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Editorial: Sustainable postharvest management practices for fresh produce

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Editorial on the Research Topic
Sustainable postharvest management practices for fresh produce

Food losses have huge environmental implications. Postharvest losses are not just the loss of food—it is the loss of water, energy, fuel, fertilizers, and many other resources. Food waste has a significant carbon footprint and makes a major contribution toward greenhouse gas emissions (Niu et al., 2022). Thus, developing sustainable and resilient food systems cannot be achieved without "arresting" postharvest food losses. The high perishability of horticultural fresh produce, particularly in underdeveloped and developing countries, requires pragmatic approaches to postharvest management. While various technologies have been developed to maintain quality and extend the shelf-life of fresh produce, the high costs and health complications associated with some postharvest techniques remain a major concern. The use of chemical treatments poses various threats both to consumers and the environment. There is a need for sustainable alternative treatments that are environmental-friendly and cost-effective. The articles in this Research Topic involve innovative methods and practices that can be employed to extend shelf-life and reduce losses along food handling, value and cold chain.

Green mold, caused by *Penicillium digitatum*, leads to serious economic losses at postharvest. It affects various fruits and vegetables, but it is more prevalent in citrus fruits—accounting for more than 90% of decay incidence (Cheng et al., 2020). The potential of UV-C irradiation as the postharvest treatment for controlling decay has been extensively studied (Mditshwa et al., 2017). In this Research Topic, the research of Phonyiam et al. evaluated the effect of UV-C irradiation on decay incidence caused by green mold in satsuma mandarin fruit. The research team found UV-C to be highly effective in suppressing the green mold incidence. The *in vivo* studies demonstrated that the efficacy of UV-C is linked to its ability to (i) maintain the cellular structure of the albedo tissues, (ii) reduce the levels of malondialdehyde, and (iii) promote the accumulation of jasmonic acid, total phenolics and flavonoids which strengthens the biochemical defense mechanisms of the treated fruit. Sripong et al. (2015) and Bambalele et al. (2021) also provided possible mechanisms used by UV-C to extend shelf-life and reduce decay incidence. Other studies have shown that UV-C elevates the expression of defense-related enzymes such as GLU and PAL, while it suppresses the respiration and ethylene-linked enzymes such as ACS and ACO (Sripong et al., 2015; George et al., 2016).

Chilling injury (CI) is an important physiological disorder largely affecting fresh produce from tropical and subtropical origins. The symptoms of CI include necrotic spots, pulp browning, and the affected produce becomes unmarketable. Affandi et al. conducted a study to investigate the role played by growth and storage temperatures on CI incidence in dwarf tomatoes. From the flowering stage, two tomatoes cultivars, "Ponchi Re" and "Tarzan", were kept 16, 22, or 28°C under controlled greenhouse conditions. At mature green stage, the tomatoes were harvested and stored at either 20°C for 20 days or 4°C for 15 days and thereafter stored at shelf-life conditions. Their findings showed that the susceptibility of fresh produce to CI is cultivar-dependent with "Tarzan" tomatoes showing higher incidence compared to "Ponchi Re". The research team also found that "Tarzan" tomatoes grown under low temperatures had higher membrane integrity and CI tolerance, however, "Ponchi Re" showed opposite results. In addition to postharvest technologies such as hot water treatments, 1-MCP, UV-C and edible coatings used to control CI (Zhang et al., 2021), this Research Topic suggests that preharvest growth factors, especially temperature, must be managed and regulated based on the specific cultivar requirements. Harvest maturity is another critical factor influencing fruit susceptibility to CI (Rai et al., 2022), and the sensitivity depends on fruit type and cultivar. Strong defense mechanisms against postharvest physiological, pathological and mechanical disorders can be developed through proper management of the crop in the field.

The drying of fresh produce is a commonly used postharvest technique for preserving quality and extending shelf-life. There are various drying techniques such as solar drying, vacuum during and ultrasound, with varying input costs and impact on the treated produce. In this Research Topic, Zahoor et al. assessed the response of chicory herb quality and biochemical attributes to microwave-assisted fluidized bed drying (MAFBD). Based on the tested models, the optimum microwave power, temperature and velocity of 462.3 W, 70°C and 15 m/s achieved the highest consumer desirability and higher concentrations of ascorbic acid, antioxidants, carotene and total phenolics. In terms of energy use, microwave drying is considered to be highly efficient compared to its counterparts such as conventional hot air drying, which is known for longer processing time and negative impact on quality (Hu et al., 2006; Lv et al., 2016). Considering the urgent need for developing economic and sustainable postharvest practices, the decarbonization of drying systems has become a topical issue in food research (Adnouni et al., 2022). Renewable energy-based systems with relatively shorter drying duration while offering superior quality should be explored.

The management of postharvest supply chains is pivotal in reducing food losses. To ensure uncompromised quality, every step must be carefully managed, from the farmgate to the packhouse to the consumer table. Le et al. conducted a comprehensive literature review on causes of quality loss along the mango fruit supply chains. They identified improper harvest maturity, packaging, storage, distribution and pre-treatments as the major contributors to postharvest losses. This research team also provided techniques that can be employed at critical stages of the supply chain. The research team proposed that harvest date should be selected based on well-established and tested maturity indexes. Postharvest treatments such as edible coatings, 1-MCP and hot water reduce respiration rate and ethylene production thereby extending the shelf-life (Khaliq et al., 2015; Bambalele et al., 2021). The packaging has to be well-designed in order to minimize mechanical damage during transportation. Moreover, the storage conditions must be constantly monitored to avoid storage temperature abuse during supply chain. In fact, the possibility of tracking respiration rate in real-time should be explored for highly perishable fresh produce.

The articles in this Research Topic highlight the critical role played by postharvest practices in reducing food losses. All the articles provided possible mechanisms used by the treatments to suppress the array of unwanted physiological changes and disorders. The postharvest practices discussed in this issue are cost-effective with relatively low energy requirements. All the research findings in this issue could be considered for food industry application, and also used as the basis for further investigation.

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.

Publisher's note

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