Nondestructive simultaneous prediction of internal browning disorder and quality attributes in 'Rocha' pear (*Pyrus communis* L.) using VIS-NIR spectroscopy

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Abstract

This study explores the possibility of predicting the soluble solids content (SSC), firmness and the presence of internal browning disorders in 'Rocha' pear (*Pyrus communis* L.) using a single VIS-NIR spectroscopic measurement in semi-transmittance mode. The spectroscopic measurement setup was developed to mimic real world conditions and takes into account geometry and technical requirements of a commercial fruit sorting optical module. The randomness of the fruit position during the spectra acquisition was simulated by sampling each fruit on four sides. Calibration models for internal quality properties were built using individual and/or average side spectra. The results show that models using the spectrum of each side as an individual sample only under-perform slightly relatively to the models based on spectra averages, which are common in the laboratory but very difficult to implement on an automated grading line. The performance of PLS, SVM and Ridge Regression models was compared for the prediction of SSC and firmness. Multiple types of spectra pre-processing were computed and the best combination of model and pre-processing method identified. The lowest RMSEP results for SSC and firmness were 0.7% (R^2 = 0.71) and 7.66 N (R^2 = 0.68) respectively, achieved using SVM on data pre-processed with Standard Normal Variate corrected 2nd derivative. For the internal disorder detection (browning), a classification benchmark composed by five different models (PLS-LDA, PCA-Logistic Regression, PCA-Extremely Randomized Trees, Extremely Randomized Trees and SVC) was implemented. PLS-LDA applied to the raw spectra presented the highest sensitivity, 76%. The results confirm that simultaneously achieving viable firmness and SSC predictions and internal disorder detection levels in pears is possible using a single VIS-NIR spectral measurement.