Effects of Nutrition on Prevalence and Severity of Mastitis

THE OHIO STATE UNIVERSITY
COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES

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SCC: Potential Quality Bonus

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

	200,000 SCC	500,000 SCC
Milk yield, lbs	82	78
Milk fat, %	3.5	3.2
Milk protein, %	3.20	3.17
$/day*	**13.1**	**11.40**

Derived from Harmon, 1994

* 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

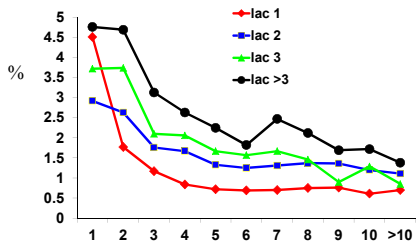
Strong Host Defense → Healthier cows

Reduces immuno-suppressors

Good Nutrition

Environmental Pathogens

Coliforms



K.L. Smith

Parturition: High Risk for Mastitis

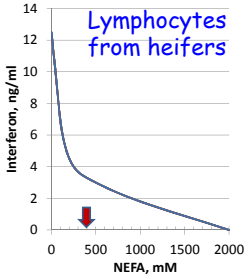
- Immuno-suppression
- Hypocalcemia
- Ketosis
- Overall low nutrient intake
- Negative energy balance

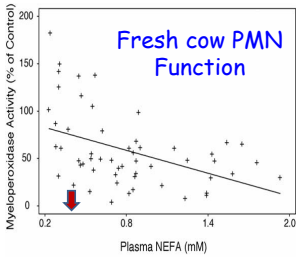
"Nutritional Immuno-suppression"

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

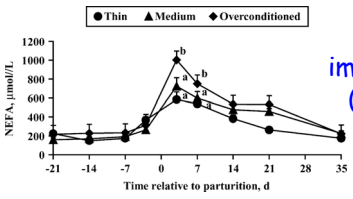
High NEFA reduces Lymphocyte and Neutrophil function





Lacetera et al., 2004

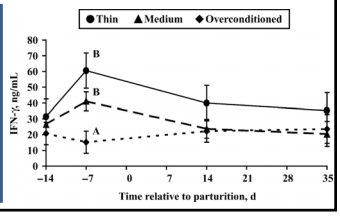
Hammon et al., 2006



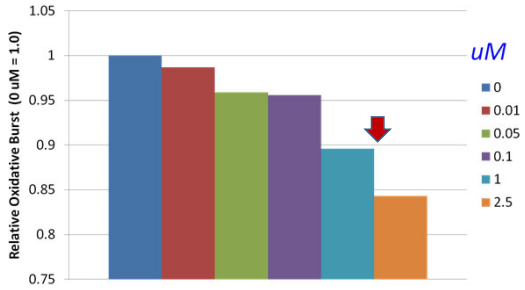
Fat cows have immuno-suppression (and high NEFA)

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



Hoeben et al (1997) Vet Immunopath 58:165

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

Strategies to Reduce NEFA and Ketones in Dairy Cows

2. Feed correct amount of energy to dry cows (~14 Mcal/day)

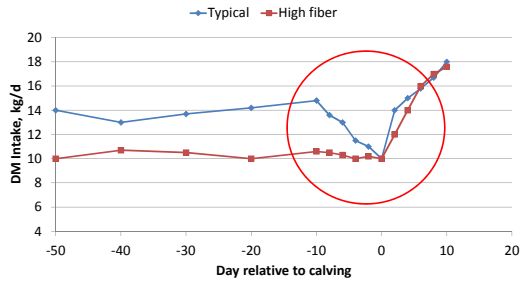
-make sure cows are full (**~12 kg DM/d**)

- ~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

-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%)

First Choice:
Easy stuff + Ca as close as possible and K as low as possible + use Mg sulfate

Strategies to Reduce Hypocalcemia

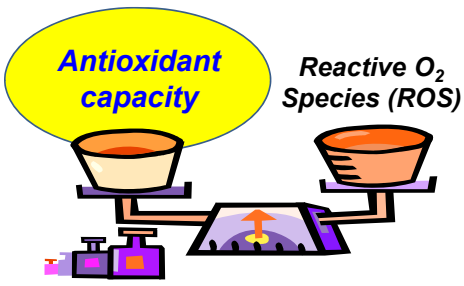
Second Choice:
Feed supplements to reduce DCAD

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:

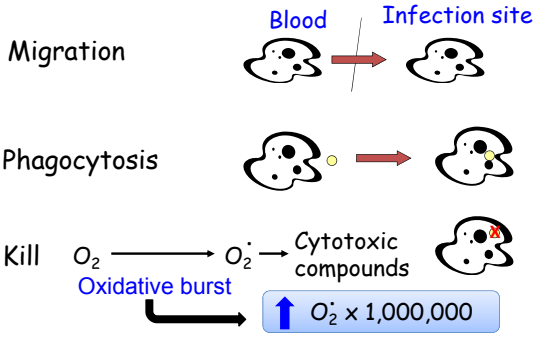
[ROS] > Required



Sources of ROS

1. Breathing (its normal)
2. Enzymatic production via signals
3. Enzymatic production from inflammation/immune response

PMN: Activated ROS Synthesis



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

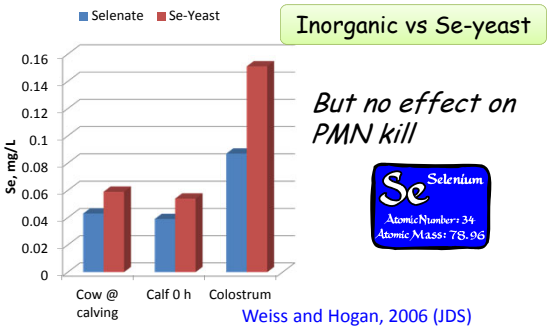
Cows with inadequate Se status:

- ↑ 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 ?



