Background Information on Lm/Listeriosis

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Listeria and foodborne illness

Listeria and produce

Listeria and the environment
FOODBORNE ILLNESS

- CDC estimates that each year 48 million people get sick from a foodborne illness, 128,000 are hospitalized, and 3,000 die.

- Many different disease-causing germs can contaminate foods, so there are many different foodborne infections.

[Data Source] https://www.cdc.gov/foodsafety/foodborne-germs.html

1 in 6 Americans get sick from foodborne illness each year
The **top five germs** that cause illnesses from food eaten in the United States are:

- **Norovirus**
- **Salmonella**
- **Clostridium perfringens**
- **Campylobacter**
- **Staphylococcus aureus** (Staph)

[Data source] https://www.cdc.gov/foodsafety/foodborne-germs.html
Question 1:

- How many illnesses are associated with listeriosis annually?
  - 16
  - 160
  - 1,600
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So why are we making a big deal about it?
Listeria is most likely to sicken people among these vulnerable groups:

- Pregnant women, fetuses, and newborn infants
- Adults 65 or older
- People with weakened immune systems

[Listeria can pass from pregnant women to their fetuses and newborns. It can cause miscarriages, stillbirths, and newborn deaths.

Listeria can spread through the bloodstream to cause meningitis, and often kills. The older you are, the greater the risk.

Tainted cantaloupes

LISTERIA OUTBREAK: Contaminated whole cantaloupes sickened 147 people in 28 states and caused one of the deadliest foodborne outbreaks in the US. There were 33 deaths, mostly in adults over 65, reported during the outbreak.

[Data Source] https://www.cdc.gov/listeria/resources/index.html
CDC estimates that *Listeria* is the third leading cause of death from foodborne illness in the United States.

An estimated 1,600 people get sick from *Listeria* each year, and about 260 die.

[Data Source] https://www.cdc.gov/listeria/risk.html
Question 2: True/ False

- *Listeria* are always pathogenic
Question 2: True/ False

- *Listeria* are always pathogenic

**False.** Only *L. monocytogenes* is a human pathogen. There are several other non-pathogenic species.
LISTERIA MONOCYTOGENES

- It is **facultative** bacterium, capable of surviving in the presence or absence of oxygen

- It is a **psychrotroph** that can even grow on foods that are refrigerated

- It is an **infectious** agent; when someone eats food contaminated with it, symptoms may not occur until many days later when it is difficult to identify which food was the source
Question 3:

- After eating contaminated food, how long is it before someone shows symptoms of listeriosis?
  - 1-4 weeks, up to 70 days
  - 3-4 days, up to 1 week
  - 2-3 months, up to 6 months
  - 7-10 days, up to 30 days
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Who remembers what they ate 70 days ago?
Tracing the Food Back to the Source

[Data Source] https://www.cdc.gov/outbreaknet/investigations/figure_traceback.html
OUTBREAK INVESTIGATION

- When a foodborne disease outbreak is detected, public health and regulatory officials work quickly to collect as much information as possible to find out what is causing it, so they can take action to prevent more people from getting sick
  - Epidemiologic data
  - Traceback data
  - Food & environmental testing data
Government and food industries need to work together to make food safer.

More multistate outbreaks are being found

Why? Better methods to detect and investigate, and wider food distribution.

Multistate outbreaks: less common, but more serious

Why? The deadly germs *Salmonella*, *E. coli* and *Listeria* cause 91% of multistate outbreaks.

Only 3% of all US foodborne outbreaks are multistate, but they cause more than their share of outbreak sicknesses, hospitalizations and deaths:

- 11% of sicknesses
- 34% of hospitalizations
- 56% of deaths


www.cdc.gov/vitalsigns/foodsafety -2015
DNA Fingerprinting Techniques

• **Pulsed-field gel electrophoresis (PFGE):** An old method used to generate DNA fingerprints of bacteria. Comparing two *Listeria* isolates by the PFGE is like comparing two books based on the chapters they each have.

