Editorial: Dispeling Myths about Environmental *Listeria* Control Using Rapid, Cost-Effective Methods

by Catherine W. Donnelly, Ph.D[i]

Recalls of food products contaminated by the pathogenic bacterium *Listeria monocytogenes (L. mono)* are on the increase, due in part to increased scrutiny of food processing plants by federal regulatory agencies. The key reason for the heightened regulatory focus on *L. mono* is that it causes a higher rate of hospitalization than any other food borne pathogen: 95% of the individuals who acquire listeriosis are hospitalized and this disease is the leading cause of death from a food borne pathogen (Mead, 1999). Control of *Listeria* requires a focused commitment to maintaining the highest levels of plant sanitation and prevention of contamination of foods being processed. The Food and Drug Administration (FDA)/United States Department of Agriculture (USDA) Risk Assessment has identified those foods at highest risk for transmission of *Listeria* to susceptible persons (Health and Human Services [HHS]/USDA, 2003). Particularly for those manufacturers of ready-to-eat (RTE) foods that support high level growth of *L. mono*, there is a critical need for environmental control which is best achieved by frequent environmental monitoring.

Listeria spp. are very common and can be found almost anywhere in the environment. As indicator organisms, *Listeria* spp. (*L. mono, Listeria innocua, and Listeria welshimeri*) are useful in assessing the potential presence of the pathogenic *L. mono* in the processing plant environment. During food processing and manufacture, there is the potential for *L. mono* to be continually introduced into the food processing plant environment. The challenge for food manufacturers, therefore, is to direct efforts to prevent the growth and establishment of *L. mono* within the plant environment through appropriate controls which include good manufacturing practices (GMPs), sanitation, and employee training. It is also critical to have in place a system which verifies that routine cleaning and sanitation procedures are functioning.

This is most-effectively accomplished through an environmental monitoring program, which includes frequent testing to ensure that control procedures are working. Absence of *Listeria* spp. is the desired outcome of this verification. Controlling the presence of *Listeria* spp. in the environment is the most effective means of reducing the likelihood of product contamination. It provides a margin of safety as when non-pathogenic species such as *L. innocua* are controlled, *L. mono* is being controlled as well. Failure to control *Listeria* may result in the establishment of niches, including biofilms, after which routine cleaning and sanitizing efforts become ineffective. Only through frequent sampling and testing can identification of niche areas be accomplished, and these areas, left unchecked, will serve as a source of product contamination (Tompkin, 2000). Sampling and testing efforts should be directed to niche areas where resident strains of *L. mono* may persist, such as drains, floors and mats (Tompkin, 2002). The International Commission on Microbiological Specifications for Foods (2002) provides guidance on environmental sampling sites and sampling zones which are ranked according to risk for product contamination. In addition to environmental monitoring, a corrective action plan should be established which functions to correct the situation when the prevalence of environmental contamination is beyond acceptable limits.

As food manufacturers choose between testing methods to verify the effectiveness of their control procedures, it is important to dispel the following myths to ensure that manufacturers are choosing the method that is right for them:

#1 Methods that do not require the same amount of time or energy as standard methods, which can take 5 days or more for a confirmed positive result, do not offer the same kind of accuracy and reliability of test results. False.

Fortunately, there are now new technologies that show equivalent performance to traditional methods, but are much easier to use and provide results more quickly. For example, we conducted a comparative study of the 3M™ Petrifilm™ Environmental Listeria (EL) Plate Method versus USDA and modified USDA procedures for recovery of *Listeria* spp. from 192 environmental and food contact surfaces (Groves and Donnelly, 2005).[ii] The USDA procedure employs primary selective enrichment in (University of Vermont Medium) UVM followed by secondary enrichment in Fraser broth and selective plating on MOX agar. Previous work from my laboratory found that the sensitivity of the USDA method could be improved through dual primary enrichment in both UVM and *Listeria* Repair Broth (LRB) media (Pritchard and Donnelly, 1999). LRB is a highly nutritious repair/ enrichment medium which supports both repair and high level growth of *Listeria*. In studies by Prichard and Donnelly (1999) on enrichment of dairy environmental samples in University of Vermont medium and *Listeria* repair broth (UVM and LRB), combining these 2 primary enrichment media into a single tube of Fraser broth for dual secondary enrichment yielded a significantly higher percentage ($p < 0.05$) of *Listeria*-positive samples than did use of either LRB or UVM alone. In our work with 3M Petrifilm EL Plates, we found specificity and accuracy to be equal to that of the Standard methods, and sensitivity higher, even when compared against dual primary enrichment using LRB to increase sensitivity and promote recovery of injured *Listeria*. In addition, the 3M Petrifilm EL Plate required less hands-on time to perform the test and achieved the results within 29±2 hours, significantly faster than the USDA procedures.

