MASTITIS

PART 2
# MILK COMPOSITIONAL CHANGES DURING MASTITIS

<table>
<thead>
<tr>
<th>Increased</th>
<th>Decreased</th>
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<tbody>
<tr>
<td>SCC</td>
<td>Production</td>
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<tr>
<td>Na</td>
<td>α-lactalbumin &amp; Lactose</td>
</tr>
<tr>
<td>Cl</td>
<td>Casein</td>
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<tr>
<td>Whey protein</td>
<td>K</td>
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<td>(e.g. serum albumin, Ig, lactoferrin)</td>
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MILK LOSS

Graphs showing milk yield changes (kg/day) for 1st and 2nd+ lactation cows over weeks relative to the occurrence of clinical mastitis. The graphs compare milk yield changes for different bacterial species: Strep. species, Staph. aureus, Staph. species, E. coli, and Klebsiella species.
LACTOFERRIN

- Iron-binding protein with antibacterial properties
- Minor whey protein in normal milk
- Unique in that the mammary gland increases production of lactoferrin when other milk proteins are decreasing (casein, α-lactalbumin, etc.) during inflammation
- Same thing happens in involution
- Also found in PMNs
WHAT HAPPENS TO HIGH SCC MILK?

- Too many higher-than-legal limit tanks will cut off farmer from selling Grade A milk
- Will go to cheese
WHAT DOES MASTITIS CHANGE?

• Also decreases:
  – Shelf life
  – Taste
  – Casein production
  – Cheese yield

• Should high SCC milk go to cheese??
WHAT HAPPENS IF TANK HAS ANTIBIOTICS IN IT?
DETECTION = DIAGNOSIS
DIAGNOSIS
DIAGNOSIS
DIAGNOSIS
GRAM STAINING

**GRAM-POSITIVE**

- Fixation
- Crystal Violet
- Iodine Treatment
- Decolorisation
- Counter stain with Safranin

**GRAM-NEGATIVE**
**Gram-Positive Bacterial Cell Wall**

- Lipoteichoic Acid
- Peptidoglycan Cell Wall
- Plasma Membrane

**Gram-Negative Bacterial Cell Wall**

- Outer Lipid Membrane
- Peptidoglycan Plasma Membrane

**Molecular Structures**

- Alternating copolymer of β(1→4)-N-acetyl-D-glucosamine and N-acetyl muramic acid
- Pentaglycine cross-link
- L-Ala-D-Glu-L-Lys-D-Ala tetrapeptide
Staphylococcus Vs Streptococcus

Catalase Test

Positive

Negative
WHY DO WE NEED TO DIAGNOSE?

• SCC and clinical information combined with culture results are best
  – Gives the whole story

• Without knowing what pathogen is causing the problem, won’t know what the solution is (e.g. treatment or monitoring)

• Without knowing what pathogen is causing the problem, won’t know what prevention methods should be improved (e.g. culling or cleaning)

• Understanding mastitis for some cows in herd helps understanding mastitis risk/relationship in whole herd
TYPES OF MASTITIS

- Environmental
- Clinical
- Opportunistic
- Contagious
- Subclinical
Mastitis Types

- Contagious
  - Spread from cow to cow

- Environmental
  - Growing in the environment and then contacts teats

- Opportunistic
  - Live on teat skin normally, but take advantage of compromised immune system
CONTAGIOUS PATHOGENS

• *Staphylococcus aureus*
  – Most common
  – Difficult to treat

• *Streptococcus agalactiae*
  – Used to be #1 cause of mastitis
  – Now eradicated in most dairy herds
  – Very susceptible to antibiotics = relatively easy to get rid of

• *Mycoplasma*
  – Difficult to diagnose and treat
  – More common in western US
  – 10% of herds have it, but less than 1% of all cows
STAPHYLOCOCCUS AUREUS

• Gram positive
• Cocci
• In pairs & tetrads
STAPH AUREUS

• All staph are gram positive so how do we know it’s Staph aureus?
• Zone of Hemolysis
• Coagulase positive
STAPH AUREUS

