

# Control Strategies for *Listeria monocytogenes* in Seafood Processing Plants

National Food Safety Initiative Project

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2000 to 2003



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## **Project Collaborators:**

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## **Industry Collaborators**

**10 RTE Seafood Processing Plants**

**(4 Smoked Fish; 4 Crab; 2 Crawfish)**

**in ME, NY, MD, VA, LA, and WA**

# Why is *Listeria monocytogenes* a problem?

## Foodborne listeriosis in the U.S.

- 2500 cases (estimated)
- 90% are hospitalized
- 500 deaths (20% of cases)

Source: Centers for Disease Control 1999

# FDA/USDA Risk Assessment

October 2003

## Foods Ranked by Predicted Cases of Listeriosis for the U.S. population on a per serving basis

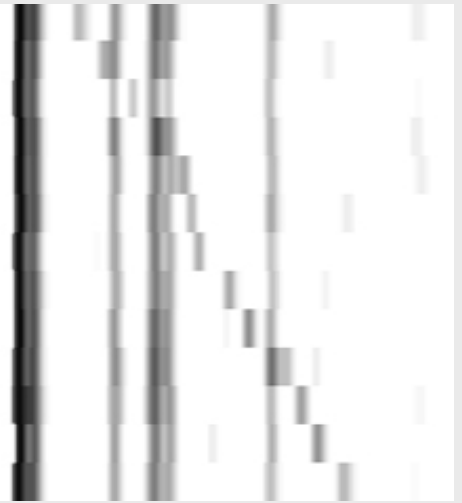
1. Deli Meats
2. Frankfurters (not re-heated)
3. Pate and Meat Spreads
4. Un-pasteurized Fluid Milk
- 5. Smoked Seafood**
- 6. Cooked Ready-to-Eat Crustaceans**

# Project Approach

- 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



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Listeria monocytogenes



# Field study results: two example plants



# Plant 1

- 50,000 square feet with ~100 employees processing ~3 million pounds of cold & hot smoked products
- Approximately 100 year old building
- Major facility & equipment upgrades during 2002 in finished product processing areas
- 56 Drains with periodic backups due to capacity limitations and aging infrastructure
- Many areas of plant never dry out
- Traffic patterns frequently chaotic

**Interventions:** Major remodel of RTE production area & new sanitation system and employee controls implemented between April through June 2002.

Plant A1	3/1/01	3/21/01	4/18/01	5/15/01	6/13/01	7/9/01	8/7/01	10/2/01	11/1/01	12/4/01	2/14/02	3/11/02	4/9/02	5/7/02	6/5/02	7/1/02	8/1/02	8/28/02	9/24/02	#####	12/2/02	#####
<b>Raw Product</b>																						
	L.spp	L.spp	1052A	1042B	-	1039A	1039C	1039C	-	-	1038B	L.spp	L.spp	L.spp	-	L.spp	L.spp	L.spp	1042C	1027A	1052A	1042B
	1 of 6	3 of 6	2 of 6	1 of 6	6 of 6	1 of 6	1 of 6	1 of 6	6 of 6	6 of 6	1 of 6	3 of 6	2 of 6	2 of 6	6 of 6	2 of 6	1 of 6	2 of 6	1 of 6	1 of 6	1 of 6	1 of 6
<b>Raw Environment</b>																						
E2: Drain	-	1043A	-	1052A	1045B	1045B	1039C	1039C	1043A	1043A	L.spp	1052A	1039C	1048A	1039C	1043A	1043A	-	1043A	1062A	1027A	1052A
E8: Apron	1062A	1062A	-	-	-	-	1052A	-	1043A	-	-	-	-	-	-	-	-	-	L.spp	1044A	-	-
Fillet knife						1043A																
<b>Finished Enviroment</b>																						
E1: Drain	1039C	1043A	1042B	1039C	L.spp	L.spp	L.spp	L.spp	1043A	L.spp	1043A	-	1043A			-	1043A	-	L.spp	-	1039C	1039C
E3: Drain	1043A	-	1043A	-	1043A	1039C	-	L.spp	-	1043A	1042C	1042C	1042C	L.spp	1043A	1042C		1043A	1052A	1038B	1052A	1052A
E4: Cooler Floor	1062A	L.spp	-	-	1043A	-	L.spp	L.spp	1052A	1043A	L.spp	-	-	L.spp	1052A	L.spp	-	-	-	1058B	-	L.spp
Floor								L.spp														
Floor mat											L.spp	1052A										
E6: Cart wheels	L.spp	1043A	-	1052A	1027A	1043A	L.spp	1043A	1043A	1052A	1052A	-	-	-	-	-	-	-	-	-	-	-
E5: Under Slice	-	-	-	-	-	-	L.spp	L.spp	-	-	-	-	-	-	-	-	-	-	-	-	-	-
E9: Sliding Door	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Food Contact Surfaces</b>																						
E7: Gloves	-	-	-	-	-	-	-	-	L.spp	1043A	-	-	-	-	-	-	-	-	-	-	-	-
E10: Slicer	-	-	-	-	-	-	-	-	-	-	1027A	-	-	-	-	-	-	-	-	-	-	L.spp
E11: Skinner	-	-	-	-	L.spp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1039C	-	-
E12: DeBoner	-	-	-	1042B	-	-	-	-	-	-	-	-	-	-	-	L.spp	-	1043A	1044A	1044A	1044A	1044A
E13: Sal. Table	-	-	-	-	-	-	-	-	-	-	-	L.spp	-	-	-	L.spp	L.spp	L.spp	-	-	1044A	-
Tubs-dirty									1062A													
Tubs-clean									1043A	1044A												
New Mixer																-	-	-	L.spp	L.spp	L.spp	-
New Table																-	-	-	-	-	-	-
<b>Finished Product</b>																						
	1 of 6	1 of 6	6 of 6	6 of 6	6 of 6	1 of 6	1 of 6	1 of 6	6 of 6	1 of 6	1 of 6	6 of 6	1 of 6	1 of 6	1 of 6	1 of 6	6 of 6	1 of 6	6 of 6	1 of 6	6 of 6	1 of 6
	L.spp	L.spp	-	-	-	1062A	L.spp	L.spp	-	1043A	1042C	-	L.spp	1042C	L.spp	1052A	-	L.spp	-	L.spp	-	L.spp



