processed by some other methods—for example, steam flaking and high moisture processing. Nevertheless, corn does not appear to be improved by processing as much as sorghum, and in many instances, the small additional benefits obtained from elaborate processing of dry corn may not offset the additional costs incurred compared to feeding it in the whole form.

Effect of Dietary Buffers on Ruminal and Systemic Acidosis of Steers[1]

G. W. Horn, J. L. Gordon, E. C. Prigge, F. N. Owens and D. E. Williams

Story in Brief

Rations containing approximately 85% ground high-moisture, ensiled corn were fed to steers in such a way as to produce lactic acid acidosis, and three dietary buffers were evaluated in regard to their effect on ruminal and systemic acidosis. The buffers consisted of (1) 2% sodium bentonite, (2) 1% sodium bentonite plus 1% dolomitic limestone, and (3) 1% sodium bentonite plus 1% potassium bicarbonate ($KHCO_3$). Using ruminal pHs, lactic acid and glucose concentrations as indices of ruminal acidosis, the combination of sodium bentonite and $KHCO_3$ was most effective in reducing the degree of ruminal acidosis. The relative changes in the base excess values of blood samples indicated that a combination of either sodium bentonite plus dolomitic limestone or sodium bentonite plus $KHCO_3$ was beneficial in enabling the steers to return to a normal acid-base status at 24 hours post-feeding.

Introduction

The effects of acidosis in feedlot cattle may range from acute physiological alterations which result in death to the chronic condition of cattle being off feed for varying periods of time throughout the feeding period. From the standpoint of total death losses of feedlot cattle, death

[1] Supported by Grain Utilization Research Funds (Guymon, Oklahoma) and Farmland Industries, Kansas City, Missouri.

losses due to acidosis *per se* generally represent a small percentage. Although the incidence of the milder cases of acidosis (subclinical acidosis) is poorly defined, it is generally agreed that losses due to decreased performance of cattle with subclinical acidosis constitute a substantial economic loss to the Feedlot Cattle Industry.

One approach to reduce the incidence of subclinical acidosis in feedlot cattle fed high-energy rations has been the inclusion of buffers into these rations. Two studies conducted to evaluate the effect of dietary buffers on ruminal acidosis have been reported (1). We report here the results of a third study that was conducted to evaluate the effects of dietary buffers on ruminal and systemic acidosis. The degree of ruminal acidosis was evaluated on the basis of ruminal pH values and lactic acid concentrations. The concentrations of ruminal glucose were also determined and their relationship to ruminal acidosis will be discussed. Systemic acidosis is characteristized by decreased blood pHs due to the absorption and/or production of greater quantities of acid than an animal can buffer or neutralize. Ruminal acidosis can occur without the subsequent occurrence of systemic acidosis; but as the degree of ruminal acidosis is increased, the likelihood that systemic acidosis will occur is increased.

Materials and Methods

Four ruminally cannulated Holstein steers were fed one of four rations for one experimental period, and then switched to another ration until all steers had been fed each of the four rations. The rations shown in table 1 consisted of approximately 85% of ground high-moisture, ensiled corn and contained either no added buffer, 2% sodium bentonite, 1% sodium bentonite plus 1% dolimitic limestone, or 1% sodium bentonite plus 1% potassium bicarbonate ($KHCO_3$).

Table 1. Composition of Rations.

Ingredient[1]	Control	Sodium Bentonite	Sodium Bentonite + Dolomitic limestone	Sodium Bentonite + $KHCO_3$
High moisture corn	86.8	84.8	84.8	84.8
Supplement[2]	7.5	7.5	7.5	7.5
Cottonseed hulls	5.7	5.7	5.7	5.7
Sodium bentonite	--	2.0	1.0	1.0
Dolomitic limestone	--	--	1.0	--
$KHCO_3$	--	--	--	1.0

[1] Percentage of ration dry matter.
[2] Supplement contained the following ingredients in lb/ton of supplement: cottonseed hulls, 600; dehydrated alfalfa meal, 600; soybean meal, 553; urea, 80; salt, 60; dicalcium phosphate, 50; calcium carbonate, 50; aurofac-50, 1.5; vitamin A supplement (30,000 I.U./g), 1.5.

