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Total Dairy Conference

Transition Cow Nutrition:

Harnessing long-term benefits from short-term choline supplementation

Dr. Heather White
Associate Professor, Department of Dairy Science
University of Wisconsin-Madison

Negative Energy Balance

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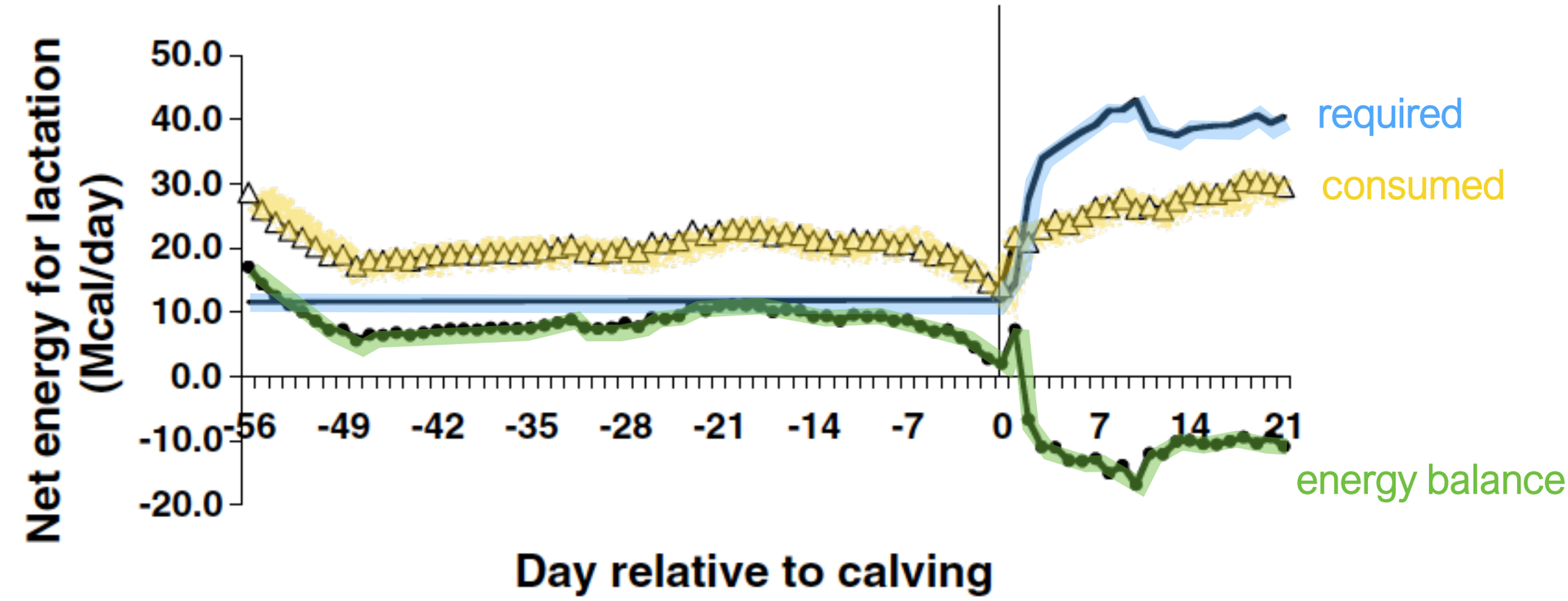

Grummer, 2008.

Glucose Production from Feed

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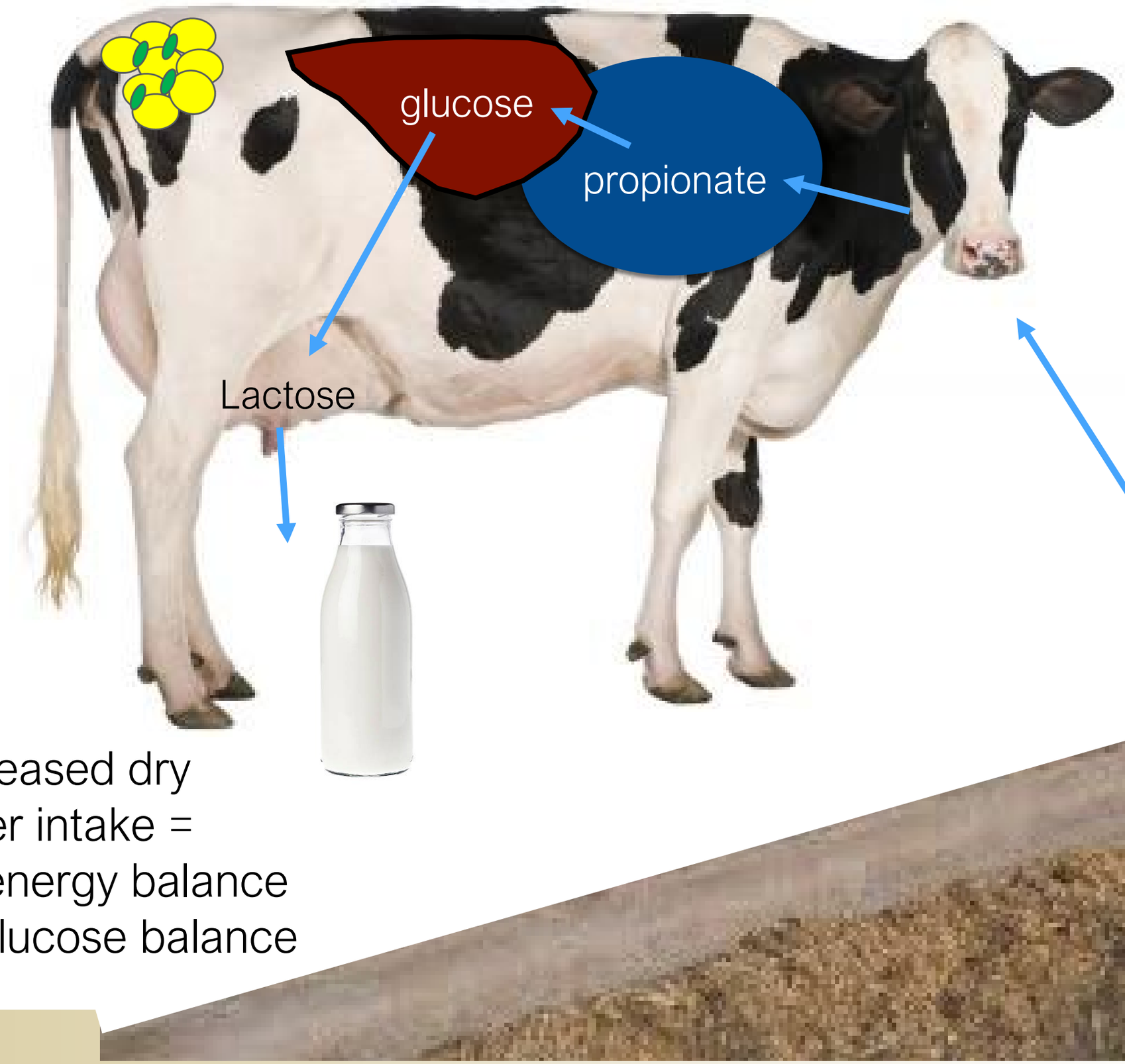

