Which Numbers on a Forage Analysis Are the Most Important To Manage Your Dairy Cows' Feeding Program?

By Donna M. Amaral-Phillips

College of Agriculture,
Food and Environment
Cooperative Extension Service

After collecting representative samples of forages available to be fed to the dairy herd, samples should be sent to a forage testing laboratory and analyzed for their nutrient content. Results are compiled and are returned to the person submitting the samples and producer. At first glance, these reports contain a sea of numbers and can be intimidating to many. Although all of the reported numbers have meaning, some are more helpful to producers when evaluating the quality of the forages they have to feed and when making decisions when to feed selected forages or to which group of animals on the farm.

Why analyze forages for their nutrient content?

The obvious answer to this question is to use the results to balance rations for lactating cows as well as dry cows and heifers. The goal when balancing rations is to optimize dairy cattle performance while keeping feed costs reasonable and using home-grown feeds available. As importantly as using the results to balance rations, these results should be used to evaluate whether the quality of forages harvested can be improved. These evaluations can be of forages harvested by contracted custom harvesters or those harvested as part of the home dairy farming operation. By using these results, one can determine if forages need to be harvested earlier/later, different varieties need to be used in the future, or changes in agronomic practices need to be instituted to prevent decreases in forage quality, i.e. spraying fungicides on a timely basis to prevent plant diseases which decrease forage quality.

Key analyzes for evaluating forage quality

Energy is the hardest nutritional component to provide in diets for lactating dairy cows. Higher quality forages are more digestible, support greater dry matter intakes, and provide more energy. Thus, they allow greater quantities of forage to be included in the ration, lowering total feed cost and/or supporting greater early-lactation milk production and reproductive performance compared to lower quality forages.

Dry matter: When balancing rations, dry matter content is used to determine the amount of each feed to add to the TMR mixer or to be fed to dairy cattle. Adding together the dry matter and moisture percentage equals 100%. The dry matter of a forage gives an indication of how well forage quality will be maintained in storage. Feeds that are stored too wet may undergo an undesirable fermentation or mold and when fed may result in reduce feed intake. Those harvested too dry

Storage type	Dry matter*
Hay stored inside	87-92%
Baleage - wrapped	40-60%
Silage	35-38%**

* % Moisture = 100% - dry matter %
**Assumes silage can be harvested within a short window—If not, some may have to be harvested wetter (~32% DM so harvest is completed at <40% DM)

may not pack as well and not ferment properly when stored as silages. For corn silages harvested at greater than 40% dry matter, research has shown lower milk production due to advanced maturity of the corn plant.

Neutral Detergent Fiber (NDF): Neutral detergent fiber or NDF is needed to maintain rumen and cow health and includes hemicellulose, cellulose and lignin found in the plant's cell wall. Lignin is indigestible and only about 30 to 40% of the cellulose can be digested by the rumen microbes. Hemicellulose, on the other hand, is about 70% digestible and provides an energy source for the rumen bacteria. As legumes and grasses mature, the percentage of NDF increases. NDF values should be compared on a dry matter basis to allow a comparison between and within forage types. Associated with these increased concentrations of NDF in grasses and legumes, feed intake and thus total energy intake is *reduced*, opposite to the desired outcome.

In contrast, as a corn plant matures, a higher percentage of the plant is contained in the grain portion resulting in a higher starch content. Thus, NDF decreases with maturity. A better indicator of quality is reflected in the *in vitro* NDF digestibility of the corn plant, known as NDF_d or IVNDFD.

Forage	NDF on Quality forage (Dry Matter Basis)
Alfalfa	35-42%
Cool Season Grasses (i.e. orchard grass)	48-55%
Small grain silage	< 58%
Corn Silage	***
For Dairy One Laboratory – crop year 2019-2020-- 30 hr- NDFd averaged 54%/hr with a range of 50-59%/hr (1 standard deviation around the mean)	

***In vitro* NDF digestibility (IVNDFD or NDF_d):** To conduct this assay, the corn silage sample is first dried and then ground. A set amount of ground sample is incubated in a test tube with rumen fluid obtained from a ruminally-cannulated cow. Samples can be incubated for variety of times, but 30 hours is the best for estimating how much of the fiber can be digested in the cow's rumen. Fiber digestion is related to feed intake and thus expected energy intake when cows are fed this forage. Since digestive enzymes and bacteria present in the rumen fluid cannot be standardized between forage testing labs, results should only be compared within a lab and ideally with samples run on the same day and sample of rumen fluid. Many forage testing labs have calibrated their NIR units to estimate digestibility of the NDF fraction, making it faster and cheaper to analyze samples for this parameter. The higher the percentage of NDF digested within 30 hours, the higher the quality of corn silage. Unfortunately, these results are not used directly when balancing rations, but may help determine expected feed and energy intakes and help explain suboptimum performance.

Energy Content: The concentration of energy contained in a feedstuff is not actually measured in the forage laboratory. This reported value, i.e. NE_l, is calculated using a mathematical equation based on research. Each laboratory uses their own equation, thus comparison across labs is not possible. However, within a lab and a type of feedstuff, the higher the energy value the higher the quality of the feed.

As stated previously, forage analyzes contain many pieces of information regarding the quality and nutritive value of the tested forages. The first scan of the numbers on these reports should reflect an evaluation of the dry matter and neutral detergent fiber content or rate of digestibility of the NDF fiber fraction. Energy is the hardest nutritional component to provide to dairy cows and these nutrients can help assess the quality of forages available to feed and allow one to optimize the use of these forages on the farm.