Fresh Cow Management - Opportunities and Pitfalls

Thomas R. Overton
Associate Professor of Animal Science
Director, PRO-DAIRY
Cornell University

The outcome challenge

- High milk production
- Maintain/minimize loss of BCS
- Low incidence of metabolic disorders
- Minimize loss of immunocompetence
- Control/decrease days to first ovulation and maintain/enhance fertility
- Make $$

A few questions

- How should we feed fresh cows?
- What are some key principles for grouping management?
- What about frequent milking (i.e., 4X/2X or 4X/3X)
- What are some ways we can assess opportunities in fresh cows?

Transition cow nutrition

- Virtually all controlled research during the past 20 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
- Very little nutritional work has focused specifically on the fresh cow
- More attention to this because of focus on intake regulation (e.g., hepatic oxidation theory)

I think we have dry cow nutrition (mostly) figured out

- Far-off
  - Keep energy down (0.60 to 0.62 Mcal/lb of NEL; 110 to 120% of energy requirements
  - Macromineral balances not important (within reason)
- Close-up
  - Low to moderate energy (0.62 to 0.66 Mcal/lb of NEL; 110 to 130% of energy requirements
  - Supplement with RUP (MP for Holsteins 1100 to 1200 g/d)
  - Macromineral relationships (K, Mg, Na, Cl; maybe Ca) critically important; Vitamins D and E; trace elements
  - If one-group dry cow formulate minerals like close-up and keep energy on low end of range
- Feeding management/consistency critical during both periods

What about fresh cow diets?

Key questions

- How fermentable should fresh cow diets be (i.e., do we need to feed lower starch diets?)
- How important is physically effective NDF in fresh cow diets?
- Should we try to feed a separate fresh cow diet?

Lower starch fresh diets?

- Lots of conjecture, but evidence not conclusive
- Miner Institute research demonstrated higher DMI and milk yield if lower starch fresh cow diet fed (Dann and Nelson, 2011)
- Higher milk yield and same DMI when cows were fed HMSC rather than dry corn meal at same starch level (Rockwell and Allen, 2011)
- Higher DMI and milk yield for BMR corn silage-based diet starting precalving (Stone et al., 2012)

Dann and Nelson, 2011

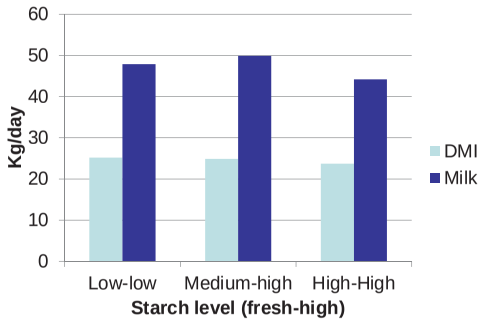
- 72 Holstein cows (2nd and greater lactation)
- Fed high straw controlled energy diet precalving
- At calving, one of three levels of starch
- After day 22, all cows fed high starch diet

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

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

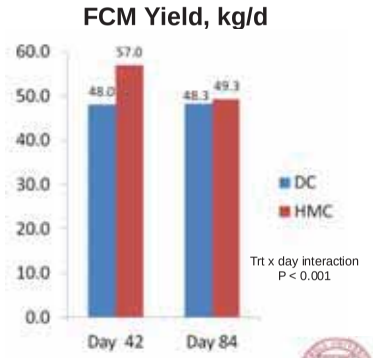


Dann and Nelson, 2011 CNC

Corn Processing??

Rockwell and Allen, 2011

- Design:
  - Dry Corn vs HMC
  - 0 to 28 DIM
  - Common diet from d28 to 84
  - n= 24 per treatment
- Results
  - No differences in DMI for first 28 days postpartum



Slide courtesy Dr. Ric Grummer

BMR corn silage during the transition period – Stone et al., 2012

3 wk Prefresh	> 3 wks post-fresh	Wks 3.5 – 15
Conventional corn silage hybrids	Conventional corn silage hybrids	Conv. CS
BMR corn silage	BMR corn silage	

Diet formulation goal: Keep all parameters the same with the exception of NDF digestibility.

Diets formulated with CPM Dairy

Corn silage analyses

- Planted in 2005; trial went from 7-06 to 2-07

% of DM	Conventional		BMR
DM	31.2		29.8
Crude protein	8.5		9.1
ADF	26.1		25.8
NDF	44.1		45.5
Lignin	3.2		2.3
Starch	26.2		23.5
In vitro starch digestibility	82.0		76.1
Soluble fiber	2.9		6.2
Ash	3.7		4.1
Total VFA	10.1		10.4
pH	3.72		3.74
NDFd, 30 h	56.8	(17 points)	73.8

