

October 2022

# Food Safety Briefs



## IAFNS Science Innovation Showcase - 2022

**Virtual Event, December 13–15, 2022**

Join us to learn about emerging science and connect with innovators developing alternative protein sources (including plant proteins) and other next-gen topics - with a dedicated session for graduate students and post-docs. [Learn more.](#)



## Risk Assessment

### Grouping of PFAS for Human Health Risk Assessment: Findings from an Independent Panel of Experts

J K Anderson, R W Brecher, I T Cousins, J DeWitt, H Fiedler, K Kannan, C R Kirman, J Lipscomb, B Priestly, R Schoeny, J Seed, M Verner, S M Hays. *Regul Toxicol Pharmacol.* 2022 Oct;134:105226. doi: 10.1016/j.yrtph.2022.105226. [Article link](#)

**Significance:** A group of convened researchers agreed that it may not be appropriate to assume equal toxicity/potency across the diverse class of PFAS compounds. A tiered approach combining multiple lines of evidence may be more viable.

An expert panel was convened to provide insight and guidance on per- and polyfluoroalkyl substances (PFAS) grouping for the purposes of protecting human health from drinking water exposures, and how risks to PFAS mixtures should be assessed. These questions were addressed through multiple rounds of blind, independent responses to charge questions, and review and comments on co-panelists responses. The experts agreed that the lack of consistent interpretations of human health risk for well-studied PFAS and the lack of information for the vast majority of PFAS present significant challenges for any mixtures risk assessment approach. Most experts agreed that “all PFAS” should not be grouped together, persistence alone is not sufficient for grouping PFAS for the purposes of assessing human health risk, and that the definition of appropriate subgroups can only be defined on a case-by-case manner. Most panelists agreed that it is inappropriate to assume equal toxicity/potency across the diverse class of PFAS. A tiered approach combining multiple lines of evidence was presented as a possible



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viable means for addressing PFAS that lack analytical and/or toxicological studies. Most PFAS risk assessments will need to employ assumptions that are more likely to overestimate risk than to underestimate risk, given the choice of assumptions regarding dose-response model, uncertainty factors, and exposure information.

## Foodborne Pathogens

### Occurrence, Transformation and Toxicity of Fumonisin and Their Covert Products During Food Processing

Diaodiao Yang, Yongli Ye, Jiadi Sun, Jia-Sheng Wang, Caihong Huang, Xiulan Sun. *Crit Rev Food Sci Nutr*. 2022 Oct 14;1-14. doi: 10.1080/10408398.2022.2134290. [Article link](#)

**Significance:** Covert fumonisins byproducts are generated during food processing, posing risks to cereals. More research is needed to understand their impact.

Fumonisin comprises structurally related metabolites mainly produced by *Fusarium verticillioides* and *Fusarium proliferatum*. Contamination with fumonisin causes incalculable damage to the economy and poses a great risk to animal and human health. Fumonisin and their covert products are found in cereals and cereal products. Food processing significantly affects the degradation of toxins and the formation of covert toxins. However, studies on fumonisin and their covert mycotoxins remain inadequate. This review aims to summarize changes in fumonisin and the generation of covert fumonisin during processing. It also investigates the toxicity and determination methods of fumonisin and covert fumonisin and elucidates the factors affecting fumonisin and their covert forms during processing. In addition to the metabolic production by plants and fungi, covert fumonisin are mainly produced by covalent or noncovalent binding, complexation, or physical entrapment of fumonisin with other substances. The toxicity of covert fumonisin is similar to that of free fumonisin and is a non-negligible hazard. Covert fumonisin are commonly found in food matrices, and methods to analyze them have yet to be improved. Food processing significantly affects the conversion of fumonisin to their covert toxins.

## Mycotoxins

### Matrix-Associated Mycotoxins in Foods, Cereals and Feedstuffs: A Review on Occurrence, Detection, Transformation and Future Challenges

Hongxia Tan, Hongyuan Zhou, Ting Guo, Ying Zhou, Shuo Wang, Xiaozhu Liu, Yuhao Zhang, Liang Ma. *Crit Rev Food Sci Nutr*. 2022 Oct 7;1-14. doi: 10.1080/10408398.2022.2131724. [Article link](#)

**Significance:** Mycotoxins ‘masked’ by macro-components occur in cereals and cereal grains and can remain, posing risks to consumers.



