

May 2022

Food Safety Science Briefs



IAFNS Annual Meeting & Science Symposium: Advancing Science for Impact

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Risk Assessment

On the Utility of ToxCast-Based Predictive Models to Evaluate Potential Metabolic Disruption by Environmental Chemicals



Dayne L Filer, Kate Hoffman, Robert M Sargis, Leonardo Trasande, Christopher D Kassotis. *Environ Health Perspect.* 2022 May;130(5):57005. doi: 10.1289/EHP6779. [Article link](#)

Significance: Using a set of 38 chemicals with previously published results in 3T3-L1 cells, researchers performed a metabolism-targeted literature review to determine consensus activity determinations and found that ToxCast predictions were aligned with their 3T3-L1 cell testing findings.

Background: Research suggests environmental contaminants can impact metabolic health; however, high costs prohibit in vivo screening of putative metabolic disruptors. High-throughput screening programs, such as ToxCast, hold promise to reduce testing gaps and prioritize higher-order (in vivo) testing. **Objectives:** We sought to a) examine the concordance of in vitro testing in 3T3-L1 cells to a targeted literature review for 38 semivolatile environmental chemicals, and b) assess the predictive utility of various expert models using ToxCast data against the set of 38 reference chemicals. **Methods:** Using a set of 38 chemicals with previously published results in 3T3-L1 cells, we performed a metabolism-targeted literature review to determine consensus activity determinations. To assess ToxCast predictive utility, we used two published ToxPi models: a) the 8-Slice model published by Janesick et al. (2016) and b) the 5-Slice model published by Auerbach et al. (2016). We examined the performance of the two models against the Janesick in vitro results and our own 38-chemical reference set. We further evaluated the predictive performance of various modifications to these models using cytotoxicity filtering approaches and validated our best-performing model with new chemical testing in 3T3-L1 cells. **Results:** The literature review revealed relevant publications for 30 out of the 38 chemicals (the remaining 8 chemicals were only examined in our previous 3T3-L1 testing). We observed a balanced accuracy (average of sensitivity and specificity) of 0.86 comparing our previous in vitro results to the literature-derived calls. ToxPi models provided balanced accuracies ranging from 0.55 to 0.88, depending on the model specifications and reference set. Validation chemical testing correctly predicted 29 of 30 chemicals as per 3T3-L1 testing, suggesting good adipogenic prediction performance for our best adapted model. **Discussion:** Using the most recent ToxCast data and an updated ToxPi model, we found ToxCast performed similarly to that of our own 3T3-L1 testing in predicting consensus calls. Furthermore, we provide the full ranked list of largely untested chemicals with ToxPi scores that predict adipogenic activity and that require further investigation.

Foodborne Pathogens

Relevance of Tracking the Diversity of *Escherichia coli* Pathotypes to Reinforce Food Safety

Yessica Enciso-Martínez, Gustavo A González-Aguilar, Miguel A Martínez-Téllez, Cristóbal J González-Pérez, Dora E Valencia-Rivera, Edwin Barrios-Villa, Jesús Fernando Ayala-Zavala. *Int J Food Microbiol.* 2022 May



19;374:109736. doi: 10.1016/j.ijfoodmicro.2022.109736. [Article link](#)

Significance: This paper discusses the diversity of *E. coli* pathobionts, their participation in foodborne outbreaks, and strategies to survey and control their spread and virulence.

Escherichia coli is among the most prevalent food contaminant microorganisms that have evolved, generating variants based on their effects on the host; these include commensals or pathobiont strains. The last classifications of *E. coli* intestinal pathobionts found in this review are enteroinvasive, enterohemorrhagic, enteropathogenic, enterotoxigenic, diffusely adherent, and enteroaggregative strains. Meanwhile, the most ancestral are enteropathogenic and enteroaggregative, and the most contemporaries are the enterotoxigenic and enteroinvasive strains. These pathobionts have been proposed based on their infective mechanisms, including toxin production, adherence effects, and tissue damage. It is also evidenced that environmental stresses, including bacterial exposition to antibiotics and disinfectants, contribute to this evolution. Therefore, new antibacterial and antivirulence agents are being explored, mainly from natural sources. In this context, this review discusses the diversity of *E. coli* pathobionts, their participation in foodborne outbreaks, and strategies to survey and control their spread and virulence.

