A novel non-destructive detection of deteriorative dried longan fruits using machine learning algorithms based on low field nuclear magnetic resonance

Yu Fu, Yu Wang, Wei Lin, Yue Deng, Honghu Sun, Yang Yu, Yanling Lan, Haoyang Cai and Qun Sun

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Abstract

Internal fungal infection and pest invasion are defects commonly found in dried longan fruits, which cannot be visualized easily without peeling. The present work was aimed to develop a non-destructive method for discriminating defective dried longan fruits *via* measuring the transverse relaxation times (T_2) by Low-Field Nuclear Magnetic Resonance (LF-NMR) that characterized the bound water in the fruits, with 274 in total and defects versus normal at 107:167. A decreasing tendency of transverse relaxation amplitude in defective samples was observed, consistent to the change of proton density distribution by Magnetic Resonance Imaging (MRI) with weakened signal in moldy/wormy flesh shown compared with normal ones. Both Principal Component Analysis (PCA) and Deep Learning Neural Network (DLNN) models were applied to analyze the T_2 relaxation time for predicting the defective fruits. The DLNN model yielded a satisfactory performance and achieved accuracy, recall and F-score marks up to 89 %, 82 % and 86 % for 10-fold cross validation, respectively, compared with approximately 80 %, 60 % and 74 % by PCA cluster. This study highlighted a novel non-destructive approach for discriminating defective dried longan fruits of high efficiency featured by high recall, precision and accuracy using DLNN modeling based on LF-NMR.