Minimum Requirements For Effective Food Safety Interventions to Reduce *Listeria monocytogenes* Contamination of Ready to Eat Meat Products

Randall Huffman, Ph.D.
Vice President, Scientific Affairs
American Meat Institute Foundation
Food Safety Interventions and Food Attribution Workshop
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Prevalence of *Listeria monocytogenes* in RTE Meat and Poultry Products

*Continuous Improvement*

How did it happen?

What did it cost?

*FSIS results of ready-to-eat products analyzed for *Listeria monocytogenes*
Objective

What led to decline?
- Awareness
- Regulations / Zero tolerance
- Sanitary redesign of equipment / facilities
- Aggressive sanitation
- Environmental testing
- Corrective action
- Ingredient technology
- New Processing methods
- Education / training

What is the cost?
- Very complex, difficult to quantitate
- Multiple points of control
- Varied cost based upon product hazard analysis
- One size does not fit all
<table>
<thead>
<tr>
<th>Cost categories</th>
<th>1986-88</th>
<th>2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changing plant operations – changing production lines/lab tests/increased sanitation/plant clean-up</td>
<td>$6.6</td>
<td>?</td>
</tr>
<tr>
<td>Capital investment in new buildings and new equipment</td>
<td>$2.4</td>
<td>?</td>
</tr>
<tr>
<td>Worker/management education programs</td>
<td>$0.3</td>
<td>?</td>
</tr>
<tr>
<td>Total</td>
<td>$9.3</td>
<td>?</td>
</tr>
</tbody>
</table>

*Adapted from Roberts & Pinner, 1990, Society for Industrial Microbiology*
AMI TASK FORCES

- **Facility Design**
  - 11 Principles for sanitary design of facilities

- **Equipment Design**
  - 10 Principles of sanitary design for RTE processing equipment

- **Listeria Intervention and Control workshop**
  - 6 strategies for effective Listeria Control
SANITARY DESIGN PRINCIPLES FOR FACILITIES

Three Broad Themes

- Provide Zones of Control
- Keep It Cold & Control Moisture
- Design to Facilitate Sanitation
SANITARY DESIGN PRINCIPLES FOR FACILITIES

