Fresh Ideas for Fresh Cow Nutrition and Management

Heather Dann, Ph.D.

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Management and Feeding Practices for Fresh Cows

- Can have a substantial impact on a cow's well-being and a farm's profitability
- Many recommendations are based on field experience and limited research (Drackley, 1998; Block, 2010; Overton and Boomer, 2010)

Components of Successful Fresh Cow Programs

- Implementation of management practices that focus on...
  - Prevention of transition disorders
  - Optimization of nutrient intake
  - Removal of stressors
- Real time monitoring and use of the information

Use of a Designated Fresh Cow Pen

- Allows dairies to facilitate monitoring of health problems, minimize social stress, and provide a diet specifically formulated for fresh cows
- Use increased with herd size (Heuwieser et al., 2010)
- Competition at the feed area increased feeding rate and altered feeding behavior (Krawczel et al., 2009; Proudfoot et al., 2009)

Use of a Designated Fresh Cow Pen

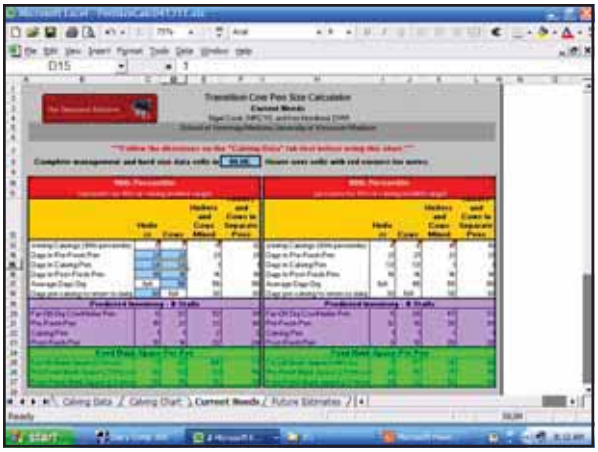
- The optimal duration of stay in a fresh pen is unknown...it most likely varies among farms and cows
- Cows housed as a separate group for 1 mo after calving with stocking density ≤100% vs. comingling with herd (Østergaard et al., 2010)
  - Primiparous: ~230 kg (506 lb) more ECM during 1st 305 DIM & less ketosis treatments (HR = 0.33)
  - Multiparous: not affected
  - Did not use a "fresh cow diet"...probably see more benefits of separate groups

Time Budgets are Restricted in Early Lactation

- Milking frequency
- Time spent in lock-up for fresh cow checks and other management tasks
  - Limit to <2 h/d with fresh feed delivery

Fresh Cow Pen Size Determined by…

- Ability to detect sick cows in a group of fresh cows
- Target stocking density of feed bunk and stalls
- Target duration of stay in the pen
- Rate of calving



Use of High-Risk and Low-Risk Fresh Cow Pens

- Opportunity for large dairies
- Target specialized management time to cows that need it
- Decrease lock-up time for exam and treatment
- Decrease time away from stalls
  - Rest for lame and sick cows
- Milking frequency adjustment (2x vs. 3x)

http://thedairylandinitiative.vetmed.wisc.edu/tdi/ac_group_size.htm

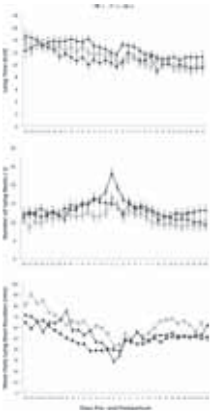
Thin Cows Have a Greater Risk of Becoming Lame

- Thickness of the digital cushion of the hoof was a strong predictor of lameness (Bicalho and Machado, 2009)
- Decreased milking frequency (2x vs. 3x) accelerated the recovery of lame cows (score >2, 1-5) (Caixeta and Bicalho, 2011)
  - 36% lower probability of lameness
  - Improved BCS (2.98 vs. 2.93)
  - No effect on milk (90.2 vs 92.2 lb/d)

www.dairyherd.com

Lameness and Transition Cow Behavior and Health

- Moderate and severely lame cows (score 3, 1-3)
  - Longer lying times throughout transition period
  - Greater number of lying bouts per day for 3 d before and after calving
    - Discomfort and hypersensitivity to pain
  - Greater risk for ketosis (elevated BHBA)



