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Risk Assessment

The Use of Effect Biomarkers in Chemical Mixtures Risk Assessment - Are They Still Important?

Carina Ladeira. *Mutat Res Genet Toxicol Environ Mutagen*. 2024 May-Jun:896:503768. doi: 10.1016/j.mrgentox.2024.503768.

[Article link](#)

Human epidemiological studies with biomarkers of effect play an invaluable role in identifying health effects with chemical exposures and in disease prevention. Effect biomarkers that measure genetic damage are potent tools to address the carcinogenic and/or mutagenic potential of chemical exposures, increasing confidence in regulatory risk assessment decision-making processes. The micronucleus (MN) test is recognized as one of the most successful and reliable assays to assess genotoxic events, which are associated with exposures that may cause cancer. To move towards the next generation risk assessment is crucial to establish bridges between standard approaches, new approach methodologies (NAMs) and tools for increase the mechanistically-based biological plausibility in human studies, such as the adverse outcome pathways (AOPs) framework. This paper aims to highlight the still active role of MN as biomarker of effect in the evolution and applicability of new methods and approaches in human risk assessment, with the positive consequence, that the new methods provide a deeper knowledge of the mechanistically-based biology of these endpoints.

Foodborne Pathogens

D-tryptophan, an Eco-Friendly Natural, Safe and Healthy Compound with Antimicrobial Activity Against Food-Borne Pathogens: A Systematic Review

Minoo Moghimani, Seyyed Mohammad Ali Noori, Asma Afshari, Mohammad Hashemi. *Food Sci Nutr*. 2024 May 1;12(5):3068-3079. doi: 10.1002/fsn3.3987. [Article link](#)

Recently, the use of D-amino acids as food preservatives has attracted considerable attention because these natural compounds do not have adverse effects on human health. In addition, D-amino acids such as D-tryptophan can reduce the harmful effects of other treatments. For instance, the use of D-tryptophan in food reduces the requirement for high temperatures and their damaging effects on nutrients such as proteins and vitamins. The purpose of this systematic review was to investigate the antimicrobial effect of D-tryptophan on food-borne pathogens *in vitro* and in food models. To identify related studies, scientific digital databases such as PubMed, Science Direct, and Google Scholar were searched from January 2000 to February 2023. The results of the studies showed that when D-tryptophan was used with other stresses such as using different salt concentrations, refrigeration, or high temperatures, it showed significant antimicrobial effects on Gram-positive and Gram-negative food-borne pathogens, and antibiofilm impacts were also observed with D-tryptophan. Since studies have shown that the antimicrobial activity of D-tryptophan depends on several factors, including the pathogen strain, the type of stress, and the concentration of D-tryptophan, and every article has focused on one of these factors, there is a need for a systematic review that summarizes and concludes the effect of all these factors on the antimicrobial activity of D-tryptophan against food-borne pathogens.

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 May 14;14(2):116-125. 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

Monitoring Mycotoxin Exposure in Food-Producing Animals (Cattle, Pig, Poultry, and Sheep)

Borja Muñoz-Solano, Elena Lizarraga Pérez, Elena González-Peñas. *Toxins (Basel)*. 2024 May 9;16(5):218. doi: 10.3390/toxins16050218. [Article link](#)

Food-producing animals are exposed to mycotoxins through ingestion, inhalation, or dermal contact with contaminated materials. This exposure can lead to serious consequences for animal health, affects the cost and quality of livestock production, and can even impact human health through foods of animal origin. Therefore, controlling mycotoxin exposure in animals is of utmost importance. A systematic literature search was conducted in this study to retrieve the results of monitoring exposure to mycotoxins in food-producing animals over the last five years (2019-2023), considering both external exposure (analysis of feed) and internal exposure (analysis of biomarkers in biological matrices). The most commonly used analytical technique for both approaches is LC-MS/MS due to its capability for multidetection. Several mycotoxins, especially those that are regulated (ochratoxin A, zearalenone, deoxynivalenol, aflatoxins, fumonisins, T-2, and HT-2), along with some emerging mycotoxins (sterigmatocystin, nivalenol, beauvericin, enniatins among others), were studied in 13,818 feed samples worldwide and were typically detected at low levels, although they occasionally exceeded regulatory levels. The occurrence of multiple exposure is widespread. Regarding animal biomonitoring, the primary objective of the studies retrieved was to study mycotoxin metabolism after toxin administration. Some compounds have been suggested as biomarkers of exposure in the plasma, urine, and feces of animal species such as pigs and poultry. However, further research is required, including many other mycotoxins and animal species, such as cattle and sheep.