• Produce toxins that destroy cell membranes and directly damage milk-producing tissue
• Leukocytes are attracted to the area and attempt to fight the infection
• Initially, the bacteria damage the tissues lining the teats and gland cisterns within the quarter, which eventually leads to formation of scar tissue
• The bacteria then move up into the duct system and establish deep-seated pockets of infection in the alveoli
STAPH AUREUS

• Abscesses form that wall-off the bacteria to prevent spread but allow the bacteria to avoid detection by the immune system
  – Abscesses prevent antibiotics from reaching the bacteria and are the primary reason why the response to treatment is poor

• BUT bacteria can also escape the killing effects of some antibiotics by hiding in PMNs

• As the PMNs attempt to remove bacteria, many organisms survive and become dormant within them, preventing contact with antibiotics

• When PMNs die, bacteria are released to resume the infection process

• Destruction of alveolar and ductal cells reduces milk yield
STAPH AUREUS

• Damaged cells may combine with leukocytes and clog ducts, contributing to further scar tissue formation, occlusion of ducts, and further decreased milk production

• Ducts may reopen at a later time, but this usually results in bacterial release to other areas of the mammary gland

• Spread within the gland results in the formation of additional abscesses that can become quite large and detectable as lumps within the udder
ENVIRONMENTAL PATHOGENS

- *Escherichia coli*
- *Klebsiella*
- Environmental streptococci (*Strep uberis* and *Strep dysgalactiae*)

- Grow rapidly and readily in bedding
COLIFORMS

Includes:
- *E. coli*
- *Klebsiella* species
- *Enterobacter* species
- *Citrobacter* species

- Gram negative
- Bacilli (rods)

- Can cause severe peracute infections
**ESCHERICHIA COLI**

- Large, gray colony
- Fecal odor

MacConkey agar:
- Pink & dry
KLEBSIELLA

- Large, gray-brown colony
- Mucoid
- Fecal odor

MacConkey agar:
- Pink-orange, mucoid
STREPTOCOCCUS SPP.

- Gram positive
- Cocci
- In chains
STREPTOCOCCUS DYSGALACTIAE

• Small, gray colony
• α hemolysis (green)
• Catalase –
STREPTOCOCCUS UBERIS

- Small, gray colony
- No hemolysis
- Catalase –
GRAM-POSITIVE COCCI

- *Staphylococcus* species
  - Catalase positive

- *Streptococcus* species
  - Catalase negative
OPPORTUNISTIC

• Coagulase negative staphylococci (CNS)
• More than 40 species
  – Examples: *Staph epidermidis*, *Staph saprophyticus*, *Staph hyicus*, etc.
  – Not *Staph aureus*
• Naturally on (“clean”) teat skin, hands, etc.
  – Not harmful until it gets into teat
OPPORTUNISTIC

- Take advantage of compromised immune system or teat blemishes
- Cause infection in the absence of proper teat disinfection
- Mainly subclinical, and the few clinical cases are typically mild
- SCC increase is usually not great and there is little or no impact on milk production

Staph epidermidis in humans
NOT HARMFUL UNLESS GET UP STREAK CANAL
CAN WE GET RID OF MASTITS?
DEFENSE MECHANISMS

• First line of defense is teat skin
  – Keep it healthy and clean!

• Once bacteria enters, the only defense is the immune system
  – Leukocytes (mostly PMNs) phagocytize bacteria

• Prevention > Treatment
PROTECT THE TEATS!
HOW DO WE PREVENT IT?
Method of transmission

- Healthy udder
- Infected quarter
- Test lesion
- Hands
- Cloths
- Machine

Between milkings:
- Environment:
  - Manure
  - Contaminated bedding
  - Soil
  - Water

