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Summary

Eight ruminally fistulated steers were used in a metabolism experiment to determine effects of an essential oil feed additive in altering steer ruminal fermentation characteristics and nutrient digestibilities. Yearling steers were fed three treatments: 1) Control (CON) 2) CRINA RUMINANTS AF (CRINA) and 3) Rumensin® (RUM). There were no differences in DMI, OM intake, total tract DM and OM digestibilities, or pH among treatments. Steers receiving the CRINA treatment consumed 24.5% fewer meals than CON. Ruminal acetate was greatest and total VFA concentrations tended to be greatest for CRINA treatment. Acetate:propionate was 1.68, 1.49, and 1.43 for CON, CRINA, and RUM, respectively, suggesting addition of CRINA RUMINANTS AF favorably alters rumen fermentation end products without negatively affecting intake or rumen pH.

Introduction

Intensive beef cattle finishing systems rely heavily on the use of cereal grains for increased efficiencies and improved net profit compared to forage- based systems. Use of large quantities of cereal grains may result in physiological disturbances such as ruminal acidosis, bloat, and digestive and metabolic upsets. Compounds that alter rumen fermentation may result in more efficient digestion and absorption of feed nutrients with the possibility of improved feed efficiency and increased gains. Rumensin® is a type of ionophore that minimizes subacute acidosis by altering ruminal fermentation and feeding behavior of cattle fed high-grain diets (Erickson et al., *2003, Journal of Animal Science).* Essential oils are another class of compounds that have exhibited the ability to alter rumen fermentation profiles. Decreased acetate:propionate ratio and increased total VFA concentrations have been observed with the addition of specific essential oil compounds (Cardoza et al., 2005, *Journal of Animal Science).* The objectives of our research were to determine effects of feed additives on ruminal fermentation characteristics, feed intake behavior, and nutrient digestibility in concentrate-fed steers.

Procedure

Eight ruminally fistulated steers (BW = 879 lb) were used in concurrent 3 x 4 Latin rectangles to determine digestibility and ruminal fermentation characteristics of diets fed without feed additives (CON), with CRINA RUMINANTS AF (**CRINA**), and with Rumensin® (**RUM**, Elanco Animal Health, Greenfield, Ind.). Basal diets (Table 1) consisted of 66% high-moisture corn, 16.5% dry-rolled corn, 7.5% alfalfa hay, 5% molasses, and 5% supplement (DM basis). The CRINA treatment was formulated for a target intake of 1 g/head/day. The RUM treatment was formulated for a target intake of 300 mg of Rumensin® per day.

Table 1. Composition of dietary treatments and formulated nutrient analysis.

Ingredient	% of diet DM
Corn, HM[a]	66.0
Corn, DR[b]	16.5
Alfalfa hay	7.5
Molasses	5.0
Supplement[c]	5.0
Nutrient Analysis	
NEg, mcal/lb	0.64
CP, %	13.0
Calcium, %	0.65
Phosphorus, %	0.33
Potassium, %	0.70

[a]HM denotes high-moisture.
[b]DR denotes dry-rolled.
[c]Supplements identical except, CRINA Ruminants AF formulated for a consumption of 1 g/head/day and Rumensin® at a rate of 300 mg/head/day.

Four, 28 day periods were used, with a 23-day adaptation period and a five-day collection period. From day 1 to day 23 steers were fed individually in pens and on the evening of day 23 moved into stanchions for the collection period. Steers remained in the stanchions during the collection period (days 24 to 28) while continuous feed intake patterns and ruminal pH measurements were collected as described in the *1998 Nebraska Beef Report,* pp. 71-75. Cattle were fed once daily at 07:30, feed refusals were collected if necessary and were composited by steer within period for analysis.

Chromic oxide was used as an indigestible marker for determination of fecal output during the collection period. Cattle were intraruminally dosed with 7.5 g of chromic oxide twice daily at 07:30 and 19:30 starting on day 20 of each period and continuing until day 28. Fecal grab samples were collected three times daily at 0, 6, and 12 hours post-feeding, composited by steer within period and analyzed to determine nutrient digestibilities. Feed samples and feed refusals were composited by period, forced-air oven dried, ground through a 2 mm screen, and subsequently analyzed.

On day 28, rumen samples were collected for determination of volatile fatty acid (VFA) concentrations. Rumen samples were collected at 0, 3, 6, 9, 12, 18, and 24 hours post-feeding. Specific VFA concentrations measured included acetate, propionate, butyrate, and total VFA.

