the effect on forage utilization of providing a limited quantity of a high-protein (40% crude protein) supplement to beef cattle grazing tallgrass prairie during the fall. Sixteen ruminally fistulated beef steers were randomly assigned to one of two treatments (fall supplementation or no fall supplementation), which were evaluated for their effect on forage intake and digestion during September and November. Within each treatment, four steers were used for measuring diet selection (by ruminal evacuation) and four were used for determining diet digestion (by total fecal collection). Data from both groups were used to calculate forage intake. Steers were individually fed a high-protein supplement at a rate of 0.14% of body weight/day (as-fed basis; 0.80 lb/day during September and 0.99 lb/day during November) but prorated and delivered only three days per week. Quality of diet selected decreased as season progressed (decreased protein and increased fiber) and, as a result, forage intake and digestion was significantly lower during the late fall period. Neither diet selection nor forage intake were significantly influenced by fall supplementation; however, supplemented steers digested their total diet to a greater extent.

Keywords

Cattlemen's Day, 2003; Kansas Agricultural Experiment Station contribution; no. 03-272-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 908; Beef; Low-level fall protein supplementation; Forage intake; Diet digestion; Steers; Tallgrass-prairie range

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INFLUENCE OF LOW-LEVEL FALL PROTEIN SUPPLEMENTATION ON FORAGE INTAKE, DIET DIGESTION, AND SELECTION BY BEEF STEERS GRAZING TALLGRASS-PRAIRIE RANGE

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Summary

This study evaluated the effect on forage utilization of providing a limited quantity of a high-protein (40% crude protein) supplement to beef cattle grazing tallgrass prairie during the fall. Sixteen ruminally fistulated beef steers were randomly assigned to one of two treatments (fall supplementation or no fall supplementation), which were evaluated for their effect on forage intake and digestion during September and November. Within each treatment, four steers were used for measuring diet selection (by ruminal evacuation) and four were used for determining diet digestion (by total fecal collection). Data from both groups were used to calculate forage intake. Steers were individually fed a high-protein supplement at a rate of 0.14% of body weight/day (as-fed basis; 0.80 lb/day during September and 0.99 lb/day during November) but prorated and delivered only three days per week. Quality of diet selected decreased as season progressed (decreased protein and increased fiber) and, as a result, forage intake and digestion was significantly lower during the late fall period. Neither diet selection nor forage intake were significantly influenced by fall supplementation; however, supplemented steers digested their total diet to a greater extent.

Introduction

Previous research conducted at Oklahoma State University demonstrated that providing a limited amount of a high-protein supplement

during the late summer period can be effective in eliciting efficient weight gains in stocker cattle grazing native range. It seems logical that a similar response might be observed in cattle grazing tallgrass prairie during the fall period. If cows are in poor body condition during the fall, such a practice may be beneficial in preparing cows for entering the winter period. The performance benefits that are realized by protein supplementation are often mediated by increases in forage intake and digestion. Therefore, the objective of our experiment was to determine if providing a limited quantity of a high-protein supplement during the early or late fall has an effect on forage intake, diet digestion, and the quality of the diet selected by steers grazing tallgrass-prairie range.

Experimental Procedures

Sixteen ruminally fistulated Hereford x Angus steers were utilized in a two-period experiment (average initial starting weight in period 1 and period 2 = 571 and 706 lbs, respectively). Each period lasted 21 days and the respective starting dates were September 17, 2001 and November 26, 2001. During each period steers grazed a single 68-acre pasture of tallgrass prairie (Table 1). Forage availability was abundant during both periods. Steers were weighed at the beginning of each period, blocked by weight, and randomly assigned to one of two treatments: 1) fall supplementation, 2) no fall supplementation. Within each treatment, four steers were used for measuring diet selection (by ruminal

evacuation) and four steers were used for estimating diet digestion (by total fecal collection). Steers remained on the same treatments and were used for the same collection activities throughout the experiment. Supplemented steers received a 40% crude protein supplement (as-fed basis; supplement composition was about 52% cottonseed meal, 30% soybean meal, 15% sunflower meal, 2.5% molasses, and 0.5% grease) in meal form at a daily rate of 0.14% of body weight measured at the beginning of each period (as-fed basis; this feeding level was commensurate that the amount fed in a companion study which monitored beef cow performance). The desired daily quantity was prorated for delivery three times per week (Monday, Wednesday, and Friday). On these days, steers were gathered in the morning and individually fed the prorated amount. Each collection period consisted of a 15-day adaptation (days 1 through 15), a 6-day fecal collection (days 16 through 21), and a 4-day diet collection (days 18 through 21). Diet selection samples were analyzed for dry matter and organic matter, crude protein, neutral detergent fiber (NDF), and acid detergent fiber (ADF). The selected forage, feces, and supplement were analyzed for acid detergent insoluble ash for use as an internal marker for calculation of digestibility. Indirect calculation of forage intake was derived from equations utilizing calculated digestibility and measured fecal output.

