Pathogen Detection

Simulation Evaluation of Power of Sampling Plans to Detect *Cronobacter* in Powdered Infant Formula Production

Significance: This work benchmarks the ability of existing industry sampling plans to detect food safety and quality hazards at relevant prevalence and levels.

Cronobacter is a hazard in Powdered Infant Formula (PIF) products that is hard to detect due to localized and low-level contamination. We adapted a previously published sampling simulation to PIF sampling and benchmarked industry-relevant sampling plans across different numbers of grabs, total sample mass, and sampling patterns. We evaluated performance to detect published *Cronobacter* contamination profiles for a recalled PIF batch [42% prevalence, −1.8 ± 0.7 log(CFU/g)] and a reference, nonrecalled, PIF batch [1% prevalence, −2.4 ± 0.8 log(CFU/g)]. Simulating a range of numbers of grabs [n = 1–22,000 (representing testing every finished package)] with 300 g total composite mass showed that taking 30 or more grabs detected contamination reliably (<1% median probability to accept the recalled batch). Benchmarking representative sampling plans ([n = 30, mass grab = 10g], [n = 30, m = 25g], [n = 60, m = 25g], [n = 180, m = 25g]) showed that all plans would reject the recalled batch (<1% median probability to accept) but would rarely reject the reference batch (>50% median probability of acceptance, all plans). Overall, (i) systematic or stratified random sampling patterns are equal to or more powerful than random sampling of the same sample size and total sampled mass, and (ii) taking more samples, even if smaller, can increase the power to detect contamination.

Foodborne Pathogens

Preliminary Incidence and Trends of Infections Caused by Pathogens Transmitted Commonly Through Food — Foodborne Diseases Active Surveillance Network, 10 U.S. Sites

Significance: Reported incidence of enteric infections was lower during the COVID-19 pandemic years of 2020–2021 compared with previous years but has now returned to or exceeded pre-pandemic levels. Collaboration across the food landscape is needed to reduce pathogens in foods.

What is already known about this topic? *Campylobacter* and *Salmonella* are the leading causes of bacterial enteric infections transmitted commonly by food. Reported incidence of enteric infections was lower during the COVID-19 pandemic (2020–2021) compared with previous years. **What is added by this report?** During 2022, FoodNet identified higher incidences of Shiga toxin-producing *Escherichia coli, Yersinia, Vibrio,* and *Cyclospora* infections compared with 2016–2018. *Campylobacter, Salmonella, Shigella,* and *Listeria* incidences did not change. **What are the implications for public health practice?** Progress in reducing enteric infection incidence was not observed during 2022, as influences of the COVID-19 pandemic subsided. Collaboration among food growers, processors, retail stores, restaurants, and regulators is needed to reduce pathogen contamination during poultry slaughter and to prevent contamination of leafy greens.

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Foodborne Illness

Investigation of a Multistate Outbreak of *Listeria monocytogenes* Infections Linked to Frozen Vegetables Produced at Individually Quick-Frozen Vegetable Manufacturing Facilities

Asma Madad, Katherine E Marshall, Tyann Blessington, Cerisé Hardy, Monique Salter, Colin Basler, Amanda Conrad, et. al. *J Food Prot*. 2023 Jun 14;86(8):100117. doi: 10.1016/j.jfp.2023.100117. Article link

Significance: Federal health officials reviewed nine *L. monocytogenes* infections in frozen vegetables which led to extensive voluntary food recalls. This is the first known multistate outbreak of listeriosis in the United States linked to frozen vegetables.

In 2016, the U.S. Food and Drug Administration (FDA), the Centers for Disease Control and Prevention (CDC), and state partners investigated nine *Listeria monocytogenes* infections linked to frozen vegetables. The investigation began with two environmental *L. monocytogenes* isolates recovered from Manufacturer A, primarily a processor of frozen onions, that were a match by whole genome sequencing (WGS) to eight clinical isolates and historical onion isolates with limited collection details. Epidemiologic information, product distribution, and laboratory evidence linked suspect food items, including products sourced from Manufacturer B, also a manufacturer of frozen vegetable/fruit products, with an additional illness. The environmental isolates were obtained during investigations at Manufacturers A and B. State and federal partners interviewed ill people, analyzed shopper card data, and collected household and retail samples. Nine ill persons between 2013 and 2016 were reported in four states. Of four ill people with information available, frozen vegetable consumption was reported by three, with shopper cards confirming purchases of Manufacturer B brands. Two identified outbreak strains of *L. monocytogenes* (Outbreak Strain 1 and Outbreak Strain 2) were a match to environmental isolates from Manufacturer A and/or isolates from frozen vegetables recovered from open and unopened product samples sourced from Manufacturer B; the investigation resulted in extensive voluntary recalls. The close genetic relationship between isolates helped investigators determine the source of the outbreak and take steps to protect public health. This is the first known multistate outbreak of listeriosis in the United States linked to frozen vegetables and highlights the significance of sampling and WGS analyses when there is limited epidemiologic information. Additionally, this investigation emphasizes the need for further research regarding food safety risks associated with frozen foods.

