CHAPTER 4

RESULTS

4.1 Experiment I Effect of UV-B irradiation on chlorophyll-degrading enzyme activities and postharvest quality in stored lime (*Citrus latifolia* Tan.) fruit

1. Effect of UV-B irradiation on Postharvest qualities of lime fruit

Surface colour was evaluated through the hue angle. As shown in Fig. 4.1, hue angle value in the control declined significantly during storage 25 °C and enhancing the yellowing of peel fruit. In contrast to those of UV-B at 19.0 kJm^{-2} lime fruits which changed little during storage (Fig. 4.2). The citric acid content in the fruit juice in the control showed an important decreased after 10 d, while UV-B at 19.0 kJm^{-2} treated fruit increased constant until day 20 and then decreased (Fig. 4.3A). The malic acid content decreased markedly in both UV-B treatment and control (Fig. 4.3B). As a consequence, UV-B treatment showed significant higher contents of citric acid and malic acid. Immediately after treatment the fructose (Fig. 4.4A), glucose (Fig. 4.4B) and sucrose contents (Fig. 4.4C) were slightly higher in control of day 5 and then decreased during storage. UV-B treatment, the level of fructose, glucose and sucrose contents were also increased until day 10 and then slightly decreased with increased after day 20.

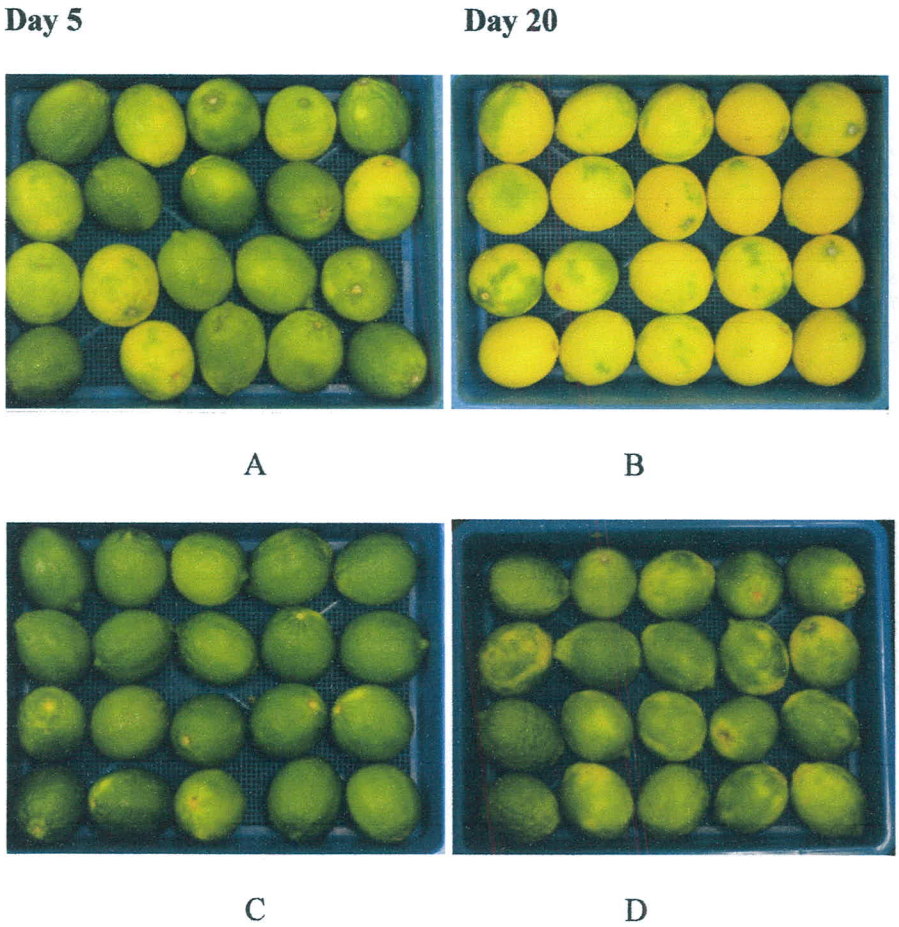

Fig. 4.1 Changes color of lime fruit treated with UV-B at 0 (Control) (A and B) and 19.0 kJm^{-2} (C and D) during storage at 25 °C of day 5 and 20.

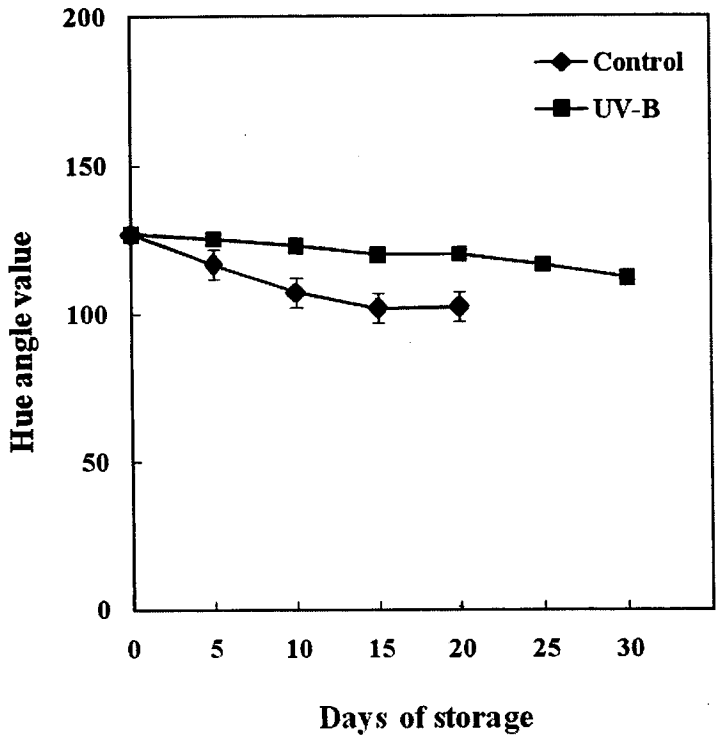

Figure 4.2 Changes in the hue angle value of the peel colour of lime fruits treated with UV-B at 0 (Control) and 19.0 kJm^{-2} during storage at 25 °C. Vertical bars represent the average values with SE (n = 3).

