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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 poeple 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[1,2]. It tolerates salt and nitrite[3], grows under low-oxygen conditions and at low refrigeration temperatures. *L. monocytogenes* is widely present in soil[4], water[5], vegetation[4], feed[6], industrial plants[7], farms[8], 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[9]. 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[10].

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[11]. 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[11]. 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[11].

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[11].

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[10]. 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[11].

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[12]. *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[12]. 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[13]. 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[11]. 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[11]. 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[14]. 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[14]. If the SSOPs are not well

designed and/or are not adequately carried out, the bacteria may then form a biofilm on food contact surfaces which are usually difficult to remove by standard sanitation protocols. These niches can be a major source of contamination during food processing[14].

2.3. Equipment

L. monocytogenes may also be found on equipment used to transport, store, or prepare food. The pathogen can hide in difficult-to-clean equipment including: slicers, wheels of food transport carts, refrigerated storage units, cracks in the preparation tables and cooling fans in chilling chambers. Additionally, any food contact surface such as knives, cutting boards, gloves, or bamboo mats may be also a potential source of *L. monocytogenes*[11]. According to the FDA Food Code[15], food equipment used with potentially hazardous foods must have food contact surfaces cleaned throughout the day, at least every 4 hours.

2.4. Employees

Employees also may be a source for *L. monocytogenes* since some humans are known to carry the pathogen in their gastrointestinal tracts[16]. It has been shown that 1–10% of healthy adults may be fecal carriers of *L. monocytogenes*[1]. Poor personal hygiene practices, such as improper hand washing or dirty uniforms can lead to the contamination of food and equipment with *L. monocytogenes*[11].

2.5. Customers and vendors

Anyone entering a retail establishment has the potential to introduce foodborne hazards into the store. For example, customers and vendors may carry microorganisms on their shoes, clothing and hands and may transfer them to carts and foods during their shopping visits. Then employees can pick up the microorganisms during the course of their normal routines and transfer them to the foods they are handling[11].

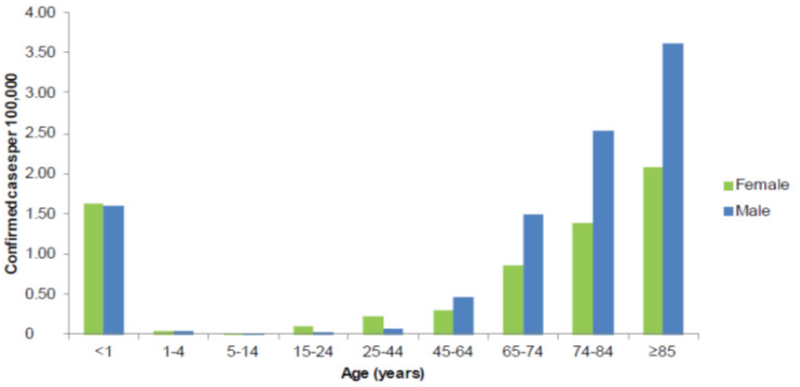

Fig. 1. Notification rates of human listeriosis by age and gender in the EU, 2012 (EFSA, 2014).

3. Conclusion

Listeria monocytogenes should be considered as an important foodborne bacterial pathogen and serious hazard in retail establishment. Potential sources of *L. monocytogenes* contamination of foods in retail and food service operations include incoming products, environment, equipment, employees, customers and vendors. Items from all food categories have been implicated in outbreaks of listeriosis. Therefore, all sectors of the food industry play a

role in the assurance of food safety. Knowledge of potential sources and routes of contamination with *L. monocytogenes* can be useful in the development of effective control measures throughout the food system.

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