A Research Note

Survey of Residential Refrigerators for the Presence of *Listeria monocytogenes*


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(Received for publication January 13, 1993)

**ABSTRACT**

One hundred and ninety-five residential refrigerators in Brazos and Robertson counties of Texas were examined for the presence of *Listeria monocytogenes*. Surfaces on which meat and vegetables were usually stored, as well as other storage areas, were sampled. *L. monocytogenes* was not recovered from any of the refrigerators sampled. The organism, if introduced, may only be a transient inhabitant of refrigerator surfaces, as long-term colonization of such surfaces does not seem to be a common occurrence.

*Listeria monocytogenes* has been of great concern to the food industry not only because of the severity of illness in susceptible individuals, but because of its ability to survive and grow at refrigeration temperatures and its prevalence throughout food processing environments (2,11). The organism has a wide distribution throughout the environment, having been recovered from decaying vegetation and soils (10), animal feces (8), sewage, silage, water and dust (5). Cox et al. (2) have concluded that almost any wet environment can provide conditions for the growth of *Listeria*. *L. monocytogenes* has been isolated from a variety of foods, including dairy products, red meats, poultry, seafood, egg products, and vegetables (4). Cox et al. (2) sampled primarily the salad compartments of refrigerators in 35 Dutch households and recovered *L. monocytogenes* from one. *Listeria* spp. also were recovered from dishcloths in six of the 35 households.

A recent investigation reported the isolation of *L. monocytogenes* from at least one food specimen in the refrigerators of 79 (64%) of 123 listeriosis patients (7). While the highest *L. monocytogenes* contamination rates were reported for raw beef and poultry (36 and 31%, respectively), the organism was also isolated from 7.6% of ready-to-eat foods, including processed meats, raw vegetables, leftovers, and cheeses. In addition, ready-to-eat foods were five times more likely than other contaminated foods to contain *L. monocytogenes* that matched the patient strain.

The presence of *L. monocytogenes* on foods subjected to listeriocidal processes could be a result of postprocessing contamination in the plant environment or could result from cross-contamination from other foods, food handlers, or food contact and storage surfaces. The objective of this study was to determine the presence and location of *L. monocytogenes* in residential refrigerators in an effort to evaluate their potential role in the contamination of ready-to-eat foods.

**MATERIALS AND METHODS**

One hundred and ninety-five residential refrigerators in Brazos and Robertson counties in Texas (1990 population 133,576 and 15,511, respectively) were sampled for the presence of *L. monocytogenes*. Residents were approached at random with a request to sample their refrigerators and, therefore, were not allowed to clean refrigerators before sampling had taken place. Socioeconomic factors were not considered in this study; however, a broad range of participants was included. For the first 145 refrigerators sampled (during the months of May and June, 1991), sterile cotton swabs were moistened with sterile University of Vermont modified Listeria enrichment broth (UVM, BBL, Cockeysville, MD) and 100-cm² areas were swabbed each from the meat tray, vegetable tray, and an additional flat surface. Where meat trays and/or vegetable trays were not present, swabbed areas corresponded to locations in refrigerators where meat or vegetables were said to be ordinarily stored by the owner. Swabs from each sampled area were individually placed in 9 ml of UVM broth and incubated up to 12 h and were subsequently incubated at 30°C for 24 h. *L. monocytogenes* Scott A was inoculated into tubes of UVM and incubated along with refrigerator samples as a positive control. Determination and confirmation of the presence of *L. monocytogenes* were performed using the Food Safety and Inspection Service (FSIS) method described by McClain and Lee (6).

