EFFECTS OF SUPPLEMENTAL DEGRADABLE INTAKE PROTEIN ON INTAKE AND DIGESTIBILITY OF FORAGE SORGHUM HAY

C. P. Mathis, R. C. Cochran, B. C. Woods, J. S. Heldt, K. C. Olson, G. L. Stokka, E. C. Titgemeyer, and E. S. Vanzant [1]

Summary

Sixteen ruminally fistulated beef steers with ad libitum access to forage sorghum hay were used to evaluate the effect of increasing level of degradable intake protein (DIP) on forage intake and digestion. Forage OM intake and total OM intake were enhanced with increasing level of DIP supplementation. Similarly, increases in total OM digestibility and total digestible OM intake (TDOMI) were evident. Compared with the negative control, TDOMI was approximately doubled at the highest level of DIP supplementation.

(Key Words: Steers, Forage, Intake, Digestion, Degradable Intake Protein.)

Introduction

Over the last decade, the approach to protein nutrition in ruminants has shifted from a crude protein (CP) system described in the 1984 NRC to a metabolizable protein (MP) system described in the 1996 NRC. Metabolizable protein is defined as the true protein absorbed by the small intestine, which is supplied by microorganisms passing out of the rumen and by undegradable intake protein (UIP, i.e., escape protein). The MP system accounts for the degradation of protein in the rumen and separates protein requirements into the needs of ruminal microorganisms and the animal. Crude protein includes some that is ruminally degraded (degradable intake protein = DIP) and some that is not (UIP).

Beef cattle in the midwestern and plains states commonly are fed forage sorghum hay as a roughage source. Frequently, this forage is of relatively low quality. Previous research on low-quality, tallgrass-prairie forage has demonstrated that DIP supplementation dramatically improved forage intake and utilization. In addition, the amount of DIP needed to maximize total digestible forage intake has been defined for this forage. However, information pertaining to the effects of DIP supplementation on forage sorghum hay is limited. This study was conducted to determine the impact of DIP supplementation on forage sorghum intake and digestion and to determine the amount of DIP needed to maximize intake of digestible material for this forage.

Experimental Procedures

Sixteen ruminally fistulated beef steers (avg BW=639 lb) were blocked by weight and assigned to one of four treatments to evaluate the effect of increasing level of DIP on forage intake and digestion. Each steer was offered forage sorghum hay at 130% of average voluntary intake for the preceding 5-day period. Supplemental DIP (sodium caseinate; 91.6% CP, 100% DIP) was ruminally infused at 7 a.m., immediately prior to feeding forage, at levels of .041, .082, and .123% BW/day (.045, .090, and .134% BW of casein as DM/day). The control treatment had no supplemental DIP. The forage contained 55.8% NDF, 4.3% CP, and 51% DIP. Forage DIP (% of CP) was estimated using a single-point enzyme assay.

[1]KSU Agricultural Research Center - Hays.

Following a 10-day adaptation, feed offered, feed refused, and total fecal output were measured for 7 days and used to calculate digestibility coefficients.

Results and Discussion

Forage OM and total OM intakes increased (P<.01) in direct proportion to increasing level of DIP supplementation, although they tended to plateau (P=.13 and P=.15, respectively) at the higher levels. Similarly, a linear increase (P<.01) with a trend toward diminishing returns (P=.17 and P=.14, respectively) was evident for both total OM digestion (TOMD) and TDOMI. Total NDF intake and total NDF digestibility responded similarly.

Compared with the negative control, TDOMI was approximately doubled at the highest level of DIP supplementation. This was due to concomitant increases in both forage OM intake and digestibility. Although some decline in relative response was evident with increasing DIP supplementation, a clear plateau was not achieved with the levels of supplement provided. However, we suspect that neither forage OM intake nor OM digestion would increase much beyond that achieved at the highest level of supplementation. Therefore, we believe that the amount of DIP needed to maximize TDOMI is close to that provided at this level of supplementation. Using the estimate of forage DIP (51% of total CP), the total DIP consumed by steers on the .123% treatment was 12.2% of TDOMI.

Table 1. Effect of Increasing Amount of Degradable Intake Protein on DM and OM Intakes and Digestibility in Beef Steers Fed Forage Sorghum Hay

	DIP (% BW)					Contrasts[a]		
Item	0	.041	.082	.123	SEM[b]	L	Q	C
DM[c] intake	---------- % BW ----------							
Forage	1.72	2.11	2.32	2.40	.11	<.01	.20	.93
Total	1.72	2.15	2.41	2.54	.11	<.01	.20	.93
DM intake	---------- g/kg $BW^{.75}$ ----------							
Forage	70.49	87.42	96.13	97.79	4.56	<.01	.13	.96
Total	70.49	89.28	99.84	103.27	4.57	<.01	.13	.96
OM[d] intake	---------- % BW ----------							
Forage	1.54	1.90	2.09	2.16	.10	<.01	.20	.93
Total	1.55	1.94	2.18	2.31	.10	<.01	.22	.95
OM intake	---------- g/kg $BW^{.75}$ ----------							
Forage	63.42	78.65	86.49	87.99	4.10	<.01	.13	.96
Total	63.57	80.45	90.39	94.07	4.10	<.01	.15	.97
Total DOMI[e]								
% BW	.71	1.05	1.28	1.43	.08	<.01	.23	.99
g/kg $BW^{.75}$	29.39	43.59	53.17	58.14	3.21	<.01	.18	>.99
Total OM D[f], %	46.34	54.13	59.00	61.70	1.70	<.01	.17	.92
Total NDF D[g], %	34.38	43.18	51.12	53.73	2.13	<.01	.18	.65

[a]L = linear, Q = quadratic, C = cubic.
[b]Standard error of the mean (n = 16).
[c]DM = dry matter.
[d]OM = organic matter.
[e]DOMI = digestible organic matter intake.
[f]OMD = organic matter digestion.
[g]NDFD = neutral detergent fiber digestion.