The rations were fed at a level of about 2.5% of body weight in 2 equal feedings (8:00 a.m. and 5:00 p.m.). On days immediately prior to sampling days in which ruminal fluid and jugular vein blood samples were taken, the steers were fed only one-half of their evening allotment of feed and on sampling days were fed all of their daily allotment of feed at the morning feeding. In order to assure comparable feed intakes and starting times, if the rations were not consumed within 30 minutes after feeding, the remaining portions were placed directly into the rumens through the cannulas. On sampling days ruminal fluid and blood samples were taken immediately prior to feeding and at 1, 2, 4, 8, 12 and 24 hours after feeding with the exception that blood samples were not taken at 1 hour after feeding. The steers were not fed again until the 24 hour post-feeding samples were taken. The pH of the ruminal fluid samples was immediately measured, and the samples were analyzed for lactic acid and glucose concentrations. Base excess values of the blood samples were determined from blood pH values and carbon dioxide (pCO_2) and hemoglobin concentrations.

Results and Discussion

The ruminal pH changes following the feeding of the 4 diets is shown in Figure 1. The depressions in ruminal pH values were similar for all rations with the exception of the ration containing sodium bentonite and $KHCO_3$ in which the ruminal pH was maintained at higher levels.

The ruminal lactic acid concentrations (Figure 2) increased markedly during the first hour after feeding all rations, but the magnitude

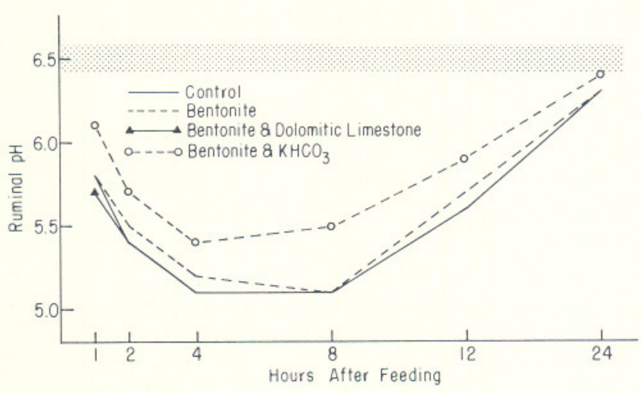

Figure 1. Time-course changes in ruminal pH; shaded area represents the average ± SEM pH of all steers at time zero.

of the initial increase was the lowest for steers fed the diet containing sodium bentonite and $KHCO_3$. Steers fed the control ration generally had higher ruminal lactic acid concentrations during the first 8 hours after feeding than steers fed the other 3 rations. However, at 12 and 24 hours after feeding the ruminal lactic acid concentrations of steers fed the "buffered" rations were slightly greater with the exception of the 24-hour post-feeding lactic acid concentrations of steers fed the ration containing sodium bentonite and $KHCO_3$.

The concentrations of ruminal glucose during the first 4 hours after feeding were greater for steers fed the control diet (Figure 3). At 1 hour after feeding steers fed the diet containing 2% sodium bentonite had the lowest ruminal glucose concentrations; whereas from 2 to 8 hours after feeding the ruminal glucose concentrations were the lowest for steers fed the diet containing 1% sodium bentonite and 1% $KHCO_3$. Interest in ruminal glucose concentrations in studies of acidosis has been prompted from studies that have shown that high glucose concentrations (or the excessive prefermentation of glucose by certain ruminal bacteria) has an inhibitory effect on the subsequent metabolism of lactic acid to acetic and propionic acids. Therefore, if ruminal glucose is present at elevated levels lactic acid would accumulate and be maintained at higher concentrations in the ruminal contents. In general, however, this relationship between ruminal glucose and lactic acid concentrations was not observed in these studies.

Base excess values of blood are useful in evaluating the amount of acid or base, expressed as milliequivalents (mEq) per liter, that has

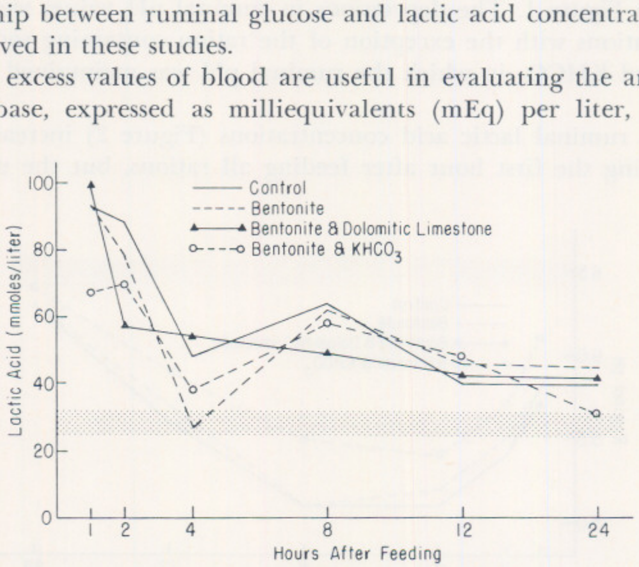

Figure 2. Time-course changes in ruminal lactic acid concentrations; shaded area represents the average ± SEM concentration of all steers at time zero.

