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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

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