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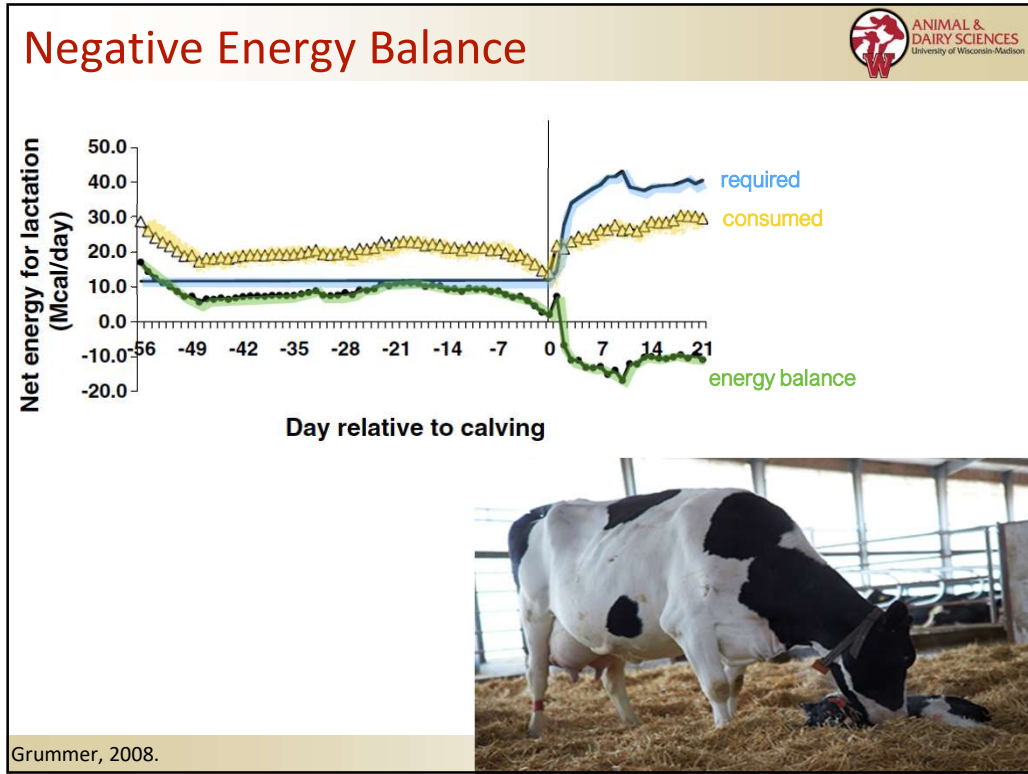
 ANIMAL & DAIRY SCIENCES
University of Wisconsin-Madison

Transition Cow Nutrition:

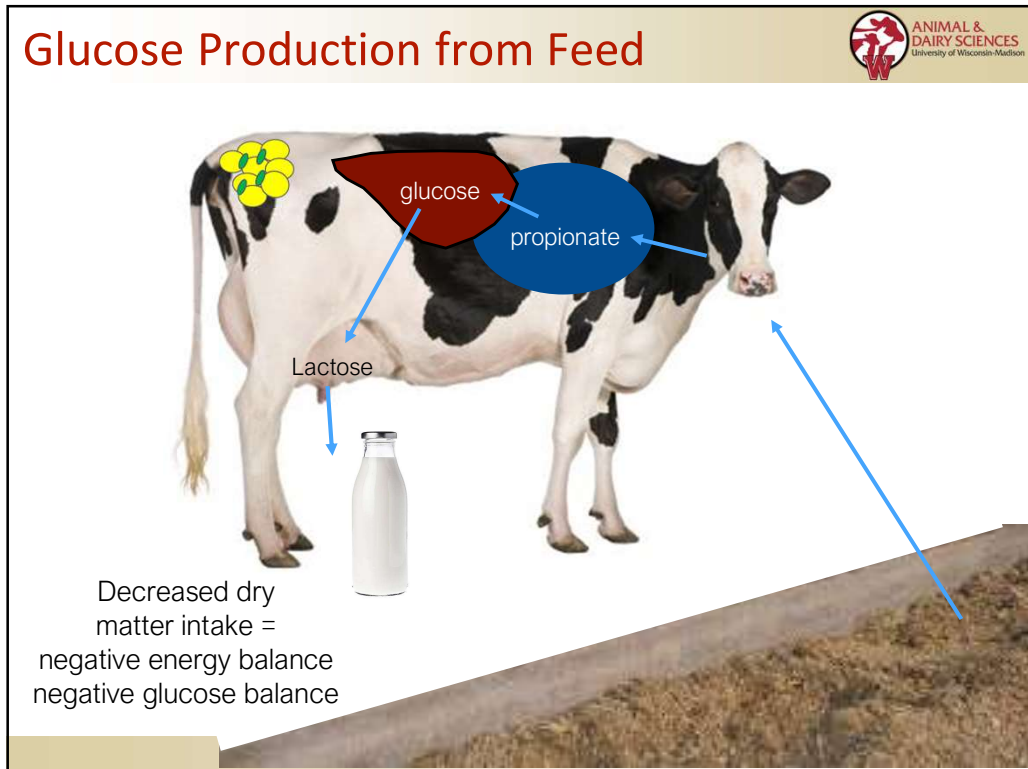
Harnessing long-term benefits from short-term choline supplementation

