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Interpreting Forage Analysis

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Crude Protein (CP)

Laboratories measure the nitrogen (N) content of the forage and calculate crude protein using the formula: CP = % N x 6.25. Crude protein will include both 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 may also be reported as ADF-N protein, ADF-CP, bound protein, or insoluble protein.

Available Protein

In some reports, this value will be the difference between crude protein and unavailable protein. Some laboratories, however, account for the naturally boundprotein 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 only reduce the crude protein value (available will be lower than crude protein) 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, 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 is comprised 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 percentagesincrease, dry matter intake will generally decrease. Many laboratories analyze for ADF but may not include NDF values.

Crude Fiber (CF)

When the crude fiber system was developed, it was thought to represent most of the cell wall portion of the forage. However, it was later discovered that it did not account for some of the hemicellulose and lignin components. A modified crude fiber (MCF), which includes the ash or mineral fraction, is used in some states, notably California, to evaluate alfalfa. Some laboratories calculate a crude fiber value based on the ADF value.

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 percent ADF and NDF increase.

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. Toconvert values in this column to dry matter values, divide by the percent dry matter. Example: 10.77 (ADF as received) divided by 0.3377 (DM) = 31.89. Forages should not be compared on an as-received basis unless they have the same percent dry matter. This column may also be reported as "As Fed."

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Minerals

In many wet chemistry laboratories, calcium and phosphorus are the only two minerals reported in a standard forage analysis. If NIRS (Near Infrared Spectrophotometry) is used to test the forage, potassium and magnesium may also be reported. Other minerals can be analyzed for by request.

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

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 between laboratories difficult. Laboratories should be able to provide the source and accuracy of the formulas they use.

Digestible Protein (DP)

This calculated value is generated using some percentage of the crude protein value, such as 70 or 72 percent. Other laboratories may use other formulas such as:

(Crude protein x 0.908) – 3.77. The digestible protein value gives no indication if any heat damage has occurred. It has little practical value in formulating rations.

Dry Matter Intake (DMI)

The percent 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 percent NDF increases in forages, animals consume less.

Digestible Dry Matter (DDM)

This is an estimate of the digestibility of the forage. This value is usually generated from the percent acid detergent fiber using formulas such as:

DDM = 88.9 – (ADF % x 0.779). As the percent ADF increases, the estimated digestibility will decrease.

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 percent ADF increases, TDN will decrease.

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

These net energy values are often calculated from TDN values, which in turn are generated from percent 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 percent ADF in the forage increases, the net energy values will decrease.

Relative Feed Value

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. A forage with ADF of 41 percent and NDF of 53 percent has an index of 100. Other forages can then be comparedagainst this value. When a forage has a value above 100, it is not necessarily a 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 percent ADF and NDF decrease, the RFV will increase.

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. For example:

RFV = (% DDM x % DMI) ÷ 1.29

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