

by John Goeser

# Dairy nutrition's tribal language: Speaking fiber

**D**ISTINCT groups of people tend to develop speech nuances over time. For example, a friend of mine in college who was a native of the Eastern U.S. described 12:45 p.m. as “quarter of one.” I had to ask what this meant as this was a foreign phrase to me.



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Languages may be associated with distinct groups based upon region, ethnicity, or profession. Many have found that dairy nutrition consultants speak a tribal language, inundated with confusing terms.

As a nutritionist, I cannot argue this outside assertion. We're driven to translate such confusing dairy nutrition terms relating to fiber, and I personally aim to have those reading this understanding and speaking the same fiber language as those of us in the nutrition profession.

## What is fiber?

Fiber is a nutritional, heterogeneous mixture of different organic compounds and chemical bonds. Fiber is like a Russian nesting doll in that neutral detergent fiber (NDF), the dairy nutrition basic fiber measure, also houses several other nutritional fiber fractions. When your forage testing laboratory measures fiber within a feedstuff, the technique is much like washing pants within a laundry machine. Just as the laundry machine washes away everything but your pants, the laboratory uses a neutral detergent to wash away everything but the fiber fraction of the feedstuff.

A laboratory first uses a neutral detergent along with amylase (a) to rinse away starch, protein, sugar, fat, and other nonfiber compounds. The residue after the neutral detergent rinse is called neutral detergent fiber (aNDF), but said residue also houses a few other nutrition components as indicated in the figure.

As pants within a washing machine cycle may have gravel or sand in the pockets during and after the final rinse, NDF contains some ash and soil contamination. The lab accounts for this by burning the sample after the NDF measure to quantify the residual ash content.

After the NDF is measured, the laboratory comes back to the feedstuff fraction with a moderate acid detergent followed by a strong (sulfuric) acid to quantify acid detergent fiber (ADF) and lignin, respectively. The aNDF, ADF, and lignin are all residue measures after detergent rinses. Both ADF and lignin have been historically understood as related to fiber digestion; however,

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**UNDERSTANDING FIBER AND ITS DIGESTIBILITY** is a bit like learning to speak a foreign language.

Ryan Ebert

newer nutrition measures are far more accurate in predicting dairy cattle performance.

## What is fiber digestion?

High-performing dairy cows can digest around 40 percent of the total fiber in the diet, and most of that digestion occurs in the rumen. In a forage testing laboratory, lab technicians use rumen simulating techniques (called *in vitro*, meaning completely removed from the animal) to “digest” fiber for different lengths of time.

NDF digestion (NDFD) is calculated by subtracting the undigested NDF (uNDF) from the total fiber and expressing that difference as a percent of total fiber. The equation looks like this:

$$\text{NDFD (percent of NDF; time = X)} = (\text{NDF} - \text{uNDF}_{\text{Time=X}}) / \text{NDF} \times 100$$

Think of this math like estimating how much fuel you've burned through while working ground. If only a quarter of the tank is left after the day's work, then we know that we've burned through 75 percent or three quarters of the diesel in the tractor. Fiber digestion is calculated the same way.

More recently, the uNDF itself has become a popular nutrition term as nutritionists are recognizing this as the “new lignin.” The uNDF at time = 240 hours (uNDF240) is replacing lignin in our ration formulations and nutritionist tribal language. This new parameter is thought to be better related to intake and is also much better measured by forage testing labs than lignin ever was.

Feed never stays in the rumen for

240 hours, but this extensive digestion is necessary to find out just how much fiber is available to burn up in the rumen. Think of this as understanding how much wood is in the fire pit when we make a campfire. We may not sit in front of the fire the entire time, but we know relatively how much energy or heat there will be in the fire by knowing how much wood is in the pit.

## What is the best NDFD time?

Initially (historically), a digestion time of 48 hours was used to estimate fiber digestion because this was the relative amount of time that forage resided in the rumen, in cows consuming at a maintenance intake level (dry cow or springing heifers only needing to maintain their body weights). Then nutritionists recognized that a high-producing dairy cow's TMR fiber may only be in the rumen for 24 to 30 hours and thus digestion time of 30 hours (30 hours NDFD) became more popular.

We've since better recognized that TMR rumen retention time depends on many factors, so using just one time point to estimate digestion is not appropriate. Today's high-performing cows (60 to 70 pounds of dry matter intake) may only retain forage fiber for 24 hours or less! Yet, that same forage may be fed to fresh cows where rumen retention time may be 36 to 40 hours. Because of this variability, there is no “best NDFD” measure on a forage analysis report. We need to measure digestion at multiple points in time and then

calculate the NDF digestion rate (NDF  $k_d$ )<sup>1</sup> to help us estimate fiber digestion in many different animal stages, at different intakes.

Think of the NDF  $k_d$  similar to how dry or wet firewood is within a fire pit. The wood burns at a certain rate depending on dryness, and fiber is very similar. Fiber either burns fast or slow, and by knowing the NDF  $k_d$ , advanced nutrition models (such as the Cornell Net Carbohydrate and Protein System (CNCPS)) will estimate real-time fiber digestion in your cows.

More recently, David Combs with the University of Wisconsin has developed the total tract NDF digestion (TTNDFD, percent of NDF) measure; the term TTNDFD has also become a popular nutrition term and practical ration component measurement tool. This tool uses both uNDF240 and NDF  $k_d$  in a rumen model to estimate true dairy cow digestion. It is simple in that it is just a single number.

Consider TTNDFD as four measurements packed into one prediction. It is a tool to help better forecast how cows will respond when switching forages.

Now that we've thoroughly discussed the many sides and corresponding terminology of fiber, your head may be spinning. The terms briefly introduced and discussed here have evolved over 40 years of dairy nutrition research. Combined with everyday analogies, these terms can improve your understanding of the complex dairy cow's nutrition.

Conceptualizing the nature and measurements of a key component of your dairy herd's ration, such as fiber, can help you better understand and engage in your discussions with your nutritionist — using his or her own tribal language. 🐄

Of note, many refer to the  $k_d$  as the “kd rate” — this is grammatically incorrect as the “k” signifies a rate and the “d” signifies digestion. This would be like saying NDF digestion rate rate, repetitively. The correct term is “NDF  $k_d$ ” which means fiber digestion rate.

## The fiber nesting doll