Dr. Heather White
Associate Professor, Department of Animal & Dairy Sciences
University of Wisconsin-Madison

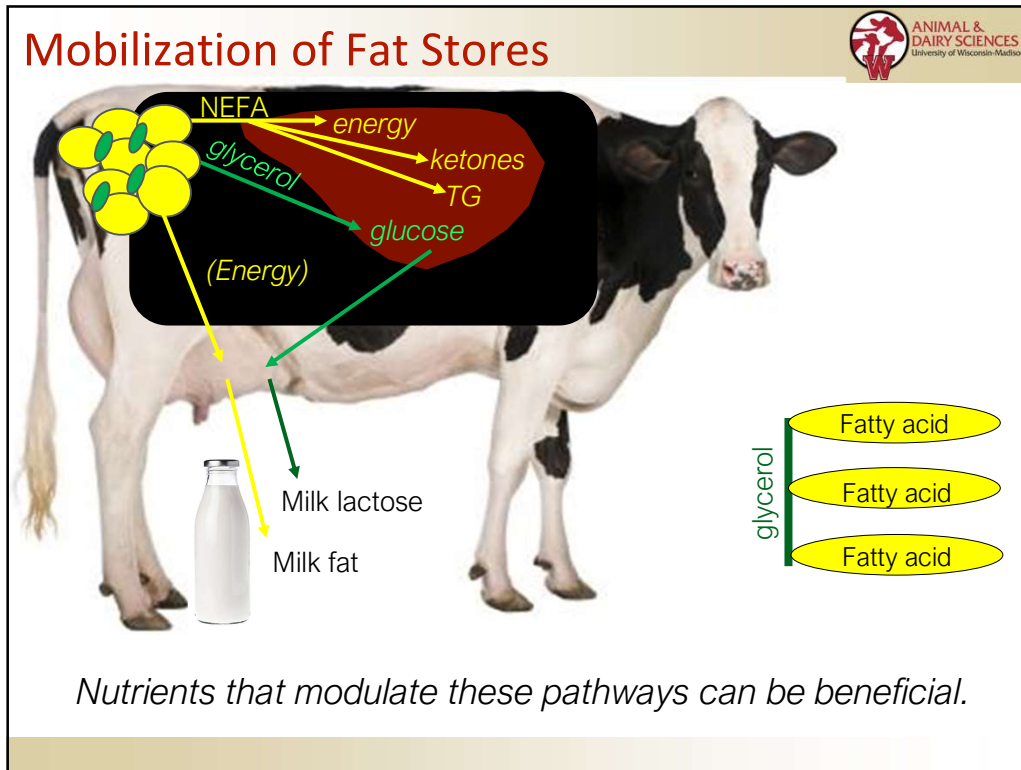
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5

Nutrition Can Propagate our Impact

- Impact of RP Choline supplementation on lactation performance
- Mechanism of action to support production
- Impact of supplementing cows with RP Choline on offspring growth and health

