Post Milking Teat Disinfection

Prevention of Contagious and Environmental Mastitis

TCH Animal Health LLP

tomhemling@gmail.com
Tom Hemling, Ph.D.

• President & CSO
  • TCH Animal Health, LLP
  • Innovation & Education

• 24 years Global Director - DeLaval
  • R&D, Technical Service, Regulatory and Quality Assurance
  • Trials and training across the Globe

• National Mastitis Council
  • 10 years Chair of Teat Dip/Teat Health Committee
  • >100 published articles or conference papers
Teat Disinfection for Mastitis Prevention

• Dairy Industry & Teat disinfection – Does it work
  • Global situation

• Contagious Mastitis & Prevention
  • Post milking disinfection: Germicides & Skin Conditioning

• Environmental Mastitis: Barrier Teat disinfectants

• Residues?

• Fly Repellent

• Application Methods
5-Point Plan

1. **Disinfect all teats after every milking**
2. **Treat all cases of mastitis promptly and record data**
3. **Use dry cow treatment on all cows**
4. **Cull all cows with 3 or more cases**
5. **Maintain milking machine properly**

*Teat Disinfection: The most important 1 second of the milk extraction process regarding impact on mastitis, milk quality and cow longevity”*

Hemling. 2014, NMC
Teat Disinfection Works!
- UK Data: same trend globally

- National SCC
- Clinical Infections
- Major Pathogens

TCH Animal Health LLP

tomhemling@gmail.com
US: SCC downward trend

- Farms are getting larger
- SCC is declining
- Milk production increasing
- 76 lb. = 34.5 kg/day

<table>
<thead>
<tr>
<th>Year</th>
<th>Cows per herd</th>
<th>Average daily milk yield</th>
<th>Average SCC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>50</td>
<td>65</td>
<td>304</td>
</tr>
<tr>
<td>2000</td>
<td>73</td>
<td>69</td>
<td>316</td>
</tr>
<tr>
<td>2005</td>
<td>90</td>
<td>71</td>
<td>296</td>
</tr>
<tr>
<td>2010</td>
<td>145</td>
<td>73</td>
<td>228</td>
</tr>
<tr>
<td>2011</td>
<td>155</td>
<td>73</td>
<td>217</td>
</tr>
<tr>
<td>2012</td>
<td>162</td>
<td>74</td>
<td>200</td>
</tr>
<tr>
<td>2013</td>
<td>168</td>
<td>75</td>
<td>199</td>
</tr>
<tr>
<td>2014</td>
<td>177</td>
<td>76</td>
<td>200</td>
</tr>
</tbody>
</table>

Annual trend: 7.0*** 0.5*** -7.0***
Quality Milk from Large Herds

• Higher production

• Lower SCC

<table>
<thead>
<tr>
<th>Herd size (cows)</th>
<th>daily milk yield (lb)</th>
<th>SCC (cells/ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;50</td>
<td>63.3</td>
<td>242</td>
</tr>
<tr>
<td>50 - 99</td>
<td>68.7</td>
<td>228</td>
</tr>
<tr>
<td>100 - 149</td>
<td>71.4</td>
<td>218</td>
</tr>
<tr>
<td>150 - 199</td>
<td>73.7</td>
<td>213</td>
</tr>
<tr>
<td>200 - 299</td>
<td>75.9</td>
<td>205</td>
</tr>
<tr>
<td>300 - 499</td>
<td>79.2</td>
<td>197</td>
</tr>
<tr>
<td>500 - 999</td>
<td>81.1</td>
<td>192</td>
</tr>
<tr>
<td>1000 - 1999</td>
<td>81.7</td>
<td>185</td>
</tr>
<tr>
<td>2000 - 2999</td>
<td>79.3</td>
<td>187</td>
</tr>
<tr>
<td>&gt;3000</td>
<td>76.2</td>
<td>183</td>
</tr>
<tr>
<td>All herds</td>
<td>76.2</td>
<td>200</td>
</tr>
</tbody>
</table>
Dairy Industry Today: Increased pressure on mastitis prevention

