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Influence of increasing amounts of supplemental alfalfa hay on intake and utilization of dormant, winter-harvested, bluestem-range forage by beef steers

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INFLUENCE OF INCREASING AMOUNTS OF SUPPLEMENTAL ALFALFA HAY ON INTAKE AND UTILIZATION OF DORMANT, WINTER-HARVESTED, BLUESTEM-RANGE FORAGE BY BEEF STEERS[1]

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Summary

Sixteen, ruminally cannulated, beef steers were used in an intake/digestion experiment to determine the effects of supplementing a dormant, winter-harvested, bluestem range, forage diet with increasing amounts of moderate quality alfalfa. Steers were allowed ad libitum access to dormant forage and were supplemented with alfalfa hay at: 1) .23, 2) .47, 3).70, and 4) .94 % of BW on a dry matter (DM) basis. As the amount of supplemental alfalfa increased, dormant forage intake decreased, but total DM intake increased. Dry matter digestibility was unaffected by treatment, and only minor changes were noted for ruminal fermentation characteristics. Changes in ruminal fill and liquid dilution rates indicated an increase in digesta passage with increasing amounts of supplemental alfalfa hay. Although these results indicate that maximal digestible nutrient intake is attained at the highest level of supplementation, levels of nutrient intake and fermentation patterns indicate that adequate performance may be attained at lower levels of supplementation.

(Key words: Protein Supplement, Winter Range, Intake, Digestibility, Alfalfa.)

Introduction

Protein supplementation is an integral part of the nutritional management of beef cows maintained on winter range. Enhancing of both the intake and digestibility of poor quality forages by protein supplementation has been well documented. Alfalfa hay is a readily available and relatively inexpensive protein source for many cow-calf producers. However, unlike concentrate supplements, alfalfa hay, with its substantial fiber component, might contribute to ruminal distension and thereby limit the intake-stimulatory effects of the protein it supplies. The objective of this experiment was to determine the impact of various amounts of supplemental alfalfa hay on the intake and utilization of dormant, winter-harvested, bluestem-range forage by beef steers.

Experimental Procedures

Sixteen ruminally cannulated steers (avg initial wt = 641 lb) were individually penned and fed for the duration of the experiment. Dormant, winter-harvested, bluestem-range forage (CP = 2.1%; NDF = 76.0%) was fed each morning at 140% of each animal's previous 5-d average intake. Supplement treatments consisted of alfalfa hay (16.8% CP; 46.5% NDF) fed at: 1) .23, 2) .47, 3).70, and 4) .94% of BW/head daily (DM basis). Alfalfa was fed 2 hours before dormant forage to ensure adequate time for all treatment groups to consume the alfalfa. Levels used in this experiment, if fed to mature 1000 lb cows in the third trimester of gestation, would provide 25, 50, 75, and 100%, respectively, of their crude protein requirements from the supplement alone.

Steers were adapted to diets for 14 d. Voluntary intake was measured over the next 7-d period. Total fecal collections were made

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during the next 7 days. Then the steers' rumens were manually emptied for ruminal fill measurements. These ruminal evacuations were performed just prior to (0 h) and 6 h after feeding alfalfa hay. The following day, Cr:EDTA, a liquid flow marker, was added to the rumen of each steer in a pulse dose. Ruminal fluid samples were obtained at various times after dosing to determine liquid dilution rate, pH, and volatile fatty acid concentrations.

Results and Discussion

The intake of dormant forage was depressed in a linear fashion ($P = .02$) with increasing alfalfa hay (Table 1). However, alfalfa did not replace forage at a 1:1 ratio. Rather, an increase of one unit in alfalfa hay consumption resulted in a decrease of .4 units in dormant forage intake. Therefore, the total DM intake increased linearly ($P < .01$) with increasing alfalfa hay. Based on these intakes, mature 1000 lb British cross cows consuming alfalfa hay at similar percentages of their BW would be expected to meet 43, 67, 91, and 113% of their crude protein requirements on the .23, .47, .70, and .94% BW treatments, respectively.