Results and Discussion

The effect of supplementation treatment on diet selection was not dependent on the period in which selection was measured (i.e., September versus November). Supplementation treatment did not affect ($P=0.62$) the percentage of crude protein in the diet selected although the amount of crude protein in the diet selected declined ($P<0.01$) during late fall (Table 2). Compared to the crude protein concentration in the standing forage, steers

selected a diet with higher crude protein content. This also has been observed in other grazing studies. Neither measure of dietary fiber (NDF and ADF) in the selected forage was significantly affected by the supplementation treatments evaluated. However, both NDF ($P=0.08$) and ADF ($P<0.01$) tended to increase with advancing season. Also, steers selected diets with less fiber (i.e., higher quality) than that present in the standing forage.

The response of steers to supplementation treatment in terms of the effect on forage intake or digestion was not significantly dependent on the period in which these characteristics were measured. Forage and total organic matter intakes (i.e., consumption of both forage and supplement) were not affected by supplementation ($P=0.61$ and $P=0.94$, respectively; Table 3). However, each of these was significantly lower ($P=0.02$) during the late fall period. Total diet digestion also was significantly lower ($P=0.02$) during the late fall. In contrast to forage intake, diet digestion tended ($P=0.06$) to be greater for supplemented compared with nonsupplemented steers, and most of this difference was due to a difference between treatments during the November sampling period. Digestion of low-quality forage diets is often restricted by lack of ruminally available protein. Providing a source of ruminally available protein provides nutrients that enable ruminal microbes to degrade forage fiber. The supplement fed in this study was both highly digestible itself, as well as an excellent source of ruminally available protein. Thus, the observed trends for improved digestion may have reflected both of these aspects. Digestible organic matter intake is a product of total intake and digestion and is a good integrated measure of how a treatment affects forage use. In our study, digestible organic matter intake was not different ($P=0.60$) between supplementation treatments but was lower ($P=0.01$) during late fall than early fall.

In conclusion, provision of limited quantities of a high-protein supplement to steers grazing native range during the late summer and fall tended to improve digestion but had

little effect on the quality of diet selected or forage intake. Changes in diet selection and digestion were consistent with decreasing forage quality.

Table 1. Chemical Composition of Available Pasture Forage

Sampling Date	Nutrient			
	Organic Matter	Crude Matter	Neutral Detergent Fiber	Acid Detergent Fiber
	----- % of Dry Matter -----			
September 25	89.3	5.8	66.6	46.3
December 7	90.1	2.9	71.9	50.6

^aFrom analysis of hand clipped samples.

Table 2. Influence of Low-Level Fall Protein Supplementation on Quality of Diet Selected by Grazing Steers

Item	September		November		SEM ^a	Statistical Comparisons (P-values)		
	Fall Supplement	No Supplement	Fall Supplement	No Supplement		Supplement	Period	Supplement x Period
Organic matter	85.7	85.6	86.2	85.5	1.21	0.70	0.88	0.79
----- % of forage organic matter -----								
Crude protein	9.5	9.3	6.4	6.1	0.43	0.62	<0.01	0.91
Neutral detergent fiber	75.0	77.1	79.4	80.1	2.21	0.32	0.08	0.71
Acid detergent fiber	43.7	46.0	49.9	51.2	1.47	0.22	<0.01	0.69

^aStandard error of the mean; n = 4.

Table 3. Influence of Low-Level Fall Protein Supplementation on Organic Matter Intake and Digestibility in Grazing Steers

Item	September		November		SEM ^a	Statistical Comparisons (P-values)		
	Fall Supplement	No Supplement	Fall Supplement	No Supplement		Supplement	Period	Supplement x Period
Organic intake, % of body weight daily								
Forage	1.97	2.07	1.69	1.79	0.15	0.61	0.02	0.97
Supplement ^b	0.12	—	0.12	—				
Total	2.09	2.07	1.81	1.79	0.15	0.94	0.02	0.97
Digestible organic matter	1.09	1.07	0.92	0.84	0.07	0.60	0.01	0.70
Total tract digestion, %								
Organic matter	52.2	51.8	50.6	46.7	1.1	0.06	0.02	0.17

^aStandard error of the mean; n = 4.