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Pathogen environmental monitoring programs in small dairy processing facilities

Sarah M. Beno
Department of Food Science
Cornell University

2016 PPS Meetings

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Take Home Messages

- The food processing environment is an important source of key pathogens
- Most processing plants need pathogen environmental monitoring programs
- *Listeria* is everywhere- *Listeria* positives in environmental monitoring programs show that a program is working and are not a concern if they are addressed appropriately

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Overview

- Importance of environmental sampling and key pathogens
- *Listeria*: seek and destroy
- Environmental sampling overview
  - how to set up a plan/where to sample
  - corrective action and documentation
- Environmental sampling in artisan cheese processing facilities

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Food Safety News

Breaking news for everyone's consumption

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CDC: Listeria Probably Contaminated WI Cheese During Production Process

BY NEWS DESK | APRIL 8, 2014

A Listeria outbreak in the Midwest linked to one death and a miscarriage likely was caused by contamination during the cheese-making process, according to a new report from the U.S. Centers for Disease Control and Prevention.

"Inspection of the cheese-making facility revealed that substantial sanitation deficiencies during the cheese-making process itself, after the milk was pasteurized, likely led to contamination," the agency's April 4 Morbidity and Mortality Weekly report stated.

Food Safety News
Breaking news for everyone's consumption

FDA Inspectors Report Long List of Problems at Blue Bell Plants

CEO says products won't be back for several months

BY CATHY SIEGNER | MAY 7, 2015

Inspection teams from the U.S. Food and Drug Administration (FDA) reported numerous problems after recent visits to three production facilities owned and operated by Blue Bell Creameries of Brenham, TX.

The company announced April 20 that it was recalling all products (ice cream, frozen yogurt, sherbet and frozen desserts) manufactured at all of its plants after receiving positive *Listeria monocytogenes* test results from samples of ice cream made at two different facilities. Blue Bell products have been linked to 10 confirmed listeriosis cases in four states and three deaths.

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Key Pathogens

- ***Listeria monocytogenes***
  - Common in many environments
    - High risk of introduction
  - Control strategies need to focus on preventing post-kill step re-contamination
    - Sanitary equipment design
    - Appropriately designed and implemented SSOPs (sanitation standard operating procedures)
    - Environmental testing
- ***Salmonella***
  - Environmental contamination sources in processing plants increasingly recognized as a problem, particularly dry environments (for example cereal, bakery products)
- ***Cronobacter:*** in plants that manufacture infant formula

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Listeria monocytogenes: Human pathogen

- Relatively few cases (1,300/year) but high mortality rate (255 deaths/year) in the US
- Causes septicema, abortion, and encephalitis
  - Symptoms can take 7-60 days to show
- Most commonly affected: elderly, immuno-compromised people, pregnant women, newborns
- Can grow at refrigeration temperatures and is resistant to some stress conditions
  - Killed by pasteurization

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Not all *Listeria* are pathogenic

- The genus *Listeria*:
  - Pathogenic: *L. monocytogenes* and *L. ivanovii*
  - Non-pathogenic: *L. innocua*, *L. seeligeri*, *L. welshimeri*, *L. grayi*, *L. marthii*, *L. rocourtiae*, *L. weihenstephanensis*, *L. fleischmannii*, *L. floridensis*, *L. aquatica*, *L. cornellensis*, *L. riparia*, *L. grandensis*, *L. booriae*, and *L. newyorkensis*
- These species are often considered "index" organisms for *L. monocytogenes*

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Listeria is everywhere

- Natural environments: 1.3% to 8% (NYS data)
- Urban environments: 7.3% (NYS data)
- Ruminant farms
  - Bovine farms with listeriosis cases: 24.3% (n=616)
  - Bovine farms without listeriosis cases: 20.1% (n=643)
  - Small ruminant farms with listeriosis: 32.9% (n=322)
  - Small ruminant farms without listeriosis: 5.9% (n=475)
- *Listeria* species are often found at around 30% prevalence

