

Transitioning to success: the intersection between peripartum nutrition, health, and reproduction

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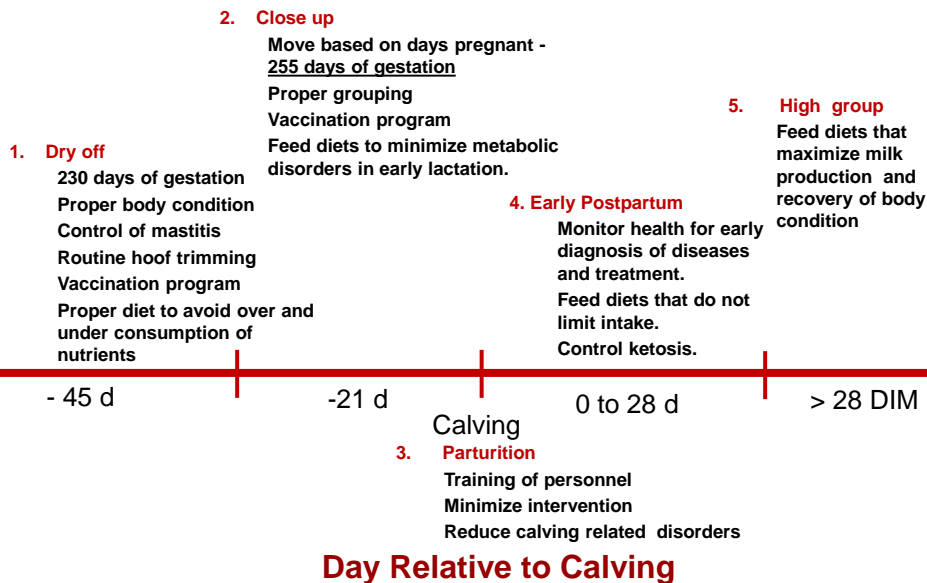
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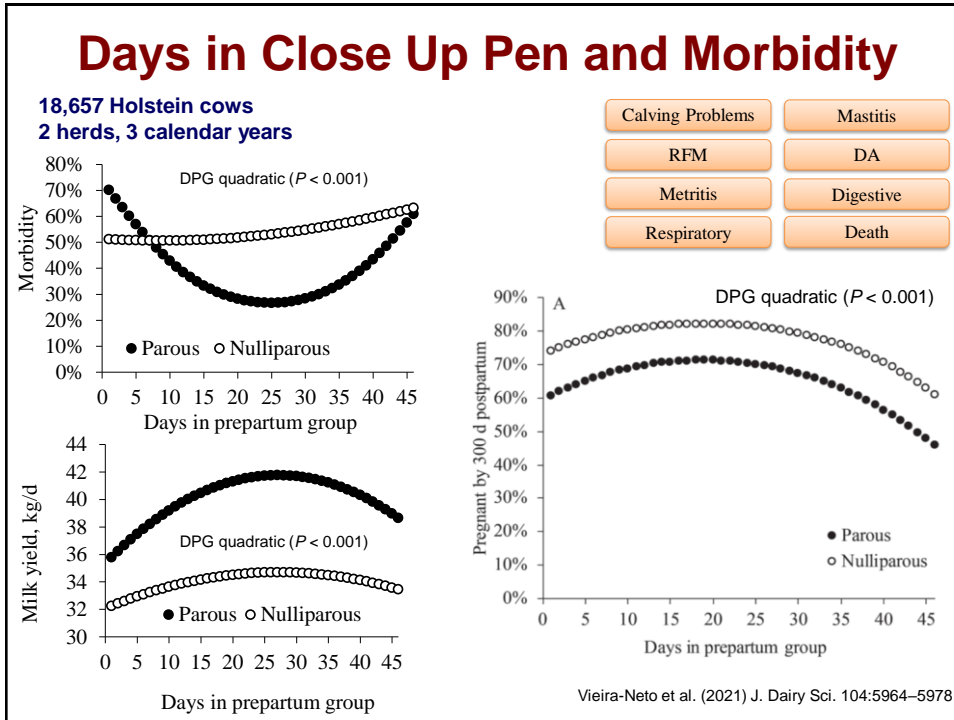
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Timeline Management of Dairy Cows For Successful Transition

Provide Proper Comfort and Heat Abatement





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Holstein Cows at Peak Production

Average Holstein cow peaks at 45 kg/day

- Maintenance energy required: 15 Mcal/d of ME
- Energy for milk synthesis 55 Mcal of ME/d
- Total energy needed = 70 Mcal of ME/d
- **Therefore, consuming at 4.6 times maintenance**

Selz-Pralle Aftershock peaked at 123 kg/day

- Maintenance energy required: 16 Mcal/d of ME
- Energy for milk synthesis 134 Mcal of ME/d
- Total energy needed = 150 Mcal of ME/d
- **Therefore, consuming at 9.3 times maintenance**

Santos et al. (2010) Reprod. Dom. Rum. VII:387-404 ⁴

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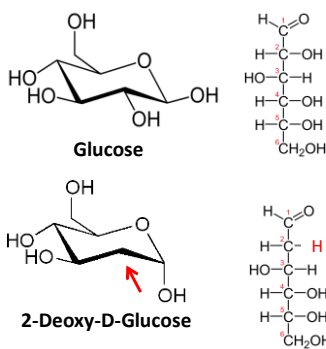
Risk factors for resumption of estrous cycles by 65 days postpartum and pregnancy at 1st AI in lactating dairy cows

