

Title Hyperspectral laser-induced fluorescence imaging for assessing apple fruit quality
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Citation Postharvest Biology and Technology, Volume 43, Issue 2, February 2007, Pages 193-201
Keywords Apple quality; Fluorescence; Hyperspectral image; Laser-induced; Neural networks

Abstract

Chlorophyll fluorescence is a promising technique for postharvest quality research, and reported studies were mainly based on the fluorescence kinetic analysis method, which has not been quite satisfactory for measuring fruit quality. This paper reports on using a hyperspectral imaging technique for measurement of laser-induced fluorescence from apple fruit for predicting multiple fruit quality parameters. A continuous wave blue laser (408 nm) was used as an excitation source for inducing fluorescence in apples. Fluorescence scattering images were acquired from 'Golden Delicious' apples by a hyperspectral imaging system at the instance of laser illumination (0 min) and after 1, 2, 3, 4, and 5 min of illumination. The hyperspectral fluorescence image data were represented by mean, maximum, and standard deviation spectra. Standard tests were performed on measuring fruit skin and flesh color, firmness, soluble solids content, and titratable acid. A hybrid method of combining principal component analysis and neural network modeling was used for developing prediction models to predict fruit quality parameters for each of the six illumination time periods. Fluorescence emission decreased steadily during the first 3 min of illumination and was stable within 5 min. The 0-min fluorescence prediction models had somewhat poorer prediction results for individual quality parameters except skin hue than did the models of longer illumination time. The differences were minimal in the model prediction results from the fluorescence data at 1, 2, 3, 4 or 5 min of illumination. Overall, excellent predictions were obtained for apple skin hue with the correlation coefficient of prediction of 0.94. Relatively good predictions were obtained for fruit firmness, skin chroma, and flesh hue with values for the correlation coefficient being equal to or greater than 0.74 for 1 min of illumination or longer times, and poorer correlations were found for soluble solids content, titratable acid, and flesh chroma. Hyperspectral laser-induced fluorescence imaging is potentially useful for assessing selected quality parameters of apple fruit and further research is needed to improve fluorescence measurement for better prediction of fruit quality.