by John Goeser

Open up your corn to new opportunities

HISTORICALLY speaking, more corn in a total mixed ration (TMR) generally has led to more milk, assuming rumen pH and health were not compromised. For many years, corn was inexpensive and returns in terms of milk production were valuable. However, corn prices are now as volatile as the milk prices and dairy margins are slim to nonexistent or negative.

Our focus has shifted to extracting every bit of energy and performance from each pound of TMR; it is not acceptable to just "feed more corn." We must better understand how the corn in the diet is being used by high-performing cattle.

Starch in corn and fiber in forage contain the same inherent energy potential per pound (both are carbohydrates). Yet, starch and fiber are very different in that we understand fiber contributes substantially less energy per pound due to being less digestible. Starch can be digested in both the rumen and lower gastrointestinal tract whereas fiber is primarily digested in the rumen. Starch and fiber digestibility will never be equivalent, hence the historic thought that more grain equates to more milk.

Starch averages 90 to 95 percent total tract digestibility whereas fiber averages 40 to 45 percent. The range around total-tract neutral detergent fiber digestion (TTNDFD) is approximately 20 to 30 units whereas the range around total-tract starch digestion (TTSD) is 5 to 10 units for dairy cattle.

Starch deserves attention

Hence, our nutrition focus is typically TTNDFD when searching for nutrition opportunities; however, corn grain and starch deserve more attention. Despite the TMR's TTSD range being 85 to 99 percent (meaning cows capture 85 to 99 percent of corn's energy value), rumen starch digestion has been recognized to vary considerably more.

Corn starch digestion averages 60 to 70 percent of starch and may range from 30 to 95. Put another way, if there are 10 pounds of corn grain in the diet, roughly 6 to 7 pounds will be digested on average, but hard corn or poorly processed corn may be as little as 3 to 4 pounds digested.

This means milk could vary 5 to 10 pounds per cow. Further, poor rumen starch digestion of fresh chopped corn silage is known to be the reason behind the historic "new crop slump" that could explain 5 pounds of milk or more per cow. Fermentation is known to soften corn and improve starch digestibility, but it's still about the particle size.

Fermentation, seed genetics, the crop's growing environment, and grind or processing (particle size) dictate how digestible starch is within the rumen for both silage and grain. Due to cereal hardness, wheat and barley grain are more readily digestible than corn, but processing is critical to performance for all grains.

Pat Hoffman, formerly of the University of Wisconsin, has taught that rumen and total tract grain and starch digestibility is a function of surface area, which is largely related to particle size. To understand how grain reacts in the rumen, think about completely covering 12 square feet in a child's sandbox with rocks versus fine sand. A larger amount of coarse gravel will be needed to blanket cover the sandbox bottom as opposed to fine sand because fine material covers more surface area pound for pound. Grain and starch digestion is somewhat similar, finer is better and covers more ground.

Mike Rankin

MANY FACTORS INFLUENCE the digestibility of starch in corn, which impacts the total energy available from corn.

Rumen bacteria and microbes floating around in the rumen fluid first need to attach to grain before digestion can begin. The finer ground or processed grain allows more attachment sites for bacteria to attach, thus digestion can proceed more quickly and to a greater extent. Greater rumen starch digestion then provides energy for microbial protein production and can kick start other nutrient (fiber) digestion to optimize TMR use by the cow.

In 2016, our team evaluated and reported at the annual dairy science meeting how mean particle size (micron) related to rumen starch digestion. We found that micron size (450 versus 650 micron) was significantly related to digestion but also that the standard deviation around the mean (was there a wide or narrow range in particle size, such as large chips of corn greater than 2,000 micron) was a substantial predictor for digestion.

Both mean micron size and standard deviation can be combined into a surface area calculation developed by Kansas State researchers. What does this mean?

Dry corn ground finer (less than 450 micron), with a consistent distribution (surface area greater than 110 cm^2/g), will optimize rumen digestibility and milk potential. The same is true for high-moisture corn and corn silage; however, the benchmarks are different depending on the extent of fermentation.

Consult with both your nutrition adviser and management team and talk about ways to further open up your farm's corn. Consider finer screens, different grinder types, contemporary processors, or finer roll gaps for better surface area.

The greater the surface area, from dry corn to corn silage, the better rumen digestion. The goal then should be better than 75 to 85 percent rumen digestion with finely processed grains. More fully opening up your corn can pay and the outcome can be substantial, adding several pounds of milk or more to your bottom line.

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