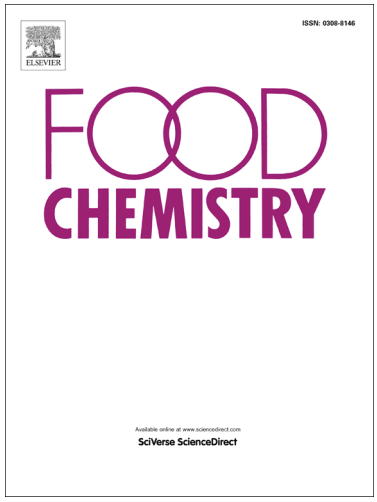

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Prediction of banana color and firmness using a novel wavelengths selection method of hyperspectral imaging

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Abstract This study investigated the feasibility of using hyperspectral imaging for determining banana color (L*, a* and b*) and firmness as well as classifying ripe and unripe samples. The hyperspectral images at wavelengths 380-1023 nm were acquired. Partial least squares (PLS) models were built to predict color and firmness. Two-wavelength combination method ($\frac{\lambda_i - \lambda_j}{\lambda_i + \lambda_j}$, $\frac{\lambda_i^2 - \lambda_j^2}{\lambda_i^2 + \lambda_j^2}$, $\frac{\lambda_i}{\lambda_j}$ and $\lambda_i - \lambda_j$) was used to identify the effective wavelengths. Based on the selected wavelengths, PLS models obtained good results with the coefficient of determination in prediction (R_p^2) of 0.795 for L*, 0.972 for a*, 0.773 for b* and 0.760 for firmness. The corresponding residual predictive deviation (*RPD*) values were 2.234, 6.098, 2.119 and 2.062, respectively. The classification results of ripe and unripe samples were excellent in two different principal components spaces (PC1+PC2 and PC1+PC3). It indicated hyperspectral imaging can be used to non-destructively determine banana color and firmness as well as classify ripe and unripe samples.

Keywords: Banana; Hyperspectral imaging; Color; Firmness; Two-wavelength combination; Prediction

1. Introduction

Fruits quality is important for determining the harvest time and storage condition (Lleó, Roger, Herrero-Langreo, Diezma-Iglesias, & Barreiro, 2011). Quality properties in fruits change rapidly along with the ripeness (Glew et al., 2005). If the fruits are harvested at a very early stage, the consumption quality will be poor (Lleó, Roger, Herrero-Langreo, Diezma-Iglesias, & Barreiro, 2011), while a late harvest may reduce the shelf life and make the fruits easily susceptible to diseases (Jha, Chopra, & Kingsly, 2007). In order to keep good quality, the fruits should be harvested at a proper time. Thus, it is