Measuring the Effectiveness of NDF and its Application in Dairy Rations

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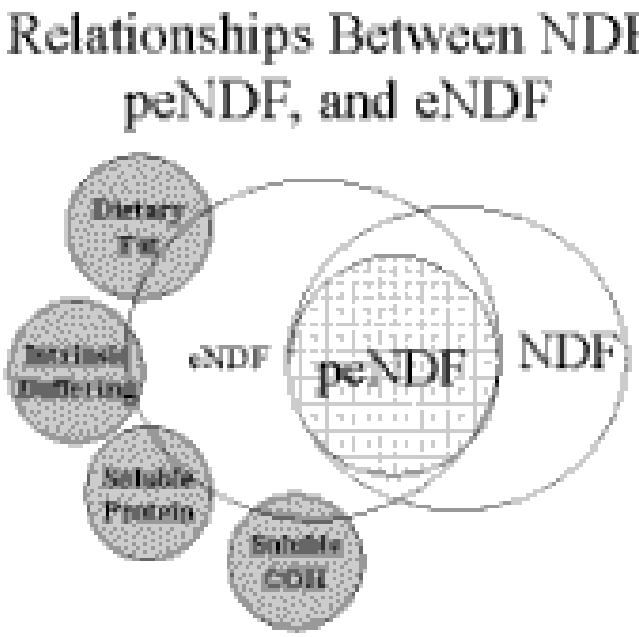
Dairy rations need to be balanced for effective fiber to assure sufficient "scratch" factor for maintaining healthy rumen environments. Historically, the concept of fibrousness was related to chewing activity and effectiveness was related to milk fat depression. In 1997, Dave Mertens at the USDA Forage Research Center in Madison, Wis., defined the fibrousness characteristics of neutral detergent fiber (NDF) as:

1. Effective NDF (eNDF) = the sum total ability of a feed to replace forage so that milk fat percentage is effectively maintained.
2. Physically effective NDF (peNDF) = the physical properties of fiber (primarily particle size) that stimulate chewing activity and maintain ruminal pH.



The illustration above shows the relationships between NDF, peNDF and eNDF. As shown, eNDF includes all the effects associated with peNDF that influences milk fat percentage, but also includes characteristics of the feed associated with dietary fat concentration and composition, intrinsic buffering or acid neutralizing capacity, soluble protein and soluble carbohydrate (COH).

The interrelationships that predict eNDF for any given feed may cause the value to be close to “0” effectiveness if the feed has minimal ability to maintain butterfat, or 1.0 when a feed maintains milk fat. Long stem dry hay has 100% eNDF while a feed by-product such as cottonseed with lint has 50% eNDF according to the Michigan State University SPARTAN Ration Balancer.

The peNDF index is based on a fixed scale and reference value called physical effectiveness factor (pef). The laboratory method to determine peNDF of a feedstuff combines NDF analysis with pef determination by measuring the proportion of dry matter (DM) retained on a 1.18 mm sieve (vertical shaking). PeNDF is then calculated as: peNDF = pef (fraction in 1.18 mm sieve) X

NDF.

A minimum requirement of 19-23% peNDF and 25-27% NDF of total ration DM is required based on fiber effectiveness in maintaining milk fat percentage or ruminal pH. The table below provides examples of common forages and the calculated peNDF values. The examples serve to demonstrate that processed corn silage chopped at ¾-inch theoretical length of chop (TLC) contributes the same amount of peNDF as does unprocessed corn silage chopped at 3/8-inch TLC. These calculations agree with a University of Wisconsin study conducted in 2000 where rumen fiber mat formation from 3/8-inch TLC was compared to ½-inch" and ¾-inch TLC processed corn silages. When the TLC of the processed silage was increased to 3/4-inch, the resulting fiber mat was considered to be statistically the same as the un-processed, 3/8-inch TLC silage.

Estimating peNDF From Particle Size Measurements

Feed	pef% X NDF = peNDF (feed retained on 1.18 mm sieve)		
Grass hay, long	.98	65	63.7
Alfalfa silage, coarse	.82	40	32.8
Corn silage unprocessed (3/8" TLC)	.85	40	34
Corn silage processed (3/8" TLC)	.70	40	28
Corn silage processed (3/4" TLC)	.85	40	34

Reference:

1. Mertens, D.R., 1999. Measuring the Effectiveness of NDF and its Applications in Dairy Rations. USDA-ARS US Dairy Forage Research Center, Madison, WI. Proceeding of SW Nutrition Conf., Feb. 25-26, 1999. p. 91-111.