

The next frontier: protein and starch digestion

FORAGE nutrient digestion and energy yield is a function of the feed's nutrient content and subsequent digestion by the animal. Fiber content and digestion has been a major focus in ruminant nutrition, laboratory measures, and forage quality for decades. Fiber quality is important and has been discussed in recent Feed Analysis interpretation columns. However, dairy and beef nutrition programs will be expanding focus over next decade to include a couple different nutritional analysis metrics in feed evaluation — protein and starch digestibility.

Protein and starch are highly valuable nutrients within forages. The protein contributed by high-quality grass or legumes provides an offset for expensive purchased feeds like soybean meal or canola meal. The protein digestibility is generally high for lush forages, though, in some cases, heat damage through inefficient fermentation or poor hay curing robs the animal from capturing the protein.

Intestinal digestibility analyses can help nutritionists account for lost protein. Several different laboratory measures capture and express protein intestinal digestibility in two different ways: protein digested in the intestine after bypassing the rumen (% of rumen undegraded protein) and the percentage of total feed protein that is undigestible in the intestines. The latter is a fairly straightforward way to understand the damaged protein in feed. The goal is less than 10% undigestible crude protein, meaning that 90% or more of the protein is used by the animal. Consult with your nutritionists for more insight here.

Corn and sorghum differ

Starch is a bit more like fiber and focuses on the rumen. Starch-rich feeds such as corn silage or sorghum silage contribute substantial pounds of starch to dairy and beef diets. Starch in these two forages is valuable and can offset purchased corn grain when the feed's starch is highly digestible.

However, nutritionists treat corn and sorghum silage starch very differently due to differing starch digestibility between the two. For example, nutritionists may discount the total starch amount in sorghum silage because sorghum berries are less digestible than corn kernels.

There is potentially valuable starch in sorghum berries much like corn kernels, but sometimes cattle are less able to access the starch in berries due to the hard grain. That's not to say that sorghum silage isn't a valuable alternative forage. Sorghum silage will outperform corn in energy yield under extreme drought conditions. This is an unfortunate reality for many; hence, there will likely be more sorghum in dairy and beef diets in the future, and starch digestibility needs to be accounted for. Thankfully, today's feed analysis report accounts for rumen starch digestibility.

In the rumen

Beyond sorghum silage, we are increasingly focusing on rumen starch digestibility to separate high-quality feeds from poor ones. Starch digested in the rumen yields energy for gain and milk production and provides energy and substrate to grow valuable microbial protein. The new crop slump associated with corn silage is mostly due to limited starch digestibility.

Fermentation enhances starch digestibility, which impacts how well the silage feeds. Over the past 10 years, feed-testing laboratories have brought feed rumen starch digestibility measures onto feed analysis reports, and we can accurately account for these factors.

As with fiber, laboratories measure rumen starch digestibility at different rumen incubation time points and express starch digestibility as a percent of total starch. These measures help rank feeds and tighten up diet formulation. With corn silage, the 7-hour starch digestibility goal is greater than 85% to 90%. The range in rumen starch digestibility is as low as

40% to 50% of total starch and as high as 95% for extremely well-processed and fermented silages.

It's a balancing act

Within diet formulation software, rumen starch digestibility measures are combined with total feed starch to calculate digestible starch. Nutritionists now formulate for both total dietary starch and digestible starch. The latter stands to be more predictive for milk production potential or milk fat depression. Too little digestible starch hampers performance, but slightly too much rumen digestible starch can be costly in milkfat depression in dairy cows.

For dairy and beef cattle, starch is digested both in the rumen and lower digestive tract. Combine the two and we end up with total tract starch digestibility (TTSD). TTSD is accurately predicted with a manure starch analysis. The starch content in manure is known to negatively correlate to TTSD for dairy and beef cattle and even growing calves. The goal for TTSD in dairy and beef cattle is greater than 98% of total starch, understanding that the best farms can achieve these levels. There is little tolerance for valuable corn grain passing through in the manure.

Whether analyzing protein rich forage, starch-filled silage, or manure, the protein and starch digestibility metrics reported on nutrition analyses are worth considering when evaluating feeds or formulating diets. Using these protein and starch digestibility metrics can help your farm optimize your feeds' potential and limit costly protein or energy supplements. ●

JOHN GOESER

The author is the director of nutrition research and innovation with Rock River Lab Inc, and adjunct assistant professor, University of Wisconsin-Madison's Dairy Science Department.