Heavy Metals

Metabolic Derangement by Arsenic: A Review of the Mechanisms

K Bibha, T M Akhigbe, M A Hamed, R E Akhigbe. *Biol Trace Elem Res*. 2024 May;202(5):1972-1982. doi: 10.1007/s12011-023-03828-4. [Article link](#)

Studies have implicated arsenic exposure in various pathological conditions, including metabolic disorders, which have become a global phenomenon, affecting developed, developing, and under-developed nations. Despite the huge risks associated with arsenic exposure, humans remain constantly exposed to it, especially through the consumption of contaminated water and food. This present study provides an in-depth insight into the mechanistic pathways involved in the metabolic derangement by arsenic. Compelling pieces of evidence demonstrate that arsenic induces metabolic disorders via multiple pathways. Apart from the initiation of oxidative stress and inflammation, arsenic prevents the phosphorylation of Akt at Ser473 and Thr308, leading to the inhibition of PDK-1/Akt insulin signaling, thereby reducing GLUT4 translocation through the activation of Nrf2. Also, arsenic downregulates mitochondrial deacetylase Sirt3, decreasing the ability of its associated transcription factor, FOXO3a, to bind to the agents that support the genes for manganese superoxide dismutase and PPARγ co-activator (PGC)-1α. In addition, arsenic activates MAPKs, modulates p53/ Bcl-2 signaling, suppresses Mdm-2 and PARP, activates NLRP3 inflammasome and caspase-mediated apoptosis, and induces ER stress, and ox-mtDNA-dependent mitophagy and autophagy. More so, arsenic alters lipid metabolism by decreasing the presence of 3-hydroxy-e-methylglutaryl-CoA synthase 1 and carnitine O-octanoyl transferase (Crot) and increasing the presence of fatty acid-binding protein-3 mRNA. Furthermore, arsenic promotes atherosclerosis by inducing endothelial damage. This cascade of

pathophysiological events promotes metabolic derangement. Although the pieces of evidence provided by this study are convincing, future studies evaluating the involvement of other likely mechanisms are important. Also, epidemiological studies might be necessary for the translation of most of the findings in animal models to humans.

Food Packaging

Application Progress of Nanocellulose in Food Packaging: A Review

Feijie Wang, Zihan Hu, Shiqiang Ouyang, Suyang Wang, Yichi Liu, Mengdi Li, Yiting Wu, et. al. *Int J Biol Macromol.* 2024 May;268(Pt 2):131936. doi: 10.1016/j.ijbiomac.2024.131936. [Article link](#)

With the increasing environmental and ecological problems caused by petroleum-based packaging materials, the focus has gradually shifted to natural resources for the preparation of functional food packaging materials. In addition to biodegradable properties, nanocellulose (NC) mechanical properties, and rich surface chemistry are also fascinating and desired to be one of the most probable green packaging materials. In this review, we first introduce the recent progress of novel applications of NC in food packaging, including intelligent packaging, nano(bio)sensors, and nano-paper; secondly, we focus on the modification techniques of NC to summarize the properties (antimicrobial, mechanical, hydrophobic, antioxidant, and so on) that are required for food packaging, to expand the new synthetic methods and application areas. After presenting all the latest advances related to material design and sustainable applications, an overview summarizing the safety of NC is presented to promote a continuous and healthy movement of NC toward the field of truly sustainable packaging.