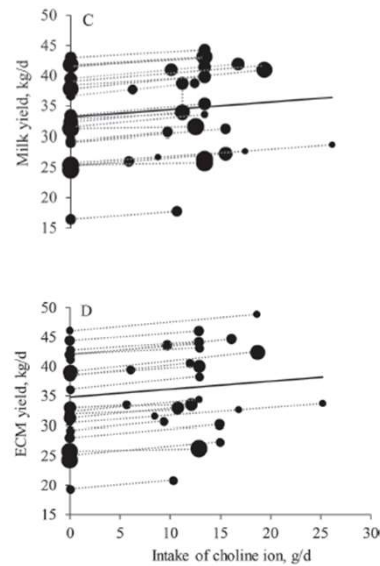
6

Choline as a Nutritional Intervention



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



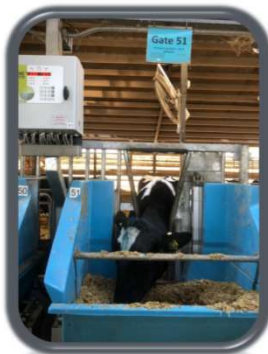
Arshad et al, 2020

7

Effects of Rumen Protected Choline Supplementation on Cow and Calf Performance



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

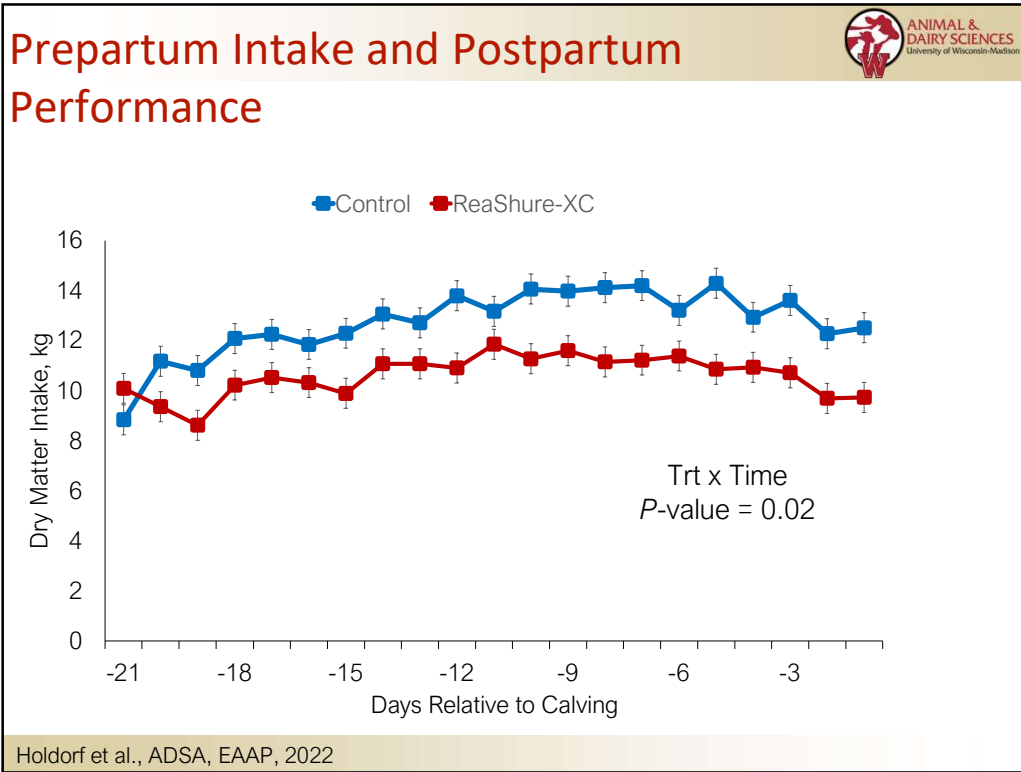


Prepartum:
Individual Cow DMI
Control vs. ReaShure-XC

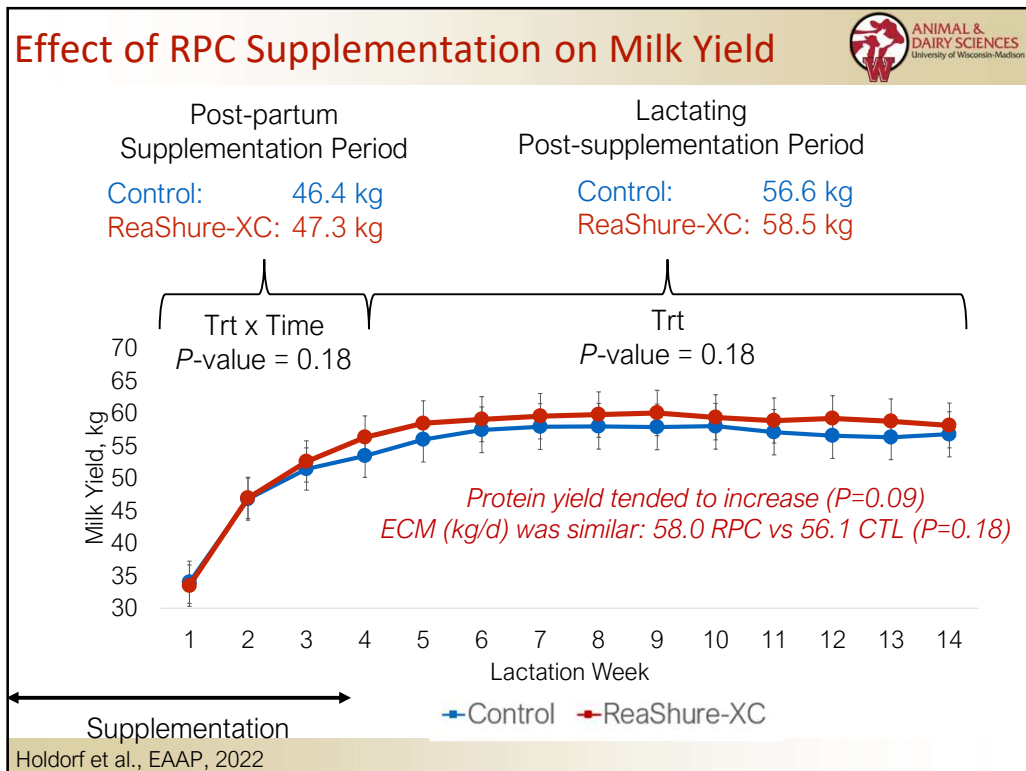
Postpartum (1 to ~21 DRTC):
Pens of 8, treatments maintained
Lactating (~21 DRTC to 100 DRTC):
Mixed pens of 16, common diet