• Small to larger farms + confinement: >_infection pressure_
  ✓ Automation: AMS; Teat Spray Robot
  ✓ Rotaries and very large parlors
  ✓ Multiple robots (VMS) on large farms
  ✓ Risk of increased environmental mastitis

• **Reduce antibiotics: lactation and dry cows!**

• **Change in Global supply**
  • Elimination of quotas
  • More milk in international trade
    • Powder, IMF, ESL, UHT-Aseptic

• **Consumer demand for wholesome food**
  • Organic, Fresh, Local, residue free

• **Sustainability: across the supply chain**
  ✓ On-farm issues: Effluent – nitrogen: Europe, NZ, US
  ✓ Residues:
    ✓ *Use the lowest level of germicide that is effective*
7 5-Point Plan -Today

1. **Disinfect all teats after every milking**

2. Treat **all** cases of mastitis *once bacteria is determined* and record data

3. Use dry cow **treatment** teat sealant on all cows & selectively use dry cow therapy

4. Cull all cows with 3 or more cases

5. Maintain milking machine properly

6. *Milk a clean, dry, disinfected teat*

7. *Use technology/nutrition to improve immunity*
Teat Disinfection = prevention
Break the Cycle of Infection

Non-infected cows

Cows with mastitis

Control Environmental and Contagious

Use the appropriate teat dips

Reduce demand on antibiotic treatment and residue risk

Self-cure / antibiotics
# Mastitis Pathogens

Teat disinfectant to deal with today’s pathogens?

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Gram</th>
<th>Cont / Env</th>
<th>Major/ Minor</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Staph. aureus</em></td>
<td>+</td>
<td>C</td>
<td>Major</td>
</tr>
<tr>
<td><em>Strep. agalactiae</em></td>
<td>+</td>
<td>C</td>
<td>Major</td>
</tr>
<tr>
<td><em>Strep. dysgalactiae</em></td>
<td>+</td>
<td>E</td>
<td>Major</td>
</tr>
<tr>
<td><em>Strep. uberis</em></td>
<td>+</td>
<td>E/C</td>
<td>Major</td>
</tr>
<tr>
<td><em>E. coli</em></td>
<td>-</td>
<td>E</td>
<td>Major</td>
</tr>
<tr>
<td><em>Klebsiella spp.</em></td>
<td>-</td>
<td>E</td>
<td>Major</td>
</tr>
<tr>
<td><em>Serratia spp.</em></td>
<td>-</td>
<td>E</td>
<td>Major</td>
</tr>
<tr>
<td>coagulase-negative staph. (CNS)</td>
<td>+</td>
<td>opportun.</td>
<td>Minor</td>
</tr>
<tr>
<td><em>C. bovis</em></td>
<td>+</td>
<td>C</td>
<td>Minor</td>
</tr>
</tbody>
</table>

- **Contagious:** Cow-to-cow during milking
- **Environmental:** From dairy environment
- **Opportunistic:** Advantageous situation
Teat Disinfection
What is the right product for the right occasion?

- Contagious Mastitis:
  - Post milking teat disinfection,
    - Low viscosity spray-dip
    - HV viscosity, high emollient
    - barrier teat disinfectant

- Cluster disinfection between cows - backflush
# Teat Dip requirements: Post dip

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Test</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kill mastitis bacteria*</td>
<td>In vitro test: w/wo milk soil</td>
<td>5 log (99.999%) in 30 seconds</td>
</tr>
<tr>
<td>Prevents Mastitis**</td>
<td>Clinical efficacy trial</td>
<td>Equal to positive control</td>
</tr>
<tr>
<td>Mild on Skin</td>
<td>Clinical safety/teat conditioning</td>
<td>Low teat skin and end scores</td>
</tr>
<tr>
<td>Residue</td>
<td>Residue trial</td>
<td>Detected below allowed limit</td>
</tr>
<tr>
<td>Stability</td>
<td>Store at ambient, high and low temperatures</td>
<td>Chemically stable; physically stable</td>
</tr>
</tbody>
</table>

