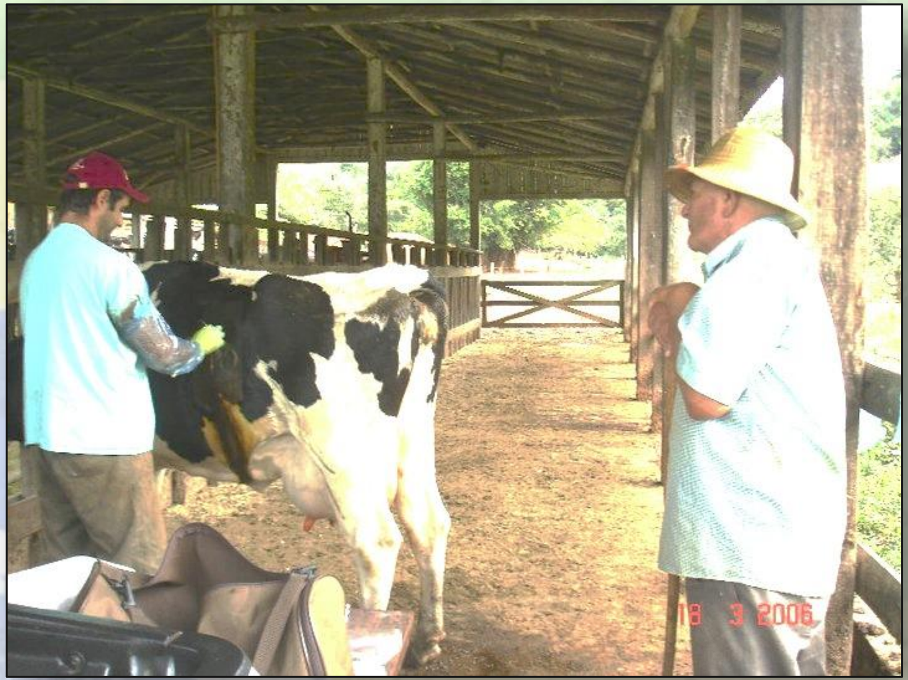
Reproduction of dairy cows – how much depends on protein and AA intake?

Phil Cardoso DVM, MS, PhD

Associate Professor

UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

Dairy Focus Lab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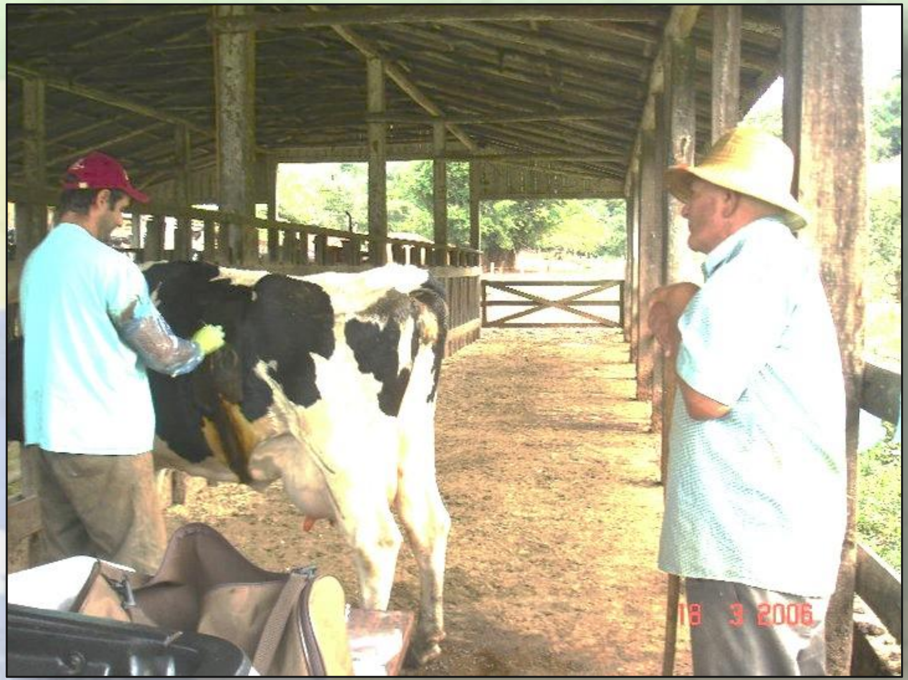
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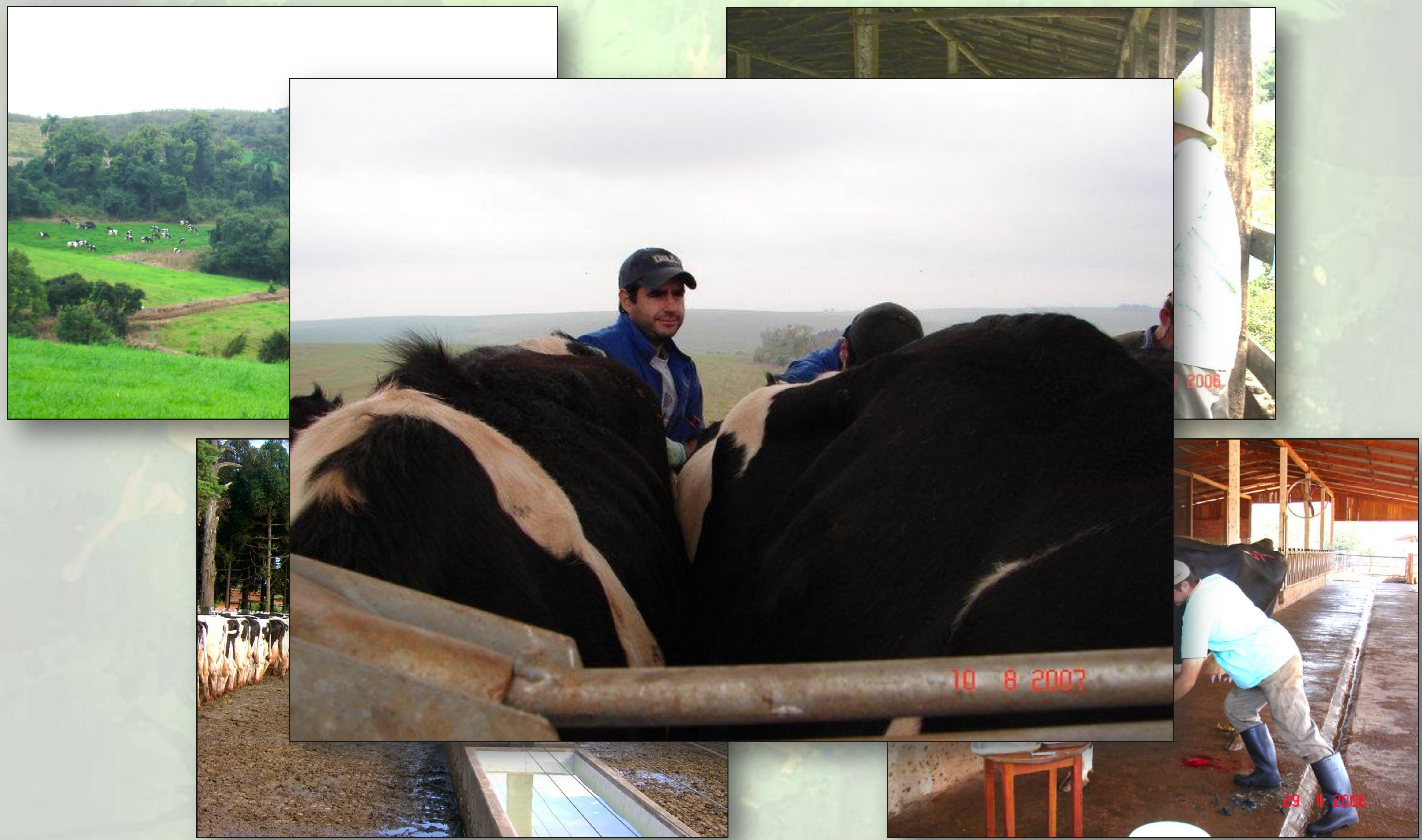
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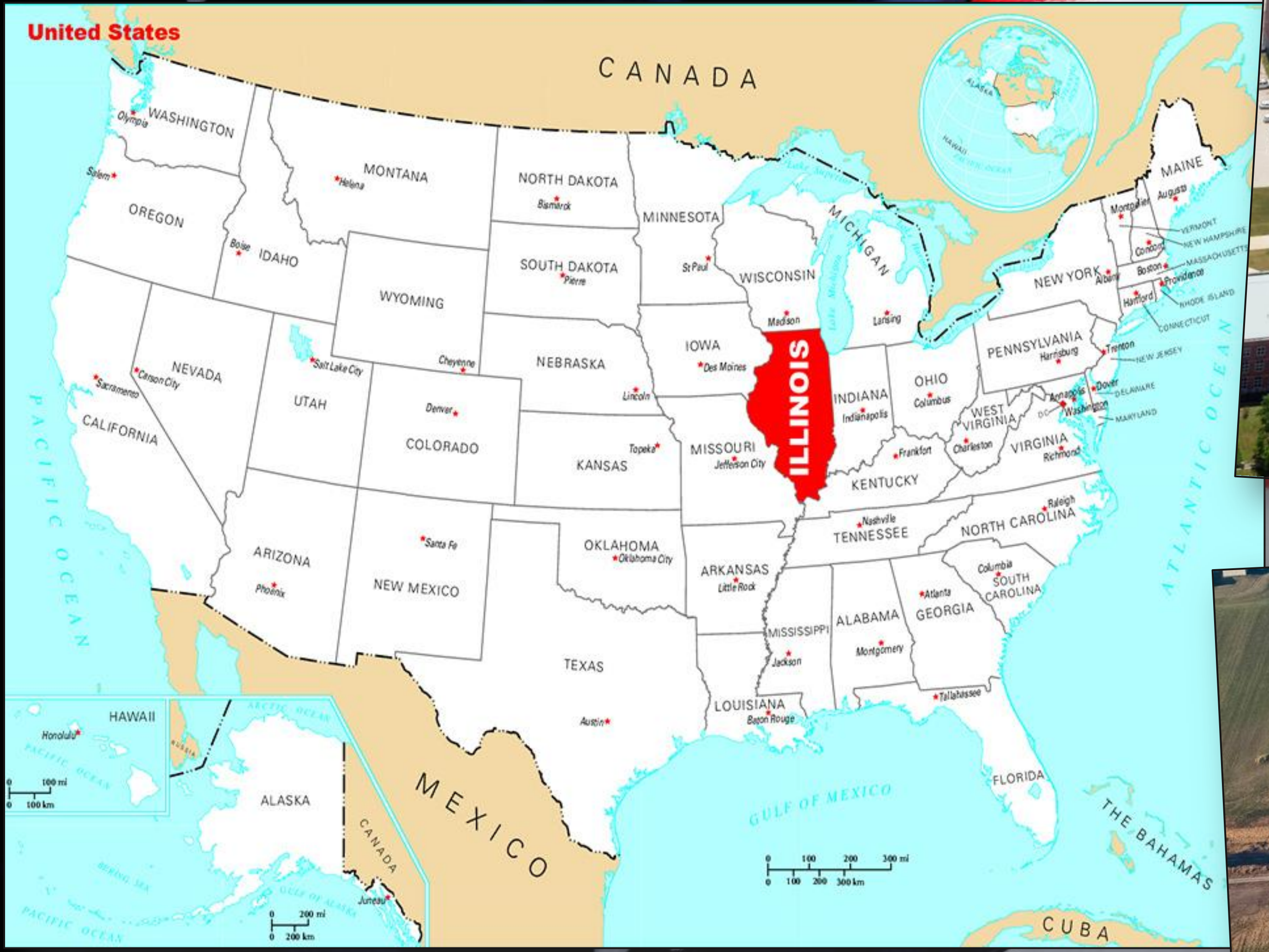
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Juneau
MEXICO
GULF OF MEXICO
CUBA
THE BAHAMAS
PACIFIC OCEAN
ATLANTIC OCEAN


Livestock species have different limiting nutrients according to their main output

Most limiting amino acid(s):

- Wool → arginine and sulfur amino acids (i.e., methionine)
- Lambs → methionine, and lysine, histidine and arginine

- Feathers and eggs → methionine and cysteine

- Meat

  - Swine and beef → lysine
  - Broilers → methionine and lysine

- Milk → methionine and lysine

National Research Council

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and cysteine

Impacts of supplemental arginine on the reproductive performance of fall lambing ewes

A. R. Crane, R. R. Redden, M. L. Van Emon, T. L. Neville, L. P. Reynolds, J. S. Caton, C. S. Schauer

Journal of Animal Science, Volume 94, Issue 8, August 2016, Pages 3540–3549,
https://doi.org/10.2527/jas.2016-0379

Published: 01 August 2016 **Article history** ▾

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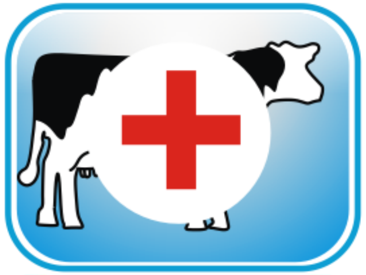
So, What do we want from this cow?

We should feed and manage dry and transition cows to:

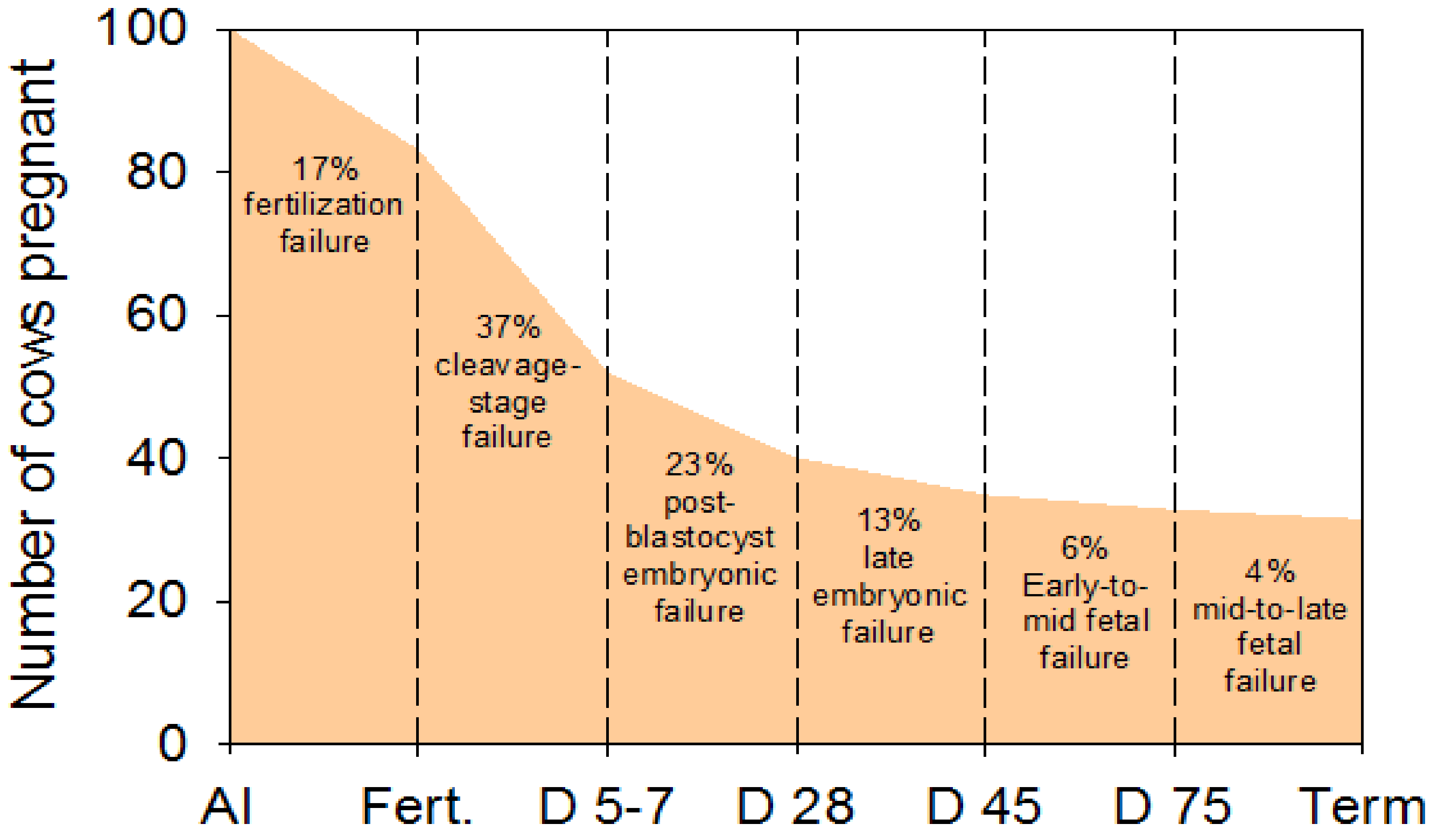
1. Minimize health disorders



2. Maximize production

3. Maximize reproduction

Embryonic and fetal losses from conception to term in lactating dairy cows



Hansen, *Rev Bras Reprod Anim* 2011

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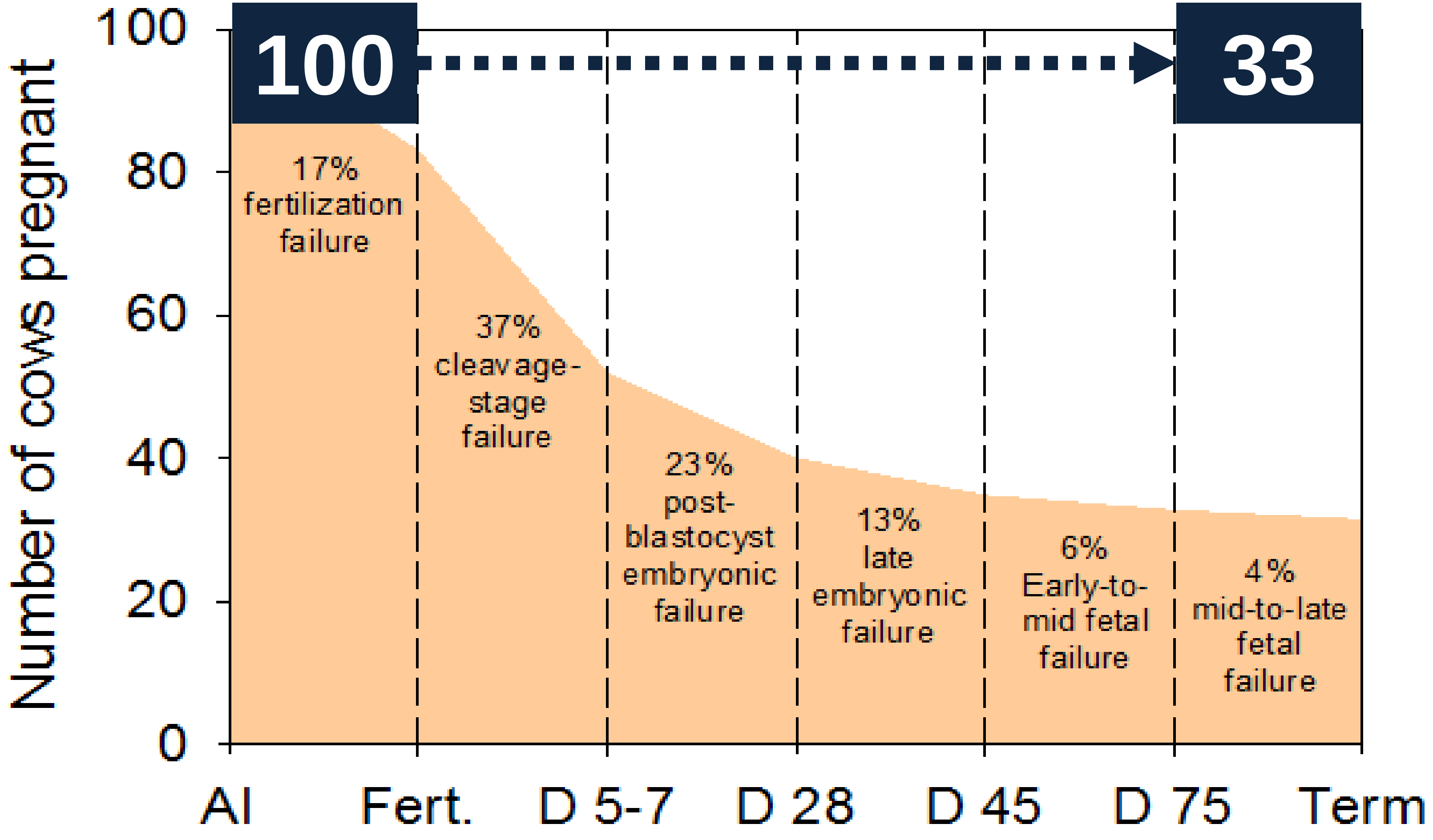

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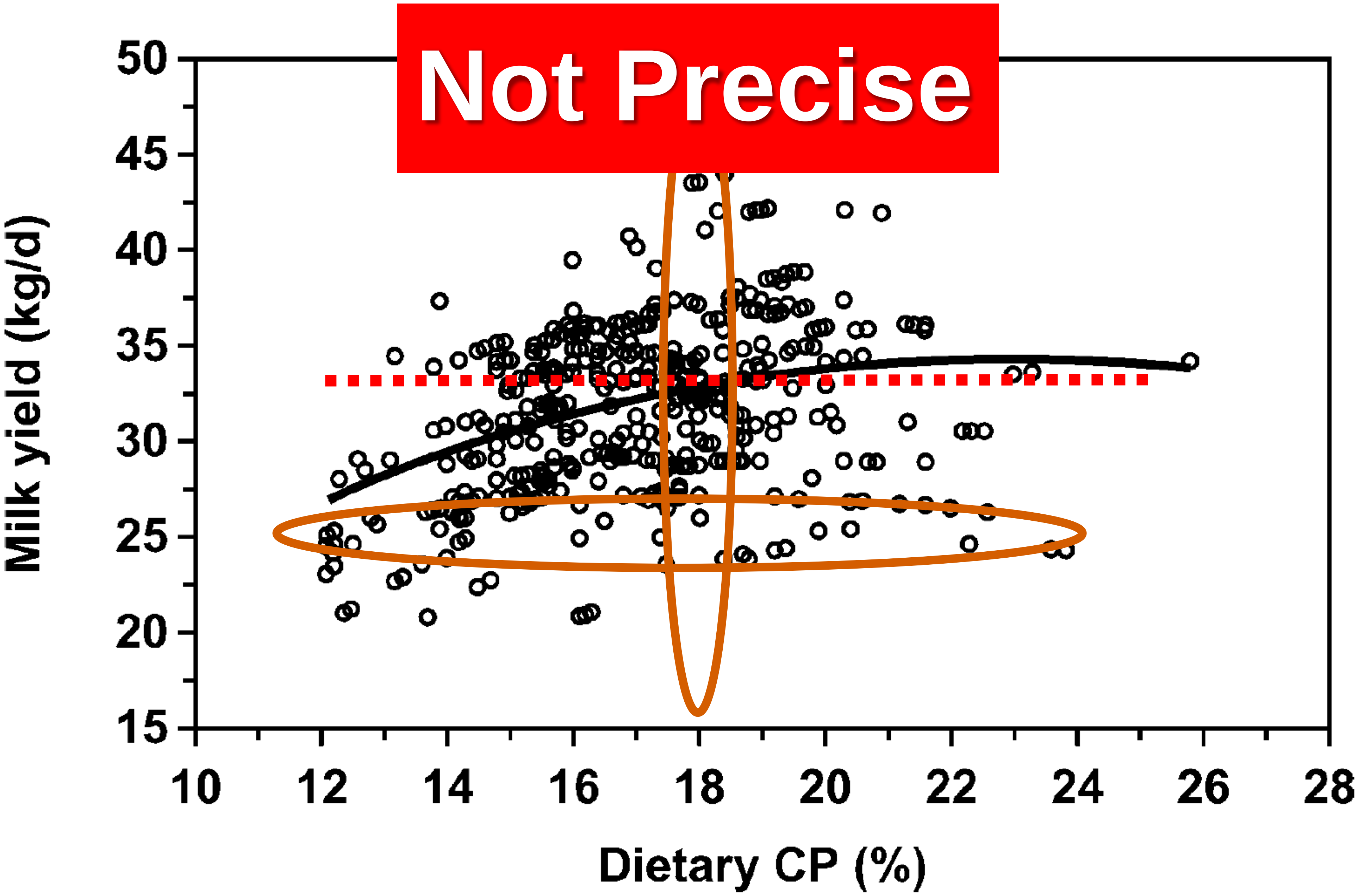
The right diet

Let’s be precise. I believe WE can do it!

https://www.youtube.com/watch?v=HyLoRyKvZvE

Relationship between milk yield and dietary CP (%) for lactating dairy cows



Ipharraguerre and Clark, 2005

Diet Formulation – Precision Feeding

Diet Formulation – Precision Feeding

Ration Outputs | AA Supp. Tool | CNCPS | Min & Vit | Additives | Amino Acids | Met E & P | P & E

Units			Current	Desired	grams Req.
◉ % MP ◯ grams ◯ g/Mcal		MET	2.83	0.00	0
		LYS	7.56	0.00	0

Feed	MET			LYS	
	lbs/day	$/hd		lbs/day	$/hd

Fehlberg et al., 2020

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Units		Current	Desired	grams Req.
( ) % MP (•) grams ( ) g/Mcal	MET	33.38	0.00	0
	LYS	89.28	0.00	0

Feed	MET		LYS	
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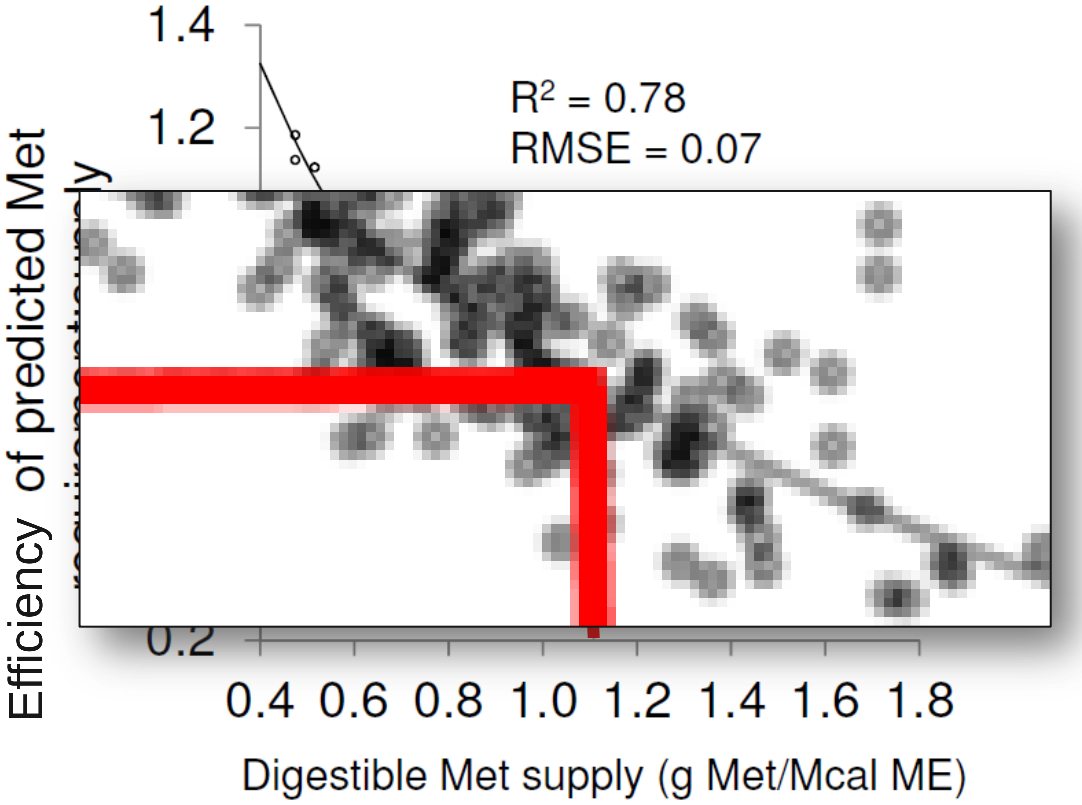
Units				Current	Desired	grams Req.
( ) % MP ( ) grams (●) g/Mcal			MET	1.18	0.00	0
			LYS	3.16	0.00	0
Feed			MET			LYS
	lbs/day	$/hd		lbs/day	$/hd	

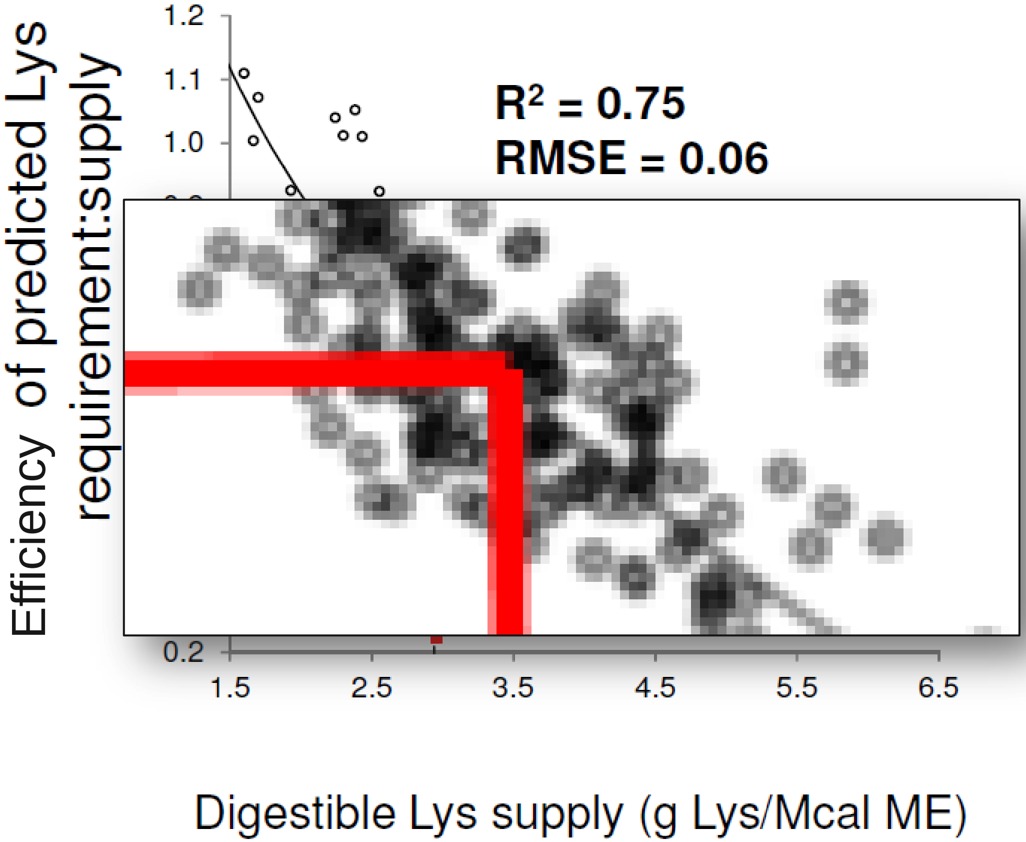
Fehlberg et al., 2020

Diet Formulation – Precision Feeding

Methionine



Lysine



Adapted from Van Amburgh, 2019

Effects of Precision Essential Amino Acid Formulation on a Metabolizable Energy Basis for Lactating Dairy Cows

- One hundred and forty-four (n = 144) Holstein cows [26 primiparous and 118 multiparous; 2.9 ± 1.4 lactations; 92 ± 24 DIM at enrollment] were enrolled in a 114 day longitudinal study.
- Cattle were blocked into 16 cow pens (free stall) and balanced for parity, DIM, previous lactation performance, and current body weight.
- Each pen was fed TMR once daily at approximately 0600 h and pens were targeted for 5% refusal rate. All nine pens were fed the POS diet during a 14 day covariate period and randomly assigned to one of three diets described above for the remaining 100 d.

