



BEEF CATTLE RESEARCH UPDATE

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April 2006

Effect of Feed Delivery Fluctuations on Ruminal Acidosis and Performance of Feedlot Cattle

Feedlot nutritionists and managers generally associate subclinical acidosis with abnormal or erratic feeding behavior by cattle. In a summary of several individual feeding trials reported at the 1995 Oklahoma Feed Intake Symposium¹ it was noted that intake variance was negatively correlated ($r = -0.28$) with gain efficiency indicating that intake variation has some negative relationship with cattle performance. However, a growing body of data demonstrates that feedlot cattle on finishing diets can readily adapt, such that day-to-day intake variability does not negatively affect performance².

Recent Canadian research³ looked at the effect of feed delivery fluctuation on the incidence of ruminal acidosis and performance of feedlot cattle. In their first experiment, the effects of constant (C) versus fluctuating (F) daily feed delivery on ruminal pH were measured in a crossover experiment (two 28-day periods) using six rumen cannulated steers. The steers were fed a high-concentrate diet containing (dry matter basis) 86.8% stem-rolled barley, 8.3% barley silage, and 4.9% supplement (contained no antibiotics or medications). Twenty-eight days before the experiment, the steers were adapted to this diet. During this adaptation period the ad libitum dry matter intake (DMI) of each steer was estimated over a 2-week period. Steers in group C were offered a constant amount of feed daily equal to their predetermined DMI, whereas, steers in group F were fed at 110% of ad libitum DMI for 3 days followed by 90% of ad libitum DMI for 3 days. Ruminal pH of each steer was measured continuously via an indwelling electrode inserted in the rumen during the last 6 days of each 28-day period.

These researchers found that mean ruminal pH tended to be 0.1 units lower for steers in group F than for steers in group C (5.63 vs 5.73). In addition, the ruminal pH of steers in group F tended to remain below 5.8 for a longer duration each day than for steers in group C (14.7 vs 12.5 hr/day). A similar trend was observed for the time ruminal pH remained below 5.5. Inconsistent feed delivery lowered ruminal pH, suggesting increased risk of subclinical acidosis.

In a second experiment, 234 crossbred beef steers (682 lb initial weight) were used to determine the effects of constant versus fluctuating feed delivery on performance and feeding behavior during a 56-day backgrounding period and 153-day finishing period. The steers were adapted to the same diet fed in experiment 1 over the last 21 days of the backgrounding period. Steers in group C were fed a constant amount of feed to meet ad libitum intake by ensuring that there was always a small amount of feed left in the bunk before feeding. Steers in group F were fed 10% more or 10% less than steers in group C on a rotating 3-day schedule. Pattern of feed delivery did not affect DMI, daily gain or feed efficiency during the backgrounding period, finishing period, or entire feeding period. Feeding behavior (time spent at feed bunk and number of meals/day) was also not affected by feed delivery method.

These results are consistent with several other studies. New Mexico research⁴ reported similar results in limit fed cattle (fed to gain 2.75 lb/day) indicating that 10% daily variation in feed intake did not affect performance over an 84-day feeding period in two of three experiments. In one experiment, feed intake fluctuation depressed performance during the first 56 days of the feeding period but had no affect during the last 28 days. These results suggest that feed intake fluctuation in limit-fed cattle might decrease performance early in a feeding period; however, limit-fed cattle seem to adapt to intake fluctuation as the feeding period progresses. Nebraska research⁵ found that intake variation of up to 4 lb/day did not decrease performance in ad libitum fed finishing steers.

These researchers speculated that subjecting steers to alternating days of intake variation allowed the steers to build buffer capacity on the days that reduced feed was offered, so that, upon over-consumption the following day, acidosis was not induced. California research⁶ found that limit feeding Holstein steers to gain 2.42 lb/day (799 lb initial weight) over a 138-day feeding trial with or without a 20% daily intake variation did not effect performance. In addition, it was noted that daily feed fluctuation did not adversely affect ruminal and total tract digestion during the late finishing period.

