CHAPTER 5

EXTENSION OF POSTHARVEST HANDLING TECHNIQUES FOR COMMERCIAL VIETNAMESE LONGAN FRUIT CV. LONG

5.1. Introduction

At present in Vietnam, the method recommended for controlling postharvest decay and preventing the pericarp browning of 'Long' longan fruit, is to dip the fruits in 0.2% carbendazim solution for 3 minutes and then store them at 10ºC, and results show that using this method can prolong the shelf-life of the fruits and maintain good quality for 20 days, with a rate of fruit decay of about 10% (Nguyen *et al*., 2001). Longan consumers are becoming cautious regarding carbendazim residues, due to the fact that it is a type of pesticide and is harmful to human health, so should be used for planting. There is thus a need to develop effective methods that can replace the carbendazim treatment, methods that are less harmful to humans and the environment.

The main purpose of this study was to use the best treatment described in Chapters 3 and 4 with 'Long' longan fruit stored in large quantities for commercial purposes. This study also investigated the storage life of individual fruits stored at 25ºC±2ºC and at ambient temperature, having already been stored at 5ºC±1ºC for 28 days.

5.2. Material and Methods

5.2.1. Plant material

Mature 'Long' longan fruits from the 2010 crop of a commercial orchard in Hung Yen Province, Vietnam, were used for this research. Fruit age at harvesting date was 180 days after full bloom. Fruits were harvested, packaged, transported and selected in the same way as for Chapters 3 and 4. Their initial qualities were also assessed, with the average results from the testing of eighteen fruits being as follows: (i) the thickness of the pericarp was 0.72 ± 0.03 mm, (ii) the thickness of the flesh was 3.8 ± 0.4 mm, (iii) the diameter of the fruit was 25.15 ± 1.8 mm, (iv) the weight of the fruit was 8.16 ± 0.5 g, (v) the weight of the seeds was 1.29 ± 0.4 g, (vi) the soluble solids content was 17.8 ± 2.3 %Brix, and (vii) the color of the fresh fruit expressed as an L* value (lightness) was 47.3 ± 1.8; the a* value (redness) was 7.9 ± 1.3, and b* value (yellowness) was 26.9 ± 1.5.

5.2.2. Methods

The data collection methods used were similar to the methods described in Chapters 3 and 4, and included: measurement of fruit weight and diameter; observation of the changes in visual appearance of the fruit, the measurement of fruit pericarp color and total soluble solids content; an evaluation of sensory properties; assessment of fruit decay; an evaluation of the percentage of fruit drop; the determination of storage life; and a statistical analysis.

- Analysis of sulfur dioxide residue

Longan fruits given the best treatment, this is, soaked in 7.5% sodium metabisulfite (SMB) for 10 minutes, were selected for the analysis of sulfur dioxide (SO_2) residues at 7 day intervals. A 50 g sample from the flesh and pericarp of the fruits was obtained from a minimum of 30 fruits and stored overnight at -70°C. Samples were then examined in duplicate for SO_2 residue according to De-Vries *et al*. (1986).

5.2.3. Experimental design

The best treatment - soaking 'Long' longan fruits in 7.5% SMB solution for 10 minutes, was used for both individual and bunches of longan fruit. After treatment, the longan fruits were air dried at room temperature (25 ± 2ºC) for 10 minutes and packed in polypropylene bags (508 x 762mm in size, and 0.035 mm thick) with 5 kg being placed in each bag. A completely randomized design was used for the experiment. Each treatment and the control went through three replications, after which the bags were stored at 5±1ºC in a cold room and sampled for analysis at 7 day intervals.

After 28 days in storage at 5±1ºC, individual fruits continued to be assessed for storage life and postharvest quality at 25ºC ± 2ºC and ambient temperature to assess quality within marketing.

