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Animal Nutrition

Oleic Acid Reduces Milk Fat Percentage

Evidence Links Higher Oleic Diets to Reduced Fat Test + Yield in Cows

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AND



Effects of different palmitic (C16:0) and oleic acid C18:1 ratios on intake, feeding behavior, digestibility, lactation performance and selected blood parameters in lactating Holstein cows. Kahyani, A. et al., 2025. An Fd. Sci Tech. 329:116497

A new study has reported similar findings to published research by de Souza et al., 2018, de Souza et al., 2019, Western et al., 2020, and Burch et al., 2022 that showed significant reduction in MF% and/or yield when C18:1 was increased in the diet of lactating cows. Several high oleic soybeans studies are also showing a decrease in de-novo and mixed fatty acids and an increase in C18:1, trans-10 fatty acid in milk fat (Bales and Lock, 2024, Bales and Lock, 2024). Oleic acid as an unsaturated fatty acid (RUFAL) still possesses the ability to decrease milk fat %.

Table 1. Kahyani, A. et. al., 2025. Effects of C16:0 and C18:1 on lactation performance in lactating cows

Item	Unit	Treatment % C16:0/C18:1				P Values	
		100/0	66/34	34/66	0/100	Trt	Linear
DMI	lb/d	52.1	53.5	53.2	51.5	0.72	0.92
MY	lb/d	83.8	83.2	83.4	84.3	0.97	0.92
MF	%	3.61%	3.61%	3.38%	3.34%	<0.01	<0.01
MFY	g/d	1370	1360	1280	1290	0.09	0.02
MP	%	2.79%	2.78%	2.80%	2.89%	0.27	0.10
MPY	g/d	1060	1050	1060	1110	0.66	0.34
ECM	lb/d	82.9	82.1	79.9	81.0	0.71	0.37
Fat + Pro	lb/d	5.4	5.3	5.2	5.3	-	-
ECM/DMI		1.59	1.54	1.55	1.57	0.92	0.83
Digestibility							
DM	%	71.3	70.1	71.5	71.9	0.46	0.39
NDF	%	47.7	49.1	50.2	51.3	0.07	<0.01
TFA	%	79.4	80.1	81.3	83.1	<0.01	<0.01
Milk FA							
De Novo	%	23.9	22.8	22.8	22.7	0.15	0.06
Mixed	%	39.1	38.2	36.5	35.2	<0.01	<0.01
Preformed	%	37.2	38.9	40.7	42.0	<0.01	<0.01
Blood Values							
NEFA	mmol/L	0.24	0.22	0.18	0.17	<0.01	<0.01
Insulin	ul/mL	11.4	12.2	12.3	13.2	0.13	0.02

In the Kahyani et al. trial, there were no differences in DMI or MY. They reported increases in FA and NDF digestibility as C18:1 increased in the diet, but no increases in ECM while significant decreases in MF% and MFY occurred. The decrease in MF% likely occurred due to altered biohydrogenation issues of the oleic acid and/or reduction in palmitic acid intake. There were no changes in body weight, milk efficiency, or energy partitioning. Biohydrogenation of calcium salts is extensive, therefore, minimal oleic acid actually reaches the duodenum. In the Dos Netos meta-analysis (2021), calcium salts that contain oleic acid decreased de-novo fat yield ($P < 0.01$), protein test ($P = 0.04$), and had no change in fat concentrations (0.00 , $P = 0.90$) when feeding 1% of diet DM. For every 100 gm/d of oleic acid that you feed a lactating cow, 75-85% of oleic acid is biohydrogenated to stearic acid (C18:0). Table 2 aids in explaining why we have these major discrepancies in C18:1 trial data.

Table 2. The extent of C18:1, C18:2, and C18:3 biohydrogenation (BHEXT) in lactating cows.

	<u>Glasser et al. 2008</u>	<u>Baldin et al. 2022</u>	
<u>Fatty Acids</u>	<u>BH Extent %</u>	<u>BH Extent %</u>	<u>Rate/hr %</u>
cis-9 C18:1	76	83.4	44
18:2 n-6	95	87.8	53
18:3 n-3	96	93.3	87

