PT-08

CHANGE OF LYCOPENE AND SOLUBLE SOLIDS CONTENT OF WATERMELON (KINNAREE VARIETY) AT DIFFERENT MATURITY

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ABSTRACT

The change of lycopene and soluble solids content in watermelon (Kinnaree variety) at different maturity included commercial harvesting date was studied. The 90 fruits (15 fruits per one harvesting date) were harvested at 6 dates which were 19, 21, 23, 25 (commercial harvesting date), 27 and 29 days after flower blooming. The flesh in the middle part of 6.5×5×2 cm of half cut fruit was cut for measuring soluble solids content (%Brix) by refractometer and lycopene (ppm) by hexane extract using spectrophotometer. The soluble solids content was increased from 11.3 %Brix in the first harvesting date to 13.1 %Brix in the fifth harvesting date and decreased in the last harvesting date. The lycopene increased from 0.383 to 0.936 ppm. This data suggested that the farmers should not harvest watermelon after 27 days after flower blooming for the limit of its sweetness but if the lycopene content is a requirement the fruit should be harvested at 29 days after flower blooming. The information from this study will be useful to customers, farmers and the watermelon processing factory.

INTRODUCTION

Currently, the watermelon is a fruit that can easily seek for eating, and it can be eaten throughout the year in all seasons. Due to the watermelon is an easy and maintain growing plant and the harvesting period are also short about 1-2 months which depends on the cultivar of watermelon[1]. Mostly watermelon cultivars which are preferred by Thai people is Kinnaree watermelon. The reasons that make the consumers be interested in this cultivar are that it is not too expensive, sweet and juicy taste. Furthermore, all of parts of watermelons have many medicinal properties [2].

The well-known and commonly used nutritive sweetener is sugar, which has many types such as sucrose, glucose, fructose, and maltose, etc.[3] and the sugar that are found mostly in fruits and vegetables is fructose. Fructose is a monosaccharide which is as the component of sucrose. Each of sucrose molecule is composed of fructose and glucose. Fructose is suitable for diabetics, children and people of all ages. It results in sugar in blood level is not as much as by flour or sugar in the same amount of energy. But if, they have been eaten in large amounts like a 20 percent of energy, it could cause the disadvantage on cholesterol and LDL levels in the blood [4]. American Diabetes Association recommended that fructose can be used in patients with diabetes; however, in a proper amount and the effect on cholesterol levels blood in should be studied.

Lycopene is an antioxidant which can prevent a variety of chronic diseases; in particular, various cancers because lycopene have special properties against free radical in the body. These free radicals are a major cause of the damage on DNA and finally, they lead to cancer. Lycopene is a substance as "Antioxidant" in the body to resist the oxidation of Low Density Lipoprotein (LDL) fat; therefore, it can prevent for atherosclerosis and can reduce the risk of various diseases, including all cancers such as prostate cancer, digestive tract cancer, bladder cancer, skin cancer, breast cancer, cervical cancer and cardiovascular disease [5]. This experiment was to study the effect of harvesting period on the content of soluble solids (% Brix) and lycopene (ppm), which could be the indicator for appropriate harvesting time of watermelon.

MATERIALS AND METHODS

The watermelon used in this study was Kinnaree watermelon which was taken from the farm in Phang Khon district, Sakon Nakhon province, Thailand. This farm produces the watermelon for the leading department store in Bangkok. This experiment was conducting in September to October 2012. The blooming flowers of watermelon were tagged and the harvesting dates were specified. The watermelons were harvested in 19, 21, 23, 25, 27 and 29 days, after flower blooming, respectively. There were 15 fruit for each harvesting date. The watermelon were transported to Laboratory in King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand and placed at room temperature (25 ± 1°C), for 3 hrs, before experiment. The pulp (6.5 x 5 x 2 cm) in the center of half cut watermelon was cut off and the 3 cubes (2 x 2 x 2 cm) were cut off from the piece. Therefore, one watermelon provided 6 pieces of samples. The soluble solids content, which is an indicator of sweetness was measured with a Brix refractometer (ATAGO, PAL-1, Japan). The refractometer was calibrated at 0%Brix with distilled water.

