

New Insights from University of Wisconsin Transition Cow Research

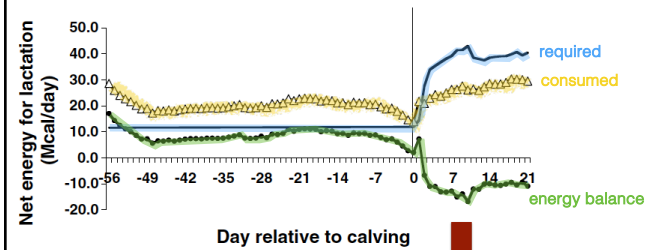
Dr. Heather White

University of Wisconsin-Madison
 Professor, Nutritional Physiology
 Faculty Director, Dairy Innovation Hub



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Peripartum Challenges and Opportunities



Grummer, 2008

Nutrients that
 modulate these
 pathways can be
 beneficial.

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Nutrition Can Propagate our Impact



- Impact of RP Choline supplementation on lactation performance
- How does RP Choline impact the transition period?
- Impact of supplementing cows with RP Choline on offspring growth and health

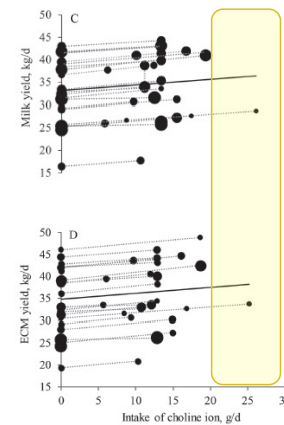
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Choline as a Nutritional Intervention



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



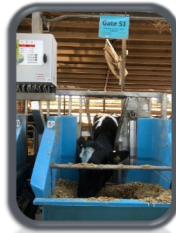
Arshad et al, 2020

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Prepartum RPC Dose



- Multiparous cows (n=116) enrolled 21 days prior to calving and fed in electronic feeding gates
- Treatment additives were balanced for non-choline nutrients and amount, and mixed into the TMR



- **Control:** no RPC
- **RPC1_{RD}:** recommended dose (15 g choline ion; ReaShure, Balchem, Corp)
- **RPC2_{RD}:** recommended dose (15 g choline ion; ReaShure XC, Balchem, Corp)
- **RPC2_{HD}:** high dose (22 g choline ion; ReaShure XC, Balchem, Corp)

Prepartum:
Individual Cow DMI
Increasing prepartum RPC

Holdorf et al., 2023, JDS

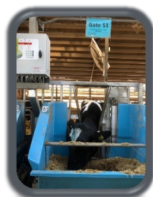
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Prepartum RPC Dose



Pre > Post

- Control > **Control**
- RPC1_{RD} > **RPC1_{RD}**
- RPC2_{RD} > **RPC2_{RD}**
- RPC2_{HD} > **RPC2_{RD}**

