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Observations on Acidosis Through Continual Feed Intake and Ruminal pH Monitoring

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Observations on Acidosis Through Continual Feed Intake and Ruminal pH Monitoring

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A system of continually monitoring feed intake and ruminal pH of finishing steers has provided many opportunities for making anecdotal observations of subacute acidosis during the finishing period.

Summary

A system of continual data acquisition of feed intake and ruminal pH has been developed for studying subacute acidosis in finishing steers. Feed intake is monitored with feedbunks which are suspended from weigh cells. Ruminal pH is monitored with submersible pH electrodes suspended in the rumen. Numerous anecdotal observations of subacute acidosis have been made throughout the feeding periods of several steers, providing information unlikely to be recognized during a planned trial. Therefore, this model for studying subacute acidosis offers many unique opportunities for enhancing our understanding of the interactions between feed intake and acidosis.

Introduction

The cattle feeding business in the United States has evolved into an intensively managed, production-oriented industry. Due to costs associated with interest on cattle, yardage in the feedlot and the price and inconvenience of roughages, economics usually favor rapidly increasing the grain portion of the diet to put the cattle on a high concentrate diet as soon as possible. However, both the rapid increase in concentrate and low roughage levels in the finishing diet increase the potential for subacute acidosis.

Subacute acidosis is generally characterized as ruminal pH between 5.6 and 5.2. Ruminal pH below 5.2 is indicative of acute acidosis. The major response seen with subacute acidosis is reduced intake; therefore subacute acidosis is more subtle and more difficult to access than acute acidosis. Even in metabolism studies it is difficult to measure all the effects of subacute acidosis, because as ruminal pH declines cattle adjust by decreasing feed intake and alter their eating patterns. However, subacute acidosis continues to be a major factor limiting feedlot cattle performance. Several models have been used to study subacute acidosis. One model, the evaluation of intake variation of individually fed cattle (1991 Nebraska Beef Report, pp. 55), is based on the premise that intake variation is caused by subacute acidosis. Therefore, subacute acidosis can be evaluated by monitoring the magnitude of feed intake variation. The second model is a steer metabolism model (1993 Nebraska Beef Report, pp. 60). Fistulated cattle are challenged with sufficient grain to create subacute acidosis. The challenge, usually half-corn and half-wheat, is placed directly in the rumen, and the ruminal pH determined

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at 3-hour intervals over a 24-hour period. These two models have been very useful in the study of acidosis; however, each has limitations. The challenge used in the steer metabolism model may not be appropriate for the study of subacute acidosis as it may overwhelm the system. While erratic day-to-day intake variation is indicative of subacute acidosis, within-day intake patterns have not been evaluated directly in the intake variance model. Therefore, it was desirable to develop a more complete subacute acidosis model. A system of continual acquisition of feed intake and ruminal pH was developed so a more complete understanding of the interactions between ruminal pH and feed intake would be possible.

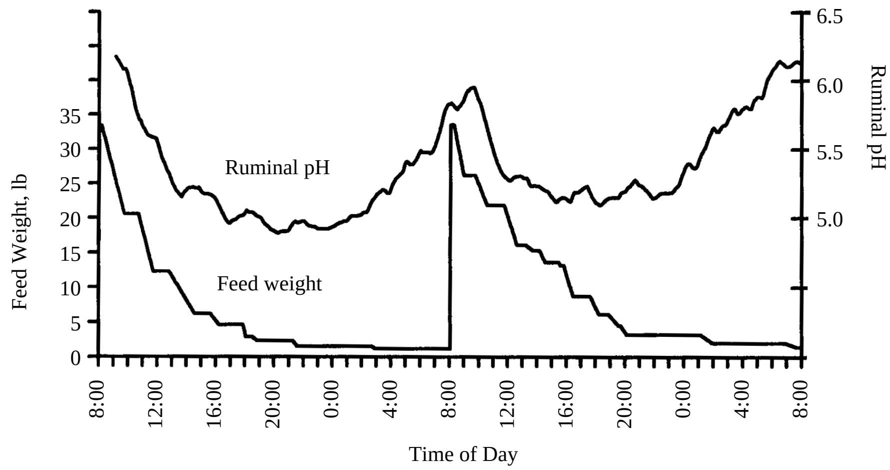

Figure 1. Feed intake and ruminal pH of a steer over a two-day period on a finishing diet (92.5% concentrate).