Decreased dry matter intake = negative energy balance negative glucose balance

Mobilization of Fat Stores

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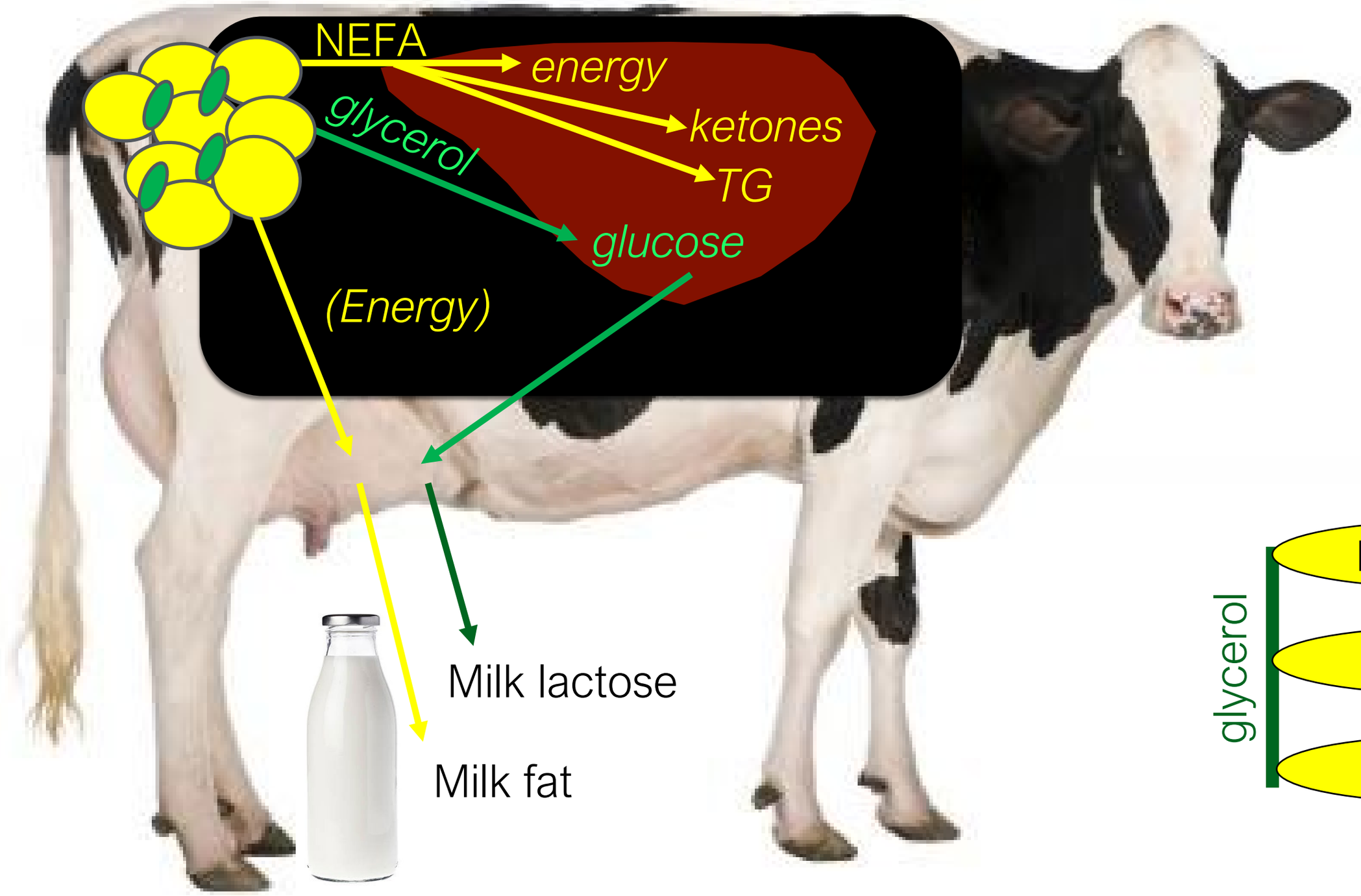

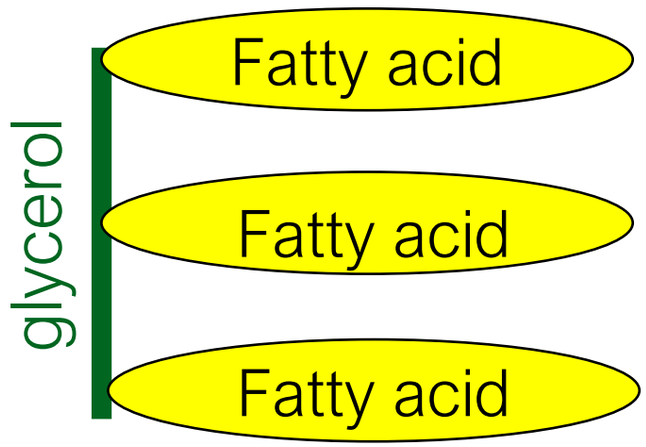

Nutrients that modulate these pathways can be beneficial.

Nutrition Can Propagate our Impact

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- Impact during RP Choline supplementation on lactation performance

- Mechanism of action to support production

- Impact of supplementing cow with RP Choline of offspring growth and health

Choline as a Nutritional Intervention

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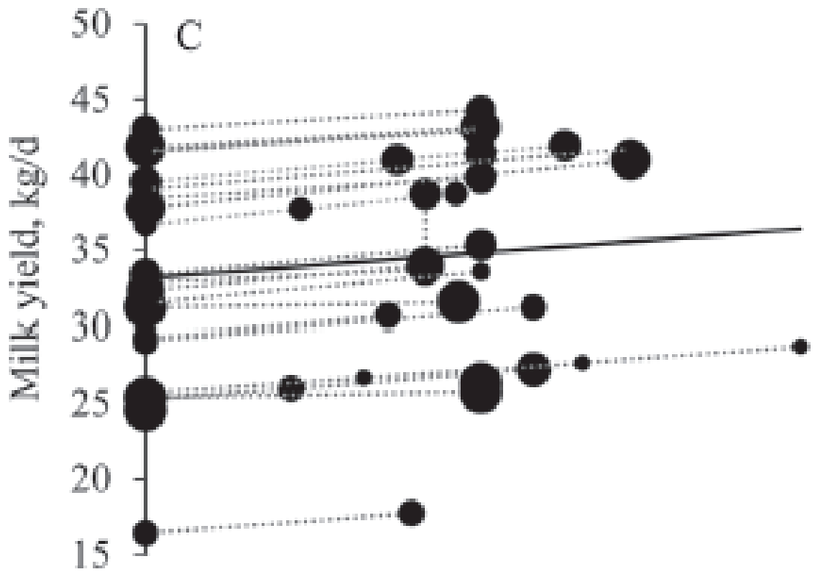
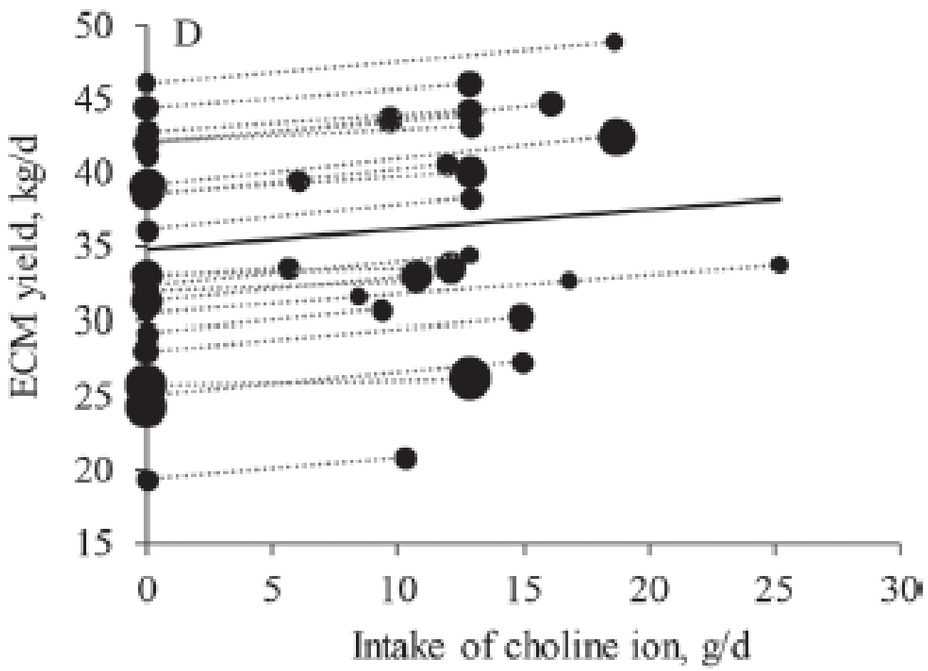
Choline meta-analysis of
23 transition cow studies;
74 treatment means; 1,938 cows



- Energy-corrected milk: Increased 1.61 kg/day
- Milk fat yield: Increased 0.08 kg/day
- Milk protein yield: Increased 0.06 kg/day
- DMI: Increased pre- and postpartum 0.28 and 0.47 kg/d



