Milk Quality and Mastitis Treatments on Organic and Small Conventional Dairy Farms

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Outline

- Organic rules and regulations
- Study design & overview
- Mastitis perceptions
- Bulk tank results & management
Introduction

- The USDA regulates and defines the organic standards in the United States
- All organic producers must follow these rules to be certified and market their product as “certified organic”
- Certification is enforced by independent organic certification agencies (such as MOSA or Oregon Tilth)
- Each certifying agency maintains its own rules and standards that may be more strict than the USDA rules

US organic rules relevant to dairy production

- Farmers must maintain records of animal identification & all treatments administered to animals
- Animals older than 6 months must have access to pasture that provides at least 30% DMI for minimum 120 days/year (most locations are longer)
- Antibiotics, hormones, and all other synthetic products are prohibited
  - Vaccines and electrolytes are allowed
  - Other products allowed only under specific circumstances
    - Banamine, oxytocin, xylazine, lidocaine
- Animals that receive a prohibited product must be removed from organic production permanently
  - Few exceptions to this for youngstock
- Most natural products are allowed under USDA organic regulations
  - Aloe, garlic, herbas, essential oils, colostrum whey, homeopathics
  - Few to none of these products have FDA approval
  - Depending on route of administration, these products may be classified as a “drug”
    - Non-approved drugs are illegal for use in food producing animals under FDA rules
Introduction

- Organic is a small but growing portion of the US dairy industry
  - Number of US organic dairy cattle 2002: 67,207
  - Number of US organic dairy cattle 2008: 249,766
- Organic management is diverse
- Need to understand the impact of organic management on milk quality
  - Mastitis
    - Perceptions, treatments, outcomes
  - Bulk tank
    - SCC, culture, foodborne pathogens

Materials and Methods

- Farms were recruited as part of a larger project
- Nearly 300 herds visited in OR, NY, and WI
- All farms required to have 20 or more cows
- Organic (ORG) farms must have been shipping certified ORG milk for at least 2 years
- Conventional farms were matched to organic based on size and location
- One single herd visit:
  - Questionnaire on management practices
  - Collected bulk tank milk sample
  - Collected information on mastitis cases in preceding 60 days
  - Left paperwork to record information on mastitis cases for next 60 days

<table>
<thead>
<tr>
<th></th>
<th>OR</th>
<th>CON</th>
</tr>
</thead>
<tbody>
<tr>
<td>OR</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>NY</td>
<td>72</td>
<td>25</td>
</tr>
<tr>
<td>WI</td>
<td>96</td>
<td>51</td>
</tr>
</tbody>
</table>
Analysis of bulk tank milk samples

- All bulk tank samples were sent to QMPS in Ithaca, NY for analysis
- Aerobic culture for mastitis pathogens
- Mycoplasma culture
- PCR for genes of selected foodborne pathogens:
  - *Salmonella* spp.
  - *invA*
  - *Listeria monocytogenes*
  - *hly*
  - Shiga-toxin *E. coli*
  - *stx1*
  - *stx2*

Results
Herd Characteristics

- Lesser proportion of CON farms use grazing
  - “Grazing” means at least 30% DMI for lactating cows comes from pasture

- Herd size differed, but not likely to be meaningful
- Lower Rolling Herd Average on ORG farms
- Differing breed distributions between farm types
Mastitis Perceptions, Treatments, and Outcomes on Organic and Small Conventional Dairy Farms

Objective

- To characterize management of clinical and subclinical mastitis on organic and conventional dairy farms
  - Definition & diagnosis
  - Products and procedures used for treatment
  - Definition of cure
  - Satisfaction with mastitis cases
  - Outcomes of clinical mastitis
Definitions

- **Clinical mastitis**
  - Abnormal milk – flakes, clots, gargot
  - Abnormal udder – redness, heat, swelling, inflammation
  - Abnormal cow – off feed, fever, decreased milk production