5.3. Results and Discussion

5.3.1. Changes in visual appearance

The visual appearance of 'Long' longan fruits during storage period at 5ºC was expressed using the flesh color index (FCI) and browning index (BI). **Figure 5.1** and **Appendix Table C1** show the impact of the best treatment on the BI of both individual fruits and bunches of fruit, when compared to the control fruits. Fruits with a BI above 2.0 were considered as unacceptable for sales and marketing purposes. According to **Figure 5.1**, there was a significant difference in the BI scores of the treated and the control fruits during the storage period ($P \leq 0.05$). The control fruits were not acceptable by day 7 in storage as they had a BI of above 2.0; their BI even reached 4.8 by day 28 in storage. Our results are consistent with other studies on the BI of longan fruit (Nguyen *et al*., 2001; Jaitrong, 2006; Whangchai *et al*., 2006; Apai, 2009 and 2010). Disease incidence is one factor that has an effect on browning development (Jiang *et al*., 2002). The BI of the treated individual fruits and the treated bunches of fruit was not different and both sets of fruit were acceptable (BI below 2.0) after 21 days in storage ($P \leq 0.05$). Treated fruits stored at 5ºC significantly delayed pericarp browning for 20 days (Apai, 2009). There was a significant difference in BI between the treated individual fruits and the treated bunches of fruit by day 28; after 28 days in storage the treated individual fruits retained a BI below 2.0 and the fruits were acceptable for marketing purposes. The SO_2 treatment inhibited browning (Whangchai *et al*., 2006). Our results are consistent with another study on the BI for litchi fruit pericarp (Joas *et al*., 2005).

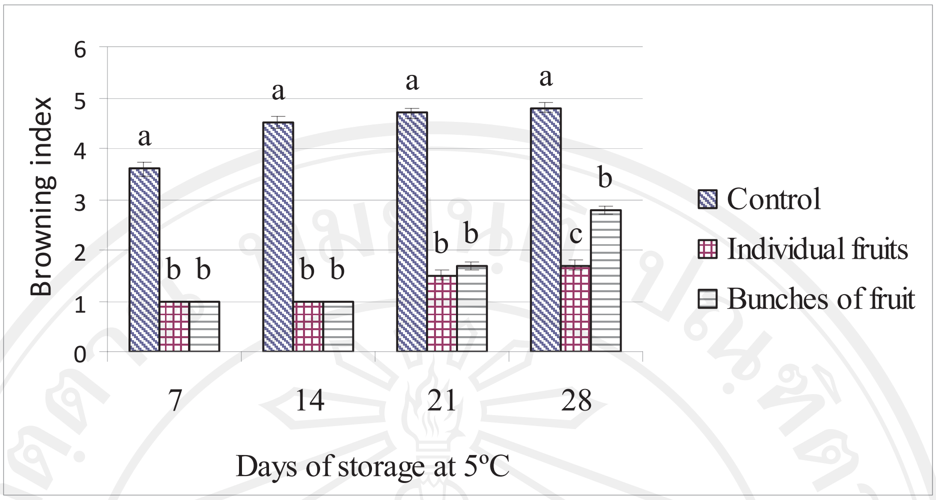

Figure 5.1 Changes in pericarp browning index (BI) of both 7.5% SMB treated individual longan fruits and bunches of longan fruit compared with the control during storage period at 5ºC.

BI: 1 = 0%; 2 = 1-25%; 3 = 26-50%; 4 = 51-75%, and; 5 = 76-100% pericarp browning area. Fruits with BI above 2.0 were considered as unacceptable. Vertical bars represent standard errors. Columns with different letters indicate significant differences by Duncan's multiple range test ($P \leq 0.05$).

The changes in FCI of the treated fruits as compared to the control fruits were observed and the results are shown in **Figure 5.2** and **Appendix Table C2**. Fruits with an FCI above 2.0 are considered unacceptable for sales and marketing purposes. After 7 in storage, the FCI was below 2.0 and was not different across all treatments; however, after 21 days in storage, the FCI of the control was above 2.0, and was significantly different to the FCI of the treated fruits. There was no difference in FCI among the treated fruits, and the fruits were still acceptable (BI below 2.0) after 28 days in storage ($P \leq 0.05$).

