## Rapid measurement of apple quality parameters using wavelet de-noising transform with Vis/NIR analysis

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## Abstract

Quality assessment of fruits and vegetables is important for all involved in production, processing, trading and even consumption of the products. This study was conducted for non-destructive estimation of moisture content (MC), soluble solids content (SSC), pH and firmness of Gala apple samples using near-infrared spectroscopy in the 350–2500 nm range by application of wavelet transform for pre-processing of raw spectral data. Wavelet transform was combined with other usual pre-processing functions widely used for constructing PLS regression models. The models' predictive capability was evaluated using correlation coefficient of determination (R2), root mean square error of estimation (RMSE) and correlation coefficient (R). The best calibration and validation results were obtained for MC with 8 factors,  $R_{C}^2 = 0.90$ , RMSEC = 0.0042,  $R_{CV}^2 = 0.88$ , and RMSECV = 0.0047. The PLS regression parameters for SSC with 9 model factors, were  $R_{C}^{2}$  = 0.90, RMSEC = 0.37,  $R_{CV}^{2}$  = 0.86, and RMSECV = 0.45. The calibration and validation model parameters for pH and firmness with 10 model factors were  $R_{C}^{2} = 0.87$ , RMSEC = 0.04,  $R_{CV}^{2} = 0.84$ , RMSECV = 0.05, and  $R_{C}^2$  = 0.76, RMSEC = 2.23,  $R_{CV}^2$  = 0.0.59, and RMSECV = 3.04, respectively. In the prediction set, the model that was developed for moisture content had RMSEP = 0.009,  $R^2p$  = 0.6. The  $R^2p$ , and RMSEP for SSC were, 0.87 and 0.55, respectively. The model prediction parameters for pH were 0.72 and 0.06 for,  $R^2$ p and RMSEP, respectively. Finally, predicted firmness of apple samples were acceptable ( $R^2p = 0.65$  and RMSEP = 3.86). Because of noise removal ability, application of wavelet transform for pre-processing on spectral data led to accurate, simple and fast development of PLS regression models.