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EFFECTS OF TEMPORARILY ALTERING ALFALFA LEVELS IN HIGH-CONCENTRATE DIETS ON SUBACUTE ACIDOSIS

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Summary

Four ruminally cannulated crossbred steers (882 lb) were used to investigate the effects of temporarily altering the levels of alfalfa in a high-concentrate diet on ruminal characteristics during a bout of experimentally induced subacute acidosis. A diet based on dry rolled corn with 8% alfalfa hay was fed before and after a 2-day challenge phase when steers were forced to consume 2.5% of their body weight in 90 minutes each day after a prior 24-hour fast. During the challenge phase, steers were fed diets containing 5, 8, 11, or 14% alfalfa. Feed intake quickly recovered for steers fed all but the 5% alfalfa diet, with a tendency for a linear ($P<.11$) decline in feed intake as alfalfa was decreased in the challenge diet. The intensity and duration of the pH drop were increased as the level of alfalfa decreased. Mean pH decreased, total VFA concentration increased, and the ratio of acetate:propionate decreased linearly ($P<.06$) as level of alfalfa decreased. Because the ruminal parameters measured for the 8% and 11% alfalfa diets were similar, the data suggest that temporarily increasing the basal diet to more than 11% alfalfa is necessary to mitigate the effects of a forced disruption in feed intake. Increasing the level of alfalfa hay from 8 to 14% of diet dry matter increased fluid dilution rate, lowered time that ruminal pH was below 5.5, and resulted in higher mean ruminal pH in steers with experimentally induced acidosis.

(Key Words: Steers, Acidosis, Roughage Level, Alfalfa.)

Introduction

Modern feedlot management attempts to force the square peg of feeding high concentrate diets through the round hole of an animal adapted by evolution to an all-forage diet. Ruminal acidosis often can be the result of this geometric improbability. Practical considerations make roughage a useful component of high-grain diets for finishing cattle, because it helps protect against effects of intake variation on ruminal function. Because feeding equipment sometimes breaks down and weather is variable, roughage levels often are temporarily increased to moderate the ruminal ecosystem of feedlot cattle and to minimize disruptions in feed intake. However, experimental data regarding the viability of this approach, as well as how much roughage levels should be increased, are lacking. Our objective was to simulate a severe disruption in feed intake and determine whether temporarily increasing roughage levels was effective in moderating the ruminal insult from experimentally induced variability in feed intake.

Experimental Procedures

Four ruminally cannulated crossbred steers (882 lb) were used in an experimental subacute acidosis model. Steers were fed an 8% alfalfa diet (Table 1) at 2% of BW in two equal feedings (8 AM and 8 PM) for a 10-day adaptation period. On day 11, steers received their 8 AM feeding, but the PM feeding was omitted. Steers were challenged on the mornings of days 12 and 13 by being offered diet dry matter at 1.5% of BW in the feed bunk, followed by introduction of diet dry matter at 1% of BW via the ruminal cannula 1.5 hrs postfeeding. Any offered feed that was not consumed also was placed into the

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rumen through the cannula at that time. The challenge was followed by a 3-day (days 14 to 16) intake recovery period when the 8% alfalfa diet was offered. Ruminal samples were obtained at feeding (0 hr) and 3, 6, 9, and 12 hrs after (day 10) or 3, 6, 9, 12, 18, and 24 hrs after (days 12 and 13) and 12 and 24 hr after the AM feeding on days 14 to 16. Prior to the beginning of each period, rumens of all steers were observed for gross appearance to verify health of the ruminal epithelium. Dietary treatments (Table 1) were imposed on days 12 and 13 during the challenge phase. The sequence of dietary treatments was designed to evaluate the effects of altering roughage level in situations where wide fluctuations in intake are known to exist (e.g., prior to an impending weather change, after a storm system has passed, or after a mechanical breakdown). The 8% alfalfa diet represented no management change, the 11% and 14% alfalfa diets represented two levels of increased roughage (i.e., storm rations), and the 5% alfalfa diet served as the negative control.

