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Editorial

Special Issue: Food Safety Management and Quality Control Techniques

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The use of quality control methods is essential to guaranteeing food safety. Given the recent safety issues in the global food supply chain, the development of rapid, accurate, and sophisticated approaches is crucial for food safety management. Food safety and quality have been assessed using a variety of analytical techniques, including elemental analysis [1], microbiological analysis [2], chromatography [3–5], spectroscopy [6], mass spectrometry [7,8], physical property analysis [9], and molecular biology procedures [10,11]. Recently, the utilization of artificial intelligence (AI) in food safety management has received much attention [12,13]. It would be interesting to clarify the change in the efficiency of traditional food control techniques after employing AI. The current Special Issue of *Processes*, "Food Safety Management and Quality Control Techniques", includes two review papers and eight research articles that focus on the above-mentioned techniques and issues. Each of these contributions is briefly introduced below:

Ismail et al. used a hierarchical scoring scheme to clarify the effects of pre-treatment and temperature on the quality of rice noodles subjected to hot air drying, heat pump drying, and freeze drying [14]. The results showed that rice noodles that underwent hot air drying at 30 °C produced comparable quality attributes, including texture, color, oil content, and starch gelatinization, to freeze-dried rice noodles. This also indicated that hierarchical scoring is a useful tool in quality determination for the food industry.

Ting's research group developed a pressure-processed phospholipid nanoemulsion that can increase the storage stability of pterostilbene, a health-promoting phytochemical, suggesting that nanoencapsulation is a good approach for controlling the quality of phytochemicals [15]. Nanoencapsulation also increases the bioavailability of pterostilbene, which may enhance its health-promoting effects.

Huang et al. established a C2C12 cell model of fluoxetine-induced muscle atrophy, the molecular mechanism of which focused on hypertrophy and protein break signals [16]. This model can be utilized for the quality control of nutraceuticals aimed at preventing atrophy.

Gvozdanović et al. found that the on-farm rest period significantly affected carcass composition, meat quality traits, and stress levels in culled sows [17]. Their results indicate that the rest period positively impacts pH, drip loss, thawing loss, cooking loss, and tenderness of the meat, as well as the dressing percentage, backfat thickness, and shoulder weight and percentage of the carcass. Furthermore, extended rest periods show beneficial effects on stress indicator levels. These findings can be applied to the quality and safety control of pork sourced from culled sows.

Aflatoxins are highly concerning food toxins with potent carcinogenic and immunosuppressive properties. Hellany et al. investigated the contamination of aflatoxin B1 and related toxigenic strains in shelled and unshelled pistachios, peanuts, and walnuts from the Lebanese market. The results showed aflatoxin B1 contamination in 43.8% of the samples, with concentrations ranging from 0.4 to 25 μg/kg (maximum tolerable limits for aflatoxin B1 in Lebanon: 2 and 8 μg/kg), and the highest contamination rate was found in shelled pistachios [18]. This information can serve as a reference for improving aflatoxin specifications in Lebanese food products.

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Karami et al. used an electronic nose equipped with eight metal oxide sensors for identifying adulteration and additives in lemon juice. The data were further trained by linear discrimination analysis (LDA), support vector machines (SVMs), and artificial neural networks (ANNs). The Nu-SVM linear function method was found to show the highest accuracy among all models [19]. Therefore, an electronic nose combined with chemometric methods can be an effective approach for the rapid classification of pure lemon juice and its counterfeits, and can be used for lemon juice authentication in food safety management.

Ku's research group developed an APPD model for planting edible mint in an office. This quality control technique for food materials can enable people to effectively control the growth of agricultural products in home plantings [20]. In addition, Ku et al. proposed an IF4BT platform with convenience, consistency, effectiveness, scalability, and lightweight computing for the quality and safety control of bubble tea [21]. This technique can be further applied to ensure food safety, enhance food protection, and prevent allergen cross-contamination, food expiration, and food fraud.

