**Effects of Nutrition on Prevalence and Severity of Mastitis**

**SCC: Potential Quality Bonus**

The effect of reducing mastitis on milk yield and components exceeds the quality bonus.

<table>
<thead>
<tr>
<th></th>
<th>200,000 SCC</th>
<th>500,000 SCC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk yield, lbs</td>
<td>82</td>
<td>78</td>
</tr>
<tr>
<td>Milk fat, %</td>
<td>3.5</td>
<td>3.2</td>
</tr>
<tr>
<td>Milk protein, %</td>
<td>3.20</td>
<td>3.17</td>
</tr>
<tr>
<td>$/day*</td>
<td>13.1</td>
<td>11.40</td>
</tr>
</tbody>
</table>

* Protein = $2.0/lb; fat = $2.6/lb (OH 2018)

**Potential Nutritional Link (TBD)**

- Diet carbs, protein, minerals ...
- Manure output
  - Manure fluidity
  - Manure chemistry
  - Manure pathogens
- Pathogen exposure at teat end

**Good Nutrition**

Optimal system and cell functions

Strong Host Defense

Healthier cows

Reduces immuno-suppressors

Good Nutrition

**Environmental Pathogens**

- Coliforms
- K.L. Smith

**Parturition: High Risk for Mastitis**

- Immuno-suppression
- Hypocalcemia
- Ketosis
- Overall low nutrient intake
- Negative energy balance
"Nutritional Immuno-suppression"

1. Diets that promote high NEFA
2. Diets that promote ketosis
3. Diets that promote hypocalcemia

Preventing Metabolic Diseases via Good Nutrition improves immune function

High NEFA reduces Lymphocyte and Neutrophil function

Fat cows have immuno-suppression (and high NEFA)

1. Fat cows NEFA
2. Lymphocytes from fat cows secrete IFN

Lacetera et al (2005)
JDS 88:2010

Bovine PMN Function Reduced with increased BHBA


Strategies to Reduce NEFA and Ketones in Dairy Cows

1. Avoid fat cows
   - Dry off and calve at 3.5 (or a little less)
   - Make NEL-first limiting in late lactation
   - Group cows based on BCS and milk
   - Have a good repro management system

2. Feed correct amount of energy to dry cows (~14 Mcal/day)
   - make sure cows are full (~12 kg DM/d)
   - ~1.2 Diet NEL (e.g., corn silage = 1.4)
   - must include lots of high fiber forage

2a. Feed Monensin during dry period
Large drop in DMI is associated with fatty liver and ketosis

Strategies to Reduce NEFA and Ketones in Dairy Cows

3. Get rapid increase in DMI post-calving
   - Low cow density (1.2 headlocks/cow)
   - Highly digestible forage
   - Moderate fiber (~30%) & starch (~24%)
   - Limit supplemental fat (<5% total fat)
   - High protein (SBM)

Hypocalcemia (milk fever) and mastitis

1. Epidemiological link (OR = 3 to 6X)
2. Pathogen exposure link (down cows)
3. Pathogen invasion link (sphincter)
4. Hormonal link (↑ cortisol)
5. Immune cell function link

Strategies to Reduce Hypocalcemia

First Choice:
- Easy: Mg (~0.3%) and vit D (~22 kIU/d)
- Usually easy: P (0.26 to 0.28%)
- Difficult: K (~1%) and Ca (<0.50%)

Second Choice:
Feed supplements to reduce DCAD

DCAD (mEq) = (Na + K) - (Cl + S)

- Very effective
- Requires a prefresh group
- May increase risk of ketosis
- Must be monitored (urine pH)
- Expensive

Oxidative Stress:

\[ [\text{ROS}] > \text{Required} \]
Sources of ROS
1. Breathing (its normal)
2. Enzymatic production via signals
3. Enzymatic production from inflammation/immune response

PMN: Activated ROS Synthesis
- Migration
- Phagocytosis
- O$_2$ Oxidative burst
- Cytotoxic compounds
- $O_2 \times 10^6$

Oxidative stress occurs in the periparturient period
and
Cows get sick in the periparturient period
Is there a link?

