

CONSULTANT'S DIGEST

Digestibility: Setting the Story Straight on Stearic and Palmitic Fatty Acids

Stearic and palmitic fatty acids have similar digestibilities. Yet, fats containing stearic acid have gotten a bum rap for years even though stearic acid provides the cow with more energy for milk production than does palmitic acid. Here now are the real facts on fatty acid digestibility.

Digestibility Nearly Equal

Research has shown that saturated long chain fatty acid inclusion in dairy diets is beneficial in terms of milk yield and quality. These types of fatty acids can be found in premium dry fats like calcium soaps (Ca-SOAPS), where the primary fatty acid is palmitic acid (C16:0), and free fatty acids¹ (FFAs) containing primarily stearic acid (C18:0).

Properties such as stearic acid's higher melting point and lower solubility have led to speculation that palmitic acid digestibility may be higher than stearic acid, and therefore that Ca-SOAPS may be more digestible than FFAs.

Studies comparing digestibilities of fatty acids from *hydrogenated* fats (~40% digestible) to fatty acids from FFAs and Ca-SOAPS (~80% digestible) also have contributed to the misconceptions. Applying conclusions from studies using hydrogenated fats estimating individual fatty acid digestibilities results in inaccuracies.

Further misconceptions arose from research where conclusions were based on **apparent digestibility** – the amount fed minus the amount in the feces. These comparisons promote the stearic acid myth because apparent digestibility is not indicative of individual fatty acid digestibility. Since rumen bacteria synthesize stearic acid and biohydrogenate oleic, linoleic, and linolenic acids, converting them into stearic acid, more stearic acid may be found in the feces than was fed. In fact, the amount of stearic acid leaving the rumen may be up to 10 times the amount that the cow actually consumes.²

Widespread use of apparent digestibility measurements in feeding trials continues to fuel the misconceptions surrounding stearic acid.

Though all currently available methods for estimating the actual digestibility of dietary fatty acids have significant problems and tend to **underestimate** the actual absorption of stearic acid, one thing is clear: apparent digestibility is the most inaccurate. The best estimate of fatty acid digestibility available is **small intestinal digestibility**. Because data on small intestinal digestibility is extremely difficult to obtain, very few trials have been conducted. Based upon the only trial with reliable data, the small intestinal digestibility of all fatty acids was identical (80.5%).³

Total intestinal digestibility (misnamed "true") results in large errors when individual fatty acid digestibility is estimated. Failure to account for biohydrogenation in the large intestine and ruminal effects on individual fatty acids results in underestimation of stearic acid digestibility while overestimating the digestibility of palmitic and unsaturated fatty acids.

A summary of eight trials determined that total intestinal digestibility of stearic acid was 71% while palmitic acid was 76%.⁴ However, when both ruminal effects and total intestinal digestibilities were combined, the figures flip-flop: absorption of dietary stearic acid and palmitic acids were 76% and 71%, respectively (Table 1; lines A & B).

Large intestinal biohydrogenation, which changes undigested unsaturated fatty acids into stearic acid, occurs at rates similar to ruminal biohydrogenation, resulting in underestimation of stearic acid absorption by an additional 3% – 9% (Table 1; line C).

Table 1. Best estimates of individual fatty acid digestibilities.

	Stearic Acid	Palmitic Acid
A. Total Intestinal Digestibility (Misnamed "true")	71%	76%
B. Dietary content absorbed (Adjusted for ruminal effects)	76%	71%
C. Dietary content absorbed (Adjusted for ruminal & intestinal effects)	79-86%	71%

There's More to the Story

Not only is stearic acid more digestible than palmitic acid, it also provides more energy. When fed on an equal weight basis, stearic acid results in significantly more energy available for milk production than does palmitic acid (Table 2).

Table 2. Energy absorbed for milk production.

	Stearic Acid	Palmitic Acid
Energy content, Mcal/lb	4310	4229
Relative energy absorbed for milk production per unit of acid added to diet	100%	81-88%

Fat Fast Facts

- FFAs contain higher amounts of stearic acid, while Ca-SOAPS contain higher amounts of palmitic acid.
- When all known factors affecting estimates of fatty acid digestibility are accounted for, stearic acid is more digestible than palmitic acid.
- When fed at equal rates, stearic acid provides 14-23% more energy for milk production than does palmitic acid.

¹Only available as Energy Booster 100[®].

²Van Soest, 1982. Nutritional Ecology of the Ruminant.

³Weisbjerg et al., 1992. Acta Agric. Scand., Sect. A, Anim. Sci. 42:106

⁴Moate et al., 2000. J Dairy Sci. 83 (Suppl. 1):279a&b (abstr.)