During the summer of 2008, Canadians faced the worst listeriosis outbreak in the nation’s history. The consumption of contaminated deli meats produced at a Toronto Maple Leaf Foods plant sickened a total of 57 Canadians and claimed 23 lives. Illnesses were reported in seven provinces, and the number of deaths was more than triple that of the *Escherichia coli* outbreak that struck Walkerton, Ontario in May 2000. A panel of international food safety experts later concluded that the source of the contamination was most likely meat residue, which accumulated deep within the slicing machines of two production lines in the processing plant. This residue provided an ideal environment for the *Listeria* bacteria to multiply and subsequently contaminate the deli meats produced on the lines.

**WHAT IS LISTERIOSIS?**

Listeriosis is a relatively rare infection caused by *Listeria monocytogenes*—one of six known *Listeria* species. *L. monocytogenes* is a facultatively anaerobic, gram-positive bacterium that is pervasive in the environment: it can be found in soil, decomposing vegetation and water, and may also form part of the fecal flora of various mammals, including some healthy humans.

Almost all listeriosis cases are believed to arise through the foodborne route. *L. monocytogenes* may be present in raw vegetables, fruits, and meats, as well as in unpasteurized dairy products. *Listeria* may also contaminate certain foods, such as deli meats and hot dogs, during processing. Unfortunately, refrigeration does not keep the bacterium at bay: *L. monocytogenes* is able to multiply at temperatures ranging from 3°C to 45°C. Moreover, there is no change to the appearance, smell or taste of foods harbouring *Listeria*, so it is impossible for a food handler or a consumer to identify contaminated products. These factors undoubtedly contributed to the 2008 outbreak.

The manifestations of listeriosis vary considerably. The majority of healthy adults and children who consume foods contaminated with *L. monocytogenes* experience only mild to moderate illness, such as gastroenteritis. The symptoms of gastroenteritis associated with listeriosis usually arise following an incubation period of six to 48 hours, and include fever, chills, headache, myalgias, abdominal pain, and diarrhea. Some people experience life-threatening effects from listeriosis, however, including meningitis, encephalitis, and sepsis.

Those at highest risk of developing listeriosis and experiencing serious illness from the infection include: pregnant women and their unborn children, the elderly, and immunocompromised individuals including chemotherapy or transplant patients, and those with HIV/AIDS or diabetes. Pregnant women who develop listeriosis are at increased risk of chorioamnionitis, preterm labour and stillbirths, and neonatal infection may also occur. Up to 20 to 30% of listeriosis cases in high-risk individuals result in death despite treatment with antibiotics, such as penicillin, erythromycin, ampicillin ± gentamicin, trimethoprim-sulfamethoxazole, and chloramphenicol.

**KEY POINTS**

- In 2008, the accumulation of *Listeria* bacteria within meat slicing equipment at a Toronto Maple Leaf Foods plant led to Canada’s worst-ever listeriosis outbreak.
- Almost all cases of illness and death involved elderly individuals in hospitals or long-term care homes.
- Deli meats, known to be at high risk of harbouring *Listeria*, were being served to individuals recognized as being more susceptible to severe illness from listeriosis. Years prior to 2008, prominent American and Canadian agencies had published documents referring to these risks.
- Heating deli meats prior to serving is a relatively simple and practical step that could have been employed to prevent or reduce the consequences of the outbreak.
GAMBLING WITH THE VULNERABLE

There were several factors that contributed to the 2008 outbreak, including unsatisfactory Listeria control measures at the Maple Leaf Foods facility, deficiencies in federal meat inspection regulations, and slow recognition of the developing outbreak. Perhaps most surprising is the gamble that was taken leading up to the event: individuals at a higher risk of developing listeriosis were served foods that are at a comparably high risk of causing the infection. Moreover, knowledge of these particular risks was well-established prior to the listeriosis outbreak.

WHO WAS MOST SEVERELY IMPACTED BY THE OUTBREAK?

Almost 95% of the 57 listeriosis cases involved elderly individuals in hospitals or long-term care homes. As of November 2008, when 56 cases were confirmed, the average age of affected patients was 74. Although it would be expected for elderly and/or chronically ill individuals to be impacted more heavily by a listeriosis outbreak, this situation was somewhat unique: during the spring and summer of 2008, Maple Leaf Foods was dramatically increasing its production at the Toronto plant in order to meet heightened demand for large packages of deli meats at institutions such as hospitals and long-term care homes. Therefore, some of the deli meats contaminated with L. monocytogenes were specifically manufactured for hospital patients and long-term care home residents—two of the most vulnerable populations. In fact, the final numbers indicated that approximately 80% of the total listeriosis cases involved hospital patients or long-term care residents who were served deli meats from the large packages specifically made for these institutions.