Additional Canadian research^{2,7} evaluated the relationship between eating patterns and performance in feedlot cattle by electronically tracking individual visits and feed consumption. Daily variation in intake (defined as difference in total amount of feed consumed between consecutive days) by individual animals was compared among animals grouped according to high, average or low DMI, daily gain, or efficiency. High gain steers had daily variation in intake that was on average 0.79 lb higher and consumed 4.62 lb more feed than did low gain steers. The more efficient steers had higher daily variation in intake (0.84 lb), and lower intake (2.42 lb) than steers with low efficiency. These researchers concluded that the best-performing (gain and efficiency) cattle have the most variable feeding patterns which is contrary to industry perception.

Rapid vs. Gradual Adaptation to Finishing Diets

Adaptation of feedlot cattle from high-roughage to high-concentrate diets causes marked changes in the ruminal environment and time is needed to establish a stable microbial population. An abrupt change from a high-roughage to a high-concentrate diet can result in acute or subclinical acidosis. Decreased intake and performance are generally though to be associated with subclinical acidosis. To minimize problems with acidosis, feedlot cattle are traditionally started on a higher roughage diet and then gradually switched to a high-concentrate diet by feeding a series of diets containing sequentially increasing amounts of grain over a period of 3 to 4 weeks. Recent Canadian research⁸ tried to determine whether gradual adaptation to a high-concentrate diet modulates ruminal pH, feed intake, and ruminal fermentation patterns to a greater extent than rapid adaptation to a high-concentrate feedlot diet.

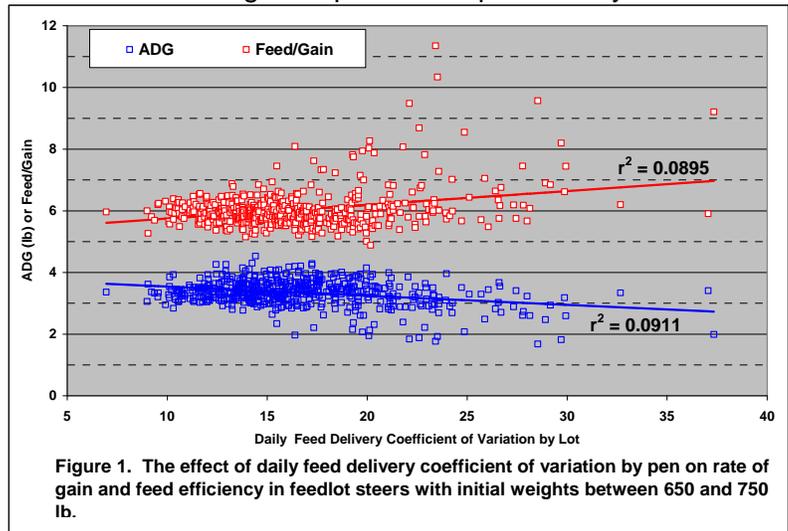
In this research, crossbred heifers were transitioned from a 40 to 90% concentrate diet (dry matter basis) either by rapid adaptation (65% concentrate diet fed for three days) or by gradual adaptation (five intermediate diets fed for 3 days each). Feed intake and ruminal pH (by indwelling ruminal electrodes) were monitored over a 20 day period. In this study, few ruminal pH measurements were affected by rapid versus gradual adaptation to a high-concentrate diet, but the variance of most pH values (daily mean, minimum and maximum pH, areas under the curve and daily durations) were far greater for rapidly adapted than gradually adapted heifers. This greater variance suggests a greater risk of subclinical acidosis. It was noted that even gradual adaptation did not completely eliminate the occurrence of acidosis. Rather, the incidence and severity of individual cases of acidosis are likely decreased by a gradual adaptation program. Their data also showed that considerable variation exists in the ability of individual animals to cope with grain challenge.

Implications of this Research

In summary, research suggests that increased day-to-day fluctuations in feed intake increases the risk of subclinical acidosis based on pH measurements. However, this greater risk of acidosis has not translated to impaired feedlot performance. There is some indication that intake variation by cattle in a limit feeding system might increase the incidence of acidosis early during the feeding period. It appears that most feedlot cattle on finishing diets can readily adapt to dietary changes and fluctuating intakes; however, cattle may be less able to adapt to changes during adaptation to the final diet.

