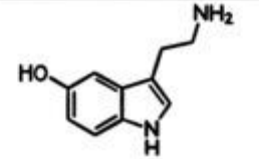
Department of Animal & Dairy Sciences
UNIVERSITY OF WISCONSIN–MADISON

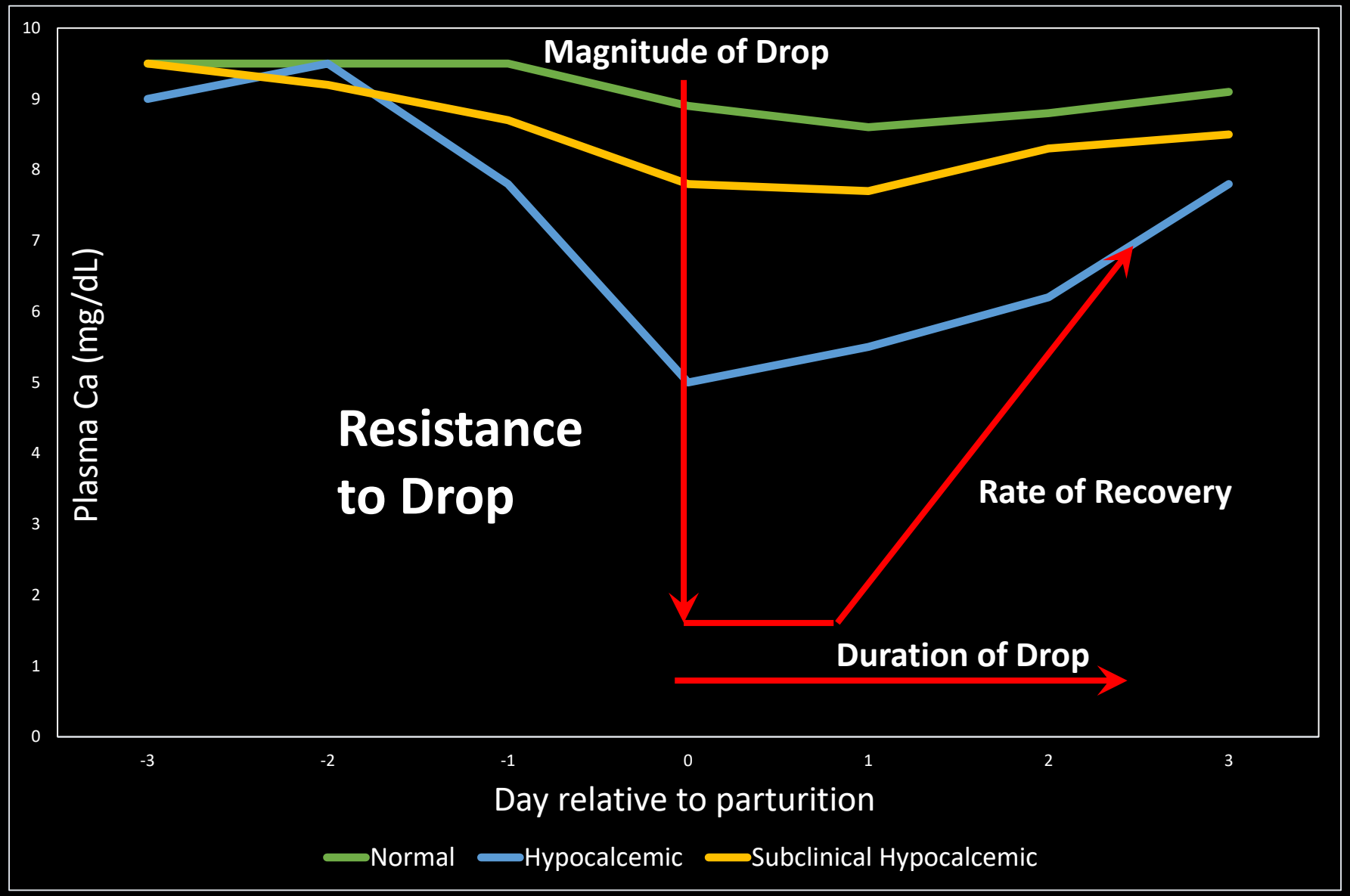
THE HERNANDEZ LAB



How do different methods of Ca manipulation control the physiology of parturition?

Laura L. Hernandez, Ph.D.
Professor
Department of Animal and Dairy Sciences

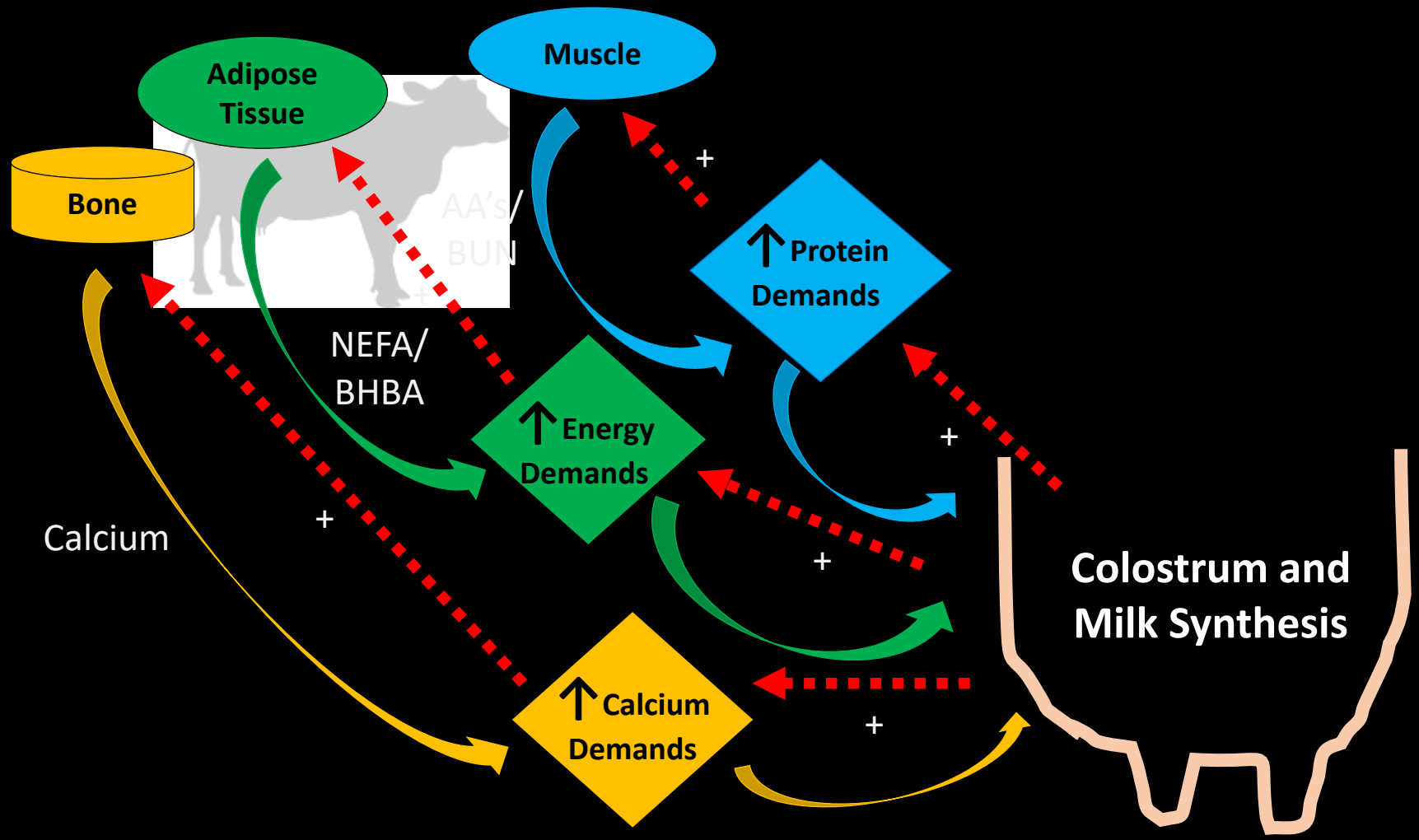
Calcium Status of Periparturient Dairy Cows based on Serum Calcium Concentrations



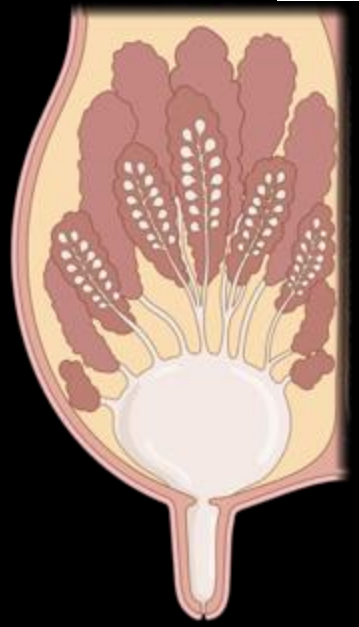
- Several factors contribute to regulating calcium homeostasis:
  - *Resistance to Drop*
  - *Magnitude of Drop*
  - *Duration of Drop*
  - *Rate of Recovery*

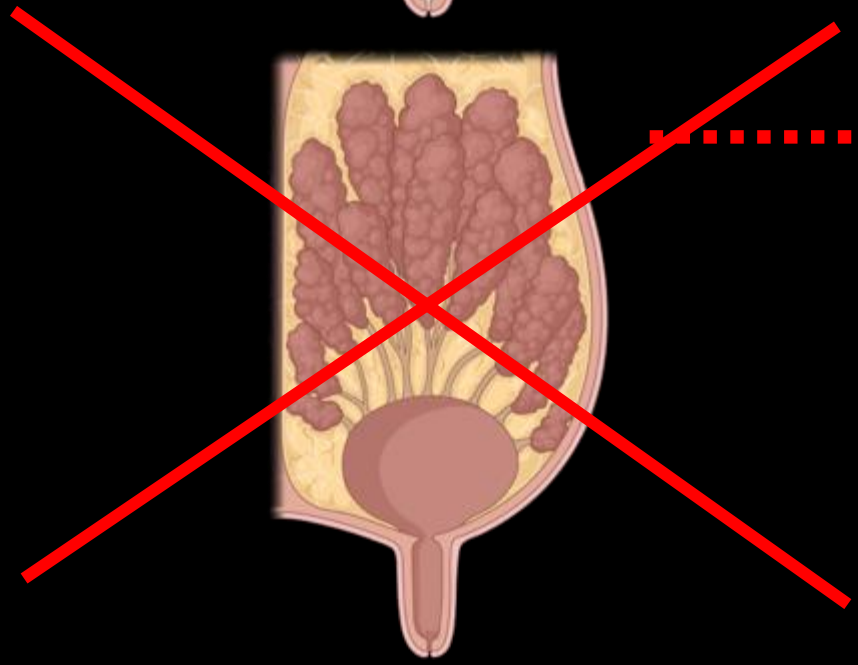
Adapted from Horst and Jorgensen, 1982

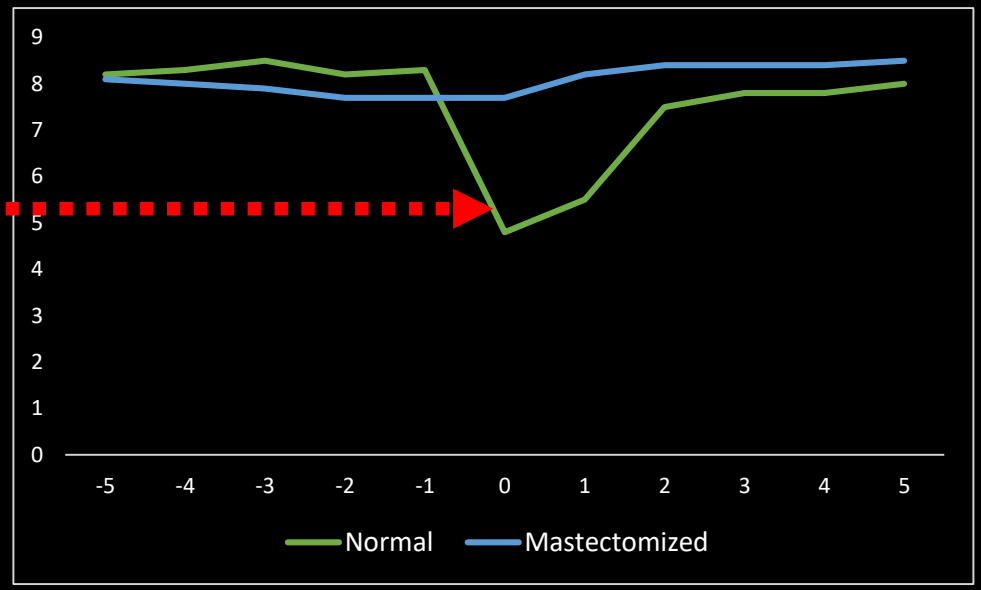
Mammary Gland's Control of Milk Synthesis

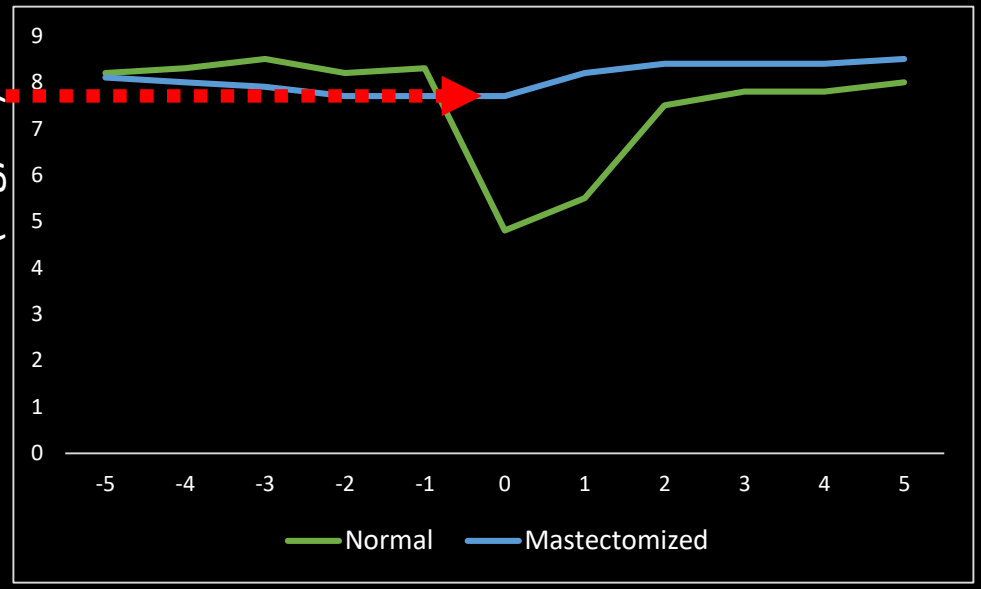


Milk synthesis controls calcium decline at parturition



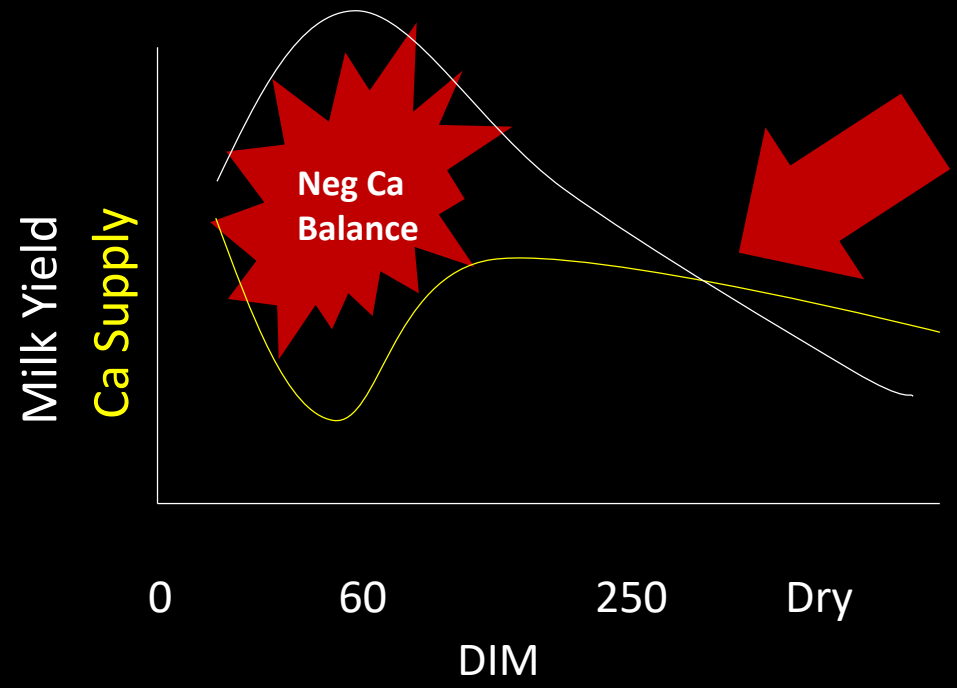






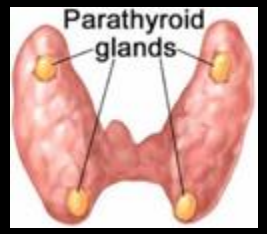
Goff et al., 2002

Skeletal Ca is required → 7.8 – 8.5 kg



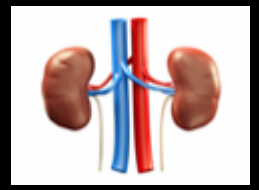
Dietary Ca solely meets fetal and maintenance requirements