Qiao et al. summarized a series of sensors and biosensors utilized with nanomaterials for food safety sensing, which included optical sensors and biosensors (colorimetric sensors and biosensors, fluorescence sensors and biosensors, and surface plasmon resonance sensors and biosensors), electrochemical sensors and biosensors (impedance sensors and biosensors, voltammetry sensors and biosensors, and potentiometric sensors and biosensors), and mobile sensors and biosensors (smartphone-based optical biosensors and smartphone-based electrochemical biosensors) [22]. This review is useful for the development of food quality and safety control techniques.

Jelali and Papadopoulos comprehensively introduced the microwave/terahertz technology-based inline inspection of packaged food such as chocolates, cookies, pastries, cakes, and similar confectionery products for food quality control and assessment, as well as the latest developments in this field. Notably, this review also highlights emerging research topics and potential possibilities for future applications of electromagnetic systems in the food industry, as well as providing a current overview of industrial products and system prototypes [23].

In conclusion, the articles presented in this Special Issue provide valuable insights into food quality and safety aspects. They explore innovative tools for determining food quality, propose advanced approaches and models for the quality control of nutraceuticals and phytochemicals, and suggest strategies to improve pork meat quality. Additionally, these articles highlight the application of AI platforms in quality control for small-scale plantings and the safety management of cold beverages. The review articles published in this issue comprehensively summarize the potential of nanomaterial-based sensors and microwave/terahertz technologies for inline food inspection. Collectively, these contributions can support the development of better food quality and safety systems.

Conflicts of Interest: The author declares no conflict of interest.

References

1. Ibourki, M.; Hallouch, O.; Devkota, K.; Guillaume, D.; Hirich, A.; Gharby, S. Elemental analysis in food: An overview. *J. Food Compos. Anal.* **2023**, *120*, 105330. [CrossRef]
2. Kumar, V.; Ahire, J.J.; Taneja, N.K. Advancing microbial food safety and hazard analysis through predictive mathematical modeling. *Microbe* **2024**, *2*, 100049. [CrossRef]
3. Nie, Q.; Nie, S. 13—High-performance liquid chromatography for food quality evaluation. In *Evaluation Technologies for Food Quality*; Zhong, J., Wang, X., Eds.; Woodhead Publishing: Sawston, UK, 2019; pp. 267–299. [CrossRef]
4. Lehotay, S.J.; Hajšlová, J. Application of gas chromatography in food analysis. *TrAC Trends Anal. Chem.* **2002**, *21*, 686–697. [CrossRef]
5. Bhogal, S.; Grover, A.; Mohiuddin, I. A Review of the Analysis of Phthalates by Gas Chromatography in Aqueous and Food Matrices. *Crit. Rev. Anal. Chem.* **2023**, 1–25. [CrossRef] [PubMed]
6. Qu, J.H.; Liu, D.; Cheng, J.H.; Sun, D.W.; Ma, J.; Pu, H.; Zeng, X.A. Applications of near-infrared spectroscopy in food safety evaluation and control: A review of recent research advances. *Crit. Rev. Food Sci. Nutr.* **2015**, *55*, 1939–1954. [CrossRef]
7. Chiang, C.-F.; Liao, P.-L.; Hsu, K.-C.; Shen, J.-Y.; Lin, J.-T.; Yang, D.-J. Establishment of optimal QuEChERS conditions of various food matrices for rapid measurement of heterocyclic amines in various foods. *Food Chem.* **2022**, *380*, 132184. [CrossRef]