Inactivation of Foodborne Pathogens on Inshell Walnuts by UV-C Radiation

Ye-Seul Yun, Sung-Joo Bae, Sang-Hyun Park. *Food Prot.* 2022 May 5. doi: 10.4315/JFP-21-442. [Article link](#)

Significance: UV-C radiation could be a potential tool for reducing various foodborne pathogens on inshell walnut surfaces while maintaining the quality of the nuts.

Inshell walnuts could be contaminated with pathogens through direct contact or cross-contamination during harvesting and postharvest hulling, drying, or storage. This study aimed to assess the efficacy of ultraviolet-C (UV-C) radiation in inactivating foodborne pathogens on inshell walnut surfaces. Intact inshell walnut surfaces were inoculated separately with *Salmonella* spp., *Escherichia coli* O157:H7, *Listeria monocytogenes*, and *Staphylococcus aureus*, and then subjected to UV-C radiation at doses of 29.4, 147.0, 294.0, 588.0, and 882.0 mJ/cm². UV-C radiation inactivated the inoculated pathogens in a dose-dependent manner, and a tailing effect was observed for the inactivation of pathogens. UV-C radiation at 29.4 mJ/cm² and 882.0 mJ/cm² reduced the populations of *S. Enteritidis* PT 30, *S. Typhimurium*, *E. coli* O157:H7, *L. monocytogenes*, and *S. aureus* on inshell walnut surfaces by 0.82-1.25 and 1.76-2.41 log CFU/walnut, respectively. Scanning electron photomicrographs showed pathogenic bacterial cells in the cracks and crevices of the inshell walnut surface, and the shielding of microorganisms by the cracks and crevices may have contributed to the tailing effect observed during UV-C inactivation. No significant changes ($p > 0.05$) were found in walnut lipid oxidation following UV-C radiation at doses up to 882.0 mJ/cm². Together, the results indicate that UV-C radiation could be a potential technology for reducing the populations of various foodborne pathogens on inshell walnut surfaces while maintaining the quality of walnuts.

Foodborne Illness

Multistate Outbreak Investigation of *Salmonella* Infections Linked to Kratom: A Focus on Traceback, Laboratory and Regulatory Activities

Johnson Nsubuga, Joseph Baugher, Elizabeth Dahl, Colin Schwensohn, Tyann Blessington, Ryan Aguillon, Brooke Whitney, et. al. *J Food Prot.* 2022 May 1;85(5):747-754. doi: 10.4315/JFP-21-319. [Article link](#)

Significance: *Salmonella* isolates recovered from product samples and a lack of traceback convergence suggested that kratom tree products were widely contaminated across multiple sites from which it was grown, harvested, and packaged.

During spring 2018, the U.S. Food and Drug Administration (FDA), Centers for Disease Control and Prevention, and state and local public health agencies responded to a multistate outbreak of gastrointestinal illnesses caused by multiple *Salmonella* serovars and associated with consumption of kratom, a product harvested from a tropical tree native to Southeast Asia. The outbreak included 199 case-patients reported by 41 U.S. states, with illness onset dates ranging 11 from January 2017 to 8 May 2018, leading to 54 hospitalizations and no deaths. Case-patients reported purchasing kratom products from physical and online retail points of service (POSS). Products distributed to 16 POSS where 24 case-patients from 17 states purchased kratom were selected for traceback investigation. Traceback revealed that the kratom was imported from several countries, the most common being Indonesia. Local and state officials collected product samples from case-patients and retail POSS. The FDA collected 76 product samples from POSS and distributors, of which 42 (55%) tested positive for *Salmonella*. The positive samples exhibited a range of pulsed-field gel electrophoresis patterns and whole genome sequence genetic heterogeneity, and 25 (60%) of 42 samples yielded at least one isolate indistinguishable from one or more outbreak-related clinical isolates. Although it does not exclude

a possibility of a single contamination source, the extent of genetic diversity exhibited by the *Salmonella* isolates recovered from product samples and a lack of traceback convergence suggested that kratom was widely contaminated across multiple sites from which it was grown, harvested, and packaged. As a result of the contamination, kratom products were recalled by numerous firms (both voluntarily and mandatory). Epidemiologic, traceback, and laboratory evidence supported the conclusion that kratom products were associated with illnesses.

Mycotoxins

An Update on Immunotoxicity and Mechanisms of Action of Six Environmental Mycotoxins

Yuhang Sun, Kehe Huang, Miao Long, Shuhua Yang, Ying Zhang. *Food Chem Toxicol.* 2022 May;163:112895. doi: 10.1016/j.fct.2022.112895. [Article link](#)

Significance: Six environmental mycotoxins have both immunosuppressive and immunostimulatory effects and this review strongly dispels the viewpoint that “immunotoxicity is equivalent to immunosuppression.” The authors describe the mechanistic pathway and how it contributes to immunosuppression or immunostimulation.