LaPierre et al., 2019

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	-1 SD		+1 SD
Item	Negative	Neutral	Positive
CP, % of DM	14.04	14.75	15.95
Soluble fiber, % of DM	6.01	5.55	5.05
ADF, % of DM	20.79	19.96	19.77
NDF, % of DM	32.39	31.03	31.39
uNDF240, % of NDF	25.5	29.09	28.73
Lignin, % of NDF	8.06	9.65	8.73
Starch, % of DM	29.82	29.31	29.30
Sugar. % of DM	3.95	4.06	3.9
Ether extract, % of DM	3.49	3.61	3.78
Ash, % of DM	6.60	6.92	6.57
Metabolizable Energy, Mcal/kg of DM	2.58	2.60	2.61
Methionine, g	71.44	78.30	92.67
Methionine, g AA/Mcal ME[1]	1.01	1.09	1.29
Lysine, g	201.70	222.12	250.07
Lysine, g AA/Mcal ME[1]	2.84	3.00	3.49
Histidine, g	62.78	70.42	83.81
Histidine, g AA/Mcal ME[1]	0.88	0.98	1.17

[1] formulated

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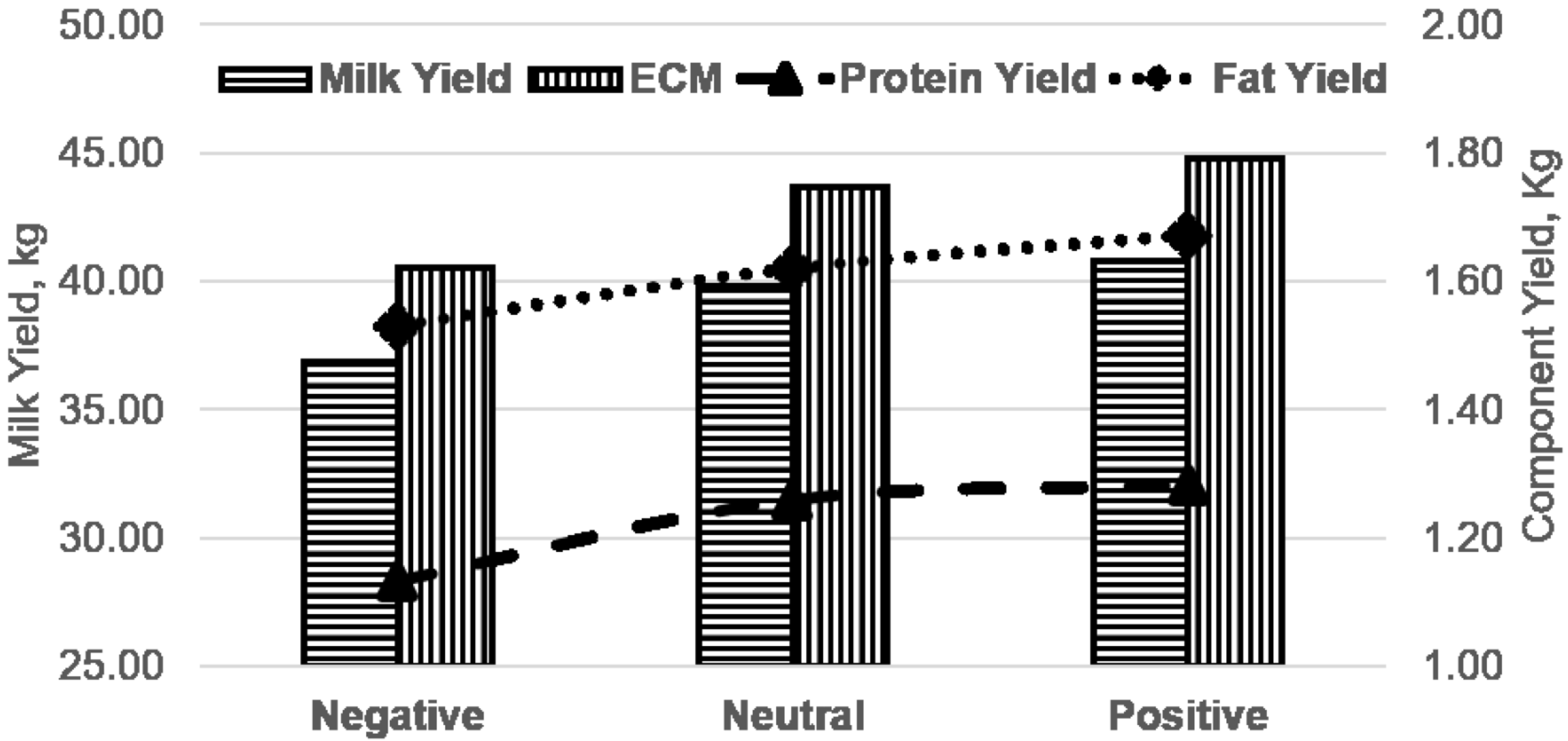
Cows fed ***Neutral*** produced similar levels of energy corrected milk and yield similar production of fat components when compared to cows fed the ***Positive*** treatment



No difference in dry matter intake (~28 kg/d)

LaPierre et al., 2019

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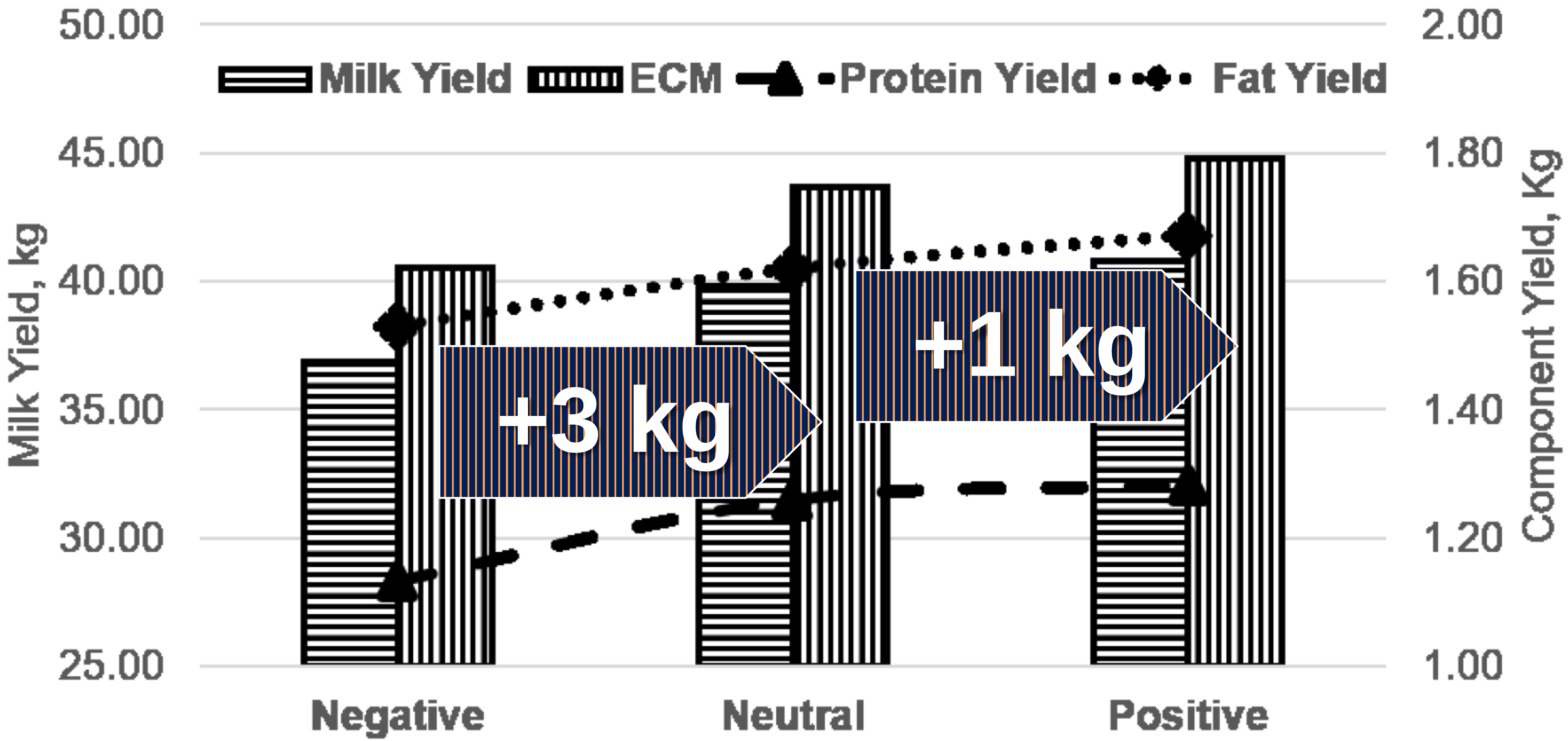

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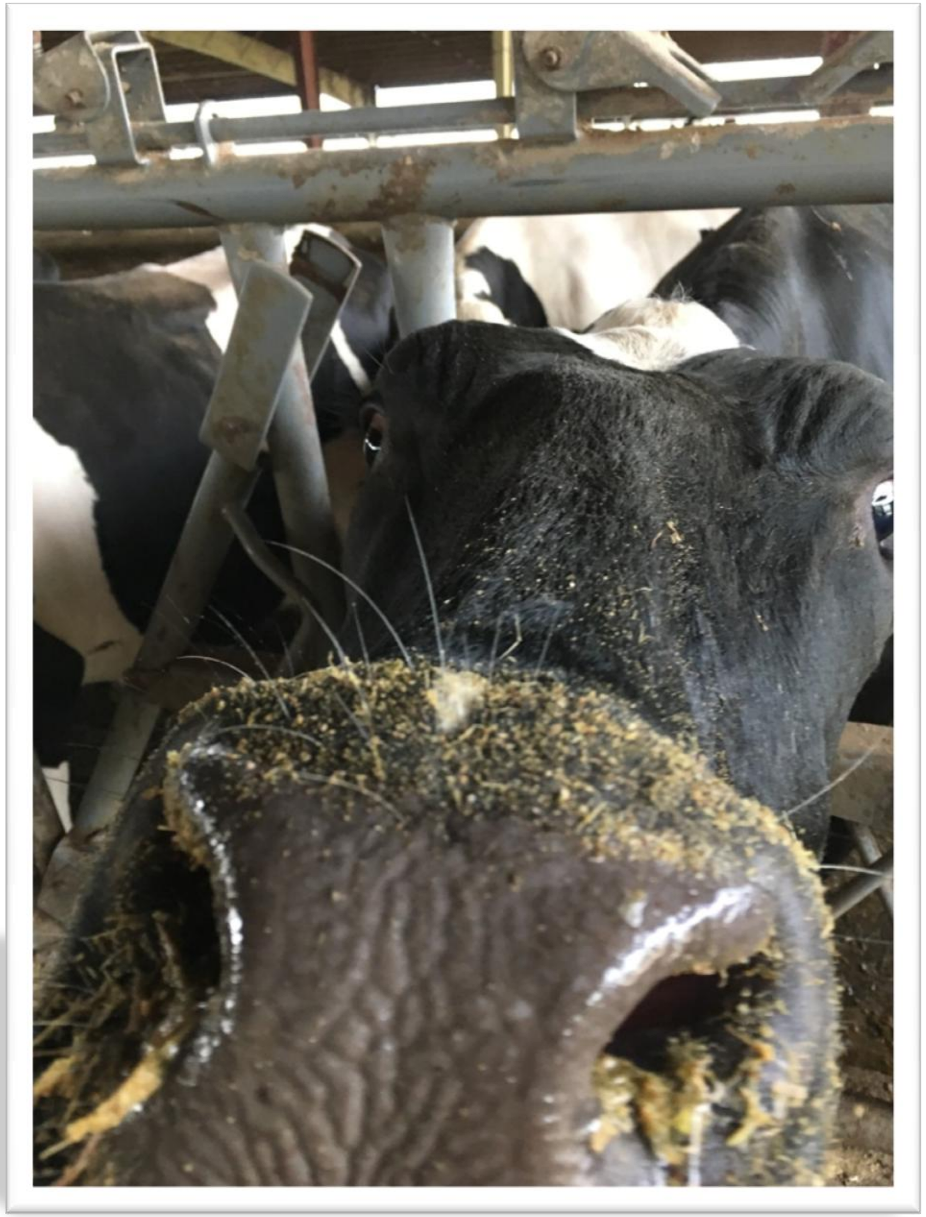
How about dry cows?



The right diet

Dietary Recommendations for Dry Cows

- **NEL:** Control energy intake at 18 to 20 Mcal daily [diet ~ 1.39 Mcal/kg (0.63 Mcal/lb) DM] for mature cows
- **Crude protein:** 12 – 14% of DM
- **Metabolizable protein (MP):** > 1,200 g/d
- **Starch content:** 12 to 15% of DM (NFC < 26%)
- **NDF from forage:** 40 to 50% of total DM or 4.5 to 6 kg per head daily (~0.7 – 0.8% of BW). Target the high end of the range if more higher-energy fiber sources (like grass hay or low-quality alfalfa) are used, and the low end of the range if straw is used (2-5 kg)
- **Total ration DM content:** <50% (add water if necessary)
- **Minerals and vitamins:** follow guidelines (For close-ups, target values are 0.40% magnesium (minimum), 0.35 – 0.40% sulfur, potassium as low as possible (Mg:K = 1:4), a DCAD of near zero or negative, calcium without anionic supplementation: 0.9 to 1.2% (~125g) calcium with full anion supplementation: 1.5 to 2.0% (~200g), 0.35 – 0.42% phosphorus, at least 1,500 IU of vitamin E, and 25,000 – 30,000 IU of Vitamin D (cholecalciferol)

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MUN is Negatively Associated with the First AI Conception Rate in Lactating Dairy Cows

No effect on subsequent AI

Guo et al., 2004

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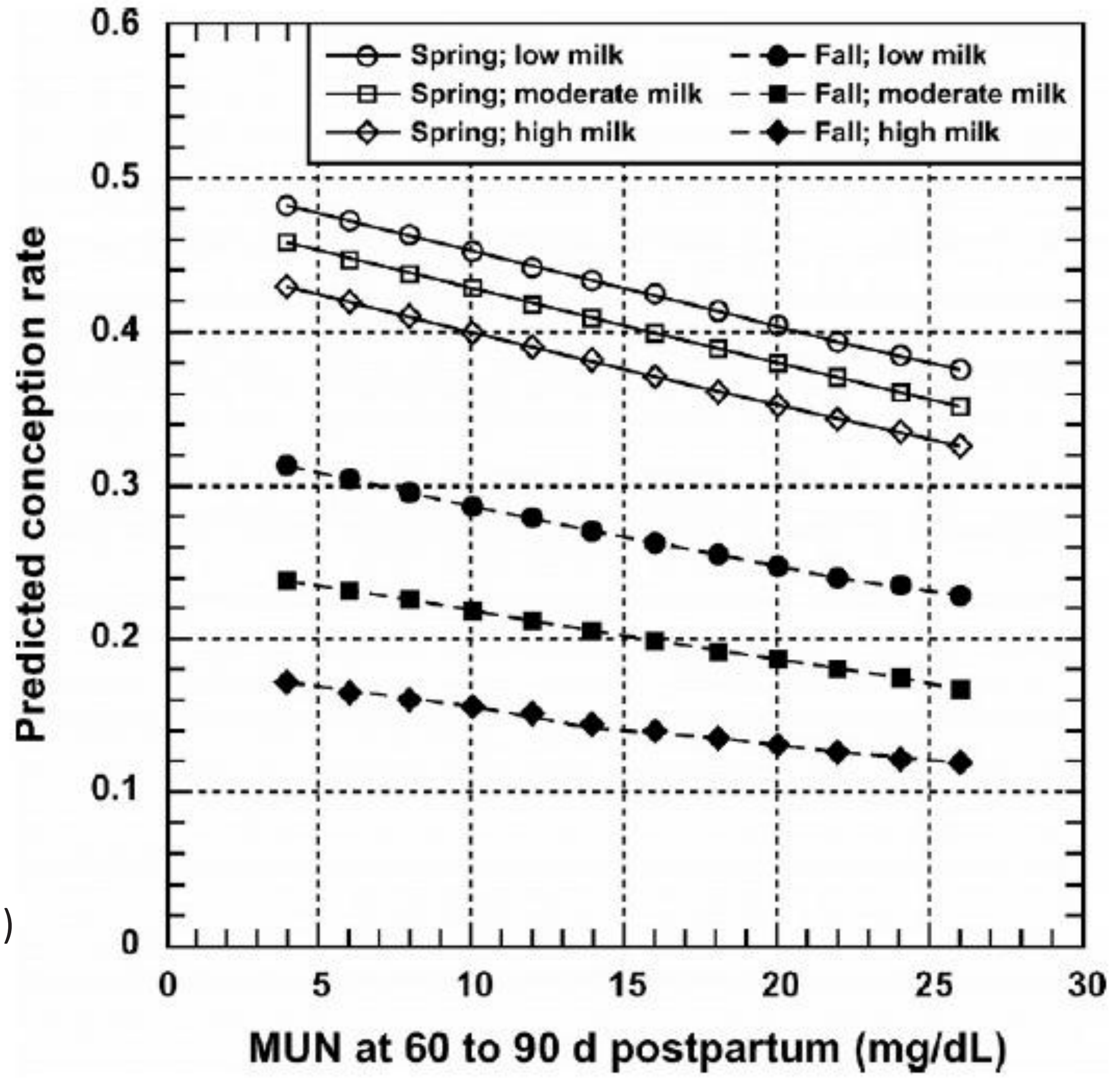
Low milk production = 56 lb/d (25.4 kg/d)
Moderate milk production = 83 lb/d (37.6 kg/d)
High milk production = 113 lb/d (51.2 kg/d)



A total of 10,271 cows from 713 herds were selected

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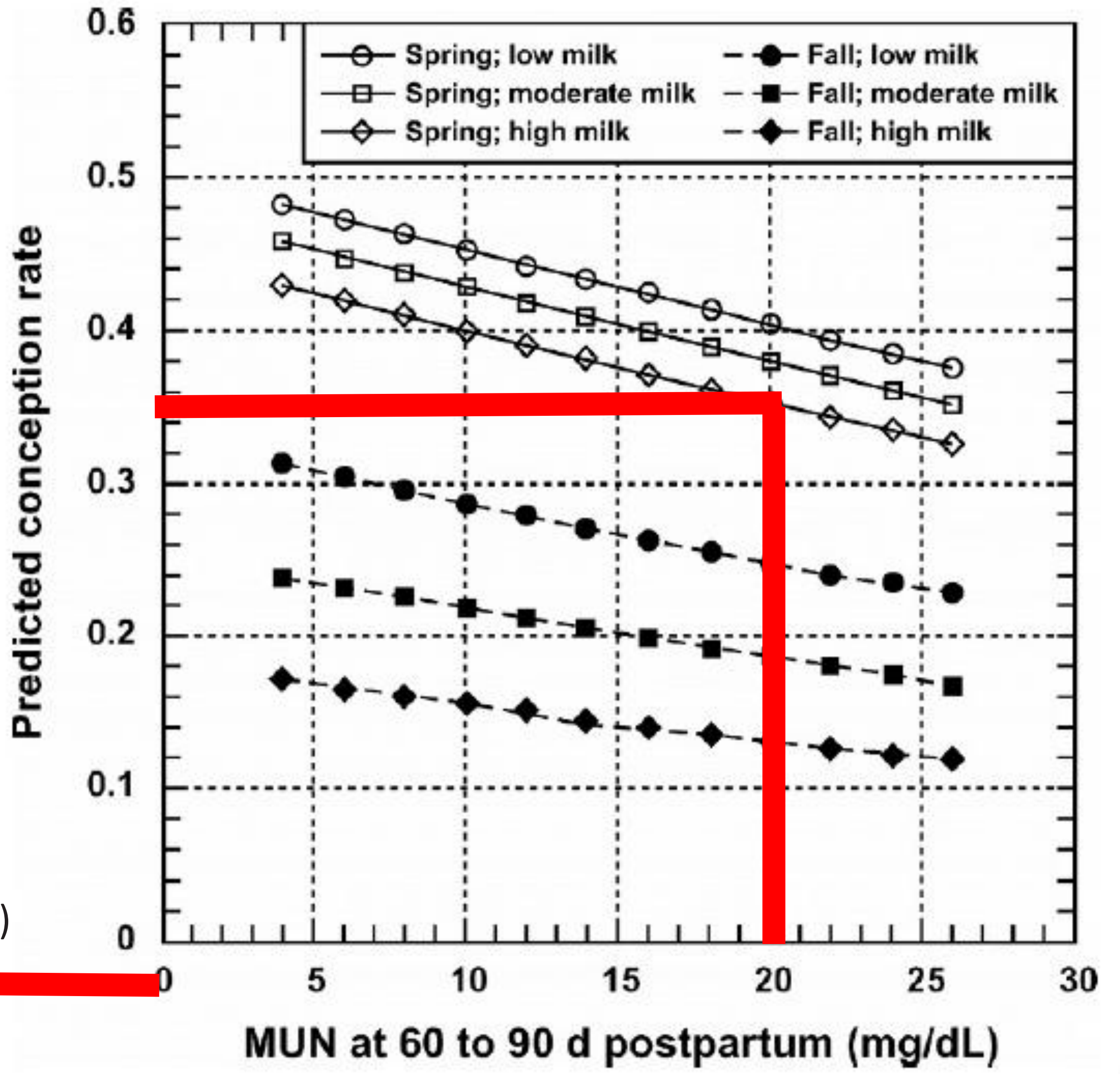

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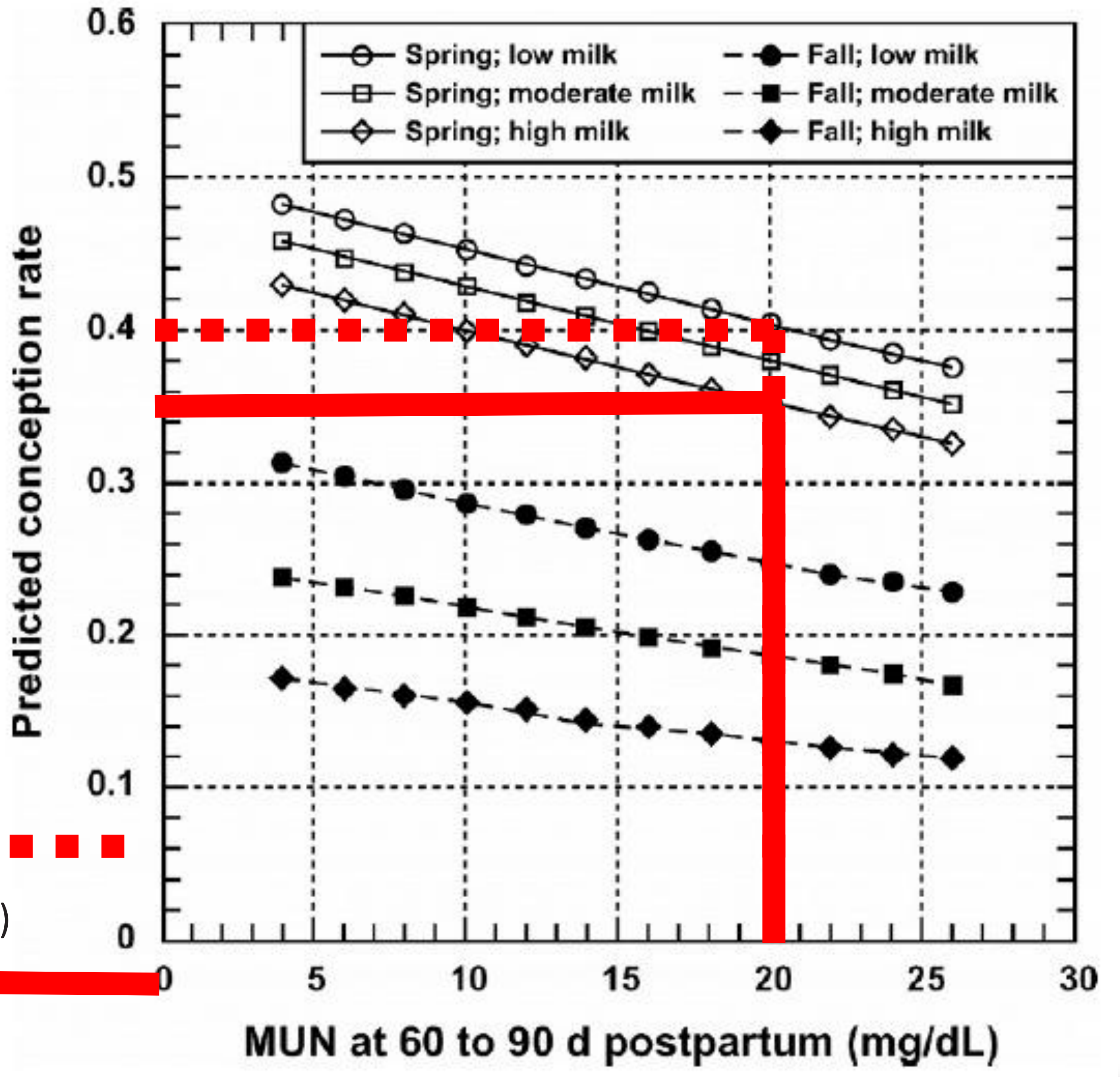

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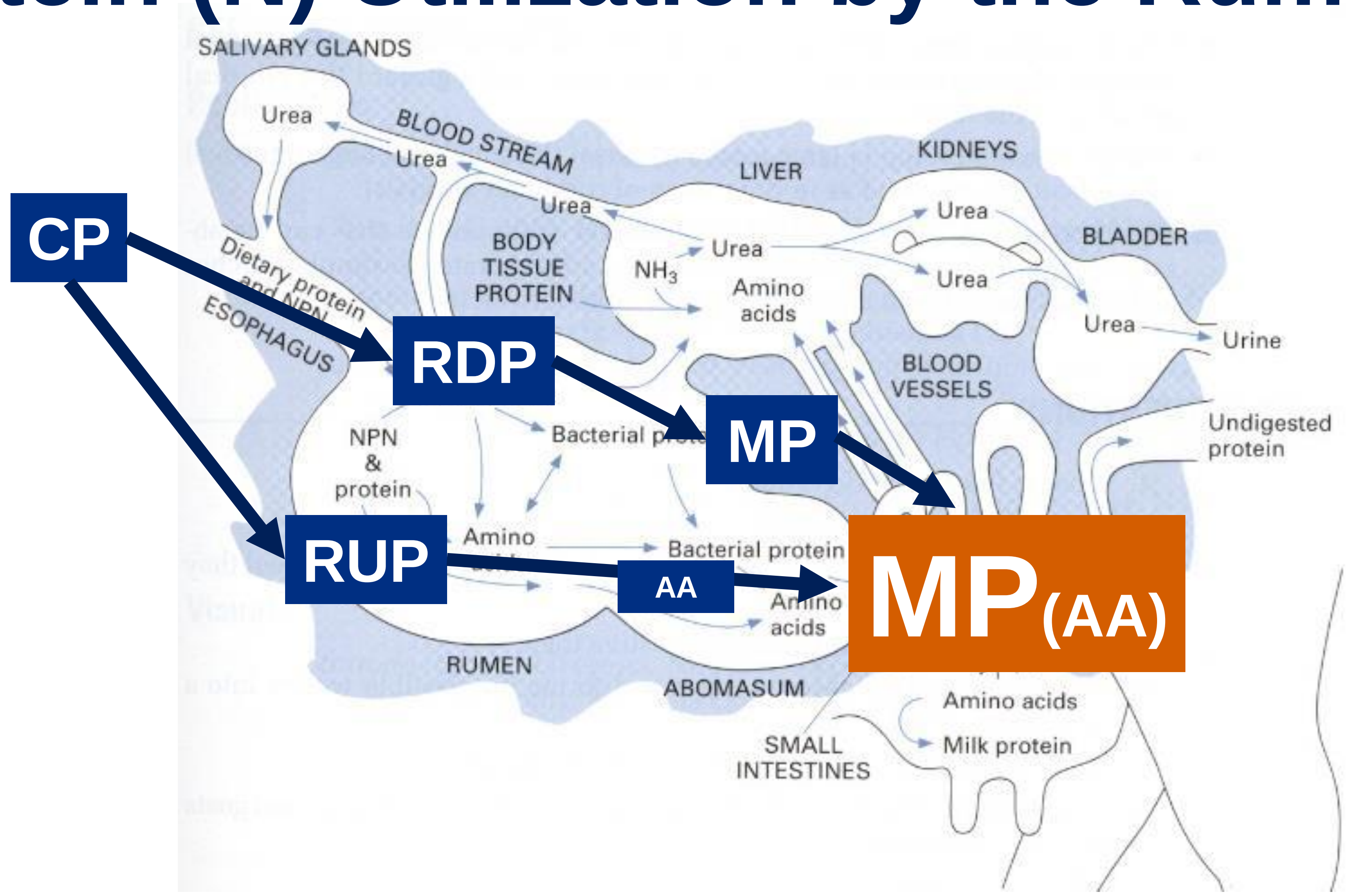
Protein (N) Utilization by the Ruminant



J. Bryant and B. R. Moss, Montana State University

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Met
Lys

CNCPS v6.55

1.17 g Met / Mcal of ME (1.05 – 1.10)

2.7:1 Lys:Met

2.9 – 3.20 g Lys / Mcal of ME

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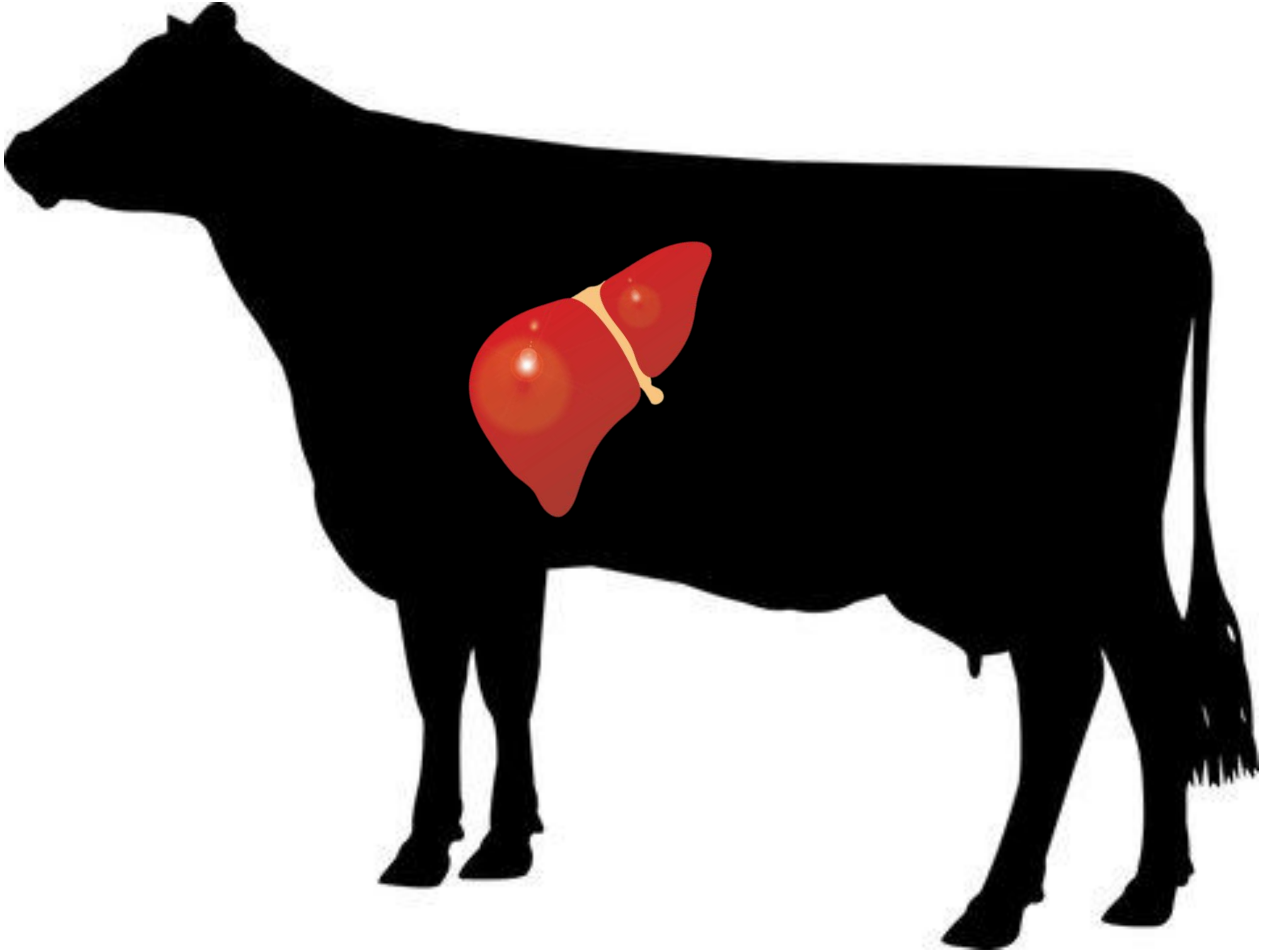


Liver Functionality Index: LFI

Uses changes in plasma concentrations of several blood biomarkers
(i.e., albumin, cholesterol, and bilirubin)

- **Low LFI (LLFI)** is indicative of a pronounced inflammatory response and less favorable circulating AA profile, which together suggest a more difficult transition from gestation to lactation

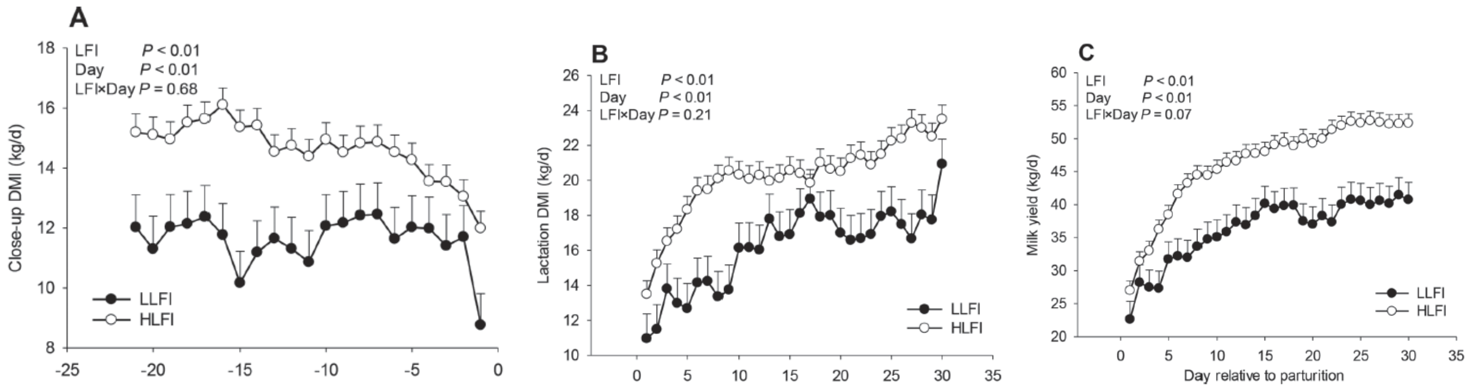
- **High LFI (HLFI)** is suggestive of a smooth transition

A tendency ($P = 0.06$) for a greater number of Met-supplemented cows in the HLFI was observed

Trevisi et al., 2012; Zhou et al., 2017

Rumen-protected methionine improves LFI in dairy cows during the peripartal period

A tendency for a greater (P = 0.06) number of Met-supplemented cows in the HLFI was observed



Zhou et al., 2017

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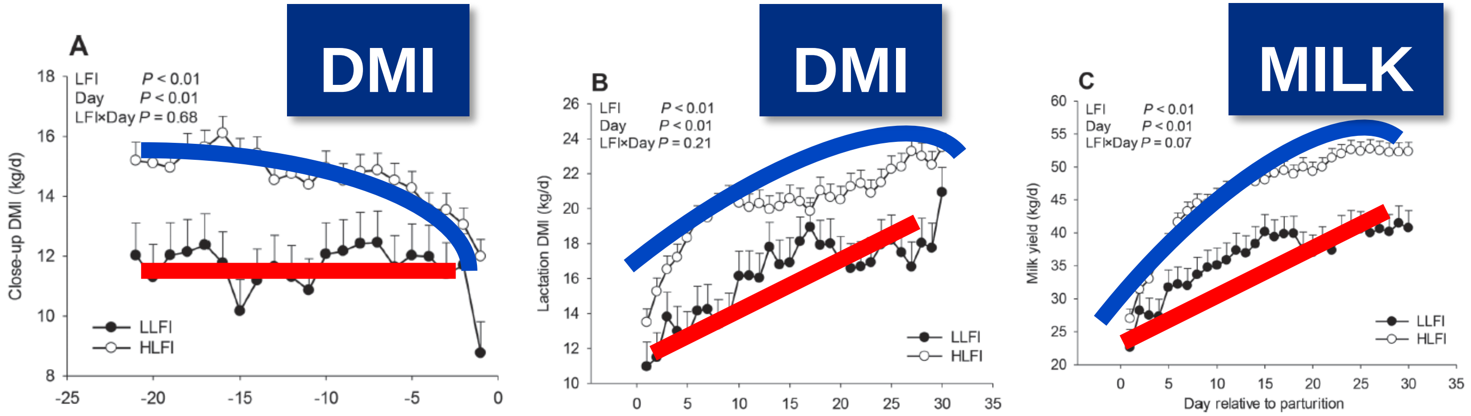

Low LFI

High LFI

Zhou et al., 2017

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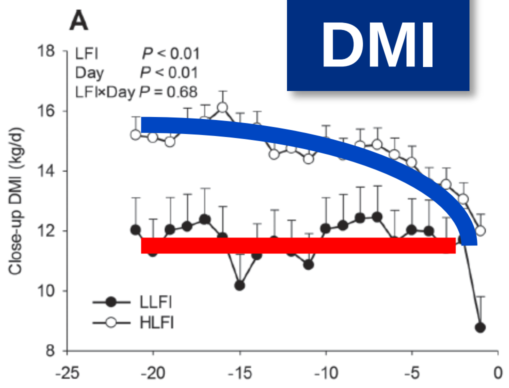

