Dealing with Listeria
A Guide for Food Manufacturers

“A document produced jointly by Diversey, now a part of Sealed Air, and University of Nottingham”
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Introduction

The purpose of this document is to provide information for food manufacturers about the biology and behaviour of *Listeria monocytogenes* in the food production environment, and to set this information in a practical context. It will also provide examples of how this organism has caused outbreaks of disease and give illustrations of ways that the problem of *Listeria* can be addressed within the factory environment.

Above all it is important to remember that *Listeria* is a universal problem for food manufacturers, and that even when all reasonable hygiene measures have been put in place, problems can still arise. In the long term the only answer is really to understand the organism, so that managers can try and pre-empt problems before they arise.

Why is *Listeria* priority for the FSA?

In the late 1980’s the first outbreaks of food-borne disease were identified. This coincided with the increased distribution of pre-prepared and cook-chill foods that provide a perfect vehicle for *Listeria* transmission to humans. *Listeria* is considered to be primarily a food borne pathogen, with very few cases of non-food associated listeriosis being described.

Once the risk of *Listeria* had been identified, measures were put in place by Government agencies to control its presence in food production areas and to reduce the risk of transmission by the introduction of more stringent controls on levels in product. For a long period of time this controlled the problem with the number of cases of listeriosis worldwide declining. However in recent years there has been a steady increase in reports of listeriosis, an annual cases in the UK since 2000 have reached the same levels as were seen at the peak of the outbreak that occurred in the late 1980’s, leading to *Listeria* being highlighted as a priority area for action by the Food Standards Agency.

Listeriosis

Until the 1980’s *Listeria* infections were mostly associated with agricultural workers, in particular those who worked with sheep because the organism causes “circling disease” in these animals. It was known that pregnant women were particularly vulnerable, and it became a disease associated with the immuno-compromised, such as the elderly and those with underlying disease.

In humans the organism causes a range of diseases, from mild flu-like symptoms, sometimes associated with gastroenteritis, to blood poisoning and meningitis. The bacterium has the unusual ability to invade many different organs of the body, and in pregnant women can cross the placenta to infect the baby.

In healthy adults, symptoms are mild and self-limiting. However once infection becomes established, toxins cause lasting tissue damage.
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What do we mean when we refer to Listeria?

*Listeria* is a group (genus) of bacteria that includes both pathogens and non-pathogens. Within the group, *Listeria monocytogenes* is the major human pathogen causing a variety of diseases which range from mild and self-limiting to severe and life-threatening.

All members of the family are versatile and can live in a variety of natural environments, such as in soil, associated with plants, in the gut of animals and also in open water sources. Because of this similarity in behaviour, the presence of the non-pathogens is often used as an indicator that there is a risk that *L. monocytogenes* might also be found. This is why during testing, the presence of any of the *Listeria* species is reported, despite the fact that only *L. monocytogenes* is a real threat to human health.

These bacteria are Gram-positive; this Gram-stain result indicates that these bacteria have a thick, rigid cell wall made up primarily of carbohydrates and proteins with no outer membrane. This makes the cells particularly resistant to both acids and alkalis, and more resistant to disinfectants and detergents. Like many other bacteria, *Listeria* is known to form biofilms when it grows on surfaces in colonies embedded in a matrix of organic material that protects it from chemicals – again increasing resistance to cleaning agents and making it difficult to eradicate.

On the plus side, *Listeria* do not form spores; dormant, long-term survival forms of bacteria which are even more resistant to disinfectants. Spore-formers have to be treated with particular chemicals which have been shown to be effective at killing spores (sporocidal) but there is no need to use these agents to kill *Listeria* cells.

Why is *Listeria* a particular problem for the food industry?

Unlike many foodborne pathogens, *Listeria* is able to colonise the factory environment and become part of the environmental bacterial population. Although the optimum growth temperature for *Listeria* is 37 °C, it is unusual among bacteria that cause infections in humans in that it can continue to grow at low temperatures; for instance *E. coli*, *Salmonella* and *Campylobacter* all stop growing below 10 °C. In contrast, *Listeria* is able to continue growing slowly at refrigeration temperatures (in fact it

### FSA Priority

Why an increase in listeriosis has occurred in recent years is unclear. It is not due to more outbreaks, rather a steady rise in sporadic cases. It appears that the “at risk” group has also changed, with the elderly now being seen as the most vulnerable group, rather than pregnant women.

For this reason the Food Standards Agency’s Foodborne Disease Strategy 2010-2015 identifies *Listeria* as a priority for action (see [http://www.food.gov.uk/aboutus/publications/busreps/strategicplan](http://www.food.gov.uk/aboutus/publications/busreps/strategicplan)).

This is not because of a high number of cases of listeriosis (there are less than 300 cases annually in the UK), but because the high mortality rate means it is the leading cause of death from foodborne disease. Therefore, finding ways to reduce exposure of vulnerable consumers to *Listeria* in ready-to-eat foods is a high priority.
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has been shown to be able to grow down to -1.5 °C in foods that do not freeze at this temperature).

