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Risk Assessment

Online and Offline Prioritization of Chemicals of Interest in Suspect Screening and Non-targeted Screening with High-Resolution Mass Spectrometry

Drew Szabo, Travis M Falconer, Christine M Fisher, Ted Heise, Allison L Phillips, Gyorgy Vas, Antony J Williams, Anneli Kruve. *Anal Chem.* 2024 Mar 5;96(9):3707-3716. doi: 10.1021/acs.analchem.3c05705. [Article link](#)

Recent advances in high-resolution mass spectrometry (HRMS) have enabled the detection of thousands of chemicals from a single sample, while computational methods have improved the identification and quantification of these chemicals in the absence of reference standards typically required in targeted analysis. However, to determine the presence of chemicals of interest that may pose an overall impact on ecological and human health, prioritization strategies must be used to effectively and efficiently highlight chemicals for further investigation. Prioritization can be based on a chemical's physicochemical properties, structure, exposure, and toxicity, in addition to its regulatory status. This Perspective aims to provide a framework for the strategies used for chemical prioritization that can be implemented to facilitate high-quality research and communication of results. These strategies are categorized as either "online" or "offline" prioritization techniques. Online prioritization techniques trigger the isolation and fragmentation of ions from the low-energy mass spectra in real time, with user-defined parameters. Offline prioritization techniques, in contrast, highlight chemicals of interest after the data has been acquired; detected features can be filtered and ranked based on the relative abundance or the predicted structure, toxicity, and concentration imputed from the tandem mass spectrum (MS²). Here we provide an overview of these prioritization techniques and how they have been successfully implemented and reported in the literature to find chemicals of elevated risk to human and ecological environments.

Foodborne Pathogens

Recent Advances on the Formation, Detection, Resistance Mechanism, and Control Technology of *Listeria monocytogenes* Biofilm in Food Industry

Xin Liu, Xuejuan Xia, Yangtai Liu, Zhuosi Li, Tianqi Shi, Hongzhi Zhang, Qingli Dong. *Food Res Int.* 2024 Mar;180:114067. doi: 10.1016/j.foodres.2024.114067. [Article link](#)

Listeria monocytogenes is an important foodborne pathogen that causes listeriosis, a severe and fatal condition. Biofilms are communities of microorganisms nested within a self-secreted extracellular polymeric substance, and they protect *L. monocytogenes* from environmental stresses. Biofilms, once formed, can lead to the persistence of *L. monocytogenes* in processing equipment and are therefore considered to be a major concern for the food industry. This paper briefly introduces the recent advancements on biofilm formation characteristics and detection methods, and focuses on analysis of the mechanism of *L. monocytogenes* biofilm resistance; Moreover, this paper also summarizes and discusses the existing different techniques of *L. monocytogenes* biofilm control according to the physical, chemical, biological, and combined strategies, to provide a theoretical reference to aid the choice of effective control technology in the food industry.

Foodborne Illness

Polyphenolic Compounds in the Combat of Foodborne Infections - An Update on Recent Evidence

Carolin B Menikheim, Soraya Mousavi, Stefan Bereswill, Markus M Heimesaat. *Eur J Microbiol Immunol (Bp).* 2024 Mar 25. doi: 10.1556/1886.2024.00018. [Article link](#)

In recent years, the incidence of food-borne bacterial enteric diseases has increased worldwide causing significant health care and socioeconomic burdens. According to the World Health Organization, there are an estimated 600 million cases of foodborne illnesses worldwide each year, resulting in 420,000 deaths. Despite intensive efforts to tackle this problem, foodborne pathogenic microorganisms continue to be spread further. Therefore, there is an urgent need to find novel anti-microbial non-toxic compounds for food preservation. One way to tackle this issue may be the usage of polyphenols, which have received increasing attention in the recent years given their pleiotropic health-promoting properties. This prompted us to perform a literature search summarizing studies from the past 10 years regarding the potential anti-microbial and disease-alleviating effects of plant-derived phenolic compounds against foodborne bacterial pathogens. The included 16 studies provide evidence that polyphenols show pronounced anti-bacterial and anti-oxidant effects against both Gram-positive and Gram-negative bacterial species. In addition, synergistic anti-microbial effects in combination with synthetic antibiotics were observed. In conclusion, phenolic compounds may be useful as natural anti-microbial agents in the food, agricultural, and pharmaceutical industries in the combat of foodborne infections.

Mycotoxins

Food Security and Foodborne Mycotoxicoses-What Should Be the Adequate Risk Assessment and Regulation?

