Turbocharge your fresh cow diets

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Fresh cow nutrition

- The vast majority of controlled research during the past 25 years on transition cow nutrition has focused on the ***dry*** cow
- Most lactating cow nutrition studies did not start until three to four weeks after calving
- Several studies published over the past 10 years focused specifically on feeding the fresh cow

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Fresh cow diets – common themes

- Frequently based upon high cow diet
- Some common "tweaks"
  - Lower starch
  - Higher physically effective fiber
    - Usually less than 0.5 kg/d of chopped straw/hay
  - Additional RUP/AA
  - Additional fat
  - Strategic addition of other nutrients (e.g., RP-choline)
- Success usually gauged by farm-level outcomes

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Fresh diets – a few key questions

- How fermentable should fresh cow diets be?
  - do we need to feed lower starch diets to fresh cows?
  - what about starch fermentability?
- How important is physically effective NDF in fresh cow diets?
- MP supply to the postcalving cow

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To starch, or not to starch?

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Several experiments conducted by groups at University of Alberta, Miner Institute, Cornell, and Michigan State University

- Starch level in fresh diet
  - Dann and Nelson, 2011 Cornell Nutrition Conference
  - Sun and Oba. 2014. J. Dairy Sci. 97:1594-1602.
  - McCarthy et al., 2015. J. Dairy Sci. 98:3335-3350.
  - Williams et al., 2015 ADSA-ASAS Joint Annual Meeting
  - Haisan et al., 2021. J. Dairy Sci. 104:4362-4374.
- Starch source in fresh diet
  - Rockwell and Allen. 2016. J. Dairy Sci. 99:4453-4463.
- Starch source and level in fresh diet
  - Dyck et al., 2011. J. Dairy Sci. 94:4636-4646.
  - Albornoz and Allen. 2018. J. Dairy Sci. 101:8902-8915.

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Dann and Nelson, 2011 Cornell Nutrition Conference

- 72 Holstein cows (2nd and greater lactation)
- Fed high straw controlled energy diet for 40-d dry period
- At calving, one of three starch regimens
  - Low starch (~ 21%) for first 91 DIM
  - Medium starch (~23%) for first 21 d followed by high starch (~25.5%) until 91 DIM
  - High starch (~25.5%) for first 91 DIM

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Table 1. Ingredient and analyzed chemical composition (mean ± standard error) of low, medium, and high starch diets fed to early lactation Holstein cows.

Item	Low	Medium	High
Ingredients, % of DM			
Corn silage	34.6 ± 0.1	34.6 ± 0.1	34.6 ± 0.1
Haylage	11.4 ± 0.4	11.7 ± 0.3	11.4 ± 0.4
Wheat straw	4.1	4.1	4.1
Corn meal	6.9 ± 0.4	11.1 ± 0.1	16.7 ± 0.4
Soybean meal	11.4 ± 0.1	11.9 ± 0.1	11.9 ± 0.1
Soybean hulls	9.7	6.5 ± 0.2	3.2
Wheat middlings	6.1	3.9 ± 0.1	1.8 ± 0.1
Canola meal	3.1	6.1	6.1
AminoPlus	2.5	-	-
Other	10.2 ± 0.3	10.1 ± 0.3	10.2 ± 0.2
Chemical composition			
DM, %	49.5 ± 0.7	50.1 ± 0.9	49.6 ± 0.7
CP, %	17.3 ± 0.1	17.0 ± 0.2	16.7 ± 0.2
NDF, %	35.7 ± 0.3	33.9 ± 0.4	31.9 ± 0.3
Sugar, %	6.1 ± 0.1	5.8 ± 0.1	5.9 ± 0.1
Starch, %	21.0 ± 0.3	23.2 ± 0.3	25.5 ± 0.3
Rumen fermentable starch, %	16.8 ± 0.5	18.9 ± 0.6	20.2 ± 0.5
Digestibility			
24-h NDF, % NDF	58.4 ± 0.6	57.3 ± 0.5	54.0 ± 0.8
7-h starch, % starch	76.5 ± 1.4	76.7 ± 1.2	74.5 ± 1.2

