Sweet Cider

**Where:** Gallery Overlook (upper level) Room E & F

**Moderator:** Rob Long, Long’s Family Farm and Orchard, Commerce Township, MI

- **9:00 am** Producing the Safest Cider Possible and Recent Developments in Food Safety –Featured Speaker
  - Les Bourquin, Food Science Dept., MSU

- **9:50 am** Michigan Cider Makers’ Guild Takes A New Direction
  - Ed Robinette, MCMG President and Robinette’s Apple House & Winery Grand Rapids, MI

- **10:05 am** Pure Michigan Apples in Michigan Cider
  - Denise Donohue, Executive Director, Michigan Apple Committee, Lansing, MI

- **10:20 am** Improving the Quality of Early Season Cider-Ideas from Fellow Cider Makers
  - Bob Tritten, District Fruit Educator, East Michigan. MSU Extension

- **10:35 am** Cider Mill Inspection Results from 2011 and Plans for 2012
  - Kevin Halfmann, Food & Dairy Division, MDARD

- **10:55 am** Master Cider Maker Award-Jim Engelsma
  - Bob Tritten, District Fruit Educator, East Michigan. MSU Extension
Producing the Safest Cider Possible &
Recent Developments in Food Safety

Leslie D. Bourquin
Michigan State University
Great Lakes Expo
December 7, 2011

Outline of Presentation

- Food Safety Issues with Apple Cider
- Legal Issues
- Pre-Harvest Practices
- Harvest Practices
- Fruit Handling and Storage
- Processing Practices
- Food Safety Training Resources

Cider Safety Issues

- Pathogenic microorganisms
  - *E. coli* O157:H7 (and O111)
  - *Cryptosporidium parvum*
  - Patulin
  - Arsenic?
- Physical Hazards – haven’t been a major problem

Pathogenic Microorganisms

- Certain pathogenic microorganisms survive in apple cider despite its relatively high acidity
- These pathogens can arise from human or animal feces, contaminated water, or other environmental sources (including poor facility or equipment sanitation)
- Surveillance data for indicator organisms indicates potential for contamination with pathogenic microorganisms.

Outbreaks Associated with Apple Cider

<table>
<thead>
<tr>
<th>Product</th>
<th>Date</th>
<th>Hazard</th>
<th>Cases</th>
<th>States</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple cider</td>
<td>OCT 1991</td>
<td><em>E. coli</em> O157:H7</td>
<td>25</td>
<td>MA</td>
<td>Private home</td>
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<tr>
<td>Apple cider</td>
<td>OCT 1993</td>
<td><em>Cryptosporidium</em> spp.</td>
<td>160</td>
<td>ME</td>
<td>Fair</td>
</tr>
<tr>
<td>Apple cider</td>
<td>SEP 1996</td>
<td><em>C. parvum</em></td>
<td>31</td>
<td>NY</td>
<td>Cider mill</td>
</tr>
<tr>
<td>Apple cider</td>
<td>OCT 1996</td>
<td><em>E. coli</em> O157:H7</td>
<td>12</td>
<td>CT</td>
<td>Private home</td>
</tr>
<tr>
<td>Apple cider</td>
<td>OCT 1996</td>
<td><em>E. coli</em> O157:H7</td>
<td>6</td>
<td>WA</td>
<td>Private home</td>
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<tr>
<td>Apple cider</td>
<td>OCT 1996</td>
<td><em>E. coli</em> O157:H7</td>
<td>70</td>
<td>W, CA, CO</td>
<td>Commercial Processor</td>
</tr>
<tr>
<td>Apple cider</td>
<td>OCT 1997</td>
<td><em>E. coli</em> O157:H7</td>
<td>6</td>
<td>IN</td>
<td>Farm</td>
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<tr>
<td>Apple cider</td>
<td>OCT 1999</td>
<td><em>E. coli</em> O157:H7</td>
<td>25</td>
<td>OK</td>
<td>Private home</td>
</tr>
</tbody>
</table>

