DORMANT, TALLGRASS-PRAIRIE FORAGE: INFLUENCE OF RUMINAL DEGRADABLE PROTEIN ON INTAKE BY BEEF COWS AND FERMENTATION CHARACTERISTICS [1]

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Summary

Five ruminally and duodenally fistulated Angus × Hereford cows were fed dormant tallgrass-prairie forage ad libitum to monitor intake and fermentation responses associated with providing increasing amounts of supplemental ruminal degradable protein (RDP). The RDP was provided from sodium caseinate and infused intraruminally immediately before feeding forage. Levels of RDP were 0, 180, 360, 540, and 720 g/d. Maximal intake of dormant, tallgrass-prairie forage occurred with provision of 540 g RDP/d. Ruminal dry matter fill declined with increasing level of RDP infusion. Increasing supplmentation of RDP generally improved ruminal fermentation characteristics.

(Key Words: Beef Cows, Ruminal Degradable Protein, Intake, Forage.)

Introduction

Ruminants depend on the microorganisms that inhabit the rumen for effective use of fiber in forages. However, when low-quality forages are fed, protein and other important microbial nutrients may be deficient, limiting the ability of fiber- digesting microorganisms to grow and to ferment forage fiber. In order to overcome such deficiencies, supplemental ruminal degradable protein (RDP) frequently is required. Furthermore, intake of low-quality forage is increased in response to the provision of RDP. Because protein supplementation can be costly, it is important to know the amount of RDP required to optimize forage intake and digestion. Therefore, our objective was to determine the influence of different RDP levels on the intake and fermentation characteristics of a low-quality, tallgrass-prairie forage by beef cows.

Experimental Procedures

Five ruminally and duodenally fistulated Angus × Hereford cows (1296 lb) were penned individually and fed dormant tallgrass-prairie forage (1.9% crude protein [CP]; 70% neutral detergent fiber) ad libitum for the duration of the experiment. RDP was provided in the form of sodium caseinate (casein; 90% CP) which was solubilized in water (7 liters/d), divided into two equal portions, and infused intraruminally at 6:30 a.m. and 6:30 p.m. immediately before feeding forage. Levels of RDP were 0, 180, 360, 540, and 720 g/d. The amounts of RDP provided by these infusion levels would be approximated by 0, 1.1, 2.2, 3.3, or 4.4 lb soybean meal/d (dry matter [DM] basis), respectively, if the SBM contained approximately 50% CP on a dry basis (assumes approximately 75% of CP is ruminally degradable). During each experimental period, the cows were adapted to the diets for 14 days. Voluntary intake then was measured, and digesta samplings were made over the next 4 days. Subsequently, each cow's rumen was emptied manually to determine ruminal DM and liquid fill. Ruminal

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evacuations were performed just prior to (0 h) and 4 h after feeding hay and infusing casein. Ruminal fluid samples were obtained at several times after feeding to determine pH, ammonia N (NH_3N), and volatile fatty acid (VFA) concentrations.

Results and Discussion

Forage DM intake increased in a quadratic (P<.01) fashion in response to increasing RDP infusion, with the peak observed at the 540 g infusion level (Table 1). This quantity equates to providing .42 g RDP/lb of BW. Increased forage intake in response to RDP concurs with the results of numerous other research trials. The direction and magnitude of the effect on forage intake further verifies the need to provide RDP to ensure optimal utilization of low-quality forage.

Table 1. Influence of Amount of Ruminal Degradable Protein (RDP) on Intake, Ruminal Fill, and Ruminal Fermentation in Beef Cows Consuming Dormant Tallgrass-Prairie Forage

	RDP Level (g/day)					Effect[a]			
Item	0	180	360	540	720	L	Q	C	SEM
FDMI[b], g/kg $BW^{.75}$	32.2	52.7	63.1	70.2	67.7	<.01	<.01	.97	3.08
Ruminal DM fill, g/kg $BW^{.75}$	15.3	14.7	15.9	12.3	12.4	.09	.95	.22	.40
Liquid fill, g/kg $BW^{.75}$	102	96	104	109	105	.03	.99	<.01	2.50
pH	6.92	6.62	6.63	6.58	6.52	<.01	<.01	.02	.02
NH_3 N, mM	0.24	1.36	3.47	5.17	6.87	<.01	.80	.69	.73
VFA, mM	43.3	65.9	71.4	74.5	76.4	<.01	<.01	.04	2.18
Acetate, moles/100 moles	78.0	75.4	74.8	73.6	72.4	<.01	.15	.14	.39
Propionate, moles/100 moles	15.2	16.1	16.3	16.5	15.7	.01	<.01	.50	.15
Butyrate, moles/100 moles	6.11	6.18	5.98	6.19	6.33	.18	.13	.52	.09
Isobutyrate, moles/100 moles	.43	.78	.94	1.11	1.70	<.01	.08	.02	.08
Isovalerate, moles/100 moles	.17	.84	1.14	1.40	2.21	<.01	.66	.05	.14
Valerate, moles/100 moles	0	.68	.91	1.17	1.60	<.01	.31	.12	.12
Acetate:propionate	5.14	4.70	4.61	4.48	4.66	<.01	<.01	.90	.08

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

[b]FDMI=forage dry matter intake.

[c]DM=dry matter.

The influence of treatment on ruminal DM and liquid fill did not depend (P>.10) on the time of ruminal evacuation. At both evacuation times, liquid fill decreased somewhat with the 180 g infusion level, increased to a peak at the 540 g infusion level, and then slightly declined (cubic, P<.01). In contrast, ruminal DM fill tended (P=.09) to decrease linearly with increasing infusion level. The response for DM fill is opposite to that in previous trials at Kansas State University. The different response might be because RDP was infused alone, compared with actually feeding a supplement that contains RDP as well as other nutrients. In the present experiment, the increased forage DM intake with increasing RDP infusion appears related to changes in forage digestibility and (or) passage.

Variability was observed in the response over time for the different fermentation variables measured. Ruminal pH decreased rapidly with the initial RDP level, stabilized with the intermediate infusion levels, and then decreased slightly with the highest infusion level (cubic, P=.02). Total VFA concentration increased rapidly with the infusion of 180 g RDP/d and continued to increase slightly with increasing casein infusion (cubic, P=.04). Acetate proportion declined linearly (P<.01) with increasing infusion level, whereas propionate and acetate:propionate ratio responded in a quadratic (P<.01) manner. The peak in propionate and the low point in the acetate:propionate ratio corresponded with maximal forage DM intake. Molar proportions of isobutyrate and isovalerate increased with initial infusion level, continued to increase slightly with the intermediate infusion levels, and then exhibited a larger proportional increase at the highest level of infusion (cubic, P<.05). Valerate tended (P=.12) to follow the same trend. In general, increasing availability of RDP improved ruminal fermentation characteristics, reflecting improvement in nutrient supply to microorganisms.