Listeria Control in Processed Foods -
How far have we come and where do we go from here?

Jenny Scott - GMA/ FPA
Randy Huffman - AMI Foundation
Steps to control an emerging problem

1. Detect the problem
2. Develop info needed to understand problem, control it
3. Identify appropriate points for control
4. Implement control measures
5. Share Best Practices
6. Measure impact of interventions
7. Repeat steps 2-6
Listeriosis - USA

Cases per 100,000

Contamination Levels of *Lm* When Detected
FSIS Testing for \( Lm \) in RTE products
How did we get here?
1. Detecting the problem

- Key outbreaks/cases –
  - coleslaw, 1981
  - Mexican soft cheese – 1985
  - Turkey frank – 1989
  - Deli meats – 1998-1999
2. Develop info to understand & control \textit{Lm}

- The war against \textit{Listeria monocytogenes}
  - Dairy \(\sim 1985\)
  - Meat and Poultry \(\sim 1989\)
  - Smoked Seafood \(\sim 2000\)
  - All RTE foods that support growth?
  - Retail
From the dairy battle zone we learned...

- Where *Lm* can be found
  - surveillance in dairy products and the environment
- Heat resistance of *Lm* in milk
  - efficacy of milk pasteurization
- Role of post-pasteurization contamination
  - environmental sources within the plant
From the m&p battle zone we learned...

- More on the epidemiology of listeriosis
- The role of niches in *Lm* contamination of foods
- The importance of growth inhibition
- The role of post-packaging pasteurization
- Importance of comprehensive *Lm* control programs
From the seafood battle zone we learned...

- The difficulty of control where there is no lethal process
- The importance of raw material controls
- The importance of temperature controls
3/4. Development and implementation of best practices

- What did industry have to do differently/better to achieve the reductions we have seen in listeriosis?
  - New interventions – process, additives
  - Equipment design
  - Environmental monitoring
  - Sanitation, sanitation, sanitation
Best Practices


Control measures that helped

1. Validated kill steps (e.g., cooking, fermenting/drying)
2. Weekly equipment & environmental sampling program
3. Covered & steamed critical equipment (e.g., collators, slicers & packaging equipment)
Control measures that helped

5. Added citric acid to brine chill systems (pH \leq 3.5)

6. Prevented recontamination after the kill step
   - Detected & eliminated harborage sites

7. Improved equipment design for cleanability
Control measures that helped

8. Added inhibitors to products (e.g., lactate, diacetate)

9. Pasteurized packaged product (steam, hot water, UHP)
5. Sharing best practices

- One company’s sharing
- AMI workshops
- Seafood workshops
One company’s sharing of best practices for *L. monocytogenes* in RTE m&p products

- Sampled products and environment beginning in 1987
- Shared data with trade association and competitors
- Shared data with USDA from 1990 to 2003
One company’s sharing of best practices for *L. monocytogenes* in RTE m&p products (cont.)

- Developed control measures, shared with competitors and USDA
- Created videos and published best-practice guides
- Held 5 annual workshops for customers, suppliers, co-packers; USDA, FDA, CDC participated
- Shared information with consumer groups
AMI TASK FORCES

- Equipment Design
  - 10 Principles of sanitary design for RTE processing equipment
- Facility Design
  - 11 Principles for sanitary design of facilities
- *Listeria* Intervention and Control
  - 6 strategies for effective *Listeria* Control
AMI Sanitary Equipment Design Task Force

Kraft
Sara Lee
Con Agra
Minot
Excel
Hormel
Bar S
Smithfield Foods
Hatfield Quality meats
Tyson Foods
AMI 10 PRINCIPLES OF SANITARY DESIGN

1. Cleanable to a Microbiological Level
2. Made of Compatible Materials
3. Accessible for Inspection, Maintenance, Cleaning & Sanitation
4. No Product or Liquid Collection
5. Hollow areas Hermetically Sealed
6. No Niches
7. Sanitary Operational Performance
8. Hygienic design of maintenance enclosures
9. Hygienic Compatibility with Other Plant Systems
10. Validate Cleaning & Sanitizing Protocols
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.
Principle #8
Hygienic Design of Maintenance Enclosures

