Rumen Acidosis in Dairy Cattle: Bunk Management Considerations

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Take Home Messages

- Bunk management is a risk factor for sub-acute rumen acidosis (SARA).
- A myriad of errors in feed delivery and bunk management can occur on commercial dairies.
- Bunk management practices that promote feed sorting and slug feeding must be controlled to minimize the incidence of SARA.
- Cow comfort, her environment, and the formulated diet need to be evaluated in conjunction with bunk management practices when investigating laminitis problem herds.

Introduction

Laminitis has been linked to lactic acidosis (16). Acidosis is caused by the consumption of high amounts of ruminally-available carbohydrate, low amounts of effective fiber, or both (16). Nordlund (18) and Oetzel (19) reported that SARA is a prevalent problem for commercial dairies.

Despite diet formulation for chemical (15) and physically-effective fiber (12) minimums, non-structural carbohydrate (NSC) and starch maximums (16), and the use of total mixed rations (TMR), some degree of SARA may be inevitable in high-producing dairy herds because total chewing and rumination times per kg of rumen-fermentable organic matter (RFOM) intake declines as RFOM intake increases (Figures 1 and 2). Using RFOM intake to predict fermentation acid production and total chewing time to predict salivary buffer flow, the widening difference between acid production and buffer flow as RFOM intake increases is presented in Figure 3. Increased intake of RFOM as milk production increases is a normal consequence of high milk production, because

of increases in DM intake and the feeding of higher-concentrate diets to increase dietary energy density (15).

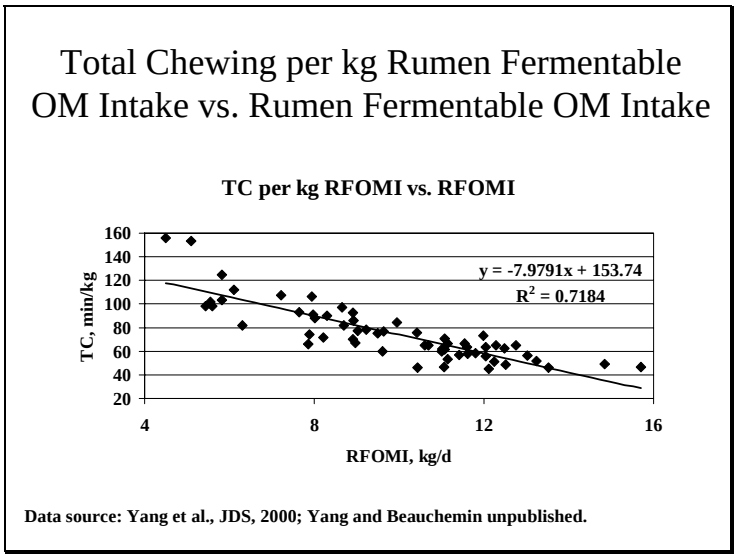

Figure 1. Relationship between total chewing time per kilogram of rumen-fermentable organic matter intake and intake of rumen fermentable organic matter.

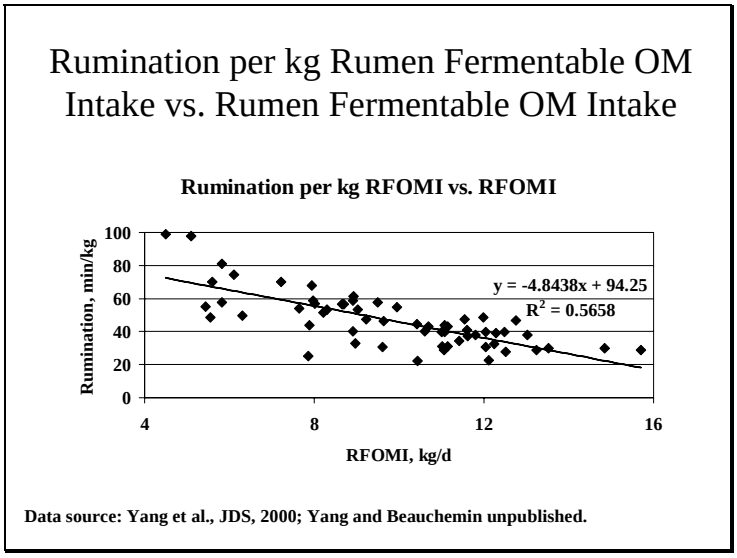

Figure 2. Relationship between rumination time per kilogram of rumen-fermentable organic matter intake and intake of rumen fermentable organic matter.

