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## Risk Assessment

### **Risk Factors Affecting the Food Safety Risk in Food Business Operations for Risk-Based Inspection: A Systematic Review**

Y. Ze, E. D. van Asselt, M. Focker, H. J. van der Fels-Klerx. *CRFSFS*. Sept. 2, doi.org/10.1111/risa.17642. [Article link](#)

Foodborne illnesses result in a high disease burden worldwide, making food safety control of food business operations (FBOs) an urgent issue. With public agencies and FBOs facing challenges in monitoring the complex food supply chain with limited resources, scientific and objective insights into those factors that are related to food safety at FBOs are needed. These factors can be used as input for risk-based inspection. We conducted a systematic review to identify and analyze risk factors affecting the FBOs' food safety risk. We used a set of predefined search strings in Scopus and Web of Science to search for scientific manuscripts published in the English language between January 1, 2003, and February 1, 2023. The review identified 53 relevant studies and 43 risk factors. The presence of certified personnel turned out to be the most cited factor. Nearly half of the extracted factors had only been investigated in one study. Additional challenges were identified for developing a universal ready-to-use list of factors for the building of a risk-based inspection method, such as the limitation in the applicability of identified factors in different types of FBOs, and the variability in conclusions between publications for certain factors (e.g., FBO location and inspection history), stressing the need for additional research. Future studies should also prioritize standardizing definitions and measurements, particularly regarding compliance factors. In general, the current list of factors brought forward in our review lays the groundwork for building a transparent, objective, and risk-based method for food safety inspections of FBOs.

## Foodborne Pathogens

### **Antibacterial Mechanism of Garviecin LG34 Against *S. Aureus* and *L. Monocytogenes* and its Application in Milk Preservation**

Yurong Gao, Dapeng Li. *JFP*, Vol. 87, Issue 10, Oct 1. doi.org/10.1016/j.jfp.2024.100345. [Article link](#)

The objective of this study was to reveal the antibacterial mode of action of garviecin LG34 against *S. aureus* CICC 21600 and *L. monocytogenes* CICC 21633 and measure the inhibitions on these two foodborne pathogenic bacteria in milk. Antibacterial mechanism of garviecin LG34 was ascertained by its effect on the efflux of Potassium (K<sup>+</sup>) ions, extracellular electrical conductivity, UV-absorbing substances, potential across the membrane ( $\Delta\Psi$ ), and cell permeability. The inhibition of garviecin LG34 against *S. aureus* CICC 21600 and *L. monocytogenes* CICC 21600 in milk was studied by viable counting method. Supplementation with 160 AU/ml of garviecin LG34 had a bactericidal effect on *S. aureus* CICC 21600 and *L. monocytogenes* CICC 21633. A total of 80, 160, and 320 AU/ml of garviecin LG34 resulted in the effusion of potassium ion

and UV-absorbing substances, the leakage of cellular electrolytes, and the dissipation of electrical potential across the membrane of these two food-borne bacteria and showed a dose-dependent. Moreover, the increase in cell permeability of both strains was observed by flow cytometer after cells treated with 160 AU/ml of garviecin LG34. Garviecin LG34 significantly inhibited the growth of these two food-borne bacteria in milk, especially in skimmed milk. Garviecin LG34 could cause pore formation, intracellular materials release, and permeability increase of *S. aureus* CICC 21600 and *L. monocytogenes* CICC 21633, and could be applied to milk as bio-preservative.

## Foodborne Illness

### Combating Foodborne Disease through Household Food Handling Behavior Improvement: A Comparison between Education and Price Interventions

Meg Zhang, H. Holly Wang, Junfei Bai. *Risk Anal.* Sept. 2. doi.org/10.1111/risa.17642. [Article link](#)

Foodborne disease cases are increasingly occurring in home kitchens because of improper food handling behavior. Human factors are considered major determinants of such behavior, although economic factors, which have attracted little attention, may also be important influencers. Taking the service time of kitchen towels as an example, we construct a theoretical model to analyze food handling behavior under an economic framework and empirically explore its economic determinants. Empirically, we use a randomized controlled trial (RCT) coupled with pre- and post-surveys in rural China. The RCT intervention includes information with tips for proper kitchen towel use and in-kind subsidies of one, two, or three packs of kitchen towels, which is regarded as a price intervention. We find that information alone and information plus one pack of towels are not enough to stimulate behavior improvement, whereas information plus two or three packs is sufficient. This implies that the quantity of kitchen towels used increases only as the towel price drops below a certain threshold. As an early attempt, we indicate that food handling behavior is economically driven, suggesting that a well-designed policy should combine educational campaigns and appropriate economic incentives to improve such behavior to reduce the risk of foodborne disease.