Results and Discussion

A nearly complete recovery of feed intake occurred after the challenge phase for steers challenged with all dietary treatments except the 5% alfalfa diet (Table 2). As a result, feed intake tended ($P<.11$) to have a linear decline as alfalfa level was decreased. A linear ($P<.01$) and a cubic ($P<.02$) increase in the hours that pH was below 5.5 occurred as the dietary level of alfalfa decreased. A linear ($P<.03$) decline in pH, a linear ($P<.06$) increase in VFA concentration, and a linear ($P<.05$) decrease in acetate:propionate ratio occurred as the level of alfalfa in the challenge diets was decreased. Ruminal lactate concentrations were unaffected by treatment and were low. These data are similar to those from other acidosis experiments and suggest that ruminal acidosis in cattle adapted to high grain diets is a function of increased VFA production and not accumulation of lactate. Although fluid dilution rate was similar among treatments on the first day of the challenge phase, on the second day of the challenge, fluid dilution rate was highest for steers receiving the 14% alfalfa diet. The challenge became more severe on the second day, as reflected by VFA concentrations (Table 3). Increased fluid dilution, if associated with increased salivary flow, would help to buffer rumen contents. The increased fluid dilution rate for steers fed the 14% alfalfa diet combined with the lesser amount of corn presented to the rumen likely explains the greater pH, lower VFA concentration, and greater acetate:propionate ratio. Given that steers fed the 5% level of alfalfa were presented with greater amounts of fermentable substrate when challenged, it is not surprising that the ruminal parameters were indicative of a greater acid insult. What is more difficult to explain is the similarity between the 8% and 11% alfalfa levels in ruminal measurements. The similarity in ruminal profiles of steers challenged with those diets suggests that increasing chopped alfalfa from 8% to 11% was ineffective in moderating the ruminal insult induced by our experimental model. Although feed intake recovered quickly in all steers except those fed the negative control diet, our data suggest that the acidotic insult was moderated only at dietary levels of alfalfa above 11%.

Table 1. Composition of Experimental Diets (%, Dry Matter Basis)

	Level of Alfalfa			
Ingredient	5%	8%	11%	14%
Dry rolled corn	86.05	83.05	80.05	77.05
Chopped Alfalfa	5.00	8.00	11.00	14.00
Supplement [a]	6.45	6.45	6.45	6.45
Molasses	2.50	2.50	2.50	2.50

[a]Formulated so diets contained: 12.5% crude protein, .7% Ca, .3% P, .7% K, 1435 IU/lb vitamin A, 16 IU/lb vitamin E, 27 ppm monensin, and 10 ppm tylosin.

Table 2. Effects of Alfalfa Level on Intake and Ruminal Fermentation Characteristics

	Level of Alfalfa					Statistical Contrasts[a]		
Item	5%	8%	11%	14%	SEM	L	Q	C
Intake,% BW[b]	1.65	1.99	2.00	1.96	.11	.11	.14	.58
Hours pH <5.5[c]	17.9	11.5	14.9	9.5	1.33	.01	.76	.02
Dilution rate, %/hr								
day 12	4.50	4.21	4.56	4.76	.54	.66	.66	.75
day 13	3.32	3.62	2.45	5.79	.78	.12	.10	.14
pH	5.34	5.48	5.41	5.61	.06	.03	.63	.12
VFA, mM	128.3	119.6	118.0	113.9	4.2	.06	.60	.64
A:P[d]	1.08	1.18	1.11	1.41	.08	.05	.28	.22
Lactate, mM	.26	.28	.25	.24	.10	.84	.86	.92

[a]Effect of alfalfa level: L = linear, Q = quadratic, C = cubic . [b]During recovery days (days 14 to 16). [c]During challenge days (days 12 and 13) . [d]Acetate:Propionate.

Table 3. Effects of Alfalfa Level on Total Volatile Fatty Acid Concentrations (mM)[a]

	Level of Alfalfa			
Hours after Feeding	5%	8%	11%	14%
Day 10 (Baseline)				
0	12	112.9	112.2	102.9
3	11	119.1	118.2	107.5
6	11	112.2	106.3	104.6
9	11	110.5	108.9	105.0
12	10	109.0	106.5	99.6
First challenge (Day 12)				
0	99.	95.7	98.2	95.9
3	14	134.6	129.9	129.9
6	15	147.0	127.5	119.4
9	13	123.7	131.6	126.8
12	11	108.8	127.8	114.3
18	12	116.0	117.4	109.6
24	11	104.7	106.7	104.6
Second challenge (Day 13)				
3	17	164.1	158.3	143.2
6	18	154.6	145.3	149.6
9	15	136.4	128.5	142.8
12	13	132.6	127.7	125.4
18	12	128.8	130.5	115.0
24	12	115.0	118.1	109.5
Recovery, a.m. feeding (Day 14)				
12	11	102.9	105.9	103.8
24	11	117.6	109.1	94.6
36	11	108.4	95.2	99.7
48	11	108.6	107.1	104.2
60	10	98.1	100.7	111.2
72	12	115.5	113.8	115.5

[a]Pooled standard error = 9.0.