* In vitro test does not prove mastitis control

** Clinical efficacy not required for registration in Europe
# Teat Dip Germicides: Sustainability Issues

<table>
<thead>
<tr>
<th>Germicide</th>
<th>Natural in milk</th>
<th>% in Teat dip</th>
<th>Other</th>
<th>Germicide as Residue in Milk</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Iodine</strong></td>
<td>Yes</td>
<td>0.1 – 1%</td>
<td>NPE?</td>
<td>No – converts to iodide</td>
</tr>
<tr>
<td><strong>Peroxide</strong></td>
<td>Yes</td>
<td>0.5 – 1%</td>
<td></td>
<td>No - decomposes</td>
</tr>
<tr>
<td>Chlorine Dioxide</td>
<td>no</td>
<td>0.5 Chlorite; 100-200 ppm Chlorine Dioxide</td>
<td>Chlorite residue</td>
<td>No - decomposes</td>
</tr>
<tr>
<td>Chlorine (bleach)</td>
<td>no</td>
<td>0.05 to 2%</td>
<td>THM - chloroform</td>
<td>No - decomposes</td>
</tr>
<tr>
<td>Lactic-Organoic Acid</td>
<td>Yes</td>
<td>2 to 6%</td>
<td></td>
<td>not germicidal at milk pH</td>
</tr>
<tr>
<td>Chlorhexidine</td>
<td>No</td>
<td>0.3 to 0.5%</td>
<td>Synthetic</td>
<td>Yes</td>
</tr>
</tbody>
</table>

NPE: nonylphenol ethoxylate  
THM: trihalomethane (chloroform)
Iodine Teat Dips

- 0.1 to 1% available iodine as surfactant or PVP complex
- Broad-Spectrum – Oxidative
- Free Iodine – Varies with formulation
- pH: 2 to 6: > 6 not stable; < 3.5 irritation
- Compatible with range of emollients
- RTU and concentrates
- Many product forms / types
- Spray, dip, foam, barrier
- Extensive testing and registrations

Issues

- Milk residue concern if not properly used:
- Use food grade surfactants

TCH Animal Health LLP

tomhemling@gmail.com
### In-vitro Efficacy

**Iodine Teat Dips: high free iodine versus conventional**

<table>
<thead>
<tr>
<th></th>
<th>Product A</th>
<th>Product B</th>
<th>Product C</th>
<th>Product D</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Free iodine</strong> ppm</td>
<td>75</td>
<td>2.5</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>Available iodine</strong> %</td>
<td>0.05</td>
<td>0.5</td>
<td>1</td>
<td>0.25</td>
</tr>
<tr>
<td><strong>% Reduction</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Staph. aureus</strong></td>
<td>99.999</td>
<td>94.5</td>
<td>83.75</td>
<td>31.724</td>
</tr>
<tr>
<td><strong>10% Milk Challenge</strong></td>
<td>99.999</td>
<td>99.89</td>
<td>97.675</td>
<td>92.413</td>
</tr>
<tr>
<td><strong>30 sec.</strong></td>
<td>99.999</td>
<td>99.995</td>
<td>99.999</td>
<td>99.172</td>
</tr>
</tbody>
</table>
### Iodine Efficacy: 33 listings NMC Bibliography

#### NMC Post Dip Clinical Trial - Challenge Protocol

*0.25% Iodine: high versus low free iodine: Cornell University*

<table>
<thead>
<tr>
<th></th>
<th>Quarters</th>
<th>Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Streptococcus agalactiae</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative Control</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>Low Free Iodine (1 - 2 ppm)</td>
<td>10</td>
<td>58.3%</td>
</tr>
<tr>
<td>High Free Iodine (4 - 6 ppm)</td>
<td>4</td>
<td>83.3%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Quarters</th>
<th>Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Staphylococcus aureus</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative Control</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Low Free Iodine (1 - 2 ppm)</td>
<td>7</td>
<td>66.6%</td>
</tr>
<tr>
<td>High Free Iodine (4 - 6 ppm)</td>
<td>3</td>
<td>85.7%</td>
</tr>
</tbody>
</table>
Hydrogen Peroxide
Oxidative

