Influence of harvesting period on mango quality as determined by near infrared spectroscopy

P. Rungpichayapichet and B. Mahayothee

Department of Food Technology, Faculty of Engineering and Industrial Technology, Silpakorn University, Nakhon Pathom, 73000, Thailand.
E-mail: busarakornm@yahoo.com

Keywords: harvesting period, quality, golden nam dokmai, NIR, season

Introduction

Mango is a seasonal fruit with a huge demand on the world market throughout the year.[1] To satisfy the long-term demand, growers have to extend the harvesting period with an earlier start, or by delaying the end of the season. Fruits that are harvested at different periods vary in terms of quality. This could affect the use of near infrared spectroscopy (NIRS) for quality control. This prompted the present study, to evaluate the potential of NIRS to determine the quality of mangoes, harvested early in the season, and during the peak harvest season.

Materials and methods

Mango cv. Golden Nam Dokmai was used. A total of 432 fruits were obtained from different harvesting months and were classified into two groups, early and peak season mangoes (240 and 192 fruits, respectively). Early season samples were harvested in December, 2008 (84 fruits), in January 2009 (60 fruits) and February, (96 fruits). Peak season samples were harvested in March (96 fruits) and April, 2009 (96 fruits). Fruits were ripened in plastic baskets at an ambient temperature of (30.2 $\pm$ 1.8°C) and relative humidity of 67.0 $\pm$ 5.3% for seven days, or until spoilage. Ten fruits per day were scanned in the wavelength region of 700–1100 nm at a 1 nm interval using a portable NIR spectrometer, model HandySpec Field 1000 (tec5AG, Germany). The NIR spectra were measured with interactance fibre-optics. Prior to spectral acquisition, the temperature of the samples was controlled by placing them in an air-conditioned room at 25°C for 30 minutes. The Unscrambler software (CAMO, Oslo, Norway) was used to evaluate the spectral data. Savitzky-Golay smoothing (left and right averaging of 14 and 2nd order polynomial) was applied for spectrum pretreatment. Partial least squares (PLS) regression was used to make the calibration and prediction. Validation was performed by using the test set. Reference data included total soluble solids (TSS), titratable acidity (TA) as percentage citric acid, and firmness (F) of the fruit were determined using a digital refractometer (Atago, Japan), titration with 0.1N NaOH, and a Texture

Table 1. PLS calibration results for predicting F, TSS, TA, TSS•TA-1 and RPI for early, peak season and all lots mangoes using spectra treated with Savitzky-Golay smoothing.

	F (g)	TSS (°Brix)	TA(g/100g)	TSS•TA-1	RPI
Early season					
R^2	0.85	0.92	0.83	0.81	0.87
SEC	376.64	0.97	0.43	19.62	0.64
SEP	447.24	1.05	0.47	20.86	0.56
Bias	–101.89	0.13	–0.04	–1.25	–0.05
RPD	2.18	3.26	2.28	2.18	3.09
Peak season					
R^2	0.82	0.89	0.78	0.74	0.86
SEC	367.98	0.63	0.3	36.95	0.68
SEP	357.47	0.77	0.31	32.77	0.72
Bias	22.55	–0.03	–0.03	–0.07	–0.08
RPD	2.43	2.38	2.07	2.26	2.54
All lots					
R^2	0.88	0.90	0.86	0.77	0.84
SEC	345.42	0.92	0.37	30.76	0.77
SEP	374.12	1.02	0.44	29.64	0.76
Bias	23.02	0.06	–0.01	0.76	0.03
RPD	2.63	2.76	2.24	2.17	2.53

Analyzer model TA-xti2 (Stable micro systems, UK), respectively. Sugar-acid ratio ($TSS{\cdot}TA^{-1}$) and ripening index[2], $RPI = \ln 100F{\cdot}TSS^{-1}{\cdot}TA$ were calculated.

Results and discussions

Changes in the physicochemical parameters of mangoes, which are harvested at early and peak season during ripening, were typical; decreasing in firmness, TA, and RPI, and increasing in TSS and sugar-acid ratio. Firmness and TA of early season mangoes were higher than those of peak season mangoes (data not shown). The PLS calibration results for predicting firmness, TSS, TA, TSS/TA and RPI for early, peak season and all lots are shown in Table 1.

The R^2 of ripening index values, reported as combined physical and chemical parameters for both early and peak season mangoes were similar. Moreover, the R^2 values of all parameters studied for early and peak season fruits were not obviously different. The highest R^2 was observed in TSS. This is consistent with other works that show the potential of NIR spectroscopy for predicting TSS in fruits.[3–5] The scatter plots of F, TSS and RPI for all lots are shown in Figures 1, 2 and 3, respectively.