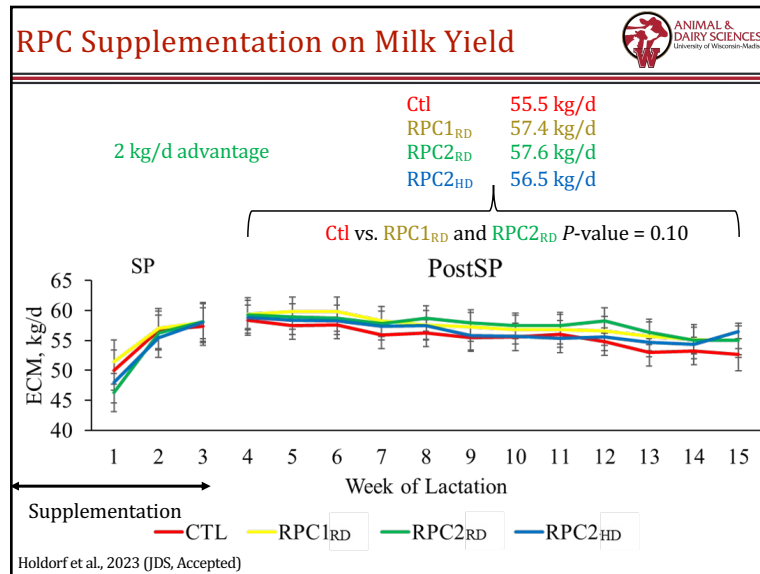


Prepartum:
Individual Cow DMI
Increasing prepartum RPC

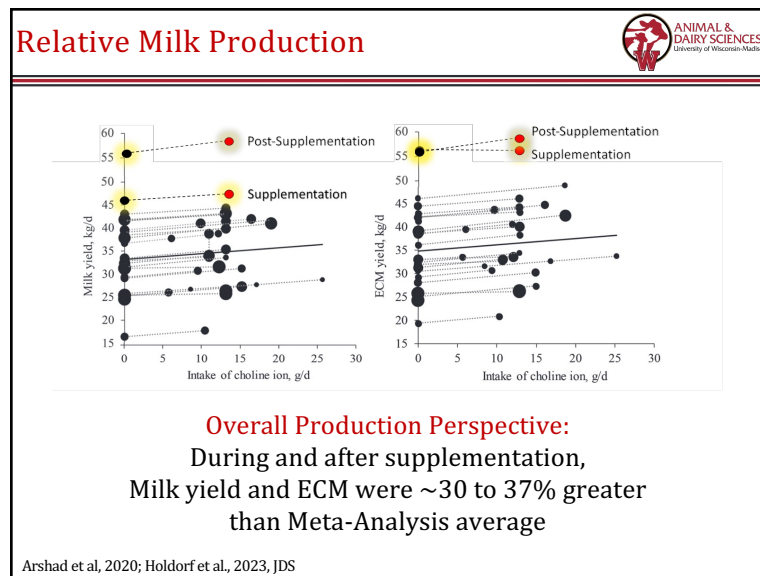
Postpartum (1 to ~21 DRTC):
Pens of 8, **RD of treatments maintained**
Lactating (~21 DRTC to 100 DRTC):
Mixed pens of 16, common diet

Holdorf et al., 2023 (JDS, Accepted)

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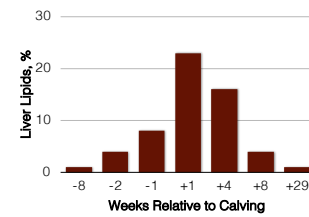


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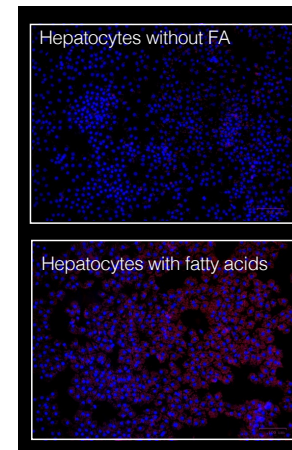
What is the mechanism of choline's effects during, and AFTER, supplementation of RP choline??

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Fatty Liver and Cellular Lipids

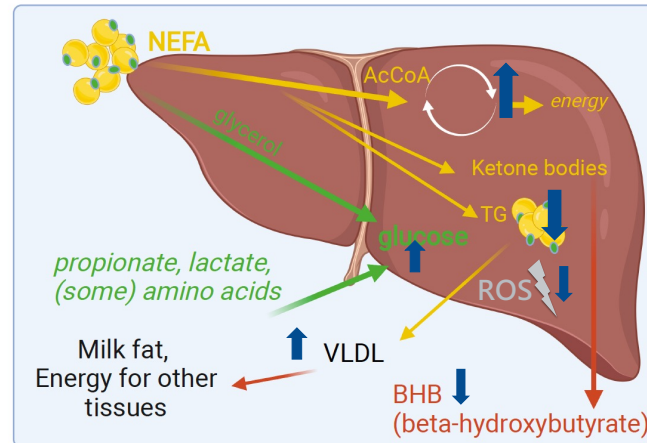


Zenobi et al, 2018



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Choline Shifts Nutrient Use



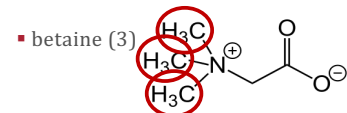
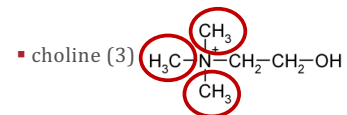
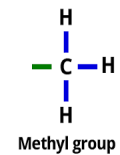
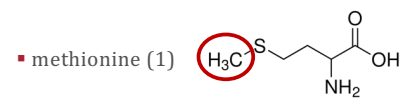
Chandler and White, 2017; Chandler et al, 2020

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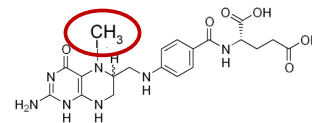
Methyl Group Metabolism



- Methyl groups come from methyl donors




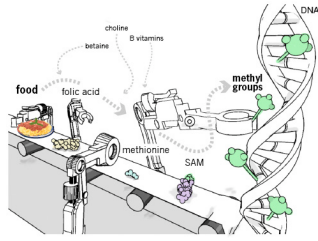
- folate (5-methyltetrahydrofolate; 1)



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Across species, a lack of methyl donors
=
increased liver inflammation,
decreased liver oxidation, and
decreased DNA methylation

What does this mean to the calf in utero?

