

Online detection of apples with moldy core using the Vis/NIR full-transmittance spectra

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Abstract

Moldy core is a common disease of apples, but it is difficult to detect because there is no obvious difference in appearance of fruit. In this study, the full-transmittance spectra of apples were collected online with three different orientations at speed of 0.5 m/s using a short-integration-time mode. Spectral measurement orientation has a great influence on the spectral intensity, but no effect on the spectral trends. The spectral intensity of healthy fruit was higher than diseased fruit for all three orientations due to the stronger absorption of damaged tissues. To detect apples with moldy core, four kinds of classification models including naive bayes (NB), linear discriminant analysis (LDA), extreme learning machine (ELM) and support vector machine (SVM) were developed based on the full-transmittance spectra. The results showed that the spectra extracted from medial zone resulted in better detection performance than for intact fruit, and the T2 orientation was more suitable for moldy core detection. The best classification model was built based on the medial zone spectra collected by T2 orientation with the success rate of 90.4 %, 86.9 % and 93.9 % for total, healthy and diseased samples in the validation set. Overall, it is feasible to online detect moldy core with full-transmittance spectroscopy technology, moreover, the spectral acquisition technology of short-integration-time mode can be used to detect internal defect by extracting the effective discrimination information from infected region.