Dann and Nelson, 2011 CNC

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DMI and milk during first 13 wk of lactation for cows fed varying levels of starch in early lactation

Item	Low-low	Medium-High	High-High	SEM	P, Trt	P, Trt x wk
DMI, kg/d	25.2^{x}	24.9^{xy}	23.7^{y}	0.5	0.06	0.09
Milk, kg/d	47.9^{ab}	49.9^{a}	44.2^{b}	1.6	0.04	0.75
SCM, kg/d	47.4	47.9	43.5	1.5	0.09	0.39
NEFA, uEq/L (wk 1-3)	452^{aby}	577^{ax}	431^{by}	43	0.03	0.11
BHBA, mg/dL (wk 1-3)	9.3	8.8	7.8	1.1	0.15	0.97

^{ab} Least squares means within a row without a common superscript differ ($P \leq 0.05$).
^{xy} Least squares means within a row without a common superscript differ ($P \leq 0.10$).

Dann and Nelson, 2011 CNC

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J. Dairy Sci. 97:1594–1602
http://dx.doi.org/10.3168/jds.2013-7068

Effects of feeding a high-fiber byproduct feedstuff as a substitute for barley grain on rumen fermentation and productivity of dairy cows in early lactation

Y. Sun and M. Oba[1]
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- 61 Holstein cows (22 PP and 39 MP)
- Treatments fed from calving through 12 wk postpartum
  - Control (high starch; 29.2% of DM)
  - DDGS (low starch; 19.1% of DM)

% of DM	Control	DDGS
Barley silage	43.0	43.1
Corn grain, rolled	21.6	21.6
Barley grain, rolled	17.3	---
Wheat DDGS	---	17.2
Corn gluten meal	8.3	---
Beet pulp	3.2	12.3
Balance	6.6	5.8
CP, %	17.3	19.4
NDF, %	27.2	30.5
Starch, %	29.2	19.1

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Results

Item	Control		DDGS		SE	P value	
Milk, kg/d	35.3		34.9		1.03	0.83	
Fat, kg/d	1.33		1.31		0.05	0.85	
CP, kg/d	0.97		0.97		0.03	1.00	
ECM, kg/d	35.6		35.4		1.03	0.88	
	PP	MP	PP	MP		TRT	TRT*PAR
DMI, kg/d	14.7	21.3	16.2	20.1	0.45	0.62	<0.001
Rumen pH, mean	6.33		6.30		0.07	0.78	
pH < 5.8, min/d	126		108		49.4	0.80	
Area, pH x min/d	28.8		16.6		11.3	0.53	

Sun and Oba, 2014

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J. Dairy Sci. 98:3335–3350
http://dx.doi.org/10.3168/jds.2014-8820

Performance of early-lactation dairy cows as affected by dietary starch and monensin supplementation

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†Elanco Animal Health, Greenfield, IN, 46140

- 70 Holstein cows (21 PP and 49 MP)
- Fed high straw, moderate energy diet during close-up
- At calving, fed one of two rations
  - Low starch (~ 20.9% starch; 35.9% NDF)
  - Higher starch (~ 25.5% starch; 33.6% NDF)
  - Beginning at 22 DIM, all cows fed higher starch ration
- Also fed either 0 mg/d monensin or 400 mg/d prepartum/450 mg/d postpartum via topdress pellet

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Diet Composition, % of DM

Item	Prepartum	Postpartum	
		High Starch	Low Starch
Corn Silage	39.5	—	—
BMR Corn Silage	—	37.0	37.0
Haylage	—	9.3	9.3
Wheat Straw	20.5	11.1	11.1
Corn meal, finely ground	3.9	20.2	9.9
Corn Germ Meal	—	2.4	5.4
Citrus Pulp	6.6	0.9	6.7
Soy Hulls	6.6	—	3.4
Soybean Meal	5.0	5.5	3.7
Canola Meal	4.3	2.6	2.0
Blood Meal	1.0	1.9	1.9
Supplements	6.6	5.3	5.9
Topdress	6.1	4.2	4.2

