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Risk Assessment

Innovative Analytical Methodologies for Characterizing Chemical Exposure with a View to Next-Generation Risk Assessment

Žiga Tkalec, Jean-Philippe Antignac, Nicole Bandow, Frederic M Béen, Lidia Belova, Jos Bessems, Bruno Le Bizec, et. al.
Environ Int. 2024 Apr;186:108585. doi: 10.1016/j.envint.2024.108585. [Article link](#)

The chemical burden on the environment and human population is increasing. Consequently, regulatory risk assessment must keep pace to manage, reduce, and prevent adverse impacts on human and environmental health associated with hazardous chemicals. Surveillance of chemicals of known, emerging, or potential future concern, entering the environment-food-human continuum is needed to document the reality of risks posed by chemicals on ecosystem and human health from a one health perspective, feed into early warning systems and support public policies for exposure mitigation provisions and safe and sustainable by design strategies. The use of less-conventional sampling strategies and integration of full-scan, high-resolution mass spectrometry and effect-directed analysis in environmental and human monitoring programmes have the potential to enhance the screening and identification of a wider range of chemicals of known, emerging or potential future concern. Here, we outline the key needs and recommendations identified within the European Partnership for Assessment of Risks from Chemicals (PARC) project for leveraging these innovative methodologies to support the development of next-generation chemical risk assessment.

Foodborne Pathogens

A Critical Review of Risk Assessment Models for *Listeria monocytogenes* in Produce

Ursula Gonzales-Barron, Vasco Cadavez, Juliana De Oliveira Mota, Laurent Guillier, Moez Sanaa. *Foods*. 2024 Apr 4;13(7):1111. doi: 10.3390/foods13071111. [Article link](#)

A review of quantitative risk assessment (QRA) models of *Listeria monocytogenes* in produce was carried out, with the objective of appraising and contrasting the effectiveness of the control strategies placed along the food chains. Despite nine of the thirteen QRA models recovered being focused on fresh or RTE leafy greens, none of them represented important factors or sources of contamination in the primary production, such as the type of cultivation, water, fertilisers or irrigation method/practices. Cross-contamination at processing and during consumer's handling was modelled using transfer rates, which were shown to moderately drive the final risk of listeriosis, therefore highlighting the importance of accurately representing the transfer coefficient parameters. Many QRA models coincided in the fact that temperature fluctuations at retail or temperature abuse at home were key factors contributing to increasing the risk of listeriosis. In addition to a primary module that could help assess current on-farm practices and potential control measures, future QRA models for minimally processed produce should also contain a refined sanitisation module able to estimate the effectiveness of various sanitisers as a function of type, concentration and exposure time. Finally, *L. monocytogenes* growth in the products down the supply chain should be estimated by using realistic time-temperature trajectories, and validated microbial kinetic parameters, both of them currently available in the literature.

Foodborne Illness

Integrating Research on Bacterial Pathogens and Commensals to Fight Infections — An Ecological Perspective

Lisa Maier, Christoph Stein-Thoeringer, Ruth E Ley, Heike Brötz-Oesterhelt, Hannes Link, Nadine Ziemert, Samuel Wagner, Andreas Peschel. *Lancet Microbe*. 2024 Apr 9:S2666-5247(24)00049-1. doi: 10.1016/S2666-5247(24)00049-1. [Article link](#)

The incidence of antibiotic-resistant bacterial infections is increasing, and development of new antibiotics has been deprioritised by the pharmaceutical industry. Interdisciplinary research approaches, based on the ecological principles of bacterial fitness, competition, and transmission, could open new avenues to combat antibiotic-resistant infections. Many facultative bacterial pathogens use human mucosal surfaces as their major reservoirs and induce infectious diseases to aid their lateral transmission to new host organisms under some pathological states of the microbiome and host. Beneficial bacterial commensals can outcompete specific pathogens, thereby lowering the capacity of the pathogens to spread and cause serious infections. Despite the clinical relevance, however, the understanding of commensal-pathogen interactions in their natural habitats remains poor. In this Personal View, we highlight directions to intensify research on the interactions between bacterial pathogens and commensals in the context of human microbiomes and host biology that can lead to the development of innovative and sustainable ways of preventing and treating infectious diseases.

