The cow's perspective on transition health and herd longevity

HIGH PLAINS DAIRY CONFERENCE

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Dairy Focus Lab

Reproduction: Early Embryonic Loss

Reference	Cows	Days 1st Check	Days last Check	Days	Loss %	Loss/ Day %
Chebel et al., 2002a	195	28	42	14	17.9	1.28
Moreira et al., 2000a	139	27	45	18	20.7	1.15
Chebel et al., 2002b	1,503	31	45	14	13.2	0.94
Stevenson et al., 2000	203	28	45	17	15.8	0.93
Santos et al., 2002b	360	31	45	14	11.1	0.79
Santos et al., 2002a	220	27	41	14	10	0.71
Cerri et al., 2002	176	31	45	14	9.7	0.70
Juchem et al., 2002	167	28	39	11	11.4	1.03

Daily embryonic loss in the first 50 days of pregnancy = 0.9%

Adapted from Santos et al., *Anim.Repro.Sci.* 2004

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$152 to $361 pregnancy loss - 1st month of pregnancy. DeVries et al., 2006

Daily embryonic loss in the first 50 days of pregnancy = 0.9%

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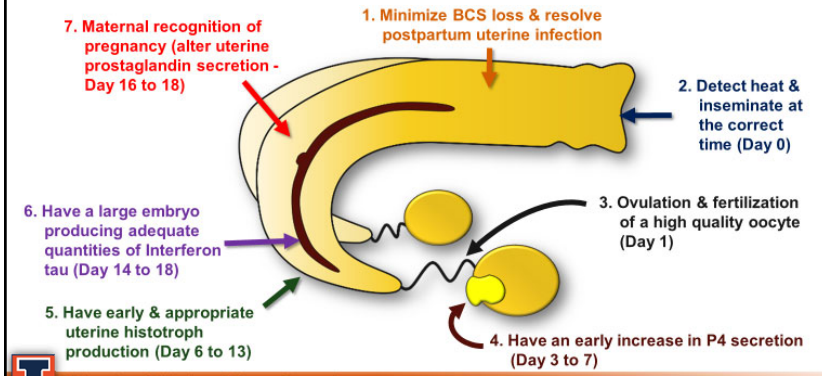
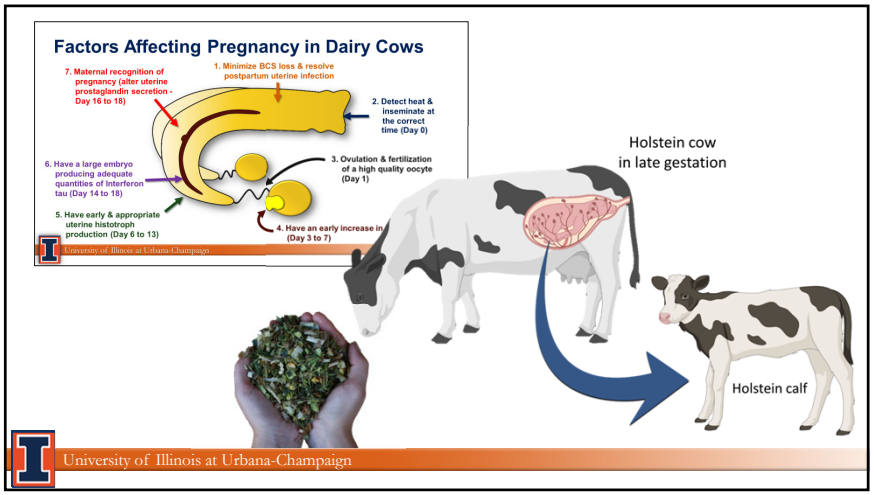
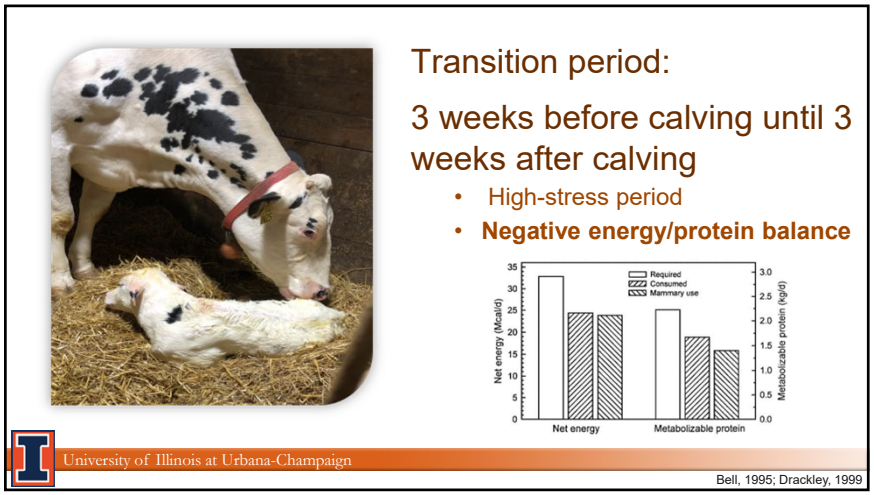
Factors Affecting Pregnancy in Dairy Cows