Variable	Cyclic, % (n/n)	Adjusted OR (95% CI)	P value
BCS change from calving to 65 DIM			
Lost 1 unit or more	58.7 (279/475)	Referent	-----
Lost < 1 unit	74.6 (2,507/3,361)	1.96 (1.52, 2.52)	< 0.001
No change	80.9 (2,071/2,560)	2.39 (1.74, 3.28)	< 0.001
Milk yield in the first 90 DIM			
Q1, 32.1 kg/d	72.7 (1,011/1,390)	Referent	-----
Q2, 39.1 kg/d	77.6 (1,204/1,552)	1.34 (1.13, 1.60)	< 0.01
Q3, 43.6 kg/d	77.6 (1,350/1,739)	1.36 (1.15, 1.62)	< 0.001
Q4, 50.0 kg/d	75.3 (1,292/1,715)	1.21 (1.02, 1.43)	0.04
Variable	Pregnant, % (n/n)	Adjusted OR (95% CI)	P value
BCS change from calving to 65 DIM			
Lost 1 unit or more	28.9 (132/472)	Referent	-----
Lost < 1 unit	37.3 (1204/3230)	1.42 (1.13, 1.79)	< 0.01
No change	41.6 (1008/2422)	1.69 (1.32, 2.17)	< 0.001
Milk yield in the first 90 DIM			
Q1, 32.1 kg/d	37.2 (496/1,334)	Referent	-----
Q2, 39.1 kg/d	38.9 (576/1,481)	1.06 (0.91, 1.24)	0.42
Q3, 43.6 kg/d	39.3 (652/1,661)	1.09 (0.93, 1.26)	0.26
Q4, 50.0 kg/d	37.6 (620/1,648)	1.03 (0.88, 1.21)	0.65

Santos et al. (2009) Anim. Reprod. Sci. 110: 207–221

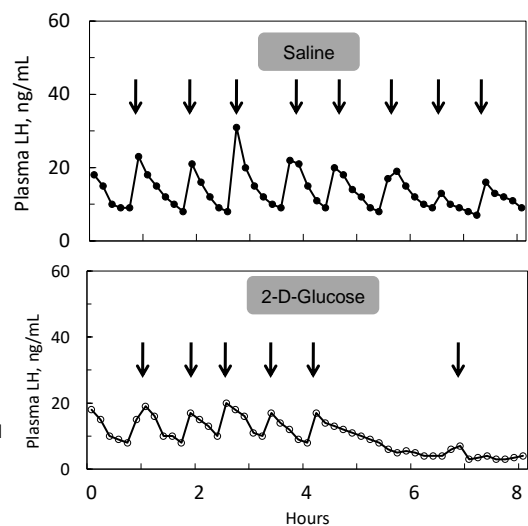
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Plasma LH Pulsatility in Sheep Infused with 2-Deoxy-D-Glucose or Saline in the 4th Ventricle

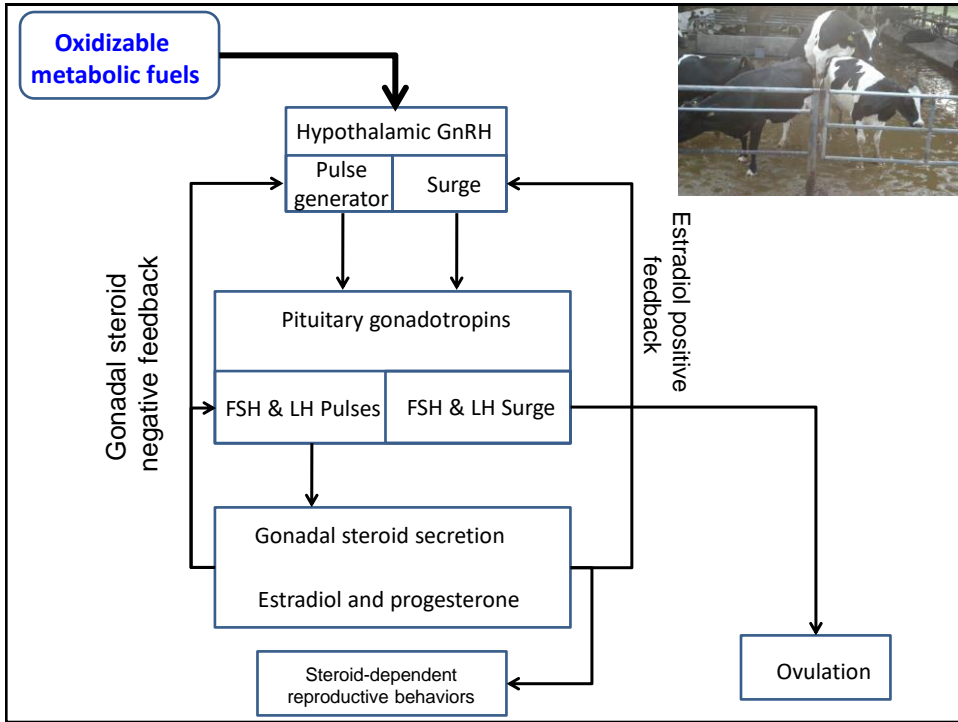


2-Deoxy-D-Glucose is a glucose molecule that has the 2-OH group in glucose replaced by H.