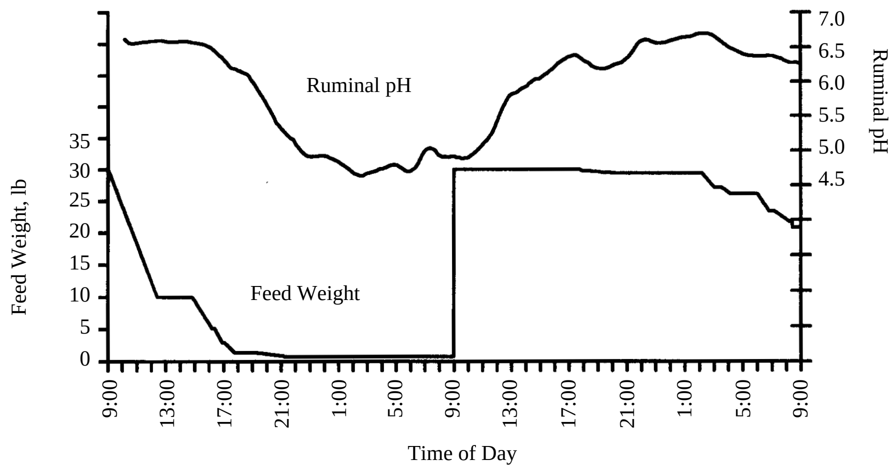

Figure 2. Feed intake and ruminal pH of a steer during the first and second day on feed (55% concentrate).

Procedure

Continuous data acquisition of feed intake and ruminal pH has been collected on many steers throughout several different trials. In some of these trials, subacute acidosis has been monitored during the grain adaptation period. Feed intake and ruminal pH data also have been gathered on numerous steers during periods of subacute acidosis induced by varying dry matter intake of steers fed a high concentrate diet, directly placing grain in the rumen and late feeding. The results from these trials have been previously reported. However, in this report, observations and comments will be made concerning interesting situations and anecdotal events which have occurred throughout the large amount of data collected.

During all trials in which these data were collected, steers were tethered in individual metabolism stalls. Feed intakes were monitored with individual feedbunks suspended from weigh cells. Ruminal pH was monitored with submersible pH electrodes suspended through the plug of the rumen cannula of each steer. Each pH electrode was encased in a weighted, four wire metal shroud to keep the electrode in a stationary position 5 inches above the ventral floor of the rumen while allowing rumen contents to flow freely through it. Weigh cells and pH electrodes were linked directly to a computer allowing data acquisition software to record both a feed weight and a ruminal pH every minute for each steer during collection periods.

Although steers were tethered in metabolism stalls, both intake and animal performance have been favorable in all trials. It was not uncommon for the yearling steers used in these trials to consume over 25 lb of dry matter and to gain approximately 4 lb per day.

Results

Examples of feed weight and ruminal pH data collected are shown in Figure 1, which depicts the two-day intake and ruminal pH of a steer in the middle of the finishing period. This steer was fed a 92.5% concentrate, dry-rolled corn-based diet once daily at 0800. Figure 1 also shows the typical cyclic pattern of ruminal pH, which is usually highest at feeding and declines to its lowest point 5-10 hours later. The graph for feed weight in Figure 1 actually shows feed disappearance from the bunk. Therefore a meal is depicted when the feed weight line declines. As Figure 1 shows, this steer ate at a more rapid rate and consumed larger meals on day 1 than on day 2. The effects of these intake patterns are reflected in the ruminal pH, which dropped lower and stayed lower longer during the first day than compared to the second. This figure shows the truly cyclic nature of ruminal pH and its relationship to feed intake. Ruminal pH was relatively high at the beginning of the first day which probably promoted (or at least did not

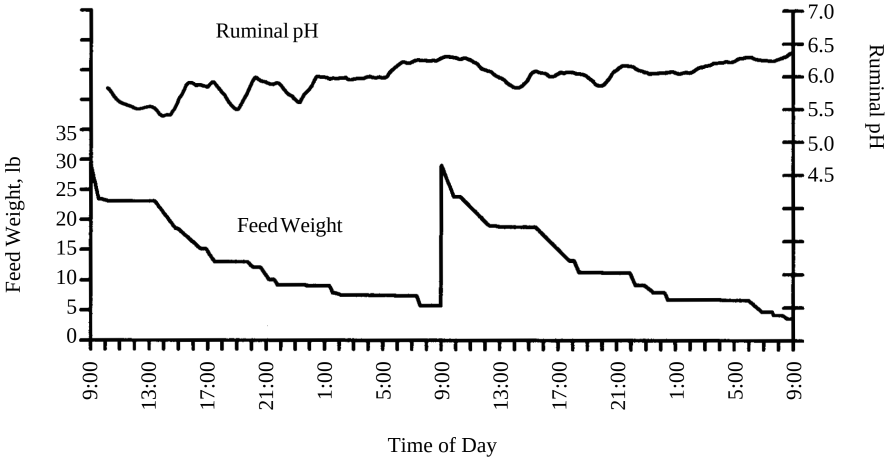

Figure 3. Feed intake and ruminal pH of same steer as in Figure 2, first and second day of step 2 (65% concentrate).

