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Estimating Alfalfa Hay and Corn Silage Energy Levels

UC Davis Equations using NDF and ADF

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The fundamental characteristic of formulated rations for dairy cattle, around which all other nutrients are structured, is its energy content. Expressed variably as TDN (total digestible nutrients) or NE_l (net energy for lactation), the level of energy in a total mixed ration (TMR) is the sum of the energies of its component feeds. And therein lies the rub since, unlike chemical components such as protein or fiber, the energy content of a feedstuff cannot be analyzed. Energy represents the potential of a feed's chemical components to do work as biological products, such as meat or milk, or as heat. Nevertheless an accurate knowledge of the energy content of feeds is central to formulation of rations, which maximize the animal's output of usable products.

The two most important forages used in California dairy rations are alfalfa hay and corn silage. This article presents the best available UC Davis predictive equations to estimate the energy value of California alfalfa hay and corn silage from NDF or ADF.

The Complicated UCD Approach to Estimate Energy Levels

It has long been recognized that the two key factors that determine the energy value of a feedstuff for dairy cattle are its content of fat, due to its high energy value, and the digestibility of its structural fiber (i.e., NDF), due to its high content in forages. The former can be dealt with by chemical analysis, although the latter has proven to be more difficult. The tendency has been to rely upon the basic similarity of fiber, within a forage type, to develop unique energy prediction equations for each forage type. This approach has also been used by the National Forage Testing Association (NFTA), which lists numerous equations at its web site to predict the energy value of specific forages.

The most common approach to estimate the energy value of feedstuffs has been to calculate its TDN level using an equation based on analyzable components of feedstuffs. Although the TDN equation has changed over the past 100 years, as feedstuff analyses

have improved, the principles have remained unchanged. TDN is calculated based on digestible crude protein (CP), digestible fat, digestible neutral detergent fiber (NDF), and digestible non-structural carbohydrate (NSC) all corrected for a metabolic cost of digestion by the animal. The TDN value can then be used to estimate the NE_l value of individual feedstuffs.

However this package of chemical and biological characteristics of feeds is expensive (about $70/sample) with a long turnaround time (about 2 weeks). Most dairy producers require faster response times and desire lower costs. However over the past 3 to 4 years a number of samples of California alfalfa hays and corn silages have had their NE_l values estimated in the author's lab by this expensive, and time consuming, approach that includes numerous analyses on each sample. The numbers of samples, while not extensive, are sufficient to allow equations to estimate the NE_l values (at 3 times maintenance; 3xM) of alfalfa hay and corn silage from their NDF or ADF level.

The UC Davis Method to Estimate Energy Levels of Alfalfa Hay & Corn Silage

The NE_l content of both these feeds can be estimated from NDF or ADF. While both NDF and ADF are measures of the fiber content of a feed, use of ADF is gradually being replaced by NDF in commercial laboratories.

Alfalfa Hay

The best predictive equations for the NE_l value of California alfalfa hay are:

NE_l (Mcal/lb DM) = 0.906 – (0.00730 * *NDF*(% DM)) $r^2 = 0.724$

NE_l (Mcal/lb DM) = 0.883 – (0.00824 * *ADF*(% DM)) $r^2 = 0.696$

Neither equation was improved substantively by addition to the predictive equation of the CP or ash content of the alfalfa hays. As the r^2 value represents the proportion of the variation in NE_l that is explained by either NDF or ADF, both equations explain about 70% of the variation, which is good, although the NDF equation is slightly better.

Corn Silage

The best predictive equations for the NE_l value of California corn silage are:

NE_l (Mcal/lb DM) = 1.242 – (0.01236 * *NDF*(% DM)) $r^2 = 0.726$

NE_l (Mcal/lb DM) = 1.065 – (0.01371 * *ADF*(% DM)) $r^2 = 0.595$

As with alfalfa hay, neither equation was improved substantively by addition of CP or ash. The equation based upon NDF is much better than that based on ADF.

Conclusions

The NE_l content of both California alfalfa hay and corn silage can be estimated with good accuracy based upon its NDF content alone. Use of ADF allows similar accuracy within alfalfa hay, but is much less accurate for corn silage.

California forage testing laboratories should adopt the predictive equations based on NDF in order to provide the most accurate estimates possible of the energy value of California alfalfa hay and corn silage.

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