

FORAGE TESTING

Why, What and How

Why Test Feeds?

Increased profit is the primary reason producers need to know the quality of the forages they feed livestock. It's important to know the nutrient composition and potential animal performance that can be expected from a given forage. Accurate analysis of all feedstuffs is needed for balancing rations, formulating least-cost supplements, using homegrown forages efficiently and pricing hay correctly.

Grass hay can vary between 4 and 20 percent crude protein. This variation can dramatically affect how animals are supplemented. If the protein content of a forage is underestimated by 2 percent, the additional protein in the grain mixture will cost \$9 to \$10 per ton of grain. More important, if the protein content of a forage is overestimated, you may feed an inadequate level of protein.

Methods of Testing Feeds

Physical. This is the oldest and most widely used method. It includes color, leafiness, maturity, foreign material (mold, dust, weeds, etc.), texture and odor. Because this method relies heavily on subjective evaluation, it's possible no two people will evaluate the same forage in the same way. In addition, research shows these physical characteristics do not necessarily relate well to animal performance. The major advantage of this method is that it can be performed in just minutes.

Chemical. A truly meaningful assessment of forage quality requires an evaluation of its chemical makeup. Determining the chemical components requires laboratory procedures. This is the most accurate method of determining forage quality. The main limitation of this method of forage testing is slow turnaround time.

Definitions of Common Forage Analysis Terms

Dry matter (DM). This indicates the percentage of forage that is not water. Water does not add protein or energy to the diet, so forage nutrient values must be compared on a dry matter basis.

Crude protein (CP). This is a measure of the amount of nitrogen (N) in a forage. Crude protein is calculated by multiplying the total N content by a



constant, 6.25. This is based on the assumption that proteins contain about 16 percent N. It includes both true protein and non-protein N and does not make a distinction between available or unavailable protein.

Heat-damaged protein (ADIN). This occurs when hay is rained on and heats, when hay is stored wet or when haylage is put up with too much oxygen (not properly packed). Excessive heating causes some of the available protein to become chemically bound and thus, less available to animals. It is measured as the nitrogen (CP) left in the acid detergent fiber and is referred to as acid detergent insoluble nitrogen (ADIN). If ADIN is more than 10 percent of the CP content of the sample, protein value should be discounted accordingly. For example, if the CP of a forage is 12 percent and the ADIN is more than 1.2 percent, the protein value of that sample should be discounted.

Fiber. In general, fiber refers to the less digestible plant carbohydrate that must be ruminated by the animal. Fiber contributes to rumen fill, so it is somewhat negatively associated with forage feeding value. Fiber is measured by the methods outlined below.

Crude fiber (CF). Crude fiber is one of the earliest methods of analyzing forage fiber content. It is seldom used for forage nutritive evaluation today, but it is the regulatory standard for purchased concentrates and still can be found on feed tags. Crude fiber is not an accurate method of measuring forage nutritive value. It underestimates the value of good quality hay and overestimates the value of poor quality hay.

Neutral detergent fiber (NDF). Neutral detergent fiber is a measure of total structural carbohydrate in the plant. The NDF fraction is partially digestible. As such, NDF is considered an indicator of forage bulkiness and is related to dry matter intake (DMI). Lower NDF indicates more forage intake potential. At similar stages of maturity, grasses have more NDF than legumes.

Acid detergent fiber (ADF). This is a measure of the least-digestible plant carbohydrate (cellulose and lignin). It is negatively correlated with digestibility and consequently is often used to estimate energy content of forages. Total digestible nutrients (TDN) are estimated using ADF. Lower ADF indicates higher digestibility.

Energy estimates. The energy content of a forage is one of its most important nutritive characteristics. Energy content will have a major impact on how much milk or meat a forage can produce. Energy can be analyzed in the animal directly (in vivo), in the lab (in vitro) or estimated from fiber by using equations. The in vivo and in vitro methods are time-consuming, expensive and require using animals. Therefore, forage energy content is generally estimated from fiber.

Total digestible nutrients (TDN). This is an estimate of all digestible organic nutrients (protein, carbohydrates and fat) of a forage that are available to the animal.

Relative feed value (RFV). This is an index used to rank forages based on estimated digestibility (ADF) and intake potential (NDF) of a forage. Relative feed value attempts to measure the overall feed value of a forage using a single number. Relative feed value is not measured in percentage, but simply is used to compare quality of various forages. Relative feed value was developed for alfalfa, but it can also be used to rank the quality of legumes and grasses grown in the South.

Relative feed quality (RFQ). This is similar to RFV except that RFQ uses fiber digestibility to estimate intake as well as the TDN of the forage. This measure allows for relative comparisons among forages and for the prediction of animal performance. RFQ also differentiates legumes from grasses. This method may result in more useful predictions of feed value of southern forages.

Net energy (NEI, NEm, NEg). Net energy is the energy available to an animal after removing the energy lost to feces, urine, gas and heat during digestion and metabolism. The net energy value of a forage depends on whether the feed is used for maintenance (NEm), gain (NEg) or milk production (NEI).

Near infrared reflectance spectroscopy (NIR or NIRS). This computerized method of estimating nutrient content is based on accurate chemical analysis of feedstuffs. This technique measures the chemical composition of a sample based on the principle that each quality parameter has unique NIRS spectra. Mathematical

and statistical methods are used to extract information from chemical methods. A big plus for NIR is the potential for fast turnaround time. Normal “wet lab” determinations of CP, NDF and ADF can take from one to two weeks to perform, whereas the NIR can analyze a forage sample in minutes if an NIRS equation is available. If the spectra are not within the specified confidence limits, wet chemistry analyses are run on the sample.

