



1

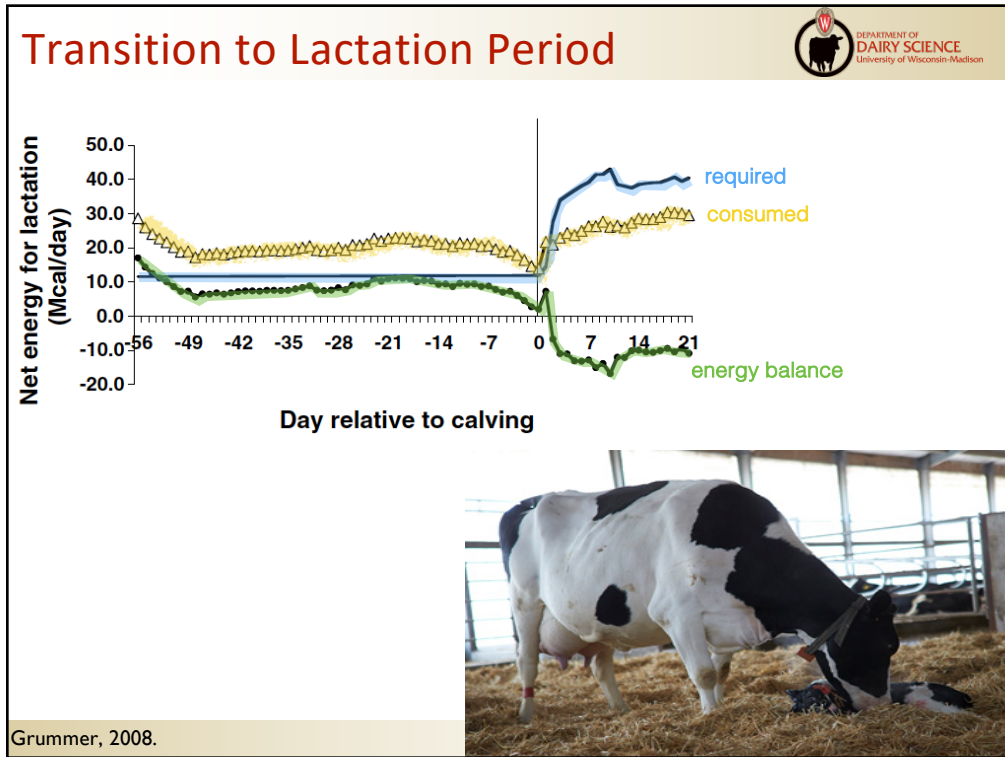


Real Science Lecture Series

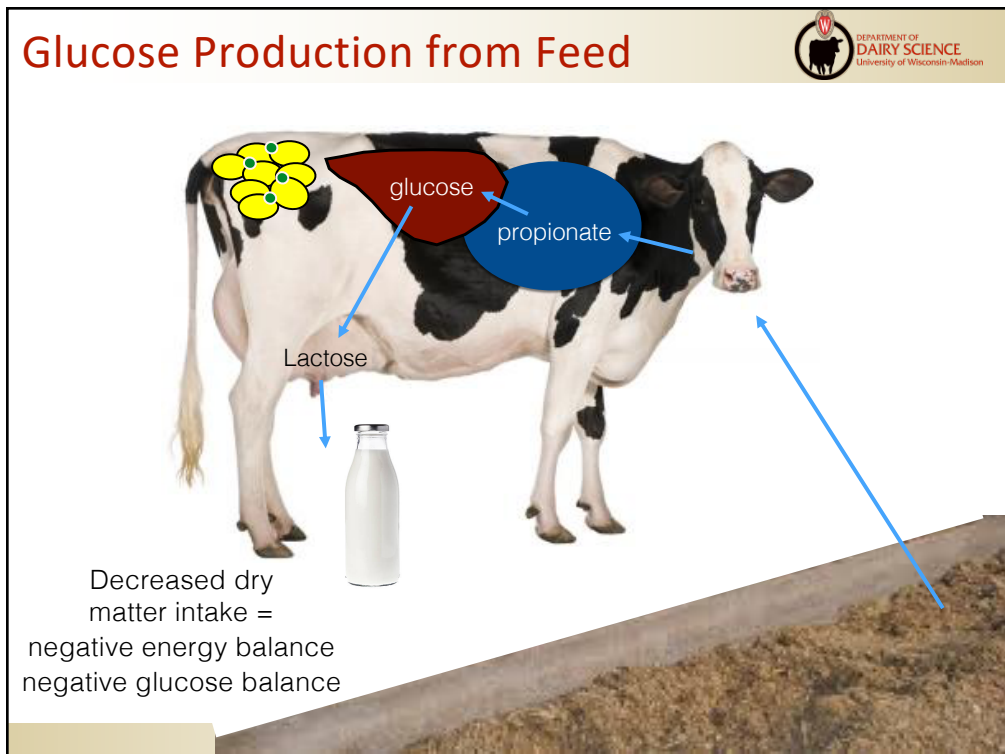
**Choline's Long-Lasting Impact on
Animal Health and Productivity**