Walsh et al., 2011



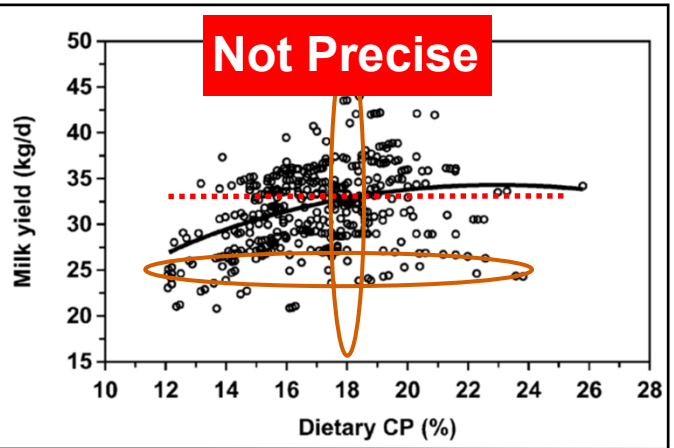


Dietary Recommendations for Dry Cows

- **NEL:** Control energy intake at 18 to 20 Mcal daily [diet ~ 1.43 Mcal/kg (0.65 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)

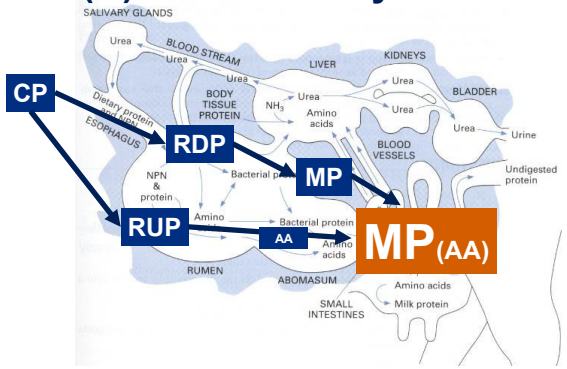
University of Illinois at Urbana-Champaign

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



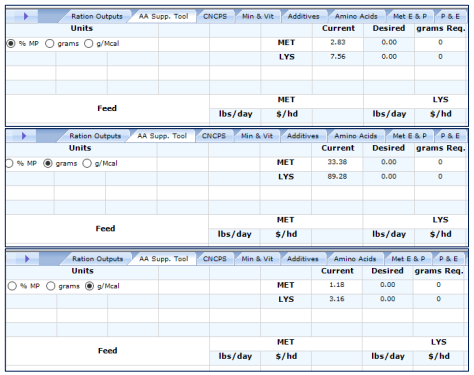
Ipharraguerre and Clark, 2005

Protein (N) Utilization by the Ruminant



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

Diet Formulation – Precision Feeding

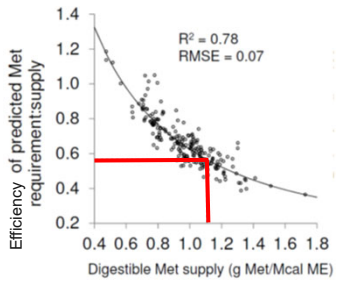


AMTS

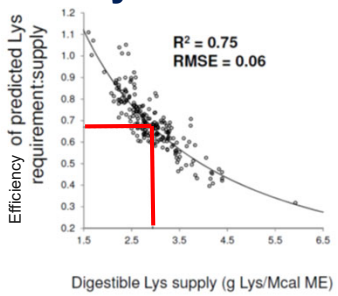
Fehlberg et al., 2020

Diet Formulation – Precision Feeding

Methionine



Lysine



Adapted from Van Amburgh, 2019

Diet Formulation – Precision Feeding

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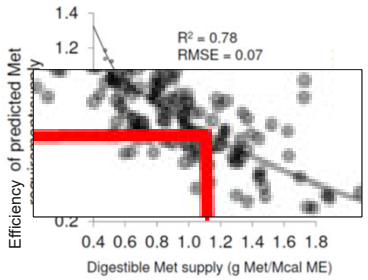
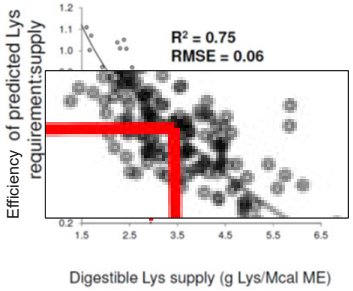