A look at recently collected actual feedlot data does indeed suggest that fluctuations in daily intake have a limited impact on feedlot performance. Closeout records and daily feed delivery records (dry matter basis) from 536 pens of 650 to 750 lb beef steers fed during 2001 thru 2005 at Hitch Feeders

I at Hooker, OK were analyzed. As a measure of feed intake variation, the coefficient of variation (CV) of the daily feed delivery records was calculated for each pen. The average initial weight on this group of steers was 704 lb with an average dry matter intake of 20.00 lb, an average daily gain of 3.35 lb and an average feed conversion ratio of 6.04. The CV of daily intake values ranged from 6.95 to 37.34% with an average across pens of 16.56%. Figure 1 presents a plot of daily intake variation vs daily gain and feed efficiency of these pens. There is a negative correlation between intake variation and gain of -0.30 indicating that as intake variation increases that gain decreases. However, linear regression between intake variation and gain showed that intake variation explains only 9.11% of the variation ($r^2 = 0.0911$). The correlation between intake variation and feed efficiency is 0.30 indicating that as variation increases that the feed to gain ratio also increases (poorer feed efficiency). Regression analysis shows that intake variation only explains 8.95% of the variation in feed efficiency. These analyses do not take into account variation in performance due to season, previous cattle background, origin, etc. Accounting for other sources of variation might result in different conclusions.



- ¹ Stock, R., T. Klopfenstein, and D. Shain. 1995. Feed intake variation. In: Symposium: Intake by Feedlot Cattle. Okla. Agric. Exp. Sta. P-942:56-59.
- ² Schwartzkopf-Genswein, K. S., K. A. Beauchemin, D. J. Gibb, D. H. Crews, Jr, D. D. Hickman, M. Streeter, and T. A. McAllister. 2003. Effect of bunk management on feeding behavior, ruminal acidosis and performance of feedlot cattle: A review. J. Anim. Sci. 81 (E. Suppl. 2):E149-E158.
- ³ Schwartzkopf-Genswein, K. S., K. A. Beauchemin, T. A. McAllister, D. J. Gibb, M. Streeter, and A. D. Kennedy. 2004. Effect of feed delivery fluctuations and feeding time on ruminal acidosis, growth performance, and feeding behavior of feedlot cattle. J. Anim. Sci. 82: 3357-3365.
- ⁴ Soto-Navarro, S. A., G. C. Duff, C. R. Krehbiel, M. L. Galyean, and K. J. Malcolm-Callis. 2000. Influence of feed intake fluctuation, feeding frequency, time of feeding, and rate of gain on performance by limit-fed steers. Prof. Anim. Sci. 16: 13-20.
- ⁵ Cooper, R. J., T. J. Klopfenstein, R. A. Stock, C. T. Milton, D. W. Herold, and J. C. Parrott. 1999. Effects of imposed feed intake variation on acidosis and performance of finishing steers. J. Anim. Sci. 77: 1093-1099.
- ⁶ Zinn, R. A. 1994. Influence of fluctuating feed intake on feedlot cattle growth-performance and digestive function. In: Southwest Nutr. and Manage. Conf. Proc., Phoenix, AZ. p 77-83.
- ⁷ Hickman, D.D., T.A. McAllister, K.S. Schwartzkopf-Genswein, D.H. Crews, Jr., C.R. Krehbiel, and R. Silasi. 2002. Relationship between feeding behavior and performance of feedlot steers. J. Anim. Sci. 80(Suppl. 1):15 (Abstr.).
- ⁸ Bevans, D. W., K. A. Beauchemin, K. S. Schwartzkopf-Genswein, J. J. McKinnon, and T. A. McAllister. 2005. Effect of rapid or gradual grain adaptation on subacute acidosis and feed intake by feedlot cattle. J. Anim. Sci. 83: 1116-1132.

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