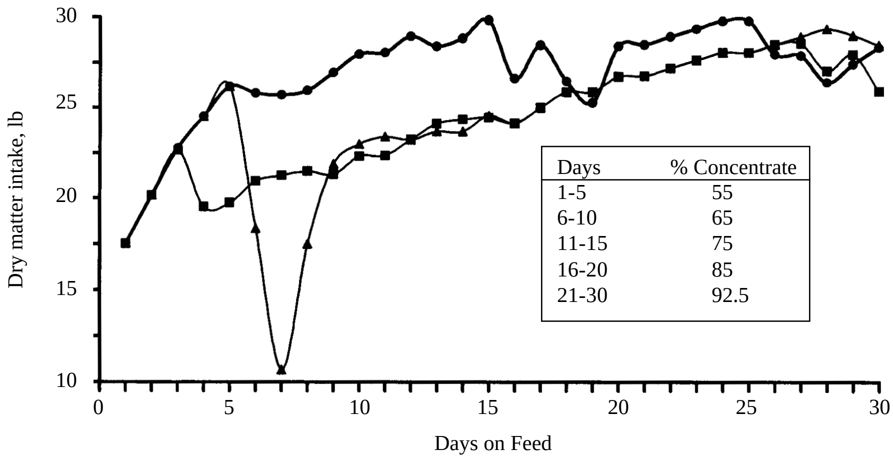

Figure 4. Dry matter intake of three steers during grain adaptation.

hinder) the rapid rate of intake. As a result of the rapid intake during day one, ruminal pH dropped to a level indicative of subacute acidosis. Rate of intake was not as rapid during the second day. This is likely due to both the low ruminal pH experienced during day 1 and to a lower initial ruminal pH at feeding time during day 2. During day 2, it appears the steer consumed feed at a rate which prevented ruminal pH from dropping to the first day's level. It is important to note the steer consumed approximately the same amount of feed on both days. However, the intake patterns had significant effects on ruminal pH and acidosis.

Figure 2 shows the feed intake and ruminal pH of a steer which experienced acidosis during the first day of step 1 of the grain adaptation period. Previously, this steer had been offered alfalfa hay ad libitum. Figure 2 shows the first and second day of step 1, a 55% concentrate dry-rolled corn-based diet. This steer consumed the diet very rapidly on day 1, eating approximately 30 lb (as-fed) in only two meals. Consequently, ruminal pH dropped to approximately 5.0 and did not increase until the next morning. The following day, the steer was offered the same amount of feed but did not consume a meal until about midnight and then only ate approximately 7 lb (as-fed) in several small meals. Even on only a 55% concentrate diet, a steer can become acidotic if the diet is consumed too rapidly. This figure clearly shows the relationship between feed intake and ruminal pH and how an acidotic steer will adjust intake to return ruminal pH to a normal level. It is likely this steer learned from this experience and was consequently less aggressive at the feedbunk later in the feeding period to avoid acidosis. Figure 3 shows the feed intake and ruminal pH of the same steer on day 1 and day 2 of step 2, a 65% concentrate diet (days 5 and 6 on feed). During these days, the steer ate at a slower rate, consuming small meals throughout the day. As a result, ruminal pH stayed relatively high and constant compared to the two days in Figure 2. Both figures show how a steer learns to adjust intake pattern during grain adaptation in order to avoid acidosis.