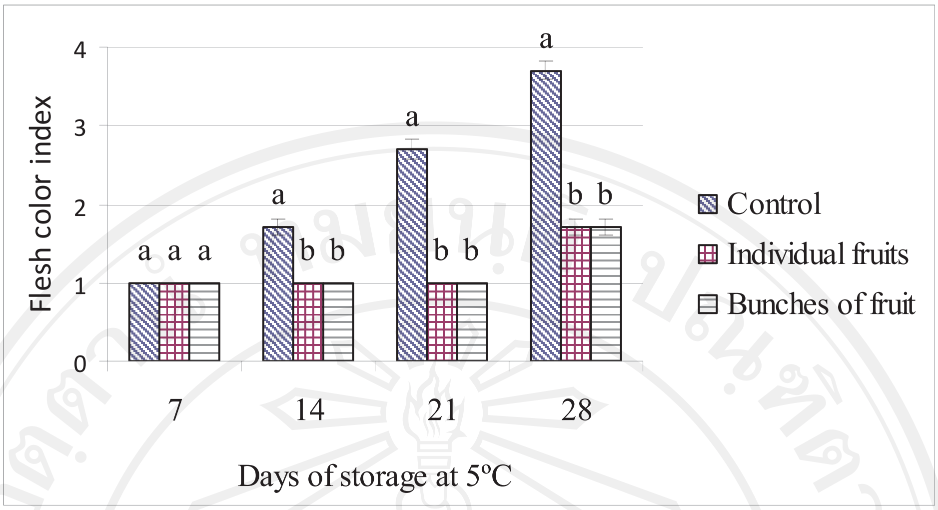

Figure 5.2 Changes in flesh color index (FCI) of both 7.5% SMB treated individual longan fruits and bunches of longan fruit compared with the control during storage period at 5ºC.

The index shown is: 1 = normal color; 2 = slightly abnormal color, but still acceptable; 3 = moderately abnormal color and unacceptable, and; 4 = severely abnormal color. Fruits with FCI above 2.0 were considered as unacceptable. Vertical bars represent standard errors. Columns with different letters indicate significant differences by Duncan's multiple range test ($P \leq 0.05$).

Overall, those fruits soaked in 7.5% SMB for 10 minutes showed the best visual appearance and the longest storage life at 28 days for individual fruits and at 21 days for bunches of fruit. Nguyen *et al*. (2001) found that the visual appearance quality of 'Long' longan fruit is acceptable after 20 days in storage at 10ºC.

5.3.2. Changes in L*, a*, and b* values

The impact of the best treatment on L* values (lightness) of the pericarp in both individual fruits and bunches of fruit, as compared to the control fruits, are shown in **Figure 5.3** and **Appendix Table C3**. The L* values of the treated fruits and the control tended to decrease during the storage period, and the L* values ranged from 40.2 to 48.7 by day 28 in storage. Rattanapanone *et al*. (2001) found that L* values for the outside of longan fruit pericarp cv. Daw decreased from 52.4 to 46.9 after 14 days in storage at 5ºC, Jaitron (2006) found that the L* values of longan fruit cv. Daw decreased from 53.2 to 41.6 after 14 days in storage at 5ºC, and Apai (2009) found that the L* values decreased when treated fruits were stored at 10ºC for 15 days. Our results are different to those of Shodchit *et al*. (2008), who found that the L* values of longan fruit pericarp ranged between 22.89 and 31.76 after 6 days at 15ºC. According to **Figure 5.3**, the L* values were not different among the treated fruits, though the L* values of the treated fruits were higher than those of the control fruits, and were significantly different from the L* values of the control fruits during the storage period ($P \leq 0.05$).

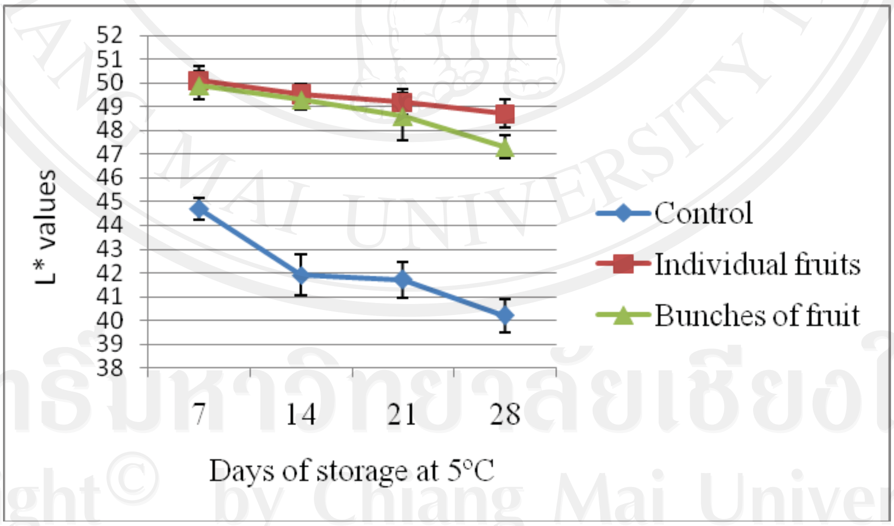

Figure 5.3 The changes in L* values of pericarp color of both 7.5% SMB treated individual fruits and bunches of fruit compared with the control fruits during storage period at 5ºC.

Vertical bars represent standard errors.