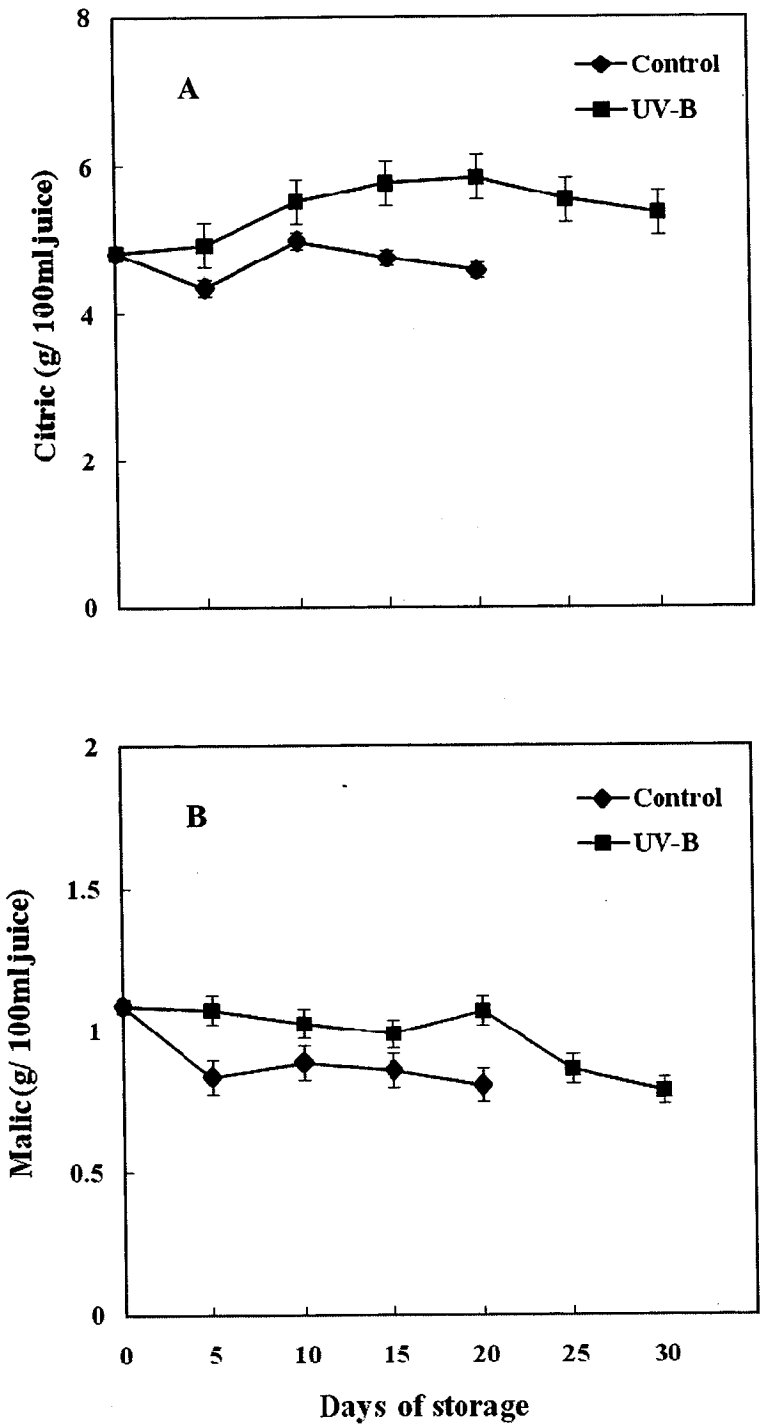

Figure 4.3 Changes in citric acid (A) and malic acid (B) contents of the juice in lime fruits treated with UV-B at 0 (Control) and 19.0 kJm^{-2} during storage at 25 °C. Vertical bars represent the average values with SE (n = 3).

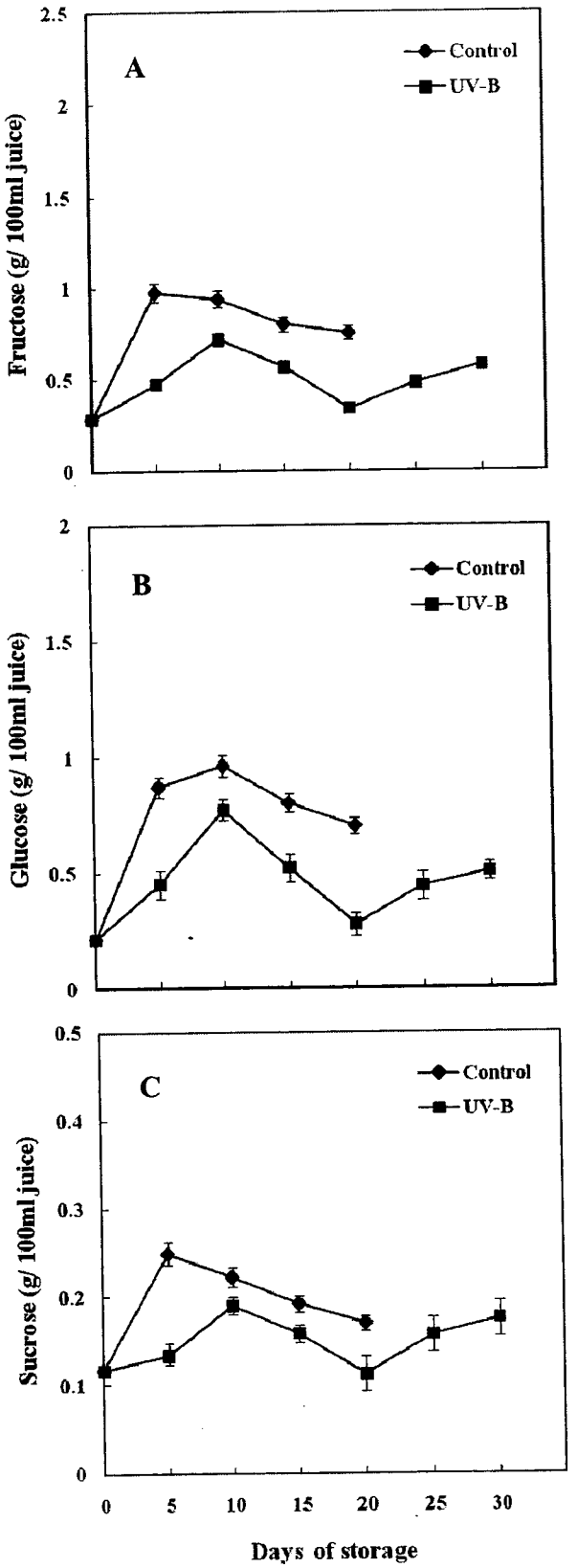

Figure 4.4 Changes in fructose (A), glucose (B) and sucrose (C) contents of the juice in lime fruits treated with UV-B at 0 (Control) and 19.0 kJm^{-2} during storage at 25 °C. Vertical bars represent the average values with SE (n = 3).

2. Effect of UV-B irradiation on chlorophyll degradation and chlorophyll-degrading enzyme activities of lime fruit

UV-B treatment delayed the reduction of Chl *a* and Chl *b* contents in limes, as shown in Fig. 4.5. The Chl *a* content in lime peel treated with UV-B was delayed of the reduction during storage, whereas that in the control sharply decreased after day 0 until the end of storage (Fig. 4.5A). In the case of Chl *b*, the change in content was similar to that of Chl *a* contents during storage (Fig. 4.5B). The lime fruit treated with UV-B had a higher content of Chl *b* than the control fruit.

