Effects of dietary methionine and calcium salts enriched in omega-3 fatty acids on lactation and liver function in periparturient dairy cows

Tanya L. France, A. Javaid, K. S. Juarez-Leon, M. G. Vogellus, and J. W. McFadden

Take-home message: Diets adequate in methionine (>1.13 g/Mcal of ME) or with omega-3 fatty acids derived from fish oil (EPA and DHA, 3-7 g) enhanced energy-corrected milk and milk protein yield, increased postpartum dry matter intake, reduced body weight loss, increased postpartum liver functionality index, modified hepatic methyl donor metabolism, and modified nutrient partitioning at calving in transition cows.

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Hypothesis

Feeding a diet adequate in Methionine (Met) and with omega-3 (n-3) FA's during the transition period will enhance liver function and improve milk production.

Why is this feeding strategy important in transition cows?

- Diminished dietary nutrient supply but increased energy demand during late gestation and early lactation
- Systemic inflammatory response occurs at parturition, increasing risk of metabolic disease and lower milk production
- Feeding strategies used to reduce metabolic disease and increase milk production in early lactation cows

Methionine (Met) feeding in dairy cows

- Rumen-protected (RP)-Met is fed to enhance Met bioavailability
  - Increases milk production
  - Reduces oxidative stress
  - Improves liver function

- Past recommendation: RP-Met fed at ~0.08% ration DM (~14 g/d prepartum and ~16 g/d postpartum); however, new data suggests that Met feeding should be on the basis of metabolizable energy supply

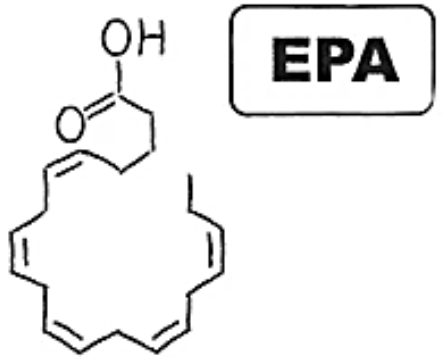
Zhou et al., 2016; Batistel et al., 2018

Omega-3 fatty acid (n-3 FA) feeding in dairy cows

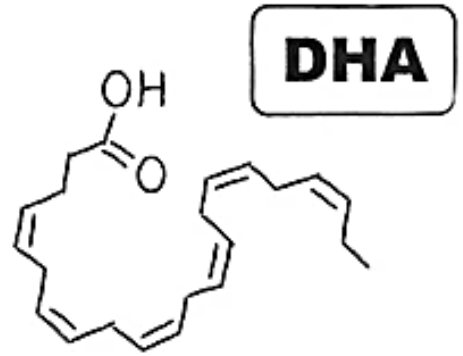
- Fed as calcium salts to reduce biohydrogenation

- Beneficial for immune function
  - Activate anti-inflammatory response
  - Inhibit pro-inflammatory response

- No established feeding rate in dairy cows



Eicosapentaenoic Acid (EPA) (20:5, n-3)



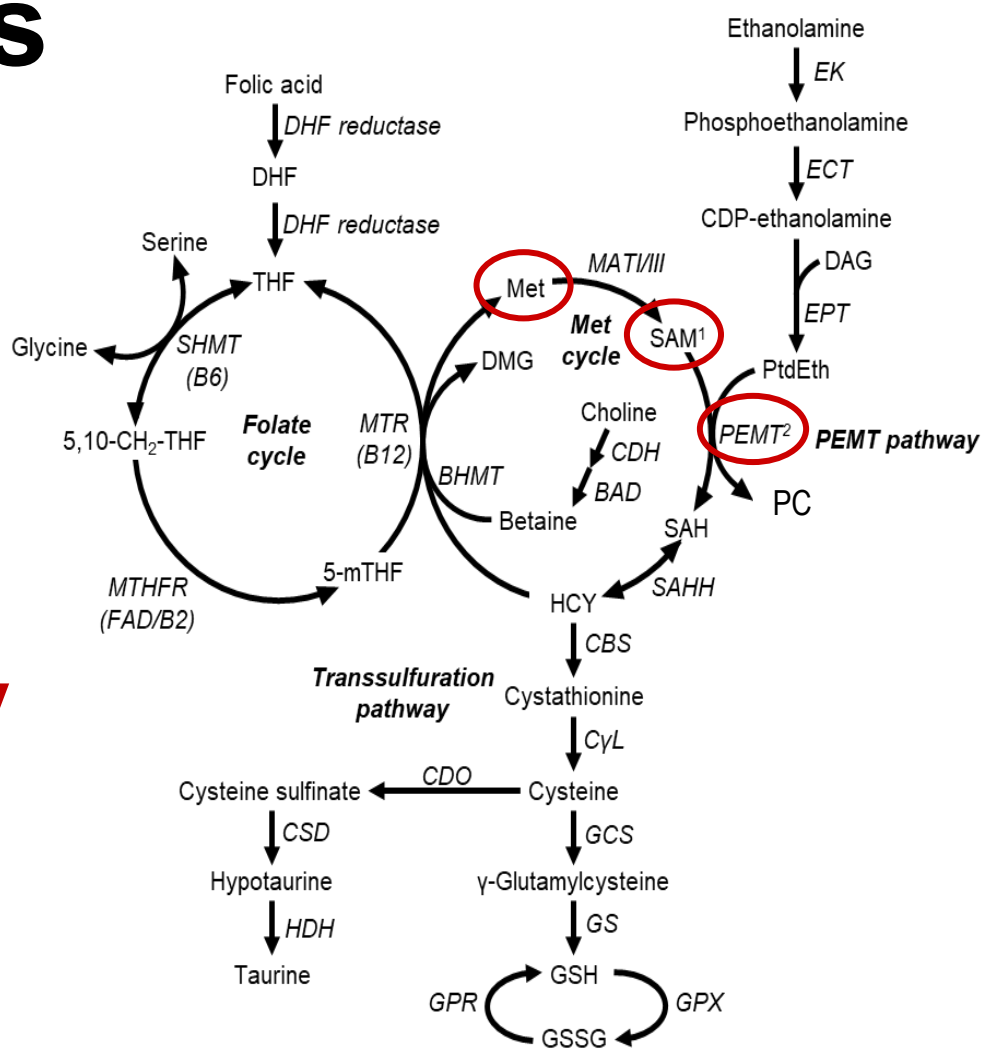
Docosahexaenoic Acid (DHA) (22:6, n-3)

