Preventing Identifying and Treating Mastitis in Small Ruminant Dairy Animals

Katherine Gottwald
PhD Student, Animal Science
QMPS Assistant

What Is QMPS?
(Quality Milk Production Services)
- Established in 1946
- Formerly known as the New York State Mastitis Program
- Part of the Animal Health Diagnostic Laboratory at Cornell University

The mission of QMPS is to meet the needs of producers, veterinarians, and the dairy industry through integrated on-farm service, diagnostics, education, and research

Identifying, Treating, and Preventing Mastitis in Small Ruminants

Objectives
- Mastitis-The Disease and Costs
- Somatic cells and their effects
- Mastitis Pathogens and Management
- Mastitis pathogenesis
- Milk quality measurements
- Mastitis Prevention
Mastitis Definitions
Intramammary Infections

Inflammatory Definition
-mast: mammal 'breast' or 'mammary'
-it is: inflammatory diseases

Clinical Definition

Bacterial Definition

Economic Definition

Cost of Mastitis

<table>
<thead>
<tr>
<th>Cost Type</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical Mastitis</td>
<td>$293/case</td>
</tr>
<tr>
<td>Subclinical Mastitis</td>
<td>$78/goat/year</td>
</tr>
</tbody>
</table>

Mastitis Pathogenesis
Intramammary Infections

Mastitis...
A pathogen party in the udder

Macrophages recognize pathogens

Pathogen-associated molecular patterns (PAMP)
Somatic Cell Migration

Electrical Conductivity
Further investigation – clinical signs, CMT, SCC are necessary, but signal can be very helpful.

Measurements of Milk Quality

- Bacterial Counts
  - Standard Plate Count (<100,000 cfu/ml)
  - Pre-incubation Count
  - Laboratory Pasteurized Count
- Somatic Cell Counts (<1,500,000 cells/mL - goats)
- Antibiotic Residues & Inhibitors
- Sediment
- Added Water

Bacteria Counts
- Standard Plate Count
  CFU/ml of aerobic bacteria (32°F, <100,000 cfu/ml)
  Cleaning (equipment, teats), cooling, mastitis
- Pre-incubation Count
  CFU/ml of bacteria at cool temperatures (50°F, <50,000,000 cfu/ml)
  Equipment sanitizing, cleaning, hot water, rubber parts,
- Lab Pasteurized Count
  CFU/ml of thermophilic bacteria (140°F, <100-200 cfu/ml)
  Sporeforming bacteria, environment, equipment cleaning, animals
- Coliform Count
  CFU/ml of coliform bacteria, (<10-50 cfu/ml)
  milking procedures, environmental hygiene, animal hygiene

Effect of Somatic Cells on Milk

Studies show that sheep milk with a SCC>1,000,000 decreases the cheese yield and increases the development of rancid flavors in the cheese (Jaeggi, 2001).

Effect of Somatic Cells on Milk/Product Quality

<table>
<thead>
<tr>
<th>Trait</th>
<th>Mean</th>
<th>Low 95%</th>
<th>High 95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fat (%)</td>
<td>3.15</td>
<td>2.90</td>
<td>3.40</td>
</tr>
<tr>
<td>Protein (%)</td>
<td>3.00</td>
<td>2.80</td>
<td>3.20</td>
</tr>
<tr>
<td>Non-Fat Solids (%)</td>
<td>4.00</td>
<td>3.80</td>
<td>4.20</td>
</tr>
<tr>
<td>Pasteurized Coliform (%)</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Pasture Pasteurized (%)</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Pasteurized Amid (%)</td>
<td>1.00</td>
<td>0.80</td>
<td>1.20</td>
</tr>
<tr>
<td>Sediment (%)</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Note: All values are reported in g/L or mg/L.
Cellular Immune System
Somatic Cells in Milk

<table>
<thead>
<tr>
<th>Cell type</th>
<th>Normal milk</th>
<th>Mastitis milk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total cells</td>
<td>&lt; 100,000</td>
<td>&gt;&gt; 250,000</td>
</tr>
<tr>
<td>Leucocytes</td>
<td>&gt;85%</td>
<td>&gt;99%</td>
</tr>
<tr>
<td>Macrophages</td>
<td>35%</td>
<td>99-100%</td>
</tr>
<tr>
<td>PMNs</td>
<td>25%</td>
<td>99-100%</td>
</tr>
<tr>
<td>Lymphocytes</td>
<td>25%</td>
<td>99-100%</td>
</tr>
<tr>
<td>Epithelial cells</td>
<td>&lt;15%</td>
<td>&lt;1%</td>
</tr>
</tbody>
</table>