Prefresh diet formulation

% of TMR, DM	Dry Close Conventional	Dry Close BMR
Corn silage	46.4	47.8
Alfalfa haylage	7.2	6.9
Wheat straw	18.1	18.1
Corn meal	.8	3.6
Citrus pulp	7.2	7.2
Wheat midds	4.4	4.7
Corn gluten feed	1.4	1.8
SBM-48	5.6	2.9
Corn gluten meal	.5	.5
Blood meal	1.45	1.45
Feather meal	.5	.5
Biochlor	.5	1.27
Yeast culture	.4	.4
Smartamine	.04	.04
Rumensin	320 mg	320 mg

Prefresh – diet composition

% of TMR, DM	Dry Close Conventional		Dry Close BMR	
	Formulated (Analyzed)		Form. (Analyzed)	
Dry matter, %	44		43.2	
CP	14.1	(13.8)	13.8	(13.5)
ADF	27	(28)	27	(28.9)
NDF	44.1	(44)	44.5	(45)
Starch	18.6	(17.7)	16.9	(15)
NeL, Mcal/Kg	1.50	(1.48; .67)	1.52	(1.50; .68)
Ca	0.8	(0.94)	.8	(0.77)
P	0.4	(0.4)	.4	(0.37)
Mg	0.4	(0.4)	.4	(0.42)
K	1.3	(1.18)	1.4	(1.18)
Cl	0.4	(0.42)	0.5	(0.51)

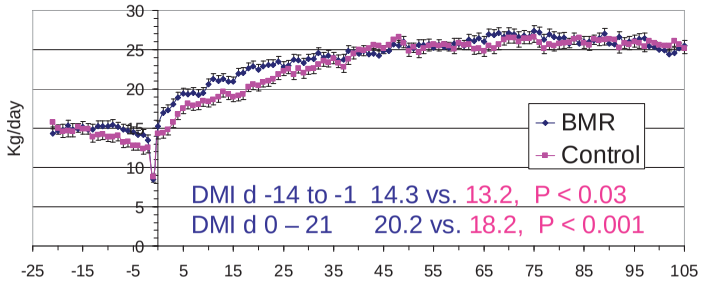
Fresh cow diet formulation

% of TMR, DM	Fresh Conventional	Fresh BMR
Corn silage	39.6	42.1
Alfalfa haylage	14.9	14.9
Wheat straw	1.1	1.1
Corn meal	11.1	11.4
Citrus pulp	5.0	5.0
Cereal tailings	5.0	5.0
Soyhulls pellets	2.2	1.5
SBM-48	9.9	8.0
AminoPlus	2.5	2.8
Blood meal	2.1	2.2
Tallow	.6	.6
Energy Booster	.6	.6
Yeast culture	.3	.3
Smartamine	.07	.08

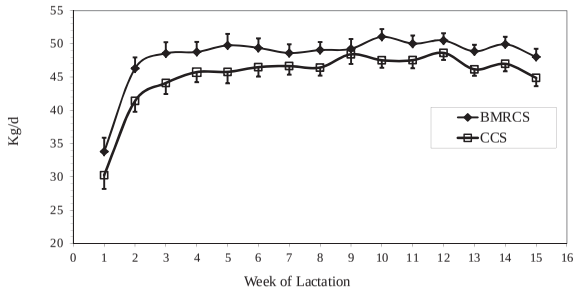
Fresh cows – diet composition

% of TMR, DM	Fresh Conventional		Fresh BMR	
	Formulated	(Analyzed)	Form.	(Analyzed)
CP	17.3	(17.5)	17.4	(16.8)
ADF	19.7	(22.2)	19.0	(21.4)
NDF	32.4	(33.7)	32.0	(32.5)
Starch	22.6	(19.7)	22.1	(19.1)
Soluble fiber	7.3		6.7	
Lignin	2.6		2.5	
Silage acids	5.25		6.35	

DMI of cows fed BMR or conventional corn silage during the transition period (Stone et al., 2012)



3.5% FCM of cows fed BMR or Control corn silage during the transition period (Stone et al., 2012)



	Wk 1 - 3				Wk 4 – 15			
Variable	CCS	BMR CS	SE	P-value	CCS	BMR CS	SE	P-value
Milk, kg	34.3	37.5	1.0	0.03	45.3	47.3	0.90	0.11
3.5% FCM, kg	38.8	42.9	1.5	0.06	46.7	49.4	1.1	0.09

Adequate physically effective NDF in rations is probably very important in fresh cows

A case study

- Cornell T&R study evaluating high or low starch diets for fresh cows
- Controlled energy/high straw dry cow approach starting 28 to 35 days before calving
- At calving, one of two fresh diets until 21 DIM
- First cows that calved onto either ration developed significant health problems

Case study – health events

Item	Low starch	High starch
# cows calved	9	5
# RP	2	1
# DA	1	2
# Clinical ketosis (> 2.5 mM BHB on Precision Xtra	4	4

Controlled energy dry cow diet composition (as formulated)