# Plant 2

- 40,000 square feet with ~150 employees processing >2 million pounds of cold & hot smoked products
- New building: all areas less than 10 years old
- Major facility & equipment upgrades-1996 & 1999
- 46 Drains with adequate capacity
- Many areas of plant never dry out
- Traffic patterns well controlled with good separation of raw and finished product areas

**Interventions:** Employee training on Lm control and modification of policies, evaluation of traffic controls, modification of some sanitation procedures.

Plant A2	2/28/01	3/26/01	4/24/01	5/22/01	6/19/01	7/17/01	8/14/01	9/18/01	10/9/01	11/6/01	12/12/01	1/29/02	3/5/02	4/2/02	5/14/02	6/10/02	7/1/02	7/23/02	8/20/02	9/17/02	10/15/02	11/12/02	12/10/02	
<b>Raw Product</b>													1-L.spp			2-L.spp			1-L.spp			1-L.spp		
	1062D	1060A	-	-	-	-	-	-	-	L.spp	-	L.spp	1025A	-	1053C	-	-	1039C	-	-	-	-	1039C	
	1 of 6	1 of 6	6 of 6	6 of 6	6 of 6	6 of 6	6 of 6	6 of 6	6 of 6	3 of 6	6 of 6	1 of 6	1 of 6	6 of 6	1 of 6	6 of 6	6 of 6	1 of 6	6 of 6	6 of 6	6 of 6	6 of 6	1 of 6	
<b>Raw Areas</b>																								
E3:Drain	1053A	-	-	-	-	-	-	-	-	L.spp	L.spp	L.spp	1053A	-	-	-	-	-	-	-	-	-	-	
Drain						L.spp	1053A	-	-	L.spp	-	-	L.spp	-	-	-	-	L.spp	L.spp	L.spp	-	-	-	
Drain													1053A	1053A	-	-	1053a	1053A	-	1053A	1062A	L.spp	1053A	
Drain													1053A	1053A	1053A	-	L.spp	1053A	1053A	L.spp			-	
Floor mats													1053A	1053A		1053A	1053A	1053A	1053A	1053A	1053A	1053A	1053A	
Mats-clean															1053A									
Plastic pallet													1053A	-	-	-	L.spp	-	-	-	-	-	-	
Pallet jack handle													-	-	-	-	-	-	-	-	-	-	-	
E8: Apron	1062D	-	-	1053A	-	1053A	1025A	-	1053A	-	1053A	-	-	-	-	-	-	-	-	-	-	-	-	
Fish Box																				L.spp	-	L.spp	-	
<b>Finished Product Areas</b>																								
E1:Trench Drain	L.spp	-	-	116-693	L.spp	L.spp	L.spp	-	L.spp	L.spp	-	L.spp	1042C	L.spp	1042C	L.spp	-	-	L.spp	L.spp	L.spp	L.spp	L.spp	
E2:Trench Drain	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	L.spp	-	-	L.spp	-	-	L.spp	
Trench drain																								
E4:Cart wheels	L.spp	-	-	-	-	-	-	L.spp	-	L.spp	-	-	-	-	-	-	-	-	-	L.spp	L.spp	-	L.spp	
E5:Floor	L.spp	-	-	-	-	L.spp	L.spp	L.spp	L.spp	L.spp	L.spp	-	-	-	-	-	-	-	-	-	1053	1053	-	
Floor mats-Clean													L.spp	L.spp	L.spp	L.spp	L.spp	L.spp	L.spp	L.spp	1042B	L.spp	L.spp	
E6:Slicer platfor	-	-	-	-	-	-	L.spp	L.spp	L.spp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
E9:Door handle	L.spp	-	-	-	-	-	-	1053A	L.spp	-	-	-	-	-	-	-	-	L.spp	-	-	-	-	-	
<b>Food Contact Surfaces</b>																								
