Forage Quality Testing: Why, How, and Where

For nearly four decades, scientists have been refining the ability to test forages for quality. This research is being done in an effort to improve animal nutrition and, consequently, animal production. In the past, analytical procedures required a week or more to complete. They can now be done in less than 10 minutes, with greater accuracy than before.

As procedures for analyzing forages have improved, knowledge of how to use test results to increase animal efficiency and performance has also improved. Despite these advancements, many livestock producers still do not recognize forage quality testing as a valuable management tool.

WHY SHOULD I TEST FORAGES FOR QUALITY?

Greater net profit is the primary reason livestock producers need to know the quality of forages they are feeding. Not knowing the forage's exact quality acts as a two-edged sword that can cut into profits either way it swings. The examples in Table 1 are simplistic, but the costs are real.

Dairy producers who estimate the crude protein (CP) content of their haylage to be 2 percentage units lower than it is, and the crude protein content of their corn silage to be 1 percentage unit lower than it is, end up feeding more supplemental protein than necessary (see Table 1). This extra crude protein in the ration will add $0.09 per cow per day in feed costs. For a herd of 100 cows, this is equivalent to $9.00 per day. It would take just a little over 3 days of not knowing the quality of the forages and feeding extra protein, as in this example, to pay for the cost of quality analyses. (Forage quality testing usually costs less than $15.00 per sample.)

The other edge of this two-edged sword cuts into profits when forage quality is overestimated. Table 1 shows that estimating forage crude protein to be greater than it is results in adding insufficient supplemental protein to the ration and saving $0.06 per cow per day in feed costs. Unfortunately, the cows are being "short-changed" of crude protein, and this can lower milk production, especially in early lactation.

Table 1. Costs associated with not knowing forage quality when balancing a dairy ration.

Situation	Percent crude protein[a] in: Haylage	Corn silage	Ration	$/cow/day	$/100 cows/day
Actual forage crude protein	19.3	8.8	16.0	2.72	272
Farmer estimates crude protein below actual and balances ration accordingly	17.3	7.8	16.9	2.81	281
Farmer estimates crude protein above actual and balances ration accordingly	21.3	9.8	15.0	2.66	266

[a]dry matter basis

Guessing at fiber and mineral content also will have an enormous economic impact. For example, the neutral detergent fiber (NDF) content of a forage helps determine how much of the forage an animal will consume. Estimating the NDF too high or too low can adversely affect intake, animal performance, and health. Knowing the actual NDF content not only saves or makes more money, it also allows managers to provide better animal nutrition. Better nutrition results in greater production and improved efficiency (pounds of milk or weight gained per pound of feed consumed).

Knowing the quality of the forages you're selling or buying is economically wise as well. This fact is confirmed at Pennsylvania hay auctions, where hay quality is analyzed and the results posted on each load of hay prior to the auction. At auctions during 1990-91, each percentage-unit increase in the crude protein of hay resulted in a selling price of $8.00 more per ton (Table 2). Selling 10 tons of 20 percent CP hay as 18 percent CP hay because the quality was not tested will cost the seller about $160.00. On the other hand, buying 10 tons of 18 percent CP hay as 20 percent CP hay will cost the buyer $160.00.

Table 2. Relative feed value (RFV), crude protein (CP), and sale price of hay sold at hay auctions in Pennsylvania during 1990 and 1991.

RFV	CP (%)	Sale price of hay when quality was known ($/ton)
115	18	144
124	20	160
133	22	177

A similar relationship between quality and price did not occur at hay auctions when the quality of the hay was unknown. Establishing a "fair" price for hay, if you are buying or selling, means that both parties know the quality of the hay.

HOW DO I COLLECT A FORAGE SAMPLE FOR QUALITY TESTING?

Collecting a representative forage sample to be tested for quality is the first step in obtaining accurate and useful results. Quality results will be useful only if the sample represents what the animals will eat. Therefore, you should take a good random sample from each lot (the same species and variety of forage from the same cutting at the same stage of maturity, from the same field at the same time). Remember that the small sample collected may represent several tons of forage. Note the location of each lot in the barn or silo for easy reference when feeding.

Collecting Samples of Baled Hay

1. Take a separate sample from each field and cutting.
2. Always sample with a bale corer such as a Penn State Forage Sampler. It is impossible to get a representative sample using bale slices.
3. Insert the sampler to full depth into the end of each bale to be sampled. This will insure an accurate sample.
4. Take at least 20 widely separated sample cores from each lot.
5. Mix the 20 cores in a clean pail and place in a clean, airtight plastic bag.
6. Label each bag clearly with your name, address, sample number, forage mixture, stage of maturity, and date harvested.

Collecting Samples of Haylage and Silage at Harvest

1. Take sample as the silage is placed in the silo. Silage from silos with excessive seepage should be resampled upon feeding.
2. Collect three to five handfuls of haylage or silage from the first load of the day in a plastic bag, and place in refrigerator or freezer immediately.
3. Follow the same procedure for several loads of forage throughout the day. Combine samples and mix well to obtain a representative sample.
4. Repeat for each field if more than one field is harvested in any one day.
5. Throw styrofoam egg cartons of different colors into the blower at the end of each lot. This will aid you in identifying the lots later as the feed is unloaded.
6. Label the bag clearly with your name, address, sample number, forage mixture, stage of maturity, and date harvested.