Arshad et al, 2020

Effects of Rumen Protected Choline Supplementation on Cow and Calf Performance

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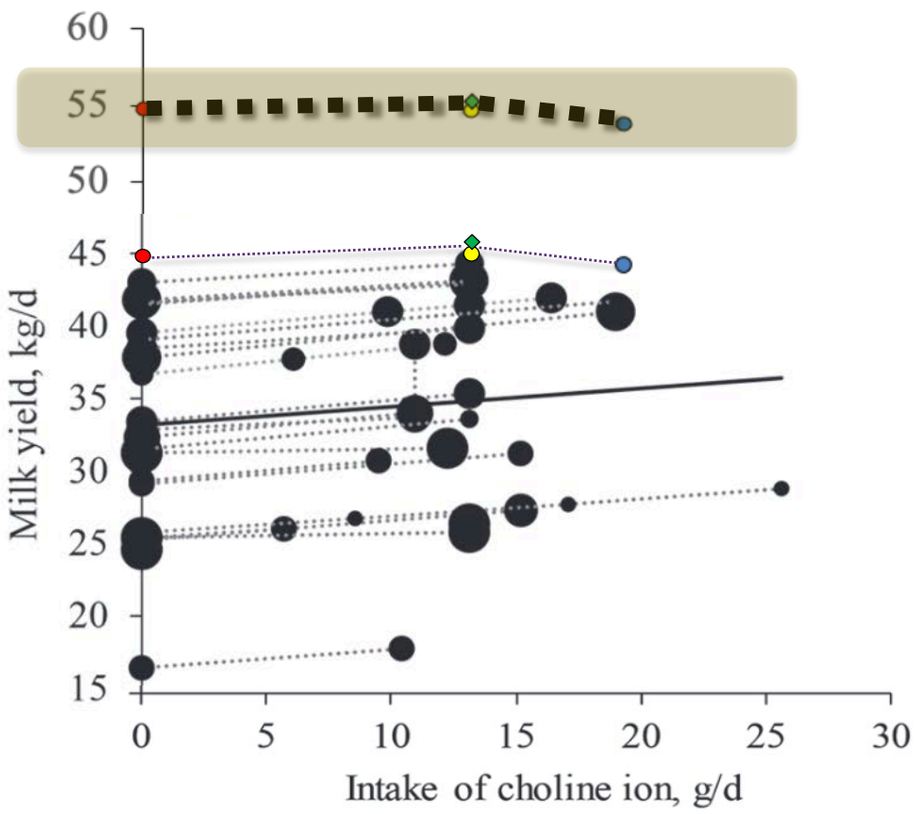
- Multiparous cows (n=24/treatment) enrolled 21 days prior to calving and fed in electronic feeding gates
- Treatments mixed into the TMR

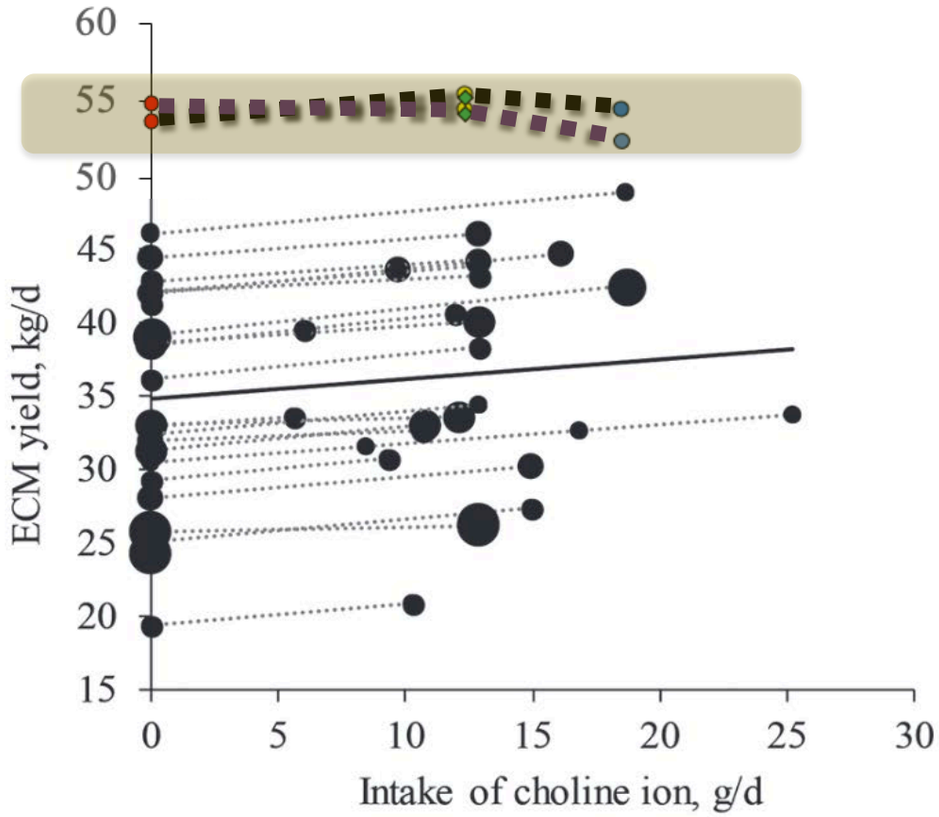
Prepartum:
Individual Cow DMI
Control vs. ReaShure-XC

Postpartum *(1 to ~21 DRTC):*
Pens of 8, treatments maintained
Lactating *(~21 DRTC to 100 DRTC):*
Mixed pens of 16, common diet

Holdorf et al., unpublished data

Milk Production compared with Meta Analysis





Overall Production Perspective:

Post-partum period: Milk yield ~30% and ECM ~37% greater than Meta-Analysis average

Lactating period: Milk yield and ECM ~37% greater than Meta-Analysis average

Arshad et al, 2020; Holdorf et al., unpublished data

What is the mechanism of choline's effects during, and AFTER, supplementation of RP choline??

