Kansas Agricultural Experiment Station Research Reports

Volume 0
Issue 1 *Cattleman's Day (1993-2014)*

Article 596

1995

Influence of degradable intake protein on site and extent of digestion in beef cows consuming low-quality, tallgrass-prairie forage

H.H. Köster

R.C. Cochran

E.S. Vanzant

See next page for additional authors

Influence of degradable intake protein on site and extent of digestion in beef cows consuming low-quality, tallgrass-prairie forage

Abstract

Five Angus x Hereford cow s with ruminal and duodenal fistulas were used to evaluate the effect of providing increasing degradable intake protein (DIP) o n the site and extent of digestion of dormant, tallgrass-prairie forage. The DIP was provided from sodium caseinate, divided in two equal portions and infused intraruminally twice daily. Levels of DIP were: 0, 180, 360, 540, and 720 g/day. Supplemental DIP generally improved utilization of low quality forage, with maximum effects on duodenal N flow and forage organic matter intake at 540 g DIP/day.

Keywords

Cattlemen's Day, 1995; Kansas Agricultural Experiment Station contribution; no. 95-357-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 727; Beef; Beef cows; Intake; Digestibility; Forage

Authors

H.H. Köster, R.C. Cochran, E.S. Vanzant, G. St Jean, and Evan C. Titgemeyer

INFLUENCE OF DEGRADABLE INTAKE PROTEIN ON SITE AND EXTENT OF DIGESTION IN BEEF COWS CONSUMING LOW-QUALITY, TALLGRASS-PRAIRIE FORAGE [1]

H. H. Köster, R. C. Cochran, E. C. Titgemeyer, E. S. Vanzant [2], and G. St Jean [3]

Summary

Five Angus × Hereford cows with ruminal and duodenal fistulas were used to evaluate the effect of providing increasing degradable intake protein (DIP) on the site and extent of digestion of dormant, tallgrass-prairie forage. The DIP was provided from sodium caseinate, divided in two equal portions and infused intraruminally twice daily. Levels of DIP were: 0, 180, 360, 540, and 720 g/day. Supplemental DIP generally improved utilization of low quality forage, with maximum effects on duodenal N flow and forage organic matter intake at 540 g DIP/day.

(Key Words: Beef Cows, Intake, Digestibility, Forage.)

Introduction

In many parts of the Western United States, beef cattle are maintained on low-quality forages. To optimize the utilization of these forages and maintain acceptable animal performance, it is frequently necessary to provide supplemental nutrients that will enhance intake and fiber digestion. Generally, protein is considered to be "first limiting" to the utilization of low-quality forage. However, for ruminal microorganisms to be able to use protein for their growth and, hence, degradation of forage fiber, protein must be in a form that will degrade in the rumen (i.e., degradable intake protein [DIP]). Our objective was to define the amount of DIP required to optimize the utilization of low-quality, tallgrass-prairie forage consumed by mature beef cows.

Experimental Procedures

Five Angus × Hereford cows (1296 lb) with ruminal and duodenal fistulas were housed in individual tie stalls and had unlimited access to dormant tallgrass-prairie forage (1.9% crude protein [CP]; 77% neutral detergent fiber [NDF]). Sodium caseinate (casein; 90% CP) was used to provide DIP because it is high-quality protein that is almost entirely degraded in the rumen. The casein was solubilized in water (7 liters/day), divided in two equal portions, and infused intraruminally at 6:30 AM and 6:30 PM immediately before feeding forage. DIP levels were 0, 180, 360, 540, and 720 g/day. Acid insoluble ash was used as an indigestible marker for calculating digestion values. Cows were allowed to adapt to diets for 14 days during each of the five experimental periods. Adaptation was followed by a 4-day sampling period for intake and digesta. On days 16 through 18, duodenal and fecal grab samples were collected every 6 hours (collection time advanced 2 hours each day). Fluid dilution rate was determined by pulse dosing (just before the morning feeding) and collecting ruminal fluid samples at 3, 6, 9, 12, and 24 hours after dosing.

[1]The authors express their appreciation to Gary Ritter, Wayne Adolph, Gary Breault, and Mike Sheffel for their expert assistance in conducting this experiment.
[2]KSU Agricultural Research Center - Hays.
[3]Department of Clinical Sciences.

