

***Listeria*: A persistent food-borne pathogen**

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Listeriosis is a relatively rare infection caused by the Gram-positive bacterium *Listeria monocytogenes*. This microorganism is a motile Gram-positive bacillus that is ubiquitous in our environment; it is readily isolated from soil, wood and decaying matter. However, the principal route of acquisition of *Listeria* is through the ingestion of contaminated food products. The recent widely publicized national outbreak of listeriosis (1) has focused attention on this microorganism and its association with the food chain; it was considered timely to review its association with food products in Canada.

On August 23, 2008, the Public Health Agency of Canada and the Canadian Food Inspection Agency received laboratory results from Health Canada that established a link between meat products recalled by Maple Leaf Foods Inc (Canada) from their plant in Toronto, Ontario, and an outbreak of listeriosis in four provinces (2). As of September 9, 2008, 38 cases of listeriosis have been confirmed across eight provinces, another 20 cases are under investigation and 14 deaths have been recorded in which listeriosis was considered the underlying or contributing cause (3). According to information released by the Public Health Agency of Canada, the results of genetic testing from three samples of the products recalled by Maple Leaf Foods showed that two of the products tested positive for the outbreak strain of *Listeria* (2). Test results for the third product were a close match to the outbreak strain, but showed a slight variance. While these results are highly significant, the investigation is not complete. It is interesting to note that the implicated meat-processing facility in Toronto was associated with a total of 33 different company brands of recalled meat products, representing almost 200 different processed meats and meat combinations including turkey, chicken, meat loaf, ham, bologna, beef, salami, pepperoni, garlic sausage, summer sausage, beef sausage, ham sausage, polish sausage, kolbassa sausage, Bavarian sausage, bratwurst sausage, Italian sausage and pastrami (4). The number of products under different brand names and the presence of cases from across the country point to wide distribution of the products, and provide important insights into the distribution system for these types of food products, highlighting the ability of contamination at a single site to have a far-reaching impact.

Although the microorganism has been known since the early 1920s to cause infections in humans (5), only sporadic cases of listeriosis, often associated with workers in contact with diseased animals, were reported until the 1980s when interest in the microorganism increased rapidly among food

manufacturers and government bodies, with a concomitant increase in publications on listeriosis (6).

The incidence of listeriosis varies, but may be on the increase worldwide (5). Rates of endemic disease have varied from two to 15 cases per million population, with one of the highest rates being reported in France (5). The estimated annual incidence of listeriosis is approximately four cases per million population in Canada. As with many microorganisms and surveillance systems, it is uncertain whether this reflects a true increase in the incidence or simply improvements in diagnosis and heightened levels of awareness to the microorganism as a cause of illness. However, susceptible patient populations are increasing, and the numbers and types of foods in which *L. monocytogenes* is able to survive and grow has increased considerably over the years.

It is noteworthy that until the early 1980s, food products were not recognized as a vehicle for *Listeria* transmission. A seminal study by Schlech et al (7) investigating a 1981 outbreak of *Listeria* infections in the Maritimes (34 perinatal and seven adult cases), considered to be a "model of its kind" (5), provided evidence of a linkage to contaminated food products. The outbreak caused significant morbidity and mortality, with nine stillbirths and a 27% mortality rate among 23 live births of an ill infant. The adult mortality rate was 28.6%. The investigation revealed that coleslaw consumption was associated with the illness; the epidemic strain was isolated from coleslaw in the refrigerator of one of the patients. The coleslaw had been prepared by a regional manufacturer, and a review of the sources of vegetables for the plant identified cabbage from a farm that also had a flock of sheep, two of which had died of listeriosis in the preceding two years. The cabbage came from fields fertilized with compost and raw manure from the flock of sheep that had sustained the listeriosis infections. The harvested cabbage was stored in a cold-storage shed, which acted as a 'cold enrichment' for the microorganism (7). Following this observation, several high-profile studies (8-11) of listeriosis were published in the 1980s implicating milk, soft cheese and other dairy products. The outbreak involving soft cheese was the first one to be associated with a recall of the implicated food product and a plant closure (10). These outbreaks were followed by an explosion of published listeriosis outbreaks between 1983 and 1987, with 122 listeriosis cases and 31 deaths reported (5). Multiple foods were identified; the list is quite long, but most commonly prepared meats (eg, hot dogs and deli meat), dairy products, unwashed raw vegetables

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and seafood were implicated. Soft cheeses and unpasteurized milk have been the most frequently incriminated of the dairy products.

Individuals who have an underlying condition that leads to suppression of their T cell-mediated immunity account for the majority of cases of listeriosis, which manifest in a number of syndromes, usually bacteremia and/or meningoencephalitis. Predisposing conditions associated with listeriosis include neoplastic disease, immunosuppression, pregnancy, extremes of age (the elderly and newborn), diabetes mellitus, alcoholism, cardiovascular and renal collagen diseases, and dialysis-dependent renal failure.

Preventing listeriosis involves both basic personal food safety for those who are at risk and implementation of standard quality assurance systems in the food-processing industry (5,12). The risk for acquiring any food-borne illness may be reduced by following simple and basic food hygiene principles, including following all package labels and instructions for purchased products on food preparation and storage; thoroughly cleaning and sanitizing all surfaces – including knives and cutting boards – used for food preparation, especially for any raw food; promptly refrigerating or freezing perishable food; defrosting food in the refrigerator, in cold water or in a

microwave; keeping leftovers for no more than four days; ensuring refrigerators for cold storage of food are working properly and maintaining a clean refrigerator (12).

The principles of basic quality assurance systems in the food-processing industry include hazard analysis critical control point procedures that start with raw material acquisition and continue through to finished product and handling (5). In food-processing plants, many of the problems linked to contamination with *L monocytogenes* have been associated with postprocessing contamination. *L monocytogenes* can survive for prolonged periods in low temperatures on plant-processing equipment. This latter point may be pertinent to the current outbreak. Environmental sampling can identify trouble areas and reveal plant conditions that may have contributed to contamination (5). Efforts have been expended by the dairy, meat and fish industries to improve sanitation, hygiene and general cleanliness inside food-processing operations. However, despite all increased efforts at improved sanitation, it remains difficult to completely eliminate all *L monocytogenes* from all products. Thus, it remains necessary to have continued vigilance in both the food-processing industry and among at-risk individuals who need to apply basic food safety principles in their household food preparation.

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