Collecting Samples of Haylage and Silage from Storage

1. Collect a 1- to 2-pound sample from the silo as it is discharged from the unloader.
2. Do not collect samples from spoiled material on top of the silo. In upright silos, wait until 2 to 3 feet of silage has been removed.
3. Collect samples from the morning and evening feedings over a 2-day period.
4. Mix the samples thoroughly, place in a clean plastic bag, and seal.
5. Store immediately in a cold place, preferably in a freezer, until analyzed.
6. Label the bag clearly with your name, address, sample number, forage mixture, stage of maturity, and date harvested.

Preparing and Storing Collected Samples

Keep hay samples in a cool place. Keep haylage and silage samples frozen in an airtight container, then mail them in insulated bags—preferably early in the week—to prevent bacterial decay that might alter the results.

Remember: the results will only be as good as the sample taken. Follow the above steps to collect a representative sample for an accurate analysis.

WHERE DO I SEND FORAGE SAMPLES FOR ANALYSIS?

Once you have gone to the effort of collecting a sample correctly, how can you be sure the results you receive from the testing laboratory are accurate? Concerns about laboratory testing often focus on methods used for determining forage quality. Concern should be focused, however, on the accuracy of results and not on the technique used. To help you determine if test results are accurate, we have listed some questions to ask the laboratory manager:

1. Is the lab certified or does it participate in a check-sample program (also called a proficiency testing program)? The National Forage Testing Association has a certification program that compares a laboratory's performance with that of other labs to warn of potential inaccuracies. The American Association of Feed Control Officials conducts a check-sample program that insures consistency and accuracy among participating labs. Involvement in either program indicates that the laboratory is concerned with the accuracy of its results.

2. Does the lab include duplicate samples or quality control check samples in each group of samples analyzed? One of the easiest ways for a laboratory to monitor results is by analyzing replicates of a sample. If the analyses for replicates are not similar, there is a problem in the testing procedure. In addition, the inclusion of standards or check samples (material of known quality) in each group of samples analyzed can indicate if the analytical procedure is working correctly or not. Standards or check samples can also alert the laboratory technician of small changes in results over time and allow corrective steps to be taken.

3. What analytical methods does the laboratory use? There is more than one method of analysis for most plant constituents. Laboratories should use methods that are well validated and approved by the Association of Official Agricultural Chemists.

Laboratories that use near infrared reflectance spectroscopy (NIRS) to analyze forage for quality can be asked three additional questions that will help determine if the results are accurate. Like other laboratory analyses, NIRS analysis is sophisticated and should be conducted and monitored by trained personnel.

4. How often are NIRS instruments and calibration equations monitored? NIRS instruments should be monitored by running a check sample daily or after every 25th sample, whichever is more frequent. Calibration equations should be monitored by conducting laboratory analyses on every 25th sample. Again, this additional monitoring adds extra costs that will increase the fee charged for each sample.

5. Does the laboratory do chemical analysis in addition to NIRS? NIRS methods are based on calibrations derived from chemical methods. NIRS labs without a chemical analytical capability have no way to monitor the reliability of their calibration equations. It is not impossible for a NIRS-only lab to have a good monitoring program. But monitoring is much more difficult, since all of the monitoring samples have to be sent to another lab for chemical analysis.

6. How does the lab identify and analyze inappropriate samples received for NIRS analysis? Each NIRS calibration is specific for a particular type of sample. For example, corn silage is most accurately analyzed with a calibration equation developed for corn silage and not a calibration equation developed for alfalfa haylage. A lab should have a procedure for identifying samples that are inappropriate for the calibration equation and a protocol for properly analyzing these samples.

Keep in mind that laboratory monitoring practices increase the cost of analysis. Asking these six questions will help you evaluate a laboratory and become more knowledgeable about purchasing analytical services.

Laboratories generally report results of analyses as a single number. This does not mean that a hay sample testing at 20 percent crude protein is exactly 20.0 percent CP. Instead, it means that the hay is 20.0 percent CP plus or minus some variation. The amount of this variation will differ from lab to lab and from method to method. A variation of about 3 percent can be expected between labs for measurements of CP. In other words, a hay sample testing at 20 percent CP at one lab is expected to test anywhere from 19.4 to 20.6 percent CP at another lab or at the same lab if the analysis is repeated. Variation is usually much higher for fiber measurements than for crude protein measurements.

PENNSTATE

College of Agricultural Sciences
Cooperative Extension

Prepared by Marvin H. Hall, associate professor of forage management, and Virginia A. Ishler, extension assistant in dairy and animal science. Portions of this publication are taken from *How to Evaluate a Forage Testing Laboratory*, South Dakota State University Agric. Exp. Stn. Bulletin C255.

This publication is available in alternative media on request.

Issued in furtherance of Cooperative Extension Work, Acts of Congress May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture and the Pennsylvania Legislature. L.F. Hood, Director of Cooperative Extension, The Pennsylvania State University.

R5M1295ps