McCarthy et al., 2015a; *J. Dairy Sci.* 98:3335-3350

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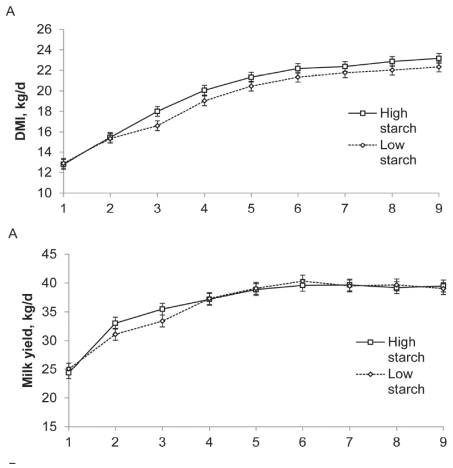

DMI and milk yield for cows fed low vs. high starch postpartum.

From McCarthy et al. 2015

	DMI	Milk yield
	P, starch x wk	P, starch x wk
Wk 1 to 3	0.04	0.002
Wk 1 to 9	0.32	<0.001

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J. Dairy Sci. 99:4453–4463
http://dx.doi.org/10.3168/jds.2015-10344

Chromium propionate supplementation during the peripartum period interacts with starch source fed postpartum: Production responses during the immediate postpartum and carryover periods

R. J. Rockwell and M. S. Allen[1]
Department of Animal Science, Michigan State University, East Lansing 48824

- 48 Holstein cows entering 2+ lactation
- 2 x 2 factorial
  - control vs. Cr-prop peripartum
  - Dry ground vs. High Moisture corn postpartum through d 28

% of DM	Dry corn	HM corn
Corn silage	25.0	25.0
Alfalfa silage	19.2	19.2
Alfalfa hay	11.8	11.8
Dry ground corn	23.3	---
High-moisture corn	---	23.3
Soybean meal	12.9	12.9
Vitamin-mineral mix	7.8	7.8
CP, %	16.2	16.2
NDF, %	31.4	31.1
Starch, %	26.4	26.5

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Results (d 1 to 28 postpartum)

Item	Dry corn	HM corn	SE	P value
Milk, kg/d	38.5	41.4	1.65	0.02
Fat, kg/d	1.95	1.99	0.13	0.33
TP, kg/d	1.27	1.32	0.06	0.28
ECM, kg/d	47.9	49.5	2.61	0.18
DMI, kg/d	18.1	18.6	0.7	0.53
Cumulative DMI, kg	507	521	20	0.51

Rockwell and Allen, 2016

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J. Dairy Sci. 101:8902–8915
https://doi.org/10.3168/jds.2018-14843

Highly fermentable starch at different diet starch concentrations decreased feed intake and milk yield of cows in the early postpartum period

Rodrigo I. Albornoz and Michael S. Allen[1]
Department of Animal Science, Michigan State University, East Lansing 48824

- 52 Holstein cows entering 2+ lactation
- 2 x 2 factorial arrangement of treatments (calving to 23 DIM)
  - Low (22%) starch vs high (28%) starch
  - Dry ground corn vs high-moisture corn

	Low starch		High starch	
% of DM	Dry corn	HM corn	Dry corn	HM corn
Alfalfa silage	37.0	37.1	37.7	37.0
Grass hay	8.25	8.35	8.35	8.21
Dry ground corn	27.5	---	35.4	---
High-moisture corn	---	28.1	---	36.2
Soyhulls	11.0	11.0	1.87	2.18
Soybean meal	11.7	11.1	12.2	12.4
Balance of mix	4.5	4.5	4.5	4.5
CP, %	17.2	16.7	17.3	16.9
NDF, %	33.0	33.0	28.3	27.6
Starch, %	21.4	21.9	27.1	27.8

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Results (d 1 to 23 postpartum)