Calderon and Cook, 2011; J. Dairy Sci. 94:2883

Pain Management is an Emerging Issue

- Types of pain at calving
  - Visceral: dilation phase with pain stimuli coming from cervical dilation and distention of the lower uterine segment
  - Somatic (musculoskeletal): due to distention and traction on pelvic structures surrounding the vagina and distention of the pelvic floor
- Assessment of pain
  - General indices
  - Physiological indicators
  - Measures of behavior
- Dystocia

Weary et al., 2006; Mainau and Manteca, 2011

Limited Work on the Impact of Pain Relief During and After Calving

- Hypoalgesia - decreased sensitivity to painful stimuli
  - Occurs during late pregnancy and parturition via endogenous opioids
  - Placental opioid-enhancing factor in amniotic fluid
- Drugs not labeled for pain reduction in cattle
- Pain physiology, immunology, and metabolism are interrelated
  - Relationships are very difficult to understand and predict outcomes with NSAID administration

Mainau and Manteca, 2011

Administration of Ketoprofen at Calving on the Milk Yield and Fertility of Holstein-Friesian Cattle

- Ketoprofen (NSAID) treatment at calving and +24 h
  - Tended to lower incidence of retained fetal membranes
    - 1.7 times less likely to develop condition
  - No effect
    - Endometritis score
    - Presence of CL at 20-25 DIM
    - Time to 1st insemination
    - Inseminations per pregnancy
    - Milk yield
- No measure of inflammatory mediators, behavior, comfort, early intake and performance

Richards et al., 2009; Veterinary Record 165:102

Flunixin Meglumine (Banamine) Administration the 1st 3 Days of Lactation Shows No Benefit

Item	Control	Banamine
1st 7 DIM		
Rectal temperature, °F	101.8	102.2
DMI, lb/d	41.4	32.6
Milk, lb/d	63.4	56.1
1st 35 DIM		
DMI, lb/d	48.4	42.9
Milk, lb/d	79.4	75.2

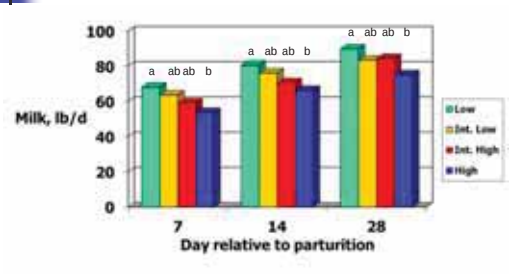
$P \leq 0.05$; Shwartz et al., 2009

Inflammation is Common During Early Lactation and is Stimulated by Several Pathways

- Sources
  - Infection
    - Inflammatory cytokines
  - Oxidative stress (Sordillo and Aitken, 2009)
    - Lipid peroxides during negative energy balance
  - Ruminal acidosis (Gozho et al., 2007)
- Problems
  - Negative effects on lipid and glucose metabolism (Bradford et al., 2009; Bradford, 2012)

Milk Yield is Related to Inflammation

Liver Activity Index (LAI) Based on Plasma Acute Phase Proteins



$^{ab}P < 0.05$; Bertoni et al., 2008

Health and Fertility are Related to Inflammation

Liver Activity Index (LAI) Based on Plasma Acute Phase Proteins

	Inflammation			
Item	**Low**	**Int. Low**	**Int. High**	**High**
Health problems, frequency				
Metritis	0.0^{a}	5.0^{a}	5.3^{a}	26.3^{b}
Cows with ≥ 1 problems	5.3^{a}	26.3^{b}	45.0^{b}	42.1^{b}
Fertility indices				
Days open, d	92.9^{a}	132.5^{b}	138.8^{b}	110.5^{ab}
Conception rate (1st service), %	52.6	45.0	21.0	36.8
Services per pregnancy, #	1.65	2.04	2.68	2.01

$^{ab}P < 0.05$; Bertoni et al., 2008

Practical Considerations when Feeding for Immunity

- Feeding management – diet on paper vs. consumed, imbalances
  - Antioxidants and trace elements
    - Vitamin E, selenium (organic), β-carotene/vitamin A, copper, zinc, chromium, commercial products
- Metabolic modifiers
  - Choline, agonists for peroxisome proliferator-activated receptors (PPAR) such as 2,4-thiazolidinedione (not approved for use on dairies)
- Anti-inflammatory agents (NSAIDs)
  - Aspirin, flunixin meglumine (Banamine)

