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Understanding Forage Quality Analysis

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Many dairy producers in Texas do not have the land to grow their own forages. Consequently, they rely on both local and out-of-state farmers for supplies. This gives Texas forage producers an excellent opportunity to expand their markets into the dairy industry.

To take advantage of this opportunity, both dairy and forage producers need more information about the terms associated with forage quality analysis. Understanding forage quality analysis should improve the marketing relationship between dairy producers and forage growers. By collectively developing a suitable price for a forage crop, both parties can benefit.

Methods of Forage Quality Analysis

There are two methods used to analyze forage samples in a laboratory. These include the traditional wet chemistry analysis and the newer, near-infrared reflectance spectroscopy (NIRS) analysis. Wet chemistry analysis, based upon well-established chemical principles, uses chemicals and drying agents to determine the components of a forage. NIRS analysis is a computerized method of forage analysis that uses near-infrared light to determine forage quality. Although NIRS analysis is faster and less costly, there is debate on the complete accuracy and interpretation of the analysis, particularly if a sample contains a mixture of forage species or if the machines are not calibrated with the same species from the same area.

Forage Quality Parameters

While most dairy producers are familiar with detailed forage quality analysis, many forage producers are not. This is primarily because forage producers have been traditionally paid on the basis of tonnage produced. Understanding quality factors is a key to marketing forages to dairies. Forage quality indicators important to dairy producers include protein, neutral detergent fiber (NDF), acid detergent fiber (ADF), net energy for lactation (NE_l), and relative feed value (RFV).

Protein. Crude protein (CP) can be a significant nutrient component of forages, particularly legumes. Unfortunately, many producers (both dairy and forage) use this value as a sole indicator of quality. Laboratories measure the nitrogen (N) content of a forage and calculate crude protein using the formula CP = %N x 6.25. Generally, forages harvested at early vegetative stages of growth have higher crude protein contents than more mature forages harvested at (or later than) flowering stages.

Fiber. Plant fiber consists of three components: cellulose, hemicellulose and lignin. The primary source of ration fiber comes from forages. As the fiber content of a forage generally increases its energy content decreases. The dairy cow needs a minimum amount of fiber to maintain good rumen function by stimulating cud chewing, rumen movement, and the production of saliva for buffering. The forage variety and its stage of maturity at harvest influence the fiber content of the crop.

The traditional measure of energy content in feedstuffs was total digestible nutrient (TDN) content. However, this is a vague term and does not accurately describe the plant's available energy. Because a better indicator of energy was needed, a new system was developed for feedstuff analysis. The detergent analysis system was developed to separate the cell solubles (starch, protein, sugars) from the fibrous portion (structural support for the plant). The soluble portion provides most of the energy, while the fibrous portion may limit intake. The fibrous portion is separated into two components, NDF and ADF, which nutritionists use to more accurately formulate dairy rations.

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Neutral Detergent Fiber measures all the fiber found in forage (hemicellulose, cellulose and lignin). The NDF fraction is partially digestible, depending on forage species and stage of maturity. Bulk density and NDF are positively correlated, so forage and ration NDF levels are used to predict feed intake. A high NDF content in forages not only decreases intake, but limits the effectiveness of a forage in supporting high milk production.

Acid Detergent Fiber measures the cellulose and lignin content in the plant. ADF is also partially digestible. Both animal and laboratory trials have shown that increasing ADF levels decrease fiber digestion. Because of this negative relationship between ADF and digestibility, low ADF is desirable. Factors increasing forage ADF content include increasing maturity, weathering, rain damage, high temperatures and weeds.

Of the fiber fractions (hemicellulose, cellulose, lignin), cellulose is the major one digested by the animal. However, lignin can bind up the cellulose fraction and lower digestibility. This is a concern with southern-grown forages, as high temperatures during the growing season increase plant lignification. The higher the concentration of lignin, the less digestible the fiber will be. For example, compare two forages having similar ADF contents (30%). Forage A is 25% cellulose and 5% lignin, while forage B is only 20% cellulose but 10% lignin. Forage A, containing the lower percentage of lignin, is more digestible and can support greater milk production.

Net Energy for Lactation. This is a calculated value to estimate the energy available to support milk production. This calculation is based on a formula that includes the results of ADF analysis. Net energy is expressed in terms of megacalories per unit of feed. Different equations are used around the country, so caution is required when comparing the NE_l of feeds tested at different locations.

Relative Feed Value. A number of factors must be considered to accurately evaluate forage quality. Analyze forages for CP, NDF and ADF, as well as for mineral content. While each is used directly in the formulation of dairy rations, comparing several forages for quality rank can be confusing. Relative Feed Value is an index (no units attached to values) which combines digestibility and intake potential into one number. The RFV system was developed for comparing forages on the basis of energy. The RFV ranks a forage relative to full bloom alfalfa (full bloom alfalfa is considered to have a RFV equal to 100). For example, a forage with a RFV of 120 contains 20 percent more energy than mature alfalfa. The digestibility and potential intake values are determined from ADF and NDF analysis. Previously, crude protein was also included; however, it was removed from the equation because of its low correlation with digestibility and intake and its considerable variability. Also, protein is much more easily manipulated in the dairy ration than fiber digestibility.

Forages ranked by RFV are assigned a quality grade ranging from prime (highest) through grade 5 (lowest). Values for bermudagrass need to be used with caution, as a high RFV does not always equate to high levels of milk production. Also be careful comparing values from different sources, as there are several different equations for calculating RFV.

Table 1. Hay grades and their relative feed values (RFV).

GRADE	RFV
Prime	>151
1	125-151
2	103-124
3	87-102
4	75-86
5	<75

Summary

Putting forage quality analysis into use with commercial dairy rations can be complicated. Many environmental and management factors affect forage quality. However, forage quality is critical to the dairy producer as it drives the feed supplementation program and the resulting milk production.

Forage quality should be determined only through analysis from a reputable laboratory. Important quality factors to consider include CP, NDF and ADF. Both dairy and forage producers must understand forage quality analysis. The dairy producer must know the nutritional content of a particular forage crop to develop the best possible feeding strategies. The forage producer must understand forage quality analysis to grow forage that dairies are willing to pay for. Table 2 summarizes the target nutrient parameters for common forages grown in Central Texas for dairy rations.

Table 2. Targeted nutrient content (dry matter basis) of selected forages for dairy rations.

Feed	CP %	NDF %	ADF %
Alfalfa hay	20	40	30
Bermudagrass hay	14-16	65	30
Corn silage	8	51	28
Sorghum silage	6-8	63-69	33-38
Wheat silage	12	49-57	27-34

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