	Low starch		High starch			P value		
Item	Dry	HM	Dry	HM	SE	Level	Source	L x S
DMI, kg/d	18.6	17.7	20.2	16.3	0.8	0.96	< 0.01	0.07
Cumulative DMI, kg	415	385	445	370	12	0.69	<0.01	0.20
Milk, kg/d	40.6	37.0	41.5	36.6	1.8	0.88	0.02	0.66
Fat, kg/d	1.81	1.70	1.84	1.58	0.10	0.59	0.03	0.40
TP, kg/d	1.24	1.14	1.35	1.09	0.07	0.64	0.01	0.21
ECM, kg/d	45.1	41.9	46.7	40.0	2.2	0.94	0.01	0.37

L = effect of starch level
S = effect of starch source

Albornoz and Allen, 2018

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Studies that had favorable responses to higher starch levels or increased starch fermentability generally had higher forage or forage NDF levels

- Favorable responses
  - McCarthy et al., 2015 (28.2% of DM as F-NDF)
  - Rockwell and Allen, 2016 (27.4% of DM as F-NDF)
- Neutral or negative responses
  - Albornoz and Allen., 2018 (~22.5% of DM as F-NDF)
  - Sun and Oba, 2014 (Diet was 39.9% forage)
  - Dann and Nelson, 2011 (Diet was ~ 50% forage)
  - Haisan et al., 2021 (~18% of DM as F-NDF)

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Can you go too far with higher peNDF/uNDF$_{240}$/peuNDF$_{240}$ in fresh cow rations?

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Ingredient and nutrient composition of experimental diets (LaCount et al., 2017)

	Diet		
Item	Prepartum	Low Fiber (LF)	High Fiber (HF)
Ingredients, % of ration DM			
Conventional corn silage	45.21	42.31	38.46
Alfalfa hay	-	10.58	10.58
Straw	20.84	1.15	8.65
Corn meal	2.43	17.64	20.15
Soybean meal	-	6.03	4.73
Wheat middlings	-	4.82	1.58
Amino Plus	5.9	4.34	5.31
Canola meal	3.47	1.61	3.88
Corn gluten feed	1.74	1.61	0.47
Blood meal	2.43	0.95	1.09
Soybean hulls	6.95	2.41	-
Citrus pulp	4.52	-	0.79
Energy Booster	-	1.29	1.58
Rumensin, mg/d[1]	439	365	334
Other	6.4	2.3	2.3
Analyses, % of ration DM			
aNDFom	43.1 ± 0.3	32.8 ± 1.4	35.3 ± 2.3
ADF	29.0 ± 0.5	21.3 ± 1.1	22.9 ± 2.1
Starch	15.6 ± 0.3	24.8 ± 1.7	24.6 ± 2.3
Sugar	3.5 ± 0.4	5.0 ± 0.7	3.9 ± 0.1
Fat	2.3 ± 0.2	3.3 ± 0.2	3.2 ± 0.2
$uNDF_{240}$	12.8 ± 0.5	9.5 ± 0.4	12.2 ± 1.6
peNDF	33.3	21.6	23.2
MP, g/kg DM[1]	89.0	112.1	108.0

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Dry matter intake, milk yield, and milk composition for cows fed low fiber (LF) or high fiber (HF) diets from d 1 to 28 postcalving. LaCount et al., 2017

				P-Value	
Item	LF	HF	SEM	Trt	Trt×Time
Prepartum DMI, kg/d	15.5			-	-
Postpartum DMI, kg/d	21.1	19.4	0.4	<0.01	<0.01
uNDF intake, %BW	0.27	0.32	0.01	<0.01	0.06
Milk yield, kg/d	46.2	44.7	1.0	0.26	0.001
Fat, %	3.89	4.06	1.1	0.55	0.10
Protein, %	3.27	3.20	0.06	0.31	0.41
Lactose, %	4.73	4.69	0.04	0.49	0.39
Total solids, %	12.9	13.0	0.2	0.50	0.57
ECM, kg/d	47.2	46.0	1.1	0.55	0.10
Rumination, min/d	544	543	8	0.56	0.14