Paradoxically, aflatoxin B1 (AFB1), ochratoxin A (OTA), deoxynivalenol (DON), T-2 toxin (T-2), fumonisin B1 (FB1), and zearalenone (ZEA) have both immunosuppressive and immunostimulatory effects. The immunotoxicity of six mycotoxins exhibits immune suppression or stimulation, which depends on multiple factors. Low doses of mycotoxins can induce an inflammatory response, but elevated levels of ones can induce immunosuppression; long-term instead of short-term mycotoxin exposure is immunosuppressive. These six mycotoxins play anti-inflammatory roles when the immunologic stimulants are present but pro-inflammatory roles when the immunologic stimulants are absent. Pigs are most sensitive animals to mycotoxins, followed by humans and poultry, rodent, and marine organism, and ruminants are the least susceptible. Female animals are more susceptible to mycotoxins than male ones. The immunosuppression mechanism of mycotoxins are mainly in, oxidative stress, apoptosis and autophagy of immune cells, as well as inhibits the immunity-related signal pathways; and AFB1, OTA, DON, and T-2 induce immunostimulation via directly activating the TLRs/NF- κ B pathway and other crossing pathways including cyclooxygenase-2 (COX-2) and mitogen-activated protein kinase (MAPK). This review strongly dispels the viewpoint that “immunotoxicity is equivalent to immunosuppression”, clearly demonstrates the mechanistic pathway and how it contributes to immunosuppression or immunostimulation, thereby providing reliable references for future studies.

Heavy Metals

The Effect of a High-Selenium Lentil Diet on Cardiovascular Risk Markers in an Arsenic-Exposed Population

Regina M Krohn, Evana Akhtar, Grace P S Kwong, Rubhana Raqib, Judit E G Smits. *Eur J Clin Nutr.* 2022 May;76(5):772-774. doi: 10.1038/s41430-021-01029-7. [Article link](#)

Significance: High-selenium lentil diets were examined for effects on blood pressure and plasma lipid levels in an arsenic-exposed population by conducting a 6-month randomized controlled dietary intervention trial with over 400 participants.

Chronic arsenic exposure is associated with a number of systemic diseases, including cardiovascular disease. Selenium has been shown to promote arsenic excretion from the body. We investigated if a high-selenium lentil diet has an effect on blood pressure and plasma lipid levels in an arsenic-exposed population by conducting a 6-month randomized controlled dietary intervention trial with 405 participants.

Food Packaging

Plant Protein-Based Nanocomposite Films: A Review on the Used Nanomaterials, Characteristics and Food Packaging Applications

Shima Jafarzadeh, Mehrdad Forough, Sajed Amjadi, Vahid Javan Kouzegaran, Hadi Almasi, Farhad Garavand, Masoumeh Zargar. *Crit Rev Food Sci Nutr.* 2022 May 6;1-27. doi: 10.1080/10408398.2022.2070721. [Article link](#)

Significance: The performance, barrier, mechanical, optical, thermal and antimicrobial properties of plant protein-based materials can be extended by incorporating nanomaterials.

Consumer demands to utilize environmentally friendly packaging have led researchers to develop packaging materials from naturally derived resources. In recent years, plant protein-based films as a replacement for synthetic plastics have attracted the attention of the global food packaging industry due to their biodegradability and unique properties. Biopolymer-based films need a filler to show improved packaging properties. One of the latest strategies introduced to food packaging technology is the production of nanocomposite films which are multiphase materials containing a filler with at least one dimension less than 100 nm. This review provides the recent findings on plant-based protein films as biodegradable materials that can be combined with nanoparticles that are applicable to food packaging. Moreover, it investigates the characterization of nanocomposite plant-based protein films/edible coatings. It also briefly describes the application of plant-based protein nanocomposite films/coating on fruits/vegetables, meat and seafood products, and some other foods. The results indicate that the functional performance, barrier, mechanical, optical, thermal and antimicrobial properties of plant protein-based materials can be extended by incorporating nanomaterials. Recent reports provide a better understanding of how incorporating nanomaterials into plant protein-based biopolymers leads to an increase in the shelf life of food products during storage time.

