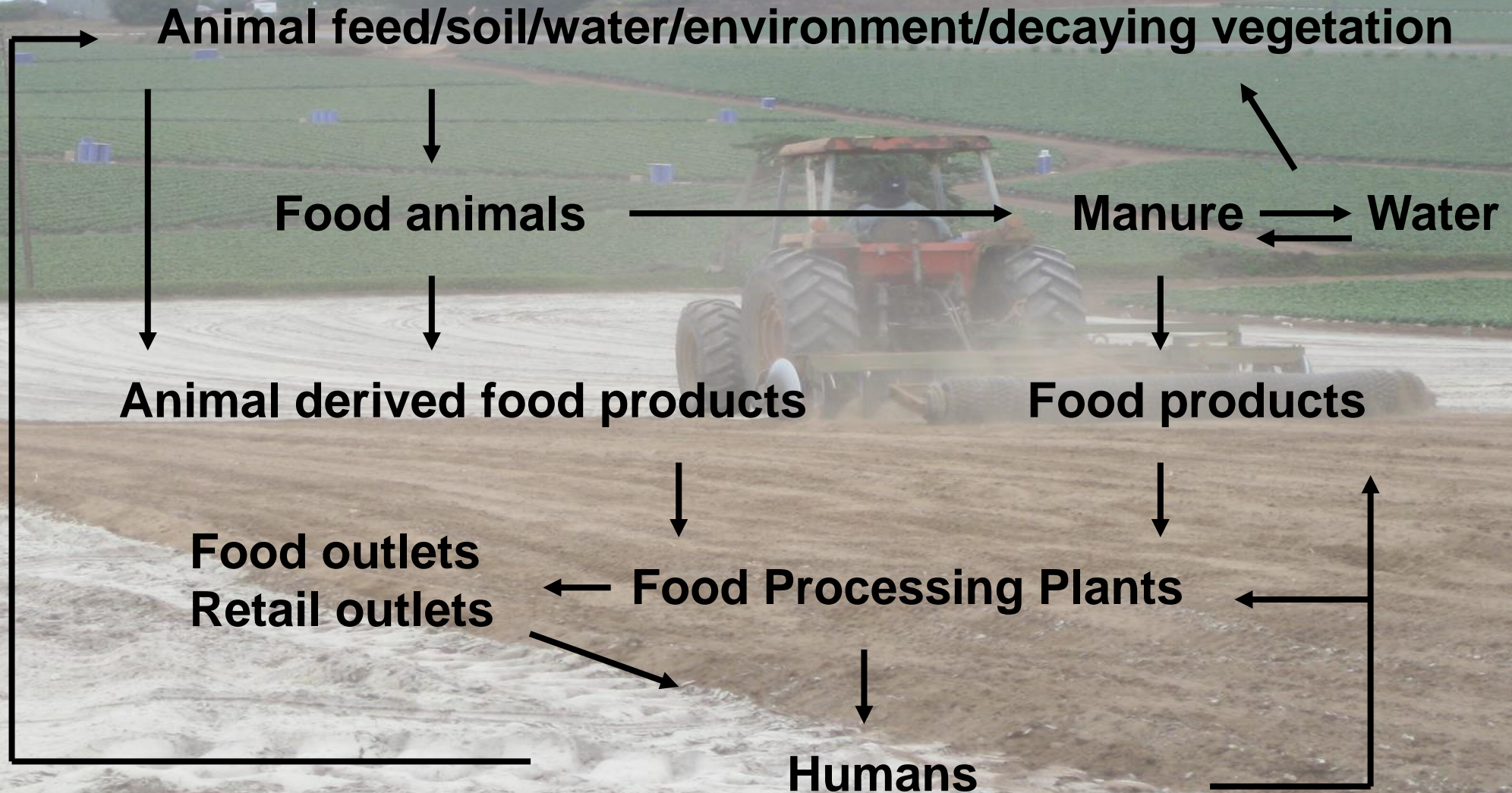




Listeria vs Salmonella Vulnerabilities and Control Measures in Growing and Packing Environments

