Shape induced reflectance correction for non-destructive determination and visualization of soluble solids content in winter jujubes using hyperspectral imaging in two different spectral ranges

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Abstract

Soluble solids content (SSC) is an important quality attribute in determining fruit maturity and grading after harvest. This study explored the potential of hyperspectral imaging (HSI) coupled with multivariate analysis in visible and near-infrared (Vis-NIR, 380–1030 nm) and near-infrared (NIR, 874–1734 nm) regions for measuring SSC in winter jujube fruit. The effectiveness of applying area normalization to reduce the influence of non-uniform light distribution on the spherical surface of intact fruit was explored. Then linear and non-linear regression models were developed and compared in two spectral ranges. The performance obtained by the least squares-support vector machine (LS-SVM) models based on successive projection algorithm (SPA) was satisfactory. The determination coefficient of prediction (R_p^2) and residual predictive deviation (RPD) were 0.873 and 2.81 for the NIR range, and 0.894 and 3.07 for the Vis-NIR range, respectively. The SPA-LSSVM models were applied on the pixel-wise and object-wise spectra of region of interest before and after area normalization for comparison of visualization performance of corresponding prediction maps for SSC. Area normalization could effectively correct the non-uniform reflectance on a spherical object. The overall results indicated that HSI could be used to non-destructively predict and visualize SSC in winter jujubes.