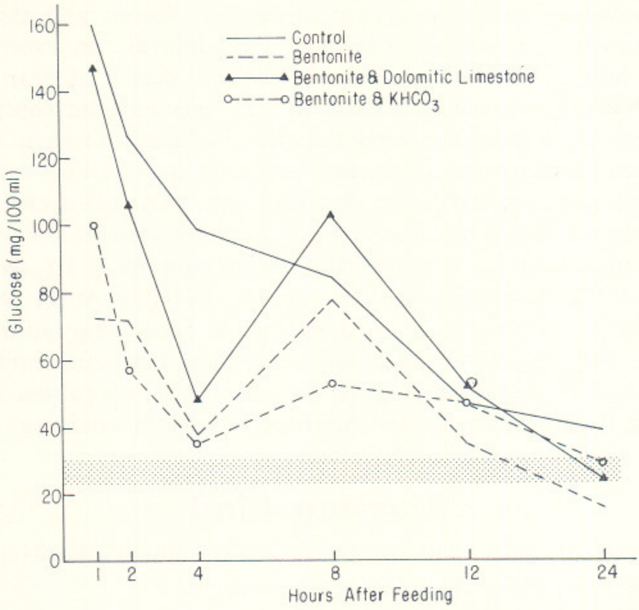

Figure 3. Time-course changes in ruminal glucose concentrations; shaded area represents the average ± SEM concentration of all steers at time zero.

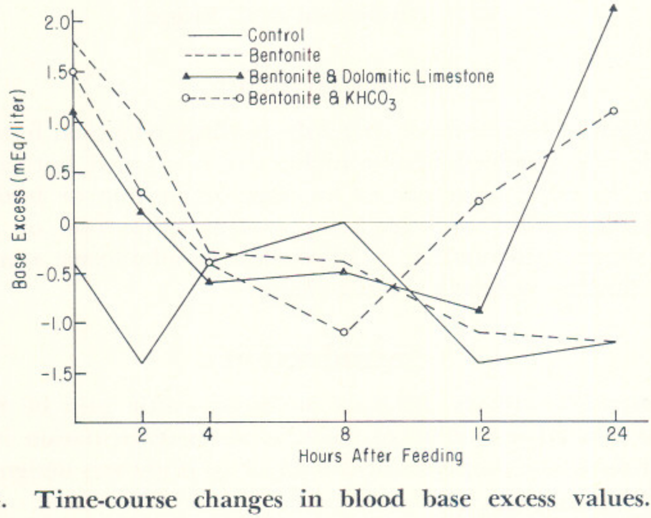

Figure 4. Time-course changes in blood base excess values.

caused a change in the acid-base content of blood; and therefore in evaluating systemic acidosis. Positive values indicate an excess of base; negative values indicate an excess of acid or a deficit of base. The pre-feeding base excess values (Figure 4) of steers fed the control ration were lower than those of steers fed the "buffered" rations, and at 24 hours after feeding were decreased below the pre-feeding values. The base excess values of steers fed the "buffered" diets all decreased markedly during the first 4 hours after feeding, and remained low at 24 hours after feeding except for steers fed the rations containing 1% sodium bentonite and 1% dolomitic limestone or 1% $KHCO_3$. At 24 hours after feeding the base excess values of steers fed the rations containing sodium bentonite and dolomitic limestone or sodium bentonite and $KHCO_3$ had returned to values very similar to the pre-feeding values. This indicates that these dietary buffers were beneficial in enabling the steers to return to a normal acid-base status.

Literature Cited

1. Prigge *et al,* 1975. Animal Sciences and Industry Research Report (MP-94), Okla. Agric. Exper. Sta., p. 56.

Rumensin Addition to Silage

F. N. Owens and E. C. Prigge

Story in Brief

Addition of low levels of rumensin to silage enhanced fermentation and lactic acid production, but higher levels allowed butyrate to accumulate. Addition of rumensin to silage at ensiling or feeding time increased digestibility slightly. Since a large proportion of rumensin survives silage fermentation, it is possible to administer rumensin to cattle by feeding rumensin treated silage.

Introduction

Rumensin[1] increases efficiency of feedlot cattle gain by 8 to 15% according to a large number of trials. It alters fermentation in the rumen, increasing the propionic acid level. This study was designed to ex-

[1] Elanco, Inc., Greenfield, Indiana.