View from back side

From This
Previous Design

To This
Sanitary Redesign

Fully Enclosed
Supply line
AMI Sanitary Design Principles for Facilities

Three Broad Themes

- Provide Zones of Control
- Keep It Cold & Control Moisture
- Design to Facilitate Sanitation

11 Principles developed
AMI Sanitary Design Principles for Facilities

PRINCIPLE #5

Room air flow and room air quality controlled

BUILD IT TIGHT AND VENTILATE IT RIGHT
5.6 HVAC/Refrigeration system components located to avoid risk of product contamination
Principle #8
Interior spatial design promotes sanitation

8.3 There is sufficient access to clean the wall-floor interface
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!!!)*
Sanitary Zones

Zone 1
(Product contact surfaces; e.g. slicers, conveyors, peelers, strip tables, utensils, racks, work tables)

Zone 2
(Exterior of equipment; chill units; framework; equipment housing, floors)

Zone 3
(Phones; mules; forklifts; walls; drains)

Zone 4
(Locker rooms, cafeteria, halls)
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** (e.g., 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.
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.
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
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.
Smoked Seafood Working Group

- National Fisheries Institute
- National Food Processors Association
- Sea Grant Programs – NY, Delaware, Virginia
- Cornell University
- 10 smoked seafood processors

Established in 2001
Control Strategies for *Listeria monocytogenes* in Seafood Processing Environments

National Food Safety Initiative Project
Funded by:
Cooperative State Research, Education and Extension Service of USDA under Agreement No. 00-51110-9769
Project Goal:

To understand sources and spread of *Listeria monocytogenes* in ready-to-eat (RTE) seafood processing facilities and to develop intervention strategies that can be implemented by industry.
Project Approach

Study - 4 smoked fish operations (2 East Coast & 2 West Coast)

Year 1 (2001) – Track and evaluate *Listeria* contamination patterns in each plant using molecular DNA subtyping techniques

Year 2 (2002) - Implement and evaluate intervention strategies & their effectiveness

Year 3 (2003) – Conduct industry workshops to facilitate industry use of effective Lm controls
SSWG LM workshops

- Series of 5 workshops in 2003 for RTE seafood processors
  - Implementation of in-plant controls to minimize contamination with Lm
  - 94 from firms that process RTE seafood
  - Follow-up survey: 80% of firms responding (~40% of processors attending) reported modification of existing *Listeria* controls
Where do we go from here?

How do we get the listeriosis numbers down?
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Where do we go from here?

- Better targeting – focus on foods that support growth to prevent high numbers
- Application of what has been learned in dairy, m&p and seafood to ALL RTE foods that support growth
- Evaluate the role of retail in contamination, determine appropriate points for control and implement
Best Practices for Retail

- 2006 Conference for Food Protection:
  - Voluntary guidelines – Sanitation practices, standard operating procedures, and good retail practices to minimize contamination and growth of *Listeria monocytogenes* within food establishments.
  - Workshop “Interventions for *Listeria monocytogenes* in retail food establishments”
Where do we go from here?

- Determine the need for safety-based date labels on foods that support growth where $Lm$ cannot be eliminated.
Shelf life (Days) Remaining on Products Found to Contain *L. monocytogenes* (n=293)
Where do we go from here?

- More research
  - Can we identify specific strains of concern?
  - Can we develop control measures that target these strains?
Where do we go from here?

- Disseminate what we have learned about control of *L. monocytogenes*
  - Emphasize the importance of preventing growth to high numbers - Good temperature control
  - Emphasize the importance of preventing contamination through environmental monitoring programs
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
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AMIF Listeria Control Task Force
Goal

- To find LM if it is present in the environment
Goal

- Consumer Protection