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Detection of sunn pest-damaged wheat samples using visible/near-infrared spectroscopy based on pattern recognition

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Abstract

The presence of sunn pest-damaged grains in wheat mass reduces the quality of flour and bread produced from it. Therefore, it is essential to assess the quality of the samples in collecting and storage centers of wheat and flour mills. In this research, the capability of visible/near-infrared (Vis/NIR) spectroscopy combined with pattern recognition methods was investigated for discrimination of wheat samples with different percentages of sunn pest-damaged. To this end, various samples belonging to five classes (healthy and 5%, 10%, 15% and 20% unhealthy) were analyzed using Vis/NIR spectroscopy (wavelength range of 350-1000 nm) based on both supervised and unsupervised pattern recognition methods. Principal component analysis (PCA) and hierarchical cluster analysis (HCA) as the unsupervised techniques and soft independent modeling of class analogies (SIMCA) and partial least squares-discriminant analysis (PLS-DA) as supervised methods were used. The results showed that Vis/NIR spectra of healthy samples were correctly clustered using both PCA and HCA. Due to the high overlapping between the four unhealthy classes (5%, 10%, 15% and 20%), it was not possible to discriminate all the unhealthy samples in individual classes. However, when considering only the two main categories of healthy and unhealthy, an acceptable degree of separation between the classes can be obtained after classification with supervised pattern recognition methods of SIMCA and PLS-DA. SIMCA based on PCA modeling correctly classified samples in two classes of healthy and unhealthy with classification accuracy of 100%. Moreover, the power of the wavelengths of 839 nm, 918 nm and 995 nm were more than other wavelengths to discriminate two classes of healthy and unhealthy. It was also concluded that PLS-DA provides excellent classification results of healthy