Lysine



Adapted from Van Amburgh, 2019

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

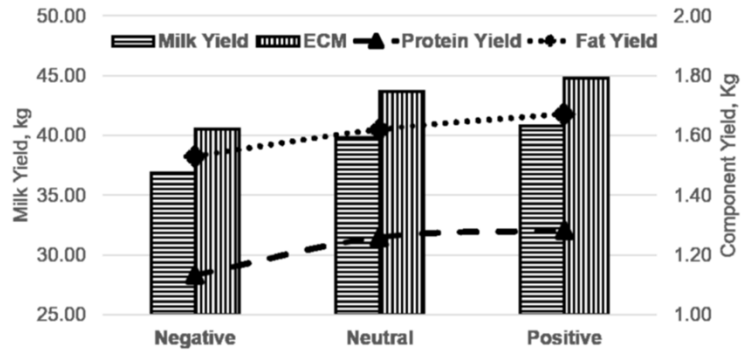
- One hundred and forty-four (n = 144) Holstein cows [26 primiparous and 118 multiparous; 2.9 ± 1.4 lactations; 92 ± 24 DIM at enrollment] were enrolled in a 114 day longitudinal study.
- Cattle were blocked into 16 cow pens (free stall) and balanced for parity, DIM, previous lactation performance, and 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.

	-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

LaPierre et al., 2019

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)

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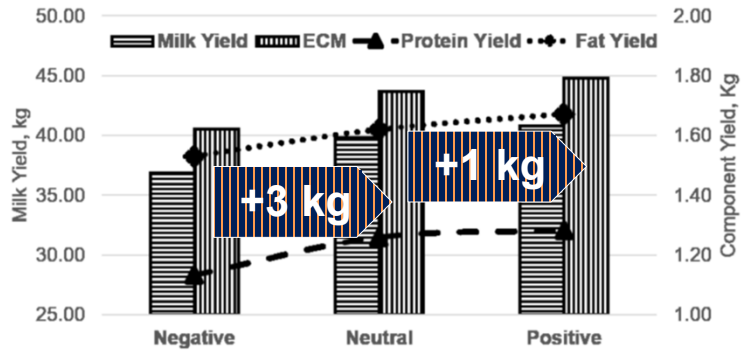

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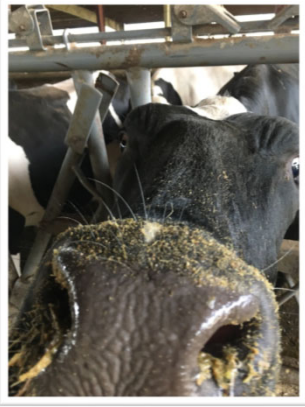
LaPierre et al., 2019

How about dry cows?



Dietary Recommendations for Dry Cows

- **NEL:** Control energy intake at 18 to 20 Mcal daily [diet ~ 1.43 Mcal/kg (0.65 Mcal/lb) DM] for mature cows
- ~~**Metabolizable protein (MP):** > 1,200 g/d~~
- **Starch content:** 12 to 15% of DM (NFC < 26%)

Met
Lys

CNCPS v6.55 — Lactation

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

- **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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- **Starch content:** 12 to 15% of DM (NFC < 26%)

Met
Lys

CNCPS v6.55 — Dry

~ 35g Met

2.65:1 Lys:Met (92g Lys)

- **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)
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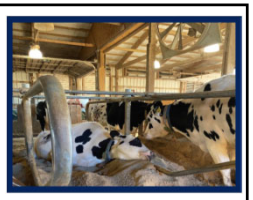
Evaluation of rumen-protected amino acids (RPAA; methionine and Lysine) supplementation in a close-up diet with two energy levels on performance, health, and fertility of Holstein cows during the transition period and early lactation

University of Illinois at Urbana-Champaign

O'Meara et al., *unpublished*

From – 21 through 70 days in milk

	Prepartum			Postpartum
Composition of MP[1]	HEAA[2] NE_L 1.71 Mcal/kg of DM	CEAA[3] NE_L 1.45 Mcal/kg of DM	CENAA[3] NE_L 1.45 Mcal/kg of DM	Fresh[4] NE_L 1.73 Mcal/kg of DM
Metabolizable protein, g/d	1372	1200	1186	2262
Lys, % of MP	7.30	7.34	6.82	7.26
Met, % of MP	2.76	2.77	2.23	2.73
Lys:Met	2.64	2.65	3.06	2.66
Lys, g/d	99.53	88.15	81.02	164.32
Met, g/d	37.63	33.24	26.4	61.71
Lys, g/Mcal	3.21	3.21	2.94	3.21
Met, g/Mcal	1.21	1.21	0.96	1.21