• Oxidative…but some bacteria produce an enzyme that inactivates peroxide
• 0.5-1% in teat dips
  ✓ Peroxide not effective by itself unless concentration >3%
  ✓ Formulated with **activator** to increase germicidal activity
  ✓ 30 second 5 log reduction
• pH: 3.5 – 5 for optimum stability, efficacy skin compatibility
• **No residue concerns; breaks down to water and oxygen**

**Issues**

• Difficult to formulate for efficacy, skin safety, and stability
Hydrogen Peroxide

- Rapid kill – if properly activated
- Broad Spectrum: 5 log = 99.999% kill
- Peroxide itself is not effective
Summary of quarter SCC changes during 20 week study

<table>
<thead>
<tr>
<th>Time (wk)</th>
<th>Chlorhexidine</th>
<th>Peroxide</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>35,000</td>
<td>33,000</td>
</tr>
<tr>
<td>20</td>
<td>41,000</td>
<td>50,000</td>
</tr>
</tbody>
</table>

- No difference in SCC at beginning or end between treatments
- No difference in SCC between beginning and end of study
- **SCC maintained at very low level**

Bradley (2005) n = 414 cows from 3 herds
Lactic Acid
Non Oxidative

• Broad spectrum at low pH
• Known effective at low pH: <4
  ✓ Alone effective at >6% and pH 2.5
  ✓ Excipients to optimize efficacy and skin compatibility
  ✓ Teat Dips: 2.5% to 4% lactic acid

• Compatible with emollients in RTU
• Considered Natural – naturally present in milk
• Dip, spray, barrier, post, pre, winter dip
Lactic Acid In vitro Efficacy, EN1040 and EN1656

- Product pass EN1656 with and without interfering substance for 30 seconds contact time, RT.
- Dilutions made with 300 ppm HW.

### New Zealand Concentrate Efficacy

**30 second Contact Time**

**Room Temperature**

<table>
<thead>
<tr>
<th>Interfering Conditions</th>
<th>S. aureus</th>
<th>E. coli</th>
<th>S. uberis</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>6.00</td>
<td>6.00</td>
<td>6.00</td>
</tr>
<tr>
<td>Milk</td>
<td>6.00</td>
<td>6.00</td>
<td>6.00</td>
</tr>
<tr>
<td>Low Soil</td>
<td>6.00</td>
<td>6.00</td>
<td>6.00</td>
</tr>
<tr>
<td>High Soil</td>
<td>6.00</td>
<td>6.00</td>
<td>6.00</td>
</tr>
</tbody>
</table>
Chlorine Dioxide
Oxidative

- Efficacy considered good; broad-spectrum
  ✓ *Published efficacy trials*
- Products are generally low pH(3-3.5)
- Not naturally present in milk
- Spray, dip, barrier, post dip, premilking
- Claimed benefit of softening teat end hyperkeratosis

**Issues**

- Not available as RTU, must be mixed on-site
  ✓ *Stability 12 - 24 hours after mixing*
  ✓ *Sodium chlorite reacts with acid to give chlorine dioxide*
Generation of Chlorine Dioxide

• Chlorine Dioxide (CD) is formed by the reaction of
  ✓ sodium chlorite and a source of acid; and
  ✓ is a gas, that is soluble in water

• Acid(s) type and concentration determine:
  ✓ The rate of generation of CD: 15, 30 minutes?
  ✓ Stability after generation: 2-12 hours?
    o Generation and stability are a function of the type and concentration of acids used

• Proper Mixing and Storage?
  
