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Food Safety Science Briefs



Risk Assessment

Quantitative Risk Assessment Model to Investigate the Public Health Impact of Varying *Listeria monocytogenes* Allowable Levels in Different Food Commodities: A Retrospective Analysis

Fernando Sampredo, Fernando Pérez-Rodríguez, Joseph L Servadio, Sanjay Gummalla, Craig W Hedberg. *Int J Food Microbiol.* 2022 Sep 15;383:109932. doi: 10.1016/j.ijfoodmicro.2022.109932. [Article link](#)

Significance: This analysis concludes that removing product lots with a concentration higher than 1 CFU/g of *L. monocytogenes* will reduce contamination by 15%-88% and number of cases by 60%-100 %. Introducing lot-by-lot testing and defining allowable quantitative regulatory limits for low-risk ready-to-eat foods also may reduce the public health impact of *L. monocytogenes*.



Invasive listeriosis is a potentially fatal foodborne disease that according to this study may affect up to 32.9 % of the US population considered as increased risk and including people with underlying conditions and co-morbidities. *Listeria monocytogenes* has been scrutinized in research and surveillance programs worldwide in Ready-to-Eat (RTE) food commodities (RTE salads, deli meats, soft/semi-soft cheese, seafood) and frozen vegetables in the last 30 years with an estimated overall prevalence of 1.4-9.9 % worldwide (WD) and 0.5-3.8 % in the United States (US). Current *L. monocytogenes* control efforts have led to a prevalence reduction in the last 5 years of 4.9-62.9 % (WD) and 12.4-92.7 % (US). A quantitative risk assessment model was developed, estimating the probability of infection in the US susceptible population to be 10-10,000× higher than general population and the total number of estimated cases in the US was 1044 and 2089 cases by using the FAO/WHO and Pouillot dose-response models. Most cases were attributed to deli meats (>90 % of cases) followed by RTE salads (3.9-4.5 %), soft and semi-soft cheese and RTE seafood (0.5-1.0 %) and frozen vegetables (0.2-0.3 %). Cases attributed to the increased risk population corresponded to 96.6-98.0 % of the total cases with the highly susceptible population responsible for 46.9-80.1 % of the cases. Removing product lots with a concentration higher than 1 CFU/g reduced the prevalence of contamination by 15.7-88.3 % and number of cases by 55.9-100 %. Introducing lot-by-lot testing and defining allowable quantitative regulatory limits for low-risk RTE commodities may reduce the public health impact of *L. monocytogenes* and improve the availability of enumeration data.

Foodborne Pathogens

Lifestyle of *Listeria monocytogenes* and Food Safety: Emerging Listericidal Technologies in the Food Industry

Sinisa Vidovic, Gunaranjan Paturi, Sravani Gupta, Graham C. Fletcher. *Crit Rev Food Sci Nutr.* 2022 Sep 5;1-19. doi: 10.1080/10408398.2022.2119205. [Article link](#)

Significance: There is a need to develop effective and sustainable approaches to control contamination of food products with *L. monocytogenes* to prevent listeriosis which threatens food safety.

Listeria monocytogenes, a causative agent of listeriosis, is a major foodborne pathogen. Among pathogens, *L. monocytogenes* stands out for its unique ecological and physiological characteristics. This distinct lifestyle of *L. monocytogenes* has a significant impact on food safety and public health, mainly through the ability of this pathogen to multiply at refrigeration temperature and to persist in the food processing environment. Due to a combination of these characteristics and emerging

trends in consumer preference for ready-to-eat and minimally processed food, there is a need to develop effective and sustainable approaches to control contamination of food products with *L. monocytogenes*. Implementation of an efficient and reliable control strategy for *L. monocytogenes* must first address the problem of cross-contamination. Besides the preventive control strategies, cross-contamination may be addressed with the introduction of emerging post packaging non-thermal or thermal hurdles that can ensure delivery of a listericidal step in a packed product without interfering with the organoleptic characteristics of a food product. This review aims to present the most relevant findings underlying the distinct lifestyle of *L. monocytogenes* and its impact on food safety. We also discuss emerging food decontamination technologies that can be used to better control *L. monocytogenes*.

Foodborne Illness

Response of Sensitive and Resistant *Listeria monocytogenes* Strains Against Bacteriocins Produced by Different *Enterococcus* spp. Strains

Carolina Ibarguren, M Virginia Guitián, Romina M Lenz, Soria M Cecilia, M Carina Audisio. *Int J Food Microbiol.* 2022 Sep 15;382:109928. doi: 10.1016/j.ijfoodmicro.2022.109928. [Article link](#)

Significance: The emergence of *L. monocytogenes* strains resistant to the inhibitory action of bacteriocins has been detected and this review identifies alternative inhibitors.

