Title Non-invasive techniques for measurement of fresh fruit firmness

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Abstract

A sound velocity technique and visible–short wave near infrared (400–1100 nm) interactance spectroscopy were considered in the context of the assessment of fruit firmness in intact banana, mango and peach fruit. The velocity of a vibration ('sound') wave moving through the fruit decreased during ripening of mango (from 84 to 39 m s^{-1}), banana (29 to 14) and peach (28 to 15) fruit. Fruit firmness assessed using a penetrometer (F_{pen}) was linearly correlated ($R^2 > 0.8$) with sound velocity in mango, but not peach or banana. Spectra were related to the penetrometer and sound velocity readings using partial least squares regression. A cross-validation result of $R^2 = 0.92$, 0.86 and 0.79 for the penetrometer reading and $R^2 = 0.88$, 0.77 and 0.58 for the sound velocity reading was achieved for banana, mango and peach fruit, respectively. However, these results are likely to be a peel-related attribute for banana, potentially a skin pigment, as the optical geometry used would primarily optically sample the peel, rather than pulp tissue. Prediction results, involving independent data sets, were very poor ($R^2 < 0.75$) for both the penetrometer and sound velocity readings in all three commodities, with the marginal exception of that for the penetrometer reading for banana ($R^2 = 0.76$). The visible–short wave near infrared interactance spectroscopy technique is therefore not recommended for assessment of fruit firmness. The sound velocity technique is recommended for measurement of an index descriptive of the stage of ripening of mango, banana and peach fruit, although it does not assess the same character as a penetrometer reading.