Ration Fed

Ingredient	$/hd	%DM	DM lbs/day
Corn Silage Processed 35 DM 41 NDF Medium-CNCPS-03021	0.00	32.3	12.00
Wheat Straw 5 CP 79 NDF 16 LNDF-CNCPS-03085	0.00	88.6	6.20
Citrus Pulp Dry-CNCPS-01031	0.00	88.6	2.00
Soybean Hulls Ground-CNCPS-01103	0.00	91.0	2.00
Soybean Meal 47.5 Solvent-CNCPS-02027	0.00	90.0	1.50
Canola Meal Solvent-CNCPS-02006	0.00	90.2	1.30
Blood Meal-CNCPS-07001	0.00	90.0	0.30
MinVit-CNCPS-05053	0.00	95.0	1.50
Amino Plus-CNCPS-08022	0.00	88.0	0.50
Corn Grain Ground Fine-CNCPS-01039	0.00	88.0	1.20
Totals	0.00	51.3	28.50

Nutrient Balances

Nutrient	Balance	%Req
ME	4.0 Mcal	115
MP	115 g	110
Rum. NH3-N	21 g	119
Rum. Pep-N	65 g	168
peNDF	2.6 lbs	140
MP Lys	36.8 g	171.9
MP Met	9.0 g	154.0
Ca	6.49 g	132%
P	6.83 g	141%

Total ME Avail.	28.36 Mcal/day
Total MP Avail.	1191 g/day
MP Bact	63.8 %MP
ME Bal	4.0 Mcal
MP Bal	115.1 g
Urea Cost	0.13 Mcal
Rumen pH	6.46

Diet Concentrations

DM	51.3 %DM
Forage	63.9 %DM
CP	12.20 %DM
RDP	7.94 %DM
NDF	42.19 %DM
Forage NDF	79.02 %NDF
Forage NDF	0.64 %FBW
EE	2.5 %DM
LCFA	1.8 %DM
Lys	7.35 %MP
Met	2.75 %MP
Lys:Met	3.41
TDN	60.7 %DM
ME	0.99 Mcal/lb
NEm	0.60 Mcal/lb
NEg	0.34 Mcal/lb
Sugar (A4)	3.8 %DM
Starch (B1)	17.0 %DM

Low starch fresh diet composition (as formulated)

Ration Fed

Ingredient	$/hd	%DM	DM lbs/day
BMR Corn Silage Processed 30 DM 41 NDF Medium-	0.00	31.9	24.00
Mix Silage 18 CP 48 NDF 12 LNDF-CNCPS-04069	0.00	41.4	5.00
Wheat Straw 5 CP 79 NDF 16 LNDF-CNCPS-03086	0.00	88.6	2.00
Corn Grain Ground Fine-CNCPS-01039	0.00	88.0	5.35
Corn Germ Meal-CNCPS-02014	0.00	93.4	2.91
Citrus Pulp Dry-CNCPS-01031	0.00	88.6	3.60
Soybean Hulls Ground-CNCPS-01103	0.00	91.0	1.84
Soybean Meal 47.5 Solvent-CNCPS-02027	0.00	90.0	2.00
Canola Meal Solvent-CNCPS-02006	0.00	90.2	1.08
Blood Meal-CNCPS-07001	0.00	90.0	1.01
Amino Plus-CNCPS-08022	0.00	88.0	1.20
Energy Booster-CNCPS-09006	0.00	99.0	0.50
MinVit-CNCPS-05053	0.00	95.0	1.50
Maris topdress-CNCPS-C171617	0.00	89.7	2.02
Totals	0.00	46.9	54.01

Nutrient Balances

Nutrient	Balance	%Req
ME	0.8 Mcal	101
MP	124 g	105
Rum. NH3-N	83 g	149
Rum. Pep-N	158 g	188
peNDF	0.2 lbs	101
MP Lys	47.4 g	133.1
MP Met	10.8 g	124.9
Ca	-15.60 g	76%
P	-2.41 g	96%

Total ME Avail.	59.99 Mcal/day
Total MP Avail.	2795 g/day
MP Bact	46.7 %MP
ME Milk Prod	86.5 lbs/day
MP Milk Prod	90.9 lbs/day

Diet Concentrations

DM	46.9 %DM
Forage	57.4 %DM
CP	16.17 %DM
RDP	9.04 %DM
NDF	33.67 %DM
Forage NDF	72.64 %NDF
Forage NDF	0.92 %FBW
EE	4.4 %DM
LCFA	3.4 %DM
Lys	6.82 %MP
Met	1.93 %MP
Lys:Met	3.53
TDN	65.0 %DM
ME	1.11 Mcal/lb
Sugar (A4)	3.9 %DM
Starch (B1)	21.2 %DM

High starch fresh diet composition (as formulated)

