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Editorial

Food Quality and Safety: Advances in Analytical Methods and Applications

Angela Sorbo [1,*], Claudia Zoani [2] and Daniele Passeri [3,4]

[1] Department of Food Safety, Nutrition and Veterinary Public Health, Istituto Superiore di Sanità (ISS), Viale Regina Elena 299, 00161 Rome, Italy
[2] ENEA—Italian National Agency for New Technologies, Energy and Sustainable Economic Development, Department for Sustainability, Biotechnology and Agroindustry Division (SSPT-BIOAG)—Casaccia Research Centre, Via Anguillarese 301, 00123 Rome, Italy; claudia.zoani@enea.it
[3] Department of Basic and Applied Sciences for Engineering, Sapienza University of Rome, Via A. Scarpa 16, 00161 Rome, Italy; daniele.passeri@uniroma1.it
[4] Research Center for Nanotechnology Applied to Engineering (CNIS), Sapienza University of Rome, Piazzale A. Moro 5, 00185 Rome, Italy
* Correspondence: angela.sorbo@iss.it

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1. Introduction

Over the past decade, the global food supply has continued to grow in volume and complexity to meet new markets and the increase in global food demands [1]. By 2050, the global food demand will have doubled, partly due to the increased consumption of foods of animal origin and protein-rich foods and changes in dietary habits [2]. As a result, agri-food supply chains are expanding and have become longer and more fragmented. This leads to greater complexity for all actors in the food supply chain who must guarantee the origin, traceability, quality and safety of products at all stages of the supply chain and address the growing amount of economic food fraud and food supply terrorism [3,4].

Unsafe food is both a risk to consumer health and a limiting factor for the socio-economic development of countries [5,6]. In order to avoid food safety and quality risks, all participants involved in the food supply chain should assess the quality and safety characteristics of a product, its origin, the legal requirements and the compliance with the parameters laid down in the manufacturer's declaration, as well as the safety of materials in contact with food both in the processing and packaging stages. For all these reasons, assessing food safety and quality is nowadays a key area in global policy [7–13]. The need to protect the health of the consumer, maintain consumer confidence in the integrity of the products, respect commercial standards and, above all, direct the food industry towards more sustainable processes and products are the key drivers of these policies [14].

The need to protect public health is leading to increasingly stringent legislation that, in some cases, requires a lowering of the limits allowed for certain substances in foods, such as cadmium and lead [15,16]; persistent organic pollutants (POPs), such as pesticides (i.e., DDT), industrial chemicals (i.e., polychlorinated biphenyls, PCBs) and unintentional by-products of industrial processes (i.e., dioxins and furans) [17]; BPA released from materials in contact with food [18] and others. On the other hand, there is a need to develop new and increasingly sensitive methods for the determination of substances and contaminants at trace-level concentrations.

Furthermore, from the perspective of a circular economy [19], other global challenges are affecting food quality and safety, such as climate change [20–22], excessive use of natural resources and environmental pollution [23–25], food fraud [26], emerging contaminants [27], microorganisms [28], changes in production processes [29], the introduction of novel foods [25,30], the use of upcycled ingredients [31], the use of food waste and by-products to extract high value-added molecules [32] for use as food additives [33] and challenges related to the cosmetics industry [34].

In addition, awareness of the contribution of nutrition to the overall health of individuals is a driving force for new studies that encourage integrated approaches, e.g., foodomics [35], or non-destructive tools to improve consumer well-being, health [36], education and confidence [37–40].

These are further reasons why the development of new analytical methods and devices to support food quality and safety and the authenticity, traceability and sustainability of the whole food supply chain, as well as the development of tools for early diagnosis and new techniques for extracting high value-added molecules using "green" extraction technologies, are necessary and urgent. The availability of reliable analytical methods and devices to be applied in food quality and safety studies and monitoring can further support national and regional development, trade and public health decisions, as well as contribute to nutrition education. Furthermore, it can support the practical realization of the "One Health" approach, taking into account the unbreakable links between human health, animal health and environmental health [41] and considering the impacts and close relations with agri-food systems, food production and consumption and the environment.