- **Subclinical mastitis**
  - **No clinical signs!!**
    - No abnormal signs in milk, udder, or cow
  - Must use a diagnostic test to identify
    - DHIA, CMT, or WMT to measure SCC

Results

**Complete Milking Routine & Presence of Mastitis**

- Complete milking routine includes:
  - strip
  - dip or wash
  - dry
  - postdip

<table>
<thead>
<tr>
<th>Herd Characteristic</th>
<th>ORG n = 192</th>
<th>CON grazing n = 36</th>
<th>CON non grazing n = 64</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete milking routine</td>
<td>47%</td>
<td>58%</td>
<td>48%</td>
</tr>
<tr>
<td>No clinical mastitis present on farm</td>
<td>2%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>No subclinical mastitis present on farm</td>
<td>2%</td>
<td>0%</td>
<td>2%</td>
</tr>
</tbody>
</table>
Results
Diagnosis of Clinical Mastitis

- Of farmers who reported having clinical mastitis on their farm

Results
Diagnosis of Subclinical Mastitis

- Of farmers who reported having subclinical mastitis on their farm

- 23% of ORG, 19% of CONGR and 30% of CONNG farmers did not have a clear definition of subclinical mastitis, and a definition was provided.
Results
Use of Antibiotics for Mastitis Treatment

- "Do you ever use antibiotic products to treat mastitis"

<table>
<thead>
<tr>
<th></th>
<th>ORG</th>
<th>CON grazing</th>
<th>CON non-grazing</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>192</td>
<td>36</td>
<td>64</td>
</tr>
<tr>
<td>17%</td>
<td>100%</td>
<td>98%</td>
<td></td>
</tr>
</tbody>
</table>

Products used in treatment of mild & moderate clinical mastitis
Procedures used in treatment of mild & moderate clinical mastitis

<table>
<thead>
<tr>
<th>Procedure</th>
<th>ORG n = 189</th>
<th>CON grazing n = 36</th>
<th>CON non grazing n = 64</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry quarter</td>
<td>9%</td>
<td>6%</td>
<td>5%</td>
</tr>
<tr>
<td>Segregate milk</td>
<td>13%</td>
<td>3%</td>
<td>11%</td>
</tr>
<tr>
<td>Ship cow</td>
<td>4%</td>
<td>3%</td>
<td>5%</td>
</tr>
<tr>
<td>Strip quarter</td>
<td>51%</td>
<td>39%</td>
<td>27%</td>
</tr>
<tr>
<td>Udder massage</td>
<td>2%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Vet treats</td>
<td>&lt;1%</td>
<td>3%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Products used in treatment of severe clinical mastitis

- ORG (n=177)
- CON graze (n=36)
- CON no graze (n=64)
### Procedures used in treatment of severe clinical mastitis

<table>
<thead>
<tr>
<th>Procedure</th>
<th>ORG n = 177</th>
<th>CON grazing n = 36</th>
<th>CON non grazing n = 64</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry quarter</td>
<td>16%</td>
<td>22%</td>
<td>19%</td>
</tr>
<tr>
<td>Segregate milk</td>
<td>6%</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>Ship cow</td>
<td>11%</td>
<td>0%</td>
<td>6%</td>
</tr>
<tr>
<td>Strip</td>
<td>38%</td>
<td>31%</td>
<td>27%</td>
</tr>
<tr>
<td>Udder massage</td>
<td>1%</td>
<td>3%</td>
<td>0%</td>
</tr>
<tr>
<td>Vet treats</td>
<td>14%</td>
<td>19%</td>
<td>28%</td>
</tr>
</tbody>
</table>

### Products used in treatment of subclinical mastitis

![Bar chart showing usage of different products in ORG (n=166), CON graze (n=31), and CON no graze (n=57).]
Procedures used in treatment of subclinical mastitis

