

An Integrated Experimental and Numerical Approach to Develop an Electronic Instrument to Study Apple Bruise Damage

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Abstract : Apple bruise damage from harvesting, handling, transporting and sorting is considered to be the major source of reduced fruit quality, resulting in loss of profits for the entire fruit industry. The three factors which can physically cause fruit bruising are vibration, compression load and impact, the latter being the most common source of bruise damage. Therefore, prediction of the level of damage, stress distribution and deformation of the fruits under external force has become a very important challenge. In this study, experimental and numerical methods were used to better understand the impact caused when an apple is dropped from different heights onto a plastic surface and a conveyor belt. Results showed that the extent of fruit damage is significantly higher for plastic surface, being dependent on the height. In order to support the development of a biomimetic electronic device for the determination of fruit damage, the mechanical properties of the apple fruit were determined using mechanical tests. Preliminary results showed different values for the Young's modulus according to the zone of the apple tested. Along with the mechanical characterization of the apple fruit, the development of the first two prototypes is discussed and the integration of the results obtained to construct the final element model of the apple is presented. This work will help to reduce significantly the bruise damage of fruits or vegetables during the entire processing which will allow the introduction of exportation destinies and consequently an increase in the economic profits in this sector.

Keywords : apple, fruit damage, impact during crop and post-crop, mechanical characterization of the apple, numerical evaluation of fruit damage, electronic device

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