Greco et al., 2015; Moallem, 2018

Potential interaction between Met and n-3 FA's

- Met donates methyl groups to SAM
  - Increases phosphatidylcholine (PC) synthesis via PEMT pathway
- PEMT pathway prefers very-long chain FA such as DHA in non-ruminants

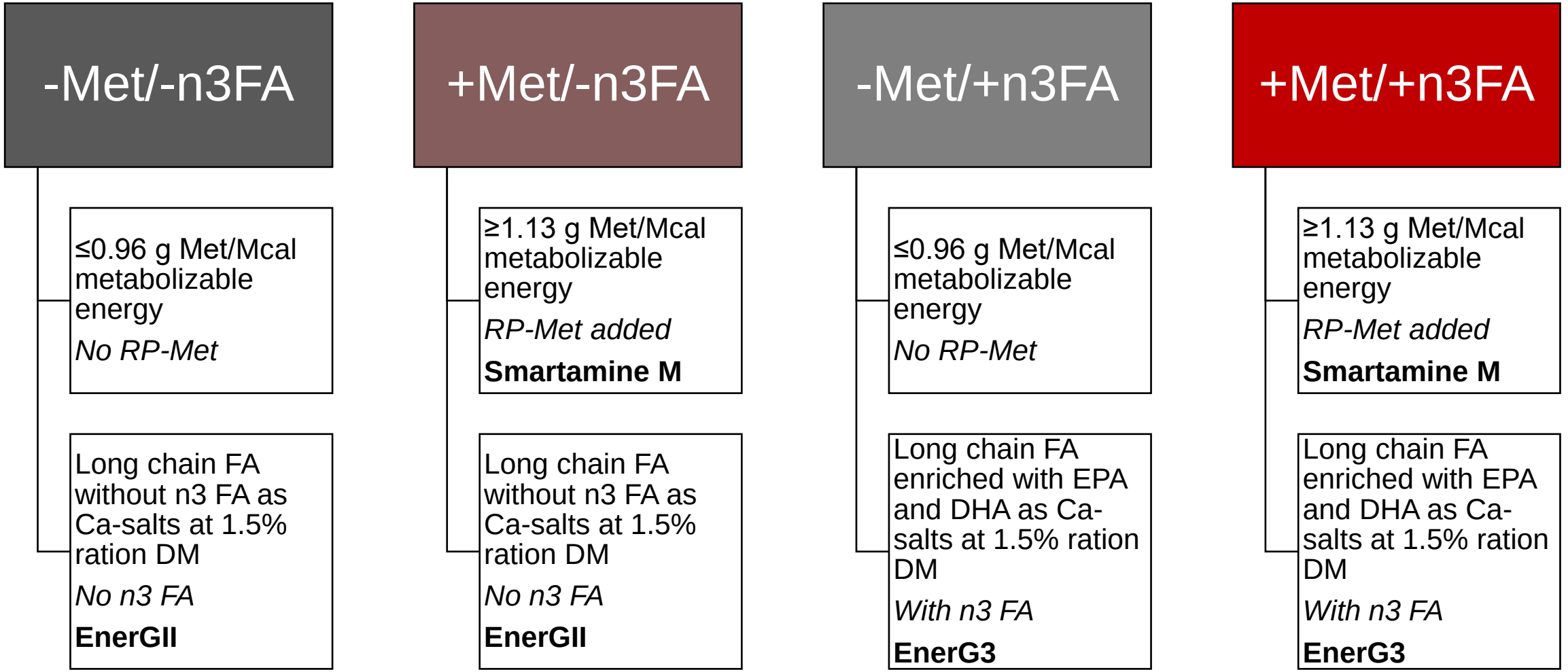
Possible downregulation of this pathway in transition period due to insufficient dietary supply of Met and n-3 FA



[1]*S*-adenosylmethionine
[2]Phosphatidylcholine *N*-methyltransferase

DeLong et al., 1999; Watkins et al., 2003

Pre and postpartum dietary treatments



Summary of results

Diets adequate in Met (>1.13 g/Mcal ME) and with n-3 FA (EPA and DHA, 3-7 g) in transition cows:

Enhanced lactational performance

↑ ECM (+5.53 kg/d ECM in +Met/+n3FA compared to –Met/-n3FA), milk protein % and yield, milk fat % and yield

Improved postpartum performance

↑ Postpartum DMI, liver functionality index

Reduced postpartum body weight loss

Modified hepatic methyl donor metabolism

↑ Liver SAH

Indirect measurement of ↑ activity of PEMT pathway

Modified nutrient partitioning at calving

↑ Plasma glucose concentrations

↓ Plasma triglyceride concentrations

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