#2 If my current method is working, then there is no need to look at new technologies. False.

Food manufacturers should always be aware of new ways to better manage environmental *Listeria*. Investigation of a multistate outbreak of listeriosis, which occurred in 2000 and was linked to delicatessen turkey meat, revealed contamination by a strain of *L. mono* which may have persisted in the incriminated processing plant for at least 12 years and caused intermittent contamination during that time period (Olsen, et. al. 2005). Because frequent testing vastly improves the chances of finding *Listeria* if it is present in the processing plant, manufacturers should consider new technologies which offer a more cost-effective means of testing for *Listeria*, allowing them to test more frequently, without necessarily increasing their budget. Compared to real-time Polymerase Chain Reaction (PCR), Enzyme Linked Immuno-Assay (ELISA)-based and other rapid methods which require use of costly equipment, we have found the 3M Petrifilm EL Plates to be extremely cost-effective. Compared with traditional protocols which require preparation of enrichment and plating media, the 3M Petrifilm EL Plates are ready-made and user-friendly, allowing more testing and less media preparation time. This easy-to-use format is suitable not only for small food manufacturers, who are limited by lab size, lack of incubator space, and lack of analytical equipment, but also for large manufacturers who want to stretch their quality assurance budget to accommodate more frequent testing, enabling them to track *Listeria* over time.

#3: My method needs to have an enrichment step for higher sensitivity. False.

As I have mentioned, in our study with 3M Petrifilm EL Plates, which is a direct plating method and requires no enrichment, we found its sensitivity to be higher than that of the Standard methods.

With direct plating methods, results can be interpreted quantitatively, providing more information to identify hot spots, niches of resident strains, and contamination sources for appropriate corrective action. Routine environmental monitoring and testing through use of *Listeria* spp. as indicator organisms for the pathogen *L. mono* allows the establishment of a baseline which can then be used for comparative purposes, to observe trends or detect a contamination problem. Once plant history and normal values have been established for a particular plant, threshold limits can be established and used to determine when corrective action is required. On-line sampling during production, coupled with use of quantitative data, can indicate times when periodic cleaning and sanitation are necessary to reduce numbers and overall probability of product contamination. Quantitative data can be used to document the effectiveness of interventions such as application of sanitizer, track levels of *Listeria* spp. which may increase over time during a production cycle, or monitor traffic patterns of plant personnel which lead to inadvertent plant contamination.

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Dr. Catherine W. Donnelly currently serves as the Associate Director for the Vermont Institute for Artisan Cheese and previously served as the Associate Director for the Northeast Center for Food Entrepreneurship, a research consortium between Cornell University and the University of Vermont. Dr. Donnelly served as the Associate Dean for Research and the Interim Dean of the College of Agriculture and Life Sciences at UVM from 1988-1999.

During her tenure at the University of Vermont, she has developed a research program that investigates the foodborne role of *Listeria monocytogenes.* Widely regarded as an international expert on this bacterial pathogen, Dr. Donnelly has published numerous articles and delivered hundreds of presentations on the topic of *Listeria.* Her research interests center on development of detection methods for *Listeria* and understanding the impact of sublethal injury on *Listeria* recovery and detection. Dr. Donnelly and her research colleagues pioneered the development of methods to detect *Listeria* in foods, including development of UVM media.

In 1999, the U.S. Secretaries for Agriculture and Health and Human Services appointed Dr. Donnelly to the National Advisory Committee on the Microbiological Criteria for Foods. Dr. Donnelly was appointed by the FDA Commissioner to serve on the Science Advisory Board of the FDA's National Center for Toxicological Research. Dr. Donnelly served as Chair of the Program Committee for the 2005 International Association for Food Protection Meetings.

[i] Dr. Catherine Donnelly was hired as a consultant to write this editorial.

[ii] The study referred to in this editorial was an independent study conducted by the University of Vermont.

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USDA/ FSIS; Microbiology Laboratory Guidebook (MLG) 8.04, 2005; Hitchins; 2002; ISO 11290