Stoycho D Stoev. *Microorganisms.* 2024 Mar 14;12(3):580. doi: 10.3390/microorganisms12030580. [Article link](#)

The purpose of this review is to elucidate the actual threat of the most prevalent mycotoxins in agricultural commodities and human/animal food/feed for the induction of foodborne diseases or ailments. The underestimated hazard of combined mycotoxin uptake by animals or humans is critically discussed with regard to synergistic or additive interaction between some target mycotoxins. The real toxicity of target mycotoxin combinations as it happens in practice is evaluated and possible lower limit values or control measures are suggested in such cases. Some critical points on adequate risk assessment, hygiene control, and regulation of mycotoxins are discussed. The efficiency of current mycotoxin regulations and control measures is evaluated in regard to human/animal health hazards. The risk assessment in the case of multiple mycotoxin exposure of humans/animals via food/feed or agricultural commodities is evaluated and some suggestions are proposed in such cases. Appropriate control measures and food safety issues throughout the food supply chain are proposed in order to prevent the target foodborne diseases. Some preventive measures and possible veterinary hygiene controls or risk evaluations are proposed in some natural cases of foodborne diseases for preventing mycotoxin contamination of animal products designed for human consumption and to avoid possible public health issues.

Heavy Metals

Cadmium Exposure and Cardiovascular Disease Risk: A Systematic Review and Dose-Response Meta-Analysis

Pietro Verzelloni, Teresa Urbano, Lauren A Wise, Marco Vinceti, Tommaso Filippini. *Environ Pollut.* 2024 Mar 15;345:123462. doi: 10.1016/j.envpol.2024.123462. [Article link](#)

Exposure to toxic metals is a global public health threat. Among other adverse effects, exposure to the heavy metal cadmium has been associated with greater risk of cardiovascular disease (CVD). Nonetheless, the shape of the association between cadmium exposure and CVD risk is not clear. This systematic review summarizes data on the association between cadmium exposure and risk of CVD using a dose-response approach. We carried out a literature search in PubMed, Web of Science, and Embase from inception to December 30, 2023. Inclusion criteria were: studies on adult populations, assessment of cadmium exposure, risk of overall CVD and main CVD subgroups as endpoints, and observational study design (cohort, cross-sectional, or case-control). We retrieved 26 eligible studies published during 2005-2023, measuring cadmium exposure mainly in urine and whole blood. In a dose-response meta-analysis using the one-stage method within a random-effects model, we observed a positive association between cadmium exposure and risk of overall CVD. When using whole blood cadmium as a biomarker, the association with overall CVD risk was linear, yielding a risk ratio (RR) of 2.58 (95 % confidence interval-CI 1.78-3.74) at 1 µg/L. When using urinary cadmium as a biomarker, the association was linear until 0.5 µg/g creatinine (RR = 2.79, 95 % CI 1.26-6.16), after which risk plateaued. We found similar patterns of association of cadmium exposure with overall CVD mortality and risks of heart failure, coronary heart disease, and overall stroke, whereas for ischemic stroke there was a positive association with mortality only. Overall, our results suggest that cadmium exposure, whether measured in urine or whole blood, is associated with increased CVD risk, further highlighting the importance of reducing environmental pollution from this heavy metal.

Food Packaging

Recent Advances in Modified Starch Based Biodegradable Food Packaging: A Review

Saeeda Fatima, Muhammad Rehan Khan, Imran Ahmad, Muhammad Bilal Sadiq. *Heliyon.* 2024 Mar 8;10(6):e27453. doi: 10.1016/j.heliyon.2024.e27453. [Article link](#)

This study reviews the importance of resistant starch (RS) as the polymer of choice for biodegradable food packaging and highlights the RS types and modification methods for developing RS from native starch (NS). NS is used in packaging because of its vast availability, low cost and film forming capacity. However, application of starch is restricted due to its high moisture sensitivity and hydrophilic nature. The modification of NS into RS improves the film forming characteristics and extends the applications of starch into the formulation of packaging. The starch is blended with other bio-based polymers such as guar, konjac glucomannan, carrageenan, chitosan, xanthan gum and gelatin as well as active ingredients such as nanoparticles (NPs), plant extracts and essential oils to develop hybrid biodegradable packaging with reduced water vapor permeability (WVP), low gas transmission, enhanced antimicrobial activity and mechanical properties. Hybrid RS based active packaging is well known for its better film forming properties, crystalline structures, enhanced tensile strength, water resistance and thermal properties. This review concludes that RS, due to its better film forming ability and stability, can be utilized as polymer of choice in the formulation of biodegradable packaging.

Chemical Contaminants

Recent Advances in the Use of Composite Titanium Dioxide Nanomaterials in the Food Industry

Xixi Mao, Changlong Hao. *J Food Sci.* 2024 Mar;89(3):1310-1323. doi: 10.1111/1750-3841.16968. [Article link](#)

Titanium dioxide (TiO₂) nanomaterials have attracted significant attention due to their good biocompatibility and potential for multifunctional applications. In the last few years, there has been growing interest in the use of TiO₂ nanomaterials in the food industry. However, a systematic review of the synthesis methods, properties, and applications of TiO₂ nanomaterials in the food industry is lacking. In this review, we provide a summary of the synthesis and properties of TiO₂ nanomaterials and their composites, with a focus on their applications in the food industry. We also discuss the potential benefits and risks of using TiO₂ nanomaterials in food applications. This review aims to promote food innovation and improve food quality and safety.