Sources of Differences in Somatic Cells
- Immune Responses to infections
- Parity
- Stage of lactation
- Season
- Milk yield
- Stress
Breed Differences in Goat Somatic Cell Count

Regional Differences in Goat Somatic Cell Count

Somatic Cell Count

California Mastitis Test (CMT)
SQUIRT...

SLURP...
...equal parts CMT solution and milk

SWIRL...
...for 10 – 20 seconds.

California Mastitis Test

<table>
<thead>
<tr>
<th>Level</th>
<th>CMT Cells/ml</th>
</tr>
</thead>
<tbody>
<tr>
<td>N (negative)</td>
<td>0 – 200,000</td>
</tr>
<tr>
<td>T (trace)</td>
<td>150,000 – 500,000</td>
</tr>
<tr>
<td>1 (Weak Pos)</td>
<td>400,000 – 1,500,000</td>
</tr>
<tr>
<td>2 (Positive)</td>
<td>800,000 – 5,000,000</td>
</tr>
<tr>
<td>3 (Strong Positive)</td>
<td>&gt; 5,000,000</td>
</tr>
</tbody>
</table>

How Do We Determine What Organisms Are Causing Mastitis?

Bulk Tank Screening

Individual Animal Samples
### Aseptic Milk Sampling
- Use 70% alcohol
- Gauze must be moist, not soaked
- Allow teat to dry 15 seconds before sampling

### Common Mastitis Pathogens
- **Contagious Agents**
  - *Escherichia coli*
  - *Enterobacter aerogenes*
  - *Klebsiella sp.*
  - *Streptococcus dysgalactiae*
  - *Streptococcus uberis*
  - *Staphylococcus sp.*
  - *Pseudomonas aeruginosa*
  - *T. pyogenes*
  - *Serratia*
  - *Pasteurella*
  - *Proteus*
- **Yeast**
  - *Staphylococcus aureus*
  - *Streptococcus agalactiae*
  - *Mycoplasma bovis*

### Major Pathogens
- *Some response to treatment*

### What should you examine to prevent mastitis?
- Average claw vacuum at peak flow
- Pulsation under load
- Unit alignment scoring
- Milking routine timing
- Milk flow rate analysis
- Milking efficiency and throughput timing
- Strip yields
- Teat scoring
- Teat-end cleanliness
- Udder cleanliness

### Mastitis Management
- There are no intramammary antibiotics that are labeled for use in sheep or goats for the treatment of mastitis. Therefore, all treatment of mastitis for sheep and goats is considered extra-label and must be done on the advice and under the supervision of a veterinarian. Extra-label is the use of any drug that is used for something that is not specifically labeled on the label and is only permitted under the written orders of a veterinarian. Does and ewes with clinical mastitis can be very ill and often require other supportive care. The use of intramammary dry off treatment can help with treatment of mastitis during the dry period but must be done under the direct recommendation and supervision of a veterinarian as there are no dry treatment antibiotics labeled for sheep and goats.

### Selective Dry Treatment
- 72.5-79% cure rates of infected quarters with dry treatment
- Selective dry treatment recommended
- Blanket treatment recommended if high prevalence of subclinical mastitis (>30-40%)
Main Equipment Components

• The Six Basic Parts of a Milking Machine
  – Vacuum Pump
  – Regulator or Controller
  – Receiver/bucket
  – Pulsator
  – Milking units (claw, cups and inflations)
  – Vacuum Lines

Basic Machine Function

Differential vacuum between claw and pipeline vacuum moves milk through the long milk tube to milk line.

Air vent lowers vacuum in claw relative to milk tube.

Air pushes milk to milk line in a slug up the long milk line.

Basic Machine Function

• Milk flows in milk line by gravity, not air movement
• Milk line must have a slope of 1% to get the milk to flow to the receiver jar.
• Once in Receiver Jar, milk is pumped across into the Bulk Tank, going from the vacuum to atmospheric pressure.