From the results, NIR spectroscopy is concluded to have the potential to be applied for quality monitoring of mangoes harvested early in the season, and during the peak season.

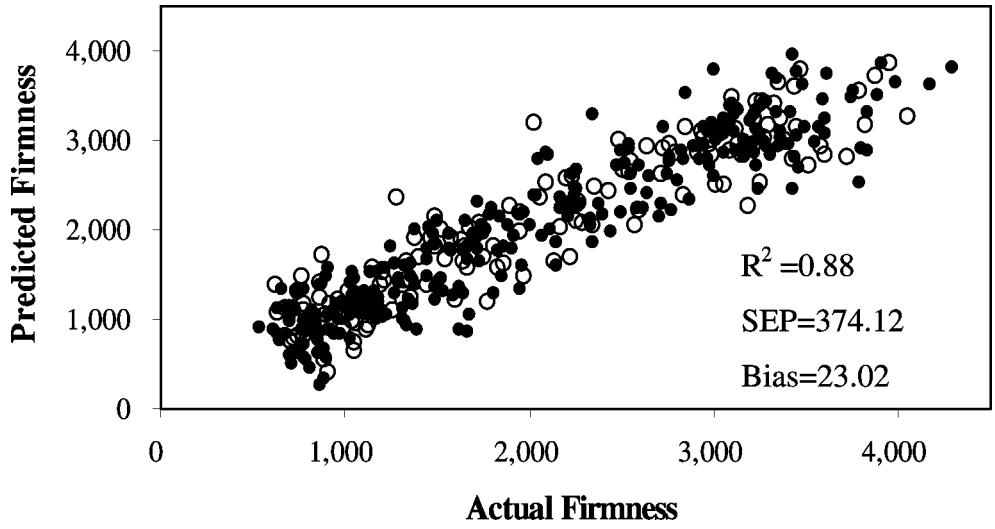

Figure 1. Scatter plots for predicting firmness of mango all lots (○ validation set, • calibration set).

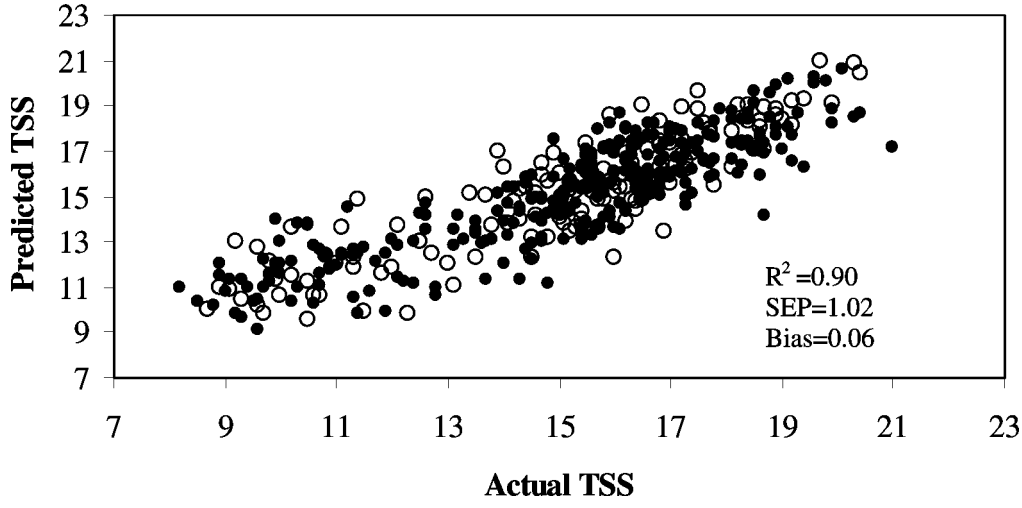

Figure 2. Scatter plots for predicting TSS of mango all lots (○ validation set, • calibration set).

References

1. S.N. Jha, S. Chopra and A.R.P. Kingsly, *J. Food Eng.* **78,** (2007).
2. B. Mahayothee, Ph.D dissertation, Hohenheim University, Germany. (2005).
3. P.P. Subedi, K.B. Walsh and G. Owens, *Postharvest Biol. Technol.* **43,** (2007).
4. V.A. Mcglone and S. Kawano. *Postharvest Biol. Technol.*. **13,** (1998).
5. G. Fan, J. Zha, R. DU and L. Gao. *J. Food Eng.* **93**, (2009).