Matrix-associated mycotoxins that bind with macromolecular components through covalent or non-covalent interactions easily occur in various cereals, cereal-based products, and cereal-based feedstuff. They are “masked” by macro-components, causing the underestimation of total exposure risk of mycotoxins. Most of the current reports focus on the free and modified mycotoxins, while the matrix-associated forms are ignored but still can exert toxic effects after ingestion. In this paper, current research and future prospects of matrix-associated mycotoxins are reviewed. Especially, a focus is set on the transformation of matrix-associated mycotoxins with their free forms during metabolism and food processing. Enzymes, temperature and

pH levels during food processing can induce the interconversion of matrix-associated mycotoxins with free mycotoxins. Furthermore, the analytical methods targeted on matrix-associated mycotoxins are discussed. Due to the lack of efficient methods releasing the mycotoxins from matrix, the standard analytical methods has not developed so far. Also, we further analyzed the challenges of matrix-associated mycotoxins about variety, occurrence, toxicity and transformation, exposure assessment, which contributes to establish preventive measures to control their hazards for consumers. Overall, this overview is significant for perfecting risk assessment, as well as developing effective prevention and control actions to matrix-associated mycotoxins.

## Heavy Metals

### A Systematic Review of Adverse Health Effects Associated with Oral Cadmium Exposure

Heather R Schaefer, Brenna M Flannery, Lynn Crosby, Olivia E Jones-Dominic, Cecile Punzalan, Karlyn Middleton. *Regul Toxicol Pharmacol*. 2022 Oct;134:105243. doi: 10.1016/j.yrtph.2022.105243. [Article link](#)

**Significance:** A risk of bias approach is applied to studies on the metal cadmium in an effort to firm up its toxicological reference value.

Scientific data characterizing the adverse health effects associated with dietary cadmium (Cd) exposure were identified in order to make informed decisions about the most appropriate toxicological reference value (TRV) for use in assessing dietary Cd exposure. Several TRVs are available for Cd and regulatory organizations have used epidemiologic studies to derive these reference values; however, risk of bias (RoB) evaluations were not included in the assessments. We performed a systematic review by conducting a thorough literature search (through January 4, 2020). There were 1714 references identified by the search strings and 328 studies identified in regulatory assessments. After applying the specific inclusion and exclusion criteria, 208 studies (Human: 105, Animal: 103) were considered eligible for further review and data extraction. For the epidemiologic and animal studies, the critical effects identified for oral Cd exposure from the eligible studies were a decrease in bone mineral density (BMD) and renal tubular degeneration. A RoB analysis was completed for 49 studies (30 epidemiological and 19 animal) investigating these endpoints. The studies identified through the SR that were considered high quality and low RoB (2 human and 5 animal) can be used to characterize dose-response relationships and inform the derivation of a Cd TRV.

## Food Packaging

### Machine-Learning-Based Predictions of Polymer and Postconsumer Recycled Polymer Properties: A Comprehensive Review

Nagababu Andraju, Greg W Curtzwiler, Yun Ji, Evgenii Kozliak, Prakash Ranganathan. *ACS Appl Mater Interfaces*. 2022 Sep 28;14(38):42771-42790. doi: 10.1021/acsmi.2c08301. [Article link](#)

**Significance:** Machine-learning is a powerful tool for exploring the physical and chemical structures of polymers, lending itself to exploring their potential.



This work was supported by [IAFNS Food Packaging Safety & Sustainability Committee](#).

There has been a tremendous increase in demand for virgin and postconsumer recycled (PCR) polymers due to their wide range of chemical and physical characteristics. Despite the numerous potential benefits of using a data-driven approach to polymer design, major hurdles exist in the development of polymer informatics due to the complicated hierarchical polymer structures. In this review, a brief introduction on virgin polymer structure, PCR polymers, compatibilization of polymers to be recycled, and their characterization using sensor array technologies as well as factors affecting the polymer properties are provided. Machine-learning (ML) algorithms are gaining attention as cost-effective scalable solutions to exploit the physical and chemical structures of polymers. The basic steps for applying ML in polymer science such as fingerprinting, algorithms, open-source databases, representations, and polymer design are detailed in this review. Further, a state-of-the-art review of the prediction of various polymer material properties using ML is reviewed. Finally, we discuss open-ended research questions on ML application to PCR polymers as well as potential challenges in the prediction of their properties using artificial intelligence for more efficient and targeted PCR polymer discovery and development.

### Expanding Plastics Recycling Technologies: Chemical Aspects, Technology Status and Challenges

Houqian Li, Horacio A. Aguirre-Villegas, Robert D. Allen, Xianglan Bai, Craig H. Benson, Gregg T. Beckham, Sabrina L. Bradshaw. *Green Chemistry*. Sept 14, 2022. doi: 10.1039/d2gc02588d. [Article link](#)

**Significance:** Emerging new technologies to chemically recycle waste plastics are receiving tremendous interest from academia and industry. Chemists need to understand the fundamentals of these technologies to design improved recycling systems.



