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Controlling *Listeria monocytogenes* in ready-to-eat foods: Working towards global scientific consensus and harmonization – Recommendations for improved prevention and control

Petra Luber [a,1], Scott Crerar [b,1], Christophe Dufour [c,1], Jeff Farber [d,1], Atin Datta [e,1], Ewen C.D. Todd [f,g,*,1]

[a] *Federal Office of Consumer Protection and Food Safety (BVL), Mauerstr. 39-42, D-10117 Berlin, Germany*
[b] *Risk Assessment Production Process, Food Standards Australia New Zealand, 55 Blackall Street, Barton, ACT 2600, Australia*
[c] *Silliker SAS, Immeuble le Mercury, 1 Rue de la Croix des Maheux, F-95031 Cergy-Pontoise Cedex, France*
[d] *Bureau of Microbial Hazards, A.L. 2203B, Food Directorate, Health Canada, Ottawa, Ontario, Canada K1A 0K9*
[e] *Virulence Mechanisms Branch, CFSAN/FDA, 8301 Muirkirk Road, Laurel, MD 20708, USA*
[f] *Department of Advertising, Public Relations, and Retailing, Michigan State University, East Lansing, MI 48823, USA*
[g] *Ewen Todd Consulting, Okemos, MI 48864, USA*

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ABSTRACT

An international group of experts from the food industry, academia, and governments met in Amsterdam in May 2009 to discuss approaches for controlling *Listeria monocytogenes* in ready-to-eat (RTE) foods in anticipation of an agreement by Member States on the Codex Guidelines for the pathogen in foods. The workshop was organised by Ewen Todd (Michigan State University) in cooperation with the European Federation of Food Science and Technology and the Global Harmonization Initiative. The group felt there is a need for a risk-based policy with input from all the stakeholders at local and national levels. An important part of the background is to review the critical factors for control, including the unique growth, survival and virulence characteristics of the pathogen; identifying specific populations at risk; and defining what RTE foods are. They also saw the need for *L. monocytogenes* food-source attribution through review of outbreak data, implementation of case–control studies, expert elicitations, microbial source tracking, and development of risk assessment models. They also indicated that surveillance of both listeriosis and the gastrointestinal non-invasive form of illness caused by the pathogen are important for public health agencies to establish or enhance; this would require coordination of laboratories through better communication and reporting for the analysis of clinical cases, foods and environmental sources. These laboratories should be also accredited, with some being reference laboratories at national or regional levels. There was consensus agreement on the microbiological criteria as specified in the Codex Guidelines, but it was recognized there were challenges for industry to meet these and government agencies to assess compliance, requiring a robust testing regime for both food and food-contact surfaces at all stages in the production system, as well as for environmental monitoring. Other issues are the development, validation, and acceptance of quantitative methods sufficient to detect the pathogen in food at levels <100 CFU g^{-1}; determining the food's ability to support the growth of the pathogen or not through challenge studies, and risk assessment models, appropriate labelling of RTE foods, and a standardized approach to tracing and tracking of products throughout the food chain. There is also a need for food worker education and training, and consumer awareness and responsibility. Message mapping is one approach to instill the essential food safety messages regarding listeriosis and the safety of RTE foods for both employees and the public.

1. Introduction

Following an invitation by the Global Harmonization Initiative (GHI) (http://www.globalharmonization.net) and Professor Ewen Todd of Michigan State University from May 5–7, 2009, an international group of experts from the food industry, academic research, and governments met in Amsterdam at a Workshop to

* Corresponding author. Ewen Todd Consulting, Okemos, MI 48864, USA.
E-mail address: todde@msu.edu (E.C.D. Todd).

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discuss approaches for controlling *Listeria monocytogenes* in ready-to-eat (RTE) foods in anticipation of an agreement by Member States on the Codex guidelines for the pathogen in foods. The publishing house Elsevier provided the facilities for the Workshop, and the European Federation of Food Science & Technology (EFFoST) supplied personnel resources for registration, travel arrangements, and other administrative functions. Funding was provided by a USDA/CSREES (now National Institutes of Food and Agriculture) grant awarded to Professor Todd. The basis for the discussions was the development of the Codex Alimentarius *Guidelines on the Application of General Principles of Food Hygiene to the Control of Listeria monocytogenes in Ready-To-Eat Foods* with its three Annexes (CAC, 2009). The main goal was to review these Codex Guidelines and explore ways of implementing specific prevention and control measures for industry to use, for governments to monitor, and for consumers to act on. As the group was especially interested in working towards global scientific consensus and harmonization, specific attention was given to the draft Annex II of the Guidelines with microbiological criteria for *L. monocytogenes* in RTE foods, which were formerly adopted a month later in June 2009. The meeting was designed as a workshop with a number of oral presentations covering the aspects of *Listeria* control from the viewpoint of governments, food industry, researchers, and communication experts. Moreover, experts on microbiological criteria gave presentations on setting microbiological criteria following a risk-based approach. However, it was agreed that all facets of control are important, not just compliance with microbiological criteria, and communication of the Guidelines and their implications was considered a high priority. This paper is a part of a special issue of Food Control that expands on the information presented at the Workshop. In addition to hearing the presentations, the participants of the Workshop came together in groups to discuss various aspects in detail from industry, government, risk management and risk communication perspectives.

