Understanding Feed Testing

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The Importance of Feed Testing

Many factors can affect the nutrient composition of feedstuffs. Factors such as fertilization level, plant stress (i.e. drought), and many other management factors can all have an impact on the value of a feed. As a feed buyer, you need to understand the nutrient composition of the feed you are purchasing and how it can impact your animals.

It is important to match your feeds to your animal's nutrient requirements. For example, lactating females will require greater nutrient density of their rations as compared with dry, open females. Understanding the nutrient composition of your feeds is the first step to properly managing your nutritional program.

Producers should analyze any feedstuff that can substantially influence the cost of the ration or animal performance. The feeds that are most critical to evaluate are forages and by-product feeds, as these feeds can vary greatly in nutrient composition. Additionally, feeds raised under adverse weather conditions should also be analyzed.

Feed analyses are designed to provide information for producers to make safe, economical, and productive use of the feeds.

Methods of Feed Testing

Observation

Take a look at the feed. Factors such as stage of maturity, leafiness, color, foreign material, and pests can all be evaluated visually. Additionally, evaluate the feed for excess dust or mold that might reduce the feeding value of that feed. NOTE: observation alone will not tell you anything about the nutrient composition of the feed. You will still need to have your feed analyzed for the most accurate estimate of feeding value.

Chemical

The most common method of evaluating feeds is to chemically extract various nutrient fractions in a laboratory. It is imperative that representative samples of the feeds be sent in for analysis. The resulting fractions can be used to optimize animal performance when developing rations. The various fractions are discussed later in this document.

Near Infrared Reflectance Spectroscopy (NIRS)

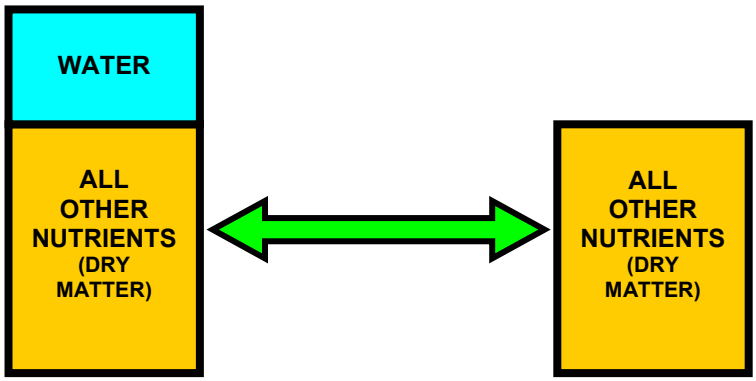
NIRS is a rapid, cost-effective method for analyzing feedstuffs. Near infrared light is used to identify the various nutrient fractions of the feed. NIRS is a relatively new method of analysis, and as a result, not all feeds are able to be tested.

Interpreting Analyses

The first time you see the results from a feed test, the amount of information can be overwhelming. The following is list of terms and acronyms commonly found on feed test results.

Dry Matter (DM). Dry matter is the percentage of feed that is not water. Dry matter is generally calculated after the amount of moisture in a feed has been determined. It is important to have an estimate of the amount of moisture or dry matter in a feed as the water will "dilute" the nutrient concentrations of a feed.

Figure 1. Comparison of methods of expressing nutritive value of feeds.



As – Fed Basis
Nutrients are less concentrated (lower %)
Feed is heavier (more pounds)

Dry Matter Basis
Nutrients are more concentrated (higher %)
Feed is lighter (less pounds)

Measures of Protein:

Crude Protein (CP). The amount of nitrogen in a feed is measured and then converted to a crude protein value. This value includes all nitrogen, that which is available and that which is not available for use by the animal. Crude protein will provide you with a "ballpark estimate" of the protein value for your feed.

Insoluble Crude Protein (ICP). Insoluble crude protein (ICP), acid detergent insoluble crude protein (ADICP), and heat-damaged protein all refer to the proportion of CP that is not available to the animal. Almost all feeds will have some amount of ICP, use this value to determine how much CP may be available to the animal.

Adjusted Crude Protein (ACP). If the ratio of ICP/CP is above 0.1, excessive heating of the feed may have taken place, resulting in even more of the protein not being available to the animal. ACP takes this into account and should be used to balance rations, if the ICP/CP ratio is above 0.1.

Measures of Carbohydrates:

Crude Fiber (CF). Crude fiber is an older method of determining fiber content of a feed. It is included on feed tags. However, it is not the best estimate of the fiber content of a feed, other fractions such as NDF and ADF are recommended instead of CF.