  Allow enough time for generation.  
  Do not use after indicated shelf life.
Germicidal Efficacy After Mixing

EN-1656 Staphylococcus aureus
5 minutes contact, 25°C, milk

- Rapid kill: 30 seconds
- Broad Spectrum

TCH Animal Health LLP
tomhemling@gmail.com
**Clinical Efficacy Trial**

**NMC Natural Exposure: New IMI**

<table>
<thead>
<tr>
<th>Bacteria isolated</th>
<th>Vanquish Pre Post</th>
<th>4XLA</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Staphylococcus aureus</em></td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Coagulase-negative <em>Staphylococcus</em> spp.</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td><em>Streptococcus uberis</em></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><em>Streptococcus dysgalactiae</em></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><em>Escherichia coli</em></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><em>Bacillus</em></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><em>Arcanobacterium pyogenes</em></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><em>Corynebacterium</em> spp</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Streptomyces</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Gram-positive rod</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>10</strong></td>
<td><strong>13</strong></td>
</tr>
</tbody>
</table>

- Products did not differ in their ability to prevent new IMI
  - ✔ *University of Tennessee – S. Oliver*
    - ◦ *Jersey Herd: Around 150 cows in milking*
What is the right product for the right occasion?

- **Environmental Mastitis:**
  - pre-milking hygiene,
  - barrier teat disinfectant

<table>
<thead>
<tr>
<th>Type of bacteria</th>
<th>Source</th>
<th>Comments</th>
<th>High SCC</th>
<th>High SPC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coliforms (E.coli, Klebsiella)</td>
<td>Manure, bedding, wet &amp; dirty teats</td>
<td>Clipped, dean, and dry udders &amp; teats: freestalls</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Environmental streptococci (S.uberis, S.dysgalactiae)</td>
<td>Manure, bedding, wet &amp; dirty teats, liner slips</td>
<td>Wet &amp; dirty conditions that expose teat ends to bacteria: dirty housing and calving environments</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Pseudomonas spp.</td>
<td>Water, soil, manure</td>
<td>Found in dirty milking equipment, contaminated water, contaminated antibiotics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prototheca</td>
<td>Water. Manure, infected quarters</td>
<td>No treatment, Eliminate stagnant water and manure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serratia</td>
<td>Contaminated water, bedding or litter</td>
<td>Eliminate washing of udders and teats</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Teat Dip requirements: Post Dip Barrier

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Test</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kill mastitis bacteria</td>
<td>In vitro test: w/wo milk soil</td>
<td>5 log (99.999%) in 30 seconds</td>
</tr>
<tr>
<td>Prevents Mastitis</td>
<td>Clinical efficacy trial</td>
<td>Equal to positive control</td>
</tr>
<tr>
<td>Mild on Skin</td>
<td>Clinical safety/teat conditioning</td>
<td>Low teat skin and end scores</td>
</tr>
<tr>
<td>Residue</td>
<td>Residue trial</td>
<td>Detected below allowed limit</td>
</tr>
<tr>
<td>Stability</td>
<td>Store at ambient, high and low temperatures</td>
<td>Chemically stable; physically stable</td>
</tr>
<tr>
<td>Persistent Protection</td>
<td>Clinical Efficacy trial</td>
<td>Improved result environmental mastitis</td>
</tr>
<tr>
<td>Barrier readily removed</td>
<td>Field trial</td>
<td>No barrier present after teat prep.</td>
</tr>
</tbody>
</table>
Barrier Teat Dips: *Control of environmental Mastitis?*

**A: Barrier vs. B: non-barrier**

- **10,000 Cow US Dairy: Rainy season in Arizona**
- **McClure et al Commercial herd: 5000 cows per treatment**
- **Change In Incidence**