Fatty Liver and Cellular Lipids

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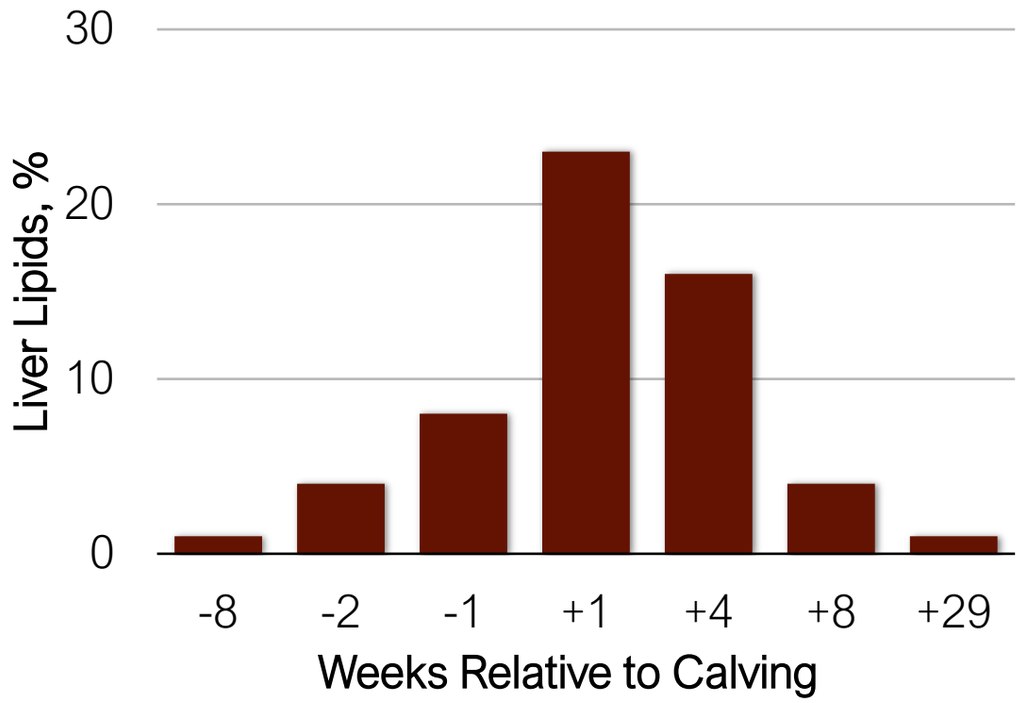
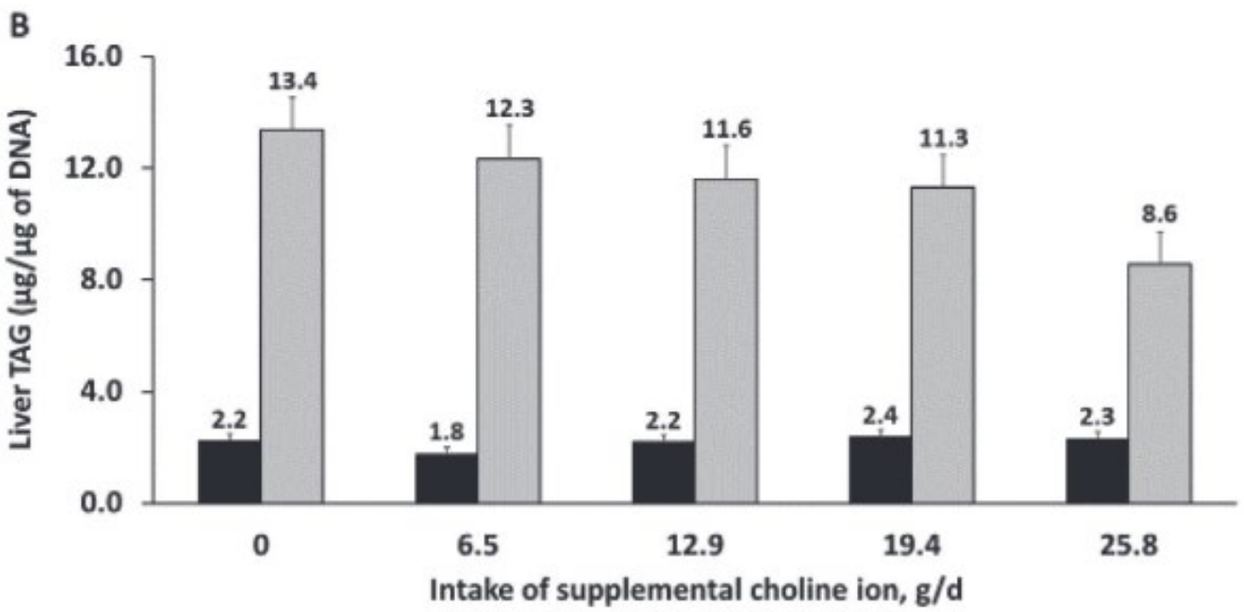
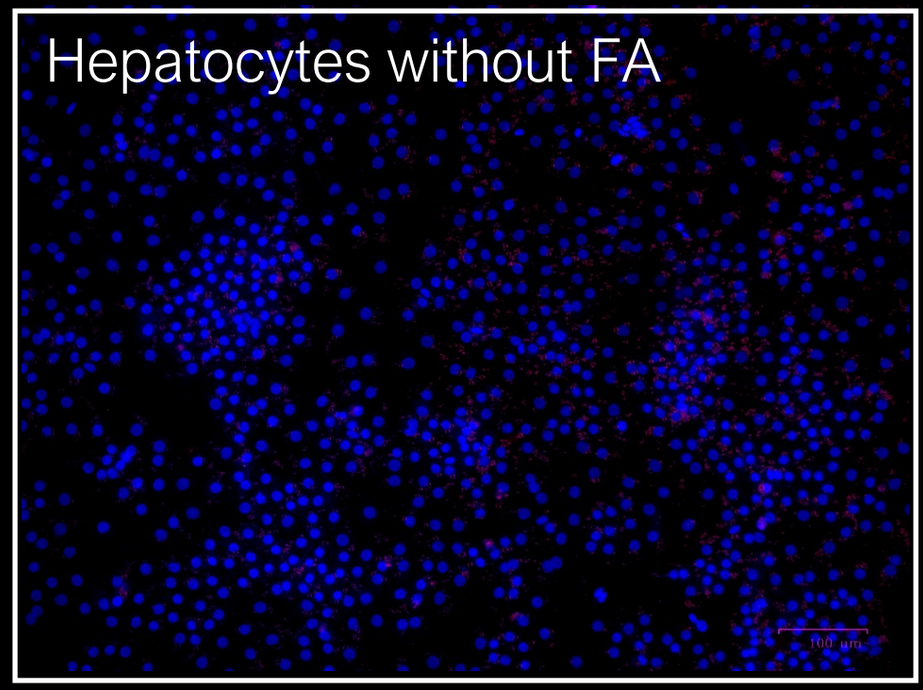
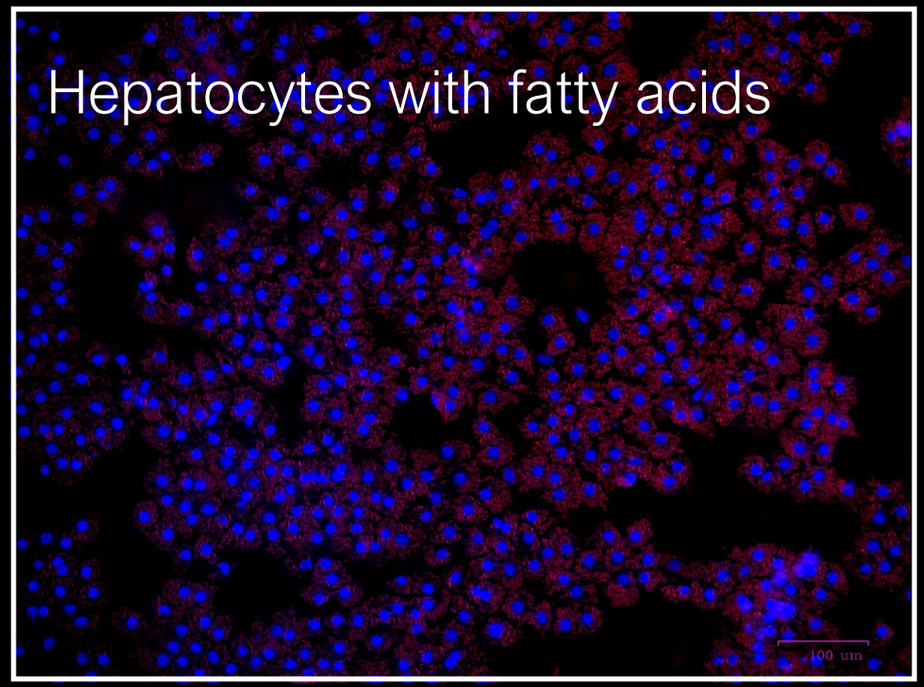