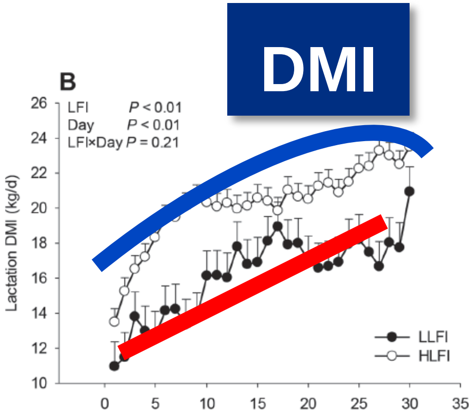

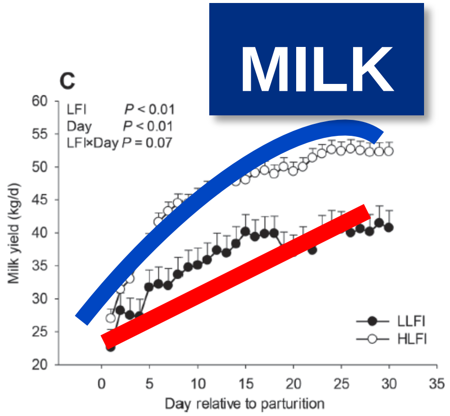

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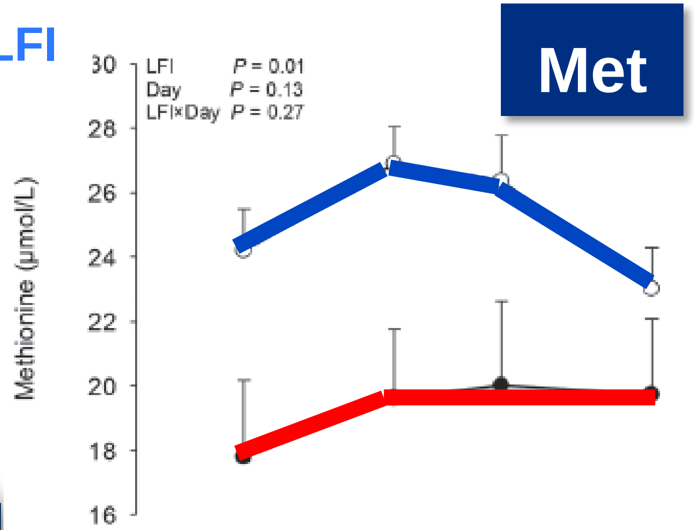
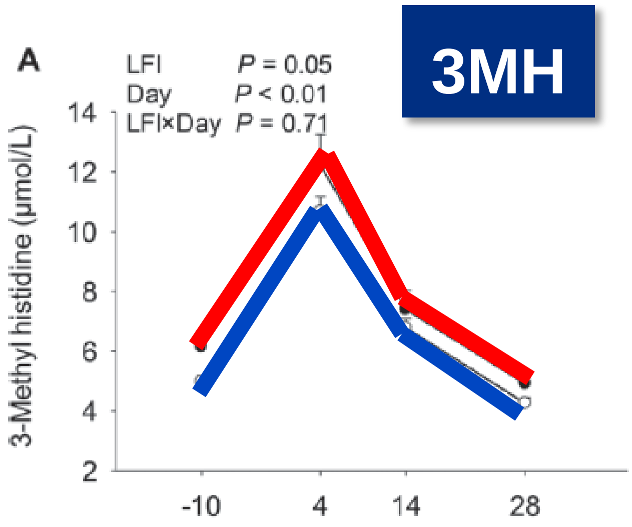
High LFI

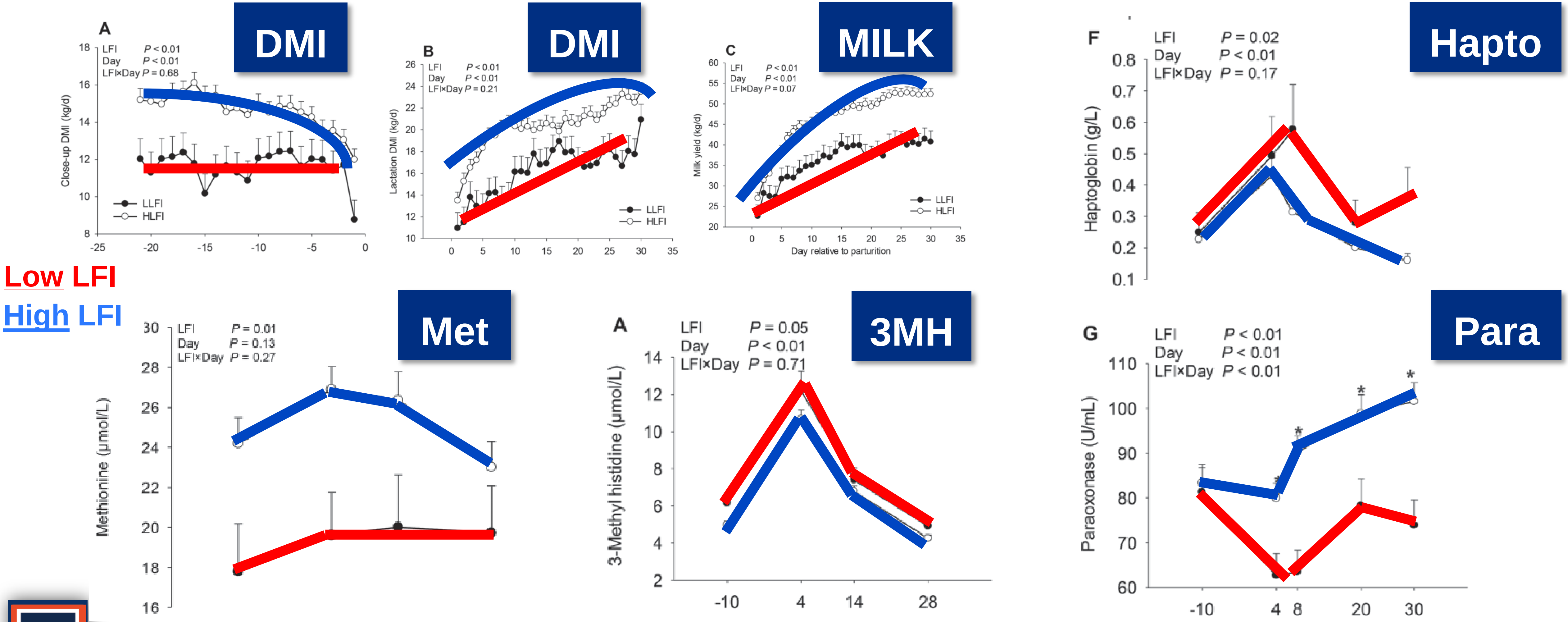




Zhou et al., 2017

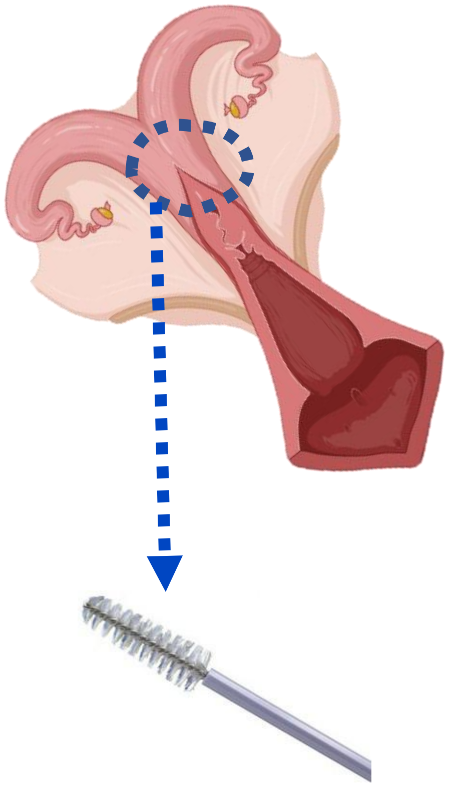
Rumen-protected methionine improves LFI in dairy cows during the periportal period

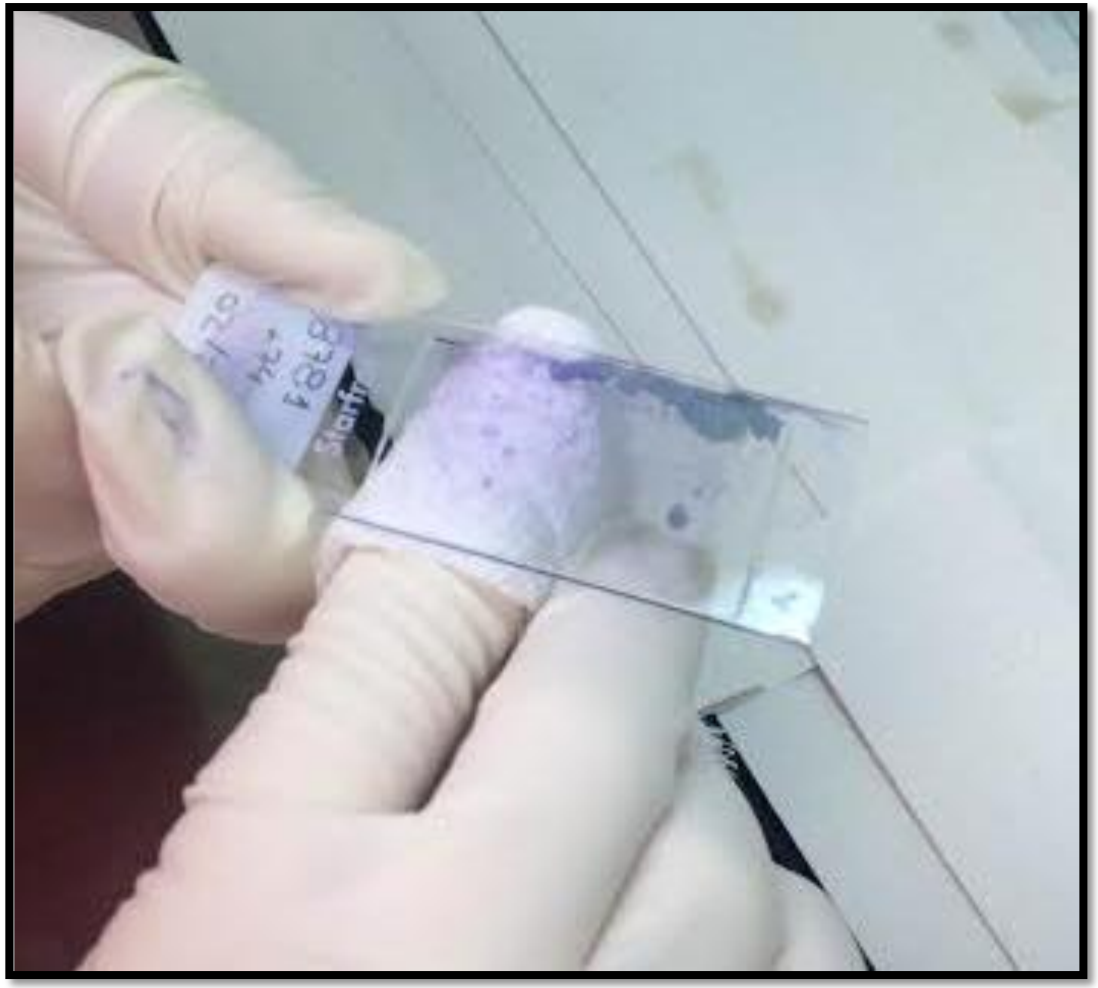
A tendency for a greater ($P = 0.06$) number of Met-supplemented cows in the HLFI was observed

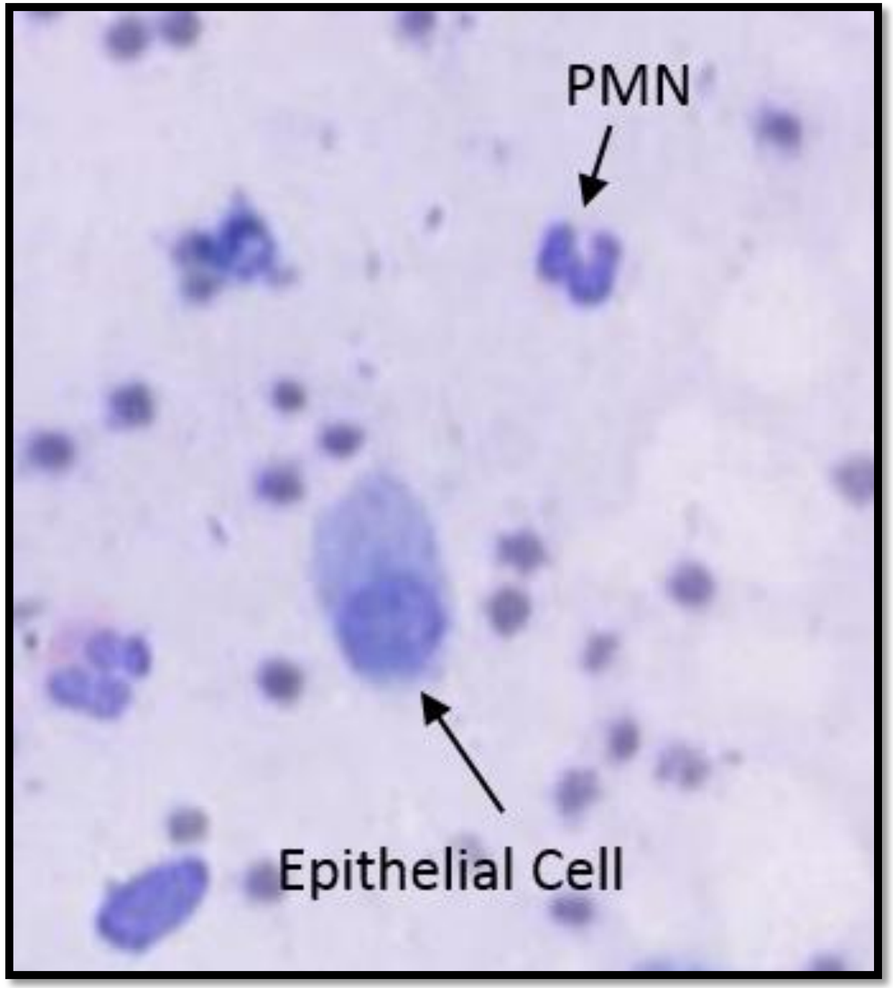


Zhou et al., 2017

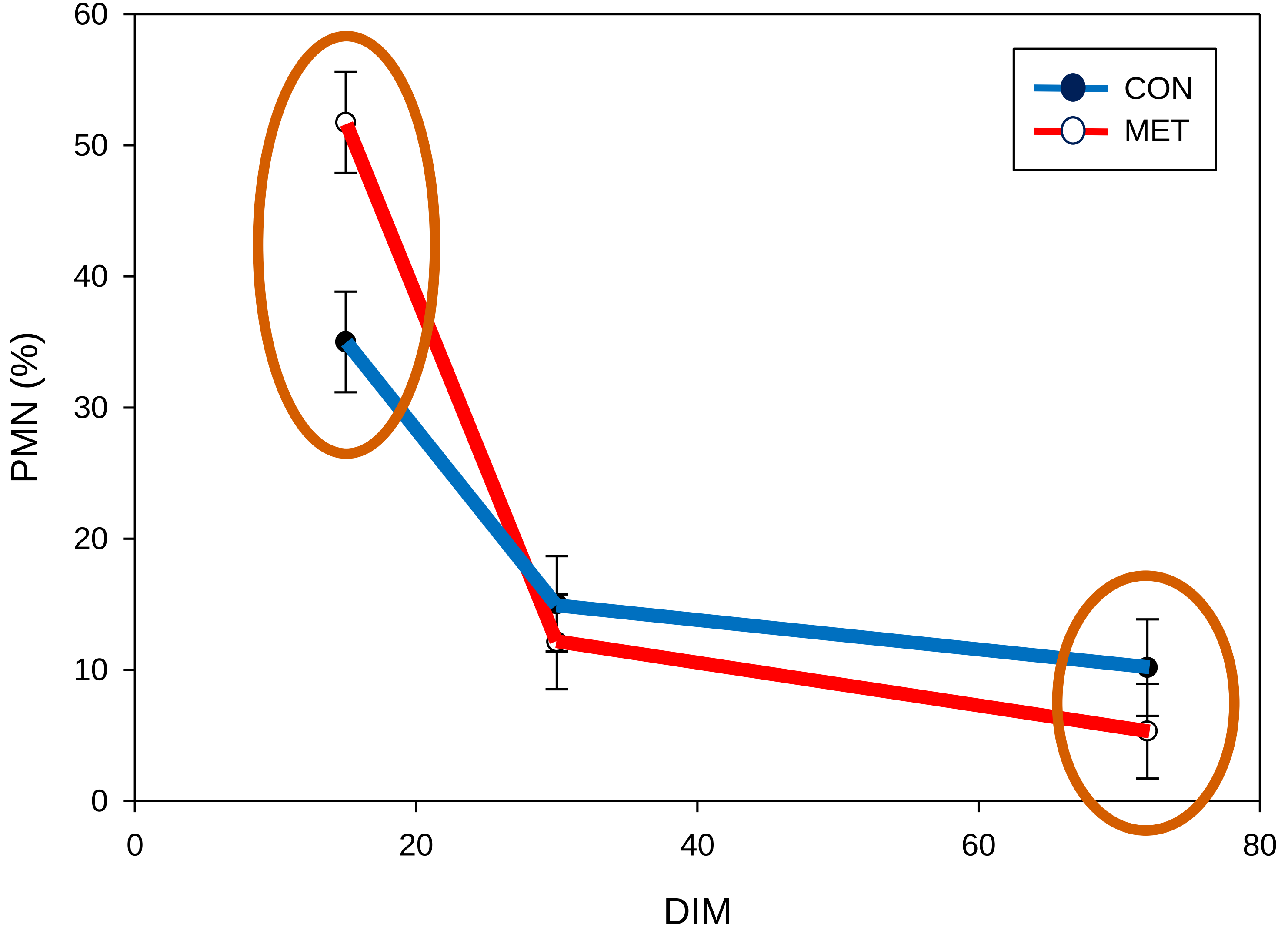
Uterine Cytology – Polymorphonuclear (PMN)







PMN in Uterus of Cows Fed rumen-protected methionine (MET) or not (CON)



Effect	*P*-Value
TRT	0.93
DIM	<0.001
TRT*DIM	0.01

Control: n = 36; Methionine: n = 36

Skenadore et al., 2017

Animal (2014), 8:s1, pp 54–63
doi:10.1017/S1751731114000524

animal

Reproductive tract inflammatory disease in *postpartum* dairy cows

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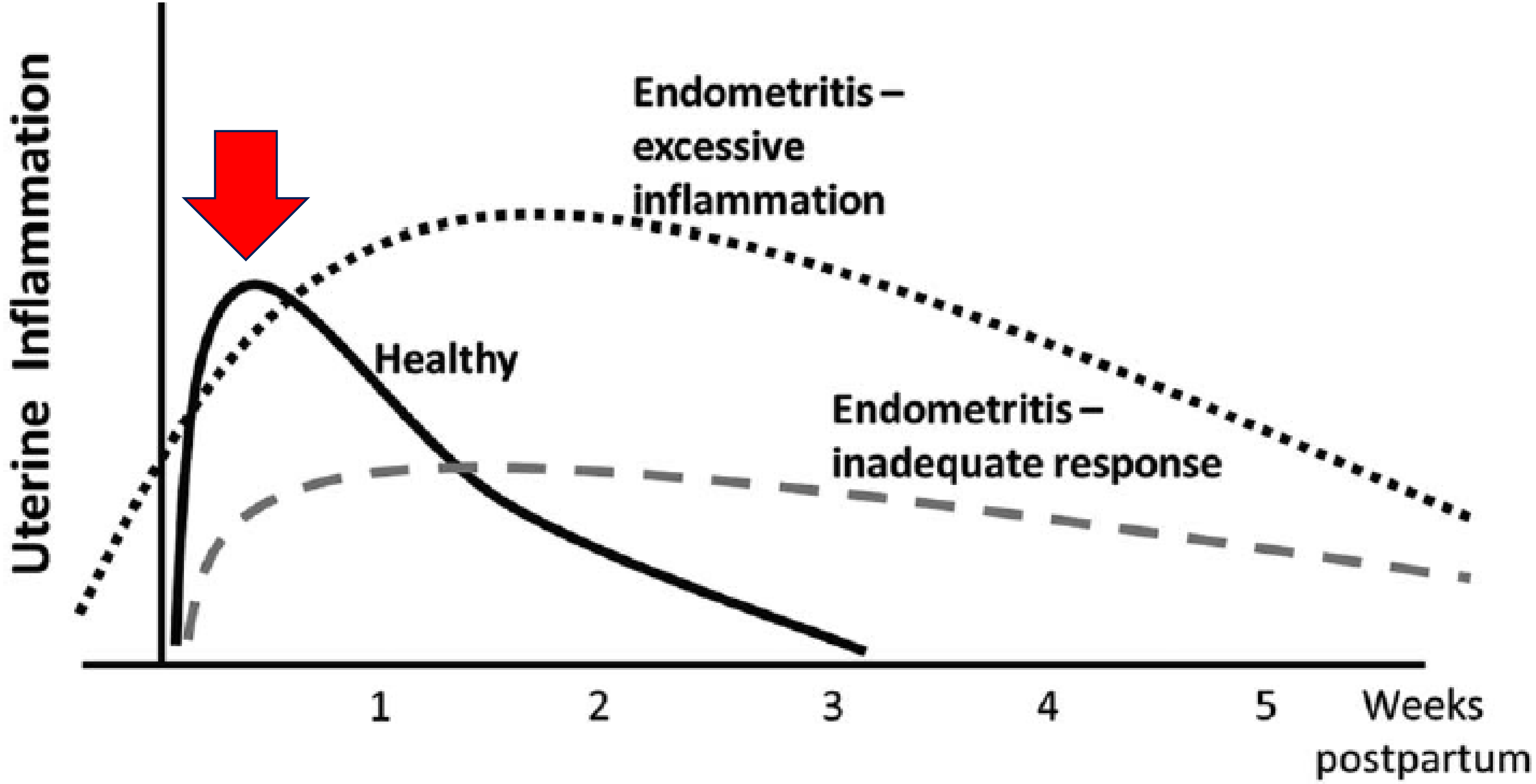
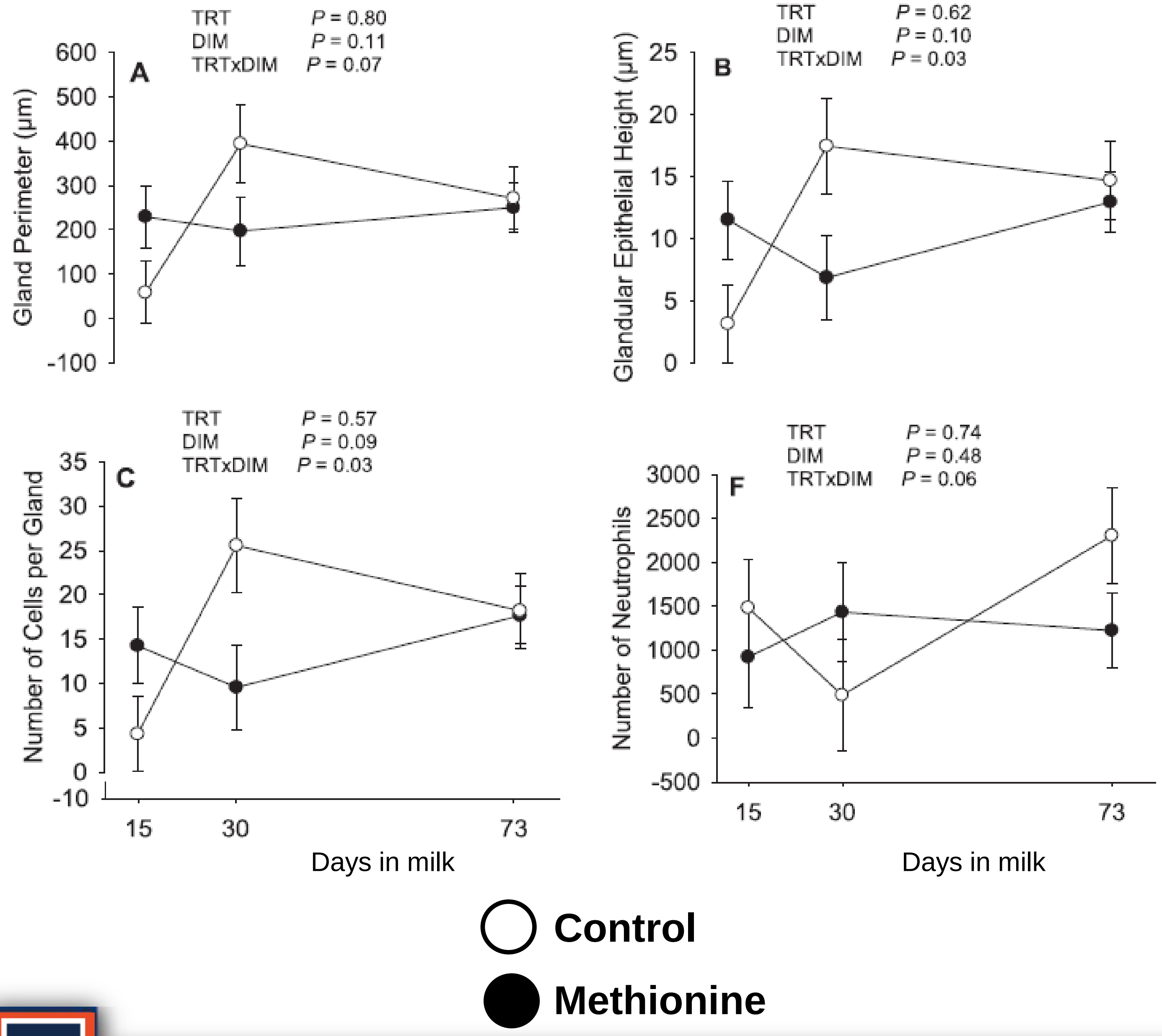
Department of Population Medicine, University of Guelph, Guelph, ON, Canada N1G 2W1

(Received 23 October 2013; Accepted 10 February 2014; First published online 28 March 2014)

Schematic Representation of Concepts of the Patterns of Immune and Inflammatory Response in Dairy Cows in the Postpartum Period

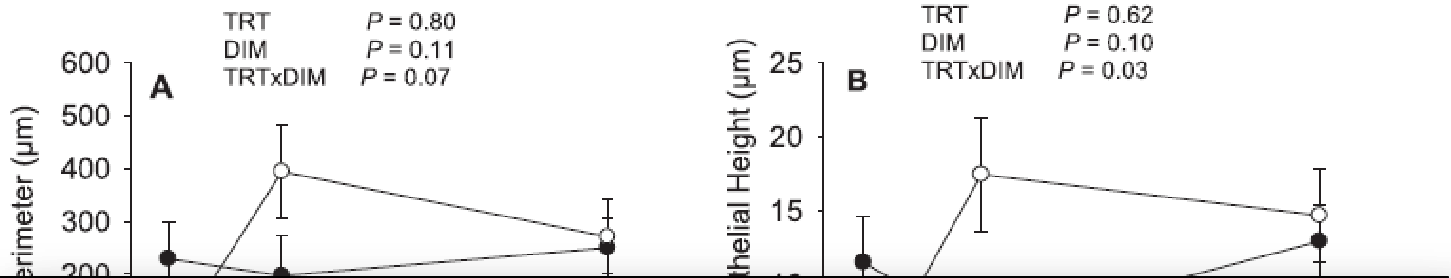


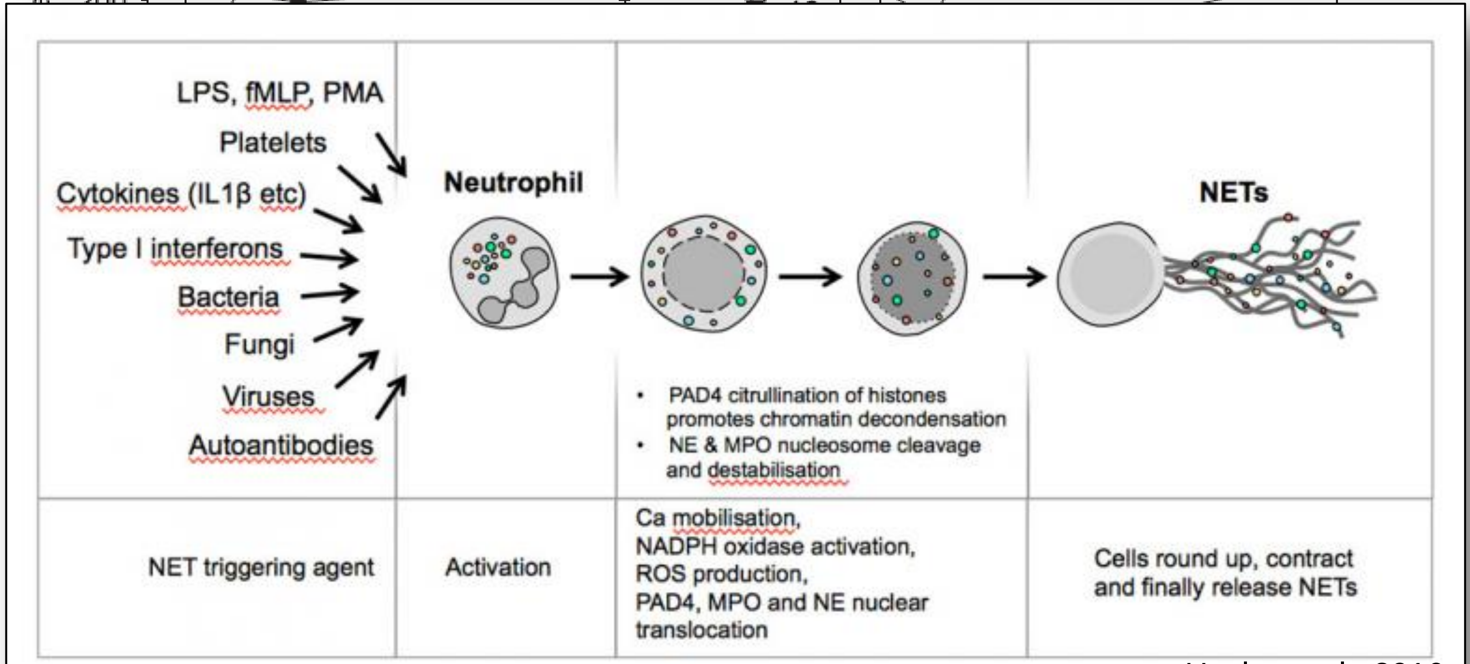
LeBlanc, 2014



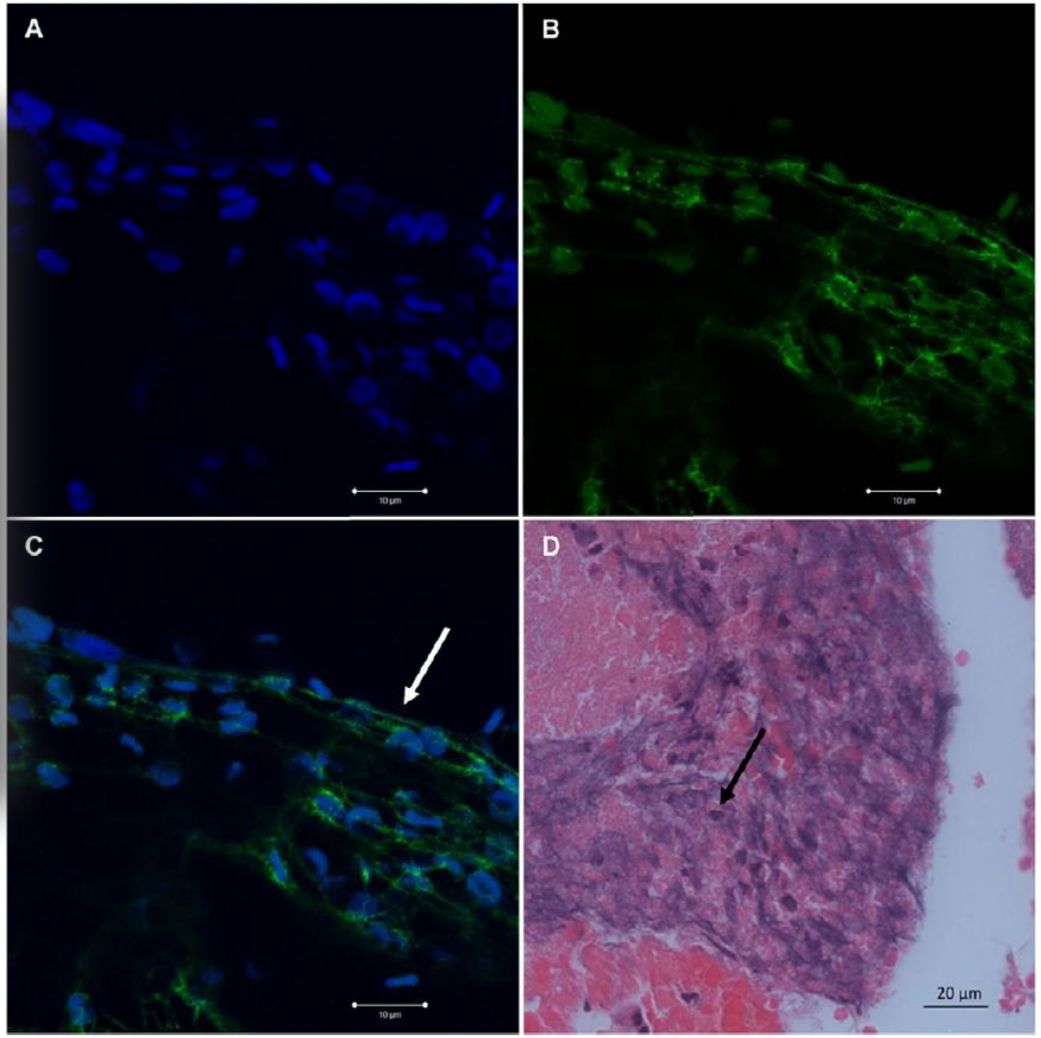
Stella et al., 2018

Neutrophil Extracellular Traps (NET)