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Seek and destroy

- *Listeria* contamination frequently linked to the environment
- Implementing a pathogen environmental monitoring program allows tracking of the problem
  - Determining appropriate action toward positives will lead to better control

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Seek and destroy targets Niches

- Niches
  - Drains, floor cracks, floor-wall junctures, hollow table legs, etc.
  - Used to identify sources
- Transfer points
  - Door handles, hands, wheels on a cart, etc.
  - Help determine how the pathogen is moving through the plant

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DNA fingerprinting and persistence

- Pathogens can persist in the environment for years
- DNA fingerprinting can be used to identify sites where the pathogen may be persisting

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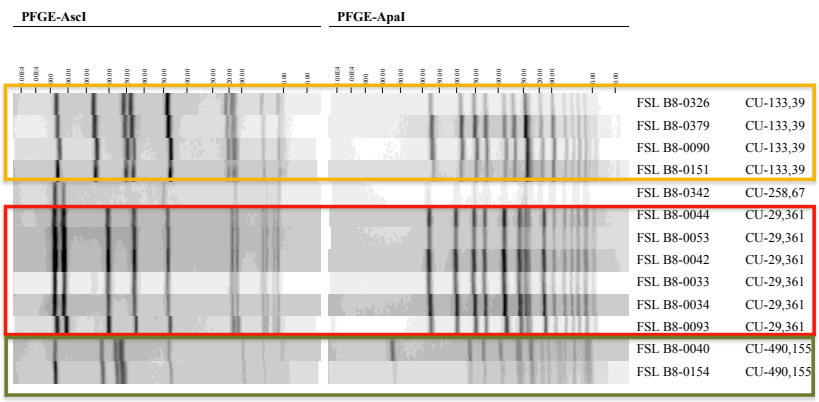
PFGE from Plant H



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Plant H

Site #	May 5/22/14	June 6/19/14	July 7/22/14	August 8/11/14	September 9/15/14	October 10/9/14	November 11/19/14	December 12/9/14	January 1/14/15	February 2/11/15	March 3/11/15	April 4/13/15
1a	*L. mono*	*L. spp.*	*L. mono*	*Neg*	*Neg*	*Neg*	*L. spp.*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*
1b	*L. spp.*	*L. spp.*	*Neg*	*Neg*	*Neg*	*Neg*	*L. spp.*	*L. mono*	*Neg*	*Neg*	*Neg*	*Neg*
2	*Neg*	Neg	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*
3	*L. mono & L. spp.*	*L. spp.*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*L. spp.*	*Neg*	*Neg*	*Neg*
4	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*
5	*Neg*	*L. mono*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*
6	*L. mono*	*L. mono*	*L. mono*	*Neg*	*Neg*	*Neg*	*Neg*	*L. mono*	*Neg*	*Neg*	*L. mono*	*Neg*
7	*L. spp.*	*L. spp.*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*
8a	*L. mono*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*
8b	*L. mono & L. spp.*	*Neg*	*Neg*	*Neg*	*L. spp.*	*Neg*	*Neg*	*L. spp.*	*Neg*	*Neg*	*Neg*	*Neg*
8c	*L. mono & L. spp.*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*
9	*Neg*	*L. spp.*	*Neg*	*L. spp.*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*L. spp.*	*Neg*
10	*Neg*	*L. spp.*	*Neg*	*Neg*	*Neg*	*L. spp.*	*Neg*	*Neg*	*Neg*	*Neg*	*L. spp.*	*Neg*
15	NS	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*
16	NS	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*
17	NS	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*
18	NS	*L. spp.*	*Neg*	NS	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*
19	NS	*Neg*	*Neg*	*Neg*	*L. spp.*	*L. spp.*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*	*Neg*
24a	NS	NS	NS	NS	*Neg*	NS	NS	NS	NS	NS	NS	NS
24b	NS	NS	NS	*Neg*	NS	NS	NS	NS	NS	NS	NS	NS
24c	NS	*Neg*	NS	*Neg*	NS	NS	NS	NS	NS	NS	NS	NS