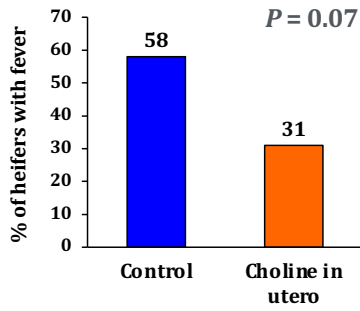
<http://learn.genetics.utah.edu/content/epigenetics/nutrition/>

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Performance of Choline Calves

↑ ADG increased ~0.05 kg/d heifer & ~.11 kg/d bull calves exposed to choline in utero



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

$P = 0.07$

↑ Immune Maturation & Function

↑ Lung Development & Maturation

Rectal temperatures measured daily.
Fever: >103.1°F; >39.5°C

UF | IFAS Research
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Maternal RPC and Calf Growth



Recommended doses of **RPC1** and **RPC2** increased colostrum yield **1** and **2** kg, respectively



**in this study, we fed all calves the same amount of colostrum*

	Ctl	RPC1 _{RD}	RPC2 _{RD}	RPC2 _{HD}	P-value
Colostrum Yield, kg	3.4	4.4	5.4	4.2	0.04 <i>Ctl vs RD</i>
Colostrum Quality, brix %	25.7 ^{ab}	24.4 ^b	24.8 ^{ab}	26.7 ^a	0.08 Trt

Holdorf et al., 2023, JDS

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Maternal RPC and Calf Growth



OR



Female Holstein Calves



Male and Female Angus x Holstein Cross Calves

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Maternal RPC and Calf Growth



	Ctl	RPC1 _{RD}	RPC2 _{RD}	RPC2 _{HD}	P-value
Birth Weight, kg	39.8	39.4	40.5	39.3	
1 to 2 week					
ADG, kg	0.2	0.3	0.2	0.3	<i>0.08</i> <i>Ctl vs RPC2_{HD}</i>
3 to 8 weeks					
ADG, kg	0.9	0.8	0.9	0.8	



Holdorf et al., 2023, JDS

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*Challenges happen
on farm,
even during research studies...*

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Maternal RPC and Calf Health



- There was no evidence for an effect of treatment ($P \geq 0.12$) on bloat, respiratory, or fecal score
- No interaction of maternal trt x bloat on ADG

Holdorf et al., 2023, JDS

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Maternal RPC and Calf Growth




	Ctl	RPC1 _{RD}	RPC2 _{RD}	RPC2 _{HD}	P-value
Birth Weight, kg					
Female	38.8	41.8	38.5	42.0	
Male	45.5	45.4	47.3	44.1	
1 to 2 week					
ADG, kg	0.3	0.3	0.3	0.2	
3 to 8 weeks					
ADG, kg					<i>0.01 trt x time</i>
Female	1.0	0.9	1.0	1.0	<i>0.08 Ctl vs RPC2_{HD}</i>
Male	1.0 ^b	1.0 ^{ab}	1.1 ^{ab}	1.2 ^b	



Holdorf et al., 2023 (JDS, Accepted)

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**Was DNA methylation increased
with in utero choline exposure?**

**Yes . . .
in male Holstein x Angus calves**

**But . . .
There are also differences in
energy, growth, and gut
integrity markers**

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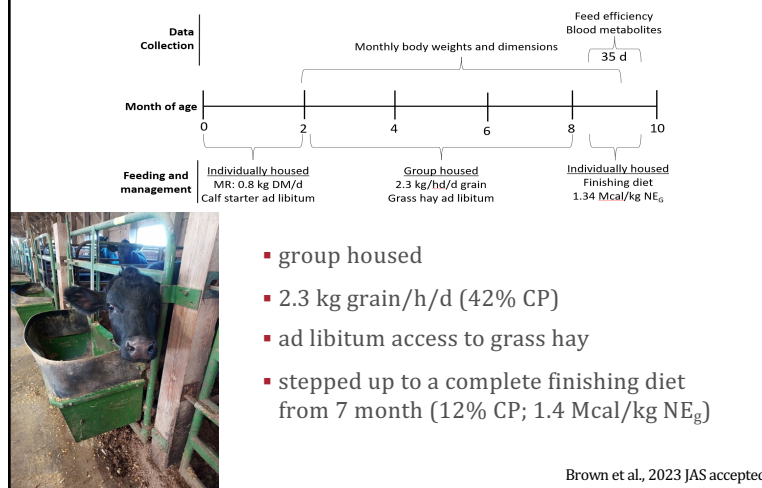
We didn't stop there, because:

1. baseline data is important
2. sometimes you do things that are motivated by the desire to bring things full circle



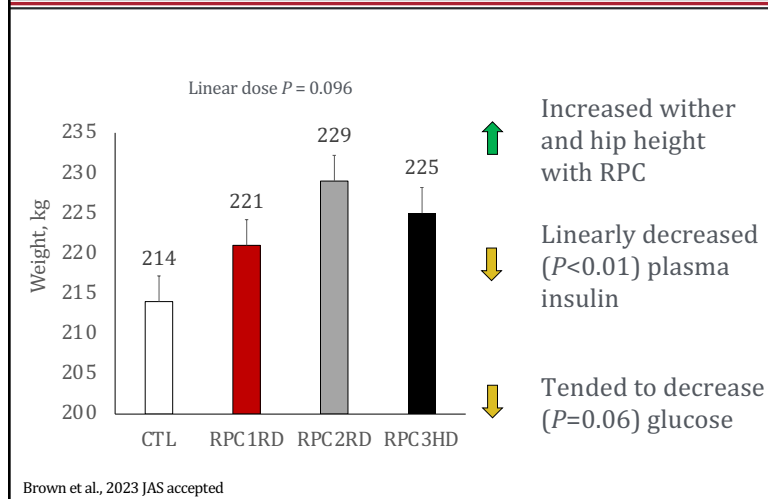
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Maternal RPC and Beef x Dairy Calves



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Beef x Dairy Calves: 2 to 9 months

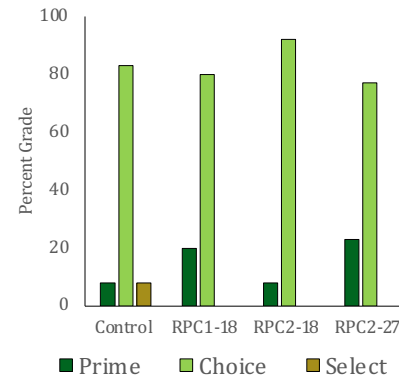


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Beef x Dairy Calves at finish



- Finish live weights (sex $P < 0.001$) at 16 months
 - Male: 700 kg
 - Female: 640 kg



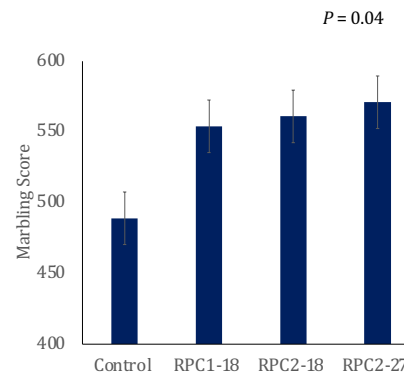
Brown et al., 2023 JAS accepted

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Beef x Dairy Calves at finish



- Finish live weights (sex $P < 0.001$) at 16 months
 - Male: 700 kg
 - Female: 640 kg



Brown et al., 2023 JAS accepted

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Long-Lasting Impact from Choline



- Strategic nutritional interventions during the transition period can have long-term impacts on cow and calf
- Mechanism of RP Choline action is through improved liver function
- Supplementing RP Choline during the transition period tended to increase energy-corrected milk yield even at higher production levels
 - Postpartum production relative to prepartum intake, together with long-lasting effects, suggests changes in metabolism or nutrient use efficiency
- Supplementation of cows with RP Choline also improves calf growth, immune function, and metabolic health and supported carcass quality in beef x dairy calves
- Higher supplementation rates (higher than recommended dose) of RPC resulted in further benefits to calves, but not cows

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Overall Take-Home Messages




- **Consistent postpartum production benefits are observed**
 - Even in very high producing cows and with cows with high genetic merit for milk
 - Regardless of BCS
 - **How?** Shifts in metabolism and nutrient partitioning to support increased production and maintained or improved health
- **In utero programming provides added benefits to the calf**
 - Benefits on calf growth and health are observed with maternal choline supplementation
 - Improved feed efficiency to finish weight and improved marbling in Angus x Holstein
 - **How?** Increased colostrum yield, increased global methylation, and changes in calf metabolism


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Acknowledgments






Dr. Henry Holdorf
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


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Questions?

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