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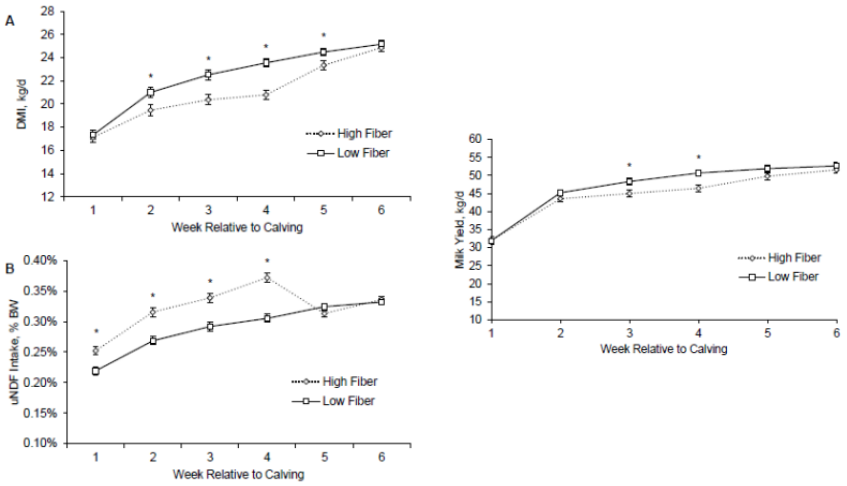

DMI, uNDF240 intake, and milk yield for cows fed High Fiber or Low Fiber diets from d 1 to 28 postpartum. From LaCount et al., 2017.

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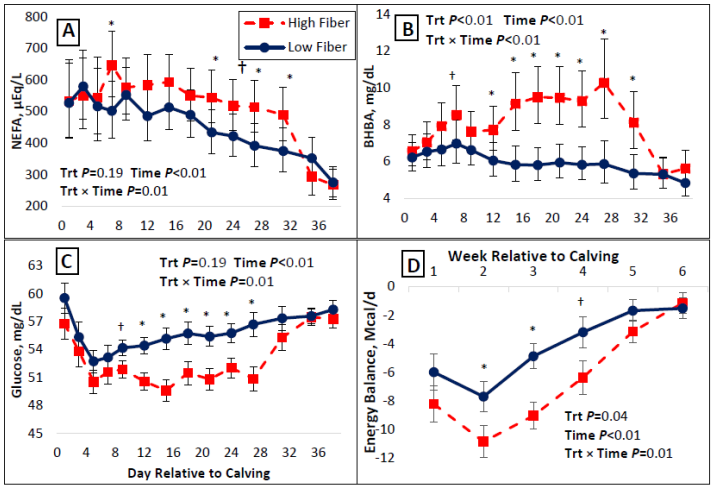

Figure 1. Plasma NEFA (A), BHBA (B), glucose (C), and energy balance (D) by time relative to calving, NEFA and BHBA reported as geometric means with back transformed 95% confidence intervals. Significant differences indicted with an asterisk (*), trends with a cross (†). Energy balance was calculated according to NRC (2001).

LaCount et al., 2017

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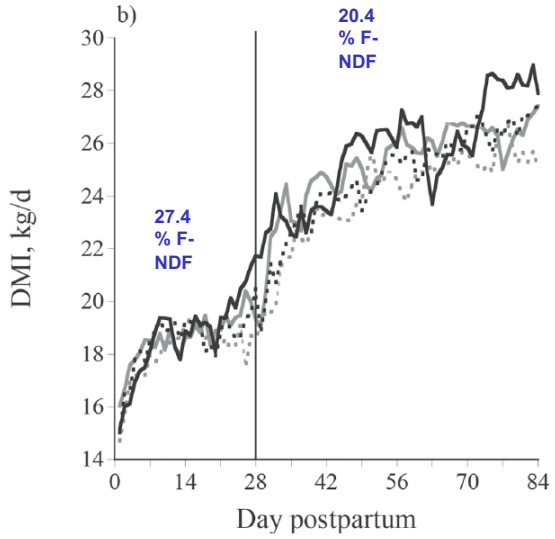

Effects of chromium propionate (CrPr) and corn grain source on DMI (kg/d) over time during the treatment (1 to 28 d postpartum) and carryover (29 to 84 d postpartum) periods.