Ration Fed

Ingredient	$/hd	%DM	DM lbs/day
BMR Corn Silage Processed 30 DM 41 NDF Medium-	0.00	31.9	24.00
Mix Silage 18 CP 48 NDF 12 LNDF-CNCPS-04069	0.00	41.4	5.00
Wheat Straw 5 CP 79 NDF 16 LNDF-CNCPS-03086	0.00	88.6	2.00
Corn Grain Ground Fine-CNCPS-01039	0.00	88.0	10.90
Corn Germ Meal-CNCPS-02014	0.00	93.4	1.30
Citrus Pulp Dry-CNCPS-01031	0.00	88.6	0.50
Soybean Hulls Ground-CNCPS-01103	0.00	91.0	0.00
Soybean Meal 47.5 Solvent-CNCPS-02027	0.00	90.0	3.00
Canola Meal Solvent-CNCPS-02006	0.00	90.2	1.40
Blood Meal-CNCPS-07001	0.00	90.0	1.00
Amino Plus-CNCPS-08022	0.00	88.0	0.86
Energy Booster-CNCPS-09006	0.00	99.0	0.40
MinVit-CNCPS-05053	0.00	95.0	1.62
Maris topdress-CNCPS-C171617	0.00	89.7	2.02
Totals	0.00	46.8	54.00

Nutrient Balances

Nutrient	Balance	%Req
ME	2.6 Mcal	104
MP	202 g	108
Rum. NH3-N	87 g	154
Rum. Pep-N	156 g	182
peNDF	-0.6 lbs	95
MP Lys	50.5 g	135.7
MP Met	11.1 g	125.9
Ca	-32.65 g	50%
P	-0.18 g	100%

Total ME Avail.	61.75 Mcal/day
Total MP Avail.	2829 g/day
MP Bact	46.6 %MP
ME Milk Prod	90.1 lbs/day
MP Milk Prod	94.6 lbs/day

Diet Concentrations

DM	46.8 %DM
Forage	57.4 %DM
CP	16.38 %DM
RDP	9.27 %DM
NDF	30.03 %DM
Forage NDF	81.45 %NDF
Forage NDF	0.92 %FBW
EE	4.1 %DM
LCFA	3.3 %DM
Lys	6.78 %MP
Met	1.90 %MP
Lys:Met	3.57
TDN	66.6 %DM
ME	1.14 Mcal/lb
Sugar (A4)	2.8 %DM
Starch (B1)	28.1 %DM

BMR corn silage analyses

- Used for formulation

Sample Description	Farm	Code	Sample
CORN SILAGE		323D	17872670

731 BMR CORN SILAGE 4/25

Analysis Results

Components	As Fed	DM
% Moisture	9.3	
% Dry Matter	90.7	
% Crude Protein	9.2	10.2
% Available Protein	8.4	9.3
% ADICP	.8	.9
% Adjusted Crude Protein	9.2	10.2
Soluble Protein % CP		62
Degradable Protein %CP		72
% NDICP	1.0	1.1
% Acid Detergent Fiber	23.9	26.4
% Neutral Detergent Fiber	41.9	46.3
% Lignin	2.6	2.8
% NFC	31.6	34.9
% Starch	23.9	26.3

- Actual (5/21/12)

Sample Description	Farm	Code	Sample
CORN SILAGE		323	17943680

731 BMR CORN SILAGE

Analysis Results

Components	As Fed	DM
% Moisture	72.1	
% Dry Matter	27.9	
% Crude Protein	2.4	8.5
% Available Protein	2.2	7.8
% ADICP	.2	.7
% Adjusted Crude Protein	2.4	8.5
Soluble Protein % CP		63
Degradable Protein %CP		73
% NDICP	.2	.9
% Acid Detergent Fiber	6.6	23.6
% Neutral Detergent Fiber	11.6	41.4
% Lignin	.8	2.8
% NFC	11.9	42.6
% Starch	9.4	33.8

Revised high starch fresh diet

Ration Fed

Ingredient	$/hd	%DM	DM lbs/day
BMR Corn Silage Processed 30 DM 41 NDF Medium-	0.00	31.9	20.00
Mix Silage 18 CP 48 NDF 12 LNDF-CNCPS-04069	0.00	41.4	5.00
Wheat Straw 5 CP 79 NDF 16 LNDF-CNCPS-03086	0.00	88.6	6.00
Corn Grain Ground Fine-CNCPS-01039	0.00	88.0	10.90
Corn Germ Meal-CNCPS-02014	0.00	93.4	1.30
Citrus Pulp Dry-CNCPS-01031	0.00	88.6	0.50
Soybean Hulls Ground-CNCPS-01103	0.00	91.0	0.00
Soybean Meal 47.5 Solvent-CNCPS-02027	0.00	90.0	3.00
Canola Meal Solvent-CNCPS-02006	0.00	90.2	1.40
Blood Meal-CNCPS-07001	0.00	90.0	1.00
Amino Plus-CNCPS-08022	0.00	88.0	0.86
Energy Booster-CNCPS-09006	0.00	99.0	0.40
MinVit-CNCPS-05053	0.00	95.0	1.62
Maris topdress-CNCPS-C171617	0.00	89.7	2.02
Totals	0.00	50.3	54.00

Nutrient Balances

Nutrient	Balance	%Req
ME	2.4 Mcal	104
MP	163 g	106
Rum. NH3-N	93 g	159
Rum. Pep-N	158 g	185
peNDF	-0.1 lbs	100
MP Lys	47.8 g	133.7
MP Met	10.0 g	123.4
Ca	-33.36 g	49%
P	-1.94 g	97%