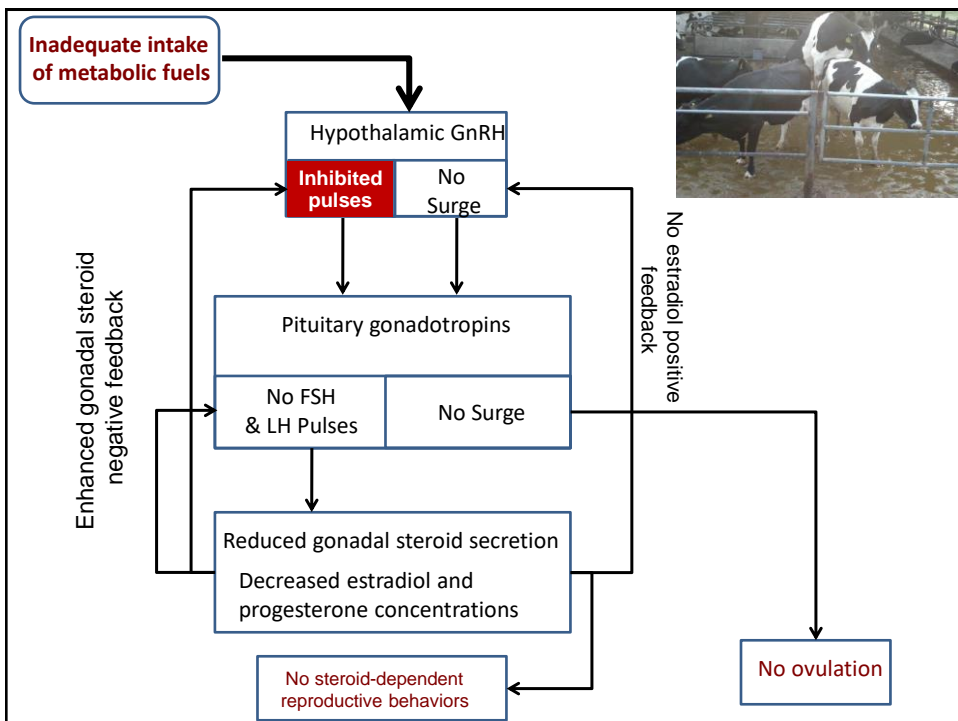
This substitution inhibits glycolysis and ATP synthesis



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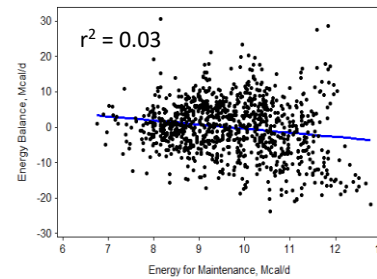
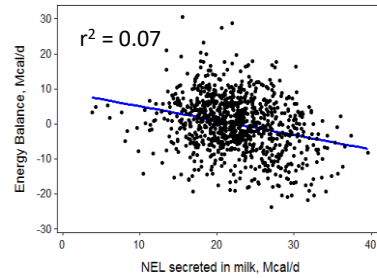
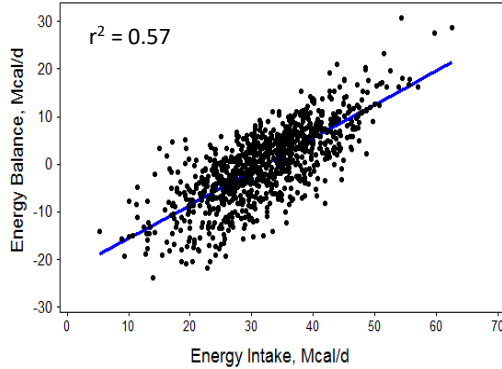


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If Energy Balance is a Major Drive of Reproductive Success in Dairy Cows, then the Focus Should be on Intake and not Milk Yield



Santos et al. (2010) Soc. Reprod. Fertil. Suppl. 67: 387-403

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Take Home Message

- ✓ Avoid excessive body condition loss with the onset of lactation
 - ✓ Ideally, cows should not lose more than 0.5 units of body condition from the week before calving to first AI

Important that cows and heifers do not calve overconditioned



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What About Feed Efficiency



Nehme Marinho et al. (2021) J. Dairy Sci. 104: 5493-5507

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Associations between residual feed intake (RFI) and incidence of diseases and survival in Holstein cows

Item	RFI in mid-lactation		SEM	P-value
	25% most efficient (-2.13 kg/d)	25% least efficient (+2.26 kg/d)		
Disease by 90 DIM, %				
Retained placenta	12.2	14.3	3.3	0.92
Metritis	13.3	22.5	4.0	0.40
Mastitis	15.3	15.3	3.5	0.89
Displaced abomasum	1.0	4.1	1.5	0.60
Lameness	10.2	8.2	2.4	0.14
Pneumonia	2.0	2.0	1.4	0.81
Multiple diseases	13.3	20.4	3.5	0.38
Morbidity	37.8	43.9	4.9	0.66
Left herd by 300 d, %	10.2	9.2	2.9	0.29

Nehme Marinho et al. (2021) J. Dairy Sci. 104: 5493-5507

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Feed Efficiency and Reproduction

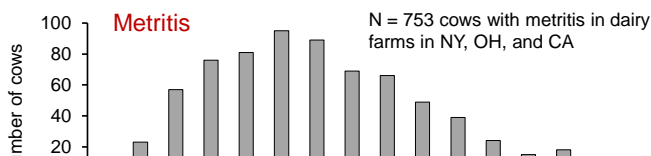
Item	RFI quartile				SEM
	Q1 (-1.90 kg/d)	Q2 (-0.48 kg/d)	Q3 (0.41 kg/d)	Q4 (1.98 kg/d)	
Cows, n	212	213	213	213	---
Do not inseminate, %	10.2	9.0	8.8	12.8	2.3
21-d cycle AI rate, %	68.1	67.4	69.3	66.6	2.1
P/AI all AI,* %	31.4	30.6	31.2	24.5	2.2
21-d PR, [§] %	21.2	21.1	22.0	16.6	1.9
Pregnant by 300 d, [§] %	79.0	80.7	82.49	71.5	3.3

* Linear effect of RFI quartile; § Quadratic effect of RFI quartile
Results based on diagnosis performed on day 74 after each AI

Nehme-Marinho and Santos (2022) Front. Anim. Sci. 3:847574

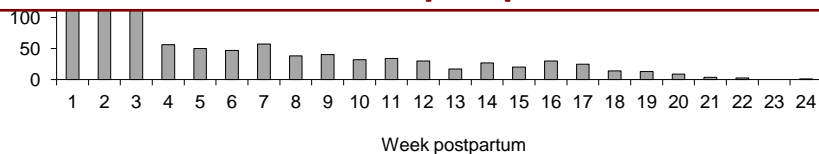
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Morbidity is a Problem of Early Lactation Cows