Lactation



PTH

PTH



Increased Ca Resorption

PTH

Increased Ca Absorption

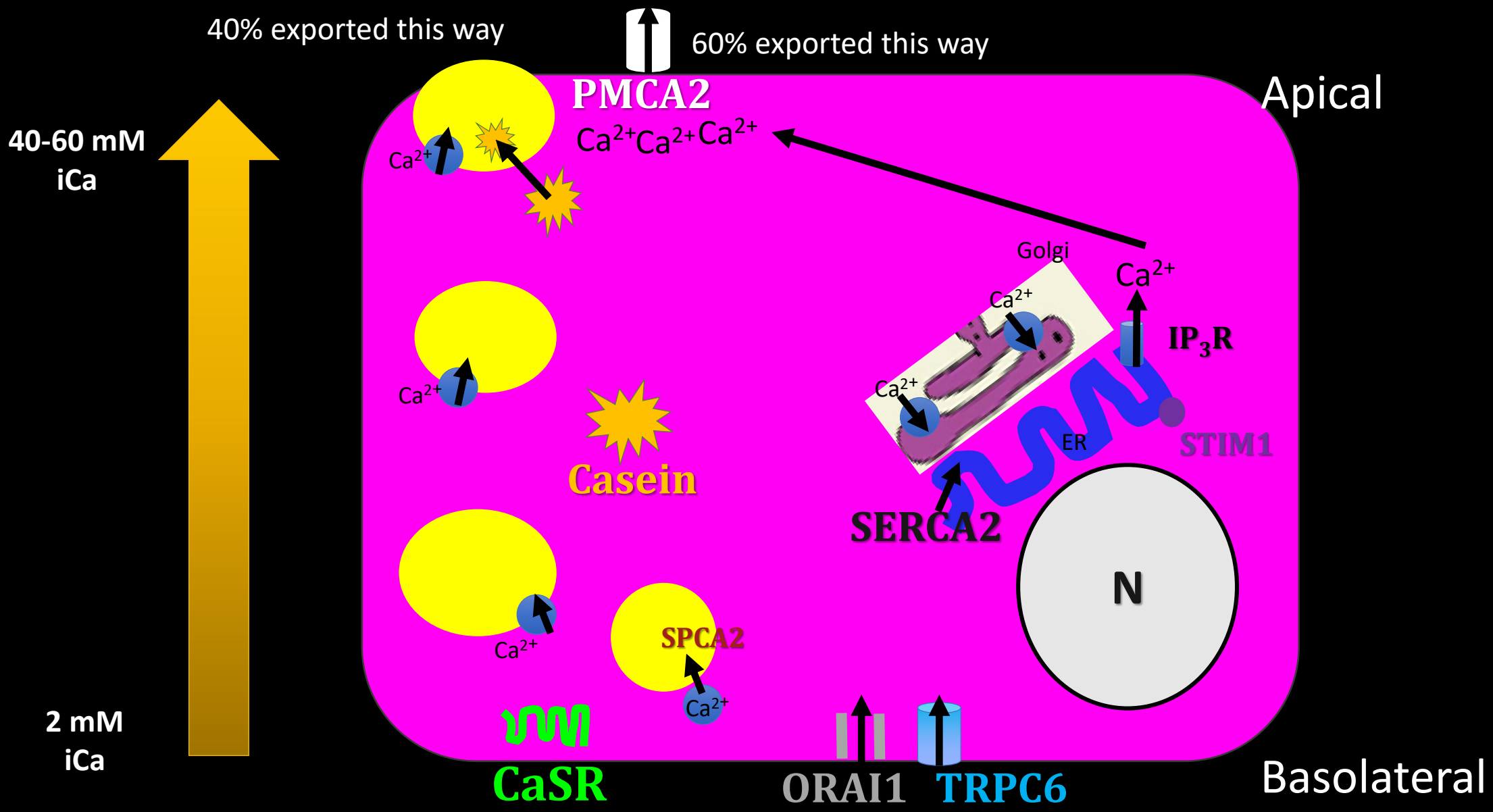
Vitamin D

Mammary Gland

PTHrP

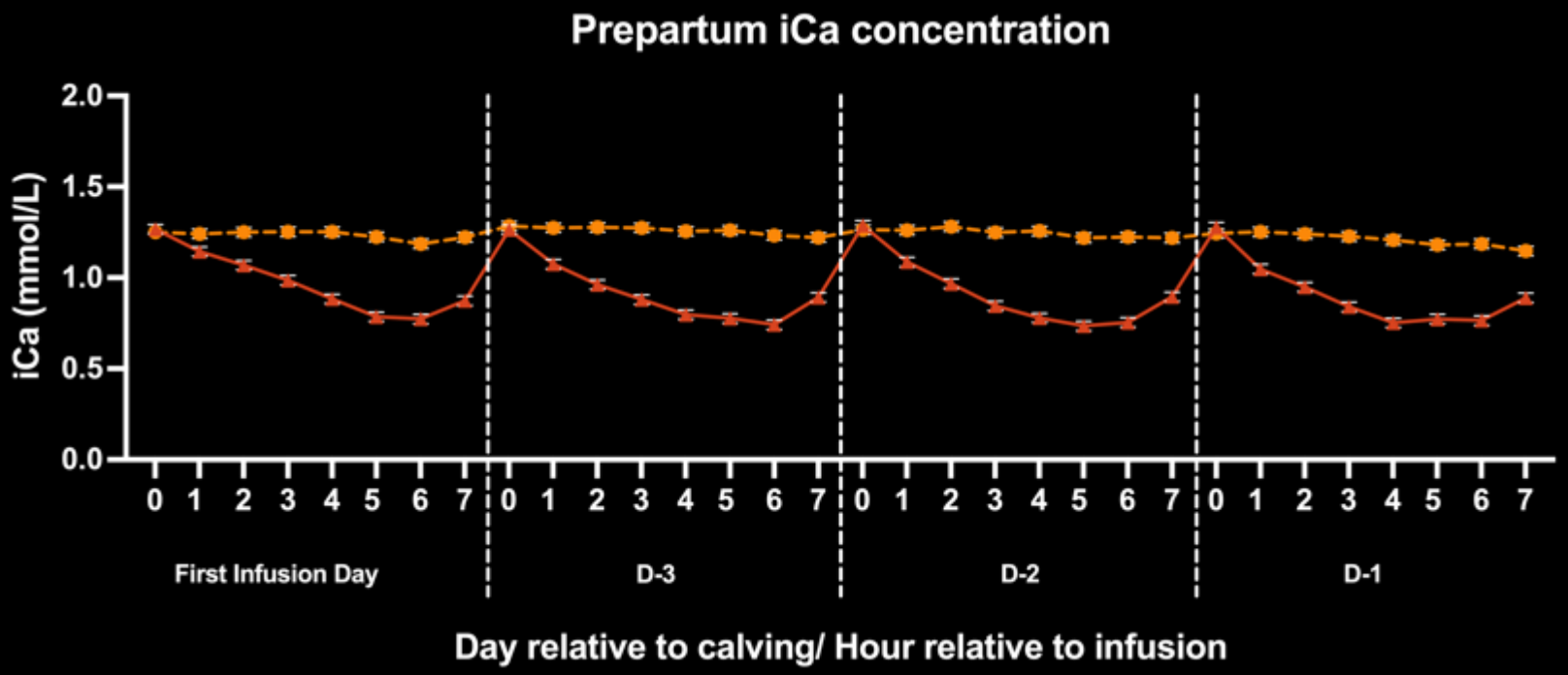
Increased Ca Resorption

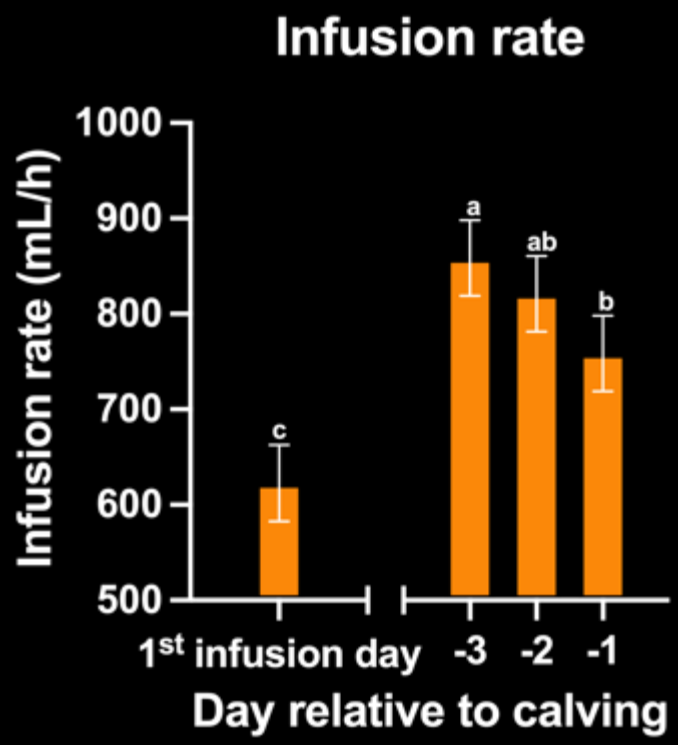
Mammary Epithelial Cell Ca^{2+} Dynamics During Lactation



