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การตอบสนองของอาการสะท้านหนาวในมะม่วงน้ำดอกไม้สีทองต่อแสงเนียร์อินฟราเรด

Responsibility of chilling injury in mango cv. Nam Dok Mai Si Thong on near infrared

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Abstract

Mango fruit cv. Nam Dok Mai Si Thong was kept in the chamber at 5±1°C to induce the chilling injury symptom. NIRSystem 6500 was used to measure spectra of mangos in wavelength region from 700 nm to 1100 nm (short wavelength) and then, determined the electrolyte leakage of the flesh at initial time on days 15 and 30. Spectral data were analyzed by using principle component analysis (PCA). It was found that the spectrum of mango could be separated into two groups with PC2 and PC3. The first group was the spectrum of normal mango: no chilling injury symptom. The second was the spectrum of mango which it had been kept at 5±1°C for 15 and 30 days showed severe of chilling injury symptom. Similar to the electrolyte leakage of the flesh increased from 8.6 % at the initial time to 15.4 % and 13.0 % when the mangoes were kept at 5±1°C for 15 and 30 days, respectively. The electrolyte leakage were significantly different ($P<0.05$). Chilling injury of mango fruit responsed differently to near infrared which was the importance properties for detecting the chilling injury symptom.

Keywords: mango, chilling injury, near infrared

บทคัดย่อ

ผลมะม่วงพันธุ์น้ำดอกไม้สีทองถูกทำให้เกิดอาการสะท้านหนาว โดยนำไปเก็บรักษาในตู้ควบคุมอุณหภูมิ 5±1 องศาเซลเซียส วัดสเปกตรัมด้วยเครื่อง NIRSystem 6500 ช่วงความยาวคลื่น 700 – 1100 นาโนเมตร (คลื่นสั้น) ร่วมกับการวัดการรั่วไหลของสารอิเลกโตรไลต์จากเนื้อมะม่วงเริ่มต้นและเก็บรักษาแล้ว 15 และ 30 วัน วิเคราะห์ข้อมูลเปกตรัมด้วยวิธี principle component analysis (PCA) พบว่า สเปกตรัมของมะม่วง สามารถแบ่งได้เป็น 2 กลุ่ม ด้วย PC 2 และ PC3 โดยกลุ่มที่ 1 คือ สเปกตรัมของมะม่วงที่มีลักษณะปกติหรือมะม่วงเริ่มต้น ซึ่งไม่ปรากฏอาการสะท้านหนาว และกลุ่มที่ 2 คือ สเปกตรัมของมะม่วงเก็บรักษาที่อุณหภูมิ 5±1 องศาเซลเซียส เป็นเวลา 15 และ 30 วัน ซึ่งแสดงอาการสะท้านหนาวอย่างชัดเจน สอดคล้องกับการรั่วไหลของสารอิเลกโตรไลต์จากเนื้อมะม่วงที่มีค่าเพิ่มขึ้นจากวันแรกที่มีค่าเท่ากับ 8.6% เป็น 15.4 % และ 13.0 % เมื่อเก็บรักษาแล้ว 15 และ 30 วัน ตามลำดับ แตกต่างอย่างมีนัยสำคัญทางสถิติ ($P<0.05$) จะเห็นว่ามะม่วงที่แสดงอาการสะท้านหนาวมีการตอบสนองต่อแสงเนียร์อินฟราเรด ซึ่งเป็นคุณสมบัติสำคัญในการตรวจสอบอาการสะท้านหนาวของมะม่วง

คำสำคัญ: มะม่วง อาการสะท้านหนาว เนียร์อินฟราเรด

Introduction

Mango (*Mangifera indica* L.) is a major tropical fruit in domestic and export markets of Thailand because of their attractive color, delicious taste and excellent nutritional properties (Lizada, 1993; Mitra and Baldwin, 1997). After harvesting mangoes fruit were stored at low temperature (below 13 °C) to extend the shelf life and maintain their availability, but it is susceptible to chilling injury. It leads to a storage disorder manifested mainly as dark, scald-like disorderation and pitting or sunken lesions on the peel (Wang et al., 2008). The chilling injury symptom is difficult to detect by human eyes who do not have an experience. Therefore, a new technique has been developed to assess this symptom.