The a* values (redness) of the pericarp for both individual fruits and bunches of fruit soaked in 7.5% SMB for 10 minutes, as compared to the control fruits, are shown in **Figure 5.4** and **Appendix Table C4**. After 28 days in storage, the a* values ranged between 10.8 and 11.5. Sodchit *et al*. (2008) reported that the a* values of longan fruit pericarp cv. Daw treated with N-acetyl-L-cysteine and 4-hexylresorcinol ranged from between 5.1 and 6.59 by day 6 in storage at 15ºC. In **Figure 5.4** it can be seen that there was not a significant difference in the a* value of treated fruits during the storage period; the a* values of the control fruits were also not different on day 7 and 28, but were significantly different on day 14 and 21 under storage, when compared with the treated fruits ($P \leq 0.05$).

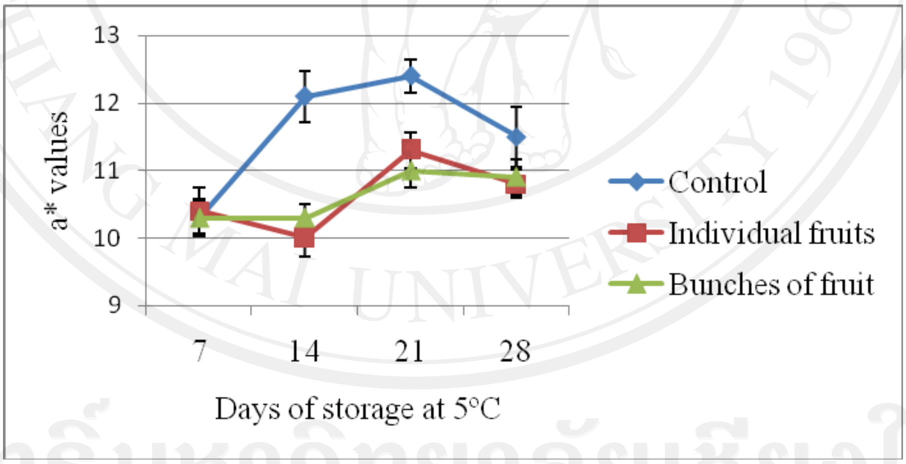

Figure 5.4 The changes in a* values of pericarp color of both 7.5% SMB treated individual fruits and bunches of fruit compared with the control fruits during storage period at 5ºC.

Vertical bars represent standard errors.

Figure 5.5 and **Appendix Table C5** show the impact of the optimum treatment on the b* values (yellowness) of the pericarp in the both the individual and bunches of fruit, as compared to the control fruits. It can be seen that there was a significant difference in the b* values of the treated and control fruits during the storage period. The b* values of the treated fruits were not different during the storage period, though by day 21 there was some difference seen ($P \leq 0.05$). According to **Figure 5.5**, the b* values of the treated and the control fruits decreased, ranging from 18.0 to 27.8 by day 28 in storage. The treated fruits revealed higher b* values than the control during the storage period. Sodchit *et al*. (2008) reported that the b* values of longan fruit pericarp cv. Daw, treated with N-acetyl-L-cysteine and 4-hexylresorcinol, ranged between 8.87 and 14.89 by day 6 in storage at 15ºC. Apai (2009) also reported decreasing b* values and a corresponding decrease in the BI.

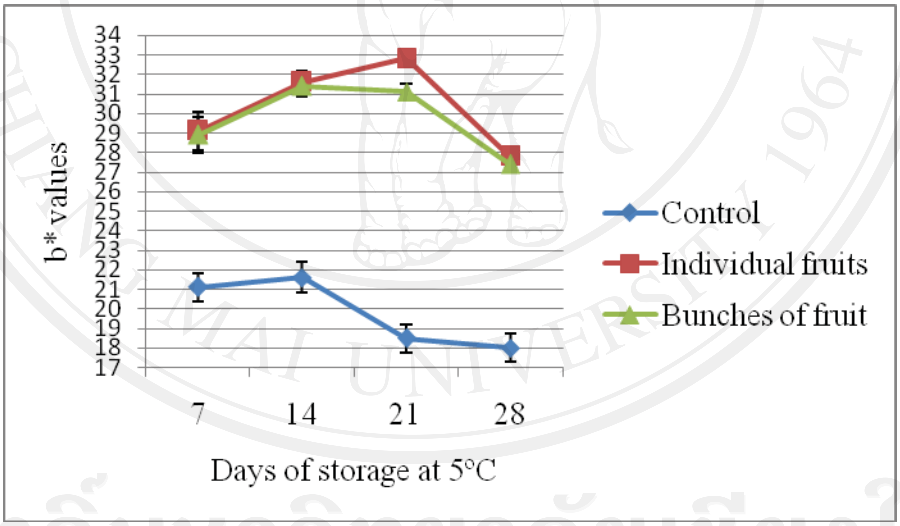

Figure 5.5 The changes in b* values of pericarp color of both 7.5% SMB treated individual fruits and bunches of fruit compared with the control fruits during storage period at 5ºC.