Total ME Avail.	61.60 Mcal/day
Total MP Avail.	2793 g/day
MP Bact	45.9 %MP
ME Milk Prod	89.8 lbs/day
MP Milk Prod	92.8 lbs/day

Diet Concentrations

DM	50.3 %DM
Forage	57.4 %DM
CP	16.22 %DM
RDP	9.14 %DM
NDF	30.20 %DM
Forage NDF	81.56 %NDF
Forage NDF	0.92 %FBW
EE	4.0 %DM
LCFA	3.2 %DM
Lys	6.78 %MP
Met	1.89 %MP
Lys:Met	3.59
TDN	66.5 %DM
ME	1.14 Mcal/lb
Sugar (A4)	3.0 %DM
Starch (B1)	27.9 %DM

Revised low starch fresh diet

Ration Fed			
			DM
Ingredient	$/hd	%DM	lbs/day
BMR Corn Silage Processed 30 DM 41 NDF Medium-	0.00	31.9	20.00
Mix Silage 18 CP 48 NDF 12 LNDF-CNCPS-04069	0.00	41.4	5.00
Wheat Straw 5 CP 79 NDF 16 LNDF-CNCPS-03086	0.00	88.6	6.00
Corn Grain Ground Fine-CNCPS-01039	0.00	88.0	5.35
Corn Germ Meal-CNCPS-02014	0.00	93.4	2.91
Citrus Pulp Dry-CNCPS-01031	0.00	88.6	3.60
Soybean Hulls Ground-CNCPS-01103	0.00	91.0	1.84
Soybean Meal 47.5 Solvent-CNCPS-02027	0.00	90.0	2.00
Canola Meal Solvent-CNCPS-02006	0.00	90.2	1.08
Blood Meal-CNCPS-07001	0.00	90.0	1.01
Amino Plus-CNCPS-08022	0.00	88.0	1.20
Energy Booster-CNCPS-09006	0.00	99.0	0.50
MinVit-CNCPS-05053	0.00	95.0	1.50
Maris topdress-CNCPS-C171617	0.00	89.7	2.02
Totals	0.00	50.4	54.01

Nutrient Balances		
Nutrient	Balance	%Req
ME	0.6 Mcal	101
MP	85 g	103
Rum. NH3-N	89 g	155
Rum. Pep-N	160 g	192
peNDF	0.7 lbs	106
MP Lys	44.7 g	131.2
MP Met	9.7 g	122.5
Ca	-16.31 g	75%
P	-4.17 g	93%

Total ME Avail.	59.85 Mcal/day
Total MP Avail.	2759 g/day
MP Bact	45.9 %MP
ME Milk Prod	86.2 lbs/day
MP Milk Prod	89.1 lbs/day

Diet Concentrations	
DM	50.4 %DM
Forage	57.4 %DM
CP	16.00 %DM
RDP	8.91 %DM
NDF	33.84 %DM
Forage NDF	72.78 %NDF
Forage NDF	0.92 %FBW
EE	4.4 %DM
LCFA	3.4 %DM
Lys	6.82 %MP
Met	1.92 %MP
Lys:Met	3.55
TDN	64.8 %DM
ME	1.11 Mcal/lb
Sugar (A4)	4.2 %DM
Starch (B1)	21.0 %DM

A few questions

- How should we feed fresh cows?
- What are some key principles for grouping management?
- What about frequent milking (i.e., 4X/2X or 4X/3X)
- What are some ways we can assess opportunities in fresh cows?

Potential management/facility related stressors for transition cows

- Overcrowding (increased stocking density)
- Commingling of cows and heifers
- Excessive number of pen moves (group changes)
- Heat stress
- Overall cow comfort/hygiene

Overstocking affects behavior

- Increased aggression
- Reduced feeding times
- Increased feeding rate
- Increased inactive standing time
- Reduced lying time

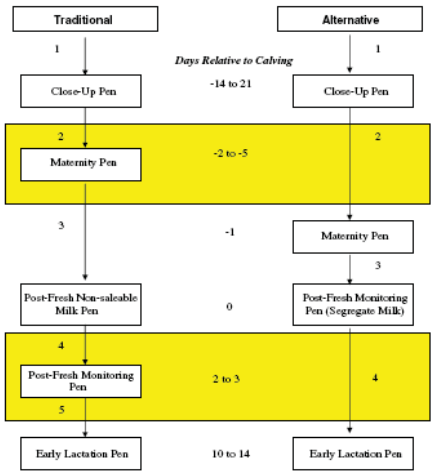
Little work has evaluated how these behavioral changes influence subsequent health

Feeding Behavior of Heifers vs. Cows

Activity	Heifers	Cows
Prepartum total daily feeding time, min/d	213	187
Prepartum meal duration, min/d	27.2	24.2
Prepartum feeding rate, g DM/min	66.6	95.1
Postpartum feeding rate, g DM/min	78.8	106.7

Heifers need more time for access to feed; eat more slowly than cows

DeGroot and French, 2004



Important to minimize number of pen moves during transition period (Cook and Nordlund, 2004)

A few questions

- How should we feed fresh cows?
- What are some key principles for grouping management?
- What about frequent milking (i.e., 4X/2X or 4X/3X)
- What are some ways we can assess opportunities in fresh cows?

