FEED SAMPLING AND ANALYSIS

Feed Sampling

It is always best to use actual feed sample analyses in diet formulation. Book values can be useful to get a general idea of feed composition, but to fine tune diets, or formulate accurately, an actual feed sample is needed. The results of feed analysis depend on obtaining a good, representative sample of the feed.

Hay – For baled hay it is best to use a sharp edged core sampler (often can be borrowed from county extension offices). A minimum of 20 cores should be bored to the full depth of the probe for 5% of the bales from each "lot" of hay being sampled. With standard square bales, core samples should be taken from the ends of randomly selected bales. With large, round bales cores should be taken from the side of the bale. Cores from different bales within a "lot" of hay are mixed together to form the representative sample for analysis.

Silage and Haylage – During harvest, samples can be collected in a large plastic bucket from several representative loads by taking random handfuls. After ensiling, take random handfuls from at least 20 various locations in the pit or bunk silo, or from the unloader of a tower silo. Samples can be placed in plastic bags and frozen until analysis.

Grain or Pelleted Feeds – Samples of grain stored in a bin or on a truck are best taken with a grain probe. At least five cores should be taken from various locations. These are mixed together and one pound is adequate to send for analysis.

Pasture or Range – The number of samples needed to obtain a representative sample of pasture or range depends on the uniformity of species present, soil types, and topography. A total of 20 plots are clipped for each area by going through the area in an "X" or "Z" pattern. Each plot is a 12 inch by 12 inch area clipped at the approximate height the animals are grazing. For short-grass range, plots are clipped at 1 inch height, and for mid- and tall-grass range clip at 2 inches. In pastures or ranges that are more diverse, more areas will need to be represented in the sample.

PROXIMATE ANALYSIS

For over 100 years this system has been used for feedstuff analysis, and while it has some limitations, it is still widely used.

Water & Dry Matter (DM) - The water and DM content of a sample are determined by drying the sample above 100°C and measuring the water loss.

% water = [(sample weight – sample weight after drying)/sample weight] x 100%
% DM = 100 - % water

Crude Protein (CP) – Crude protein is estimated by the Kjeldahl laboratory procedure, which measures the total nitrogen content in the feed. Total nitrogen (%) is multiplied by 6.25 to arrive at the crude protein content (%). The CP value contains both true protein (which contains amino acids) and non-protein nitrogen compounds, hence the name "crude protein."

% CP = % N x 6.25
Example: % CP = 1.5% N x 6.25 = 9.38% CP

Excessive heating of feedstuffs, such as poorly managed hay or silage, can cause a portion of the CP to be unavailable. The CP analysis gives no indication that heat damage may have occurred. If heat damage is suspected (hay put up too wet, or silage put up too dry) then an analysis for unavailable protein, such as acid detergent fiber nitrogen (ADF-N) or acid detergent insoluble nitrogen (ADIN) should be requested.

Crude Fiber (CF) – Crude fiber is measured by boiling the sample in acid and then in alkali. The residue represents the less readily digestible carbohydrates, mostly cellulose and some lignin. However, ruminants can digest a portion of the CF, so this method is less useful for ruminant feedstuffs.

Ash – Ash is determined by burning the sample in a furnace to remove any organic matter. The residue is inorganic matter and represents the total mineral content, but does not give any information about specific minerals.

Ether Extract (EE) - Ether extract is determined by treating the sample with the solvent, ether, to remove any lipid compounds. Ether extract represents the fat or lipid content of the feed.

Nitrogen-Free Extract (NFE) – Nitrogen-Free Extract represents the non-structural carbohydrates such as starches and sugars, and is found by difference.

%NFE = 100 – (%water + %CP + %CF + %Ash + %EE)

VAN SOEST FIBER ANALYSIS

A newer method for evaluating the fiber fraction of feeds was developed in the 1960s by P.J. Van Soest. This system was developed because it was determined that CF did not accurately estimate the energy content of forages for ruminants. This method consists of measuring NDF and ADF fractions in forages.

Neutral Detergent Fiber (NDF) – Neutral detergent fiber is determined by boiling the sample in a detergent solution with a pH of 7.0. The soluble portion is removed (sugars, starch, pectins, lipids, soluble carbohydrates, protein, non-protein nitrogen), and the insoluble NDF fraction remains. The NDF contains cellulose, hemicellulose, lignin, silica, and any heat-damaged protein. Neutral detergent fiber estimates the intake potential of the forage. Forages with a high NDF content are considered to be lower in quality. High levels of NDF cause forages to be eaten in lesser amounts than forages with low NDF levels. The NDF content increases with advancing maturity of forages.

Acid Detergent Fiber (ADF) – Acid detergent fiber is determined by boiling the sample in an acid detergent solution. The soluble portion is removed, and the insoluble ADF fraction remains. The ADF contains cellulose and lignin. Most laboratories use ADF to estimate the digestibility and energy value of forages. High levels of ADF cause forages to be less digestible, and have a lower energy value.

VALUES CALCULATED FROM LABORATORY ANALYSES

Total Digestible Nutrients (TDN) – An estimate of the TDN content of a feedstuff can be calculated from the Proximate Analysis values. Total Digestible Nutrients is an estimate of the energy content of a feed, and is based on the digestible portion of the nutrients that can supply energy, carbohydrates (crude fiber and NFE), protein, and fat. Average digestibility values are used of 50% for CF, 90% for NFE, 75% for CP, and 90% for EE. Ether extract is multiplied by 2.25 to adjust for its higher energy value compared to carbohydrates and proteins.

TDN, % = (% dig x %CF) + (% dig x %NFE) + (% dig x %CP) + (2.25 x % dig x %EE)
TDN, % = (0.50 x %CF) + (0.90 x %NFE) + (0.75 x %CP) + (2.25 x 0.90 x %EE)

Forage Dry Matter Intake (DMI) – Forage dry matter intake for ruminants (as a % of body weight) can be estimated by the following equation:

Intake, %BW = (120 / % NDF)
Example: Hay with 75% NDF
Intake, %BW = 120/75 = 1.6% BW

Digestible Dry Matter (DDM) – Digestible DM is an estimate of the percentage of the forage that is digestible. It is roughly equal to % TDN content and can be used to estimate TDN %.

DDM, % = 88.9 - (0.779 x % ADF)
Example: Hay with 45% ADF
DDM, % = 88.9 – (0.779 x 45) = 53.85%

Relative Feed Value (RFV) – Relative feed value is a measure of forage intake and energy value. It is used to compare one forage to another. Relative feed value is expressed as a percentage compared to full bloom alfalfa hay, which has a RFV of 100%. Relative feed value increases as forage quality increases. Relative feed value of a forage does not take into account the protein content of the forage, which must be evaluated separately.

RFV, % = (% DDM x % DMI)/1.29
Example: Hay with 75% NDF and 45% ADF
RFV, % = (53.85 x 1.6)/1.29 = 66.79%

Total Digestible Nutrients (TDN) of Forages

All forages: TDN, % = 88.9 – (0.779 x %ADF)