30 to 35% of cows are affected by disease in the first 3 weeks of lactation

78% the first disease diagnosis occurs within the first 3 weeks postpartum

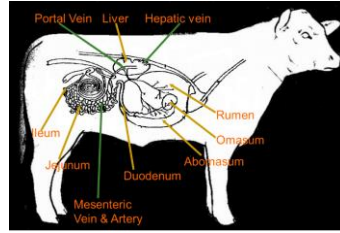


Ribeiro et al. (2016) J. Dairy Sci. 99: 2201-2220

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Disease Reduces Nutrient Balance

- ✓ Control/Fed
 - Fed *ad libitum* and not challenged
- ✓ Control/Fasted
 - Fasted for 72 h (-14 to +58 hours relative to challenge) and not challenged
- ✓ Challenge/Fed
 - Fed *ad libitum* and underwent intra-tracheal challenge with *M. haemolytica*
- ✓ Challenge/Fasted
 - Fasted for 72 h (-14 to +58 hours relative to challenge) and underwent intra-tracheal challenge with *M. haemolytica*



Burciaga-Robles PhD Dissertation (2009)

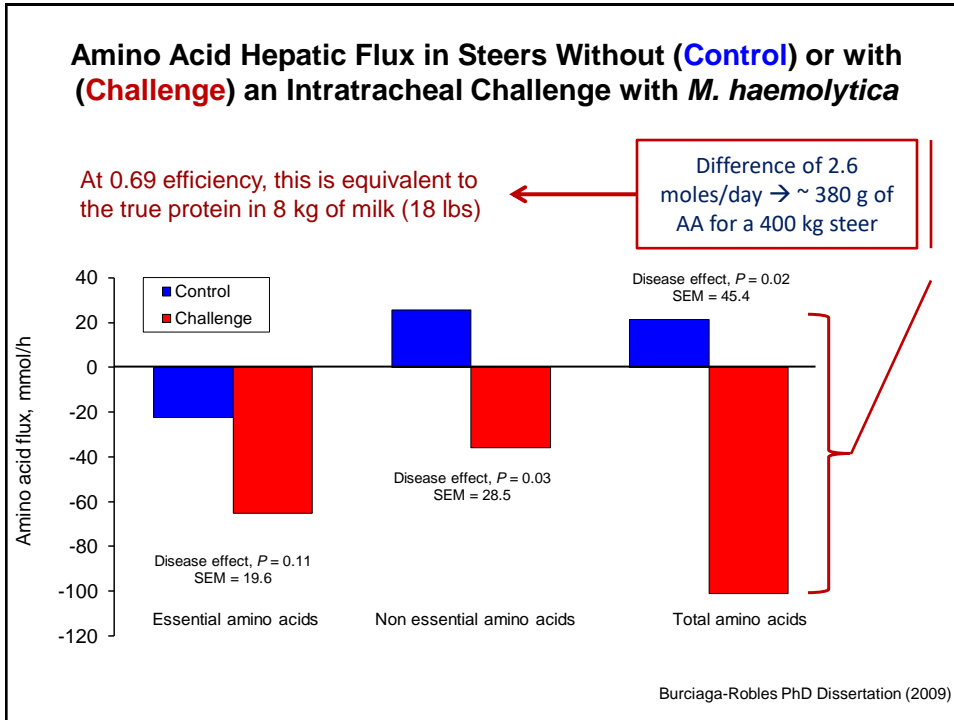
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Two Conditions that Induce Systemic Inflammatory Responses