Listeria monocytogenes is a relevant foodborne pathogen causing invasive listeriosis in humans, a disease with high mortality rates. Its ubiquity and growth characteristics enable this pathogen to survive harsh food processing environments. The addition of bacteriocins, antimicrobial peptides ribosomally synthesized by certain bacteria, appears as a natural alternative to control this pathogen in food. However, the emergence of *L. monocytogenes* strains resistant to the inhibitory action of bacteriocins has been detected. In order to analyse the development of this resistance, different properties of *L. monocytogenes* strains susceptible to bacteriocins (strains 01/155, 99/287 and 99/267) and their respective resistant isolates (strains 01/155B6R, 99/287B6R, 99/286C1R, 99/287 M01R, 99/287 M1bR, 99/287 M2dR, 99/267B6R), were compared in this work. Differences were analysed in: a) growth of the pathogen strains in direct contact with bacteriocin solution, in co-cultures with the producing strain, or with different sugars; b) response to antibiotics typically used against listeriosis; c) changes in cell morphology, observed by transmission or scanning electron microscopy; d) expression of mobility and haemolysin activity, two of *L. monocytogenes* main virulence factors; and e) biofilm formation ability. For all the isolates, the acquired resistance was permanent and crossed between the different bacteriocins under study. An inhibitory effect was observed for resistant strains only when they were grown in mixed culture with any of the bacteriocin-producing strains, with an acidified medium as additional growth stress. In all cases, the decrease in viability was lower for resistant strains and followed a particular profile for each strain. The variation of sugar substrate influenced resistant variants growth ability, with a more pronounced difference in the medium supplemented with glucose. Susceptibility to antibiotics was similar or higher for resistant variants, while neither the mobility nor the haemolytic activity presented differences among resistant or susceptible strains. Finally, the resistant variants showed a greater capacity to form biofilms, although this effect was reversed when grown in the presence of bacteriocins. Each resistant isolate had a particular behaviour pattern, and the acquisition of resistance appeared to be strain and bacteriocin dependent. These results contribute to the knowledge of *L. monocytogenes* bacteriocin-resistance development, which is essential to favour the use of these peptides as biopreservatives.

Mycotoxins

The Importance of Transcriptomics and Proteomics for Studying Molecular Mechanisms of Mycotoxin Exposure: A Review

A Cimbalò, M Frangiamone, G Font, L Manyes. *Food Chem Toxicol.* 2022 Sep 7;169:113396. doi: 10.1016/j.fct.2022.113396. [Article link](#)

Significance: The use of test animal models and alternative methods to better understand mycotoxins are needed to evaluate their mode of action in animal and human health.

This review aims to highlight recent advances where transcriptomics and proteomics have been used as a key tool to understand molecular toxicity of mycotoxins. The most studied mycotoxin by using transcriptomic approach is deoxynivalenol (DON), followed by aflatoxins (AFs) and zearalenone (ZEA). Instead, proteomics mostly focuses on AFs but also in this case, mildly to ZEA and DON. However, in both -omics approaches, fewer studies investigated the toxicological effect of emerging mycotoxins, patulin, ochratoxin A, T-2 toxin, alternariol and amino-14,16-dimethyloctadecan-3-ol. The study of changes in the expression of genes involved in immune system are the most common purposes for transcriptomics whereas cellular processes in proteomics field. Concerning the techniques used

to perform the experiments, RT-qPCR is the most employed in gene expression analysis whereas liquid chromatography coupled with mass spectrometry is the master technique for proteomics assays. The gathered data have reported that the interest in using these omic approaches has increased in the last five years. However, *in vitro* models take precedence over the *in vivo* and *ex vivo* ones. Therefore, there is a need to enhance the use of *in vivo* models and alternative methods to better understand mycotoxins mode of action on animal and human health.

Heavy Metals

Plant-Mediated Gold and Silver Nanoparticles as Detectors of Heavy Metal Contamination

Sneha Nayak, Louella Concepta Goveas, P Senthil Kumar, Raja Selvaraj, Ramesh Vinayagam. *Food Chem Toxicol.* 2022 Sep;167:113271. doi: 10.1016/j.fct.2022.113271. [Article link](#)

Significance: The production and characteristics of nanoparticles synthesized by plant mediation would be enhanced through a “design of experiments” approach, extending their feasibility in the detection of heavy metals.