Vertical bars represent standard errors.

5.3.3. Changes in sensory quality

The changes in sensory quality of both the individual and bunches of fruit during storage time at 5ºC, as compared to the control fruits, are shown in **Figures**

5.6, **Appendix Table C6** and **Figure 5.7**, **Appendix Table C7**. For sensory quality, expressed using an odor and flavor score, then fruits with an odor or flavor score above 1.5 are considered abnormal and thus unacceptable for marketing purposes. From **Figure 5.6**, it can be seen that the odor scores for all treatments were below 1.5 and were not different to each other by day 7. After 14 days in storage, there was a significant difference in odor scores for all treatments. The odor score of the control was above 1.5 by day 14, whilst the odor scores of the treated fruits remained below 1.5 with no differences shown by day 21 and day 28 in storage ($P \leq 0.05$). According to **Figure 5.7**, the flavor scores of the treated fruits remained below 1.5, remaining similar throughout the storage period ($P \leq 0.05$). In contrast, the flavor score of the control was above 1.5 by day 14 in storage, and was significantly different from the scores for the treated fruits by day 14, 21 and 28 in storage. Generally, both the individual and bunches of fruit soaked in 7.5% SMB for 10 minutes revealed the best sensory quality and the longest storage life at 28 days. Our results differ from other studies into sensory quality of longan fruit (Thavong, 2009), in which the eating quality of all the treated fruit decreases gradually over the storage period (Whangchai *et al*., 2006)

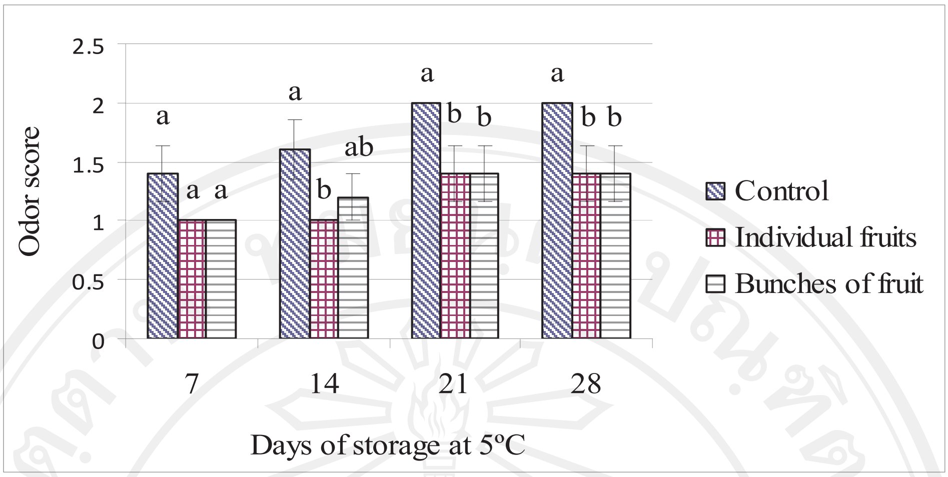

Figure 5.6 Changes in odor score of both 7.5% SMB treated individual longan fruits and bunches of longan fruit compared with the control during storage period at 5ºC.

Fruits with odor score above 1.5 were considered as unacceptable. Vertical bars represent standard errors. Columns with different letters indicate significant differences by Duncan's multiple range test ($P \leq 0.05$).