Rumen-protected Met top-dressed
0.093% of DMI prepartum; CE
0.115% of DMI prepartum; HE
0.150% of DMI postpartum

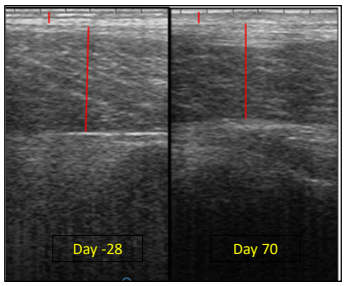
Rumen-protected Lys top-dressed
0.150% of DMI prepartum; CE
0.214% of DMI prepartum; HE
0.375% of DMI postpartum

[1]Metabolizable protein and AA predicted by AMTS
[2]Formulated for a dry cow at 1562 lb BW and 28.07 lb/d
[3]Formulated for a dry cow at 1562 lb BW and 29.13 lb/d
[4]Formulated for a cow at 14 days in milk, 1649 lb BW, producing 88.2 lb/d of milk

University of Illinois at Urbana-Champaign

O'Meara et al., *unpublished*

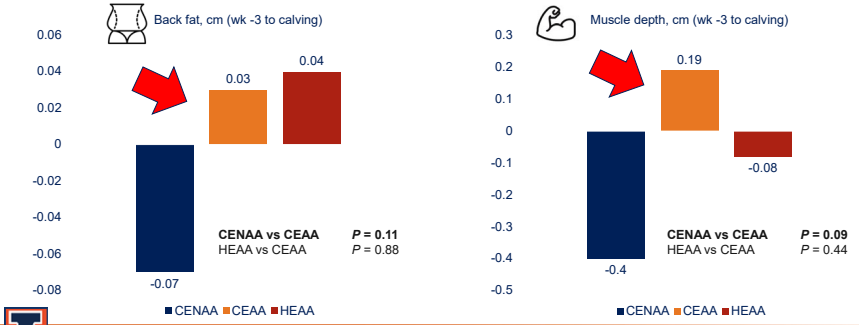
Ultrasound measurement of backfat thickness and muscle depth in Holstein cows



University of Illinois at Urbana-Champaign

O'Meara et al., *unpublished*

Cows that consumed RPAA prepartum had reduced *muscle* depth and *back fat* change

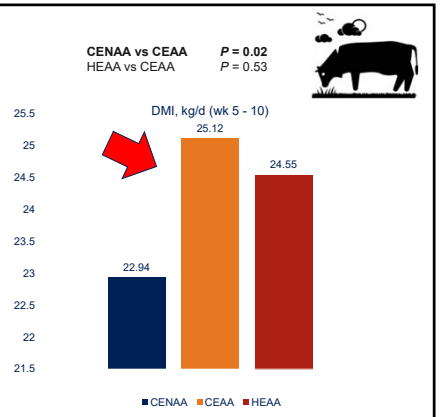


University of Illinois at Urbana-Champaign

Data was collected at days -28, -14, -7, and 0

O'Meara et al., *unpublished*

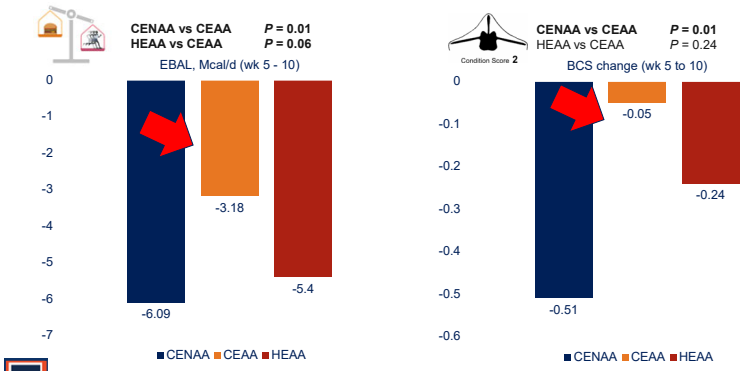
Cows that consumed rumen-protected AA had higher DMI than cows that did not receive RPAA from WK 5 – 10