KNOWLEDGE OF RISK WAS WELL-ESTABLISHED PRIOR TO 2008

The knowledge that deli meats are at a comparably high risk of causing listeriosis, and that the elderly and immunocompromised are at higher risk of developing the infection, was realized and published long before the 2008 outbreak occurred. The unsafe nature of deli meats was firmly established at least as early as 2003. A Listeria monocytogenes Risk Assessment published in that year by the Food and Drug Administration (FDA) and the US Department of Agriculture (USDA) examined the relative risk of foodborne listeriosis from 23 different categories of ready-to-eat (RTE) foods with a documented history of contamination with Listeria. The report listed the predicted number of listeriosis cases for each RTE food category for the total US population. On a per serving basis, six food categories, including deli meats, were described as high risk (>5 predicted cases of listeriosis per billion servings); three were described as moderate risk; and the 14 remaining categories were described as low risk. Ultimately, the FDA/USDA report indicated that deli meats were the highest risk food of the 23 categories examined, assigning an overall listeriosis risk designation of “very high” (>100 predicted cases). This increased risk was attributed to the following: the fact that deli meats have moderate contamination frequency but high contamination levels, readily support rapid Listeria growth at refrigeration temperatures, are stored for prolonged periods, are regularly consumed, and have been directly linked to listeriosis outbreaks. As a result, the report called for the establishment of improved control strategies and consumer education programs regarding these “very high risk” products, in an effort to reduce the national incidence of listeriosis.

The 2003 FDA/USDA report also emphasized that certain populations are particularly susceptible to listeriosis, including the elderly and the immunocompromised. The risk assessment placed these populations into the category of “high risk individuals.” This information was not new in 2003, however. A 1988 WHO Bulletin on foodborne listeriosis made reference to the vulnerability of these populations, as did a number of reputable reviews published between 1980 and 1990.

Prior to the 2008 outbreak, Canadian agencies were also aware of the susceptibility of elderly and immunocompromised individuals to listeriosis, as well as the high risk of deli meats in causing the infection. In fact, Health Canada (HC) and the Canadian Food Inspection Agency (CFIA) jointly published a “Policy on Listeria monocytogenes in Ready-to-Eat Foods” in 2004 that emphasized these concepts. The Policy indicated that the presence of L. monocytogenes in Category 1 foods (the highest-risk category, including deli meats) should trigger a Health 1 concern: this describes an instance where there is reasonable probability that exposure to the food will cause serious health consequences, or where probability of a foodborne illness outbreak is high. Moreover, the HC/CFIA Policy indicated that any RTE food contaminated with L. monocytogenes that is specially produced for susceptible populations, including the elderly and immunocompromised, should be at least a Health 2 concern, indicating a reasonable probability that exposure to the food will cause some degree of health consequences (albeit those that are temporary or non-life threatening).

PROTECTING THE VULNERABLE

Multiple factors were responsible for the extent and devastation of the 2008 listeriosis outbreak. Sadly, the fact that food products known to be at a comparably high risk of causing listeriosis were served to individuals known to be at higher risk of developing the infection (and serious cases, no less) also contributed to the morbidity and mortality that occurred.

At first glance, it seems that a straightforward preventative measure would have been simply not serving deli meats to susceptible people, such as hospital patients and long-term care home residents. Yet one must consider some of the reasons for providing deli meats to these individuals: these products are easy to chew, relatively nutritious, require little
preparation, and are reasonably economical. If the recommendation of removing these products from hospitals and long-term care homes had been made, it likely would have been considered impractical, unachievable, and somewhat excessive. A simpler, more pragmatic solution could have been adopted to prevent—or at least reduce—the consequences of the outbreak: heating the products before serving. Indeed the 2003 FDA/USDA Listeria monocytogenes Risk Assessment includes the statement that sufficiently heating food will kill Listeria, thus eliminating the bacterium’s pathogenicity.

Fortunately, since 2008, considerable progress has been made with respect to protecting Canadians from future listeriosis outbreaks. For example, Health Canada has altered their health risk assessment process by decreasing the turn-around time from 24 hours to eight hours for Health 1 concerns. Moreover, a drafted copy of Health Canada’s upcoming Policy on Listeria monocytogenes in Ready-to-Eat Foods calls for the use of listericial/listeriostatic agents in RTE products, and encourages all levels of government and various governmental organizations to educate consumers, especially the vulnerable and their caregivers, about the risks of foodborne listeriosis. From the industry perspective, Maple Leaf Foods has implemented numerous improvements, such as doubling the number of testing sites and the frequency of sampling on all production lines of their RTE food products, and reconstructing some slicing equipment in order to help eliminate points of bacterial harbourage.

CLOSING REMARKS

The dire consequences of the 2008 listeriosis outbreak serve as a reminder of the importance of taking heed of infection risks and appropriate precautions, particularly in widely-distributed food products. The retrospective examination of this incident brings to light various approaches that can be used to prevent such an incident from recurring, allowing us to recognize that public health measures can make a large difference to vulnerable populations.

REFERENCES


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