The rest of the piece was used for analysis of lycopene by spectrophotometer method. The 2g ground watermelon was added with 25 ml ethanol, 25 ml acetone and 0.05% (w/v) Butylated Hydroxytoluene (BHT) and 50 ml hexane, respectively. Then the mixture was stirred by a magnetic stirrer for 15 minutes at 5 °C. After that the 15 ml 5 ºC distilled water was added and the mixture was stirred for 5 minutes and left for 15 minutes to separate the layers. It would appear the layer of hexane with lycopene, on the top and it was pipetted for measuring [6] by spectrophotometer (Miltonroy Spectronic 601, Germany) at a wavelength of 503 nm [7].

The standard pure lycopene was from Sigma Chenicals. For construction of lycopene calibration curves, the 2 ppm lycopene stock solution in hexane were diluted with hexane so that a concentration range from 0.5-2 ppm was obtained

(working standard solution). The solution was measured for lycopene content by spectrophotometer Miltonroy Spectronic 601, Germany) at a wavelength of 503 nm.

Means and standard deviation on of soluble solids and lycopene content of watermelon at each harvesting date were calculated. Duncan Multiple Range Test (DMRT) was applied to establish significant differences between means with a confidence level of 95%.

RESULTS AND DISCUSSION

The total soluble solids content of Kinnaree watermelon harvested in various periods is shown in Figure 1. The increasing age affected the soluble solids content in watermelon which increased during 19 to 27 days after flower blooming and decreased after that. This indicated that 29 days after flower blooming was too long for harvesting date.

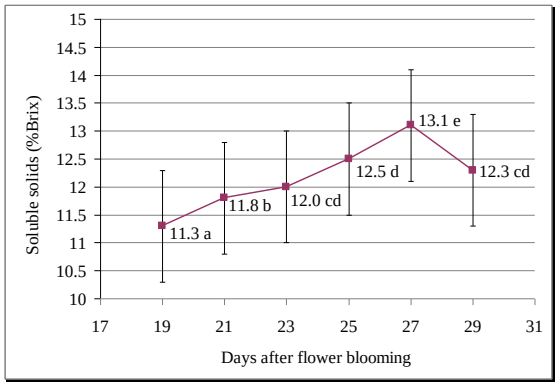

Figure 1. Total soluble solids content of Kinnaree watermelon harvested in various periods

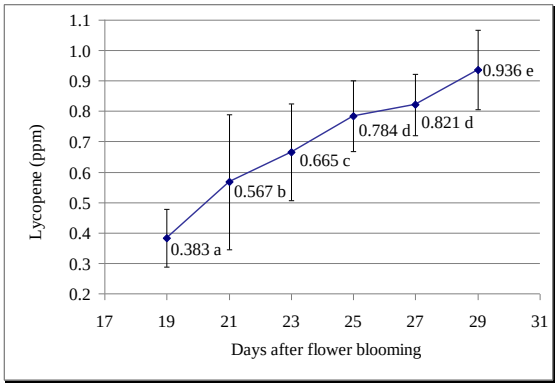

Figure 2. Lycopene content of Kinnaree watermelon harvested in various periods

The lycopene content of watermelon is shown in Figure 2. The increasing age also affected the amount of lycopene in fruit. It can be seen that the lycopene content increased along the harvesting period.

CONCLUSION

The effect of harvesting time of Kinnaree watermelon cultivated in the rainy season was studied. The soluble solids content was increased from 11.3 %Brix in the first harvesting date to 13.1 %Brix in the fifth harvesting date and decreased in the last harvesting date. The lycopene increased from 0.383 to 0.936 ppm. This data suggested that the farmers should not harvest watermelon after 27 days after flower blooming for the limit of its sweetness but if the lycopene content is a requirement the fruit should be harvested at 29 days after flower blooming. The information from this study will be useful to customers, farmers and the watermelon processing factory.

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PT-09

CLASSIFICATION OF DRINKING WATER IN THAILAND BY NEAR INFRARED SPECTROSCOPY

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Keywords: Drinking Water; Near-infrared spectroscopy; Classification.

