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Tackling Food Waste Challenge with Nanotechnology: Controllable Ripening via Metal Organic Framework

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Abstract : Ripening of climacteric fruits, such as bananas and avocados, are usually initiated days prior to the retail marketing. However, upon the onset of irreversible ripening, they undergo rapid spoilage if not consumed within a narrow climacteric time window. Controlled ripening of climacteric fruits is a critical step to provide consumers with high-quality products while reducing postharvest losses and food waste. There is a high demand for technologies that can retard the ripening process or enable accelerated ripening immediately before consumption. In this work, metal−organic framework (MOF) was developed as a solid porous matrix to encapsulate gaseous hormone, including ethylene, for subsequent application. The feasibility of the on-demand stimulated ripening of bananas and avocados is also evaluated. MOF was synthesized and loaded with ethylene gas. The MOF−ethylene was placed inside sealed containers with preclimacteric bananas and avocados and stored at 16 °C. The fruits were treated for 24-48 hours, and evaluated for ripening progress. Results indicate that MOF−ethylene treatment significantly accelerated the ripening-related changes of color and textural properties in treated bananas and avocados. The average ripening period for both avocados and bananas were reduced in half by using this method. No significant differences of quality characteristics at respective ripening stages were observed between produce ripened via MOF-ethylene versus exogenously supplied ethylene gas or endogenously produced ethylene. Solid MOF matrices could have multiple advantages compared to existing systems, including easy to transport and safe to use by minimally trained produce handlers and consumers. We envision that this technology can help tackle food waste challenges at the critical retail and consumer stages in the food supply chain.

Keywords : climacteric produce, controllable ripening, food waste challenge, metal organic framework
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