From Rockwell and Allen, 2016

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MP and AA in the fresh cow

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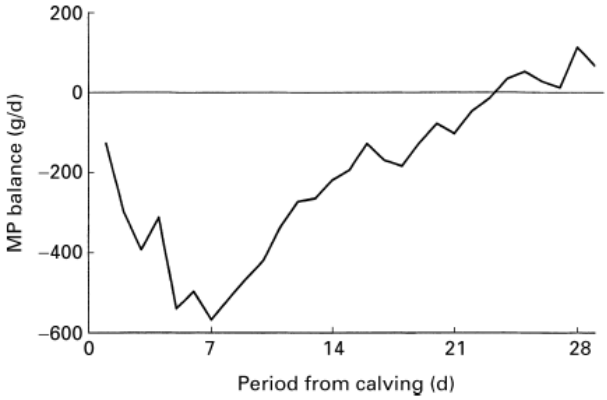

Fig. 1. Calculated metabolizable protein (MP) balance in post-parturient cows (*n* 80) fed on a ration containing (/kg DM) 178 g crude protein (nitrogen × 6·25) and 7·0 MJ net energy for lactation. Individual values were calculated from daily individual measurements of crude protein intake and milk yield, and weekly measurements of milk composition.

Bell et al., 2000

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Increasing MP supply postpartum?

- 8 Holstein cows entering second lactation
- Received either water (control) or casein infused into the abomasum to meet approximate calculated deficit in MP
- Casein was supplied at 360 g/d at 1 DIM, 720 g/d at 2 DIM, followed by daily reductions of 19.5 g/d ending at 194 g/d at 29 DIM.

Larsen et al., 2014. J. Dairy Sci. 97:5608–5622

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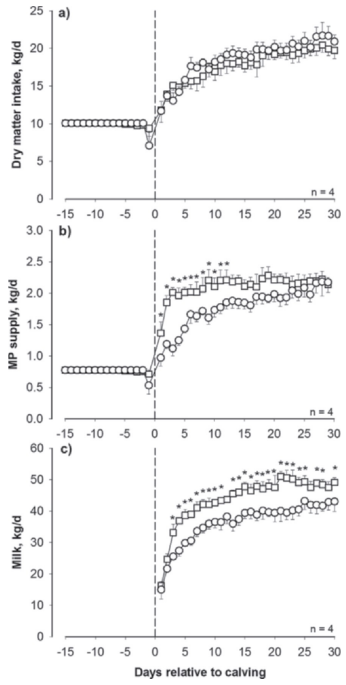

Milk yield was increased (~ 7.2 kg/d) in cows receiving additional MP by casein infusion postpartum

