

The Role of Palmitic Acid Products in Dairy Nutrition

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What is Palmitic Acid?

Palmitic acid dairy products are produced from refining Palm Oil. Palm oil is produced from the fruit of the oil palm with about 70 million tonnes produced in 2018. In recent years production has increased about 7% annually, with Indonesia producing about 40%, and Malaysia and Thailand about 25% each with some production in West Africa and South America.

Demand is driven by use as cooking oil, industrial lubricant, and margarine and for manufacture of soap, biofuels and cosmetics. It is used in manufactured foods to improve texture, to protect nutrients such as choline from rumen degradation and as a dairy feed supplement to increase milk fat yield.

Palm oil is a semi solid at 20°C and is refined by several methods to separate palmitic acid and other fatty acids. Palm oil is about 44% palmitic acid (16 carbons fully saturated) and most of the other fatty acids are oleic acid (C18:1) and linoleic acid (C18:2). When palmitic acid has been extracted, the remaining fatty acids are called olein and are liquid at room temperature and have a variety of uses.

How is Palmitic Acid Used?

Palmitic acid has a melting point of 63°C and is almost insoluble in water and rumen fluid. This means that it has little effect on rumen fermentation and passes through into the small intestine where up to 80 percent is absorbed. Research over the past 15 years has found that about 35% of the palmitic acid consumed appears in the milk. This was reported by de Souza and Lock 2018, and in unpublished work at the University of Saskatchewan. Other research has reported a palmitic transfer to milk of 27% and 47% from the feed supplement. Commercial palmitic acid products came into general use by dairy farmers in Canada in about 2001. These commercial products contain 85 to 95% palmitic acid with the remainder being other palm oil fatty acids. They are usually fed to Holstein cows at 200 to 400 grams per cow daily or approximately 1 to 2 % of ration dry matter. As shown in Table 1, there is a consistent increase in milk fat yield from feeding palmitic acid.

Palmitic acid is of interest to dairy producers based on benefits to milk yield and composition, cow health and dairy product quality and characteristics. Therefore, there is economic benefit to inclusion in feed.

Table 1. The effect of feeding palmitic acid on dairy cow performance (Lock et al. 2013)

Item	Control	Palmitic
DM intake, kg/day	24.7	23.3
Milk, kg/day	32.0	32.0
3.5% FCM	33.6	35.1
Milk Fat, %	3.88	4.16
Fat, kg/day	1.23	1.32
Palmitic, % of milk fatty acids	35.2	41.8
Palmitic, milk g/day	408	518

2% of palmitic source added, 86% palmitic

~34% of palmitic acid added to ration appeared in milk

Metabolic Effects of Palmitic Acid

Although palmitic acid has little effect in the rumen it is metabolically active after absorption. Recent research has shown that after it is absorbed it may combine with the amino acid serine in the liver and form complex molecules (ceramides) that reduce the effect of insulin. The result is that energy is directed to milk synthesis rather than body tissue, which may increase total milk production.

As an example of economic value, the cost of palmitic acid is in the order of \$2 per kg. Without feeding palmitic acid the milk yield may average 36 kg daily with 3.75% fat. Feeding 300 grams per day of palmitic acid may be expected to increase daily milk fat from 1.35 kg (3.75% of 36kg) to 1.45 kg fat (4.03%). At 2019 farm revenue for fat the return would be \$1.70 compared to the cost of \$0.60 for the 300 grams of palmitic acid, a return on cost of 2.9 fold. A response of this magnitude is commonly found, but may be influenced by other ration ingredients such as fatty acids.

Other Effects of Feeding Palmitic Acid

Research has shown a variable increase in milk yield and protein content when a palmitic acid source is fed. Feeding palmitic acid has not been shown to have a consistent effect on Body Condition Score, probably because nutrients are directed to milk synthesis rather than body tissue. The production response may be greater in multiparous cows than in the first lactation when more energy may be directed to body reserves.

The palmitic acid content of milk fat can range from 25 to 38% depending on the ration. Feeding a palmitic acid source consistently increases the percentage of palmitic fatty acids in milk. Because of its high melting point it will increase the melting point of butter and affect the texture of cheese. It has been suggested that more than 32% palmitic acid in milk fatty acids may result in noticeable changes in butter and cheese characteristics. Undesirable metabolic effects on fertility, ketosis, toxicity, or other conditions have not been identified in cows.

Summary Points

- Palm oil and palmitic acid are widely used in food and other products, and world production is increasing
- When palmitic acid is added to dairy rations at 1 to 2%, it increases milk fat production and may increase milk yield
- Feeding palmitic acid is likely to increase its level in milk fat, which alters butter and cheese characteristics