Evaluation of amylose content in rough rice, brown rice and milled rice by using near infrared spectroscopy

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Introduction

In rice trading, cooking quality (hard or soft and sticky) is an important quality characteristic. It is difficult to determine in rough, brown and milled rice. Consumers will only discover this quality aspect after the rice has been cooked. It would be useful to know the cooking quality before purchase. Amylose content is an indicator of cooking quality in rice, and is important in determining whether the rice is hard, intermediate, or soft after cooking. Normally, amylose analysis follows the method of Juliano.[1] The method uses chemicals, is time-consuming, and calls for experienced staff. Also the analysis causes the samples to be destroyed.

NIR spectroscopy has been used widely to determine chemical composition of various agricultural products, especially of grains such as wheat, soybean, rice, and others. It is nondestructive of the sample, accurate, precise, rapid can be used to determine several constituents simultaneously, and has low running costs.

Materials and methods

Samples

A total of 101 samples of whole grain milled rice (MR), brown rice (BR) and 50 samples of rough rice (RR) were collected from the Rice Research Institute, Bangkok, Thailand in the year 2007. The samples contained a range in amylose content from 15.59 – 30 %. The work was carried out at the Postharvest and Processing Research Development Office in the year 2009. Sample characteristics are shown in Table 1.

Samples were scanned and then divided into calibration and validation sample sets before analysis for amylose content.

Spectral acquisition

NIR spectra of rice samples were measured by a Foss Model 6500 operated in reflectance mode over the wavelength region of 800 –2500 nm. Original spectra are shown in Figure 1.

Table 1. Composition characteristics of the rice samples used.

Items	Rough rice	Brown rice		Milled rice	
	Full cross	Calibration	Validation	Calibration	Validation
No. of samples	50	51	50	51	50
Range	15.93–28.64	15.59–30.00	15.66–29.82	15.59–30	15.66–29.82
Mean value	23.06	24.11	24.15	24.15	24.17
SD	4.28	4.00	3.89	3.97	3.88
Unit used	%	%	%	%	%

Reference analysis

The method of amylose content analysis in rice flour was that of Juliano (1971). Rice grains were ground before analysis.

Data analysis

The Unscrambler software (Camo) was used for PLS regression. Full cross validation was used for small sample-sets of rough rice. Calibration and validation sets were used for brown and milled rice to evaluate the calibration equations developed.

Results and discussion

PLS calibration results developed from original spectra for the percent of amylose content in rough rice, brown rice and milled rice are shown in Table 2.

The most effective models showed high coefficients of correlation (r) of 0.98, 0.84 and 0.88 % in rough rice, brown rice and milled rice, respectively. The models also showed low standard errors of prediction (*SEP*) of 3.85, 2.79 and 1.99 % respectively (Figure 2).

The regression coefficients showed strong influences at wavelengths 1215, 1360, 1705, 1725 and 1900 nm are involved with starch.

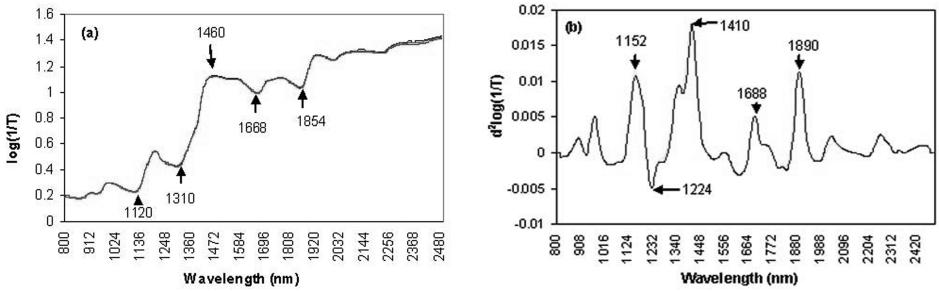

Figure 1. Original spectra of RR, BR and MR in the range 800–2500 nm.

Table 2. PLS calibration results for amylose content measured from rough rice, brown rice and milled rice kernels.

Items	Wavelength region (nm)	Pretreatment	*R*	*SEC*	*SEP*	Bias	*F*
Rough rice	800–2000	Original	0.98	0.83	3.85	0.10	6
Brown rice	800–2000	Original	0.84	2.18	2.79	0.50	11
Milled rice	1000–2000	Original	0.88	1.91	1.99	−0.32	7

F: the number of factors used in the calibration equation; R: multiple correlation coefficients; *SEC*: standard error of calibration; *SEP*: Standard error in prediction; Bias: the average of difference between actual value and NIR value.

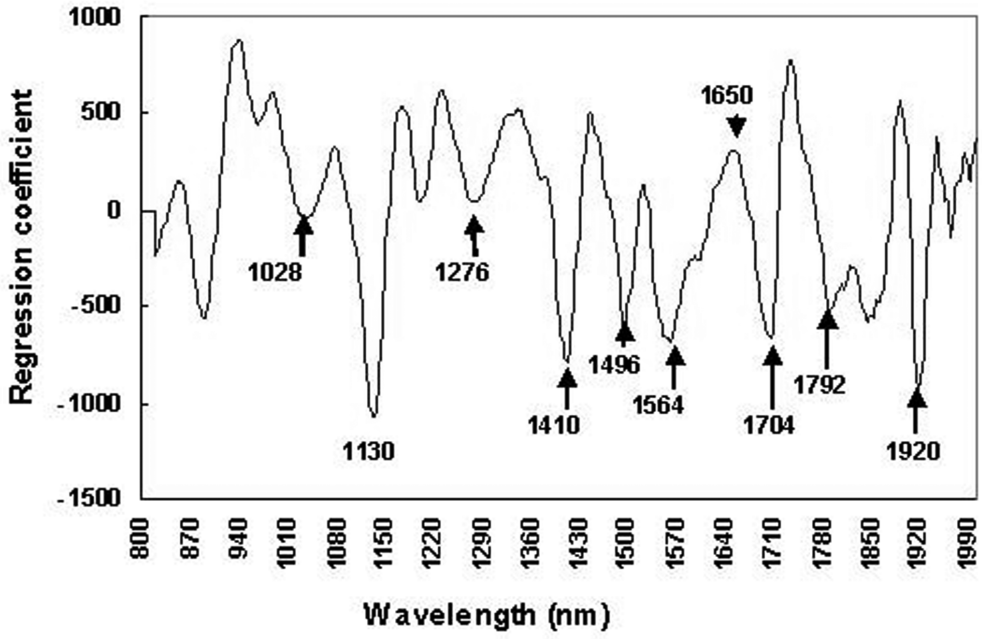

Figure 2. PLS regression for % of amylose content of rough rice, brown rice and milled rice kernels.

Conclusion

NIR spectroscopy (800–2500 nm) using reflectance mode could be an effective method for determining amylose content in rough rice, brown rice and milled rice.

Reference

1. B.O. Juliano, *Cereal Sci. Today* **16,** 334 (1971).