ABSTRACT

Near-infrared spectroscopy (NIRS) appears as a prominent technique for non-destructive food quality assessment. This research work was focused on evaluating the use of NIRS in classification of drinking water for the benefit of consumers. The water samples were six groups which were 1) Natural Mineral Water 2) Bottled Mountain Mineral Water 3) Bottled Underground Mineral Water 4) Filtered Water (including bottled and household filtered water) 5) Tap Water 6) Distilled Water. The sample was subjected to FT-NIR spectrometer with the pathlength of 2 mm in transflectance mode. The optical data of full spectral range (12500-3600 cm^{-1}) were analyzed by statistic methods of principle component analysis (PCA), soft independent modeling by class analogy (SIMCA), partial least square discriminant analysis (PLS-DA) and cluster analysis (CA). The PLS-DA model confirmed its best performance among the methods used with the average accuracy of 89.22%. It was concluded that the NIRS measurement technique is an attractive and efficient tool for classifying the types of drinking water in Thailand.

INTRODUCTION

Drinking water is a finite and precious resource essential for sustaining life and health, and for ensuring the preservation of ecosystems [1]. Over 1 billion people lack access to safe drinking water, and an estimated 80% of child deaths from digestive-tract diseases such as diarrhoea (approximately 2 million per year) are caused by consumption of contaminated drinking water.

Chromatography is widely used as reference method to verify the authenticity of drinking water. However, chromatographic methods present many inconveniences like the time-consuming required to prepare a large variety of standard solutions that produces dangerous residues, and the use of instrumentation of high cost and maintenance and moreover, the chromatography is an invasive technique and is relatively slow, what implicates in a low sample throughput [2].

Ideally, an analytical method used to verify the quality and authenticity of drinking water should perform an analysis without sample pre-treatment. The combination of chemometric methods with NIR spectroscopy is a good way to eliminate the problems. In this work, a new strategy for classification of drinking water using NIR spectroscopy is proposed and the methods of chemometric classification, i.e. PCA, PLS-DA, SIMCA and cluster analysis are compared.

MATERIAL AND METHOD

Water samples

A total of 17 drinking water samples from different lots and 6 groups (group A, Natural Mineral Water of 3 samples which were collected directly from the natural mineral hot spring (Ruksa Varin well) in the south of Thailand; group B, Bottled Mountain Mineral Water of 3 commercial brands, group C, Bottled Underground Mineral Water of 2 brands, group D, Filtered Water (including bottled and household filtered water) of 7 brands, group E, Tap Water, and group F, Distilled Water, were collected in Thailand.

Near infrared transflectance measurements

The transflectance spectra in the near infrared were obtained from untreated samples by using a Multi-Purpose Analyzer (MPA) FT-NIR spectrometer (Bruker, Bremen, Germany). For instrument control and data acquisition the OPUS program version 7.0.129 from Bruker was employed.

Each sample was transferred into a glass vial of 22 mm, as a measurement cell, covered with a transflection plate made from stainless steel which provided an optical path length of 2 mm and scanned between 12500-3600cm^{-1} with a nominal resolution of 16 cm^{-1}, accumulating 32 scans per spectrum using a background of the gold. The scanning was done in a room temperature of 25±1 °C.

Data analysis

The principal component analysis (PCA) method was used to detect outlier spectra for each drinking water group. It was also used to assess the effectiveness of a non-supervised statistical method to separate the different drinking water groups according to their average spectral data as represented by the principal components (PCs).

Partial Least Square Discriminant Analysis (PLS-DA) and Soft Independent Modeling of Class Analogy (SIMCA) were then used to develop supervised classification models for drinking water using the calibration data set. PLS-DA is a classification method based on modeling the differences between several classes with PLS. If there are more than two classes to separate, the PLS model uses the corresponding response variables, which code for class membership as follows: 1 for members of one class, 0 for members of the other ones. SIMCA is based on making a PCA model for each class in the training set. Unknown samples are then compared to each class model and are assigned to a particular class according to their similarity to the calibration set samples.

The performances of the PLS-DA or SIMCA models were tested using the validation set based on the percent of

correctly classified into their respective drinking water classes (i.e. correct classification rate). The SIMCA model classification cut-off was determined based on the 95% confidence level.