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<th>Cases</th>
<th>States</th>
<th>Source</th>
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</thead>
<tbody>
<tr>
<td>Apple cider</td>
<td>SEP 2003</td>
<td><em>C. parvum</em></td>
<td>144</td>
<td>OH</td>
<td>Orchard &amp; park site</td>
</tr>
<tr>
<td>Apple cider</td>
<td>SEP 2004</td>
<td><em>E. coli</em> O111, <em>C. parvum</em></td>
<td>212</td>
<td>NY</td>
<td>Private home, farm</td>
</tr>
<tr>
<td>Apple cider</td>
<td>OCT 2007</td>
<td><em>E. coli</em> O157:H7</td>
<td>9</td>
<td>MA</td>
<td>Other</td>
</tr>
<tr>
<td>Apple cider</td>
<td>OCT 2008</td>
<td><em>E. coli</em> O157:H7</td>
<td>5</td>
<td>IA</td>
<td>Fair, festival, temporary mobile service</td>
</tr>
<tr>
<td>Apple cider</td>
<td>OCT 2010</td>
<td><em>E. coli</em> O157:H7</td>
<td>7</td>
<td>MD</td>
<td>Farm (also sold product in retail store)</td>
</tr>
</tbody>
</table>
Surveillance for Microbial Hazards and Indicator Organisms in MI Apple Cider

- No samples of Michigan apple cider obtained between 1997 and 2004 were confirmed as being positive for pathogenic microorganisms
  - E. coli O157:H7 (all years; 1,203 samples screened)
  - Salmonella (2003; 257 samples screened)
- Indicator organisms indicated that the risk of pathogen contamination does exist.

| TABLE 6. Data for total aerobic organisms in Michigan apple cider samples, 1997 through 2004a |
| Parameter | No. of samples detected (% of samples) | Count (log MPN/ml) | Range (log MPN/ml) |
| Totals | 1,183 | 98.5 ± 0.4 | 3.74 ± 0.03 | 1.0-7.4 |
| Food safety control measures | | | | |
| None | 897 | 99.6 ± 0.2 A | 4.00 ± 0.03 A | 1.0-7.4 |
| Thermal pasteurization | 182 | 94.5 ± 1.7 B | 2.85 ± 0.10 B | 1.0-5.9 |
| UV light radiation | 104 | 96.2 ± 1.9 B | 2.89 ± 0.11 B | 1.0-5.4 |


Patulin

- A mycotoxin produced by certain species of mold (Penicillium expansum) is most common source
- Has been found in a number of foods including apple juice, apples and pears with brown rot.
- There is significant concern with juice prepared from moldy or rotten apples and apple juice concentrates.
- FDA action level 50 parts per billion in apple juice, apple juice concentrate (at final dilution), and apple sauce

| Patulin Concentrations in Michigan Apple Cider - 2002-2004 |
| Year | <50 µg/L | 4-49.9 µg/L | ≤4 µg/L |
| 2002 | 20% | 10% | 70% |
| 2003 | 20% | 10% | 70% |
| 2004 | 20% | 10% | 70% |


Patulin

TABLE 2. Data for nonspecific E. coli in Michigan apple cider samples, 1997 through 2004a

| Parameter | No. of samples (log MPN/ml) | Count (log MPN/ml) | Range (log MPN/ml) |
| Totals | 1,203 | 6.4 ± 0.7 | 1.03 ± 0.07 | 0.5-3.0 |
| Food safety control measures | | | | |
| None | 912 | 7.6 ± 0.9 A | 1.08 ± 0.08 A | 0.5-3.0 |
| Thermal pasteurization | 186 | 2.7 ± 1.2 B | 0.61 ± 0.09 A | 0.5-0.96 |
| UV light radiation | 105 | 2.9 ± 1.6 AB | 0.56 ± 0.00 A | 0.6 |


Patulin Concentrations in Apple Juice Obtained from Retail Grocery Stores

| Parameter | No. of samples detected (% of samples) | Average Patulin Concentration (µg/liter) | Range (µg/liter) |
| Totals | 159 | 2.3 ± 0.1 | 526.0 ± 25.1 | 0.8-2586.3 |
| Ingredients | | | | |
| Apples | 49 | 4.8 ± 7.1 | 46 ± 125 | 0.8-4174 |
| Concentrate | 99 | 33.1 ± 7.4 | 472.7 ± 228.7 | 11.6-2780.4 |
| Both | 11 | 36.4 ± 15.2 | 182.2 ± 122.4 | 13.6-347.4 |

