Meet Our Presenter

- Steve is PSSI's Corporate Microbiologist and is based out of the Minneapolis, MN area. Steve joined PSSI in 2013, bringing with him a strong, diverse technical background. His experience includes extensive experience as a Clinical Microbiologist, QA Manager in the nutraceutical industry, and has worked and consulted with leading companies in the food industry – including Hilmar Cheese, McKee Foods, and Agropur Ingredients.
- Additionally, Steve has a solid food safety and HACCP background, with certifications as a PCQI by the FDA, ISO 17025 program training/lab auditing (A2LA), Advanced HACCP training (KSU), Food Safety Risk Assessment training (U of MN), and is a Certified Food Safety Professional (NEHA).
- Education: BS in Biology, BA in Chemistry and a Master's in Microbiology from Mankato State University

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“Microbial Detection and Prevention of Listeria, Salmonella, Molds and Yeasts”

Preventing contamination is the top food safety priority for any food business, and this requires a robust and effective detection program. A “zero tolerance” for any human pathogen occurrence in a food plant is the target goal, especially for higher-risk “ready to eat” foods.

Some economic business challenges that are due to microbial contaminants are:

- Product spoilage risks and consistent product quality
- Having acceptable product shelf life
- Ultimately, consumer satisfaction!

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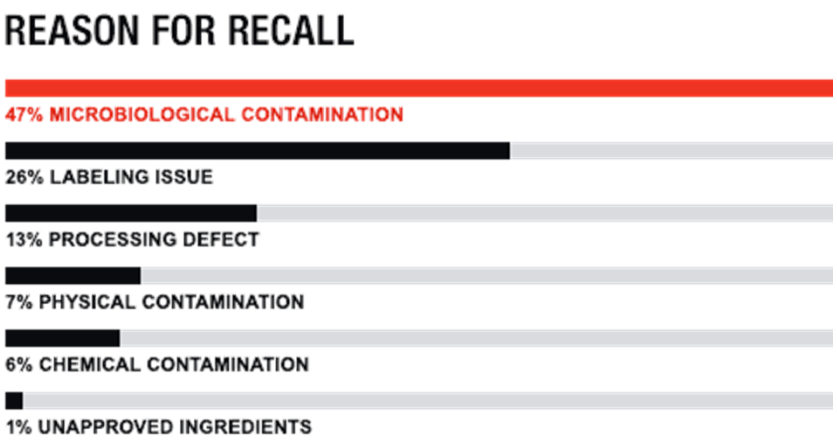
Food-born Illness–
Serious Statistics from the CDC

- Of an estimated total of 47.8 million cases of gastrointestinal illnesses in 2011:
  - 9.4 million due to known causes
  - 38.4 million due to unknown or unidentified pathogens
- Further consequences of unknown pathogens:
  - 71,000 hospitalizations
  - 1,686 deaths



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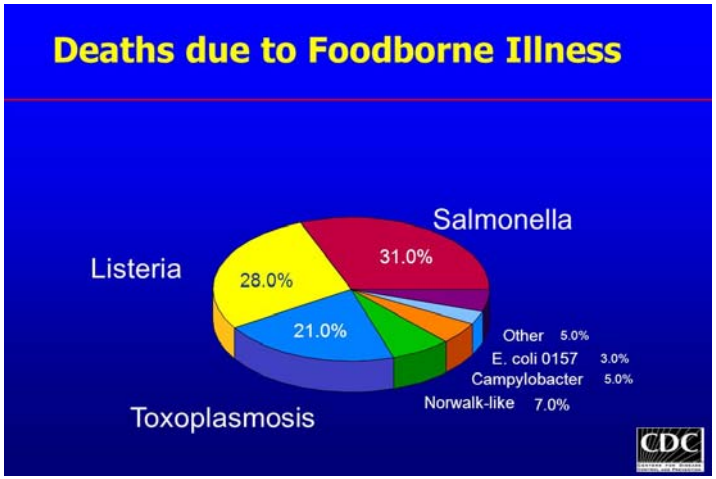
Five Pathogens Cause 90% of Problems

Table 2. Top five pathogens causing domestically acquired foodborne illnesses

Pathogen	Estimated annual number of illnesses	90% Credible Interval	%
Norovirus	5,461,731	3,227,078–8,309,480	58
Salmonella, nontyphoidal	1,027,561	644,786–1,679,667	11
Clostridium perfringens	965,958	192,316–2,483,309	10
Campylobacter spp.	845,024	337,031–1,611,083	9
Staphylococcus aureus	241,148	72,341–529,417	3
Subtotal			91



