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Interpreting Forage Analysis

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Feed quality analysis,

especially forage testing, involves determining nutrient levels. It is one of the most effective feed and forage management tools to eliminate guesswork and effectively match forage and feed supplies to animal nutrient requirements, design supplemental feeding programs and evaluate forage production.

Visual appraisal does not reflect forage nutrient content reliably. Laboratory analysis is the recommended way to determine forage nutrient content and value. Once you have the lab report, understanding the terminology is equally important for interpreting forage nutrient analysis reports effectively. Below are definitions for common components of a nutrient analysis report.

As Received

All values under this heading show the content of the nutrients with the moisture in the forage sample included. Because of the dilution with water, the values will be lower than the dry-basis column. To convert values in this column to dry-matter values, divide by the percentage of dry matter.

Example:
10.77 (ADF as received) divided by 0.3377 (DM) = 31.89.

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Forages should not be compared on an as-received basis unless they have the same percentage of dry matter. This column also may be reported as "As Fed."

Dry Basis

Values in this column give the nutrient information with the water removed. This allows comparisons to be made between forages. It is the best indication of nutrient value because animals tend to eat on a dry-matter basis. Unless forages get very wet, animals will eat more of a wetter forage until they have eaten the same amount of dry matter. Conversion to the as-received or as-fed value can be made by multiplying the value by the percentage of dry matter.

Example:
19.36 percent crude protein on the as-received basis would be 19.36 x 0.3377 (DM) = 6.54.

Crude Protein (CP)

Laboratories measure the nitrogen (N) content of the forage and calculate crude protein using this formula:

CP = % N x 6.25.

Crude protein will include true protein and nonprotein nitrogen. Cattle can use both types to some varying degree. Crude protein values give no indication if heat damage has occurred, which may alter protein availability.

Unavailable Protein

A forage analysis report will not always show this value unless heat damage is suspected and the analysis is requested. This value will give an indication if excessive heating has occurred, reducing protein digestibility. All forages have some unavailable protein. This value also may be reported as ADF-N protein, ADF-CP, bound protein or insoluble protein.

Available Protein or Adjusted Crude Protein (ADICP)

In some reports, this value will be the difference between crude protein and unavailable protein. However, some laboratories account for the naturally bound protein found in all forages. This normally bound protein may be up to 12 percent of the crude protein. Laboratories that account for the naturally bound protein will reduce the crude protein value (available will be lower than crude protein) only when the 12 percent value is exceeded.

Acid Detergent Fiber (ADF)

This value refers to the cell wall portions of the forage that are made up of cellulose and lignin. These values are important because they relate to the ability of an animal to digest the forage. As ADF increases, the digestibility of a forage usually decreases. Many of the calculated values appearing on the forage reports are generated using ADF values.

Neutral Detergent Fiber (NDF)

The NDF value is the total cell wall, which consists of the ADF fraction plus hemicellulose. Neutral detergent fiber values are important in ration formulation because they reflect the amount of forage the animal can consume. As NDF percentages increase, dry-matter intake generally will decrease. Many laboratories analyze for ADF but may not include NDF values.

Neutral Detergent Fiber Digestibility (NDFd)

NDFd is a measure of the digestibility of neutral detergent fiber. This approach enables nutritionists to formulate better rations. More accurate energy predictions can be made and dry-matter intake achieved. Wet in vitro and NIRS (near infrared spectrophotometry) tests are used.

Lignin

Lignin is the prime factor influencing the digestibility of plant cell-wall material. As lignin increases, digestibility, intake and animal performance usually decrease and the percentage of ADF and NDF increase.

Minerals

In many wet-chemistry laboratories, calcium and phosphorus are the only two minerals reported in a standard forage analysis. If NIRS is used to test the forage, potassium and magnesium also may be reported. Other minerals can be analyzed for by request. Wet-chemistry processes determine macro minerals as a percent and trace minerals as parts per million (ppm). The macro minerals include calcium, phosphorus, potassium and magnesium. Wet chemistry will be required to determine iron as ppm, copper, zinc and manganese.

Ash

This represents the mineral content of the feed or forage. Forages contain 3 to 12 percent ash on a dry-weight basis while grains and concentrates contain 1 to 4 percent.