## Heavy Metals

### Unlocking Plant Resilience: Advanced Epigenetic Strategies against Heavy Metal and Metalloid Stress

Babar Iqbal, Naveed Ahmad, Guanlin Li, Arshad Jalal, Ali Raza Khan, Xiaojun Zheng, Muhammad Naeem, et. al. *Plant Science*, Vol. 349, 2024, 112265. doi.org/10.1016/j.plantsci.2024.112265. [Article link](#)

The escalating threat of heavy metal and metalloid stress on plant ecosystems requires innovative strategies to strengthen plant resilience and ensure agricultural sustainability. This review provides important insights into the advanced epigenetic pathways to improve plant tolerance to toxic heavy metals and metalloid stress. Epigenetic modifications, including deoxyribonucleic acid (DNA) methylation, histone modifications, and small ribonucleic acid (RNA) engineering, offer innovative avenues for tailoring plant responses to mitigate the impact of heavy metal and metalloid stress. Technological advancements in high-throughput genome sequencing and functional genomics have unraveled the complexities of epigenetic regulation in response to heavy metal and metalloid contamination. Recent strides in this field encompass identifying specific epigenetic markers associated with stress resilience, developing tools for editing the epigenome, and integrating epigenetic data into breeding programs for stress-resistant crops. Understanding the dynamic interaction between epigenetics and stress responses holds immense potential to engineer resilient crops that thrive in environments contaminated with heavy metals and metalloids. Eventually, harnessing epigenetic strategies presents a promising trajectory toward sustainable agriculture in the face of escalating environmental challenges. Plant epigenomics expands the potential for sustainable agriculture by implementing advanced epigenetic approaches becomes increasingly evident. These developments lay the foundation for understanding the growing significance of epigenetics in plant stress biology and its potential to mitigate the detrimental effects of heavy metal and metalloid pollution on global agriculture.

## Food Packaging

### Effect of Nitrite-Embedded Packaging Film on Growth of *Listeria monocytogenes* in Nitrite-free and Conventionally-Cured Bologna Sausage

Michael S. Cropp, Joseph G. Sebranek, James S. Dickson, Angela M. Walla, Terry A. Houser, Kenneth J. Prusa, Daniel A. Unruh, et. al. *JFP*, Vol. 87, Issue 11. Sept. 23, doi.org/10.1016/j.jfp.2024.100361. [Article link](#)

*Listeria monocytogenes* is a pathogen frequently associated with ready-to-eat (RTE) meat and poultry products. Nitrite is a key antimicrobial additive that can offer some degree of protection against *L. monocytogenes* when included in meat product formulations. The objectives of this study were to determine the potential of nitrite-embedded film to affect the growth of *L. monocytogenes* following post-thermal processing of conventionally-cured and nitrite-free bologna. Two bologna treatment formulations, a conventionally-cured control formulation (CON) and a nitrite-free formulation (UCC), were manufactured, packaged in conventional (CF) or nitrite-embedded (NEF) film, inoculated with 3.5 log CFU/cm<sup>2</sup> of a cocktail of *L. monocytogenes* strains, and stored at 10 ± 1 °C. CON-NEF and UCC-NEF treatments had significantly slower ( $P < 0.05$ ) growth of *L. monocytogenes* than CON-CF and UCC-CF, with populations in UCC-CF (which contained no nitrite) increasing by 3.4 logs after 10 d of storage in UCC-CF and 3.6 logs after 50 d in CON-CF (which had formulated nitrite only), while in the NEF-packaged samples, with or without formulated nitrite, they did not exceed the inoculum level until after day 40. Initial (day 0) residual nitrite was significantly greater ( $P < 0.05$ ) in the control formulation. Packaging in NEF, however, resulted in an increase of 27–28 ppm by day 3, regardless of formulation, after which it decreased rapidly. Results suggest NEF can be used as a post-lethality antimicrobial intervention in food safety intervention strategies, in both cured and uncured processed meat products.

## Chemical Contaminants

### PFAS Levels, Early Life Factors, and Mammographic Breast Density in Premenopausal Women

Yitao S. Ning, Kayla R. Getz, Joy K. Kyeyune, Myung Sik Jeon, Chongliang Luo, Jingqin Luo, Adetunji T. Toriola. *EHP*, Vol. 132, Issue 9, Sept. 18. doi.org/10.1289/EHP14065. [Article link](#)

