Abstract

Fungal contamination in food products leads to mustiness, biochemical changes, and undesirable odors, which result in lower food quality and lower market value. To develop a rapid method for detecting fungi, hyperspectral imaging (HSI) was applied to identify five fungi inoculated on plates (*Aspergillus niger*, *Aspergillus flavus*, *Penicillium chrysogenum*, *Aspergillus fumigatus*, and *Aspergillus ochraceus*). Near-infrared (NIR) spectroscopy, mid-infrared (MIR) spectroscopy, and an electronic nose (E-nose) were applied to detect and identify freeze-dried *Agaricus bisporus* infected with the five fungi.

Partial least squares regression (PLSR) models were used to distinguish the HSI spectra of the five fungi on the plates. The *A. ochraceus* group had the highest calibration performance: coefficient of calibration (R_c^2) = 0.786, root mean-square error of calibration (RMSEC) = 0.125 log CFU g^{-1}. The *A. flavus* group had the highest prediction performance: coefficient of prediction (R_p^2) = 0.821, root mean-square error of prediction (RMSEP) = 0.083 log CFU g^{-1}. The ratio of performance deviation (RPD) values of all of the models was higher than 2.0 for the NIR, MIR, and E-nose results for freeze-dried *A. bisporus* infected with different fungi. The fungal species and degree of infection can be distinguished by principal component analysis (PCA) and partial least squares discriminant analysis (PLS-DA) using NIR, MIR, and E-nose, as the discrimination accuracy was more than 90%. The NIR methods had a higher recognition rate than the MIR and E-nose methods.

Principal component analysis (PCA) and PLSR models based on full spectra of HSI can achieve good discrimination results for these five fungi on plates. Moreover, NIR, MIR, and the E-nose were proven to be effective in monitoring fungal contamination on freeze-dried *A. bisporus*. However, NIR could be a more accurate method.