

California ARPAS Alfalfa Hay Study

A collaborative project of California ARPAS, Sapienza Analytica, LLC and the USDA/ARS Dairy Forage Research Center

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The California ARPAS Alfalfa Study

Current forage quality and marketing systems in California are fiber based, a practice dating from the mid-nineteenth century. Alfalfa hay quality is based upon a single laboratory measurement of the content of acid detergent fiber (ADF). Variation in acid detergent fiber explains approximately 70 percent of the variation in TDN and 75 percent of that in digestible energy.

The use of both ADF and NDF in prediction equations has been suggested. Acid detergent fiber is a subset of NDF; if the pairwise correlation is significant (.70 or greater) multicollinearities may exist. For multiple predictor variable equations such as:

$$Y = b_0 + a_1\text{ADF} + a_2\text{NDF}$$

it is possible that solutions are unique to the data from which they were developed. For our data, the pairwise correlation between ADF and NDF is greater than .90, suggesting that multiple variable prediction equations of this type may be inappropriate.

Relative feed value (RFV) has been proposed as a measure of alfalfa quality. Neutral detergent fiber (NDF) is the predictor variable for dry matter intake (DMI) and ADF is the predictor variable for dry matter digestibility (DDM), RFV is calculated as $f(\text{DMI} \cdot \text{DDM})$. Calculations of this sort may prevent some of the problems associated with multicollinearity. However, Sanson and Kercher (1996) reported that variation in ADF content accounted for only 20 percent of the variation in DDM and that the slopes of the lines for $\text{DMI} = f(\text{NDF})$ and $\text{RFV}_{\text{est}} = f(\text{RFV}_{\text{act}})$ were not different from zero. Hackman et al. (2008) also commented on the poor predictability of RFV from the RFV equation. As a tool to estimate alfalfa

quality, RFV appears to be lacking. *Si non e vero e molto ben trovato*. Detergent residues are related to the extraction medium and reaction conditions, as well as plant maturity and growing conditions; therefore, prediction equations based on detergent residues may not accurately reflect the utilization of alfalfa hay in the ruminant digestive system. Graham made this comment in 1966 “..... a simple but demonstrably misleading system is no substitute for a reliable though complex one. The real choice is not between unmanageable truth and facile fiction, but between science and rule of thumb.” It is as true today as it was 44 years ago.

The California Chapter of the American Registry of Professional Animal Scientists (California ARPAS) has undertaken a study whose goal is to replace current fiber based methods of alfalfa hay evaluation with an alternative method of measuring the quality of alfalfa hay. It will have the advantage of describing feed inputs and animal requirements in the same terms (digestible and metabolizable energy) and will allow for better estimates of alfalfa value. The lack of uniqueness of solution for DE, ME or NE_i in commonly used equations, based on either ADF or NDF, is apparent and indicates that some or all of the equations are incorrectly specified. Based on recently completed work DE can be predicted using our model.

Samples collected during the 2008 growing represented more diversity in ADF than for the data set used to determine the current TDN estimating equation. These samples are also more diverse in content of NDF, ADF, crude protein and presumed hemicellulose than the 3000 alfalfa hay samples analyzed by Dairyland Laboratories, Inc. during 2007. Two ton lots of eleven samples, representing the range in diversity for the 150 total samples, were purchased and sent to the DFRC for a metabolism study to determine digestibilities of various chemical and proximate entities. In vitro studies are underway at Sapienza Analytica, LLC and in silico studies in California to determine rate and extent of ruminal disappearance of dry matter, crude protein, selected amino acids and NDF. We are also determining post ruminal disappearance of selected amino acids.

Assuming a successful outcome we will be developing transferable NIR prediction models. California ARPAS will be releasing a commercial beta test version in 2011.