E7: Gloves	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1053	-	L.spp	
E10:Skinner	L.spp	-	L.spp	-	-	-	L.spp	L.spp	L.spp	-	L.spp	-	L.spp	-	-	-	-	-	-	L.spp	-	L.spp	-	
E11:Slicer	L.spp	-	-	-	-	-	-	-	-	-	L.spp	-	-	-	-	-	-	-	-	-	1053	-	-	
E12:Vac belt	-	-	-	L.spp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<b>Finished Product</b>																								
	6 of 6	6 of 6	6 of 6	6 of 6	6 of 6	6 of 6	6 of 6	6 of 6	6 of 6	6 of 6	6 of 6	6 of 6	6 of 6	6 of 6	6 of 6	6 of 6	6 of 6	6 of 6	6 of 6	6 of 6	6 of 6	6 of 6	6 of 6	
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1039A	-	

# **Conclusions - Elements of a Complete *Listeria* Control Plan**

- 1. Sanitation and GMPs**
- 2. Training of Plant Personnel**
- 3. Plant Environmental Monitoring/Testing**
- 4. Raw Material Controls**
- 5. Minimize Growth in Finished Product**

**Developed Smoked Seafood Working Group  
(SSWG) *Listeria* control manual**

# Smoked Seafood Working Group (SSWG) members

- National Fisheries Institute
- Food Products Association (formerly National Food Processors Association)
- Sea Grant Programs in NY, VA & DE
  - Cornell University
- 8 Industry Volunteers from NY, ME, MN, IL, and WA

# *SSWG Listeria monocytogenes*

## Control Manual for Smoked Seafood

- Reviewed by FDA Office of Seafood staff – 2003
- Distributed at industry workshops across the U.S. (April-May 2003)
- Published in 4 peer-reviewed manuscripts in Food Protection Trends
- Incorporated into AFDO's model "Cured, Salted, and Smoked Fish Establishments Good Manufacturing Practices" in May 2004 (Docket No. 2005N - 0065);

# Extending the Results

**5 Full-Day Workshops conducted Feb-May 2003**  
in NY City, Louisiana, Virginia, Seattle & Chicago

**175 attendees from 19 states and Canada**

96 attendees (58%) from 65 seafood processing firms

34 attendees (20%) from State agencies in NY, LA, VA, WA, OR

26 attendees (15%) from Federal agencies (FDA, NMFS, Army)

# Post Workshop Evaluation

- Mean overall workshop rating was 4.5 on a 5 point scale where 5=Excellent and 4=Good (n=111)
- Two thirds of the firms reported that they had implemented some Listeria controls in their plant prior to attending the workshop.
- 98% of the industry firms reported that they were planning to modify or enhance their Listeria controls after attending the workshop.

# Six Month Follow-Up Evaluation

~40% (25/65) of the seafood processing firms responded to the follow-up evaluation.

84% (21/25) had implemented some Listeria controls prior to attending the workshop.

