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Editorial: Emerging non-thermal technology applications for sustainable food processing

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Editorial on the Research Topic
Emerging non-thermal technology applications for sustainable food processing

Nonthermal technologies refer to methods of food processing that do not rely on high temperatures and are considered emerging technologies in the food industry because of their potential to enhance food safety, quality, and sustainability. These technologies are gaining popularity due to their ability to maintain the nutritional and sensory properties of food, while also reducing energy consumption and minimizing the environmental impact of food production. The food industry is constantly seeking innovative ways to improve food processing techniques, and nonthermal technologies are becoming increasingly important in this regard. These technologies include high-pressure processing, pulsed electric fields, ultrasound, cold plasma, UV radiation (UV-C), ozone and irradiation. In this Research Topic, some of these "*Emerging non-thermal technology applications in sustainable food processing*" are presented.

High-pressure processing (HPP) is a nonthermal technology that uses high pressure to inactivate microorganisms and enzymes in food products. HPP has a minimal impact on the nutritional and sensory properties of food, making it an attractive alternative to traditional thermal processing methods. HPP is commonly used in the processing of ready-to-eat foods, such as salads, meats, and seafood, to extend their shelf life and improve safety. HPP has also been used to extract valuable compounds from fruits and vegetables, such as antioxidants and vitamins, which can be used in functional food products. A research work on "*Impact of High-Pressure Treatment on Amino Acid Profile, Fatty Acid Compositions, and Texture of Yellowfin Seabream (Acanthopagrus arabicus) Filets* (Ahmed et al.)" described the optimization of the pressure–time combination for the inactivation of *Listeria monocytogenes* in fish medium using a wide range of pressure (225–525 MPa) and holding time (5–30 min). This work also indicated that HPP treatment can be utilized to maintain the nutritional quality of seabream filets; however, further research is needed to maintain the visual color of the fish. Another research article on "*Synergistic effect of UV-C irradiation and high-pressure processing in reducing microbial load in "Nanglae" pineapple juice compared to conventional heat treatment* (Suthiluk et al.)" investigated the effect of combining UV-C and HPP (UV-C + HPP) treatments on microbial loads and

quality of "Nanglae" pineapple juice during cold storage at 5 ± 1°C for 91 days. Results of the work demonstrated that the combination of UV-C and HPP can ensure the safety of "Nanglae" pineapple juice while retaining bioactive compounds. Combining these two technologies could be a new approach to producing healthy and safe juices.

Ultrasound technology is another nonthermal processing method that uses high-frequency sound waves to disrupt the cellular structure of microorganisms in food products. This technology has been shown to reduce the number of microorganisms in liquid and semi-solid foods, such as milk, fruit juices, and sauces, while also preserving their nutritional and sensory properties. Ultrasound has also been used in the extraction of bioactive compounds from plant materials, such as essential oils, which can be used in food and beverage products. A research on "*Stability parameters during refrigerated storage and changes on the microstructure of orange-carrot blend juice processed by high-power ultrasound* (Lepaus et al.)" evaluated the effect of ultrasound treatments (40 kHz; 40, 50, or 60°C; 5 or 10 min) and thermal treatment (90°C; 30 s) on the stability parameters of orange-carrot juice. It was concluded that ultrasound processing improved the quality of juices and can be proposed as a potential novel processing technique for blended vegetable-fruit juices.

Nonthermal technologies offer several sustainability benefits compared to traditional thermal processing methods. These benefits include reduced energy consumption, decreased water usage, and reduced greenhouse gas emissions. Nonthermal technologies also reduce food waste by extending the shelf life of food products, which reduces the need for preservatives and additives. Additionally, these technologies allow for the production of high-quality food products that maintain their nutritional and sensory properties, which can increase consumer demand and reduce food waste. In these aspects, an article on "*Non-thermal Processing Technologies for Dairy Products: Their Effect on Safety and Quality Characteristics* (Neokleous et al.)" reviewed various nonthermal technologies for dairy products and summed up that further studies should focus on the cost efficiency of the production, on ensuring the safety of food especially regarding inactivation of spores and informing the consumers about the advantages of these non-thermal technologies in order to accept them. Another combination of nonthermal processing technologies had been reviewed for "*Applications of water activated by ozone, electrolysis, or gas plasma for microbial decontamination of raw and processed meat* (Roobab et al.)" focused on novel means of electrochemically activate water that is being investigated as a sanitizing agent for carcasses and processing area decontamination during production or at the end. This review highlighted the efficacy of activated-water decontamination of raw and processed meat *via* non-thermal solutions.

Emerging nonthermal technology applications in sustainable food processing offer several advantages over traditional thermal processing methods. These technologies offer a promising way to improve food safety, quality, and sustainability while maintaining the nutritional and sensory properties of food. High-pressure processing, pulsed electric fields, ultrasound, and irradiation are some of the nonthermal technologies that are gaining popularity in the food industry. By adopting these technologies, the food industry can meet the growing demand for sustainable food products and reduce its impact on the environment. The research scope of emerging nonthermal technology applications for sustainable food processing is vast, and there is still much to be explored in terms of their potential applications and benefits. Future prospects include continued advancements in these technologies, such as the development of more efficient and cost-effective equipment, as well as further research into their impact on food safety, nutritional value, and sensory properties. As consumer demand for sustainable food products grows, the adoption of nonthermal technologies in the food industry is likely to increase, with potential for expanded applications in new areas such as plant-based proteins and alternative meat products.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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