



Listeria in Poultry Processing

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Listeria monocytogenes is a microorganism found in the environment, primarily in soil and water. This bacterium can contaminate a variety of raw foods, such as meats and vegetables, and processed foods, such as cold cuts on deli counters. Domestic animals used for human food may be carriers of the bacteria without showing any signs of clinical disease. During the processing of domestic animals for food, the bacteria can be easily transferred to the food products and be ingested by humans. Listeriosis is the term used to describe the disease produced by *L. monocytogenes* in humans or animals. Older adults, pregnant women, newborns, and people with vulnerable immune systems are at a higher risk of developing foodborne listeriosis. In these people the disease can be serious and deadly. An estimated 2,500 people become sick from listeriosis each year in the US, with an estimated 20% death rate. Of all pregnancy-related cases, 22% result in fetal loss or neonatal death, but mothers usually survive. With the exception of pregnant women, no sex predisposition is recognized.

Clinical Features of the Infections

The presentations of human listeriosis vary according to the number of bacteria consumed and the age and resistance of the patient. Listeriosis appears predominantly in two groups of people: pregnant women, with a severe infection of their fetuses or newborn babies; and the immunocompromised, e.g. cancer patients, the elderly, etc. There is usually a long incubation period, with symptoms beginning three weeks or longer after infection. Common symptoms of the disease include fever, muscle aches, nausea and diarrhea. Sometimes, the bacteria infect the nervous system and produce symptoms characterized by headache, stiff neck, loss of balance and convulsions. Infected pregnant women may experience only a mild, flu-like illness. However, maternal infections during pregnancy can be passed to the fetus, leading to miscarriage, premature delivery, or neonatal infections. The mother's illness usually resolves in 5 to 10 days. Meningitis and the spread of the bacteria in blood are the main presentations of listeriosis in the elderly and immunocompromised. Disease in healthy adults is usually transient, with mild to moderate flu-like symptoms.

Sources of Listeria

The main route of transmission is oral, through ingestion of contaminated foods. Soil or manure used as fertilizer can contaminate vegetables, and food animals can be asymptomatic carriers. The infectious dose is unknown.

In recent years, the major outbreaks of listeriosis have been associated with ready-to-eat (RTE) foods, such as hot dogs, cold cuts and luncheon meats. Fermented or dry sausage and other deli-style meat and poultry products have also been incriminated in the production of listeriosis.

Most *L. monocytogenes* strains can cause disease. There is a large range of virulence among strains, with some being avirulent and others highly virulent. The virulence in *L. monocytogenes* appears to be linked to several genes, and we do not have a complete understanding of why some strains are more virulent than others. Yet, only three serotypes have accounted for more than 90% of all cases of human listeriosis.

Contamination and Survival in Foods

The Food and Drug Administration (FDA) in conjunction with the Food Safety and Inspection Service of the U. S. Department of Agriculture (FSIS, USDA) and the Centers for Disease Control and Prevention (CDC) calculated the relative risk to public health from foodborne *L. monocytogenes* among selected categories of RTE foods. The calculation was done on outbreaks from 1970 to 2000. When ranked by number of outbreaks of listeriosis, dairy products ranked highest, followed by meat products, then seafood and finally produce. When the total numbers of cases of listeriosis in the outbreaks cases were ranked, meat products were first and dairy products were second. Meat and dairy products were implicated in more than 90% of the cases of listeriosis. Dairy and meat products were also implicated in three outbreaks with multiple food vehicles. Between 1990 and 2000, the FSIS USDA conducted a microbiology testing in 1,800 federally inspected establishments. From that testing, the cumulative prevalence of *L. monocytogenes* in RTE meat and poultry products was: 4.47% for sliced ham and luncheon meats; 2.95% for cooked beef, roast beef and corned beef; 2.83% for salads/spreads/pâtés; 2.67% for fermented sausages; 1.97% for cooked, uncured poultry products; 1.09% for large-diameter cooked sausages; 2.97% for small-diameter cooked sausages; and 0.58% for jerky. In other parts of the world, and for a variety of foods, the prevalence of *L. monocytogenes* varies from 1 to 10% or more. *Listeria monocytogenes* has the ability to grow at refrigerator temperatures, a feature that makes these bacteria extremely dangerous in certain foods where growth is allowed to occur. The annual incidence of listeriosis has steadily decreased by 44% between 1989 and 1993. However, outbreaks have continued to occur as recently as 2002, in which an outbreak traced to consumption of contaminated turkey meat produced 54 illnesses, eight deaths, and three fetal deaths in nine states.

