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Palmitic and Stearic Acids: Milk Fatty Acids

The recent interest in feeding highly concentrated palmitic acid to lactating dairy cows for the purpose of improving milk fat test and yield has caused researchers and consultants alike to search for information to aid in making informed decisions on long chain fatty acid (LCFA) supplementation. Researchers have fed or infused highly purified palmitic acid (C16:0) and stearic acid (C18:0) to determine their effects on milk production and milk fatty acid (FA) content. The landmark studies of Steele and Moore (1968) and Noble et al. (1969) were the first to look at effects of feeding a purified source of C16:0 and C18:0 on milk yield and milk components. In their study, Steele and Moore (1968), fed 578 g/day of highly purified C16:0 and 564 g/d of C18:0 which increased milk fat percentage by 0.86% and 0.30% units respectively. Milk production was similar for all treatments and was low compared to today's standards. Feeding C16:0 increased milk fat percentage and yield of C16:0 in milk fat, but concentration and yield of C4 to C14 FA along with C18:0 and C18:1 in milk fat decreased. Noble et al. (1969) observed similar shifts in milk FA proportions when they fed 448 g/d of either C16:0 or C18:0. Enjalbert et al. (2000) abomasally infused 490 g/d of C16:0 or 460g/d of C18:0 in lactating dairy cows and observed elevated milk fat % and similar shifts in milk FA proportions. High levels of either fed or infused C16:0 increases the proportion of C16:0 in milk fat but reduces that of the C18 FA. When high levels of C18:0 were fed, C18 FA proportions increased whereas C16:0 proportions were depressed. From these published trials, it can be concluded that feeding or abomasally infusing high levels of either C16:0 or C18:0 interferes with the others proportions and yield in milk fat. High levels of purified C16:0 and C18:0 inhibit denovo synthesis of milk FA and reduce the proportions of small and mid-chain FA as well as seen in Table 1.

C16:0 at high levels of intake pose a problem for the cow with respect to milk FA content. As observed in the 7 recent production trials, only 15-20% of the added C16:0 intake is incorporated into milk fat.

Table 1.
Effects of feeding high levels of either C16:0 or C18:0 to lactating cows

Fatty acid wt %	Control	578 g/d C16:0	564 g/d C18:0
C4-C8	7.0^{b}	5.6^{a}	6.9^{b}
C10:0	0.5^{a}	0.1^{b}	0.5^{a}
C12:0	2.1^{b}	0.9^{a}	1.2^{a}
C14:0	11.4^{a}	6.3^{b}	9.2^{a}
C14:1	0.5	0.4	0.2
C4-C14	21.5	13.3	18.0
C16:0	38.7^{b}	60.7^{a}	27.7^{c}
C16:1	1.3^{b}	3.5^{a}	1.2^{b}
C18:0	10.1^{a}	4.3^{b}	18.7^{c}
C18:1	21.3^{a}	14.2^{b}	30.1^{c}
C18:2	2.9^{a}	1.7b	1.4^{b}
C18 Total	34.3	20.2	50.2

a,b,c. Means with different superscripts are different $P<0.05$. Adapted from Steele and Moore, 1968.

That leaves 80-85% of the remaining added C16:0 intake to be utilized as an energy source or as a source for adipose tissue deposition. In early lactation, we have previously discussed the problem of C16:0 accumulations in the liver (Consultant Digest v32). Hepatic oxidation of C16:0 may lead to reductions in DMI (Allen, 2009).

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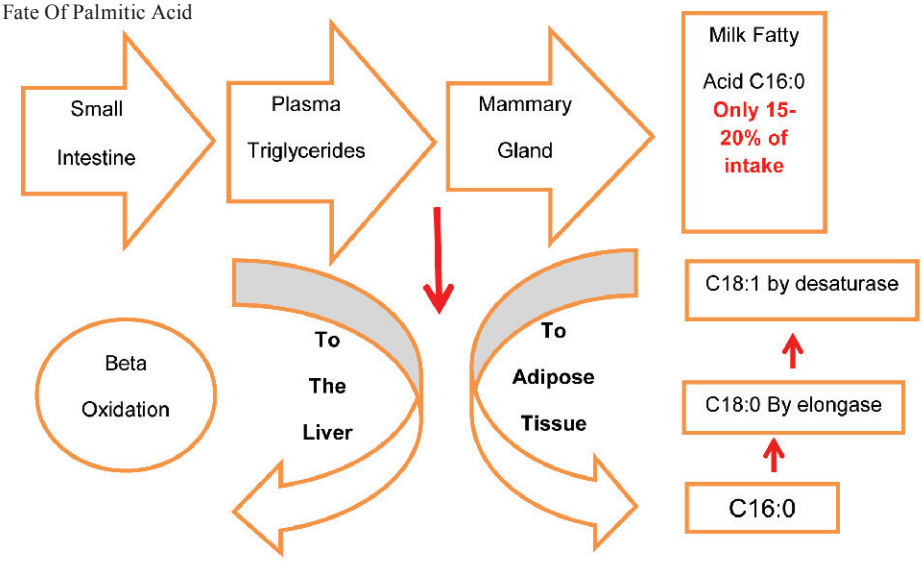
Figure 1. The Metabolic Fate Of Palmitic Acid



In these two studies 15 years apart, the researchers either fed or infused Energy Booster 100 to high producing lactating cows. In both published studies, milk yield and milk fat test were increased over the control. However, milk fatty acid proportions were not significantly changed when a 1:1 combination of both C16:0 and C18:0 were fed.

Table 3. The effects of feeding or infusing a LCFA mixture containing nearly equal concentration of C16:0 and C18:0.

Research Trial	Drackley et al. 1992		Relling & Reynolds 2007	
Fatty Acid Wt %	Control	442 g EB1	Control	630 g EB2
C4-C15:0	28.3	25.6	23.1	17.4
C16:0	30.0	29.6	28.4	31.4
C18:0	7.4	8.5	7.7	9.0
C18:1	16.6	18.8	25.7	29.6
C18:2	2.3	2.0	4.1	3.3
C18:3	0.3	0.2	0.5	0.4

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