Application of Forage Testing Results

1. Ration formulation. Use of forage test results for ration formulation has two goals: first, developing a nutritionally balanced ration; second, developing a lowest-cost ration. Different kinds and classes of livestock have different nutrient needs.
2. Evaluation of forage production practices. Forage testing allows producers to see how nutrient composition changes as forages mature. Forage test results can be used by producers to see where they can improve their management practices. Areas of management that can be identified through forage testing include the effect of time of harvest, fertilization practices, drying methods, baling management, storage methods, use of preservatives, etc. Forage test results also allow for accurate forage inventories based on quantity and quality of available forage.
3. Forage marketing. Forage testing is important for setting reasonable prices based on forage feeding value. Often, high- and low-quality hay are the same price. Selling a forage based on its feeding value helps both the buyer and the seller. Higher-quality forages can improve animal performance and profit, and thus command greater prices.

Forage Sampling

A forage analysis is only as good as the sample submitted. Poor sampling can result in misleading values and less-than-expected animal performance. One forage sample should be sent to the laboratory for each “lot”



of forage. A lot is a quantity of similar forage taken from the same field, the same cutting, the same fertilization management, the same stage of maturity and cured and stored the same way. Be certain to obtain a random sample. If you take samples from the part

of the field that looked “best,” the test results may not accurately represent the forage you will be feeding. Use a bale probe to collect samples (contact your extension agent for use of a bale probe). Most bale probes can be attached to a power drill or a battery-operated drill.

Conventional square bales

Sample at least 15 to 20 average bales from each lot. Steps in getting a good sample are:

1. Take one core from the end of each bale.
2. Place the forage from core samples in a clean plastic bucket.
3. Mix the forage well.
4. Put about 1 quart in a zippered plastic bag for analysis.
5. Repeat the procedure for each lot.

If a bale probe is not available, reach inside of each bale and carefully remove a handful of forage. Cut each sample into 2-inch sections with a pair of shears. Mix samples from a lot, and remove about 1 quart for analysis.

Round bales

Sample at least 10 bales from each lot. Take two samples from the sides (not the ends) of each bale, and mix the forage thoroughly. Remove about 1 quart for analysis. If a bale probe is not available, sample by hand as described for the conventional square bales, with the exception that two or three handfuls should be removed from each bale.

Loose hay

Take samples from at least 12 locations in the lot. Handle the samples as described for the conventional square bales.

Silage

Sampling silage when filling the silo is one way to get a representative sample for analysis. This can be helpful for early ration balancing. It is probably best, however, to collect a sample after the forage has been ensiled. When silage is properly ensiled, fresh sample forage analysis will agree closely with fermented forage analysis. Samples collected when feeding result in the most accurate nutritional information for ration formulation.

Suggestions for sampling silage. Harvested (fresh) samples. Collect 20 samples periodically from each lot of silage. Take samples as loads are brought to the silo. Be sure the container is closed between samples to avoid moisture loss.

Bunk or pit silo. Collect about 2 gallons of silage in a clean plastic container by taking handfuls at 20 different locations on the feeding surface (avoid silage that will not be fed to animals). Silage is best sampled at least three

weeks after it has been ensiled, and as close to the time of feeding as practical.

Vertical silo. Pass a clean container under the chute several times (once per minute), collecting 1 to 2 quarts with each pass.

With all silage samples, mix thoroughly and place about 1 quart in a zippered plastic bag for analysis. Be sure to seal the bag so an accurate dry matter can be determined. When mailing silage samples, freeze the sample before mailing, and mail early in the week so samples won't sit in the post office over the weekend.

Bale silage. Use the same sampling method that is used for round bale hay. Make sure to reseal the holes made in the plastic by the bale probe. Duct tape can be used successfully for this purpose.

Grain and mixed feed sampling

Collect five samples from various locations in the bin or truck. Thoroughly mix samples in a clean plastic container, place 1 pint of the mix in a plastic bag and seal it tightly. Be careful to avoid sifting where bigger pieces are on top and smaller on the bottom.

If sampling out of a mix mill, sample as outlined for silage from a vertical silo.

Sample Submission

Label the plastic bags containing the samples with your name, address, type of feed and some sort of sample identification. Identifying the sample allows you to match the analysis with the proper sample when you receive the analysis. The samples can be submitted through your local extension office (all extension offices have sample submission forms). Samples also can be hand-delivered or mailed directly to the lab: Forage Testing Laboratory, Southeast Research Station, P. O. Drawer 569, Franklinton, La. 70438. Telephone 985-839-3740. Ship samples and submission forms in rigid cardboard boxes to reduce chances of damaging the bag.

All samples submitted will be analyzed for DM, CP, NDF and ADF. Total digestible nutrients will be estimated for forages. The charge for this routine analysis is \$10 per sample. If requested, mineral analyses also can be obtained. Mineral analyses include calcium, phosphorus, potassium, magnesium, copper, zinc and manganese. The charge for the routine analysis plus mineral analysis is \$15 per sample. Checks can be made payable to the Southeast Research Station. You should receive your test results in about one week.

For more information on the LSU AgCenter Forage Testing Lab, and to download your own sample submission forms, visit the following Web site:

www.lsuagcenter.com/labs



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