



Is forage quality upsetting your cows' time budget?

FORAGE quality and feedbunk management affect the time that cows need to stand at the bunk while they consume, chew, and swallow their feed. Research tells us that poorer quality forages take the cow longer to chew into smaller pieces that are easily swallowed.

If the cow spends too much time at the feedbunk eating, it likely reduces the time the cow has available for resting and ruminating. The most effective rumination occurs while lying down — termed recumbent rumination — and we need



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to ensure that our forages and feeding management allow the cow to balance eating time with resting and rumination time.

The healthiest and most productive cows are able to simultaneously meet their needs for eating, resting, and ruminating. Cows that aren't rushed while eating and have the freedom to lie down and ruminate tend to have higher rumen pH. We know that avoiding rumen acidosis or a low pH promotes fiber fermentation, microbial growth, and more milk component production.

Forage and dietary characteristics such as fiber content, fiber digestibility, and especially ration particle size can alter eating time substantially. A review of the scientific literature shows us that variations in these fiber attributes can easily change eating time by as much as one hour per day. Typically, a cow will eat between three and five hours daily, so a shift of one hour is something we need to be concerned about.

For example, a simple substitution of brown midrib corn silage, with its higher fiber digestibility, for conventional silage in a total mixed ration can reduce eating time by a half hour. Or, if poorer quality, coarsely chopped forage causes your cows to spend an extra hour of eating each day, will they have sufficient time to meet their feed intake targets and resting requirements?

Rethinking particle size

Eating time changes noticeably in response to forage quality, but rumination time is often much less affected — why is that? The answer lies in what happens to the forage and feed particle length while the cow is eating.

For rations where the main forages are corn or hay crop silage and

some chopped hay, we have noted a sixfold reduction in the longest particles of the total mixed ration prior to swallowing of a feed bolus during eating. The cow spends the time and effort to reduce the particle size of the ration to a relatively uniform size before swallowing. This may not be the case with pastured cows, but it certainly seems true for cows fed diets based primarily on silage and modest amounts of hay.

Even when a cow is fed forages or a ration with longer particle size, what is swallowed is fairly uniform at 8 to 11 millimeters (mm) in length, regardless of particle size of the feed in the bunk. Research shows that with longer or less digestible particles, cows spend more time chewing each mouthful of forage fiber before they swallow it.

The relatively uniform particle size of the swallowed bolus of feed explains why rumination is not as affected as eating time by dietary particle size. What enters the rumen is much more uniform, and the longest particles have been chewed and reduced in size during eating. Essentially, the leveling effect of chewing while eating dampens the rumination response because many of the longest particles get chewed into smaller pieces before swallowing.

Based on this research, time spent eating at the feedbunk can be considered an overlooked component of forage quality. We know that lower quality forage is less digestible, and we need to also understand that it takes longer to eat. Both have the potential to reduce energy intake.

The trade-offs

What happens to chewing activity if you don't adjust for differences in fiber particle size, content, or digestibility?

Table 1 illustrates what can happen. In this study, the same forage mix comprised mainly of corn silage and alfalfa was fed at increasing percentages in the diet. As forage percentage went up, dry matter intake dropped, which is not surprising. At the higher forage levels, the cow simply filled up with fiber.

Associated with this reduction in intake, eating time climbed by nearly two hours per day. The extra time spent eating was especially evident when forage percentage went to 60% of the ration and above.

An important point to remember is that eating time between three and five hours per day encourages natural feeding behavior and cow performance. When the ration is more than 50% forage, it takes more than five hours per day to eat the feed. This situation is far from optimal, and it illustrates why it is so important to make sure that forage quality and particle size are correct

as higher forage diets are fed.

Rumination times climbed as well, but much less than eating time for the reasons explained earlier. Here is the important point — as total chewing time increased (driven mainly by eating time), resting time diminished in direct proportion. In other words, the extra time required for the cow to stand at the feedbunk to chew and swallow the feed as forage content rose was at the expense of resting time.

We know that we should never put a cow in a management environment where it must choose between eating and resting. Resting is fundamental to cow health and productivity, and our feeding management should never force the cow to choose between eating and lying down.

Thoughts on particle size

Based on the effect of forage and ration particle size on chewing behavior and the need to encourage the cow to have a good balance between eating and resting, we have put together the recommendations in Table 2 for total mixed ration particle size distributions when using the Penn State Particle Separator.

We want to minimize the long particles that are retained on the top (19 mm) sieve, targeting 2% to 5% of the sample (as-fed basis). These long particles are easily sorted and require more time for eating, especially as they reach 8% to 10% of the ration.

The most important sieve is the next lower one (8 mm), which should retain more than 50% of the ration sample. These particles are still long enough to stimulate rumina-

tion and are approximately the size that the cow will chew the particles to during eating anyway.

So, why not make a cow's work easier when chopping the forages? The overall management goal is to provide a diet that can easily be consumed within three to five hours, leaving ample time to lie down and ruminate.

Keep in mind that the ration fiber characteristics and the recommended particle size must be part of a system that keeps feed in front of the cow, minimizes excessive competition for feed at the bunk, and provides ample access to comfortable stalls.

The ideal situation

To strike the right balance between time at the feedbunk and time spent resting and ruminating, we must ensure that ration forage content, particle size, and fiber digestibility allow efficient feed intake. We want to populate the rumen with particles retained on the second sieve of the Penn State Particle Separator to avoid excessive eating time and to stimulate rumination. Importantly, cows must have access to stalls to encourage resting and rumination, which effectively buffer the rumen. And finally, feed needs to be available all day, every day and be pushed up within easy reach of the cow.

We need to focus on feedbunk management and forage fiber characteristics. In many ways, we have done a disservice to the dairy industry by focusing on these separately when, in fact, they interact on the farm to affect the cow's behavior and performance. 🐮

Table 1. Time needed as ration forage content increases

Item	40%	50%	60%	70%	Difference, 40% vs. 70%
Dry matter intake, lb./d	49.3	47.3	44.7	41.1	-8.2 lb/d
Eating, min/d	286	292	342	393	+107 min/d
Rumination, min/d	426	454	471	461	+35 min/d
Total chewing, min/d	712	745	813	853	+141 min/d
Resting, min/d	728	695	627	587	-141 min/d

Source: Jiang et al., 2017. J. Dairy Sci. 100:2660-2671.

Table 2. Optimal total mixed ration (TMR) particle size¹

Sieve	Sieve size, mm	% of sample retained	Comments
Top	19	2 to 5	Sortable material, too long, increases time needed for eating; especially if >10%.
Mid 1	8	>50	Still long and functional particles, more so than 4-mm material. Maximize amount on this sieve, 50% to 60%.
Mid 2	4	10 to 20	Functions as physical effectiveness factor (pef) sieve; no recommendation for amount to retain here other than total on the top 3 sieves = pef.
Pan	—	25 to 30	40% to 50% grain diet results in at least 25% to 30% in the pan.

¹Source: Cotanch, 2017. The Wm H. Miner Ag Research Inst. Farm Report, Feb., page 9.