Hasler et al., 2016

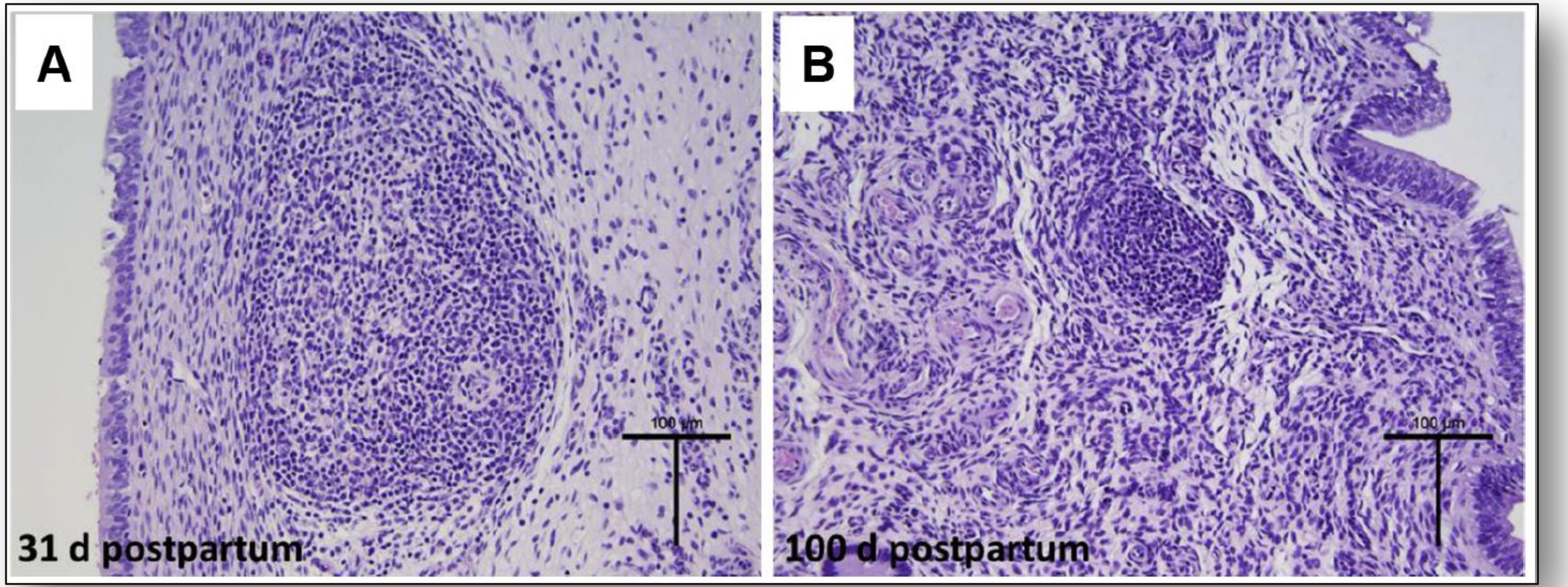


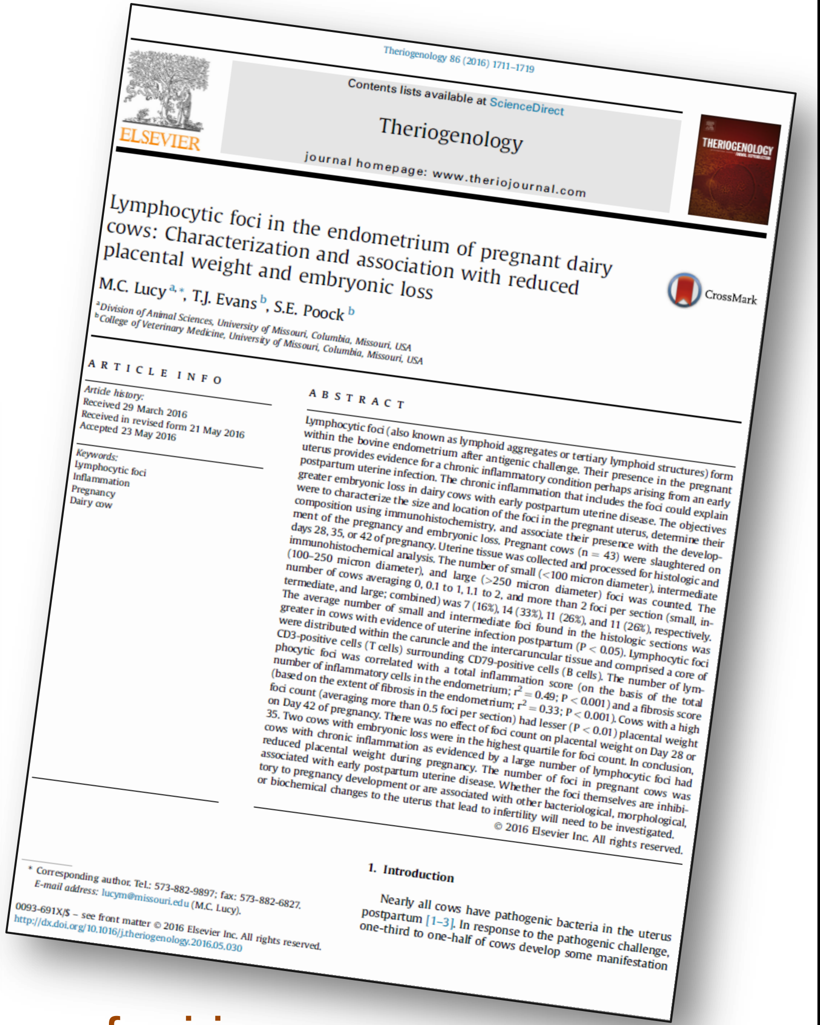
Control

Methionine

Stella et al., 2018

Increased number of lymphocytic foci was associated with the extent of uterine inflammation and fibrosis





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journal homepage: www.theriojournal.com

Lymphocytic foci in the endometrium of pregnant dairy cows: Characterization and association with reduced placental weight and embryonic loss

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ABSTRACT
Lymphocytic foci (also known as lymphoid aggregates or tertiary lymphoid structures) form within the bovine endometrium after antigenic challenge. Their presence in the pregnant uterus provides evidence for a chronic inflammatory condition perhaps arising from an early postpartum uterine infection. The chronic inflammation that includes the foci could explain greater embryonic loss in dairy cows with early postpartum uterine disease. The objectives were to characterize the size and location of the foci in the pregnant uterus, determine their composition using immunohistochemistry, and associate their presence with the development of the pregnancy and embryonic loss. Pregnant cows (n = 43) were slaughtered on days 28, 35, or 42 of pregnancy. Uterine tissue was collected and processed for histologic and immunohistochemical analysis. The number of small (<100 micron diameter), intermediate (100–250 micron diameter), and large (>250 micron diameter) foci was counted. The number of cows averaging 0, 0.1 to 1, 1.1 to 2, and more than 2 foci per section (small, intermediate, and large; combined) was 7 (16%), 14 (33%), 11 (26%), and 11 (26%), respectively. The average number of small and intermediate foci found in the histologic sections was greater in cows with evidence of uterine infection postpartum ($P < 0.05$). Lymphocytic foci were distributed within the caruncle and the intercaruncular tissue and comprised a core of CD3-positive cells (T cells) surrounding CD79-positive cells (B cells). The number of lymphocytic foci was correlated with a total inflammation score (on the basis of the total number of inflammatory cells in the endometrium; $r^2 = 0.49$; $P < 0.001$) and a fibrosis score (based on the extent of fibrosis in the endometrium; $r^2 = 0.33$; $P < 0.001$). Cows with a high foci count (averaging more than 0.5 foci per section) had lesser ($P < 0.01$) placental weight on Day 42 of pregnancy. There was no effect of foci count on placental weight on Day 28 or 35. Two cows with embryonic loss were in the highest quartile for foci count. In conclusion, cows with chronic inflammation as evidenced by a large number of lymphocytic foci had reduced placental weight during pregnancy. The number of foci in pregnant cows was associated with early postpartum uterine disease. Whether the foci themselves are inhibitory to pregnancy development or are associated with other bacteriological, morphological, or biochemical changes to the uterus that lead to infertility will need to be investigated.

1. Introduction

Nearly all cows have pathogenic bacteria in the uterus postpartum [1–3]. In response to the pathogenic challenge, one-third to one-half of cows develop some manifestation

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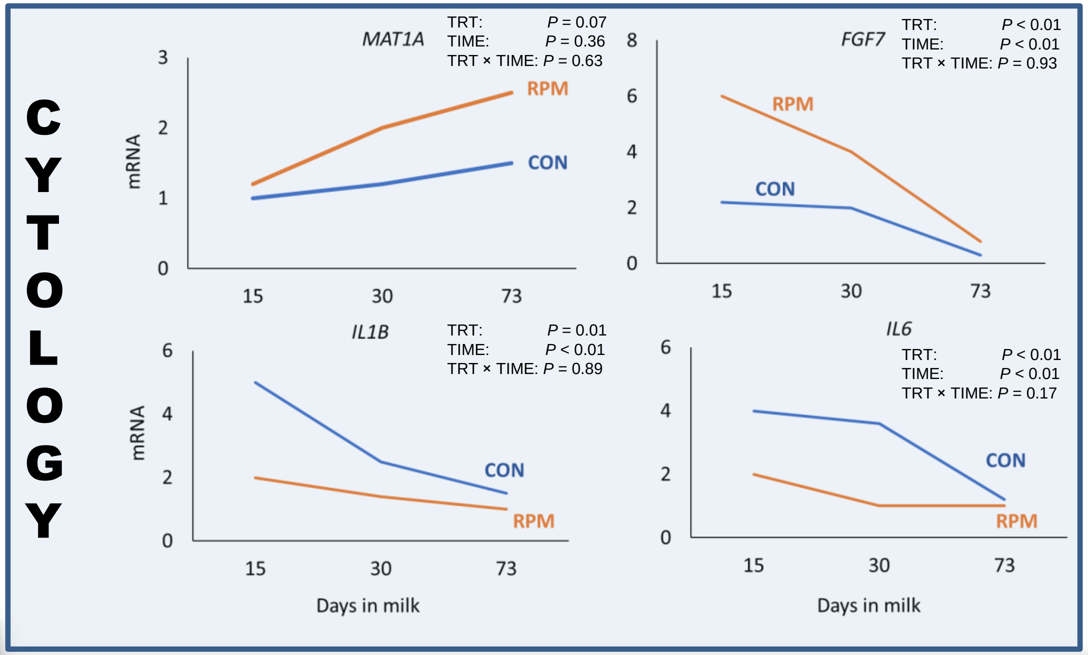
http://dx.doi.org/10.1016/j.theriogenology.2016.05.030

- Cows with evidence of uterine infection postpartum had more foci in the pregnant uterus.
- A large number of small or intermediate foci in the histologic sections was associated with a smaller placenta and embryonic loss.

Lucy et al., 2016

Feeding methionine improved uterine resilience mechanisms and capacity to prevent uterine diseases

↓ expression of transcripts involved in **inflammatory processes** are indicative that cows that are fed methionine throughout transition period are having a less inflammatory uterine environment after 15 days in milk.
↑ expression of transcripts involved in **cell metabolism** and **proliferation** processes.



Guadagnin et al., 2021

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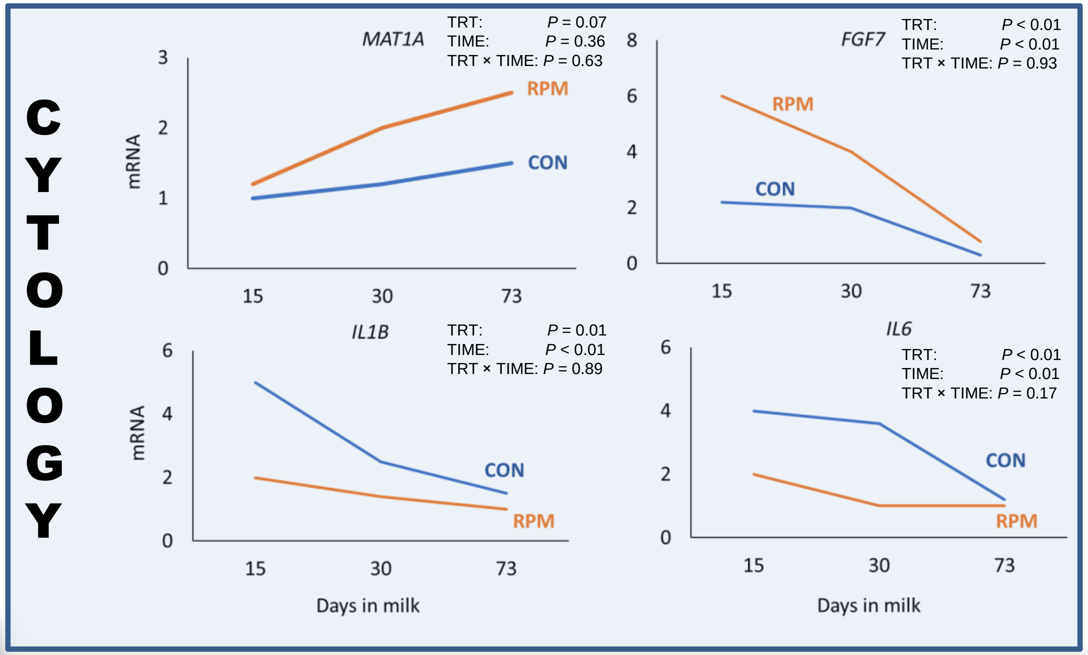
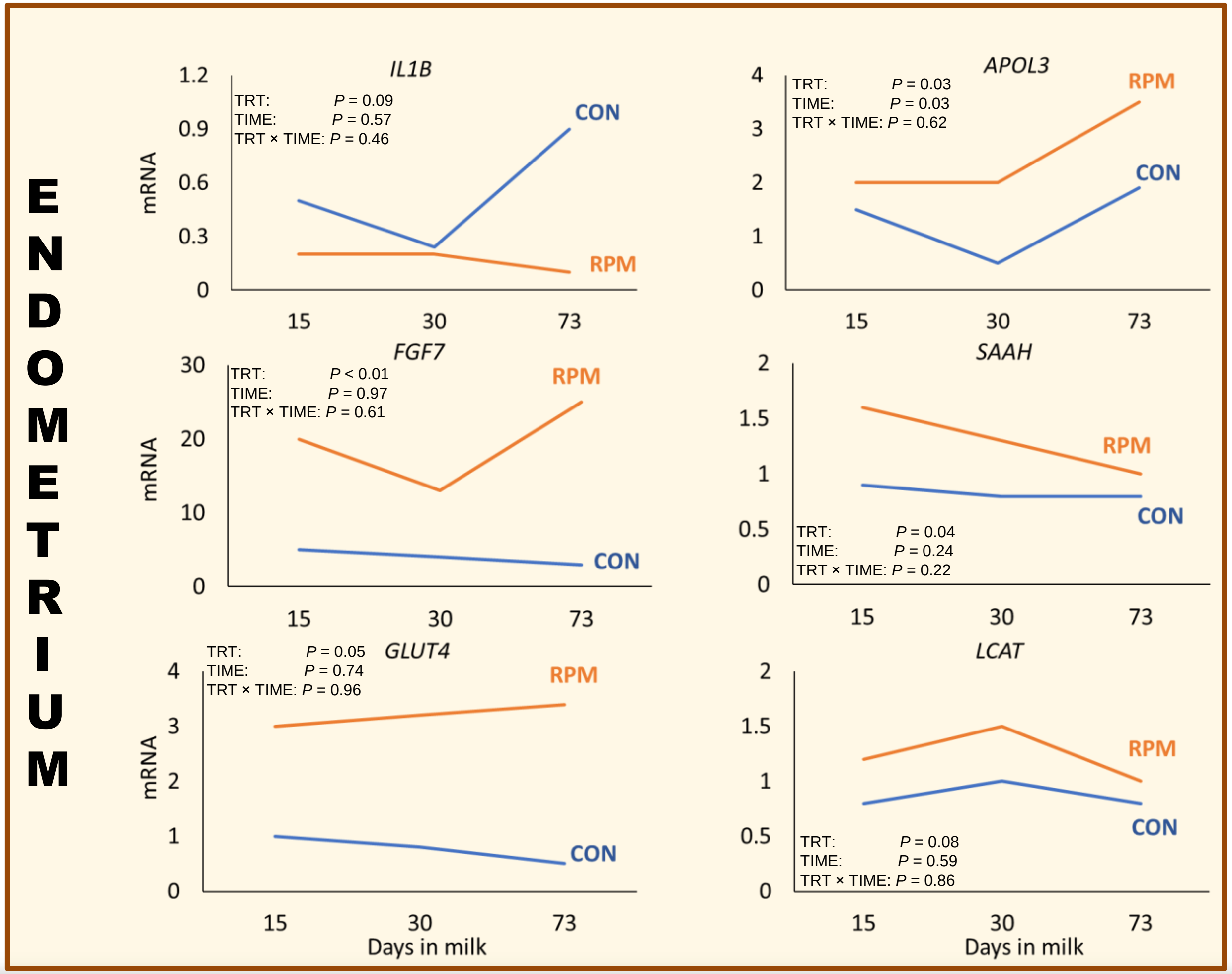
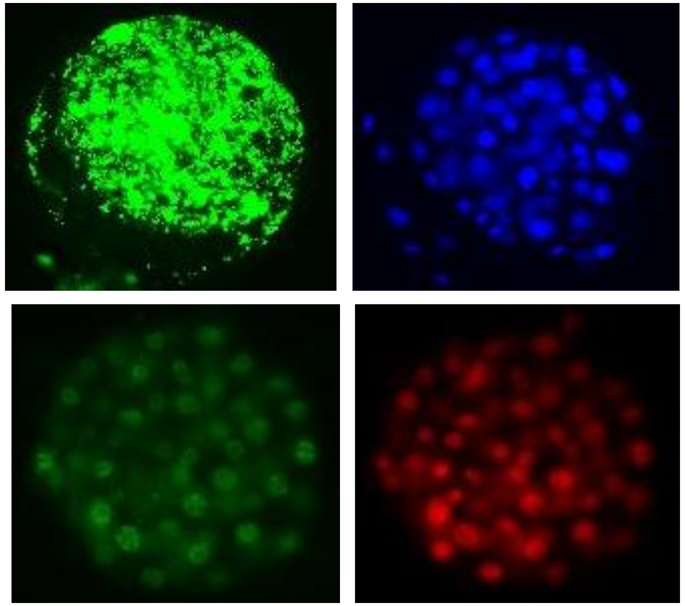


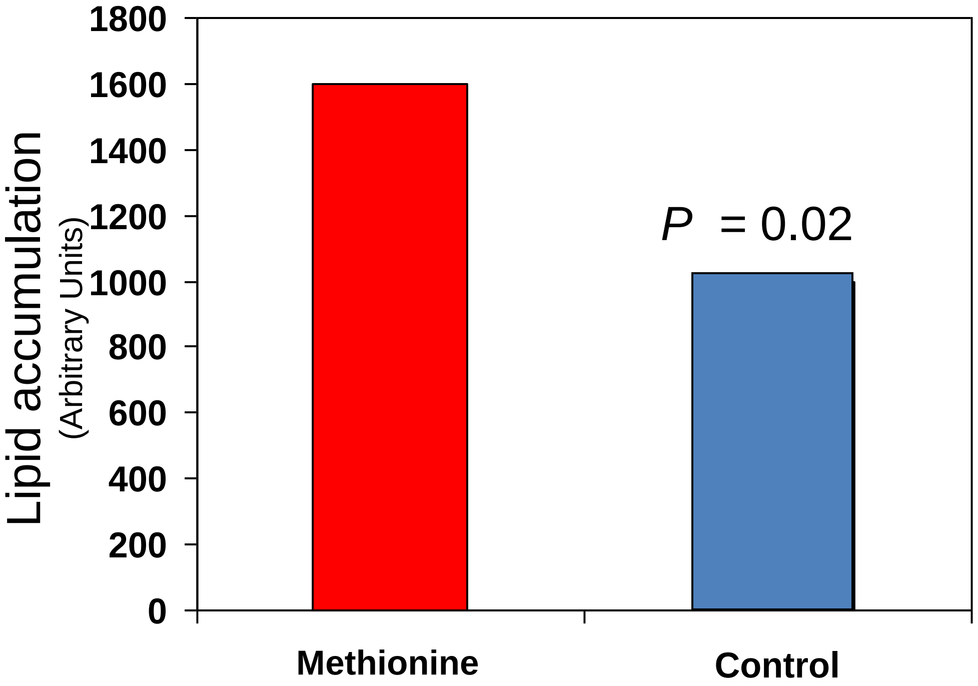


Guadagnin et al., 2021

Effect of Methionine Supplementation from -21 to 72 Days relative to calving on Lipid Accumulation of Preimplantation Embryos

Embryos (n = 37) harvested 7 d after timed AI at 63 DIM from cows fed a control diet or the control diet enriched with rumen-protected methionine.

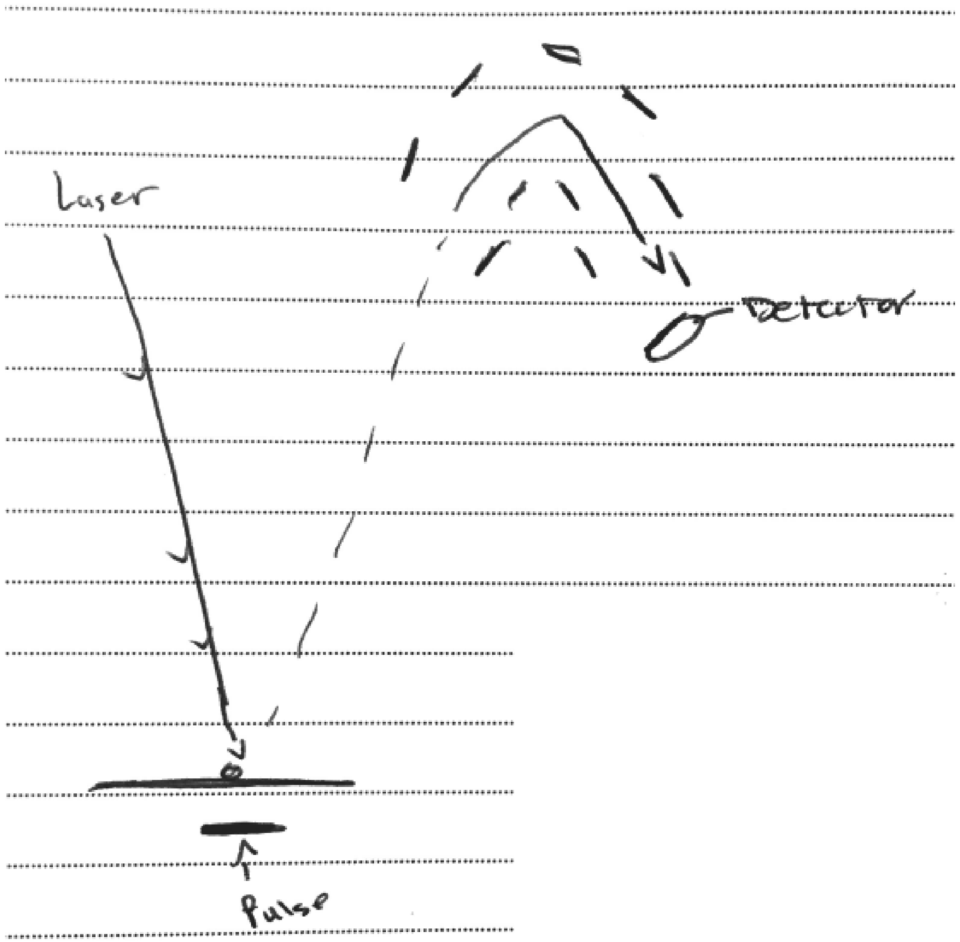




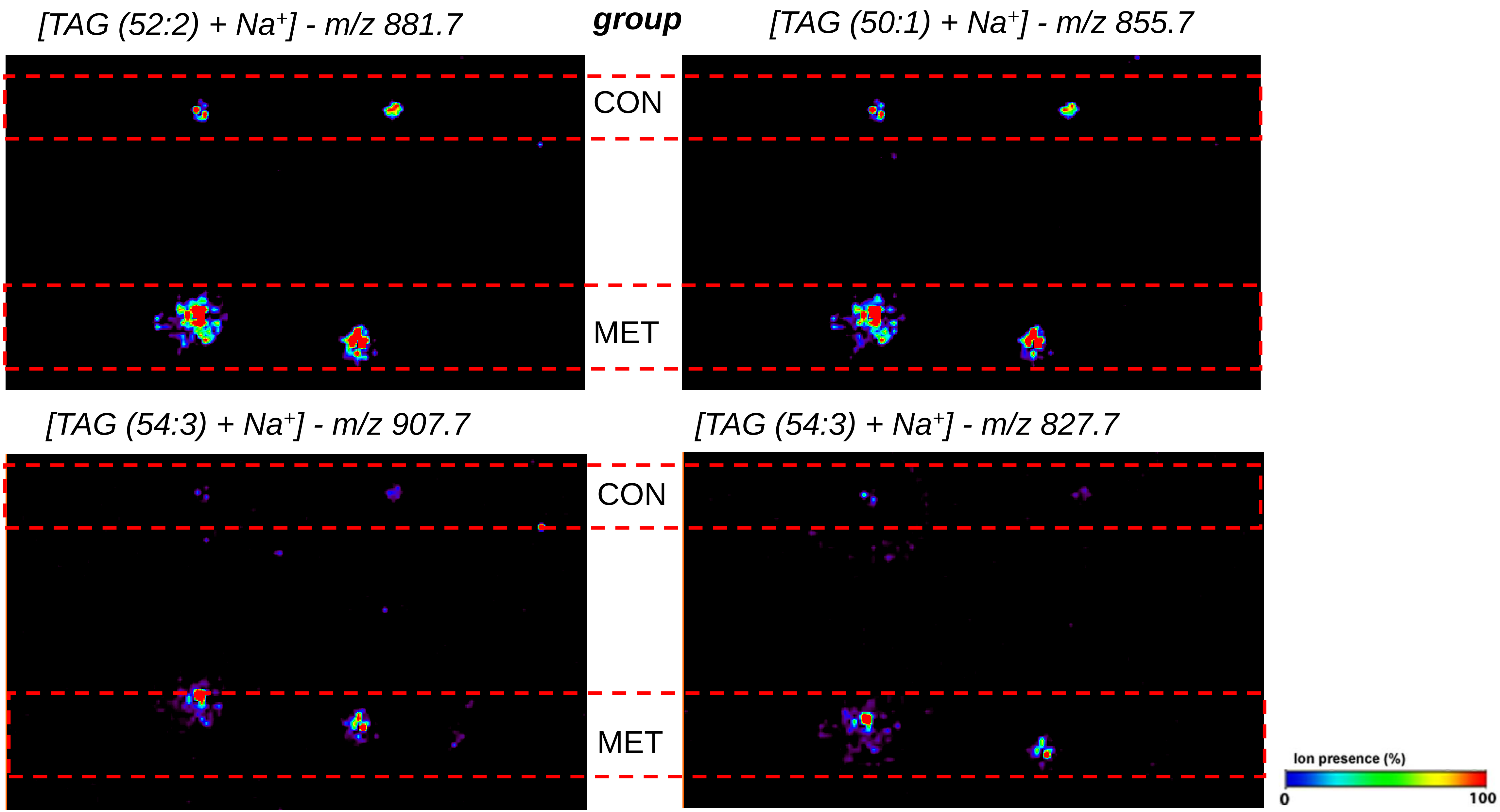
Fluorescence intensity of Nike Red staining

Acosta et al., 2016

Matrix-assisted laser desorption/ionization mass spectrometry imaging (MALDI-MSI)

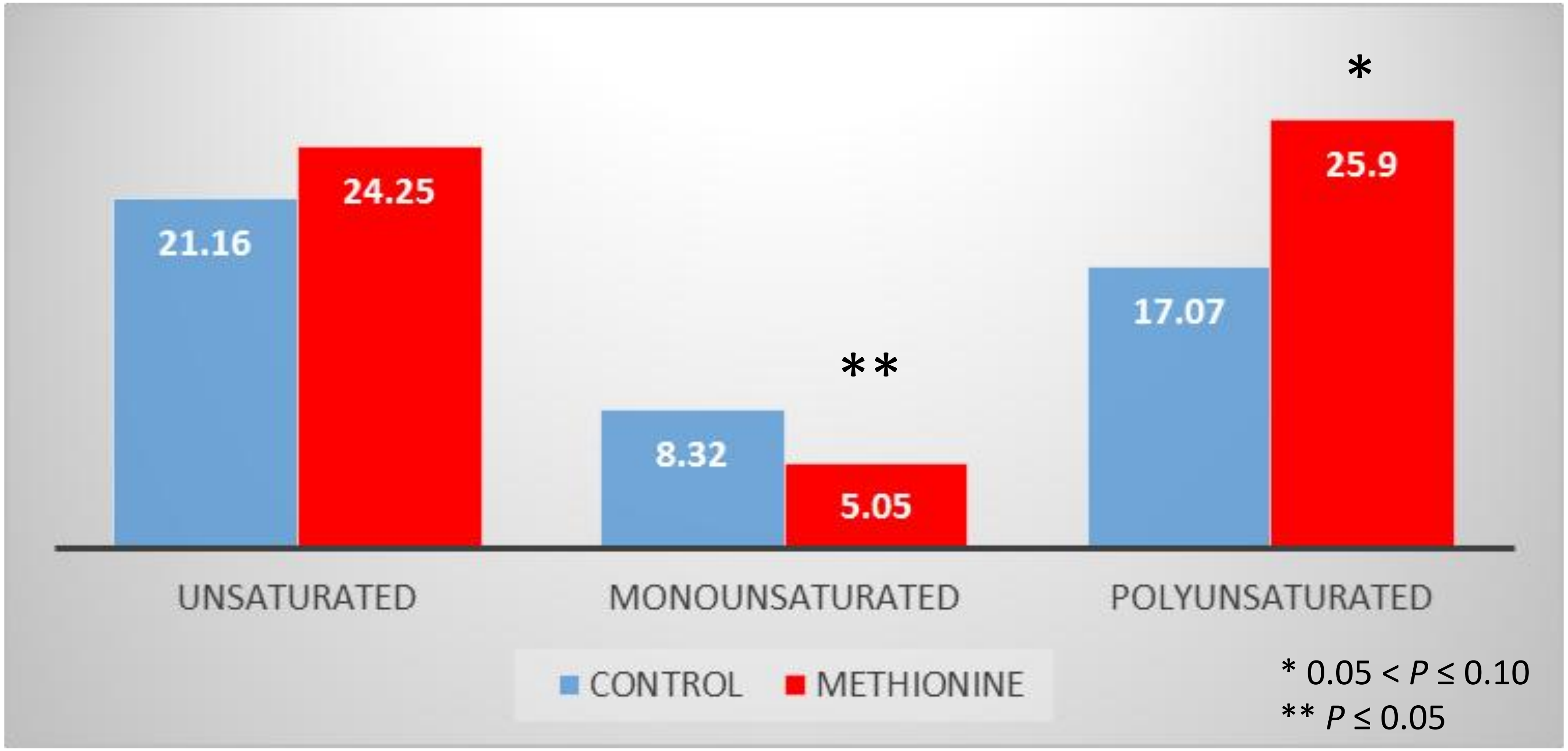


Stella et al., *unpublished*



Stella et al., *unpublished*

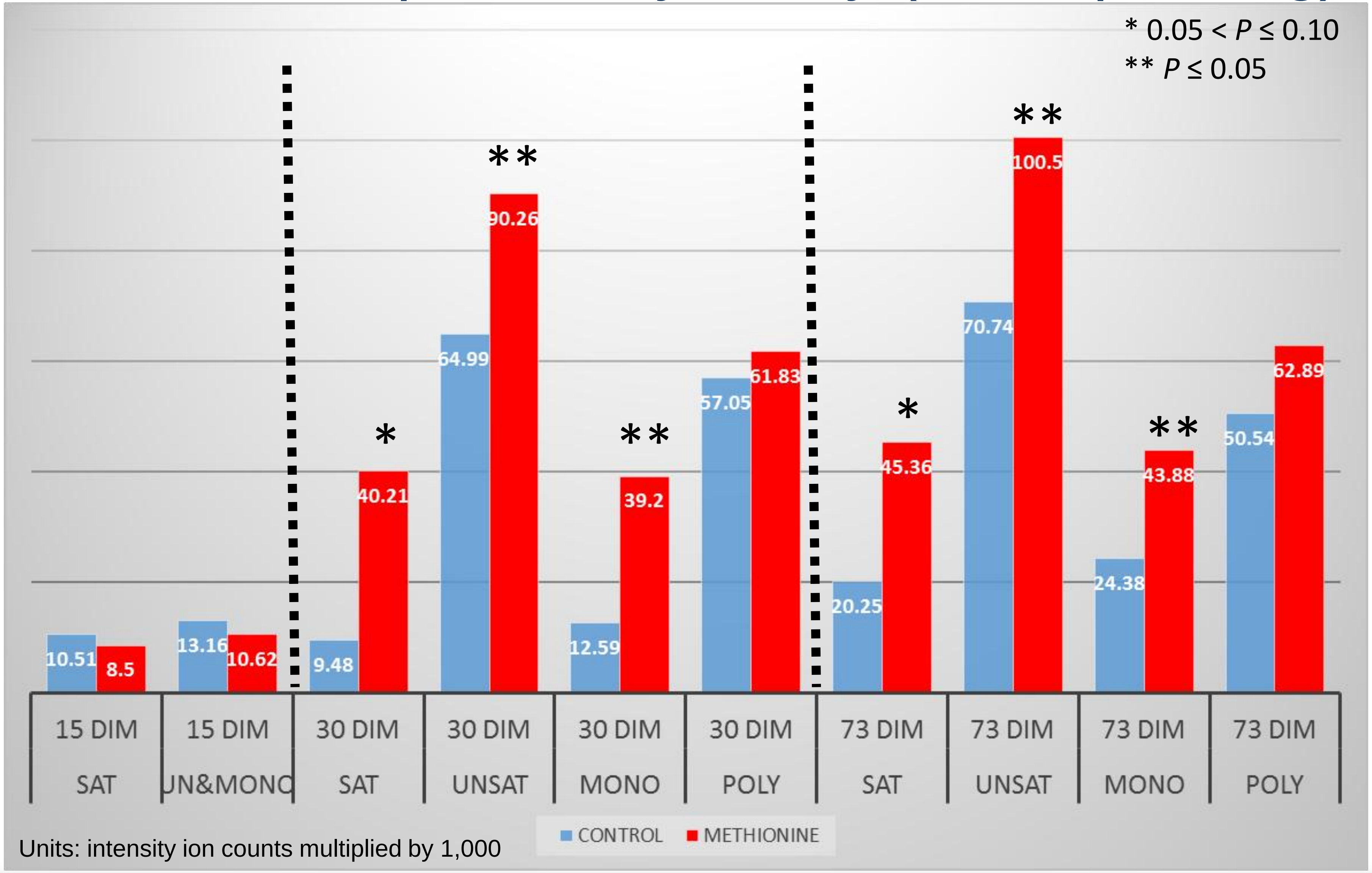
Embryo samples analyzed by (MALDI-MSI)



Units: intensity ion counts multiplied by 1,000

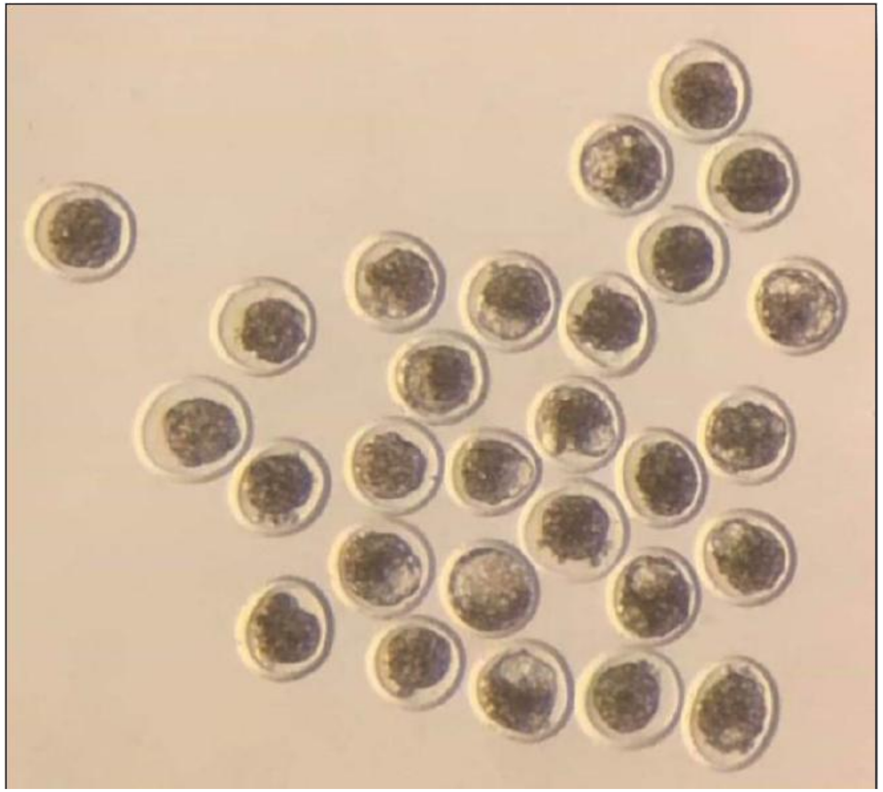
Stella et al., *unpublished*

Uterine samples analyzed by (MRM-profiling)



Stella et al., *unpublished*

Effect of Maternal Methionine Supplementation on the Transcriptome of Bovine Preimplantation Embryos



Penagaricano et al., 2013

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Table 3. Top 30 most significant genes that showed differential expression between control and methionine-rich treatment.