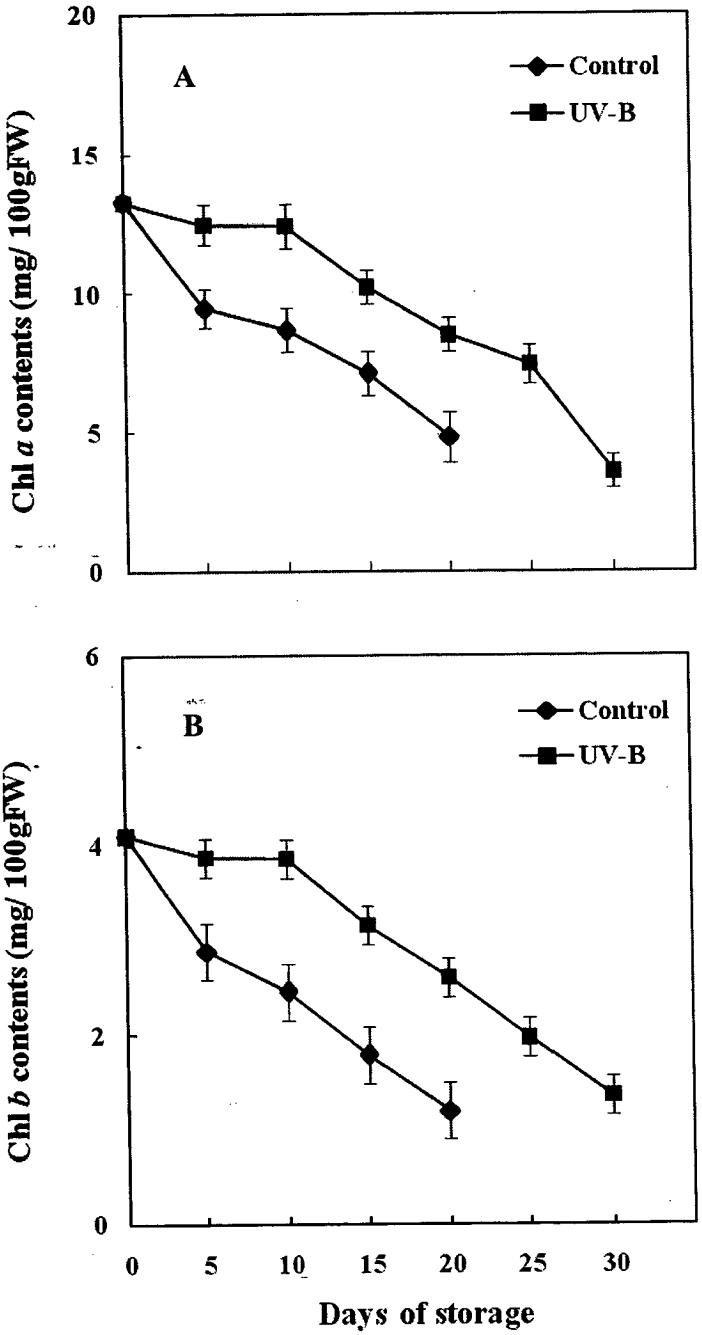

Figure 4.5 Changes in Chl *a* (A) and Chl *b* (B) contents in lime fruits treated with UV-B at 0 (Control) and 19.0 kJm^{-2} during storage at 25 °C. Vertical bars represent the average values with SE (n = 3).

In Fig. 4.6A, Chlase activity increased in the control lime during storage at 25 °C. While, Chlase activity in UV-B treatment was a little change during storage but remained below the activity in compare the control. Notably, Chlase activity was suppressed by UV-B treatment after 10 day of storage. Chl-POX activity markedly increased in both the control and the UV-B treatment along the storage period. Moreover, UV-B treatment showed lower Chl-POX activity than the control (Fig. 4.6B). In this study, MDS activity was examined by using Chlide *a* as a native substrate. MDS activity showed an increase until day 15 and then slightly decreases. UV-B treatment also showed an increase in MDS activity immediately after treatment and after 5 d. (Fig. 4.7A). However, after that MDS activity dropped to lower levels than those found in the control. In the case of a new enzyme, PPH activity was determined. PPH activity in the control started to increase until day 15 and then slightly decreased during storage. While, the UV-B treatment sharply reached in PPH activity after treatment through 5 d and then significant declined to lower than the control (Fig. 4.7B).

