Title Application of microwave return loss for sensing internal quality of peaches

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Citation Biosystems Engineering, Volume 96, Issue 4, April 2007, Pages 525-539

Keywords peach; internal quality; microwave spectroscopy

Abstract

Microwave (MW) spectroscopy was studied as an internal-quality estimating technique for peaches. During two seasons, just harvested, early and mid-season, varieties were studied. The main objective of the research was to establish the feasibility of MW measurements for the firmness and sugar estimation of peaches. The MW parameter, return loss (L_R in dB), was measured from 1 to 20 GHz, simultaneously with reference parameters such as firmness, acidity, sugar content and optical reflectance using a contact co-axial probe. The techniques used for amplifying the variability range of the fruit samples, by well-planned sampling and cold storage, were developed. It is shown that, while any reference parameter does not change significantly by the application of wet and dry cold treatments to the peaches, MW response changes greatly in the treated samples showing, in accordance with the literature, that dielectric response in fruits is greatly affected by moisture content and temperature. The return loss increases 50–100% when fruits are moist (submerged in water during 1 h) and cold (1 °C) as compared to dry fruits at ambient temperature (20 °C). Significant correlations were observed between return loss values obtained at the different measured frequencies: 1, 7, 9·9 and 19 GHz, when taken on the same fruit. Low correlation is observed between the values for L_R at 7, 9·9 and 19 GHz with fruit firmness, which is not consistent enough to be applied for fruit inspection and sorting purposes. Different estimative models of fruit firmness were calculated for different peach samples. The multiple linear regression (MLR) models based on return loss plus reflectance variables were not robust, showing unstable coefficients. The most significant independent variable for estimating peach firmness is always the reflectance at 680 nm. Added to L_R at 7, 9·9 and 19 GHz, the explained variance (coefficient of determination) of the firmness models reaches just 50–60%, with lower values for sugar estimation models. A low repeatability of L_R was demonstrated.