

Title Detection of early apple bruises using pulsed-phase thermography
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Abstract

The study is based on a hypothesis that internal defects and physiological disorders of fruit lead to changes in tissue thermal properties. During thermal stimulation, heterogeneities of thermal properties lead to the occurrence of thermal contrasts on the surface of fruit material, which can be successfully registered with the use of a thermographic device. A method was developed to detect apple bruising early using pulsed-phase thermography (PPT). In PPT the studied object is heated with an individual thermal pulse (most frequently a rectangular pulse) and the temperature decay on the surface is analysed on a pixel-by-pixel basis as a mixture of harmonic waves, thus enabling the computation of phase and amplitude images. The fast Fourier transform was used to obtain ampligrams and phasegrams of fruit heat response to defects occurring at different depths. The automatic segmentation procedure made it possible to select areas of bruised tissue in thermograms. A comparison of PPT results and visual inspection of bruising was performed, indicating high possibilities of the active thermography method for detecting defects up to several millimetres.