Mycotoxins

Metabolomics as an Emerging Approach for Deciphering the Biological Impact and Toxicity of Food Contaminants: The Case of Mycotoxins

Payal Mandal, Olga Lanaridi, Benedikt Warth, Kausar M Ansari. *Crit Rev Food Sci Nutr*. 2023 Jun 7;1-25. doi: 10.1080/10408398.2023.2217451. Article link

Significance: A review of the most extensively studied mycotoxins reported in the literature and their impact on the metabolome upon exposure.

Exposure to mycotoxins through the dietary route occurs on a daily basis while their deleterious effects are exhibited in the form of ailments, such as inflammation, cancer, and hormonal imbalance. The negative impact of mycotoxins can be attributed to their interaction with various biomolecules and their interference in metabolic pathways. The activity of biomolecules, such as enzymes/receptors, which engage the intricate mechanism of endogenous metabolism, is more susceptible to disruption by metabolites of high toxicity, which gives rise to adverse health effects. Metabolomics is a useful analytical approach that can assist in unraveling such information. It can simultaneously and comprehensively analyze a large number of endogenous and exogenous molecules present in biofluids and can, thus, reveal biologically relevant perturbations following mycotoxin exposure. Information provided by genome, transcriptome and proteome analyses, which have been utilized for the elucidation of biological mechanisms so far, are further complemented by the addition of metabolomics in the available bioanalytics toolbox. Metabolomics can offer insight into complex biological processes and their respective response to several (co-) exposures. This review focuses on the most extensively studied mycotoxins reported in literature and their respective impact on the metabolome upon exposure.

Heavy Metals

Dietary Exposure to Cadmium from Six Common Foods in the United States

Ashish Pokharel, Felicia Wu. *Food & Chemical Toxicology*, June 12, 2023. doi.org/10.1016/j.fct.2023.113873. Article link

Significance: This research aids the FDA metals reduction effort by estimating the American population's Cadmium exposures in food, by age group and by consumption patterns of six common foods. Food safety policy can be developed to target the age group at highest risk and increase the safety of food for children.

 Recently, U.S. Food and Drug Administration (FDA) launched a Closer to Zero Action Plan to assess the risks of and develop action levels for certain heavy metals in food including cadmium (Cd). This research aids the FDA Action Plan by estimating the American population's Cd exposures in food, by age group and consumption patterns of certain high-risk foods; and by determining circumstances in which exposures exceed tolerable daily intakes developed by policymaking groups in the US and worldwide. We found that the age groups 6–24 months and 24–60 months old are the most highly exposed to Cd in common foodstuffs. American infants and young children of these age groups who regularly consumed rice, spinach, oats, barley, potatoes, and wheat had mean Cd exposures exceeding maximum tolerable intake level was set by the Agency for Toxic Substances and Disease Registry (ATSDR). We have identified age groups at highest potential risk, and therefore of interest for developing food safety policies to improve the safety of commercial food for children.

Food Packaging

Antimicrobial Properties of Poly (vinyl alcohol) Films with Zeolitic Imidazolate Framework (ZIF-8) Nanoparticles for Food Packaging

Yutaro Hara, Maria Elena Castell-Perez, Rosana G Moreira. *J Food Sci*. 2023 Jun;88(6):2512-2522. doi: 10.1111/1750-3841.16572. Article link

Significance: This article expands the food safety body of knowledge regarding fresh produce and other packaged foods through the development of active biopolymeric films with embedded nanoparticles to entrap natural antimicrobials.