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	2/25/02
Raw Product Samples	1062D	1060A	-	-	-	-	-	-	-	L. spp	-	L. spp	
	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	
Raw/In-Process Areas													
E3: Floor drain, raw salmon ro	1053A	-	-	-	-	-	-	-	-	L. spp	L. spp	L. spp	
Salmon receiving floor drain				-	-	L. spp	1053A	-	-	L. spp	-	-	
Raw salmon room, Drain (SB-FD1)													
Raw salmon room, Drain (SB-FD2)													
Raw salmon room, 3 floor mats													
RawSalmon room, mats- post cleaning													
Raw salmon room, plstic pallet													
Raw Salmon room, pallet, post cleaning													
Raw salmon room, pallet jacket handle													
E8: Apron, employee in raw are	1062D	-	-	1053A	-	1053A	1025A	-	1053A	-	1053A	-	
Incoming raw materisl packaging												-	
Finished Product Areas													
E1: Trench Drain, processing	L. spp	-	-	116493	L. spp	L. spp	L. spp	-	L. spp	L. spp	-	L. spp	
E2: Trench Drain, smoke room	-	-	-	-	-	-	-	-	-	-	-	-	
Smoke room trench drain, in use													
E4: Cart wheels, for box transp	L. spp	-	-	-	-	-	-	L. spp	-	L. spp	-	-	
E5: Floor, under conveyor belt	L. spp	-	-	-	-	L. spp	L. spp	L. spp	L. spp	L. spp	L. spp	-	
Finish Room, floor mats #1													L. spp
Finish room, floor mats #2													L. spp
Finish room, floor mats, reg. Clean													
Finish room, floor mats, reg. Clean													L. spp
Finish room, 1200 ppm Quat, weekend													L. spp
Finish room, 1200 ppm Quat, weekend													-
Bootdip valve cover, processin	-	-	L. spp										
E6: Platform under Geba #1 sli	-	-	-	-	-	-	L. spp	L. spp	L. spp	-	-	-	
E9: Sliding door handle, skinnin	L. spp	-	-	-	-	-	-	1053A	L. spp	-	-	-	
Food Contact Surfaces													
E7: Gloved hands, finish prod.	-	-	-	-	-	-	-	-	-	-	-	-	
E10: Skinning machine	L. spp	-	L. spp	-	-	-	L. spp	L. spp	L. spp	-	L. spp	-	
E11: Geba #5 slicer	L. spp	-	-	-	-	-	-	-	-	-	L. spp	-	
E12: 20/20 vac belt	-	-	-	L. spp	-	-	-	-	-	-	-	-	
	6 of 6	6 of 6	6of 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	
Finished Product Sample	-	-	-	-	-	-	-	-	-	-	-	-	