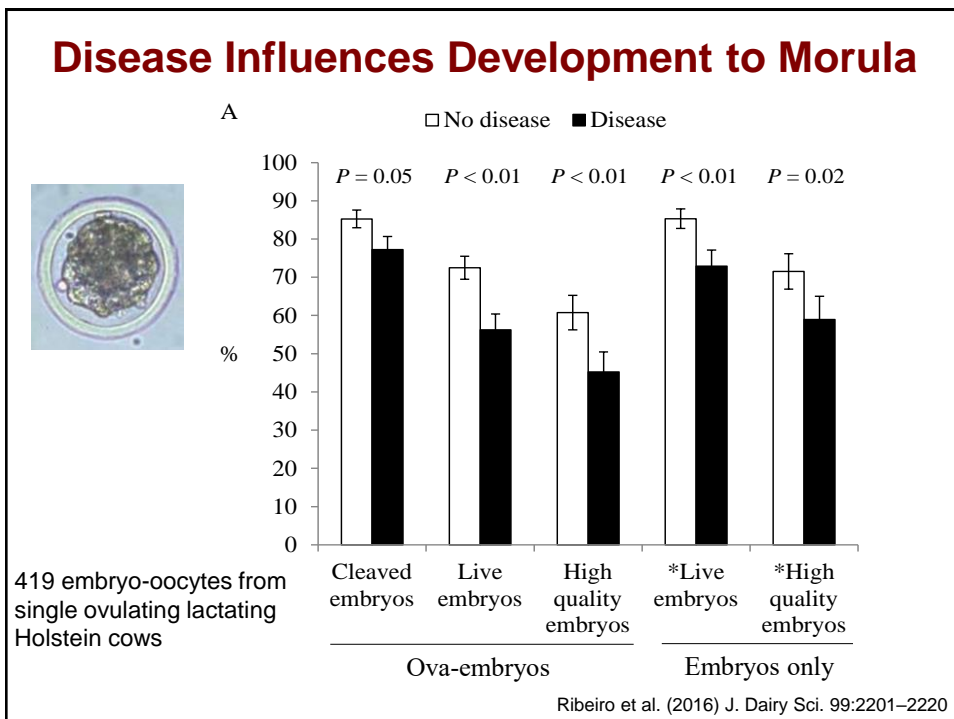


Courtesy of Dr. Klíbs Galvão and Segundo Casaro

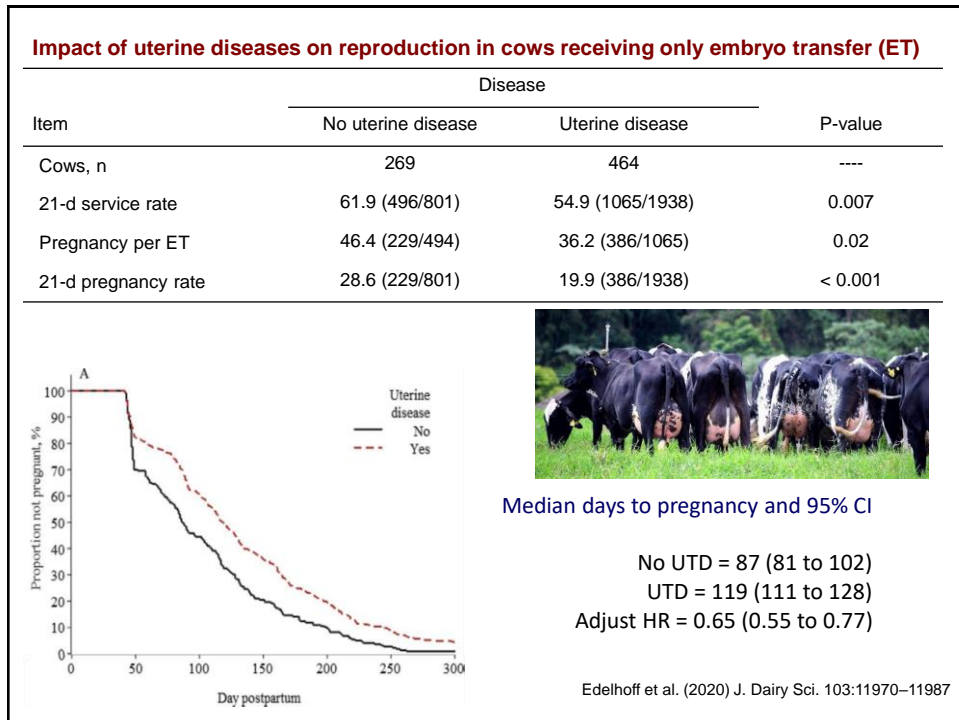
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Bovine Conceptus Changes its Gene and Protein Expression to Allow Maintenance of Pregnancy

Ovoid **Tubular** **Filamentous**

Downregulation of genes that alert the maternal immune system

Tolerance to conceptus alloantigens

Ribeiro et al. (2016) Biol. Reprod. (2016) 94(4):97, 1–18

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Take Home Message

✓ Stimulate DM intake

- ✓ Intake influences nutrient balance that is critical for resumption of ovarian cyclicity
- ✓ Cyclic cows have increased estrous expression, pregnancy per AI, and improved maintenance of pregnancy

✓ Minimize disease

- ✓ Disease causes inflammation and tissue damage, which alters function
- ✓ Alters partition of nutrients to favor control of infection and tissue repair in place of tissue accretion
- ✓ The priority shifts from production/growth to survival
- ✓ Creates long-term negative effects on reproduction

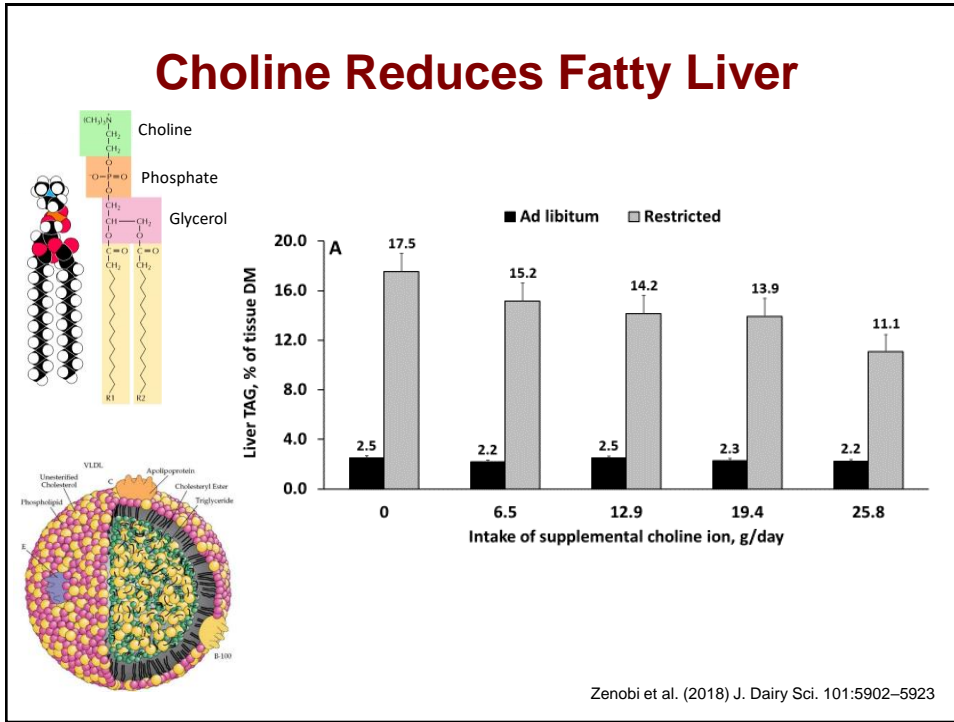
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Diet Formulation to Improve Reproduction