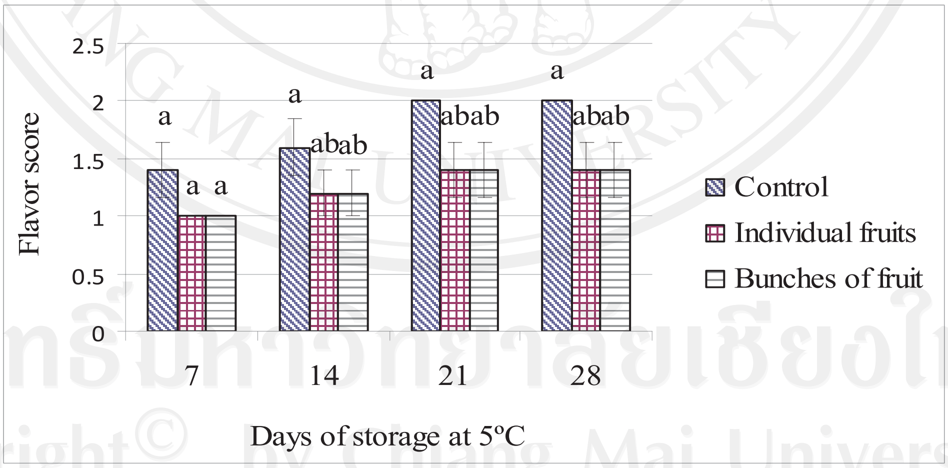

Figure 5.7 Changes in flavor score of bunches of both 7.5% SMB treated individual longan fruits and bunches of longan fruit compared with the control during storage period at 5ºC.

Fruits with flavor score above 1.5 were considered as unacceptable. Vertical bars represent standard errors. Columns with different letters indicate significant differences by Duncan's multiple range test ($P \leq 0.05$).

5.3.4. Changes in total soluble solids (TSS) content, fruit decay, and fruit drop

Figure 5.8 and **Appendix Table C8** show the TSS contents of both individual fruits and bunches of fruit soaked in 7.5% SMB for 10 minutes, as compared with the control fruits during the storage period. Overall, there was no difference in TSS contents between the treated fruits and the control fruits during the storage period ($P \leq 0.05$). After 28 days in storage, the TSS content ranged from 16.7 to 18.1 % Brix. The TSS content for all treatments varied in a narrow range, from 14.6 to 16.9 %Brix after 24 days in storage at 5ºC (Thavong, 2009). Our results are in accordance with reported data on the TSS contents of 'Long' longan fruit (Tran, 1999; Nguyen *et al*., 2001; Duong, 2003), and are also close to those found in fresh longan.

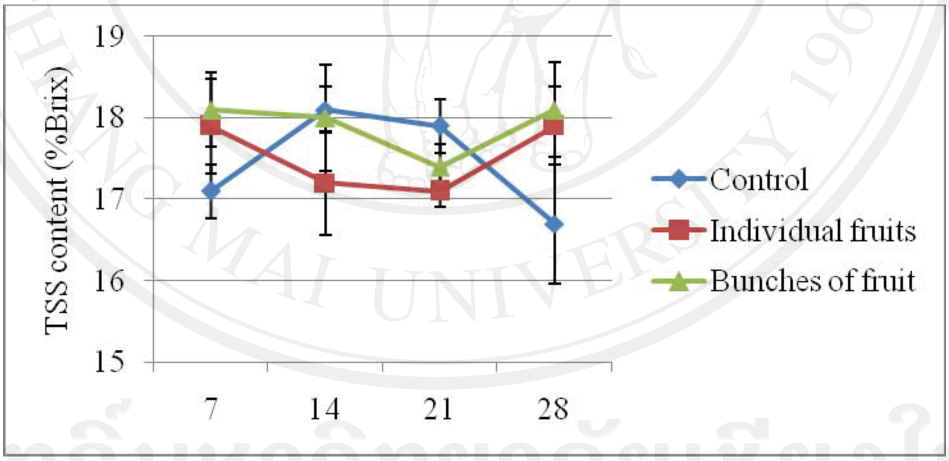

Figure 5.8 The changes in TSS content of both 7.5% SMB treated individual fruits and bunches of fruit compared with the control fruits during storage period at 5ºC.

Vertical bars represent standard errors.

The impact of the best treatment on the percentage of fruit decay in both the individual fruits and the bunches of fruit, as well as on the control fruits, is shown in **Table 5.1**. After 21 days in storage, the treated fruits showed 0% fruit decay, while the control fruits had 13.4% fruit decay. There was a significant difference in the percentage of fruit decay across all treatments by day 28 in storage (the control showed 100%, bunches of fruit was 5.3% and the individual fruit was 0% fruit decay). Our results are clearly different to the results of Nguyen *et al*. (2001), who in their study found that 'Long' longan fruit decay was about 10% after 20 days in storage. Apai (2009) also reported that fruit decay correlated with the browning index and that the control showed the highest level of fruit decay. The incidence of disease in the treated longan fruits increased with storage time (Shodchit *et al*., 2008; Apai, 2009). The SO_2 treatment decreased decay very significantly during the storage period (Whangchai *et al*., 2006). Activity packaging combined with three sheets of SO_2 grape guards delayed infection of the fruit with rot disease (Jitareerat and Uthairatanakij, 2007).

