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Non-destructive and Rapid Detection of Paddy Hardness by Using Shortwave Near Infrared (SW-NIR) Spectroscopy

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Abstract

Quality of rice depends upon large number of factors in a paddy production and processing line-up from farm to table. Hardness of paddy is one of the primary indicators for rice which holds the integrity to be performed better during milling process preserving quality and the quantity. Most of the prevailing methods for detecting paddy hardness where the impact force at the breaking point of grain is measured, are destructive and time consuming. This study evaluates Near Infrared (NIR) Spectroscopy, which has been successfully employed in quantifying various physiochemical properties of rice in rapid and non-destructive mode for detection of paddy hardness. Samples were obtained from AT-362 rice variety stored under four different temperatures (26^0C, 30^0C, 34^0C, 38^0C) for 6 months. Total number of 1152 spectra were obtained through a SW-NIR Spectrometer FQANIR Gun (588-1100nm) using 12 samples per treatment per month, which included 4 replicates. Digital force gauge (Model-500B) with electric vertical stand (SJX-2KV) was used to measure the reference paddy hardness. The experiment was repeated for 20 individual paddy grains for validation. The acquired spectra were first evaluated by Principal Component Analysis (PCA) to remove possible outliers. Then filtered spectra were introduced into Partial Least Square (PLS) calibration model in Pirouette 4.5 software to construct the prediction models for hardness. It was found that lowest standard error of calibration (SEC) as 1.222 and highest correlation coefficient of calibration, (R^2) =0.9407 could be obtained when using mean-centred pre-processing and align math transformation in the software. Further, validation results were obtained as standard error of validation (SEV= 1.304) and correlation coefficient of validation (R^2=0.934). The regression vector coefficients indicated that wave bands; 645, 707, 709, 981, 987and 997nm highly contributed for hardness prediction. As such, this research has successfully demonstrated the potential possibility of using NIR spectroscopy as a non-destructive and rapid detection tool to detect paddy hardness.

Key words: *Hardness, Near Infrared, Non-destructive, Paddy, Spectroscopy*

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