

Title An instrumented sphere for impact and temperature measurements at orange packinghouses
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Abstract

An instrumented sphere (IS) was developed and characterized for mechanical impact and temperature measurements in fruits during sorting and packing in a packing-house. The IS was carried out with oranges in a commercial packinghouse where these oranges are selected, washed, waxed, dried and boxed. During the postharvest process, temperature, frequency and intensity of impacts were measured and recorded. These results were compared with a commercial IS (IRD400) Techmark, Inc., Lansing, (76 mm) which is equipped with a tri-axial accelerometer. The data obtained from the instrumented sphere allows determining (1) the frequency and intensity of impacts, (2) the transportation velocity and (3) the temperature changes in the packing-line. Impacts were measured as maximum acceleration in G (m/s^2) and temperature in DC. The hardware of the developed IS is composed of two biaxial accelerometers, a temperature sensor, a microcontroller and a USB module. The accelerometers are MicroElectroMechanical Systems (MEMS) based on microfabricated capacitors. The range of measured acceleration is between 0.5 G to 250 G. The microelectronic temperature sensor is positioned facing the external boundary surface of the IS and can measure temperature in the range of 0 °C to 80°C. The low-power microcontroller has a stand-by operation mode to extend both the battery lifetime and IS autonomy. The IS can continuous measure the impact and temperature during 120 minutes with a bandwidth of 1 kHz. This autonomy can be extended whether the configuration of the stand-by mode is optimized according to the IS utilization. IS software was developed based on Virtual Instruments designed in LabViewR. This software allows a user friendly interface with IS. The measured data are downloaded to the computer using a plug-and-play USB connector. The impact data obtained from our develop IS were in agreement with the data obtained from the Techmark IS. Both spheres recorded impacts from 15 G to 170 G. The temperature data was especially useful during drying process after wash and through wax. The developed IS recorded temperatures from 25°C to 33 °C.