

Considerations for Fresh Produce Dry-pack Environmental Monitoring Programs (EMPs)

What environmental pathogens might be included in an EMP?

Listeria monocytogenes and *Salmonella* are both recognized as potential environmental pathogens within the food industry. *Listeria* spp. is more commonly sampled for than *Salmonella* in produce packing and fresh-cut operations due to a number of factors:

- There is a high likelihood that it can enter the packing/processing environment on raw product due to its presence in soil and the growing environment.
- Packing/processing environments are often wet, providing moisture that allows *Listeria* spp. to grow.
- Cooler packing temperatures can prevent *Salmonella* as well as non-pathogenic bacteria from growing and 'select' for *Listeria* spp. as it is capable of growing at refrigeration temperatures.
- Equipment sanitary design challenges can provide protected niche areas for *Listeria* spp. to attach and develop biofilms.
- There is a regulatory expectation (and Preventive Controls *requirement*) that operations evaluate and mitigate potential hazards in their environment (e.g., the survival and persistence of pathogens).

For a more in depth background on *Listeria* and EMPs, refer to the United Fresh [Guidance on Environmental Monitoring and Control of Listeria for the Fresh Produce Industry \(2nd Ed.\)](#).

How does this relate to dry packing environments, where *Listeria* spp. is less likely to grow?

Dry produce packing environments are less likely to harbor *Listeria* spp. and will typically have a much lower risk of cross-contamination events if the environment is dry at all times. This is because all bacteria, including *Listeria* spp., thrive with the presence of moisture. The use of water can also contribute to cross-contamination when not handled properly – without the use of water in a packing environment, this risk decreases. Additionally, dry produce packing environments are often warmer, allowing for other bacteria to survive and provide competition to *Listeria* for food/water.

However, there are some instances where it still may be beneficial to monitor for *Listeria* spp. in a 'dry' environment. Some considerations are listed below:

- *Is your environment truly dry at all times?*
 - Do you conduct routine or periodic wet sanitation on an otherwise dry packing line?
 - Are there any wet areas of your operation that employees, forklifts, or other traffic could travel through before coming to the packing line?
 - Is produce hydrocooled before dry packing?
 - Is there a possibility of employees tracking in moisture from outside?
 - Has product been held in refrigerated storage before packing? This could lead to condensation on the packing line if packed at ambient temperature.

- Is there a possibility of moisture oozing from product during packing, such as from product of lower quality grade or product that is otherwise damaged?
- Nonstandard events (e.g. roof leaks) may lead to contamination or provide enough moisture for pathogens to grow, if already present.

Water management is a key aspect of controlling *Listeria* spp. in a packing/processing environment. Regardless of how an operation defines their packing environment (i.e., dry or wet), if water is introduced, the potential for *Listeria* harborage and/or growth in the packing environment increases. This is true even if the water is mixed with sanitizer as part of your sanitation processes.

‘Dry’ operations where water is present intentionally or unintentionally should consider environmental monitoring for *Listeria* spp. on a routine basis or after a nonstandard event, as needed. Take note, this applies not only to your packing environment, but storage facilities as well.

- *What kind of product are you packing?*
 - The risk of cross-contamination with *Listeria* spp. is already low in dry packing environments, and *Listeria* is unlikely to grow on the surface of most raw agricultural commodities. Nonetheless, different produce commodities have varying levels of ‘low-risk’.
 - For example, ‘rarely consumed raw (RCR)’ dry packed product such as winter squash poses very little biological risk to consumers due to an assumed cooking kill-step. Environmental monitoring is unlikely to be beneficial to these operations, if RCR produce is the only product they pack.
 - Products such as whole onions are also considered low-risk with regard to *Listeria* environmental contamination due to dry packing (with no water introduced during cleaning), however a consumer implementing a kill-step cannot be assumed in this case.
 - Outbreak history can be used to inform environmental monitoring priorities, but it is not a guarantee that a particular commodity is safe from future outbreak events.
 - Remember that *Listeria monocytogenes* outbreaks are more commonly a result of operational contamination issues, and are not necessarily dependent on the commodity; consider the similarities and differences as they relate to your packing environment when applying learnings from an outbreak event to your own operation.
- *Are your cleaning/sanitation procedures effective at removing *Listeria* spp. from the environment?*
 - If you get a positive finding, what will your corrective actions be? Can you get rid of the contamination after you find it? Can you verify a ‘clean break’?
- *Will finding *Listeria* spp. in your dry environment reduce product risk?*
 - It is expected that *Listeria* can occasionally enter your environment from raw product – if you search for it in your environment, you are likely to find it.

- How will you use this knowledge? For example, does it identify a weakness in your food safety programs (training, operational practices, etc.)? Are you prepared to make changes if needed? Will those changes actually reduce risk?
- Have you considered the cost vs. the benefit? Are there other areas with greater impact in which your food safety funding could be invested?

Should I be routinely monitoring for *Salmonella* instead of (or in addition to) *Listeria* spp.?

Salmonella is more commonly associated with dry environments due to the pathogen's tolerance to dehydration. Outbreaks due to *Salmonella* are often due to one of two things: contamination in the growing environment (common pathway for produce, grains, flours, etc.) and cross-contamination in a facility (common pathway for dry ingredients such as powdered milk, peanut butter, etc.; typically due to post-process contamination).

Like *Listeria*, *Salmonella* is able to persist in dry environments, but it cannot grow. Similar considerations should be taken into account when deciding the value of an EMP for *Salmonella* in a dry packing environment:

- Facility outbreaks are often due to triggering events or inadvertent moisture – e.g. a roof leak that allows *Salmonella* to “blossom” and grow.
- An EMP for *Salmonella* in dry environments would typically detect dormant strains (i.e. those that are not dead, but are also not growing).
- Are your dry cleaning/sanitation procedures effective at removing *Salmonella* from the environment? Can you verify a ‘clean break’?
 - If you get a positive finding, what will your corrective actions be? Can you get rid of the contamination after you find it? Can you verify a ‘clean break’?
- Remember that all *Salmonella* are pathogens (as compared to *Listeria* spp.) – finding a pathogen in your environment can have serious regulatory consequences.

Should I ever swab for both *Listeria* spp. and *Salmonella* in the same location?

- *Listeria* spp. and *Salmonella* tend to live/persist in different environments.
- If you had a known water event or contamination issue such as those listed above, it may be prudent.
- On a regular basis, it's unlikely you'll find *Listeria* spp. and *Salmonella* in the same location, but ultimately it is a business decision.

Should I ever swab for both *Listeria* spp. and *Salmonella* in the same operation or facility, in different locations?

- If you have both dry and wet environments located throughout your operation, it may be warranted, according to the considerations given above.

Remember - While risk is never zero, any amount of *Listeria monocytogenes* or *Salmonella* on any RTE product is violative! Environmental monitoring plans are intended to be ‘living documents’ and should be approached and adjusted with a risk assessment mindset.

Additional References:

Zone 1 Sampling for *Listeria* spp. in Fresh Produce Operations, United Fresh Produce Association:

<https://www.unitedfresh.org/zone-1-testing-sampling/>

Facility Design Checklist for Produce, Commercial Food Sanitation:

<https://www2.unitedfresh.org/forms/store/ProductFormPublic/facility-design-checklist-for-produce>

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

<https://www.fda.gov/media/102633/download>

Pathogen Environmental Monitoring (PEM) Program, Almond Board of California:

https://www.almonds.com/sites/default/files/pem_book.pdf

Environmental Monitoring Handbook for the Food and Beverage Industries, 3M:

<https://multimedia.3m.com/mws/media/16845750/environmental-monitoring-handbook.pdf>