Trevor Suslow & Emily Griep

Environmental Routes of Transmission apply to *L. mono* and *Salmonella*





A key difference is that *Listeria* is a true environmental pathogen



- Exclusion of animal hosts is not an effective preventive control
- Soil, rhizosphere surfaces, water and sediments, and decaying plant matter are all natural and supportive habitats

Generalities: *Listeria* vs. *Salmonella*

<i>L. monocytogenes</i>	<i>Salmonella</i>
Rare, but very severe disease	Common community illnesses, symptoms often mild and short-lived
Potentially found everywhere; up to 10% “general environment” and up to 50% in livestock farm environments	Rare in soil and general environment (<1% prevalence); may become common in some livestock associated environments
Soil and water likely source of contamination; virtually impossible to completely prevent in farm and field	Wildlife and livestock likely direct sources Water likely indirect source Preventive controls can be effective
Human disease unlikely unless pathogen can grow on product	Growth of pathogen on product not required to cause human disease
Key strategies for farm control <ul style="list-style-type: none">• Preventive control of LM introduction on inputs• Preventive controls of LM cross-contamination at harvest	Key strategies for farm control <ul style="list-style-type: none">• Preventive control of Salmonella contamination on inputs• Minimize animal intrusion effects• Buffering against risk at harvest

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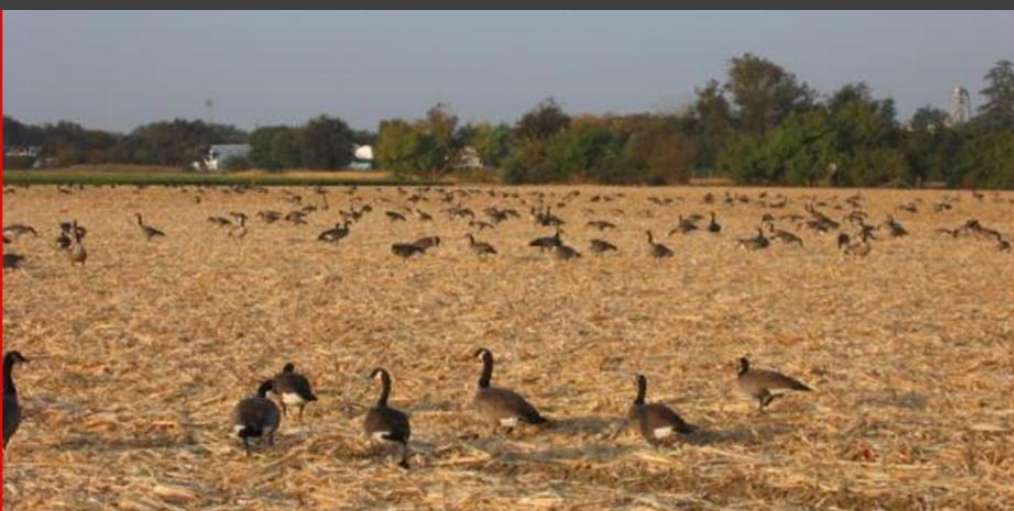
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***Listeria monocytogenes* in Multiple Habitats and Host Populations**

- Listeriosis most common in domestic ruminants (cattle, sheep, & goats)
 - silage feeding is an important risk factor
- Many animals are asymptomatic shedders of L.m. (and Salmonella)
- Poultry can be a source of L.m.
- Found in deer, elk, raccoons, fox, birds, and many others
 - Crow 43% *Listeria* sp. & 5% L.m.





