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Risk Assessment

Microbial Risk Analysis from a Food Industry Perspective – Insights from an International Survey

Alexandra Fetsch, Nunzio Sarnino, Konstantinos Koutsoumanis, Maarten Nauta, Martin Wiedmann, Katharina D.C. Stärk, Monika Ehling-Schulz, et. al. *Microbial Risk Analysis*, Vol. 29, June 2025. doi.org/10.1016/j.mran.2024.100340. Article link

Foodborne microbial hazards lead to substantial morbidity and mortality. To assure consumer protection, a need to move from hazard-based to risk-based food safety approaches is increasingly recognized. Food-business-operators play a crucial role by implementing risk management practices in their facilities. Still, there is very limited data on current approaches to ensure microbial food safety and the profiles and perceptions of professionals assessing, managing, and communicating risks in food industry. This study addresses food safety approaches and challenges in food industry aiming to provide data on microbial risk analysis according to Codex Alimentarius. A survey elicited responses from 108 food professionals involved in microbial risk assessment, risk management, or risk communication in the food industry. The findings highlight drivers and trends relevant to food safety and the food industries' internal decision-making processes. Most participants had risk-based food-safety management systems established. A microbial risk assessment according to Codex Alimentarius principles was conducted by 85 %. Professionals pinpointed areas that led to significant microbial incidents such as contaminated raw materials, poor hygiene, or emerging pathogens. Interestingly, one third of the participants believed that zero risk is possible, which contrasts with the scientific consensus that microbial food safety is not absolute as zero risk is not feasible. The results of this work provide insights into the implementation and understanding of microbial risk analysis from a food industrial perspective and could be leveraged to develop innovative microbial risk analysis frameworks that meet the challenges of future food systems.

Foodborne Pathogens

Impact of pH and Temperature on Foodborne Pathogens' Survival in Cold Brew Coffee

Amandeep Singh, Manoj Sawale, Harneel Kaur, Patnarin Benyathiar, Dharmendra K. Mishra. *Jrnl of Food Safety*, 10 June 2025. doi.org/10.1111/jfs.70024. Article link

The unique flavor and taste of cold brew coffee have made it popular in recent years. As the name suggests, it is cold-brewed, which means the absence of a thermal process in the brewing. Hence, after the roasting step, it only has to rely on the product pH and storage temperature to control the foodborne pathogens such as *Salmonella* Typhimurium, *Escherichia coli* O157:H7, and *Listeria monocytogenes*. The purpose of this study is to investigate the effect of pH (4.9 and 5.3) and temperature (4°C and 23°C) on *Salmonella* Typhimurium, *Escherichia coli* O157:H7, and *Listeria monocytogenes* in cold brew coffee. Cold brew coffee samples were inoculated with these organisms for 30 days, and survival data were collected. Results showed that pH affected the survival of *Salmonella* and *E. coli*. At pH 4.9, *Salmonella* was reduced by 5 log CFU/ml after 7 days, reaching the limit of detection in 11 days. However, at pH 5.3, 5 5-log reduction occurred after 14 days, taking 25 days to reach the limit of detection. At 23°C, both *Salmonella* and *E. coli* showed increased survival, making temperature an important factor. *Listeria* showed resistance to pH variations at both temperatures. Lower RMSE values for *Salmonella* (pH 4.9) and *Listeria* (pH 4.9) were observed in the log-linear model, making it a better fit. However, the Weibull model showed a better fit for *Salmonella* (pH -5.3), *Listeria* (pH -5.3), and *E. coli* (pH -4.9, 5.3). Overall, lower temperatures increase survival, while higher temperatures enhance the reduction in *E. coli*. These findings are crucial for enhancing the safety of cold-brew coffee and providing valuable recommendations to producers, regulators, and consumers.

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Foodborne Illness

Epidemiology, Prevention and Control of Foodborne Microbial Pathogens

Gabriel Augusto Marques Rossi, Juliano Gonçalves Pereira, Marcia Nitschke. *Mircoorganisms*, 13(7), 20 June 2025. doi.org/10.3390/microorganisms13071435. Article link

Foodborne diseases are caused by the consumption of food or water contaminated with bacteria and their toxins, viruses, parasites, or chemical substances. This concerning public health issue has an important socioeconomic impact, leading to pressure on healthcare services, reduced workforce productivity, and negative effects on sectors such as international trade. Each year, approximately one in ten individuals worldwide becomes ill due to the consumption of contaminated food, resulting in more than 420,000 deaths, mainly affecting children under the age of five years old (around 125,000 of these fatalities annually).

