Update on TTNDFD – A New Test for Evaluating Forages for High-Producing Dairy Cows

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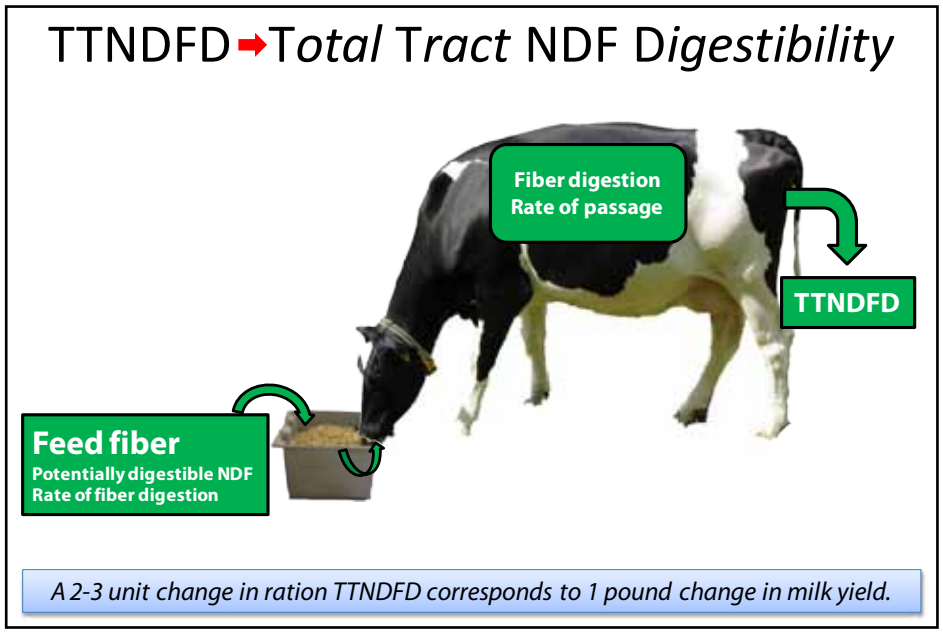
In diets for high-producing dairy cows, 20-25% of the energy for milk production comes from digested fiber. For the typical dairy ration, ~42% of the fiber consumed is digested. Digestibility of NDF is highly variable and can profoundly affect intake and milk production. Increasing ration fiber digestibility by 2-3 units provides enough additional energy to support an additional pound of milk production.

Dairy scientists at the University of Wisconsin-Madison have developed a lab test predicting total tract NDF digestion (TTNDFD). The in vitro TTNDFD assay has been calibrated to NIRS and quickly and inexpensively predicts NDF digestibility of alfalfa, corn silage, grass forages, and byproduct feeds.

Figure 1. Feed and cow factors are combined to measure true fiber digestion.



The TTNDFD test is designed to predict how the process of forage fiber digestion is expected to occur in high-producing dairy cows (Figure 1). The TTNDFD test considers several feed characteristics and cow factors affecting fiber digestion. The lab assay accounts for rate of fiber digestion and proportion of forage fiber potentially digestible. Both rate and proportion of fiber able to be digested are important plant characteristics affecting fiber utilization. In addition, the test also accounts for how the cow affects fiber digestion. As cows eat more, rate of passage increases, which means feed is not retained in the rumen as long. Microbial digestion of fiber in the rumen takes time and, therefore, higher producing cows eating more will not digest fiber as completely as cows eating less. The TTNDFD values can be adjusted for rate of passage if a cow's dry matter intake is known. Digestion beyond the rumen must also be accounted for to accurately predict the amount of energy derived from NDF. Approximately 90-95% of fiber digestion occurs in the rumen, but the digestion of fiber in the hindgut is still a significant source of energy for milk production. The TTNDFD assay integrates all four of the above factors into a single value and predicts the NDF digested between the mouth and feces.

