Milk Quality & Mastitis Strategies for Organic Dairy Farms

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Madison, WI
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Outline - Topics

• Background – NOP/rules, Organic Valley/CROPP Cooperative and milk quality

• Organic treatment of mastitis

• Mastitis prevention and SCC reduction strategies

• General health promotion (disease prevention) for organic dairy herds

• Questions?
U.S. Milk Dollar Shares

Conventional Milk: 95%

Organic Milk: 5%

Private Label: 38.3%

Horizon: 31.4%

Organic Valley: 13.9%

Stonyfield: 7.8%

Other Brands: 8.6%

Source: Nielsen Panel Data
Includes all store formats
Organic Rules in the US

- Certified organic – produced under USDA National Organic Program (NOP), Certifiers
- National Organic Standards Board (NOSB)
- National List – (Approved & Prohibited substances)
- FDA – ultimate authority, AAFCO – feed materials
- State officials – Departments of Agric., Commerce
## Milk Quality – Coop. Avg SCC

<table>
<thead>
<tr>
<th>Year</th>
<th>SCC Avg</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
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**Quality Awards 2011 - 1549 total producers**

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<th>Range</th>
<th>SCC Avg</th>
<th>Total</th>
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<tr>
<td>0-100 SCC</td>
<td>2.50%</td>
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<tr>
<td>101-150 SCC</td>
<td>9%</td>
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<td>151-200 SCC</td>
<td>13.50%</td>
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387 Total (25% total members) <200 SCC avg
2 OV Member’s SCC – WA and VT

Monthly Somatic Cell Average

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<th>Jun</th>
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Premium

cells/mL x 1000

Month/Year

2010 2011 2012
2010 and 2011 Winners from Organic Valley = 18 total
110 National Winners – All Dairies in US
18/110 = 16% of NDQ awards – Total of ~1500 member dairy farms
Antibacterial Therapy

“Ultimately, it is the immune system that eliminates infections, antibacterial drugs just help make the pathogens more susceptible to attack”

Ron Erskine, DVM, PhD  MSU
Tools for Organic Production

- Vitamins and Minerals – feed, inject.
- Allowed Synthetics (Conventional; fluids, aspirin, etc.)
- Vaccines, Biologics – antisera, cell extracts
- Herbs/plants – aloe vera, garlic, tinctures
- Topicals - essential oils, etc.
- Whey products – colostrum, cytokine
- Antioxidants
- Homeopathy
Essential Oils (EO)

- Oil portion of a plant
- Gives each plant a distinct aroma, i.e. pine tree.
- Each EO has hundreds of compound in them (aldehydes, alcohols, esters, ketones, terpenes, etc).
- EO serves as the plant’s immune system: protector, healer.


Natural Mastitis Treatment tubes: Phyto-Mast®

Gaultheria, Glycyrrhiza, Thymol (10%) Radix Angelica sinensis, Radix Angelica dahuricae, Oleum Brassica campestris q.s. intramammary tubes

**Phyto-Mast**: All ingredients are GRAS
- Available in 15cc infusion tubes
- 1-2 tubes 1st dose & 1 tube at the next 2 milkings.
- **Withhold milk**: 12 hours
- **Withhold meat**: 1 day

1) NC State / FARAD residue study with lactating goats (Student Case Sessions at AABP 2010)

2) Aurora Organic Dairy in Colorado and U. of Florida clinical trial with lactating cows (poster at AABP 2010)

3) NC State clinical trial evaluating therapy for dry cows (poster at ADSA 2010)

4) NC State 2nd dry cow clinical trial (start Aug 2010)

5) Wageningen, NL clinical trial on an organic farm with lactating cows

6) Michigan State clinical trial using Phyto-Mast as the control and using guava and honey

7) UVM and U Conn doing in vitro work
Finding Phyto-Mast: Determining Withdrawal Time of a Phytoceutical Mastitis Treatment in Lactating Dairy Goats

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Introduction

- The organic dairy industry is growing at approximately 20% per year and currently comprises about 3% of dairy milk sales.
- Organic dairy animals may not be given antibiotics or dewormers.
- Producers are not to withhold treatment from sick animals.
- There are no FDA approved mastits treatments for organic production.
- Producers use: botanical products, herbal medicine, homeopathy, whey products, vitamin supplements.
- Phyto-Mast is a plant-based mastitis treatment used in organic dairy animals (Table I).
- Indicated for use in lactating cows with clinical mastitis.
- Approved by the Ohio Ecological Food & Farm Association (DEFFA).
- Very little is known about the uptake, distribution, and clearance of this product in milk.