University of Illinois at Urbana-Champaign

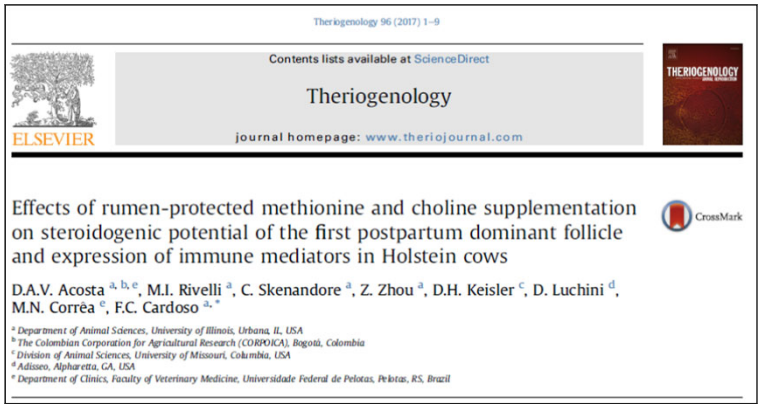
O'Meara et al., *unpublished*

Cows in CEAA had improved energy balance from WK 5 – 10



University of Illinois at Urbana-Champaign

O'Meara et al., *unpublished*



Theriogenology 96 (2017) 1–9

Contents lists available at ScienceDirect

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journal homepage: www.theriojournal.com

ELSEVIER

THERIOGENOLOGY

Effects of rumen-protected methionine and choline supplementation on steroidogenic potential of the first postpartum dominant follicle and expression of immune mediators in Holstein cows

D.A.V. Acosta [a, b, e], M.I. Rivelli [a], C. Skenandore [a], Z. Zhou [a], D.H. Keisler [c], D. Luchini [d], M.N. Corrêa [e], F.C. Cardoso [a, *]

[a] Department of Animal Sciences, University of Illinois, Urbana, IL, USA
[b] The Colombian Corporation for Agricultural Research (CORPOICA), Bogotá, Colombia
[c] Division of Animal Sciences, University of Missouri, Columbia, USA
[d] Adisseo, Alpharetta, GA, USA
[e] Department of Clinics, Faculty of Veterinary Medicine, Universidade Federal de Pelotas, Pelotas, RS, Brazil

University of Illinois at Urbana-Champaign

Ovulation, first dominant follicle (n = 40)

Follicular Aspiration, 16mm (n = 40)

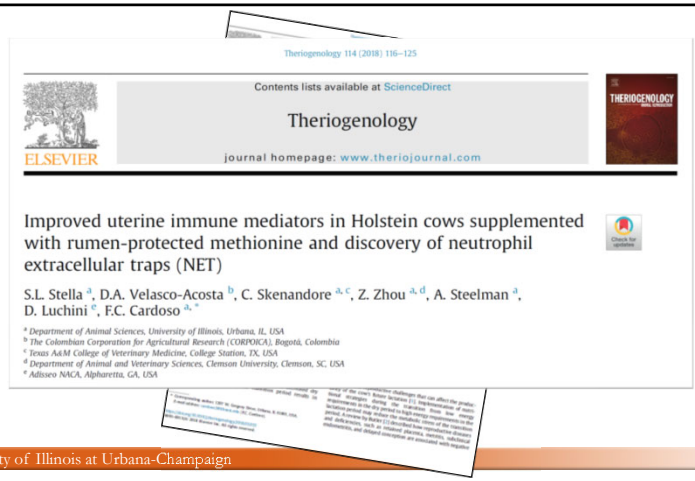
Days postpartum

0 4 7 9 11 13 15 17 19 21 23 25 27 29 30

US US US US US US US US US US US US US

★ Blood Samples
US: Ultrasonography

Acosta et al., 2017



Theriogenology 114 (2018) 116–125

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journal homepage: www.theriojournal.com

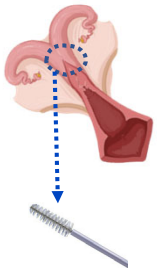
ELSEVIER

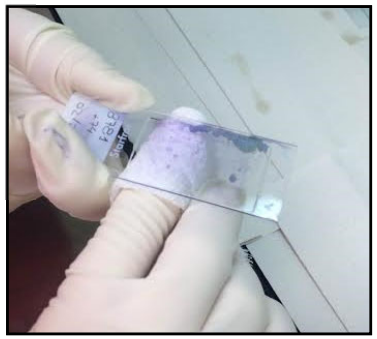
Improved uterine immune mediators in Holstein cows supplemented with rumen-protected methionine and discovery of neutrophil extracellular traps (NET)

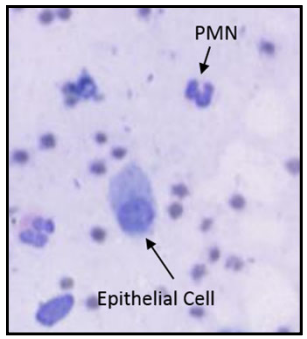
S.L. Stella [a], D.A. Velasco-Acosta [b], C. Skenandore [a, c], Z. Zhou [a, d], A. Steelman [a], D. Luchini [e], F.C. Cardoso [a, *]

