Ripening assessment of 'Ortanique' (*Citrus reticulata* Blanco x *Citrus sinensis* (L) Osbeck) on tree by SW-NIR reflectance spectroscopy-based calibration models

Rosa Pires, Rui Guerra, Sandra P. Cruz, M. Dulce Antunes, António Brázio, Andreia M. Afonso, Mariana Daniel, Thomas Panagopoulos, Isabel Gonçalves and Ana M. Cavaco

Abstract

The aim of this study was the non-destructive assessment of 'Ortanique' (*Citrus reticulate* Blanco x *Citrus sinensis* (L) Osbeck) ripening, based on the prediction of internal quality attributes (IQA) by short-wave near-infrared reflectance spectroscopy (SW-NIRS) calibration models. Spectra from fruit of 50 trees located in two different orchards, were acquired on tree using a customized portable visible near-infrared (vis-NIR) system. Partial least squares (PLS) was used to build the various IQA calibration models. The models were tested through internal validation (IV) and external validation (EV). Generally, the IV results were always superior to those of EV: regarding IV, a high regression coefficient (R^2) and low root mean square error of prediction (RMSEP) were achieved, revealing a good predictive performance for juice pH (R^2 = 0.80; RMSEP = 0.10; SDR = 2.23), soluble solids content (SSC) (R^2 = 0.79; RMSEP = 0.75 %; SDR = 2.27), titratable acidity (TA) (R^2 = 0.73; RMSEP = 0.24 % citric acid; SDR = 1.94) and the maturation index (MI) (R^2 = 0.80; RMSEP = 1.38; SDR = 2.2). The best EV predictions were obtained for TA (R^2 = 0.69; RMSEP = 0.38 % citric acid; SDR = 1.24), and MI (R^2 = 0.69; RMSEP = 2.07; SDR = 1.49). Calibration models for glucose, fructose and sucrose showed medium-coarse predictions for both validation strategies. A detailed investigation of MI models was performed, to understand the causes of their poor EV results. In the context of EV, model updating strategies were explored by using some validation samples to improve the calibration model. The methods of bias correction and spiking were tested, showing a clear improvement in the predictions.