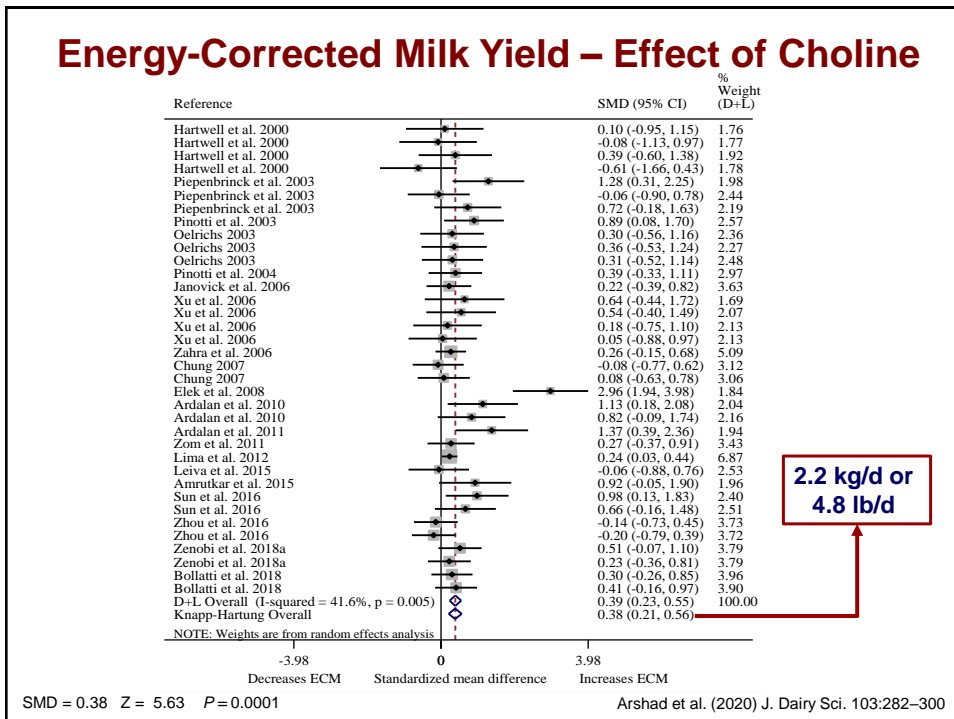
Focus on 2 important concepts

- ✓ Formulate diets that reduce the risk of diseases
- ✓ Supplement diets with nutrients shown to benefit reproduction in cows

