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Editorial

Analysis of Chemical Biomarkers and Contaminants in Food

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The quality of food has become of great importance and relevance in recent years, not only for scientific communities but also for ordinary people. Many research papers are centered around the issue of quality control with regard to the presence of contaminants in foods. Additionally, the recognition of a biomarker, intended as a biological characteristic measured and evaluated as an indicator of biological processes (normal, pathogenic, or pharmacological), plays a key role in quality control. Chemical biomarkers present in food are molecular entities of different origins. They may be present in the animal or vegetal material, exogenously, endogenously or endogenously transformed by metabolism from exogenous sources. Exogenous biomarkers can coincide with contaminants.

The identification and measurement of contaminants and biomarkers are achievable with food chemical analysis based on many analytical methods, from immunoassay detection to mass spectrometry evaluation. The qualitative and, above all, quantitative chemical methods applied to food matrices are useful for determining the threshold of contaminants that could have an adverse effect on public health.

Here, we propose a Special Issue of *Applied Sciences* to present a limited but remarkable number of researches regarding the identification and quantitation of contaminants and biomarkers in food. The main technique used is mass spectrometry (MS), coupled with gas or liquid chromatography (GC or LC), respectively. This technology allows one to quantify even traces of targeted analytes and to identify and characterize untargeted molecules. Many chemical compounds could be analyzed with mass spectrometry, from volatile substances (GC-MS) to proteins (LC-MS), or from heterocyclic and organic aromatic contaminants to highly polar substances. Five out of six research papers presented in the Special Issue achieved their goals using MS, even high-resolution MS.

However, MS is not the only suitable technique to perform analysis on food contaminants and biomarkers. Immunoassay-based devices take up a large part of food analysis, reaching very low limits of detection and quantitation.

Several food matrices were analyzed during the studies presented in this issue: hazelnuts, meats, milk (bovine and human), and water.

Summarily, this Special Issue includes six high quality research papers concerning:

- The study of the metabolome of raw and roasted hazelnuts harvested in Italy (Piedmont) and Georgia [1]. The comparison was achieved applied an innovative analytical method based on two-dimensional gas chromatography coupled with fast-scanning quadrupole mass spectrometry (GC×GC-qMS) in untargeted and targeted approaches. The data acquired were compared statistically with principal component analysis that highlighted the variations in the metabolome of raw and roasted hazelnuts.
- The validation of an analytical HPLC–UV–MS method applied to food and biological matrices for the quantitation of 16 phytoestrogens [2]. These molecules are plant metabolites and their consumption was associated with a lower probability of developing cancer or cardiovascular diseases. The method was successfully applied to highly consumed food items from North Mexico and biofluids from healthy women.
- The development of a new immunoassay device based on lateral flow for the detection of myoglobin as a specific biomarker of porcine muscle tissue [3]. The developed

technology showed a very low limit of detection of 5 ng/mL, and the applications of the method concerned the possibility of controlling the quality of the meat products. A deep investigation of the physical and chemical properties of the monoclonal antibodies and of extraction procedures was carried out. Finally, the developed lateral flow immunoassay was used to quantify myoglobin in some meat samples fortified with an increased amount of myoglobin, obtaining a satisfactory reproducibility and sensitivity.

- The development of an analytical method based on nano-high performance liquid chromatography (nanoHPLC) coupled with high-resolution mass spectrometry (HRMS) to detect trace levels of leptin in milk samples [4]. Leptin is a fundamental protein related to adipose tissue and food intake, and it was demonstrated that its intake during the early lactation period diminished the probability of developing infant obesity. The method showed good sensitivity and selectivity and applied to human breast milk detected trace levels of leptin (6.70 ng/mL) without the use of radioactive reagents.
- The investigation of acetaldehyde residues in polyethylene terephthalate bottled water using a method based on head-space solid-phase micro-extraction (SPME), isotopic dilution and gas chromatography–mass spectrometry (GC-MS) analysis [5]. The authors analyzed 104 samples of polyethylene terephthalate (PET) bottles collected in Italy from 24 producers. The levels of acetaldehyde varied very much through the samples in a range from 0.41 to 76.2 µg/L. However, the research concluded that the measured levels of acetaldehyde did not pose a risk to human health.
- The determination and quantitation of 16 polycyclic aromatic hydrocarbons by GC-MS in a traditional smoked ham produced in Croatia [6]. Mastanjevic and co-workers analyzed 30 samples from a local market to evaluate the distribution of potentially cancerogenic molecules and to compare the use of different type of woods in this distribution.

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