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	2/25/02	3/5/02	4/2/02	4/16/02	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
														1-L.spp			2-L.spp			1-L.spp					1-L.spp
Raw Product Samples	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
Raw/In-Process Areas																									
E3: Floor drain, raw salmon ro	1053A	-	-	-	-	-	-	-	-	L.spp	L.spp	L.spp		1053A	-		-	-	-	-	-	-	-	-	-
Salmon receiving floor drain				-	-	L.spp	1053A	-	-	L.spp	-	-		L.spp	-		-	-	-	L.spp	L.spp	L.spp	-	-	-
Raw salmon room, Drain (SB-FD1)														1053A	1053A		-	-	1053a	1053A	-	1053A	1062A	L.spp	1053A
Raw salmon room, Drain (SB-FD2)														1053A	1053A		1053A	-	L.spp	1053A	1053A	L.spp			-
Raw salmon room, 3 floor mats														1053A	1053A			1053A	1053A	1053A	1053A	1053A	1053A	1053A	1053A
RawSalmon room, mats- post cleaning																1053A	1053A								
Raw salmon room, plstic pallet														1053A	-			-	L.spp	-	-	-	-	-	-
Raw Salmon room, pallet, post cleaning																-	-								
Raw salmon room, pallet jacket handle														-	-		-	-	-	-	-	-	-	-	-
E8: Apron, employee in raw are	1062D	-	-	1053A	-	1053A	1025A	-	1053A	-	1053A	-		-	-		-	-	-	-	-	-	-	-	-
Incoming raw material packaging												-		-	-		-	-	-	-	-	L.spp	-	L.spp	-
Finished Product Areas																									
E1: Trench Drain, processing	L.spp	-	-	116-491	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, smoke room	-	-	-	-	-	-	-	-	-	-	-	-		-	-		-	-	L.spp	-	-	L.spp	-	-	L.spp
Smoke room trench drain, in use																1053A	-	-	-	-	-	-	-	-	-
E4: Cart wheels, for box transp	L.spp	-	-	-	-	-	-	L.spp	-	L.spp	-	-		-	-		-	-	-	-	-	L.spp	L.spp	-	L.spp
E5: Floor, under conveyor belt	L.spp	-	-	-	-	L.spp	L.spp	L.spp	L.spp	L.spp	L.spp	-		-	-		-	-	-	-	-	-	1053	1053	-
Finish Room, floor mats #1													L.spp												
Finish room, floor mats #2													L.spp												
Finish room, floor mats, reg. Clean														L.spp	L.spp	L.spp	L.spp	L.spp	L.spp	L.spp	L.spp	1042B	L.spp	L.spp	L.spp
Finish room, floor mats, reg. Clean													L.spp												
Finish room, 1200 ppm Quat, weekend													L.spp												
Finish room, 1200 ppm Quat, weekend													-												
Bootdip valve cover, processin	-	-	L.spp																						
E6: Platform under Geba #1 sli	-	-	-	-	-	-	L.spp	L.spp	L.spp	-	-	-		-	-		-	-	-	-	-	-	-	-	-
E9: Sliding door handle, skinni	L.spp	-	-	-	-	-	-	1053A	L.spp	-	-	-		-	-		-	-	-	L.spp	-	-	-	-	-
Food Contact Surfaces																									
E7: Gloved hands, finish prod.	-	-	-	-	-	-	-	-	-	-	-	-		-	-		-	-	-	-	-	-	1053	-	L.spp
E10: Skinning machine	L.spp	-	L.spp	-	-	-	L.spp	L.spp	L.spp	-	L.spp	-		L.spp	-		-	-	-	-	-	L.spp	-	L.spp	-
E11: Geba #5 slicer	L.spp	-	-	-	-	-	-	-	-	-	L.spp	-		-	-		-	-	-	-	-	-	1053	-	-
E12: 20/20 vac belt	-	-	-	L.spp	-	-	-	-	-	-	-	-		-	-		-	-	-	-	-	-	-	-	-
	6 of 6	6 of 6	6of 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	1 of 6	6 of 6
Finished Product Sample	-	-	-	-	-	-	-	-	-	-	-	-		-	-		-	-	-	-	-	-	-	1039A	-

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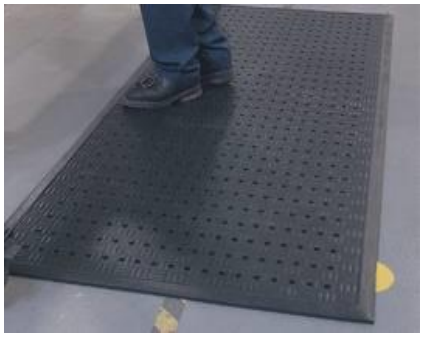
L. monocytogenes persisted in rubber floor mats despite sanitation



Listeria can be protected from sanitizer in “micro-cracks”, but can be squeezed out by pressure if people stand on mats