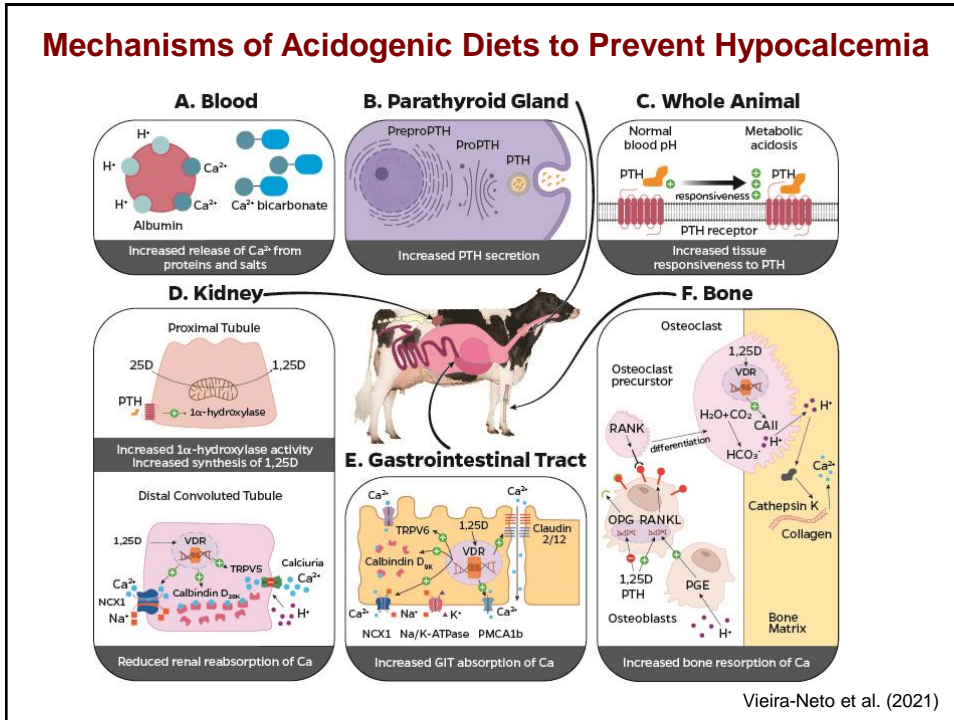
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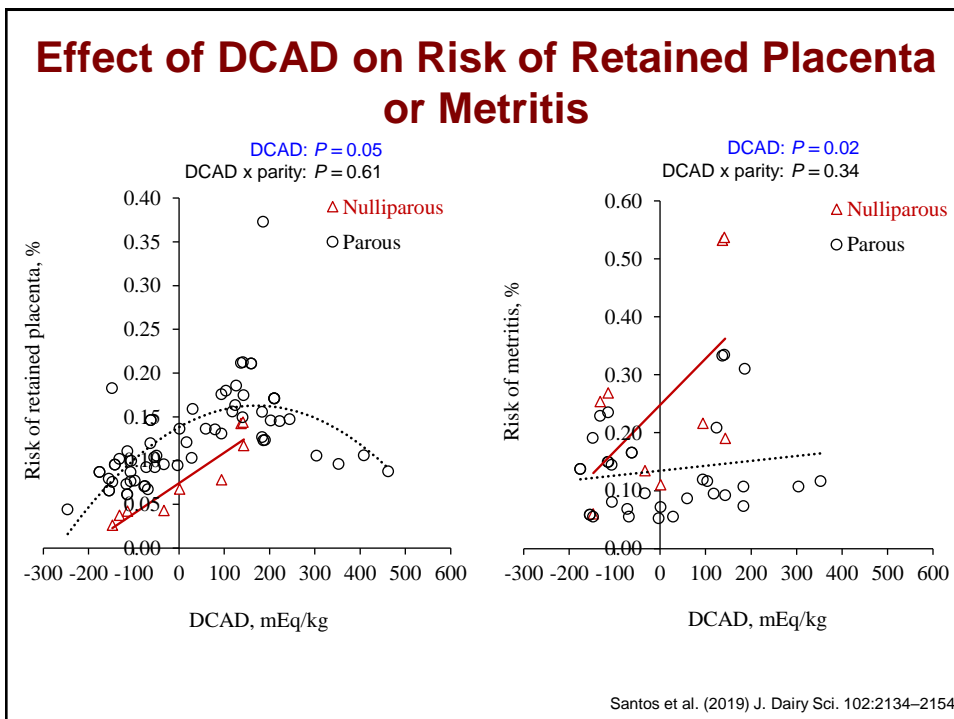
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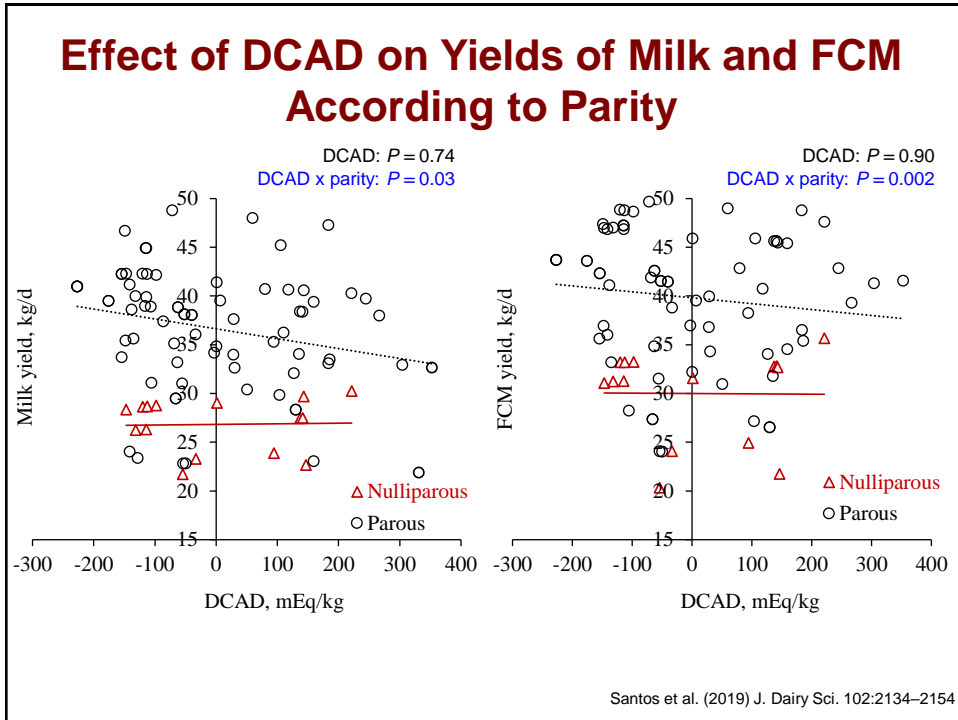
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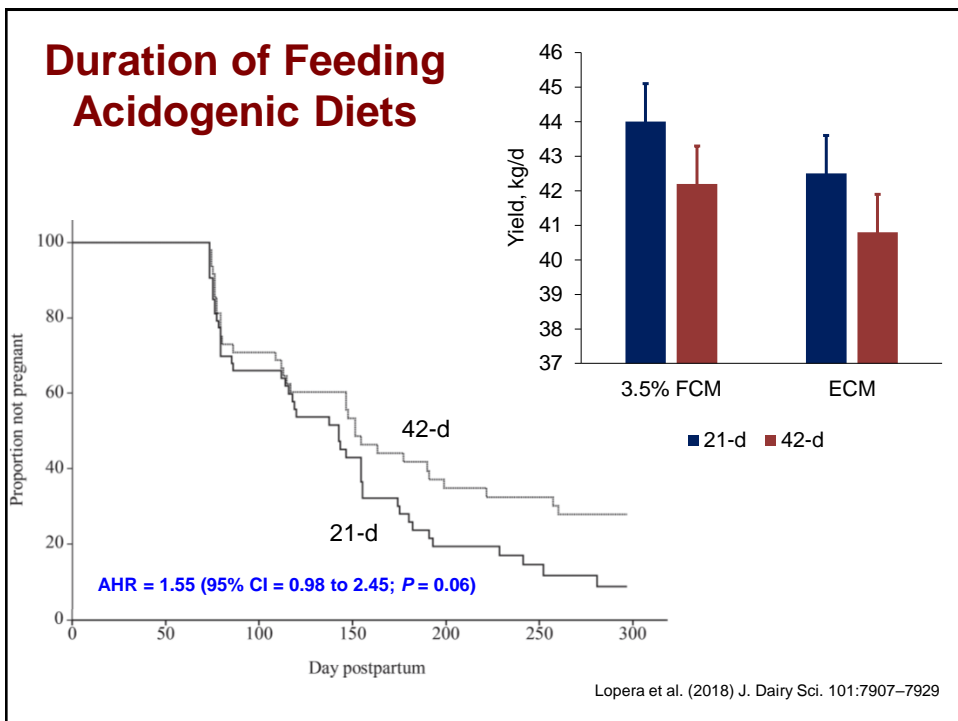
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Typical Lactating Cow Diet

24 kg of dry matter intake (53 lb/d)

Each rectangle represents 1 or 0.5 kg of DM of the diet

Production of 41 kg of milk with 3.70% fat and 3.20% protein (95 lbs of ECM)