Dr. Heather White
 Associate Professor, Department of Dairy Science
 Dairy Innovation Hub Faculty Director
 University of Wisconsin-Madison

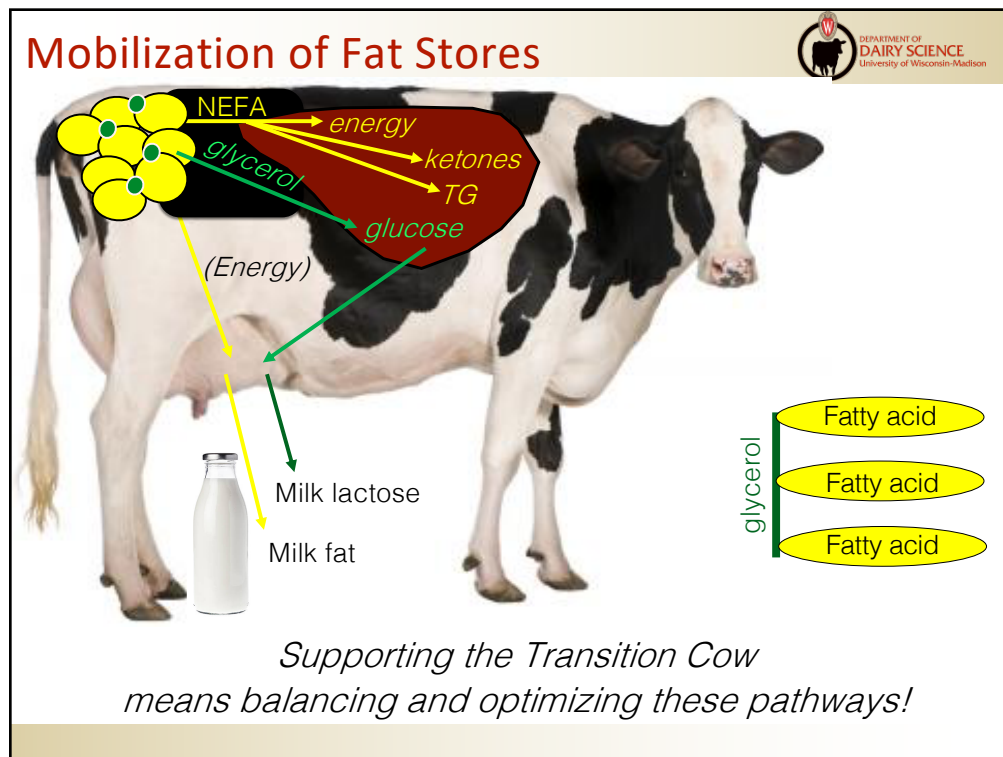
2



3



4



5

Choline as a Nutritional Intervention

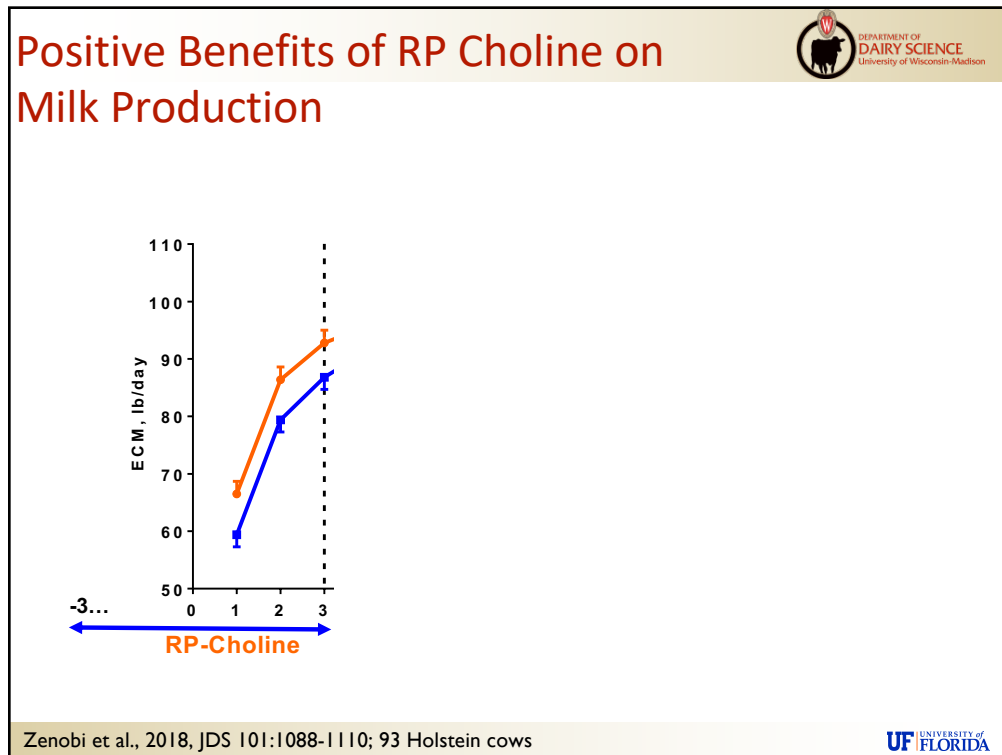
DEPARTMENT OF DAIRY SCIENCE
University of Wisconsin-Madison

