

CONSULTANT'S DIGEST

Fine Tuning Energy Calculations for Fat

Published by the National Research Council (NRC) in 2001, the 7th Revised Edition of the Nutrient Requirements of Dairy Cattle provides users with a complete and useful review of scientific literature and practical experiences that have sharpened our understanding of dairy nutrition over the years.

The 2001 NRC facilitates more accurate predictions of nutrient requirements of dairy cattle in all stages of growth, development, and production. It also provides more precise estimates of the nutrient content of feeds and diets fed to dairy cattle. While much progress was made in improving the accuracy of energy estimates for fat supplements, there was one significant oversight that occurred in the final calculations of dietary fat energy values.

To their credit, the 2001 NRC recognizes there ARE differences in energy values among fats/oils. It considers characteristics affecting digestibility, such as structure (free fatty acid vs. triglyceride), chain length, and degree of saturation. However, one important factor is overlooked: intake and its effect on digestibility and consequently on net energy for lactation (NE_L).

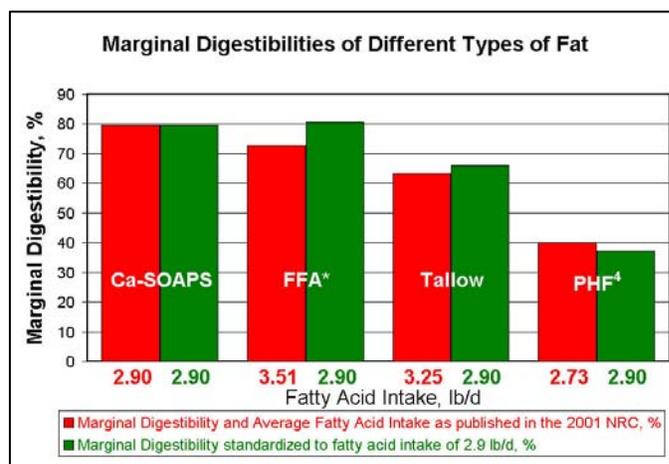
Fats Affect Intake, Intake Affects Digestibility, Digestibility Affects NE_L

Knowing the digestibility of a nutrient is essential for calculating NE_L (Total Energy x %Digestibility x 0.80 for fats). As the intake of a nutrient increases, digestibility of that nutrient decreases, a phenomenon called *marginal digestibility*. Marginal digestibility decreases when intakes increase because rates of passage increase, possibly overwhelming the digestive system's absorptive capacity. For every increase of ¼ lb. per day in fatty acid intake, marginal digestibility declines between 3.2% units¹ and 5.0% units².

The 2001 NRC uses marginal digestibility to compare fats, an improvement over the 6th Edition. But the 2001 NRC assumed "3X maintenance" intake levels for all fats, even though average fatty acid intakes vary by up to 29% between categories of fats. A 29% difference in fatty acid intakes between different types of fats represents the difference between 3X and 4X maintenance intake.

It is well documented that some fats, such as calcium soaps (Ca-SOAPS), depress dry matter intake³. As a result, fatty acid intake is less for cows fed a ration containing Ca-SOAPS than for cows consuming a ration supplemented with free fatty acids (FFA⁴), but Ca-SOAPS' percent digestibility appears higher because of the lower intake of fatty acids. To accurately compare the two products' marginal digestibility values and subsequently NE_L, we need to compare equal amounts of fatty acids consumed. In other words, we must standardize fatty acid intakes. (See chart.)

When intakes are standardized (see table), the concept of marginal digestibility results in 18% greater NE_L for FFAs than Ca-SOAPS on a dry matter basis (2.70 vs. 2.28 Mcal/lb). However, because Ca-SOAPS contain water (approximately 5%), on an as-fed basis, the spread is even wider: 24% greater NE_L for FFAs than Ca-SOAPS (2.69 vs. 2.17 Mcal/lb).



NRC fatty acid intake data and standardized digestibilities				
	Ca-Soaps	FFA ⁴	PHF ⁴	Tallow
Fatty Acid Intake, lb/d				
Basal	1.46	2.06 (+41%)	1.21 (-17%)	1.55 (+6%)
Supplemental	1.44	1.45 (+1%)	1.52 (+6%)	1.70 (+18%)
Total	2.90	3.51 (+21%)	2.73 (-6%)	3.25 (+12%)
Total Diet Fatty Acid Digestibility, %	72.2	71.0	57.0	68.3
NRC Supplemental Fatty Acid Digestibility, %	79.5	72.8	40.0	63.2
Standardized Intake (3X) Supplemental Fatty Acid Digestibility, %	79.5	80.5	37.3	66.1
NE_L @ 3X, Mcal/lb				
Dry Matter Basis	2.28	2.70 (+18%)	1.26 (-45%)	2.08 (-9%)
As-Fed Basis	2.17	2.69 (+24%)	1.26 (-42%)	2.08 (-4%)

Data from 2001 NRC and Grummer (1998), intake standardized to 6% added fatty acids @ 48 lb. DMI (or 5% added fatty acids @ 58 lb. DMI) with 50% of fatty acids from diet and 50% of fatty acids from supplement.

Fat Fast Facts

- Once fatty acid intakes are standardized to the same level of intake, marginal digestibility values for FFAs and Ca-SOAPS are very similar.
- After standardizing intakes, FFA yield 18% greater NE_L than Ca-SOAPS on a dry matter basis and 24% more on an as-fed basis.

^{*}Only available in the U.S. as Energy Booster 100[®].

¹Grummer, R.R., and E. Rabelo. 1998. Proc. Prof. Dairy Mgmt. Sem., LaCrosse, WI, June 23-4, 1998. MWPS-4SD1. Pg 3.

²Palmquist, D.L. 1991. J. Dairy Sci. 74:1354.

³See Consultant's Digest, Vol. 3.

⁴Partially hydrogenated fats