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Use of Direct Fed Microbials to Alleviate Subacute Acidosis

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Summary

Five ruminally-fistulated steers were used in a 5 × 5 Latin square design to determine the effect of four different direct fed microbial products on subacute acidosis. Treatments included 1) control, 2) Lactobacillus acidophilus (LA) , 3) Saccharomyces cerevisae (YC), 4) Lactobacillus acidophilus and Saccharomyces cerevisae(LA+YC) , and 5) Lactobacillus acidophilus, Saccharomyces cerevisae, and Streptococcus faecium (LA+YC+SF). Steers were fed a basal diet containing 50% concentrate and 50% roughage (DM basis). Rumen fluid was collected at 24 and 12 hours before dosing to determine a steady state for each animal. Treatments had no effect on steady state pH, VFA concentration, acetate plus butyrate to propionate ratio, or lactate production. Acidosis was induced by intraruminally dosing a 50:50 blend of fine ground corn and dry rolled wheat (DM basis) at 1.6% of body weight. Acetate plus butyrate to propionate ratio was highest for LA+YC+SF and lowest for LA. The average pH for the control diet was the lowest during the acidosis challenge compared to all other treatments. These data indicate that products containing Lactobacillus acidophilus, Saccharomyces cerevisae, or Streptococcus faecium may alter rumen function and may help to alleviate subacute acidosis by stabilizing rumen pH.

Introduction

Direct fed microbials are feed additives composed of live cultures of microorganisms that are currently being used in the feedlot industry to improve animal performance. Reported beneficial effects include increased feed intake and weight gain. The efficacy of these supplements have been associated with their abilities to alter rumen function, such as volatile fatty acid production, stabilization of pH, and reduction of the amount of lactate produced. This experiment was conducted to determine the effect of the direct fed microbials on rumen steady state and to evaluate their ability to alleviate subacute acidosis.

Procedure

Five ruminally fistulated steers (900 lb) were used in a 5 X 5 Latin square. Six additional ruminally fistulated steers were used as donors of ruminal contents and were fed a diet of either alfalfa (1 steer), grass hay (3 steers), 86% dry rolled corn and 7.5% alfalfa (1 steer), or corncob/soybean meal (1 steer). Steers were randomly allotted to treatments. Treatments consisted of 1) control, 2) *Lactobacillus acidophilus* (LA), 3) *Saccharomyces cerevisae* (YC), 4) LA + YC, and 5) LA + YC + *Streptococcus faecium* All direct fed microbials were refrigerated and stored in vials as freeze dried powder. From day 1 - 12 steers were fed a basal diet via automatic feeders every three hours and fed at 1.8% of body weight. The animals received a total of 7.1 g of direct fed microbial per day which contained 1×10^9 colony forming units of each microbial source when included in the treatment. Microbials were added directly to the feed twice per day. The basal diet consisted of 30% dry rolled corn, 33% corn silage, 33% alfalfa, and 4% dry supplement (DM basis). No Rumensin or Tylan was included in the

diet. Donor animals were fed once daily. On day 1 of each period, steers were ruminally evacuated and ruminal contents were replaced with rumen fluid from the donor animals to equalize microbial populations.

On the morning of day 13, steers were dosed with an all concentrate diet at 1.6% (DM basis) of body weight. The all concentrate diet consisted of 48% fine ground corn, 48% dry rolled wheat, 2.3% molasses based supplement that contained urea, .63% limestone, .3% salt, and .31% potassium chloride and was placed directly into the rumen via the cannula. The all concentrate diet was balanced to meet the degradable intake protein requirements of the steers so that amount of nitrogen available for fermentation would not limit fermentation. On day 14 steers were fed a grass hay diet to allow for recovery from the acidosis challenge.

Rumen samples were collected at 24, 12 hours before dosing and, 0, 3, 6, 9, 12, 15, 18, 21, and 24 hours after dosing. Ruminal pH was measured immediately on each sample and then the sample was frozen for later volatile fatty acid and lactate analyses.

Table 1. Effect of direct fed microbials on acidosis.