This means that even in chilled environments, any Listeria present will carry on multiplying. Hence low numbers of cells in inaccessible places provide a hidden reservoir that can continually cause recontamination after cleaning has been carried out. Another of the features of Listeria is that it is better able to withstand drying than many bacteria. Again this means it can persist in low moisture environments, so it can survive after being transferred by aerosols or in dust and recontaminate the environment. Together these properties explain why it can become persistent in factories.

Another feature of Listeria is that it is quite versatile in using different types of nutrients. In nature it grows equally well on decaying plant matter or in an animal gut. In the food factory, therefore, lots of different types of food residues can provide the appropriate nutrients for growth. This feature means that it can often be found colonising food production equipment, such as chopping blades and vacuum packing equipment and it can also colonise chillers and refrigeration units.

Persistence in the factory environment

It is important to understand the difference between persistence and repeated isolation of Listeria. Persistence refers to the identification of the same isolate from a factory over a long period of time. Repeat isolation of the bacteria at a single site is not necessarily indicative of persistence – it could indicate there is a failure to control the organism in the factory environment. Standard sampling and culture is not able to identify persistent strains, even if the bacterium is identified beyond the level of Listeria spp. and is confirmed to be L. monocytogenes.

To prove persistence, molecular subtyping is required; most commonly this is achieved by commercial ribotyping which provides a genetic fingerprint of the organism. This can tell different strains of L. monocytogenes apart, in the same way that DNA fingerprinting can identify humans. Hence if the same ribotype is identified over a long period of time it suggests that that particular strain has become established somewhere in the factory fabric or equipment.

Deli Meats and Slicer Blades

In 2008 an outbreak of listeriosis in Canada resulted in 56 cases and 21 deaths. The source was traced to sliced deli meats from one plant belonging to Maple Leaf Foods. The company had a good food safety record and routinely met all the regulatory requirements and addressed any problems highlighted by inspectors. An investigation concluded that the most probable cause of the outbreak was commercial meat slicers. It was found that the meat slicers had meat residue deep inside the slicing mechanisms, which provided a breeding ground for Listeria.

Routine cleaning could not eradicate the organism and complete dismantling of the equipment required the plant to be shut down for 2 to 3 days.

In the UK cutter blades were implicated in an outbreak (5 cases) in 2008 associated with hospital sandwiches (see www.hpa.org.uk/hpr/archives/2008/news3508.htm).
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For instance, recent molecular analysis of two outbreaks showed that a strain of *Listeria* responsible for a case of listeriosis associated with turkey frankfurters in the US in 1988, persisted in the factory for 12 years and then was responsible for a second large outbreak in 29 people (including 4 deaths) caused by deli turkey meat produced in the same processing facility in 2000.

However molecular typing data are not always need to identify whether problems are being caused by a persistent strain. Proper analysis of environmental and product sampling data to establish if there is a pattern of *Listeria* isolation can provide initial evidence of a problem. In the post-outbreak report of the 1998 frankfurter outbreak, it was noted that the data that the company had should have alerted them to the problem if it had been properly analysed.

"It was a failure to analyze test data that we weren’t even obligated to collect - a failure on our part to analyze that data and look for root-cause analysis, investigate and follow-up on individual trends, to look for patterns so that we could find the bacteria that we couldn’t see inside these facilities, and end up with a different result. It was more a failure to analyze those findings for a root cause, and a failure of those protocols, than it was a failure of inspection, per se.”

Michael McCain, CEO of Maple Leaf Foods Inc., appearing before the Canadian Agriculture Subcommittee on Food Safety, April 20, 2009

**Practical steps to control *Listeria* in the factory environment**

The basic precautions required to control *Listeria* are the same as those required to control all food borne pathogens (see next page). Often problems are caused because of an oversight, or due to equipment that has not been effectively cleaned.

Both of these factors contributed to the recent Canteloupe melon outbreak (next page), and the FDA recommendations were simply that producers should assess produce facilities and equipment design to ensure that surfaces are adequately cleanable, and eliminate opportunities for the introduction, growth and spread of *Listeria* – nothing new to be learned here for diligent food producers.
Key Practices for *Listeria* control

1. **Maintain and clean the processing environment**
   - Chillers and evaporators should be checked for *Listeria* contamination and disinfected regularly.
   - *Listeria* can become established in damaged floor or wall surfaces and these should be sealed as soon as possible.
   - Test equipment lubricants for *Listeria*.
   - Establish a schedule for deep cleaning equipment that comes into food contact or those that have hard to clean areas.

2. **Establish good personal hygiene and clean working practices**
   - Points to be emphasised are correct use and cleaning of personal protective equipment, hand sanitisation and footwear cleaning.
   - Food preparation equipment should be cleaned and sanitised regularly during production, and not just at the end of shift.