### Rate of New Infections

<table>
<thead>
<tr>
<th>Etiology</th>
<th>Totals</th>
<th>NSG</th>
<th>Staph. aureus</th>
<th>Strep. ag</th>
<th>Staph. other</th>
<th>Strep. non-ag</th>
<th>Coli</th>
<th>Other</th>
<th>Myco</th>
<th>Total Environ.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herd A</td>
<td>-59.7</td>
<td>-28.9</td>
<td>0.6</td>
<td>-1.1</td>
<td>-1.2</td>
<td>-10.3</td>
<td>-18.4</td>
<td>-0.4</td>
<td>0</td>
<td>-57.6</td>
</tr>
<tr>
<td>Herd B</td>
<td>-27</td>
<td>-17.6</td>
<td>-0.4</td>
<td>0</td>
<td>-1.4</td>
<td>0.8</td>
<td>-7.9</td>
<td>-0.6</td>
<td>0.3</td>
<td>-24.7</td>
</tr>
<tr>
<td><strong>Net Change</strong></td>
<td><strong>(A - B)</strong></td>
<td><strong>-32.7</strong></td>
<td><strong>1</strong></td>
<td><strong>-1.1</strong></td>
<td><strong>0.2</strong></td>
<td><strong>-11.1</strong></td>
<td><strong>-10.6</strong></td>
<td><strong>0.2</strong></td>
<td><strong>-0.3</strong></td>
<td><strong>-33.0</strong></td>
</tr>
</tbody>
</table>

- **33 infections/month/1000 cows**
- **33 x $250/case of mastitis = -$8250/month/1000 cows**
Barrier TD Environment Infections
Lago; Lopez: NMC 2014 (commercial herd)

0.25% iodine Barriers – differing only in **persistence** between milkings
12 weeks clinical efficacy: new intramammary infections
120 animals per group

<table>
<thead>
<tr>
<th>Persistence</th>
<th>Low</th>
<th>High</th>
<th>Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quarters at Risk</td>
<td>2804</td>
<td>2847</td>
<td></td>
</tr>
<tr>
<td>New IMI</td>
<td>95</td>
<td>68</td>
<td>27</td>
</tr>
<tr>
<td>% Incidence</td>
<td>3.4</td>
<td>2.4</td>
<td>1.0%</td>
</tr>
</tbody>
</table>

• Higher persistence = less new IMI
• 30% less environmental infections
Lactic Acid Clinical Efficacy

- Lactic Acid Barrier vs 0.25% Iodine Barrier
- **NMC Natural Exposure Trial:** Lago; Lopez: NMC 2014 (commercial herd)
- **Lactic Acid Barrier = more persistent than the iodine barrier**

<table>
<thead>
<tr>
<th></th>
<th>Lactic</th>
<th>Iodine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quarters at Risk</td>
<td>2822</td>
<td>2804</td>
</tr>
<tr>
<td>New IMI</td>
<td>68</td>
<td>95</td>
</tr>
<tr>
<td>% Incidence</td>
<td>3.4</td>
<td>2.4</td>
</tr>
</tbody>
</table>

- Lower mastitis rate with persistent lactic acid versus iodine barrier
- Efficacy is a function of the germicide and the barrier protection!
Importance of Teat Conditioning

- Healthy teats - Natural defense
- Animal welfare
- Better let down, improve milk yield
- Milking speed - parlor through put
- Reduce skin colonization
- Economic impact
Teat Conditioning
Factors Affecting Teat Conditioning

- Milk machine
  - On time, vacuum, liner type, auto detach settings
- Weather
- Bedding
- Stage of lactation
- Milking frequency: 2x, 3x, 4x
- Teat dips
Classification System
Teat End Callosity

None  Thin  Moderate  Thick  Extreme

Smooth

Rough
Hyperkeratosis and SCC

• Teats scored **VR** have increased SCC indicating increased subclinical mastitis
  
• Guarin et al., JDS 2017 100:643-652
Teat Dip formulation Variables and teat condition

- **Germicide type and concentration**
- **Surfactant** Type and amount is critical
- **pH** 3.5 to 8.5 skin compatible
- **Emollient** glycerin \( \geq \) sorbitol \( > \) prop. glycol
- **Solvent** Alcohol may tend to dry skin
- **Viscosity** Affect unknown. Thick is not always better
- **Drying Time** May be important under wind chill conditions*

* Slow drying barrier not ideal for wind chill conditions
Teat Conditioning
Teat Conditioning Agents

Moisturizing (Humectants)

• **Glycerin** – Rapid acting and efficient
• **Sorbitol** – Persistent, equivalent efficiency to glycerin
• **Propylene Glycol** – Less efficient, often used in concentrates because of difficulty in formulating with glycerin
• **Aloe / Aloe Vera** - >99% water, effective as is; effective when added in small amounts to teat dips.
Teat Conditioning (L. Fox; Washington State University)