Basic Machine Function

• Vacuum line from the bucket is plugged into a vacuum source.
• Vacuum is placed on the bucket system to operate the pulsator and apply vacuum to the milking unit(s).

Basic Milking Machine Function

• Vacuum removes milk from teat.

Vacuum differential =

The pressure difference between pressure in the teat and vacuum level in inflation

Positive Pressure inside teat

Vacuum inside inflation

Basic Milking Machine Function

• Vacuum removes milk from teat.

If we kept the vacuum constant in the claw for all of the milking, what would happen?
Basic Milking Function

- Vacuum removes milk
  
  Teats would swell due to tourniquet effect, and milk flow stops.

Teat-end Vacuum Levels

<table>
<thead>
<tr>
<th>System</th>
<th>Vacuum Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Line System</td>
<td>34-36 kPa (10.05-10.6&quot; Hg)</td>
</tr>
<tr>
<td>Bucket System</td>
<td>44-48 kPa (12.9-14.0&quot; Hg)</td>
</tr>
<tr>
<td>High Line System</td>
<td>36-38 kPa (10.6-11.2&quot; Hg)</td>
</tr>
</tbody>
</table>

Sheep & Goat Milking System Characteristics

- Pulsation rate: 90-120 pulsations/minute
- Pulsation ratio: 60:40
- 40 kPa/11.8" Hg

People factors on Milk Quality

Components of Udder Prep

- Cleaning teats
- Pre-dip
- Fore-strip
- Drying / Wiping
- (Attachment)
- Post-dip
Components of Udder Prep

• Cleaning teats
  – Removes debris and bacteria
  – Releases oxytocin
  – Disinfect
  • Pre-dip
  • Udder wash
• Pre-dip
  – Reduces new infections by 50%
  – Pre-dip better coverage compared to spray

Components of Udder Prep

• Forestripping
  – Milk quality
  – Intervene more rapidly
  – Stimulate milk letdown
• Drying
  – Disinfects
  – Reduce the risk of liner slips/squawks
  – Focus on the teat end
• Post-Dip
  – Reduces new cases of mastitis by ~50%
  – >75% coverage is necessary

Udder Preparation

Min 15 sec
STIMULATION TIME
Strip Pre-dip Wipe Attach
[clean & dry]

Although the cisternal compartment stores most of the milk produced in small ruminants, the alveoli retains the majority of the milk fat secreted, which can be only efficiently removed when milk ejection occurs (McKusick et al., 2002).

Animal factors on Milk Quality

• Influenced by several factors:
  – Effects of milking equipment
  – Mechanical forces exerted by vacuum & liner forces.
  – Milking Management
  – Teat dip, over milking
  – Environment
  – Weather,
  – Goat Factors
  – Risk of New Intramammary Infections

Teat Condition

Teat End Scoring: Normal

Photo: Utrecht University, Drs A. de Man, Dr Y.H. Schukken & Drs J.P. Koeman
**Impact of Teat Lesions**

- Increased risk for infection  
  – Elevated SCC & Clinical Mastitis
- Decreased milk yield
- Increased milking time

**Score Sheet**

<table>
<thead>
<tr>
<th>HERD</th>
<th>Full Bone Dairy</th>
<th>DATE</th>
<th>SCORER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>12/24/08</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
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</table>

**Teat End Lesion Score Sheet**

<table>
<thead>
<tr>
<th>ID</th>
<th>Quarter</th>
<th>LF</th>
<th>RF</th>
<th>FR</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1268</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>1221</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
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</tr>
<tr>
<td>1262</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Teat Cleanliness Score**

<table>
<thead>
<tr>
<th>Score 1</th>
<th>Score 2</th>
<th>Score 3</th>
<th>Score 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Udder Hygiene Scoring Card**

- Score 1: Very Rough Ring
- Score 2: Rough Ring
- Score 3: Rough
- Score 4: Clean

**Description**

- Score 1: Very Rough Ring  
  - A teat end lesion with roughened tissue  
  - Increased risk for infection
- Score 2: Rough Ring  
  - A teat end lesion with reduced tissue  
  - Decreased milk yield
- Score 3: Rough  
  - A teat end lesion with normal tissue  
  - Increased milking time
- Score 4: Clean  
  - A teat end lesion with normal tissue  
  - No risk for infection
Questions?