	Treatment[a]				
Item	Control	LA	YC	LA+YC	LA+YC+SF
Total VFA, mM[b]	107.7	107.1	103.3	109.3	88.1
Area[c]	6.55	5.33	3.72	4.30	4.79
AB:P[de]	4.07	3.37	3.73	4.09	4.34

[a]Control = lactose; LA= *Lactobacillus acidophilus;* YC = *Saccharomyces cerevisae;* LA + YC = *Lactobacillus acidophilus* plus *Saccharomyces cerevisae*; LA + YC + SF = *Lactobacillus acidophilus, Saccharomyces cerevisae*, plus *Streptococcus faecium.*
[b]Total VFA - LA vs LA+YC+SF (P<.05); LA+YC vs LA+YC+SF (P<.05).
[c] Area = time by units pH below 6.0.
[d]AB:P = acetate plus two times butyrate to propionate ratio.
[e]AB:P - LA vs LA+YC+SF (P<.05); LA vs LA+YC (P<.10).

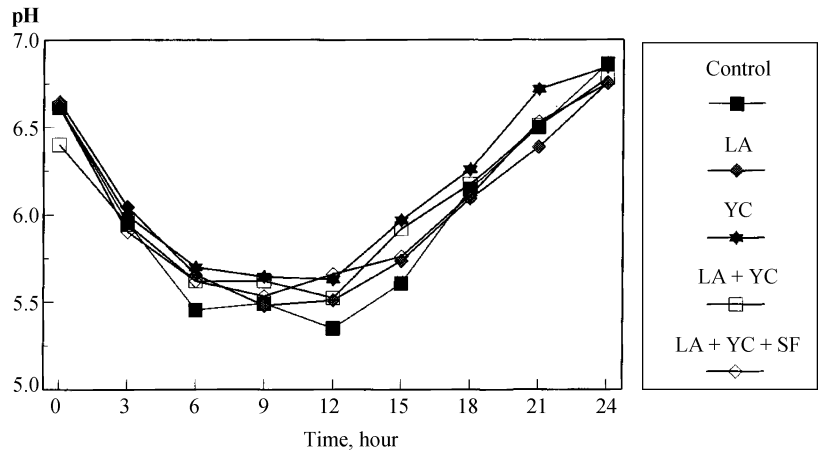

Figure 1. Effect of direct fed microbials on rumen pH during an acidosis challenge.

Results

Measurements were taken at 24 and 12 hours before dosing to determine a steady state for each animal. Prior to dosing, the average ruminal pH was 6.6 for all treatments. Additionally, VFA concentrations, acetate plus butyrate to propionate ratios and lactate concentrations did not differ among treatments during steady state (P>.10). In order to calculate the severity of acidosis, a pH curve was calculated (Figure 1). A ruminal pH of 6.0 was chosen to determine the area under the curve for each treatment (Table 1). The larger values represent longer periods of time below pH 6.0 and(or) lower pH values. The curve areas did not differ statistically (P>.10) among treatments, but the ruminal pH of the control treatment tended to have the greatest area under the curve (6.55). The treatment containing *Saccharomyces cerevisae*, tended to have the smallest area (3.72) under the curve indicating that acidosis was less severe (Table 1). The other three treatments were intermediate.

Total VFA concentrations were different among treatments. When comparing treatment two to five, the steers receiving LA + YC + SF had the lowest concentration of VFAs (P<.05). *Lactobacillus acidophilus* plus *Saccharomyces cerevisae* had the highest concentration of VFAs and was statistically different from LA + YC + SF (P<.05). The acetate plus butyrate to propionate ratio was different among treatments. Treatment five contained a three-way combination of *Lactobacillus acidophilus, Saccharomyces cerevisae,* and *Streptococcus faecium* and had the highest AB:P ratio. When comparing treatment two, which contained only *Lactobacillus acidophilus,* to LA + YC + SF, treatment two had the lower ratio. Production of propionate may be reduced during the acidosis challenge when steers are supplemented with products containing *Lactobacillus acidophilus, Saccharomyces cerevisae,* and *Streptococcus faecium.* The production of L-lactate was also determined: however, the concentrations obtained were so small the effect of L-lactate on rumen pH is questionable and therefore, the data are not presented.

Our results indicate a three-way combination reduces VFA concentration and may also shift the amount or alter the concentrations of VFAs produced. In this trial, areas under the pH curve tended to be lowest when steers were supplemented with the direct fed microbials indicating some added benefit from supplemental direct fed microbials in reducing subacute acidosis.

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