# Spotlight on *Listeria monocytogenes*

By: Francisco Diez-Gonzalez

## Characteristics of *Listeria monocytogenes*

*Listeria monocytogenes* is a foodborne pathogen capable of causing life-threatening disease. The Centers for Disease Control estimate that this bacterium causes more than 1,600 infections and over 250 deaths every year in the U. S. *L. monocytogenes* is classified as a Gram positive, non-sporulating, rod-shaped, facultative anaerobic bacterium. *Listeria* is a mesophilic bacterium, but it is also a pshycroptrophic organism that grows at temperatures below 5°C. Because of this ability to grow at low temperatures, it is a particular risk in ready-to-eat (RTE) refrigerated products. *L. monocytogenes* is a microorganism that is widely distributed in nature and it often colonizes the food processing environments. This bacterium also has very unique stress response mechanisms that allow it to survive under harsh conditions such as low pH and low moisture.

## Listeriosis

The disease caused by *L. monocytogenes* is known as listeriosis which can be characterized by two distinct syndromes. The noninvasive syndrome involves relatively mild febrile gastroenteritis, but an invasive syndrome is a systemic life-threatening infection. Invasive listeriosis is characterized by meningitis, septicemia, endocarditis, and central nervous system infection. These afflictions are responsible of stillbirths and death. Immunocompromised, elderly, pregnant and newborn individuals are more susceptible to *Listeria*. The central nervous system and the bloodstream are the preferred organs of *L. monocytogenes*, but it can also invade the pregnant uterus into fetuses.

Mortality rates range from 20 to 30%, however approx. 5% of human population carries *L. monocytogenes* asymptomatically in their intestines. The infectious dose, has been estimated to vary from $10^2$ to $10^6$ CFU/g, but it depends on the health of the person. The dose for the gastroenteritis is estimated to be larger than for invasive listeriosis. *L. monocytogenes* long incubation period take from 2 to 8 weeks after consumption of contaminated food for the onset of symptoms of invasive listeriosis. This long incubation time complicates the identification of the source of *L. monocytogenes*.

## High risks foods

This pathogen typically poses a greater risk in RTE foods. Historically, deli meats, soft and fresh cheeses, seafood and fresh produce have been associated with listeriosis outbreaks. Deli meats have included pork products, pate, frankfurters and sliced products. Since the late 1980's, several countries set a zero tolerance policy in RTE meats and in the U.S. Among dairy products, Hispanic fresh cheeses, soft cheeses and milk have causes several outbreaks. Hispanic cheeses referred as "queso fresco" have been linked to approximately 15 outbreaks since 1985. Most of these outbreaks were due to product made with raw milk, but recent outbreaks were made with pasteurized milk. This year, 8 individuals were infected with products manufactured under poor sanitary conditions, which illustrated the environmental source transmission for *L. monocytogenes*.

Fresh fruits and vegetables were not normally considered a vehicle for transmission of *L. monocytogenes* until 2011. That year, one of the largest and deadliest listeriosis outbreaks was caused by contaminated cantaloupes. Investigators determined that the cause was also environmental contamination.

## *Listeria* in the food processing environment

The risk of *L. monocytogenes* in RTE foods stems from its widespread occurrence in the environment and its ability to form biofilms. In addition to the epidemiological evidence, many studies have demonstrated the connection between *L. monocytogenes* strains on plant processing surfaces and their transference to the finished product. Those studies clearly indicate that the environment is one of the primary niches for transmission of *Listeria monocytogenes* and stress the importance of developing antimicrobial interventions.

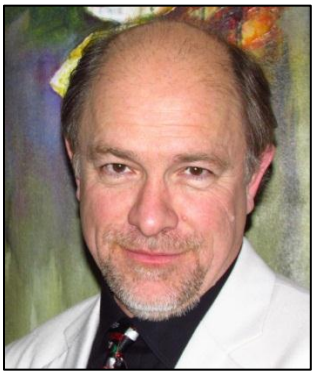
Biofilms are complex communities of microbial cells and exopolymers that have unique resistance to environmental conditions and sanitation treatments. Biofilms on food contact surfaces can be a major focus of contamination of RTE foods. *L. monocytogenes* is a bacterium that possesses unique biofilm-forming abilities that favor its transmission and survival. A better understanding of those abilities can potentially lead to designing control strategies.

## Control of *Listeria monocytogenes*

*L. monocytogenes* can be present in raw materials such as milk and meats, but it can easily be killed by heat treatments such as pasteurization and cooking. Since environmental contamination appears to be the most likely route of RTE food contamination, several other strategies should be implemented for the control of this microorganism. The first preventive intervention is an effective application of GMP's and a sanitization program that prevents the formation of biofilms. The sanitization program should be supported by microbial testing that verifies the effectiveness of environmental control.

In addition to those measures targeting the environment, depending on the food product, a variety of physical and chemical treatments could be implemented to the finished product. In a number of RTE foods, the use of high pressure processing has proven to be highly effective for *Listeria* control. Irradiation is a process that has demonstrated to be highly efficacious for many commodities where other treatments cannot be used, but the misconceptions by consumers prevents its widespread adoption. The use of antimicrobial ingredients has been successfully used in RTE meats, where combinations of lactate/diacetate salts strongly inhibit the growth of this pathogenic organism. There are many other interventions that are currently being pursued such as natural ingredients, bacteriophages and other processes, but the control of this bacterium still poses many challenges to the food industry.

**Biography**



Dr. Francisco Diez-Gonzalez is a Professor of Food Safety Microbiology in the Department of Food Science and Nutrition at the University of Minnesota. His research program is focused around studying and controlling food-borne pathogens that include Shiga-toxin producing *E. coli*, *Salmonella*, *Listeria monocytogenes* and spore-forming bacteria. His particular interests include pre-harvest ecology, the safety of organic foods, pathogens associated with fresh vegetables, low water activity foods, and Hispanic cheeses. Teaching courses on food safety and food microbiology, Dr. Diez earned a B. S. in Food Technology from the Instituto Tecnológico y de Estudios Superiores de Monterrey in Queretaro, Mexico. He then went on to earn his M. S. and Ph. D. degrees in Food Science from Cornell University. Dr. Diez's professional experience includes managing the Research and Development group for Griffith Labs, Inc. for 6 years at its Mexican branch. Before joining the University of Minnesota in 1999, Dr. Diez was a Postdoctoral Research Associate in Microbiology at Cornell University. Dr. Diez has authored over 70 peer-review articles and 10 book chapters. He serves on the editorial board for six Microbiology and Food Safety Journals and has been a panel member of seven different USDA's granting programs and a National Research Council's Committee.