Gene	Name	log2 FC	FDR
LAPTM5	Lysosomal protein transmembrane 5	−14.9	4.7×10^{-9}
NKG7	Natural killer cell group 7 sequence	−13.6	4.4×10^{-8}
VIM	Vimentin	−13.8	1.8×10^{-7}
TYROBP	TYRO protein tyrosine kinase binding protein	−13.2	3.2×10^{-6}
IFI6	Interferon, alpha-inducible protein 6	−12.6	1.5×10^{-5}
CUFF.2147.1	*Novel transcript unit*	−8.2	1.5×10^{-5}
LOC505451	Olfactory receptor, family 1, subfamily J, member 2-like	−13.0	1.5×10^{-5}
SLAMF7	Signaling lymphocyte-activating molecule family 7 family member 7	−10.4	3.5×10^{-5}
LOC788199	Olfactory receptor 6C74-like	−10.4	7.6×10^{-5}
LCP1	Lymphocyte cytosolic protein 1 (L-plastin)	−9.9	1.1×10^{-4}
LOC100849660	*Uncharacterized*	11.9	2.2×10^{-4}
BLA-DQB	MHC class II antigen	−11.1	2.2×10^{-4}
SHC2	SHC (Src homology 2 domain containing) transforming protein 2	−11.5	3.4×10^{-4}
NT5C3	5′-nucleotidase, cytosolic III	−11.5	3.5×10^{-4}
LOC510193	Apolipoprotein L, 3-like	7.8	4.3×10^{-4}
LOC100848815	SLA class II histocompatibility antigen, DQ haplotype D alpha chain-like	−11.4	4.3×10^{-4}
CUFF.606.1	*Novel transcript unit*	−5.6	4.3×10^{-4}
LOC100850656	*Uncharacterized*	−11.2	4.8×10^{-4}
SLC11A1	Solute carrier family 11 (proton-coupled divalent metal ion transporters), member 1	−10.7	6.9×10^{-4}
LOC100852347	Beta-defensin 10-like	−11.2	7.3×10^{-4}
LOC100297676	C-type lectin domain family 2 member G-like	−6.8	9.2×10^{-4}
BCL2A1	BCL2-related protein A1	−7.1	1.2×10^{-3}
INSR	Insulin receptor	−5.1	1.3×10^{-3}
NOVA1	Neuro-oncological ventral antigen 1	−10.6	1.5×10^{-3}
TBX15	T-box 15	−11.2	2.2×10^{-3}
TMEM200C	Transmembrane protein 200C	−6.6	2.2×10^{-3}
GPNMB	Glycoprotein (transmembrane) nmb	−7.5	2.3×10^{-3}
ARHGAP9	Rho GTPase activating protein 9	−5.7	2.7×10^{-3}
EIF4E1B	Eukaryotic translation initiation factor 4E family member 1B	−11.3	3.1×10^{-3}
LOC100295170	Protein BEX2-like	−9.3	3.5×10^{-3}

A negative log2 Fold Change (FC) value means that the gene showed higher expression in control treatment while a positive value means that the gene showed higher expression in methionine-rich treatment.

doi:10.1371/journal.pone.0072302.t003

Penagaricano et al., 2013

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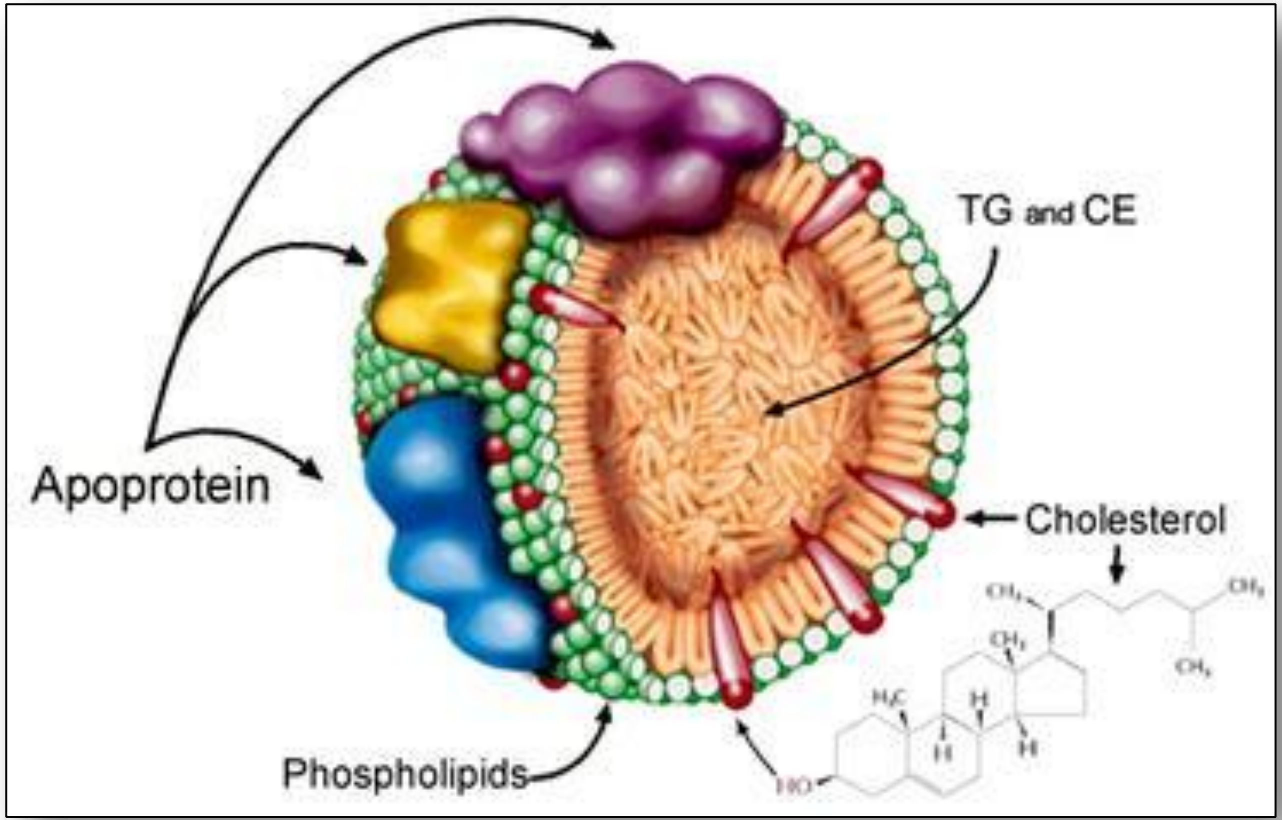
doi:10.1371/journal.pone.0072302.t003

Penagaricano et al., 2013

Apolipoproteins are involved in the transport and metabolism of lipids, including cholesterol, and allow the binding of lipids to organelles

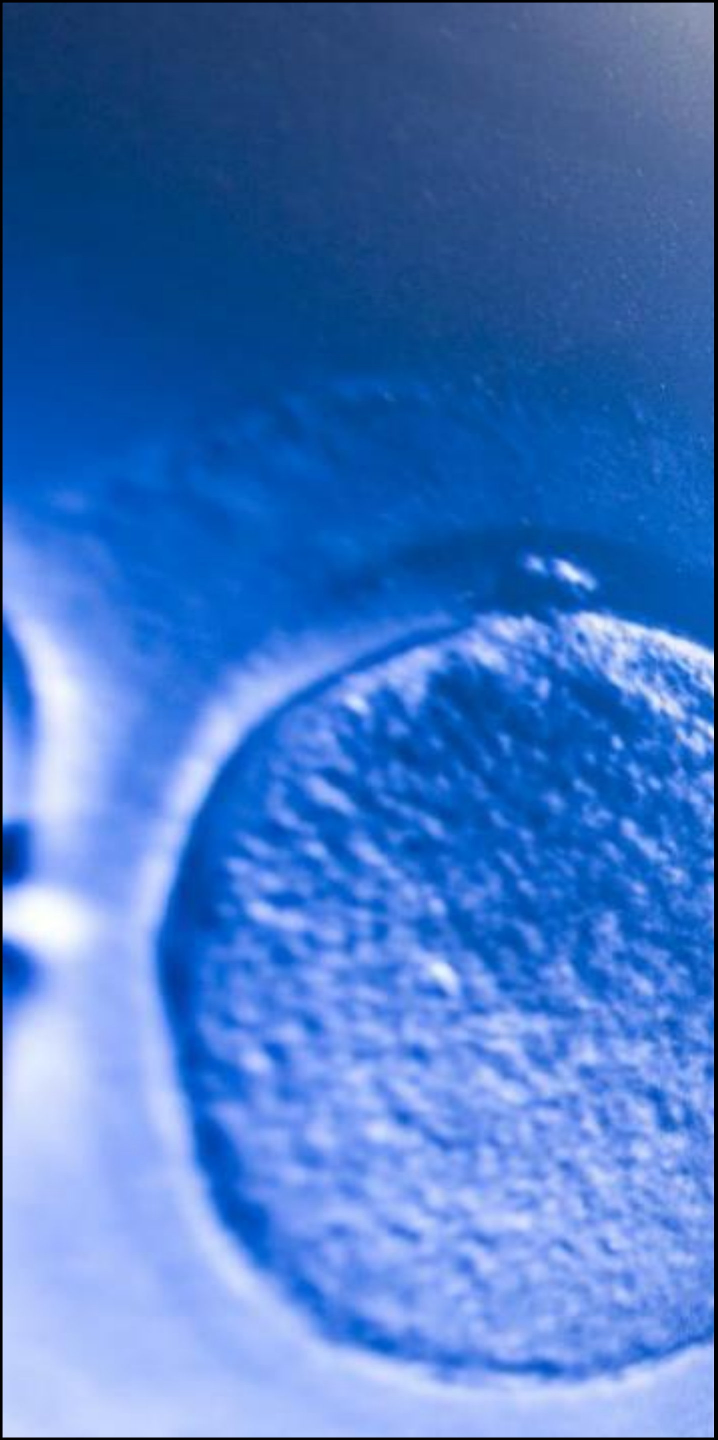


Methionine influences lipid metabolism in the preimplantation embryo

Penagaricano et al., 2013

This is happening…
Patients are seeking to genetically modify their embryos to improve their IQ

From Dr. Schatten
University of Pittsburgh
School of Medicine

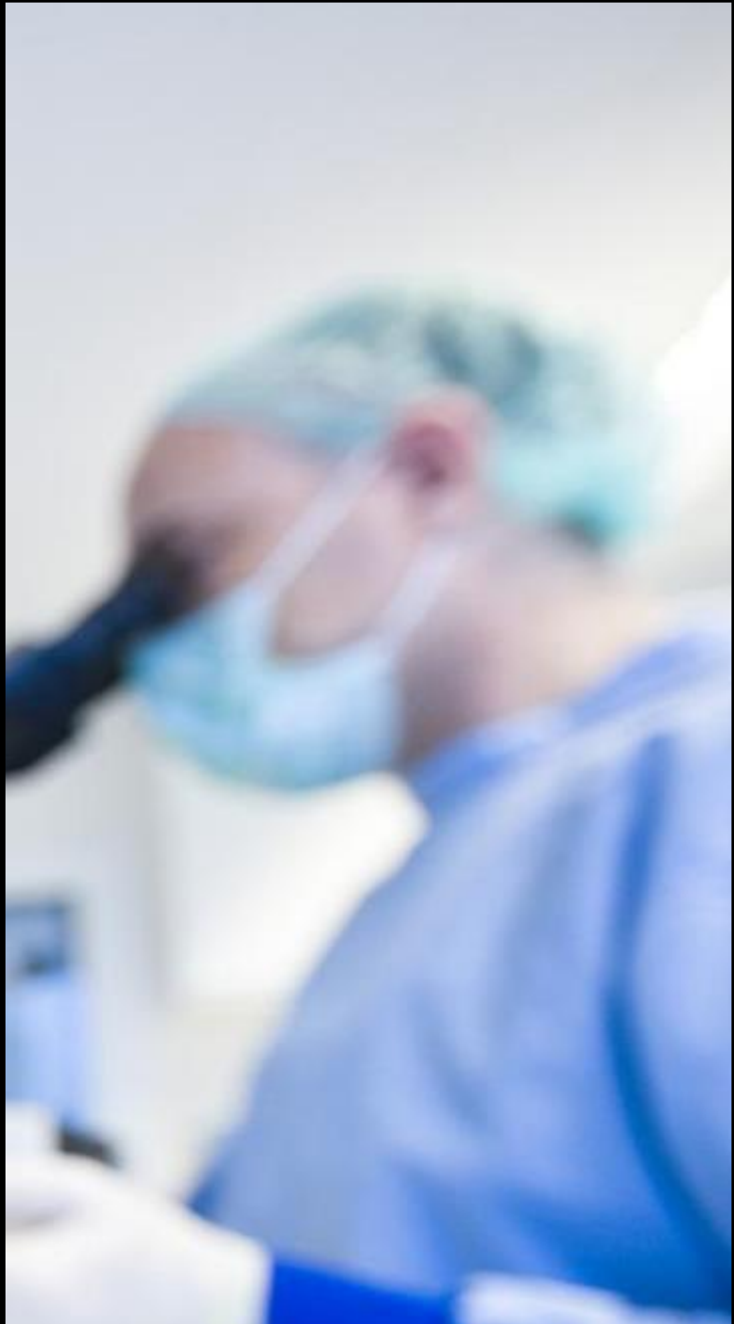


Life Chances	High Risk	Uphill Battle	Keeping Up	Out Ahead	Yours to Lose
Training Style	Slow, simple, supervised	Very explicit, hands-on	Mastery learning, hands-on; Written materials, plus experience	College format	Gathers, infers own information
Career Potential		Assembler, food service, nurse's aide	Clerk, teller, police officer, machinist, sales	Manager, teacher, accountant	Attorney, chemist, executive

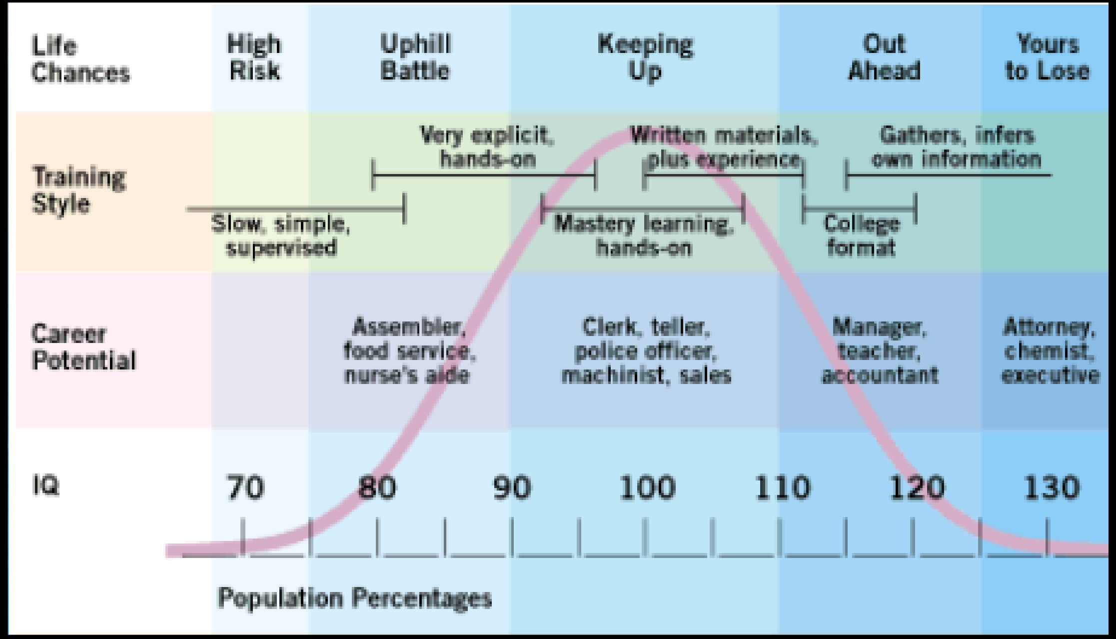
IQ 70 80 90 100 110 120 130

Population Percentages

	High Risk	Uphill Battle	Keeping Up	Out Ahead	Yours to Lose
Total population distribution	5	20	50	20	5
Out of labor force more than 1 month out of year (men)	22	19	15	14	10
Unemployed more than 1 month out of year (men)	12	10	7	7	2
Divorced in 5 years	21	22	23	15	9
Had illegitimate children (women)	32	17	8	4	2
Lives in poverty	30	16	6	3	2
Ever incarcerated (men)	7	7	3	1	0
Chronic welfare					



From Dr. Schatten
University of Pittsburgh
School of Medicine



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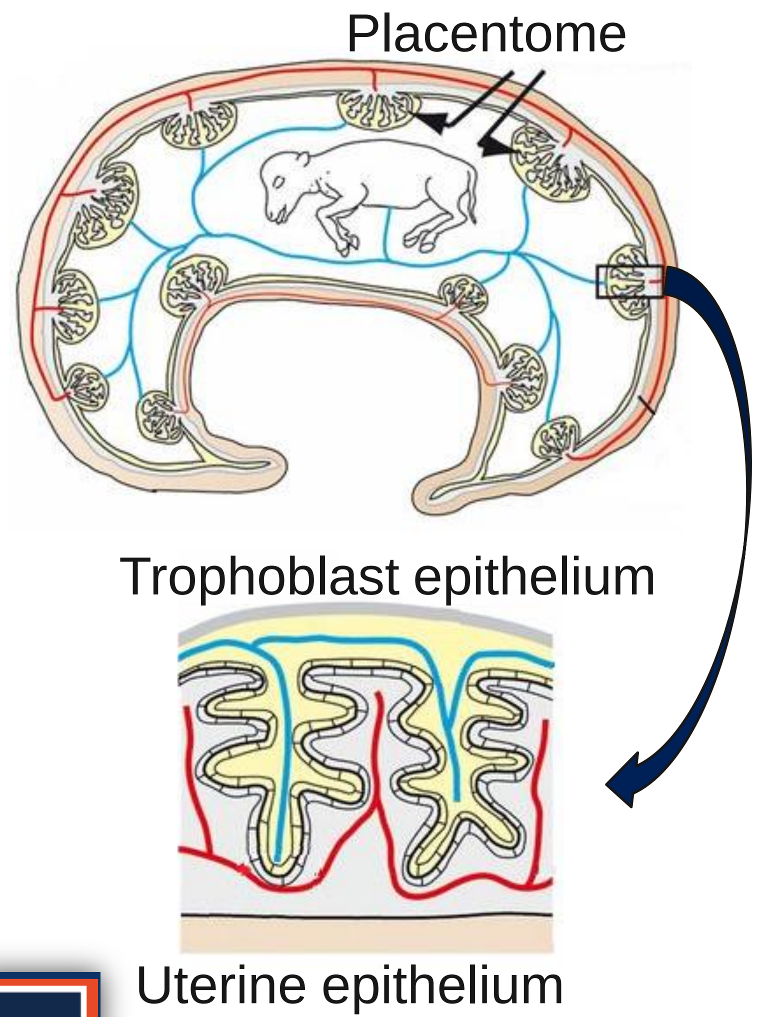
Ever incarcerated (men)	7	7	3	1	0

Divorced in 21 22 23 15 9
incarcerated (men) 7 7 3 1 0
Chronic welfare

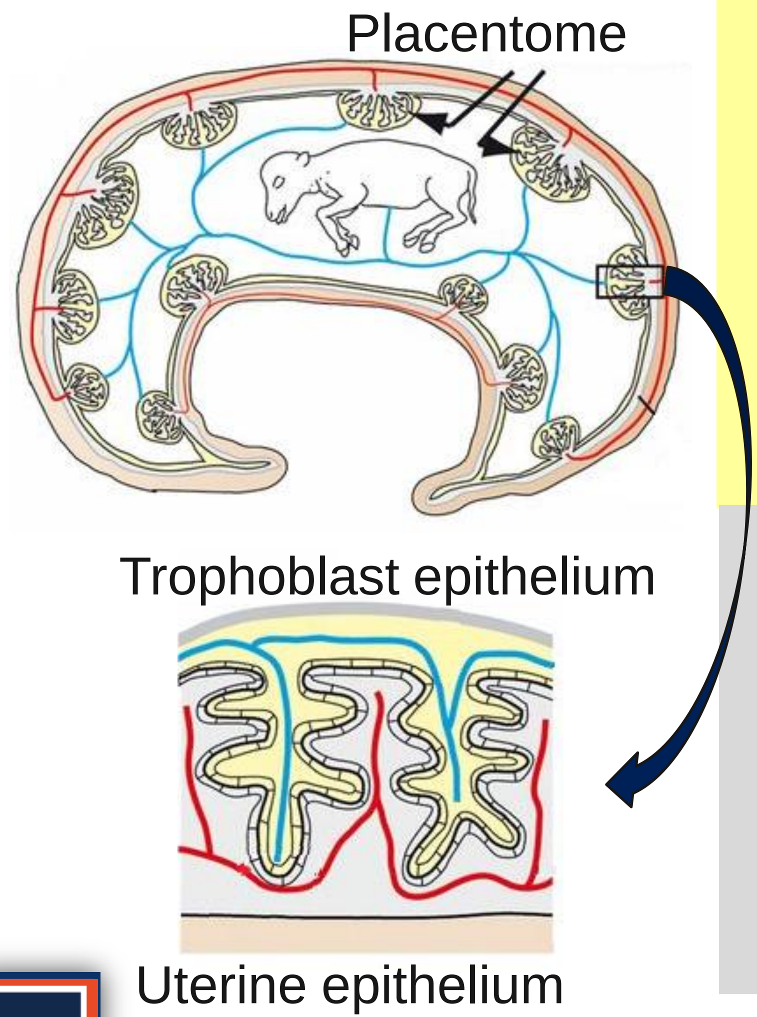
From Dr. Schatten
University of Pittsburgh
School of Medicine

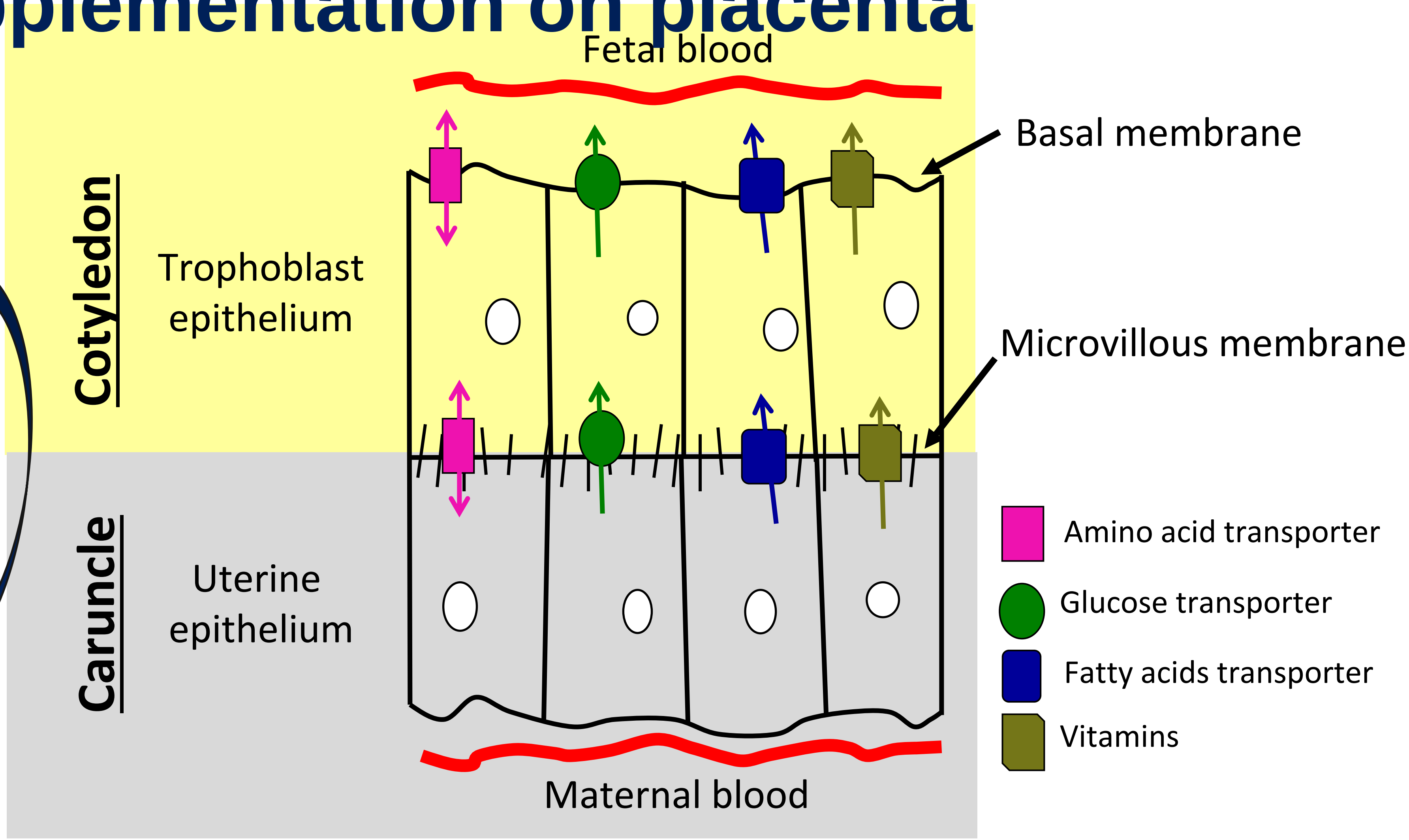
Effects of rumen-protected methionine maternal supplementation on placenta



Batistel et al., 2017

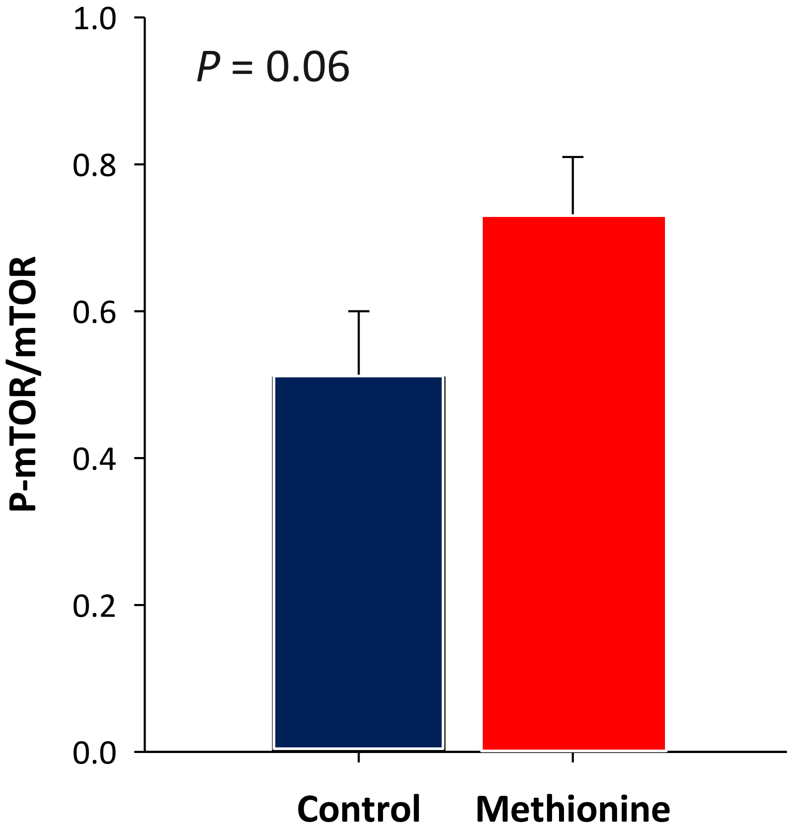
Effects of rumen-protected methionine maternal supplementation on placenta





Batistel et al., 2017

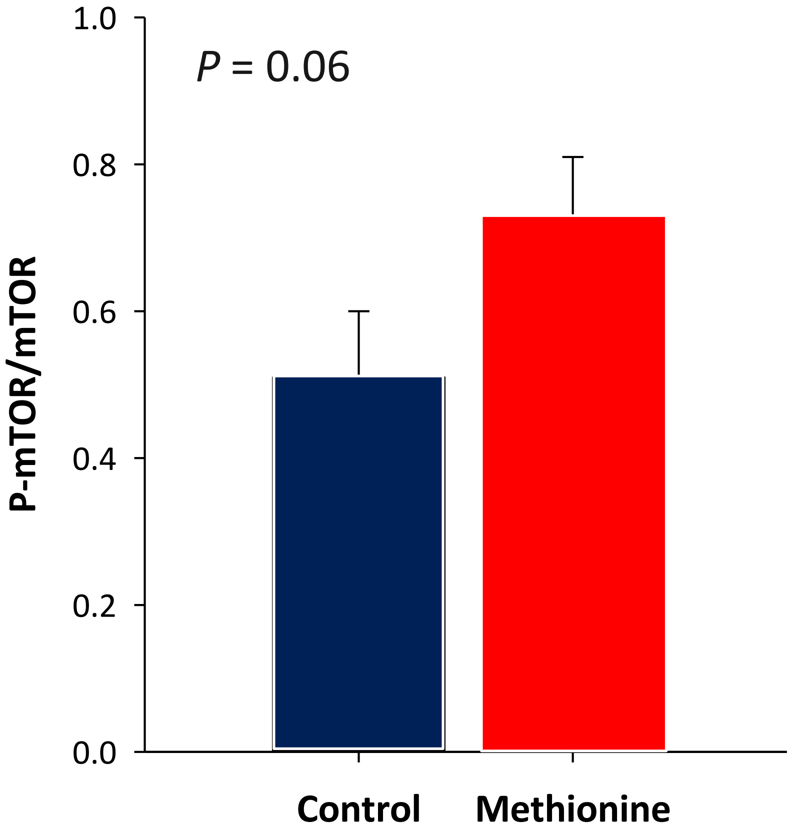
Effects of rumen-protected methionine maternal supplementation on placenta



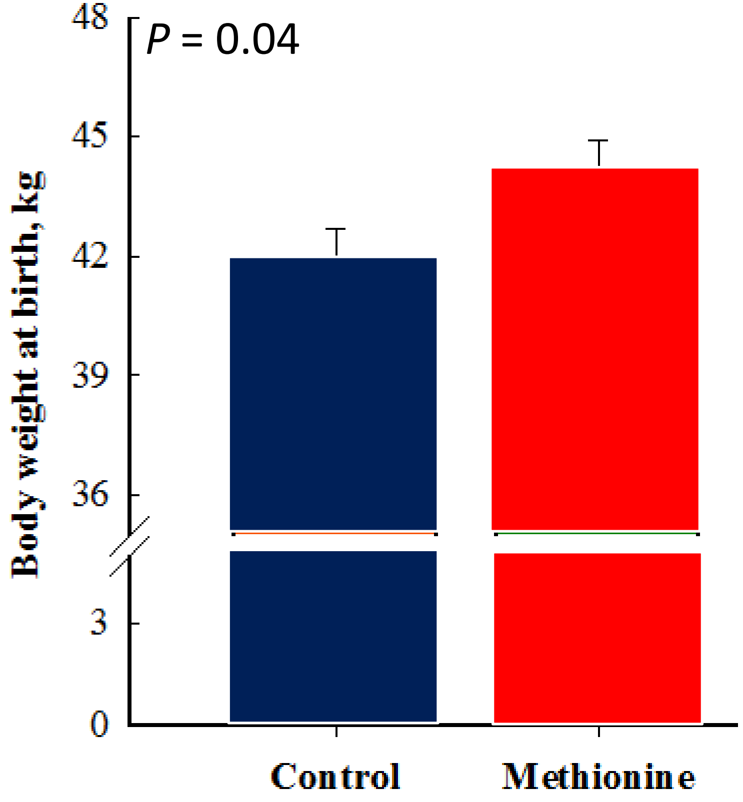
Protein activity

Batistel et al., 2017

Effects of rumen-protected methionine maternal supplementation on placenta and calf



Protein activity



Calf body weight at birth

Batistel et al., 2017

Feeding rumen-protected lysine prepratum increases energy corrected milk and milk component yields in Holstein cows during early lactation


J. Dairy Sci. 103:11386–11400

Feeding rumen-protected lysine prepartum increases energy-corrected milk and milk component yields in Holstein cows during early lactation

ABSTRACT

INTRODUCTION

PRE +

PRE -

C A L V I N G

POST +

POST -

POST +

POST -

PRE-L POST-L

PRE-L POST-C

PRE-C POST-L

PRE-C POST-C

- Plasma concentration of Lys prepartum increased for cows consuming rumen-protected lysine (RPL), without changing dry matter intake (DMI).
- Cows that consumed RPL prepartum tended to have a greater DMI postpartum and had greater energy-corrected milk, 3.5% fat corrected milk, and milk components.