As we feed higher performing cows, and concentrate fermentable CHO in diets, we must remember that oleic acid is still a source of rumen unsaturated fatty acids (RUFALs). Feeding saturated fatty acid supplements, i.e. palmitic and stearic, have minimal to no effects on altering biohydrogenation pathways in the rumen. The authors are all in agreement that increased oleic acid in the form of a Ca salt decreases MF% and nearly always MFY. The studies in Table 3 show little change in MY and ECM since MF% is reduced and C18:1, Trans-10, fatty acid intermediate is increased (altered biohydrogenation). The importance of partially biohydrogenated C18:1 is the potential appearance of trans-10 C18:1 in the rumen, and its deleterious effects on MF (Piperova et al 2004). They found significant reductions in MF synthesis when trans -10 C18:1 was fed to lactating cows. Thus, it makes it somewhat difficult to come to a conclusion that feeding more C18:1 in excessive amounts is a good practice. Many of these same trials, as shown in Table 3, reported significant increase in fatty acid (FA) digestibility, without moving the needle on ECM and depressing MF %. Recent work published in a dissertation also showed mixed results, in that infusing 50 g/d of oleic acid into the abomasum, rumen, or in the form of calcium salt yielded no change in fat digestibility (Bales, 2024) (Table 4). The question still looms, why doesn't increased FA digestibility lead to a consistent responses improving MY, ECM, or milk components. Biohydrogenation of C18:1 is

extensive which limits the ability to bypass enough C18:1 in the duodenum to elicit desired responses. It appears that biohydrogenation of C18:1, or the incomplete biohydrogenation of C18:1 produces metabolites such as trans-10 C18:1 which are known to reduce MF synthesis (de-novo).

The fact remains that C18:1 is heavily biohydrogenated to C18:0. **The vast majority of C18:1 in the body and in milk is from the desaturation of C18:0 by Δ -9 desaturase.** These trials show consistent significant responses from feeding increased levels of C18:1, reduced milk fat % and at times, milk fat yield.

In summary, the biggest source of oleic acid for lactating dairy cows is stearic acid via delta-9 desaturase pathway. Feeding more dietary oleic acid increases the amount of RUFALs, thereby increasing altered biohydrogenation. In nearly all studies involving higher supplies of oleic acid, C18:1, trans-10, intermediate is increased, de-novo and mixed often decline, and fat test is often reduced. As we pursue higher milk fat yields, maximizing all three sources of milk fat, de-novo, mixed, and preformed is important, and oleic acid in form of calcium salts appears to make that goal difficult to achieve.

Table 3. The effects of oleic acid on Milk Fat % and C18:1, Trans-10 fat from 5 published trials from J. Dairy Sci

Published Trial	Control	Treatment	P Value
de Souza et al., 2018	Blend of 85% Calcium Salts, 11% EB100, 4% Palm vs. Control		
Milk Fat, %	3.62	3.53	0.06
C18:1, Trans-10, g/100 g FA	0.42	0.63	<0.01
de Souza 2019	Blend of 71% Calcium Salts and 29% Palm (Trt) vs. Blend of 89% Palm and 11% Calcium Salts (Control)		
Milk Fat, %	3.71	3.48	0.04
C18:1, Trans-10, g/100 g FA	0.42	0.65	0.03
Western et al., 2020	Blend of 59% Calcium Salts and 41% Palm (Trt) vs. Blend of 91% Palm and 9% Calcium Salts (Control)		
Milk Fat, %	4.30	4.12	0.03
C18:1, Trans-10, g/100 g FA	0.35	0.41	<0.01
Burch et al., 2021	Blend of 71% Calcium Salts, 1% EB100, and 27.8% Palm (Trt) vs. Blend of 49.5% Palm, 50% EB100, and 0.50% Calcium Salts (Control)		
Milk Fat, %	3.86	3.80	0.22
C18:1, Trans-10, g/100 g FA	0.37	0.41	<0.01
Hu et al 2024	Blend of 73% Palm and 27% oleic (Trt) vs. Blend of 91% Palm and 9% oleic (Control)		
Milk Fat, %	3.95	3.79	0.08 (Linear)

Table 4. Effects of infusing 50 g/d of oleic acid into the abomasum, rumen, or in the form of a ca-salt (Adapted from Bales, 2024).

	Control	Infusion	Rumen	Ca-Salt	CON vs. OA	INF vs. RUM	Rum vs. SALT
DMI, lb/d	64.0	63.6	62.9	62.9	0.39	0.52	0.95
TFA intake, g/d	884	926	923	917	<0.01	0.79	0.6
TFA Digestibility, %	62.2	62.5	56.4	60.8	0.12	<0.01	0.03
ECM, lb/d	95.5	98.1	96.1	95.0	0.63	0.32	0.53
Fat + Protein, lb/d	6.3	6.5	6.3	6.2	-	-	-
Fat, %	3.49	3.47	3.45	3.47	0.58	0.77	0.7
Trans-10, C18:1	6.7	7.3	7.7	8.0	0.02	0.27	0.54