INTERPRETING YOUR HAY TEST REPORT

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ABSTRACT

As an assist to someone new to the field of hay testing, the various parts of a hay test report are discussed. An example of a typical hay test report is dissected. The analytical values of performance evaluation samples reported to the National Forage Testing Association over a 4-year period are used as a basis for determining the typical analytical variability between laboratories.

Key Words: alfalfa, reporting, forage testing, interpretation, analytical variation, hay quality

INTRODUCTION

Often people have questions about a laboratory's hay quality reports. Many times the individuals are relatively new to the arena of forage testing, and indicate that the report might just as well be written in Greek, for all the meaning that they can extract from it. "So what do all these numbers mean?" is a phrase often heard by lab personnel. Occasionally, the inquiry is from someone who has many years experience in the hay market. The questions may be about an unusual relationship between the analytical results, or about difficulties comparing reports from different labs. To address these issues an example report will be dissected and then the subject of laboratory variability will be addressed.

A REPORT

Figure 1 is a typical report one might receive from a hay testing laboratory.

- ***Client Name***. It seems to be a straightforward portion of a report, so why bring it up? Labs receive samples with no indication of who submitted the samples. Often the samples are never claimed. Be sure to make it clear whom the samples are from, and who is to receive copies of reports, when submitting samples.

- ***Sample Descriptions*** are an essential component of a hay test report. They are the link between the report in hand and the hay lot in the field. Complete sample descriptions are also helpful to the laboratory, in determining what equations are appropriate to use. If a Near Infrared analysis is to be performed on the sample, the sample type will determine which calibration to use.

- ***Laboratory Numbers*** are the code used to track the sample and associated information within the laboratory. When communicating with a lab, giving the lab personnel a laboratory number is the most efficient means of identifying the report and the sample.

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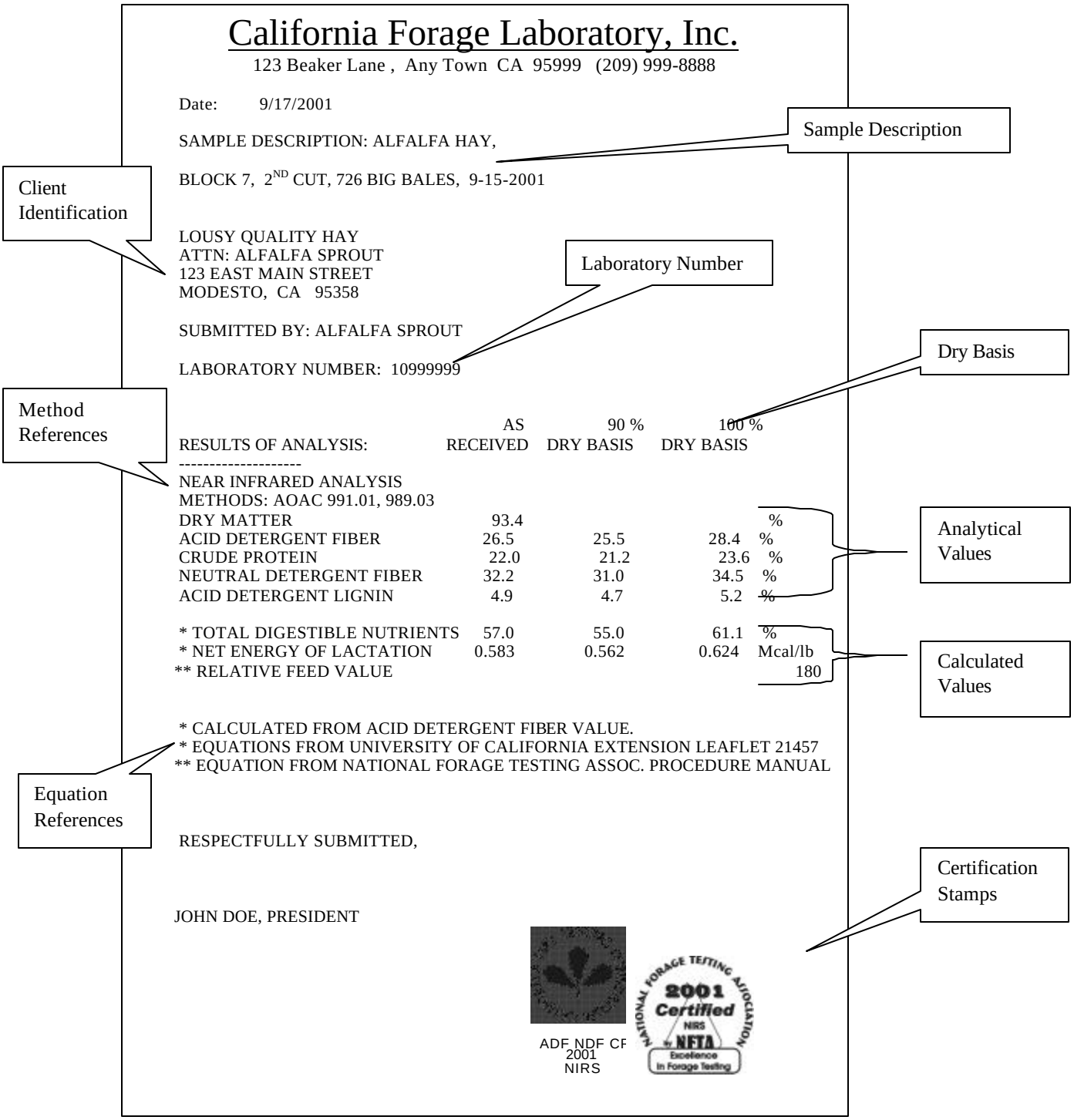
- Figure 1.