The Workshop participants reached a consensus for supporting the newly adopted Codex Alimentarius microbiological criteria for *L. monocytogenes* in RTE foods, which, following a risk-based approach, differentiate between RTE foods where no growth of the pathogen occurs and those RTE foods where growth is possible. They recognized that acceptance of the Codex Guidelines by the different stakeholders would be a very positive initiative which would lead to a harmonized approach towards the control of *L. monocytogenes* worldwide. However, it was noted that more work needs to be done to help governments and responsible (competent) country authorities, the food industry, consumers, and other stakeholders understand and implement appropriate measures to limit the contamination and subsequent growth by *L. monocytogenes* in RTE foods, thereby reducing the risks for vulnerable populations in acquiring listeriosis. Stakeholders include responsible government authorities, processing, retail, and food service industries, consumer groups, with additional expertise input from academia and professional associations. The following recommendations are crafted to help in achieving this goal.

2. Critical factors to consider in controlling *L. monocytogenes* in RTE foods

2.1. Science-based nature of control systems

The Codex Alimentarius "Guidelines on the Application of General Principles of Food Hygiene to the Control of *Listeria monocytogenes* in Foods" (CAC, 2009) was developed for the purpose of providing guidance on the controls and associated tools that can be adopted by regulators and industry to minimize the likelihood of illnesses arising from the consumption of RTE foods containing *L. monocytogenes*. The controls and tools identified have been developed from the outcomes and consensus achieved in recent years through international and national risk assessments. The Guidelines therefore reflect what is currently considered best scientific practice, and are risk-based in terms of the types of foods and industries for which controls need to be applied.

2.1.1. The unique characteristics of Listeria

The control measures identified within the Codex Guidelines are multi-factorial and the extent of *Listeria* controls applied to a particular situation will depend on the nature of the food, its processing environment, and the type of hurdles applied. Control measures must be able to take into account the specific and unique characteristics of *L. monocytogenes* such as: i) its ability to survive and grow at cold temperatures and in a moist wet processing environment; ii) the widespread occurrence of the pathogen in nature, and the ease with which the organisms becomes associated with food, equipment, other food-contact surfaces, and the environment in processing plant facilities; and iii) the association of food-borne listeriosis with the ingestion of what is usually large numbers of bacteria. Importantly, many of these factors are unique and will differ from those of other food-borne pathogens such as *Salmonella*. Generic pathogen management programmes may fail to take into account or prioritize the impact that, for example, factors such as growth of *Listeria* spp. at low temperatures and their persistence within biofilms, have on food becoming contaminated with high levels of *L. monocytogenes*.

2.1.2. Control measures at all stages of production

The control measures for *Listeria* need to address every aspect of the farm-to-fork continuum and should include:

- Practices during primary production to minimize the introduction of *Listeria* spp. into the processing environment;
- Design and maintenance, including cleaning and disinfection, of processing equipment and facilities to reduce the opportunity for the introduction, survival and multiplication of *Listeria*;
- Processes that reduce the numbers of *Listeria* present in RTE food and the potential for any surviving *L. monocytogenes* to multiply during storage of the product (shelf life);
- Microbiological testing to validate the effectiveness of listericidal processes, cleaning and sanitation programmes, to identify sources of *Listeria* spp. in the processing environment and the presence and level in the RTE food or ingredients;
- Education of all stakeholders, so that they understand their contribution to the strategy, whether this be providing raw milk for making raw-milk cheeses, providing appropriate sanitisers to industry, providing food to at-risk consumers, or auditing of food processors food safety systems.

While there is a need to have appropriate control measures at all stages of the food continuum, specific measures at particular points will vary for different production systems and must be prioritised on the basis of the degree of risk mitigation that each may achieve.

2.1.3. Control measures within the context of a national Listeria control strategy

As the control measures identified in the Codex Guidelines are generalised, to be effective they must be applied in the context of the specific types of RTE foods or food sectors unique to each country. While previous outbreaks and microbiological testing provides some insight into high-risk foods, the low incidence of listeriosis means that these will not provide sufficient information to allow an overall assessment of the relative risks posed by each type of RTE food. There will, therefore, also need to be a review of