This work was supported by [IAFNS Food Packaging Safety & Sustainability Committee](#).

Less than 10 percent of the plastics generated globally are recycled, while the rest are incinerated, accumulated in landfills, or leak into the environment. New technologies are emerging to chemically recycle waste plastics that are receiving tremendous interest from academia and industry. Chemists and chemical engineers need to understand the fundamentals of these technologies to design improved systems for chemical recycling and upcycling of waste plastics. In this paper, we review the entire life cycle of plastics and options for the management of plastic waste to address barriers to industrial chemical recycling and further provide perceptions on possible opportunities with such materials. Knowledge and insights to enhance plastic recycling beyond its current scale are provided. Outstanding research problems and where researchers in the field should focus their efforts in the future are also discussed.

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## Chemical Contaminants

### Detection Methods for Sub-Nanogram Level of Emerging Pollutants - Per and Polyfluoroalkyl Substances

Sunantha Ganesan, Chamorn Chawengkijwanich, Mohan Gopalakrishnan, Dao Janjaroen. *Food Chem Toxicol.* 2022 Oct;168:113377. doi: 10.1016/j.fct.2022.113377. [Article link](#)

**Significance:** Reliable and rapid detection methods for PFAS chemicals are important given the growing interest in the compounds by regulatory scientists.

Per- and polyfluoroalkyl substances (PFAS) are organofluorine compounds that have been manufactured for more than five decades and used in different purposes. Among persistent organic pollutants, PFAS are toxic, bioaccumulative in humans, wildlife, and global environment. As per environmental protection agency (EPA) guidelines, the perfluorooctanoate and perfluorooctane sulfonate permissible limit was 0.07 ng/L in drinking water. When the concentration exceeds the acceptable limit, it has negative consequences for humans. In such a case, PFAS monitoring is critical, and a quick detection technique is highly needed. Health departments and regulatory agencies have interests in monitoring of PFAS presences and exposures. For the detection of PFAS, numerous highly precise and sensitive chromatographic methods are available. However, the drawbacks of analytical techniques include timely sample preparations and the lack of on-site applicability. As a result, there is an increasing demand for simple sensor systems for monitoring of PFAS in real field samples. In this review, we first describe the sample pre-treatment and analytical techniques for the detection of PFAS. Second, we broadly discussed available sensor system for the quantification of PFAS in different filed samples. Finally, future trends in PFASs sensor are also presented.

## Caffeine

### Chemical Composition and Anti-Inflammatory Activity of Water Extract from Black Cocoa Tea

Xiong Gao, Xiaorong Lin, Chi-Tang Ho, Yuanyuan Zhang, Bin Li, Zhongzheng Chen. *Food Res Int.* 2022 Nov;161:111831. doi: 10.1016/j.foodres.2022.111831. [Article link](#)

**Significance:** Cocoa tea can be developed into a promising functional beverage with anti-inflammatory properties.



Cocoa tea (*Camellia ptilophylla*) is a non-conventional tea variety with low caffeine and high gallic acid gallate (GCG). The anti-inflammatory activity of black cocoa tea and its underlying mechanisms remain virtually unknown. In this study, the chemical composition and anti-inflammatory activity of water extracts from black cocoa tea (BCWE) and Yunnan Daye tea (BYWE) were compared. Results showed that the dominant alkaloid in BCWE and BYWE were theobromine and caffeine, respectively. The contents of gallic acid, total catechins, and total polyphenols in BCWE were significantly higher than those in BYWE. For tea pigments, BYWE contained a little more

total theaflavins and theabrownins than BCWE, while no significant difference was observed in thearubigins. Interestingly, a novel theaflavin synthesized from GCG and catechin was found in BCWE. In lipopolysaccharide-induced RAW264.7 cells, both BCWE and BYWE could inhibit the production of nitric oxide and prostaglandin E2 by down-regulating the expression levels of inducible nitric oxide synthase and cyclooxygenase-2. They also markedly reduced the release of tumor necrosis factor- $\alpha$  and interleukin-6 at a high dose. Additionally, BCWE exhibited stronger anti-inflammatory activity than BYWE. Finally, BCWE exerted anti-inflammatory effect by inhibiting the activation of mitogen-activated protein kinases, phosphatidylinositol-3-kinase/protein kinase B, and nuclear factor-kappa B signaling pathways. These findings suggest that black cocoa tea can be developed into a promising functional beverage with anti-inflammatory property.

