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Editorial

Analysis of Contaminants and Residues in Food

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The food supply chain contains several steps that start with the farm and end with the forks of consumers. Within this chain, pesticide application, veterinary drug administration, environmental and storage conditions, process-induced changes, formation of undesired and toxic compounds, use of food additives, and final food packaging materials can potentially contaminate the food (either intentionally or non-intentionally), and hazardous chemical substances or their residues may end up in the final food product. Hence, there is a strong need for suitable and reliable analytical methods for the detection and quantitative analysis of all these targeted analytes.

Contaminants in food can contain a vast variety of chemical compounds belonging to several chemical groups. In these groups, different chemicals can be included, such as inorganic elements or compounds (e.g., oxides), allergens, antibiotics in food and animal products, food additives and colorants, mycotoxins, pesticides, polyaromatic hydrocarbons (PAH), process-induced changes and oxidation products, as well as food contact materials (FCM). The importance of studying, analyzing, identifying, and quantifying the aforementioned groups of compounds is of high importance, as there are cases that might be related to endocrine-disrupting activity or potential toxicity [1,2].

Certain chemical contaminants can be considered quite ubiquitous in the environment (air, soil, water) and then plants, fruits, and vegetables, which eventually will be transferred to humans. Currently there is a perception that organically grown and cultivated foods are of better quality, healthier, and more nutritious compared to conventional foods. However, the presence of heavy metals is always of concern, either in the environmental or food chemistry, independently of climate or agrotechnical conditions [3]. In terms of methodology, apart from atomic absorption spectroscopy (AAS), validated methodologies of Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES) and Inductively Coupled Plasma Mass Spectrometry (ICP-MS) are of the highest efficiency.

In addition to vegetables, seaweed is considered to be a potential alternative source of protein [4], although it has a great tendency to absorb or store heavy metals from the marine environment. In this framework, it is very important the development of appropriate analytical methodologies, not only heavy metals but for contaminants overall.

Apart from more applied sample preparation techniques, new techniques using zeolite H-beta, as a material for dispersive solid phase extraction (d-SPE) protocols, which represent a significant advancement of the basic SPE methodology, are also being performed for the analysis of pesticides, as well as insecticides, in combination with liquid chromatography triple-quadrupole mass spectrometry (LC-QQQ-MS) [5]. The d-SPE, or the so-called QuEChERS, is a sample preparation that represents a reference method in case of pesticide residues analysis, mainly via combined MS [6]. Another state-of-the-art sample preparation technique for pesticide analysis is microwave-assisted extraction (MAE). It is related to high efficiency and extraction yields and can also be combined with LC-QQQ-MS. [7]. Of particular interest is the analysis of bisphenol A (BPA). Recently, the European Food Safety

Authority (EFSA) published an opinion regarding the re-evaluation of the risks of BPA in food. In this opinion, a considerably lower tolerable daily intake (TDI) of 0.04 ng/kg of body weight per day is proposed [8]. The latter highlights the importance of state-of-the-art methodologies and analytical methods with appropriate sample preparation, as well as the use of high-resolution mass spectrometry (HR-MS; Orbitrap MS) [6].

Also in relation to BPA, nucleating clarifying agents are another class of substances of interest very commonly used for the production of polymers to improve their physical properties and improve their clarity and transparency [9] following the Commission Regulation (EU) No. 10/2011 [10]. However, limited analytical methods are available at the moment for this group of chemicals. Sorbitol-based compounds, among other regulated FCM substances, present limited solubility, which in the end can create problems for their quantification [11], also indicating challenges for their chemical identification and elucidation.

Safety requirements for an increasing number of chemicals existing in FCM are highlighting and triggering the need for an efficient screening strategy to prioritize the substances of highest concern and even more so the harmonization of chemical analysis, identification, elucidation, and quantification of multiple compounds from food contact materials. The latter requires the combination of hyphenated techniques, in conjunction with HR-MS, together with the development, integration, and use of appropriate mass spectra databases, together with quantitative or semi-quantitative strategies. The latter can be considered very important, either in cases of IAS or NIAS, where no mass spectra databases are available nor analytical standards or compounds with a known purity are available.

This Special Issue in *Applied Sciences* focuses on all these challenges and highlights existing analytical approaches, new trends, research work, and perspectives.

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