Systematic Evidence on Migrating and Extractable Food Contact Chemicals: Most Chemicals Detected in Food Contact Materials are Not Listed for Use

Birgit Geueke, Ksenia J Groh, Maricel V Maffini, Olwenn V Martin, Justin M Boucher, Yu-Ting Chiang, Frank Gwosdz, et. al. *Crit Rev Food Sci Nutr.* 2022 May 18;1-11. doi: 10.1080/10408398.2022.2067828. [Article link](#)

Significance: To date, 2881 food contact chemicals (FCCs) have been detected, in a total of six groups (Plastics, Paper & Board, Metal, Multi-materials, Glass & Ceramic, and Other Materials). 65% of these detected FCCs were previously not known to be used.

Food packaging is important for today's globalized food system, but food contact materials (FCMs) can also be a source of hazardous chemicals migrating into foodstuffs. Assessing the impacts of FCMs on human health requires a comprehensive identification of the chemicals they contain, the food contact chemicals (FCCs). We systematically compiled the "database on migrating and extractable food contact chemicals" (FCCmigex) using information from 1210 studies. We found that to date 2881 FCCs have been detected, in a total of six FCM groups (Plastics, Paper & Board, Metal, Multi-materials, Glass & Ceramic, and Other FCMs). 65% of these detected FCCs were previously not known to be used in FCMs. Conversely, of the more than 12,000 FCCs known to be used, only 1,013 are included in the FCCmigex database. Plastic is the most studied FCM with 1975 FCCs detected. Our findings expand the universe of known FCCs to 14,153 chemicals. This knowledge contributes to developing non-hazardous FCMs that lead to safer food and support a circular economy.

Chemical Contaminants

Chemical Food Safety Hazards in Circular Food Systems: A Review

E D van Asselt, A Arrizabalaga-Larrañaga, M Focker, B J A Berendsen, M G M van de Schans, H J van der Fels-Klerx. *Crit Rev Food Sci Nutr.* 2022 May 25;1-13. doi: 10.1080/10408398.2022.2078784. [Article link](#)

Significance: Limited information is available on the chemical hazards that could occur when reusing crop residues in circular agriculture. Chemical hazards in manure, sewage sludge, crop residues, and animal by-products may lead to accumulation in a circular food production system.

Food production has increasingly become effective but not necessarily sustainable. Transitioning toward circular production systems aiming to minimize waste and reuse materials is one of the means to obtain a more sustainable food production system. However, such a circular food production system can also lead to the accumulation and recirculation of chemical hazards. A literature review was performed to identify potential chemical hazards related to the use of edible and non-edible resources in agriculture and horticulture, and edible plant and animal by-products in feed production. The review revealed that limited information was available on the chemical hazards that could occur when reusing crop residues in circular agriculture. Frequently mentioned hazards present in edible and non-edible resources are heavy metals, process and environmental contaminants, pesticides and pharmaceuticals. For feed, natural toxins and pharmaceutical residues are of potential concern. Studies, furthermore, indicated that plants are capable of taking up chemical hazards when grown on contaminated soil. The presence of chemical hazards in manure, sewage sludge, crop residues, and animal by-products may lead to accumulation in a circular food production system. Therefore, it is relevant to identify these hazards prior to application in food production and, if needed, take precautionary measures to prevent food safety risks.

Caffeine

Association of Sugar-Sweetened, Artificially Sweetened, and Unsweetened Coffee Consumption with All-Cause and Cause-Specific Mortality: A Large Prospective Cohort Study

Dan Liu, Zhi-Hao Li, Dong Shen, Pei-Dong Zhang, Wei-Qi Song, Wen-Ting Zhang, Qing-Mei Huang, et. al. *Ann Intern Med.* 2022 May 31. doi: 10.7326/M21-2977. [Article link](#)

Significance: Moderate consumption of unsweetened and sugar-sweetened coffee was associated with lower risk for death.

