Title Non-invasive sensing of fruit maturity in the supply chain

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Abstract

In apple, banana, and tomato characteristic fruit pigment changes appear during pre-and postharvest fruit development. A handheld instrument was developed for application in the field, equipped with a photodiode array spectrometer and optical geometry for non-invasive remittance analysis. With this device, fruit remittance readings were carried out to monitor the fruit pigment changes during fruit development on the plant. Calibration models were built for non-invasive fruit pigment analysis. Algorithms were implemented in the embedded software of the device and validated on different fruit material. Parallel readings were carried out regarding the fruit pigment contents by means of HPLC, fruit color, and fruit respiration rate. Fruit chlorophyll content in apple, banana, and tomato as well as b-carotene and lycopene contents in tomato were non-invasively analyzed with fruit remittance readings showing high correlation and low errors, e.g. in banana chlorophyll analysis r=0.95 and SEP<7.5% In apples, a high correlation of the non-invasively analyzed fruit chlorophyll content and the fruit respiration rate was found (r=-0.90). Regarding the color data, highest correlation with respect to the fruit respiration rate appeared for the a* value (r=0.79). In banana fruit, the chlorophyll content analyzed non-invasively by means of spectrometry was highly correlated with the maturity of individual fingers (r=-0.85) and the hand maturity stage (r=-0.97). Spectral remittance recordings were also highly correlated with tomato fruit maturation. Based on the non-invasive remittance readings, a Matlab script was developed to animate changes of specific pigment contents during fruit development. Generally, the spectral signature of a specific pigment shows a horizontal shift caused by changes in the fruit matrix due to maturation. With the script developed an in situ spectrum of a pigment under question can be extracted.