

South Dakota State University
**Open PRAIRIE: Open Public Research Access Institutional
Repository and Information Exchange**

Agricultural Experiment Station Circulars

SDSU Agricultural Experiment Station

4-1993

How to Evaluate a Forage Testing Laboratory

N.J. Thiex

South Dakota State University, nancy.thiex@sdstate.edu

E.K. Twidwell

South Dakota State University

Follow this and additional works at: http://openprairie.sdstate.edu/agexperimentsta_circ

Recommended Citation

Thiex, N.J. and Twidwell, E.K., "How to Evaluate a Forage Testing Laboratory" (1993). *Agricultural Experiment Station Circulars*. Paper 311.

http://openprairie.sdstate.edu/agexperimentsta_circ/311

This Circular is brought to you for free and open access by the SDSU Agricultural Experiment Station at Open PRAIRIE: Open Public Research Access Institutional Repository and Information Exchange. It has been accepted for inclusion in Agricultural Experiment Station Circulars by an authorized administrator of Open PRAIRIE: Open Public Research Access Institutional Repository and Information Exchange. For more information, please contact michael.biondo@sdstate.edu.

C 255

How to evaluate a forage testing laboratory

Agricultural Experiment Station
South Dakota State University
U.S. Department of Agriculture





How to evaluate a forage testing laboratory

N.J. Thiex, Chemistry Department, and
E.K. Twidwell, Plant Science Department
South Dakota State University

Can you be sure that the results that come back from your forage testing lab are accurate? To help you evaluate your lab, ask the questions in this publication.

Accurate laboratory analysis requires an organized, plan in the laboratory and properly trained technicians to assure quality data.

Concern over laboratory accuracy and repeatability is frequently focused on results generated by near infrared reflectance spectroscopy (NIRS). However, NIRS is just one of the methods used by laboratories to test forage samples for nutrient levels.

Your concern as a user of laboratory analysis is not in the type of method used but in the accuracy of the information you receive. Answers to these questions will reveal if your laboratory is following proper quality control procedures.



1. In what check-sample programs (also called proficiency testing programs) does the lab participate?

Check-sample programs allow laboratories to compare their results to those of other laboratories.

Quality labs involved in feed analysis participate in the AAFCO (American Association of Feed Control Officials) and other check-sample programs. Involvement in these programs indicates that the laboratory monitors its performance against that of other labs. You can ask to see the latest report dealing with samples similar to yours.

2. Is the lab certified by NFTA (National Forage Testing Association) for forage analysis?

The NFTA certification programs monitor the performance of a laboratory against other labs. In addition, labs can become “certified” by obtaining consistently accurate results that match the median value of other labs.

Certification is currently granted for dry matter (moisture), crude protein, and acid detergent fiber determinations using either chemical or NIRS methods or both. You should check to see if your lab is certified for the method in which you are interested.

3. Does the lab report the results of a single determination or an average of replicate determinations?

One of the easiest ways to monitor in-house laboratory repeatability is by running replicate analysis.

Some labs routinely report the average of duplicate analysis, other labs report the results of single determinations. If a lab is reporting results based on single determinations without additional quality control (random replications, quality control, or check samples), there is no indication whether or not the one determination is in error.

Obviously, duplicated analyses are better than singles, but you should realize that it costs the laboratory twice as much to run duplicates as singles, and the cost will be reflected in the fees. If you are requesting duplicate analyses and question the result reported, you have the right to ask for the duplicate values.

4. Does the lab include standards and/or quality control check samples in each batch of samples?

For some determinations, such as for protein, standards are included in each batch of samples analyzed. In addition to standards, whenever possible, quality control check samples should also be included. These are usually samples of the same type as those being analyzed. A history of results from these samples can detect trends (bias) in analytical results and indicate whether or not the analytical procedure is working correctly.

For determinations where neither standards nor quality control check samples are available, replicate determination is the only check on the method. These practices are not complicated and they are used by quality laboratories. Just like duplicates, including extra samples in each batch of samples increases costs and will be reflected in fees charged by the laboratory.

5. Does the lab grind the entire sample submitted for analysis? If not, how is sample size reduced?

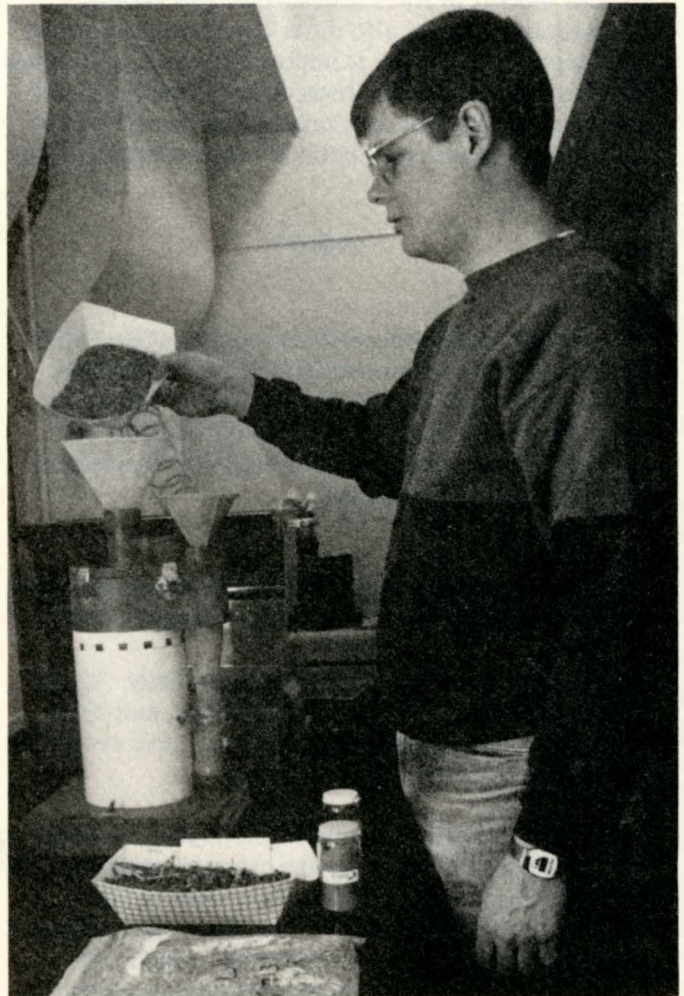
Sampling is often the largest source of error in an analysis.