Andrieu, 2008; Spears & Weiss, 2008; Bradford, 2009; Waldron, 2009

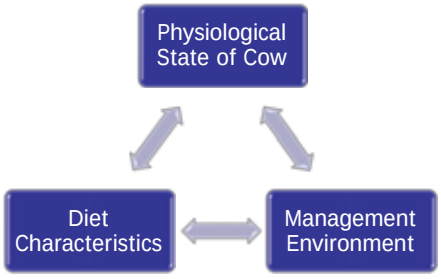
Nutrition for the Fresh Cow

- Should feed diets that
  - Provide nutrients to accelerate the postpartum increase in intake and milk
  - Support noncompromised lipid mobilization
  - Minimize health problems
  - Prepare cows for conception

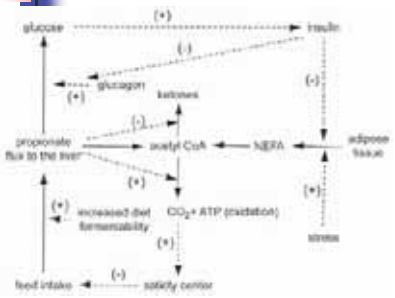
Strategies for Feeding Early Lactation Cows

- **Increasing the dietary nutrient (energy/protein) density**
  - Increase starch, protein or fat components at expense of forage
  - Implications for rumen function, milk composition, nutrient partitioning, and metabolic hormones
- **Altering the source of fermentable carbohydrates**
  - Implications for acidosis risk and intake
- **Changing the availability of glucogenic nutrients relative to lipogenic nutrients**
  - Implications for reproductive performance
- **Targeting use of specific fatty acids**
  - Implications for immunity and reproductive performance
- **Changing amount and source of metabolizable protein and amino acids**

Eating Behavior and Feed Intake are the Result of Neural Integration of Numerous Signals



Mechanism of Intake Regulation by the Hepatic Oxidation Theory



- Propionate: end product of ruminal fermentation
- Stimulates oxidation in the liver
- Meal terminates - oxidative fuel metabolism by liver exceeds liver energy requirement, brain is signaled to ↓ intake
- Propionate flux affected by starch fermentability

Allen et al., 2009; J. Anim. Sci. 87:3317

Recommendations for Fresh Cows

(Low insulin, insulin resistant, high NEFA)

- Maintain rumen fill during transition period
  - Forages with long ruminal retention time (grass, straw)
- Avoid feeding highly fermentable diets to fresh cows (may be ~7 to 21 d)
  - Rapid production and absorption of propionate will suppress intake
  - Ground corn is good choice...moderate ruminal fermentability, high small intestinal digestibility
  - Use of nonforage fiber sources

Allen and Bradford, 2011

Miner Study

- **72 multiparous Holstein cows**
- **40-d dry period**
  - **Controlled-energy, high-straw diet**
- **91-d lactation period**
  - **21% (low), 23% (medium), and 26% starch diets**

Treatment	1-21 DIM	22-91 DIM
Low (LL)	Low	Low
Medium-High (MH)	Medium	High
High (HH)	High	High

Ingredient Composition of Diets

(% of Dry Matter)

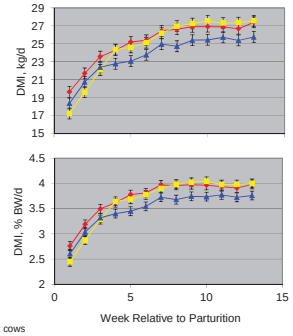
Item	Dry	Low	Medium	High
Corn silage	30.7 ± 0.3	34.6 ± 0.1	34.6 ± 0.1	34.6 ± 0.1
Haylage	11.0 ± 1.0	11.4 ± 0.4	11.7 ± 0.3	11.4 ± 0.4
Wheat straw	24.9 ± 0.9	4.1 ± 0.1	4.1 ± 0.1	4.1 ± 0.1
Corn meal	-	6.9 ± 0.4	11.1 ± 0.1	16.7 ± 0.4
Soybean meal	8.6 ± 0.5	11.4 ± 0.1	11.9 ± 0.1	11.9 ± 0.1
Soybean hulls	9.3 ± 0.1	9.7 ± 0.1	6.5 ± 0.2	3.2 ± 0.1
Wheat middlings	-	6.1 ± 0.1	3.9 ± 0.1	1.8 ± 0.1
Canola meal	-	3.1 ± 0.1	6.1 ± 0.1	6.1 ± 0.1
DDGS	-	3.2 ± 0.1	3.1 ± 0.1	3.1 ± 0.1
AminoPlus	-	2.5 ± 0.1	-	-
Other	15.5 ± 1.2	7.0 ± 0.3	6.9 ± 0.3	7.1 ± 0.3