3. **Clean food contact surfaces**
   - Establish clean-as-you-go procedures as well as end of production cleaning regimes to reduce accumulation of food residues.
   - Use detergent to remove food residues and microbes before disinfecting.

4. **Prevent cross-contamination**
   - Spray equipment wheels with disinfectant to prevent transfer between areas.
   - Dedicate equipment to areas of high risk to reduce the potential for cross-contamination.
   - The use of empty trays to physically protect product in stacks from cross-contamination via strip curtains and aerosols or water splashes from the floor.
   - Clean and sanitise temperature probes after use to prevent cross-contamination.
   - Disinfect cleaning equipment after use so that *Listeria* left on them cannot grow during storage and then be reintroduced into the factory environment.

5. **Control water**
   - Keep the factory as dry as possible to reduced cross-contamination and transmission by water aerosols.
   - Do not use hosepipes during production to avoid the creation of aerosols - these can hang in the air for several hours after cleaning, leading to recontamination.
   - Take care not to generate aerosols when cleaning drains – these are an ideal area for *Listeria* growth (cold, damp and with a continuous supply of nutrients).

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**Cantaloupe melon outbreak**

In 2011 the US Jensen Farms cantaloupe outbreak resulted in 146 cases of listeriosis, 30 deaths and one miscarriage.

The FDA report concluded that both cross-contamination between livestock and farm equipment and the use of a potato-washing machine that had not been disinfected contributed to the outbreak. Also the canteloupes were stored under conditions that allowed *Listeria* to grow (a moist environment created by water pools on the floor next to packing equipment) and a lack of pre-cooling prior to cold storage resulting in condensation on the melon surface.

They concluded that this outbreak highlighted the importance of employing good agricultural and management practices in packing facilities as well as in growing fields.
Tracing *Listeria* in the factory environment

When a problem with *Listeria* occurs, often it is found that just focusing on the hygiene control programme is sufficient to improve the situation, and educating staff about the serious consequences of *Listeria* contamination may provide added focus to their efforts.

As highlighted by the Maple Foods example, often the data required to help identify the fact that there is a source of *Listeria* in a factory is already available. Environmental testing programmes designed to inform HACCP programmes are sufficient for routine monitoring of *Listeria* but if a problem arises, additional testing and monitoring may be needed to trace the source.

1. **The first step is to determine the *Listeria* “hot spots”**

   This can be achieved by mapping the results of *Listeria*-positive environmental swab samples onto a detailed map of the plant. The location of production lines associated with products that are *Listeria* test-positive can also be added to this map to try and establish the source of contamination.

2. **Further information from molecular typing**

   This can determine if the *Listeria* being isolated are a persistent strain (in which case the majority of the isolates will be similar) or whether there is a failure in the hygiene or HACCP processes (in which case the strains isolated will be more variable). Typing will also determine whether there is any link between the strains found in product and isolates from particular areas in the factory.

3. **Finally analyse the results**

   All these data can be compared with production processes to identify any link with movements of personnel, equipment or product around the factory. Key pieces of equipment to consider are those known to be factory sources of *Listeria*:

   - Equipment used for handling/processing
     - Especially rotating blades and conveyor belts
   - Packaging equipment
     - Especially vacuum packing machinery
   - Trolleys, forklifts and pallet lifters
   - Maintenance and cleaning equipment
   - Drains
   - Damaged Floors, Ceilings and Walls
     - Especially in cold or damp areas
   - Refrigeration units and chillers

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**Recommended Diversey products for *Listeria* control**

- **Detergent for routine open plant cleaning:**
  - HYPOGEL (3-5% v/v)
- **Disinfectant for routine open plant use:**
  - TEGO 2001 (1-2% v/v)
- **Disinfectant for periodic open plant use:**
  - DIVERFOAM ACTIVE (1-2% v/v)
- **Detergent-Disinfectant for open plant cleaning:**
  - SUREFOAM (2-3% v/v)
- **Disinfectant for chiller evaporators:**
  - SECUREGEL (applied neat)
- **Disinfectant for drains:**
  - TITAN CHLOR TABS
- **Hand Care Product:**
  - SENSISEPT
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To make an appointment for a member of our Technical Team to further assist with your hygiene protocols contact David Childs on +44 (0)7967 694122.

For more details of how Diversey can benefit your business visit our website www.diversey.com

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Feedback
We would welcome your views on this document and further ideas that you have to control Listeria. We will then re-issue it with these amends. Thank you in advance for your contributions. Please send them to david.childs@sealedair.com

Disclaimer
Every effort has been made to ensure the information in this brief is accurate. However Diversey, now a part of Sealed Air, does not accept any responsibility or liability whatsoever for any error of fact, omission, interpretation or opinion that may be present, however it may have occurred.

References


Environmental Assessment: Factors Potentially Contributing to the Contamination of Fresh Whole Cantaloupe Implicated in a Multi-State Outbreak of Listeriosis (October 19, 2011) http://www.fda.gov/Food/FoodSafety/FoodborneIllness/ucm276247.htm#recommendations

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