Choline meta analysis of
21 transition cow studies;
66 treatment means; 1,313 cows

- Average supplementation was 12.9 g/d choline ion pre and postpartum
 - Milk yield: 1.6 kg/day
 - Energy-corrected milk: Increased 1.7 kg/day
 - Milk fat yield: Increased 0.07 kg/day
 - Milk protein yield: Increased 0.05 kg/day
 - DMI: Increased pre- and postpartum 0.2 and 0.5 kg/d
- No interactions between prepartum choline and Met, % MP or postpartum average choline (12.9 g/d choline ion) and Met, % MP

Arshad et al., 2020 JDS

6



7

Nutrition Can Propagate our Impact

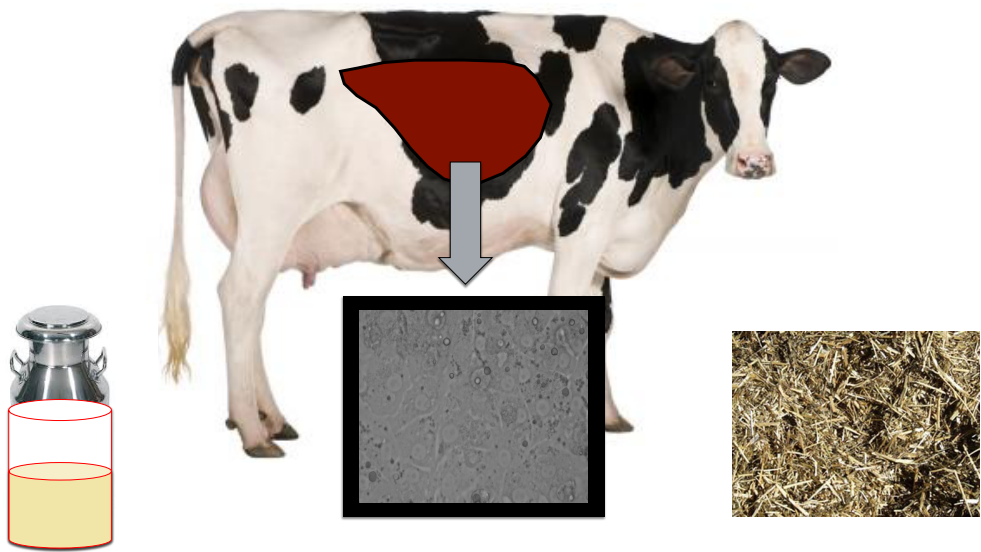
- The positive impact of rumen-protected choline supplementation is well documented
- There is evidence for sustained impact after RP Choline supplementation ceases
 - HOW?
 - Indirect benefits
 - Improved metabolic function
- Does supplementation of nutrients prepartum impact the calf?
 - In utero programming?
 - Colostrum?

8

*How is milk production increased during,
and AFTER,
supplementation of RP choline??*

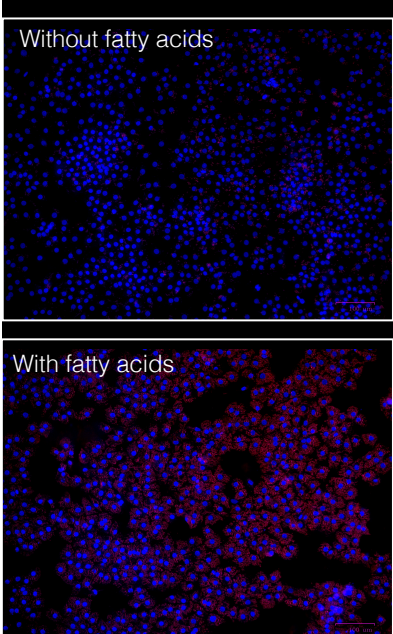
9

Black Box Nutrition



10

Cellular Lipids



Without fatty acids

With fatty acids

What's the value of the model?