Heavy metals are dumped into the environment as a result of human activities, posing a serious threat to ecology and human health. Surface water, potable drinking water, potable groundwater, and majority of wastewater include their traces, due to which, their detection by nanoparticles has received a lot of attention in recent years. Although microorganisms are utilized for green nanoparticle production, plant materials have recently been explored because they are more environmentally friendly, easier to scale up, and require fewer specific growth conditions. The production and attributes of nanoparticles synthesized by plant mediation could be enhanced through design of experiments approach, extending their feasibility in the detection of heavy metals in polluted environmental samples. A concise review on green synthesis of silver and gold nanoparticles utilizing plant phytochemicals, its mechanism of synthesis along with significance of design of experiments for enhancement, and their use as heavy metal contamination detectors is presented in the current study.

Food Packaging

Recent Advances in the Application of Nanotechnology to Create Antioxidant Active Food Packaging Materials

Hao Cheng, Long Chen, David Julian McClements, Hao Xu, Jie Long, Jianwei Zhao, Zhenlin Xu, et. al. *Crit Rev Food Sci Nutr.* 2022 Sep 30;1-16. doi: 10.1080/10408398.2022.2128035. [Article link](#)

Significance: Nanoparticles, nanofibers, nanocrystals and nanoemulsions can incorporate antioxidants into packaging materials. Recent advances are reviewed in the application of nano-enabled antioxidant packaging materials to preserve meat, seafood, fruit, vegetables and other foods.

Nanotechnology is being used to create innovative food packaging systems that can inhibit the oxidation of foods, thereby improving their quality, safety, and shelf life. These nano-enabled antioxidant packaging materials may therefore increase the healthiness and sustainability of the food supply chain. Recent progress in the application of nanotechnology to create antioxidant packaging materials is reviewed in this paper. The utilization of nanoparticles, nanofibers, nanocrystals, and nanoemulsions to incorporate antioxidants into these packaging materials is highlighted. The application of nano-enabled antioxidant packaging materials to preserve meat, seafood, fruit, vegetable, and other foods is then discussed. Finally, future directions and challenges in the development of this kind of active packaging material are highlighted to stimulate new areas of future research. Nanotechnology has already been used to create antioxidant packaging materials that inhibit oxidative deterioration reactions in foods, thereby prolonging their shelf life and reducing food waste. However, the safety, cost, efficacy, and scale-up of this technology still needs to be established before it will be commercially viable for many applications.

Chemical Contaminants

Epidemiology Evidence for Health Effects of 150 per- and Polyfluoroalkyl Substances: A Systematic Evidence Map

Elizabeth G Radke, J Michael Wright, Krista Christensen, Cynthia J Lin, Alexandra E Goldstone, Courtney Lemeris, Kristina A Thayer. *Environ Health Perspect.* 2022 Sep;130(9):96003. doi: 10.1289/EHP11185. [Article link](#)

Significance: Epidemiologic studies of PFAS compounds are uncommon. This review finds that public exposure to 15 PFAS compounds that had data was fairly low, although these exposures could grow if the 15 are used as substitutes for other PFAS in the event of phase-downs.

Background: Per- and polyfluoroalkyl substances (PFAS) comprise a large class of chemicals with widespread use and persistence in the environment and in humans; however, most of the epidemiology research has focused on a small subset. **Objectives:** The aim of this systematic evidence map (SEM) is to summarize the epidemiology evidence on approximately 150 lesser studied PFAS prioritized by the EPA for tiered toxicity testing, facilitating interpretation of those results as well as identification of priorities for risk assessment and data gaps for future research. **Methods:** The Populations, Exposure, Comparators, and Outcomes (PECO) criteria were intentionally broad to identify studies of any health effects in humans with information on associations with exposure to the identified PFAS. Systematic review methods were used to search for literature that was screened using machine-learning software and manual review. Studies meeting the PECO criteria underwent quantitative data extraction and evaluation for risk of bias and sensitivity using the Integrated Risk Information System approach. **Results:** 193 epidemiology studies were identified, which included information on 15 of the PFAS of interest. The most commonly studied health effect categories were metabolic (n=37), endocrine (n=30), cardiovascular (30), female reproductive (n=27), developmental (n=26), immune (n=22), nervous (n=21), male reproductive (n=14), cancer (n=12), and urinary (n=11) effects. In study evaluation, 120 (62%) studies were considered High/Medium confidence for at least one outcome. **Discussion:** Most of the PFAS in this SEM have little to no epidemiology data available to inform evaluation of potential health effects. Although exposure to the 15 PFAS that had data was fairly low in most studies, these less-studied PFAS may be used as replacements for “legacy” PFAS, leading to potentially greater exposure. It is impractical to generate epidemiology evidence to fill the existing gaps for all potentially relevant PFAS. This SEM highlights some of the important research gaps that currently exist.

