Developing an accelerated vibration simulation test for packaged bananas

Indika Fernando, Jiangang Fei, Roger Stanley, Hossein Enshaei and Vincent Rouillard

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Abstract

Mechanical damage in packaged fruits is known to be exacerbated by the intensity and exposure duration of vibration excitation during road transport. However, the current single degree of freedom (SDOF) vibration simulation test standards for road vehicle transport have limitations for simulating long distance road trips. The accelerated vibration simulation testing, based on the Basquin model of cyclic fatigue, has been used for reducing the simulation test time. However, the time-compression factor used in this model can result in significant errors in simulation outcome as the power constant is usually assumed (i.e. k = 2 or 5). This work aimed at developing an accelerated vibration simulation test for packaged bananas. For this, mechanical damage levels that occurred during the field transport of packaged bananas were compared with the damage levels resulted from laboratory-based vibration simulation. A SDOF averaged power-spectra derived from the measurement of vertical acceleration levels during the field transport, with a vibration intensity of 0.36 gRMS for a test duration of three hours, was found to be the most suitable test protocol that closely replicated the field damage levels during long distance transport of bananas. The power constant in the Basquin model was derived by comparing the simulation-induced mechanical damage levels, with those occurred during the field transport. This study therefore provides a practical time-compressed simulation test for packaged bananas and other similar products undergoing long distance transport. Improved package testing will contribute to developing more realistic solutions to minimize damage to delicate products in-transit.