[a] Department of Animal Sciences, University of Illinois, Urbana, IL, USA
[b] The Colombian Corporation for Agricultural Research (CORPOICA), Bogotá, Colombia
[c] Texas A&M College of Veterinary Medicine, College Station, TX, USA
[d] Department of Animal and Veterinary Sciences, Clemson University, Clemson, SC, USA
[e] Adisseo NACA, Alpharetta, GA, USA

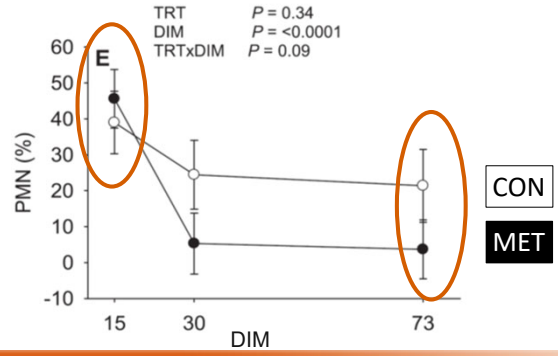
Uterine Cytology – Polymorphonuclear (PMN)







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



Control: n = 36; Methionine: n = 36

Stella et al., 2018

Theriogenology 85 (2016) 1669–1679

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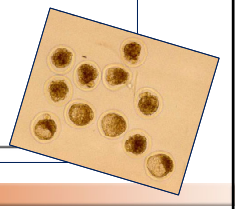
Effects of rumen-protected methionine and choline supplementation on the preimplantation embryo in Holstein cows

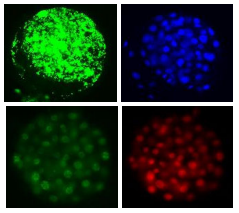
D.A.V. Acosta [a,b], A.C. Denicol [c,d], P. Tribulo [d], M.I. Rivelli [a], C. Skenandore [a], Z. Zhou [a], D. Luchini [e], M.N. Corrêa [b], P.J. Hansen [d], F.C. Cardoso [a,*]

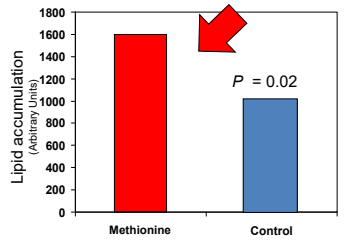
[a] Department of Animal Sciences, University of Illinois, Urbana, Illinois, USA
[b] Faculty of Veterinary Medicine, Department of Clinics, Universidade Federal de Pelotas, Pelotas, Rio Grande do Sul, Brazil
[c] Department of Biology, Northeastern University, Boston, Massachussets, USA
[d] Department of Animal Science, University of Florida, Gainesville, Florida, USA
[e] Adisseo NACA, Alpharetta, Georgia, USA



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.

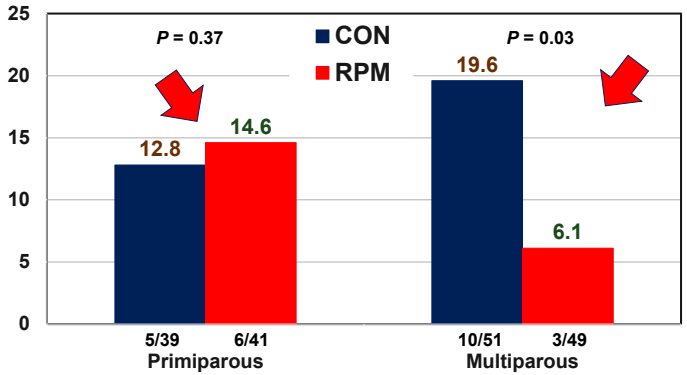




Fluorescence intensity of Nike Red staining

Acosta et al., 2016

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



Toledo et al., 2017

431 lactating cows. Annual rolling herd milk average: 37,424 lb (122.7 lb/cow/day)

Haybuster with a 2" to 3" screen

PRESCRIPTION PREMIX

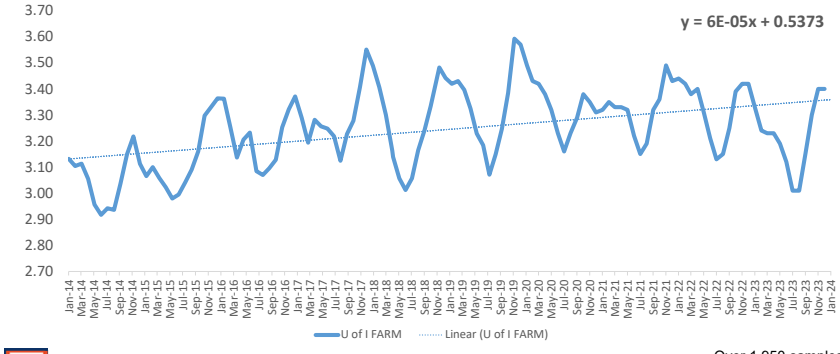
[redacted]