Although the proportion of the total diet provided by alfalfa increased from 14% on the low level of alfalfa to 46% on the high level, no treatment differences were found ($P > .10$) for DM digestibility. Because total intake increased with no change in digestibility, total digestible nutrient intake would be highest with the highest level of supplemental alfalfa.

The influence of treatment on ruminal fill depended ($P < .10$) on the time of ruminal evacuation. Prior to feeding, when fill values would be expected to be at a minimum, liquid fill decreased linearly ($P = .06$) and DM fill tended to decrease linearly ($P = .14$) with increasing alfalfa hay. However, 6 h after feeding alfalfa hay (4 h after feeding dormant forage), neither DM nor liquid fill differed ($P > .10$) among treatments. Thurs, one would expect a higher rate of digesta passage as levels of alfalfa hay increased. Indeed, liquid dilution rates increased linearly ($P = .02$) with increasing level of alfalfa hay. An increased passage rate could account for the lack of effect on DM digestibility with increasing alfalfa.

Only minor effects were noted for fermentation variables measured. Treatments had no effect ($P > .10$) on ruminal pH at any sampling time. Total volatile fatty acid concentrations tended ($P = .18$) to increase linearly with increasing alfalfa hay. Although molar percentage of acetate in the rumen decreased linearly ($P = .04$) with increasing alfalfa hay, the magnitude of the change was very slight, and no changes were noted ($P > .10$) for molar percentage of propionate or acetate:propionate ratio.

Our experiment indicates that digestible nutrient intake by beef steers increased as a dormant, bluestem-range, forage diet was supplemented with increasing amounts of alfalfa hay from .23 to .94 % of BW. This increase was primarily a result of increased total intake, as total tract DM digestibility remained unaffected, perhaps because of increased digesta passage rates. Studies are underway to determine the impact of the highest three levels of alfalfa hay supplementation on performance of grazing beef cows.

Table 1. Influence of Amount of Supplemental Alfalfa Hay on Intake, Digestibility, Ruminal Fill, Liquid Dilution, and Ruminal Fermentation in Beef Steers Consuming Dormant, Bluestem-Range Forage

Item	Alfalfa hay DM, % body weight					Effect[a]	
	.23	.47	.70	.94	SE	L	Q
Steer wt, lb	643	635	641	645			
DM Intake, % BW							
Dormant forage	1.44	1.32	1.37	1.12	.08	.02	.36
Alfalfa hay	.23	.47	.70	.94			
Total	1.67	1.79	2.08	2.05	.07	.00	.35
DM Digestibility, %	45.9	48.8	48.7	48.5	1.6	.30	.34
0 h Evacuation							
DM fill, % BW	1.8	1.8	1.4	1.4	.2	.14	.99
Liquid fill, % BW	17.5	18.9	15.1	15.5	1.0	.06	.61
6 h Evacuation							
DM fill, % BW	2.4	2.2	2.3	2.2	.0	.50	.78
Liquid fill, % BW	19.5	21.3	18.9	20.4	1.0	.95	.85
Liquid Dilution Rate, %/h	4.0	4.7	5.2	5.8	.5	.02	.96
Ruminal pH	6.60	6.64	6.59	6.63	.06	.82	.98
Ruminal VFA, mM	81.5	84.0	90.1	87.8	3.8	.18	.55
Ruminal acetate, mol/100 mol	77.8	77.4	76.3	76.5	.4	.04	.51
Ruminal propionate, mol/100 mol	15.6	15.7	15.9	15.5	.2	.90	.37
Acetate/Propionate	5.0	4.9	4.8	5.0	.1	.57	.36

[a]Probability of a greater F value. L = linear change with increasing alfalfa. Q = quadratic change with increasing alfalfa.