Analyzed Chemical Composition of Diets (% of Dry Matter)

Item	Dry	Low	Medium	High
DM, %	52.9 ± 1.1	49.5 ± 0.7	50.1 ± 0.9	49.6 ± 0.7
CP, %	13.4 ± 0.2	17.3 ± 0.1	17.0 ± 0.2	16.7 ± 0.2
ADF, %	34.2 ± 0.3	22.9 ± 0.2	21.8 ± 0.2	20.3 ± 0.3
NDF, %	50.7 ± 0.3	35.7 ± 0.3	33.9 ± 0.4	31.9 ± 0.3
Starch, %	13.5 ± 0.4	21.0 ± 0.3	23.2 ± 0.3	25.5 ± 0.3
RFS, %	11.5 ± 0.5	16.8 ± 0.5	18.9 ± 0.6	20.2 ± 0.5
Sugar, %	4.5 ± 0.1	6.1 ± 0.1	5.8 ± 0.1	5.9 ± 0.1
Fat, %	2.6 ± 0.1	4.0 ± 0.1	4.1 ±0.1	4.2 ±0.1

RFS = rumen fermentable starch

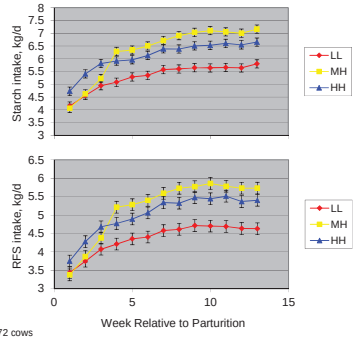
Dry Matter Intake (DMI)



Trt: $P = 0.06$
Time: $P < 0.001$
Trt x Time: $P = 0.09$
LL > HH: $P \leq 0.10$

n = 72 cows

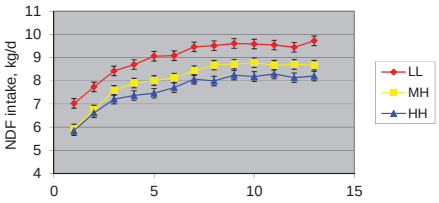
Starch Intake



Trt: $P < 0.001$
Time: $P < 0.001$
Trt x Time: $P < 0.001$
LL < MH, HH: $P \leq 0.05$

n = 72 cows

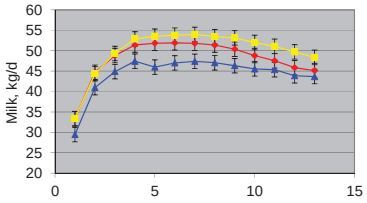
Neutral Detergent Fiber (NDF) Intake



Trt: $P < 0.001$
Time: $P < 0.001$
Trt x Time: $P = 0.85$
LL > MH, HH: $P \leq 0.05$

n = 72 cows

Milk Yield



Trt: $P = 0.04$
Time: $P < 0.001$
Trt x Time: $P = 0.75$
MH > HH: $P \leq 0.05$

n = 72 cows

Milk Yield and Composition for 13 wk of Lactation

	Treatment				*P* - value		
Item	LL	MH	HH	SE	TRT	Time	TRT × Time
3.5% FCM, kg/d	51.9	52.2	47.4	1.7	0.09	<0.001	0.40
SCM, kg/d	47.4	47.9	43.5	1.5	0.09	<0.001	0.39
Fat, %	3.88^{x}	3.64^{y}	3.79^{xy}	0.08	0.08	<0.001	0.59
Fat, kg/d	1.91^{x}	1.86^{xy}	1.71^{y}	0.06	0.09	<0.001	0.93
True protein, %	2.90	2.92	2.97	0.04	0.52	<0.001	0.08
True protein, kg/d	1.42^{ab}	1.50^{a}	1.34^{b}	0.04	0.03	<0.001	0.48
MUN, mg/dL	15.2^{a}	12.7^{b}	11.9^{b}	0.3	<0.01	<0.001	0.88