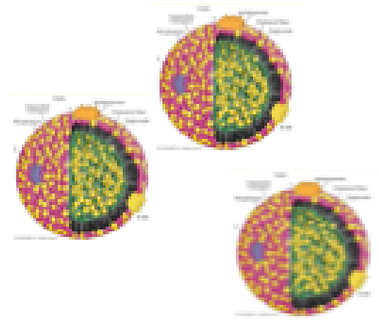


Zenobi et al, 2018

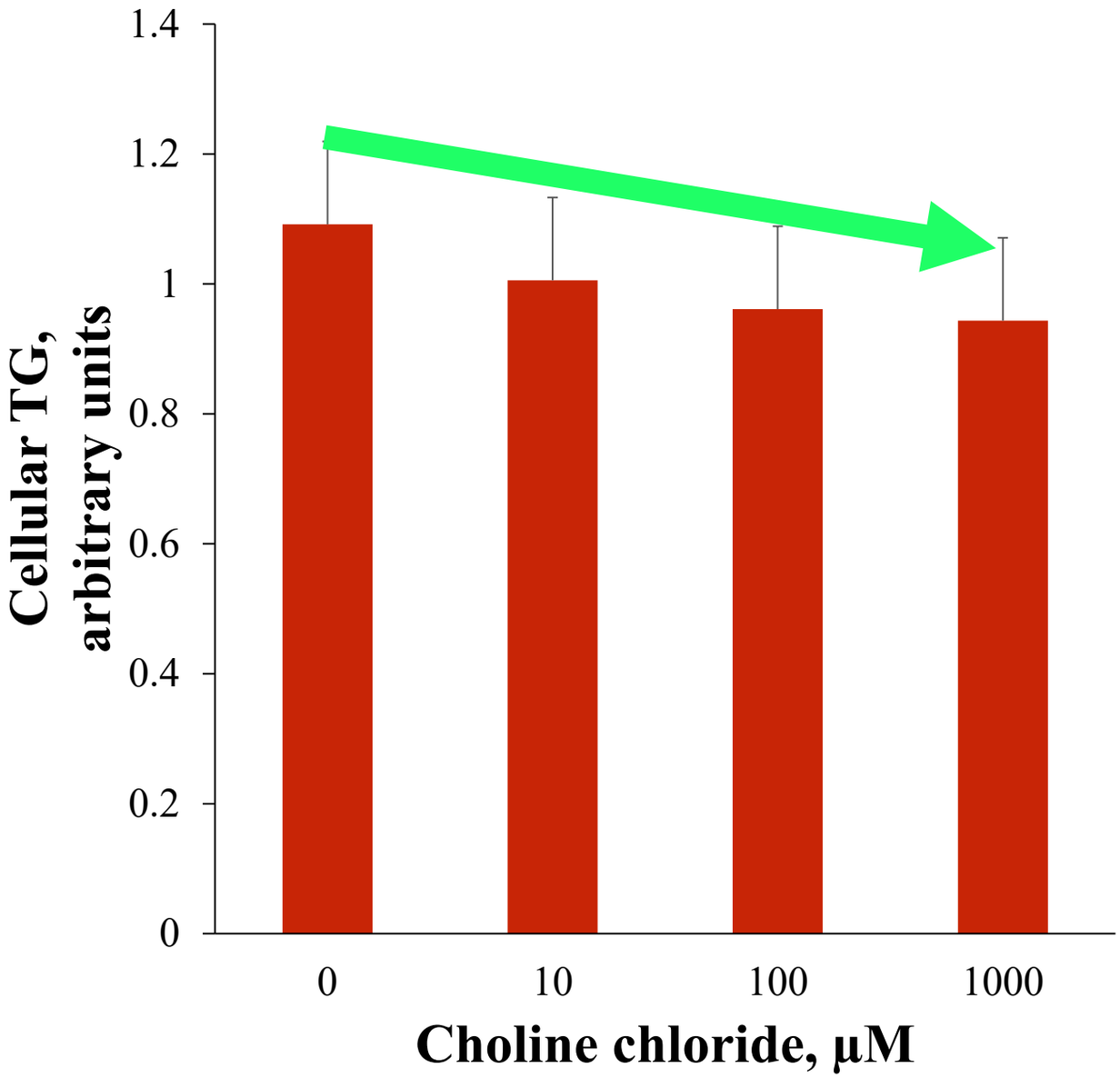




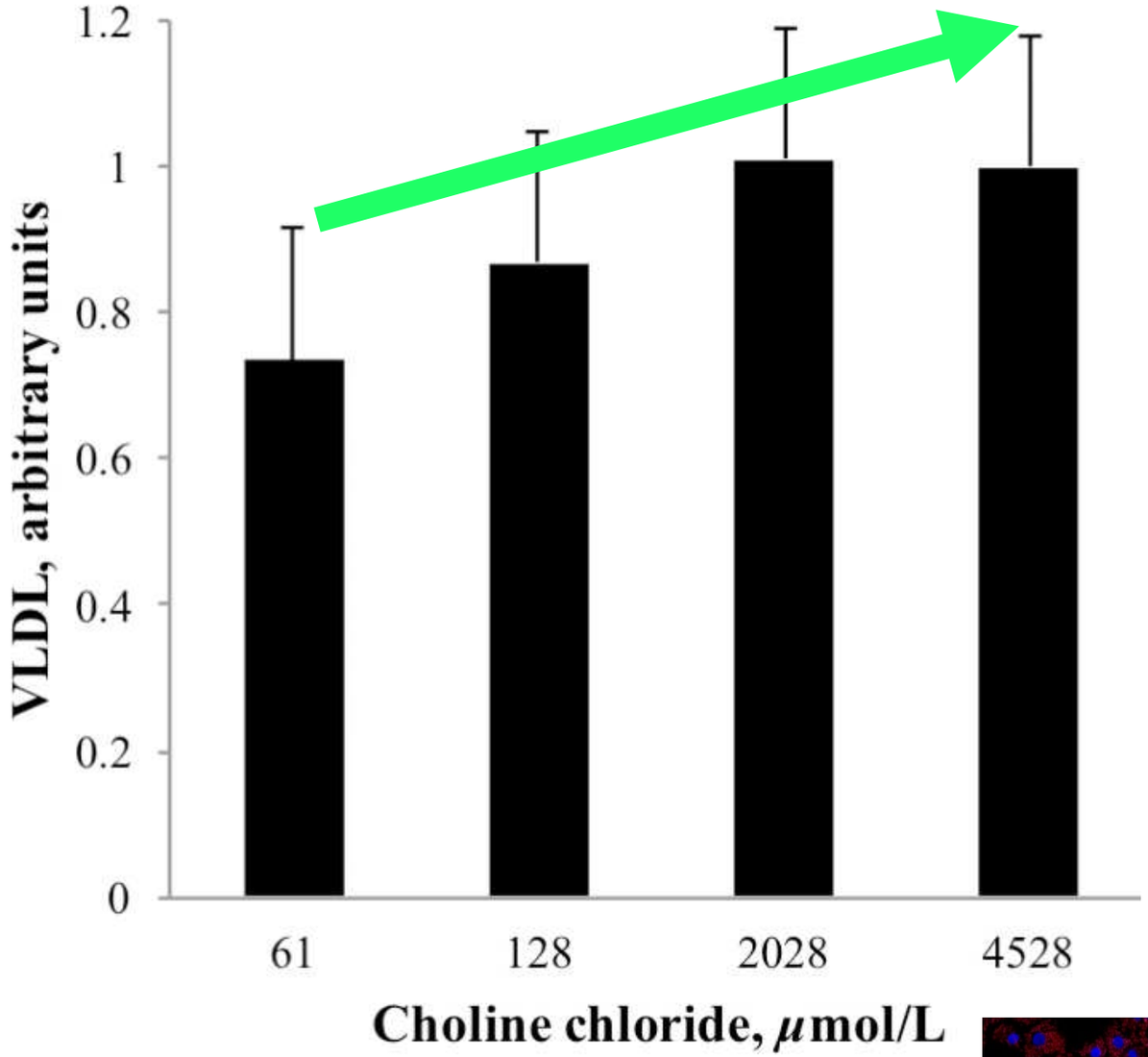
Choline Supplementation Increases VLDL export