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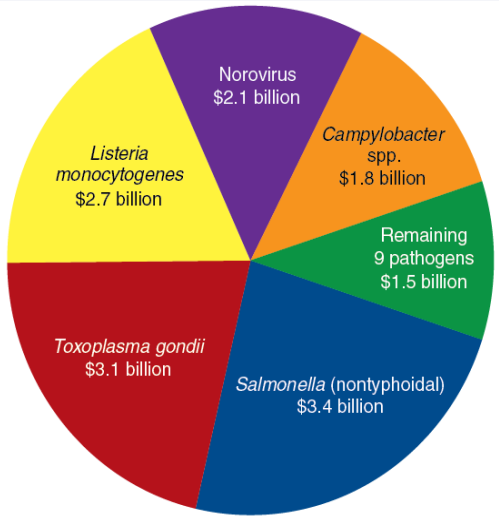
Financial Impact of a Listeria Outbreak

- The USDA recently estimated the cost for four pathogens: *Campylobacter, Salmonella*, *E. coli* O157:H7, and *Listeria monocytogenes*
- The total cost in the US for these four pathogens was estimated at **$6.5 billion a year**
- For *Listeria* specifically, it was estimated that costs amounted to **$2.3 billion** per year

Annual cost of foodborne illness in the United States, by 14 major pathogens



Note: The nine pathogens are (in order from most to least costly): *Clostridium perfringens, Vibrio vulnificus, E. coli* O157:H7, *Yersinia enterocolitica, Shigella* spp., *Vibrio* spp. other, *Cryptosporidium parvum,* STEC non-O157, and *Cyclospora cayetanensis.*
Cost estimates are in 2010 dollars based on disease incidence estimates published in 2011.
Source: USDA, Economic Research Service.

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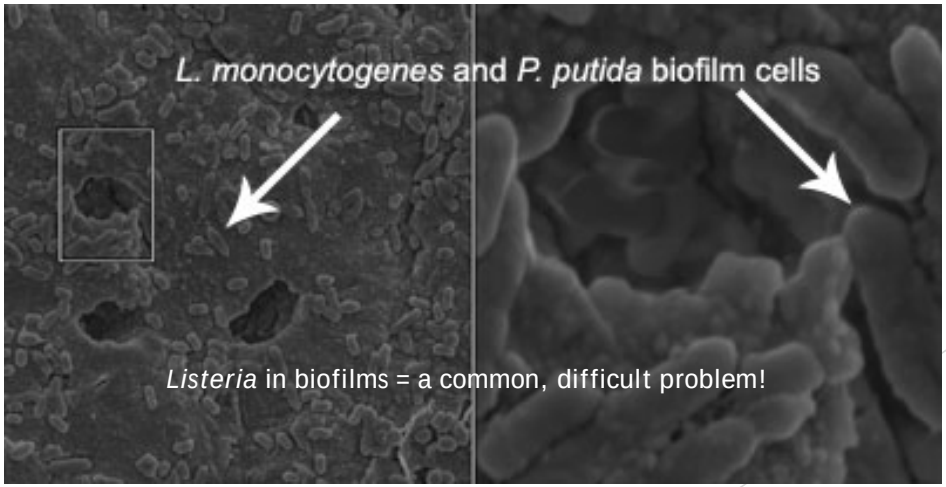
Listeria Defined.

In order to really delve into *Listeria*, some technical info is needed:

- *Listeria monocytogenes* is known as a psychrophilic bacteria. This bacteria WILL grow and reproduce at cool, even cold temperatures!
- Does freezing kill off *Listeria* cells?
- *Listeria* is a non-spore forming bacteria, but is a very rugged survivor in many diverse, even harsh environments – and it definitely loves to live in biofilms!
- There are 10 known *Listeria* species, but only one is truly pathogenic to people (*Listeria monocytogenes*), and one species (*L. ivanovii*) causes disease in ruminants



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Listeria Morbidity/Mortality and Testing