• **Whole genome sequencing (WGS):** A cutting-edge technology that determines an organism’s complete genetic composition and gives a more detailed DNA fingerprint. Comparing two *Listeria* isolates with WGS is like comparing two books word for word.
- Detect more clusters of *Listeria* infections
- Link cases of *Listeria* to a likely source
- Identify unrecognized sources of *Listeria*
- Stop *Listeria* outbreaks while they are still small

**Whole Genome Sequencing Prevents *Listeria* Illness**

Question 4: True/ False

- FDA performs Whole Genome Sequencing on every *L. monocytogenes* found during a swabathon
Question 4: True/False

- FDA performs Whole Genome Sequencing on every *L. monocytogenes* found during a swabathon

True

How many of you have experienced a swabathon?
Listeria and foodborne illness

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PRODUCE SAFETY

- *Listeria* can contaminate many foods that we don't usually cook, including fruit and vegetable

- Some foods we might not suspect can be contaminated with *Listeria* and cause sickness and outbreaks, such as cantaloupe and celery

[Data Source] https://www.cdc.gov/vitalsigns/listeria/index.html
Question 5:

- Which of the following foods has not been recalled due to *L. monocytogenes*?
  - Ice cream
  - Hummus
  - Macadamia nuts
  - Frozen waffles
  - Organic basil pesto
  - Butternut spirals
  - Frozen vegetables
  - Leafy greens, sliced apples, onions, etc.
  - Peaches
This study compared frozen “edamame” to other varieties of frozen beans sold in Virginia

- *Listeria* spp. in 15% of the overall samples (n = 80) and in 10% of the edamame (n = 40) samples
- *L. monocytogenes* in 4% of the overall samples and in 5% of the edamame samples
Strawberries were inoculated with *L. monocytogenes*

- The pathogen is capable of survival but not growth on the surface of intact or cut strawberries throughout the shelf life of the fresh fruit.
- It can survive on frozen strawberries for a period of at least 4 weeks.
Challenge Studies with Selected Pathogenic Bacteria on Freshly Peeled Hamlin Orange

STEVEN PAO, G. ELDON BROWN and KEITH R. SCHNEIDER

Fig. 5—Effect of storage temperature (●, 4°C; ■, 8°C; ◆, 24°C) on the growth and survival of Listeria monocytogenes on peeled Hamlin oranges. Symbols represent the means (±SE) of three replications.

- LM growth on peeled orange at 24 °C

Volume 63, No. 2, 1998—JOURNAL OF FOOD SCIENCE
L. monocytogenes growth on stem-end inoculated Granny Smith caramel apples with different stick materials during storage at 25 °C
TAKE-HOME MESSAGE

- *Listeria* can easily contaminate frozen produce and survive in the products

- Do not underestimate the potential growth capability of *Listeria* on fresh and minimally processed produce
Listeria and foodborne illness

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Listeria and the environment
Question 5: True/False

- *Listeria* is a zoonotic organism like *Salmonella*, meaning that it’s commonly associated with animal hosts?
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- *Listeria* is a zoonotic organism like *Salmonella*, meaning that it’s commonly associated with animal hosts?

**False.** *Listeria* is a soil-associated organism.
The microbial quality of ground beef and ground beef patties was evaluated

- *Listeria spp.* in 29% of all samples (n = 152)

- *L. monocytogenes* in 11.1% of local frozen patties, 10.5% of Internet frozen ground, 7.9% of Internet frozen patties, and 5.0% of local raw ground
The microbial quality of raw fillets of aquaculture catfish, salmon, tilapia, and trout was evaluated

- *Listeria* spp. in 27% of fillets (n = 272)
- *L. monocytogenes* in 23.5% of catfish, 10.6% of salmon, 10.3% of tilapia, and 5.7% of trout
- Evisceration may cause *Listeria* contamination
Question 6:

- Why is *Listeria* difficult to control?
  - *Listeria* can *grow* at refrigeration temperatures
  - *Listeria* can hide in niches where they are difficult to remove through normal sanitation
  - It’s “ubiquitous” in the environment
  - All of the above
Question 6:

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  - All of the above

What does “ubiquitous” mean?
“ubiquitous”

- 17.5% NY farm soil samples positive for *L. monocytogenes* (2013 Strawn et al. AEM)
  - 30% of 74 water samples positive
  - Non-irrigation surface water

- 1% positive for “raw cut vegetables” in market basket survey (2017 Luchansky et al. JFP)

- Ubiquitous ≠ can’t be controlled in your facility
Notable for its persistence in food-manufacturing environments

http://www1.clermont.inra.fr/proteome/index_angl.htm

https://microbewiki.kenyon.edu/index.php/Listeriosis
- *L. monocytogenes* declined considerably on a conveyor belt material with and **without** antimicrobial additives especially at warmer temperatures

*International Journal of Food Microbiology 142 (2010)*
A decline of *L. monocytogenes* on inoculated fruit carriers under natural environmental conditions
CONCLUSION

- *Listeria* is ubiquitous in the environment and can grow under refrigeration

- *Listeria* can hide and persist in produce production and handling environment

- Learning how to effectively control *Listeria* is imperative for produce safety
Thank you!

Questions?