



by Steve Martin

# Cows need both digestible and indigestible fiber

**E**ARLY in my dairy nutrition career, I spent more time in milking parlors because that is where much of the nutrition was delivered in those days. Pellets in the barn and free-choice grass hay in the lot was the norm in East Texas back in 1991. The diets weren't very complicated in the ration software, but several principles of dairy nutrition were in play and resulted in the success of those cows. We've come a long way in feeding dairy cows since, but the fact that both digestible and indigestible fiber play pivotal roles to success has not changed.



Martin

In those days, we had just started talking about acid detergent fiber (ADF) and neutral detergent fiber (NDF). At least these breakthroughs moved the U.S. past the days of crude fiber. The problem with the parlor-fed diets was the slug feeding of palatable grain either two or three times a day in the parlor and free-choice hay that included no guarantee of actual consumption. To make matters worse, at times, the hay was not particularly good quality.

But, why did it work as well as it did? Sure, those cows milked less than cows of today, but more complicated feeding systems aren't the only improvements we have made in our industry in the past 30 years.

## Why did it work?

There are two factors that resulted in success. One was that the forage that was consumed was in a long form and required significant rumination. So, cud chewing could be pretty good.

Secondly, the most successful grain diets that were fed in the parlor were not high in starch but contained high levels of fiber by-products. The most important one of these grain by-products was soybean hulls. Though some grain mixes higher in starch were also successful, the ones higher in fiber were probably the best choices.

It sounds like a lot of fiber, though. — fiber in the barn and fiber in the hay ring. There are two key nutrients we use today in building more modern dairy rations that describe the situation back in the pastures of East Texas and still help cows today.

These two nutrients are digestible NDF (NDFD) and undigested NDF (uNDF). It is through understanding what these two measures

are attempting to describe that supports the high-fiber pellet parlor feeding approach.

## The great fibers

This brings me to why I love soy hulls. I guess to be fair, and not to overtly support the soybean industry, I love digestible hemicellulose. Soy hulls are rich in this fiber as are other ingredients like beet pulp, citrus pulp, and even common corn by-products. It is this fiber, which even though it is still fiber and thus needs microbial action to be digested, is actually quite high in energy to support milk.

Carbons are at the root of all forms of energy from oil to corn. We often think about starch as the primary energy driver in rations. This is true, but we know that there is a limit to how much starch you can feed a healthy dairy cow.

Enough about starch . . . this column is about fiber! What about the carbons in the fiber? Don't they count, too?

Fiber, as a defined nutrient in a dairy diet, also can be described with terms like roughage and forage. Cows and other ruminants were designed to harvest energy from these carbon chains that are unavailable to mammalian digestive tracts and the enzymes in those tracts. Fiber simply keeps a human's digestive system in good, working order. Fiber for a cow, though, is fuel.

Most dairy producers are familiar with the terms ADF and NDF as well as relative feed value (RFV), which is a blend of the two attempting to capture a forage's real feeding value. Over time, NDF has become the measure of choice and has now been fractionated to better describe the high soy hull pellet and the low-quality grass hay.

This fractionation allows us to predict how much of the NDF will be digested in a diet and how fast it can happen. First, NDFD tells us something about the speed at which this fiber can be fermented by rumen microbes.

Conversely, uNDF tells us that no matter how long it stays in the rumen, this portion of fiber will never turn into fuel for the cow. That sounds like a failure for fiber, but wait — we need some of that as well in the ration if we are to milk healthy cows. It is this indigestible fiber that keeps the cow healthy and encourages good rumination. This is non-negotiable in a successful dairy diet.

## Make a solid connection

I love it when science connects with good cow sense. Every beef and dairy owner has a concept of what is good quality forage and what is not. They also know a few things about when to expect each type.

Lower maturity, early season hay is known to be better than later season hay that maybe grew a bit

too long between cuttings. Even the novice cattle owners have a good grasp of this situation. Measuring the NDFD and uNDF in these differing forages will explain why they were right about their gut feeling. More importantly, these nutrients assign numeric values to these perceived quality differences.

The reason the basic diets worked for me in East Texas in 1991 is that there was enough digestible fiber (NDFD) in the high soy hull pellet and enough undigestible fiber (uNDF) in the long-stem grass hay to support good milk flow and cow health. When I build much more complicated total mixed rations (TMRs) for my clients today, I am doing math on those two nutrients. I must be sure we have enough digestible fiber in the rumen to compliment the starch and protein along with enough indigestible, structural fiber in silage and hay to encourage healthy rumination and good components.

## Back to the beginning

There is one last kicker I want to mention. With recent interest in de novo fatty acid analysis and the diagnostic tool that it can be for a nutritionist, it is amazing that the de novo fatty acid we want to create for high milkfat results come not only from the fiber in our forages but also the fiber in the by-products like soy hulls. Both of these very different fiber ingredients in the ration result in acetic acid production in the rumen.

Acetic acid is the building block for milkfat. The soy hulls don't offer much in effective fiber to encourage good rumen health, but they are highly digested and support milk flow. Most forages aren't nearly as highly digested as the soy hull fiber, but they are partially digested for fuel while they offer structure to a healthy rumen.

In my master's thesis defense, I was asked by a leading forage nutrition researcher on my committee to draw the breakdown of the different fiber fractions on the board. I remember describing a grass hay by drawing pie charts showing the cellulose, hemicellulose, and lignin and how these types of fiber combined to create the common ADF and NDF we use today. I knew then that as a plant matured, the lignin began to combine with the hemicellulose, and thus, reduced its digestibility in the rumen.

Now, some 35 years later, every forage analysis I study and carefully enter details into my model uses these same principles in the two nutrients NDFD and uNDF. We all have an idea of what we might consider good forage and bad forage. In reality, they are not really good and bad. The cow needs some of both. Using NDFD and uNDF helps me be sure they get enough of each. 🐄

The author is the founder of DNMCmilk, which works with dairy producers and heifer growers in several regions of the U.S. and around the world.