Caffeine

Common Questions and Misconceptions about Caffeine Supplementation: What Does the Scientific Evidence Really Show?

Jose Antonio, Daniel E Newmire, Jeffrey R Stout, Brandi Antonio, Maureen Gibbons, Lonnie M Lowery, Joseph Harper, et. al. *J Int Soc Sports Nutr.* 2024 March;21(1):2323919. doi: 10.1080/15502783.2024.2323919. [Article link](#)

Caffeine is a popular ergogenic aid that has a plethora of evidence highlighting its positive effects. A Google Scholar search using the keywords "caffeine" and "exercise" yields over 200,000 results, emphasizing the extensive research on this topic. However, despite the vast amount of available data, it is intriguing that uncertainties persist regarding the effectiveness and safety of caffeine. These include but are not limited to: 1. Does caffeine dehydrate you at rest? 2. Does caffeine dehydrate you during exercise? 3. Does caffeine promote the loss of body fat? 4. Does habitual caffeine consumption influence the performance response to acute caffeine supplementation? 5. Does caffeine affect upper vs. lower body performance/strength differently? 6. Is there a relationship between caffeine and depression? 7. Can too much caffeine kill you? 8. Are there sex differences regarding caffeine's effects? 9. Does caffeine work for everyone? 10. Does caffeine cause heart problems? 11. Does caffeine promote the loss of bone mineral? 12. Should pregnant women avoid caffeine? 13. Is caffeine addictive? 14. Does waiting 1.5-2.0 hours after waking to consume caffeine help you avoid the afternoon "crash?" To answer these questions, we performed an evidence-based scientific evaluation of the literature regarding caffeine supplementation.

Food Allergens

Precautionary Allergen Labeling: Avoidance for All?

Allison Schaible, Jamie Kabourek, Wendy Elverson, Carina Venter, Amanda Cox, Marion Groetch. *Curr Allergy Asthma Rep.* 2024 Mar;24(3):81-94. doi: 10.1007/s11882-024-01129-x. [Article link](#)

Purpose of review: Precautionary allergen labeling (PAL) suggests the risk of unintended allergen presence (UAP) in food but is unregulated in most countries and inconsistently applied by food manufacturers. This review evaluates the current use of PAL, its relevance to allergic consumers, and weighs possible advantages and disadvantages of avoiding products with PAL. Recent findings: In most countries, manufacturers are free to decide whether, when, and how to apply PAL resulting in inconsistencies and consumer confusion. Patients with food allergy often interpret PAL incorrectly and without guidance from their health care providers. Health care providers are also prone to misinterpreting PAL, indicating a need for better education. Consumers desire guidance on whether to avoid products with PAL or not. Until further regulatory guidance is available, shared decision-making between patient and provider is required to offer individualized, rather than one-size-fits-all, approaches to PAL.

Emerging Science Areas

Regulatory Science Perspective on the Analysis of Microplastics and Nanoplastics in Human Food

Timothy V Duncan, Sadia Afrin Khan, Anil K Patri, Stacey Wiggins. *Anal Chem.* 2024 Mar 19;96(11):4343-4358. doi: 10.1021/acs.analchem.3c05408. [Article link](#)

Microplastics are increasingly reported, not only in the environment but also in a wide range of food commodities. While studies on microplastics in food abound, the current state of science is limited in its application to regulatory risk assessment by a continued lack of standardized definitions, reference materials, sample collection and preparation procedures, fit-for purpose analytical methods for real-world and environmentally relevant plastic mixtures, and appropriate quality controls. This is particularly the case for nanoplastics. These methodological challenges hinder robust, quantitative exposure assessments of microplastic and nanoplastic mixtures from food consumption. Furthermore, limited toxicological studies on whether microplastics and nanoplastics adversely impact human health are also impeded by methodology challenges. Food safety regulatory agencies must consider both the exposure and the risk of contaminants of emerging concern to ascertain potential harm. Foundational to this effort is access to and application of analytical methods with the capability to quantify and characterize micro- and nanoscale sized polymers in complex food matrices. However, the early stages of method development and application of early stage methods to study the distribution and potential health effects of microplastics and

nanoplastics in food have largely been done without consideration of the stringent requirements of methods to inform regulatory activities. We provide regulatory science perspectives on the state of knowledge regarding the occurrence of microplastics and nanoplastics in food and present our general approach for developing, validating, and implementing analytical methods for regulatory purposes.

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