Chapter 2
Invisible Threats on the Plate:
Detecting Emerging Contaminants in Food

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ABSTRACT

Emerging food contaminants have gained significant attention due to their potential adverse effects on human health and the environment. This paper focuses on three critical categories of emerging contaminants: microplastics, per- and polyfluoroalkyl substances (PFAS), and pharmaceutical residues. Microplastics are ubiquitous in the environment and can enter the food chain, posing risks to aquatic organisms and potentially human consumers. PFAS, often referred to as "forever chemicals," are persistent in the environment and have been linked to various health issues, leading to their classification as emerging pollutants. Additionally, pharmaceutical residues, stemming from agricultural runoff and wastewater discharge, are increasingly found in food matrices, raising concerns about their impact on food safety. This review aims

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to synthesize current knowledge on the occurrence, pathways, impacts, and detection techniques for these contaminants, highlighting the urgent need for effective risk management strategies to mitigate their effects on food systems and public health.

1. INTRODUCTION TO FOOD CONTAMINANTS

Food safety is an ever-present concern for our societies. Foodborne diseases are responsible for about 420,000 deaths in the world annually with an economic burden of approximately 110 million diseases each year (Green 2022). Governments implement exhaustive monitoring systems to guarantee foodborne diseases do not pose a health threat to the public. To this aim, actions are enforced to reduce or eliminate foodborne pathogens both by the consumer, through proper food handling, and food producers, by complying with directives regarding hygiene practices at all stages of food production. However, the presence of food contaminants is another important aspect to be taken into consideration when assessing food safety, because it goes beyond the mere presence of pathogens, that if overcome should guarantee food safety. Food safety can be compromised by any chemical agent, such as a food contaminant, that may cause food to undergo a biochemical degradation process or alter its composition in such a way that there is an unwanted change in organoleptic characteristics or risk for human health, in particular, through the development of cancer or other chronic pathological conditions. While the absorption of hazardous substances, from highly polluted land, by plants and animals is the origin of classical food contaminants (Angon et al., 2024), such as metals, such substances can also be released into food through processing from packaging materials, by migration processes, and thus also form important classes of food contaminants, known as packaging migrants. However, the presence of compounds in food, which were not added intentionally by the manufacturer throughout the entire production process (Table 1), does not imply a strict relationship with food safety violations. In other words, the presence of food contaminants does not mean that the food does not satisfy legal safety limits or is of poor quality. Nonetheless, the recent increased media coverage regarding the presence of emerging food contaminants, such as microplastics, PFAS, and pharmaceutical residues, has highlighted their occurrence in food and proposed that governments should implement comprehensive monitoring strategies for these compounds to guarantee food safety since their presence in food should not be neglected (Lee et al., 2025).