California Forage Laboratory, Inc.
123 Beaker Lane , Any Town CA 95999 (209) 999-8888
Date: 9/17/2001
SAMPLE DESCRIPTION: ALFALFA HAY,
BLOCK 7, 2ND CUT, 726 BIG BALES, 9-15-2001
LOUSY QUALITY HAY
ATTN: ALFALFA SPROUT
123 EAST MAIN STREET
MODESTO, CA 95358
SUBMITTED BY: ALFALFA SPROUT
LABORATORY NUMBER: 10999999
RESULTS OF ANALYSIS: AS RECEIVED | 90 % DRY BASIS | 100 % DRY BASIS
NEAR INFRARED ANALYSIS
METHODS: AOAC 991.01, 989.03
DRY MATTER 93.4 %
ACID DETERGENT FIBER 26.5 25.5 28.4 %
CRUDE PROTEIN 22.0 21.2 23.6 %
NEUTRAL DETERGENT FIBER 32.2 31.0 34.5 %
ACID DETERGENT LIGNIN 4.9 4.7 5.2 %
* TOTAL DIGESTIBLE NUTRIENTS 57.0 55.0 61.1 %
* NET ENERGY OF LACTATION 0.583 0.562 0.624 Mcal/lb
** RELATIVE FEED VALUE 180
* CALCULATED FROM ACID DETERGENT FIBER VALUE.
* EQUATIONS FROM UNIVERSITY OF CALIFORNIA EXTENSION LEAFLET 21457
** EQUATION FROM NATIONAL FORAGE TESTING ASSOC. PROCEDURE MANUAL
RESPECTFULLY SUBMITTED,
JOHN DOE, PRESIDENT
ADF NDF CP
2001
NIRS
NATIONAL FORAGE TESTING ASSOCIATION
2001 Certified NIRS by NFTA Excellence In Forage Testing
Sample Description
Client Identification
Laboratory Number
Dry Basis
Method References
Analytical Values
Calculated Values
Equation References
Certification Stamps

- ***Method References*** indicate what procedures were actually performed on the sample. It is helpful when evaluating results to know specifically which methods were used. For example, there are many different dry matter methods in use. They vary in the type of oven (gravity convection, mechanical convection, vacuum oven, etc.), the temperature and time spent in the oven. Some have significant biases compared to the NFTA reference method.

- ***Analytical Values*** are the results of the tests actually performed on the sample by the lab. The results are usually expressed on more than one dry matter basis.

- ***Dry Basis.*** When comparing values between samples, always make sure that the results are on the same dry matter basis. Traditionally the California marketplace uses the TDN on a '90% dry' basis as the standard for evaluating alfalfa hay. The '100% dry' basis is what the values would be, if all the water were removed from the hay. Hay is never naturally found in this state. Energy calculations are based on the '100% dry' basis values.

  The '90% dry' basis is used in many cases for comparing different hay lots because in the dry climate of most western states, the hay will equilibrate to approximately 90% dry matter upon long storage. The 'As Received' values (sometimes called 'As Is') are the values in the sample at the time of sampling. The most critical 'as received' value to evaluate is the Dry Matter. If the dry matter is too low, there will be storage problems such as mold growth and possibly even heat buildup to the point of spontaneous combustion.