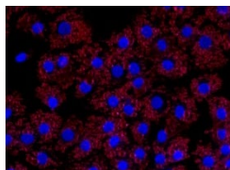


No Choline vs. Choline (10, 100, 1000 µM CC): *P*=0.06



***P* = 0.03**





Chandler and White, 2017; Chandler et al., 2020

Choline Shifts Pathways in Liver Cells

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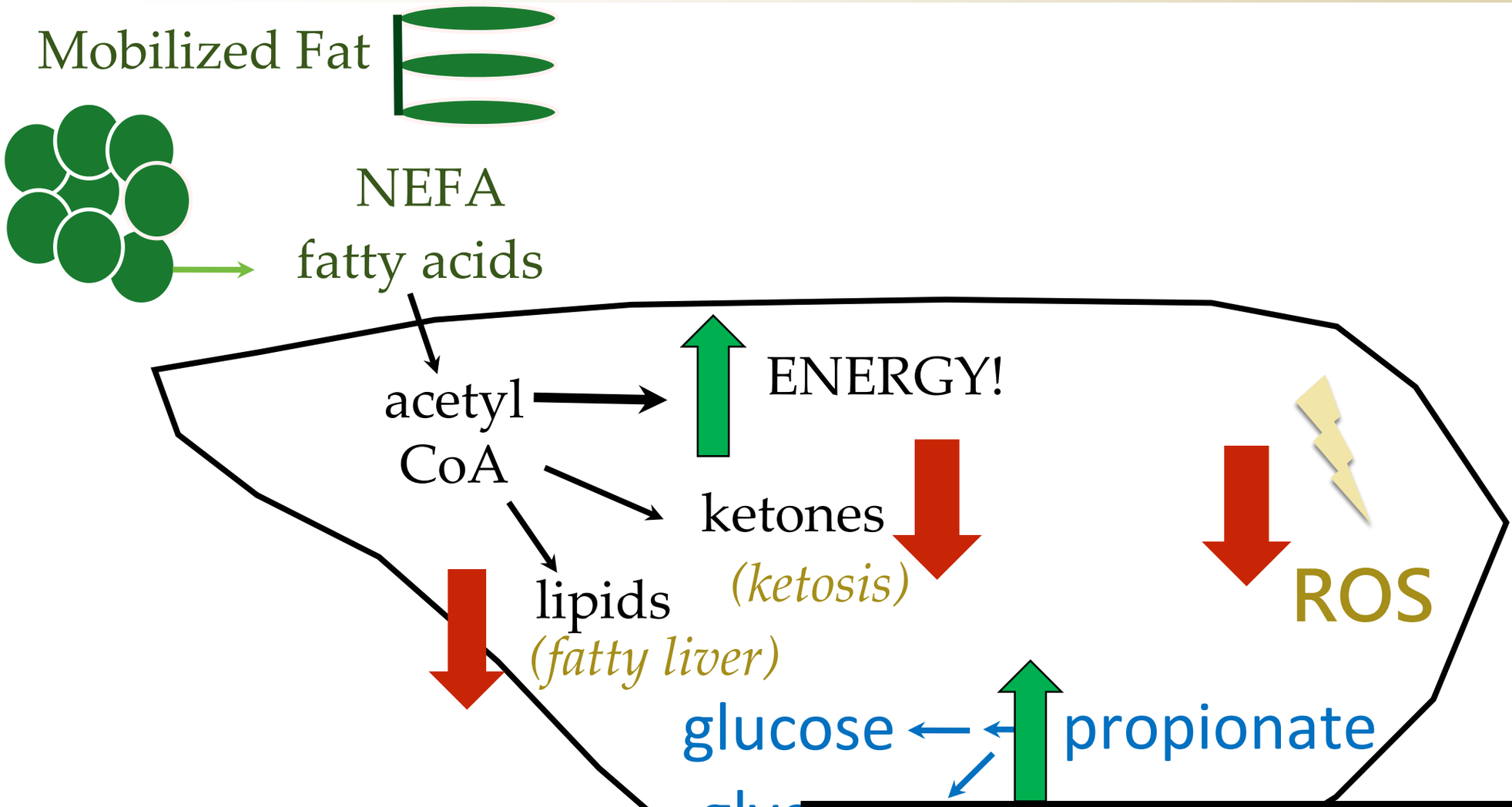
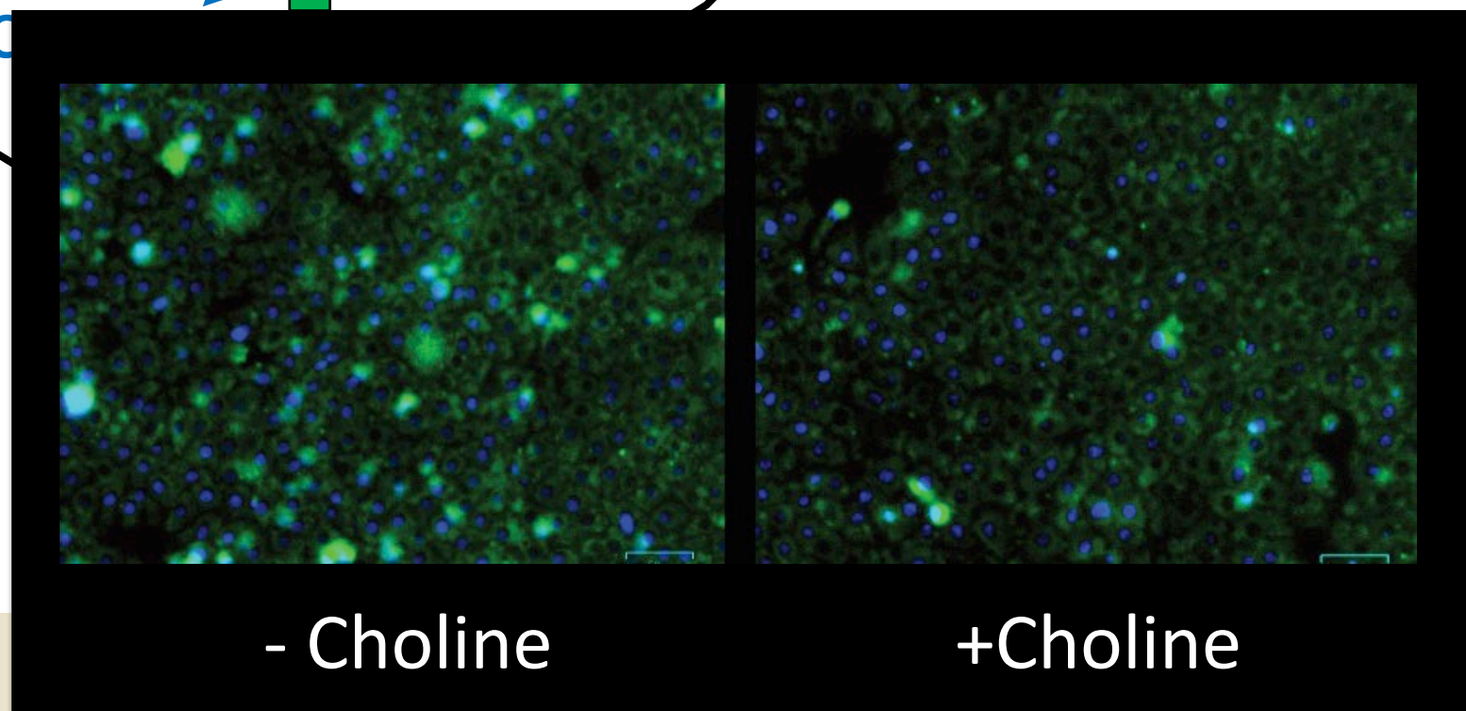
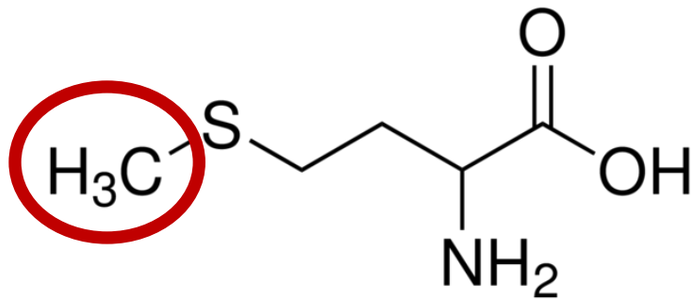


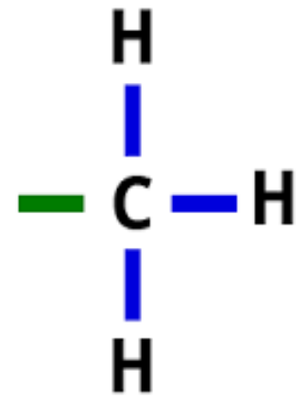


Chandler and White, 2017; Chandler et al, 2020

Methyl Group Metabolism

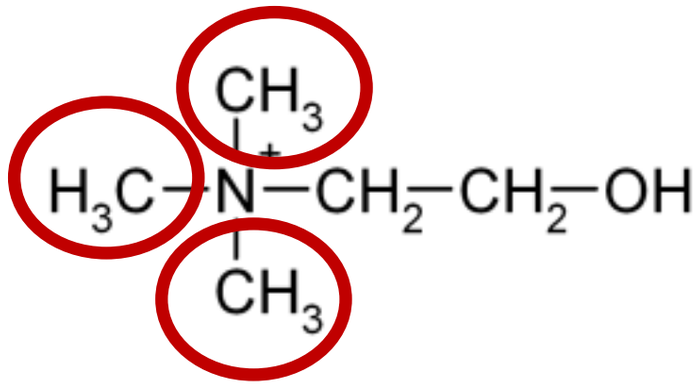
- Methyl groups come from methyl donors
  - methionine (1)



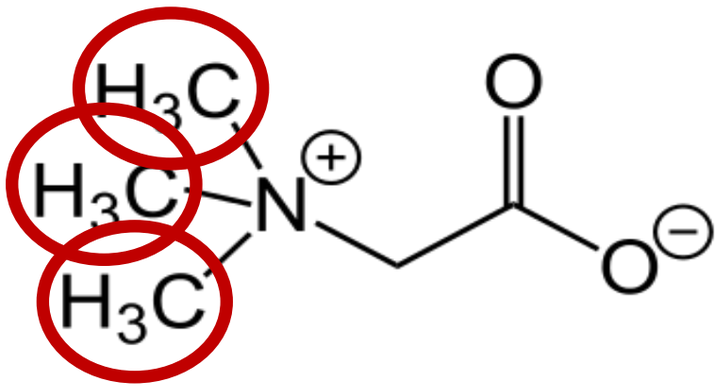


Methyl group

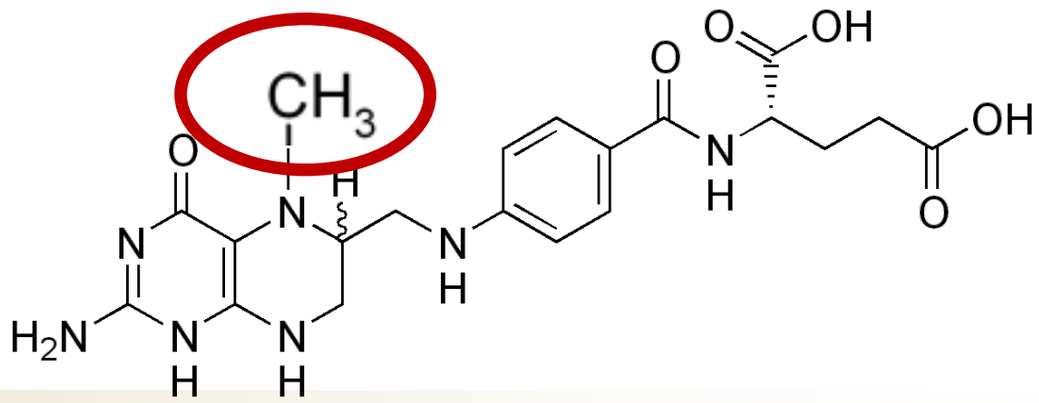
  - choline (3)



