Buffers and Subclinical Acidosis in Steers

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Story in Brief

To simulate subclinical acidosis, four fistulated steers in two trials were fed high moisture corn rations at 200 percent of voluntary consumption by forcing diet into the rumen through a fistula. Lactic acid levels and pH were monitored at 0, 1, 2, 4, 8, 12 and 24 hours after feeding and influence of added buffers, potassium bicarbonate, sodium bicarbonate and calcium carbonate, were studied.

All the buffers tested in trial 1 stabilized rumen pH and prevented lactic acid concentrations with potassium bicarbonate appearing to be the most effective. The calcium carbonate did limit pH depression to some extent, however delayed the return of pH in the rumen to more neutral conditions. In a second trial, potassium bicarbonate, sodium bentonite and dolomitic limestone were tested and again potassium bicarbonate limited lactic acid production and pH depression to a greater degree than any of the other buffers tested. The sodium bentonite and dolomitic limestone were also effective as buffers.

Of the compounds tested, potassium bicarbonate was most effective as a buffering agent with high moisture corn rations. However the cost of this chemical make sodium bicarbonate, sodium bentonite, dolomitic limestone and possibly calcium carbonate desirable economical alternatives.

Introduction

The use of high concentrate rations is still perhaps the most desirable method of feeding cattle to maximize gains and efficiency. However the feeding of rations with high energy densities has resulted in a series of digestive disturbances including poor food consumption, chronic rumen and liver lesions and predisposition to other diseases. Such a condition, usually brought on by over-consumption of feed, and is often called sub-clinical acidosis. Symptoms of subclinical acidosis are increased ruminal lactic acid levels and marked depression in ruminal pH.

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Studies from this laboratory have indicated that processing of grains increases the tendency to cause acidosis due to more rapid fermentation of grain in the rumen. If subclinical acidosis can be prevented by adding buffers to the diet, considerable economic advantage would be realized. This investigation was to examine the addition of buffers to the ration on the changes in ruminal pH and lactic acid levels.

Materials and Methods

Two trials were conducted to determine the effect of various buffers on ruminal pH and lactic acid levels. The basic rations utilized are shown in Table 1. High moisture corn was used in this study as the main concentrate ingredient. Four rumen fistulated Holstein steers were fed one of three buffers and a control ration for one sampling period, after which they were switched to another ration and this was continued until all steers were fed all rations. The buffers used in the first trial were potassium bicarbonate ($KHCO_3$), sodium bicarbonate ($NaHCO_3$) and calcium carbonate ($CaCO_3$) and in the second trial, $KHCO_3$, dolomitic limestone and sodium bentonite[5].

The rations used in both trials were fed at about 2.5 percent of body weight in 2 equal feedings. On the day previous to testing, the steers were fed one half of their half day allotment in the evening and on the sampling day the steers were offered 200 percent of their allotment for the morning feeding. If the ration was not consumed within 30 minutes, the remaining portion of the ration was placed directly into the rumen through a fistula. These procedures were used to assure comparable consumption and starting times for rumen sampling.

[5] American Colloid Company, Skokie, Illinois 60070.

Table 1. Composition of Rations Used in Trials 1 and 2.

Ingredient	Control[1]	Buffered[1] Ration
High Moisture Corn	86.8	84.8
Cottonseed hulls	8.0	8.0
Dehy Alfalfa meal	2.2	2.2
Soyban meal	2.1	2.1
Urea	0.3	0.3
Salt, trace mineralized	0.2	0.2
icalcium phosphate	0.2	0.2
$CaCO_3$	0.2	0.2
Buffer	--	2.0
Aurofac—50	225 g/ton	225 g/ton
Vitamin A (300,000 I.U./g)	200 g/ton	200 g/ton

[1] On an as is basis.

Samples of rumen fluid were taken prior to feeding on the test day and at 1, 2, 4, 8, 12 and 24 hours after feeding. No additional feed was given until the rumen sampling was completed. Lactic acid and pH were determined on the rumen samples in both trials.

When the steers were fed at regular intervals all steers usually consumed the total amount of the ration offered. However, on the day following the sampling day, the steers were frequently "off feed", especially in trial 1. The next testing period was therefore delayed until all offered feed was consumed for two consecutive days.