Increased milking frequency (IMF)

- Historically employed in the dairy industry during the course of the entire lactation to increase yields of milk and milk components
- Summary of 19 literature reports (Erdman and Varner, 1995)
  - 3X milking increased milk yield by 3.5 ± 0.2 kg/d compared with 2X milking
    - Slight decrease in milk fat (~ 0.14) and milk protein (~0.06) percentages
  - 4X milking increased milk yield by 4.9 ± 0.8 kg/d compared with 2X milking
    - Slight decrease in milk fat (~ 0.18) and milk protein (~0.04) percentages

IMF during early lactation only

- Most readily implemented on farms where early lactation cows can be separated from rest of herd
- Minimal economic investment (low downside risk)
- 7% increase in milking capacity and labor for 4X/2X compared to 30% increase for 3X compared with 2X
  - McFadden and Wall (2007)
- Two major IMF schemes
  - 6X/3X
  - 4X/2X (beginning and end of each milking)
  - Other variations exist (e.g., 4X/3X)

Author	Milking scheme	Length of IMF	DIM	Milk yield Response Kg/d	Fat yield response Kg/d	Prot. Yield response Kg/d
Bar-Peled et al., 1995	6x-3x	42 d	1-42 d	7.31	0.19	0.2
			42-126 d	5.1	0.15	0.15
Hale et al., 2003	4x-2x	21 d	1-21 d	8.8	0.02	0.23
			21-70 d	4.6	0.09	0.07
			21-308 d	2.6	0.03	0.06
Fernandez, 2004	4x-2x	21 d	~ 15 d	3	nr	nr
			~ 45 d	3.5	nr	nr
			1-270 d	*1.6*	*0*	*0.01*
Dahl et al., 2004	6x-3x	21 d	1-21 d	8.4	nr	nr
			305 d	3.6	nr	nr
VanBaale et al., 2005	6x-3x	7 d	1-63 d	*-1.7*	-0.12	*-0.03*
			63-308 d	*-0.8*	*-0.03*	*0.04*
		14 d	1-63 d	*0.2*	*-0.04*	*0*
			63-308 d	*-0.2*	*0.01*	*-0.01*
No bST produced 4.6 kg/d less milk		21 d	1-63 d	*-2.3*	-0.15	*-0.1*
			63-308 d	*-0.6*	*-0.04*	*-0.02*
Wall and McFadden, 2007	4x-2x Unilateral	21 d	1-21 d	3.5*	nr	nr
			21-305 d	1.8*	nr	nr

Summary – Cornell research

- Early lactation IMF for the first 21 d postpartum increased yields of milk and milk components (~ 3.5 lb/d of component corrected milk)
  - dairy farms varying in management schemes
  - minimum milking intervals ranging from 3.5 to 6 h
- Early lactation IMF did not affect udder health as assessed by linear score
- Early lactation IMF did not appear to affect BCS during early lactation and had minimal effects on serum NEFA
- Serum BHBA concentrations were increased by early lactation IMF, but the proportion of cows categorized as subclinically ketotic (BHBA > 14 mg/dL) was not affected by treatment

Bar napkin economics

- Assume:
  - 3.5 lbs/d component corrected milk response, 305-d lactation
  - $16/cwt milk, $0.12/lb of feed DM; 2.25 lbs of milk/lb of DM
  - 10 min/cow/day increased labor for 21 d @ $10/h
- Increased revenue
  - 1,067 lbs of milk -- $170 per cow
- Increased cost
  - Labor -- $35 per cow
  - Feed – 474 lbs DM -- $56.88
- Net -- $78 per cow

Key management considerations for application of early lactation IMF

- Feed quality and availability
- Additional milking time (minimize)
- Overall quality of transition cow management program
- Mastitis control and management

A few questions

- How should we feed fresh cows?
- What are some key principles for grouping management?
- What about frequent milking (i.e., 4X/2X or 4X/3X)
- What are some ways we can assess opportunities in fresh cows?