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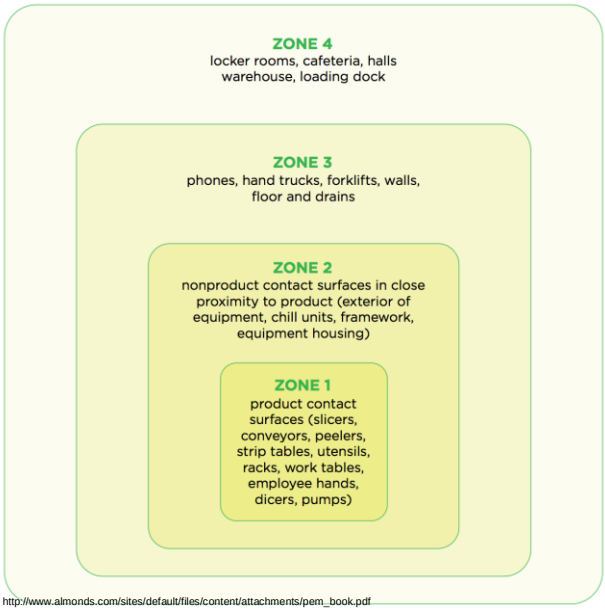

http://www.almonds.com/sites/default/files/content/attachments/pem_book.pdf

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Where to sample

- Niches
  - Drains, floor cracks, floor-wall junctures, hollow table legs, etc.
  - Used to identify sources
- Transfer points
  - Door handles, hands, wheels on a cart, etc.
  - Help determine how the pathogen is moving through the plant

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What are you sampling?

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What about when you hear…

"*If sampling reveals the presence of Listeria species, it is important that the processor immediately shuts down the plant and implements an aggressive sanitation protocol and resampling until Listeria is not found*." (KSU professor in IFT ePerspectives)

"Our company goal for 2016 is zero Listeria environmental positives" (Anonymous)

"FDA will collect 100s of environmental samples in your plant if your records show a single Listeria positive" (industry rumors after an FDA visit and record review, followed by FDA swab-a-thon)

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Corrective Actions

- Plant-specific correction plan
- Positive samples need follow-up: re-testing and vector swabbing
- Sometimes a problem area may need to be closed off

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Plant G: Problem Area

		May	June	July	July	August	September	October	November	December	January	February	March	April
Site #	Zone	5/22/14	6/17/14	7/1/14	7/9/14	8/11/14	9/16/14	10/8/14	11/13/14	12/10/14	1/13/15	2/4/15	3/11/15	4/21/15
1	3	Neg	Neg	NS	L. spp.	Neg	Neg	L. spp.	Neg	Neg	Neg	Neg	Neg	Neg
2	3	Neg	Neg	NS	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg
3	3	Neg	Neg	NS	L. mono	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg
4	3	Neg	Neg	NS	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg
5a	3	Neg	Neg	NS	Neg	Neg	L. mono	Neg	Neg	Neg	Neg	Neg	Neg	Neg
5b	3	Neg	Neg	NS	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg
5c	3	Neg	L. mono	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg
6	3	Neg	Neg	NS	Neg	Neg	Neg	L. spp.	Neg	Neg	Neg	Neg	Neg	Neg
7	3	L. spp.	Neg	NS	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg
8	3	L. spp.	Neg	NS	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg
9	3	Neg	L. mono, L. sp	L. spp.	L. spp.	L. mono., L. sp	NS	NS	NS	NS	NS	NS	NS	NS
9a	3	NS	NS	NS	NS	NS	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg
10	3	Neg	Neg	NS	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg
11	3	Neg	L. spp.	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	L. spp.
12a	3	Neg	Neg	NS	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg
12b	3	Neg	Neg	NS	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg
13a	3	Neg	Neg	NS	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	NS	NS
13b	3	Neg	Neg	NS	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	NS	NS
14a	3	Neg	Neg	NS	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg
14b	3	Neg	Neg	NS	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg
14c	3	Neg	Neg	NS	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg
15	3	Neg	Neg	NS	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg	Neg

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Corrective Actions

- Plant-specific correction plan
- Positive samples need follow-up: re-testing and vector swabbing
- Shutting down problem areas
- **Written records**
  - Results from environmental sampling should be kept and organized (binder)
  - Corrections should be documented with detail
    - Who, what, when, where, and why

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Date of Environmental Sampling/Swabbing: 5/15/2013