Results and Discussion

Trial 1. The pH depressions following 200 percent feeding can be seen in Figure 1. The pH's for all treatments were at their lowest at 8 hours after feeding, with the unbuffered diet causing the greatest depression in pH and the $KHCO_3$ being the most effective buffer with the pH about 0.3 of unit greater than the unbuffered control. The $CaCO_3$ and $NaHCO_3$ buffers showed some improvement over the controls, however, the advantage was not great. In addition the $CaCO_3$ tended to delay the return of acid condition on the rumen to more neutral (pH 7) levels following feeding. The reason for this delay is not known, however, under certain conditions it could provide lactic acid producing bacteria a more suitable environment for proliferation and this type of fermentation could possibly lead to higher incidence of acute acidosis. Lactic acid levels determined at the same time are illustrated in Figure 2.

The levels of lactic acid observed in this trial (Figure 2) were high and reached over 100 mM/liter for both the control and the $CaCO_3$ treatment. Levels in this range are frequently observed with acute acidosis. Acute acidosis was never observed in this study, however the animals were constantly "off feed" following the treatments.

Trial 2. In trial 2 the effectiveness of $KHCO_3$, dolomitic limestone and sodium bentonite as buffers were tested. $KHCO_3$ was again used as in trial 1. The rumen pH levels can be found in Figure 3. The $KHCO_3$ appeared to have the same effects as in trial 1 and was more effective than the other buffers tested. However, the cost of this chemical is high so use as a buffer in feedlot rations may not be practical.

Both the dolomitic and sodium bentonite helped control rumen pH when compared to the control ration. In addition, the pH of all the buffer treatments appeared to return to neutrality more rapidly with buffers. Again a rapid return of rumen pH to neutral levels could be as important as total extent of pH depression as a stimulating factor in subclinical acidosis due to the opportunistic nature of lactic acid producing bacteria.

These rumen lactic acid levels for trial 2 can be seen in Figure 4.

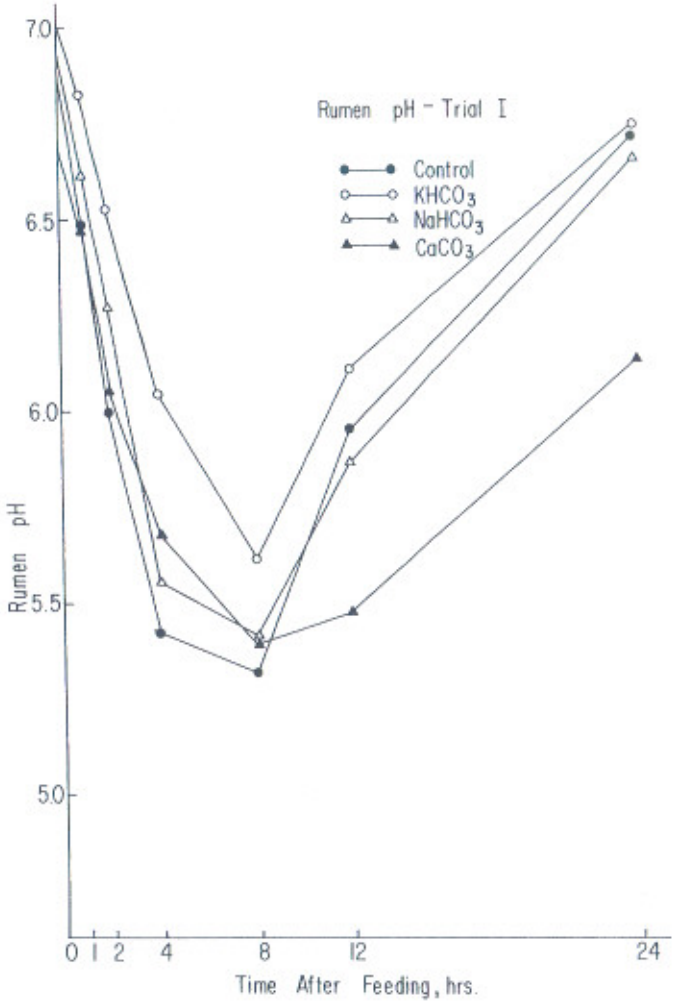

Figure 1. Changes in rumen pH after feeding rations containing either a control or $KHCO_3$, $NaHCO_3$, and $CaCO_3$ as a buffer.

