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Editorial: Plant-based antimicrobials and their role in food safety

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Editorial on the Research Topic
Plant-based antimicrobials and their role in food safety

Access to safe and nutritious food is paramount for ensuring food sustainability. The widespread occurrence of foodborne pathogens is a significant global public health concern. The impact of foodborne diseases on public health and economies is often underappreciated due to the frequent underreporting of cases and the difficulty in establishing direct links between food contamination and resulting illnesses or fatalities (Abebe et al., 2020). A World Health Organization report found that foodborne diseases result in >600 million cases of illness and 420,000 deaths each year, with the highest burden falling on vulnerable populations, especially children under 5, the elderly, the immunocompromised, and low- and middle-income countries (World Health Organization, 2015). A World Bank report estimated that the economic impact of foodborne diseases in low- and middle-income countries is significant, resulting in an estimated productivity loss of US$95.2 billion annually and an estimated cost of US$15 billion for treating foodborne illnesses (World Bank, 2018).

Globally, the food industry is grappling with the issue of controlling foodborne pathogens and spoilage-causing microorganisms to maintain safety without compromising the nutritional and sensory characteristics of food. To mitigate this challenge, the food industry often rely on synthetic preservatives. However, the use of these traditional synthetic antimicrobials have faced criticism due to their potential negative impact on human health, organoleptic and nutritional properties of food and the environment. In addition, development of antimicrobial resistance to single compound antimicrobials is an emerging issue. There is a growing need to find safer and more sustainable solutions that not only guarantee food safety but also sustain the food supply chain for the future. This has led the researchers and food producers to shift their focus toward natural, plant-based preservatives. The use of natural, plant-based antimicrobials is seen as a more health-conscious and environment-friendly approach to food safety.

In this special issue, McClements et al. examine various plant-based preservatives that can be utilized in food, including essential oils (EOs) and their active constituents. EOs which are made up of a blend of compounds such as terpenes and phenylpropanoids compounds are becoming increasingly popular in the food industry due to their eco-friendly nature,

antimicrobial, anti-mycotoxin, and antioxidant properties. Another contribution by Maurya et al. aims to provide insights into the use of EOs as eco-friendly preservatives, with a focus on their antimicrobial mechanism of action.

The application of plant-based antimicrobials in food is often limited by their chemical instability, poor dispersibility and solubility in food matrices, potential negative interaction with food ingredients and overpowering sensory properties (Olszewska et al., 2020). Encapsulation technologies like emulsion-based systems are being developed to overcome these challenges. McClements et al. comprehensively discuss nanoemulsion-based technologies for delivering natural plant-based antimicrobials in foods, and how these nanoemulsions can be delivered effectively through the formulation of nanoemulsions. The authors have illustrated the utilization of nano-emulsified plant-based preservatives with specific examples in meat, fish, dairy, and fresh produce, highlighting their potential to enhance food quality and safety. Maurya et al. focus on advanced delivery approaches for consistent and effective application in the food sector including nanoencapsulation and the possibility of using EOs and different film-forming materials to develop the environmentally friendly way of ensuring food safety through active packaging of food products.

The effectiveness of plant-based antimicrobials in food preservation depends on several factors such as the type of plant extract used, the concentration of the extract, the method of application, and the intrinsic and extrinsic properties of the food being preserved. In this special issue, Das et al. examined the effect of cranberry pomace extract on different types of *E. coli* found in broiler chickens, either alone or in combination with an antibiotic (ceftriaxone). The researchers also looked at how these treatments affected the gene expression of a specific strain of *E. coli* that has been linked to urinary tract infections in humans and increased virulence in young chickens. The results of this study could contribute to the development of cranberry extracts as a cost-effective option for preventing the spread of multidrug-resistant bacteria in broiler chickens.

Yegin et al. have demonstrated in this special issue that encapsulating antimicrobials in a water-soluble system such as polymeric micelles can improve their efficacy. The study aimed to assess the effectiveness of antimicrobial-loaded nanoparticles in reducing the occurrence of *Escherichia coli* O157:H7 and *Salmonella enterica* serovar Typhimurium on spinach leaves in multiple simulated scenarios of pathogen contamination. The results showed that the treatment with encapsulated geraniol was highly effective in reducing both pathogens to undetectable levels, even after a second contamination event. These findings fill a crucial research gap by offering a novel and an effective solution to address enteric bacterial pathogens on spinach, even with multiple contamination events. This is a critical step in ensuring the safety of minimally processed edible produce.

The utilization of plant-based antimicrobials holds great promise in food preservation, but it is still in its early phase and needs further study. The scientific information on their overall safety such as toxicological data, presence of contaminants such as heavy metals and efficacy is lacking. To ensure safety and efficiency of these preservatives for consumers, regulatory bodies must establish clear guidelines for their use in food preservation. In some nations, these substances are classified as food additives and are monitored by agencies such as the FDA in the US and the EFSA in Europe. This makes it challenging for food producers to make informed decisions about using these substances.

In conclusion, plant-based antimicrobials offer effective, eco-friendly and consumer appealing alternatives to synthetic preservatives. To fully realize the potential of plant-based antimicrobials, it will be important for researchers to continue exploring new and innovative methods for improving their efficacy and applications. This will require a multidisciplinary approach that integrates the fields of food science, microbiology, toxicology, molecular biology, and nanotechnology. With the right investment of time and resources, it is likely that plant-based antimicrobials will play an increasingly important role in ensuring the safety and quality of our food supply in the years to come.

Author contributions

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

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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