Holdorf et al., ADSA, EAAP, 2022

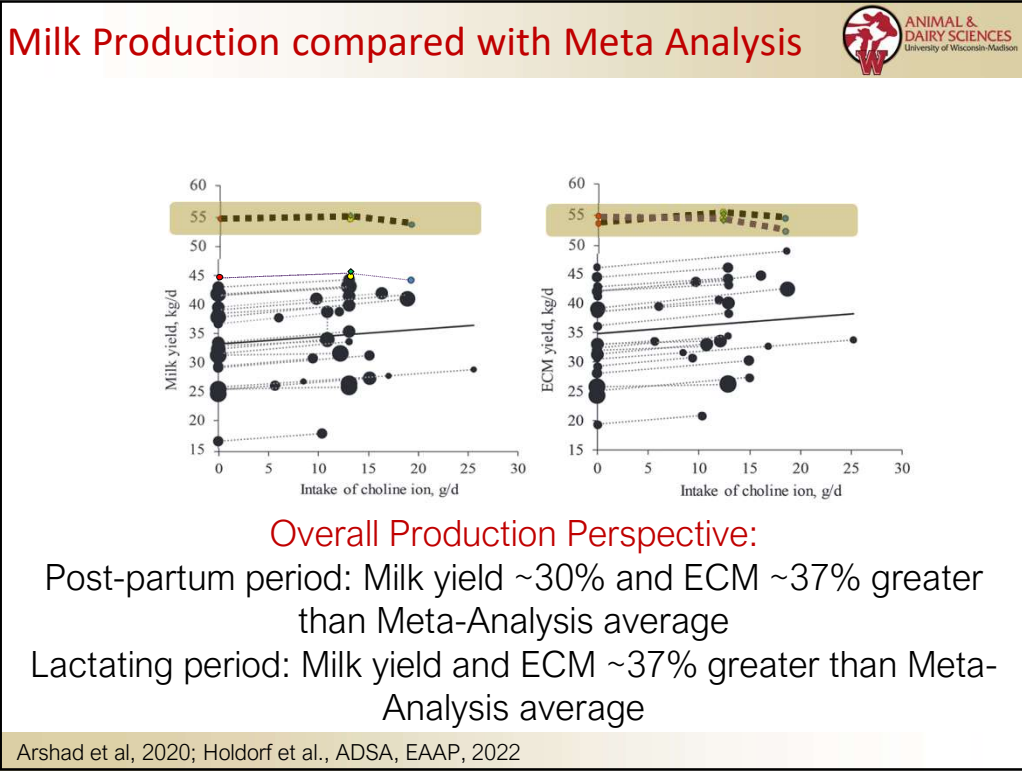
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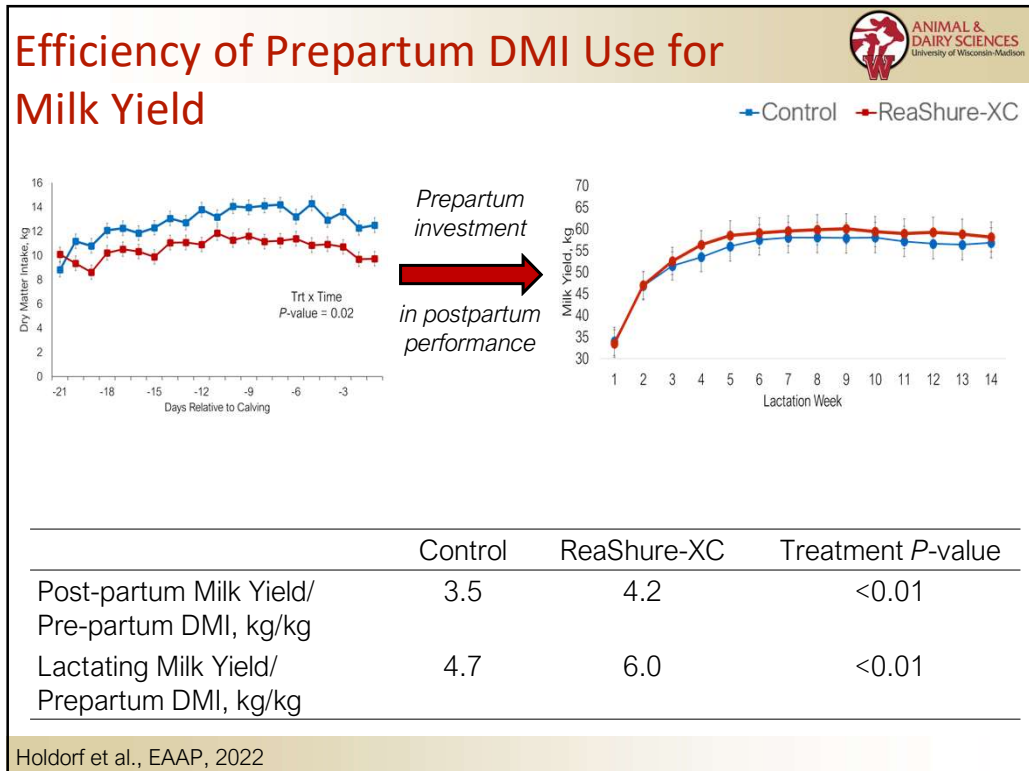
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10