Therefore, second in importance to the procedure you use to sample the lot of forage or feed is the procedure used by the laboratory to obtain a subsample. Whenever possible, the entire sample submitted to the laboratory should be ground for analysis. When it is impossible to handle the entire sample, strict protocols for reducing sample size should be observed.

Some acceptable methods for reducing sample size include the use of a gated riffle splitter, coning and quartering, and a corner-to-corner roll method. Find out whether your lab is grinding the entire sample or using one of these methods if you have doubts about the accuracy of your sample report.

6. Does the lab report indicate the moisture basis ("as received" basis or "dry matter" basis) on which the results are reported?

Your lab report should clearly indicate this. Generally, the results of forage analysis should be reported on both "as received" and "dry matter" (or "moisture free") bases. Feed or forage should be compared only on a dry matter basis since varying moisture contents will affect the "as received" (or "as fed") values of the other constituents.



You know it pays off to formulate a balanced and economical livestock ration. So you send in a sample to a forage testing lab, expecting to trust the accuracy of the results you get back. Is your trust justified? Answers to a few questions will help you select a lab; judge those answers about quality control against those given in this publication.

7. What analytical methods are used by the laboratory?

There is more than one method of analysis for almost any constituent. Different methods can give slightly different results, and some methods are known to be more accurate and/or less variable than others. Your laboratory should be using methods of analysis which are well validated, collaborated, and/or approved by organizations such as AOAC International.

If you ask your laboratory which methods it uses, the staff should be able to tell you. Likewise, NIRS laboratories should know which reference methods were used for calibration of their instruments.

Various models of NIRS instruments and various calibration equations also differ in accuracy. If a very high degree of accuracy is important to you, you should become knowledgeable about different methods and how they compare to each other. You should also be willing to pay more for methods which are more costly.



You can ask additional questions specifically on NIRS testing. NIRS is just one method to test for nutrient levels. It is reliable when used properly. Like many other laboratory techniques, it is sophisticated and should be performed and monitored only by properly trained laboratory personnel.

8. How is the lab instrument monitored? And how are calibration equations monitored?

NIRS instruments should be monitored daily: 1) for instrument "noise," 2) for lamp intensity, and 3) by running a sealed check sample daily or after every 25th sample, whichever is more frequent.

Calibration equations should be monitored by analyzing every 25th sample by reference chemical methods. This should be done for each calibration used in the laboratory. This is expensive and time-consuming and therefore most likely to be neglected. Again, you should be willing to pay an increased fee to cover the cost of the monitoring of the calibrations.

9. Does the lab do chemical methods in addition to NIRS?

NIRS methods are based on calibrations by chemical methods. NIRS labs which have no chemical analytical capability have no in-house way to monitor the reliability of the NIRS calibrations and would have to send the test samples to an outside laboratory.

It is not impossible for a NIRS-only lab to have a good monitoring program. But it is much less probable since all of these samples have to be sent out to another lab for chemical analysis.

10. How does the lab eliminate inappropriate samples received for NIRS analysis?

NIRS calibrations are specific for a given sample type. Samples are frequently received at the laboratory mislabeled. For example, a corn and sorghum silage

mix might be labeled as "corn silage" or a corn and soybean meal mix might be labeled as "corn." Poor attention to these details on your part may result in poor NIRS results.

The NIRS program includes a feature that avoids using an inappropriate calibration for an unknown sample. A statistical check ("H" statistic) compares the sample to those in the calibration set. Usually an "H" statistic of 3.0 is recommended as the upper limit for using the results generated by NIRS.



You must understand that laboratory quality control practices increase the cost of the analysis. More than in any other industry, "cheap" and "fast" seem to be important to many feed and forage clients. If cheap and fast are the priorities, accuracy and repeatability may likely be sacrificed.

Learning to evaluate your laboratory is one way to become knowledgeable about purchasing analytical services. Learning to evaluate the data is another.

It is customary for laboratories to report results of analyses as a single number. For example, your alfalfa hay tested at "20.0%" crude protein. This does not mean that your hay is exactly 20.0% protein. Instead, it means that your hay is 20.0% protein plus or minus some variation. The amount of variation will differ from lab to lab and from method to method.

A relative variation of about 3% between laboratories is considered typical for crude protein. This means that results from 19.4 to 20.6 would be acceptable for a sample averaging 20.0% crude protein.

The variation is usually much higher for fiber than for crude protein analyses. Relative feed value (RFV) is calculated from acid detergent fiber (ADF) and neutral detergent fiber (NDF), and will, therefore, reflect the variation in both of these analyses.

Published in accordance with an act passed in 1881 by the 14th Legislative Assembly, Dakota Territory, establishing the Dakota Agricultural College and with the act of re-organization passed in 1887 by the 17th Legislative Assembly, which established the Agricultural Experiment Station at South Dakota State University.

This publication was prepared by the Ag Communications Department, SDSU, and printed at the SDSU Printing Laboratory. Printed with AGRI-TEK ink (containing soy, corn, and other vegetable oils).

1,000 copies of C255 were printed by Agricultural Experiment Station at a cost of 23 cents each. AX131 April 1993