Feeding Blends of Fatty Acids
UPDATE ON PALMITIC AND OLEIC ACIDS

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The Fatty Acid Forum sponsored by
Feeding Blends of Fatty Acids: Palmitic & Oleic
Impact of Dietary Fatty Acids on Digestion, Metabolism, & Nutrient Use in Lactating Dairy Cows
Dr. Adam Lock, Michigan State University

Effects on DMI
FA digestibility

Use of FA for other purposes
Energy and/or glucose sparing
Delivery of n-3 + n-6 FA

Balance of 18-C + de novo FA
Direct effect of specific FA

MFD intermediates
↓ Milk fat synthesis
↑ BW/BCS

Milk Fat/lactose

MAMMARY GLAND

BH or UFA
Shifts in BH pathways
Effects on microbial populations
Effects on NDF/starch
Effects on NDF/starch $K_d$

RUMEN

16:0 18:0 18:1 18:2 18:3

SMALL INTESTINE

Use of FA for other purposes

ADIPOSE

LIVER

16:0 18:0 18:1 18:2 18:3
Feeding Blends of Fatty Acids: Palmitic & Oleic
Recent Focus on Palmitic, Stearic, and Oleic Acids
Dr. Adam Lock, Michigan State University
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- C18:0, under typical feeding situations, is the predominant FA available for absorption by the dairy cow (due to BH)
- Represent the majority of FA in milk fat and adipose tissue
- Predominant FA in the 3 main categories of dietary FA supplements
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- All three FA are important for dairy cow metabolism
- Is there an “ideal” ratio among C16:0, C18:0, and C18:1 to optimize their utilization
- Interactions with other dietary and animal factors
# Feeding Blends of Fatty Acids: Palmitic & Oleic

3 Major Categories of FA Supplements Available

Dr. Adam Lock, Michigan State University

<table>
<thead>
<tr>
<th>Fatty Acid, g/100g</th>
<th>Ca-Salt PFAD</th>
<th>Mix</th>
<th>C16:0-Enriched</th>
</tr>
</thead>
<tbody>
<tr>
<td>14:0 Myristic</td>
<td>2.0</td>
<td>2.7</td>
<td>1.6</td>
</tr>
<tr>
<td>16:0 Palmitic</td>
<td>51.0</td>
<td>32.8</td>
<td>89.7</td>
</tr>
<tr>
<td>18:0 Stearic</td>
<td>4.0</td>
<td>51.4</td>
<td>1.0</td>
</tr>
<tr>
<td>18:1 Oleic (n-9)</td>
<td>36.0</td>
<td>5.8</td>
<td>5.9</td>
</tr>
<tr>
<td>18:2 C18:2 (n-6)</td>
<td>7.0</td>
<td>0.8</td>
<td>1.3</td>
</tr>
</tbody>
</table>

Saturated Free FA Supplements
Supplement blends fed at 1.5% DM
Blends of 3 commercially available FA supplements:
• C16:0-enriched free FA supplement
• C16:0 and C18:0 free FA supplement
• Ca-salt palm FA
Blended in different ratios to alter content of C16:0, C18:0, and C18:1
24 cows in a 4 x 4 Latin square with 21 d periods

Feeding Blends of Fatty Acids: Palmitic & Oleic Effect of Altering the FA Profile of Supplemental Fats on Apparent Total Tract NDF Digestibility
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Feeding Blends of Fatty Acids: Palmitic & Oleic Effect of Altering the FA Profile of Supplemental Fats on Apparent Total Tract FA Digestibility
Dr. Adam Lock, Michigan State University

All P value for FA treatment = 0.01

Feeding Blends of Fatty Acids: Palmitic & Oleic
Abomasal Infusion of Oleic Acid Improves
Total Tract Fatty Acid Digestibility
Dr. Adam Lock, Michigan State University

Prom & Lock (ADSA Abstract, 2018)
Feeding Blends of Fatty Acids: Palmitic & Oleic Acid Intake on Fat and Energy-Corrected Milk Yields

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de Souza & Lock, 2018. TSDNC
Feeding Blends of Fatty Acids: Palmitic & Oleic Effect of Palmitic, Stearic, and Oleic Acids in Post Peak Cows
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Feeding Blends of Fatty Acids: Palmitic & Oleic Acid
Effect of Palmitic, Stearic, and Oleic Acids in Post Peak Cows
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de Souza et al. 2019. J. Dairy Sci. in press
Feeding Blends of Fatty Acids: Palmitic & Oleic
Effect of Palmitic to Oleic Ratio
and Production Level on ECM
Dr. Adam Lock, Michigan State University