## Food Allergens

### Psychosocial Functioning in Pediatric Food Allergies: A Scoping Review

Grace K Cushman, Kristine Durkin, Rebecca Noga, Frances Cooke, Linda Herbert, Cynthia Esteban, Elizabeth L McQuaid. *J Allergy Clin Immunol.* 2022 Oct 1;S0091-6749(22)01328-8. doi: 10.1016/j.jaci.2022.09.024. [Article link](#)

**Significance:** Future well-being research on how children handle food allergies should make an effort to diversify samples regarding race, ethnicity, and country of origin; examine functioning longitudinally; go beyond quality of life; and adopt a biopsychosocial approach.

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The psychosocial burden of food allergy (FA) can significantly affect the lives of pediatric patients and their families. A comprehensive understanding of the state of the literature on psychosocial functioning is imperative to identify gaps that may affect clinical care and future research. This review characterizes the current literature on psychosocial functioning in pediatric patients with FA and their caregivers, siblings, and families. A literature search of 5 databases (PubMed, Ovid MEDLINE, PsycINFO, Web of Science, and Embase) was conducted to identify original research articles and abstracts on psychosocial functioning of patients with FA who were aged 0 to 18 years and their caregivers, siblings, and families. A total of 257 studies met the inclusion criteria. The majority of studies examined child or caregiver psychosocial functioning, with child and caregiver quality of life examined most frequently. Most studies utilized quantitative and cross-sectional methods and inconsistently reported participant race and ethnicity. Existing research on psychosocial functioning in pediatric FA may not be generalizable to patients of color and families and siblings. Future research should diversify recruited samples regarding race, ethnicity, and country of origin; examine psychosocial functioning longitudinally; examine constructs beyond quality of life; and adopt a biopsychosocial approach by considering the interplay among psychosocial functioning, disease burden, and social contexts.

## Emerging Science Areas

### Emerging Area: Food Safety

**Category:** *FDA Blueprint for Smarter Food Safety*

#### New Era of Smarter Food Safety Blueprint: Modern Approaches for Modern Times

[Article link](#)

**Significance:** The FDA New Era of Smarter Food Safety represents a new approach to food safety, leveraging technology and other tools to create a safer and more digital, traceable food system.

This blueprint represents the thinking of FDA food safety experts, consumers, the food industry, technology firms, federal and state regulatory partners, regulatory counterparts in other nations, and academia, centering on four foundational pillars: Tech-enabled Traceability; Smart analytic tools for Prevention and Outbreak Response; New Business Models and Retail Modernization; and Food Safety Culture.

#### Excerpts from Summary

“...The New Era of Smarter Food Safety represents a new approach to food safety, leveraging technology and other tools to create a safer and more digital, traceable food system. Smarter food safety is about more than just technology. It’s also about simpler, more effective, and modern approaches and processes. It’s about leadership, creativity, and culture.

This blueprint outlines the approach FDA will take over the next decade to usher in the New Era of Smarter Food Safety. It will evolve as food technologies and the food system evolve. It builds on work that FDA has done to implement the FDA Food Safety Modernization Act (FSMA), which established science and risk-based protections.

This document represents the thinking of FDA food safety experts, consumers, the food industry, technology firms, federal and state regulatory partners, our regulatory counterparts in other nations, and academia. Together, we envision a framework that will enable food to be traced to its source in seconds and will utilize new data analytical techniques to strengthen prevention of foodborne illnesses, alerting consumers in real time before contaminated or misbranded foods are consumed. We envision a framework in which education, communication, and democratization of data will enable industry, public health advocates, and government to work in concert to keep the food supply safe.”

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## Engage with IAFNS

### IAFNS-USDA Beltsville Webinar Series

October 26, 2022 - December 1, 2022

Orlando Florida

- This series is co-organized by IAFNS and researchers with the USDA ARS Beltsville Human Nutrition Research Center. Join current scientists as they share their latest research on nutrition focusing on the following: Dietary Added Sugars, Complex Carbohydrates, Botanicals, and Flavonoids
- Webinar 3: “Botanicals and the Impact of Growing Conditions and Food Preparation on Food Composition”  
November 15, 2:00 – 3:30 ET. Register [here](#).
- Webinar 4: “Learning About Flavonoids, Diet and Health”  
December 1, 2:00 – 3:30 ET. Register [here](#).

### Federal And State Efforts to Restrict PFAS: Impact on Food Companies

November 14, 2022. 1:00 pm - 2:00 pm ET

Virtual, Event

- Federal and State regulatory bodies are increasing their scrutiny of the potential presence of PFAS in food and food packaging. The webinar will highlight EPA’s actions under the PFAS Strategic Roadmap and preview expected actions later in 2022 and beyond.  
Register [here](#).