Near Infrared Spectroscopy (NIRS) is the nondestructive technique which can be used to evaluate the quality of many agricultural and food products such as peach, apple, melon, citrus fruit and kiwifruit (Iwamoto et

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al., 1995). Also, it is low cost, rapid, repeatable and chemical free analyses. This study was to evaluate the responsibility of chilling injury in mango on near infrared.

Material and methods

Mango fruit cv. Nam Dok Mai Si Thong were kept in the chamber at 5±1°C to induce the chilling injury symptom (CI). Spectra of mangoes were measured by using NIRSystem 6500 (Figure 1) in wavelength region from 700 nm to 1100 nm and determined the electrolyte leakage (EL) of flesh at the initial time, on days 15 and 30. Principle component analysis (PCA) was used to analyze the spectral data. The mean of EL data was compared by using least significant different (LSD.)

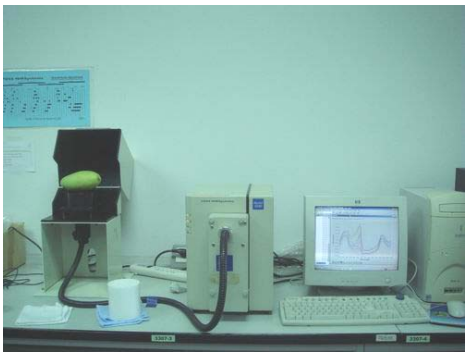

Figure 1 NIR instrument (NIRSystem6500) with fiber optic in interactance mode.

Result

Figure 2 (a) showed the original spectra [log (1/R)] at the initial time, on days 15 and 30 when they were kept at 5±1°C and (b) second derivative spectra of mango fruit. The spectra of mango fruit at different storage times were similar with each other. The second derivative spectra were calculated with the method of Savitzky-Golay to reduce the effect of overlapping peak (Osborne et al., 1993). Strong absorption band due to water was observed in second derivative spectra at 970 nm.

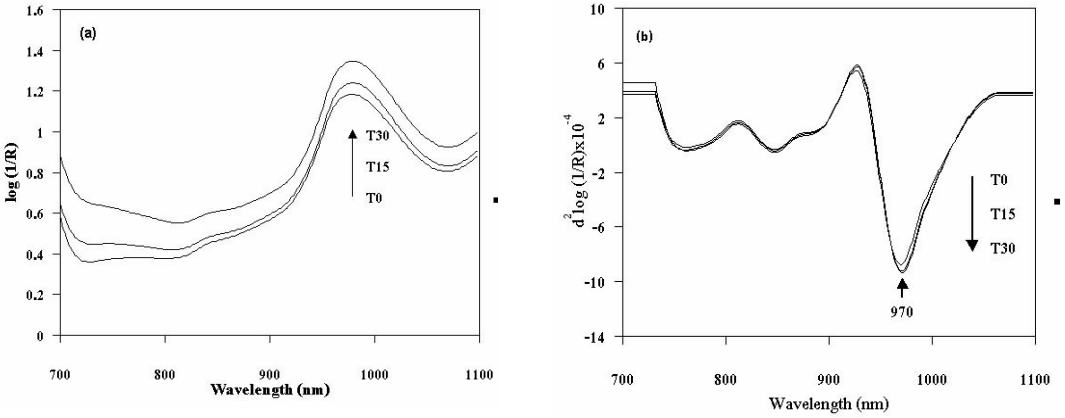

Figure 2 (a) Original [log (1/R)] and (b) second derivative spectra of mango fruit at initial time (T0), 15 days (T15) and 30 days (T30) after storage at 5±1°C.

PCA was performed on the second derivative with whole spectra (700-1100 nm) to visualize the hyper spectral data and describe the differentiation of mango. The PCA score plot showed that mango spectra at different storage times could be separated into two groups with PC2 vs. PC3 (Figure 3). The first group was the

spectrum of normal mango: no chilling injury symptom. The second was the spectrum of mango which it had been kept at 5±1°C for 15 and 30 days as showed severe of chilling injury symptom (Figure 4). CI symptom of mangoes were browning and darkening color on the peel and watery on the flesh. The result was parallel with the electrolyte leakage of the flesh which increased from 8.6 % at the initial time to 15.4 % and 13.0 % when the mangoes were kept at 5±1°C for 15 and 30 days, respectively. The electrolyte leakage were significantly different ($P<0.05$)(Table 1).

