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Abstract
Roughage level and method of corn processing were evaluated for the propensity to cause subacute acidosis in a controlled acidosis challenge model. Four ruminally fistulated steers were adapted to a high grain diet, randomly allocated within a 4 x 4 Latin square, and fed a corn-based finishing ration at 2% of BW/day (dry basis) in two equal feedings. Chopped alfalfa hay was used as the roughage source and added at 8% of the diet dry matter or not added. Corn was fed either whole (WSC) or dry rolled (DRC). Roughage level and grain processing had no effect on postchallenge molar percentage of acetate or total volatile fatty acid production. An interaction (P<.05) was seen in both percent propionate and acetate:propionate ratio. Eliminating roughage in the WSC diet resulted in increased production of propionate and a lower acetate:propionate ratio. Ruminal pH at 3 hours postchallenge and intake during the recovery period were lower (P<.05) for 0 vs 8% roughage. Ruminal pH at 3 and 6 hours postchallenge was lower (P<.05) for DRC than for WSC. Intake during the recovery period did not differ between DRC and WSC. Hours below pH 5.6 were greater (P<.05) for DRC vs WSC and for 0 vs 8% roughage. Though statistically higher (P<.05), no biologically significant levels of lactate were found for either DRC or WSC. This study indicates that adding roughage or feeding WSC vs DRC reduces the propensity for subacute acidosis.

Keywords
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ROUGHAGE LEVEL AND CORN PROCESSING IN FINISHING DIETS: SUBACUTE ACIDOSIS

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Summary

Roughage level and method of corn processing were evaluated for the propensity to cause subacute acidosis in a controlled acidosis challenge model. Four ruminally fistulated steers were adapted to a high grain diet, randomly allocated within a 4 × 4 Latin square, and fed a corn-based finishing ration at 2% of BW/day (dry basis) in two equal feedings. Chopped alfalfa hay was used as the roughage source and added at 8% of the diet dry matter or not added. Corn was fed either whole (WSC) or dry rolled (DRC). Roughage level and grain processing had no effect on postchallenge molar percentage of acetate or total volatile fatty acid production. An interaction (P<.05) was seen in both percent propionate and acetate:propionate ratio. Eliminating roughage in the WSC diet resulted in increased production of propionate and a lower acetate:propionate ratio. Ruminal pH at 3 hours postchallenge and intake during the recovery period were lower (P<.05) for 0 vs 8% roughage. Ruminal pH at 3 and 6 hours postchallenge was lower (P<.05) for DRC than for WSC. Intake during the recovery period did not differ between DRC and WSC. Hours below pH 5.6 were greater (P<.05) for DRC vs WSC and for 0 vs 8% roughage. Though statistically higher (P<.05), no biologically significant levels of lactate were found for either DRC or WSC. This study indicates that adding roughage or feeding WSC vs DRC reduces the propensity for subacute acidosis.

(Key Words: Cattle, Grain Processing, Roughage Level, Rumen pH, Acidosis.)

Introduction

Research has shown that decreasing roughage in finishing diets leads to improved feed efficiency and decreased cost of gain. This is most likely due to higher digestible energy values for grain than roughage. However, low or no roughage may result in increased incidences of liver abscesses and digestive upsets. Acute rumen acidosis would be the digestive upset most commonly expected. However, subacute acidosis may represent a larger problem, because reductions in feed efficiency and weight gain, caused by fluctuations in dry matter intake, exist even though cattle may not be clinically ill. Our study was conducted to determine the propensity for subacute acidosis with two different roughage levels. We also compared whole shelled vs dry rolled corn because whole shelled corn is thought to have some roughage value and, thus, may be used successfully in a diet with a lower level of roughage.

Experimental Procedures

Four ruminally fistulated black-baldy steers (550 kg) were adapted to a high grain diet, randomly allotted within a 4 × 4 Latin square with a 2 × 2 treatment structure, and fed a corn-based finishing diet at 2% of BW/day (dry basis). Chopped alfalfa hay was the roughage source and was added at 8% of the diet dry matter or not added. Corn was either whole shelled (WSC) or dry rolled (DRC). All diets were isonitrogenous (11.8% crude protein). Each 15-day period consisted of a 10-day treatment adaptation (diet dry matter at 1% of BW at 8 a.m. and 8 p.m.), a fasting period (no feed given at 8

p.m. on day 11), a feeding challenge on day 12 (1.5% of BW in a bunk at 8 a.m. plus 1% of BW via rumen fistula 1.5 hours later), and an intake recovery period when feeding returned to the prechallenge regimen. On the challenge day, any uneaten feed at 1.5 hours postfeeding was given via the rumen fistula. Feed refusals were weighed and discarded each day prior to the 8 a.m. feeding. At the beginning of each period, steers were inoculated with 1 liter of ruminal fluid from a common donor. Ruminal samples were obtained at feeding and 3, 6, 9, 12 hours postfeeding (day 10); 3, 6, 9, 12, 18, 24 hours postfeeding (day 12); and 12 and 24 hours after the a.m. feeding on days 13-15. Ruminal samples were analyzed for pH and concentrations of volatile fatty acids (VFA) and lactate (L).