Fehlberg et al., 2020

TMR

Ingredient, % of DM	Prepartum	Postpartum
Corn silgae	31.06	39.38
Canola meal	1.45	5.36
Alfalfa hay	-	20.95
Wheat midds	4.10	-
Corn gluten feed	6.69	-
Soybean meal, 48% CP	2.19	-
Wheat straw	40.25	-
Ground corn	0.16	15.26
Rumen-protected methionine	0.12	0.09
Rumen-protected fat	-	1.93
Soybean meal expeller	5.74	6.66
Anionic salt	3.85	-
Urea 46%	0.23	0.30
Mg oxide	-	0.09
Mg sulfate	0.25	-
Dicalcium phosphate	-	0.33
Molasses	-	4.43
Ca carbonate	2.08	-
Vitamin and mineral prepartum	1.31	-
Vitamin and mineral postpartum	-	4.73

Chemical composition

Item	Prepartum	Postpartum
DM, %	43.43 ± 1.42	45.71 ± 1.64
CP, % of DM	**14.22 ± 0.68**	**16.75 ± 1.06**
ADF, % of DM	28.41 ± 2.80	20.94 ± 1.77
NDF, % of DM	44.82 ± 2.75	31.25 ± 3.29
Lignin, % of DM	4.44 ± 0.74	3.80 ± 0.49
Starch, % of DM	**13.99 ± 1.69**	**24.39 ± 2.62**
Ehter extract, % of DM	3.03 ± 0.21	4.95 ± 0.51
Ash, % of DM	10.34 ± 1.34	9.16 ± 0.74
NE_L, Mcal/kg of DM	1.44 ± 0.03	1.67 ± 0.05
Ca, % of DM	1.46 ± 0.35	1.12 ± 0.21
P, % of DM	0.37 ± 0.04	0.41 ± 0.04
Mg, % of DM	0.50 ± 0.07	0.38 ± 0.03
K, % of DM	1.12 ± 0.11	1.75 ± 0.17
Mn, ppm	91.9 ± 17.5	99.3 ± 13.7
Mo, ppm	1.20 ± 0.30	1.32 ± 0.30

TMR

Ingredient, % of DM	Prepartum	Postpartum
Corn silgae	31.06	39.38
Canola meal	1.45	5.36
Alfalfa hay	-	20.95
Wheat midds	4.10	-
Corn gluten feed	6.69	-
Soybean meal, 48% CP	2.19	-
Wheat straw	40.25	-
Ground corn	0.16	15.26
Rumen-protected methionine	0.12	0.09
Rumen-protected fat	-	1.93
Soybean meal expeller	5.74	6.66
Anionic salt	3.85	-
Urea 46%	0.23	0.30
Mg oxide	-	0.09
Mg sulfate	0.25	-
Dicalcium phosphate	-	0.33
Molasses	-	4.43
Ca carbonate	2.08	-
Vitamin and mineral prepartum	1.31	-
Vitamin and mineral postpartum	-	4.73

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K, % of DM	1.12 ± 0.11	1.75 ± 0.17
Mn, ppm	91.9 ± 17.5	99.3 ± 13.7
Mo, ppm	1.20 ± 0.30	1.32 ± 0.30

Rumen-protected Lysine top-dressed
0.54% of DMI prepartum
0.40% of DMI postpartum

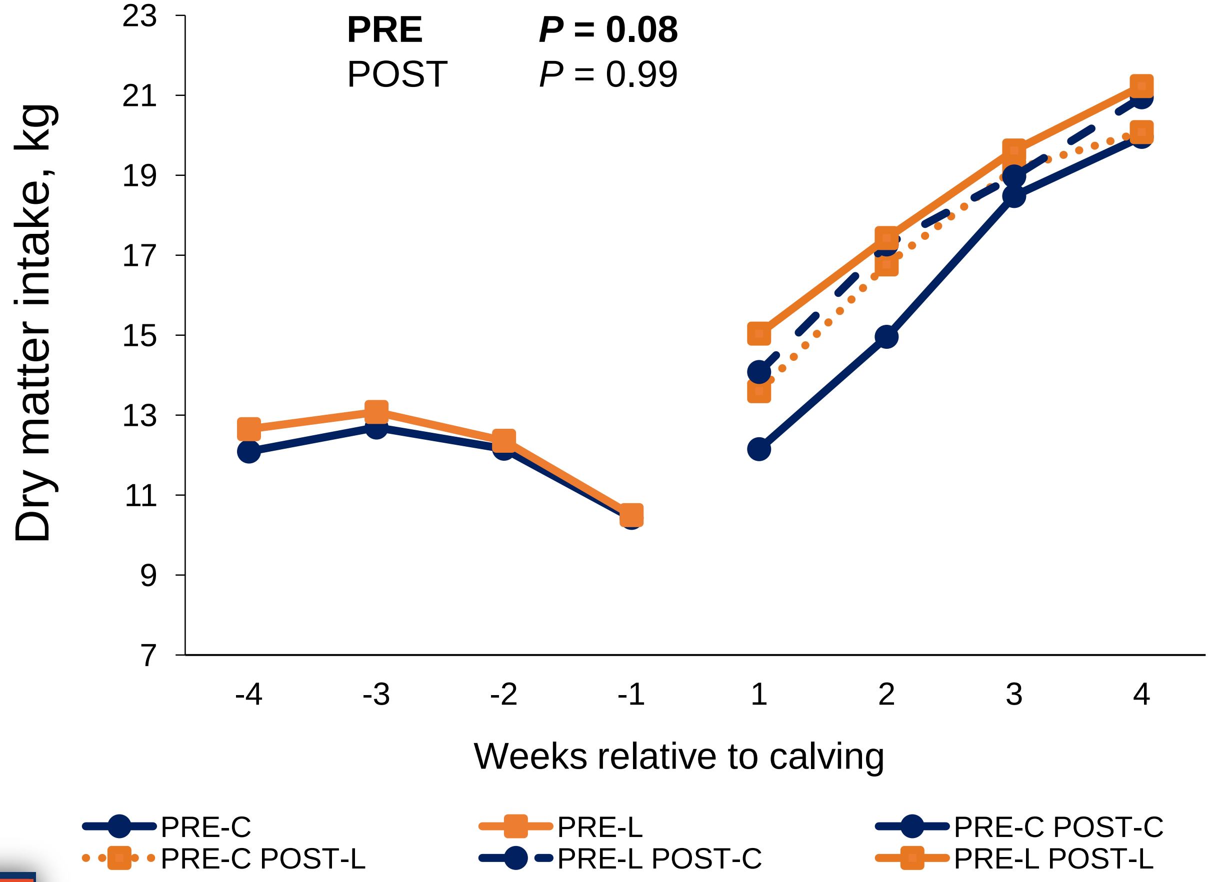
Amino acid supply

	Prepartum[2]		Postpartum[3]	
Composition of MP[1]	PRE-L	PRE-C	POST-L	POST-C
Metabolizable protein, g/d	1190	1170	2220	2280
Lys, % of MP	8.24	6.86	7.15	6.27
Met, % of MP	2.94	2.98	2.55	2.54
Lys:Met	2.80	2.30	2.80	2.46
Lys, g/d	98	80	159	143
Met, g/d	35	35	57	57
Lys, g/Mcal	3.55	2.95	3.11	2.73
Met, g/Mcal	1.27	1.19	1.11	1.11

[1]Metabolizable protein and AA predicted by AMTS
[2]Formulated for a dry cow at 1527 lb BW and 28.6 lb/d
[3]Formulated for a cow at 14 days in milk, 1612 lb BW, producing 86 lb/d of milk

Fehlberg et al., 2020

RPL provided prepartum tended to increase DMI postpartum



Fehlberg et al., 2020

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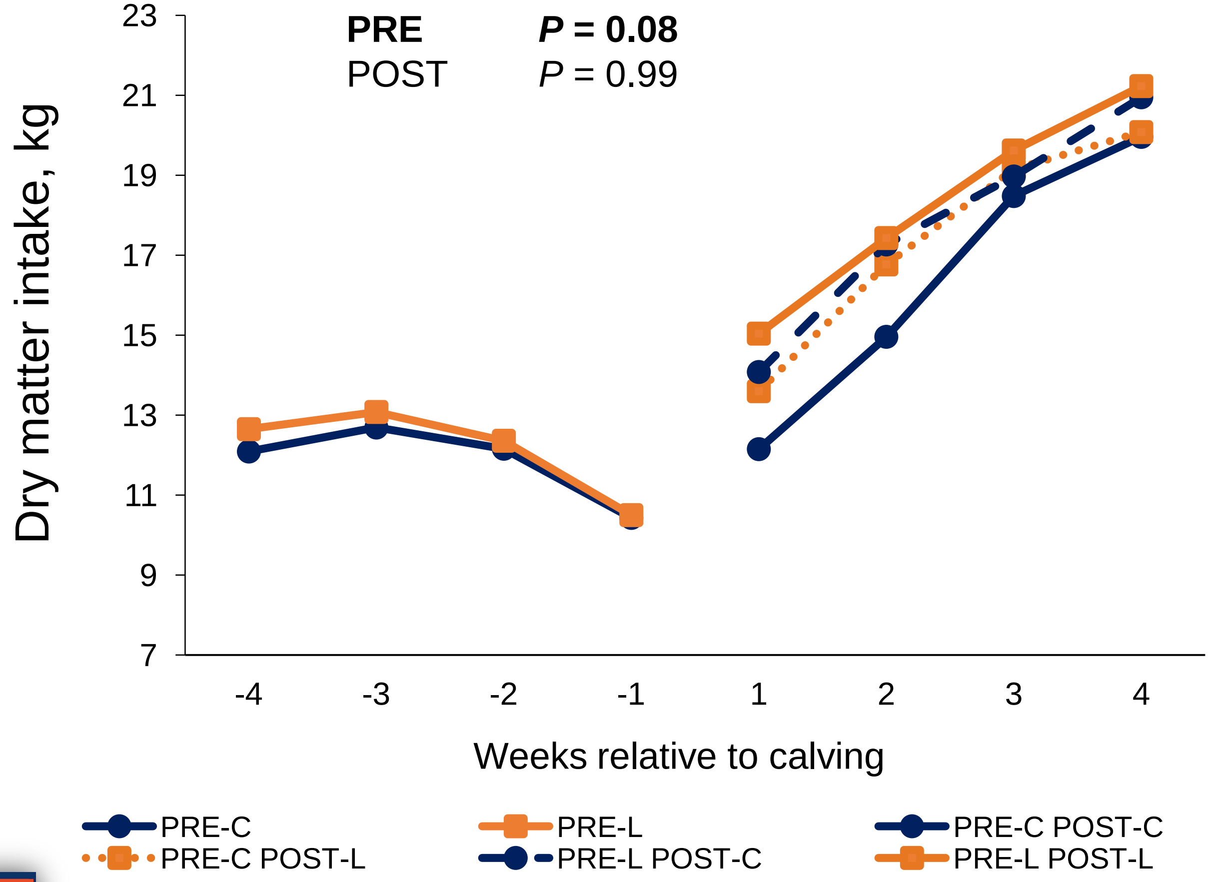
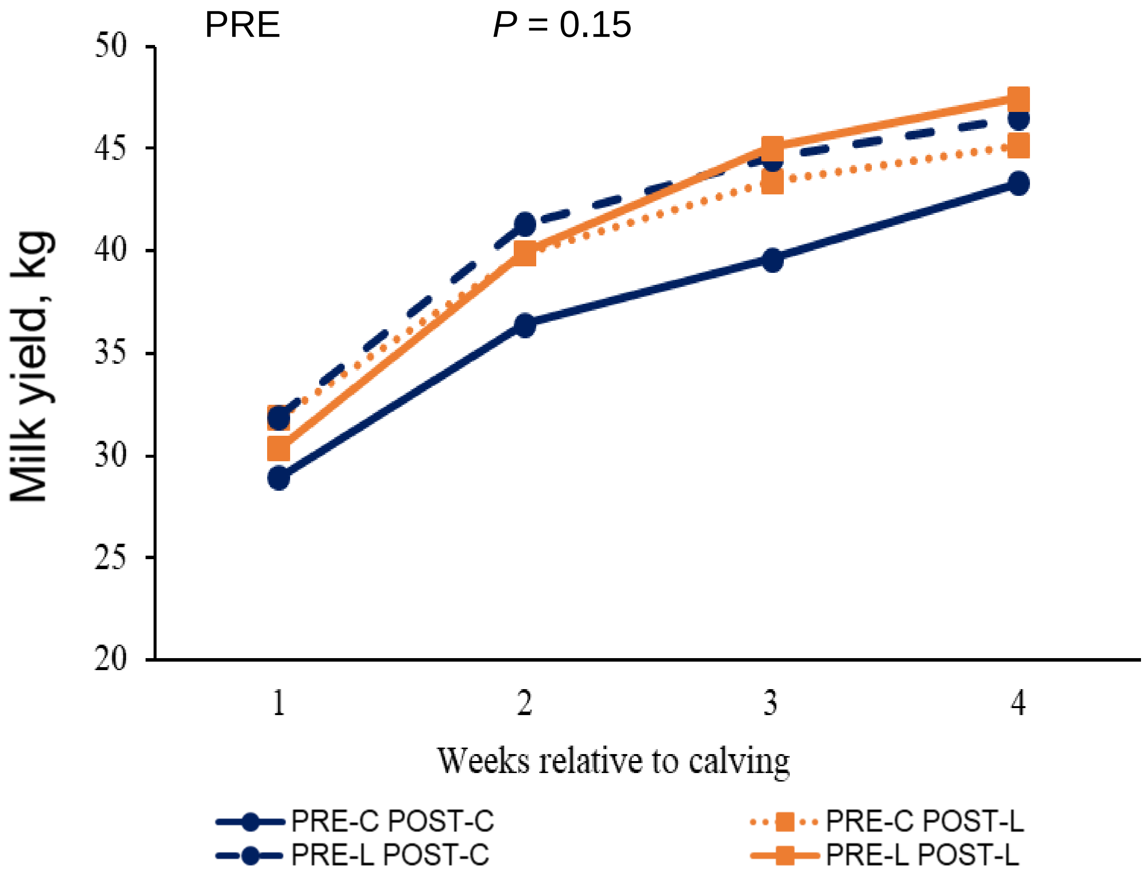
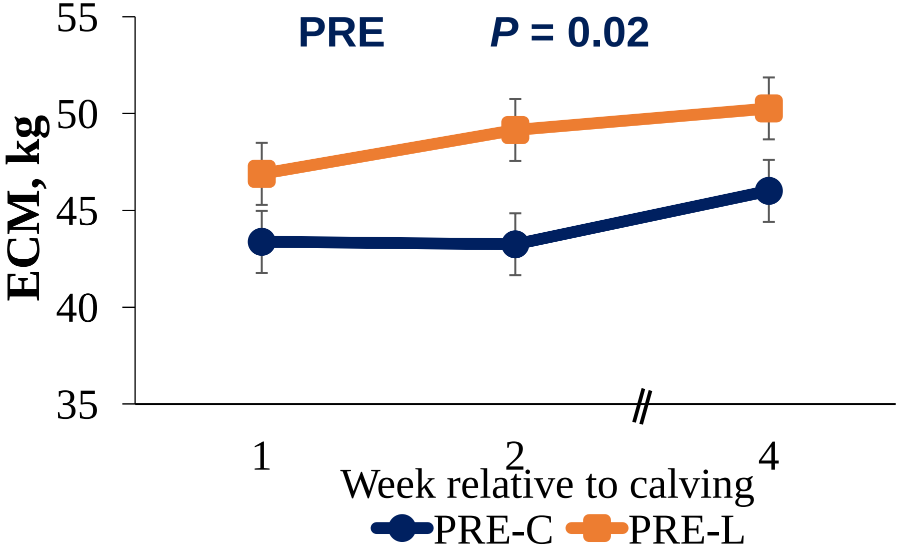
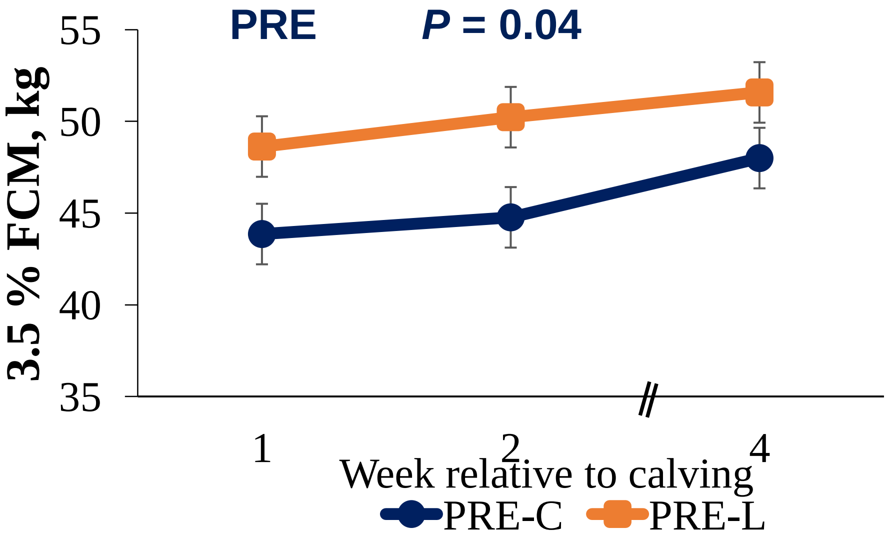


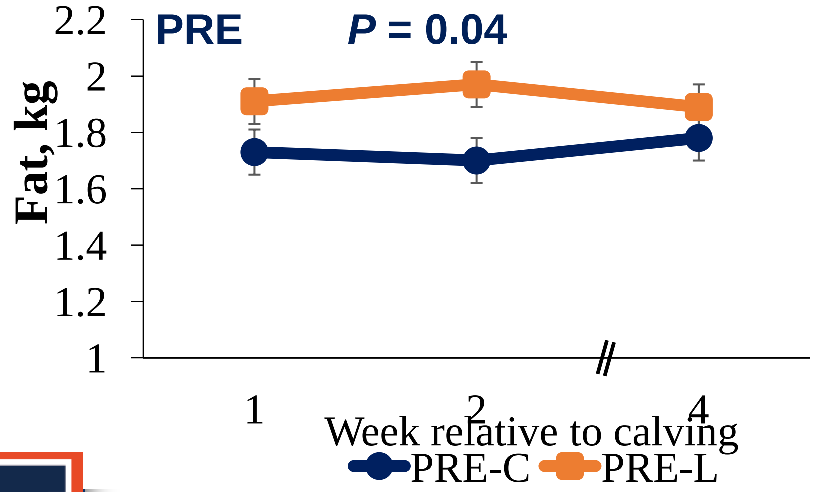


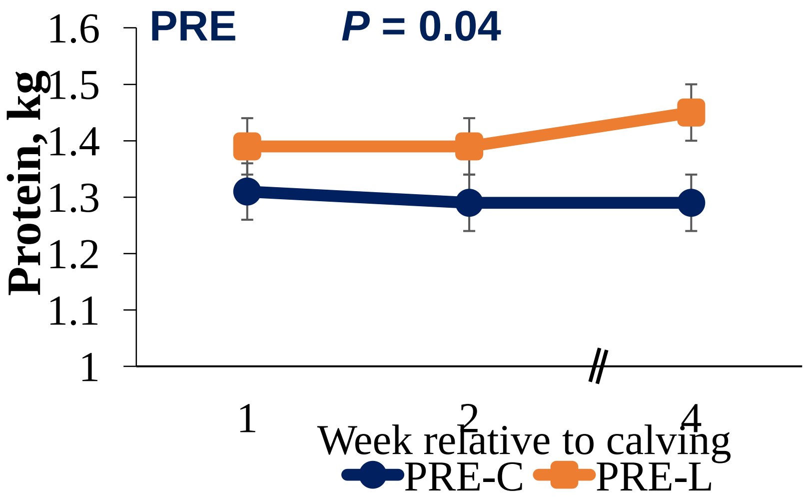
Fehlberg et al., 2020

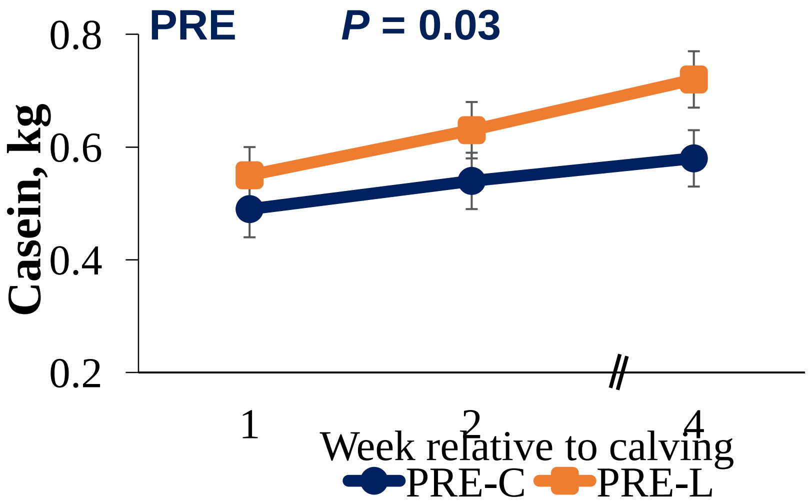
RPL prepartum increased ECM, FCM, and milk composition yields postpartum





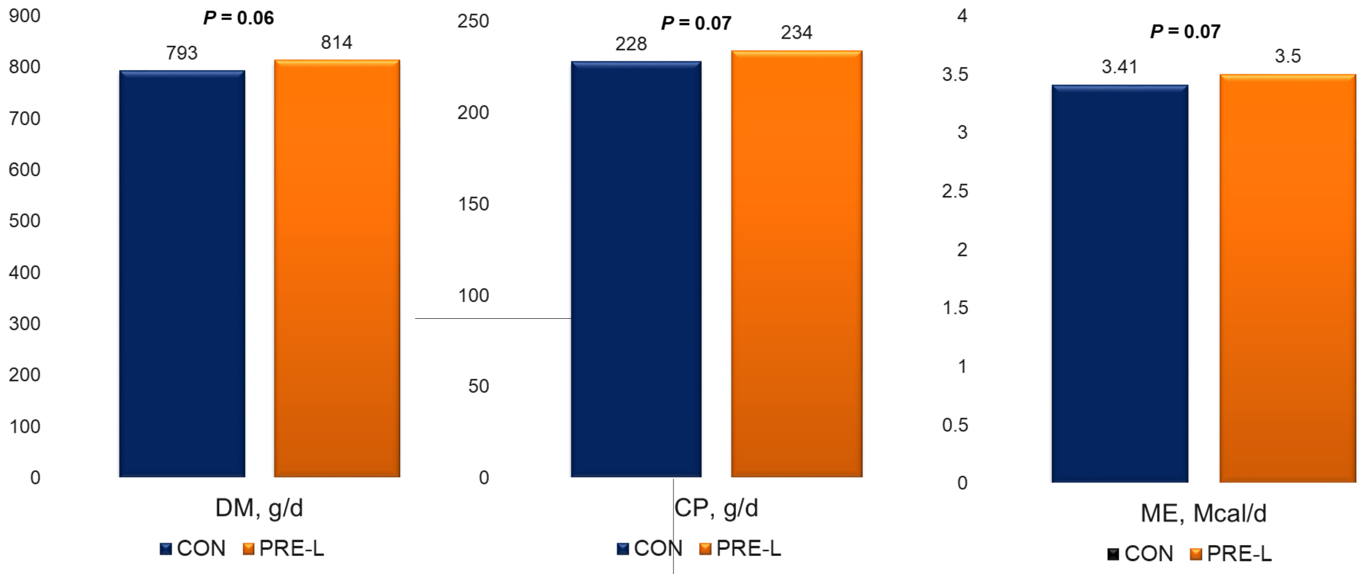






Fehlberg et al., 2020

Calves from cows fed rumen-protected LYS tended to consume more milk replacer (wk 1-6)



Thomas et al., 2021

EFFECT OF FEEDING RUMEN-PROTECTED LYSINE THROUGH THE TRANSITION PERIOD ON POSTPARTUM UTERINE HEALTH OF DAIRY COWS

RPL = Rumen-protected lysine DMI = dry matter intake

PRE-L 0.54% of DMI RPL prepartum

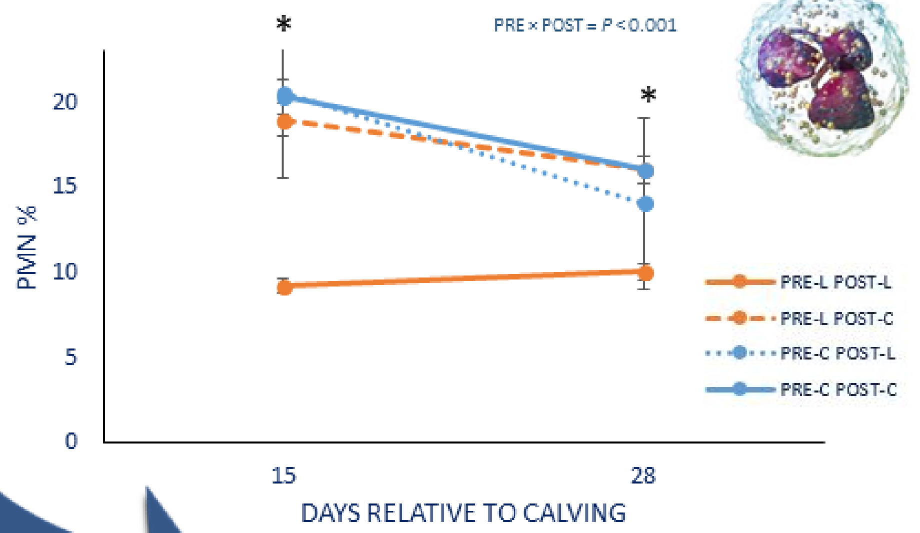
PRE-C No RPL prepartum

POST-L 0.40% of DMI RPL postpartum

POST-C No RPL postpartum

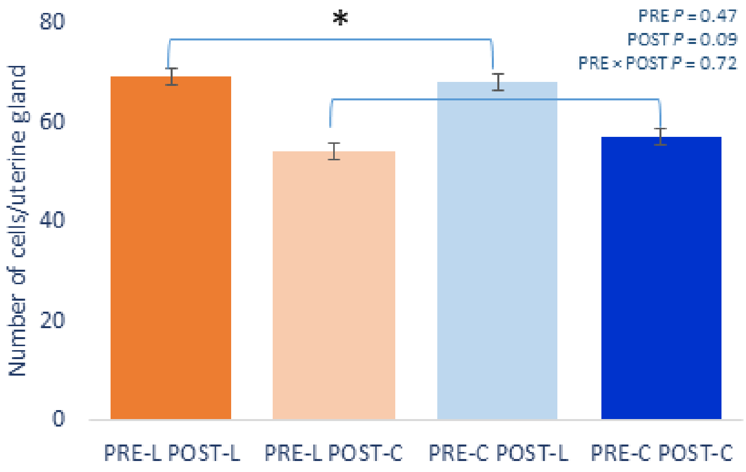
28 d

LESS POLYMORPHONUCLEAR (PMN) CELLS IN THE UTERUS OF COWS IN PRE-L POST-L

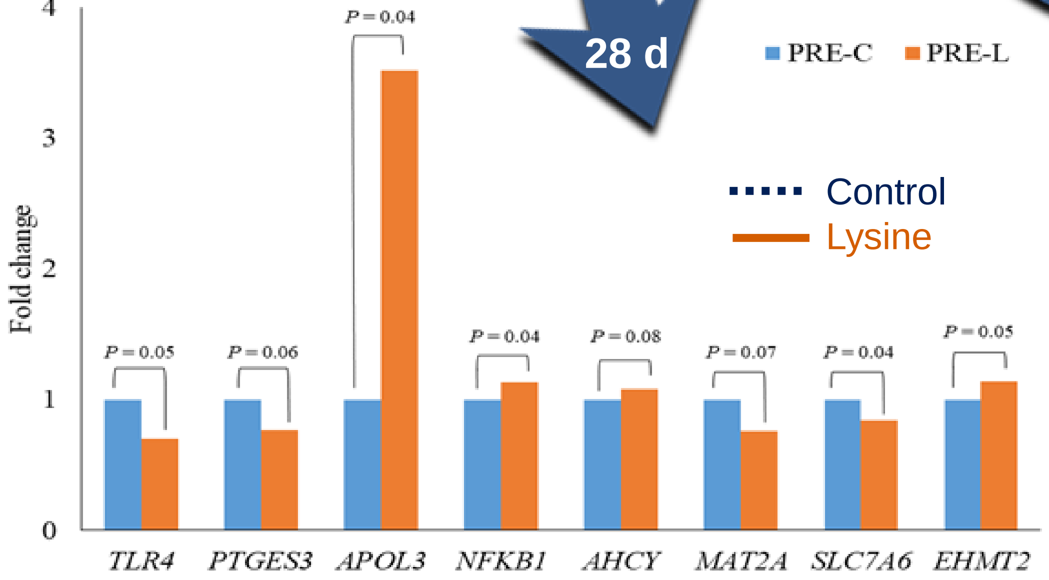


28 d

TREND FOR A HIGHER NUMBER OF CELLS PER UTERINE GLAND



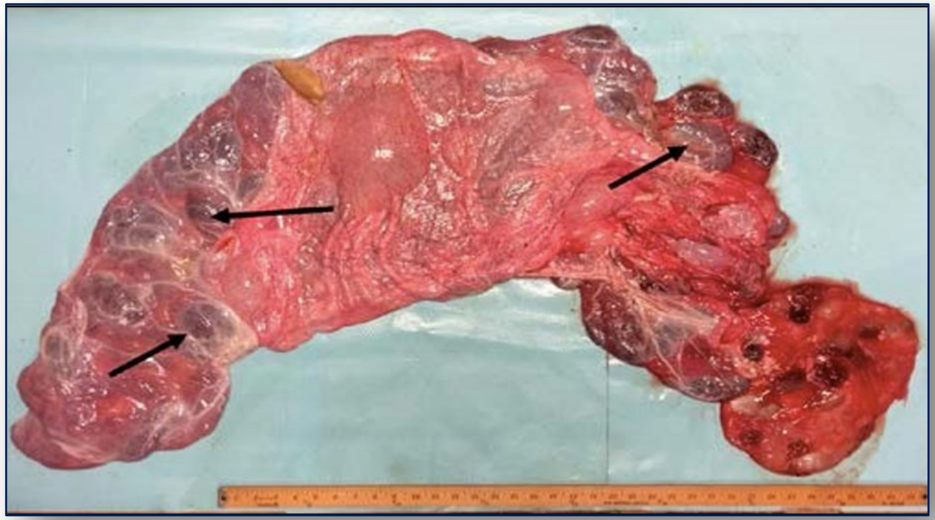
MODULATION OF GENES INVOLVED IN UTERINE IMMUNE RESPONSE AND METABOLISM

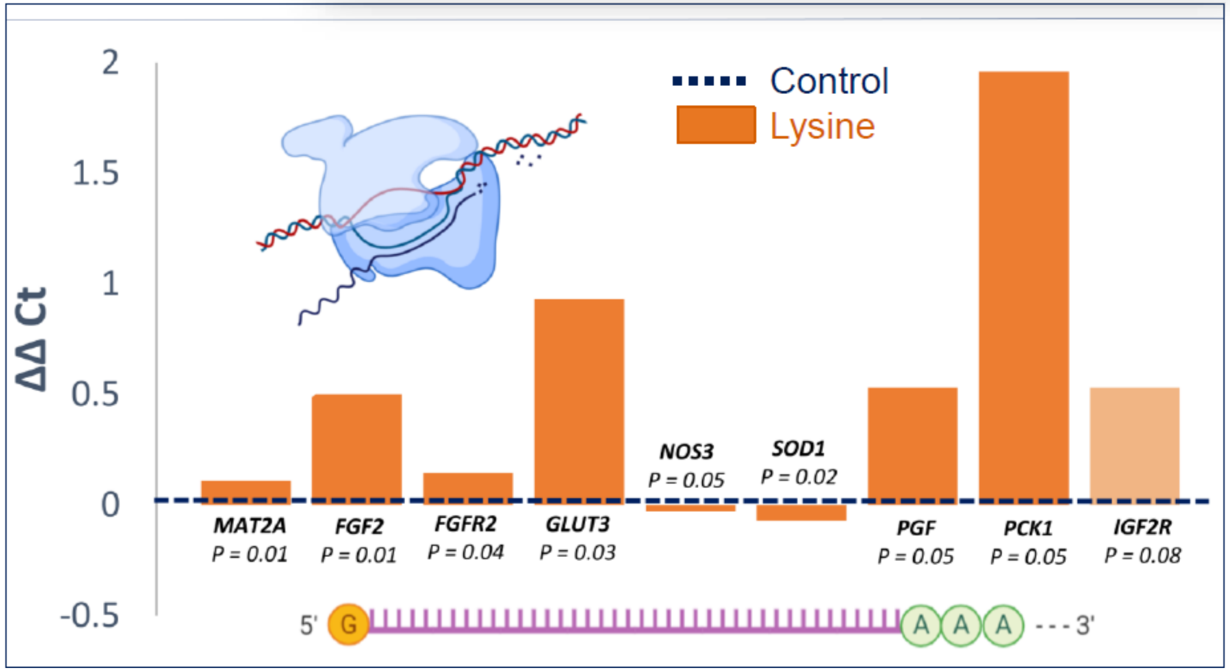


University of Illinois at Urbana-Champaign

Guadagnin et al., 2022

Placental transcript expression from cows fed rumen-protected LYS

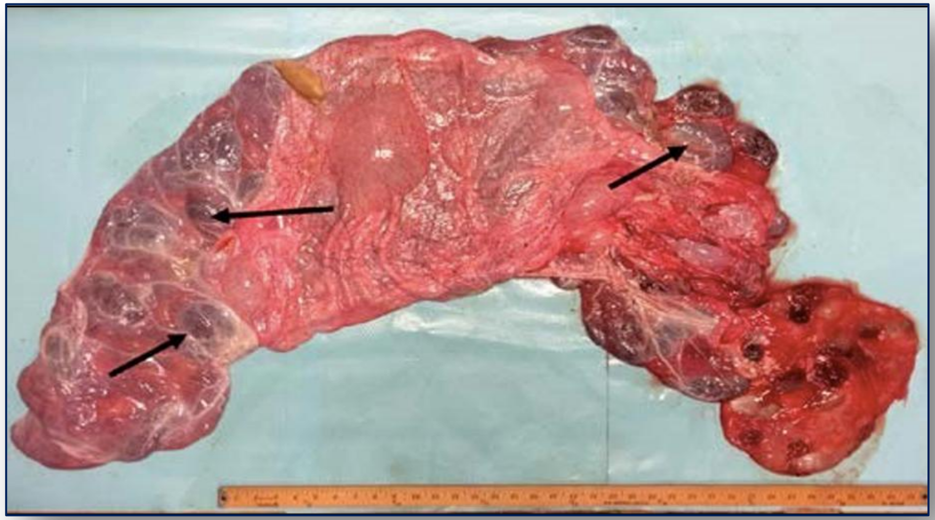


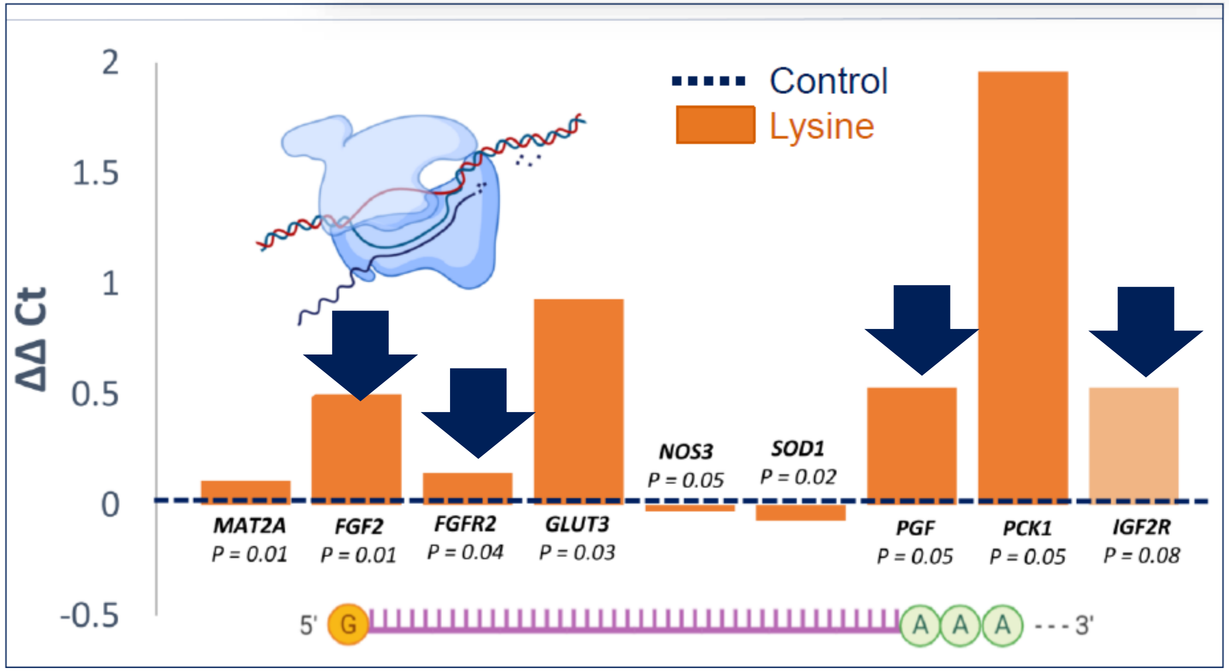


Guadagnin, *unpublished*

Placental transcript expression from cows fed rumen-protected LYS

- **Increased placental cell processes**, such as cell proliferation and growth, are indicated by the upregulation of *FGF2*, *FGF2R*, *PGF*, and *IGF2R*, the latest being a major fetal growth factor.
- These processes require **energy** and, thus, are likely related to the upregulation of *GLUT3* and *PCK1*.
- The downregulation of *SOD1* could indicate a **better redox status**, due to less need of the superoxide dismutase enzyme.
- It is likely that increasing supply of lysine allows for a greater **utilization of other amino acids** as well, such as methionine, exemplified by the upregulation of *MAT2A*.