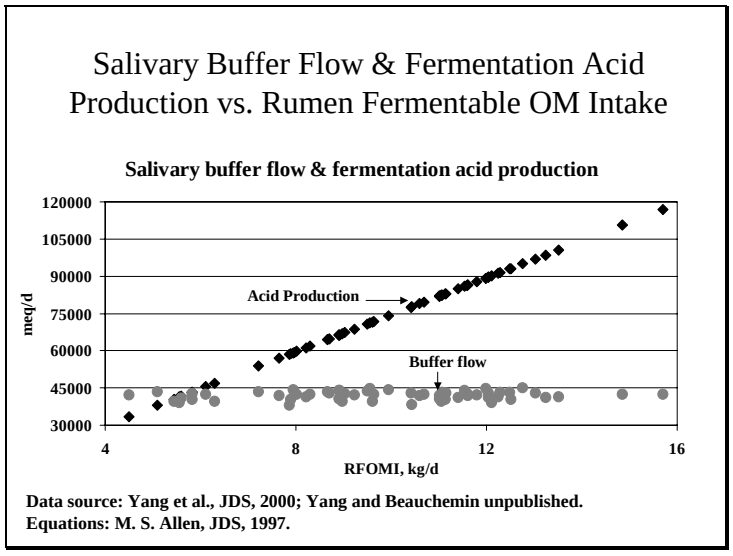

Figure 3. Calculated fermentation acid production and salivary buffer flow at varying intakes of rumen-fermentable organic matter.

Increases in chewing duration (min/d) at increasing levels of milk production were not proportional to the increase in DM intake, and total chewing and rumination times per kg of DM intake declined as milk production and DM intake increased (5). Total chewing ($r = -0.77$; $P < 0.01$) and rumination ($r = -0.68$; $P < 0.05$) times per kg of DM intake were negatively correlated with milk production (5). These observations explain the relationships presented in Figures 1 – 3, which highlight the difficulty that we face in avoiding SARA in high-producing dairy herds. The foregoing discussion implicates bunk management as a risk factor for SARA in high-producing dairy herds, because margins for error in feeding programs are small.

Shaver (20) discussed feed delivery and bunk management aspects of acidosis and laminitis in dairy herds. Included in the myriad of errors in feed delivery and bunk management that can occur on commercial dairies were:

- errors in feed sampling and analyses,
- errors in ingredient dry matter (DM) adjustments,
- failure to evaluate forage and TMR particle size,
- failure to evaluate grain moisture content and degree of processing,
- errors in ingredient feeding rates,
- mixing errors including over-mixing that causes particle size reduction,
- poor feeding and management of transition cows,
- feed sorting, and
- practices that promote consumption of fewer and larger meals more quickly.

The latter two areas will be discussed in this paper. It should be noted that bunk management practices that cause an increased incidence of SARA may or may not result in an increased incidence of laminitis. Nordlund (17) reported on the diagnosis of SARA without a high corresponding incidence of laminitis in three grazing herds, and attributed this to the fact that the cows were on dirt rather than concrete. Comparing these findings to diagnostic work-ups done in confined herds, Nordlund (17) suggested that the degree of SARA needed to cause laminitis is greater for cows on dirt than for cows with significant exposure to concrete. Colam-Ainsworth et al. (4) reported increased laminitis in cows that spent more time standing on concrete rather than lying in stalls. Mishra et al. (14) reported lower ruminal pH for dairy cows in hot-humid (29.4° C and 85% relative humidity) than cool (18.3° C and 50% relative humidity) environments when fed either high-roughage (35% grain; pH of 6.1 vs. 6.4) or high-grain (65% grain; pH of 5.6 vs. 6.1) diets, possibly because of decreased rumination activity, increased slug feeding, and (or) increased feed sorting associated with the hot-humid environmental conditions. Cow comfort, her environment, and the formulated diet need to be evaluated in conjunction with bunk management practices when investigating laminitis problem herds.

■ Feed Sorting

Leonardi and Armentano (8) and Martin (10, 11) observed extensive TMR sorting in the feed bunk in university and on-farm trials, respectively. Data on particle size of TMR and orts and DM intake indicated that cows sorted against the coarse particles (8). This sorting against the coarse particles was more evident for the TMR containing 40% compared to 20% alfalfa hay (DM basis), and the variation in sorting among cows was large (8).

Martin (10, 11) determined the particle size of TMR and bunk mix at 6-h intervals post-feeding on a commercial dairy. The percentages on the top screen of the Penn State shaker box (7) for TMR and bunk mix at 6-, 12-, 18-, and 24-hours post-feeding were 9.3, 13.7, 21.5, 27.5, and 58.7%, respectively. Cows sorted against the coarse particles. From a projection of the coarse particle intake at each time period, it appeared that intake of coarse particles was less than predicted during hours 0 – 12 post-feeding and more than predicted during hours 13 – 24 post-feeding.

Leonardi et al. (9) reported that feeding oat silage with increasing particle size increased sorting against coarse TMR particles. Burato et al. (3) reported that cows with the highest pre-trial milk yield had increased sorting against the coarse TMR particle fraction. This response in feeding behavior reduced the original difference in particle size between their long- and short- chopped alfalfa hay diets resulting in no effect of diet particle size on feed intake or milk production.