Results and Discussion

Forage organic matter (OM), digestible OM, and total N intake increased in response to increasing DIP levels, although the rate of increase was less with greater amounts of DIP supplementation (quadratic effect, P<.01; Table 1). The magnitude of this response underlines the importance of providing adequate degradable protein for beef cattle to make the best use of low-quality forages. The increased forage intake in response to supplementation with DIP was related at least partially to concomitant increases in rate of passage (increased fluid dilution rate; linear, P=.02) and forage digestibility. Apparent digestibility of ruminal OM and NDF, as well as total tract digestibility of OM and NDF, tended to increase with the addition of 180 to 360 g DIP/day, but in some cases declined when greater amounts of DIP were infused. The initial digestibility increase probably was due to additional supplemental protein stimulating growth of fiber-digesting microbes. At the same time, the increases in both intake and passage rate with the higher DIP infusion levels resulted in a shorter retention time of forage in the rumen, leaving less time for the microbes to digest fiber. Although maximum fiber digestibility was observed at 180 to 360 g DIP/day, total duodenal N flow (which represents the protein arriving at the small intestine) peaked at 540 g DIP/day, but declined slightly at 720 g DIP/day (quadratic effect, P<.01). Because the amount of protein flowing into the small intestine and forage intake were not increased when the supplemental DIP exceeded 540 g/day, and because digestible OM intake changed little between 540 and 720 g/day, 540 g of DIP/day is probably adequate to optimize use of low-quality, tallgrass prairie by mature beef cows.

Table 1. Effect of Increasing Amount of Degradable Intake Protein (DIP) on Intake, Flow, and Digestibility in Beef Cows Fed Dormant Tallgrass-Prairie Forage

	DIP Level (g/day)						Contrasts [a]		
Item	0	180	360	540	720	SEM	L	Q	C
OM intake	---------- g/kg $BW^{.75}$ ----------								
Forage	29.3	48.1	57.3	64.7	61.6	2.72	<.01	<.01	.91
Casein	–	1.62	3.24	4.86	6.48	–			
Total	29.30	49.72	60.54	68.56	68.08	2.73	<.01	<.01	.91
Digestible OM intake	12.9	26.8	33.1	35.5	37.4	1.77	<.01	<.01	.26
Total N intake, g/d	13.4	48.5	80.5	110.9	137.8	1.23	<.01	<.01	.94
Ruminal digestibility	---------- % of intake ----------								
Apparent OM	43.3	47.3	47.4	45.3	47.4	1.36	.22	.28	.12
True OM	46.1	52.4	54.4	53.1	58.1	1.29	<.016	.30	.03
NDF	47.2	55.6	56.7	53.2	54.6	1.15	.01	<.01	.01
Apparent N	-139.5	-34.9	-15.0	2.0	23.2	16.20	<.01	.03	.14
Duodenal flow	---------- g/day ----------								
Total N	30.7	65.6	92.4	111.7	109.3	5.83	<.01	<.01	.51
Microbial N	19.3	46.3	67.0	80.0	90.4	6.06	<.01	.12	.86
Ammonia N	.31	.77	1.94	4.20	4.77	.35	<.01	.36	.07
Nonmicrobial-nonammonia N	11.1	18.5	23.5	27.5	14.1	2.87	.17	<.01	.16
ADIN	6.9	9.8	12.3	11.4	12.0	.91	<.01	.05	.57
Microbial efficiency, g N /kg OM truly digested	12.2	15.2	17.0	19.1	20.0	1.21	<.010	.43	.98
Total tract digestibility	---------- % ----------								
OM	44.6	54.3	54.2	51.3	53.8	2.27	.09	.09	.08
NDF	50.3	58.7	57.9	54.6	55.6	1.85	.34	.04	.06
N	-39.8	39.0	51.1	60.5	70.4	6.96	<.01	<.01	.02
Fluid dilution rate %/hour	4.74	5.47	6.29	7.07	6.39	.48	.02	.16	.37

[a]Probability of a greater F value . L = linear change with increasing DIP, Q = quadratic change with increasing DIP, C = cubic change with increasing DIP.