Food Classification

Definitions of Ultra-Processed Foods Beyond NOVA: A Systematic Review and Evaluation

Anine Christine Medin, Stine Rambekk Gulowsen, Synne Groufh-Jacobsen, Ingunn Berget, Ida Synnove Grini, Paula Varela. *Food & Nutrit. Research*, 16 June 2025. doi.org/10.29219/fnr.v69.12217. Article link

Background: Ultra-processed foods (UPFs) are associated with negative health outcomes, but current classification systems, including the dominant NOVA system, are typically not suitable for identifying which factors of these foods may be harmful. New ways of defining UPFs are needed to better understand how food processing affects health. **Objective:** To identify classification systems that include a category for ultra-processed or highly processed foods with a focus on comparing their definitions and provide a current evaluation of available alternatives to NOVA. **Design:** A systematic literature review was conducted following the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines, with the search strategy developed in collaboration with a university librarian. The literature search was completed on 18 December 2023, using databases Medline, Embase (via Ovid), and Web of Science. No human participants were included. **Results:** We identified six systems – NOVA, European Prospective Investigation into Cancer and Nutrition (EPIC), International Food Policy Research Institute (IFPRI), University of North Carolina (UNC), UnProcessed Pantry Project (UP3), and Siga – that categorize highly processed food or UPFs. These systems differ in structure and detail, with NOVA, EPIC, and Siga providing specific examples of processing techniques. Regarding additives, NOVA, Siga, and UP3 include them explicitly, with Siga offering the most detailed categorization based on additives and ingredients. Siga also includes quantitative measures for nutritional quality, including cut-offs for sugar, fat, and salt, while IFPRI and UP3 address nutritional quality non-quantitatively. **Discussion:** When comparing NOVA's UPF category with the highly processed food or UPF categories used in the other five identified systems, we found that none specifies processing techniques clearly. Both NOVA and Siga define additives unique to their UPF categories. Siga stands out by addressing the diverse risks associated with additives and offering quantitative nutritional quality criteria, thus addressing some of the criticisms of how UPFs are commonly defined. **Conclusions:** Siga represents a valuable, but not final, step forward in classifying UPFs and could serve as a reference in developing a new operational definition for UPFs.

The Effect of a Mobile Health Dietary Education Intervention on Ultra-processed Food Consumption in Patients with Type 2 Diabetes: A Randomized Controlled Trial

Valeria Cecchini, Linnea Sjoblom, Ylva Trolle Lagerros, Stephane E. Bonn. *Current Dev. In Nutrition*, Vol. 9, Issue 6. 25 June 2025. DOI: 10.1016/j.cdnut.2025.107454. Article link

Background: Globally, there is a significant rise in the consumption of ultra-processed foods (UPFs), which has been associated with negative health outcomes. Mobile health (mHealth) interventions could be used to target dietary intake and reduce UPF consumption. **Objectives:** This study aims to evaluate the effect of an mHealth education intervention for healthy eating on UPF consumption in individuals with type 2 diabetes mellitus (T2DM). This study presents the results of an exploratory analysis of data from the Healthy eating using APP technologY (HAPPY) Trial. **Methods:** Conducting post-hoc analyses on data from the HAPPY trial, we examined the effect of a 12-week mHealth dietary education intervention. Dietary intake was assessed at baseline and after 3 months using 4-day food records. The NOVA classification was used to quantify UPF consumption. A total of 80 participants (intervention group n = 35 and control group n = 45) were included in analyses.

The intervention effect on UPF consumption was determined by linear regression analysis. **Results:** The majority of participants were males (61.3%), the mean age was 63.0 years, and the mean body mass index 29.7 kg/m^2. In the intervention group, the UPF percentage contribution to the total energy intake was 21.5 interquartile range (IQR): (16.5–31.0) at baseline and 19.7 (IQR: 12.6–30.2) at the 3-month follow-up. In the control group, the UPF percentage contribution was 17.4 (IQR: 13.7–30.5) at baseline and 16.8 (IQR: 9.6–24.9) at the 3-month follow-up. We found no effect of the intervention on UPF consumption. **Conclusions:** This exploratory study, based on data from the HAPPY trial, indicates that the mHealth dietary education intervention did not significantly reduce UPF consumption in individuals with T2DM. Interventions specifically targeting UPF intake require further investigation and might provide a promising strategy for addressing this issue in the future.

