by John Goeser

Quantifying nutrient digestibility starts with fiber

I'VE recently opted for a diesel truck, primarily to step up the range between fuel stops. It's got a 33-gallon fuel tank, but the range equation is more than just a larger fuel tank. Both tank size and fuel conversion efficiency are needed to project distance to empty. Sorting out energy value in your forage analysis is similar.

Nutrient content and digestibility measures are needed to project the energy value of forage. Nutrient amount is like the fuel tank size, then measuring nutrient digestibility is like the miles per gallon in the energy value equation.

Measuring and reporting forage nutrient digestibility began with neutral detergent fiber (aNDF) decades ago. Fiber, sugar, and starch each contain the same calorie potential, but the energy released from fiber by dairy or beef cattle is roughly half that of starch or sugar due to limited digestibility. Fiber digestibility is also related to how much forage dairy or beef cattle can consume. Hence, growers, feeders, and nutritionists have focused on fiber content and digestibility initially to better quantify forage energy value.

Forage testing laboratories use in vitro rumen techniques to assess fiber digestibility. These biological assays are complex. The short method explanation is that living rumen microorganisms are collected from cannulated donor cows via rumen fluid, and the fluid is used to inoculate and digest a feed sample on a lab bench. The term for this approach is in vitro, meaning simulated rumen.

Expanded measures

The undigested fiber amount (uNDF) is measured after a designated time period. Laboratories began with a 48-hour in vitro rumen incubation and have expanded to report many more digestion time periods. The common fiber digestibility measure (NDFD) is actually a calculated value. Laboratory technicians measure total fiber and undigested fiber and then calculate NDFD. This has been a confusing topic, with forage reports listing both uNDF and NDFD on forage reports. For clarification, the math is as follows:

- uNDFX, % DM = undigested fiber after X time period, as a % of feed dry matter
- NDFDX, % aNDF = (aNDF - uNDFX) / aNDF x 100

Initially, a NDFD48 was a good and simple start, but the aNDF digestibility section within the feed analysis report has grown to be exceedingly complex over the past decade. The following NDFD time points are now reported for different feeds: 12, 24, 30, 48, 72, 96, 120, and 240 hours. Further, Cornell University researchers noted that fiber contains a bit of ash contamination. Thus, fiber digestibility measures are now reported on an organic matter basis as well. The math is as follows:

- uNDFXom, %dry matter = uNDFX minus residual ash, as a % of feed dry matter

Less repeatable

Consider the following points to aid in fiber digestibility data interpretation. Laboratory NDFD is a biological measure, originating from living cattle. We readily understand that cattle and farms are quite different from one another; hence, a lab assay originating from an animal's rumen should be recognized as less repeatable relative to lab measures like crude protein or starch, which rely upon standard chemical reagents.

Further, forage testing laboratories also utilize multiple different wet chemistry fiber digestion methods such as a rumen fluid standardization protocol (standardized) or a traditional rumen fluid protocol (traditional). In general, fiber digestion results should not be compared between different laboratories or methods.

Beyond NDFD48, NDFD30 has become more popular with nutritionists and incorporated into the relative forage quality (RFQ) index. The RFQ is a more robust forage quality ranking than the relative feed value (RFV) calculation, partly because it accounts for NDFD. These feed index calculations are covered in more depth by Dave Mertens and me in previous columns originally published in the April/May and August 2020 issues.

In addition to NDFD30 or 48, the 12- to 72-hour measures have been brought online to estimate fiber digestion over time and calculate digestion rate in nutrition models. Think of this like how your truck measures fuel consumption per mile over a trip to calculate fuel conversion efficiency.

Similar to rebar

Then the 120- and 240-hour measures have been brought onto the report to quantify the lignified and indigestible fiber. Think of this fraction as equivalent to the rebar in concrete. The uNDF240 measure has become useful to benchmark different crops and make forage to concentrate adjustments within farms. In general, compare your forage uNDF or NDFD results to laboratory and method benchmarks and within time point and laboratory measures.

Lastly, the 24-, 30-, 48-, and 240-hour in vitro rumen measures have been integrated into a total tract NDF digestibility (TTNDFD) measure, which the University of Wisconsin's Dave Combs spent roughly a decade investigating and verifying. The TTNDFD equation is similar to that used by advanced nutrition models, accounting for both lignified fiber and digestion rate. It is comparable between forages, and, in general, the TTNDFD goal is 45% or greater. ●

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