Table 5.1 The percentage of fruit decay in both 7.5% SMB treated individual fruits and bunches of fruit compared with the control fruits during storage period.

Treatment	Days of storage at 5ºC[1]			
	7	14	21	28
Control	0.0 ± 0.0	0.0 ± 0.0	13.4 ± 0.6a	100.0 ± 0.0a
Individual fruits	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0b	0.0 ± 0.0c
Bunches of fruit	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0b	5.3 ± 0.5b

[1]Means within a column with the same letter are not significantly different at 95% (P≤0.05) level by least significant difference comparison. Data are mean value ± SE.

The number of fruit falling from the bunches was recorded and the results are shown in **Figure 5.9**. The control fruits and treated fruits showed no fruit drop by day

14 in storage, but after that, the number of fruit falling from the bunches for both the control and the treated fruits increased significantly with increased storage time. After 21 days in storage, the percentage of fruit drop from treated bunches of fruit was 5.1% and the control was 5.9% but was not significantly different ($P \leq 0.05$). Our results are consistent with the findings of Shodchit *et al*. (2008), who reported that browning inhibitor has no impact on the percentage of fruit drop during storage period.

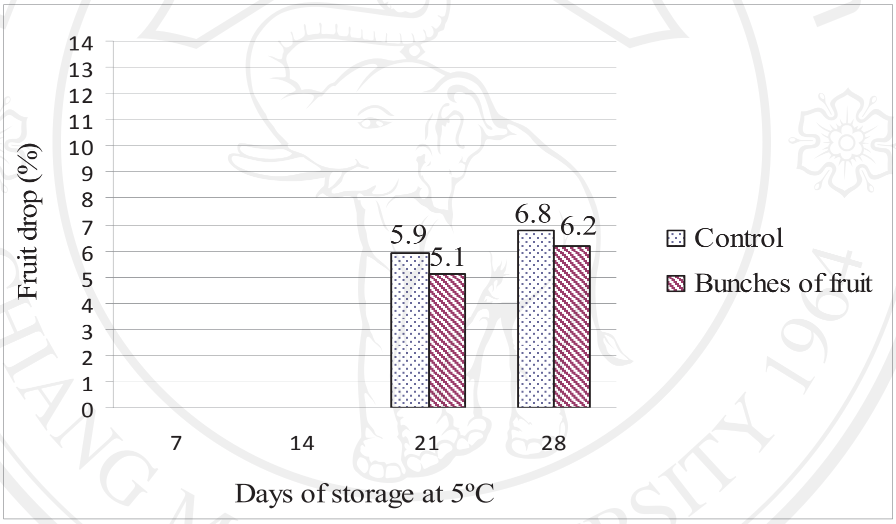

Figure 5.9 Effects of SMB on the percentage of fruit falling from 7.5% SMB treated bunches of fruit and the control fruits during storage period at 5ºC.

5.3.5. The SO_2 residue of longan fruit cv. Long during storage period

The amount of SO_2 residue in the 'Long' longan fruits after soaking them in 7.5% sodium metabisulfite solution for 10 minutes (day 0), and during the storage period, is shown in **Table 5.2**. It can be seen that the SO_2 residue left within the flesh was 0 ppm after soaking and during the storage period. This means that 'Long' longan fruits soaked in 7.5% sodium metabisulfite for 10 minutes had SO_2 residue levels in the flesh which were within the allowed SO_2 levels (ppm) for food in selected countries, as reported by Tongdee (1993). The SO_2 residue within the fruit pericarp (unedible part) significantly decreased from 1,453 to 0 ppm with increased storage time (from day 0 to day 28 in storage). The level of SO_2 residue left in the fruit pericarp by day 21 was 176.5 ppm, and by day 28 it was 0 ppm. Our results are significantly different to the findings of Chankaewmanee *et al*. (2007) who studied fresh longan fruits cv. Daw kept in a $60 m^3$ fumigation room using 4.2 kilograms of sulfur, and then stored at 2-5ºC. The sulfur dioxide residue level found in the edible part was not higher than 10 ppm, whereas the residue in the fruit pericarp was found to be the highest at 2,612.29 ppm on the first day after fumigation, and the lowest at 920.92 ppm on day 19^{th} after fumigation. Chitbanchong *et al*. (2009) reported that the SO_2 residue of longan fruit was found to be the highest immediately after treatment at a rate of 4.50 tons per 2.5 kg-SO_2; thereafter, it significantly decreased along with the storage duration. After 56 days in storage at 2ºC, the SO_2 residue of the pericarp was 900.20 ppm, and in the flesh was 0.17 ppm.