- High morality risk groups (elderly, pregnant women, infants, etc.) stand to be effected the most. Listeria can cause an invasive, deadly diseases which are very difficult to treat:
  - Sepsis
  - Meningitis
  - Encephalitis
- DEATH RESULTS in about 1 in every 5 cases of Listeria infection!
  - **Overall, Listeriosis infection fatality rate in the past 30 years has decreased about 10%, but** *Listeria monocytogenes* **continues to be a killer to many!**
- Increased testing requirements and improved test performance for detection/confirmation of Listeria has helped industry surveillance and improved technical monitoring capability
- Indicator organism ("presumptive") testing and full Listeria confirmation

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Producing Safe Products AND PROVING IT

- Management Commitments
- Determination of Need
- Risk Evaluation
  - Use of Cross-functional Teams
  - "Front Door to Back Door" Assessments
- Sampling Plan and Facility Mapping – Production Environment and "Zonal" Swabbing
- Sampling Methods (Swabs/Sponges/Product Samples)
- Testing
  - In-house Monitoring vs. Certified Lab Testing
- Evaluation of Results
  - Presumptive Positives and Follow-up
  - "House Bugs" vs Transients
  - Non-pathogen Surveillance and "Out-of-Specification" Results
- Positive HOLD/RELEASE PROGRAM and Preventing Recalls

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Baking, Frying and Lethality Testing

- In order to prove that a “kill” step (cooking) is working, often a food product is “challenged” with living microbes and then evaluated microbiologically after the product is processed
  - **This step can be performed on a small scale (pilot plant) to prove that the cook step (a “CCP”) is working as expected**
  - Non-pathogenic strains of potential pathogens can be used in a challenge test
  - Controls need to be included (raw dough, cooked dough, “spiked” raw and cooked dough, and also a growth curve microbial reference control)
- Low-moisture foods can harbor salmonella and make it tough to kill (TDT’s)
- Consider use of an outside testing laboratory to perform the validation if the testing cannot be done in-house. AIB has consulting services for this need.

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Environmental Monitoring and Sanitation

- When to Clean and When to Sample
- In-process Environmental Monitoring
- In-process Cleaning (“Extended Runs”) During Food Production
- Sanitation Verifications
  - Visual Inspections(“Pre-op”)
  - ATP Monitoring
  - Microbiological Testing

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Micro Testing – Where and Who

- Micro testing is most often done in a dedicated Microbiology laboratory
- Do all facilities have appropriate Micro labs? No!
  - Sometimes, samples are taken and logged in by Quality Assurance staff and then sent out to contract micro testing labs for evaluation
  - This can be very expensive for the food manufacturing facility and time-consuming to obtain test results
- Ideally, a trained Microbiologist will do the actual sample testing. Is this the way things work in the lab? Not always!
  - A person with experience in biology / chemistry laboratory procedures, a solid technical background, Microbiology testing methods, AND "hands-on" training can perform!

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Who, What, Where, Which, How

- What samples are tested and why?
- Who does the testing?
- Where is the testing done?
- Which tests are selected and why? Is ATP Really a "Microbiology" test? Yes? No? Maybe?!
- How do the tests work?
- What happens to the test results?

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What is Being Tested?

- **Samples that are often being tested:**
  - Food production/packaging equipment
  - Facility environment (drains, vents, walls, floors, mats, etc.)
  - Air/water samples, even people, too! (gloves, boots, gowns)
  - Raw ingredients that are used in the preparation of foodstuffs
  - "In-process" food samples
  - Finished food products

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Why Micro Testing?

Because of food-borne illness and food quality issues

- Who set up all of the rules? FDA, USDA, Health Canada, BRC, AOAC…
- Quality-focused customers also require micro testing programs
- Some Microbiology tests used for food and food environment evaluation:
  - PetriFilm (most common media-based test format used by labs today)
  - API ("old school" prepared test media testing methodology)
  - Making laboratory media, in-house preparation – inoculate / incubate / isolate / identify ("older-school" testing method)
  - PCR ("fingerprinted microbes") = VERY MUCH A "GO TO" TEST FORMAT CURRENTLY
  - Immunoassay (antibodies, anyone?) = ALSO A COMMON "GO TO" TEST method
  - Oxygen Depletion Bio-Sensors (It's new, so it must be better?!)