Data were analyzed using the mixed procedures of SAS (*Version 9.1, SAS Inc., Cary, N.C.)* as a Latin square, with animal as the experimental unit. When treatment differences were sig-

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nificant, based on a protected F-test, means were separated using the PDIFF option of SAS.

Results

Results from this study show no significant differences in DMI among the different dietary treatments. Cattle averaged 18.5 lb of DMI with a range of 1.5 lb between the RUM and CON treatments. Organic matter intake followed similar trends to DMI with the CON having numerically higher intake and the RUM treatment consuming the least (Table 2). There were no apparent differences ($P>0.10$) in DM or OM digestibility due to inclusion of feed additive. Dry matter digestibilities of the diets ranged from 83.6% for the RUM treatment to 79.9% for the CON treatment. Average meals per day were 6.1, 5.5, and 5.5 for CON, CRINA, and RUM, respectively ($P=0.36$). Cattle receiving the RUM spent numerically more time eating compared to cattle fed the CRINA treatment (354.7 vs. 323.7 min).

Cattle fed the CON had an average pH of 5.71 with a range in pH from 6.55 to 5.08 (Table 3). Average ruminal pH was numerically lower for the RUM treatment with a value of 5.61 and a maximum observed pH of 6.47 and minimum pH of 4.98. Cattle receiving CRINA treatment had an average pH of 5.68 with a range of 6.75 to 5.01. There were no significant treatment differences between the CON, CRINA, and RUM treatments for pH change and pH variances ($P>0.10$).

There was a significant treatment difference for acetate concentration ($P=0.04$) and total VFA concentrations tended to be affected by treatment ($P=0.07$). Total VFA production was 108.8, 125.9, and 105.9 mM for CON, CRINA, and RUM treated groups respectively. Acetate concentrations were 54.4, 63.9, and 52.5 mM for CON, CRINA, and RUM group respectively. Cattle receiving the CRINA treatment had a 17.5% greater acetate concentration compared to CON treated cattle (63.9 vs. 54.4 mM). Propionate concentrations were 32.4, 42.9, and 36.6 mM for CON, CRINA, and RUM, respectively. Numerically, the CRINA treatment had a lower acetate:propionate ratio CON than the treatment.

In summary, the addition of CRINA and RUM to finishing steer diets did not have an affect on intake and digestibility of DM and OM. Ruminal pH variables were also unaffected by the addition of feed additives to the basal diet. Acetate concentrations were significantly greater and there was a trend for total VFA concentrations to be greater for the CRINA treated cattle. The greater total VFA concentrations and acetate concentrations in the CRINA treatment may be an indicator of increased ruminal fermentation of the treatment diet. The addition of CRINA RUMINANTS AF tended to result in a positive change in ruminal fermentation products and may lead to more efficient digestion of feed nutrients.

Table 2. Effects of feed additives on nutrient digestibility and feed intake.

	Treatment[a]			Statistics[b]
Item	CON	CRINA	RUM	P-value
Intake and Digestibility				
Dry Matter				
Intake, lb/day	18.5	21.2	17.0	0.28
Digestibility, %	79.9	83.1	83.6	0.44
Organic Matter				
Intake, lb/day	17.8	20.5	16.3	0.26
Digestibility, %	82.7	85.6	85.5	0.46
Intake Patterns				
Meals/day[c]	6.1	5.5	5.5	0.36
Total eating time, min	351.1	323.7	354.7	0.78

[a]CON = Control, CRINA = CRINA RUMINANTS AF, RUM = Rumensin®.
[b]No differences ($P>0.10$) due to treatment.
[c]Meal is defined as an eating bout where ≥ 1.0 lb of feed is consumed.

Table 3. Effects of feed additives on rumen fermentation characteristics.

	Treatment[a]			Statistics[b]
Item	CON	CRINA	RUM	P-value
Rumen pH				
Average pH	5.71	5.68	5.61	0.71
Maximum pH	6.55	6.75	6.47	0.45
Minimum pH	5.08	5.01	4.98	0.84
pH change	1.48	1.72	1.48	0.68
pH variance	0.113	0.123	0.110	0.85
VFA Production				
Total, mM	108.8	125.9	105.9	0.07
Acetate, mM	54.4[b]	63.9[c]	52.5[b]	0.04
Propionate, mM	32.4	42.9	36.6	0.18
Butyrate, mM	13.7	13.1	11.9	0.80
Acetate:Propionate	2.29	1.67	1.83	0.28

[a]CON = Control, CRINA = CRINA RUMINANTS AF, RUM = Rumensin®.
[b,c]Within a row means without a common superscript letter differ ($P<0.05$).

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