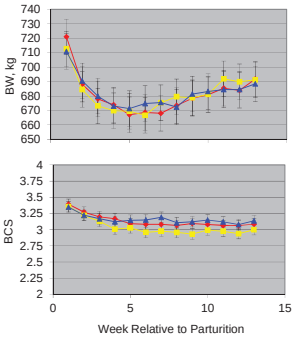
^{ab} $P \leq 0.05$; ^{xy} $P \leq 0.10$

Serum NEFA and BHBA During First 21 DIM

	Treatment				*P* - value		
Item	LL	MH	HH	SE	TRT	Time	TRT × Time
NEFA, uEq/L	452^{ab}	577^{a}	431^{b}	43	0.03	<0.001	0.11
BHBA, mg/dL	9.3	8.8	7.8	1.1	0.15	0.46	0.97

^{ab} $P \leq 0.05$

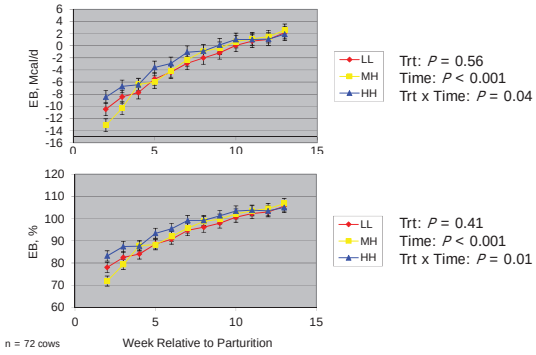
Body Weight and Body Condition Score



Trt: $P = 0.99$
Time: $P < 0.001$
Trt x Time: $P = 0.59$

Trt: $P = 0.46$
Time: $P < 0.001$
Trt x Time: $P = 0.37$

Energy Balance

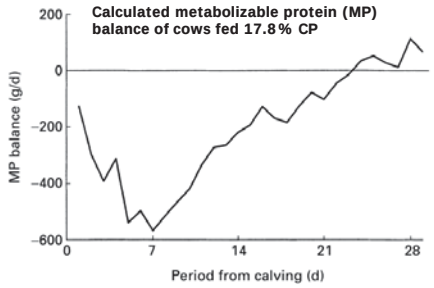


Fresh Cow Feeding Guidelines for Carbohydrates

- Group fresh cows separately and use a fresh cow diet
- Balanced carbohydrate blend
  - ~21-24% starch
  - 4-6% sugar
  - 9-10% soluble fiber
  - 34-38% NFC
  - 28-34% NDF

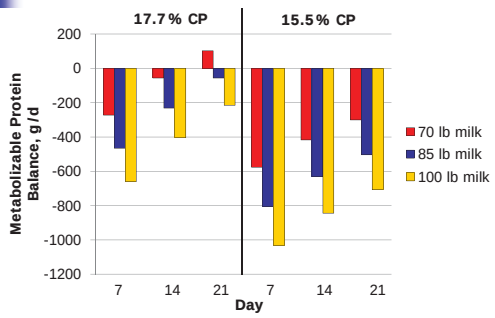
  Just a starting point…adjust for digestibility and particle size
- Ensure adequate peNDF
- **Formulate in the context of the dry and high group diets**

Cows Experience Negative Protein Balance in Early Lactation



Bell et al., 2000; Proc. Nutr. Soc. 59:119

Potential Deficiencies in Metabolizable Protein (CPM v. 3)



Protein Recommendations for Fresh Cows

- Maximize MP balance and quality
  - Optimize ruminal fermentation and microbial protein synthesis
    - Sufficient RDP and fermentable carbohydrates
  - Use high quality RUP to provide digestible amino acids
  - Use ruminally protected amino acids
    - Especially for lower CP diets
- Feed dry cows adequate MP (Van Saun et al., 1993; Moorby et al., 1996)

Amino Acid Supply in Early Lactation

- Few studies focus on fresh period
- Lysine and methionine limiting in wk 4 (Schwab et al., 1992)
- Factor in regulating milk yield and milk protein production (Schei et al., 2005)
- Lysine supplementation is preferentially used to support body protein turnover then milk protein synthesis in early lactation (Robinson et al., 2011)

