

Hay Sampling Techniques

Hay sampling is probably the most important aspect of forage testing.

Think about what we are trying to do: The pinky-sized ground-up sample the lab analyzes must represent tons and tons of alfalfa hay from the field. The sample must fairly represent the leaf/stem ratio, as well as the weed composition. Whether the sample accurately represents a stack is the responsibility of the sampler. The lab can only accurately test whatever sample is presented to them! Protein and fiber can vary considerably from bale to bale. Leaves & stems are very different in protein and fiber. Therefore, it is important to follow a definite protocol when sampling. The goal is to obtain a respective and randomly-chosen sample. Each core should represent the stack. Never present an uncored sample to a lab (e.g. a flake).

Here are some important guidelines for taking samples of alfalfa hay:

- 1. Identify a single lot of hay** - Lots must be from the same cutting, variety, field, stage of maturity and harvested within 48 hours. Do not mix lots. A lot should not exceed 200 tons.
- 2. Choose a good, sharp coring device** -The coring device should have an inside diameter of the cutting edge (3/8 to 5/8 inch). The cutting edge must be kept sharp, as dull edges will cause material to be pushed out of the core. Do not use an auger or corkscrew type device, which selectively samples leaves. Both leaves and stems are needed for an accurate sample.
- 3. Sample at random** - Walk around the entire stack and sample bales at various heights. Do not bias the sample by avoiding some bales or choosing others.
- 4. Take enough cores** – Sample at least 20 bales (one core per bale). Take more cores (20-40) in larger lots or if the hay is very mixed.
- 5. Use good Technique** -probe the end of the bale near the center, and at least 12-18 inches. The probe should be at a right angle to the bale end. Do not slant the probe.
- 6. Handle samples correctly** -Combine cored samples into a single sample and store them in a sealed plastic (i.e. Ziploc® qt or gallon) freezer bag. Do not expose to heat or direct sun, and send to the lab as soon as possible.
- 7. Sample size** - The sample should weigh about ½ lb. Too small a sample will not truly represent the hay lot.
- 8. Splitting samples** - It is very difficult to accurately split core samples. If you want to test the performance of a lab, have the lab return your ground sample for further testing.

Condensed from an article by Steve Orloff and Dan Putnam

Feed analysis reports contain the following information:

Moisture — Forage moisture content is used to calculate constituents on a dry matter (DM) and on “as received” or wet basis. Forages should be compared for their nutritive value on the DM basis.

Protein — Grasses typically have 4 to 16 percent crude protein (CP). Legumes have 10 to 25 percent CP depending on soil fertility, plant species, and plant maturity. If the test value is greater than 25 percent CP you should test for nitrates, and expect that some CP is actually non-protein nitrogen.

Acid detergent insoluble nitrogen (ADIN) or acid detergent insoluble crude protein (ADICP) are indicators of unavailable nitrogen which may be the result of heat damaged protein. Heat damage occurs when forage heats above 140 degrees causing sugars and amino acids to combine forming indigestible compounds appearing like lignin.

Fiber — or structural carbohydrate, supplies a highly variable amount of energy to the diet because digestibility varies greatly. Fiber is most often reported as acid detergent fiber (ADF) and neutral detergent fiber (NDF).

Neutral Detergent Fiber (NDF) — This is fiber that remains after part of the digestible cell wall is removed with a neutral detergent. NDF varies from 30 percent NDF in fresh alfalfa to 60 percent in mature straws and tropical grasses. NDF is related to animal intake of the forage: as NDF increases, intake decreases. Digestible NDF (NDFD) is a better indicator of energy content of forage. Legume forages generally have lower NDF than grasses, but the NDFD in grasses may be higher.

Acid Detergent Fiber (ADF) — This is fiber that remains after part of the digestible cell wall is removed with an acid detergent. ADF is related to forage digestibility: as ADF increases, digestibility decreases.

Energy — Energy is not directly measured but is commonly predicted. Total digestible nutrients (TDN) is the best practical prediction of forage energy as properly determined (National Research Council, 2001) by a summative equation developed at the Ohio State University.

Total Digestible Nutrients (TDN) — TDN represents the sum of all digestible nutrients in the forage.

Minerals — Minerals important to forage analysis include phosphorus (P), calcium (Ca), potassium (K), and magnesium (Mg).

Secondary measured values from laboratory analysis

- Total N – nitrogen content (% of DM)
- DIN – rumen degradable intake nitrogen (% of total N)
- UIN – rumen undegradable intake nitrogen (% of total N)
- ADFN – acid detergent fiber N (% of total N)

Calculated Values

- DM – dry matter (%) is calculated as $100 - \text{moisture content}$
- Crude Protein (CP) – estimate of protein (% of DM) = $\text{Total N} \times 6.25$
- Digestible Crude Protein (DCP) – (% of total CP) = $\text{CP} \times 0.72$
- Digestible Dry Matter (DDM) – (% of DM) = $88.9 - (0.779 \times \text{ADF})$
- DMI – dry matter intake (% of body weight) = $120 / \text{NDF}$
- RFV – relative feed value index = $(\text{DDM} \times \text{DMI}) / 1.29$

The National Forage Testing Association describes the purpose of calculating RFV below:

Digestible Dry Matter (DDM), Dry Matter Intake (DMI), and Relative Feed Value Index (RFV) calculations are applicable to legume, legume-grass and cool season grass fresh forages, hays and haylages. Relative feed value index is an index that ranks cool season legumes, grasses and mixtures by potential digestible dry matter intake.

New developments in forage testing

A Michigan State University study found that for each percentage point increase in NDF digestibility (NDFD), dry matter intake increased 0.37 pounds and 4 percent fat corrected milk production increased 0.5 pounds. The National Research Council (NRC) adopted the procedure of measuring digestibility of the NDF fraction. The NRC in Nutrient Requirements for Dairy Cattle (2001) recommends using NDFD in a revised summative equation to predict TDN. Relative Forage Quality (RFQ) was developed by University of Wisconsin researchers to replace RFV. RFQ is more accurate in predicting forage utilization by animals, is more useful across different forage types such as grass and mixed hays, and provides more separation of forage value than the RFV index.

Near Infrared Reflectance Spectroscopy (NIRS): analysis NIRS detects the absorption of near infrared light by molecules based on calibrations derived from wet chemistry. NIRS is rapid and less expensive than chemical laboratory analyses, and NIRS is highly precise. The NIRS Forage and Feed Testing Consortium provides prediction equations that most University and commercial labs use.

Forage sampling and testing accuracy: Sampling is the largest source of error in forage analyses. Laboratory error is added to sampling error in test analysis. Normally there might be +/-5% variation (error) in results, e.g. +/- 1.5% ADF or +/- 8 RFV. Usually a test of 31.5 percent ADF is not different than 30 percent ADF, and neither is a test of 172 RFV different than 180 RFV.

Forage quality evaluation and interpretation is a multifaceted system. Quality values are not absolute, and forage quality is not adequately described by any one variable. The National Forage Testing Association (NFTA) certifies the proficiency of laboratories for accuracy in testing hay and corn silage for dry matter, crude protein, ADF, and NDF. Select an NFTA-certified lab so that variability due to analysis is minimized.

Web sites with information about forage quality:

National Forage Testing Association: www.foragetesting.org

University of Idaho Forage Extension: www.extension.uidaho.edu/forage/

NIRS Forage and Feed Testing Consortium: www.nirsconsortium.org

Forage Quality and Testing, U. of Wisconsin: www.uwex.edu/ces/crops/uwforage/alfalfa.htm

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