Title Investigation of Raman chemical imaging for detection of lycopene changes in tomatoes during postharvest ripening

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Abstract

Lycopene is a major carotenoid in tomatoes and detecting changes in its content can be used to monitor the ripening of tomatoes. Raman chemical imaging is a new technique that shows promise for mapping constituents of interest in complex food matrices. In this study, a benchtop point-scan Raman chemical imaging system was developed to detect and visualize internal lycopene distribution during postharvest ripening of tomatoes. Tomato samples at different ripeness stages (i.e., green, breaker, turning, pink, light red, and red) were selected and cut open for imaging. Hyperspectral Raman images were acquired from fruit cross-sections in the wavenumber range of 200–2500 cm^{-1} with a spatial resolution of 1 mm. A polynomial curve-fitting method was used to correct for the underlying fluorescence background in the original spectra. A hyperspectral image classification method was developed based on spectral information divergence to identify lycopene in the tomato cross-sections. Raman chemical images were created to visualize the spatial distribution of the lycopene for different ripeness stages. The system was also configured to test the feasibility of utilizing spatially offset Raman spectroscopy (SORS) technique for subsurface detection of a Teflon slab placed under samples of outer pericarp cut in 5-mm and 10-mm thick slices from green and breaker tomatoes. The results showed that the Raman spectrum of Teflon can be extracted from the SORS measurements of the pericarps placed over the Teflon, demonstrating the potential of the future development of a Raman-based nondestructive approach for subsurface detection of lycopene as an indicator of tomato maturity.