What a CAMPFIRE can teach us about FIBER DIGESTION

John Goeser for *Progressive Dairyman*

Forage will always be an important and key point of dairy nutrition. With constant fluctuation in forage quality crop-to-crop and year-to-year, it can be perplexing to try to determine how cows will respond. As a supporting consultant working with thousands of dairy consultants, three key questions continue to re-emerge relating to forage quality and change.

- How do we better determine how much forage we can feed?
- How does this year's crop look?
- How can I expect my dairies to respond?

These seem like simple questions, yet it has historically been extremely difficult to project animal responses to forage crop changes. But why?

In most cases, dairy performance swings following forage changes are a result of carbohydrates, namely fiber and starch. These two nutrients make up 50 percent or more of an average dairy TMR and provide a majority of the diet's energy.

Following corn silage crop changes, pinning down which nutrient caused an animal response can be difficult. In some cases, the response is caused by corn silage rumen fiber (neutral detergent fiber or NDF) breakdown differences between crops, while in other cases starch triggers the performance swing. In grasses and legumes, for crop changes stimulating animal response, the focus is purely on fiber.

So if rumen fiber breakdown (or lack thereof) explains half of the corn silage crop and nearly all of the grass- or legume-triggered performance changes, why do we still struggle to forecast the response magnitude or size? The answer lies in how fiber is metabolized in the cow's rumen.

Professor David Combs with the University of Wisconsin has taught that fiber is broken down dynamically in the rumen very similarly to how wood burns in a fire pit. Moreover, determining how much energy comes from fiber digestion is akin to realizing how warm a bystander will be when sitting at that fire. This analogy can help us understand the complex digestion process.

With a campfire, two things are important to determine warmth and to roast marshmallows: enough wood to sustain the fire and dry wood that needs to burn fast. Fiber-fueled energy yield in the rumen is no different. There are two factors that need to be quantified and integrated to accurately forecast how cows will respond:

1. Potentially digestible NDF (pdNDF, percent of NDF)
   - The amount of wood in the fire pit
   - This is determined in a laboratory as 100 – uNDF content.
   - uNDF = undigested NDF after extremely long rumen incubation time, e.g., 120 or 240 hours
2. Fiber digestion rate (kd, percent per hour)
   - The speed of the wood in the pit burning
   - This is determined in a laboratory by making several rumen fiber digestion measures over time (e.g., 24, 30 and 48 hours) and assessing how fast the fiber disappears.

So where do the 30- or 48-hour NDF digestibility (NDFd) measures fit? In the past, the industry used 30 and 48 hours as a proxy for rumen feed retention time. These data were a good start in trying to better understand animal responses, but we can do better. Your dairy demands improved precision and accuracy, and 30- or 48-hour NDFd estimates are not the most accurate measures this industry has available. Rumen NDF retention time ranges from 20 to 50-plus hours, depending on dry matter intake (DMI). Dry and transition cows, with much less DMI, will have much longer rumen retention times than your high-pen cows, where it's common to have 60 to 70-plus pounds of DMI.

So how do we harness just a single forage analysis and ration to match up to various DMI levels and dynamically predict cattle performance? The answer lies in using both the NDF kd and pdNDF values for a forage.

This is complicated, but we can now more accurately assess animal response to forage changes by integrating both NDF digestion rate and potentially digestible NDF with the fiber passage rate (or a rumen retention time estimate, based on animal factors). By simplifying these concepts into tools that can be applied in herd nutrition decision-making, there are two popular evaluating applications available in the industry:

1. *Ration evaluation model:* The Cornell Net Carbohydrate and Protein System (CNCPS)
2. *Forage evaluation model:* The total tract NDF digestibility (TTNDFd) developed by Combs and the University of Wisconsin – Madison

Both CNCPS and TTNDFd integrate NDF kd and pdNDF with animal passage rate to better help us understand how cows will respond to forage changes, whether from crop to crop or year to year.

The CNCPS framework is utilized most heavily by consultants to evaluate an entire ration and not necessarily individual forages. This aids in making on-farm nutrition decisions or in determining new crop potential.

The TTNDFd measure is used by both dairies and consultants. This value has taken a different approach, being simple and straightforward. The TTNDFd measure evaluates individual forages, with capabilities to predict across forages, and is reported on forage analyses. Yet TTNDFd further has potential to evaluate the entire ration, if one desires.

We can use these tools to document current forage performance and then, through laboratory analyses with the new forage, better predict animal responses. In either application and regardless of forage type or ration, the goal is 48 percent or greater TTNDFd.

Fiber digestion and applications in determining animal performance are confusing topics. However, through analogies and explanation, we can better understand these complex yet valuable tools that dairies and consultants are using, ultimately working to improve precision and performance. **PD**

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