ALFALFA HAY TESTING, METHODS OF ANALYSIS AND REPORTING

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Alfalfa hay analysis, when performed and reported correctly, yields valuable information for both the livestock feeder and the hay producer. The results of the analysis are used to adjust fiber and protein intake for optimum conversion of feed to milk or meat. The hay grower can adjust his farming practices to produce high quality forage that is easier to market and hopefully will return a higher profit.

The analysis performed by the laboratory can be no better than the sample submitted. The individual charged with the responsibility for sampling a lot of material, therefore, must to the best of his ability obtain a representative sample. Good judgement is a prerequisite to good sampling procedure. Grab samples or partial bale samples are not representative and are not acceptable.

Alfalfa hay quality is determined by three testing procedures, namely moisture, crude protein and modified crude fiber determinations. A properly sampled quantity of hay is submitted to the laboratory where it is first ground to a fine particle size. The ground sample is then quickly weighed into the appropriate reaction vessels and the analysis is started. The currently accepted procedure for moisture is the drying oven where an accurately weighed sample is deposited into a tared pan. The sample is placed into the oven and dried for a prescribed length of time at a specified temperature. Moisture results are reported to the nearest tenth percent. Dry matter is simple 100 % moisture. Crude protein is measured by the standard Kjeldahl procedure. This procedure measures the nitrogen content of the material by a high temperature digestion in concentrated sulfuric acid. At this high temperature and strong acid concentration, the plant material is broken down into simple inorganic compounds. Specifically, complex protein molecules are converted into simple compounds of carbon and nitrogen. The nitrogen can then be measured by a variety of techniques. The value of crude protein that is expressed on the final report is %Nitrogen x6.25. Modified crude fiber is performed by first digesting the sample in a dilute acid solution followed by digestion in a dilute alkali solution. The material that survives these digestions is collected, dried, weighed and reported as modified crude fiber. An important difference between this procedure and the standard crude fiber is that the modified is so named because it includes not only fiber but any dirt or sand present in the sample. Alfalfa grown in areas where dust storms are common can accumulate a considerable amount of sand after cutting and before baling. The end result is an elevated modified crude fiber and a lower quality rating.

The above outlines the current methods of testing alfalfa hay in California. With a trained and competent analyst, very accurate and reproducible results can be obtained. The drawback to these procedures is that they are very time consuming and require a high expenditure in electricity, chemicals and glassware. Like in any other business, time is money not only to the laboratory but to the client submitting the analysis. A faster method for performing these analyses is needed. With the rapid advancement of electronics, new methodologies are emerging. Near infrared reflectance spectroscopy appears to be promising.

The theory behind near infrared reflectance is that molecules of interest such as protein, fiber (cellulose) and water interact with electromagnetic radiation. Electromagnetic radiation is a spectrum of energy, the visible portion that we are all familiar This spectrum is made up of other regions such as xray, infrared, microwave and near infrared. In this technology a beam of near infrared energy is directed at the surface of a very finely ground sample of hay contained in a container covered with a quartz window. As the energy beam interacts with the sample, certain wavelengths are absorbed out by molecules of interest; the amount of energy absorbed by the sample is related by the number of molecules present, hence, a measure of the concentration is obtained. The design of the instruments available varies, but the end result is that absorbance of different wavelengths is measured and converted to percentages of constituents of interest.

The theory behind the above technology is well accepted. Most of the problems associated with this procedure are mechanical. The plant materials must be ground to a

very fine consistency which is difficult with high moisture hay. Moisture changes in the sample during grinding are also a problem. Calibration of the instrument requires wet chemical analysis of a sample set that covers the range of fiber and protein that are encountered. At the time of this writing our laboratory is working in conjunction with Dairymans Creamery Cooperative Association's laboratory in the calibration of a near infrared unit located at that facility. The results so far have been encouraging. When the above mentioned obstacles have been overcome, the analysis of alfalfa hay testing can be performed very quickly, less than a minute after grinding. The current testing procedure for fiber alone requires a mimimum of 4 hours.

Now that we have seen how a sample of alfalfa hay is analyzed, we come to an important topic at what dry matter basis should the sample be reported. Below is an example of a report of analysis at two different dry matter bases. An analysis reported on a 90% dry matter basis means that the fiber, protein, energy, digestable protein and total digestable nutrients have been adjusted from their "as is" basis to a 10% moisture basis. The rationale for this conversion is that even though the hay has been baled and tested at a 20% moisure level, by the time is fed, it will have dried to a 10% moisture level. This may or may not be the case. As you can see, the difference in the two reports is considerable. It is important that the laboratory reporting the analysis clearly state at what moisture level the analysis has been calculated. Please note that the formulas for converting between the two moisture levels is listed on the report.

Lab No.: 11001
Date Received: 11/4/83
Sample Description: Alfalfa Hay:

Submitted To:
A Diary

Analysis: As Received Basis

DRY MATTER %.....	80.0
MOISTURE %.....	20.0

Analysis:	"90 % Dry Matter"	"As Received"
CRUDE PROTEIN %.....	19.9	16.7
CRUDE FAT %.....		
CRUDE FIBER %.....		
MODIFIED CRUDE FIBER %.....	23.0	20.4
ASH %.....		
E.N.E. KCAL/LB.....	440	391
DIGESTABLE PROTEIN %.....	15.2	13.5
T.D.N. %.....	53.3	47.4
N.F.E. %.....		
N.P.N. as c.p. %.....		
CALCIUM %.....		
PHOSPHORUS %.....		
MOLYBDENUM ppm.....		
A.D.F. b.c.p. %.....		
ACID DETERGENT FIBER %.....		
LIGNIN %.....		
SILICA %.....		

To convert from 90 % to as received
Divide the result on a 90 % basis
by 90 then multiply that result
by the actual dry matter %
Example:
Crude protein at 90 % = 19.9
19.9/90 X 80.0 = 16.7 % an an as
received basis.

RATING SYSTEM:
EXCELLENT: Above 450 E.N.E.
GOOD: 420-450 E.N.E.
FAIR: 385-419 E.N.E.
POOR: Below 385 E.N.E.

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In closing, testing alfalfa hay quality by chemical analysis, when tested properly interpreted correctly and used in conjunction with visual analysis of the hay tested, can provide useful information for the producer and the consumer of this commodity.