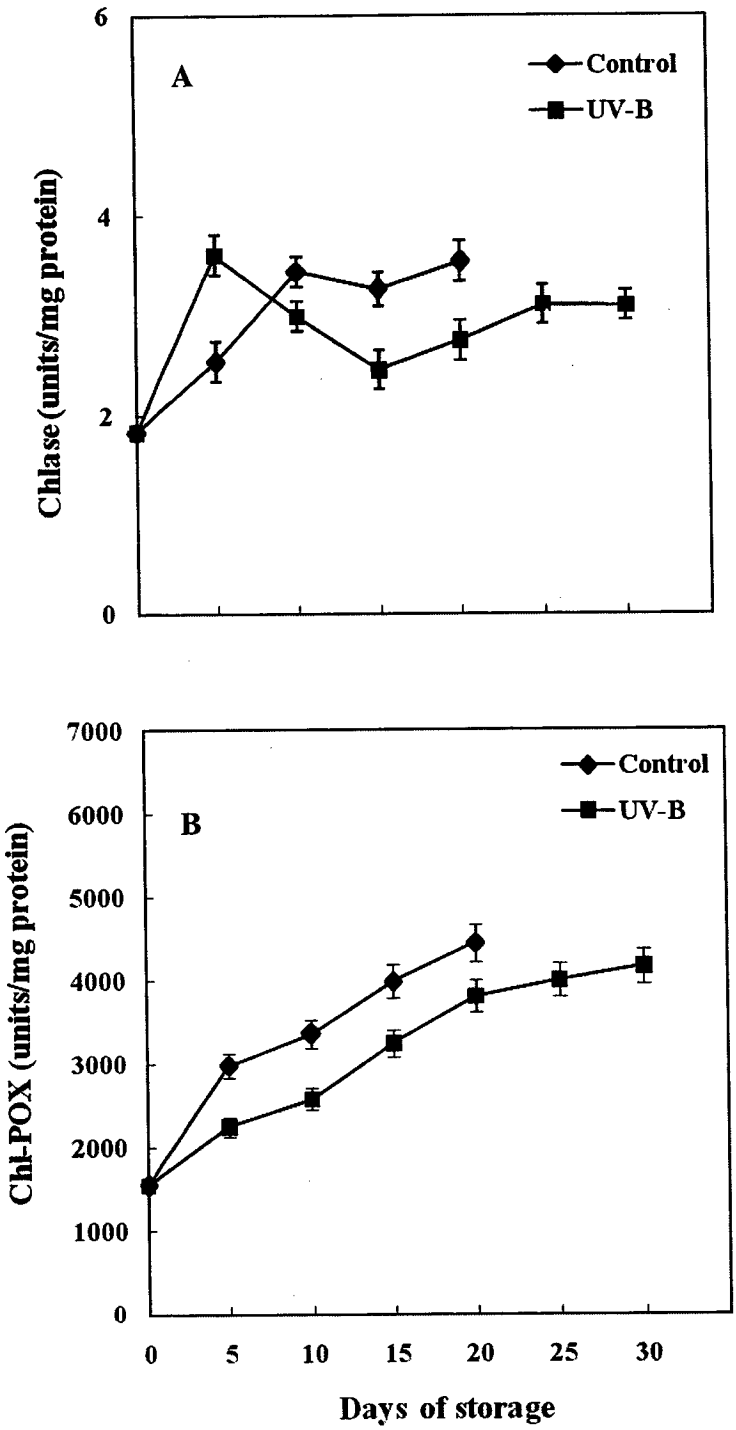

Figure 4.6 Changes in Chlase (A) and Chl-POX (B) activities in lime fruits treated with UV-B at 0 (Control) and 19.0 kJm^{-2} during storage at 25 °C. Vertical bars represent the average values with SE (n = 3).

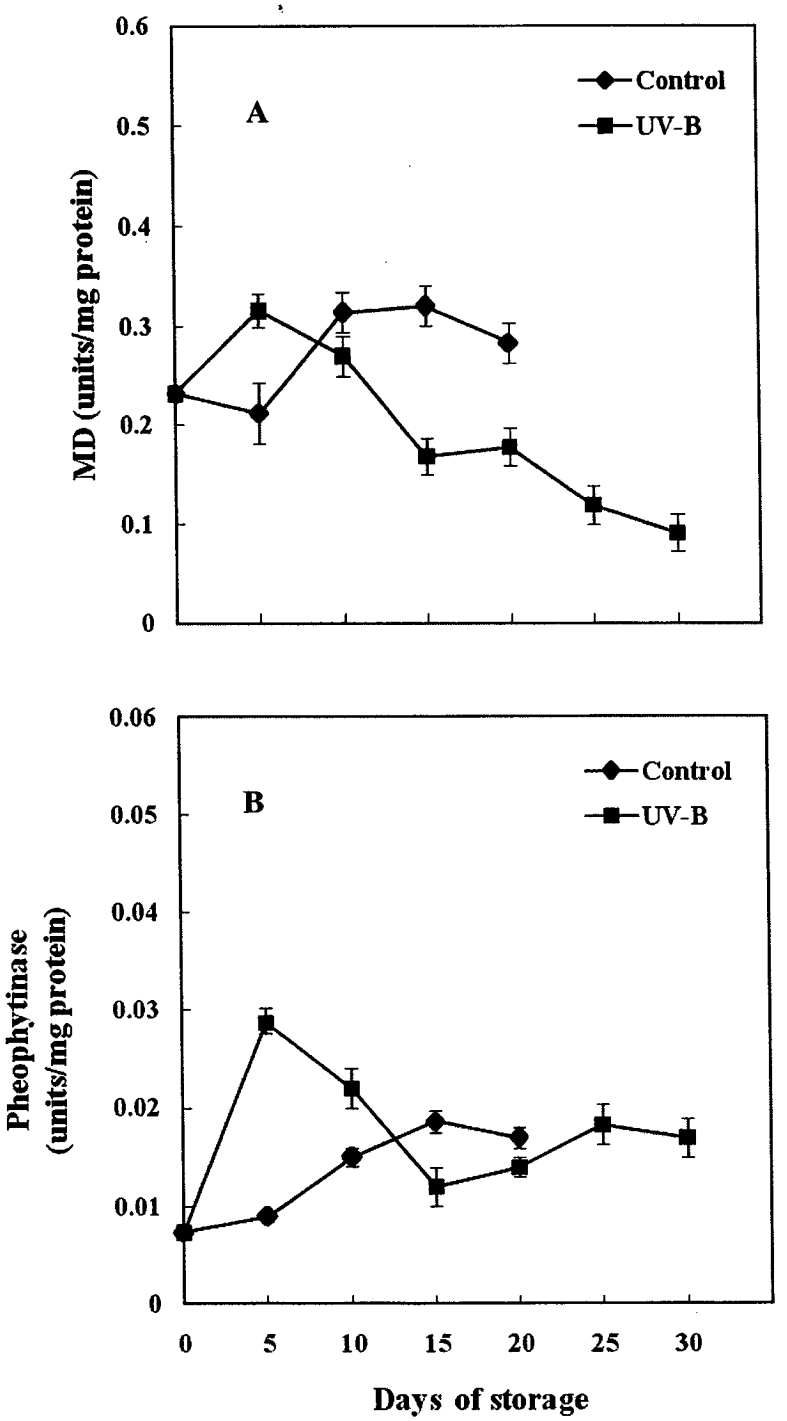

Figure 4.7 Changes in MDS (A) and PPH (B) activities in lime fruits treated with UV-B at 0 (Control) and 19.0 kJm^{-2} during storage at 25 °C. Vertical bars represent the average values with SE (n = 3).

3. Effect of UV-B irradiation on weight loss and stomatal apertures of lime fruit

Weight loss by the control and UV-B treated fruit in creased relative to length of the storage. Weight loss of the control was significantly greater than that in UV-B treated fruit (Fig. 4.8).

To evaluate the UV-B treatment that affects on stomatal using epidermal peels of lime fruit every 10 days until the end of storage. The stomatal in the control lime fruit showed still close from day 0 (Fig. 4.9A) and its started to little open on day 20 (Fig. 4.9B). However, stomatal was completely opened in last day of storage (day 30) of the control (Fig. 4.9C). On other hand, the stomatal in UV-B treatment was no significant opened throughout storage of lime fruit (Fig. 4.9 D, E and F).

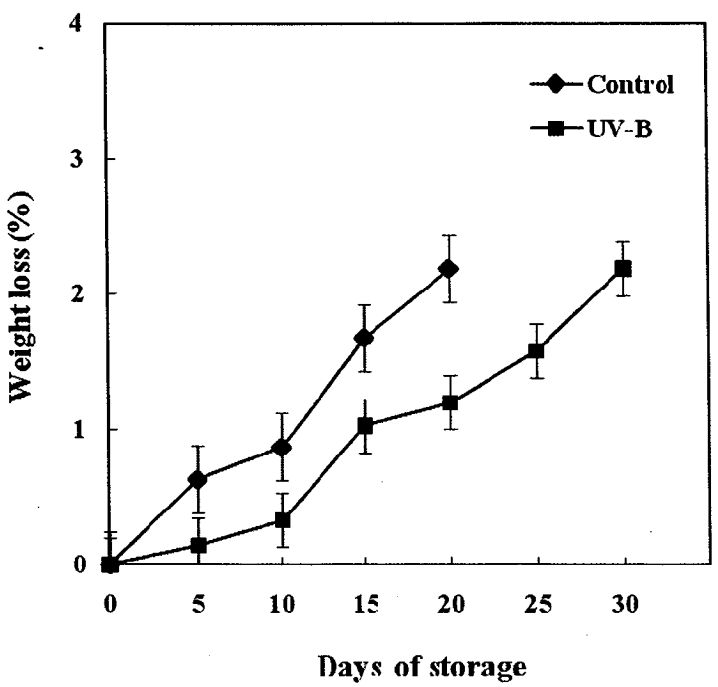

Figure 4.8 Changes in weight loss in lime fruits treated with or without UV-B at 19.0 kJm^{-2} during storage at 25 °C.

