EFFECTS OF INCREASING AMOUNTS OF SUPPLEMENTAL SOYBEAN MEAL ON INTAKE AND DIGESTIBILITY OF TALLGRASS-PRAIRIE HAY

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Summary

Twenty ruminally fistulated beef steers with free-choice access to prairie hay were used to evaluate the effect of increasing level of soybean meal (SBM) on forage intake and digestion. Forage intake, total organic matter intake, and organic matter digestion were enhanced with increasing level of SBM supplementation, although forage intake and digestion appeared to plateau at higher levels. The concomitant rises in intake and digestion as supplemental SBM increased resulted in an increase in total digestible organic matter intake, with the largest response to the initial increment of supplement.

(Key Words: Steers, Forage, Intake, Digestion, Soybean Meal.)

Introduction

Prairie hay is a common roughage source for beef cattle throughout Kansas and the midwest. Previous research conducted at Kansas State University demonstrated that supplementation with degradable intake protein (DIP) dramatically improves intake and digestion of low-quality, tallgrass-prairie forage, and demonstrated the amount of DIP needed to maximize total digestible forage. However, in those preliminary studies, DIP was supplied in a purified form, sodium caseinate. Therefore, to link previous work to a more practical setting, potential feedstuffs high in DIP must be identified, and their response evaluated. The present study was conducted to evaluate the impact of increasing levels of soybean meal (SBM), an oilseed by-product containing a relatively high concentration of DIP, on prairie hay intake and digestion.

Experimental Procedures

Twenty ruminally fistulated beef steers (average body weight, 813 lb) were blocked by weight and assigned to one of five treatments to evaluate the effect of increasing level of high-protein SBM on forage intake and digestion. Each steer was offered prairie hay at 130% of average voluntary intake for the preceding 5-day period. The forage contained 69.4% NDF, and 5.3% CP, 49% of which was DIP (single-point enzyme assay). Supplemental SBM (9.8% NDF, 53.4% CP) was fed at 6:30 AM and steers were fed forage at 7:00 AM. Supplemental SBM was offered at .08, .16, .33, and .50% BW/day, which provided .029, .058, .116, and .175% BW/day of DIP. Controls recieved none. The SBM crude protein was assumed to be 66% DIP (1996 National Research Council; Nutrient Requirements of Beef Cattle). We also used a single-point enzyme system to provide an alternate estimate. Following a 14-day adaptation, feed offered, feed refused, and fecal output were measured for 7 days, and the information was used to monitor intake response and calculate digestibility coefficients.

Results and Discussion

Forage and total organic matter intakes (FOMI and TOMI, respectively) increased (P<.01) with increasing SBM supplementation (Table 1). However, FOMI appeared to plateau (P=.02) once the level of SBM supplementation reached .16% BW/day. However, TOMI continued to increase up to the highest level fed (.5% BW/day). Organic matter digestibility (OMD) also increased (P<.01) with increasing supplemental SBM up to the highest level. Fiber digestion (NDF digestion) responded similarly. The concomitant rises in TOMI and OMD as supplemental SBM increased resulted in an increase in TOMI. The largest proportional response was observed with the initial increment of supplement. Thereafter, the response was smaller, and once the .16% BW/day level was reached, appeared to be due predominately to higher levels of highly digestible SBM. If the table values are used for SBM DIP (i.e., 66%), then the total DIP intake is 8.4% of the TOMI for the .16% BW treatment. If the enzymatic estimate of SBM DIP is used (84% of CP), that value is about 9.4%. We suspect that the breakpoint in response (which should be indicative of maximal forage utilization) would fall close to these values.

Table 1. Effects of Increasing Amounts of Soybean Meal on DM and OM Intakes and Digestibility in Beef Steers Fed Tallgrass-Prairie Hay

	Soybean Meal (% BW)						Contrast[a]		
Item	0	.08	.16	.33	.50	SEM	L	Q	C
DM[c] intake	- - - - - - - - - - - - - % BW - - - - - - - - - - - - -								
Forage	1.89	2.39	2.72	2.48	2.73	.13	<.01	.04	.02
Total	1.89	2.47	2.89	2.80	3.23	.13	<.01	.04	.02
DM intake	- - - - - - - - - - - - - - g/kg $BW^{.75}$ - - - - - - - - - - - - -								
Forage	81.9	105.2	119.1	108.6	118.6	5.2	<.01	.02	.01
Total	81.9	108.8	126.4	123.0	140.2	5.2	<.01	.02	.01
Om[d] intake	- - - - - - - - - - - - - - $BW^{.75}$ - - - - - - - - - - - - - -								
Forage	1.75	2.22	2.52	2.29	2.53	.12	<.01	.04	.02
Total	1.75	2.29	2.67	2.60	2.99	.12	<.01	.04	.02
OM intake	- - - - - - - - - - - - - - g/kg $BW^{.75}$ - - - - - - - - - - - - -								
Forage	75.7	97.5	110.3	100.5	110.0	4.9	<.01	.02	.01
Total	75.7	100.8	116.9	113.9	130.0	4.9	<.01	.02	.01
Total DOMI[e]									
% BW	.88	1.31	1.44	1.58	1.87	.09	<.01	.05	.03
g/kg $BW^{.75}$	37.9	57.4	67.3	69.5	81.6	3.7	<.01	.03	.03
Total OMD[f]	50.0	56.8	57.6	60.9	62.6	1.2	<.01	.02	.18
Total NDFD[g]	48.7	56.0	56.6	57.7	58.2	1.6	<.01	.03	.12
Total DIPI[h]									
% BW	.049	.091	.129	.180	.246	.003	<.01	.05	.01
g/kg $BW^{.75}$	2.12	4.00	5.63	7.90	10.69	.14	<.01	.02	.01
Total DIPI[i]									
% BW	.049	.099	.144	.211	.293	.003	<.01	.07	.02
g/kg $BW^{.75}$	2.12	4.34	6.31	9.26	12.74	.136	<.01	.02	.01

[a]L = Linear, Q = Quadratic, C = Cubic. [b]Standard error of the mean (n=4). [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. [h]DIPI = degradable intake protein intake; SBM DIP estimate from 1996 Beef NRC.