Background: Previous observational studies have suggested an association between coffee intake and reduced risk for death, but these studies did not distinguish between coffee consumed with sugar or artificial sweeteners and coffee consumed without. **Objective:** To evaluate the associations of consumption of sugar-sweetened, artificially sweetened, and unsweetened coffee with all-cause and cause-specific mortality. **Design:** Prospective cohort study. **Setting:** Data were extracted from the UK Biobank. **Participants:** A total of 171 616 participants (mean age, 55.6 years [SD, 7.9]) without cardiovascular disease (CVD) or cancer at baseline were eligible. Baseline demographic, lifestyle, and dietary data from the UK Biobank were used, with follow-up beginning in 2009 and ending in 2018. **Measurements:** Dietary consumption of sugar-sweetened, artificially sweetened, and unsweetened coffee was self-reported. All-cause, cancer-related, and CVD-related mortality were estimated. **Results:** During a median follow-up of 7.0 years, 3177 deaths were recorded (including 1725 cancer deaths and 628 CVD deaths). Cox models with penalized splines showed U-shaped associations of unsweetened coffee, sugar-sweetened coffee, and artificially sweetened coffee with mortality. Compared with nonconsumers, consumers of various amounts of unsweetened coffee (>0 to 1.5, >1.5 to 2.5, >2.5 to 3.5, >3.5 to 4.5, and >4.5 drinks/d) had lower risks for all-cause mortality after adjustment for lifestyle, sociodemographic, and clinical factors, with respective hazard ratios of 0.79 (95% CI, 0.70 to 0.90), 0.84 (CI, 0.74 to 0.95), 0.71 (CI, 0.62 to 0.82), 0.71 (CI, 0.60 to 0.84), and 0.77 (CI, 0.65 to 0.91); the respective estimates for consumption of sugar-sweetened coffee were 0.91 (CI, 0.78 to 1.07), 0.69 (CI, 0.57 to 0.84), 0.72 (CI, 0.57 to 0.91), 0.79 (CI, 0.60 to 1.06), and 1.05 (CI, 0.82 to 1.36). The association between artificially sweetened coffee and mortality was less consistent. The association of coffee drinking with mortality from cancer and CVD was largely consistent with that with all-cause mortality. U-shaped associations were also observed for instant, ground, and decaffeinated coffee. **Limitation:** Exposure assessed at baseline might not capture changes in intake over time. **Conclusion:** Moderate consumption of unsweetened and sugar-sweetened coffee was associated with lower risk for death.

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 Guarneri, Mimi L K Tang, Adrian J Lowe, Shyamali C Dharmage, Kirsten P Perrett, Lyle C Gurrin et. al. *J Allergy Clin Immunol.* 2022 May 10;S0091-6749(22)00543-7. doi: 10.1016/j.jaci.2022.04.008.

[Article link](#)

Significance: Most egg allergy and nearly one-third of peanut allergy resolves naturally by age 6 years. Infants with eczema, or multiple food sensitizations and/or allergies were less likely to acquire tolerance to either peanut or egg.

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:** 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.

Metabolomic Profiling Revealed Altered Lipid Metabolite Levels in Childhood Food Allergy

Haerin Jang, Eun Gyu Kim, Mina Kim, Soo Yeon Kim, Yoon Hee Kim, Myung Hyun Sohn, Kyung Won Kim. *J Allergy Clin Immunol.* 2022 May;149(5):1722-1731.e9. doi: 10.1016/j.jaci.2021.10.034. [Article link](#)

Significance: The lipid metabolite profile is closely related to childhood food allergy (FA) and FA resolution. Potential predictive biomarkers and more specific understandings of the mechanisms underlying childhood FA could advance treatment.

Background: The pathophysiology of childhood food allergy (FA) and its natural history are poorly understood. Clarification of the underlying mechanism may help identify novel biomarkers and strategies for clinical intervention in children with FA. **Objective:** This study aimed to identify metabolites associated with the development and resolution of FA. **Methods:** The metabolomic profiles of 20 children with FA and 20 healthy controls were assessed by liquid chromatography-tandem mass spectrometry. Comparative analysis was performed to identify metabolites associated with FA and FA resolution. For subjects with FA, serum samples were collected at the time of diagnosis and after resolution to identify the changes in metabolite levels. The selected metabolites were then quantified in a quantification cohort to validate the results. Finally, genome-wide association analysis of the metabolite levels was performed. **Results:** The study demonstrated a significantly higher level of sphingolipid metabolites and a lower level of acylcarnitine metabolites in children with FA than those in healthy controls. At diagnosis, subjects with resolving FA had a significantly high level of omega-3 metabolites and a low level of platelet-activating factors compared to persistent FA. However, the level of omega-3 metabolites decreased in children with resolving FA but increased in children with persistent FA during the same time. The quantification data of omega-3-derived resolvins, platelet-activating factor, and platelet-activating factor acetylhydrolase activity further supported these results. **Conclusion:** The lipid metabolite profile is closely related to childhood FA and FA resolution. This study suggests potential predictive biomarkers and provides insight into the mechanisms underlying childhood FA.

