Feed Management

A Key Ingredient in Livestock and Poultry Nutrient Management

Feeding Dairy Cows: In Vitro NDF Digestibility

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Disclaimer
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Introduction

This fact sheet has been developed to support the implementation of the Natural Resources Conservation Service Feed Management 592 Practice Standard. The Feed Management 592 Practice Standard was adopted by NRCS in 2003 as another tool to assist with addressing resource concerns on livestock and poultry operations. Feed management can assist with reducing the import of nutrients to the farm and reduce the excretion of nutrients in manure.

The Natural Resources Conservation Service has adopted a practice standard called Feed Management (592) and is defined as “managing the quantity of available nutrients fed to livestock and poultry for their intended purpose”. The national version of the practice standard can be found in a companion fact sheet entitled “An Introduction to Natural Resources Feed Management Practice Standard 592”. Please check in your own state for a state-specific version of the standard.

Conclusions reached regarding in vitro neutral fiber digestibility (IVNDFD) and its impact on lactation performance in a literature review for a symposium presentation at the 2006 ADSA/ASAS Annual Meeting (Shaver, 2006) were as follows:

- IVNDFD has been related to > milk production across an array of different forages.
- Milk production response to IVNDFD is thru DMI, and not energy density.

- DMI and milk production responses to IVNDFD > in higher producing cows.

- Benefits of brown midrib corn & sorghum silages for IVNDFD, DMI, and milk production have been observed consistently.

- More IVNDFD/in vivo research is needed with legumes & other grasses.

- Increased IVNDFD has not been fully exploited by researchers in trials attempting to maximize dietary forage or optimize forage mixtures, or by field nutritionists feeding higher forage diets with the aim of improving cow health.

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IVNDFD Analysis

Several commercial testing laboratories offer wet chemistry IVNDFD measurements. Ranges for IVNDFD of forages are presented in Table 1. The IVNDFD values are highly variable among and within forage types. Introduction of low-lignin, brown midrib hybrids for production of corn and sorghum silages has widened the variation in IVNDFD for these forage types (Oba and Allen, 1999b). NIRS calibrations for predicting IVNDFD on hay-crop forage and corn silage samples are available at some commercial forage testing laboratories. However, Lundberg et al. (2004) found poor prediction by NIRS of legume-grass silage and corn silage IVNDFD. It is hoped that NIRS calibration equations can be improved upon in the future.

The NRC (2001) recommended a 48-h IVNDFD for use in the NRC (2001) model, and for that reason we used 48-h IVNDFD measurements in MILK2000 (Schwab et al., 2003). However, debate continues within the industry about the appropriateness of 48-h vs. 30-h IVNDFD measurements. Some argue that the 30-h incubation better reflects ruminal retention time in dairy cows (Oba and Allen, 1999a) and that most of the in vivo trials that have evaluated effects of varying IVNDFD on animal performance also performed 30-h IVNDFD measurements (Oba and Allen, 2005). Labs and their customers also like the faster sample turn around that is afforded by the 30-h incubation time point. For that reason, and also for improved lab operation efficiency, a 24-h incubation time point is being employed by some labs. However, some argue that the 48-h incubation time-point is less influenced by lag time and rate of digestion, and thus is more repeatable in the laboratory (Hoffman et al., 2003). Hoffman et al. (2003) provided data on the relationship between 30- and 48-h IVNDFD measurements that showed a strong positive relationship (r-square = 0.84). But, the lab average at a specific incubation time point and the relationship between incubation time points within a lab can be highly variable among labs making the development of a universal incubation time point adjustment equation difficult. The average lignin-calculated corn silage NDF digestibility in the NRC (2001) is 59%. This reference point is important for adjustment of IVNDFD values from different labs and varying incubation time points so that the resultant TDN and NE_L values are comparable to NRC (2001) values.

Average IVNDFD values for selected high-fiber by-product feeds (Peter Robinson, CA-Davis, personal communication) are presented in Table 2. The IVNDFD values are highly variable among these high-fiber by-product feeds. The IVNDFD values for these high-fiber by-product feeds were poorly related to lignin-calculated (NRC, 2001) NDF digestibility. High digestible

NDF (dNDF; % of DM) for soy hulls and beet pulp relative to other high-fiber by-products suggest a high potential for using these ingredients at reasonable inclusion rates to partially replace forage with low fiber digestibility to increase diet dNDF. Monitoring and maintaining effective NDF in the diet is critical when employing this feeding strategy.