### FDA Patulin Surveillance in Apple Juice Products 1994-2008

**Frequency of detection (%)**

<table>
<thead>
<tr>
<th>Year</th>
<th>n</th>
<th>Detectable</th>
<th>At or above 50ppb</th>
<th>Average</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Years</td>
<td>3061</td>
<td>50.2</td>
<td>4.4</td>
<td>24.8 ± 1.4</td>
<td>0.4 – 1031</td>
</tr>
<tr>
<td>1994-1998</td>
<td>619</td>
<td>56.2</td>
<td>4.9</td>
<td>25.3 ± 2.7</td>
<td>1.7 – 708</td>
</tr>
<tr>
<td>2002</td>
<td>366</td>
<td>61.9</td>
<td>6.0</td>
<td>30.4 ± 5.6</td>
<td>0.7 – 1031</td>
</tr>
<tr>
<td>2003</td>
<td>376</td>
<td>46.8</td>
<td>5.9</td>
<td>29.1 ± 1.9</td>
<td>0.8 – 344</td>
</tr>
<tr>
<td>2004</td>
<td>469</td>
<td>49.0</td>
<td>3.0</td>
<td>24.0 ± 3.9</td>
<td>0.8 – 502</td>
</tr>
<tr>
<td>2005</td>
<td>437</td>
<td>50.6</td>
<td>5.3</td>
<td>20.0 ± 2.4</td>
<td>1 – 322</td>
</tr>
<tr>
<td>2006</td>
<td>399</td>
<td>44.5</td>
<td>4.0</td>
<td>20.3 ± 2.2</td>
<td>0.8 – 145</td>
</tr>
<tr>
<td>2007</td>
<td>267</td>
<td>39.0</td>
<td>1.1</td>
<td>14.4 ± 1.4</td>
<td>0.4 – 75</td>
</tr>
<tr>
<td>2008</td>
<td>228</td>
<td>39.0</td>
<td>3.5</td>
<td>25.1 ± 4.4</td>
<td>1.1 – 241</td>
</tr>
</tbody>
</table>

### Arsenic in Apple Juice

- Lead arsenate used as a pesticide in orchards for decades, resulting in accumulation of lead and arsenic in soil.
- Uptake of arsenic from the soil by growing plants, resulting in As in edible portions of these plants.
- Arsenic toxicity:
  - Organic forms – essentially harmless
  - Inorganic arsenic – toxic
- FDA has an “action threshold” of >23 PPB for total arsenic. When samples test above that concentration, further testing is conducted to determine if the inorganic As concentration.
- To date, FDA has not taken any action related to As in apple juice.

### Current Status

- FDA is considering lowering its level of concern for total arsenic from 23 PPB.
- Michael Taylor, FDA’s deputy commissioner for foods commented on November 30:
  - “We continue to think that apple juice is generally safe based on the fact that the vast majority of samples are very low, but we want to minimize these exposures as much as we possibly can.”

### Arsenic in Apple Juice

- September 2011 – Dr. Oz Show
  - Testing on apple juice indicated concern about As
  - FDA testing on apple juice did not corroborate the results cited by the Dr. Oz Show
- November 2011 – Consumers Union
  - Found that 10% of store-bought apple juice samples contained >10 PPB total Arsenic (the EPA limit for drinking water)
  - Important to note this analysis uses total As, and uses the drinking water standard, not the FDA “level of concern.”

### FDA: Apple Juice is Safe To Drink
Legal Issues

Michigan Food Law (As Amended in 2007)

SEC. 7106.
(1) All processors of juice shall comply with the regulations of the U.S. Food and Drug Administration in 21 CFR part 120. [The FDA Juice HACCP Regulation]

(2) An establishment that presses apple cider shall have at least 1 active employee currently certified under a program described in section 2129 or having completed a current course recognized by the department as pertinent to safe cider production.

Who Must Comply With the FDA Juice HACCP Regulation?