Cattle can have high % of herd carrying *L.m.* and/or *Salmonella* - Interactions with birds as vectors are recognized

Listeria spp. were isolated from 47 of 495 samples (7%) of Canada geese

Birds and other animals are recognized vectors for both pathogens



Damage by seed eaters
(finches, sparrows)



Damage by flesh eaters
(blackbirds, starlings, seagulls,
ground squirrels, mice)





Both Salmonella and Listeria might be expected in on-farm impoundments in areas where frost control may be used

- Samples from 26 of 99 (26%) gulls resident at sewage sites were positive for *Listeria* spp. and 15 of 99 (15%) were positive for *L. mono*
- At non-sewage sites, 14 (8%) gulls were positive for *Listeria* spp. with only 8 (5%) positive for *L. monocytogenes*.



Adjacent environmental areas may be a source of transfer

- *Listeria Species in a California Coast Estuarine Environment.*
- K. G. Colburn et al. 1990. AEM 56: 2007-2011
- **Listeria sp. and L. monocytogenes found in 81% of fresh water samples (n = 37)**
- **L. mono in 62% of samples from low-salinity sloughs**
- **L. monocytogenes most common when domesticated animals (cows, horses) nearby**
- **Incidence associated with recent rainfall**



Awareness of risk is critical



A wide-angle photograph of a strawberry field. The field is filled with rows of green strawberry plants, many of which have small white flowers and some ripe red strawberries. The plants are spaced out, and a central path or furrow runs down the middle of the field. The ground between the rows is covered with black plastic mulch. In the background, several people wearing yellow protective suits are visible, likely workers in the field. There are also some structures and a tractor in the distance. The sky is overcast and grey. The text "Critical Thinking Exercise" is overlaid in the center of the image in a bold, yellow, sans-serif font.

Critical Thinking Exercise

What are the microbiological hazards and risk considerations for harvest under these conditions ?





What are the continuing risk considerations for the crop?



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Main Takeaways (Post-harvest)

- Expect *Listeria* spp. (potentially *Salmonella*) to be present on product and transferred to your environment – take action to **prevent** their residence
- Basic GMP and sanitation procedures can go a long way if followed and implemented appropriately
 - Environmental monitoring can be used to verify this
- *Listeria* spp. and *Salmonella* are not created equal – EM requires different approaches and considerations

What is an environmental pathogen?

“A pathogen capable of **surviving** and **persisting** with the manufacturing processing, packing, or holding environment such that food may be contaminated and may result in foodborne illness if that food is *consumed without treatment* to significantly minimize the environmental pathogen.

Examples of environmental pathogens include ***Listeria monocytogenes*** and ***Salmonella*** spp...”

-FDA Hazard Analysis and Risk-Based Preventive Controls for Human Food: Guidance for Industry

Why focus on *Listeria* spp. in RAC and Fresh-Cut?

- *Listeria* is a soil-borne microorganism ('ubiquitous' in the environment)
 - It can come in on raw product

BUT

- Listeriosis outbreaks and recalls have consistently traced back to **facility** issues
 - Coleslaw, Cantaloupe, Stone fruit, Caramel apples, Packaged salads, etc.
 - *Lm* can grow under refrigeration and loves wet, undisturbed environments

└─→ Can 'select' for *Listeria*

What if the packing environment is dry?

- *Listeria* is not a strong competitor
 - Warmer environments (not climate controlled) promote bacterial growth
 - Does not survive dehydration
 - Not a likely target for an EMP
- *Salmonella*:
 - In produce, most often associated with growing environment
 - Survives in dry packing environments, thrives with introduction of water
 - Low likelihood; Can be dormant in a produce packing environment

What does a 'dry environment' mean to you?

Key Postharvest Control Measures - GMPs

No 'kill-step' is available in produce – **prevention is key:**

- Personnel
- Plant and grounds
- Sanitary operations
- Sanitary design of facility and equipment
- Equipment and utensils
- Processes and controls
- Warehousing and distribution

Controlling *Listeria* Begins Before the Packinghouse

- Minimizing contamination in the field
 - GAPs, training workers, minimize dirt on containers, etc.
- Keeping grounds tidy outside the facility
 - Mow lawns, no litter, etc.