Mycotoxins

Mitigation of Mycotoxins in Food-Is It Possible?

Eliana Badiale Furlong, Jaqueline Garda Buffon, Maristela Barnes Cerqueira, Larine Kupski. *Foods*. 2024 Apr 5;13(7):1112. doi: 10.3390/foods13071112. [Article link](#)

Among microorganisms found in food, fungi stand out because they are adaptable and competitive in a large range of water activities, temperatures, pHs, humidities and substrate types. Besides sporulating, some species are toxigenic and produce toxic metabolites, mycotoxins, under adverse biotic and abiotic variables. Microorganisms are inactivated along the food chain, but mycotoxins have stable structures and remain in ready-to-eat food. The most prevalent mycotoxins in food, which are aflatoxins, fumonisins, ochratoxin A, patulin, tenuazonic acid, trichothecenes and zearalenone, have maximum tolerable limits (MTLs) defined as ppb and ppt by official organizations. The chronic and acute toxicities of mycotoxins and their stability are different in a chemical family. This critical review aims to discuss promising scientific research that successfully mitigated levels of mycotoxins and focus the results of our research group on this issue. It highlights the application of natural antifungal compounds, combinations of management, processing parameters and emergent technologies, and their role in reducing the levels and bioaccessibility. Despite good crop management and processing practices, total decontamination is

almost impossible. Experimental evidence has shown that exposure to mycotoxins may be mitigated. However, multi-disciplinary efforts need to be made to improve the applicability of successful techniques in the food supply chain to avoid mycotoxins' impact on global food insecurity.

Heavy Metals

Effects of Combined Microplastics and Heavy Metals Pollution on Terrestrial Plants and Rhizosphere Environment: A Review

Lei Xu, Wenjun Xie, Huiping Dai, Shuhe Wei, Lidia Skuza, Jianan Li, Cailing Shi, Lichang Zhang. *Chemosphere*. 2024 Apr 22;358:142107. doi: 10.1016/j.chemosphere.2024.142107. [Article link](#)

Microplastics (MPs) can enter the soil environment through industry, agricultural production and daily life sources. Their interaction with heavy metals (HMs) poses a significant threat to a variety of terrestrial ecosystems, including agricultural ones, thereby affecting crop quality and threatening human health. This review initially addresses the impact of single and combined contamination with MPs and HMs on soil environment, including changes in soil physicochemical properties, microbial community structure and diversity, fertility, enzyme activity and resistance genes, as well as alterations in heavy metal speciation. The article further explores the effects of this pollution on the growth characteristics of terrestrial plants, such as plant biomass, antioxidant systems, metabolites and photosynthesis. In general, the combined contaminants tend to significantly affect soil environment and terrestrial plant growth, i.e., the impact of combined contaminants on plants weight ranged from -87.5% to 4.55%. Similarities and differences in contamination impact levels stem from the variations in contaminant types, sizes and doses of contaminants and the specific plant growth environments. In addition, MPs can not only infiltrate plants directly, but also significantly affect the accumulation of HMs in terrestrial plants. The heavy metals concentration in plants under the treatment of MPs were 70.26%-36.80%. The co-occurrence of these two pollution types can pose a serious threat to crop productivity and safety. Finally, this study proposes suggestions for future research aiming to address current gaps in knowledge, raises awareness about the impact of combined MPs + HMs pollution on plant growth and eco-environmental security.