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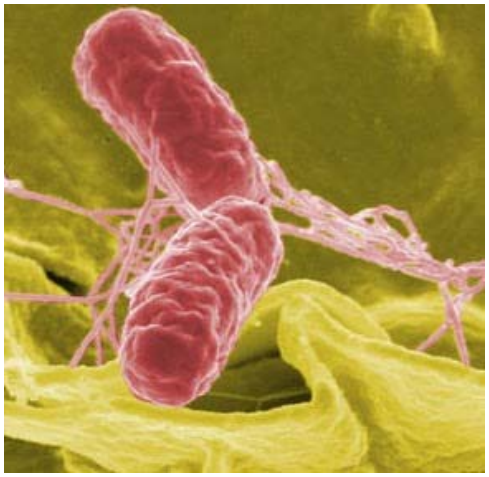
Salmonella Detection and Control

- Environmental “indicator organism” testing (what is it and why do it?)
- Swab/sponge sample locations (zonal swabbing, but not zone 1)
- Food contact surface testing and “indicator” organism testing value
- Product pathogen testing (certified laboratory, sample handling and processing, timely results reporting, follow-up and secondary testing)
- Control of salmonella (ingredients, facility integrity, process cross-contamination, GMP’s, sanitation)



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Water Availability and Salmonella Control

- During production, eliminate use of water hoses. Monitor and question uses of water in dry areas.
  - **NO WATER SPRAYING DURING PRODUCTION!**
  - CLEAN / SANITIZE / SWAB PROOFING TUNNELS
- Eliminate water draining to the floor and drain directly to the floor drain
- Use EPA-registered solid or powder quaternary sanitizer (follow label instructions)
- Store all hoses, hose nozzles, parts and equipment off the floor
- Shovel, sweep or squeegee away any food product that hits the floor
- Control condensation & clean drip pans and drain lines from air conditioners or dehumidifiers
- **Investigate and repair all leaks immediately!** This includes any leaking water and sanitizer hoses, roof leaks and pipe or steam leaks
- Remove all old equipment from area if not in use. Production areas are NOT boneyards!
- Maintain all pipe insulation in sealed, cleanable condition

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Molds and Yeasts

- Molds and yeasts are everywhere! Especially molds - they are really rugged survivors!
- **Mold spoilage is THE leading economic challenge to the baking industry**
- Some molds can produce harmful toxins
- "Wild" yeasts can cause product quality challenges (fermentable sugar availability, product pH)
- "Resting" (dormant but viable) molds and yeasts and what "wakes them up" (food/water/temp)
- Mold and yeast food grade inhibitors (sorbic acid/sorbates, benzoates, propionates, parabens)
- "Natural" inhibitors (acetic acid/vinegar, raisin juice, cultured whey protein)
- Newer "natural" inhibitors (clove, cinnamon, eucalyptus, oregano, mustard seeds)

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Rapid Detection of Molds and Yeasts

- Conventional detection of molds and yeasts involves air sampling to concentrate any airborne spores
- Swabbing with larger sponge devices can also be done to aid in location of any fungal activity
- Until recently, it could take a full week to obtain final testing results. There are newer test formats that can cut this time down to 48 hours!

Preventing Mold/Yeast Problems

- Think “manageable numbers” instead of complete elimination of mycological problems. Incorporate quality-focus in all areas, including new products.
- Ingredient vendor audits and accountability
- Process control improvements, including final packaging (MAP possible?), storage and product shipment
- Mold/yeast monitoring in a food plant (sampling methods, ingredient testing, product testing). Manage “wild” yeasts and optimize target fermentations
- Sanitation challenges
- Wet vs. “dry” cleaning
- Cleaning frequencies and cleaning time frames (staggered cleaning options)
- Chemicals used in cleaning and sanitizing and choosing a solid chemical partner

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Sanitation Impact on Microbial Control

- Effective sanitation of food-contact equipment depends on:
  - Equipment “cleanability” (design and condition of equipment)
  - Maintenance of equipment and proper sanitary set-up processes
  - Adequate cleaning times are needed
  - Adherence to the sanitation process (proper sequence of steps, proper chemicals and application, proper rinsing when needed)
  - Effective pre-operational inspections and visual deficiency identification; with sufficient time/resources for any needed re-cleaning of equipment
  - Microbial environmental monitoring – clear communication of all test results!
  - Future production expansions, facility modifications and sanitation concerns

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"Microbial Detection and Prevention of Listeria, Salmonella, Molds and Yeasts"

-Steve Weiland

PSSI Corporate Microbiologist

QUESTIONS?

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Photo Op’s

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