Calibration transfer between developed portable Vis/NIR devices for detection of soluble solids contents in apple

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Abstract

Calibration transfer is an important step for practical applications of Visible and Near-infrared (Vis/NIR) instruments, making the developed model transferable and avoiding recalibration. A calibration transfer method between two developed portable Vis/NIR devices (master and slave devices) for predicting soluble solids content (SSC) of apples was investigated in this study. The partial least squares (PLS) calibration models based on the spectra of the master and the slave devices in the range of 550–930 nm yielded high prediction performance, with the correlation coefficient (R_p) and the root mean square error of the prediction set (RMSEP) of 0.918, 0.552 % and 0.881, 0.666 %, respectively. However, the direct use of the PLS model built by the master instrument to the slave instrument was impracticable. A Hg (Ar) lamp was used to correct the spectral dimension for the two devices, followed by the transfer performance comparison of three methods including piecewise direct standardization (PDS), spectral space transformation (SST), and calibration model transformation based on canonical correlation analysis (CTCCA). The prediction results indicated that PDS yielded better performance when the window size was 3 and the number of the transfer samples was 25, with R_p and RMSEP of 0.874 and 0.713 %, respectively. Lower spectral angle θ and Υ higher spectral correlation coefficient also illustrated that PDS had a preferable performance compared with SST and CTCCA.After PDS and slope/bias (S/B), the SSC was successfully predicted, achieving high accuracy of R_p = 0.926 and RMSEP = 0.778 %. The above results illustrated that the proposed algorithm was a promising calibration transfer method from the master device to the slave device, and could effectively compensate for the differences of spectral response between the developed Vis/NIR devices and different batches of samples.