Heavy Metals

Redistribution and Introduction of Heavy Metals during Wheat Milling: A Process-Based Study

Cagla Kayisoglu, Secil Uzel, Bulent Kabak. *Jrnl of Cereal Science*, 25 June 2025. doi.org/10.1016/j.jcs.2025.104235. Article link

Heavy metal contamination in food products poses a significant threat to global food safety and public health. In this study, the impact of wheat milling processes on the concentrations of ten heavy metals, including aluminium (Al), arsenic (As), cadmium (Cd), chrome (Cr), cobalt (Co), copper (Cu), iron (Fe), lead (Pb), nickel (Ni), and zinc (Zn) was determined across 43 milling streams. The assessment was conducted across key processing stages, including intake, pre-cleaning, cleaning, and tempering, as well as the subsequent milling phases of breaking, reduction, and crushing. Wheat samples were analyzed for nine metals (Al, Cd, Cr, Co, Cu, Fe, Pb, Ni, and Zn) using Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES), while As was determined by Atomic Absorption Spectrometry (AAS). No As was detected in both raw wheat samples or any stage of milling stages, indicating no associated contamination risk. Coarse fractions, such as bran and germ, contained higher levels of heavy metals, particularly Al and Zn, while refined flour fractions exhibited significantly lower concentrations due to the removal of outer grain layers. Al levels decreased from 13.63 mg/kg in raw wheat to 0.36 mg/kg in refined flour. Cd, which was not detected in earlier stages, appeared at 0.58 mg/kg during crushing, indicating potential metal transfer caused by mechanical abrasion. These findings highlight the role of milling in reducing heavy metal content and underscore the need for strict control of external sources and regular equipment maintenance to ensure the safety of wheat-based products.

Chemical Contaminants

Identification of Mutagenicity, MOA, and Dose Response Analysis

Christopher A. Bates, Lynne T. Haber, Rita Schoeny, Andrew Maier. *Food & Chemical Tox*, Vol. 202, 29 May 2025. doi.org/10.1016/j.fct.2025.115441. Article link

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Bates et al. (2023) developed a cancer risk assessment framework to evaluate dietary carcinogens. The framework 1) evaluates gene mutation as an early key event of cancer development; 2) considers the dose metric appropriate based on mode of action understanding; and 3) integrates the appropriate dose metric category with relevant exposure data to evaluate dose response options and cancer level of concern for the specified exposure scenario. Here, we test the framework with three demonstrated rodent carcinogens with varying human cancer assessments and underlying cancer biology: acrylamide, aflatoxin B1, and β-myrcene. While traditional cancer assessment approaches might characterize these chemicals as potential human carcinogens based primarily on rodent tumorigenicity data, the framework evaluates the cancer MOA in the context of exposure patterns to provide more information on conditions that may increase risk. We found that mutation is an early key event for aflatoxin B1 carcinogenicity, and linear low-dose extrapolation is an appropriate approach. In contrast, MOA data support a dose threshold-based approach for acrylamide and β-myrcene, and their respective dietary consumption patterns suggest a low concern for cancer. The framework provides a more nuanced approach to cancer risk assessment and provides for a more informed risk management decision.

Caffeine

Coffee Consumption and Mortality among United States Adults: A Prospective Cohort Study

Bingjie Zhou, Mengyuan Ruan, Yongyi Pan, Lu Wang, Fang Zhang. *Jrnl of Nutrition,* 12 May 2025. doi.org/10.1016/j.tjnut.2025.05.004. Article link

Background: Although coffee consumption has been associated with a variety of health benefits, it remains unclear whether the addition of sugar and saturated fat modifies these effects. **Objectives:** This study aimed to examine the relationship between coffee intake, including the amount of added sugar and saturated fat, and mortality among United States adults. **Methods:** We conducted a prospective cohort study using data from the National Health and Nutrition Examination Survey from 1999 to 2018, linked to National Death Index Mortality Data. The study included 46,332 adults aged 20 y and older who completed valid first-day 24-h dietary recalls. Coffee consumption was categorized by type (caffeinated or decaffeinated) and by sugar (<2.5 g per 8-oz), and saturated fat content (<1 g per 8-oz). Mortality outcomes included all-cause, cancer, and cardiovascular disease (CVD) mortality. Cox proportional hazards models were used to estimate hazard ratios (HRs) and 95% confidence intervals (CIs) for mortality risk based on type, intake levels (nondrinkers, <1 cup/d, 1 to <2 cups/d, 2 to <3 cups/d, and ≥3 cups/d) and the amount of added sugar and saturated fat. **Results:** Over a median follow-up of 9.3–11.3 y, a total of 7074 deaths occurred, including 1176 cancer-specific and 1089 CVD-specific deaths. Higher coffee consumption was associated with lower all-cause mortality [HR (95% CI): 0.89 (0.78, 1.02) for < 1 cup/d; 0.84 (0.77, 0.92) for 1 to <2 cups/d; 0.83 (0.75, 0.93) for 2 to <3 cups/d; and 0.85 (0.77, 0.95) for ≥3 cups/d; P-trend = 0.004]. However, the mortality benefits were restricted to black coffee [HR (95% CI): 0.86 (0.77, 0.97)] and coffee with low added sugar and saturated fat content [HR (95% CI): 0.86 (0.75, 0.99)]. **Conclusions:** The health benefits of coffee consumption may be diminished when sugar and saturated fat are added.