PRINCIPLE #2

Personnel & Material Flows Controlled to Reduce Hazards
Personnel Controls

$20,000/scrubber

$10,000/door

Boot Scrubbers

Access Control Card Reader

Magnetic Lock
SEPARATE LOCKER ROOMS FOR HIGH RISK & LOWER RISK PERSONNEL
SANITARY DESIGN PRINCIPLES FOR FACILITIES

PRINCIPLE #5

ROOM AIR FLOW & ROOM AIR QUALITY CONTROLLED

BUILD IT TIGHT AND VENTILATE IT RIGHT
Typical Unit Cooler

$120,000/room
Critical Process Air Handler

- Make-up Air
- Filtration
- Clean-up Purge Exhaust

$420,000/room
SANITARY DESIGN PRINCIPLES FOR FACILITIES

PRINCIPLE #8

INTERIOR SPATIAL DESIGN PROMOTES SANITATION
ADEQUATE EQUIPMENT SPACING - 360° ACCESS

Increased square footage @$250/ft^2

From This
Design

To This More
Sanitary Design
### PRINCIPLES OF SANITARY DESIGN

<table>
<thead>
<tr>
<th>Principle</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Separate Raw from RTE</td>
<td>A food plant should have physical separation between ready-to-eat (RTE), and raw area. This separation should include personnel, personnel traffic, air handling, equipment, CIP systems, locker rooms, or other situations that could carry microorganisms from a raw to an RTE area.</td>
</tr>
<tr>
<td>Must Be Cleanable</td>
<td>A food plant and equipment must be constructed and be maintained to sustain cleanability, to prevent bacterial and insect ingress, survival, growth and reproduction. This includes: equipment, walls, floors, ceilings, doors and insulation.</td>
</tr>
<tr>
<td>Made of Compatible Materials</td>
<td>Construction materials used for structure must be completely compatible with the product, environment and cleaning materials used and the method of cleaning. Equipment materials of construction must be inert, nonporous and nonabsorbent.</td>
</tr>
<tr>
<td>Smooth and Accessible Surfaces</td>
<td>All parts of the product zone shall be free of pits, cracks, corrosion, recesses, open seams, gaps, lap seams, protruding ledges, inside threads, bolts rivets and dead ends, and shall be readily accessible for cleaning and inspection of easily disassembled for cleaning without the use of tools.</td>
</tr>
<tr>
<td>Must be Self Draining</td>
<td>Equipment shall be self-draining to assure that water or product liquid does not pool on the product zones and that liquid cannot drain, be drawn, or drip onto product zone areas.</td>
</tr>
<tr>
<td>Framework Not Penetrated</td>
<td>Tubular steel equipment framework must be totally sealed and unpenetrated. Bolts, studs, etc. must be welded to the surface of the tubing and not attached via drilled and tapped holes.</td>
</tr>
<tr>
<td>Proper Ventilation</td>
<td>Adequate ventilation of appropriately filtered air (by product sensitivity) should be provided to prevent the formation of condensation, odor or mold, which could result in contamination of raw materials or food.</td>
</tr>
</tbody>
</table>
Principles of Sanitary Equipment Design

Principle #2:
Must be Cleanable

A food plant and equipment must be constructed and be maintained to sustain cleanability, to prevent bacterial survival, growth and reproduction. This includes: equipment, walls, floors, ceilings, doors and insulation.
Must be Cleanable

Uncleanable plastic-metal interface
Must be Cleanable

Makeshift equipment adjustments
Must be Cleanable

Hollow roller on conveyor
Principles of Sanitary Equipment Design

Principle #3: Smooth Surfaces and Accessible

All parts of the product zone shall be free of pits, cracks, corrosion, recesses, open seams, gaps, lap seams, protruding ledges, inside threads, bolts, rivets, and dead ends, and shall be readily accessible for cleaning and inspection of easily disassembled for cleaning without the use of tools.
Overlapping surfaces of belt tensioner are not accessible.
Must be Accessible

Improved belt tensioner design minimizes hidden surfaces
Principles of Sanitary Equipment Design

Principle #6: Framework not penetrated

*Tubular steel equipment framework must be totally sealed and unpenetrated. Bolts, studs, etc. must be welded to the surface of the tubing and not attached via drilled and tapped holes.*
Framework Not Penetrated

Hardware improperly mounted to frame by bolting through tubing.
Framework Not Penetrated

RIVETED NAME PLATE PENETRATES FRAME

WELDED NAME PLATE
– FRAMEWORK NOT PENETRATED
Strategies for Control of *Lm*

*(adapted from AMI Listeria control workshop)*

1. Prevent *Listeria* growth in a niche or other site that can lead to RTE product contamination.
2. Implement appropriate post-lethality technology to eliminate, reduce or prevent the growth of *Listeria*.
3. Implement a *Listeria* sampling plan to assess in a timely manner whether the processing area is “under control.”
4. Respond to each positive product contact sample as rapidly and effectively as possible.
5. Verify the problem has been corrected.
6. Review and analyze data to ensure the *Listeria* control program is working.
Harborage site / niche

A site within the food processing environment wherein microorganisms become established and multiply.
Two factors determine the effectiveness of a *Listeria* control program:

- Environmental testing
  - *(FIND IT!!!)*
- Response to a positive finding
  - *(FIX IT!!!)*
An Effective Sampling Program Will Yield Positive Samples

• The ultimate goal is a *Listeria* negative environment, but this is difficult to maintain over the long term.

• The sampling plan should be designed to detect *Listeria*, if it is present.

• Positives must be treated as a “success” because they enable corrections that can protect consumers!
Transfer Points vs Niches

Many positive sites found during monitoring are not growth niches. They are transfer points (i.e., a product handler’s gloved hands, floor sample in high traffic pathway).

Transfer points are not growth niches because the organism is eliminated during the cleaning and sanitizing process.
GROWTH NICHES

Locations harboring the organism after the routine sanitation process for that area has been completed.