Dry matter: 53.5% - Moisture: 46.5%

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

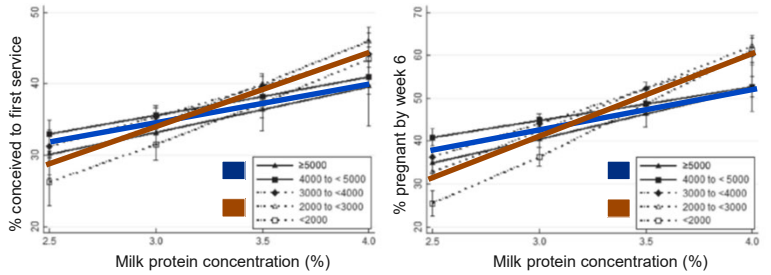
https://www.koesterdairy.com

Bulk tank – Milk true protein, %



Over 1,950 samples

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

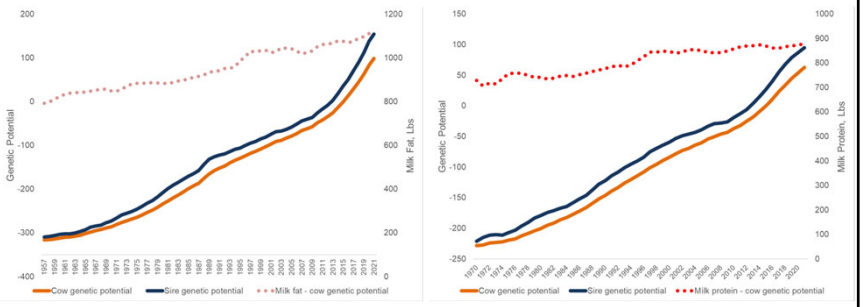


A retrospective, single cohort study was conducted using data collected from 74 Australian dairy herds. These herds provided data for 126,277 cows; these cows had 359,892 calvings (and hence lactations) recorded.

University of Illinois at Urbana-Champaign

Morton et al., 2016

Trends in phenotypic average milk fat and protein yield of the recorded US Holstein population and its genetic potential



Milk Fat ••••

Milk Protein ••••

University of Illinois at Urbana-Champaign

In consultation with Dr. João Dürr; Council on Dairy Cattle Breeding CDCB

Herd Dynamics

DairyCOMP 305

DairyComp 305 — Not my farm — Page 1

Command : BREEDSUM\E

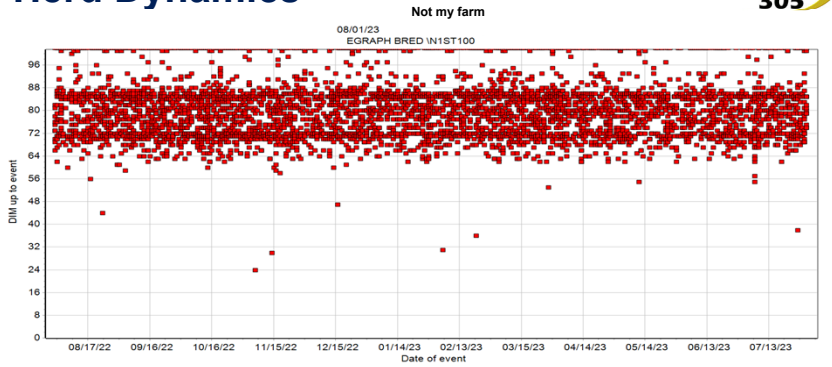
32504509 University of Illinois-DCTEACH 1 Instructor 08/01/23

Date	Br Elig	Bred	Pct	Pg Elig	Preg	Pct	Aborts	
7/19/22	1313	674	51	1294	193	15	30	
8/09/22	1451	769	53	1430	252	18	38	
8/30/22	1538	830	54	1518	275	18	33	
9/20/22	1580	861	54	1562	270	17	38	
10/11/22	1605	957	60	1589	387	24	50	
11/01/22	1469	840	57	1454	338	23	34	
11/22/22	1422	722	51	1407	288	20	37	
12/13/22	1421	768	54	1404	298	21	28	
1/03/23	1387	755	54	1372	278	20	23	
1/24/23	1423	784	55	1402	309	22	34	
2/14/23	1424	798	56	1412	303	21	36	
3/07/23	1402	789	56	1385	314	23	28	
3/28/23	1291	736	57	1281	299	23	25	
4/18/23	1208	733	61	1199	310	26	19	
5/09/23	1105	618	56	1095	270	25	14	
5/30/23	1119	557	50	1109	242	22	2	
6/20/23	1145	578	50	0	0	0	0	???? Preg Stat
7/11/23	1137	689	61	0	0	0	0	???? Preg Stat
Total	22158	12191	55	21913	4626	21	469	

