


Dietary Strategies to Reduce Hypocalcemia




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The Transition Period

- ▶ Most critical time in the life of a dairy cow
- ▶ Metabolism is in severe stress
- ▶ High nutrient demand to meet requirements for milk production
- ▶ Most susceptible to some diseases and metabolic disorders
 - ▶ Milk fever
 - ▶ Retained placenta
 - ▶ Displaced abomasum
 - ▶ Mastitis




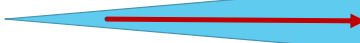
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Transition Period Goals

- ▶ High milk production
- ▶ Low incidence of metabolic disorders
- ▶ Minimum loss of immunological capacity
- ▶ Controlling or decreasing days to first ovulation
- ▶ Maintaining or enhancing fertility
- ▶ Low stillborn rate
- ▶ Healthy calves

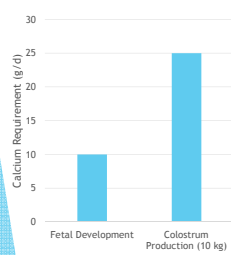
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Demand for Calcium

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Calcium Demand Around Calving



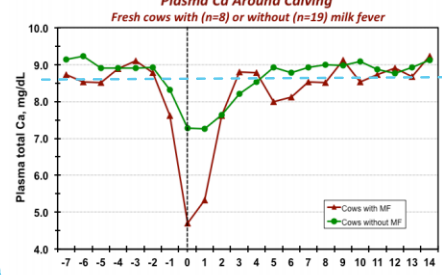
Category	Calcium Requirement (g/d)
Fetal Development	~10
Colostrum Production (10 kg)	~25

- ▶ Start of Lactation Challenges
 - ▶ Colostrum and milk are very high in Ca
 - ▶ Cows must draw on bone Ca to survive
 - ▶ Negative Ca balance continues for first 2 months of lactation
- ▶ Failing to adapt:
 - ▶ 5% clinical milk fever
 - ▶ 47% subclinical milk fever in 2nd and greater lactations
 - ▶ Blood calcium ≤ 8 mg/dL
 - ▶ New cutpoint ≤ 8.5 mg/dL total calcium

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The Start of Each New Lactation...

Plasma Ca Around Calving
Fresh cows with (n=8) or without (n=19) milk fever



Days relative to calving	Cows with MF (mg/dL)	Cows without MF (mg/dL)
-7	~8.5	~9.0
-6	~8.5	~9.0
-5	~8.5	~9.0
-4	~8.5	~9.0
-3	~8.5	~9.0
-2	~8.5	~9.0
-1	~8.5	~9.0
0	~8.5	~9.0
1	~4.5	~8.5
2	~5.5	~8.5
3	~8.5	~8.5
4	~8.5	~8.5
5	~8.5	~8.5
6	~8.5	~8.5
7	~8.5	~8.5
8	~8.5	~8.5
9	~8.5	~8.5
10	~8.5	~8.5
11	~8.5	~8.5
12	~8.5	~8.5
13	~8.5	~8.5
14	~8.5	~8.5

Figure 1. Plasma concentrations of total calcium before and after calving in mature Jersey cows with or without clinical milk fever (Kimura et al., 2006).

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Implications of Subclinical Hypocalcemia

- ▶ Result in lower milk production, poor reproductive performance, decreased responsiveness of the immune system
- ▶ Increased risk for:
 - ▶ Developing uterine prolapse
 - ▶ Retained placenta
 - ▶ Metritis (3.2 x)
 - ▶ Displaced abomasum
 - ▶ Ketosis (1.0 vs 0.7 mmol/L increased BHBA)
 - ▶ Longer median days open (123 vs 109 days)
- ▶ Affects nearly 50% of second and later lactation dairy cattle fed typical pre-fresh diets (Goff, 2008)
- ▶ If anions are used, percentage of hypocalcemia cows is reduced to about 15-25% (Oetzel, 2004)



More Costly Than Clinical Milk Fever...

- ▶ Clinical Cases:
 - ▶ Herd size: 2,000 cows
 - ▶ Annual incidence of clinical milk fever: 2%
 - ▶ Cost per case: \$300
 - ▶ Total cost to producer: \$12,000 per year
- ▶ Subclinical Cases:
 - ▶ Affects higher percentage of cows in herd
 - ▶ Herd size: 2,000 cows
 - ▶ Annual incidence of subclinical milk fever: 30%
 - ▶ Cost per case: \$125
 - ▶ Total cost to producer: \$48,750 per year

4X greater



Current Preventative Practices



- ▶ Anionic salts in close-up dry cow feed
 - ▶ 26.7% of operations
 - ▶ 44.5% of cows in US
- ▶ Limited potassium in dry cow ration
 - ▶ 46.9% of operations
 - ▶ 62.8% of cows in US

Source: 2007 NAHMS



Minimizing Hypocalcemia

- ▶ Nutritional means of prevention
 - ▶ Low calcium diets pre-fresh (dietary Ca restriction)
 - ▶ Low potassium forages/diets pre-fresh
 - ▶ Feeding anionic salts for 21 days pre-fresh (dietary acidification)
 - ▶ Supplemental dietary Mg
- ▶ Individual cow treatments
 - ▶ Oral supplementation
 - ▶ Intravenous preparations