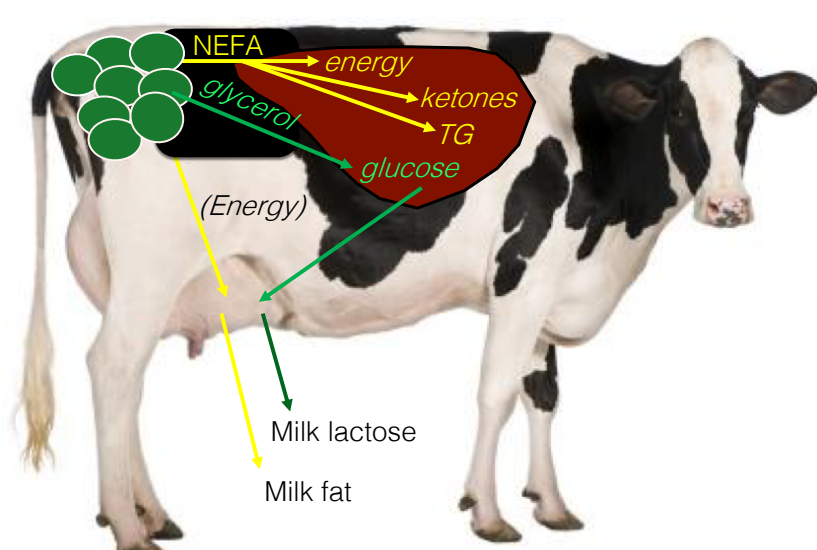
We can mimic the conditions the liver "sees" during the transition period while excluding other confounders and we can test multiple conditions at once

Ex. Mastitis, metritis, retained placenta, etc

11

11

Allows us to zoom in on specific pathways. . .



NEFA

energy

ketones

TG

glycerol

glucose

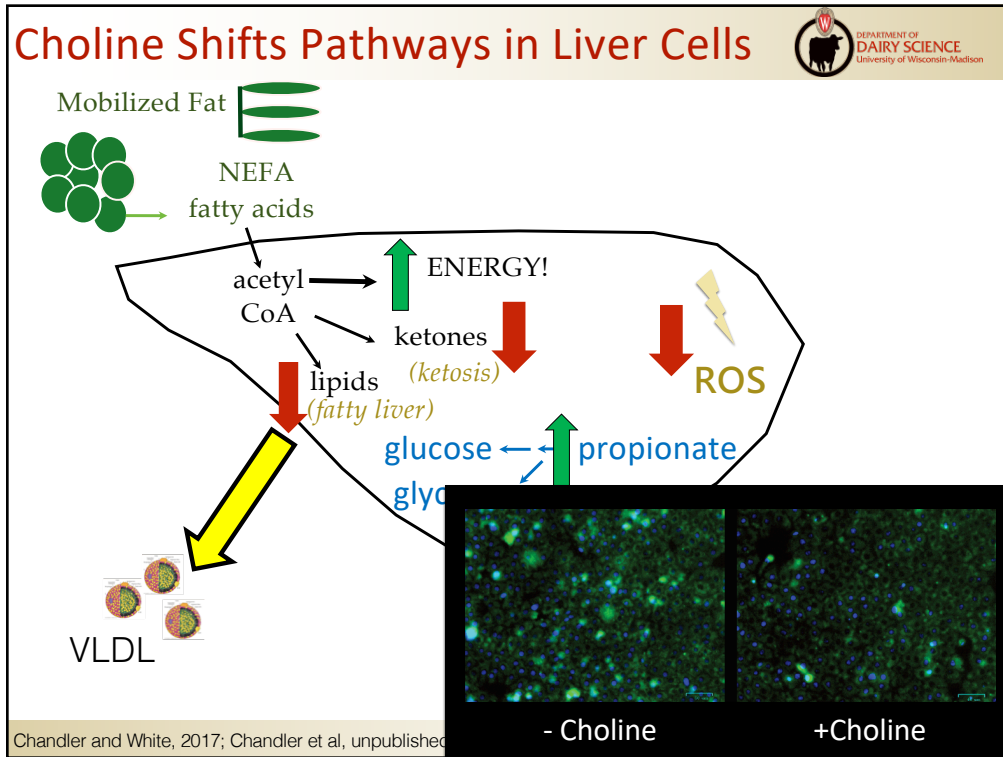
(Energy)