Fat

These are the oils and related compounds found in grains and forages that naturally make up approximately 2 to 4 percent of the ration.

Starch

Starch is classified as a carbohydrate. Nonstructural carbohydrates reside in the cell, and their digestibility is about 90 percent.

Volatile Fatty Acids (VFA)

Fermentation analysis will assist in understanding the quality of the fermentation and silage. Data interpretation will tell us whether an excellent, average or poor fermentation occurred. An analysis report will include pH; lactic, acetic, propionic and butyric acids; ammonia; and ethanol.

Calculated Values

These values are generated from equations that use other data from the analysis of the forage sample. Laboratories are not required to use the same standardized formulas. This makes comparisons among laboratories difficult. Laboratories should be able to provide the source and accuracy of the formulas they use.

Total Digestible Nutrients (TDN)

Some laboratories use the same formula to calculate the TDN value as they do the DDM; therefore, the two values would be the same. Other laboratories will use different formulas, such as:

Alfalfa: % TDN = 96.35 – (ADF % x 1.15)
Corn silage: % TDN = 87.84 – (ADF % x 0.70)

As the percentage of ADF increases, TDN will decrease.

Net Energy-Lactation, Net Energy-Maintenance and Net Energy-Gain

These net energy values often are calculated from TDN values, which in turn are generated from the percentage of ADF.

Examples are:

NEL: Mcal/lb = (TDN % x 0.01114) – 0.054
NEM: Mcal/lb = (TDN % x 0.01318) – 0.132
NEG: Mcal/lb = (TDN % x 0.01318) – 0.459

As the percentage of ADF in the forage increases, the net energy values will decrease.

Relative Feed Value (RFV)

Relative feed value is an index that combines the important nutritional factors of intake and digestibility. It has no units, but the index allows comparisons of legume, grass and legume-grass forages.

For example, a forage with an ADF of 41 percent and an NDF of 53 percent has an index of 100.

When forage has a value of 100 (indexed to full-bloom alfalfa), it is not superior quality forage. This is because the ADF and NDF values that generate the value of 100 are relatively high, thus the forage is not considered any better than average. As the percentage of ADF and NDF decrease, the RFV will increase. Theoretically, hay with a 110 RFV would have 10 percent more energy than full-bloom alfalfa.

The dry-matter intake (DMI) potential may not be reported but rather used to calculate RFV. This combines dry-matter intake and the digestible dry-matter (DDM) values of the forage discussed in the next column.

For example:

RFV = (% DDM x % DMI) ÷ 1.29

Dry Matter Intake (DMI)

The percentage of NDF can be used to estimate dry-matter intake. The formula used for the calculation is:

DMI (as a % of body weight) = 120 ÷ % NDF

For example, DMI = 120 ÷ 40% NDF = 3.0% of body weight

Feeding studies have shown that as the percentage of NDF increases in forages, animals consume less.

Digestible Dry Matter (DDM)

This is an estimate of the digestibility of the forage. This value is generated from the percentage of acid detergent fiber formula:

DDM = 88.9 – (ADF % x 0.779).

As the percentage of ADF increases, the estimated digestibility will decrease.

Higher RFV values indicate higher forage quality. Because the RFV system was developed using legume forages and intake responses of lactating dairy cows, it works best when applied to that situation.

Relative Forage Quality (RFQ)

Researchers designed the relative forage quality (RFQ) index to use fiber digestibility to estimate intake as well as total digestible nutrients (energy) of the forage. The RFQ index is an improvement over the RFV index for those who buy and sell forages, and it better reflects the performance that can be expected from cattle fed those forages. In addition, RFQ prediction differentiates legumes from grasses.

The RFQ emphasizes fiber digestibility while RFV uses digestible dry-matter intake. For a more thorough understanding of the complexity of RFQ, see ***www.uwex.edu/ces/crops/uwforage/RFQvsRFV.htm***, which University of Wisconsin researchers created.

Yeast/Mold Count

A yeast and mold count determines whether microbial changes in a silage will degrade the nutritional content, leading to possible mycotoxin formation. Yeast counts are a good indicator of unstable or hot silage.

For more information on this and other topics, see www.ag.ndsu.edu

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