11

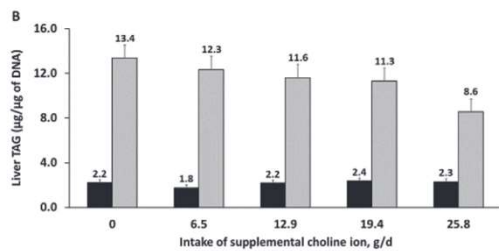
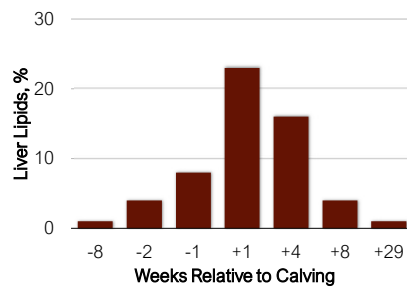


12

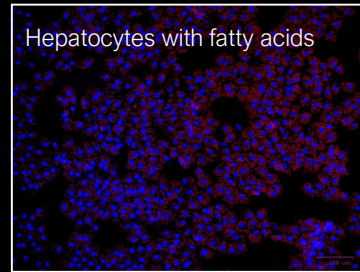
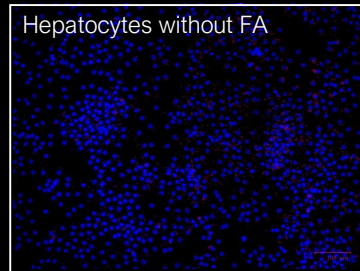
What is the mechanism of choline's effects during, and AFTER, supplementation of RP choline??