Antimicrobial packaging films are of interest to the fresh produce industry due to the high number of foodborne illness outbreaks associated with these products. This study evaluated the antimicrobial effectiveness of poly (vinyl alcohol) (PVA) films with embedded zeolitic imidazolate framework (ZIF-8) nanoparticles carrying trans-cinnamaldehyde (TC) against Escherichia coli MG1655 in spinach leaves. PVA films were synthesized using distilled water and mixed at 90°C for 1 h. The synthesized nanoparticles were introduced at various mass ratio concentrations (0%-5% weight of ZIF-8@TC nanoparticles to PVA), namely PVA-Z8-0 (control) through PVA-Z8-5. The PVA and ZIF-8@TC solution was mixed for 24 h until it seemed homogenous, cast, and dried in a ventilated oven at 35°C for 24 h. The release rate of TC from the PVA/ZIF-8@TC into both ethanol and methanol was characterized using HPLC methods. Disk diffusion and growth studies were performed to quantify the films antimicrobial effectiveness. Disk diffusion test showed that antimicrobial activity against E. coli MG1655 increased ($p < 0.05$) with increased nanoparticles concentration. Growth characteristics were described by the Baranyi model with some variations. About 0.26, 0.73, and 1.65 log reductions were achieved with the PVA-Z8-1 to PVA-Z8-3 films, respectively, while total inactivation was achieved with both the PVA-Z8-4 and PVA-Z8-5 films ($p < 0.05$). Similarly, the Baranyi model described the inhibitory profiles of the different films. This study contributes to the overall food safety body of knowledge regarding fresh produce and other packaged foods through the development of biopolymeric films with embedded nanoparticles to entrap natural antimicrobials. PRACTICAL APPLICATION: This study paves the way for further research on the development of active polymeric films for food packaging applications.

Chemical Contaminants

Plasma Protein Binding Evaluations of Per- and Polyfluoroalkyl Substances for Category-Based Toxicokinetic Assessment

Marci Smeltz, John F Wambaugh, Barbara A Wetmore. *Chem Res Toxicol*. 2023 Jun 19;36(6):870-881. doi: 10.1021/acs.chemrestox.3c00003. Article link

Significance: 67 PFAS chemicals spanning a wide range of functional groups were evaluated for in vitro human plasma protein binding, aiding the development of PFAS new approach methodologies.

New approach methodologies (NAMs) that make use of in vitro screening and in silico approaches to inform chemical evaluations rely on in vitro toxicokinetic (TK) data to translate in vitro bioactive concentrations to exposure metrics reflective of administered dose. With 1364 per- and polyfluoroalkyl substances (PFAS) identified as of interest under Section 8 of the U.S. Toxic Substances Control Act (TSCA) and concern over the lack of knowledge regarding environmental persistence, human health, and ecological effects, the utility of NAMs to understand potential toxicities and toxicokinetics across these data-poor compounds is being evaluated. To address the TK data deficiency, 71 PFAS selected to span a wide range of functional groups and physico-chemical properties were evaluated for in vitro human plasma protein binding (PPB) by ultracentrifugation with liquid chromatography-mass spectrometry analysis. For the 67 PFAS successfully evaluated by ultracentrifugation, fraction unbound in plasma (fup) ranged from less than 0.0001 (pentadecafluorooctanoyl chloride) to 0.7302 (tetrafluorosuccinic acid), with over half of the PFAS showing PPB exceeding 99.5% (fup < 0.005). Category-based evaluations revealed that perfluoroalkanoyl chlorides and perfluorinated carboxylates (PFCAs) with 6-10 carbons were the highest bound, with similar median values for alkyl, ether, and polyether PFCAs. Interestingly, binding was lower for the PFCAs with a carbon chain length of ≥11. Lower binding also was noted for fluorotelomer carboxylic acids when compared to their carbon-equivalent perfluoroalkyl acids. Comparisons of the fup value derived using two PPB methods, ultracentrifugation or rapid equilibrium dialysis (RED), revealed RED failure for a subset of PFAS of high mass and/or predicted octanol-water partition coefficients exceeding 4 due to failure to achieve equilibrium. Bayesian modeling was used to provide uncertainty bounds around fup point estimates for incorporation into TK modeling. This PFAS PPB evaluation and grouping exercise across 67 structures greatly expand our current knowledge and will aid in PFAS NAM development.

Caffeine

Coffee Consumption and Skeletal Muscle Mass: WASEDA'S Health Study

Ryoko Kawakami, Kumpei Tanisawa, Tomoko Ito, Chiyoko Usui, Kaori Ishii, Isao Muraoka, Katsuhiko Suzuki, et. al. *Br J Nutr*. 2023 Jul:14;130(1):127-136. doi: 10.1017/S0007114522003099. Article link

Significance: Coffee consumption may be inversely associated with the prevalence of low muscle mass.