Site Found Positive: 23 Circle one: *Listeria monocytogenes* or *Listeria* species or *Salmonella*

Date action taken: 5/23/2013

Detailed description of action taken on positive site:

Thorough cleaning with an acid cleaner (vs. our old chlorine bleach) was performed

Mark which applies:

- x perform immediate out of cycle testing
- o swab again during next scheduled testing

Follow-up Environmental testing Results (circle one): Negative or Repeat Positive

AUA 6/13/2013

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ARTISAN CHEESE- ENVIRONMENTAL SAMPLING

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Project Goals

- Develop and implement environmental pathogen control plans in small and medium facilities
  - Focus on *Listeria monocytogenes* and *Listeria* spp.
- Develop an approach to scientifically validate sampling plans for a given plant

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Ultimate goal is to provide processors with data to demonstrate that a scientifically validated approach is used to control environmental pathogen sources.

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- Plants were selected based on willingness to participate, location, and frequency of production
  - New York State
  - produce cheese at least 7 months/year

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- 9 plants
  - 5 original participants
  - 4 additional after 2 plants stopped making cheese
- Farmstead
  - 7/9 facilities are on the same land as the animals that provide the milk
- Seasonal vs. Year-round
  - 2 plants produce cheese seasonally
  - 7 produce cheese throughout the year

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Site selection

- Zones 2-4
- ~20-50 samples per plant
- Raw milk

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Testing

- Samples shipped overnight to Cornell and processed upon arrival
  - Monthly
- Samples tested for *Listeria monocytogenes* and other *Listeria* species
- FDA BAM

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Overall *Listeria* prevalence in environmental samples

- 4,430 samples taken
- 267 positives (6.03%)

- 1.4% of environmental samples were positive for *L. monocytogenes*.

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Listeria prevalence in raw milk by plant

Plant (n=)	ANY *Listeria* spp.	*L. monocytogenes*
A (73)	27%	16%
C (19)	10%	5%
D (9)	--	--
E (24)	--	--
F (14)	--	--
G (26)	--	--
H (6)	--	--
I (0)	--	--
J (12)	--	--

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Listeria environmental prevalence by plant

Plant (n=)	ANY *Listeria* spp.	*L. monocytogenes*
A (917)	3.2%	1.3%
C (257)	12%	5.8%
D (202)	1.5%	1%
E (1000)	12.7%	0.7%
F (422)	0.9%	<0.2%
G (596)	4.2%	1.3%
H (259)	14%	5.02%
I (501)	0.2%	<0.2%
J (276)	4.0%	1.1%

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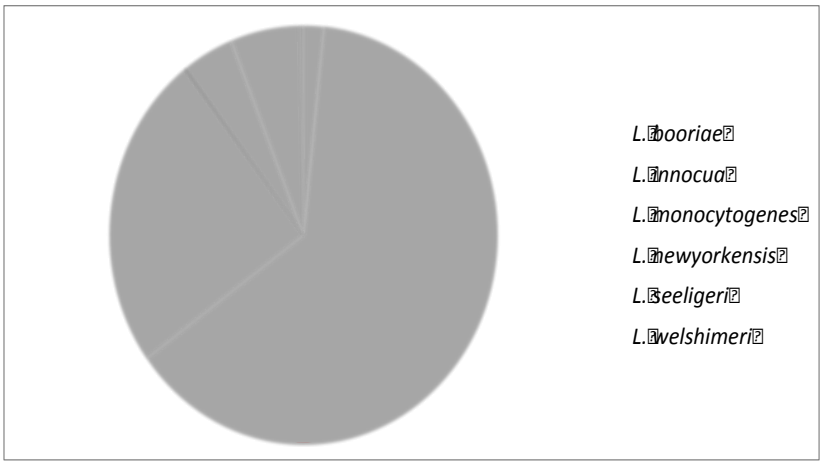
Overall *Listeria* by species



