Vibration damage in guava during simulated transportation assessed by digital image analysis using response surface methodology

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Abstract

Vibration damage on guava peel is an important criterion for fruit grading classification and consumer perception. Response surface methodology (RSM) using central composite design (CCD) with three independent variables as frequency (7, 13.5 and 20 Hz), vibration duration (15, 30 and 45 min), and acceleration (2.942, 5.884 and 8.826 m s^{-2}) were employed for vibration testing of 'Glom Sali' guava. Twenty simulated vibration treatments were conducted at 20 °C for 48 h to assess and analyze browning index (BI), total color difference (TCD), digital image analysis of bruise area (BA) and normalized fractal dimension difference ($\Delta FD/FD_0$) for vibration bruising damage on guava peel. Results showed that acceleration was an important factor in vibration bruising, particularly combined at 8.826 m s^{-2}. For a fixed target value of $\Delta FD/FD_0$ at 1.088 and BA at 10 % of the total area, the optimized treatment condition was frequency level 13.5 Hz, vibration duration 30 min and acceleration level 6.570 m s^{-2}. The correlation coefficient (*r*) between TCD and either BA (0.7724) or $\Delta FD/FD_0$ (0.7484) showed a higher relationship than BI (0.4605), while $\Delta FD/FD_0$ value had greater reliability and repeatability than BA to predict vibration bruising in guava. Results demonstrated that fractal dimension difference assessed by image analysis was a potential methodology to determine the severity of vibration bruising in guava fruit.