Dietary Calcium Restriction

- ▶ Require very low calcium intake to work best
 - ▶ <20 g/day
- ▶ Activates the Ca homeostatic mechanisms
 - ▶ PTH is increased prior to calving
- ▶ Must avoid pre-partum alfalfa
 - ▶ Utilize grass hay with additional corn silage



Dietary Acidification

- ▶ More important controlling milk fever than calcium intake
- ▶ Lowering pre-fresh DCAD by 300 mEq/kg (136 mEq/lb) results in:
 - ▶ 5.1 x reduction in clinical milk fever
 - ▶ Decrease dry matter intake by 11.3%
 - ▶ Decrease urinary pH from 8.1 to 7.0



Image source: <http://www.fishbase.org/abstract/2009/1/20090101.html>

Source: Charbonneau et al., J. Dairy Science 89:537, 2006



Dietary Magnesium

- ▶ Magnesium plays important role in maintaining calcium homeostasis
- ▶ Higher pre-fresh dietary Mg lowers risk
 - ▶ Mg is needed for parathyroid hormone release
 - ▶ Mg is needed to synthesize active Vitamin D
- ▶ Suggest 0.30 to 0.45% Mg in diet dry matter
 - ▶ -40 to 50 grams of Mg per day

Source: DeGaris and Lean, Vol. 1, 176-58, 2008



Treatment of Hypocalcemia Stage 2 and Stage 3

- ▶ Intravenous calcium
- ▶ Do not give oral administration to down cow
- ▶ To reduce risk of relapse:
 - ▶ Additional oral calcium once alert and able to swallow
 - ▶ 2nd oral supplementation approximately 12 hours later



Source: Thilising-Hansen, et al., 2002; Oetzel, 2011



Treatment of Hypocalcemia Stage 1

- ▶ Oral administration
- ▶ Best approach for standing cows with hypocalcemia
 - ▶ Do not give IV Ca to standing cows
- ▶ Cows absorb oral Ca rapidly and sustain blood levels for 4 to 6 hours peak levels within 30 minutes



Effect of IV Calcium Treatment

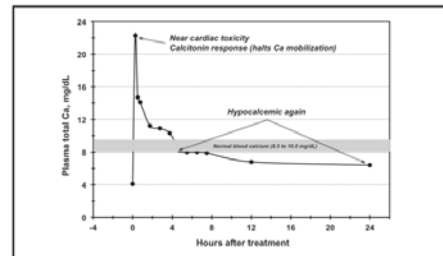


Figure 4. Effect of IV calcium treatment with 10.5 g of elemental calcium on serum total calcium concentrations in a mature Jersey cow with clinical milk fever (Goff, 1999).



Strategic Use of Oral Ca Boluses

- ▶ Early stage 1 milk cases
 - ▶ Cold ears, wobbly, triceps tremors, poor GI
 - ▶ One dose now, one dose 12 hours later
- ▶ After successful IV treatment of down cows
 - ▶ One dose after cow is up and swallowing, one dose -12 hours later
- ▶ Off feed early lactation cows
 - ▶ Cover for secondary hypocalcemia



Forms of Calcium for Oral Administration:

- ▶ Calcium chloride
- ▶ Calcium propionate
- ▶ Calcium carbonate
- ▶ Boluses of multiple calcium forms



Preventative Treatments With Use of Oral Ca Boluses

- ▶ Herds with hypocalcemia problems:
 - ▶ Clinical cases
 - ▶ Jerseys
 - ▶ No anionic salts
 - ▶ High prevalence of measured hypocalcaemia
 - ▶ Blanket supplementation 2+ lactation with oral Ca (2 doses)
- ▶ Herds without hypocalcaemia problems
 - ▶ Supplement lame and high previous lactation milk cows with oral Ca (2 doses)

Oetzel and Miller, J. Dairy Science, 95:7051, 2012



Non-Nutritional Factors

- ▶ Proper stocking density
- ▶ Avoiding excessive pen moves
- ▶ Segregating cows and heifers during transition period
- ▶ Heat abatement

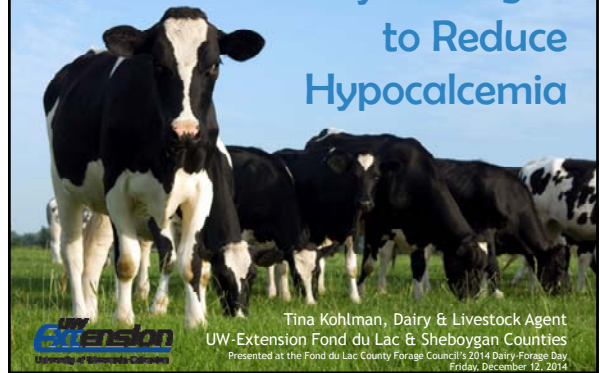


Five Key Principles

- ▶ Second-lactation and greater cows have a transient hypocalcemia around calving
- ▶ Hypocalcemia is linked to other fresh cow problems
- ▶ Supplementation with oral calcium is preferred approach for supporting cows exhibiting early signs of milk fever but still standing
- ▶ Subclinical hypocalcemia has greater associated costs to dairy than clinical cases
- ▶ Even herds with successful anionic salts programs and minimal cases of milk fever will benefit from strategic use of calcium supplements



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