During milking:
- Air admission in milking unit
- Wash cloth
- Hands

Infected quarter or test lesion
NMC 10 STEP PLAN

- Establish goals for udder health
- Maintain clean, comfortable environment
- Proper milking procedures
- Proper maintenance and use of milking equipment
- Good record keeping
- Appropriate management of clinical mastitis
- Effective dry cow treatment
- Maintenance of biosecurity and culling chronically infected cows
- Regular monitoring of udder health status
- Periodic review of mastitis control program
MASTITIS CONTROL PRACTICES

• Reduce bacteria level at teat end
  – Clean, dry area for cows to lie down
  – Clean, dry teats being milked = good milking practices

• Keep cows comfortable
  – Avoid heat stress
  – Access to a good ration and water

• Cull cows if necessary

• Treat what’s treatable (unless organic)
  – https://www.youtube.com/watch?v=vdycrWv2rQs&list=PL2VM-bB_ggVK62CXIQQI-ORdHptJspEEFK&index=19&nohtml5=False

• Dry cow therapy
CONTAGIOUS PREVENTION
MILKING PROCEDURE

- Strip
- Pre-Dip
- Dry
- Attach
- Detach
- Post-Dip

- Steps 1 and 2 can be reversed but no others can
MILKING PRACTICES

• One cloth or paper towel per cow
  – Cloth towels need to be cleaned properly between cow milkings (hot water with detergent, bleach, drying)

• Wear disposable gloves

• Avoid overmilking

• Use pre- and post-dip

• Milk sick cows last, especially those with contagious mastitis
OVERMILKING

Absence of milk flow allows entry of milk droplets.

Reverse flow of milk droplets.
GOOD OR BAD?

• https://www.youtube.com/watch?v=GslHu-k_lz4&ebc=ANyPxKqixxAknpDeM5GoJH8im9FVnwWuaKjiy4hVqGa2Aohg6oQjxLP7Z7NTEpMbjlQUoqBzlIEIpN7ismNSmLWMH0fj5IL5BA&nohtml5=False

• https://www.youtube.com/watch?v=mBgon39usbQ&nohtml5=False
ENVIROMENTAL PREVENTION
KEEP COWS CLEAN AND DRY
WHO DOES THIS AFFECT?

• Environmental mastitis is most common in low SCC herds
BEDDING OPTIONS

- Sand
- Sawdust
- Straw
- Pasture
COLIFORM BACTERIA IN BEDDING

4X more coliform mastitis

NIRD, 1984
COMPOST BEDDED PACKS
TOXINS

• Lipopolysaccharides (LPS) are large molecules consisting of a lipid and a polysaccharide
  – Aka endotoxins
  – Found in outer membrane of Gram-negative bacteria
  – Elicit strong immune response

• Environmental infections tend to hit hard and fast

• When pathogens die and toxins are released, cow can become “toxic” and die
COLIFORM VACCINES

- J-Vac, J-5, Endovac-Bovi
- Reduces clinical severity
- Needs to be administered to manufacturer recommendations
- Does not override good management
RATE OF COLIFORM IMI

![Graph showing the rate of coliform IMI](image)

- **Dry** period: 60 days
- **Lactation** period: 305 days

The graph indicates a higher rate of coliform IMI during the lactation period (305 days) compared to the dry period (60 days).
RATE OF STREPTOCOCCAL IMI

Smith et al., 1985
DON’T FORGET DRY COWS OR CALVING AREAS!

I’m starting to think this was a bad idea…
THE DRY PERIOD IS VERY IMPORTANT!!

Why??
RISK PERIODS
DRY COW THERAPY

- Mainly contagious pathogen protection
- Treat all quarters of all cows with longer acting antibiotic specifically made for dry cows
- Clean teats before inserting
- Works best with an internal teat sealant (e.g. Orbeseal)
  - Acts as a really good keratin plug
  - Prevents bacteria from moving into teat canal

https://www.youtube.com/watch?v=MS4cnZ8N43Y&nohtml5=False
KEYS FOR ALL MASTITIS

- Key to lower SCC is control of mastitis
- Key to control of mastitis is PREVENTION
Daisy: I was artificially inseminated this morning
Dolly: I don't believe you
Daisy: It's true; no bull!