The peak lactic acid level for all ration occurred at one hour after feeding with the control having the highest level and $KHCO_3$ the lowest, with the dolomite and Na bentonite levels being intermediate. It is of interest to note that the lactic acid levels in trial 2 were approximately one tenth of the levels observed in trial 1. In addition the steers in trial 2 seemed to go "off feed" less frequently than in trial 1.

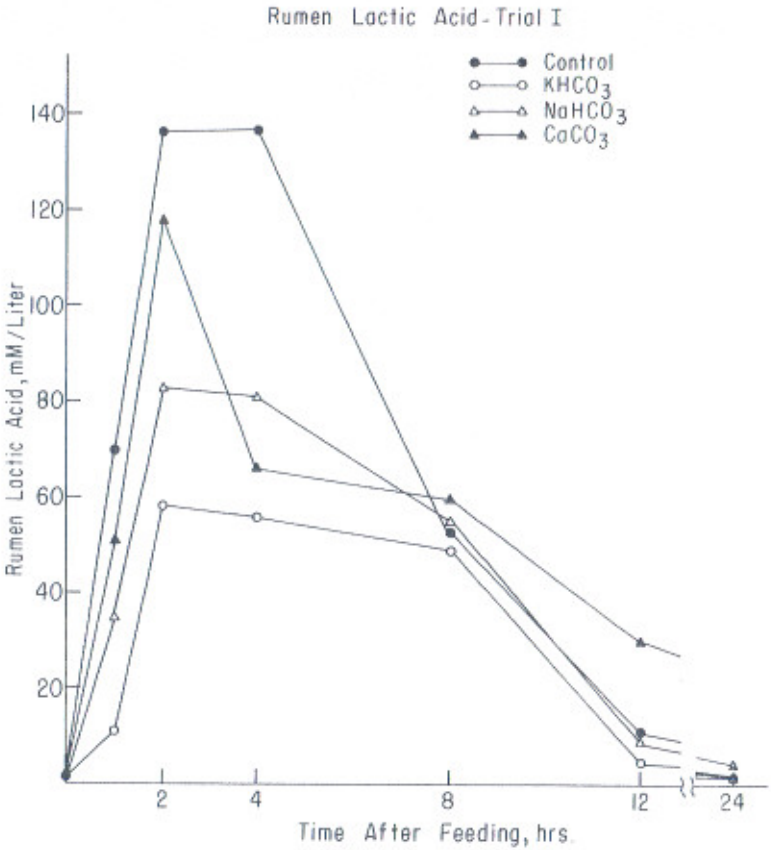

Figure 2. Changes in lactic acid levels after feeding rations containing either a control or $KHCO_3$, $NaHCO_3$ and $CaCO_3$ as a buffer.

Trial 2 was conducted one year later than in trial 1 and the high moisture corn used in trial 2 had lower levels of moisture and soluble nitrogen. Based on these observations it seems possible that the incidence of subclinical acidosis could be reduced to a greater extent by environmental factors and proper management practices during the harvesting and ensiling of high moisture corn than by the use of buffers. However since ideal management conditions and environment are not always present and buffers, such as potassium bicarbonate, sodium bicarbonate, sodium bentonite, dolomitic limestone and, possibly, calcium carbonate may aid to lower the incidences of subclinical acidosis.