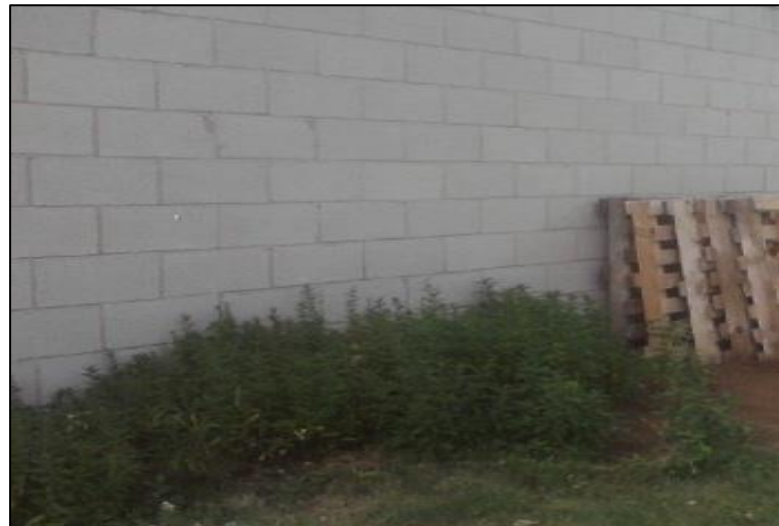


Photo credit: M. Danyluk

Controlling Listeria - Know your Facility

- Facility design
 - Where are areas with excess moisture, or standing water?
 - Drains & Floors
 - Condensate
 - Access to equipment



- Product Flow
 - What are contact surfaces?
 - Where does product enter? Where does it go out?



- Pest issues
- Water Management

Controlling Listeria - Know your Facility

- Vehicle and employee traffic patterns
 - Signage, footbaths, quat crystals, barriers, etc.
- Employee practices
- Equipment/ tool design
 - Easy disassembly?
 - Color coding
 - Hollow rollers/supports, sandwich joints, etc.
 - ‘Legacy’ equipment, capital prioritization
- Air flow



Employee Training and Practices

- *Listeria/ Salmonella* awareness
 - Source and spread
 - Importance of cleaning/sanitation procedures
 - Encouragement to find it
- Facility-specific procedures
- Hand-washing, glove use, hygiene policies, etc.



Photo credit: T. Suslow

Water Management – DRY DRY DRY

Once water is introduced to the environment, the potential for harborage and/or growth of environmental pathogens in the packing environment increases!

Routine/ Intentional

- Nightly sanitation
 - Niches can hold moisture
- Hydrocooling of product prior to packing



Unintentional water ‘events’

- Employee and equipment traffic
- Condensation on packing line from cold-stored product
- Moisture from damaged product or lower quality grade
- Roof leaks
 - ‘triggering’ events often associated with packing/processing facility outbreaks

Key Control Measures – Environmental Monitoring

Primary Objectives:

- **Preventing** transient *Listeria* from becoming entrenched, forming biofilms, and spreading within the facility
- **Verifying** existing control measures are effective
- **Detecting** *Listeria* that has become entrenched in the produce handling environment before it can spread to the point of contaminating product
- **Determining** when and what corrective action is appropriate.

What about EMPs in a hybrid environment?

- Approach with a risk assessment mindset
 - *Listeria* spp. more likely to be carried in on raw product; harbors in moist environments
 - **Target for routine environmental monitoring**
 - *Salmonella* less frequently associated with product, w/ exception of contamination events
 - **Target for less frequent routine monitoring and/or on event basis**

Where to find more information

- United Fresh
 - Listeria Guidance
 - Zone 1 sampling resource
 - Webinars
 - And much more!



- FDA Draft Guidance
- Extension, association resources

Control of *Listeria monocytogenes* in Ready-To-Eat Foods: Guidance for Industry Draft Guidance