Results and Discussion

Date are shown in Table 1. Neither roughage level nor grain processing had an effect on postchallenge molar percentage acetate (49%) or total VFA (106 *m*M). An interaction was seen for both propionate concentration and acetate:propionate level. Eliminating roughage in the WSC diet resulted in an increased percentage of propionate and a correspondingly lower acetate:propionate ratio. Roughage level had no effect on those measures in the DRC diet. Though statistically different ($P<.05$), no biologically significant levels of lactate were observed. Intake during the recovery period did not differ between DRC and WSC. Ruminal pH at 3 hours postchallenge and intake during the recovery period were both lower ($P<.05$) for 0 vs 8% roughage (5.29 vs 5.69 and 1.7 vs 1.9 %BW/day, respectively). Ruminal pH at 3 and 6 hours post feeding on the challenge day was lower ($P<.05$) for DRC than for WSC (Figure 1), and pH remained below 5.6 longer for DRC ($P<.05$; Table 1). Hours below pH 5.6 averaged 10.62 at 0% roughage vs 7.72 for 8% ($P<.06$). The addition of roughage to the diet most likely increased mastication time and, thus, increased the amount of saliva available in the rumen for buffering. Increased saliva production probably allowed the rumen environment to remain more stable during the challenge period and allowed a more rapid return to the prechallenge intake level. Lower rumen pH for DRC than WSC may have been due to a combination of the roughage value attributed to the WSC and the faster fermentation (acid production) from the DRC. Therefore, this study indicates that adding roughage or feeding WSC vs DRC reduces the propensity for subacute acidosis.

Table 1. Ruminal Fermentation Patterns during Subacute Acidosis Challenge

	Dry Rolled Corn		Whole Shelled Corn	
Item	0% Alf.	8% Alf.	0% Alf.	8% Alf.
Total VFA, *m*M	110.78	102.99	106.04	105.11
Acetate, %	46.37	48.87	45.85	49.93
Propionate [a]	40.84	40.35	43.01	39.75
Acetate:Propionate [a]	1.22	1.36	1.09	1.45
Lactate, *m*M [b]	.09	0.13	0.06	.05
Hours below pH 5.6 [cd]	11.28	10.35	9.95	5.08
Intake Recovery (%BW) [d]	1.69	1.94	1.74	1.90

[a]Roughage level × grain processing interaction ($P<.05$).
[b]Dry rolled vs whole shelled corn ($P<.01$).
[c]Dry rolled vs whole shelled corn ($P<.05$).
[d]0 vs 8% roughage ($P \leq .06$).

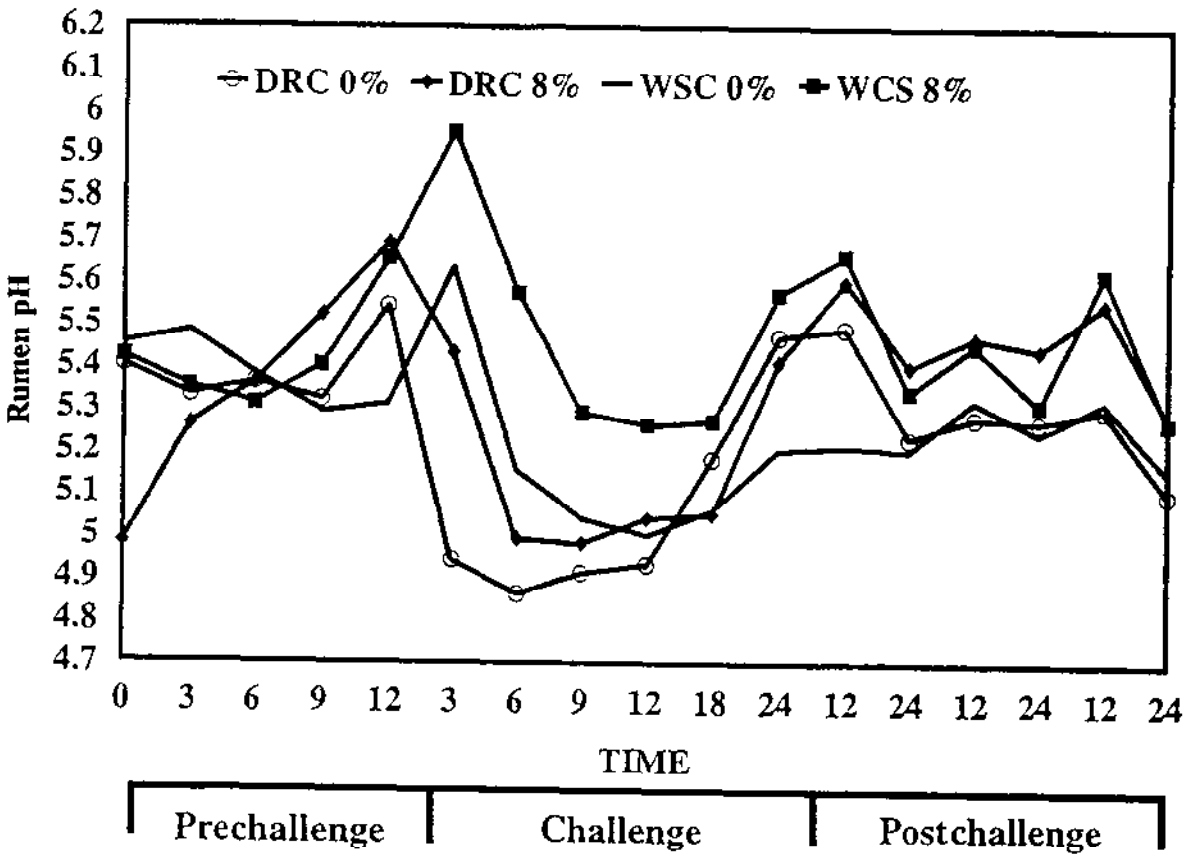

Figure 1. Effect of Corn Processing and Level of Roughage on Ruminal pH