Caffeine

Tea Consumption and All-Cause and Cause-Specific Mortality in the UK Biobank: A Prospective Cohort Study

Maki Inoue-Choi, Yesenia Ramirez, Marilyn C Cornelis, Amy Berrington de González, Neal D Freedman, Erikka Loftfield. *Ann Intern Med.* 2022 Sep;175(9):1201-1211. doi: 10.7326/M22-0041. [Article link](#)

Significance: Regardless of genetic variation in caffeine metabolism, higher tea consumption is associated with lower mortality risk.

Background: Tea is frequently consumed worldwide, but the association of tea drinking with mortality risk remains inconclusive in populations where black tea is the main type consumed. **Objective:** To evaluate the associations of tea consumption with all-cause and cause-specific mortality and potential effect modification by genetic variation in caffeine metabolism. **Design:** Prospective cohort study. **Setting:** The UK Biobank. **Participants:** 498 043 men and women aged 40 to 69 years who completed the baseline touchscreen questionnaire from 2006 to 2010. **Measurements:** Self-reported tea intake and mortality from all causes and leading causes of death, including cancer, all cardiovascular disease (CVD), ischemic heart disease, stroke, and respiratory disease. **Results:** During a median follow-up of 11.2 years, higher tea intake was modestly associated with lower all-cause mortality risk among those who drank 2 or more cups per day. Relative to no tea drinking, the hazard ratios (95% CIs) for participants drinking 1 or fewer, 2 to 3, 4 to 5, 6 to 7, 8 to 9, and 10 or more cups per day were 0.95 (95% CI, 0.91 to 1.00), 0.87 (CI, 0.84 to 0.91), 0.88 (CI, 0.84 to 0.91), 0.88 (CI, 0.84 to 0.92), 0.91 (CI, 0.86 to 0.97), and 0.89 (CI, 0.84 to 0.95), respectively. Inverse associations were seen for mortality from all CVD, ischemic heart disease, and stroke. Findings were similar regardless of whether participants also drank coffee or not or of genetic score for caffeine metabolism. **Limitation:** Potentially important aspects of tea intake (for example, portion size and tea strength) were not assessed. **Conclusion:** Higher tea intake was associated with lower mortality risk among those drinking 2 or more cups per day, regardless of genetic variation in caffeine metabolism. These findings suggest that tea, even at higher levels of intake, can be part of a healthy diet.

Food Allergens

The Natural History of Peanut and Egg Allergy in Children up to age 6 Years in the Health Nuts Population-Based Longitudinal Study

Rachel L Peters, Imma Guarnieri, Mimi L K Tang, Adrian J Lowe, Shyamali C Dharmage, Kirsten P Perrett, Lyle C Gurrin, Jennifer J Koplin. *J Allergy Clin Immunol.* 2022 Sep;150(3):657-665.e13. doi: 10.1016/j.jaci.2022.04.008. [Article link](#)

Significance: A review of a long-term study found that most egg allergy and nearly one-third of peanut allergy resolves naturally by age 6 years in children.

Background: Prospectively collected data on the natural history of food allergy are lacking. **Objective:** We examined the natural history of egg and peanut allergy in children from age 1 to 6 years and assessed whether a skin prick test

(SPT) result or other clinical factors at diagnosis are associated with the persistence or resolution of food allergy in early childhood. **Methods:** The HealthNuts cohort consists of 5276 children who were recruited at age 1 year and have been followed prospectively. Children with food allergy at age 1 year (peanut [n = 156] or raw egg [n = 471] allergy) and children who developed new sensitizations or food reactions after age 1 year were assessed for food sensitization and allergy (confirmed by oral food challenge when indicated) at the 6-year follow-up. **Results:** New-onset food allergy developed by age 6 years was more common for peanut (0.7% [95% CI = 0.5%-1.1%]) than egg (0.09% [95% CI = 0.03%-0.3%]). Egg allergy resolved more commonly (89% [95% CI = 85%-92%]) than peanut allergy (29% [95% CI = 22%-38%]) by age 6 years. The overall weighted prevalence of peanut allergy at age 6 years was 3.1% (95% CI = 2.6-3.7%) and that of egg allergy was 1.2% (95% = CI 0.9%-1.6%). The factors at age 1 year associated with persistence of peanut allergy were peanut SPT result of 8 mm or larger (odds ratio [OR] = 2.35 [95% CI 1.08-5.12]), sensitization to tree nuts (adjusted OR [aOR] = 2.51 [95% CI = 1.00-6.35]), and early-onset severe eczema (aOR = 3.23, [95% CI 1.17-8.88]). Factors at age 1 associated with persistence of egg allergy at age 6 were egg SPT result of 4 mm or larger (OR = 2.98 [95% CI 1.35-6.36]), other (peanut and/or sesame) food sensitizations (aOR = 2.80 [95% CI = 1.11-7.03]), baked egg allergy (aOR = 7.41 [95% CI = 2.16-25.3]), and early-onset severe eczema (aOR = 3.77 [95% CI = 1.35-10.52]). **Conclusion:** Most egg allergy and nearly one-third of peanut allergy resolves naturally by age 6 years. The prevalence of peanut allergy at age 6 years was similar to that observed at age 1 year, largely owing to new-onset food peanut allergy after age 1 year. Infants with early-onset eczema, larger SPT wheals, or multiple food sensitizations and/or allergies were less likely to acquire tolerance to either peanut or egg.