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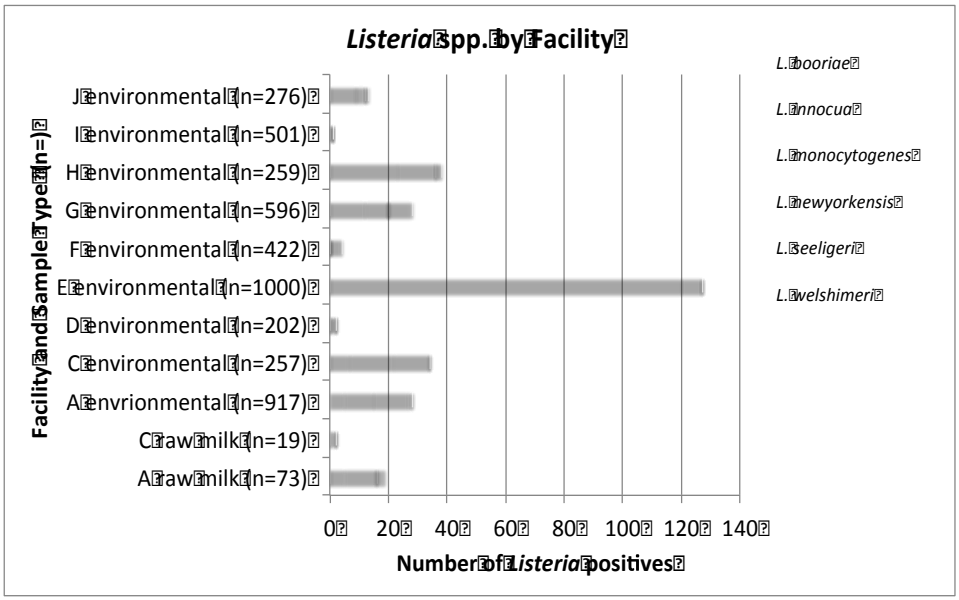

Probability of *Listeria* by Zone

Zone	Samples taken	ANY *Listeria* spp.	*L. monocytogenes*
2	1,063	2.76%	0.126%
3	3,009	3.52%	0.996%
4	358	5.72%	3.264%

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Validation

- Completed after min. 6 months of sampling
- Routine sampling
  - under supervision
- Additional sample sites
  - performed by individuals with experience in environmental sampling who did not take the routine samples
- Sites were selected from zones 2-4

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Validation results

Plant ID	Prevalence (from routine)	Goal for validation
A	**5.1%** (34/664)	<10.2%
E	**11%** (88/795)	<22%
F	**<0.3%** (0/334)	<10%
G	**9.1%** (19/209)	<18.2%
H	**23%** (24/106)	<46%
I	**0.4%** (1/222)	<10%
J	**0.9%** (1/106)	<10%

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Validation results

Plant ID	Prevalence (from routine)	Goal for validation	Prevalence (from validation)
A	**5.1%** (34/664)	<10.2%	**1.3%** (2/150)
E	**11%** (88/795)	<22%	**10%** (6/60)
F	**<0.3%** (0/334)	<10%	**6.0%** (3/50)
G	**9.1%** (19/209)	<18.2%	**2.4%** (2/85)
H	**23%** (24/106)	<46%	**4%** (2/50)
I	**0.4%** (1/222)	<10%	**<2.0%** (0/50)
J	**0.9%** (1/106)	<10%	**14%** (7/50)

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Project Summary

- 4,430 samples tested for *Listeria*
  - Overall prevalence of 6.03%
- Approximately ¾ of these were non-pathogenic species, primarily *L. innocua*
- Pathogen environmental monitoring programs help plants to control *Listeria* and prevent contamination
- Validation sampling generally had less positives than routine

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Take Home Messages

- The food processing environment is an important source of key pathogens
- Most processing plants need pathogen environmental monitoring programs
- *Listeria* is everywhere- *Listeria* positives in environmental monitoring programs show that a program is working and are not a concern if they are addressed appropriately

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Questions?

http://farmprogress.com/cdfm/Faress1/author/198/2014/10/meetings_answers_questions_new_federal_dairy_program_1_635483550818483066.jpg