

## The Basics of Forage Testing

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Technology has changed the way and the speed with which feeds are analyzed. Reports list a wide range of nutrients; some measured and some calculated from other measurements. This article will discuss the key concepts of forage and feed testing.

### Sample Collection - The key is a representative sample

In order to have an accurate forage test for ration formulation, it is important to have a representative sample. The method of sampling varies with forage type. Silages (corn or hay crop) can be sampled either at harvest or at feed out. There is a slight reduction in dry matter and increase in fiber during storage, but it is possible to use the analysis of the fresh material to indicate the quality after ensiling. If sampling fresh material at harvest, it is best to take three to four handfuls from every third load or more and place them in a container with all samples from the same field. Keep it covered to prevent drying. After mixing the composite, a sub-sample can be taken for analysis (only a pint or 100 grams is needed). When sampling at feed out, it is advisable to take three to four handfuls at different times, mix the composite, and take a smaller sub-sample for analysis. In upright silos, there can be variation from top to bottom. Bunkers are different because common layers are encountered from front to back due to layering during storage. Even if sampled at harvest, it is best to continue sampling and testing every four to six weeks during feeding.

When sampling hay, it is best to use a core sampler. Take 10 to 20 core samples from each hay lot then composite and mix and take a sub-sample for analysis. Small rectangular bales should be sampled by coring from the end. Large hay bales should be sampled from the front or back (not the sides) in order to get a cross section of the rolled hay.

### Wet Chemistry vs NIR – Specialized equipment is needed

There are two ways that forages are analyzed for nutrient content. Wet chemistry uses established laboratory tests to quantify protein, fiber, fat, and minerals. More recently, near infrared reflectance spectroscopy (NIR) has been perfected to quickly, economically, and accurately measure nutrient content without destroying the sample. Also, NIR technology uses light reflectance and works best with large compounds such as those that compose protein and fiber. The minerals are smaller and, therefore, more difficult to measure with the NIR, and wet chemistry should be used if precise levels are needed. The NIR instrument must be calibrated to wet chemistry which is the standard. Most typical forages can be analyzed with NIR but unique forages may not be appropriately analyzed because no calibration set is available to standardize the equipment. Also, total mixed rations are difficult with NIR because the composition of the mix can vary greatly from farm to farm. Individual laboratories will advise about feeds that can be analyzed with NIR, based on the calibrations available to them.

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## Basic Wet Chemistry Tests – Dry matter, crude protein, fiber, and energy

When a sample is received at a forage testing lab, a portion of it is weighed and dried in an oven to eliminate the moisture. It is then reweighed and the dry matter content determined. The dried sample is then ground for analysis. A portion of the sample is weighed into a tube for a Kjeldahl or nitrogen determination. There are other methods of nitrogen determination, but this is the most common. The sample is digested with acid and then distilled with a base solution to convert nitrogen to ammonia, a form that can be trapped and analyzed. Nitrogen is converted to crude protein by multiplying by 6.25 due to the fact protein is 16 percent nitrogen ( $100/16=6.25$ ). Crude protein measures all nitrogenous compounds present in the sample and does not distinguish true protein from nonprotein nitrogen. This is fine for ruminants (cattle, goats, and sheep) but can be a concern for chickens and swine because they can't utilize nonprotein nitrogen.

Forage testing labs typically run two types of fiber determinations. One uses an acid detergent solution to digest the dried-feed sample and the other uses a neutral detergent solution. The digested solution is filtered and the residue on the filter is the fiber. These fibers are termed acid detergent fiber (ADF) and neutral detergent fiber (NDF). NDF is larger than ADF in plants and is considered to be the cell wall component. NDF is used to predict intake while ADF is used to predict digestibility. Both can be used to estimate energy.

Energy typically is not measured in forage testing labs. It is dynamic and, unlike protein or fiber, changes with animal physiological conditions. Energy can

be estimated based on fiber content and there is an inverse relationship with high fiber being associated with lower energy. Many times different labs will report different estimates for energy because the equations used are different. Energy is usually expressed as kilocalories (1,000 calories) or megacalories (1,000,000 calories) of net, metabolizable, or digestible energy. Also, total digestible nutrients or TDN is an indicator of energy content. Generally, it is best to use conservative estimates for energy unless it is well established that reported levels are acceptable.

## Expression of Results – Comparing apples to apples

When expressing concentration of nutrients, it is necessary to define if the results are expressed on an actual (“as is” basis) or dry-matter basis. Nutrient concentrations expressed on an “as is” basis are less than when expressed on dry matter. In species such as cattle and horses that eat wet feed, rations generally are calculated on a dry basis. Pigs and chickens eat feeds that are dry and have approximately the same dry matter (88 percent to 92 percent) and will sometimes use the “as is” nutrient concentration. The feed industry uses the “as is” basis to express nutrient concentration on feed tags. Therefore, it is important to know what basis nutrients are expressed before it is possible to use the results. Crude protein, fiber, fat, and macrominerals (calcium, phosphorus, etc.) are usually expressed as %. However, microminerals (zinc, cobalt, etc.) are usually expressed in parts per million (ppm). Energy will be as % TDN or kilocalories or megacalories per pound. Vitamins are expressed as international units of activity per pound. Therefore, it depends on the nutrient type as to what units will be used.