Hypothesis

- Phytoceutical levels in milk and blood are quantifiable using volatile active ingredients as biomarkers of exposure.

Study Aims

- To administer Phyto-Mast via intrammary infusion to 2 lactating dairy goats (as a model for dairy cows) and sample plasma and milk for 10-14 days.
- To determine approximate withholding time for milk following treatment using gas chromatography with mass spectrometry (GC-MS).

Materials & Methods

Animals and Treatment

- Two healthy, lactating Alpine dairy goats (as a model for dairy cows).
- Collected baseline milk and plasma to determine background levels of thymol and other active components.
- Treated with phytoceutical (SmI per udder half) via intrammary infusion (figure I).

Sample Collection

- Blood samples were collected at 15, 30, and 60 minutes, and at 2, 4, 8, 24, 36, 48 and every 24 hours for 10 days after treatment.
- Milk samples every 12 hours (figure II), and samples for culture at 0, 24, 72, and 120 hours.
- California Mastitis Test (CMT) at every milking (figure III).
- Goats monitored for changes in vital signs and udder conformation.

Analytical Chemistry

- Developed headspace assay with a 100µm polydimethylsiloxane fiber to detect thymol in milk and plasma.
- Samples heated to 37°C and agitated for 5 minutes, fiber exposed to headspace above a 1 mL sample in sealed vial for 20 minutes, then injected into gas chromatograph with mass spectrometry (GC-MS) with a column temperature of 280°C and run for 17.5 minutes (figure IV).
- Purified chemical standards for thymol and methyl salicylate, active ingredients in Phyto-Mast, were used to create a standard curve for quantification.

Results

Following Phytoceutical Treatment

- Animals displayed no clinical signs of illness, and vital signs remained within normal limits.
- No perceptible change in udder conformation.
- Milk samples remained culture negative.
- CMT results were not substantially altered by treatment.
- No marked change in milk production (figure V).

GC-MS Analysis

- Thymol detected at retention time = 7.44 min.
- For thymol, limit of quantification (LOQ) = 0.1 parts per million (ppm); limit of detection (LOD) = 0.005 ppm, LOD = 0.001 ppm.
- Methyl salicylate detected at retention time = 7.03 min, (LOD = 0.01 ppm). Not detected in any study milk or plasma samples.
- Thymol detected in plasma samples beginning at 15- minutes post treatment (figure VI).
- Maximum plasma levels at 30-minutes post treatment.
- Plasma thymol levels below LOQ after 2 hours, below LOD after 8 hours.
- Apparent half-life of thymol in plasma = 30-40 minutes
- Thymol only detected in 12-hour post-treatment milk samples (figure VII).

Conclusions

- Demonstrated that a phytoceutical can be traced in the milk and plasma following intrammary treatment using thymol as a marker.
- Headspace analysis with GC-MS is a useful tool in quantifying thymol in biological matrices.
- Based on use of thymol as a biomarker, other ingredients in this phytocutecial with similar chemical properties are less likely to remain in the plasma or milk beyond 24 hours.
- Future work:
  - Follow pilot study with 4 or 5 more does to ensure repeatability.
  - Investigate other Phyto-Mast chemicals in milk and plasma samples, (ie. Glycyrrhizic, Methyl salicylate).
  - Trial in dairy cows with recommended dose (12 cc per quarter for 4 consecutive milkings).
  - Investigate other products to develop and advocate safe withholding times for mastitis treatments used in organic dairy production.

Approaching the issue of the human health safety of trace phytoceuticals in organic milk would be difficult and costly. A useful alternative to analyze biological markers in animals following treatment. Understanding the pharmacokinetics of active ingredients used in dairy production will lead to accurate withholding recommendations and improve organic milk safety.