Neville, 2005; Shennan, 2008; Cross et al., 2014

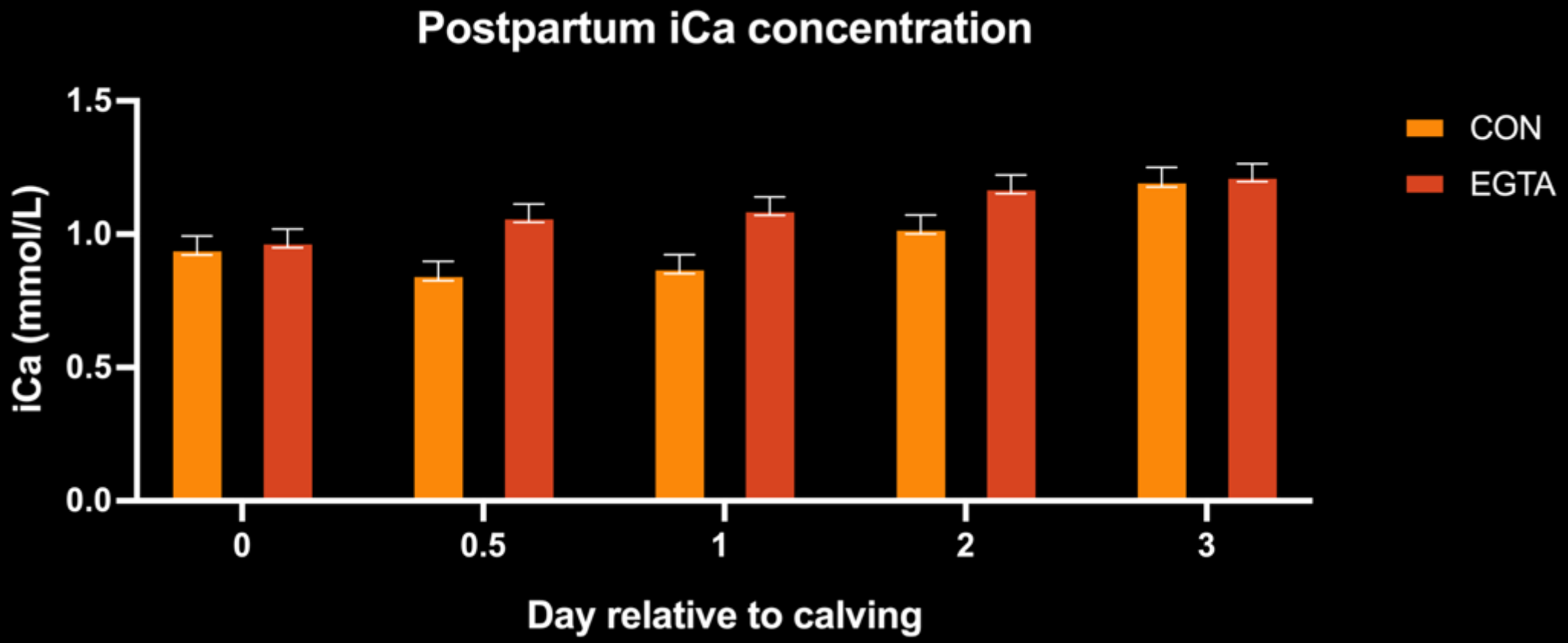
Calcium Chelation of Prepartum Cows





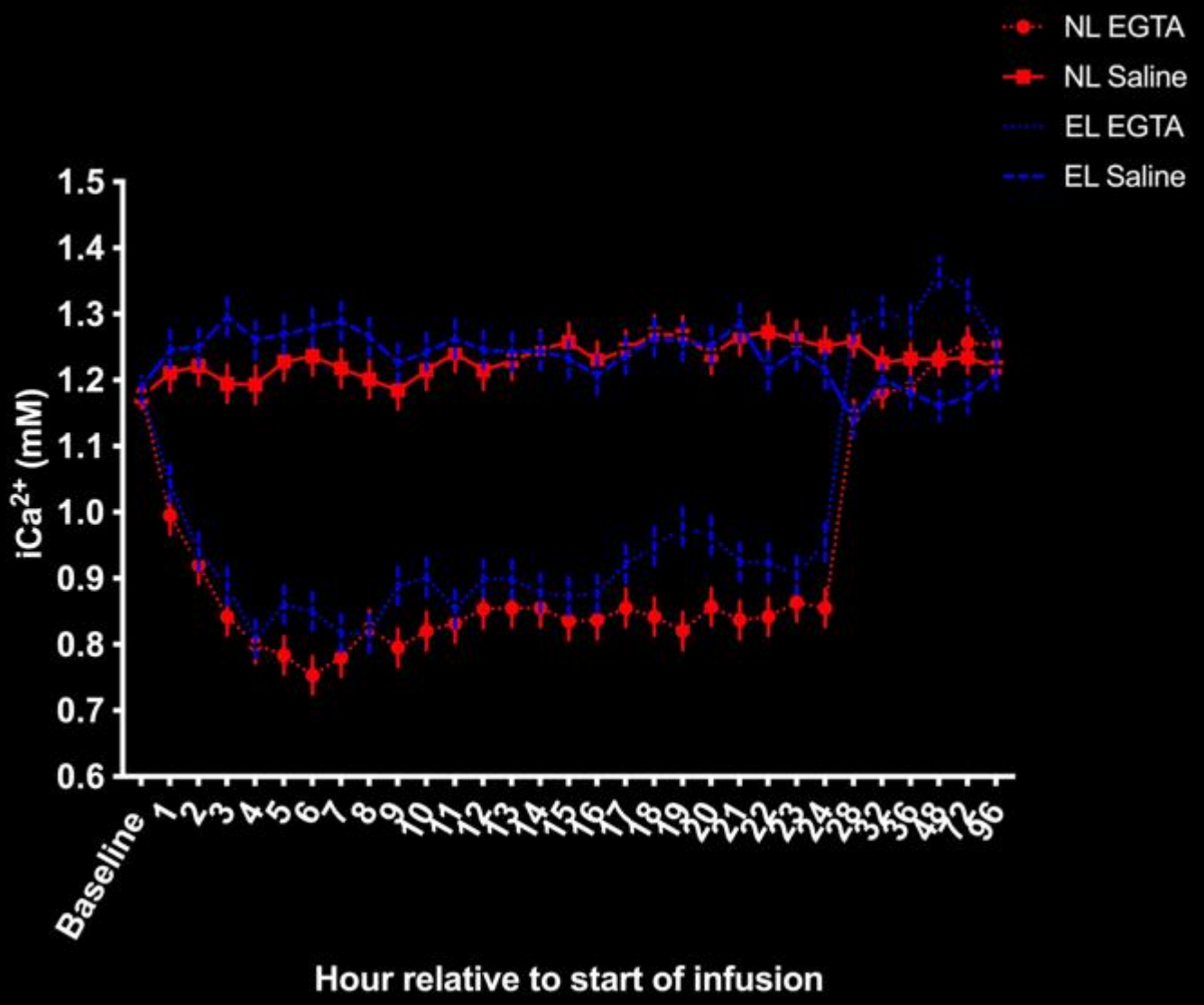
Frizzarini, unpublished results

EGTA decreased iCa concentration prepartum and increased it during postpartum



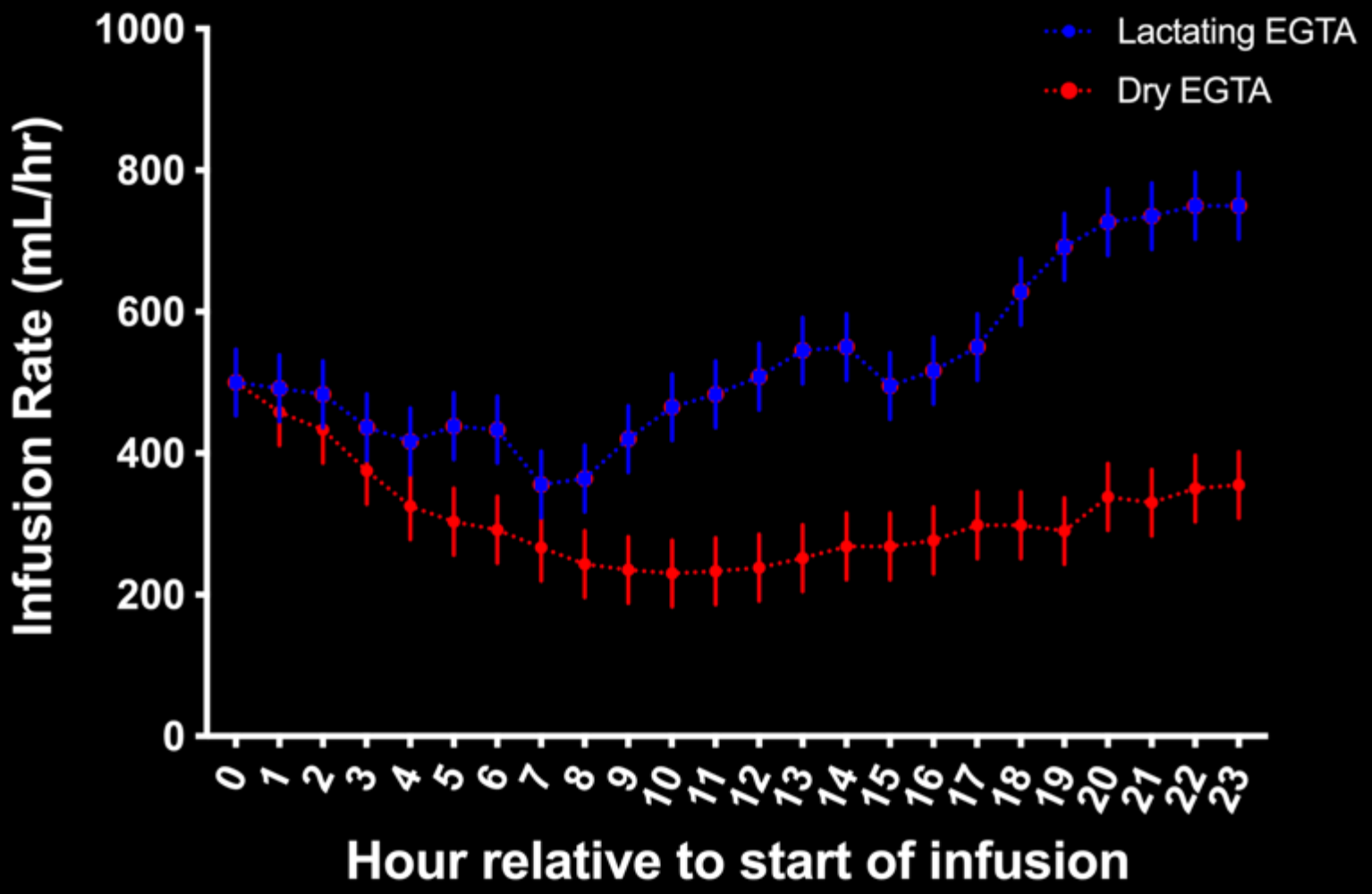
Frizzarini, unpublished results

Calcium Chelation of Early Lactation Cows

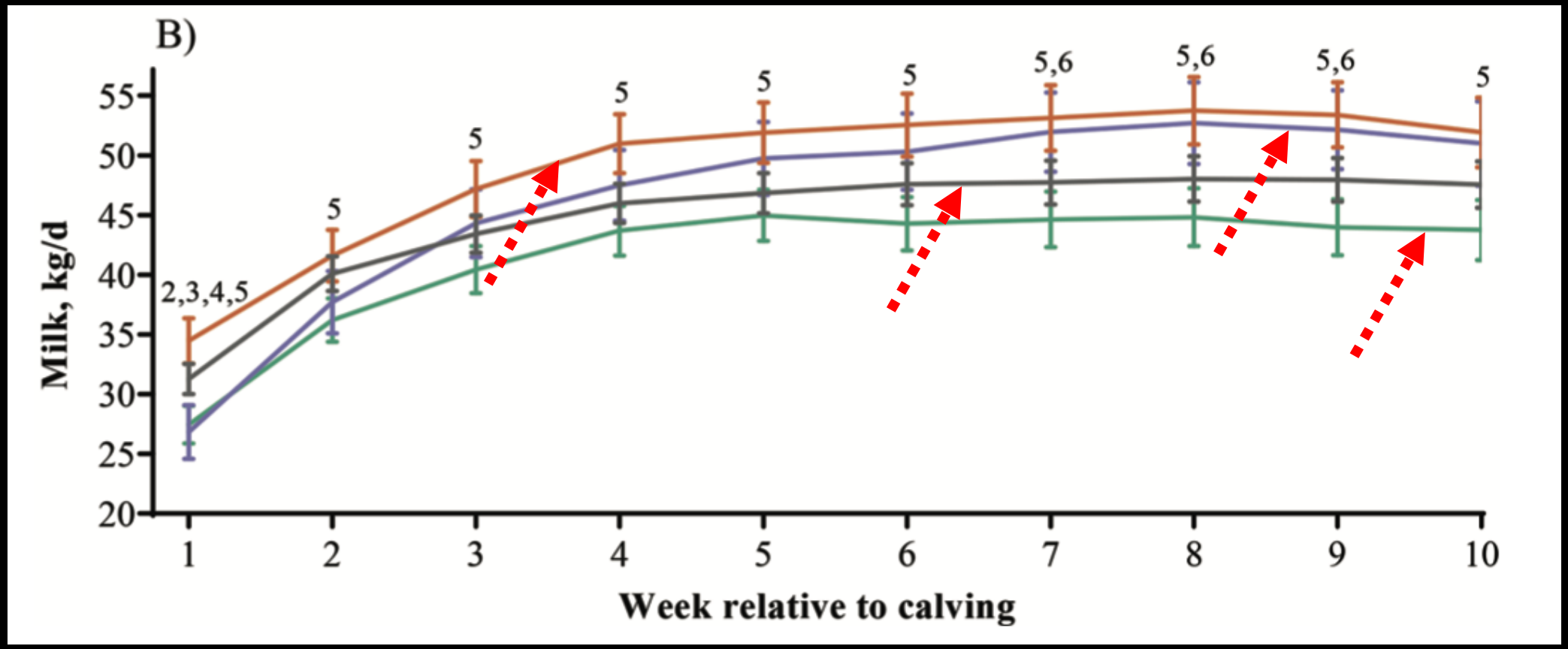


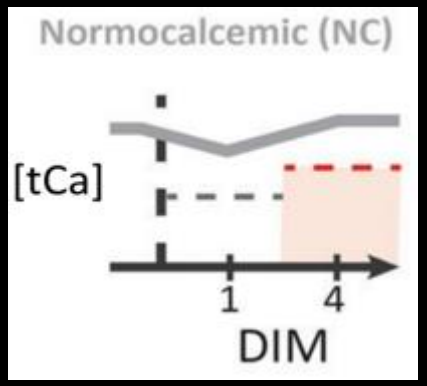
Connelly et al., 2021

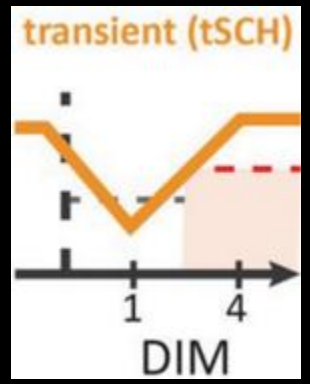
Calcium Chelation of Early Lactation Cows