According to Isaksson and Aastveit [3], cluster analysis (CA) assigned similar spectra, and therefore similar samples, to the same cluster based on a single data table [4]. Usually the dendrogram is illustrated where the Euclidean distances between the centroids of the groups are used to evaluate the similarity of the groups.

All the analyses were conducted using The Unscrambler 9.8 software (CAMO ASA, Oslo, Norway).

RESULTS AND DISCUSSION

NIR spectra

Fig. 1 presents the NIR spectra of the 17 drinking water in the range of 12500-3600 cm^{-1}. As can be clearly seen, the absorption bands of water are at 10300, 8400, 6900, and 5160 cm^{-1}.

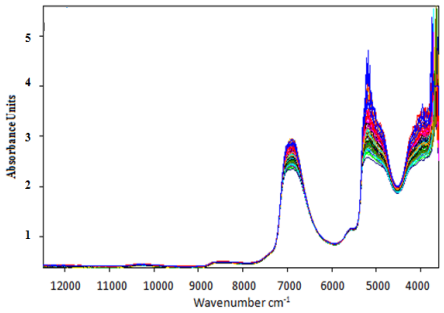

Fig. 1 Spectra of seventeen samples of drinking water analyzed in this work.

Principal component analysis (PCA)

According to PCA, there was no outlier spectrum of tested samples. In Fig. 2, the scores graph PC1 (86%)×PC2 (9%) for the drinking water samples is studied, clearly demonstrating two clusters of drinking water samples including firstly, natural mineral water (NMW) and tapped water (TW) and secondly, bottled mountain mineral water (BMMW), filtered water (FW), bottled underground mineral water (BUMW) and distilled water (DW). The TW and NMW were in the same cluster because they were not filtered as much as FW. The DW was in the cluster of the latter since there is no mineral. However, the BUMW might be processed by severe filtering too. PC1 separates the two clusters.

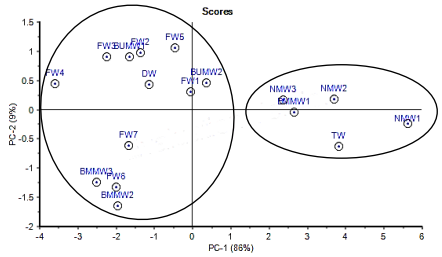

Fig. 2 PC2×PC1 score plot for the overall set of 17 drinking water samples (NMW, BMMW, BUMW, FW, TW, and DW). The explained variance by each principal component is put in parentheses.

SIMCA and PLS-DA

Table 1. Classification success rate (%) by SIMCA and PLS-DA for drinking water

	NMW	BMMW	BUMW	FW	DW	TW
SIMCA	41.18	5.88	11.76	41.18	94.12	82.35
PLS-DA	94.12	88.24	88.24	76.47	94.12	94.12

Table 1 shows that the PLS-DA provided the better performance than the SIMCA in classification of drinking water. The overall classification success rate of SIMCA and PLS-DA were 46.08% and 89.22%, respectively.

Cluster Analysis (CA)

Fig.3 shows the dendrogram for the study of drinking water samples based on cluster analysis technique. It can be seen that two main classes can be identified. One contains NMW, BMMW (one brand) and TW, and the other contains BUMW, FW and DW. The NMW and TW are more similar than BUMW which more similar to FW. This confirmed the result of PCA.

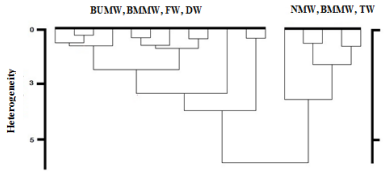

Fig. 3 Dendrogram of cluster analysis (CA) for drinking water samples of NMW, BMMW, BUMW, FW, TW and DW.

CONCLUSION

This work was proposed a new strategy for classification of drinking water in Thailand using NIR spectrometry and chemometric methods (PCA, PLS-DA, SIMCA and cluster analysis). The PLS-DA model confirmed its best performance among the methods used with the average accuracy of 89.22%. Therefore, NIR spectroscopy combined with PLS-DA may provide an attractive and efficient tool for discrimination of drinking water in Thailand.

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