Why is Antioxidant Status Low in Periparturient Period?
1. Metabolism isn't ramped up yet
2. Low intake of nutrients
3. Transfer of nutrients to fetus/colostrum
4. ROS may initiate of parturition
5. Giving birth generates ROS

Antioxidant Nutrients
- Proper Supplementation
  - Vitamin A
  - B-carotene
  - Copper
  - Zinc
  - Selenium
  - Vitamin E
  - Reduce Mastitis

Selenium and Mastitis: Clinical Data
- Cows with inadequate Se status:
  - SCC
  - Prevalence of clinical mastitis
  - Duration of clinical mastitis
  - Severity of clinical mastitis
  - Consistent across the world with cows, sheep, goats, buffalos
**Selenium questions: What Type and How Much?**

*Inorganic vs Se-yeast*

*But no effect on PMN kill*

Weiss and Hogan, 2006 (JDS)

**Se-Yeast Increased Macrophage Function in Beef Calves** (Beck et al., 2005)

- Weaned calves, 200 kg
- Free choice supplement with selenite or Se-yeast
- Macrophage function affected by source
- Lymphocyte function not affected by source

**Determining Se adequacy (based on selenite/selenate)**

<table>
<thead>
<tr>
<th>Plasma</th>
<th>Whole blood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adequate</td>
<td>&gt;0.075</td>
</tr>
<tr>
<td>Marginal</td>
<td>0.05 to 0.075</td>
</tr>
<tr>
<td>Deficient</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

Based on mastitis and RFM

**Selenium Recommendations**

- All animals (calves, heifers, dry cows, lactating cows): 0.3 ppm
- Lactating cows: Usually mostly inorganic
- Dry cows: Portion as Se-yeast
- High sulfate water: Mostly Se-yeast

**Vitamin E and Mastitis: Clinical Data**

- 5 Studies: Improved mammary gland health
- 2 Studies: No effect
- 1 Study: Negative

Various studies (all confined cattle)
None vs. ~1000/500
None vs high at transition
~500 vs extra at transition
3000 during dry period
Periparturient Cows

- Vitamin E in prefresh mastitis (3 studies)
- Colostrum DMI Utilization

Weiss et al., 1990
Kehrli, 2002

Vitamin E and Periparturient Cows

- Vitamin E in prefresh mastitis
  - (3 studies)

Weiss et al., 1997
Baldi et al., 2000

Clinical Mastitis and Vit E
3000 IU/day in dry period

Bouwstra et al., 2010

Vitamin E Recommendations

- Lactating cows: ~500 IU/d
- Far-off dry cows: ~1000 IU/d
- Prefresh: 2000 to 4000 IU/day

Grazing cattle need much less

Copper (NRC + SF = ~15-18 ppm total diet)

Feed Enough!
- Reduced mastitis
- Improved immunity
- Reduced RP

Don’t feed too much!
- Real world toxicity (i.e., death)
- Accumulation of liver Cu

Copper deficient animals have suppressed neutrophil function

Phagocytosis (n = 5)  Kill (n = 8)
Copper: Lots of Real World Antagonists

1. High Sulfur (Check water !)
2. High reduced Fe (water)
3. Grazing (soil ingestion)
4. High Mo

NRC assumes minimal antagonism: Real world situations justify increased Cu

Copper & Zinc Recommendations

Copper
- Approximately 15 ppm total diet
- Some organic if high sulfate, Mo, DDGS

Zinc
- Approximately 80 ppm total diet
- Consider some organic

Vitamin A and B-carotene

Vitamin A: ~90,000 IU/day
Less if grazing

B-carotene: Expensive (500 mg/day)
Likely not profitable
Consider if very low quality hay in dry and prefresh

Good nutrition can reduce mastitis and improve milk quality:

1. Prevent metabolic diseases
2. Feed adequate (not excessive) antioxidant
3. Feed for high intakes

But good nutrition is only one part of a mastitis control program

Hygiene, teat dipping, culling, vaccination, bedding, . . .