Forage & Fiber Terminology Review

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The number of different fiber terms on forage analysis reports has increased due to new inputs in improved nutrition models, especially to better estimate fiber digestibility in lactating dairy cattle. Understanding these helps compare forages for allocation to animal groups and management evaluation or hybrid decisions. Different fiber-related terms you may find:

- **Neutral Detergent Fiber (NDF):** Consists of the plant cell wall (containing cellulose, hemicellulose, and lignin) which contributes to rumen digesta fill and is inversely related to feed intake. In the analysis, plant cell solubles (starch, sugars, pectin, fat, and some protein and ash) are dissolved, leaving the plant cell wall. Generally, dairy cattle will have lower intake as forage fiber concentration increases due to slower digestion and greater fill. Guidelines for lactating cow ration NDF is ≤40% NDF for alfalfa and corn silage, and <45% NDF for temperate grasses. There are some variations in NDF analysis which result in different acronyms on reports:
  - **aNDF:** NDF measured with the inclusion of amylase to remove starch, and sodium sulfite to remove protein.
  - **aNDFom:** aNDF corrected for ash content, providing a better estimate of fiber when soil contamination is an issue. If not corrected, fiber may be overestimated and can lead to rumen health issues. Ash correction allows for more accurate estimation of available fiber and energy content in forages.

- **Acid Detergent Fiber (ADF):** Consists of a portion of the plant cell wall (cellulose and lignin) and is negatively related to forage digestibility. ADF used to be a part of forage energy calculations, however, it is less accurate than calculating Total Digestible Nutrients (TDN).

- **Lignin:** Part of the plant cell wall considered not digestible. Can be used to estimate fiber digestibility. Lower values are desirable.

- **Non-Fiber Carbohydrate (NFC):** A calculation to estimate the easily digestible carbohydrates (starches and sugars) in feeds. NFC is typically high in grain silages with values of 40-50% typical in corn silage.

- **Ash:** Measured by burning the forage sample in an oven. It estimates mineral and soil content. Soil contamination due to harvesting can drastically increase ash levels and reduce energy value. For every additional %-unit of ash, TDN will decrease 1%. Typical ash value of hay/haylage is 8-9% and corn silage is 5%.

- **NDF Digestibility (NDFD):** Fiber digestibility is important to estimate how much fiber cows can digest and forage energy value. Labs offer different incubation times, typically 24, 30, and 48 hours; 24 and 30 best reflect time fiber stays in the rumen of lactating dairy cattle, while 48 may better reflect high forage diets for heifers, dry cows, etc. Near Infrared Spectroscopy (NIR) or wet chemistry estimates NDFD. NIR provides a good estimate of common forages such as alfalfa and grass hay/haylage or corn silage. Use wet chemistry for uncommon forages since NIR may not be accurate.

- **Indigestible NDF (iNDF):** Nondigestible fiber in rumen with infinite time. Standard term used in research, but uNDF was coined by dairy scientist Dave Mertens to better describe fiber digestion.

- **Undigested NDF (uNDF):** Similar to iNDF except a specified fermentation time is chosen. Measured by incubating the forage either using in vitro fermentation (in the lab) or in situ (in the cow's rumen) for a time-point where minimal change in fiber occurs. The most common time-point is 240 hours. Undigested NDF estimates are important to new fiber digestion calculations in certain nutrition software. It is used to estimate the potentially digestible NDF by subtracting the uNDF from NDF which allows better estimates of forage energy. Also, uNDF is negatively related to rumen fill, so higher uNDF concentrations can limit forage intake. This can be used to compare forage with lower uNDF forages having greater intake potential.

- **Rate of NDF Digestion (Kd):** How quickly fiber is digested in the rumen. Mainly used by nutritionists to estimate fiber digestion. A faster (higher) rate of digestion is better.

- **Total Tract NDF Digestibility (TTNDFD):** A system developed at the University of Wisconsin by Dave Combs and John Goeser (Rock River Laboratory). The system is based on a new in vitro method in which data is more comparable to the cow. Samples can be analyzed by NIR or wet chemistry. The TTNDFD system uses uNDF to calculate potentially digestible NDF and uses multiple incubation time-points (24, 30, and 48 hours) to estimate fiber digestion in the rumen. It then adds the amount of hindgut fiber digestion to rumen fiber digestion to estimate total tract digestion. TTNDFD estimates can be compared across forage types, unlike traditional NDFD estimates. According to Combs, the target values for alfalfa and corn silage are >48% TTNDFD and >50% TTNDFD for temperate grasses.

- **Total Digestible Nutrients (TDN):** Estimate of energy in forage. Calculation adds up all digestible components of feed. The higher the value, the more energy is in the forage. TDN = digestible protein + digestible fat + digestible NDF + digestible NFC.