- ***Calculated Values*** are the results of calculations based on the analytical values. The energy values such as TDN, NE_l, etc… are calculated estimates of the actual energy that may be available under normal feeding circumstances. Except for rare studies at research facilities, no lab actually measures the energy value of hay samples. The equations used for estimating the energy values of hay are derived from feeding studies and nutritional models developed at research facilities.

- **Equation References.** There are many different equations available to estimate energy content, and they differ significantly in the energy values that they assign to the same analytical results[i]. It is important that the same equation be used when comparing different hay samples. Most equations currently in use are based only on the Acid Detergent Fiber value. In the California marketplace the standard equation used for alfalfa hays is the Western Region[ii] equation. The Western Region equation for TDN is based solely on the Acid Detergent Fiber value.

- ***Certification Stamps*** indicate the certification status of the laboratory. The National Forage Testing Association (NFTA) annually certifies laboratories based on the results of performance evaluation samples sent out to participating labs. The California Hay Testing Consortium (CHTC) recognizes laboratories that perform well on the alfalfa samples of the NFTA program. Currently the CHTC standard is significantly tighter than the NFTA requirements for individual analytes. Look for the presence of certification stamps on reports, it not only indicates that the lab has performed well on the performance evaluation samples, but that it is participating in programs designed to improve the overall quality of forage testing.

ANALYTICAL VARIABILITY

The issue of how much variation should there be in the analytical results both within laboratories and between laboratories is an issue that arises often. The following table indicates the current state of affairs. There seems to be a consensus among many lab managers that the within lab variations listed in the table are realistic. What we haven't had available is a good measure of the actual between lab variability.

Typical Analytical Variability		
	Within Lab[iii]	**Between Labs**
Dry Matter	+/- 0.5 %	+/- 3.7 %
Crude Protein	+/- 0.5 %	+/- 1.7 %
Acid Detergent Fiber	+/- 0.7 %	+/- 2.5 %
Neutral Detergent Fiber	+/- 1.0 %	+/- 2.8 %

One of the difficulties in determining 'between lab variability' has been the issue of how much of the observed differences between the results of different labs is sampling variation, and how much is actually due to lab variation. Sampling variation can be a huge contributor to the differences in lab results.[iv]

The 'Between Labs' values are based on 95% confidence interval of 16 sets of alfalfa hay samples reported by National Forage Testing Association's participant laboratories between 1997 and 2001. This value may be tighter than seen in the marketplace because labs use many different methods, and only labs using the reference method were included in this evaluation.

It is critical to note that this table does <u>not</u> indicate the variability of NFTA certified labs. The data includes outliers, which most likely disqualified the reporting labs from certification. This dataset was used because of the nationwide distribution of the laboratories, and the tightly controlled variation[v] in the ground samples sent out for analysis. The homogeneity (uniformity) of each of the samples was carefully checked prior to sending them out for analysis.

If we take as an example alfalfa hay with a reported value of 28.4% ADF (100% dry), the TDN on a 90% dry basis using the Western States Equation would be 55.0%. If the sample were re-analyzed in the same laboratory, the ADF would be expected to be within the range of 27.7% to 29.1% ADF. This range of ADF would correspond to a TDN(90% dry) of 55.4% to 54.5%.

If a ground sample of that hay were split and sent out for analysis, 95% of the labs involved in the study would have reported a value between 25.9% and 30.9% ADF. This corresponds to a TDN (90% dry) of 56.6% to 53.3%.

This range in values is considered appalling to most users of hay test reports. The observed variation points out why it is important to choose a NFTA certified laboratory at a minimum, and preferably to choose a CHTC recognized lab for your hay testing.

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[i] Undersander, Dan, David Mertens and Nancy Thiex, 1993, Forage Analysis Procedures, National Forage Testing Association, Appendix A3, Table 6.

[ii] Bath, Donald L. and Vern L. Marble, 1989, Testing Alfalfa for Its Feeding Value. Univ. of CA. Cooperative Extension Leaflet 21457. (WREP 109).

[iii] Ball, D.M., M.Collins, G.D.Lacefield, N.P.Martin, D.A.Mertens, K.E.Olson, D,H.Putnam, D.J.Undersander, and M.W.Wolf. 2001. Understanding Forage Quality, American Farm Bureau Federation Publication 1-01, Park Ridge, Il.

[iv] Collins, M, V.Owens, D.Putnam, P.Meyer, G.Smith, M.Wolf, 2000, Hay Sampling Demonstration Results, 2000 National Forage Testing Association Annual Workshop Proceedings

[v] Wolf, M 1997, Check Sample Preparation, Standard Operating Procedure # CC001, National Forage Testing Association