**Background:** Mammographic breast density (MBD) is a strong risk factor and an intermediate phenotype for breast cancer, yet there are limited studies on how environmental pollutants are associated with MBD. **Objective:** We investigated associations of perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), and perfluorohexane sulfonate (PFHxS) levels with measures of MBD and evaluated if early life factors modified any associations. **Methods:** Metabolon performed metabolomics analysis using ultrahigh-performance liquid chromatography/tandem accurate mass spectrometry in fasting blood from 705 premenopausal women completing their annual screening mammogram in St. Louis, Missouri. We calculated least square means (LSM) of mammographic volumetric percent density (VPD), dense volume (DV), and nondense volume (NDV) by quartiles (Q) of PFOS, PFOA, and PFHxS from multivariable linear regression modeling overall and stratified by recruitment period, race, age at menarche, and body shape at age 10. Models were adjusted for age, age at menarche, body fat percentage, race, family history of breast cancer, oral contraceptive use, alcohol consumption, parity/age at first birth, and body shape at age 10. **Results:** PFOS, PFOA, and PFHxS were not significantly associated with VPD or NDV. PFHxS was significantly positively associated with DV (Q1=67.64 cm<sup>3</sup>, Q2=69.91 cm<sup>3</sup>, Q3=69.06 cm<sup>3</sup>, Q4=75.79 cm<sup>3</sup>;  $p$ -trend=0.03). PFOS was positively associated with DV (Q1=65.45 cm<sup>3</sup>, Q2=70.74 cm<sup>3</sup>, Q3=73.31 cm<sup>3</sup>, Q4=73.52 cm<sup>3</sup>,  $p$ -trend=0.06) with DV being 8.1%, 12%, and 12.3% higher in Q2, Q3, and Q4 compared to Q1. Among women who were underweight/normal weight at age 10, PFOS was positively associated with VPD (Q1=9.02%, Q2=9.11%, Q3=9.48%, Q4=9.92%;  $p$ -trend 0.04) while there was an inverse association among women who were overweight/obese at age 10 (Q1=7.46%, Q2=6.94%, Q3=6.78%, Q4=5.47%;  $p$ -trend=0.005) ( $p$ -interaction=0.04). **Discussion:** We report novel associations of PFHxS and PFOS with DV in premenopausal women. PFOS, PFOA, and PFHxS were not associated with VPD and NDV. In addition, body shape at age 10 may modify the associations of PFOS with MBD. Further studies are needed to validate our findings and to evaluate the associations of other per- and polyfluoroalkyl substances (PFAS), as well as mixtures of PFAS, with MBD.

## Caffeine

### Habitual Coffee, Tea, and Caffeine Consumption, Circulating Metabolites, and the Risk of Cardiometabolic Multimorbidity

Xujia Lu, Xiaohong Zhu, Guochen Li, Luying Wu, Liping Shao, Yulong Fan, Chen-Wei Pan, et. al. *The Journal of Clinical Endocrinology & Metabolism*, doi.org/10.1210/clinem/dgae552. [Article link](#)

**Context:** Cardiometabolic multimorbidity (CM) is an increasing public health concern. Previous observational studies have suggested inverse associations between coffee, tea, and caffeine intake and risks of individual cardiometabolic diseases; however, their associations with CM and related biological markers are unknown. **Methods:** This prospective study involved

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172 315 (for caffeine analysis) and 188 091 (tea and coffee analysis) participants free of any cardiometabolic diseases at baseline from the UK Biobank; 168 metabolites were measured among 88 204 and 96 393 participants. CM was defined as the coexistence of at least 2 of the following conditions: type 2 diabetes, coronary heart disease, and stroke. **Results:** Nonlinear inverse associations of coffee, tea, and caffeine intake with the risk of new-onset CM were observed. Compared with non-consumers or consumers of less than 100 mg caffeine per day, consumers of moderate amount of coffee (3 drinks/d) or caffeine (200-300 mg/d) had the lowest risk for new-onset CM, with respective hazard ratios (95% CIs) of 0.519 (0.417-0.647) and 0.593 (0.499-0.704). Multistate models revealed that moderate coffee or caffeine intake was inversely associated with risks of almost all developmental stages of CM, including transitions from a disease-free state to single cardiometabolic diseases and subsequently to CM. A total of 80 to 97 metabolites, such as lipid components within very low-density lipoprotein, histidine, and glycoprotein acetyls, were identified to be associated with both coffee, tea, or caffeine intake and incident CM. **Conclusion:** Habitual coffee or caffeine intake, especially at a moderate level, was associated with a lower risk of new-onset CM and could play important roles in almost all transition phases of CM development. Future studies are warranted to validate the implicated metabolic biomarkers underlying the relation between coffee, tea, and caffeine intake and CM.