<table>
<thead>
<tr>
<th>Procedure</th>
<th>ORG grazing n = 31</th>
<th>ORG non grazing n = 57</th>
<th>CON grazing n = 31</th>
<th>CON non grazing n = 57</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry cow/quarter</td>
<td>3%</td>
<td>7%</td>
<td>3%</td>
<td>5%</td>
</tr>
<tr>
<td>Segregate milk</td>
<td>10%</td>
<td>5%</td>
<td>3%</td>
<td>4%</td>
</tr>
<tr>
<td>Ship cow</td>
<td>8%</td>
<td>4%</td>
<td>10%</td>
<td>2%</td>
</tr>
<tr>
<td>Strip frequently</td>
<td>8%</td>
<td>2%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Udder massage</td>
<td>1%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Results
Proportion of Mastitis Cases Treated

[Graph showing proportion of mastitis cases treated on farms]

- <50% Cases Treated
- 50-99% Cases Treated
- 100% Cases Treated

Clinical Mastitis *
Subclinical Mastitis *
Recorded Cases of Clinical Mastitis *
Results
Definition of Mastitis Cure

- “Other” included cow not acting sick/not off feed (19), Mas-D-Tec negative (5), increased milk production (3), never cured (3), antibiotic test negative (2)

Results
Outcomes of Clinical Mastitis Cases

- For cases reported in the 60-days preceding the farm visit

<table>
<thead>
<tr>
<th>Outcome</th>
<th>ORG</th>
<th>CON grazing</th>
<th>CON non grazing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Died</td>
<td>3%</td>
<td>2%</td>
<td>5%</td>
</tr>
<tr>
<td>Culled</td>
<td>15%</td>
<td>13%</td>
<td>12%</td>
</tr>
<tr>
<td>Dry</td>
<td>3%</td>
<td>1%</td>
<td>6%</td>
</tr>
</tbody>
</table>

- Model was adjusted for DIM, parity, milk yield prior to mastitis, and clustering of cows within farms

- Averages are adjusted for clustering of cows within farms
Conclusions
Clinical & subclinical mastitis

- Few farmers reported not having clinical mastitis or subclinical mastitis.
- Methods used to identify mastitis were similar among farm types.
- Organic farmers were more likely to use alternative products and procedures and less likely to use antibiotics and traditional therapies for treatment.
- Organic farmers were less likely to define a mastitis cure based on appearance of the milk or udder, and more likely to use CMT.
- Organic farmers were less likely to treat of cases of clinical mastitis and more likely to treat subclinical mastitis.
- Milk yield 60 days after a case of clinical mastitis was higher in CONNG as compared to CONGR and ORG. Other outcomes of mastitis were similar among farm types.
- Satisfaction with the outcome of treatment was similar among farm types.
Analysis of Bulk Tank Milk Collected on Organic and Small Conventional Dairy Farms

Objectives

- What are the characteristics of bulk tank milk on organic and conventional dairy farms?
  - Mastitis pathogens
  - Foodborne pathogens
  - Somatic cell count (SCC)

- Do organic and conventional farms employ different methods of managing bulk tank SCC?
Results
Bulk Tank SCC & Management Practices

- Average bulk tank somatic cell count:
  - ORG: 198,000 cells/mL
  - CON grazing: 166,000 cells/mL
  - CON non-grazing: 183,000 cells/mL

<table>
<thead>
<tr>
<th>Management Practice</th>
<th>ORG</th>
<th>CON grazing</th>
<th>CON non-grazing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herds with cows with three or fewer quarters present</td>
<td>95%</td>
<td>92%</td>
<td>94%</td>
</tr>
<tr>
<td>Proportion of lactating cows within herds with three or fewer quarters *</td>
<td>11%</td>
<td>7%</td>
<td>7%</td>
</tr>
<tr>
<td>At least one cow’s milk is kept out of tank *</td>
<td>72%</td>
<td>39%</td>
<td>39%</td>
</tr>
<tr>
<td>Proportion of lactating cows within herds with milk kept out of tank *</td>
<td>6%</td>
<td>3%</td>
<td>3%</td>
</tr>
</tbody>
</table>