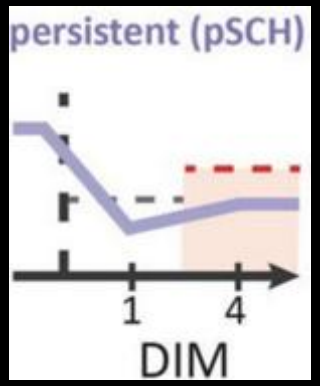


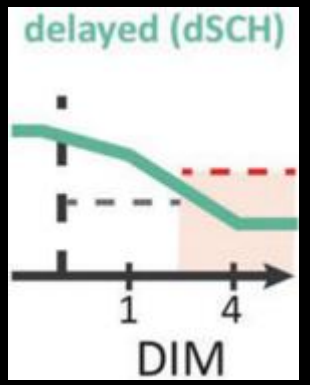
Connelly et al., 2021



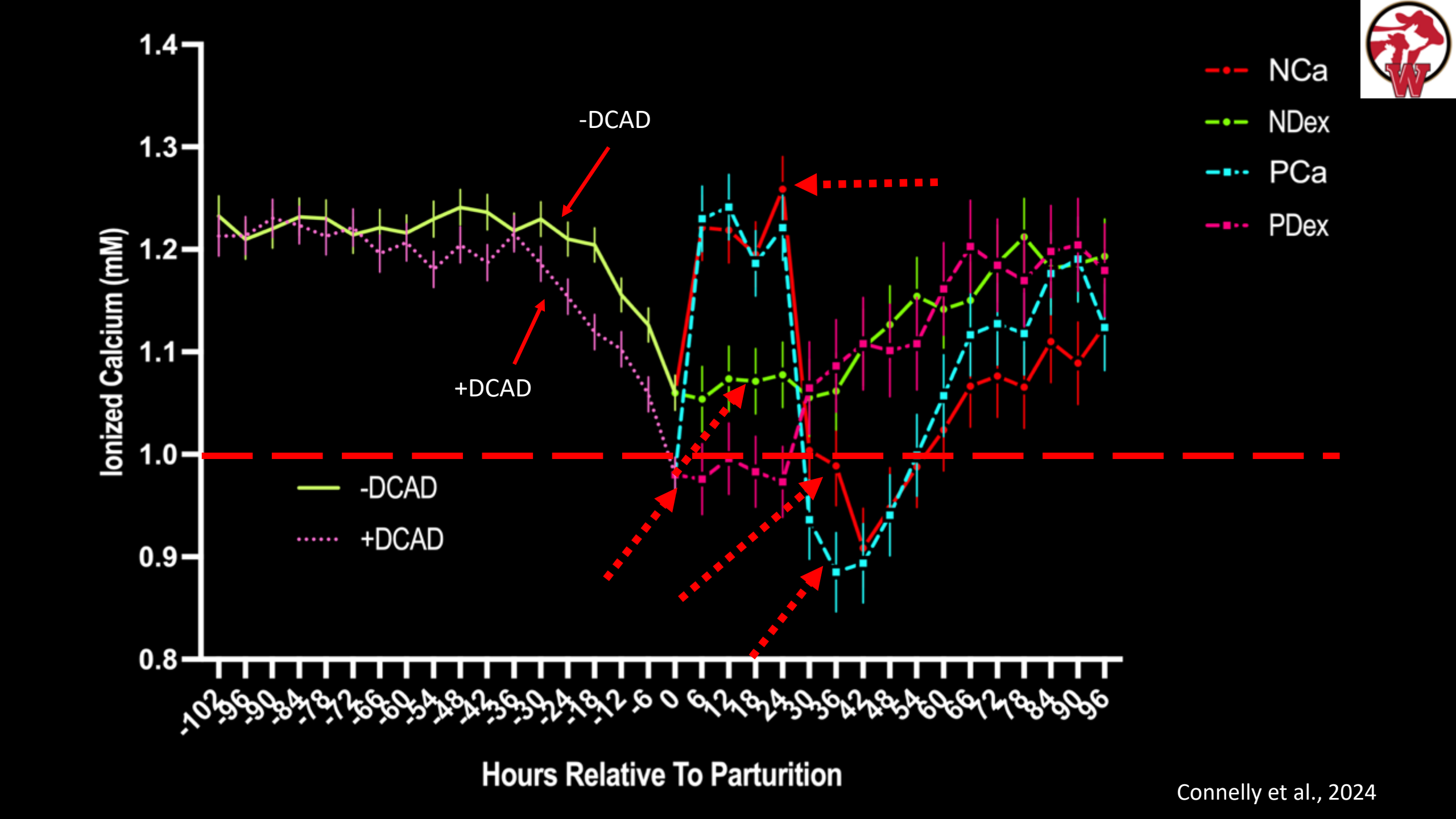






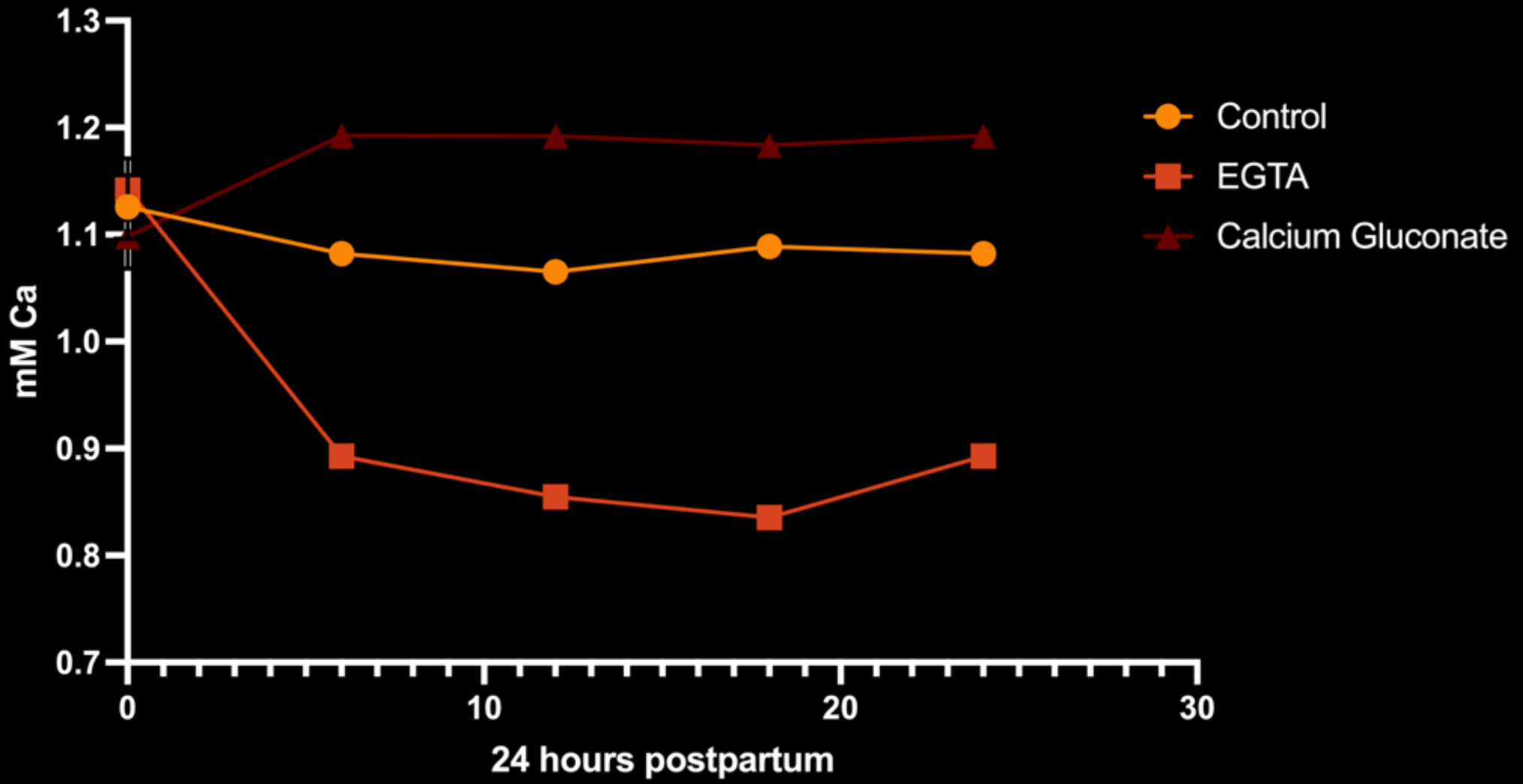


McArt and Neves, 2020



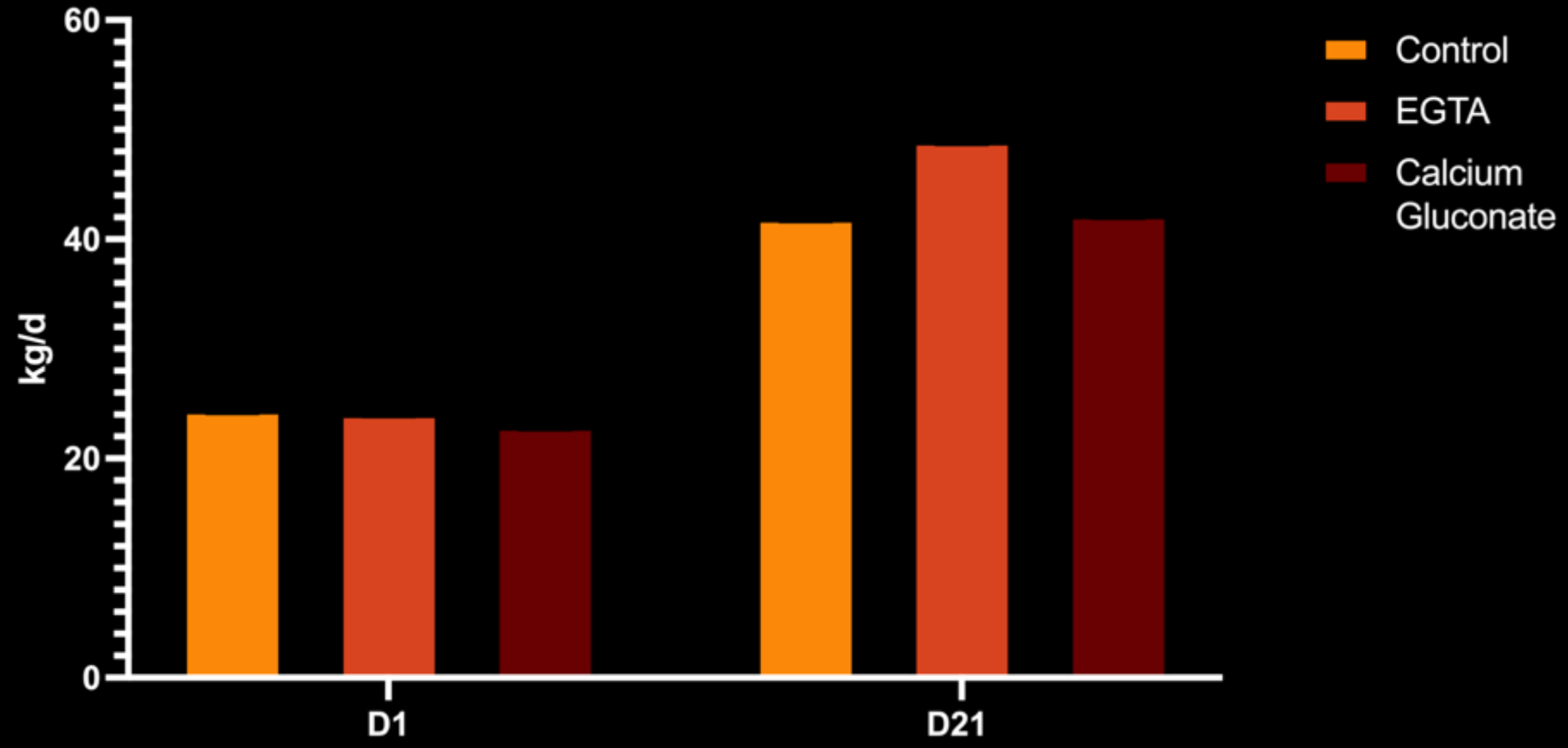
Connelly et al., 2024

Ionized Calcium Concentration at Calving



Frizzarini, unpublished results

Milk Production on D1 and D21



Frizzarini, unpublished results

How does “transient hypocalcemia” work and how do we manage it?

Prepartal strategies to modulate calcium homeostasis

1) Negative DCAD Diets (UltraChlor®, Soychlor®, Biochlor®, Animate®, etc.)

2) Calcium binders (Synthetic Sodium aluminum silicate)

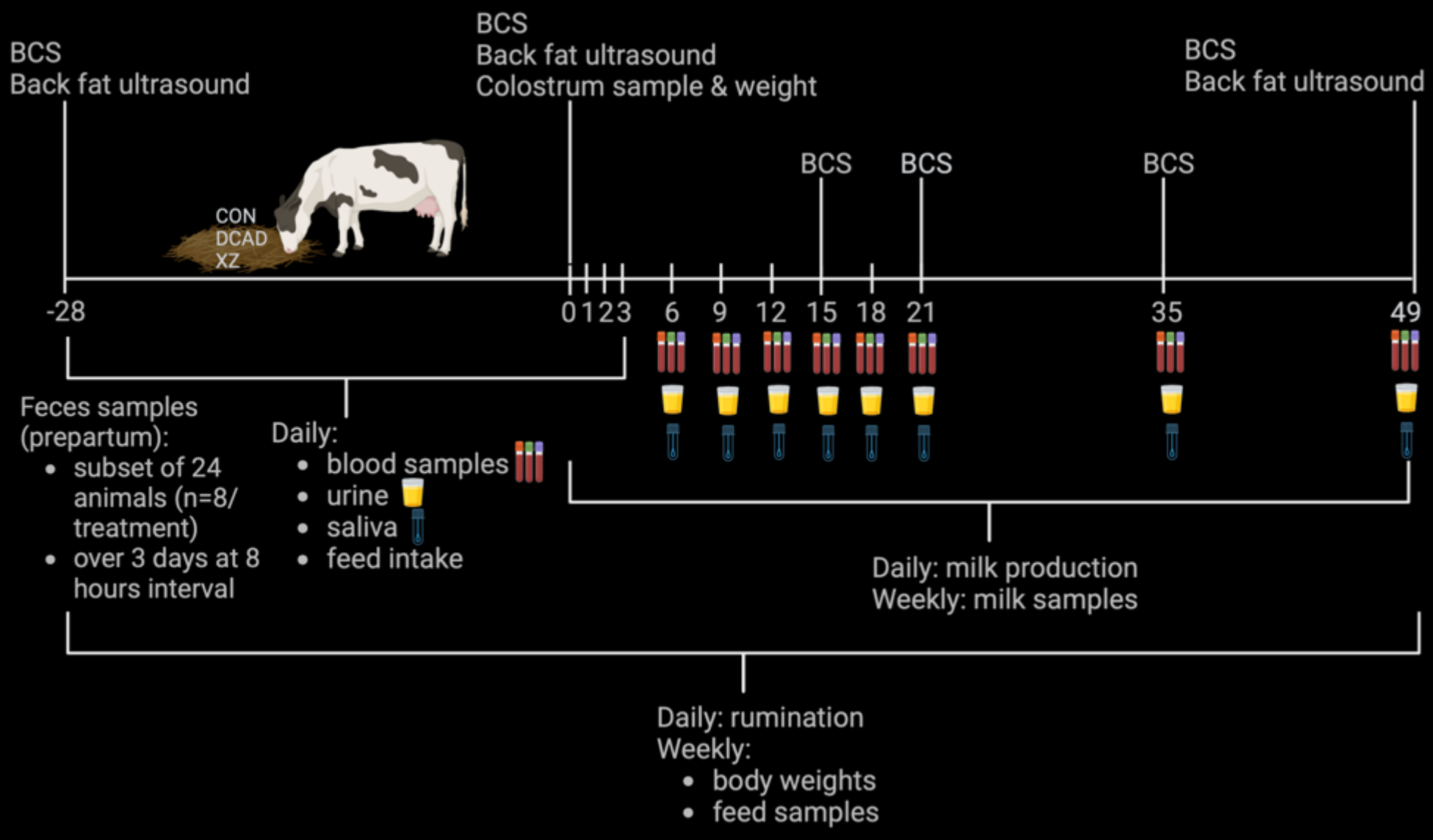
xzelit®

3) Calcium Chelators
   - EGTA-Ca
   - EDTA-Ca and Mg

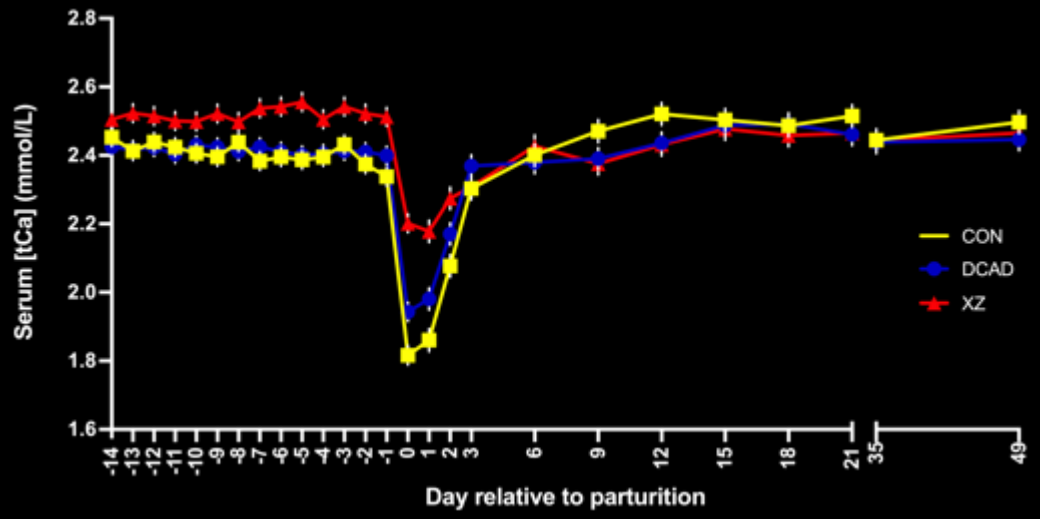
4) Low potassium diets

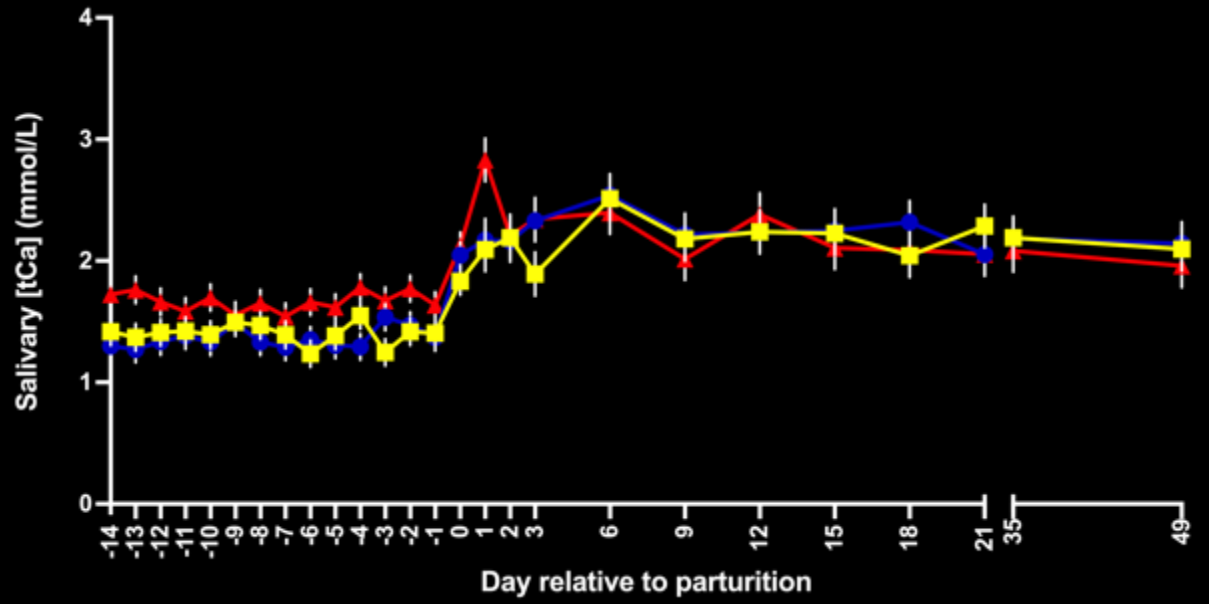
Do Calcium Binders and –DCAD diets impact Calcium Homeostasis the Same?