8. Malik, A.K.; Blasco, C.; Picó, Y. Liquid chromatography-mass spectrometry in food safety. *J. Chromatogr. A* **2010**, *1217*, 4018–4040. [CrossRef]
9. Sarkar, T.; Salauddin, M.; Kirtonia, K.; Pati, S.; Rebezov, M.; Khayrullin, M.; Panasenko, S.; Tretyak, L.; Temerbayeva, M.; Kapustina, N.; et al. A Review on the Commonly Used Methods for Analysis of Physical Properties of Food Materials. *Appl. Sci.* **2022**, *12*, 2004. [CrossRef]
10. Lauri, A.; Mariani, P.O. Potentials and limitations of molecular diagnostic methods in food safety. *Genes Nutr.* **2009**, *4*, 1–12. [CrossRef]
11. Liu, C.; Su, M.; Champ, V.D.; Gupta, S. Validation Procedures for Quantification of Food Allergens by Enzyme-Linked Immunosorbent Assay (ELISA). *Methods Mol. Biol.* **2024**, *2717*, 285–304. [CrossRef]
12. Liu, Z.; Wang, S.; Zhang, Y.; Feng, Y.; Liu, J.; Zhu, H. Artificial Intelligence in Food Safety: A Decade Review and Bibliometric Analysis. *Foods* **2023**, *12*, 1242. [CrossRef] [PubMed]
13. Kudashkina, K.; Corradini, M.G.; Thirunathan, P.; Yada, R.Y.; Fraser, E.D.G. Artificial Intelligence technology in food safety: A behavioral approach. *Trends Food Sci. Technol.* **2022**, *123*, 376–381. [CrossRef]
14. Ismail, M.H.; Lik, H.C.; Routray, W.; Woo, M.W. Determining the Effect of Pre-Treatment in Rice Noodle Quality Subjected to Dehydration through Hierarchical Scoring. *Processes* **2021**, *9*, 1309. [CrossRef]
15. Sun, F.-M.; Chou, Y.-J.; Huang, Q.; Hu, J.-Y.; Ting, Y. Making Concentrated Pterostilbene Highly Bioavailable in Pressure Processed Phospholipid Nanoemulsion. *Processes* **2021**, *9*, 294. [CrossRef]
16. Huang, S.-M.; Lin, S.-Y.; Chen, M.-K.; Peng, C.-C.; Hsieh, C.-L. Effects of Geniposide and Geniposidic Acid on Fluoxetine-Induced Muscle Atrophy in C2C12 Cells. *Processes* **2021**, *9*, 1649. [CrossRef]
17. Gvozdanović, K.; Djurkin Kušec, I.; Đidara, M.; Blažetić, S.; Komlenić, M.; Kuterovac, K.; Radišić, Ž.; Kušec, G. Changes in Carcass Composition, Meat Quality Traits, and Stress Levels in Culled Sows Exposed to Different On-Farm Rest Periods. *Processes* **2023**, *11*, 1961. [CrossRef]
18. Hellany, H.; Assaf, J.C.; Matta, J.; Khalil, M.I. Fungal Isolation, Detection, and Quantification of Aflatoxins in Nuts Sold in the Lebanese Market. *Processes* **2024**, *12*, 1018. [CrossRef]
19. Mohammadian, N.; Ziaiifar, A.M.; Mirzaee-Ghaleh, E.; Kashaninejad, M.; Karami, H. Nondestructive Technique for Identifying Adulteration and Additives in Lemon Juice Based on Analyzing Volatile Organic Compounds (VOCs). *Processes* **2023**, *11*, 1531. [CrossRef]
20. Ku, H.-H.; Liu, C.-H.; Wang, W.-C. Design of an Artificial Intelligence of Things Based Indoor Planting Model for Mentha Spicata. *Processes* **2022**, *10*, 116. [CrossRef]
21. Ku, H.-H.; Chi, C.-H.; Ling, M.-P. Design of an IOTA Tangle-Based Intelligent Food Safety Service Platform for Bubble Tea. *Processes* **2021**, *9*, 1937. [CrossRef]
22. Qiao, X.; He, J.; Yang, R.; Li, Y.; Chen, G.; Xiao, S.; Huang, B.; Yuan, Y.; Sheng, Q.; Yue, T. Recent Advances in Nanomaterial-Based Sensing for Food Safety Analysis. *Processes* **2022**, *10*, 2576. [CrossRef]
23. Jelali, M.; Papadopoulos, K. Inline Inspection of Packaged Food Using Microwave/Terahertz Sensing—An Overview with Focus on Confectionery Products. *Processes* **2024**, *12*, 712. [CrossRef]