Food Packaging

Exploring the Properties of Carboxymethyl Cellulose Blended With Other Polymeric Compounds for the Formulation of Biodegradable Packaging Films and Edible Coatings: A Review

Pritam Kasle, Aarti Bains, Gulden Goksen, Sanju Bala Dhull, Nemat Ali, Rupak Nagarik, Mohammad Fareed, Prince Chawla. *Comp. Reviews in Food Sci & Food Safety*, 24 June 2025. doi.org/10.1111/1541-4337.70215. Article link

Carboxymethyl cellulose (CMC) is a leading hydrocolloid for biodegradable packaging films and edible coatings due to its film-forming ability, biodegradability, and nontoxicity. However, its application is limited by moisture sensitivity, poor mechanical strength, flammability, and inadequate gas barrier properties. This review explores the formulation, structural properties, and practical applications of CMC when blended with other polymeric compounds such as cellulose, starch, alginate, chitosan, and polylactic acid to overcome these limitations. Blending enhances tensile strength, water resistance, and antimicrobial functionality, extends food shelf life, and reduces reliance on synthetic plastics. Nanocomposite techniques and bioactive molecule incorporation further improve film performance. Innovative processing methods, including electrospinning and three-dimensional printing, offer new opportunities for structural enhancement. This literature review aims to assess key challenges, including material compatibility, processing efficiency, scalability, and environmental sustainability. CMC-based films, especially in composite formulations, show significant promise in advancing sustainable food packaging. However, for widespread industrial adoption, optimized formulations and ecoefficient production techniques are essential.

Food Allergens

Food Allergy: Begin at the Skin, End at the Mast Cell?

Nicholas W. Lukacs, Simon P. Hogan. *Nat. Reviews Immunology*, 26 June 2025. doi.org/10.1038/s41577-025-01185-y. Article link

Food allergy is an acute IgE-mediated reaction that occurs in response to food components and affects 1–10% of the global population. It is often thought to be a disease of the gastrointestinal tract, in which oral exposure to a food allergen induces an IgE-sensitizing response that primes the host immune system to react to the eliciting allergen following subsequent oral exposure. However, emerging evidence from clinical and basic research studies suggests that

maladaptive immune responses in the skin also contribute to the development of food allergy. These responses can promote the development of food-specific IgE and reshape the gut immune microenvironment in a manner that predisposes to IgE-mediated activation of mast cells and clinical manifestations of allergic disease following subsequent food exposures. In this Review, we discuss how different routes of exposure to food antigens can contribute to allergic sensitization and describe how mast cells ultimately drive the allergic reaction to these food allergens.

Emerging Science Areas

Emerging Science Topic: Categorizing Drivers of Change

Categorization of Drivers of Change for Emerging Food Safety Risks

N.M.C. Hommels, M.C.M. Mourits, M. Focker, H.J. van der Fels-Klerx. *Curr. Res in Food Sci*, Vol. 10, 6 June 2025. doi.org/10.1016/j.crfs.2025.101098. Article link

The emergence of food safety risks can be influenced by various causes, also known as drivers of change. Understanding the characteristics related to the manageability of these drivers and the health impact of their associated hazards is critical for effective food safety management and resource allocation. This study aims to categorize drivers of change for known food safety hazards based on their impact on human health and their manageability. Identified drivers were categorized and ranked through an expert survey and a PROMETHEE multi-criteria analysis. The weighted performance criteria are controllability and volatility of the driver, and likelihood and severity of the associated hazards. Results show that the severity of associated hazards is the most important criterion, while volatility of the driver is considered least important by experts. All drivers of change were ranked based on their potential impact on food safety and categorized in a driver matrix with four categories. Categorization is based on the combined effect of expected negative health impact (low or high) and manageability (difficult or easy). The four categories are: “monitor and adapt” (low, difficult), “analyze and optimize” (low, easy), “leverage and innovate” (high, easy), and finally “strategize and endure” (high, difficult). Two drivers—environmental contamination and geopolitical conflict—are categorized as difficult to manage and associated with highly likely and severe health consequences. These drivers represent critical challenges requiring long-term strategic efforts. Six drivers are highly manageable (low health impact: legislation, policies and governance, technologies in food production, food processing technologies; high impact: management of natural resources, bioprocesses, supply chain) and could be leveraged to influence food safety hazards. The results are shown to be robust against changes in criteria weighting. These findings can support decision makers in shifting focus toward manageable drivers and tailoring strategies by driver category. For effective action, it is essential to understand the specific risks and benefits of each driver and the burden of their associated hazards. Future work should explore the top-ranked drivers and integrate these insights into holistic food safety management strategies.

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