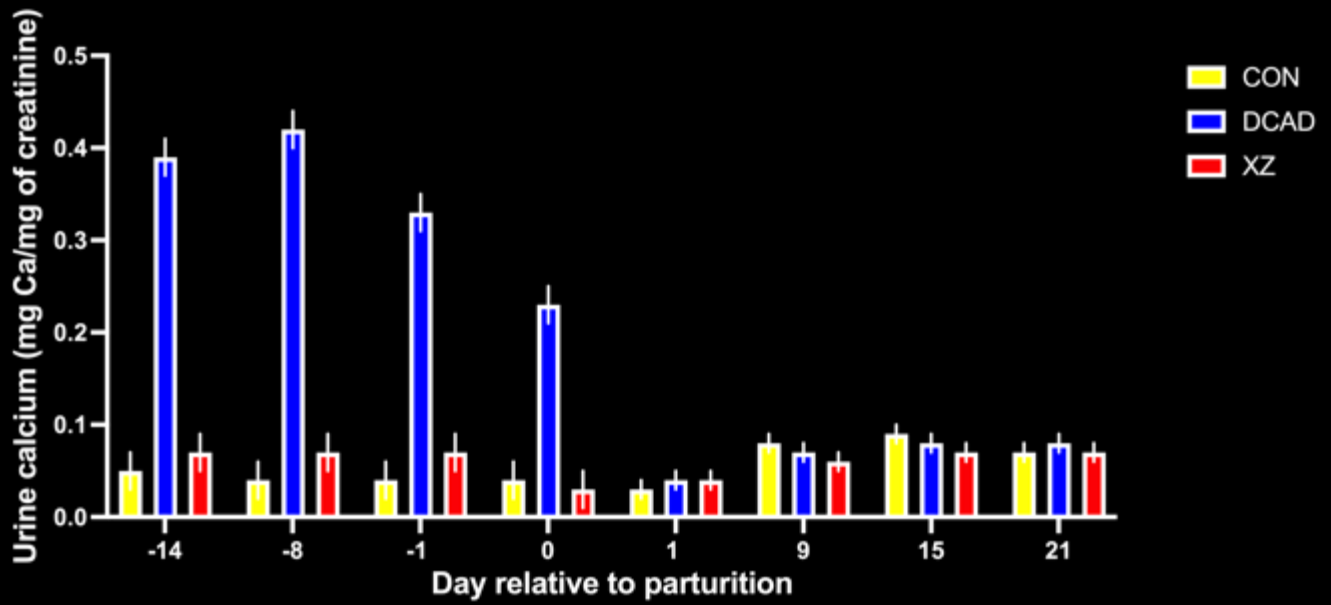
Determination of effects of feeding DCAD and X-Zelit on transition cows



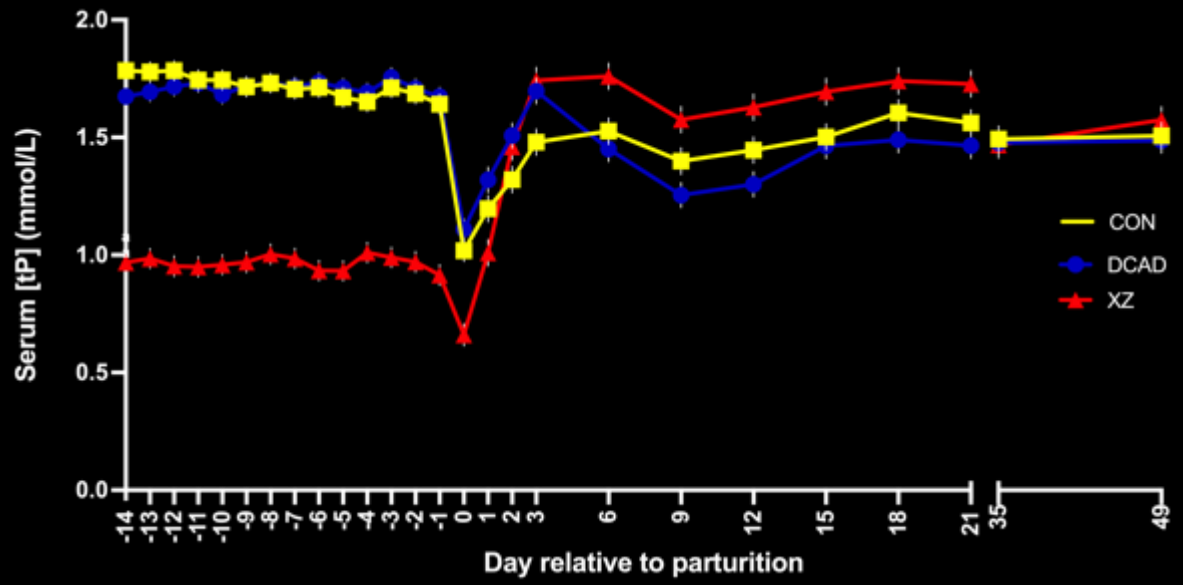
Alterations in calcium across the peripartal period

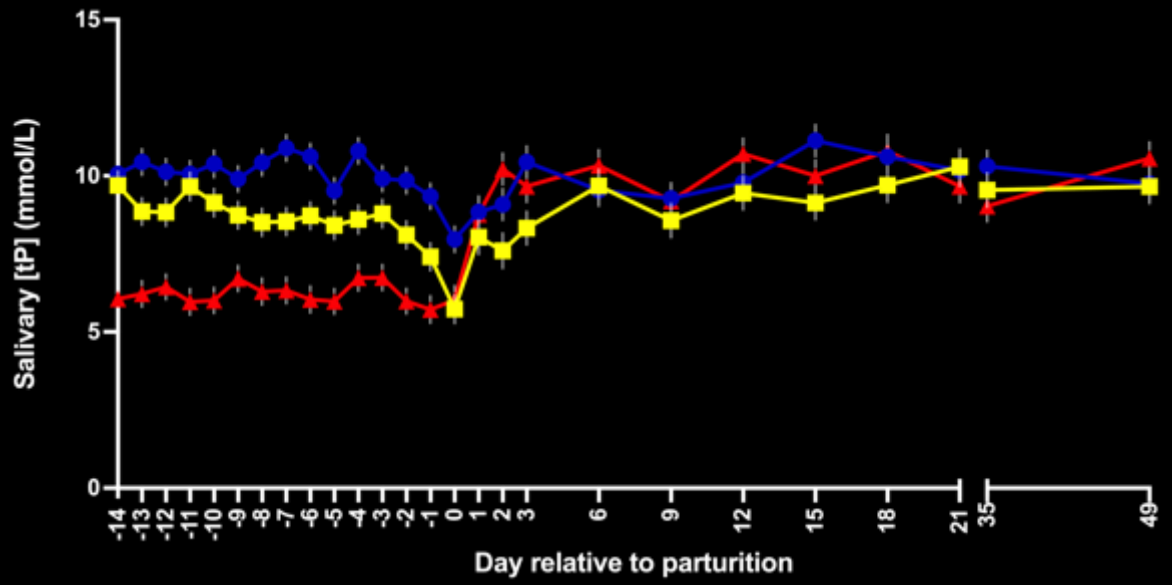


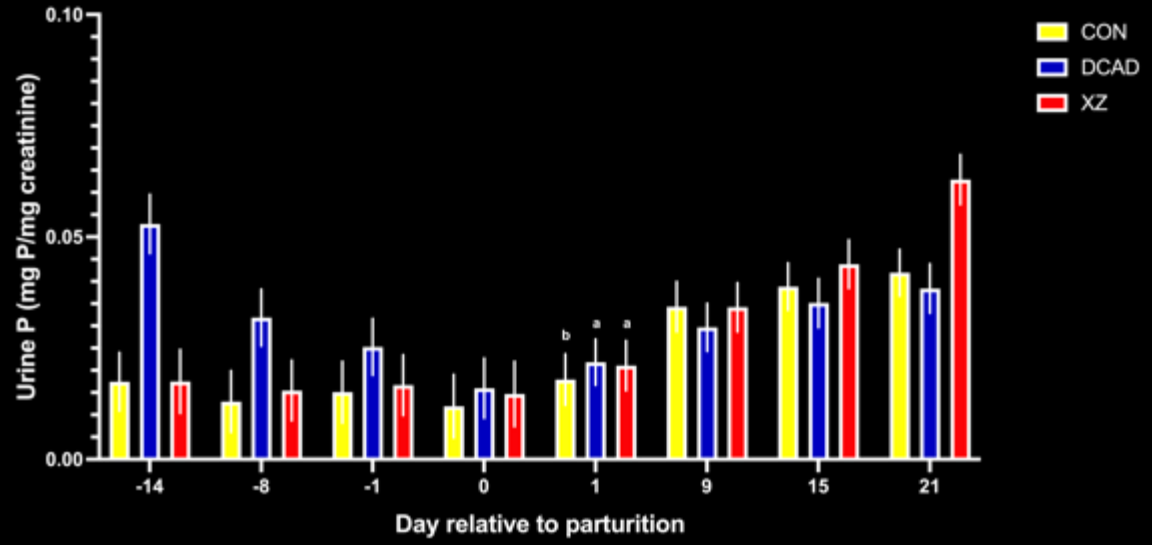




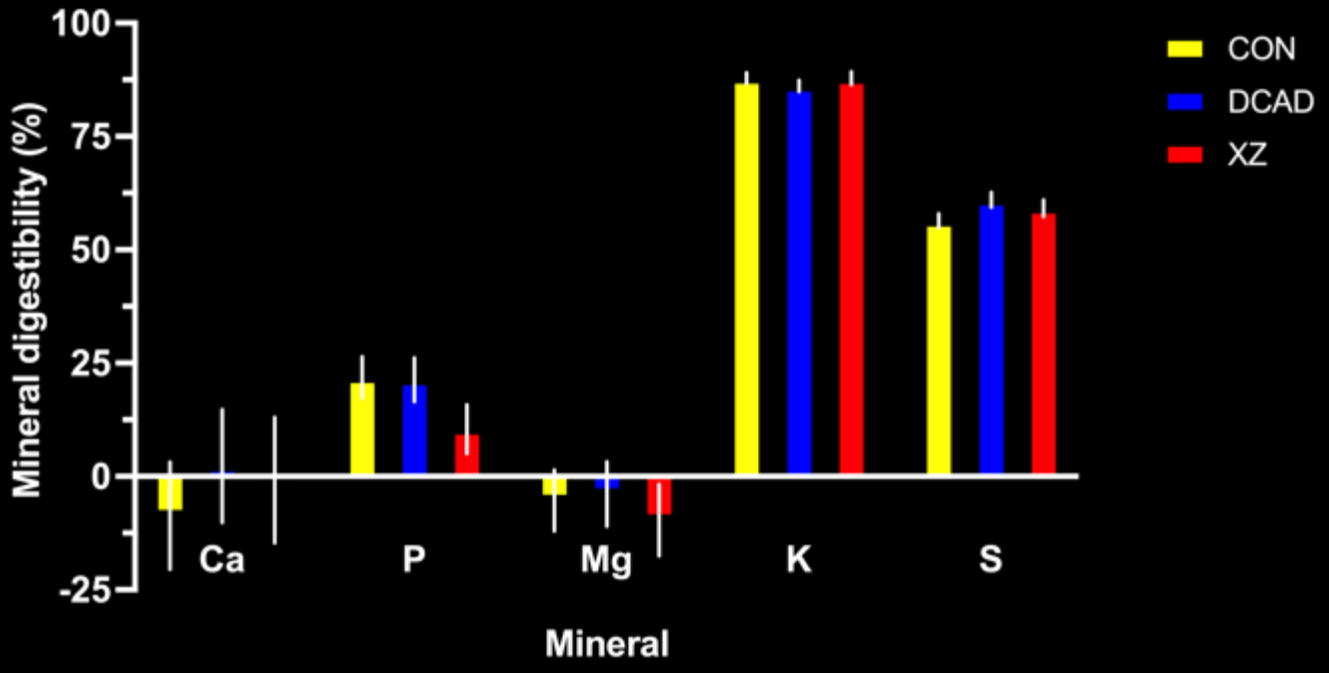
Alterations in phosphorous across the peripartal period

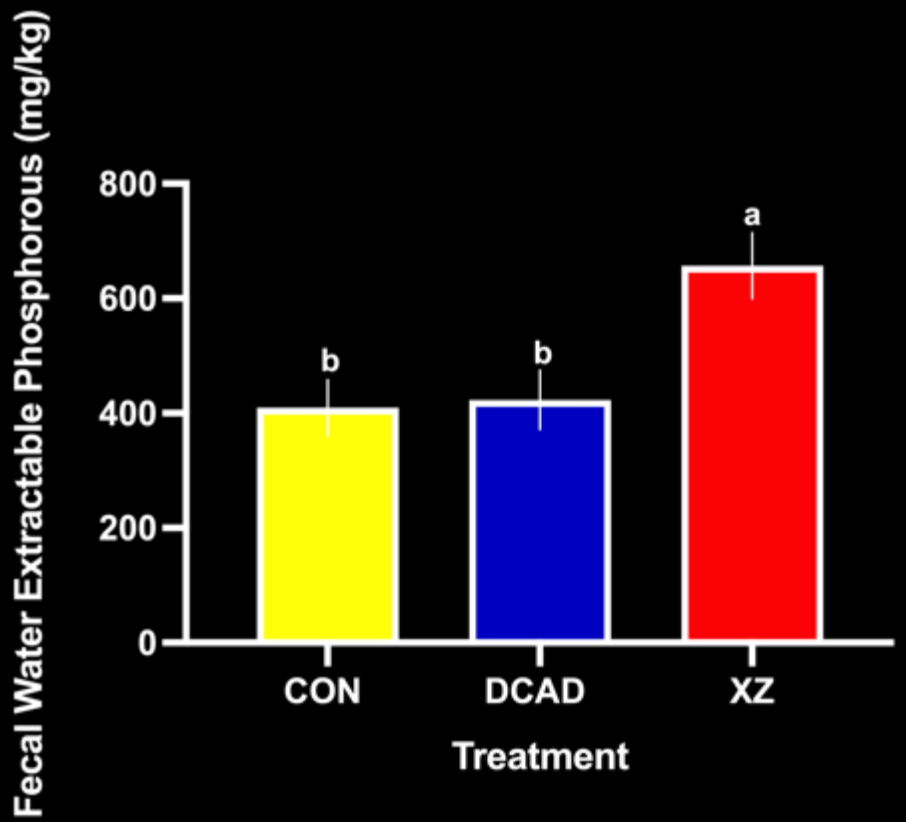






Fecal mineral digestibility





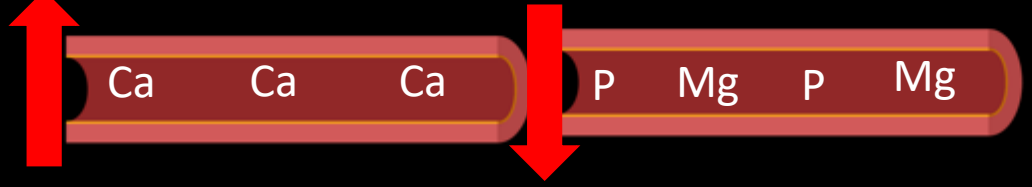
+

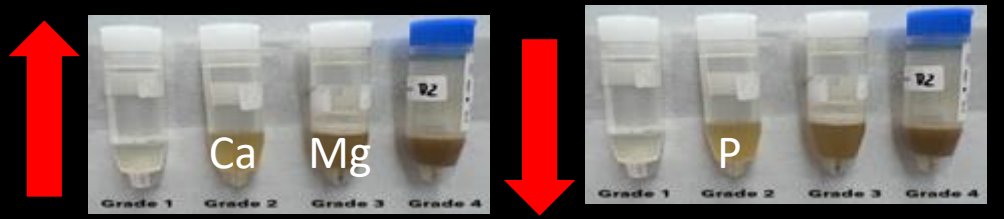
Ca P Ca P

Mg xzelit®Mg

Ca P Ca P

=





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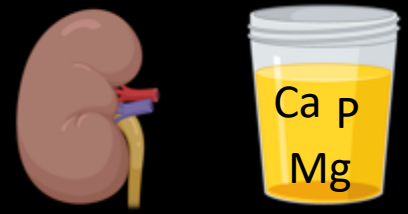