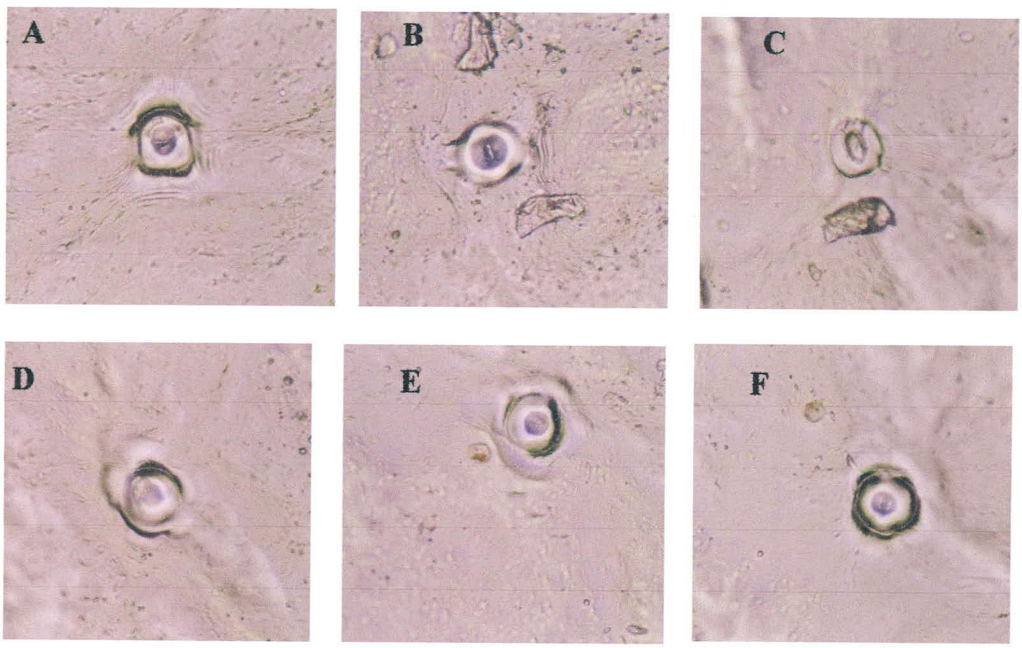

Figure 4.9 Changes in stomatal apertures in lime fruit at 25 °C. With UV-B at 0 kJm^{-2} (Control) at day 0 (A), day 20 (B) and day 30 (C). UV-B treatment at 19.0 kJm^{-2} at at day 0 (D), day 20 (E) and day 30 (F).

4.2 Experiment II Hot water treatment delays chlorophyll degradation and postharvest quality in lime (*Citrus aurantifolia* Swingle cv. Paan) fruit

1. Effect of hot water treatment on surface color and chlorophyll content during storage of lime fruit

Hue angle value in the control and hot water treatment at 50 °C for 3 min declined significantly during storage 13 °C and enhancing the yellowing of peel lime fruit. In contrast to those of hot water treatment at 50 °C for 5 min of lime fruits which changed little during storage (Fig. 4.10). Hot water treatment at 50 °C for 5 min efficiently delayed the decrease of the hue angle value.

Hot water treatment at 50 °C delayed the reduction of Chl *a*, *b* and total Chl contents in limes, as shown in Fig. 4.11. The Chl *a* and total Chl contents in lime peel treated with hot water treatment at 50 °C for 5 min was delayed of the reduction during storage, whereas that in the control sharply decreased after day 0 until the end of storage (Fig. 4.11A,C). In the case of Chl *b*, the change in content was similar to that of Chl *a* contents during storage (Fig. 4.11B). The lime fruit treated with hot water treatment at 50 °C for 5 min had a higher content of Chl *b* than the control and hot water treatment at 50 °C for 3 min.

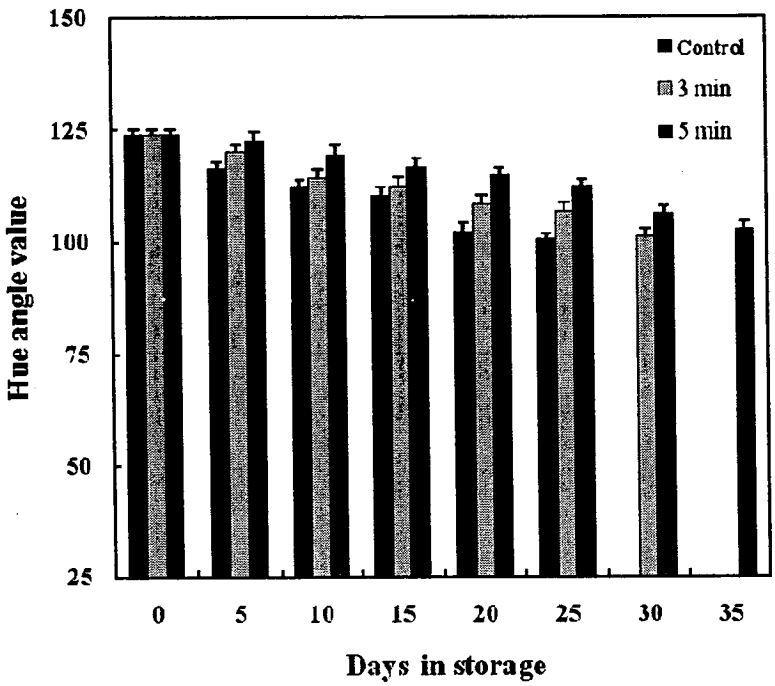

Figure 4.10 Changes in the hue angle value of the peel colour of lime fruits treated with hot water treatment at 0 (Control), 3 and 5 min during storage at 13 °C. Vertical bars represent the average values with SE (n = 3).

