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## Sources of *Listeria monocytogenes* contamination in retail establishments

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### Abstract

In the past two decades, serious outbreaks of foodborne illness have been caused by a bacterial hazard known as *Listeria monocytogenes*. Approximately, 0.2–0.8 listeriosis cases occur annually out of 100,000 people in developed countries. Although it appears that the annual incidence of listeriosis is not high, the mortality rate of about 20 % is the most serious public health concern. Understanding the contamination routes of the pathogen and factors that contribute to the risk of contamination, growth and spread of the pathogen are important building blocks to an effective control program.

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### 1. Introduction

*Listeria monocytogenes* is a pathogenic, Gram-positive, motile, non-spore-forming, highly mobile, rod-type, facultative anaerobic bacterium<sup>1,2</sup>. It tolerates salt and nitrite<sup>3</sup>, grows under low-oxygen conditions and at low refrigeration temperatures. *L. monocytogenes* is widely present in soil<sup>4</sup>, water<sup>5</sup>, vegetation<sup>4</sup>, feed<sup>6</sup>, industrial plants<sup>7</sup>, farms<sup>8</sup>, and can persist along the food continuum. It can also be readily isolated from humans, domestic animals, raw agricultural and fishery products, food processing environments and homes. Feed may be an important source of

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contamination for animals<sup>9</sup>. Domestic and wild animals harbour *L. monocytogenes* in their intestines and the bacterium is also commonly found in food processing environments and in many types of foods<sup>10</sup>.

## 2. Sources of *Listeria monocytogenes* in retail environments

There are numerous sources of contamination, including the following: food products, environment, equipment, employees, customers or vendors<sup>11</sup>. Contamination of foods by *L. monocytogenes* can occur in all the steps from farm to table and the following three are essential ways to control *L. monocytogenes* in retail establishments: prevent cross-contamination, practice proper sanitation and control time and temperature.

Cross-contamination can occur between equipment, food, the environment, and even employees. Some common vehicles for cross-contamination in retail establishments are: slicing ready-to-eat (RTE) items, display cases and coolers, drains and cracks in equipment and utensils, contamination during transport, storage and display, and from employees<sup>11</sup>. Improper or infrequent cleaning and sanitation may allow *L. monocytogenes* to grow to high levels on equipment and the environment. If *L. monocytogenes* remains on equipment and environmental surfaces for long periods of time, the risk for contamination of RTE food increases<sup>11</sup>.

This bacterium grows best between 21.1°C and 37.8°C and slows down considerably at lower temperature such as those used in refrigeration. Although the Food Code requires that refrigerated foods be held at 5°C or below, the colder the temperature of the food, the greater the impact on limiting growth of *L. monocytogenes*. It is important to get foods cold quickly and to keep them cold. If low levels of *L. monocytogenes* are accidentally present in a RTE food item that supports growth, over time the microorganism can multiply to higher numbers and pose a significant risk for human health<sup>11</sup>.

### 2.1. Food products

Contamination by *L. monocytogenes* can occur at all steps of the food chain from farm to table. The impact of contamination on public health depends on the step within the food production chain and on the type of food<sup>10</sup>. Raw items such as meats, poultry, seafood, and some fruits and vegetables may carry *L. monocytogenes*. Although processing methods such as heat or chemical treatments can destroy *L. monocytogenes*, processed foods may be frequently contaminated due to inadequate thermal process or post-processing cross-contamination. If contaminated food enters a retail establishment, the possibility that other foods may become cross-contaminated significantly increases<sup>11</sup>.

Altogether, 1,642 listeriosis cases in humans were reported in the European Union in 2012 which was a 10.5 % increase compared with 2011; there was a high fatality rate (17.8 %) among the cases<sup>12</sup>. *L. monocytogenes* was found in 10.3 % of fishery products, 2.1 % of heat-treated meat products and 0.5 % of soft and semi-soft cheese samples collected from supermarkets and shops across the EU, according to EFSA's analysis of an EU-wide baseline survey carried out from January 2010 to January 2012<sup>12</sup>. It should be noted that there was a statistically significant increasing trend ( $p = 0.018$  with linear regression) of listeriosis in the EU over the period 2009–2013 and a seasonal pattern was observed over this period<sup>13</sup>. Increased risk of listeria infection was predominantly seen in patients aged 60 years or above (Fig. 1). Other risk groups include pregnant women and persons with weakened immune systems.

### 2.2. Environment

*L. monocytogenes* harborage sites in retail establishments are likely to be similar to those found in processing facilities and include: drains, grease traps, floors, walls, air vents and areas where rodents or insects may enter the establishment<sup>11</sup>. When the processing environment is dry there is a limited opportunity for *Listeria* to increase in numbers, while the presence of extensive moisture provides more favorable conditions for the bacterial growth<sup>11</sup>. Water used for the post-processing sanitation procedures, in particular high pressure hoses, may contribute to the intensive spread of the pathogen around the food processing area, via aerosols<sup>14</sup>. Once present in the food processing plant, *Listeria* inevitably finds suitable niches, in particular damp spots, in which the microorganism can reside well and also multiply; these critical spots may also include hidden equipment surfaces<sup>14</sup>. If the SSOPs are not well

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