

Application of Near Infrared Spectroscopy for Determining Protein, Moisture and Water Activity in Rice

Charuwan Bangweak
UNU-Kirin Fellow from Thailand
Nondestructive Evaluation Laboratory

ABSTRACT

Near Infrared Spectroscopy (NIRS) is widely used for evaluating a wide range of agricultural products. Three experiments as follows were carried out for determining moisture, protein content and water activity of brown rice and rough rice in 2 types of measurement, whole-grain measurement and single-kernel measurement.

For whole-grain measurements of brown rice and rough rice, NIRSystems Model 6500 was used to measure NIR spectra in the short wavelength region from 700 nm to 1100 nm in transmittance mode for moisture content. Partial Least Squares (PLS) calibration was developed using second derivative spectra with the unscramble software. It was concluded that whole-grain NIR spectroscopy had performance to determine moisture content of brown rice and rough rice with a high accuracy. The best result for rough rice (R: 0.99, SEC: 0.29%, SEP: 0.34%) could be obtained using 2 factors calculated from the second derivative spectra in the wavelength region of 700 nm to 1050 nm. For moisture equation of brown rice, high accuracy (R: 0.97, SEC: 0.39%, SEP: 0.17%) could be also obtained.

For single-kernel measurements for protein and moisture contents of brown rice, the transmittance spectra in the short wavelength region (700 nm to 1100 nm) and long wavelength region (1100 nm to 2500 nm) were measured. PLS regression using second derivative spectra was used to develop calibration equations for moisture and protein contents, giving us accurate determination of protein (SEP: 0.58% for long wavelength) and moisture contents (SEP: 0.39% for short wavelength and SEP: 0.36% for long wavelength). The regression coefficient contained protein band at 1738 nm and water band at 966 and 1940 nm. If the single-kernel NIR spectroscopy is applied to the moisture determination of whole grains, the distribution of moisture in the lot could be obtained.

For water activity determination of brown rice, the whole-grain measurement of NIR spectra was done in short wavelength (700 nm to 1100 nm) in transmittance mode. PLS calibration was developed by full cross validation using 63 samples. From second derivative spectra, accurate calibration equation with low SEP, 0.02 could be obtained. The regression coefficient contained water band at 966 nm. However, water activity is not chemical one as moisture content but physical property. The further research is needed to understand the detail structure of the equation developed.