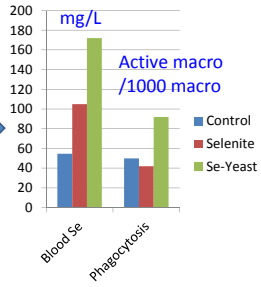
Inorganic vs Se-yeast

But no effect on PMN kill

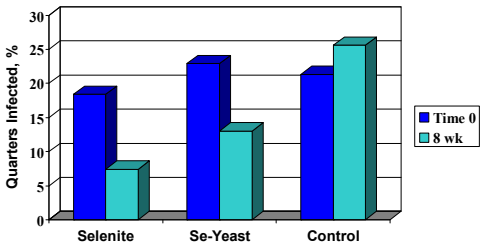
Weiss and Hogan, 2006 (JDS)

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



Selenite vs Se-yeast : Mammary Gland Health



Malbe et al., 1995

Determining Se adequacy (based on selenite/selenate)

	Plasma	Whole blood
Adequate	>0.075	>0.175
Marginal	0.05 to 0.075	0.13 to 0.175
Deficient	<0.05	<0.13

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**

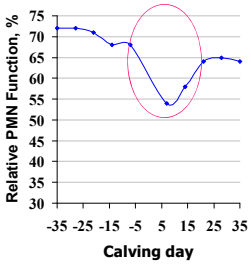
Vitamin E and Mastitis: Clinical Data

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

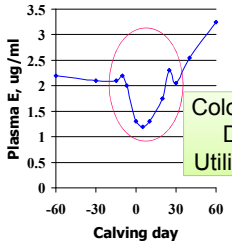
Various studies (all confined cattle)
None vs. ~1000/500
None vs high at transition
~500 vs extra at transition
3000 during dry period

Periparturient Cows

⬆ E in prefresh ⬇ mastitis
(3 studies)



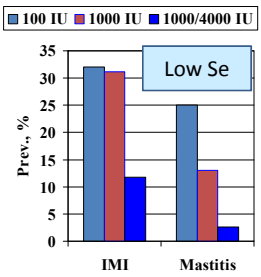
Kehrli, 2002



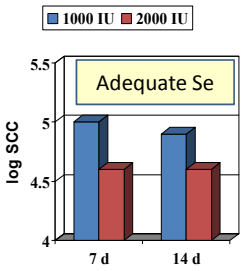
Colostrum
DMI
Utilization

Weiss et al., 1990

Vitamin E and Periparturient Cows



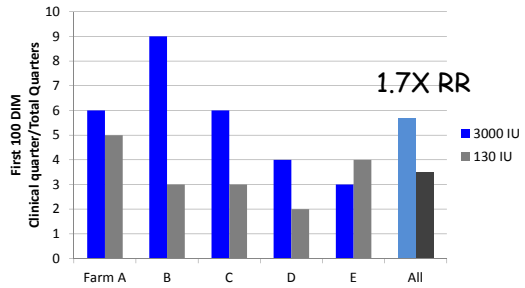
Weiss et al., 1997



Baldi et al., 2000

Clinical Mastitis and Vit E

3000 IU/day in dry period



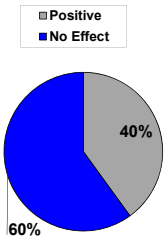
Bouwstra et al., 2010

Vitamin E Recommendations

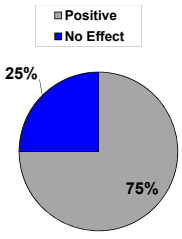
- **Lactating cows**: ~500 IU/d
- **Far-off dry cows**: ~1000 IU/d
- **Prefresh**: 2000 to 4000 Iuday

Grazing cattle need much less

Copper deficient animals have suppressed neutrophil function



Phagocytosis (n = 5)



Kill (n = 8)

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

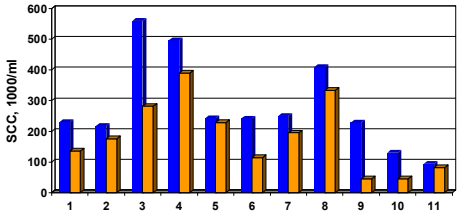
Copper: Lots of Real World Antagonists

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

Zn-Met and SCC

Zn source and amt confounded in many studies



Meta analysis: -98 (P < 0.01)

Kellogg et al., 2004

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) antioxid
3. Feed for high intakes

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

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

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