From Larsen et al., 2014. J. Dairy Sci. 97:5608–5622

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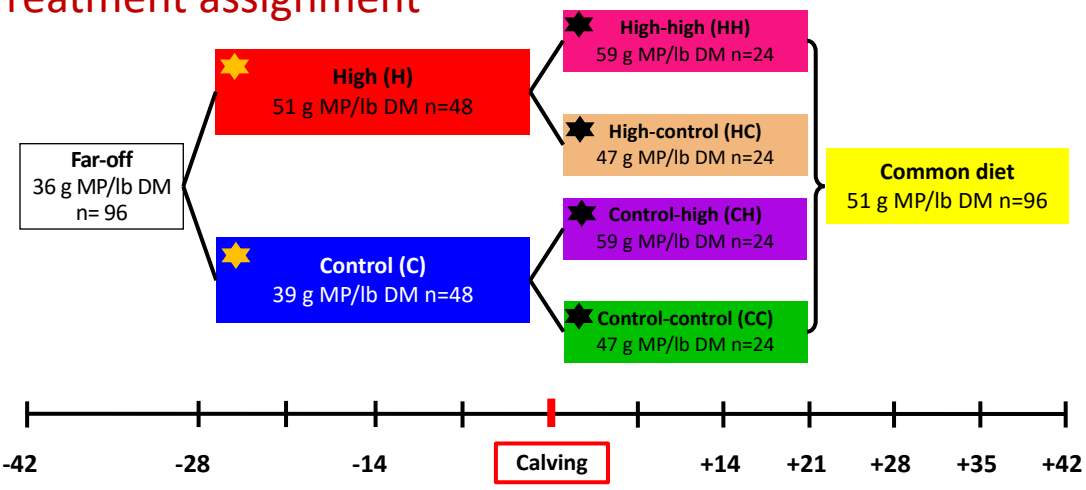
Treatment assignment



Day relative to calving

Methionine and lysine formulated at 1.24 and 3.86 g/Mcal metabolizable energy

Methionine and lysine formulated at 1.15 and 3.20 g/Mcal metabolizable energy

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Milk components (0 to 21 DIM)

	Treatment				*P*-value		
Variable	CC	CH	HC	HH	Trt	Wk	Trt x Wk
Milk yield, lbs/d	86.4 ± 2.2^{bc}	93.4 ± 2.0^{ab}	83.8 ± 2.2^{c}	98.5 ± 2.2^{a}	< 0.01	< 0.01	< 0.01
Lactose, %	4.76 ± 0.02^{b}	4.81 ± 0.02^{a}	4.81 ± 0.02^{ab}	4.79 ± 0.02^{ab}	0.04	< 0.01	0.88

LSM ± SEM with different superscripts differ (P < 0.05; Tukey's test)

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Milk components (22 to 42 DIM)

	Treatment				*P*-value		
Variable	CC	CH	HC	HH	Trt	Wk	Trt x Wk
Milk yield, lbs/d	109.3 ± 2.2^{b}	117.5 ± 2.0^{a}	108.7 ± 2.0^{b}	119.2 ± 2.0^{a}	< 0.01	< 0.01	0.21
Lactose, %	4.85 ± 0.01	4.86 ± 0.01	4.88 ± 0.01	4.85 ± 0.01	0.42	< 0.01	0.69
Fat, %	4.09 ± 0.09	4.28 ± 0.09	4.10 ± 0.10	4.11 ± 0.09	0.38	< 0.01	0.62
Protein, %	2.83 ± 0.03	2.82 ± 0.03	2.91 ± 0.03	2.79 ± 0.03	0.10	0.02	0.08
Total Solids, %	12.69 ± 0.11	12.89 ± 0.11	12.84 ± 0.11	12.70 ± 0.11	0.45	< 0.01	0.41

LSM ± SEM with different superscripts differ (P < 0.05; Tukey's test)

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Other areas of opportunity in feeding the fresh cow

- Strategic use of nutrients and feed additives to modulate metabolism, health, and performance
  - RP-choline, RP-Met and RP-Lys, Cr, biotin, improved trace mineral sources
  - Monensin, yeast culture/yeast products, rumen buffers, mycotoxin mitigators
- Sugars in fresh cow diets
- Fatty acid nutrition
  - Essential FA and anti-inflammatory FA
- Macromineral nutrition
  - Ca and Mg

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Don't forget about the nonnutritional factors!!

- Manage social interactions/hierarchy
  - Stocking density
    - > 30 in (0.8 m) of feedbunk space per cow close-up and fresh
    - > 1 stall per cow
  - Consider separating cows and heifers if facilities allow
    - Heifers will likely perform better
    - If infeasible, double down on managing stocking densities
  - Group changes
    - Streamline (e.g., avoid moves prepartum other than move to close-up group and move to calve)
  - Heat stress/heat abatement
    - Cooling cows during the dry period

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Thanks!!

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