



INTERPRETING FORAGE QUALITY REPORTS

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To be useful, a forage analysis report should be based on a representative sample from a single “lot” of hay. (A “lot” is hay from one field which has been cut, handled, baled, and stored under uniform conditions.) The sample should be a consolidation of cores taken from 15 to 20 bales. Finally, the sample should be analyzed by a laboratory whose accuracy has been certified by the National Forage Testing Association (NFTA).

Forages can be analyzed by two methods. Traditionally, laboratories processed forage samples through a series of chemical procedures to determine the various components important in animal nutrition (protein, fiber, minerals). Recent technological advances allow labs to measure these same components using Near Infrared Reflectance Spectroscopy (NIR). The new NIR techniques use light to quickly determine the nutritive value of hay without destroying the sample. Since NIR is calibrated with data from traditional chemistry techniques, both methods give accurate and similar results.

Forage Analysis Information

Forage quality analysis report forms vary from laboratory to laboratory, but usually contain information on moisture (%), dry matter (DM, %), crude protein (CP, %), acid detergent fiber (ADF, %), neutral detergent fiber (NDF, %), total digestible nutrients (TDN, %), and net energy calculations for lactation (NE_L, mcals/lb), maintenance (NE_M, mcals/lb), gain (NE_G, mcals/lb), and relative feed value (RFV) (see Figure 1).

In the analysis report in Figure 1, test results are given on an “As Fed Basis” and “Dry Matter Basis.” The “As Fed” numbers reflect nutrient concentrations in the forage as it was received in the forage lab, including all water present. Because water dilutes the concentrations of all other nutrients, all numbers in the “As Fed” column will be less than those in the dry matter column, with the exception of moisture.

FORAGE TEST REPORT		
Certified Forage Laboratory Lexington, Kentucky		
ANALYSIS REPORT		
SAMPLE NUMBER	1190	
SAMPLE TYPE	Legume Hay	
SAMPLE ID	ALFALFA	
DATE PROCESSED	01-04-1989	
NAME	JIMMY C. HENNING	
ADDRESS	Agronomy Department University of Kentucky Lexington, Kentucky	
COUNTY	Fayette	
-ANALYSIS-		
	AS FED	DRY MATTER
	BASIS	BASIS
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MOISTURE, %	13.3	0.0
DRY MATTER, %	86.7	100.0
CRUDE PROTEIN, %	16.7	19.2
ACID DET. FIBER, %	29.2	33.7
NEUT. DET. FIBER, %	42.1	48.5
TDN, %	53.1	61.2
NE/LACT, MCAL/LB	.54	.62

Figure 1. — Typical forage analysis report.

Use the “As Fed” values when figuring what weight of actual hay will be needed to supply a given amount of a nutrient. For example, the hay in Figure 1 contains 16.7% crude protein on an “As Fed” basis. If a producer wanted to grind enough hay to provide 1,000 lb of protein for a winter feed mix, it would be necessary to grind 5,988 lb of hay ($1,000/0.167 = 5,988$).

The “Dry Matter” column reports the concentration of a given nutrient with all water removed. Use the “Dry Matter” values when communicating information about the forage analysis, because the moisture contents of forages vary. (Unlike forages, nutritive values of mixed feeds are expressed on an air-dry basis, equivalent to having 10% moisture.)

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CAUTION: Buying hay on dry matter analysis alone can be costly. For example, a dairyman in a neighboring state bought a truckload of western alfalfa at a cost of \$135/ton, delivered. The alfalfa had a crude protein analysis of 23% on a dry matter basis. However, the hay also contained 25% moisture. If the load of hay weighed 16 tons, that producer paid \$135/ton for 4 tons of water present in the hay, which is pretty expensive water. A question about the moisture content might have led to a lower price for the hay.

Common Forage Analysis Terms

Moisture, expressed as percent, is the water present in the forage analyzed. **Dry matter (DM)** is the percentage of the forage that is not water. Nutrient concentrations in the “As Fed” column can be determined from the “Dry Matter” column by multiplying the DM concentration of the nutrient by DM expressed as a decimal. Using the example in Figure 1, CP (DM basis) was 19.2%, and DM was 86.7%. Therefore the “As Fed” CP concentration was 19.2×0.867 or 16.7%.

Crude protein (CP) is the sum of true protein and non-protein nitrogen. It is calculated by measuring the nitrogen concentration and multiplying by 6.25. (True protein in forages contains about 16% nitrogen, so there is about 6.25 lb of total protein for each pound of nitrogen present.) It is a measure of a forage’s ability to meet the protein needs of livestock.

Most protein in forages is true protein, with exceptions for nitrate-accumulating summer annual grasses such as sudangrass and pearl millet. Although high-protein forages are also often high in energy, CP content is of little value in determining energy content. Since protein is one of the most costly supplements for livestock, high protein forages are desirable.

Acid detergent fiber (Acid Det. Fiber or ADF) is the percentage of highly indigestible plant material present in a forage. It contains cellulose, lignin, and silica. Acid detergent fiber is a useful predictor of energy and digestibility in forages. Low ADF values mean higher energy value and digestibility since lignin and silica are not digestible by ruminants. Therefore, low ADF values are desirable. *In fact, all of the energy estimates presently used in forage testing are calculated from ADF alone.*

Neutral detergent fiber (Neut. Det. Fiber or NDF) represents all of the structural or cell wall material in the forage. The NDF of a forage is inversely related to the amount that a cow or calf is able to consume; thus, forages with low NDF will

have higher intakes than those with high NDF. In general, legumes tend to have lower NDF values than grasses.