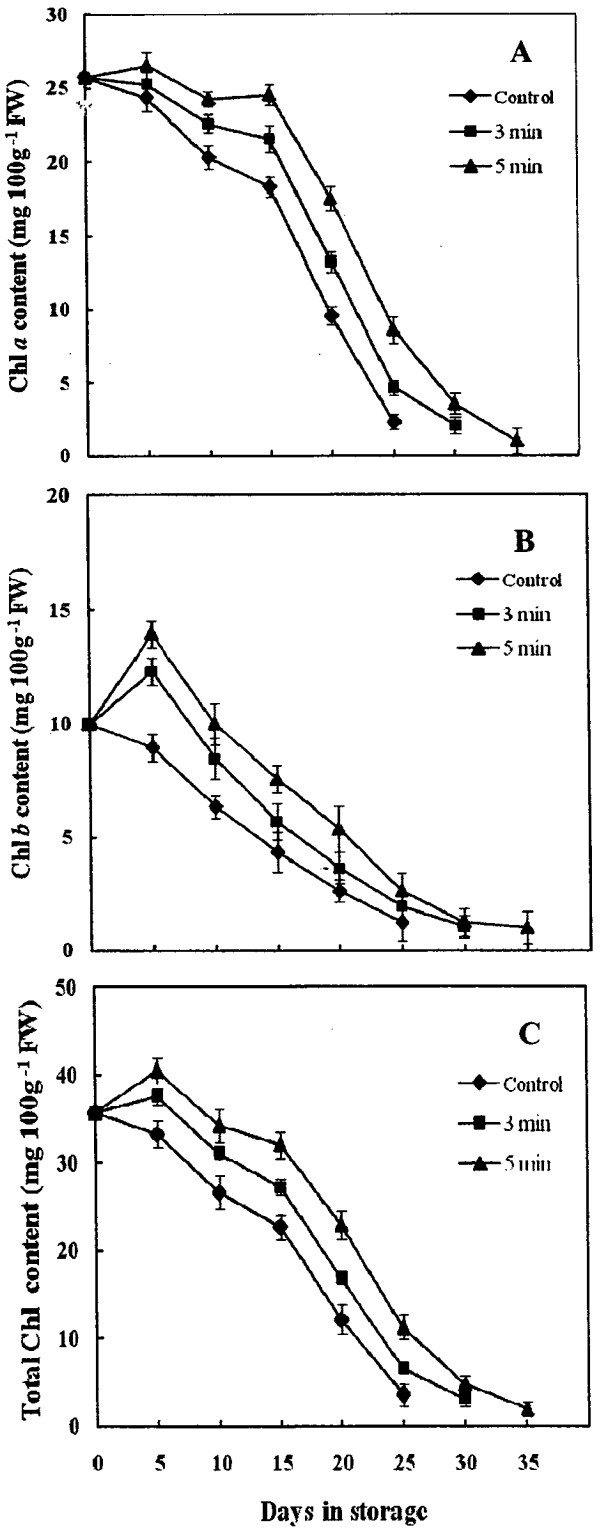

Figure 4.11 Changes in the Chl *a* (A) Chl *b* (B) and total Chl (C) contents of lime fruits treated with hot water treatment at 0 (Control), 3 and 5 min during storage at 13 °C. Vertical bars represent the average values with SE (n = 3).

2. Effect of hot water treatment on chlorophyll-degrading enzyme activities of lime fruit

In Fig. 4.12A, Chlase activity increased in the control lime during storage at 13 °C. While, Chlase activity in hot water treatment at 50 °C was a little change during storage but remained below the activity in compare the control. Notably, Chlase activity was most suppressed by hot water treatment at 50 °C for 5 min during storage. Chl-POX activity markedly increased in both the control and hot water treatment at 50 °C along the storage period. Moreover, hot water treatment at 50 °C for 5 min showed the lowest Chl-POX activity than the control (Fig. 4.12B). In this study, MDS activity was examined by using Chlide *a* as a native substrate. MDS activity showed an increase until day 5 and then slightly decreases. However, after that MDS activity of hot water treatment at 50 °C for 5 min dropped to lower levels than those found in the control (Fig. 4.13A). In the case of PPH activity was determined. PPH activity in the control started to increase until day 5 and then slightly decreased during storage. The hot water treatment at 50 °C for 5 min showed in PPH activity significant declined to lower than the control (Fig. 4.13B).

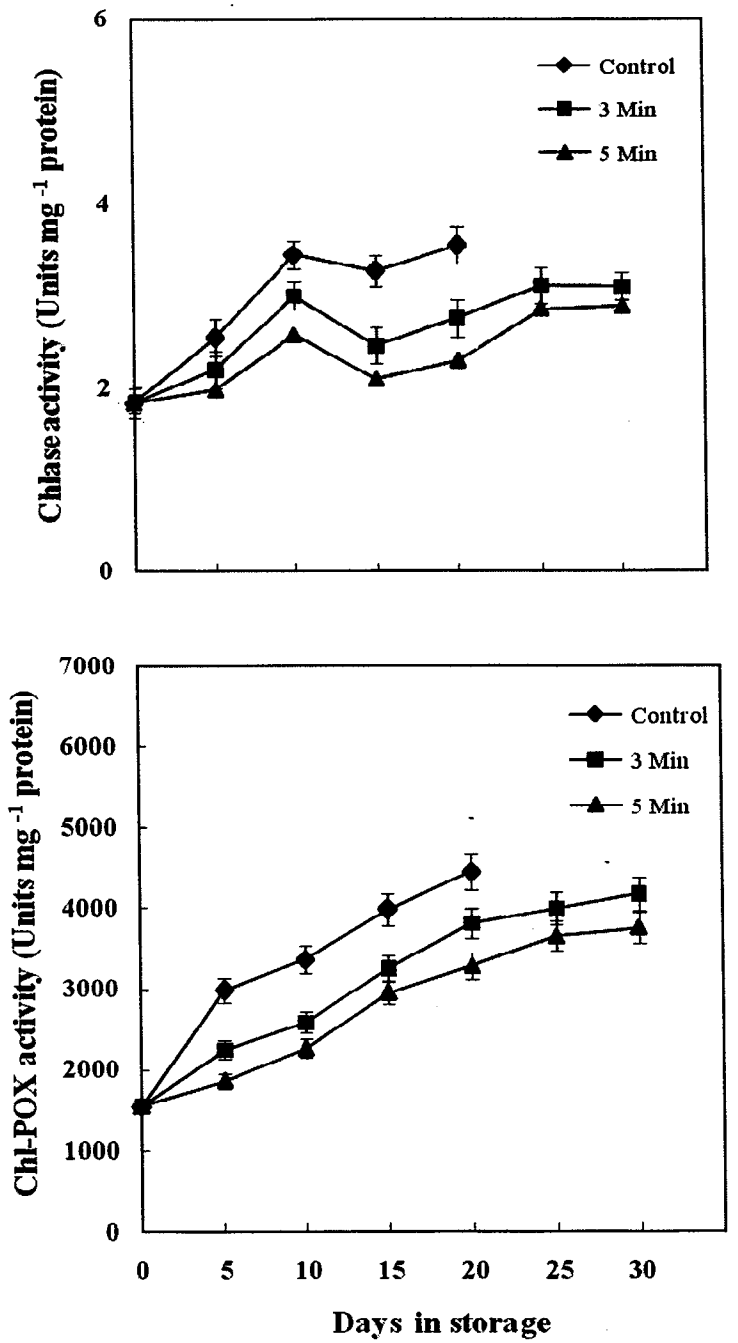

Figure 4.12 Changes in Chlase (A) and Chl-POX (B) activities of lime fruits treated with hot water treatment at 0 (Control), 3 and 5 min during storage at 13 °C. Vertical bars represent the average values with SE (n = 3).