Wait Period 50

University of Illinois at Urbana-Champaign

Herd Dynamics



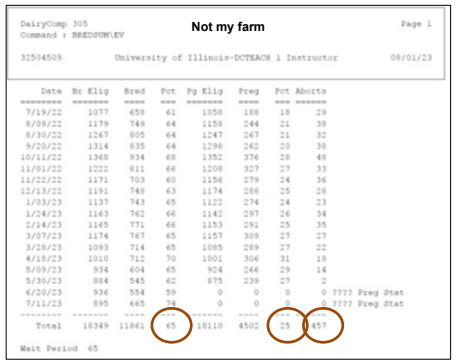
Herd Dynamics

65 to 75%
11,861 to 13,761

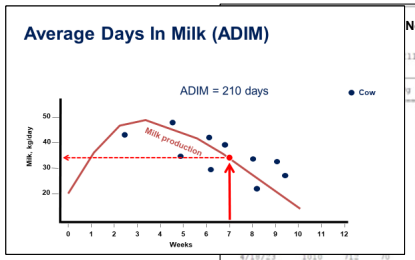
18,110 to 20,826
@ 25%
4,502 to 5,206

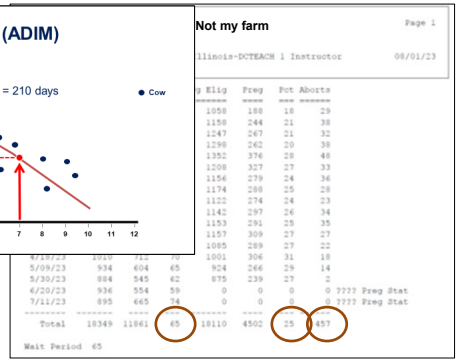
10 to 7%
457 to 315

+ 846 @ $200
$169,200



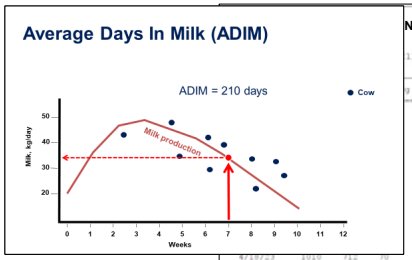
Herd Dynamics

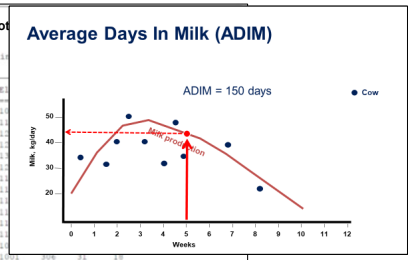




+ 846 @ $200
$169,200

Herd Dynamics

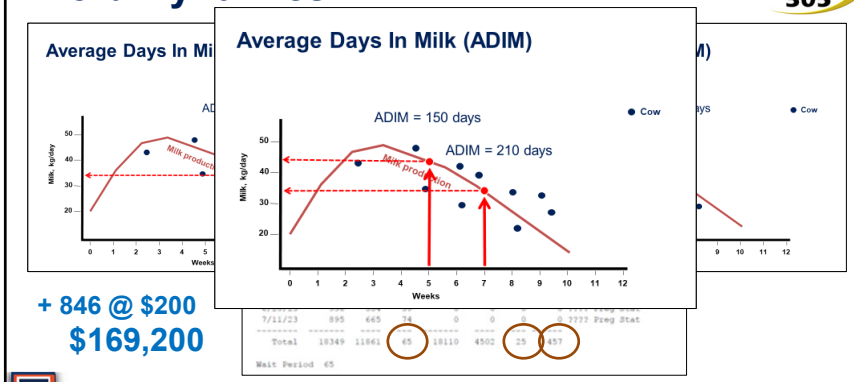




+ 846 @ $200
$169,200

Herd Dynamics

DairyCOMP 305



+ 846 @ $200
$169,200

Summary

- Amino acid balancing (methionine and lysine) during the transition period seems to improve the uterine environment of dairy cows by:
  - Increased metabolism and cell proliferation
  - Reduced oxidative stress
  - Modulating embryo and fetus nutrition (placenta)
  - Reduced prevalence of vaginal discharge
- Consider checking for the amount of AA prepartum rather than associate it with energy (target at ~ 35g metabolizable Met and ~100g metabolizable Lys).
- High milk protein concentration seems to be associated with reproductive success.
- Small increments in reproductive indicators add up to big results.