Figure 4 shows the dry matter intake of three steers during the grain adaptation period. Steers were fed a dry-rolled, corn-based diet once daily at ad libitum levels. Step-up diets consisted of 45% (d 1-5), 35% (d 6-10), 25% (d 11-15), 15% (d 26-20) and 7.5% alfalfa hay (day 21-30) in place of dry-rolled corn. Figure 5 shows the average daily ruminal pH (average of 1,440 observations per steer per day) of the same three steers during the grain adaptation period. In Figure 4, notice the steer represented by triangles steadily climbed in intake during step 1, but dramatically dropped in intake the first and second days of step 2. Figure 5 shows that as the steer was building intake during step 1, its average ruminal pH was steadily decreasing, reaching approximately 5.3 on the last day of step 1. Even if this steer had not been moved to the next step-up diet the next day, he likely would have decreased intake. To compound the steer's existing acidosis problem, step 2 (65% concentrate) was offered on day 6, further reducing average ruminal pH and causing the steer to dramatically reduce intake for several days. In retrospect, there may be two different ways to conduct the feed calling for this steer: 1) either offer enough feed during step 1, or extend step 1, until this steer was "caught" (leaving feed in the bunk) reducing its aggression during step 2; or 2) prohibit this steer from building so high an intake on step 1, so that the increase in concentrate would not so drastically impact ruminal pH. The latter method,

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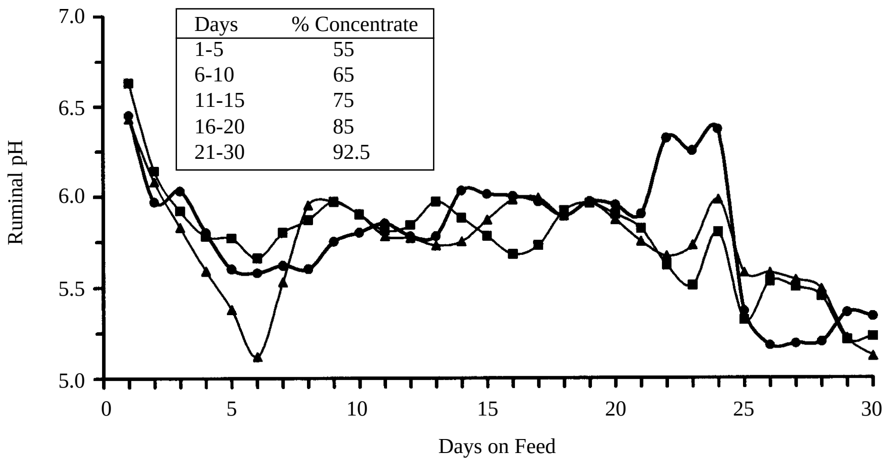

Figure 5. Average daily ruminal pH of three steers during grain adaptation.

however would encourage more rapid rates of intake, which can create acidosis even with diets relatively high in roughage, as shown in Figure 2.

Figure 5 shows another interesting anecdotal event which occurred during these steers' grain adaptation period. The figure shows that on day 24, average ruminal pH consistently increased for all three steers. On this day, a feeding mistake occurred and the steers, which were usually fed at 0800 each day were not fed until 1200. When the steers were fed, they were only given 5-10 lb at a time about every two hours to help keep them on feed. Day 24 is the fourth day on the finishing diet (92.5% concentrate), probably one of the most critical days during the grain adaptation period. It is important to note these steers were at ad libitum levels of intake and that all had some feed left in the bunk on the morning of day 24. However, by 1200 all of the bunks were slick and the steers were somewhat aggressive. Average ruminal pH likely increased on this day because the steers were out of feed for about four hours, after which they were offered feed spread out over an extended period of time. On day 25, steers were given their feed as normal. Figure 5 shows the dramatic decrease in average ruminal pH on day 25 and thereafter. As indicated by both the very low ruminal pH and slightly reduced intakes, the steer represented by circles in Figure 5 suffered subacute acidosis for several days following the feeding mistake. It is important to note these values are average daily ruminal pH; minimum daily ruminal pH reached below 5.0 for all three steers during this period. It is interesting to note that later in this trial period there were unsuccessful attempts to induce subacute acidosis by fluctuating dry matter intake by 4 lb per day. Feeding four hours late had a much more substantial effect on acidosis than intake variation of 4 lb per day. This suggests consistency and timing of feeding are critical management components in order to avoid acidosis.

These are just a few examples of anecdotal events and observations made with this system of continual feed intake and ruminal pH monitoring. Often these observations are as interesting and informational as the results collected from the respective trial. One important point needs to be emphasized. Acidosis affects individual cattle. Through continual monitoring of feed intake and ruminal pH of individual steers, it is evident that virtually all steers experience varying degrees of subacute acidosis sometime during feeding. It is unlikely, however, that these bouts would ever be noticed in a feedlot pen. Although a complete pen of cattle may not be "off feed", individual cattle are likely experiencing bouts of subacute acidosis. Many times, this acidosis goes unnoticed because individuals with reduced intake are "averaged out" by the other cattle in the pen not experiencing acidosis.

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