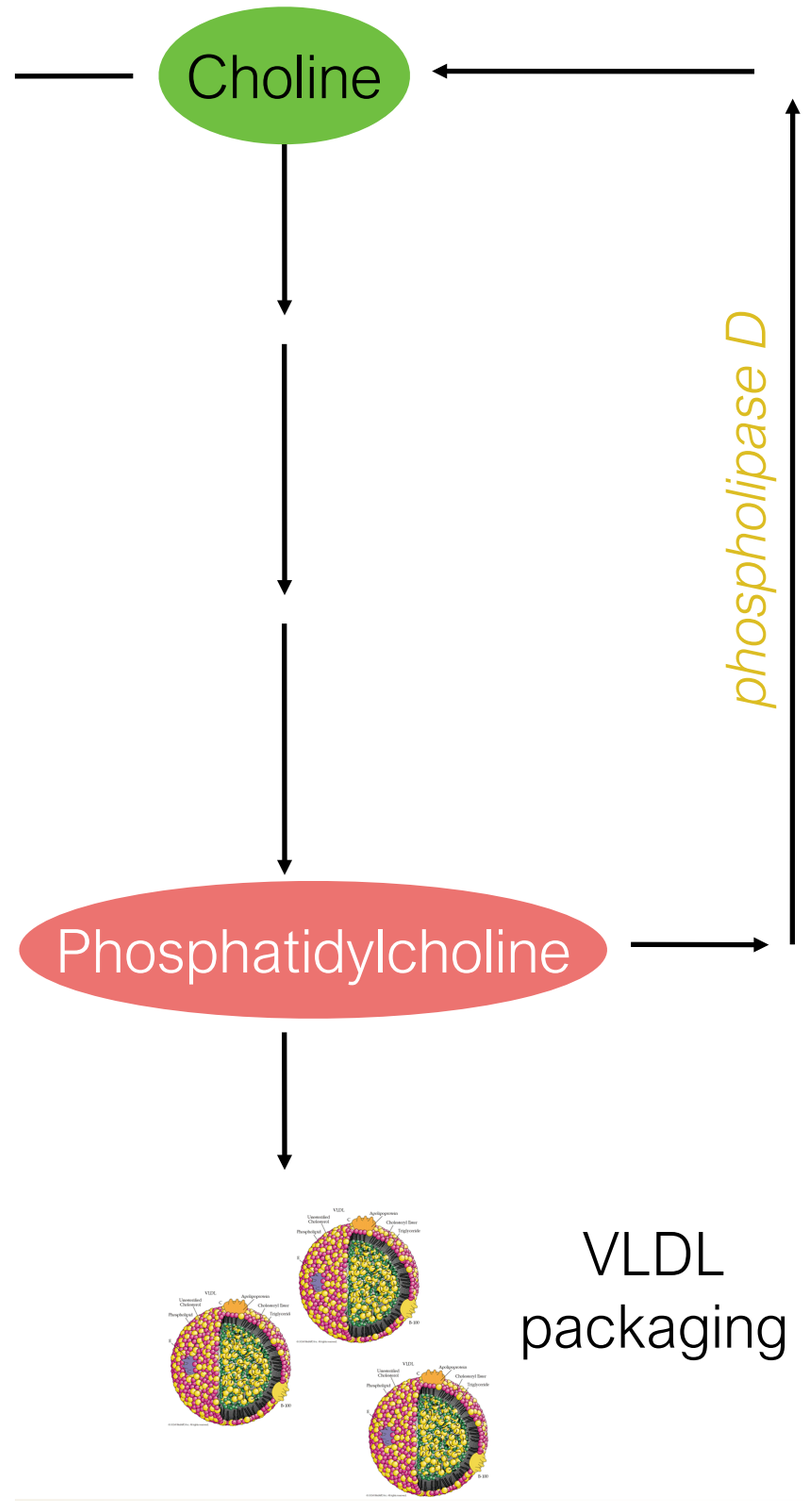
  - betaine (3)



  - folate (5-methyltetrahydrofolate; 1)



Methyl Group Metabolism



Lack of methyl donors across species

=

increased liver inflammation,
decreased liver oxidation,
and
decreased methylation of DNA

Choline supplementation of Liver Cells

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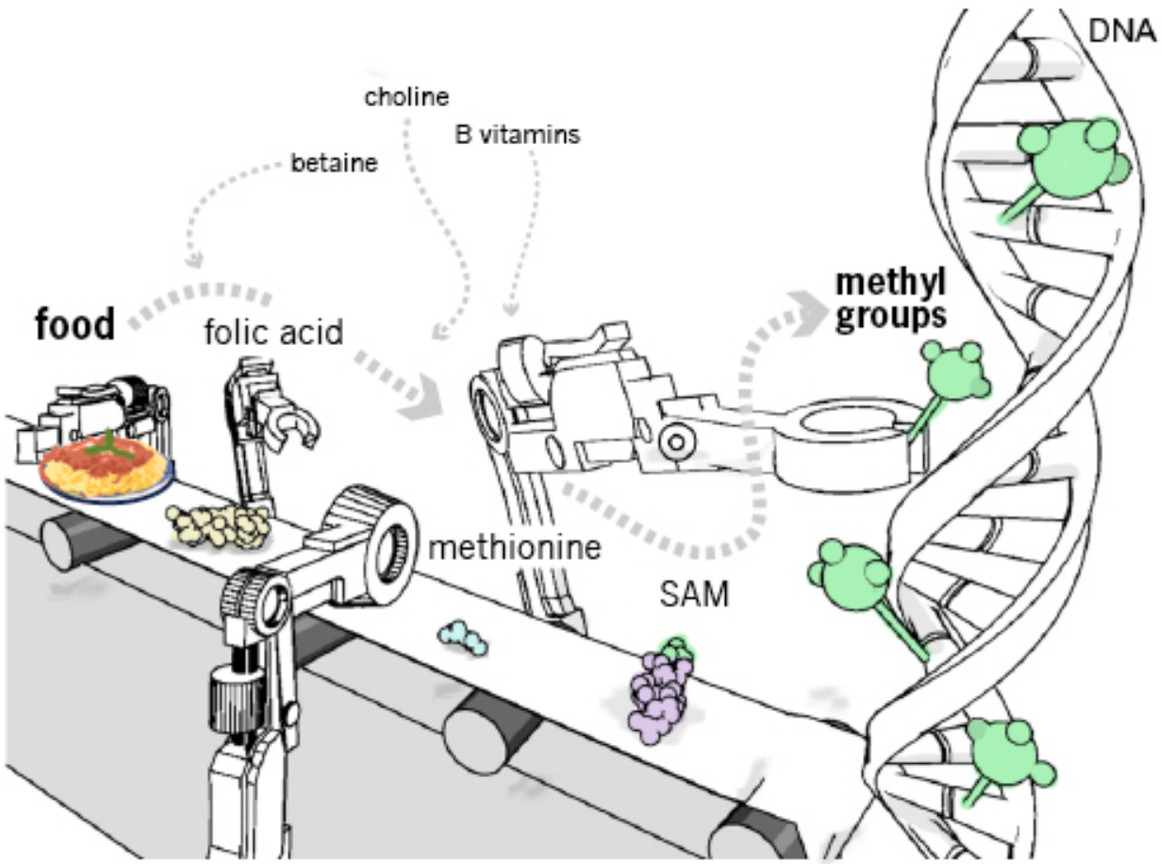
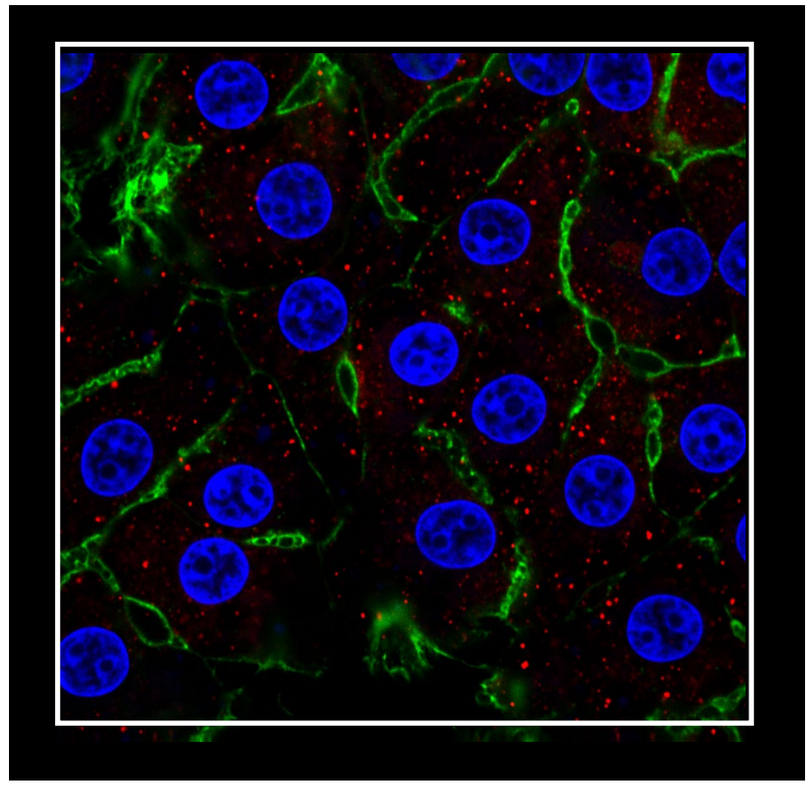
↑ Increased methyl group donation