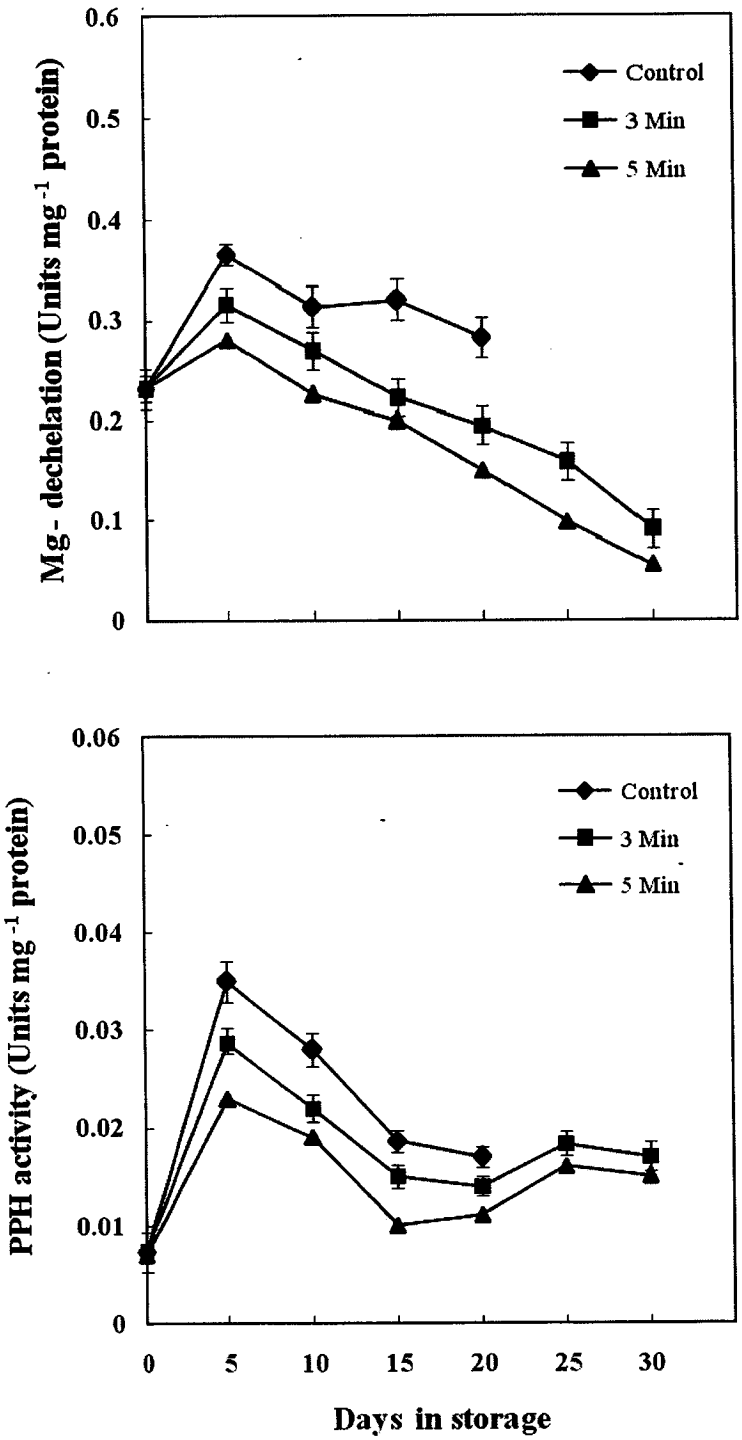

Figure 4.13 Changes in MDS (A) and PPH (B) activities of lime fruits treated with hot water treatment at 0 (Control), 3 and 5 min during storage at 13 °C. Vertical bars represent the average values with SE (n = 3).

3. Effect of hot water treatment on postharvest physiology of lime fruit

Weight loss by the control and hot water treatment at 50 °C increased relative to length of the storage. Weight loss of the control and hot water treatment at 50 °C for 5 min was significantly greater than that in hot water treatment at 50 °C for 3 min (Fig. 4.14).

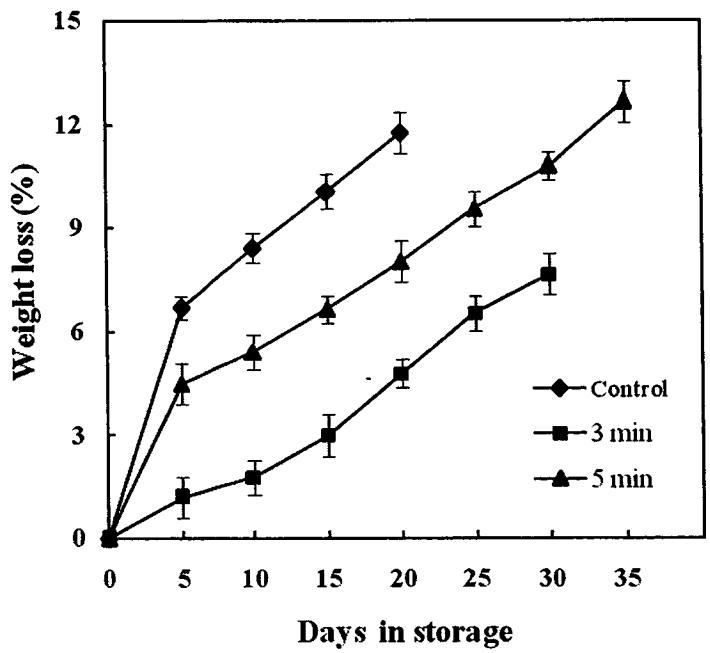

Figure 4.14 Changes in weight loss of lime fruits treated with hot water treatment at 0 (Control), 3 and 5 min during storage at 13 °C. Vertical bars represent the average values with SE (n = 3).

Respiration rate and ethylene production increased a little in both the control and hot water treatment at 50 °C along the storage period. Moreover, hot water treatment at 50 °C for 5 min showed the lowest respiration rate and ethylene production than the control (Fig. 4.15, 4.16).