- Higher proportion of ORG farms have Staph. aureus present in bulk milk
- Similar proportion of ORG and CON farms have foodborne pathogens present in bulk milk

Results
Bacterial pathogens present in bulk milk

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>ORG</th>
<th>CON grazing</th>
<th>CON non-grazing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contagious mastitis pathogens *</td>
<td>63%</td>
<td>44%</td>
<td>42%</td>
</tr>
<tr>
<td>* Staphylococcus aureus</td>
<td>62%</td>
<td>42%</td>
<td>42%</td>
</tr>
<tr>
<td>* Streptococcus agalactiae</td>
<td>3%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>* Mycoplasma bovis</td>
<td>&lt;1%</td>
<td>2%</td>
<td>0%</td>
</tr>
<tr>
<td>Foodborne pathogens</td>
<td>3%</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>* E. coli</td>
<td>2%</td>
<td>3%</td>
<td>0%</td>
</tr>
<tr>
<td>* L. monocytogenes</td>
<td>1%</td>
<td>0%</td>
<td>3%</td>
</tr>
<tr>
<td>* Salmonella spp.</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

- Higher proportion of ORG farms have Staph. aureus present in bulk milk
- Similar proportion of ORG and CON farms have foodborne pathogens present in bulk milk
Results
Average bacterial counts

<table>
<thead>
<tr>
<th>Measure (in cfu/mL)</th>
<th>ORG grazing</th>
<th>CON</th>
<th>CON non-grazing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate loop count</td>
<td>4,900</td>
<td>4,200</td>
<td>6,800</td>
</tr>
<tr>
<td>Lab pasteurized count</td>
<td>6</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>Streptococcus spp.</td>
<td>729</td>
<td>636</td>
<td>1,084</td>
</tr>
<tr>
<td>Coagulase-negative Staph</td>
<td>502</td>
<td>335</td>
<td>452</td>
</tr>
<tr>
<td>Coliforms</td>
<td>3</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>Gram negative rods</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Discussion
Mastitis & foodborne pathogens

- Populations of mastitis pathogens found in bulk tank milk were similar among ORG, CON grazing, and CON non-grazing farms
  - Higher proportion of ORG farms have contagious pathogens
  - Opportunity to improve milking and mastitis management on all small farms
  - Tendency to isolate greater amounts of coliforms from CON farms
    - Mean values in both groups were below 50 cfu/mL, which is acceptable
    - Similar amounts of Strep. spp. in all farm types
    - Mean values in all groups were over 500 cfu/mL, which is high
- Prevalence of L. monocytogenes was 2%
  - Consistent with other reports
- Prevalence of shiga-toxin E. coli was 3%
  - Lower than previous reports
  - Possibly regional difference
Discussion

Bulk Tank Somatic Cell Count

- Similar SCC levels among ORG, CONGR, and CONNG farms
- Different management strategies used between ORG & CON
  - Same proportion of farms had three-quartered cows
    - ORG farms had a greater proportion of three-quartered lactating cows per farm
    - Drying quarters may be used to treat mastitis or manage bulk tank SCC
  - Greater proportion of ORG farms keep milk from certain cows out of the tank
    - ORG farms had a greater proportion of lactating cows per farm kept out of the tank
    - Strategy may be used similarly to drying quarters to manage bulk tank SCC

Conclusions

- Similar quality of bulk milk among ORG, CON grazing, and CON non-grazing farms
- Microbiology
  - Similar prevalence of environmental mastitis pathogens and foodborne pathogens
  - High prevalence of *Staph. aureus* on all small farms
- SCC
  - Drying off quarters and keeping cows out of the tank were used to manage bulk tank SCC
  - These methods were employed on a greater proportion of ORG farms and a greater proportion of ORG lactating cows
Acknowledgements

- USDA NIFA Integrated Organic Program
  - 2008 - 2012

Questions?