An additional 50 residential refrigerators were sampled (from January through April, 1992) using sponges instead of swabs in order to sample larger surface areas. As in the previous method, meat trays, vegetable trays, and an additional flat surface were sampled. Sterile cellulose sponges (Silliker, Chicago Heights, IL) were rehydrated with sterile distilled water containing 0.1% peptone. Instead of 100-cm² areas, the entire meat tray, vegetable tray, and additional surface were sampled. Where vegetable debris, meat juices, blood, or standing water was present, an effort was made to obtain this material during sampling. Sponges were then placed into
sterile Stomacher® bags (Seward Medical, London, United Kingdom) and stored under refrigeration for up to 2 h for transportation to the laboratory. One hundred milliliters of UVM was added to each bag and sponges were massaged for 30 s. Stomacher bags were sealed by tying, leaving a small air pocket, and incubated for 24 h at 30°C. Inoculated control samples were incubated along with the samples obtained from the refrigerators. Identification and confirmation were performed using FSIS procedures (6).

RESULTS AND DISCUSSION

Listeria monocytogenes was recovered only from inoculated control samples and from none of the 195 residential refrigerators sampled using either method. When the organism was not recovered from the first 145 refrigerators sampled with premoistened swabs, the sampling method was altered. In the altered procedure, an effort was made to obtain samples from larger surface areas using sterile sponges as previously discussed. Both procedures sampled the refrigerator surfaces vigorously in an attempt to obtain bacteria that may have been firmly adhering.

The inability to recover L. monocytogenes from residential refrigerators was surprising, considering the hardness of the organism, its ability to grow at reduced temperatures, and its presence on many raw foods that could introduce L. monocytogenes onto refrigerator surfaces (4). Archer (1) suggested that the survival of L. monocytogenes in food processing establishments may be enhanced by its presence in bacterial biofilms on various environmental surfaces; however, he suggested that a key ingredient to the organism's survival is moisture. In a survey of various locations in industrial and domestic environments, Cox et al. (2) noted that L. monocytogenes was recovered most frequently in high-moisture areas such as drains, floors, and standing water and was not recovered at all from two dry culinary food factories. They concluded that dry conditions and the restriction of food residues on surfaces contribute to the control of Listeria spp. While some refrigerators sampled in the present study had moisture from meat drippings, vegetable matter, or small pools of water, the majority of the surfaces sampled were dry. Cox et al. (2) recovered L. monocytogenes from only one of 35 domestic refrigerators sampled. They suggested that the growth of the organism may have been limited by a low relative humidity as a result of the removal of water from the air by condensation and freezing. It is possible that L. monocytogenes, if introduced to refrigerator surfaces, may not be able to survive on such surfaces indefinitely, making it a transient contaminant rather than a persistent inhabitant.

Welshimer (9) inoculated glass beads with 10^6 cells per g of L. monocytogenes and stored them in sealed tubes at room temperature. He reported a decrease in the number of viable L. monocytogenes cells to 10^2 cells per g after 20 d of storage, with recovery of the organism for up to 44 d. Dickgießer (3) inoculated dry tile surfaces with L. monocytogenes at a level of 10^6 cells per cm^2 and reported detection for up to 30 d. While these studies have established the ability to recover the organism from inert and dry surfaces for relatively long periods of time, it is notable that in both studies the initial inoculum was high. It is unlikely that contamination of refrigerator surfaces with L. monocytogenes would occur at such high levels. A lower level of initial contamination in the absence of moisture could reduce the period during which viable organisms could be recovered. In addition to low numbers, sublethal injury of cells or firm attachment of the cells to surfaces could influence the ability to recover L. monocytogenes.

That L. monocytogenes was not recovered in this survey suggests that long-term colonization of refrigerators by the organism may not be a common occurrence. This by no means excludes refrigerator surfaces as potential sources for the contamination of ready-to-eat foods. A survey of the refrigerator surfaces of known listeriosis patients could reveal the role, if any, these surfaces may have played in the transmission of the organism.

The constraints of this study allowed the sampling of only a limited number of refrigerators in a relatively small geographical area. A larger survey might more effectively indicate the presence of L. monocytogenes in a small percentage of refrigerators, or determine any relationship to geographical area, or to the storage of particular types of foods.

ACKNOWLEDGMENT

Technical article 30984 from the Texas Agricultural Experiment Station.

REFERENCES