Milk lactose

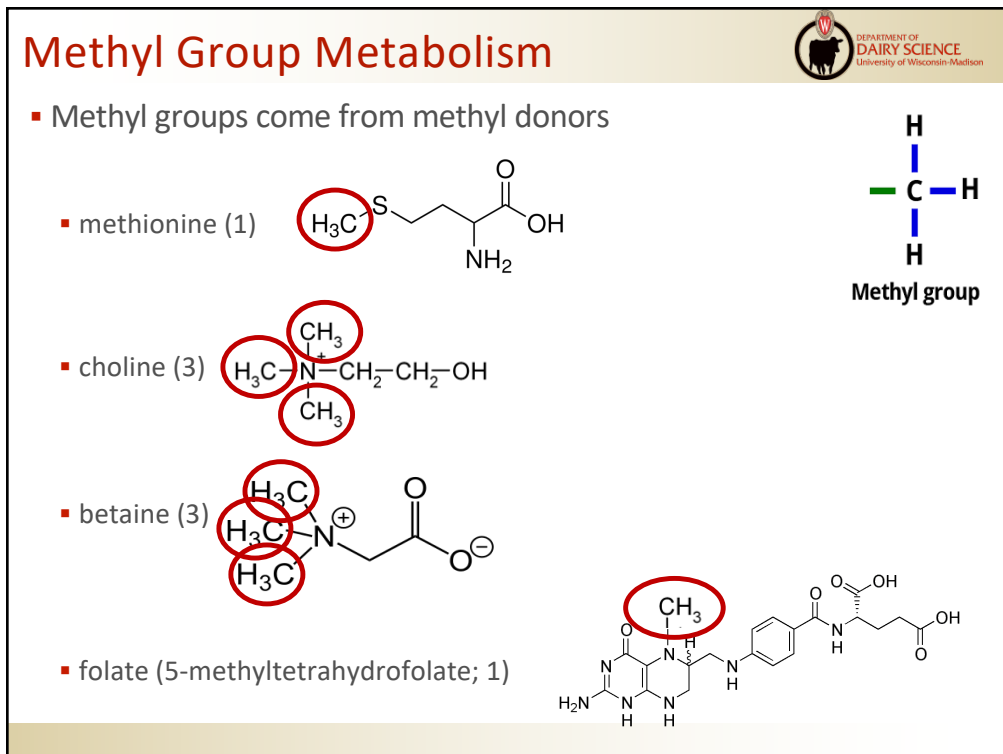
Milk fat

12

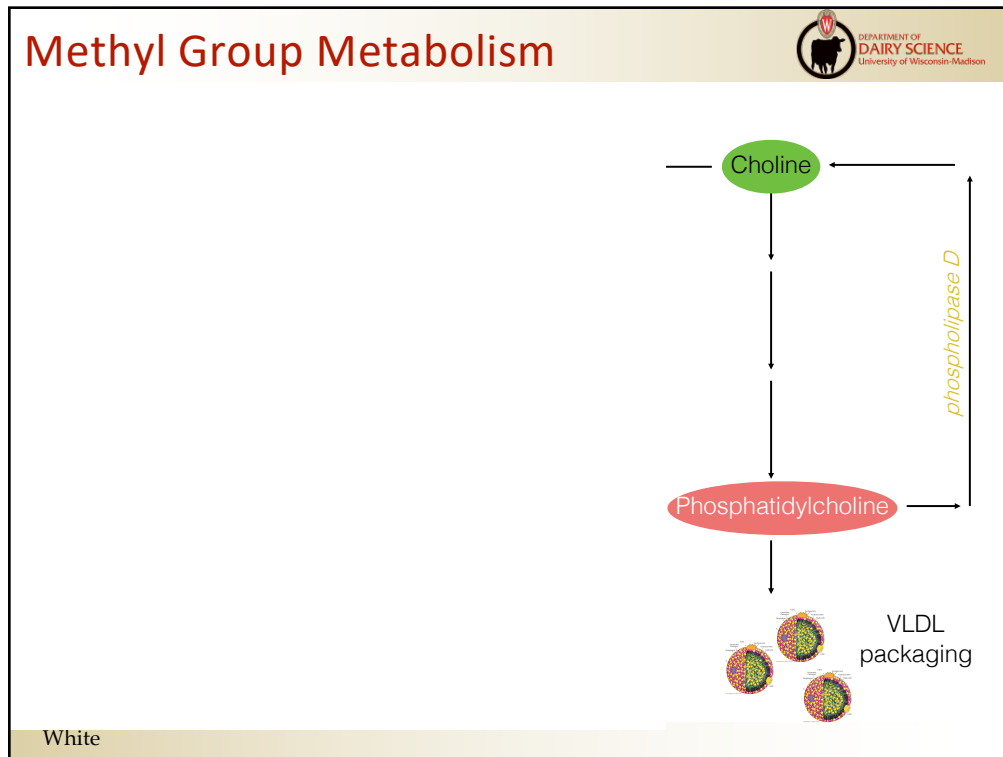
12



13



14



15

DEPARTMENT OF DAIRY SCIENCE
University of Wisconsin-Madison

Lack of methyl donors =
increased liver inflammation,
decreased liver oxidation,
and
decreased methylation of DNA
especially in offspring

16

Nutritional Programming

Animal studies have shown that a diet with too little methyl-donating choline or folate before or just after birth causes certain regions of the genome to be under-methylated for life.