- Processors – both domestic and foreign
- Importers

Operations Exempt from the FDA Juice HACCP Regulation

- The regulation does not apply to:
  - The harvest, picking or transport of raw agricultural ingredients of juice products, if the person is not otherwise engaged in processing
  - The operation of a retail establishment
    - Regardless of production volume, provided that product is sold only through the retail establishment
    - Note that cider mills who are retail exempt must still comply with the requirement for a warning label

Products Exempt from or Not Subject to the Regulation

- Juice produced as part of the operation of a retail establishment
- Beverage with a juice ingredient (but the juice ingredient is subject to the regulation)
- Non-beverage food with juice ingredient (e.g., fruit-flavored candy)
- Ingredients from fruit other than juice (e.g., citrus oil)

FDA Definition of “Juice”

- The aqueous liquid expressed or extracted from one or more fruits or vegetables, purees of the edible portions of one or more fruits or vegetables, or any concentrates of such liquid or puree.

FDA Definition of Retail Establishment

- An operation that provides juice directly to the consumers and does not include an establishment that sells or distributes juice to other business entities as well as directly to consumers. “Provides” includes storing, preparing, packaging, serving, and vending.
Practices to Minimize Food Safety Hazards in Apple Cider

- Pre-Harvest Practices
- Harvest Practices
- Fruit Handling and Storage
- Processing Practices

Pre-Harvest Practices

- Field contamination with pathogenic microorganisms most commonly occurs due to the following:
  - Contamination with animal or human feces (consider timing if using as soil amendment)
  - Use of contaminated irrigation water (consider sources, timing, method of application)
  - Use of contaminated water for chemical applications

Harvest Practices

- Only tree-picked fruit can be used for apple cider that is not subjected to a 5-log pathogen reduction step (drops legal for pasteurized or shelf-stable juices).
- Harvesting equipment, bins, totes, etc. must be clean and sanitary prior to harvest.
- No standing in bins.
- Be careful about contamination with soil from the field.
- Damage to fruit (hail, stem hits, bruises, etc.) facilitates colonization by *Penicillium expansum* and patulin formation.

Fruit Handling and Storage

- Store fruit in a manner that minimizes damage and risk of contamination
- Conditions to minimize patulin development
  - Cold storage, controlled atmosphere for long term
  - Fungicide treatments
- Be cautious about culling fruit after long-term storage

Fruit Handling and Storage
Processing Practices
- Quality of incoming fruit
- Appropriate washing and culling of fruit
  - Maintain detectable free chlorine (or other sanitizing agent) in wash water
  - Cull rot to less than 1% total by weight for patulin control
- Routine cleaning and sanitation is essential
  - Equipment, especially food contact surfaces
  - Washer brushers
  - Bulk tanks

Processing Practices
- Juice HACCP Performance Standard = 5-log reduction in the pertinent pathogens of concern
  - *E. coli* O157:H7
  - *Cryptosporidium parvum*
- Conditions to achieve the 5-log reduction
  - Thermal processing (161°F for 15 seconds is safe harbor, other thermal processes also validated)
  - Ultraviolet light treatment
  - Other technologies possible, but validation data largely lacking.

Food Safety Training Resources
- Standardized HACCP Training Curriculum – Recognized by FDA

  Available on-line at:
  http://www.rcht.iit.edu/juice%20HACCP%20First%20Edition.pdf
Cider Making Safety Course - Details

Eight modules:
1. Introduction to cider safety, laws and regulations
2. Food safety hazards
3. Pre- and Post-Harvest Food Safety for Apples
4. Sanitary Facilities and Utensils
5. Cleaning and Sanitizing
6. Worker Health and Hygiene
7. Control of Food Safety Hazards, Processing Technologies
8. HACCP and other Food Safety Management Systems

More information at:
http://www.michiganappleassociation.com/OnlineCourses.aspx

Food Safety Knowledge Network

- MSU Initiative to develop standardized, competency-based training for the food industry.
- Presentations on several food safety topics are available free at the following web sites:
  - http://fsktraining.org/coca-colafoodsafety09/program
  - http://fsktraining.org/training/intermediatetask08/program
- Additional materials available here:
  - http://www.fsktraining.org/
  - http://foodsafetyknowledgenetwork.org/

Key Take Home Messages

- For microbiological safety of untreated apple cider, quality and proper handling of incoming fruit is of paramount importance.
- NO DROPS! (illegal for untreated cider, OK for treated)
- Sanitation and hygiene during harvest and storage
- The industry needs to be diligent about patulin controls.
  - Proper culling of fruit (<1% rot in pressed apples)
  - Be careful about storage conditions of fruit – patulin can form quickly
  - Be selective about fruit – more patulin problems in “bad” years

For Additional Information

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