↑ Methionine regeneration



http://learn.genetics.utah.edu/content/epigenetics/nutrition/



What does this to the calf in utero?

Calves born to Cows fed RP Choline have increased average daily gain (ADG)

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Birth to ~50 weeks of age by heifers		Birth to 5 weeks of age by bulls (given LPS)
2015	**2017**	**2017**
0.80 vs. 0.85 kg/d	0.77 vs. 0.82 kg/d	0.44 vs. 0.56 kg/d
P = 0.06	*P* = 0.09	*P* = 0.06
n = 35	n = 46	n = 38

Zenobi et al., 2018, JDS; Zenobi et al., 2018 abstract

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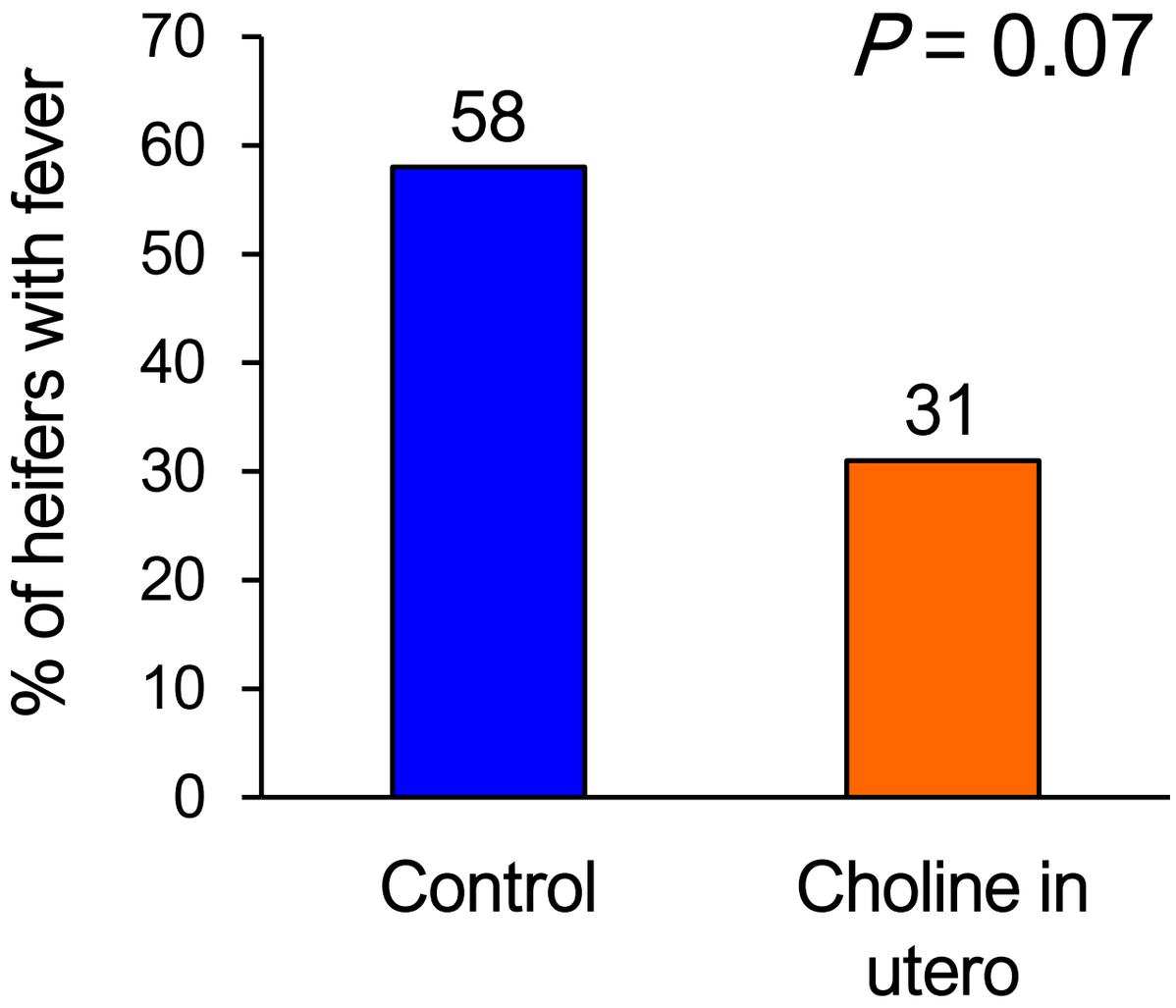
Performance of Choline Calves



Immune Maturation & Function

Lung Development & Maturation

Rectal temperatures measured daily.

Fever: >103.1°F; >39.5°C

Zenobi et al., 2018 abstract

Impact of In Utero Supplementation on Calf Growth

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OR

Female Holstein Calves (n=12/trt)

Male and Female Angus x Holstein Cross Calves (n=12/trt)

Holdorf et al., unpublished data

A Long-Lasting Impact from Choline Supplementation

- Supplementing RP Choline during the transition period increases milk yield and energy-corrected milk yield
  - Postpartum production relative to prepartum intake, together with long-lasting effects, suggests changes in metabolism or nutrient use efficiency
- Mechanism of RP Choline action is through improved liver function and health
- Supplementation of cows with RP Choline also improves calf growth and immune function

Acknowledgments

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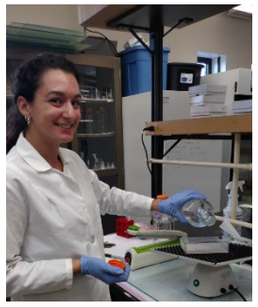
Current White Lab Group



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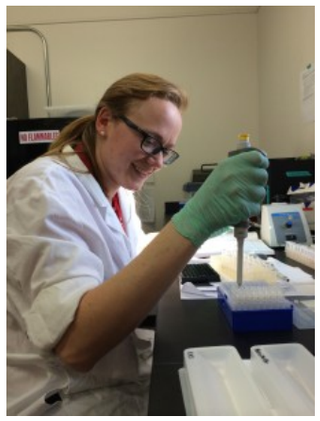

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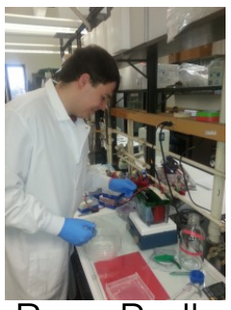

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Questions?