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

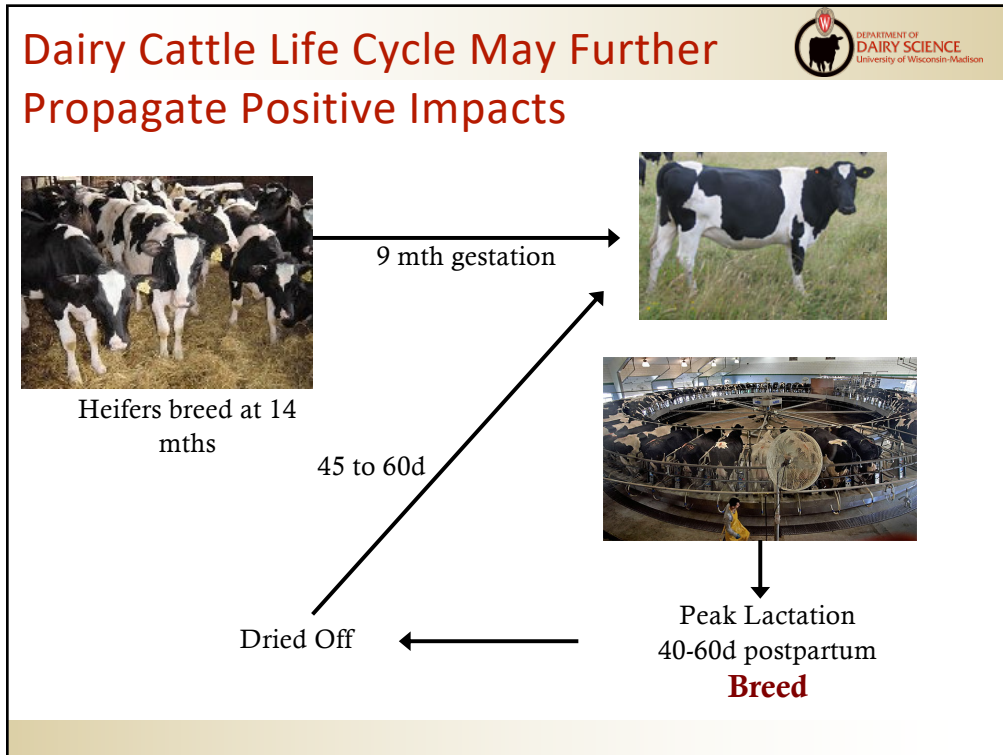
17

Nutritional Programming

Feeding particular nutrients to the mother during a critical period of fetal development can have immediate and long-term effects on the offspring.

<https://www.diet-health.info/en/100122/papers/6267/principles/nutritional-programming>

18



19

Choline supplementation of Liver Cells

DEPARTMENT OF DAIRY SCIENCE
University of Wisconsin-Madison


↑ Increased methyl group donation

↑ Methionine regeneration


What does this mean to the cow and her calf?

20

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



 DEPARTMENT OF DAIRY SCIENCE
 University of Wisconsin-Madison

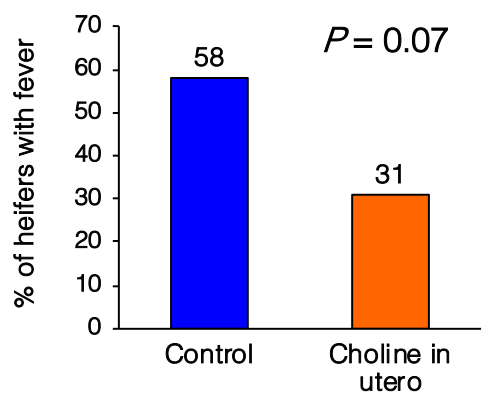
Birth to ~50 weeks of age by <u>heifers</u>		Birth to 5 weeks of age by <u>bulls</u> (given LPS)
2015	2017	2017
1.77 vs.	1.70 vs.	0.96 vs.
1.86 lb/d;	1.80 lb/day	1.23 lb/day
<i>P</i> = 0.06	<i>P</i> = 0.09	<i>P</i> = 0.06
n = 35	n = 46	n = 38