The TTNDFD assay is currently the most reliable lab measure of in vivo digestion because it is the only lab test integrating the cow and plant factors affecting fiber digestion. Other forage quality tests, such as NDFD30, uNDF240, relative forage quality (RFQ), and milk per acre or milk per ton (Milk 2006), are tools providing a relatively imprecise index of forage fiber digestibility. Comparing the NDFD30 values of two alfalfa samples, for example, can be somewhat useful. However, comparing the NDFD30 value of an alfalfa to the NDFD30 value of a grass or corn silage is not a valid comparison. This means NDFD values cannot be used to optimize the combination of corn silage, alfalfa, and grass in dairy forage systems.

The TTNDFD test, however, can be used across forage types, which means it is a much more flexible tool for evaluating forages and balancing rations. The TTNDFD values are a direct prediction of in vivo fiber digestibility. Typical corn silage or alfalfa silage will have a TTNDFD value of ~42%, which means we would expect for every pound of fiber consumed, 0.42 lbs of fiber will be digested. A typical dairy cow will consume about 16 lbs of NDF per day, which means she would digest ~6.72 lbs of NDF per day. If the TTNDFD of the diet could be increased to 45%, 16 lbs of fiber would provide another half pound of digested fiber per day.

The TTNDFD test has been available for about 4 years and thousands of forages have been assayed by this relatively new procedure. Typical TTNDFD values for corn silage, alfalfa, and grasses are summarized in Table 1. The values represent over 13,000 samples of corn silage, 7,000 samples of alfalfa, and nearly 3,000 grasses submitted to a commercial forage testing lab for routine forage analysis in 2015. The means and ranges in TTNDFD values coincide with directly measured values having been reported in dozens of controlled feeding studies published in scientific journals such as the *Journal of Dairy Science*.

Table 1. Typical TTNDFD values of forages harvested in 2015[1].

Forage	aNDF	TTNDFD	Range in TTNDFD*
Corn silage	41.0	40	30-50
Alfalfa silage	41.0	42	30-54
Grass silage	52.4	51	31-71
Grass hay	61.1	45	24-68

*Mean value ± 2 standard deviations
[1]Samples submitted to Rock River Laboratories, Watertown, WI, in 2015 and 2016.

Corn silage and alfalfa fiber have similar TTNDFD values of ~40-42%. Fiber digestibility can be quite different between two forages with virtually the same NDF content. The ranges in TTNDFD depicted in the table are two standard deviations above and below the means, which account for about 2/3 of the samples analyzed within each forage type. In the case of corn silage, for example, TTNDFD values ranged from ~30% of NDF (two standard deviations below the mean) to 50% of NDF (two standard deviations above the mean). In a dairy ration containing ~35% corn silage, cows fed a corn silage with a fiber digestibility of 50% compared to 30% TTNDFD would consume enough extra digestible energy to support up to 7 lbs more milk per day.

The grass silage samples submitted for routine testing were typically ~11 units higher in total NDF than corn silage or alfalfa silage. Fiber digestibility (TTNDFD) of grass silages, however, averaged 51%, which suggests ~0.5 lb of NDF is digested from each pound of grass NDF consumed. The higher NDF content of grass silages (and therefore lower quality) is offset to a degree by the higher NDF digestibility value for grasses.

Our feeding studies with corn silage, alfalfa, and grasses indicate TTNDFD values of feeds can be used in ration formulation to 'fine-tune' digestibility of NDF in rations of high-producing dairy cattle. Average TTNDFD value for most diets formulated with alfalfa and corn silage will be ~42% and this should be a target for ration formulations. Diets can be balanced to provide more digestible fiber by using feeds such as soy hulls or forages with TTNDFD values >45%. These more highly digestible fiber sources can be used to offset low fiber digestibility corn silage or alfalfa or to simply increase ration fiber digestibility. High quality grasses become an intriguing option in dairy rations because of their inherently high fiber digestibility. Grasses with high fiber digestibility would be a logical fit with low-fiber corn silage-based diets, for example. The ability to predict fiber digestibility and incorporate this information into rations could improve our ability to optimize forage utilization and milk production.

For additional information, visit the Wisconsin Team Forage website found at https://fyi.uwex.edu/forage/files/2016/02/TTNDFD-FOF.pdf.