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Interpreting Your Forage Test Report

By Peter Robinson, Dan Putnam, Shannon Mueller *(UCD Nutritionist, UCD Forage Specialist, and UCCE Farm Advisor, respectively)*

A nutritionist will tell you that the 'forage quality' should determine the price and feeding value of hay.

Unfortunately, forage quality is a complex trait. There are many factors for a nutritionist to consider: protein, fiber, minerals, fats, sugars, starches, antinutritional compounds, physical and olofactory factors, ability of different classes of animals to extract nutritients, etc. The type of hay can make a tremendous difference in animal performance especially for high producing dairy cows.

The best way to determine the feeding value of forage is to feed it and measure the results. That will tell you truly how that hay performed (past tense) for a specific group of animals. However, the key problem is: **We need to know before we feed!**

There are several simple measurements and observations that are of strong predictive value for the purposes of buying and selling hay. Fiber (measured by ADF or NDF) in particular is a strong predictor of forage quality, since it is the poorly-digested portion of the cell wall. Soluble components (sugars, etc) are almost completely digested. The 'standard' hay test currently includes CP, ADF, and NDF and DM.

Laboratory measurements have come into common use, but it should be emphasized that visual imspection is also important. This is the only way to detect weeds, molds, and physical problems. Different measurements may be needed for ration balancing as compared with measurements needed for ranking hays. The definitions that follow describe the most commonly-reported lab values:

Forage Quality should be Compared on a 100% DM basis, using original lab values such as ADF, NDF, and CP.

Measured Laboratory Values

Dry Matter (DM) – is used to determine the amount of water in hay or silage. The 'as received DM' should be used to adjust yields, if different from a standard DM. Most hay is sold on a 90% DM basis. DM affects only tonnage, not forage quality. Excessively low moisture could indicate brittleness or excessive leaf loss, and high moisture indicates risk of mold.

Crude Protein (CP) - is calculated from the nitrogen content of the forage. The CP value is important since protein contributes energy, and provides essential amino acids for rumen microbes as well as the animal itself. The more protein that comes from forage, the less supplement is needed. However, most nutritionists consider energy value and intake of forages to be more important than CP.

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Neutral Detergent Fiber (NDF) - consists of the slowly digested fibrous portion of the plant: hemicellulose, cellulose and lignin, which is most of the cell wall material (see diagram). As the total dietary NDF level increases, *voluntary feed intake* tends to decline. However, if NDF is too low, stomach upsets such as acidosis and displaced abomasum may occur. NDF is being increasingly used by nutritionists for ration balancing.

Acid Detergent Fiber (ADF) - ADF is a sub-fraction of NDF, consisting primarily of lignin and cellulose. The ADF represents the portion of the hay that doesn't dissolve in an acid detergent solution. It has a strong (negative) relationship with total *forage digestibility.* ADF is used in Calfornia and nationally to define guidelines for hay quality. As ADF increases, forage quality declines.

Acid Detergent Insoluble Nitrogen or Crude Protein (ADIN or ADICP) - estimates the N or CP that is indigestible in the rumen and the intestine. ADICP is important in heat damaged forages and silages.

Calculated Values

There are several values that can be calculated from these lab measurements. The potential energy value of a forage is not an analyzable fraction, since it is dependent upon many factors including type of animal, forage species,

particle size, and esiling.

A number of equations have been used to estimate energy values of forages. The TDN equation has been commonly used in California. Although TDN for alfalfa hay was standardized for alfalfa hay several years ago, ADF is now used for CA and National hay quality guidelines. TDN is not standardized across commodities and regions, whereas ADF is.

Total Digestible Nutrients (TDN) - is calculated from ADF, and estimates the proportion of the forage that can be digested by cattle. TDN is the sum of digtestible CP, digestible fat (multiplied by 2.25), digestible non-structural carbohydrates, and digestible NDF. TDN in California is commonly expressed on a 90% DM basis (multiply TDN100 x 0.9).

Net Energy (NE) - estimates the energy in a forage available to support an animal's energy needs for body maintenance (NEm), lactation (NEl), or body weight gain (NEg). NEm and NEg is often used in balancing rations for growing cattle, and NEl is often used for dairy rations.

Digestible Energy (DE) - DE is the energy in a forage that is not lost in feces.

Metabolizable Energy (ME) - ME estimates the energy in a forage that is not lost in feces, urine, or rumen gases.

Relative Feed Value (RFV) is an index which combines estimates of digestibility (Digestible Dry Matter, DDM) and intake (Dry Matter Intake, DMI). It is not used by nutritionists to balance rations, but is used in marketing.

Calculations:

CP = %N x 6.25

TDN (100%DM) = 82.38-(.7515 x %ADF) (Western Hay Equation)

NEl (Mcal/lb of DM) = ((.0245 x TDN) - .12)/2.204).

NEm = (1.37 x ME) - (.138 x ME^2) - (.0105 x ME^3) - 1.12)/ 2.204.

NEg = ((1.42 x ME) - (.174 x ME^2) - (.0122 x ME^3) - 1.65)/ 2.204.

DE (Mcal/lb of DM) = (.04409 x TDN)/2.204.

ME (Mcal/lb of DM) = ((1.01 x (.04409 x TDN))-.45)/2.204

RFV = DDM x DMI/1.29, where DDM = 88.9-(.779 x %ADF) and DMI= 120/ %NDF.

Reporting and Interpretation

Forage quality values should normally be compared on a 100% DM basis, using the orignial lab values of CP, ADF, and NDF. If hay lots differ significantly in %DM, this will effect the 'true tonnage' of the hay, not the forage quality. In these cases it may be necessary to adjust tonnage or price based upon moisture, but NOT forage quality analyses.

TDN is directly calculated from ADF at 100% DM, and does not reveal anything new about the hay compared with ADF. Therefore, it is simplest to compared ADF values directly if confusion arises. If TDN is used, however, a uniform calculation (see sidebar) and moisture % should be used.

Nutritionists are using NDF lab values much more often than in the past. It is a good idea, therefore, to become familiar with its normal range within forage types. An NDF of alfalfa hay of about 33-37% is considered desireable, 39-40% average, and forage quality significantly declines from 41-45% or above.

None of the values reported on your forage test report, either measured or calculated, should be considered to be absolute. There is a tremendous amount of variability in hay stacks, and a smaller amount of variation associated with lab analysis. Normal lab variation, not including errors associated with poor sampling of forages, are considered to be a miniumum of: CP (+/- 0.5), NDF (+/- 0.7- 0.9), ADF (+/- 0.7) and TDN (+/- 0.5) percentage points. We espect a minimum variation of +/- 0.5%. Thus a reported value of 20% CP could actually be anywhere between 19.5 and 20.5% under normal circumstances.

In conclusion, laboratory assays can provide an accurate guide to the potential nutritional value of a forage but should be combined with visual inspection. Particular care should be taken in hay sampling, which has a very large influence uponthe reliability of the results. NOTE: This article is reprinted from the Summer, 1998 issue of California Alfalfa & Froage Review. For further information on this newsletter, contact: http://alfalfa.ucdavis.edu/