Abstract

Non-destructive quality assessment of 'Valencia' orange using Fourier transform near infrared spectroscopy

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Introduction

Internal quality of citrus fruit is usually evaluated by destructive methods using a 'representative' sample. High variability in fruit batches and increased market demand for quality segmentation has spurred the search for non-destructive tools for objective quality assessment. In this study, diffuse reflectance near infrared spectroscopy (NIR) was explored as a predictive tool to detect quality attributes of individual 'Valencia' oranges.

Materials and Methods

Sixty blemish-free fruit were randomly selected from bulk bins containing about 500 fruit at a commercial citrus pack house. Fruit were pre-sorted into three size groups based on mass (small - 113.56±9.28 g, medium - 149.48±12.32 g and large - 227.25±27.55 g). FT-NIR absorbance spectra were obtained using three different acquisition methods: fibre-optic probe for solid samples (SP) and rotating integrating sphere (IS) on the Multi Purpose Analyzer (MPA) spectrometer, and the FT-NIR illumination and detection emission head (EH) of the Matrix-F FT-NIR spectrometer in the 780-2500 nm range (Bruker Optics, Germany). Spectra were generated on two opposite equatorial sides of fruit. Reference fruit quality attributes measured included mass, total soluble solids (TSS), pH, titratable acidity (TA), vitamin C, colour parameters (L*, a*, b*) and firmness. PLS regression (OPUS software) was applied to spectral data to develop prediction models for each quality attribute by randomly dividing the data into calibration (60%) and validation (40%) sets. The spectral pre-processing method which gave the lowest RMSEP value was used to develop a calibration for each quality attribute. Robustness of the calibration model was tested by exchanging validation and calibration data sets.

Results and Discussion

Fruit mass, TSS, TA, vitamin C, L* and a* were predicted with significant accuracy. Spectral acquisition method had a major influence on calibration regression statistics and accuracy of prediction. The model developed using the IS gave the best prediction of TSS (R^2=0.8846, RMSEP=0.35 °Brix and RPD=3.19), followed by the SP (R^2=0.8596, RMSEP=0.38 °Brix and RPD=2.55). The SP gave the best prediction of vitamin C (R^2=0.8454, RMSEP=3.26 mg/100mL and RPD=2.64), while the EH gave the best prediction of external and morphological quality parameters such as weight (R^2=0.9895, RMSEP=5.14 g and RPD=10.6) and L* (R^2=0.8493, RMSEP=0.09 and RPD=2.56). Regression statistics showed that pre-sorting fruit by size did not improve model accuracy. Model parameters remained fairly constant when calibration and validation data sets were exchanged during model development, indicating model robustness.

Conclusion

These results demonstrate the potential of NIR technology for non-destructive assessment of internal quality attributes of 'Valencia' oranges.

Reference paper as:
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