Emerging Science Areas

Emerging area: Food Safety

Category: Future Trends in Food Safety

FAO. 2022. Thinking About the Future of Food Safety – A Foresight Report. Rome. doi.org/10.4060/cb8667en. [Article link](#)

Significance: The FAO foresight report published to meet their 2030 agenda identifies key drivers that impact food safety progress and programs. The drivers identified include impact of climate change, changing consumer food behavior and acceptance, new food sources and systems, microbiome affecting food system and food chain, circular economy, technological advances (3D printing, automation, Artificial Intelligence, big data, and Blockchain, organ-on-a-chip), urbanization and new urban Agrisystems.

Excerpt from executive summary

“...At the 1996 World Food Summit, the Heads of State and Government reaffirmed the right of everyone to have access to safe and nutritious food, consistent with the right to adequate food and the fundamental right of everyone to be free from hunger (World Food Summit, 1996). To achieve this commitment, agri-food systems will need to be transformed to sustainably deliver safe and nutritious food for all. The Food and Agriculture Organization of the United Nations’ (FAO) Strategic Framework focuses on this transformation through achieving four pillars: better production, better nutrition, a better environment, and a better life (FAO, 2021). To “realize our shared vision for a better world” (UN Food Systems Summit, 2021) and to be better prepared to mitigate potential shocks and disruptions, we need to develop and maintain a deep understanding of the future opportunities, challenges, and threats to our agri-food systems. The FAO food safety foresight programme is geared towards the proactive identification, evaluation and prioritization of emerging trends and drivers within and around agri-food systems that can have food safety implications (Figure 1). This will lead to improved and timely strategic planning to better manage potential risks and be ready to take advantage of new opportunities...”

Engage with IAFNS

IAFNS Annual Meeting & Science Symposium: Advancing Science for Impact June 21-23, 2022, a hybrid event with online registration still open.

- The IAFNS Annual Meeting & Scientific Symposium is a forum for the presentation and discussion of research and ideas—focusing on science with impact. The focus will be on science that supports credible decision making by government regulators, industry professionals and academic researchers. The conference offers an exceptional learning environment and brings together a range of experts, including food and nutrition researchers, healthcare professionals, opinion leaders, industry representatives, government officials, and future leaders. The Keynote address will be delivered by **Dr. Susan Mayne, Director of the Center for Food Safety and Applied Nutrition (CFSAN)** at the US Food and Drug Administration. To register, click [here](#).

What is ‘Sweetness’? The Biological Role of Sweet Taste and Quality of Life for Individuals with Type 1 Diabetes

July 19, 2022, webinar, 11:00 am – 12:00 pm ET.

- The role of sweetness in the context of sensory perception and the total diet is complex, and the ability to change preference for sweet remains under investigation. Given the biological drive for sweet taste, low- and no-calorie sweeteners (LNCSs) have been acknowledged as a tool for reducing the intake of total carbohydrates, and particularly added sugars, in the nutritional management of diabetes. To learn more about this webinar, the CPE credits available, and to register, click [here](#).

‘Crash Course’ on Design and Implementation of Microbiome Research

July 21, 2022, webinar, 2:00-3:00 pm ET.

- Effective application of gut microbiome research requires clinicians to critically appraise methodological elements of research when interpreting results. In this webinar, an overview of best practices for designing and conducting diet-microbiome research in humans will be provided. Topics will include not only intervention study designs but also recruitment tips, sampling methods and important metadata to collect. To learn more about this webinar, the CPE credits available, and to register, click [here](#).

IAFNS Sessions at IAFP 2022 Annual Meeting

July 31– August 3, 2022, Pittsburgh, PA.

- Each year, the International Association for Food Protection hosts an Annual Meeting, providing attendees with information on current and emerging food safety issues, the latest science, innovative solutions to new and recurring problems, and the opportunity to network with thousands of food safety professionals from around the globe.
- This year, the IAFNS Food Microbiology Committee is supporting the following **three sessions** at the IAFP Annual Meeting:
 1. How Relevant is Finished Product Testing for Pathogens to Public Health Outcomes? August 1, 2022, from 8:30 AM to 10:00 AM ET
 2. Whole Genome Sequencing: Challenging and Defining Foodborne Pathogen Species, Risk and Virulence. August 2, 2022, from 1:30 PM to 3:00 PM ET
 3. Application of New Technologies for Improved Food Safety. August 3, 2022, from 8:30 AM to 10:00 AM ET

These sessions are supported by the IAFNS [Food Microbiology Committee](#). Learn more about the [IAFP Annual Meeting](#).