Challenges with assessing energy metabolism and inflammation-related opportunities in transition cows

- Most of dairy industry works on averages
- Challenges related to energy/grouping mgt/nonnutritional factors cause increases in ***variation*** in DMI/performance
  - Almost impossible to detect some of these on farms
- Potential tools for use in monitoring variation in transition cow management
  - NEFA (best marker for negative energy balance)
  - BHB ("gold standard" blood ketone)
  - Haptoglobin and/or fecal cortisol? (not ready for prime time)
  - Variation in early lactation milk yield

Herd-level impacts of elevated NEFA/BHB

Metabolite level	**Herd Alarm**	**Associated with:**
PRE-Partum NEFA $\geq$ 0.3 mEq/L	15%	+3.6% Disease incidence -1.2% Pregnancy rate - 529 lbs ME305 milk (both heifers and cows)
POST-Partum NEFA $\geq$ 0.6[a] - 0.7[b] mEq/L	15%	+1.7% Disease incidence[b] - 0.9% Pregnancy rate[a] Heifers: -640 lbs, Cows: - 1,272 lbs
BHB $\geq$ 10[a]-12[b*] mg/dL	15% *20%	+1.8% Disease incidence[b] -0.8% Pregnancy rate[b] Heifers: -1,179 lbs*, Cows: - 732 lbs[a]

***15% of 15 = 2-3 animals**

Ospina et al., 2010

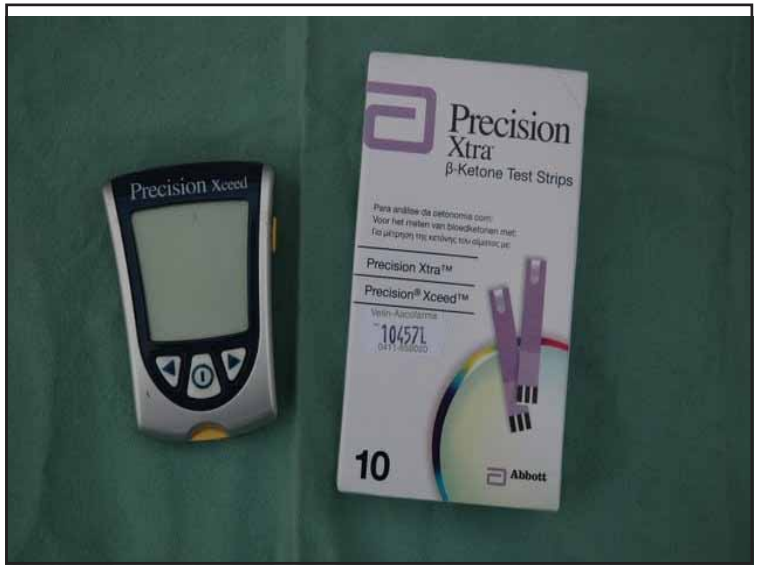
Energy-related blood analytes and postpartum outcomes

- 1315 post-partum animals
  - 25% (131/517) heifers NEFA ≥ 0.7 mEq/L
  - 33% (267/798) cows NEFA ≥ 0.7 mEq/L
  - 15% (77/517) heifers BHB ≥ 10 mg/dL
  - 27% (214/798) cows BHB ≥ 10 mg/dL

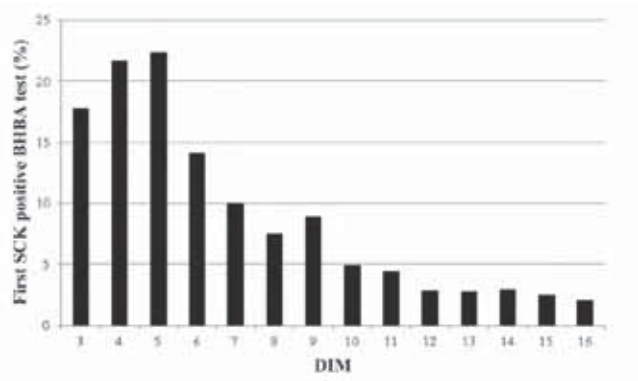
Ospina et al., 2010. J. Dairy Sci. 93:546-554.

Approach for monitoring energy-related blood analytes in transition cows

- Sample size:
  - ~ 15 to 20 cows
- Cows to sample
  - Pre-partum: 14 to 2 days before calving
  - Post-partum: 3 to 14 DIM
- Sample to take
  - Serum (red top tubes)
  - Don't shake, keep cool
- What to do with sample?
  - BHB: Lab or Precision Extra Meter
  - NEFA: Lab
- What to do with results
  - Interpret % above cut-point
  - More than 15% above cut-point indicates herd-level problem



Histogram of incidence of subclinical ketosis (SCK) in 1,717 Holstein dairy cows undergoing repeated testing for ketosis from 3 to 16 DIM. A positive test was defined as a blood BHBA concentration of 1.2 to 2.9 mmol/L



McArt et al., 2012. J. Dairy Sci. 95 :5056–5066

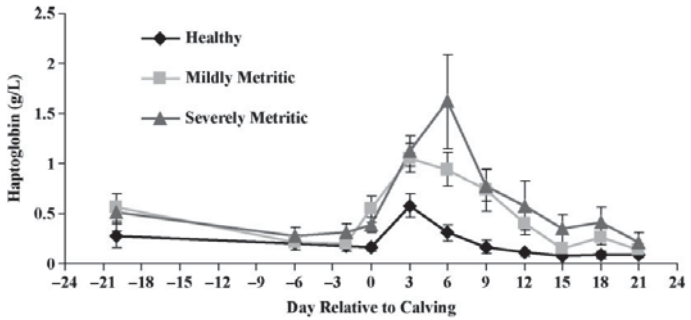
Physiological measures of stress and inflammation?