Emerging Science Area

Category: Nutrition and Health

White House Strategy on Hunger, Nutrition and Health. [Article link](#)

Significance: On Sept. 28, the White House convened a Conference on Hunger, Nutrition and Health where President Biden announced a goal of ending hunger and increasing healthy eating and physical activity by 2030 so fewer Americans experience diet-related diseases — while reducing related health disparities. Five strategies build on current existing government programs were announced.

The consequences of food insecurity and diet-related diseases are significant, far reaching, and disproportionately impact historically underserved communities. Yet, food insecurity and diet-related diseases are largely preventable, if we prioritize the health of the nation.

The Biden-Harris Administration envisions an America where no one wonders whether they will have enough money to put food on the table, where the healthy food choice is the easier choice, and where everyone has the same opportunity to be physically active. Transformative programs, policies, and system changes are needed within and outside government to achieve this vision. There is no silver bullet to address these complex issues, and there is no overnight fix. Making progress requires collective, sustained action and mobilization across every segment of society. That is why President Biden announced a goal of ending hunger and increasing healthy eating and physical activity by 2030 so fewer Americans experience diet-related diseases — while reducing related health disparities. To advance the President's goal—and build on the federal government's existing work to address hunger and diet-related diseases—this strategy identifies ambitious and achievable actions across five pillars:

1. Improving food access and affordability, including by advancing economic security; increasing access to free and nourishing school meals;
2. Integrating nutrition and health, including by working with Congress to pilot coverage of medically tailored meals in Medicare; testing Medicaid coverage of nutrition education and other nutrition supports using Medicaid section 1115 demonstration projects; and expanding Medicaid and Medicare beneficiaries' access to nutrition and obesity counseling;
3. Empowering all consumers to make and have access to healthy choices, including by proposing to develop a front-of-package labeling scheme for food packages; proposing to update the nutrition criteria for the “healthy” claim on food packages; expanding incentives for fruits and vegetables in SNAP; facilitating sodium reduction in the food supply by issuing longer-term, voluntary sodium targets for industry; and assessing additional steps to reduce added sugar consumption, including potential voluntary targets;
4. Supporting physical activity for all, including by expanding the U.S. Department of Health and Human Services' Centers for Disease Control and Prevention's (CDC) State Physical Activity and Nutrition Program to all states and territories; and

5. Enhancing nutrition and food security research, including by bolstering funding to improve metrics, data collection, and research to inform nutrition and food security policy, particularly on issues of equity and access; and implementing a vision for advancing nutrition science.

Engage with IAFNS

- **IAFNS-USDA Beltsville Webinar Series**

October 26, 2022 - December 1, 2022

Orlando Florida

- Join us for a 4-part series co-organized by IAFNS and scientists with the USDA ARS Beltsville Human Nutrition Center with a focus on the following: Dietary Added Sugars, Complex Carbohydrates, Botanicals and Flavonoids.

Find out more information about the four webinars [here](#).

- **Federal and State Efforts to Restrict PFAS: Impact on Food Companies**

November 14, 2022

Virtual, Event

- This webinar will highlight state laws and federal-level actions and how they might impact food companies and packaging suppliers. The webinar will also highlight EPA's actions under the PFAS Strategic Roadmap and preview expected actions later in 2022 and beyond.

Find more information about the webinar [here](#).

- **IAFNS Science Innovation Showcase - 2022**

December 13, 2022 - December 15, 2022

Virtual, Event

- This science-first and science-focused event will bring together scientists from multiple sectors, at all stages of their careers from graduate students to professors, technical experts to CEOs. Attendees will have the opportunity to engage in dialogue and discussion on the data, the technology and science being applied across the food and beverage ecosystem. Join us to learn about next generation possibilities!

Find more information about the Science Innovation Showcase [here](#).