21

Growth of Calves born to Cows fed RP Choline Had Fewer Fevers



 DEPARTMENT OF DAIRY SCIENCE
 University of Wisconsin-Madison



Group	% of heifers with fever
Control	58
Choline in utero	31

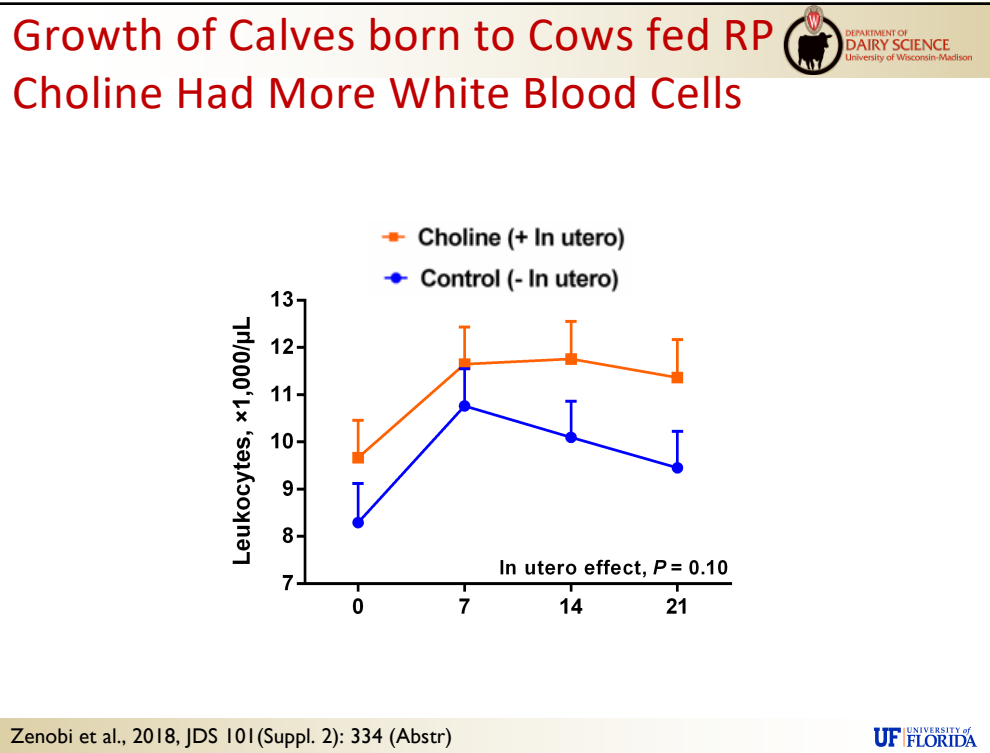
P = 0.07

Rectal temperatures measured daily.
Fever: >103.1°F.



Zenobi et al., 2018, JDS 101(Suppl. 2): 334 (Abstr)

22



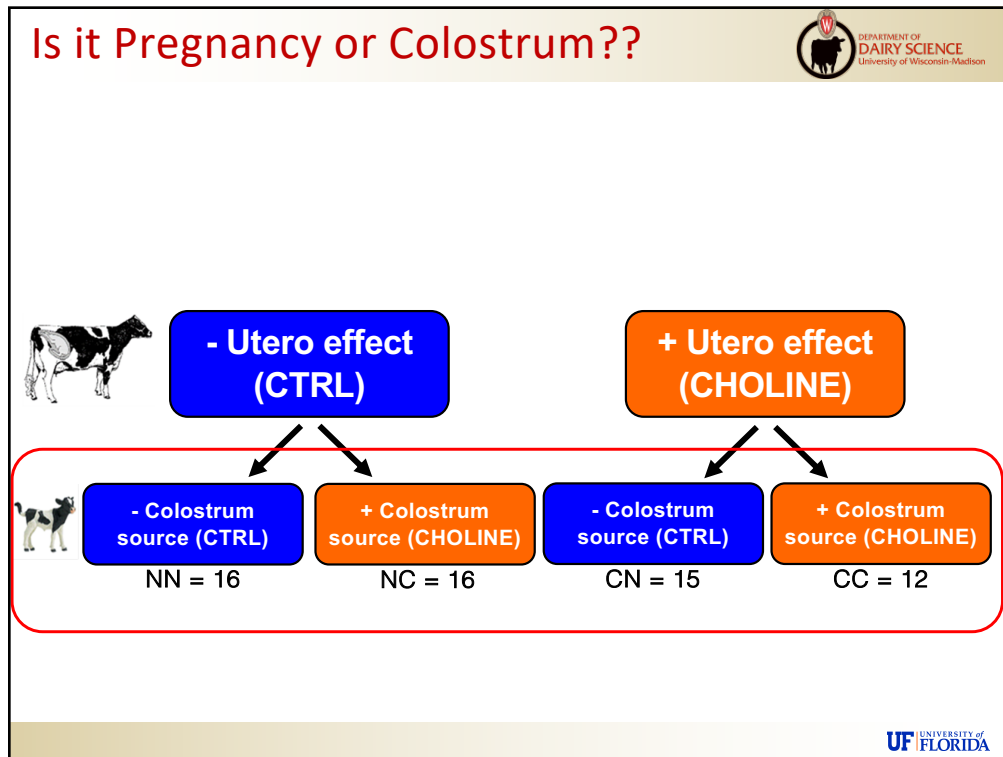
23

Choline supplementation at the end of gestation:

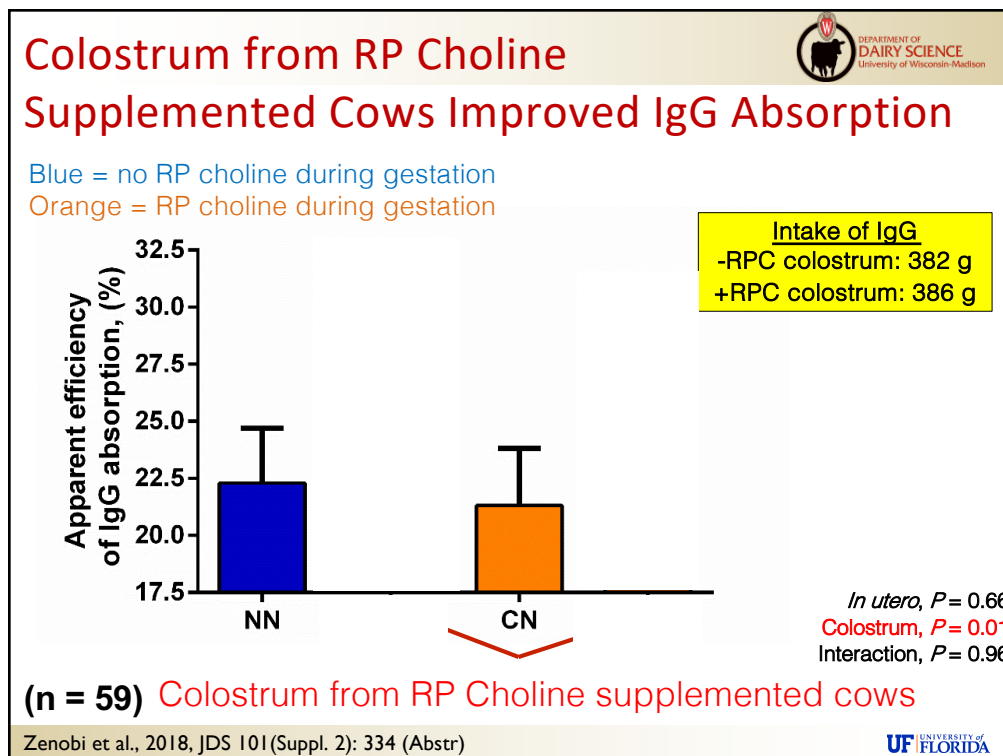
- ↑ Average Daily Gain
- ↑ Immune Maturation/Function
- ↑ Lung Development and Maturation

Is there an additional benefit from colostrum?

24



25



26

Nutrition Can Propagate our Impact



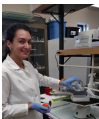
- The positive impact of rumen-protected choline supplementation is well documented
- There is evidence for sustained impact after RP Choline supplementation ceases
 - RP choline supports liver function (decreased lipid storage, ROS, and ketone production, increased glucose and energy production and provides methyl donors)
- Does supplementation of nutrients prepartum impact the calf?
 - RP choline supplementation prepartum increases ADG and improves immune function in calves
 - Colostrum from RP choline supplemented cows has improved IgG absorption in calves

27

Acknowledgments



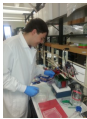
Current White Lab Group



Sophia Erb,
Research Specialist



Rafael Oliveira



Ryan Pralle



Kristina Weld



Henry Holdorf

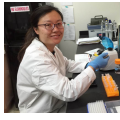


Claira Seely

Recent Contributors



Tawny Chandler



Qian Zhang
postdoc



Frankie Rathbun



Valentina Caprarulo

Collaborators:

UF UNIVERSITY of FLORIDA

Dr. Charlie Staples

Dr. Jose Santos

Dr. Marcos Zenobi

Dr. Ric Grummer, Emeritus Faculty
University of Wisconsin-Madison

BALCHEM
Real People. Real Science. Real Results.

Funding:

Balchem Corp.

USDA AFRI Foundation 2016-67015-24573

UW Foundation

28



Questions?