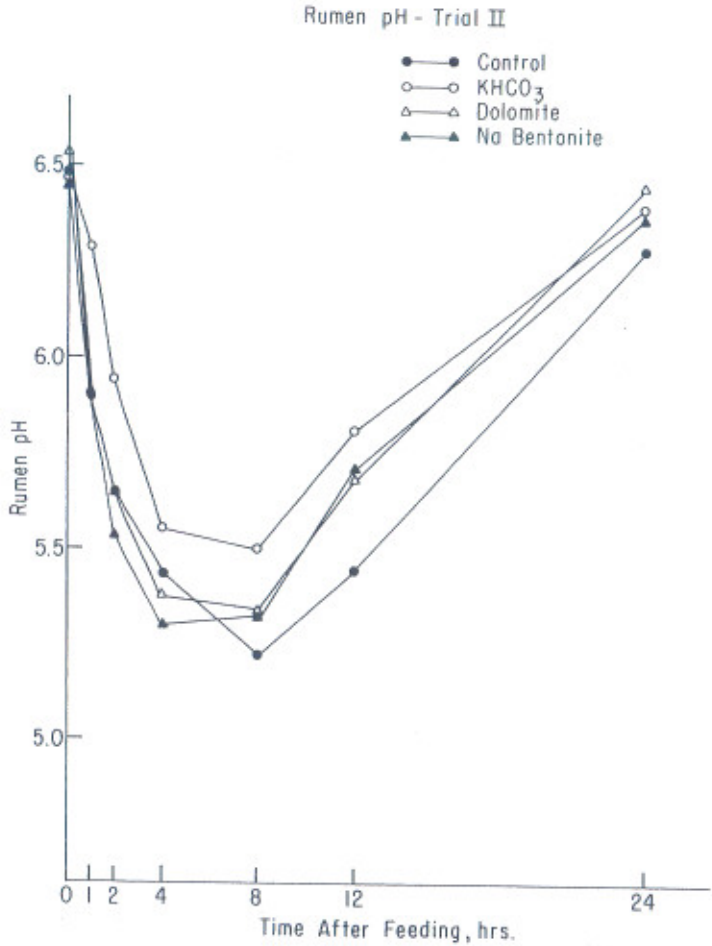

Figure 3. Changes in rumen pH after feeding rations containing a control or $KHCO_3$, dolomitic and Na bentonite as a buffer.

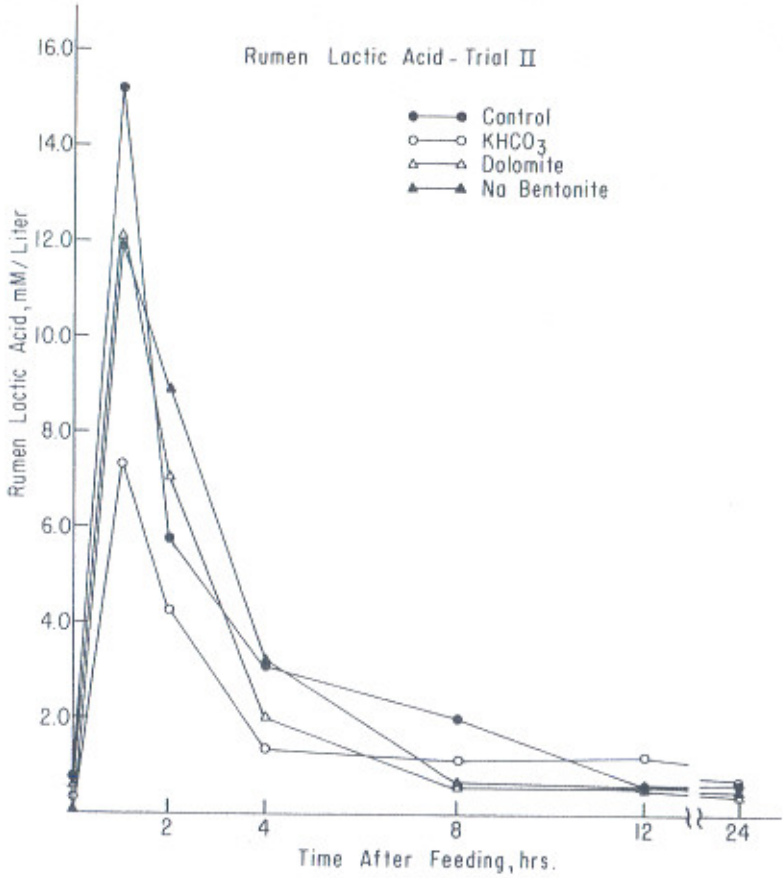

Figure 4. Changes in lactic acid levels after feeding rations containing either a control or $KHCO_3$, dolomitic and Na bentonite as a buffer.