Chemical Contaminants

Traditional Food Processing and Acrylamide Formation: A Review

Mekuannt Alefe Adimas, Biresaw Demelash Abera, Zemenu Tadesse Adimas, Henock Woldemichael Woldemariam, Mulugeta Admasu Delele. *Heliyon.* 2024 May 15;10(9):e30258. doi: 10.1016/j.heliyon.2024.e30258. [Article link](#)

Traditional methods that are applied for the processing of food commonly use relatively high temperature and long cooking time for the preparation of foods. This relatively high temperature and long processing time of foods especially in the presence of carbohydrate is highly associated with the formation of acrylamide. Acrylamide is a process contaminant that is highly toxic to humans and remains a global issue. The occurrence of acrylamide in traditional foods is a major public health problem. Studies that are conducted in different countries indicated that traditionally processed foods are highly linked to the formation of acrylamide. Therefore, understanding the factors influencing acrylamide formation during traditional food processing techniques is crucial for ensuring food safety and minimizing exposure to this harmful chemical compound. Several research reports indicate that proper food processing is the most effective solution to address food safety concerns by identifying foods susceptible to acrylamide formation. This review aims to provide an overview of traditional food processing techniques and their potential contribution to the formation of acrylamide and highlights the importance of mitigating its formation in food products. The information may be valuable to researchers, policymaker and manufacturers.

Caffeine

Caffeine: A Potential Mechanism for Anti-Obesity

Meng Wang, Wei Guo, Jiang-Fan Chen. *Purinergic Signal.* 2024 May 28. doi: 10.1007/s11302-024-10022-1. [Article link](#)

Obesity refers to the excessive accumulation of fat caused by a long-term imbalance between energy intake (EI) and energy expenditure (EE). Over recent years, obesity has become a major public health challenge. Caffeine is a natural product that has been demonstrated to exert anti-obesity effects; however, the mechanisms responsible for the effect of caffeine on weight loss have yet to be fully elucidated. Most obesity-related deaths are due to cardiovascular disease. Recent research has demonstrated that caffeine can reduce the risk of death from cardiovascular disease; thus, it can be hypothesized that caffeine may represent a new therapeutic agent for weight loss. In this review, we synthesize data arising from clinical and animal studies over the last decade and discuss the potential mechanisms by which caffeine may induce weight loss, focusing particularly on increasing energy consumption, suppressing appetite, altering lipid metabolism, and influencing the gut microbiota. Finally, we summarize the major challenges associated with caffeine and anti-obesity research and highlight possible directions for future research and development.

Food Allergens

Decoding Food Reactions: A Detailed Exploration of Food Allergies vs. Intolerances and Sensitivities

Amin Mousavi Khaneghah, Parisa Mostashari. *Crit Rev Food Sci Nutr.* 2024 May 15:1-45. doi: 10.1080/10408398.2024.2349740. [Article link](#)

The food matrix is a complex system encompassing all constituent elements in food production. It influences the digestibility of these elements through direct interactions and affects the digestive environment. Furthermore, the gastrointestinal system possesses precise mechanisms that efficiently process dietary components into essential nutrients, effectively preventing the onset of abnormal immune responses or dysfunctional host reactions in most instances. However, the incidence of adverse food reactions is constantly increasing, and evidence indicates that this process is environmental. Adverse reactions can be categorized as toxic or nontoxic. Toxic reactions are dose-dependent and can result from natural compounds, processing-induced substances, or contaminants. Nontoxic reactions like food intolerance and hypersensitivity depend on individual susceptibility and evoke specific pathological and physiological responses. This review aims to elucidate the mechanisms underlying the occurrence of immune- (food allergies and sensitivities) and non-immune-mediated (food intolerance) reactions, emphasizing the fundamental distinctions between these two categories. Enhanced comprehension and distinction of these mechanisms will significantly contribute to advancing preventive and therapeutic approaches and establishing guidelines for food labeling concerning immune-mediated reactions.

Emerging Science Areas

Emerging Area: Microbial Foods

From Sustainable Feedstocks to Microbial Foods

Kyeong Rok Choi, Seok Yeong Jung, Sang Yup Lee. *Nat Microbiol.* 2024 May;9(5):1167-1175. doi: 10.1038/s41564-024-01671-4. [Article link](#)

Climate change-induced alterations in weather patterns, such as frequent and severe heatwaves, cold waves, droughts, floods, heavy rain and storms, are reducing crop yields and agricultural productivity. At the same time, greenhouse gases arising from food production and supply account for almost 30% of anthropogenic emissions. This vicious circle is producing a global food crisis. Sustainable food resources and production systems are needed now, and microbial foods are one possible solution. In this Perspective, we highlight the most promising technologies, and carbon and energy sources, for microbial food production.

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