Prevention and Control during Processing

The realization that recontamination is an important source of *L. monocytogenes* in commercially prepared RTE foods has initiated new changes within processing plants to better manage the post-processing environment. Changes and modifications in the equipment and plant layout have been done to allow for better cleaning and sanitation. Yet, personnel training is a major component in control plans aimed at reducing the introduction and multiplication of *L. monocytogenes* into RTE environments. If a step is introduced to kill the bacteria, such as cooking, a prevalence of <0.5% of product contamination could be achieved in RTE products.

A common tool use in control programs is product testing. However, one disadvantage of product testing is that by finding a product to be positive we do not have other

information indicating the mode of contamination or how to prevent further occurrences. The industry experience has emphasized that environmental testing is a better measure for evaluating control measures implemented in a plant. The information generated by environmental sampling could be used to predict potential loss of control and to facilitate the application of timely corrective actions.

It is known that *L. monocytogenes* can become established in a processing environment, reproduce and remain viable for months or years. Certain strains have the potential of surviving in these environments more than others. Studies done in coldsmoked fish-processing plants have shown that although several strains of *L. monocytogenes* can be found in the receiving and raw-fish-handling areas, only few strains survive in further processing environments. Some food processing establishments can harbor *L. monocytogenes* for long periods without compromising the safety of the products. However, if a more virulent strain establishes itself in the environment, the risk of listeriosis due to contaminated RTE foods increases. Growth occurs in these foods before they are eaten by susceptible people. As new molecular-based methodologies to identify isolates continue to evolve, research will be able to demonstrate the extent of changes in dominant strains during processing.

Foodborne listeriosis usually appears as:

- Isolated human cases, where it is difficult to identify a specific food as the source of contamination due to the long incubation period of this disease.
- Outbreaks involving a single lot of contaminated food, where mistakes in food handling lead to the contamination of a food and an opportunity for growth before that food is consumed.
- Outbreaks involving multiple lots of food over days or months of production due to a highly virulent strain established in the food processing environment. A “niche” is usually involved in these cases. A niche is a place or site inside the manufacturing environment where *L. monocytogenes* becomes established and multiplies. Any crack on a wall or space in the equipment that is difficult or impossible to reach and sanitize is an ideal area for the development of a niche. From a niche, *L. monocytogenes* spreads and contaminates product contact surfaces and the food.

In all three of these situations, *L. monocytogenes* grows before the contaminated food is consumed. To prevent cases of human listeriosis, strategies have been designed to control *L. monocytogenes* in processing environments:

- Prevent the establishment of *L. monocytogenes* in niches or other sites that can lead to the contamination of RTE foods.
- Implement an environmental sampling program to assess potential exposure of RTE foods to *L. monocytogenes*.

- Do periodic assessments of the results from environmental samples to detect problems and trends that may appear. These assessments should be done in the short- and long-term.
- Emphasize cleaning and sanitation in areas where environmental samples turned out positive. Follow-up with sampling of those problem areas to assure that the possible contamination sources have been removed.

Control Measures to Reduce Exposure

Persons at risk can prevent listeriosis by avoiding certain high-risk foods and by handling food properly. It is important to:

- Wash all eating utensils with hot, soapy water after they have come in contact with contaminated foods.
- Cook thoroughly all foods from animal origin, such as beef and poultry.
- Do not consume unpasteurized milk or foods made from unpasteurized milk.
- Avoid cross-contamination of the food products by keeping raw meat, poultry, and seafood separated from vegetables, fruits, breads, and other RTE foods.
- Reheat luncheon meats, cold cuts, and deli-style meats until they are steaming hot if you are within the category of people at high risk for listeriosis.

Summary

Listeriosis appears predominantly in pregnant women and the immunocompromised. *L. monocytogenes* can survive and multiply in the processing environment and under refrigeration temperatures; therefore, RTE food products that become contaminated would be of high risk to the consumer. Although not all *L. monocytogenes* strains are pathogenic, the industry and government continue to treat all *L. monocytogenes* strains as potentially pathogenic. Finally, prevention and control during processing must be continuously emphasized in processing environments that make food products considered high-risk for the transmission of listeriosis.



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