Western, de Souza & Lock (ADSA Abstract 2018)

32 cows in a cross over study with 21 d periods
Supplements fed at 1.5% DM; blends made using combinations of commercially available C16:0-enriched and Ca-salts palm oil supplements

ECM, kg/d

Preliminary milk yield, kg/d

P values
Treatment = 0.35, PMY <0.01
Treatment x PMY = 0.04

Ratio of C16:0 to cis-9 C18:1 in FA blend

80:10
60:30

80.0
78.0
68.0
58.0
48.0
38.0
28.0

53
52
51
50
49
48

80:10
60:30
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Effect of Altering the FA Profile of Supplemental Fats on BW and Insulin
Dr. Adam Lock, Michigan State University

All P value for FA treatment = 0.01

de Souza & Lock, 2018. TSDNC
Feeding Blends of Fatty Acids: Palmitic & Oleic Effect of Palmitic, Stearic, and Oleic Acids in Post Peak Cows

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de Souza et. al. 2019. J. Dairy Sci. in press

de Souza & Lock (ADSA Abstract 2017)
Feeding Blends of Fatty Acids: Palmitic & Oleic
Abomasal Infusion of Oleic Acid Increases
Plasma Insulin in Post Peak Cows
Dr. Adam Lock, Michigan State University

Prom et al. (ADSA Abstract, 2018)
Feeding Blends of Fatty Acids: Palmitic & Oleic Acid Effect of Altering the Palmitic to Oleic Acid Ratio of Supplemental Fats to Fresh Cows

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de Souza, Prom, & Lock (ADSA 2019)

CON: Control diet (no supplemental fat)
FA supplement blends fed at 1.5% DM
Supplemental fat blends fed from calving for first 3 wk of lactation

P values
CON vs. FAT < 0.01, Linear < 0.01
Feeding Blends of Fatty Acids: Palmitic & Oleic Acid Ratio

Effect of Altering the Palmitic to Oleic Acid Ratio of Supplemental Fats to Fresh Cows

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de Souza, Prom, & Lock (ADSA 2018)

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P-values
CON vs. FAT = 0.19
Linear = 0.14
Quadratic = 0.94

P-values
CON vs. FAT = 0.01
Linear = 0.41
Quadratic = 0.71

P-values
CON vs. FAT = 0.71
Linear = 0.10
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Feeding Blends of Fatty Acids: Palmitic & Oleic Abomasal Infusion of Oleic Acid in Fresh Cows
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- Oleic acid (60 g/d) abomasally infused 4x/d
- Infusions from 1 to 15 DIM
- Adipose tissue (flank) sampled d –14, 6, and 12
- Glucose tolerance test d 15
Results suggest that oleic acid supplementation immediately postpartum may reduce lipolytic responses and improves insulin sensitivity of adipose tissue in early lactation dairy cows

Laguna et al. (ADSA 2019)
Our understanding of FA digestion and metabolism in dairy cows has advanced significantly in the last few decades.

Presented research focusing on specific FA and how dairy cows respond differently to combinations of FA.

Important to consider possible effects of FA in the rumen (BH/MFD/NDFd), in the small intestine (DMI/digestibility), in the mammary gland (increased incorporation/substitution), and energy partitioning between tissues.

Digestibility appears to be a good indicator of inclusion or not of a FA in a supplement, assuming that this source of FA does not markedly affect DMI.

Use of supplemental FA in the fresh period should be considered; new research suggests that FA supplementation increases performance in fresh cows.
Feeding Blends of Fatty Acids: Palmitic & Oleic
Summary
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- Profile of supplemental FA key in determining production responses and energy partitioning
  1. C16:0 drives increases in milk fat yield and ECM partially due to a decrease in BW
  2. C16:0 and C18:1 drives increases in milk yield and ECM without changing BW loss compared to non-supplemental diet
  3. Feeding FA supplements in the fresh period has carryover effects on early lactation

- Opportunity and challenge will be to continue to improve our understanding of how and which FA affect nutrient digestion, energy partitioning, and milk synthesis in lactating dairy cows, applying this knowledge in the feeding and management of today's high producing dairy cows

- Recommendation: consider use of FA supplements containing C16:0 and C18:1
Feeding Blends of Fatty Acids: Palmitic & Oleic Acid

Contact
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