13

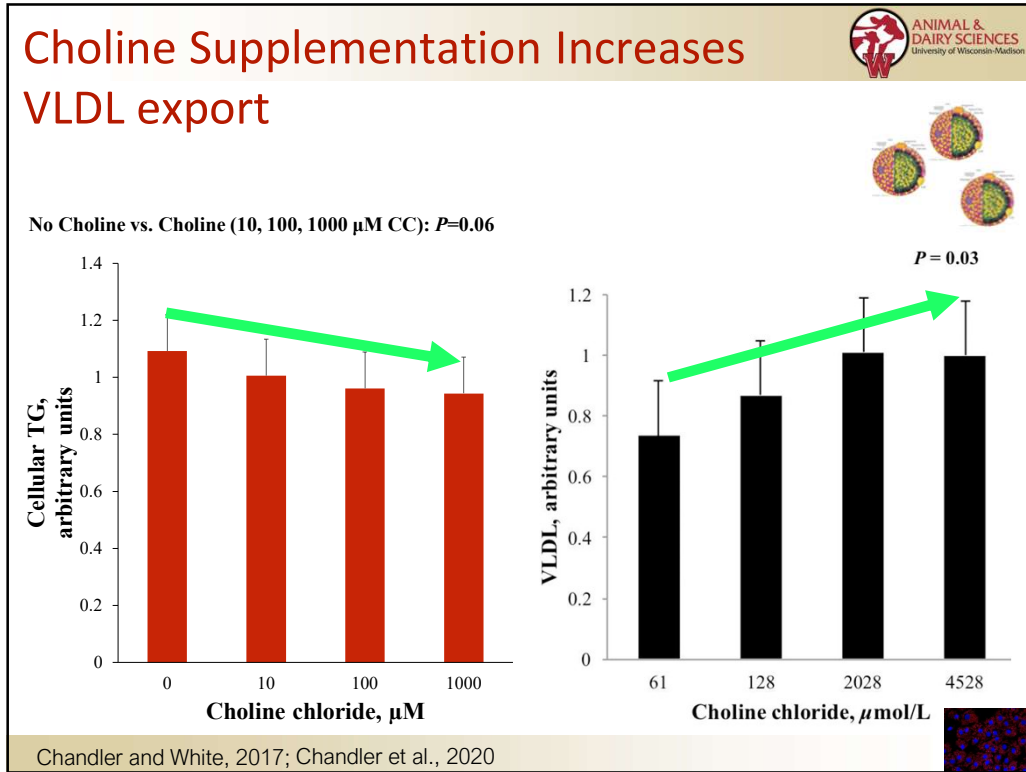
Fatty Liver and Cellular Lipids



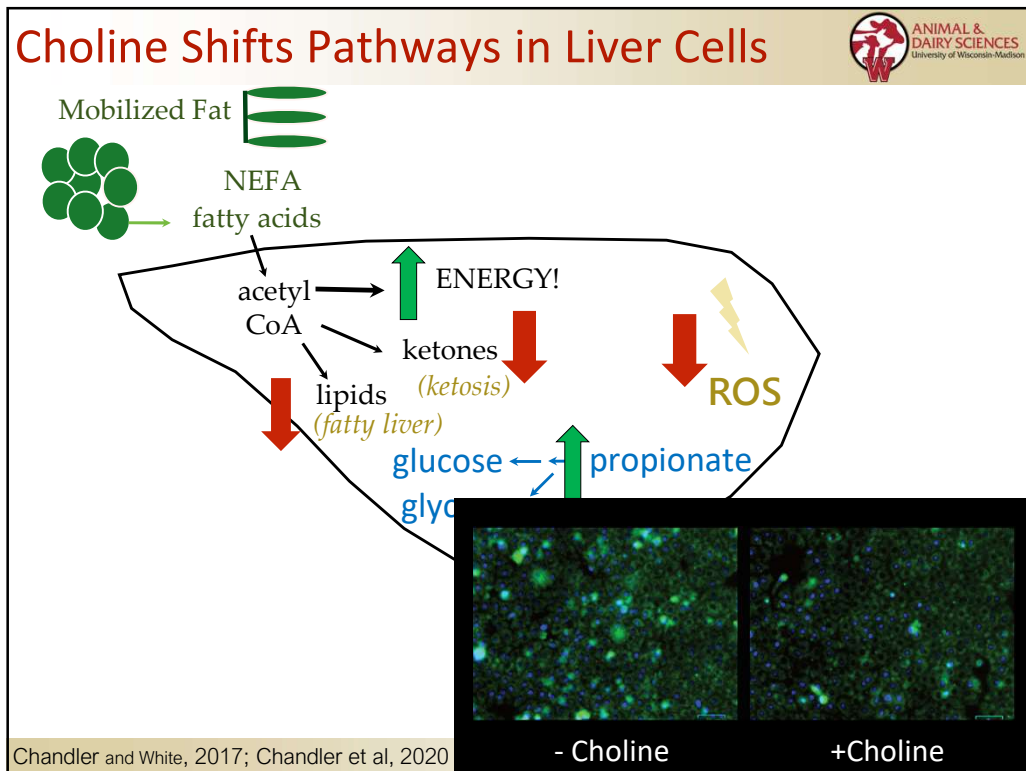
Zenobi et al, 2018



14




15

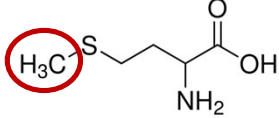
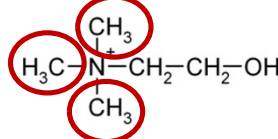
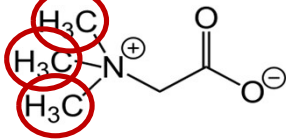
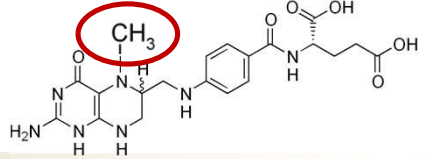


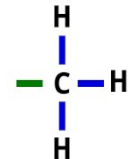
16

Methyl Group Metabolism



- Methyl groups come from methyl donors


- methionine (1) 
- choline (3) 
- betaine (3) 
- folate (5-methyltetrahydrofolate; 1) 