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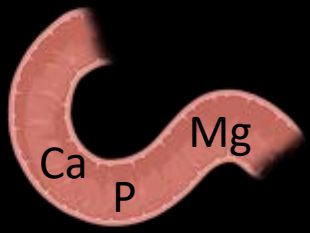
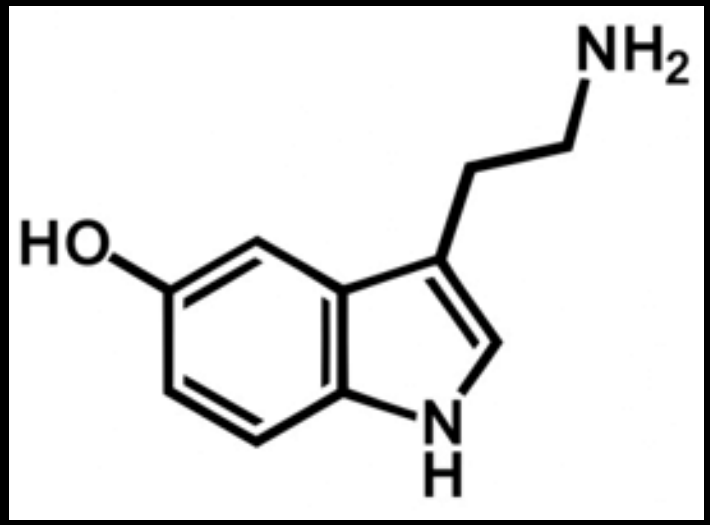
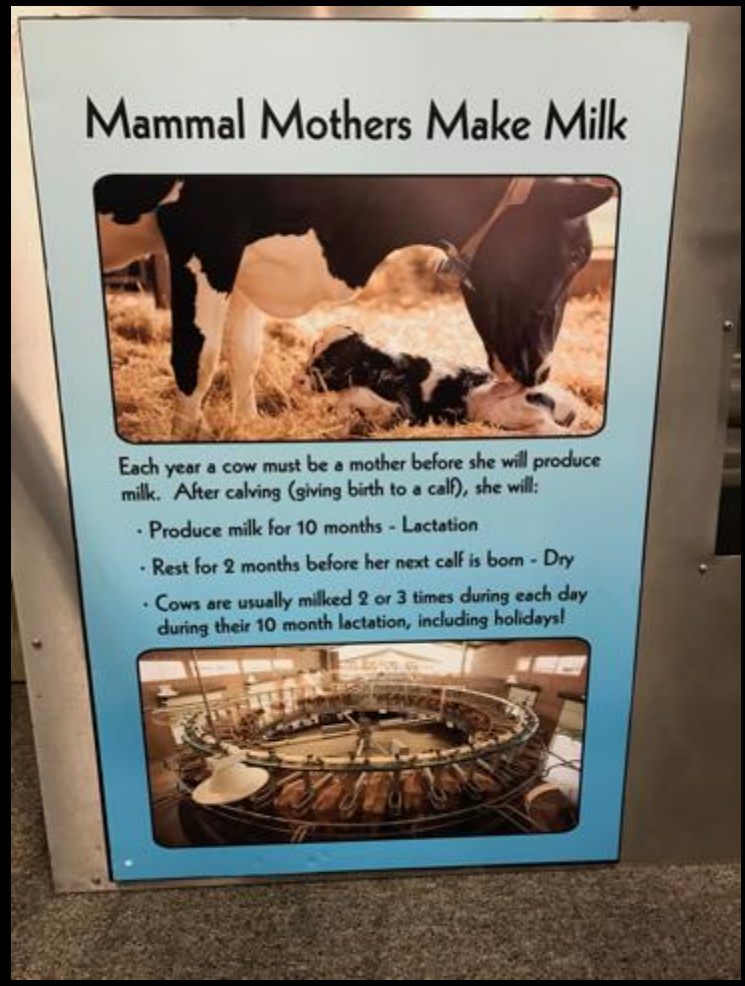


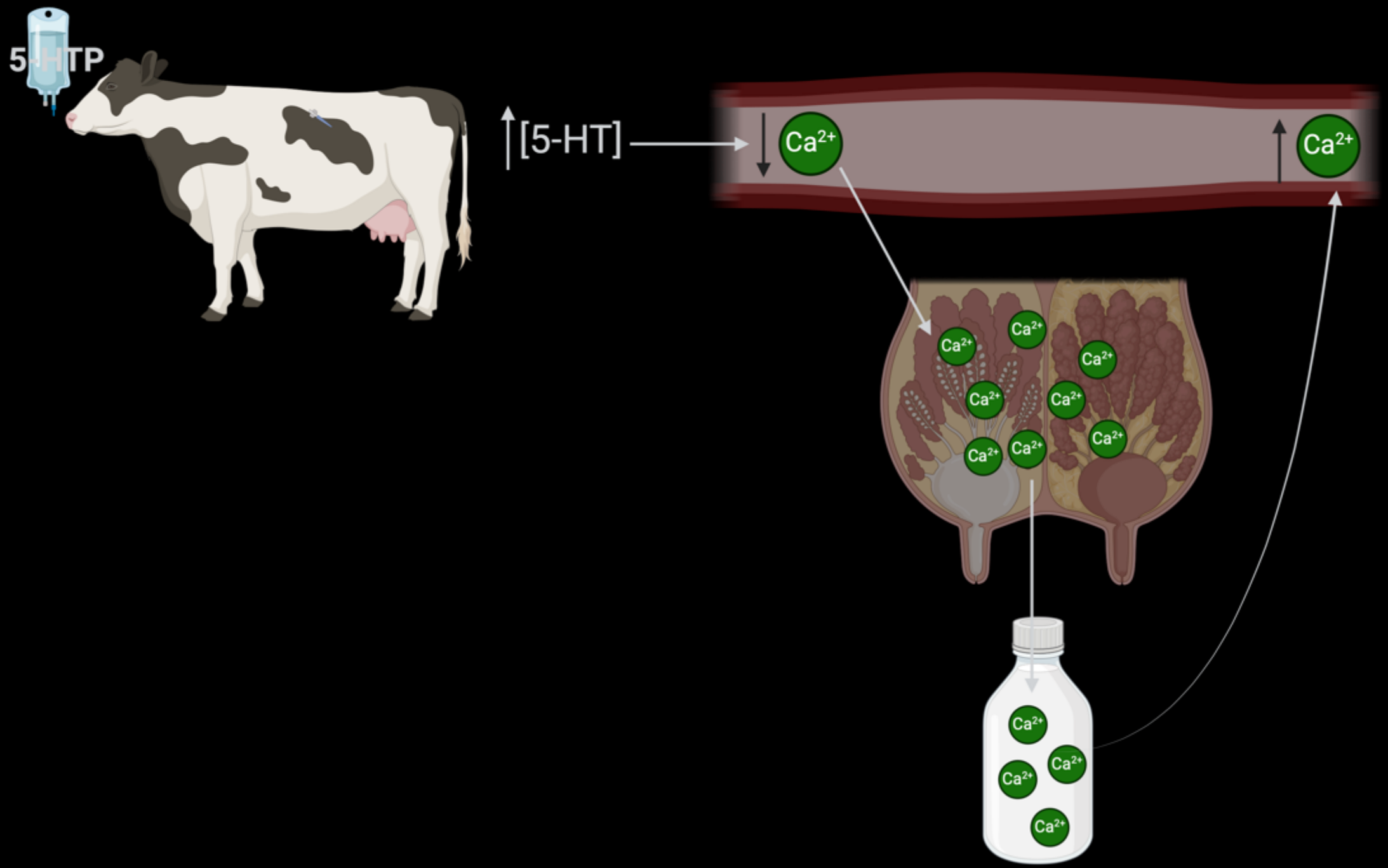
xzelit®

Prepartum

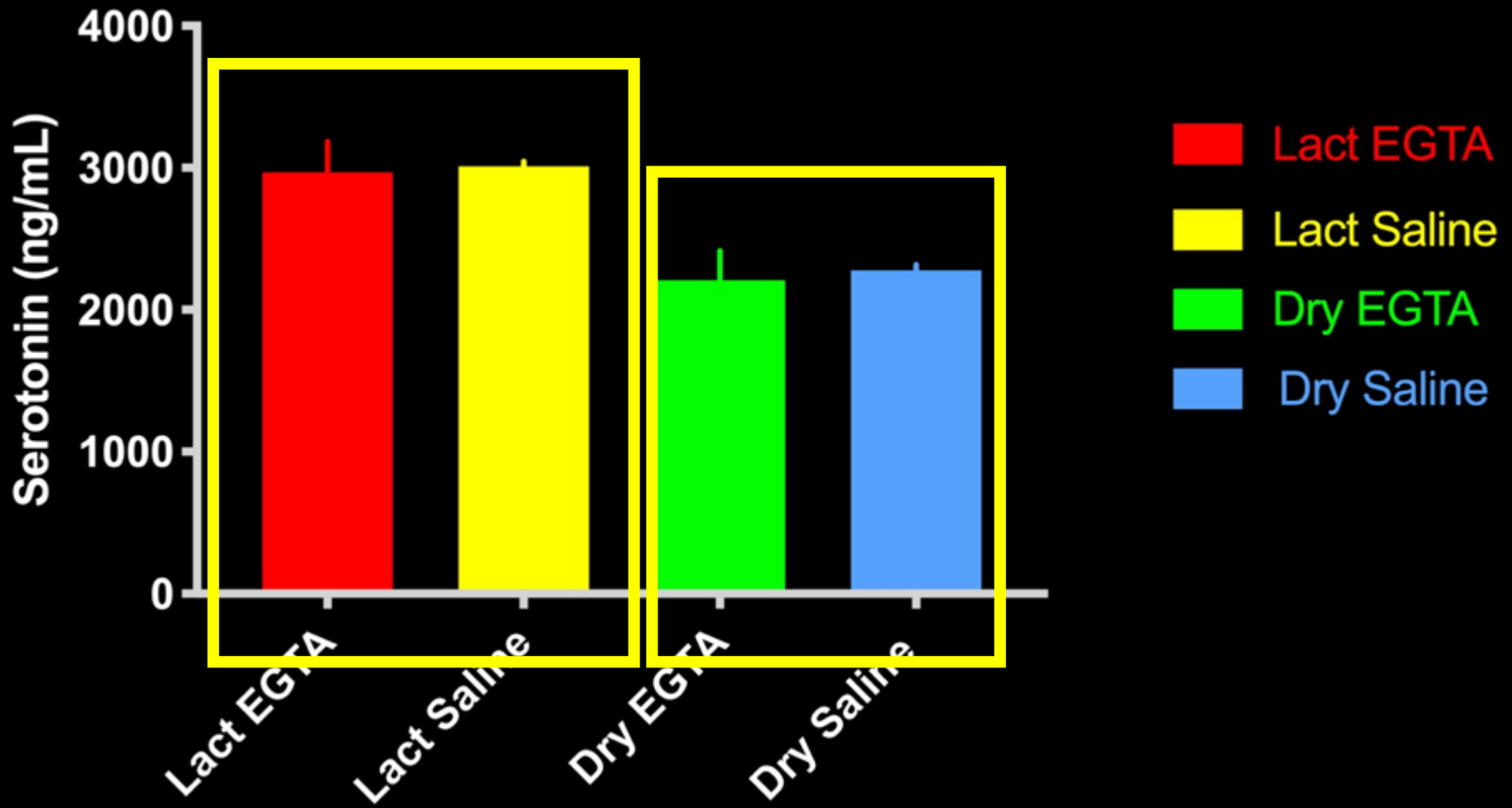

5-HTP
Mood & Relaxation
NATROL
5-HTP
Mood & Relaxation
100mg


HO
NH2
NH


Mammal Mothers Make Milk
Each year a cow must be a mother before she will produce milk. After calving (giving birth to a calf), she will:
· Produce milk for 10 months - Lactation
· Rest for 2 months before her next calf is born - Dry
· Cows are usually milked 2 or 3 times during each day during their 10 month lactation, including holidays!

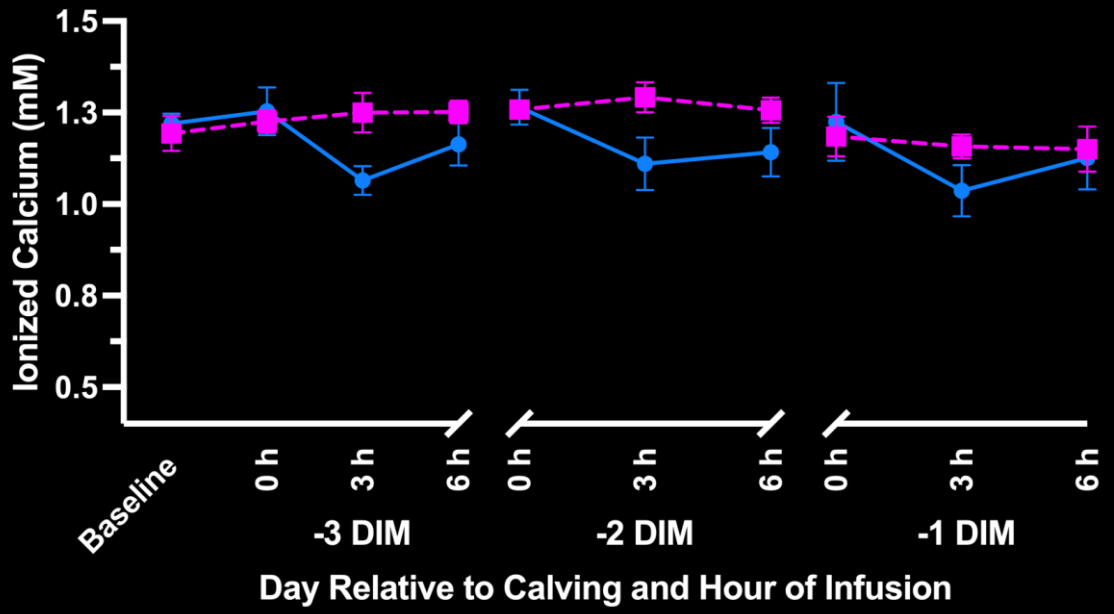

5-HTP
[5-HT]
Ca2+
Ca2+
Ca2+
Ca2+
Ca2+
Ca2+
Ca2+
Ca2+
Ca2+
Ca2+
Ca2+
Ca2+
Ca2+
Ca2+
Ca2+