Food Packaging

Recent Progress of Carrageenan-Based Composite Films in Active and Intelligent Food Packaging Applications

Bharath Kokkuvayil Ramadas, Jong-Whan Rhim, Swarup Roy. *Polymers (Basel)*. 2024 Apr 6;16(7):1001. doi: 10.3390/polym16071001. [Article link](#)

Recently, as concerns about petrochemical-derived polymers increase, interest in biopolymer-based materials is increasing. Undoubtedly, biopolymers are a better alternative to solve the problem of synthetic polymer-based plastics for packaging purposes. There are various types of biopolymers in nature, and mostly polysaccharides are used in this regard. Carrageenan is a hydrophilic polysaccharide extracted from red algae and has recently attracted great interest in the development of food packaging films. Carrageenan is known for its excellent film-forming properties, high compatibility and good carrier properties. Carrageenan is readily available and low cost, making it a good candidate as a polymer matrix base material for active and intelligent food packaging films. The carrageenan-based packaging film lacks mechanical, barrier, and functional properties. Thus, the physical and functional properties of carrageenan-based films can be enhanced by blending this biopolymer with functional compounds and nanofillers. Various types of bioactive ingredients, such as nanoparticles, natural extracts, colorants, and essential oils, have been incorporated into the carrageenan-based film. Carrageenan-based functional packaging film was found to be useful for extending the shelf life of packaged foods and tracking spoilage. Recently, there has been plenty of research work published on the potential of carrageenan-based packaging film. Therefore, this review discusses recent advances in carrageenan-based films for applications in food packaging. The preparation and properties of carrageenan-based packaging films were discussed, as well as their application in real-time food packaging. The latest discussion on the potential of carrageenan as an alternative to traditionally used synthetic plastics may be helpful for further research in this field.

Chemical Contaminants

Potential for Glove Risk Amplification via Direct Physical, Chemical and Microbiological Contamination

Barry S Michaels, Troy Ayers, Jenna Brooks-McLaughlin, Ryan J McLaughlin, Katherine Sandoval-Warren, Casey Schlenker, Lynda Ronaldson, Steve Ardagh. *J Food Prot.* 2024 Apr 26:100283. doi: 10.1016/j.jfp.2024.100283. [Article link](#)

This review focuses on the potential direct physical, chemical, and microbiological contamination from disposable gloves when utilized in food environments, inclusive of the risks posed to food products as well as worker safety. Unrecognized problems endemic to glove manufacturing were magnified during the COVID-19 pandemic due to high demand, increased focus on PPE performance, availability, supply chain instability, and labor shortages. Multiple evidence-based reports of contamination, toxicity, illness, deaths, and related regulatory action linked to contaminated gloves in food and healthcare, have highlighted problems indicative of systemic glove industry shortcomings. The glove manufacturing process was diagrammed with sources and pathways of contamination identified, indicating weak points with documented occurrences detailed. Numerous unsafe ingredients can introduce chemical contaminants, potentially posing risks to food and to glove users. Microbial hazards present significant challenges to overall glove safety as contaminants appear to be introduced via polluted water sources or flawed glove manufacturing processes, resulting in increased risks within food and healthcare environments. Frank and opportunistic pathogens along with food spoilage organisms can be introduced to foods and wearers. When the sources and pathways of glove borne contamination were explored, it was found that physical failures play a pivotal role in release of sweat build-up, liquefaction of chemical residues and incubation of microbial contaminants from hands and gloves. Thus, with glove physical integrity issues, including punctures in new, unused gloves, that can develop into significant rips and tears, not only can direct physical food contamination occur, but chemical and microbiological contamination can find their way into food. Enhanced regulatory requirements for Acceptable Quality Limits of food grade gloves, and the establishment of appropriate bioburden standards would enhance safety in food applications. Based on information provided, together with a false sense of security associated with glove use, the unconditional belief in glove chemical and microbiological purity may be unfounded.