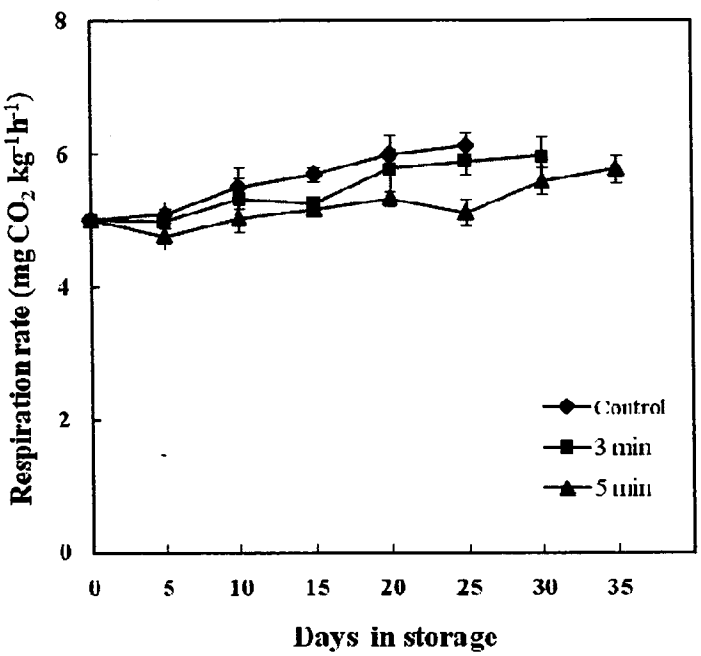

Figure 4.15 Changes in respiration rate of lime fruits treated with hot water treatment at 0 (Control), 3 and 5 min during storage at 13 °C. Vertical bars represent the average values with SE (n = 3).

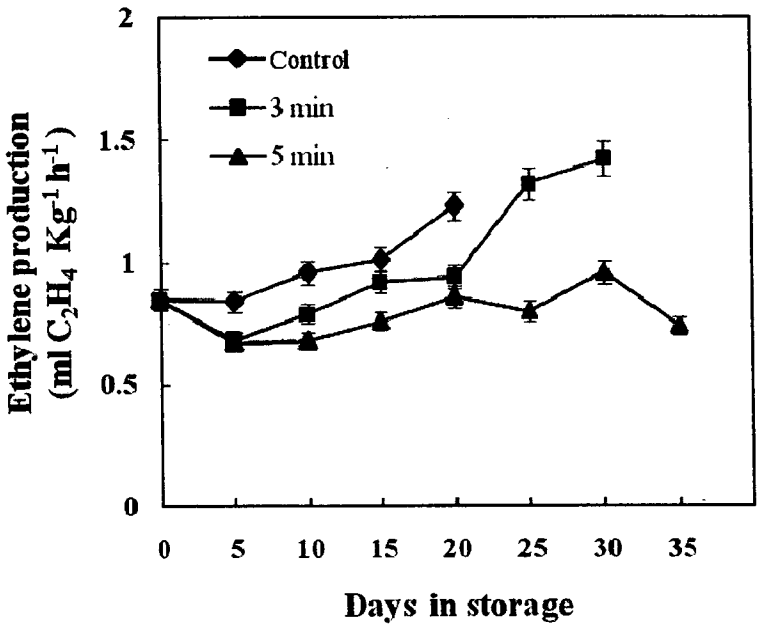

Figure 4.16 Changes in ethylene production of lime fruits treated with hot water treatment at 0 (Control), 3 and 5 min during storage at 13 °C. Vertical bars represent the average values with SE (n = 3).

4. Effect of hot water treatment on postharvest qualities of lime fruit

In relation to postharvest quality, all treatment resulted in storage life of 25, 30 and 35 days at control and hot water treatment at 50 °C for 3 and 5 min, respectively. Hot water treatment at 50 °C for 5 min caused the highest maintenance of total acidity (Fig. 4.17) and suppression the increase of total soluble solid during storage (Fig. 4.18).

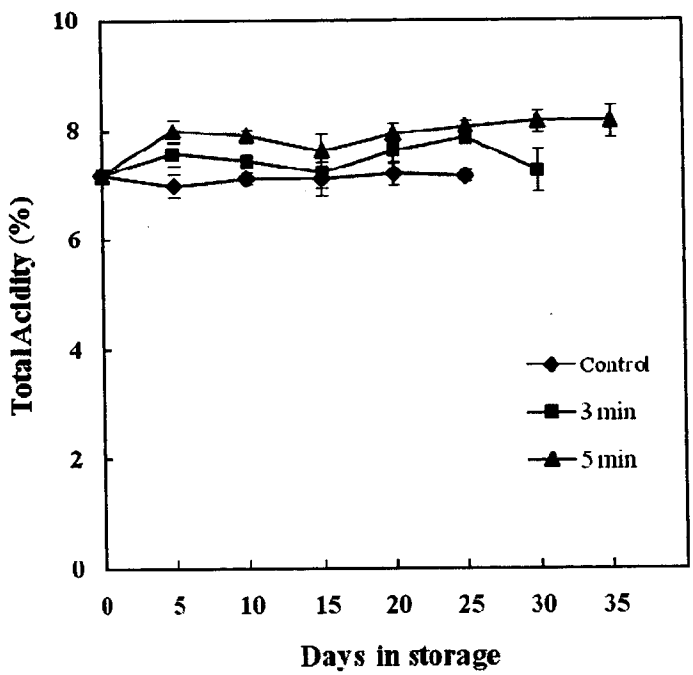

Figure 4.17 Changes in titratable acidity of lime fruits treated with hot water treatment at 0 (Control), 3 and 5 min during storage at 13 °C. Vertical bars represent the average values with SE (n = 3).

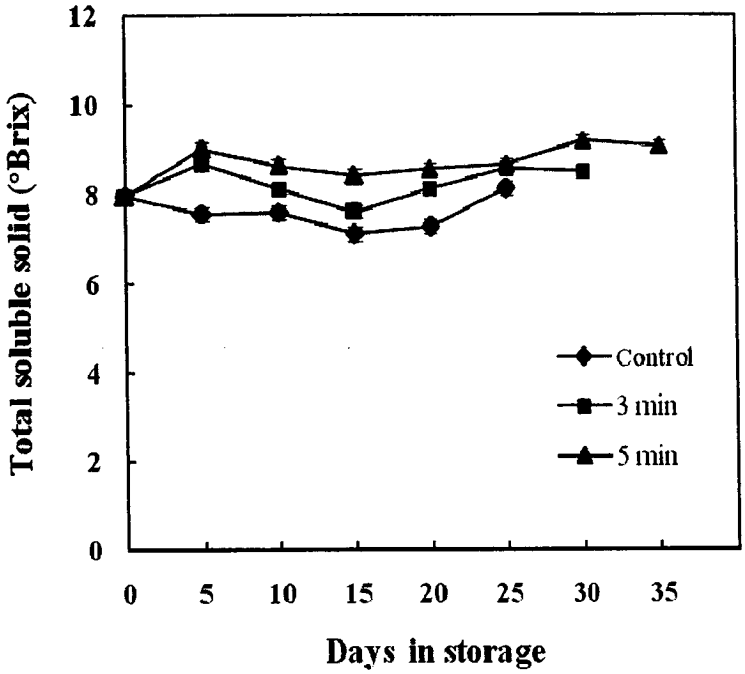

Figure 4.18 Changes in total soluble solid of lime fruits treated with hot water treatment at 0 (Control), 3 and 5 min during storage at 13 °C. Vertical bars represent the average values with SE (n = 3).