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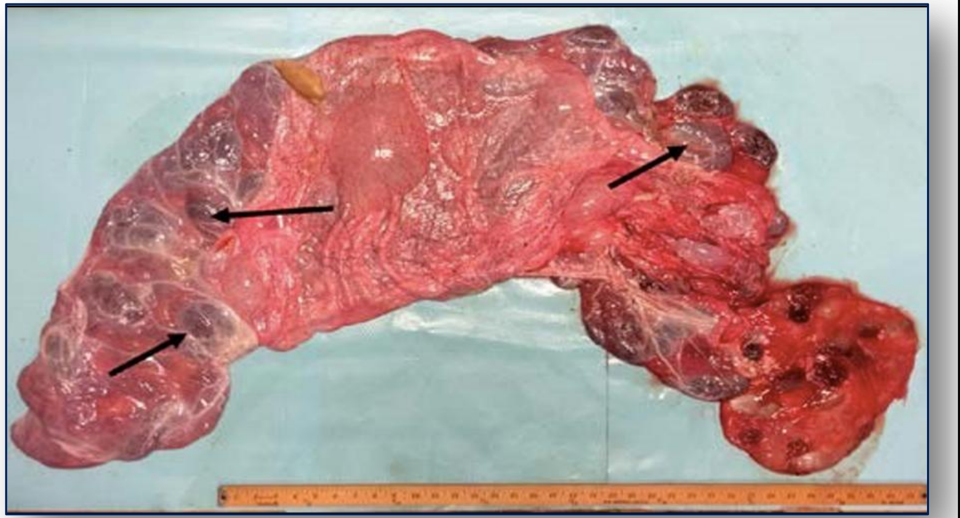

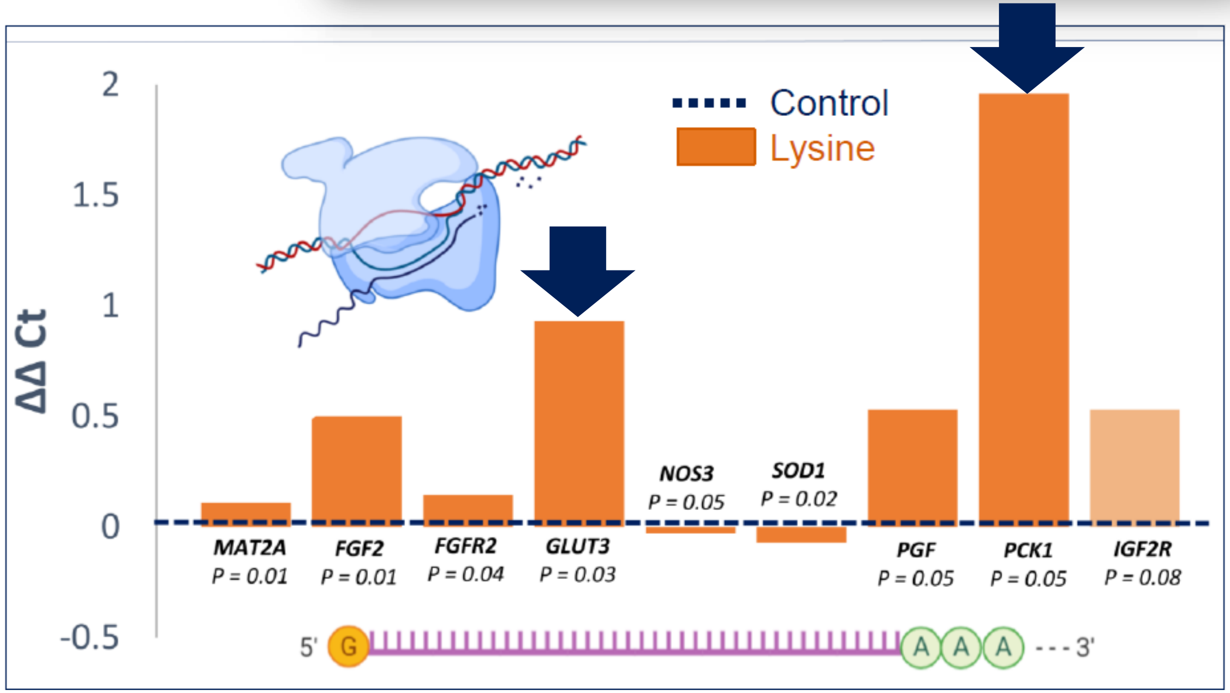

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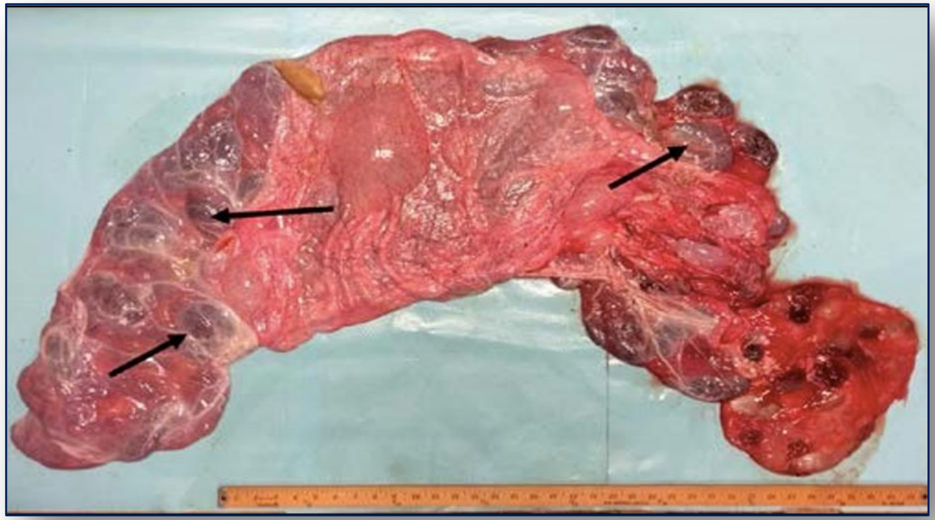

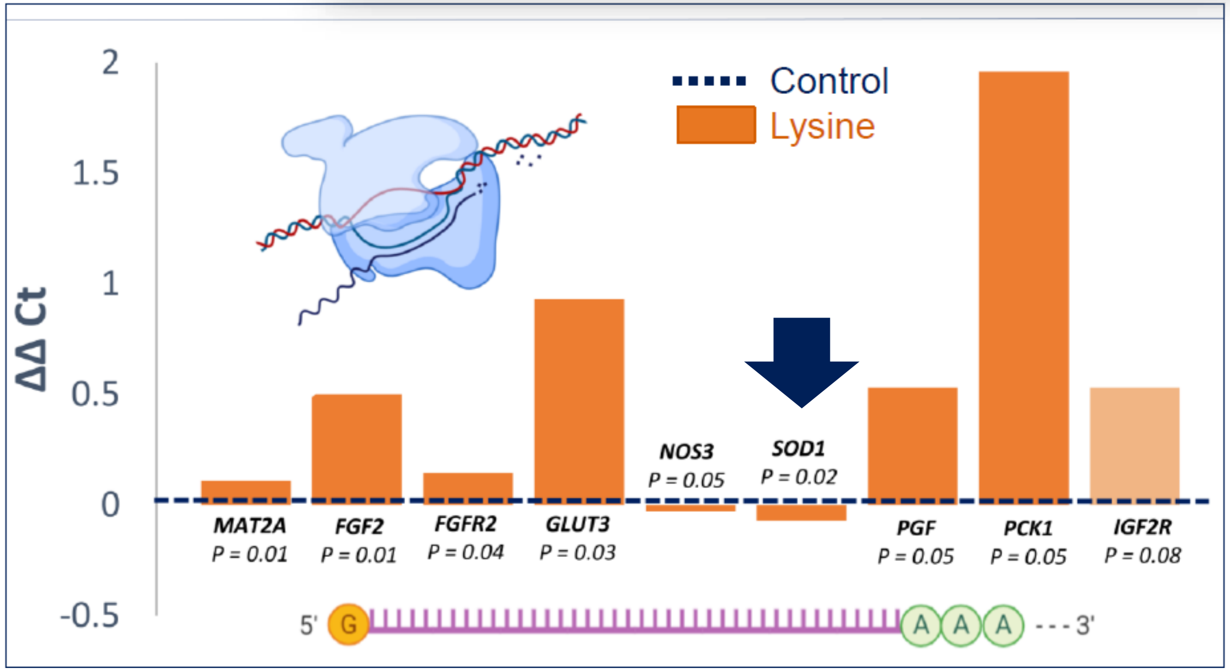

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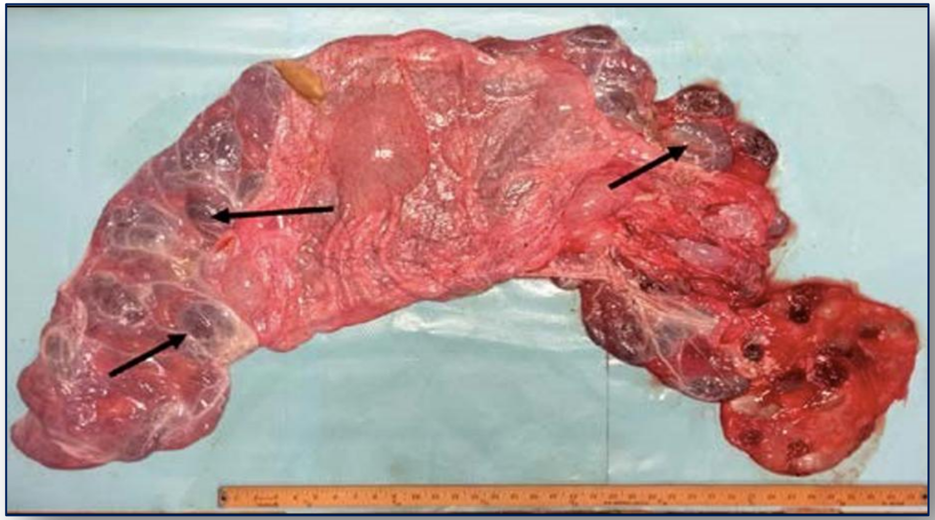
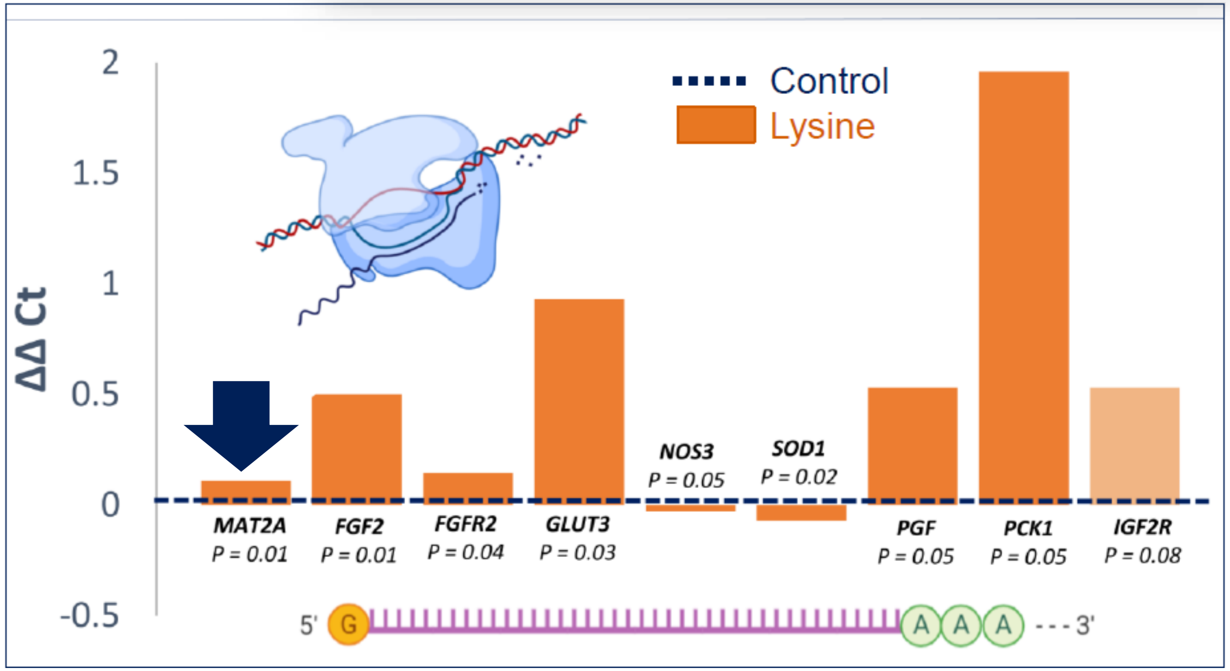




Guadagnin, *unpublished*

Effect of Supplementation with Rumen-Protected Methionine (RPM) on Reproduction of Lactating Dairy Cows

Cows were fed a basal TMR (6.9% Lys of MP and 1.87% Met of MP) from 30 ± 2 to 128 ± 2 DIM and assigned to two treatments:

RPM: Basal TMR top dressed daily with RPM

CON: Basal diet top dressed daily with DDG

Toledo et al., 2017

Effect of Supplementation with Rumen-Protected Methionine (RPM) on Reproduction of Lactating Dairy Cows

RPM cows were top dressed with 50 g (29 g DDG and 21 g of RPM)
CON cows were top dressed with 50 g of DDG

RPM

CON

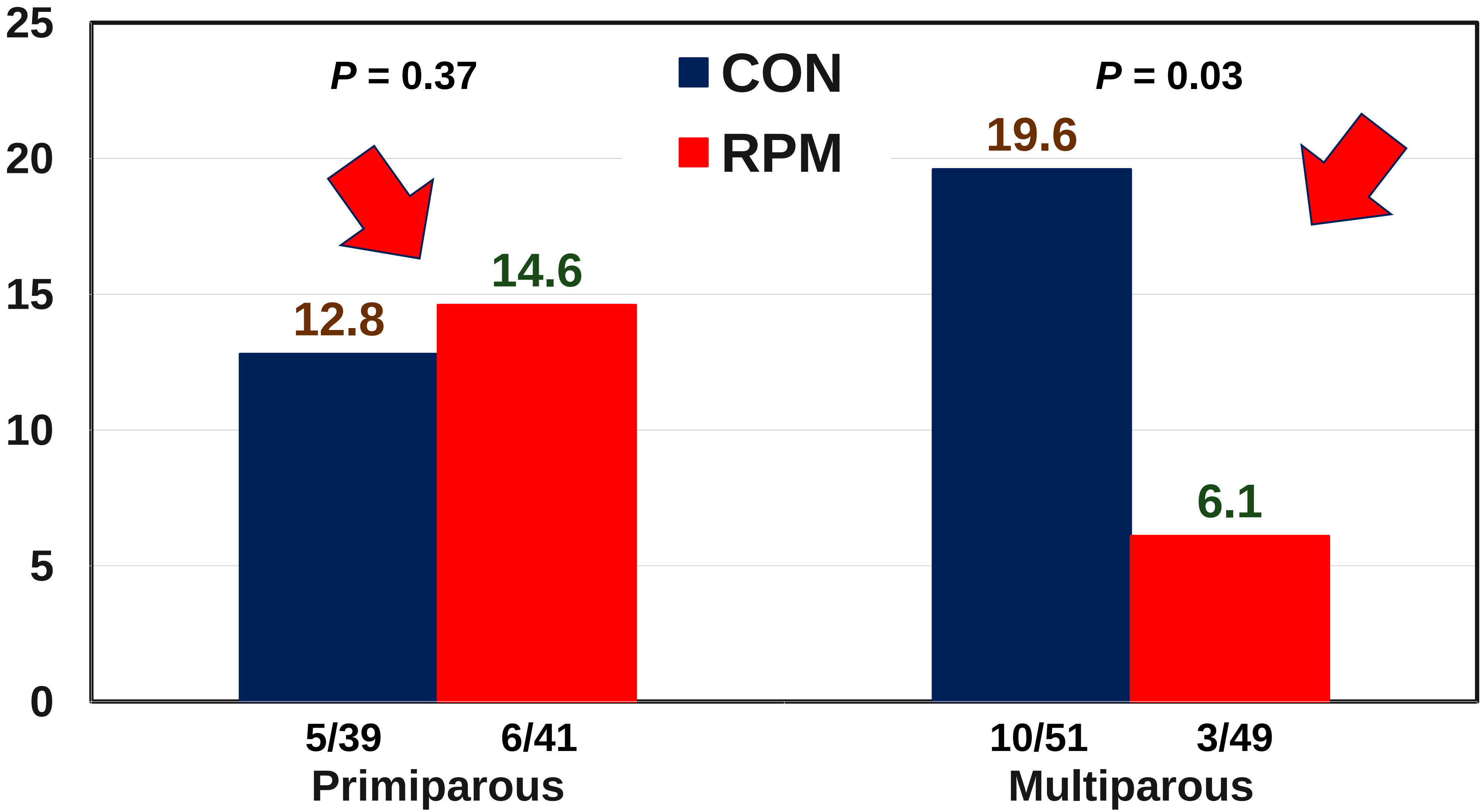
Toledo et al., 2017

Animals

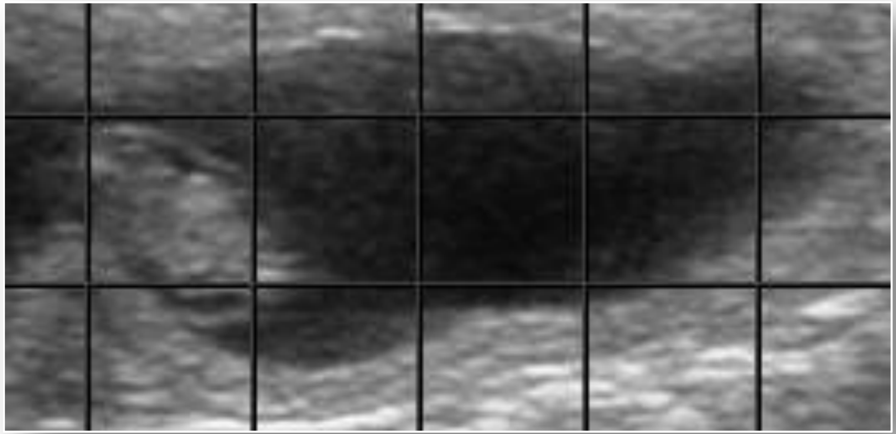
	CONTROL	RPM	TOTAL
Primiparous	68	70	138
Multiparous	85	86	171
TOTAL	153	156	309

Toledo et al., 2017

Pregnancy Losses (%) from 28 to 61 days after AI



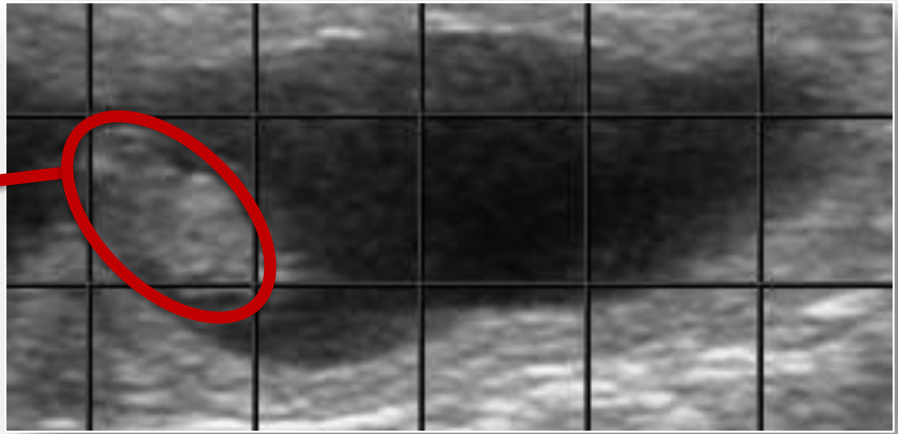
Toledo et al., 2017



Toledo et al., 2017

Amniotic vesicle size

Ellipsoid Volume



Toledo et al., 2017

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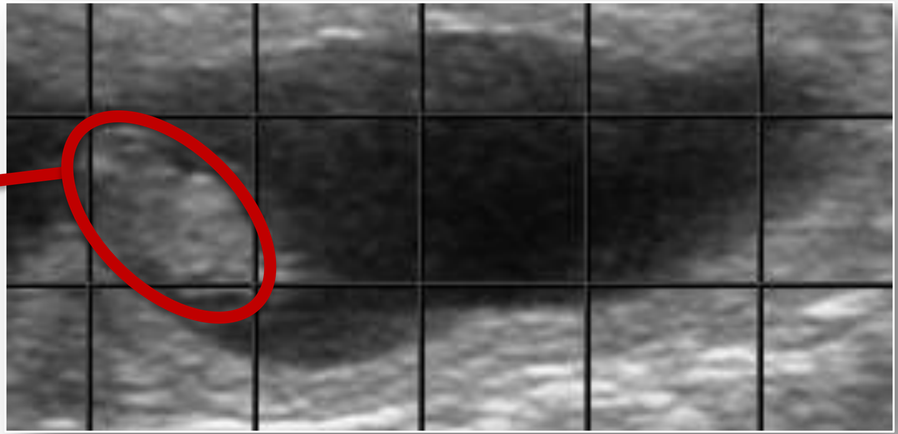

Day 33	n	Volume (mm^3) ± SEM
Primiparous		
Control	31	**610.6** ± 38.6
RPM	36	**596.0** ± 36.9
P-value		**0.71**
Multiparous		
Control	35	**472.3** ± 28.6
RPM	45	**592.1** ± 46.0
P-value		**0.05**

Toledo et al., 2017


1537
1362

431 lactating cows.

Annual rolling herd milk average: 16,975 kg (55.65 kg/cow/day)

https://www.koesterdairy.com

KOESTER DAIRY INC.
K-STAR REGISTERED HOLSTEINS

Naab Code	Name	TPI	NM$	Mil
011HO15874	Altaexquisite	3085	1131	12
011HO15655	Altakevlow	3067	1115	13
011HO15619	Altaalanzo	3062	1035	12
200HO12222	Holysmokes	3054	970	12
200HO12266	Overdo	3054	1082	6
011HO15624	Altazemini	3033	1097	12
007HO15167	Gameday	3033	1055	10
007HO15839	Magnum	3010	1027	17
200HO12156	Earlybird	3009	979	6
014HO15179	TRooper	3000	909	9
011HO15566	Altalumify	2998	1078	1
200HO12171	Mookie	2996	942	10
011HO15365	Altawheelhous	2994	1002	1
011HO15801	Altacitrine	2992	961	1
007HO15085	Parfect	2990	800	10
200HO11862	Lambeau	2989	889	10
200HO12197	Fellowship	2988	993	1
011HO15467	Altamagnifique	2987	983	1
007HO15721	Harrisenna	2981	934	1
007HO15640	Moonraker	2974	879	10
014HO15223	Conway	2935	884	[illegible]

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https://www.koesterdairy.com

PRESCRIPTION PREMIX

W7997 HOPE LAKE ROAD , LAKE MILLS WISCONSIN 53551 920-723-0386

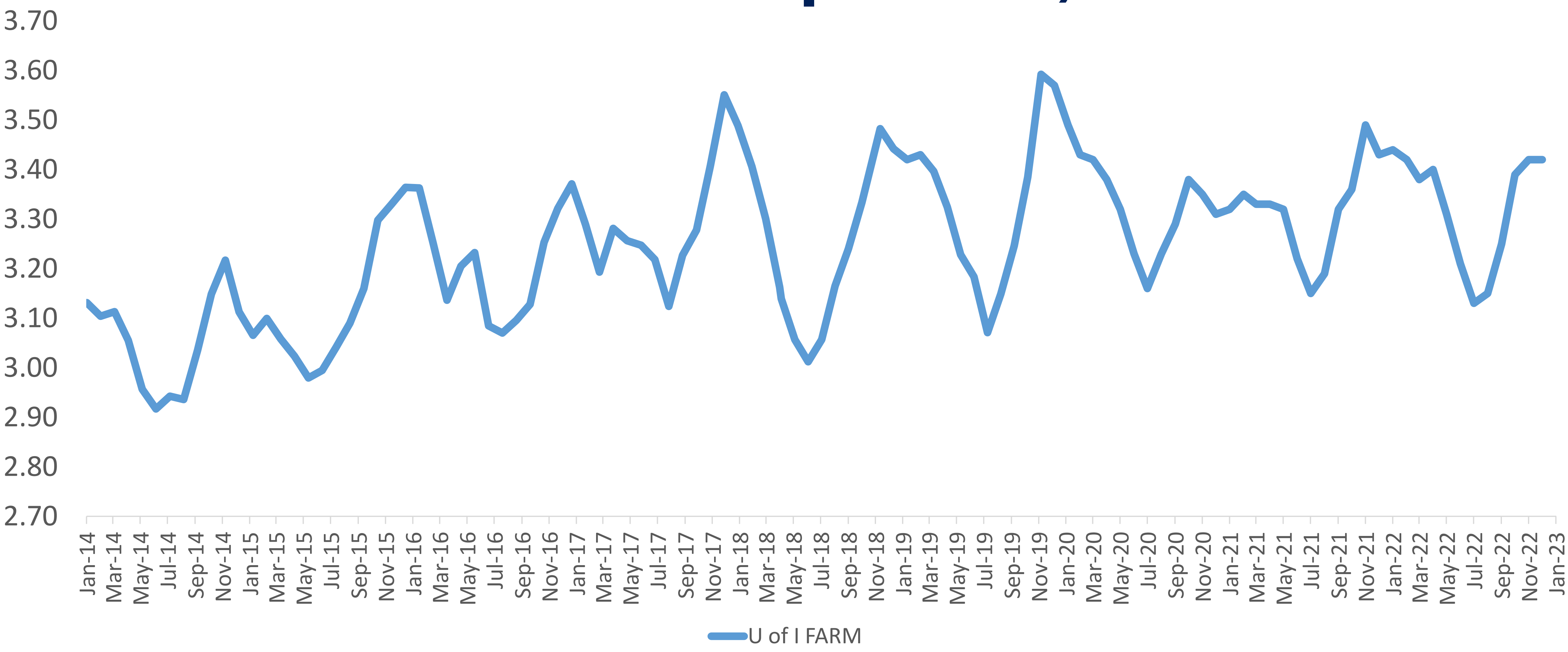
WORKSHOP NDS v3 - K-Star Dairy - Dry Cows - Far Off - Dry Cow

Dry matter: 53.5% - Moisture: 46.5%

New recipe Dry Cow			N° of
Ingredients	AF lb/d	DM lb/d	
K-Star Dry Cow Mix 040220	11.4407	10.4131	
Water	7.0000	0.0035	
corn KSTAR	1.5000	1.3154	
straw K STAR	9.0518	8.2000	
corn silage 2021 K STAR	29.0500	11.1000	
TOTAL	58.0424	31.0319	

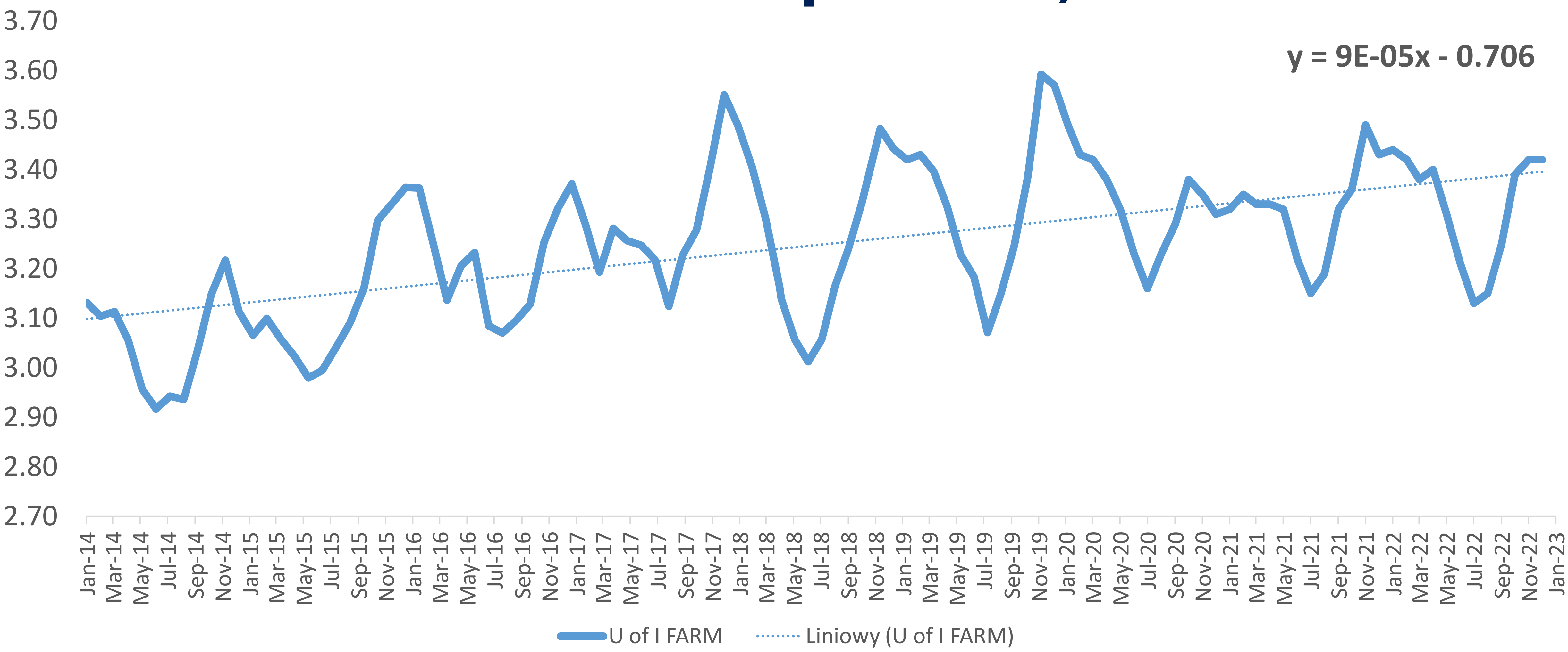
University of Illinois Dairy Farm

Bulk tank – Milk true protein, %



Over 1,800 samples

Bulk tank – Milk true protein, %



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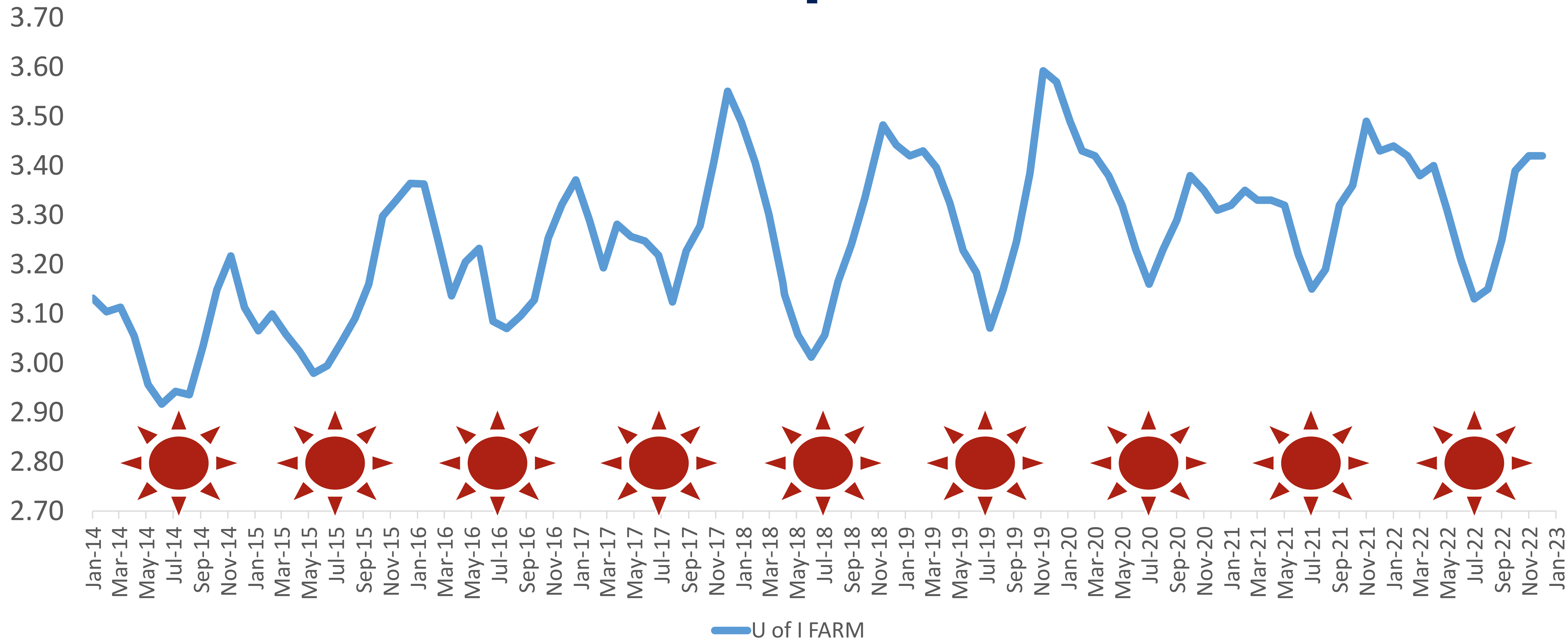

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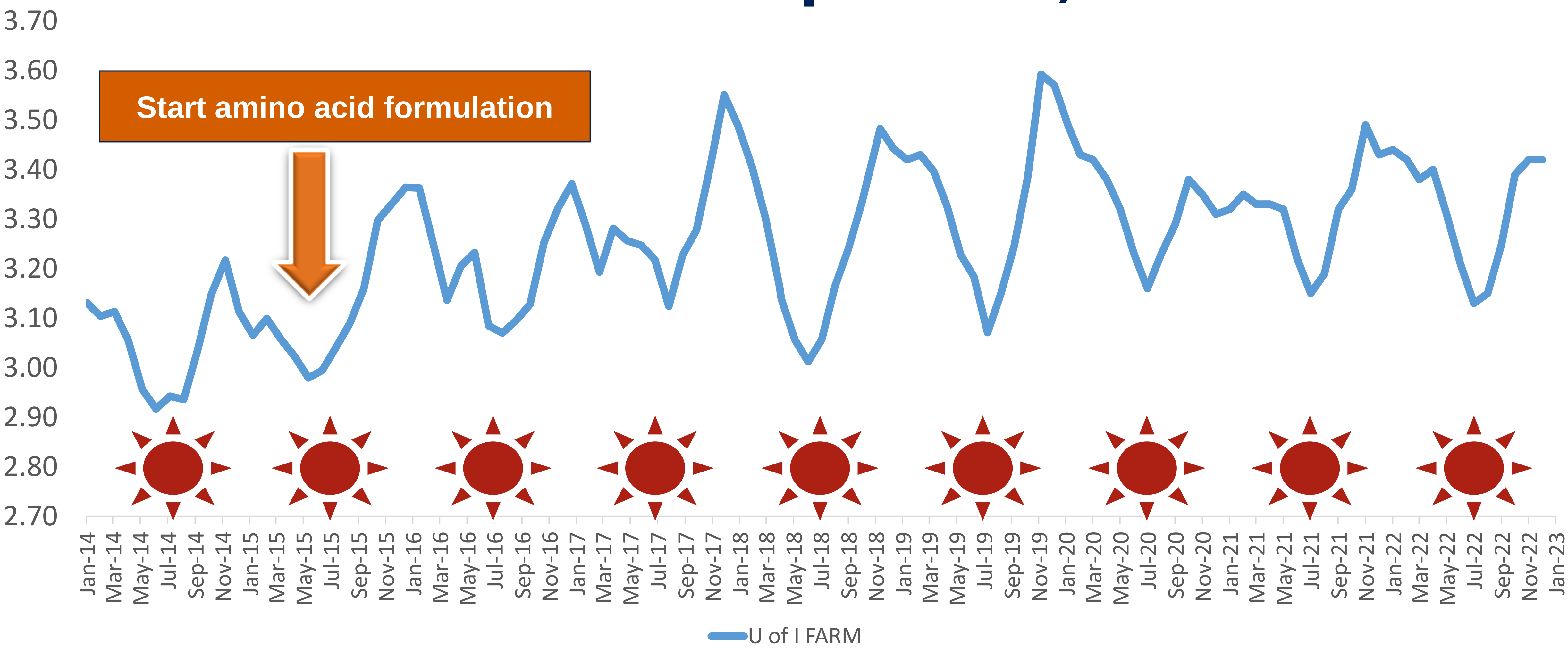