Caffeine

Using Caffeine as a Chemical Means to Induce Flow States

Niklas Reich, Michael Mannino, Steven Kotler. *Neurosci Biobehav Rev.* 2024 Apr:159:105577. doi: 10.1016/j.neubiorev.2024.105577. [Article link](#)

Flow is an intrinsically rewarding state characterised by positive affect and total task absorption. Because cognitive and physical performance are optimal in flow, chemical means to facilitate this state are appealing. Caffeine, a non-selective adenosine receptor antagonist, has been emphasized as a potential flow-inducer. Thus, we review the psychological and biological effects of caffeine that, conceptually, enhance flow. Caffeine may facilitate flow through various effects, including: i) upregulation of dopamine D1/D2 receptor affinity in reward-associated brain areas, leading to greater energetic arousal and 'wanting'; ii) protection of dopaminergic neurons; iii) increases in norepinephrine release and alertness, which offset sleep-deprivation and hypoarousal; iv) heightening of parasympathetic high frequency heart rate variability, resulting in improved cortical stress appraisal, v) modification of striatal endocannabinoid-CB1 receptor-signalling, leading to enhanced stress tolerance; and vi) changes in brain network activity in favour of executive function and flow. We also discuss the application of caffeine to treat attention deficit hyperactivity disorder and caveats. We hope to inspire studies assessing the use of caffeine to induce flow.

Food Allergens

Evaluation of Clinical Outcomes of Efficacy in Food Allergen Immunotherapy Trials, COFAITH EAACI Task Force

Pablo Rodríguez Del Río, Montserrat Álvaro-Lozano, Stefania Arasi, Raphaëlle Bazire, Carmelo Escudero, Nandinee Patel, Monica Sandoval-Ruballos, et. al. *Allergy.* 2024 Apr;79(4):793-822. doi: 10.1111/all.16027. [Article link](#)

Food allergy is a global public health problem that until recent years lacked any aetiological treatment supported by academy, industry and regulators. Food immunotherapy (AIT) is an evolving treatment option, supported by clinical practice and industry trial data. Recent AIT meta-analyses have highlighted the difficulty in pooling safety and efficacy data from AIT trials, due to secondary heterogeneity in the study. An EAACI task force (CO-FAITH) initiated by the Paediatric Section was created to

focus on AIT efficacy outcomes for milk, egg and peanut allergy rather than in trial results. A systematic search and a narrative review of AIT controlled clinical trials and large case series was conducted. A total of 63 manuscripts met inclusion criteria, corresponding to 23, 21 and 22 studies of milk, egg and peanut AIT, respectively. The most common AIT efficacy outcome was desensitization, mostly defined as tolerating a maintenance phase dose, or reaching a particular dose upon successful exit oral food challenge (OFC). However, a large degree of heterogeneity was identified regarding the dose quantity defining this outcome. Sustained unresponsiveness and patient-reported outcomes (e.g. quality of life) were explored less frequently, and to date have been most rigorously described for peanut AIT versus other allergens. Change in allergen threshold assessed by OFC remains the most common efficacy measure, but OFC methods suffer from heterogeneity and methodological disparity. This review has identified multiple heterogeneous outcomes related to measuring the efficacy of AIT. Efforts to better standardize and harmonize which outcomes, and how to measure them must be carried out to help in the clinical development of safe and efficacious food allergy treatments.

Emerging Science Areas

Emerging Contaminants

Advisory Group Recommendations on Priorities for the IARC Monographs

Amy Berrington de González, Scott A Masten, Parveen Bhatti, Renée Turzanski Fortner, Susan Peters, Tiina Santonen, et. al. *Lancet Oncol.* April 12, 2024. Vol 25, Issue 5. doi.org/10.1016/S1470-2045(24)00208-0. [Article link](#)

The Advisory Group recommended a broad range of agents for evaluation with high or medium priority. Other agents were assigned no priority for evaluation. The Advisory Group particularly noted that the Monographs Programme has not conducted an evaluation of pesticides since 2015, or of infectious agents since 2012; as a result, many high priority recommendations have accrued in these categories.

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