Energy Terms

Total digestible nutrients (TDN) reports the percentage of digestible material in a forage. Total digestible nutrients are calculated from ADF and express the differences in digestible material between forages. This term is used more often with rations for beef or sheep than with dairy rations.

Which Energy Term Should I Use?

The energy term you use (TDN, NE_L , NE_M , or NE_G) depends on how the energy needs for your class of livestock are expressed. For lactating dairy cows, energy requirements are expressed using NE_L . In beef rations for either lactating or dry cows, energy requirements are expressed most often in TDN and sometimes NE_M units. The energy needs of growing livestock are expressed in either TDN or NE units. NE_M and NE_G units must be used **together** to evaluate the ability of forages to put weight gain on livestock.

Net energy of maintenance (NE_M) and lactation (NE_L) are expressions of energy value of forage, in megacalories (Mcal)/lb; they refer to the forage’s ability to meet the energy requirements of dairy and beef cattle. Like TDN, NE_M and NE_L are calculated solely from ADF. Dairy producers generally use NE_L to balance rations for lactating cows, and some beef producers are more accustomed to using NE_M . For most hays, haylages, and silages, the net energy value for lactation will be very nearly equal in number to the net energy for maintenance.

Net energy for gain (NE_G) is the amount of energy in a forage available for growth (and, therefore, weight gain) after the maintenance needs have been met. The value of NE_G is always lower than NE_L or NE_M for a given forage because the forage is used less efficiently for gain than it is for maintenance. NE_G is used when estimating the forage’s ability to put weight on growing animals.

Relative feed value (RFV) is used to compare one forage to another on an *energy* basis. It is derived by taking into account the digestibility (calculated from ADF) and the potential intake (calculated from NDF) of a given forage.

For comparison purposes, the RFV of mature, full bloom alfalfa was set at 100. The alfalfa in Figure 1 has an RFV of 124.4; therefore, it contains 24.4% more energy than mature alfalfa. Although crude protein is not included in the calculation, forages high in RFV will almost always be high in protein.

RFV is becoming a very valuable term in describing the overall value of a forage. In fact, Minnesota research found RFV the most important price determinant in their quality-tested hay auctions.

Interpretation

Understanding a forage test is easiest when it is explained in animal performance terms. For simplicity, the forage represented by the analysis in Figure 1 will be evaluated as hay for a 1,000 lb beef cow and a 500 lb medium-frame steer (Figure 2).

The crude protein content of the alfalfa was more than enough for all production levels of the cow, and would support daily gains of between 2.5 and 3.0 lb/day in steers. However, protein would not be the limiting factor in either animal. In the mature cow, 61.2% TDN would supply enough energy for all production stages except heavy milking (>20 lb milk/day). Steer gains would be limited to about 1.5 lb/day if this alfalfa were the only feed available. So this alfalfa is a better source of protein than energy, which is true for nearly all hays and haylages.

It is more difficult to interpret forage reports from a dairy perspective, since dairy rations contain more ingredients and the nutritional requirements of the dairy cow vary with the desired milk production. However, the basic principles still apply.

Lactating dairy cows need rations high in both protein and energy content. The limiting factor in dairy production is often getting enough energy into the cow while maintaining an adequate amount of forage for good

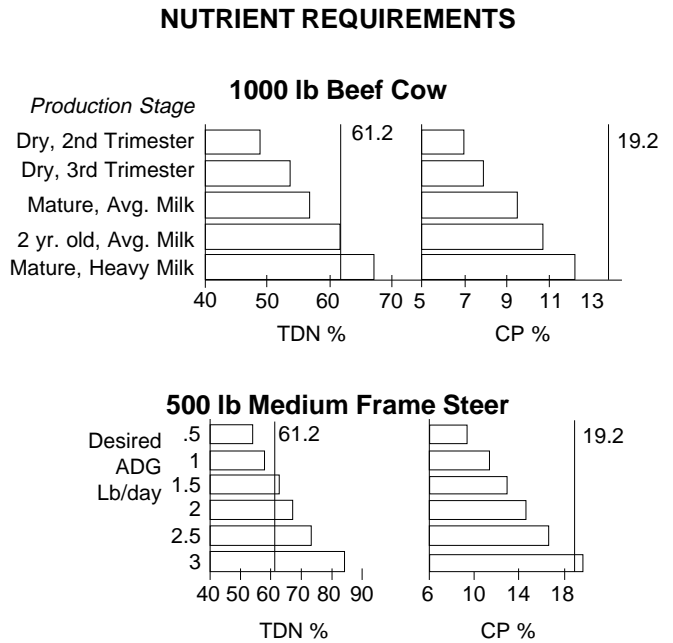


Figure 2. — CP and TDN requirements.

rumen function. High quality forages will have a higher energy concentration (lower ADF) and will be consumed in greater quantities (due to lower NDF) than low quality forages. Therefore, high quality forages decrease the amount of energy that must be supplied from the grain mix in the diet of the dairy cow.

A desirable forage for lactating dairy cows will be high in protein (>17%), and low in ADF (<35%) and NDF (<45%). Many dairymen use the 20-30-40 rule of thumb for evaluating hay. That is, they prefer hay for lactating cows that contains 20% CP, 30% ADF, and 40% NDF.

Summary

Interpreting forage analysis reports is a two-part process. You must first understand the basic terminology and meaning of the important components of the report. Then you must evaluate each forage's ability to produce a desired level of animal performance when it is consumed.