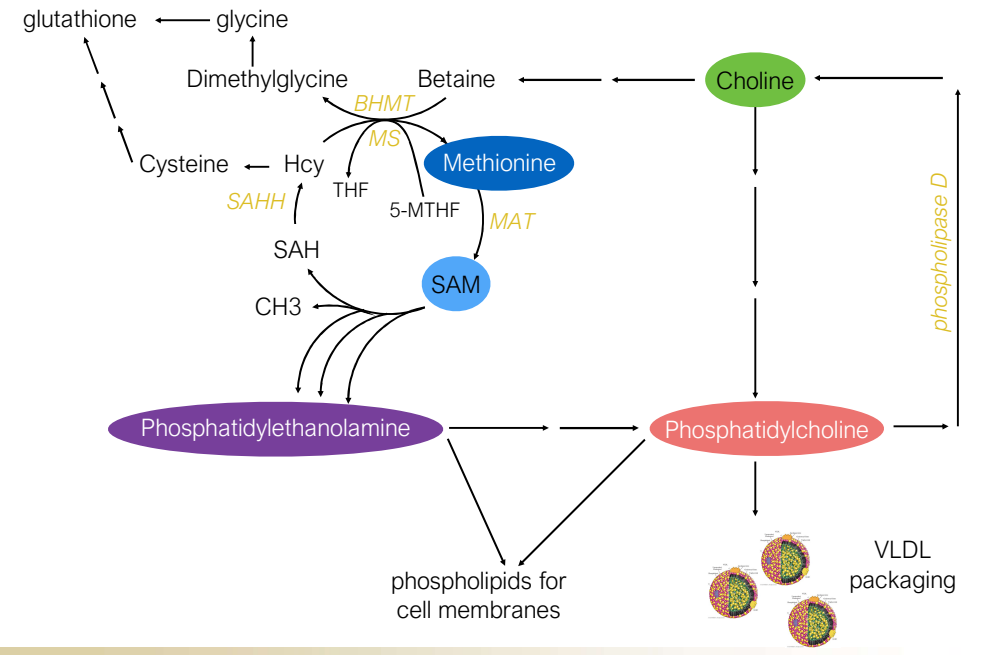


Methyl group

17

Methyl Group Metabolism





The diagram illustrates the metabolic pathway of methyl groups. Choline is converted to phosphatidylcholine via phospholipase D. Phosphatidylcholine is then used for VLDL packaging and as a component of phospholipids for cell membranes. The methyl group is transferred from choline to SAM (S-adenosylmethionine) via the enzyme MAT. SAM then donates the methyl group to various acceptors, including phosphatidylethanolamine, to form phosphatidylcholine. The methyl group is then transferred to Hcy (homocysteine) via the enzyme BHMT, which is then converted to methionine via the enzyme MS. Methionine is converted back to choline via the enzyme BHMT. The methyl group is also transferred to THF (tetrahydrofolate) via the enzyme MAT, which is then converted to 5-MTHF (5-methyltetrahydrofolate) via the enzyme MAT. 5-MTHF is used for the synthesis of SAM. The methyl group is also transferred to SAH (S-adenosylhomocysteine) via the enzyme MAT, which is then converted to SAH via the enzyme MAT. SAH is converted to Hcy via the enzyme SAHH. Hcy is converted to methionine via the enzyme BHMT. Methionine is converted to choline via the enzyme BHMT. The methyl group is also transferred to glutathione via the enzyme BHMT. Glutathione is converted to glycine via the enzyme BHMT. Glycine is converted to dimethylglycine via the enzyme BHMT. Dimethylglycine is converted to betaine via the enzyme BHMT. Betaine is converted to choline via the enzyme BHMT.

Chandler and White, 2017

18

Lack of methyl donors across species

=

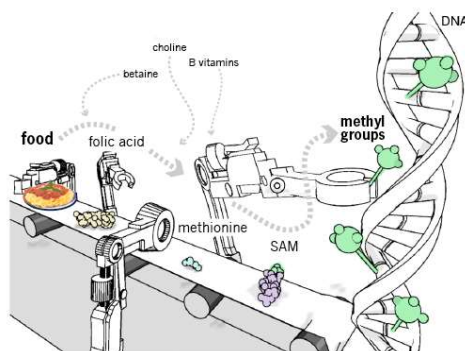
increased liver inflammation,
decreased liver oxidation,
and
decreased methylation of DNA

19

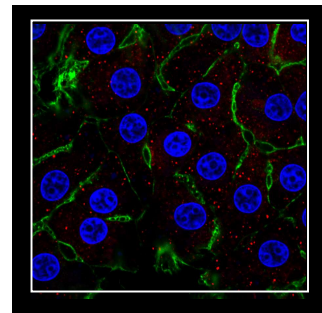
Choline supplementation of Liver Cells

↑ Increased methyl group donation

↑ Methionine regeneration




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



What does this
mean to the
calf in utero?


20

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




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

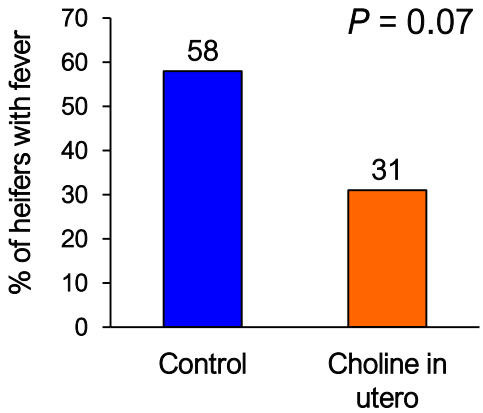
Zenobi et al., 2018, JDS; Zenobi et al., 2018 abstract



21

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




22

Impact of In Utero Supplementation on Calf Growth






OR



Female Holstein Calves
(n=12/trt)




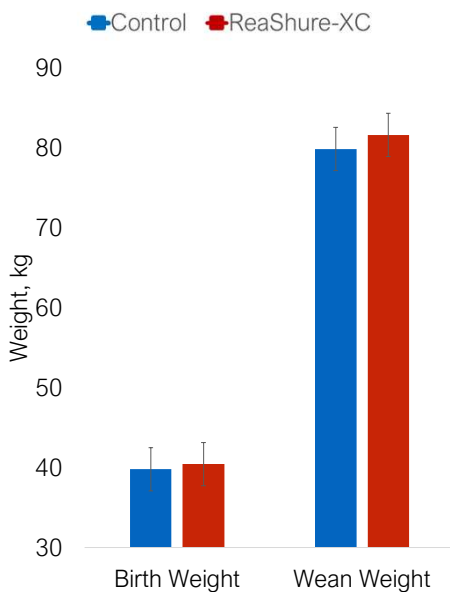
Male and Female Angus x Holstein Cross Calves
(n=12/trt)