Low quality forage → inclusion is **limited**

Forage		Forage		Forage		Forage	
Forage		Forage		Forage		Forage	
Forage		Forage		Corn	Corn	Corn	Corn
Corn	Corn	Corn	Corn	Corn	Corn	Corn	Byproduct
Byproduct	Byproduct	Byproduct	Byproduct	Byproduct	Byproduct	Byproduct	Byproduct
Prot	Prot	Prot	Prot	Prot	Prot	Prot	MinVit

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Typical Lactating Cow Diet

24 kg of dry matter intake (53 lb/d)

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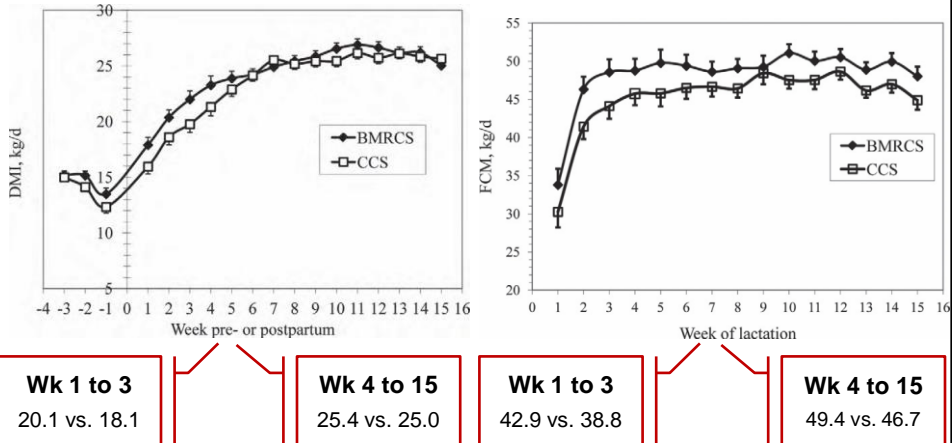
Production of 41 kg of milk with 3.70% fat and 3.20% protein (95 lbs of ECM)

High-quality forage → feed **50 to 60% of the TMR as forage**

Forage		Forage		Forage		Forage	
Forage		Forage		Forage		Forage	
Forage		Forage		Forage		Forage	
Corn	Corn	Corn	Corn	Corn	Corn	Corn	Corn
Byproduct	Byproduct	Byproduct	Byproduct	Byproduct	Byproduct	Byproduct	Byproduct
Prot	Prot	Prot	Prot	Prot	Prot	Prot	MinVit

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Corn Silage Quality in Transition Cow Diets

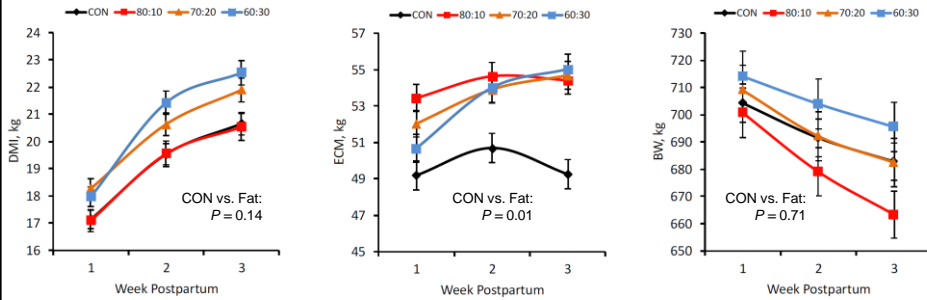


BMR corn silage vs. conventional corn silage from 3 wk pre- to 3 wk postpartum

Stone et al. (2012) J. Dairy Sci. 95:6665-6676

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Supplement Moderate Amounts of Fatty Acids to Postpartum Diets



56 cows, 14/treatment

CON = control, no fat supplementation

Fatty acids supplemented at 1.5% of diet DM with different ratios of C16:0 to C18:1

Diets fed for the first 21 DIM

de Souza et al. (2021) J. Dairy Sci. 104:2896-2909

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Meta-Analysis of Fatty Acid Supplementation During the Transition Period

- ✓ 17 experiments and 26 comparisons with 1,385 cows
- ✓ 7 different fat sources
- ✓ Effects of lipid supplementation
 - ✓ 27% increase in risk of pregnancy per AI (e.g., 32 vs. 40%)
 - ✓ Days open tended to be reduced
 - ✓ Milk yield tended to increase
 - ✓ Concentration of milk fat unchanged and milk protein tended to decrease
 - ✓ Body weight unchanged

Diets for early lactation cows should contain 1 to 1.5% supplemental fat to result in 4 to 5% total fatty acids (DM basis)

Rodney et al. (2015) J. Dairy Sci. 98:5601-5620

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Summary of Diet Manipulations

Prepartum

- ✓ Feed prepartum diets to supply 17 Mcal of NE/d (~ 1.45 Mcal/kg or 0.65 Mcal/b)
- ✓ Supplement rumen-protected choline pre- and early postpartum
 - ✓ At least 13 g of choline ion
- ✓ Formulate prepartum diets with a DCAD of ~ -100 mEq/kg for parous cows
 - ✓ Plan for 3 weeks in the close-up pen (move at 255 d of gestation)
- ✓ Formulate prepartum diets for parous and nulliparous cows separately
 - ✓ Nulliparous need more MP prepartum (~ 1,100 g/d) which is achieved with diets with 14 to 15% CP
 - ✓ Parous cows require less MP (~ 800 to 900 g/d), which can be achieved with 12 to 13% CP

Postpartum

- ✓ Prioritize high-quality forages during the transition period
 - ✓ Better, healthier, and often cheaper
- ✓ Watch the protein content of early lactation diets
 - ✓ 17 to 18% CP (12-12.5% MP), 2.5% of MP as methionine and 7.1% of MP as lysine
- ✓ Supplement moderate amounts of FA to improve fertility (1 to 1.5% diet DM in early lactation)
 - ✓ Effects differ with source of FA fed

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