## Food Allergens

### Development of a Rapid and Reliable Method to Simultaneously Detect Seven Food Allergens in Processed Foods using LC-MS/MS

Akira Torii, Yusuke Seki, Ryoichi Sasano, Yoshiki Ishida, Kosuke Nakamura, Rie Ito, Yusuke Iwasaki, et. al. *Food Chem. X*. Vol. 23, Oct, 101558. [Article link](#)

Rapid analysis of multiple food allergens is required to confirm the appropriateness of food allergen labelling in processed foods. This study aimed to develop a rapid and reliable method to simultaneously detect trace amounts of seven food allergenic proteins (wheat, buckwheat, milk, egg, crustacean, peanut, and walnut) in processed foods using LC-MS/MS. Suspension-trapping (S-Trap) columns and on-line automated solid-phase extraction were used to improve the complex and time-consuming pretreatment process previously required for allergen analysis using LC-MS/MS. The developed method enabled the simultaneous detection of selected marker peptides for specific proteins derived from seven food ingredients in five types of incurred samples amended with trace amounts of allergenic proteins. The limit of detection values of the method for each protein were estimated to be <1 mg/kg. The developed analytical approach is considered an effective screening method for confirming food allergen labelling on a wide range of processed foods.

## Emerging Science Areas

Emerging Focus on Mycotoxins in Beverages

### Establishment of Appropriate Conditions for the Efficient Determination of Multiple Mycotoxins in Tea Samples and Assessment of their Drinking Risks

Ying-Chun Wan, Zhe-Lin Kong, Yi-Hsieng Samuel Wu, Chien-Ni Huang, Tomohisa Ogawa, Jau-Tien Lin, Deng-Jye Yang. *Food Chem.* 2024 Sep 25;463(Pt 4):141438. doi: 10.1016/j.foodchem.2024.141438. [Article link](#)

Conditions were determined for rapid, convenient, and efficient determination of 16 common mycotoxins in tea samples. Mycotoxins in tea leaves and tea infusion samples were extracted using solid-liquid extraction/liquid-liquid extraction combined with ultrasonic-assisted extraction. The extraction solvent was 2-butanone/ethyl acetate (9/1 v/v) with 0.1 % formic acid. The established conditions enabled the analysis of these mycotoxins by ultra-high-performance liquid chromatography tandem mass spectrometry (UHPLC-MS/MS) in 5.5 min. In addition, HPLC with a temperature-controlled fluorescence detector was able to simultaneously determine 8 mycotoxins with fluorescent properties in 10 min without derivatization. Aflatoxin M1 (2.15 and 3.01 µg/kg), fumonisin B2 (198.89 µg/kg), and zearalenone (87.54 µg/kg) could be detected in commercially available pu-erh tea, green tea, and black tea products, and their total transfer rates from the products to brewed tea infusions were 64.08-65.13 %, 90.59 %, and 25.99 %, respectively. The risks of drinking mycotoxins from these tea infusions mostly showed low levels of concern.

## Engage with IAFNS

### **Low- and No-Calorie Sweeteners Stakeholder Exchange**

October 15, 2024, Washington, DC

IAFNS will be hosting its annual invitation-only Low- and No-Calorie Sweeteners Stakeholder Exchange to elicit input.

[Register here](#)

### **Designing a Web-Based Tool for Cognitive Test Selection in Nutrition Research**

October 18, 2024, Virtual Event

This dialogue will provide an opportunity for stakeholders to discuss identifying appropriate cognitive tests for nutrition research.

[Register here](#)

### **Report: IUFoST Task Force on Processing for Nutrition, Diet and Health**

November 4, 2024, Virtual Event

The International Union of Food Science and Technology established a Task Force to address the role of food processing and terms in food classifications. Join us to learn more about this initiative.

[Register here](#)

### **Live Microbes in the Food Supply: Why They Matter and How to Share Data with USDA**

November 6, 2024, Virtual Event

IAFNS hosts speakers that will address how to add products with live microbes to the USDA Global Branded Food Products Database.

[Register here](#)

### **Host-Microbiome Interactions in Health and Disease**

November 19, 2024, Virtual Event

Join IAFNS as we learn about the latest research in this area underway at the Weizmann Institute, under the direction of Dr. Eran Elinav.

[Register here](#)

### **Retrospective Harmonization: A Novel Approach to Examining Dietary Patterns Associated with Cognitive Decline**

December 5, 2024, Virtual Event

The IAFNS Cognitive Health committee will hear a final report from the Retrospective Harmonization Expert Group during this meeting.

[Register here](#)

### **IAFNS Science Innovation Showcase**

December 10-12, 2024, 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 to CEOs. Attendees will engage in dialogue on the data, the technology and science being applied across the food and beverage ecosystem. Submit your abstracts by Oct. 31 and join us to learn about next generation possibilities!

[Register here](#)



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