Examples

– Hollow roller on conveyor transporting food product
  - Hollow rollers not disassembled cleaned and sanitized or heat treated in a manner to eliminate any contaminating organisms can become growth niches.
  - will
Factors affecting growth niche development

- Design problem
- Operational conditions
  - Product debris works its way into an uncleanable location
    - Mid shift cleanup
- Use of high pressure during cleaning
GROWTH NICHES

Must either be designed out of the system or managed as a part of the process.

• Design Examples
  › Equipment is redesigned to eliminate or seal hollow areas
    • Hollow areas of equipment (e.g., frames, rollers) must be eliminated where possible or permanently sealed (caulking not acceptable). Bolts, studs, mounting plates, brackets, junction boxes, name plates, end caps, sleeves and other such items must be continuously welded to the surface of the equipment and not attached via drilled and tapped holes.
Growth Niches

Examples of how to minimize with process control techniques

- Disassemble clean and sanitize
- Heat sanitize
  - Cook in oven or smokehouse
  - Cover with tarp and inject steam
  - Place in COP tank
Steam as a sanitizer

“Internal” Temperature of 160 F for ~30 min.
When to sample?

Sampling objectives?

Effectiveness of Sanitation

Looking for L. Growth niches

Transfer Points

Dry clean

Production

Break

Production

Setup

Sanitize

Inspect

Assemble

Foam

Rinse

Sanitize

Assemble

Production

Break

Production

Break

Production

Break

Production

Break

Production

Break

Production

Break

Production

Break

Production

Break

Production

Break
Prevention and Control Trends

Old way......
- Reactionary mode
- React to Contact Surface positive
- Minimal indicator site sampling
- Corrective Action on Contact Surface

New way......
- Preventative mode
- React to Indicator Site positive
- Indicator sites react before CS sites
- Corrective Action on any positive
Prevention and Control Trends

**Old way......**

- Minimal hurdles to prevent entry into RTE
- Deep Clean when Ls+
- Minimal equipment Heat Treating
- Have not disassembled equipment to find problem growth niches

**New way......**

- Multiple hurdles to prevent entry into RTE
- Scheduled Deep Cleaning
- Scheduled equipment Heat Treating
- Know location of deep growth niches and treat accordingly
2004 survey … 62 responses representing 87 establishments

Industry Survey in Response to the Interim Final Rule

- **Testing**: # plants doing both PCS & non-PCS testing increased from 82 to 94%

- **Risk Classification**: 37% of those using new controls reformulated 20 to 100 products with antimicrobials

Alt 3 44% 16% Alt 1
Reformulation to prevent growth of Lm

- Sodium/potassium lactate in combination with diacetate has been documented to prevent Lm growth during storage (Seman et al. 2003; Legan, et al. 2004)

- Estimated usage:
  - 80 – 90% of retail franks
  - 60-70% of sliced deli

- Cost about $0.02/pound

- 2004 Industry-wide cost estimate: $80 - $100 million
Widespread use of Listeria Inhibitors

Lactate & diacetate added to prevent growth of Lm
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Lactate & diacetate added to prevent growth of Lm

Nutrition Facts

- Total Fat 1g (2%)
- Total Carbohydrates 2g (1%)
- Cholesterol 15mg (5%)
- Sodium 370mg (15%)

Vitamin A 0% • Vitamin C 0% • Calcium 0% • Iron 2%

Sliced and packed for Mrs. Stratton's Inc.
Birmingham, AL 35211

NET WT. 10 OZ. (283g)
Other Post Lethality Treatments in Commercial Use

- High pressure processing – in package
- Cook in bag products
- Re-thermalization

While several are proven effective....

An increase in product cost is inevitable; a change in product characteristics is likely.
Closing Thoughts

Continue to establish the linkage between human health and foods

...this is key to being able to justify regulations & apply resources appropriately
Closing Thoughts

Industry must continue to implement effective and verifiable environmental *Listeria* control programs

...remains a need for simplified access to, and implementation of, new technology
Summary

- The foundation for process control must be in place.
- Several post lethality treatments are available for RTE processors.
- Many factors must be considered in validation of the chosen intervention method.
- Do not expect that a single intervention will achieve Listeria control

... no Silver Bullet!
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