2. Summary of the Special Issue

The papers published in the Special Issue primarily address different analytical aspects related to the assessment of food quality and safety.

The Special Issue is "virtually" open by a review on metrological issues and regulation in the European Union with a specific focus on contaminants such as mycotoxins [42], contaminants of emerging concern [43], nanomaterials [44], official controls of process contaminants [45], metrology for food safety (e.g., method validation), proficiency testing [46,47], reference materials [48] and illustrating the METROFOOD-RI [49].

Ref. [50] focused their attention on the analysis of the release of 40 different inorganic elements, phthalates and bisphenol A into water from reusable bottles. Indeed, reusable water bottles have been gaining constantly increasing popularity as they undoubtedly are more environmentally friendly than single-use plastic bottles [51]. Thus, an assessment of the possible release of such elements and compounds into the water contained in such bottles is of primary importance. Notably, on the basis of an experiment simulating their real use, the authors found no release of phtalates and bisphenol A, while a certain amount of some inorganic elements was found, evidencing the need for further studies and calling for caution, especially for highly susceptible populations, e.g., infants, children and pregnant women.

The use of some kind of pesticides in agriculture is a major source of concern due to the possibility of contamination of fruits and vegetables, leading to human exposure. Therefore, the development of methods for their detection in products intended for human consumption is a topic of the outmost importance. Ref. [52] reported on the development and validation of a new, rapid and cost-effective pre-processing method for the determination of pyrethroid pesticides in vegetables. Beyond the case studies reported in the paper, the proposed approach is promising for routine analyses of a broad range of pesticides in different matrices. Ref. [53] reported the use of metal organic frameworks in dispersive solid-phase microextraction of carbaryl (a carcinogenic pesticide) in vegetable, fruit and water samples.

The extraction of bioactive compounds to be used as additives is a hot topic in the food sector, as well as the cosmetic, medical and pharmacolgical sectors. Ref. [54] provided a comprehensive review of the use of deep eutectic solvents (DES) for the extraction of several bioactive compounds, highlighting their advantages over conventional solvents, including their lower toxicity, higher eco-friendliness and biodegradability, and their potential for use in safe extraction processes and in applications in the food sector. Analyses of oil extraction procedures and extracts obtained from them are presented, focusing either on *Irvingia gabonensis*, a tree which can be found in the forests of central and western Africa [55]; *Moringa oleifera*, a plant native to India and Pakistan but that is nowadays widespread in the tropical and equatorial zones of the Earth [56]; or *Amaranthus cruentus*, a plant cultivated in many countries on the American, Asian and African continents [57]. Ref. [58] reported the analysis of dried sour cherry extracts (*Prunus cerasus* L.), a fruit with well-known health properties [59], in order assess the effect of different process parameters on maximizing the obtained content of phytochemicals, polyphenols and anthocyanins.

The continuous increase in the world's population requires the identification of new, relatively cheap, safe and sustainable protein sources. Ref. [60] reviewed the methodologies of single cell protein production from microorganisms from fruit waste nutrients and their potential applications. This method represents a promising approach both to reduce pollution and to provide protein supplements.

The development of analytical methods to quantify the presence of natural phenols and phenolic acids in fruit and vegetables has attracted great interest, as these compounds have beneficial effects on human health. Ref. [61] developed and validated a method for the determination of different aromatic carboxylic acids and phenols in fruit juices using gas chromatography coupled with mass spectrometry (GC–MS). The developed method was used to analyze different fruit juices selected from among those known to be richest in phenolic compounds. The assessment of food integrity and quality also requires the development of suitable analytical methods. Ref. [62] developed a method based on real-time PCR assays with high-resolution melting analyses to identify meat products. The method was demonstrated on both raw and cooked minced meat, either from a single animal species or a mixture of two different species, indicating that it is a promising tool for the detection of meat fraud. Among the methods for assessing food authenticity, ref. [63] reviewed the application of nuclear magnetic resonance (NMR) spectroscopy coupled with multivariate statistical analyses as a powerful technique for food traceability, focusing in particular on the effect of the year, cultivar and seasonal period in the determination of the geographical origin of food.

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