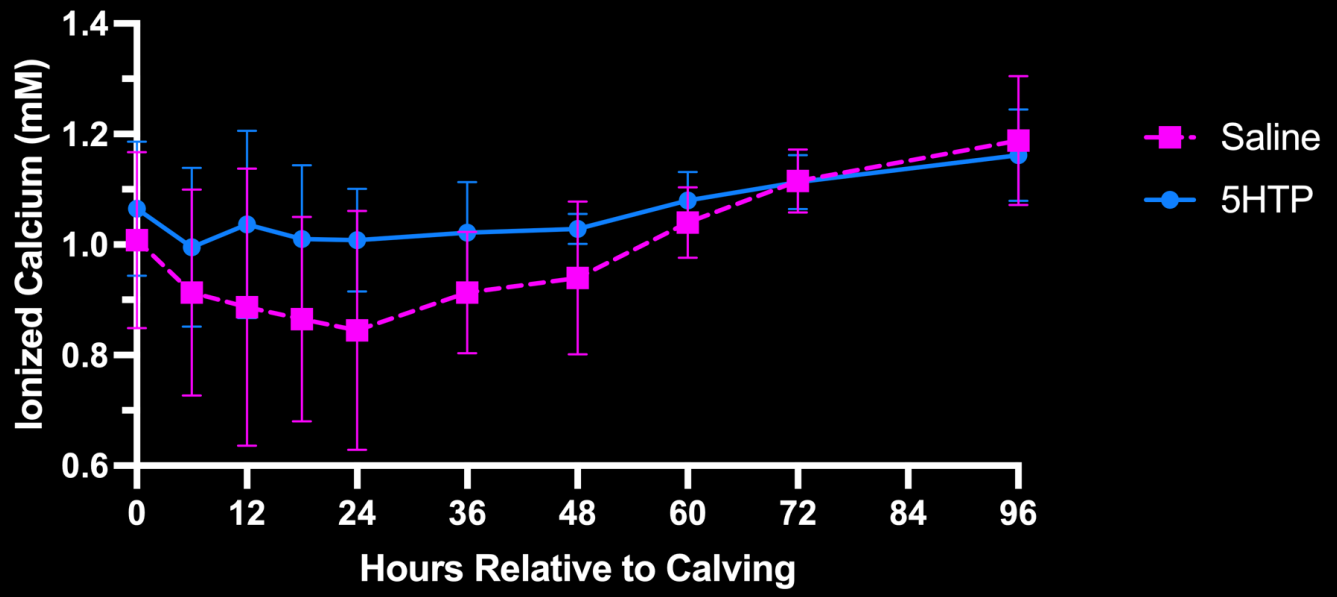
Results: Serotonin



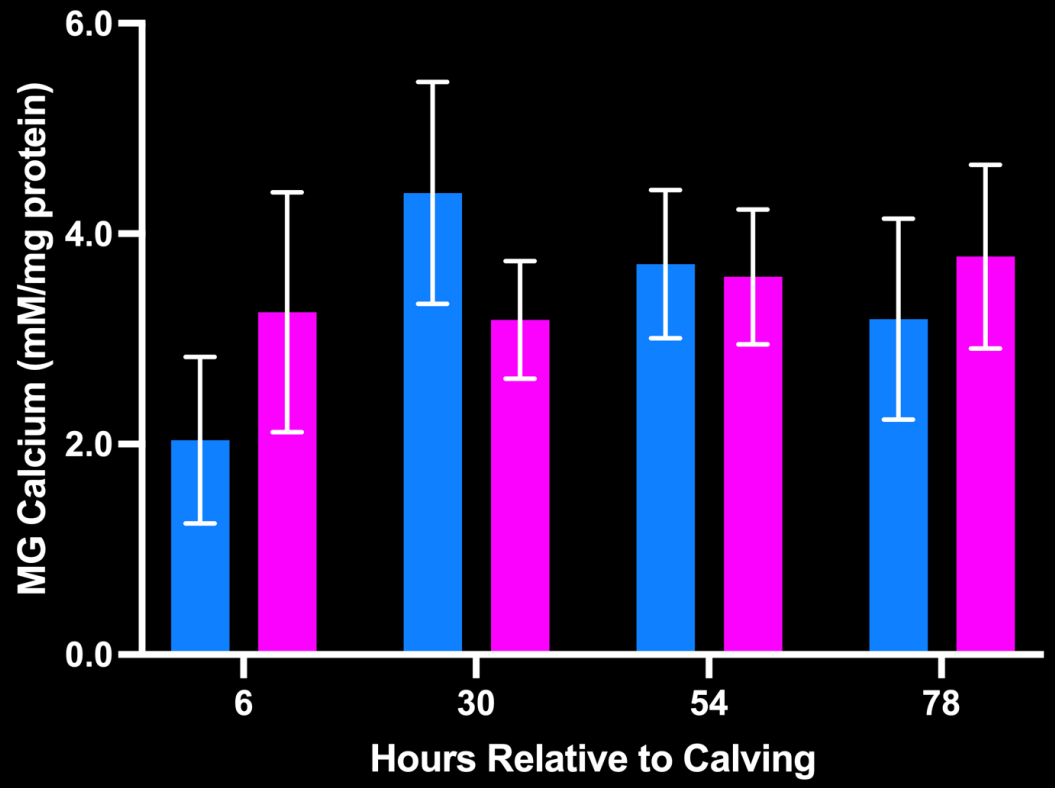
Connelly et al., 2022; J. Dairy Sci.

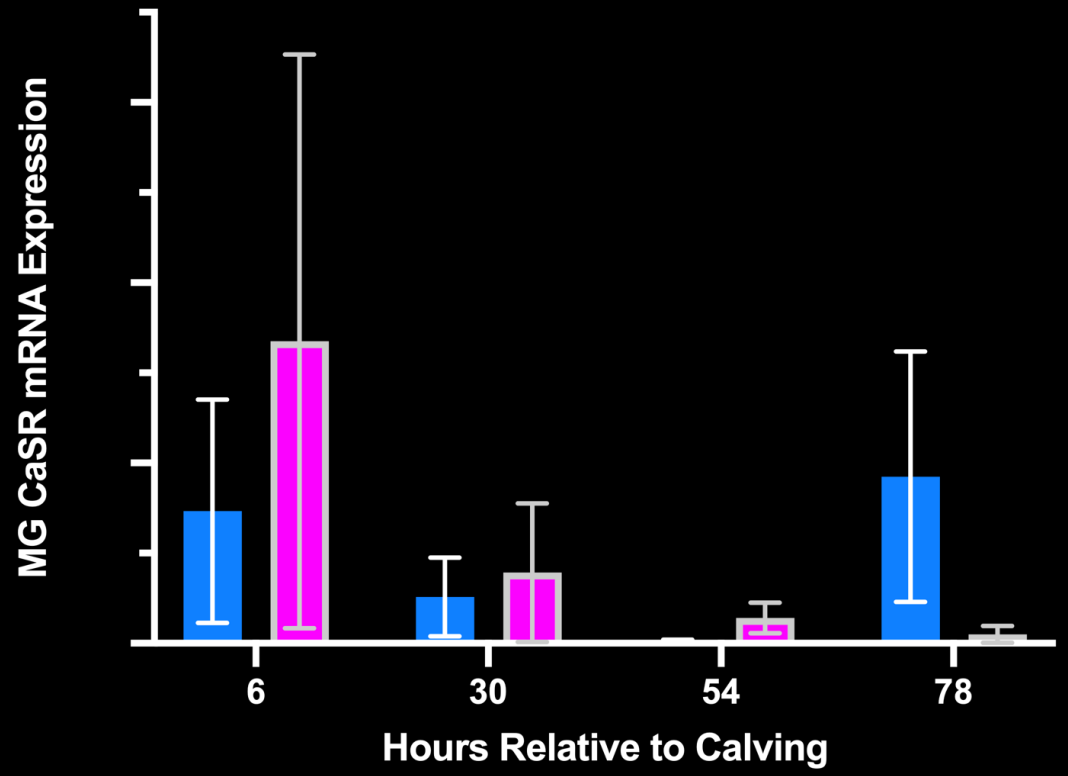
Treatment with serotonin precursor prepartum increases postpartum calcium concentrations





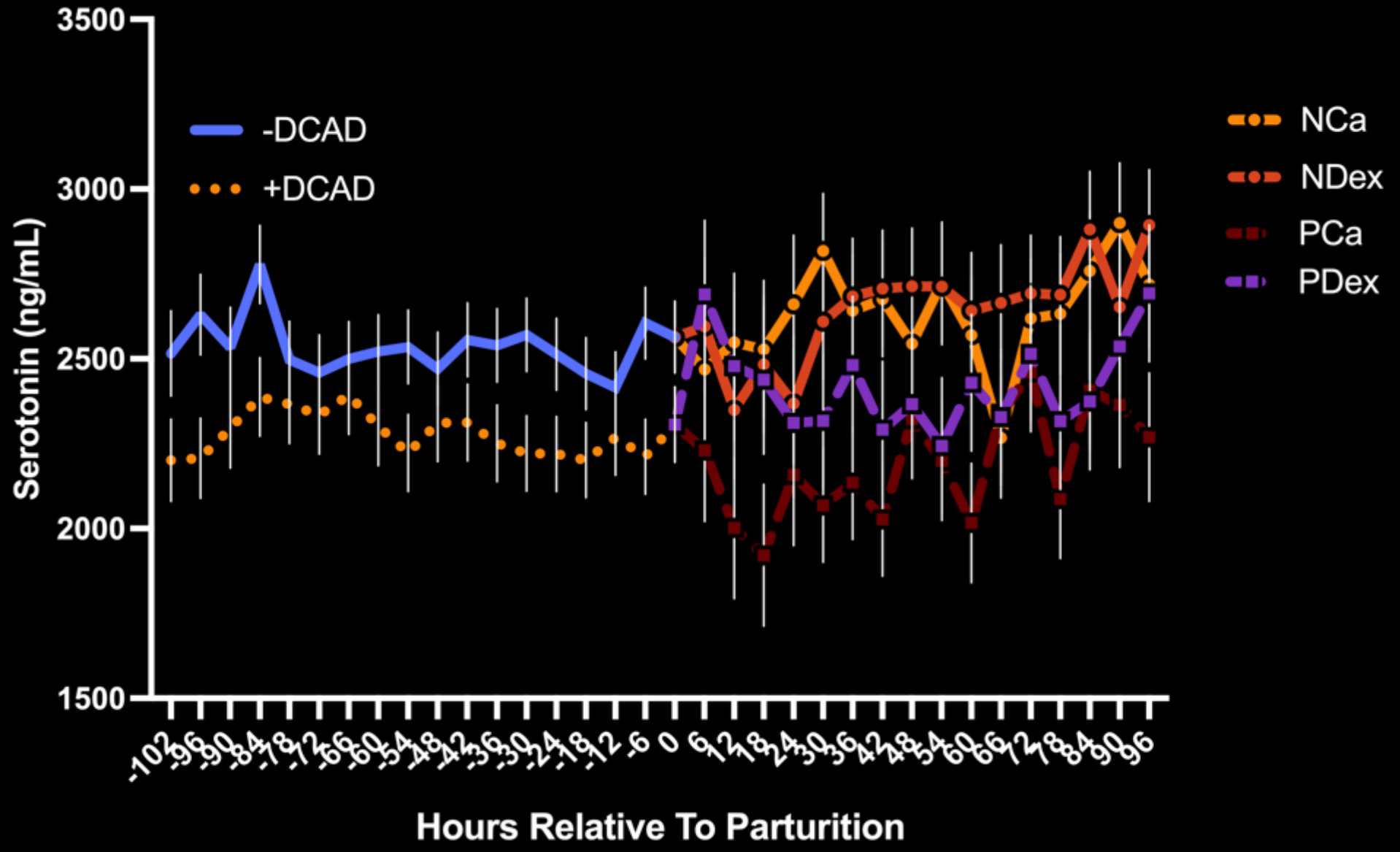
Webster et al., 2025; J. Dairy Sci.





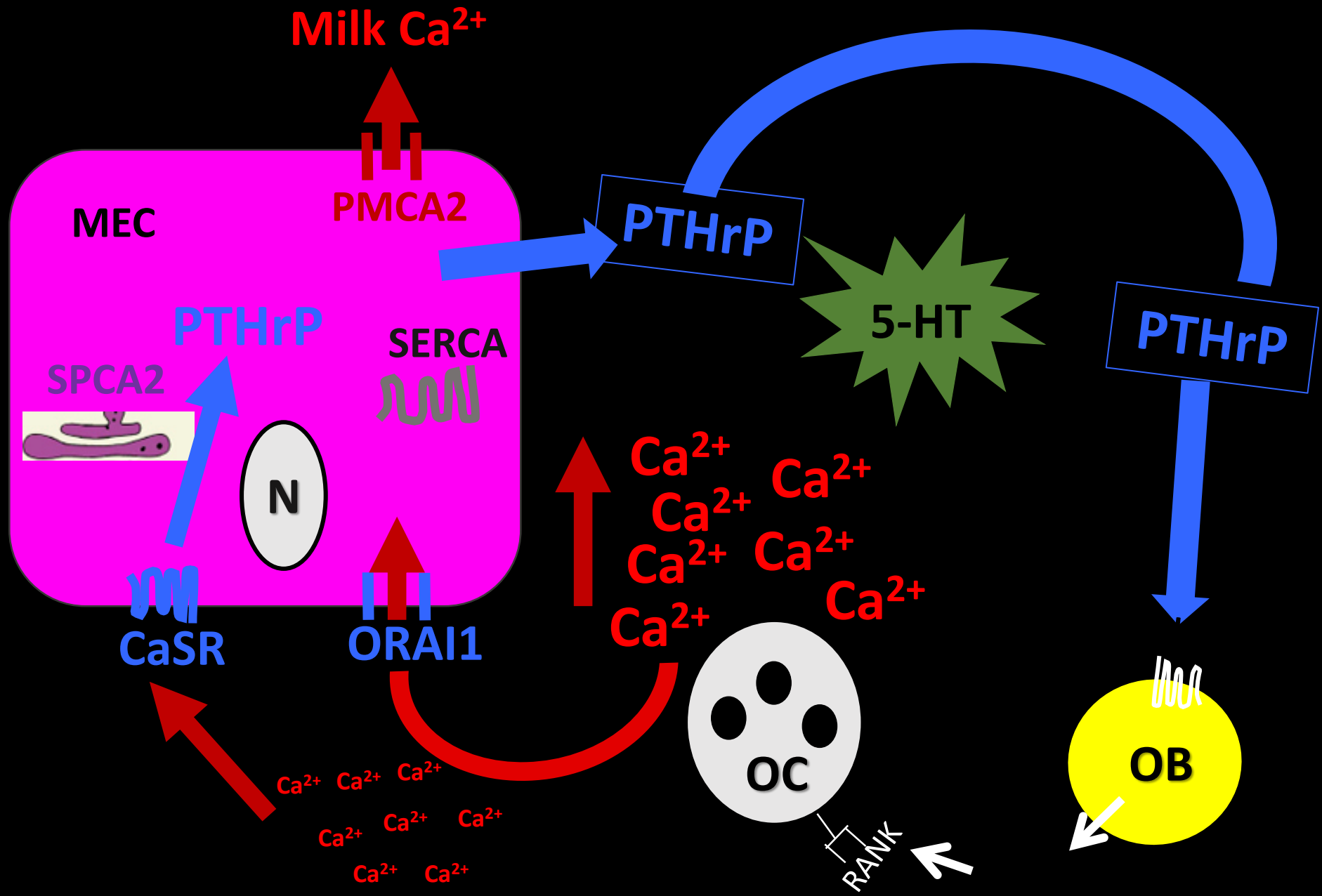
Webster et al., 2025; J. Dairy Sci.

