

Analysis and detection of decayed blueberry by low field nuclear magnetic resonance and imaging

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Abstract

Decay is a major cause of quality loss and food safety concerns for blueberry fruit. Low-field nuclear magnetic resonance (LF-NMR) has been used to analyze and detect decayed blueberry fruit. According to NMR relaxation analysis, transverse relaxation time (T_{21} , T_{22} , T_{23}) of decayed fruit increased to different degrees, while signal amplitude (A_{21} , A_{22} , A_{23}) decreased to different degrees. Six relaxation features were input into BPNN model to identify the decay classes of fruit. The identification accuracy of training set was 86.7%, and that of the validation set was 90%. According to magnetic resonance imaging (MRI), twice threshold segmentation algorithm was proposed to segment the decayed region with dark color. A total of 15 features were extracted from gray histogram, gray level co-occurrence matrix (GLCM) and gray level-gradient co-occurrence matrix (GGCM) of the image for correlation analysis. Five features were then input into a back propagation neural network (BPNN) model. The identification accuracy of training set was 92.2%, and that of the validation set was 83.3%. Finally, 11 variables, including transverse relaxation features and image features, were input into the BPNN model. The identification accuracy of training set was 98.8%, and that of the validation set was 94.2%, which showed the highest identification accuracy. The results showed that LF-NMR and MRI are suitable for analyzing and detecting the decay disease of fruit, which provides a theoretical basis for nondestructive detection of fruit disease.