Reduced Dietary Crude Protein Diets in Early Lactation

- Modification of diet to reduce CP by ~1% by removing soluble CP and replacing with RP Lys and Met
- 1 to 42 DIM
  - Maintained productivity (76 lb/d)
  - Increased proportion of dietary N captured in milk protein (37.6 vs 34.2%)

Robinson et al., 2004

Approaches of Targeted Feeding of Fat to Affect Performance and Fertility

- Feeding by-pass fat supplements to increase energy density
- Sequential feeding of high carbohydrate/insulin-stimulating to high fat/insulin-depressing diets
- Feeding specific fatty acids that exert pro- or anti-inflammatory effects

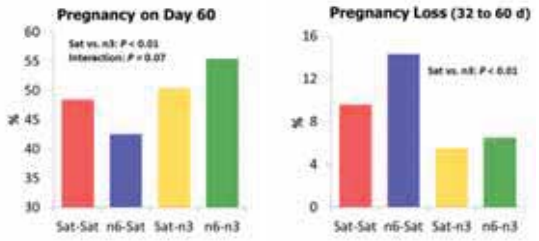
Thatcher et al., 2010; Reprod. Dom. Anim. 45(Suppl. 3) :2

Essential Fatty Acids

- **Requirement**
- **Linoleic acid (C18:2 n-6)**
  - Precursor for the biosynthesis of prostaglandins of the 2 series that exert a proinflammatory effect
  - May benefit postpartum health of cow
- **Linolenic acid (C18:3 n-3) / Eicosapentaenoic acid (EPA, C20:5 n-3)**
  - Suppression of inflammatory molecules
    - Reduce inflammatory response in uterus associated with carry-over effects of subclinical endometritis
    - Reduce potential luteolytic peaks at time that the conceptus is suppressing PGF2α secretion to maintain the CL for pregnancy maintenance
  - Feed after period of immunosuppression and uterine involution

Thatcher et al., 2010; Reprod. Dom. Anim. 45(Suppl. 3):2

Fatty Acid Supplementation (1.5% of DM) During the Transition and Breeding Periods on Fertility of Dairy Cows



Sat = palm oil: EnerGII, 47% C16:0
n6 = safflower oil: Prequel 21, 64% C18:2 n-6
n3 = fish oil: StrataG, 11% C20:5 n-3 + C22:6 n-3

Silvestre et al., 2011; J. Dairy Sci. 94:189

Sequential Feeding of Specific Fatty Acids

- During the transition period
  - Feed diets rich in linoleic acid (n-6)
- During the breeding period
  - Diets rich in EPA and DHA (n-3)
- **Probably n-6 and n-3 needed all the time**
- Impacts fatty acid composition of tissues and alters immune response...overall benefit to cow performance and fertility

Thatcher, 2010; Block, 2011

How Much Fat or Specific Fatty Acid Should be Fed and When to Improve Reproduction?

- Feed supplemental fat sources with key fatty acids at a minimum of 1.5% of dry matter (~1% for fish oil)...effective for reproduction and avoids negative effects on performance, intake, ruminal carbohydrate digestibility, milk fat depression
  - Base diet without fat supplement ~3-4%
  - Adequate peNDF
  - Watch rumen unsaturated fatty acid load (RUFAL; sum of oleic (C18:1), linoleic (C18:2) and linolenic (C18:3) acids) –
    - UFA entering reticulo-rumen from feeds, especially with DDGS and whole cottonseed
- Feed fat long enough before fatty acids are needed for restoring reproductive tissues to a new fertile state
  - 21 days...maybe 40 days before desired physiological response

Staples et al., 2007

Conclusions

- No “one size fits all” approach
- Interactions of nutrition, environment, & management

Conclusions

- Use a fresh cow group and diet
  - Minimize stress
  - Focused labor
  - Targeted nutrition
- Formulate within the context of the dry and high group diets

Conclusions

- Immediately after calving, limit use of highly fermentable starch sources and provide adequate peNDF to maximize DMI and minimize ruminal acidosis
- When NEFA and BHBA decrease, provide highly digestible carbohydrates to maximize DMI and milk production

Conclusions

- Improve metabolizable protein supply and quality through optimal ruminal fermentation, feeding high quality RUP sources, and supplementing with RPAA
- Supplement with polyunsaturated fatty acids (n-6, n-3) during key physiological periods to improve postpartum immune response and reproductive performance

www.whminer.org
dann@whminer.com