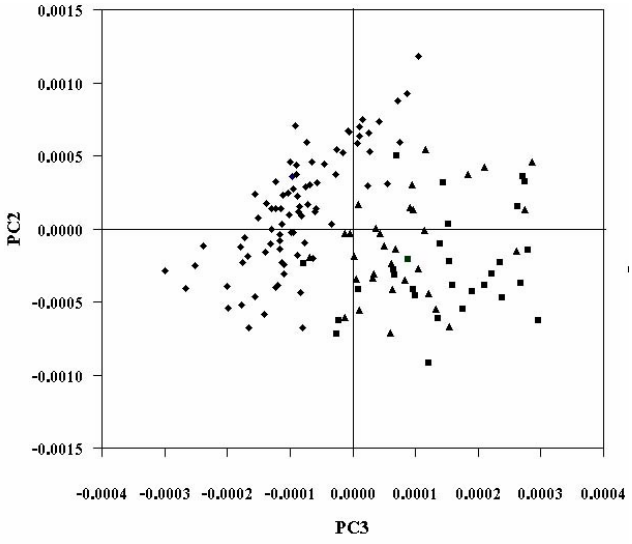

Figure 3 PCA score plot (PC2 vs. PC3) of mango fruit spectra at the initial time (♦), 15 days (▲) and 30 days (■) after storage at 5±1°C.

Figure 4 Mango fruit at the initial time, 15 days and 30 days after storage at 5±1°C.

Table 1 The electrolyte leakage of the mango flesh at the initial time, 15 days and 30 days after storage at 5±1°C.

Storage time	Electrolyte leakage (%)
Initial time	8.6
15 days	15.4
30 days	13.0
LSD.(0.005)	1.2
CV(%)	15.6

Discussion

PCA could separated the spectra of normal mango from the spectra of chilling injury mango with PC2 vs. PC3. The similar result also reported by Li et al. (2007) who used PCA to discriminate the spectra of four varieties of Chinese berry with PC1 vs. PC2. Since, the PCs summarize the systematic patterns of variation between samples and could describe as much as possible the variations of the spectra in as few PCs as possible (Martens and Martens, 2001). Moreover, the spectra contained the information of mango properties such as the electrolyte leakage and chemical composition which it related to the chilling injury symptom of mango.

Conclusion

Near infrared could be a new technique to be useful for detecting the chilling injury symptom of mango fruit.

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References

Iwamoto, M., S. Kawano and Y. Ozaki. 1995. An overview of research and development of near infrared spectroscopy in Japan. *J. Near Infrared Spectrosc*. 3: 179-189.

Li, X., Y. He and H. Fang. 2007. Non-destructive discrimination of Chinese bayberry varieties using Vis/NIR spectroscopy. *Journal of Food Engineering* 81:358-363.

Lizada, M.C.C. 1993. Mango. In: Seymour, G.B. Taylor, J.E. Tucker, G.A. (Eds.), Biochemistry of Fruit Ripening. Chap man & Hall, London, pp.255-271.

Martens, H. and M. Martens. 2001. Multivariate Analysis of Quality: An Introduction. John Wiley & Sons Ltd., England. 445 p.

Mitra, S.K. and E.A. Baldwin. 1997. Mango. pp. 12-20. In: S. Mitra, (Eds.), Postharvest Physiology and Storage of Tropical and Subtropical Fruits. CAB International, Wallingford, Florida.

Osborne, B.G., T. Fearn and P.H. Hindle. 1993. Practical NIR Spectroscopy with Applications in Food and Beverage Analysis. Longman Group, UK. 227p.

Wang B., J. Wang, H. Liang, J. Yi, J. Zhang, L. Lin, Y. Wu, X. Feng, J. Cao and W. Jiang. 2008. Reduced chilling in mango fruit by 2,4-dichlorophenoxyacetic acid and the antioxidant response. *Postharvest Biology and Technology* 48:172-181.