76% (19/25) reported that they had modified their existing Listeria controls or implemented new controls since attending the workshop.



# Employee Training

All firms who made changes reported that they had conducted employee training programs in the plant.

15 firms reported that 33 different training programs had been conducted by management.

60% of the firms used the employee training programs developed for the Cornell/USDA project. Available at: [www.foodscience.cornell.edu/wiedmann/TrainingIndex.htm](http://www.foodscience.cornell.edu/wiedmann/TrainingIndex.htm)



# Impacts from Other Attendees

**Service Providers/Educators** – 5 individuals reported that workshop information was shared with 46 RTE seafood processors in the U.S. and 21 foreign companies

**Regulatory Agencies**—11 Federal & 15 state regulators responded 80% shared information from the workshop with processors of RTE seafood products & 60% used the information while conducting inspections.

1 regulatory official used workshop information to develop a new regulation or initiative to control *Listeria* in RTE foods.

# Dissemination of Results

1. Thimothe, J., J. Walker, V. Suvanich, K. L. Gall, M. W. Moody, and M. Wiedmann. 2002. Detection of *Listeria* in crawfish processing plants and in raw, whole crawfish and processed crawfish (*Procambarus* spp.). *J. Food Prot.* 65: 1735-1739.
2. Lappi, V. R., J. Thimothe, J. Walker, J. Bell, K. Gall, M. W. Moody, and M. Wiedmann. 2004. Impact of intervention strategies on *Listeria* contamination patterns in crawfish processing plants: A longitudinal study. *J. Food. Prot.* 67: 1163-1169.
3. Thimothe, J., K. Kerr Nightingale, K. Gall, V. N. Scott, and M. Wiedmann. 2004. Tracking of *Listeria monocytogenes* in smoked fish processing plants. *J. Food. Prot.* 67:328–341.
4. Lappi, V. R., J. Thimothe, K. Kerr Nightingale, K. Gall, V. N. Scott, and M. Wiedmann. 2004. Longitudinal studies on *Listeria* in smoked fish plants: Impact of intervention strategies on contamination patterns *J. Food. Prot.* 67: 2500-2514.
5. Lappi, V. R., A. Ho, K. Gall, and M. Wiedmann. 2004. Prevalence and growth of *Listeria* on naturally contaminated smoked salmon over 28 days of storage at 4°C. *J. Food. Prot.* 67: 1022-1026.
6. Gall, K., V. N. Scott, R. Collette, M. Jahncke, D. Hicks, and M. Wiedmann. 2004. *Listeria* controls for smoked seafood: Implementing targeted GMP and sanitation procedures to prevent finished product contamination. *Trends in Food Protection* 24: 302-315.
7. Jahncke, M. L., R. Collette, D. Hicks, M. Wiedmann, V. N. Scott, and K. Gall. 2004. Treatment options to eliminate or control growth of *Listeria monocytogenes* on raw material and on finished product for the smoked fish industry. *Food Protection Trends* 24:612-619.
8. Hicks, D., M. Wiedmann, V. N. Scott, R. Collette, M. L. Jahncke, K. Gall. 2004. Minimizing *Listeria* Contamination in Smoked Seafood: Training Plant Personnel. *Food Protection Trends* 24: 953-960.
9. Scott, V. N., M. Wiedmann, D. Hicks, R. Collette, M. L. Jahncke, and K. Gall. 2005. Guidelines for *Listeria* testing of environmental, raw product, and finished product samples in smoked seafood processing facilities. *Food Protection Trends* 25:23-34.
10. Gall, K., V. N. Scott, R. Collette, D. Hicks, and M. Wiedmann. 2006. Implementation of *Listeria* Controls by Ready-to-Eat Seafood Processors Following a National Workshop Series. *Food Prot. Trends* 26: 89-95.

# Summary and Conclusions

- Field research in RTE seafood plants was used to identify plant specific *Listeria monocytogenes* transmission patterns, including through use of molecular subtyping methods
  - Subtype data were also used to illustrate “real life” *Listeria* problems in training programs
- Research data allowed for development of *Listeria* control manual, including employee training materials
- Smoked seafood processing plants showed a significant decrease in environmental *Listeria* prevalence after implementation of control strategies
  - One processing plant decreased finished product *L. monocytogenes* prevalence from 4.6 % prevalence before full implementation of control strategies to 0.33% prevalence after implementation.