Changes in the activity and functioning of the hypothalamic-pituitary-adrenal (HPA) axis are often used to quantify an animal's response to a potential stressor.

- Plasma cortisol
- Non-invasive measures of stress?
  - Fecal Cortisol Metabolites (Möstl and Palme)

Environmental stressors can also induce an acute phase response in cattle.

- Haptoglobin



Mean (±SE) haptoglobin concentration of healthy (n = 23), mildly metritic (n = 32), and severely metritic (n = 12) cows during the period around calving (From Huzzey et al., 2009)

What we did …

Data collected on 2 commercial dairy herds in NYS

Weekly blood and fecal samples from 412 transition cows

- 3 weeks before calving until 1 week after calving
- Measured plasma NEFA, haptoglobin and cortisol
- Measured fecal cortisol metabolites

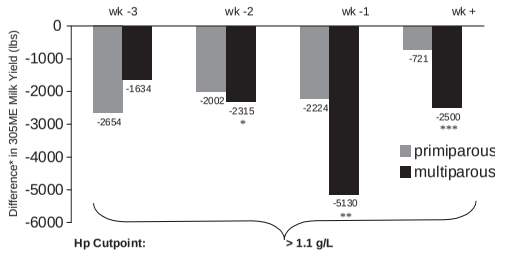
1. **Recorded disorders up to 30 DIM**
   - **DA**, **RP**, **Death** (DC305)
   - **SCK** (wk +1 BHB > 10 mg/dL) *Ospina et al. 2010 JDS 93:546-554.*
   - **High Hp** (wk +1 Hp > 1 g/L) *Huzzey et al. 2009. JDS 89:126-133*
2. **Predicted Milk Yield**
   - **305ME (2nd & 3rd Test day)**
3. **Reproductive Performance**
   - **Survival analysis**

Huzzey et al., 2011. J. Dairy Sci. 94 :5878–5889

Summary - Predictors of Health

- Prepartum plasma haptoglobin and cortisol were not good predictors of postpartum health status
- Cows that developed more than one disorder after calving had greater concentrations of fecal cortisol metabolites before calving… BUT…
- Prepartum NEFA was the analyte most strongly associated with our postpartum health outcomes
- Transition cow metabolite testing programs to evaluate **disease risk** should focus on NEFA concentrations
  - BHBA also useful as front line monitor

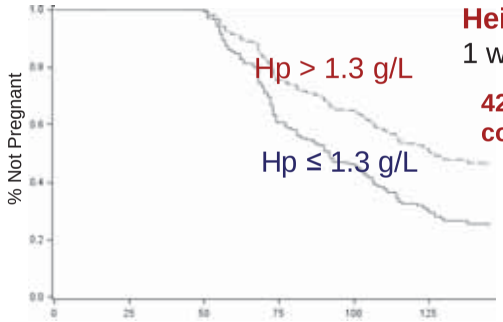
Haptoglobin & Predicted Milk Yield (~60 DIM)



Cutpoint: >1.1 g/L

% Cows Above Cutpoint	wk -3	wk -2	wk -1	wk +1
Primiparous	4.9	7.7	6.0	39.0
Multiparous	3.0	4.8	3.0	27.4

Haptoglobin and Reproduction



Heifers sampled 1 wk **after** calving

42% lower rate of conception (*P* = 0.02)

- Heifers > 0.4 g/L Pre-partum - 41% lower rate of conception (*P* = 0.05)
- Among Cows Hp not associated with reproductive performance

Current field study (Overton, Burhans, and Nydam)

- Objectives:
  - Identify relationships between dry period nutritional strategy, fresh period nutritional strategy, and postpartum outcomes related to health, milk yield, and reproduction.
  - Determine if interactions exist between dry period nutritional strategy, fresh period nutritional strategy, and biomarkers related to the above postpartum outcomes on commercial dairy farms (focus on NEFA, BHBA, and haptoglobin)
  - Identify relationships of nonnutritional factors affecting cows during the dry period and early lactation (stocking density, commingling of cows and heifers, pen moves) with postpartum health, milk yield, reproduction, and biomarkers related to these outcomes on commercial dairy farms.

General study approach

- 64 herds total across four nutritional management categories
  - Controlled energy one-group dry, fresh cows fed high diet
  - Controlled energy one-group dry, fresh cows fed fresh diet first
  - Step up (two-group) dry, fresh cows fed high diet
  - Step up (two-group) dry, fresh cows fed fresh diet first
- Will follow cohort of cows (24 per herd) through dry period and early lactation
  - BCS, lameness, calving score, blood biomarkers, metabolic disorders, milk production, reproduction
  - TMR analyses and particle size as cows move through different groups/stages

Thanks!!!

Email: tro2@cornell.edu