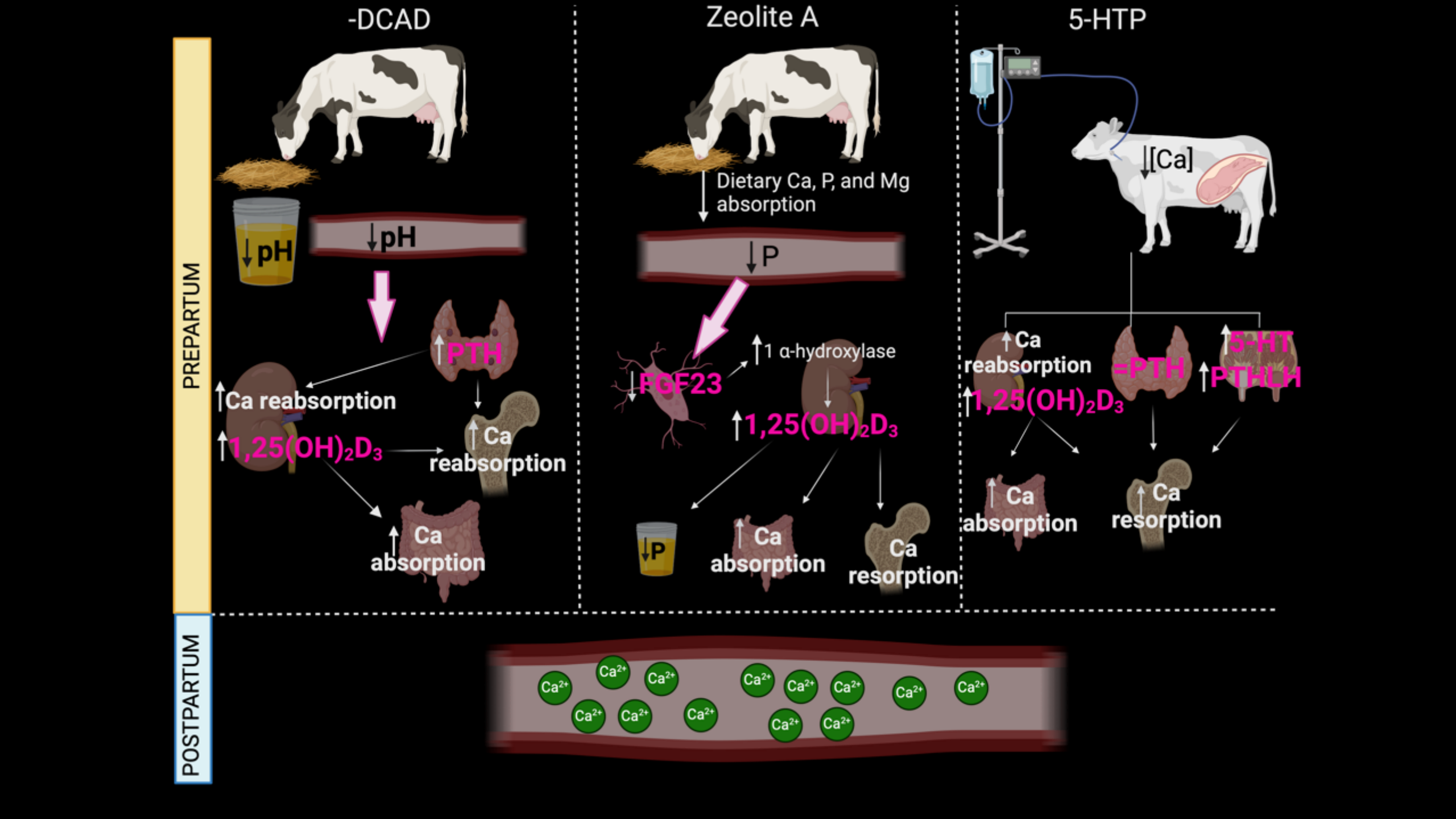
Serotonin is increased in cows fed negative DCAD



Connelly et al., 2024a; *J. Dairy Sci.*.

Coordination of calcium between the mammary gland and the dam during lactation

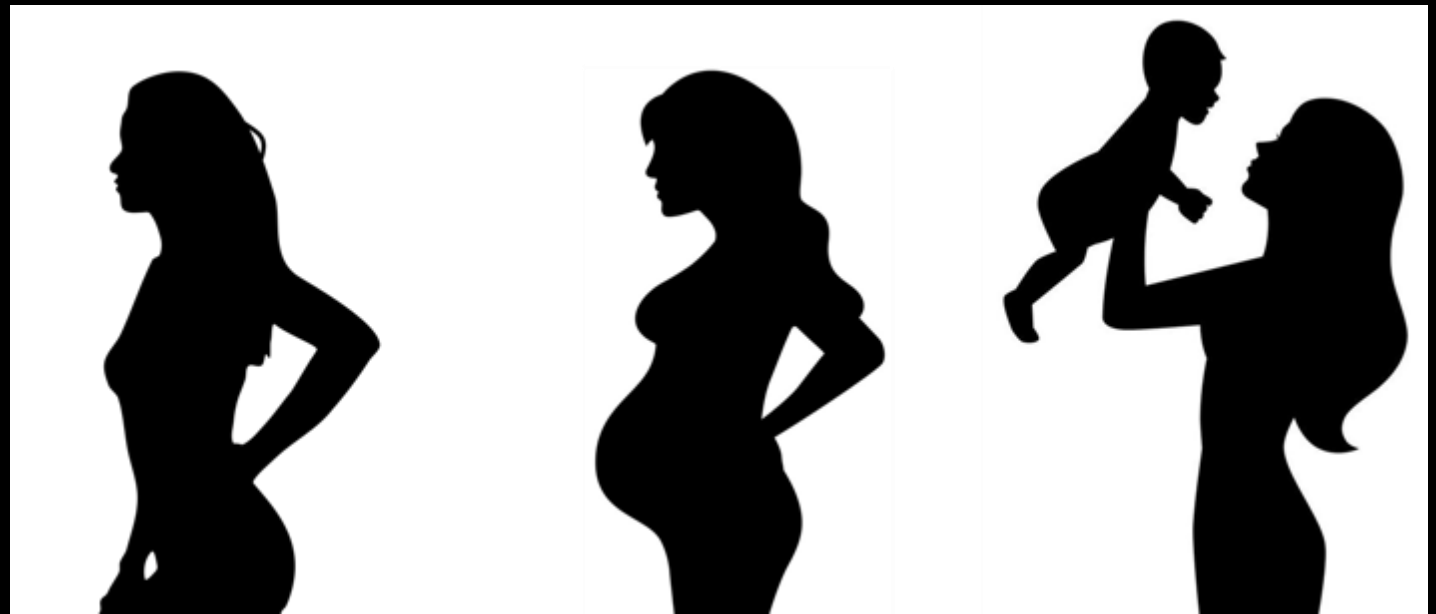


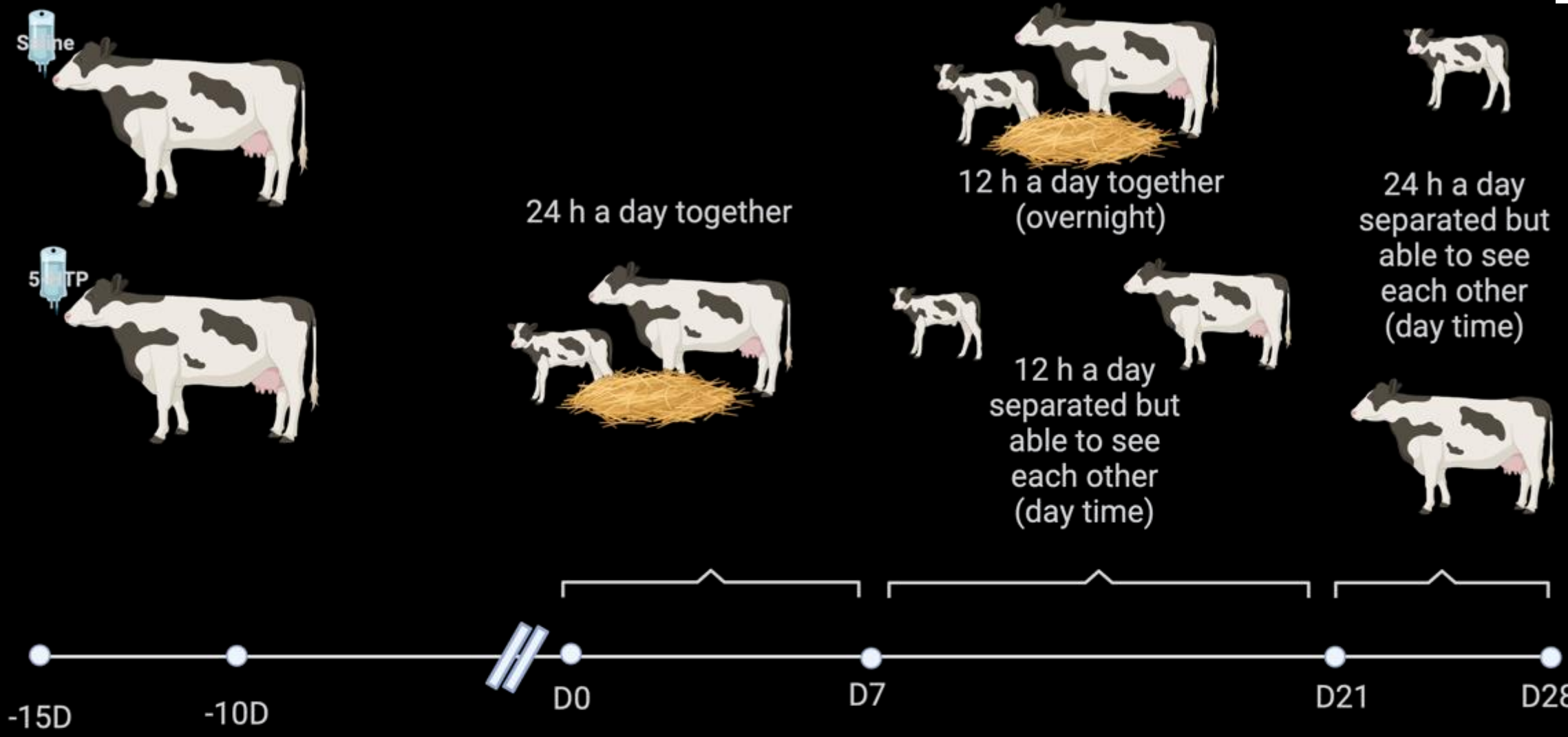

-DCAD
Zeolite A
5-HTP
PREPARTUM
POSTPARTUM
↓pH
↓pH
↑PTH
↑Ca reabsorption
↑1,25(OH)2D3
↑Ca reabsorption
↑Ca absorption
Dietary Ca, P, and Mg absorption
↓P
↓FGF23
↑1 α-hydroxylase
↑1,25(OH)2D3
↓P
↑Ca absorption
↑Ca resorption
↓[Ca]
↑Ca reabsorption
↑1,25(OH)2D3
=PTH
↑5-HT
↑PTHLH
↑Ca absorption
↑Ca resorption
Ca2+

Can we improve dam well-being using 5-hydroxy-L-tryptophan?

Depression during the Peripartal Period

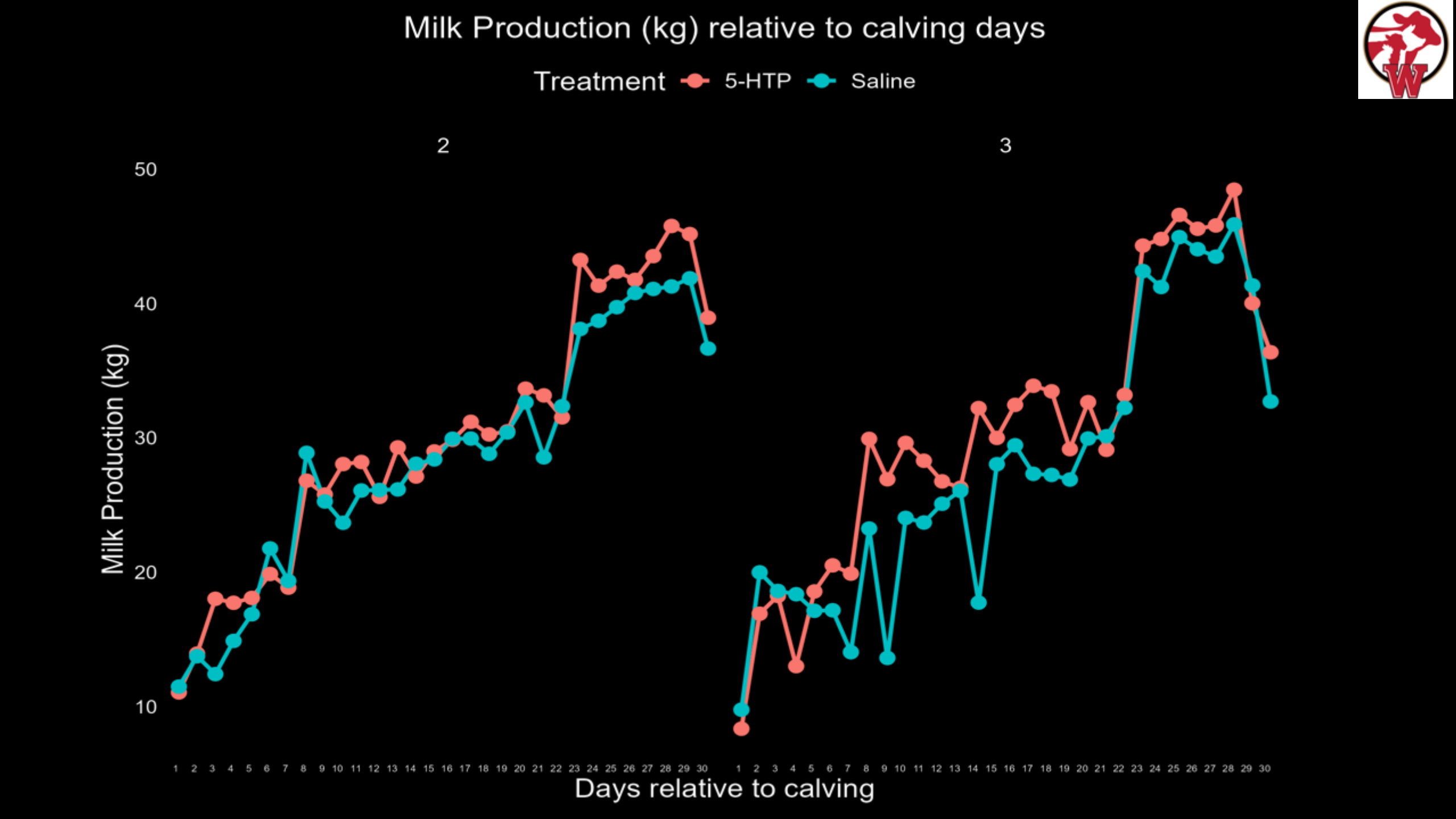
- Most common mental health condition in perinatal females worldwide
- 14% of people experience depression during the peripartal period (Sidhu 2019)
- Polymorphisms of the serotonin transporter predict maternal behavior and bonding
- Serotonin has been shown to reduce pain in fibromyalgic patients




Saline
5-HTP
24 h a day together
12 h a day together
(overnight)
12 h a day
separated but
able to see
each other
(day time)
24 h a day
separated but
able to see
each other
(day time)
-15D
-10D
D0
D7
D21
D28


1329
1329

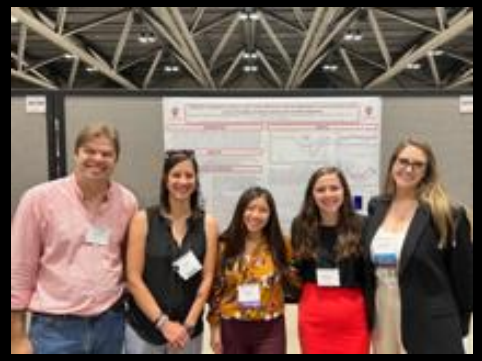

2404


Milk Production (kg) relative to calving days
Treatment
5-HTP
Saline
2
3
Milk Production (kg)
50
40
30
20
10
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Days relative to calving

Conclusions

- A certain level of decreased calcium around parturition is necessary to activate homeostatic mechanisms related to the maintenance of adequate calcium concentrations (transient hypocalcemia)
- It is critical to manage the **prepartum** cow to ensure proper calcium homeostasis post-partum and our work and others demonstrate negative DCAD diets are effective at preventing clinical milk fever and persistent and delayed subclinical hypocalcemia.
- Zeolite diets prevent clinical milk fever and persistent and delayed subclinical hypocalcemia. However, more research is needed to determine the impacts on production, health, and the calf.
- Supplementation with a serotonin precursor improve postpartum calcium metabolism
- Different prepartal interventions work via different methods to impact postpartal calcium and should be fully understood when making nutritional decisions.

The Students……..The Real Brains behind it all!



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