Alberta Dairy Management
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Understand Your Feed Analysis Report

In October and November every year, a large proportion of our work involves formulation of winter feeding programs, based on analysis results of the new forage crops. When discussing those results with our clients, it is apparent that the meanings of many of the values are not clearly understood. Here is a brief explanation of each of the numbers you are likely to find on your forage analysis report :

Moisture and Dry Matter

Moisture % indicates the proportion of water in the sample, calculated by weighing the sample before and after complete drying. For example, if a sample of silage weighs 100 grams before drying and 40 grams after, it is assumed that 60 grams of water were lost - the original sample was therefore 60% moisture. Conversely, the Dry Matter % of the sample was 40%.

Most feed labs report analysis results on both a wet and a dry basis. The wet basis may be referred to by the terms: As Is, As Fed or As Received. The 100% dry basis is usually referred to as: Dry, DM (Dry Matter), Dry Basis or Dry Result. We'll use the terms As Fed and DM in the remainder of this article. You can convert from one basis to the other using the following formulas:

$$\text{As Fed basis} = \text{DM basis} \times (\text{Dry Matter \%} / 100)$$

$$\text{DM basis} = \frac{\text{As Fed basis}}{(\text{Dry Matter \%} / 100)}$$

When we formulate rations for dairy cattle, we use analysis results quoted on a DM basis. Therefore, when we are discussing the quality of a particular forage, we normally talk about its analysis on this basis also. However, you should be aware that the analysis guarantees on manufactured feeds are stated on an As Fed basis. If you are not given a Moisture % or Dry Matter % for the product, you can assume it is 90% dry matter. Before using manufactured feeds in a ration formulation, convert their analysis levels to the DM basis using the second formula above. For example, a 16% Dairy Ration will contain 17.8% crude protein [16 / (90/100)] on a DM basis.

Protein fractions

One of the first values most of us look for when we receive a forage analysis report is Crude Protein (CP) %. Since most feed proteins contain about 16% nitrogen (N), CP % is estimated in the feed lab by measuring the % of N in the feed and multiplying that value by 6.25 - the inverse of 16% (1 / 0.16 = 6.25). However, some portion of the N in most feeds is found as non-protein nitrogen (NPN) and, therefore, the value calculated by multiplying N x 6.25 is referred to as *crude* rather than *true* protein (see article **1P1**).

Most feed labs will also measure the levels of several subfractions of crude protein that can be useful in formulating dairy rations. One of these fractions is acid detergent insoluble protein (ADIP %), used to estimate the amount of protein which is unavailable to the animal due to heat damage.

When silage is put up too dry (greater than 50% dry matter) or hay too wet (less than 85% dry matter), excessive heating may cause some of the protein to become irreversibly bound to fibre. The severity of damage is estimated in the feed lab by measuring the amount of crude protein associated with the acid detergent fibre (ADF) fraction. Depending on the feed lab used, this fraction may be reported as acid detergent insoluble nitrogen (ADIN %), acid detergent fibre protein (ADF-P %) or acid detergent fibre nitrogen (ADF-N %). Values reported as N % can be converted to protein % by multiplying by 6.25, as explained above.

Soluble protein estimates the amount of crude protein which will readily dissolve when the feed enters the rumen. It is assumed that this fraction represents crude protein which is rapidly degraded by rumen microbes (see article **1P1** for an explanation of protein degradability). The CP of most forages is 40-50% soluble. Higher soluble protein levels are often found in silages which are put up very wet (less than 30% dry matter). When this is the case, the bypass protein value of the forage should be discounted.

Nitrate % is also a nitrogen-containing feed fraction, but it contributes very little to CP %. Nitrates can accumulate in a crop which has been subjected to frost, drought or high levels of nitrogen fertilization. Feeds containing high levels of nitrate (greater than 1%) can be toxic, particularly when first offered to animals not adapted to them.

ADF and NDF

Acid detergent fibre (ADF %) is a measure of the most slowly digestible components of a forage. Since the digestibility of a feed determines its energy value, the primary use of ADF % is in the calculation of Net Energy for lactation (NE_l) and all of the other energy values reported (see below).

Neutral detergent fibre (NDF %) is a more complete measure of forage fibre than ADF % and, therefore, its value must always be higher. The difference between ADF % and NDF % is normally greater for grasses and cereal silages than it is for legumes such as alfalfa.

Both ADF % and NDF % are *chemical* measures of fibre. The measured levels will be the same for a long hay as they would be for the same hay if it were finely ground. Since dairy cattle require both *physical* (chewable) and *chemical* fibre, chemical feed analysis results must be combined with an assessment of particle size to provide a complete estimate of a feed's fibre value. A few feed labs offer particle size analysis, but most commonly the assessment is based on subjective visual evaluation. Dairy rations are commonly formulated to provide minimum levels of effective NDF or forage NDF, estimates which combine both chemical and physical attributes of fibre.

Minerals

Most feed labs offer analyses of the important macro- (Sodium (Na), Potassium (K), Calcium (Ca), Magnesium (Mg), Phosphorus (P), Chloride (Cl) and Sulphur (S)) and micro- (trace) minerals (Copper (Cu), Manganese (Mn), Selenium (Se) and Zinc (Zn). However, we routinely only test for Ca, P, K and Mg since these are the most variable in our forages. Measurement of these minerals by Near Infrared Reflectance Spectroscopy Analysis (NIR, NIRA or NIRS), although less expensive, is considered less accurate than analysis by 'wet chemistry'. But for routine use, we have found the NIR values to be quite reliable.

Dairy rations are generally formulated to supply trace minerals (and vitamins) through supplemental sources at levels well above minimum requirements. Therefore, it is seldom considered necessary to measure levels of these minerals in routine analysis of forages.

When formulating rations for cation-anion balance (DCAB - see article **1M1**), it is essential that levels of Na, K, Cl and S be measured by wet chemistry. DCAB rations for dry cows that have not been very carefully balanced have created as many problems as they have solved.

Calculated values

Several of the values normally found on a feed analysis report are calculated from the analysis values discussed above. And the formulas used for these calculations vary from lab to lab. However, the way that these values are used is typically more critical to the success of a ration formulation than the absolute values reported. Your nutritionist should be quite familiar with their correct interpretation.

Adjusted or Available Crude Protein % (ACP %) is calculated by subtracting a variable portion (depending on the lab) of ADIP % from CP %. Since ADIP normally accounts for 5-10% of CP even in non-heat damaged feeds, some labs do not adjust CP % until ADIP % exceeds 9-10% of CP %. Others subtract all ADIP % from CP %, on the basis than high feed throughput by lactating dairy cows limits their opportunity to digest fibre-bound protein.

Relative Feed Value (RFV) is an index of forage quality calculated from ADF % and NDF % using the following formula :

$$RFV = \frac{[(88.9 - (0.78 \times ADF\ \%)) \times (120 / NDF\ \%)]}{1.29}$$

Notice that RFV does not account for the CP % of the forage. It is based only on fibre levels and is, therefore, an index of forage digestibility.

As mentioned above, all energy values reported (TDN, NE_l, NE_m, NE_g, DE, ME) are calculated from ADF % using formulas specific for each forage type - grass, legume, grass/legume mix, small cereal or corn silage. It is, therefore, very important to identify the forage type to ensure that the correct equation is used.

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