Few studies have examined the association between coffee consumption and muscle mass; their results are conflicting. Therefore, we examined the association between coffee consumption and low muscle mass prevalence. We also performed an exploratory investigation of the potential effect modification by demographic, health status-related and physical activity-related covariates. This cross-sectional study included 2085 adults aged 40-87 years. The frequency of coffee consumption was assessed using a self-administered questionnaire. Muscle mass was assessed as appendicular skeletal muscle mass/height2 using a multifrequency bioelectrical impedance analyser. We defined low muscle mass using cut-offs recommended by the Asian Working Group for Sarcopenia. Multivariable-adjusted OR for low muscle mass prevalence were estimated using a logistic regression model. The prevalence of low muscle mass was 5·4 % (n 113). Compared with the lowest coffee consumption group (< 1 cup/week), the multivariable-adjusted OR (95 % CI) of low muscle mass prevalence were 0·62 (0·30, 1·29) for 1-3 cups/week, 0·53 (0·29, 0·96) for 4-6 cups/week or 1 cup/d and 0·28 (0·15, 0·53) for ≥ 2 cups/d (P for trend < 0·001). There were no significant interactions among the various covariates after Bonferroni correction. In conclusion, coffee consumption may be inversely associated with low muscle mass prevalence.

Food Allergens

Skin and Oral Intervention for Food Allergy Prevention based on the Dual Allergen Exposure Hypothesis

Kiwako Yamamoto-Hanada, Yukihiro Ohya. *Clin Exp Pediatr*. 2023 Jun 14. doi: 10.3345/cep.2023.00045. Article link

Significance: Exposing children orally and through skin may help prevent food allergy development.

Early-onset atopic dermatitis increases the risk of food allergies, suggesting that transcutaneous sensitization may occur through inflamed skin. Regarding food allergy causation, the dual allergen exposure hypothesis proposes that oral-route allergen exposure leads to immune tolerance, whereas allergen exposure via the inflamed skin causes food allergy. This hypothesis implies that it is important to induce oral immune tolerance and prevent allergic food sensitization through the skin. In this review, we focus on the breakthrough evidence based on the dual allergen exposure hypothesis-both skin intervention and oral intervention for food allergy prevention.

Emerging Science Areas

Food Safety Emerging Area: Centers of Excellence

A Concept for Comprehensive Food is Medicine Networks or Centers of Excellence

Christopher J. Lynch (Acting Director, NIH Office of Nutrition Research)

AJCN April 25,2023. doi.org/10.1016/j.ajcnut.2023.04.027. Article link

Significance: Centers of Excellence will address research and healthcare issues related to diet-related diseases, malnutrition, food insecurity, and increase nutrition training

A call for RFI was published by the NIH Office of Nutrition Research, Division of Program Coordination, Planning and Strategic Initiative, seeking comments on a proposed umbrella initiative under Food is Medicine as a critical element within the National Strategy on Hunger, Nutrition and Health, wherein nutrition will be completely integrated with health care. Food is Medicine will be the umbrella nexus for all programs that link diet and health involving (1) the provision of Food is Medicine services (medically tailored meals, medically tailored groceries, produce prescriptions, teaching kitchens, etc.), and (2) the nexus to the healthcare system, deploying community nutrition or lifestyle medicine care. A concept of four domains under Food as Medicine Networks or Centers of Excellence will address research and healthcare issues related to diet-related diseases, malnutrition, food insecurity, and increase nutrition training across stages of health professions trainings.

Engage with IAFNS

The Science and Implementation of the Low FODMAP Diet
July 12, 2023
Virtual, Event
This webinar will delve into the 3 phases of the FODMAP diet, provide helpful hints for success, grocery shopping tips and also particular nutrients that may be of concern with long-term implementation.
Read more.

Optimizing Cognitive Function with Foods, Nutrients and Dietary Patterns: The Science and the Translation
August 8, 2023
Virtual, Event
The 2020 Dietary Guidelines Advisory Committee (DGAC) addressed several questions related to neurocognition but was faced with "considerable variation in testing methods, inconsistent validity and reliability of cognitive testing methods, and differences between dietary patterns and cognitive outcomes examined," precluding the ability to develop dietary recommendations. This webinar will focus on the science and translation of optimizing cognitive function with food.
Read more.

What's In Food? How USDA's FoodData Central and the Global Branded Food Products Database Supports Nutrition Research
August 30, 2023
Virtual, Event
The USDA Global Branded Food Products Database (GBFPD) is a component of USDA's FoodData Central and the result of a Public-Private Partnership between USDA, IAFNS, GS1 US, 1WorldSync, NielsenIQ Label Insight and the University of Maryland.
Read more.

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