Holdorf et al., ADSA, 2022


23

Impact of In Utero Supplementation on Calf Growth



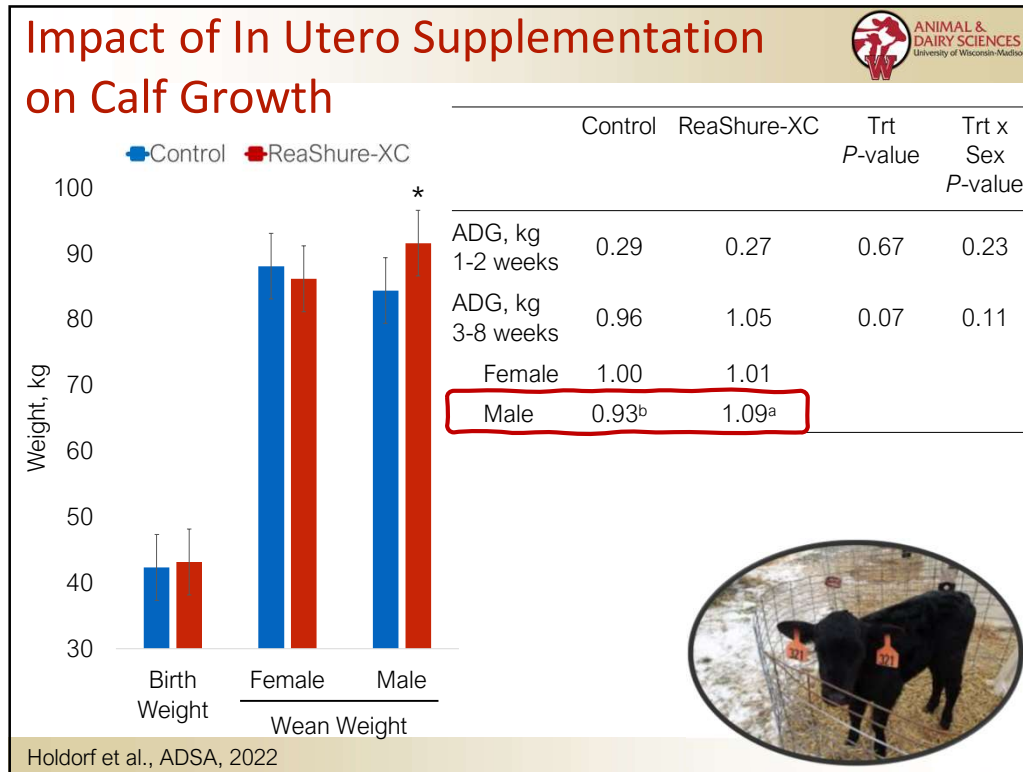


	Control	ReaShure-XC	P-value
ADG, kg 1-2 weeks	0.27	0.30	0.67
ADG, kg 3-8 weeks	0.88	0.92	0.43



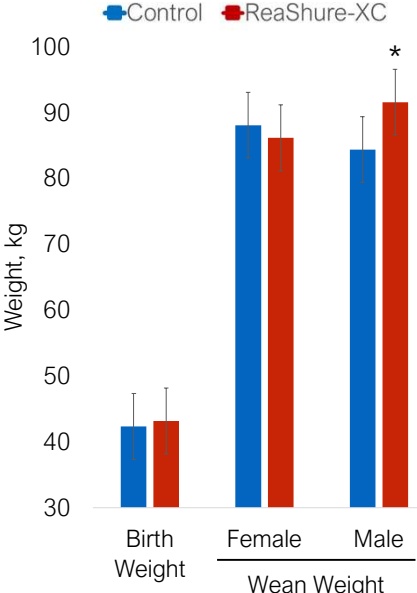

Holdorf et al., ADSA, 2022

24



25


A Long-Lasting Impact from Choline Supplementation

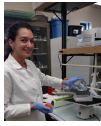
- Supplementing RP Choline during the transition period increases milk yield and energy-corrected milk yield
 - Postpartum production relative to prepartum intake, together with long-lasting effects, suggests changes in metabolism or nutrient use efficiency
- Mechanism of RP Choline action is through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

26


Acknowledgments




Current White Lab Group



Sophia Erb,
Research Specialist




Billy Brown,
Postdoc




Henry Holdorf


Collaborators:



Dr. Charlie Staples
Dr. Jose Santos
Dr. Marcos Zenobi




Malia Martin
(co-advised)



Faith Baier
(Co-advised)

Recent Contributors:





Tawny
Chandler

Valentina Caprarulo
Frankie Rathbun
Claira Seely
Kristina Weld
Qian Zhang

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27




Questions?

heather.white@wisc.edu





28