Emollient – Germicide – Effect on Teat Healing

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Percentage days chapped</th>
</tr>
</thead>
<tbody>
<tr>
<td>1% Iodine, 10% Glycerine on Chapped Teats</td>
<td>20.7</td>
</tr>
<tr>
<td>1% Iodine, 10% Glycerine on Unchapped Teats</td>
<td>0.2</td>
</tr>
<tr>
<td>10% Glycerine on Chapped Teats</td>
<td>28.4</td>
</tr>
<tr>
<td>Untreated, Chapped Teats</td>
<td>35.6</td>
</tr>
</tbody>
</table>

TCH Animal Health LLP

tomhemling@gmail.com
Lactic Acid Barrier
Teat Condition

• 12 week trial
• Lactic acid versus 0.25% iodine Barriers
• Equivalent performance
• Both treatments improved skin and end scores during the trial
Influence of Teat Spraying with an Iodine Teat Dip
2% or 8% Emollient on Teat Condition & CMT-Score of Foremilk

Teat Conditioning on AMS
Denmark - Rassmussen

Weeks
0 1 2 3 4 5 6 7 8 9 10 11 12

Teat Skin Score
0 1 2 3

2% Emollient
8% Emollient
Treat 0 *
Winter Conditions

• Low temperature and wind chill
  • Dried crack skin and teat ends

• Options
  • High glycerin dip - hydration
  • Rapid drying
  • Dip and blot dry
  • Be careful with slow drying barriers
Can teat dips significantly reduce the degree or hyperkeratosis or the roughness of hyperkeratotic tissue?

- Hyperkeratosis is primarily related to milking machine effects: total time exposed to vacuum at low milk flow
- Data to support the claim????
- Logically if the dip dissolves hyperkeratotic tissue, wouldn’t it also dissolve skin?
## Chlorine Dioxide for Treating Hyperkeratosis?

**Clinical Trial:**
*Teat Skin, Teat End Roughness, Teat End Thickness*

<table>
<thead>
<tr>
<th>Chemistry</th>
<th>Orange</th>
<th>Blue</th>
<th>Pink</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorine Dioxide</td>
<td>Chlorine Dioxide</td>
<td>Chlorine Dioxide</td>
<td>Iodine</td>
</tr>
<tr>
<td>pH</td>
<td>3.1</td>
<td>3.1</td>
<td>5.0</td>
</tr>
</tbody>
</table>

*Source: TCH Animal Health LLP*
Chlorine Dioxide for Treating Hyperkeratosis?
Chlorine Dioxide for Treating Hyperkeratosis?
Conclusions

- No evidence of reduced teat end thickness when using chlorine dioxide dips
- All treatments reduced teat end roughness
- All treatments improved teat skin condition
- One Chlorine Dioxide showed a definite negative effect on teat skin near the teat end
  - Build up of dead skin?
Fly Repellent in Teat Disinfectants?

• Flies are a vector for transmission
• Repelling flies potentially reduces mastitis

• Commercial products claiming
  • Repels flies, or
  • Contains fly repellent ingredient

• But
  • Proof or efficacy?
    • Is the repellent ingredient effective in the teat disinfectant?
    • What is the residue risk of the fly repellent
Repellent properties?

Fly Repellency of Competitive Teat Dips VS Controls (50 Houseflies)

- **Ratio of Flies Landed on Un-treated vs Treated Glue Boards**

**Competitive Barrier Teat Dips**

- Water (Neutral Control)
- Essential Oil Repellent (Positive Control)
- KENOLAC
- Film Utile D
- Filmadine
- Deosan Summer Teat Care Plus
- Blockade
- Summer Mesodip

**0.50 Hour Treatment**

**1.00 Hour Treatment**

**3.00 Hour Treatment**

**Attractant**

**Repellent**
Teat Disinfectant and milk residue

• Risk for any germicide to become a milk residue
• Products evaluated by the authorities for safety
• Residue trials required for registration