Acknowledgements

- George H. Hitchings New Investigator Award (Burroughs Wellcome Fund)
- USDA, Food Animal Residue Avoidance Databank
- NCSU Center For Chemical Toxicology Research and Pharmacokinetics Laboratory Staff
- Goats and care were supported by a donation to “Bovine Research and Development Fund” (Dr. Kevin Anderson) from Hubert E. and Rebekah Karren of Penn Duell Car Co., Narvon, PA (developer & distributor of Phyto-Mast)
- NCSU Metabolism Educational Unit

References

Instead of culling: Nurse cows
(managed as a separate group)
1) excellent way to raise calves
2) reduce labor expense
3) keeps poorer quality milk out of tank
4) keeps contagious cows away from un-infected cows
5) reduce milk being shipped if needed
6) **NEVER** use a known Johnes positive cow
Conventional Wisdom applies to Organic Systems
Proper Milking Procedures

Pre-dip
- Requires 100% coverage of teat to be effective.
- Use individual towels to completely dry teats.
- The end result should be a clean and sanitized teat.
- This will reduce bacteria exposure to teat ends – lowering new mastitis cases.
- Will also reduce bacteria load in bulk tank - resulting in lower bacteria counts.
- Dipping, wiping and drying will help stimulate a good let-down.

Timing of prep vs. unit attachment
- Cows should be prepped 60-90 seconds before milker is attached.
- Milk should be at full flow soon after unit is attached.
- Good udder prep will result in a fast and complete milk-out.

Proper unit alignment and removal
- Milker unit should hang so all quarters milk evenly.
- Unit should be removed before every last drop is milked out.
- Over-milking will cause teat-end damage and increase infection rates.

Post-dip
- Most effective tool to control contagious mastitis.
- Provides protection until teat canal can close after milking (usually takes 30-90 mins.)
High SCC and Mastitis Detection

**Fore strip or strip cup** – Look for abnormal milk….Watery, flakes, clots, etc.
- Why does most high SCC milk still look normal?

**California Mastitis Test** (CMT)
- Immediate cow side results.
- Simple and affordable….Complete kit = $15.00 Refill = $8.00
- Not as accurate as lab testing, but very effective.
- It’s easy to become a CMT “expert”.

**Mas-d-tec**
- Immediate cow side results.
- New unit will cost around $300.00
- Easy to use.
- Requires diligent care to maintain accuracy.

**Lab SCC testing** – DHIA or similar herd type testing.
- Very accurate.
- Labor intensive and costly.
- Immediate results not available.
- Excellent way to gather long term data on individual cows.
Mastitis Prevention

- **Mastitis Triangle** – Man – Environment – Machine

**Milking Procedures** – udder prep, unit attachment, on-time and post-dipping

**Environment** – Clean, Dry & Comfortable (EMF Stress)

**Equipment** – regular maintenance, performance checks – vacuum level, pulsation, dynamic tests *during* milking

Other Factors:

**Nutrition** – balanced diet, trace minerals & vitamins

Milking Order – infected cows = last, culling

Monitoring – treatment and culture records, SCC

Dry cows and heifers – environment and nutrition (+fly control for heifers)
#1 People

**Milking Procedures:**

Udder prep, proper unit attachment & removal,

Post-milking teat dipping
#2 Environment

Which cow is more likely to get mastitis?
Troubleshooting Herd Health Problems

An ounce of prevention is worth…??

In the Organic Dairy world, prevention is everything.

It’s more cost effective, labor efficient, and humane to prevent new mastitis cases, instead of trying to heal infected cows. Limit the exposure to bacteria and you will greatly reduce the risk of new udder infections.

Clean and Dry --- all the time.
#3 Equipment Function

Check System - both Static and Under Load
Animal Health on Organic Dairies

Based on Disease Prevention

The Three Most Important Factors:

1. High Forage Diet
2. Grazing
3. Soil Mineralization & Biology
Grazing Promotes Health
Excellent grazing management;
1.) Provides high quality forage
2.) Minimizes disease (i.e. parasites)
3.) Increases beneficial nutrients in meat and milk
4.) Promotes healthy soil
5.) Improves profitability
The End
Questions??