Factors that may make TMR prone to sorting include: DM content and particle size of forage and mix, variation in bulk density of feed ingredients, large pieces of cobs and husks in the corn silage, amount and quality of hay added to mix, improper sequencing of ingredients into the mixer, frequency of feeding and push-up, availability of bunk space, and bunk access time. An on-farm evaluation of sorting should include particle size determination (7) of TMR, bunk mix, and refusals.

If sorting is determined to be a problem, then one or more of the following options may need to be considered: feeding smaller amounts of TMR more frequently, adding less hay to the mix, processing hay finer, using higher quality hay, using hay that is more pliable, processing corn silage, addition of water to dry TMR, and addition of a liquid feed supplement (LFS) to TMR.

Carver (personal comm.; Quality Liquid Feeds, Dodgeville, WI) determined the particle size of TMR, bunk mix, and refusals (Lammers et al., 1996) on commercial dairies. Data for TMR and refusals are presented in Table 1. There was sorting against the coarse particle fraction for TMR with no LFS added, as shown by the increased percentages retained on the top screen of the Penn State shaker box for refusals. Addition of LFS to TMR appeared to

alleviate the problem of sorting against the coarse particle fraction, as shown by the lack of increase in percentages retained on the top screen of the Penn State shaker box for refusals. It should be noted that these would not be considered to be dry TMR, as they averaged about 55% DM across the farms with a range of 51 to 58% DM. A .9 kg. LFS/cow/day TMR inclusion appeared to be more effective than a .5 kg. LFS/cow/day TMR inclusion. Adding LFS as the final ingredient in TMR was more effective for reducing sorting than adding LFS to forage, which was more effective than adding LFS to concentrates. It should be noted that adding LFS to TMR to prevent sorting also adds rumen-fermentable carbohydrate to the diet through molasses and (or) whey. This needs to be evaluated closely relative to the diet that the LFS is being added to so as to not cause, rather than ameliorate, an acidosis problem.

Table 1. Percentages of TMR and refusals on top screen of Penn State shaker box from five dairy farms (L. Carver, personal comm., QLF).

	No LFS	No LFS	LFS	LFS
Dairy	TMR	Refusals	TMR	Refusals
	%	%	%	%
A	9.6	26.7	15.8	8.5
B	3.1	16.7	7.8	8.1
C	16.5	53.5	34.7	27.2
D	33.5	52.8	26.7	21.8
E	25.0	55.0	33.0	25.0

■ Meal Patterns

Ruminal pH declines following meals with the rate of pH decline increasing as meal size increases and as dietary neutral detergent fiber (NDF) concentration decreases (2). Bunk management practices that cause cows to eat fewer and larger meals more quickly may be associated with an increased incidence of SARA and laminitis. Factors that can cause slug feeding of the TMR include:

- limited bunk space,
- limited feed access time,
- restricted feeding versus feeding for 5% to 10% refusal,
- inconsistent feeding schedule,
- infrequent TMR push up,
- bunk competition, and
- heat stress.

The combination of limited bunk space (< .45 m per cow) and feed-access time (< 16 to 20 hours per day) is worse than either situation alone. The use of lock-ups in situations of limited bunk space and feed-access time exacerbates the problem, because each lock up and the cow in it takes up .61 m of bunk space. When overcrowding of free stalls coincides with limited bunk space, as is often the case, the potential for laminitis is greater because cows may spend more time standing on concrete rather than lying in stalls (4).

Feeding the TMR in a drive-by bunk at 10 cm above the cow alley rather than in an elevated bunk increases salivary flow and reduces sorting (1), which may help reduce SARA. Milton (13) reported that feedlot cattle fed to a clean bunk had reduced frequency of meals (4.5 versus 8.2 meals per day) and greater average meal size (3.5 versus 1.6 kg per meal) than cattle fed ad libitum. Milton (13) also reported that deviations of 2 to 4 hours from a normal feeding schedule greatly increased the risk of acidosis in feedlot cattle. Frequent TMR push-up may encourage cows to come to the bunk for more frequent consumption of small meals. First lactation heifers fed in a separate group spent 10% to 15% more time eating and consumed 0.5 to 2.0 more meals per day than herd-mates grouped with mature cows (6).

■ Conclusions

Some degree of SARA may be inevitable in high-producing dairy herds, because total chewing and rumination times per kg of RFOM intake declines as RFOM intake increases. Bunk management is a risk factor for SARA, and a myriad of errors in feed delivery and bunk management can occur on commercial dairies. Bunk management practices that promote feed sorting and slug feeding must be controlled to minimize the incidence of SARA. Cow comfort, her environment, and the formulated diet need to be evaluated in conjunction with bunk management practices when investigating laminitis problem herds.

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