• Recommendation:
  • Use germicides naturally present in milk
  • Thoroughly clean teats pre-milking
    • Especially barrier dips
  • Application methods may have an impact
### Teat Dip Germicides: Sustainability Issues & Residue

<table>
<thead>
<tr>
<th>Germicide</th>
<th>Natural in milk</th>
<th>% in TD RTU</th>
<th>Other</th>
<th>Germicide as Residue in Milk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iodine</td>
<td>Yes</td>
<td>0.1 – 1%</td>
<td>NPE?</td>
<td>No – converts to iodide</td>
</tr>
<tr>
<td>Peroxide</td>
<td>Yes</td>
<td>0.5 – 1%</td>
<td></td>
<td>No - decomposes</td>
</tr>
<tr>
<td>Chlorine Dioxide</td>
<td>no</td>
<td>0.5 Chlorite; 100-200 ppm Chlorine Dioxide</td>
<td>Chlorite residue,</td>
<td>No - decomposes</td>
</tr>
<tr>
<td>Chlorine (bleach)</td>
<td>no</td>
<td>0.05 to 2%</td>
<td>THM - chloroform</td>
<td>No - decomposes</td>
</tr>
<tr>
<td>Lactic or glycolic Organic Acid</td>
<td>Yes</td>
<td>2 to 6%</td>
<td></td>
<td>not germicidal at milk pH</td>
</tr>
<tr>
<td>Chlorhexidine</td>
<td>No</td>
<td>0.3 to 0.5%</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>DDBSA</td>
<td>No</td>
<td>2 to 4%</td>
<td></td>
<td>? Low pH normally required</td>
</tr>
<tr>
<td>Fatty Acid</td>
<td>Yes?</td>
<td>1-3%</td>
<td></td>
<td>not germicidal at milk pH</td>
</tr>
</tbody>
</table>
Post Milking Teat Dip: milk residue (Cornell; JDS)

- Products used post milking over 2 weeks
- Minimal impact on milk iodine levels
- Slightly higher for spray
- Not increased for barrier

<table>
<thead>
<tr>
<th>Product</th>
<th>% iodine</th>
<th>Application</th>
<th>Iodine in milk (ppb)</th>
<th>From Teat dip (ppb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>Peroxide</td>
<td>dip</td>
<td>148</td>
<td></td>
</tr>
<tr>
<td>Iodine</td>
<td>0.25%</td>
<td>dip</td>
<td>157</td>
<td>9</td>
</tr>
<tr>
<td>Iodine</td>
<td>0.25%</td>
<td>spray</td>
<td>178</td>
<td>30</td>
</tr>
<tr>
<td>Iodine Barrier</td>
<td>0.25%</td>
<td>Barrier – dip</td>
<td>163</td>
<td>14</td>
</tr>
<tr>
<td>Iodine</td>
<td>0.5%</td>
<td>dip</td>
<td>177</td>
<td>29</td>
</tr>
</tbody>
</table>

* WHO safe level 500 ppb
Teat Dip Application

- **Requirements**
  - Coverage
  - Hit rate
  - Consumption
  - Labor
  - Speed
  - Consistency
Teat Dip Application Methods

Robotic Milking and Teat Spraying

• Immediate after cups-off
• Uniform routine
• Uniform product consumption
• Hit rate and coverage?
Teat Disinfection for Prevention of Mastitis

- Global data proves benefit for mastitis control
- Select the appropriate products for the specific mastitis
- Barrier teat dips provide control of environmental mastitis
  - Tested and proven effective
- Application method impacts efficacy and residue
- Use only germicides that are naturally present in milk
Build Bridges Not Walls

TCH Animal Health LLP

tomhemling@gmail.com
TCH Animal Health LLP
Consulting in Research and Business Development

180 E. Loch Lloyd Parkway
Village of Loch Lloyd, MO 64012
www.tchanimalhealth.com

Thomas C. Hemling, Ph.D.
President - CSO
tomhemling@gmail.com
1-816-535-6006 cell 1-816-331-2395 office