The distribution of 48-h IVNDFD for high-group TMR samples from commercial dairies analyzed at the University of Wisconsin Forage Testing Laboratory (Marshfield, WI; Hoffman, 2003) is presented in Figure 1 with an average IVNDFD of 57.2% of NDF. The IVNDFD range for these high-group TMR samples is wide and raises concern over intake limitations on the low end and lack of effective fiber on the high end. Analyzing for IVNDFD offers another tool for troubleshooting fiber status of dairy cattle diets.

Table 1. Variation within forages for neutral detergent fiber digestibility measured in situ or in vitro.

Forage	**IVNDFD (% of NDF)**
Nocek and Russell, 1988	
Legumes	31 – 63
Grasses	41 – 77
Corn Silage	32 – 68
Allen and Oba, 1996	
Alfalfa	25 – 60
Whole-Plant Corn	30 – 60
Hoffman, 2003 (UWFTL)	
Legumes	35 – 65
Grasses	25 – 75
Corn Silage	40 – 75
Chase, 2003 (Dairy One)	
Legumes	34 – 57
Grasses	41 - 70
Corn Silage	45 - 64

Table 2. Content and digestibility of NDF for selected high-fiber by-product feeds.

Ingredient	NDF, % DM[1]	IVNDFD, % NDF[2]	dNDF, % DM
Forages	40 – 60	30 – 60	10 – 35
Corn gluten feed	36	80 (1)[3]	29
Distillers grains	39	75 (14)	29
Brewers grains	47	50 (2)	24
Wheat midds	37	50 (3)	19
Beet Pulp	46	85 (10)	39
Citrus pulp	24	85 (2)	20
Soy hulls	60	90 (2)	54
Whole cottonseed	50	50 (36)	25
Cottonseed hulls	85	20 (4)	17
Almond hulls	37	40 (5)	15

[1]NRC, 2001. [2]30-h IVNDFD (% NDF) adapted from Dr. Peter Robinson, CA-Davis. [3](n).

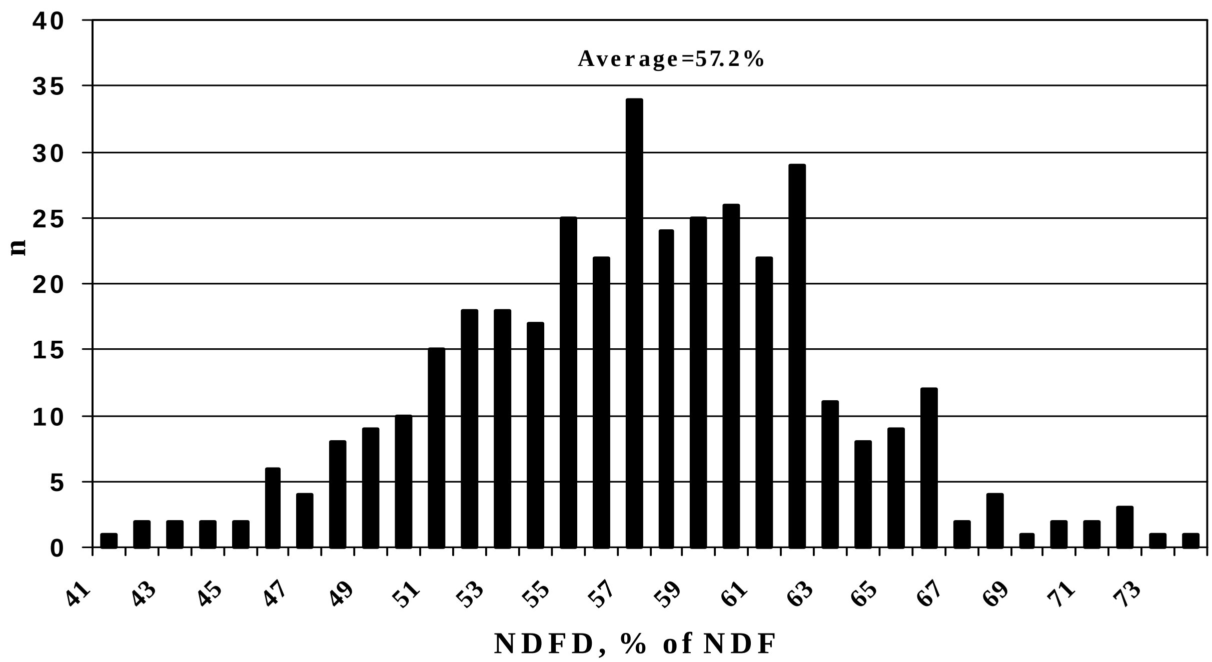

Figure 1. Distribution of 48-h IVNDFD (% of NDF) in data set of 377 high-group TMR samples from commercial dairies analyzed at UW Soil & Forage Analysis Lab, Marshfield, WI (Hoffman, 2003).

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Project Information

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