Neutral Detergent Fiber (NDF). This fiber fraction estimates the structural component of the plant – the plant cell wall. NDF can reflect the "bulk" of a diet and has a negative relationship with forage intake. For example, animals will eat less of a feed high in NDF, due to the increased bulkiness of that feed.

Acid Detergent Fiber (ADF). This fiber fraction estimates the insoluble structural component of the plant – cellulose and lignin. ADF has a negative relationship with digestibility. For example, animals will use less of a feed high in ADF, due to the reduced digestibility of that feed.

Neutral Detergent Soluble Carbohydrates (NDSC). This fiber fraction estimates the highly soluble component of the plant. NDSC are rapidly fermented in the rumen and includes both sugars and soluble fiber. Typically this fraction is 98% digestible by the animal.

Measures of Energy and Digestibility:

Total Digestible Nutrients (TDN). TDN represents the total of all the digestible components of the feed – including fiber, protein, fat, and the soluble sugars. Traditionally this value was used when formulated ruminant diets, however there has been a shift to using the Net Energy system. However, for beef cow rations, TDN is still a good number to use when developing rations.

Gross Energy (GE). Measure of the absolute amount of energy in feed. Does not take into account any energetic losses.

Digestible Energy (DE). Calculated as GE minus the amount of energy in the feces. Commonly used in horses and swine.

Metabolizable Energy (ME). Calculated as DE minus the amount of energy in urine and gas. Commonly used in horses and swine.

Net Energy (NE). Net energy is the energy available to the animal after accounting for the energy lost in feces, urine, gas, and heat. Calculated as ME minus the energy from heat of digestion and fermentation. This is the most accurate estimation of what feed energy is actually being used by the animal for maintenance (NE_m), growth (NE_g), or lactation (NE_L).

Digestible Dry Matter (DDM). Estimates the percentage of the forage that is digestible. DDM can be estimated from ADF by the following equiation:

$$DDM\ (\%) = 88.9 - [ADF\ (\%) \times 0.779]$$

Equivalent Energy Levels In Different Energy Systems*

TDN, % DM	DE, Mcal/lb	ME, Mcal/lb	NEm, Mcal/lb	NEg, Mcal/lb
40	0.80	0.65	0.27	0.03
45	0.90	0.74	0.35	0.11
50	1.00	0.82	0.44	0.19
55	1.09	0.90	0.51	0.26
60	1.20	0.98	0.59	0.33
65	1.30	1.06	0.66	0.40
70	1.40	1.15	0.74	0.46
75	1.51	1.24	0.82	0.53
80	1.60	1.31	0.88	0.59
85	1.70	1.39	0.95	0.65
90	1.80	1.47	1.01	0.70
95	1.90	1.55	1.08	0.75

*Adapted from CowBytes Beef Ration Balancer Version 4 User Instructions

Other Measures of Importance:

Dry Matter Intake (DMI). Estimates the maximum amount of forage a cow will eat. It is expressed as a percent of body weight and calculated from NDF using the following equation:

DMI (% of BW) = 120/NDF %

Relative Feed Value (RFV). RFV is a common index used for marketing hays. It combines digestibility and intake into one number. The base value is 100 and represents full-bloom alfalfa hay. This value is best used to rank various hays. The following equation is used to determine RFV:

RFV = (DDM,% x DMI,%BW) ÷ 1.29

Relative Forage Quality (RFQ). RFQ has been recently developed as an alternative index to RFV. It is also an index of 100 and represents full-bloom alfalfa hay. This index is more accurate in estimating the intake of available energy from forages. The equation is:

RFQ = (DMI,%BW x TDN,%DM) ÷ 1.23

Relationship among several estimators of alfalfa quality and suggested livestock uses*

	---% of DM---			---% of BW---	
Use	**ADF**	**NDF**	**DDM**	**DMI**	**RFV**
Prime dairy (fresh and high producers)	<31	<40	>65	>3.0	>151
Good dairy (young heifers)	31-35	40-46	62-65	2.6-3.0	125-151
Good beef (older heifers, marginal for dairy cows)	36-40	47-53	58-61	2.3-3.5	103-124
Maintenance (for beef or dry dairy cows)	41-42	54-60	56-57	2.0-2.2	87-102
Poor quality (requires supplementation – may be fed to dry beef cows under some circumstances)	>43	>61	<55	<1.9	<86

*Adapted from NebGuide G89-915-A

Minerals. It is important to match the mineral concentrations of your feed to the nutrient requirements of your animal. This will allow you to determine what supplementation may be needed. General production practices include supplementing trace minerals as "insurance" against deficiencies.

Nitrates and prussic acid. Forages that have been drought stressed, stunted, or harvested before maturity (especially sorghum/sudan forages) may need to be tested for nitrates and prussic acid to prevent toxic levels from being fed.