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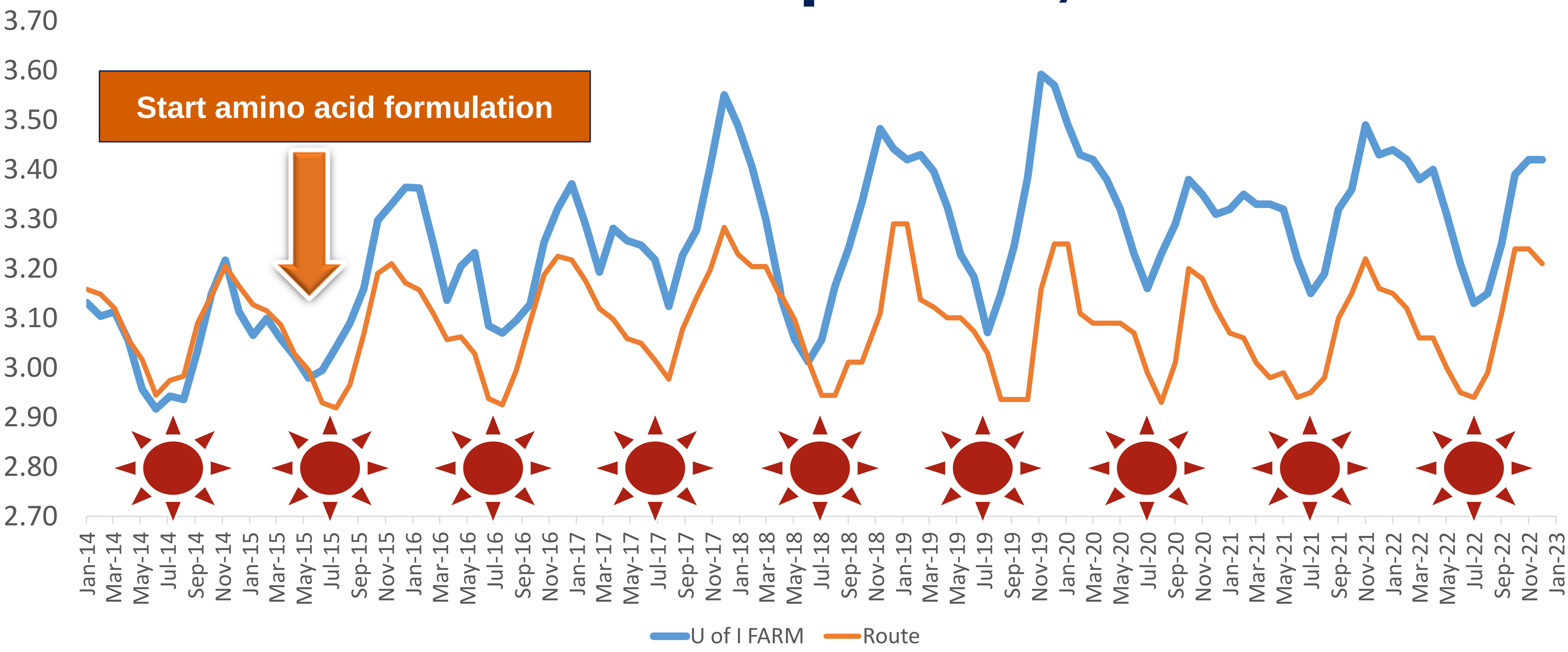

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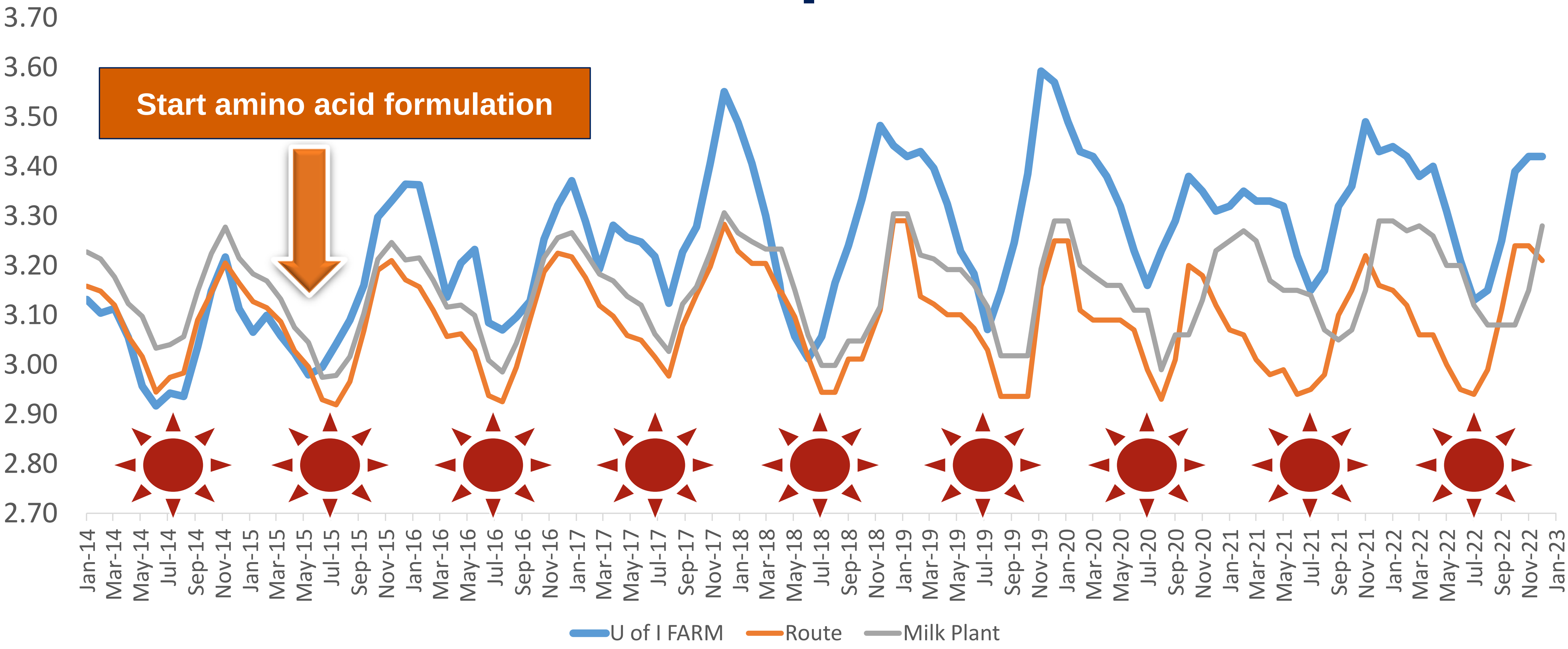
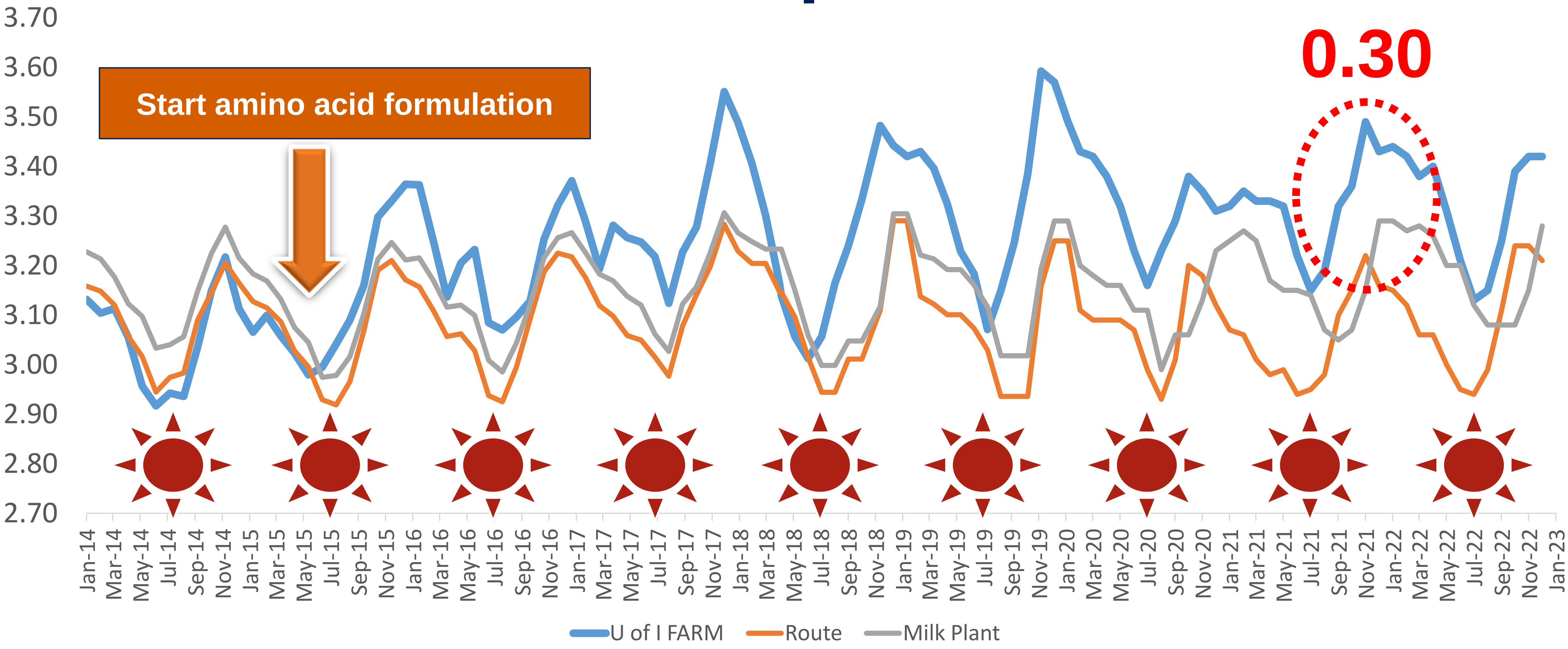


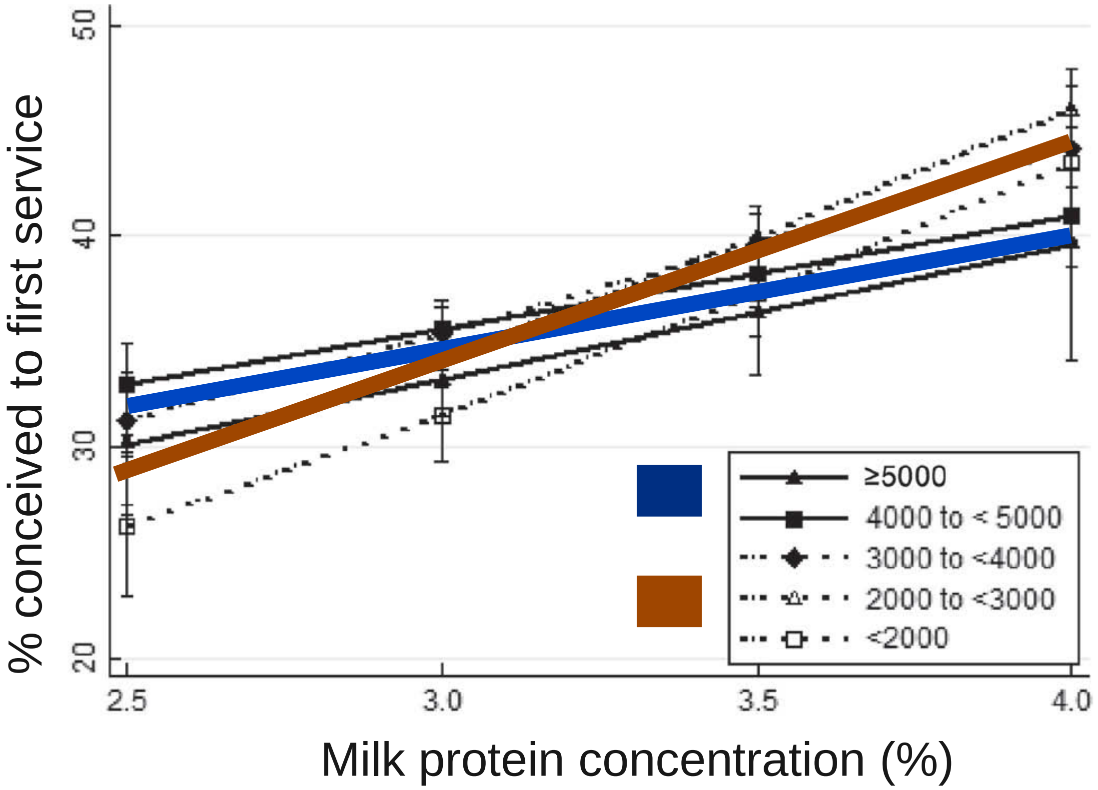
Over 1,800 samples

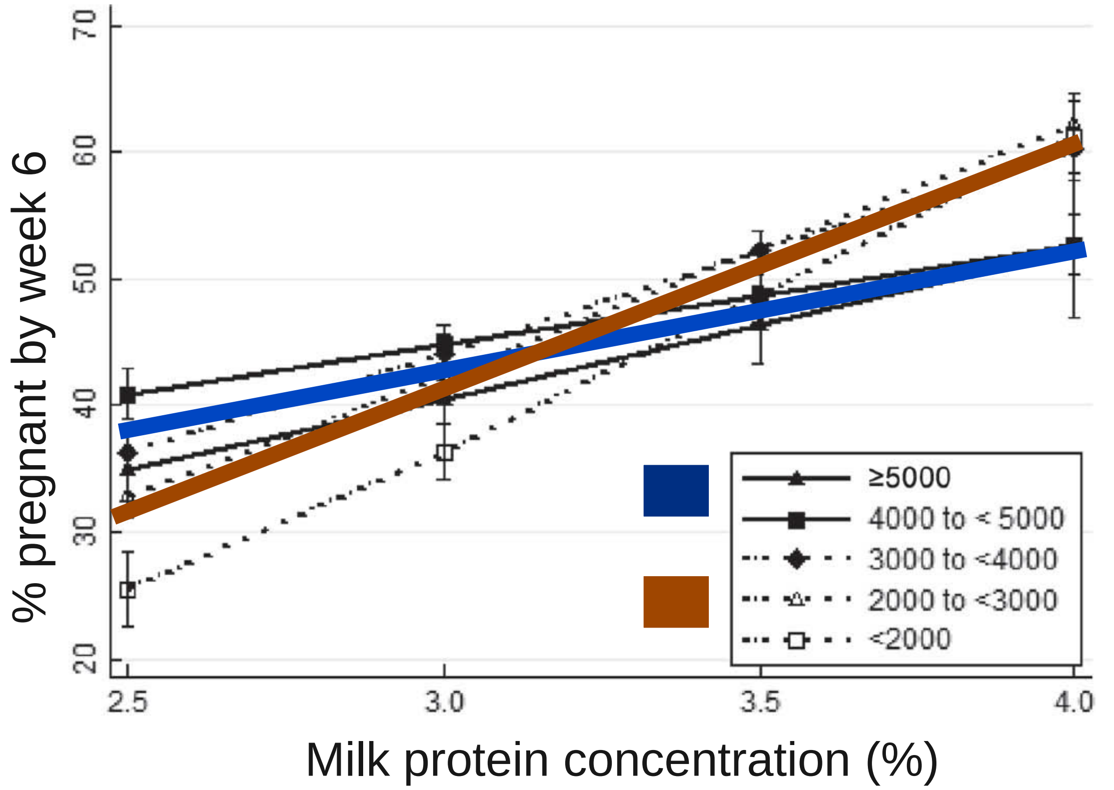
Bulk tank – Milk true protein, %



Over 1,800 samples

Cows with higher milk protein concentration had *increased* conception at first service and pregnancy by week 6



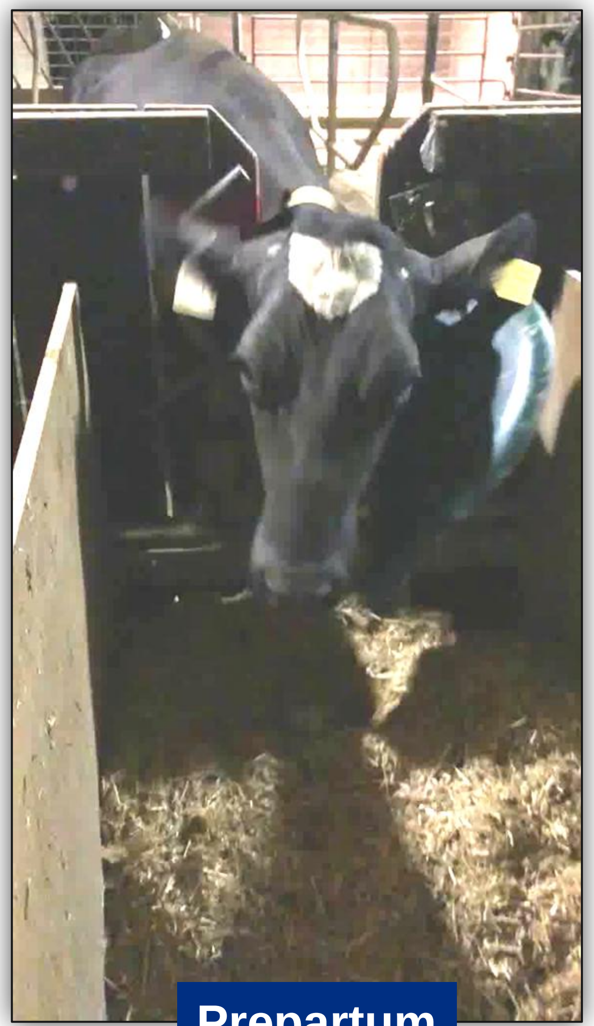


A retrospective, single cohort study was conducted using data collected from 74 Australian dairy herds. These herds provided data for 126,277 cows; these cows had 359,892 calvings (and hence lactations) recorded.

Morton et al., 2016


TAKE HOME MESSAGE
Remember!

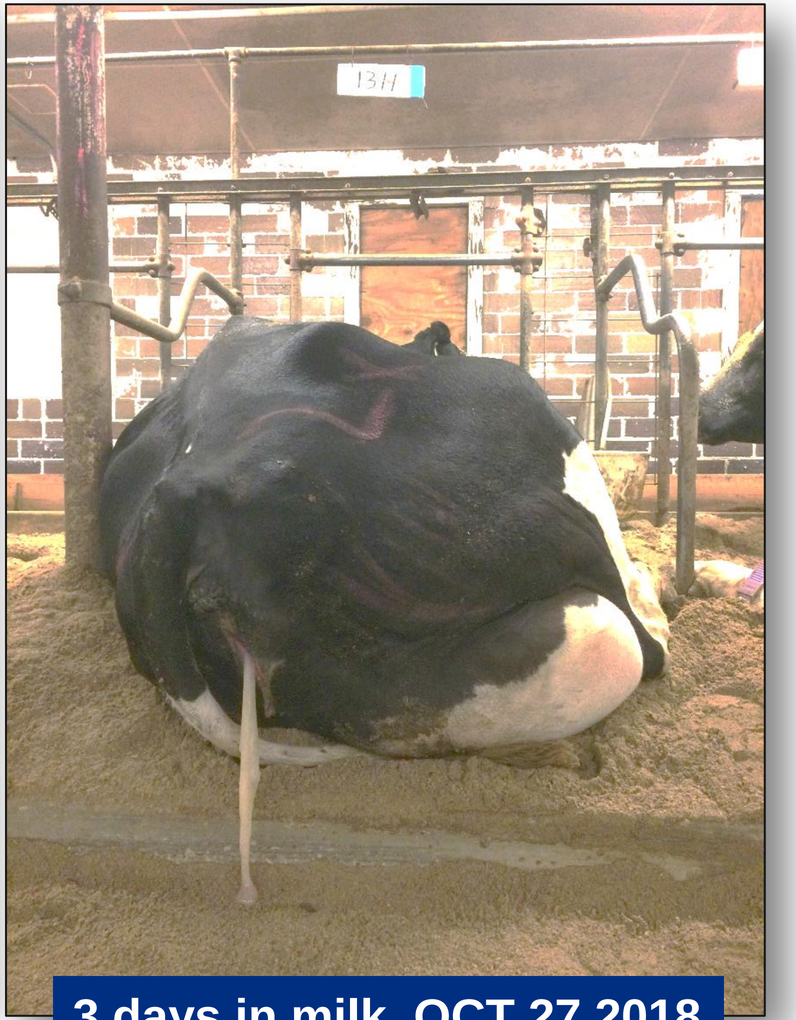
Cow # 1311 on controlled energy diet, - DCAD and AA



Prepartum

Cow # 1311 on controlled energy diet, - DCAD and AA

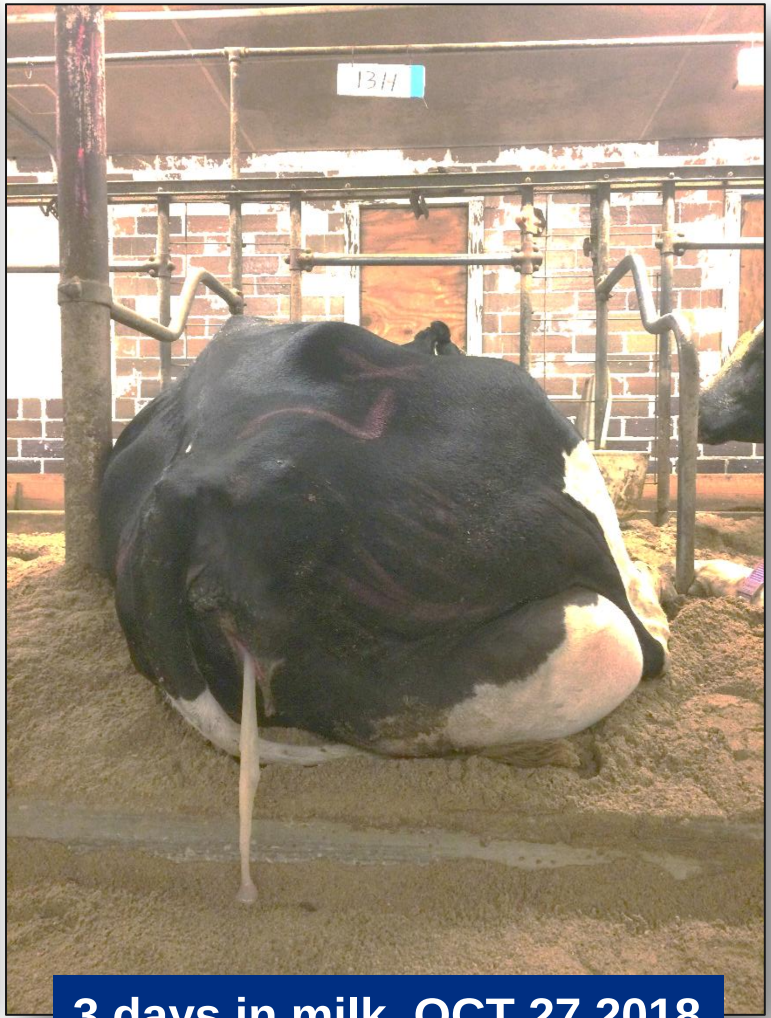
Prepartum



3 days in milk, OCT 27 2018

Cow # 1311 on controlled energy diet, - DCAD and AA

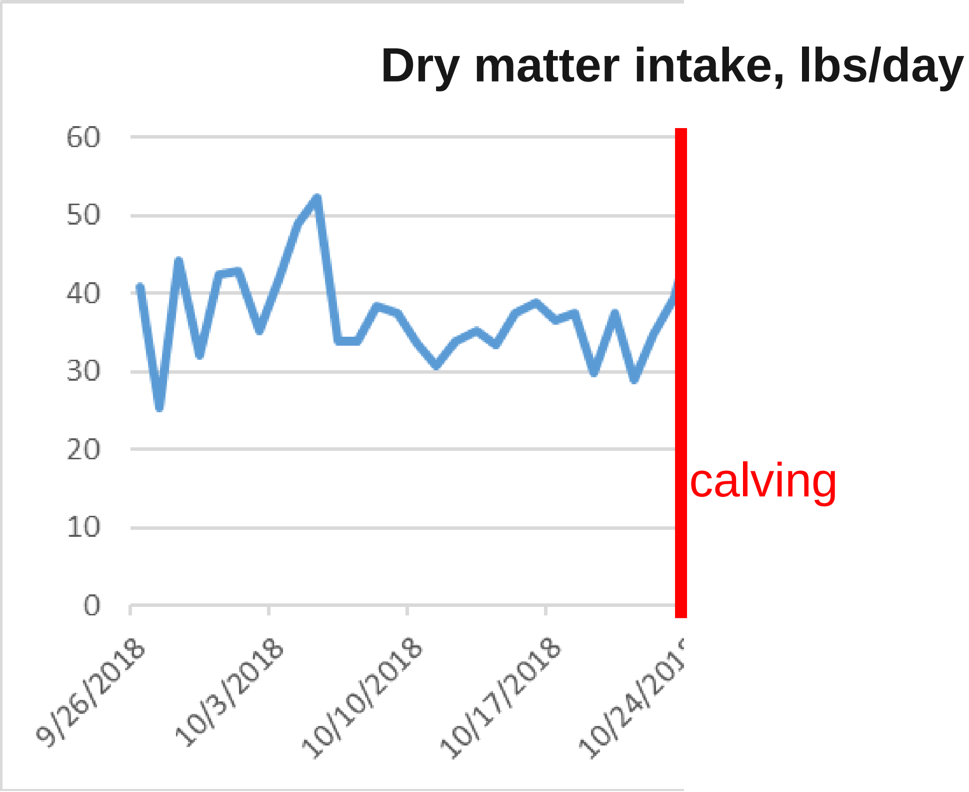
Prepartum



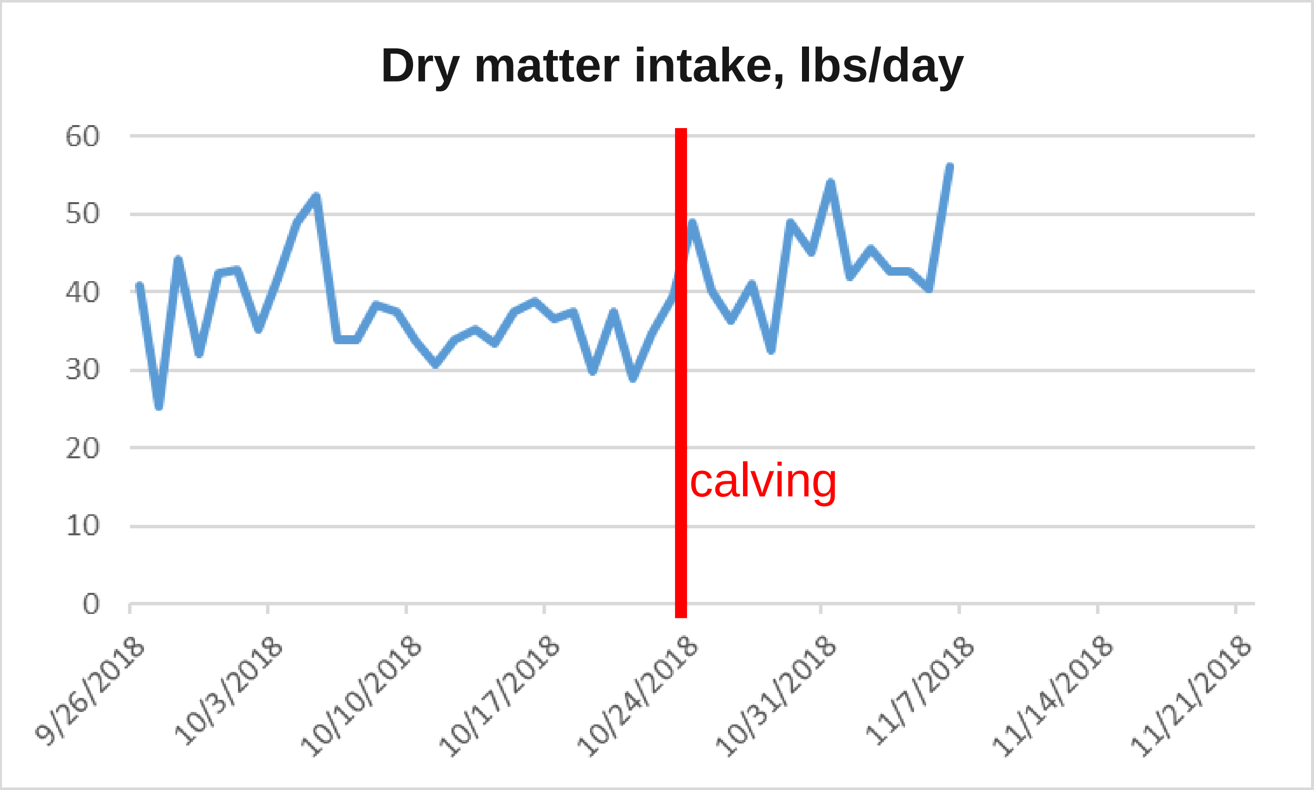
3 days in milk, OCT 27 2018

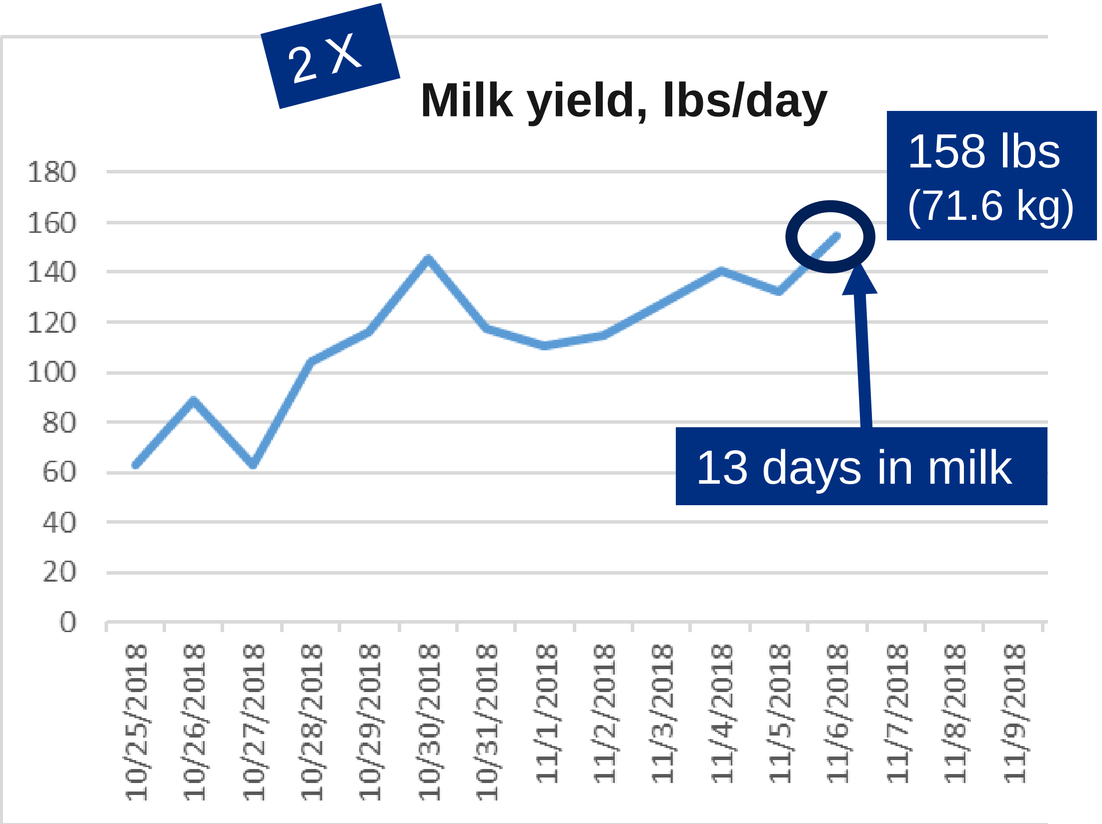
17 days in milk, NOV 10 2018

Cow # 1311 on controlled energy diet, - DCAD and AA



Cow # 1311 on controlled energy diet, - DCAD and AA





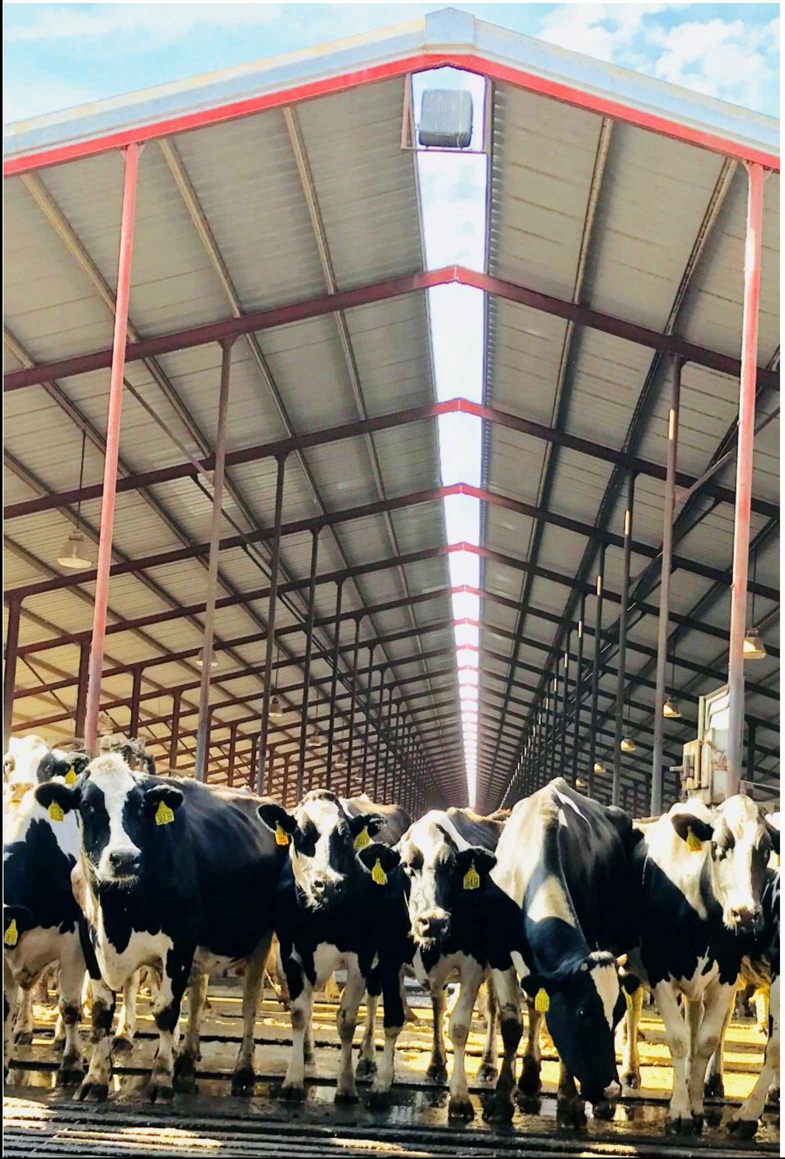
Cow	Colostrum Weight, lbs	Colostrum Brix, %	Fat, %	Total Protein, %	Total Solids, %
1311	13.15	25.6	3.43	17	24.26

Investment!

The right diet provides the nutrients necessary for the cow’s milk production, health, and fertility. Nothing more… nothing less; a “prescription.” 


Focus on it!

ILLINOIS
Animal Sciences
COLLEGE OF AGRICULTURAL, CONSUMER & ENVIRONMENTAL SCIENCES



THANKS!

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