Table 5.2 Effects of sodium metabisulfite on the SO_2 residue (ppm) of 7.5% SMB treated 'Long' longan fruits during storage period.

SO_2 residue	Days of storage at 5ºC				
(ppm)	0	7	14	21	28
Pericarp	1453 ± 0.4	734.8 ± 1.1	360.7 ± 0.8	176.5 ± 0.6	0 ± 0.0
Flesh	0 ± 0.0	0 ± 0.0	0 ± 0.0	0 ± 0.0	0 ± 0.0

Data are mean value ± SD.

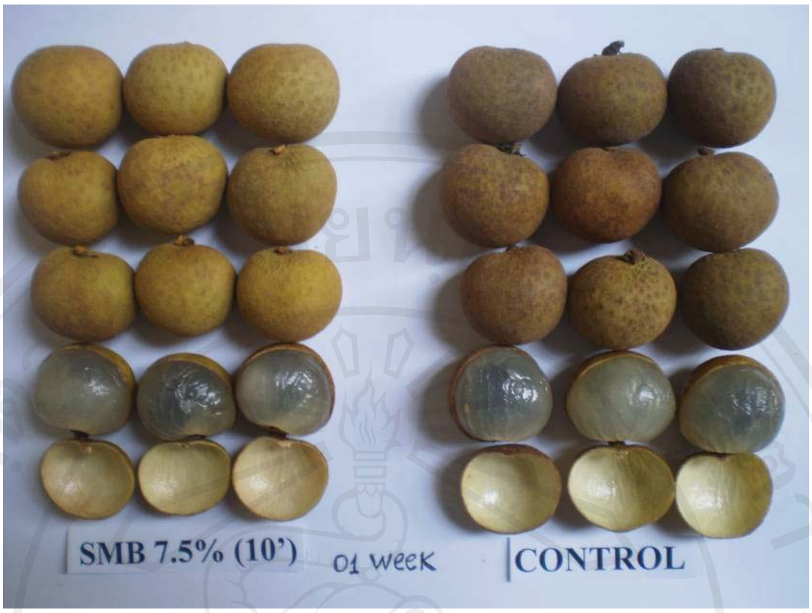

Figure 5.10 Individual longan fruits and bunches of longan fruit cv. Long of the best treatment after 7 days in storage.

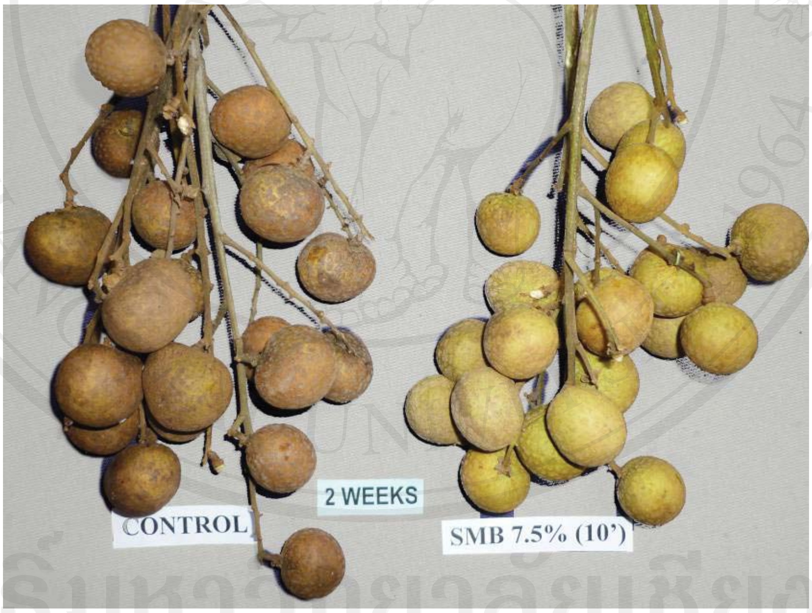

Figure 5.11 Individual longan fruits and bunches of longan fruit cv. Long of the best treatment after 14 days in storage.

Figure 5.12 Individual longan fruits and bunches of longan fruit cv. Long of the best treatment after 21 days in storage.

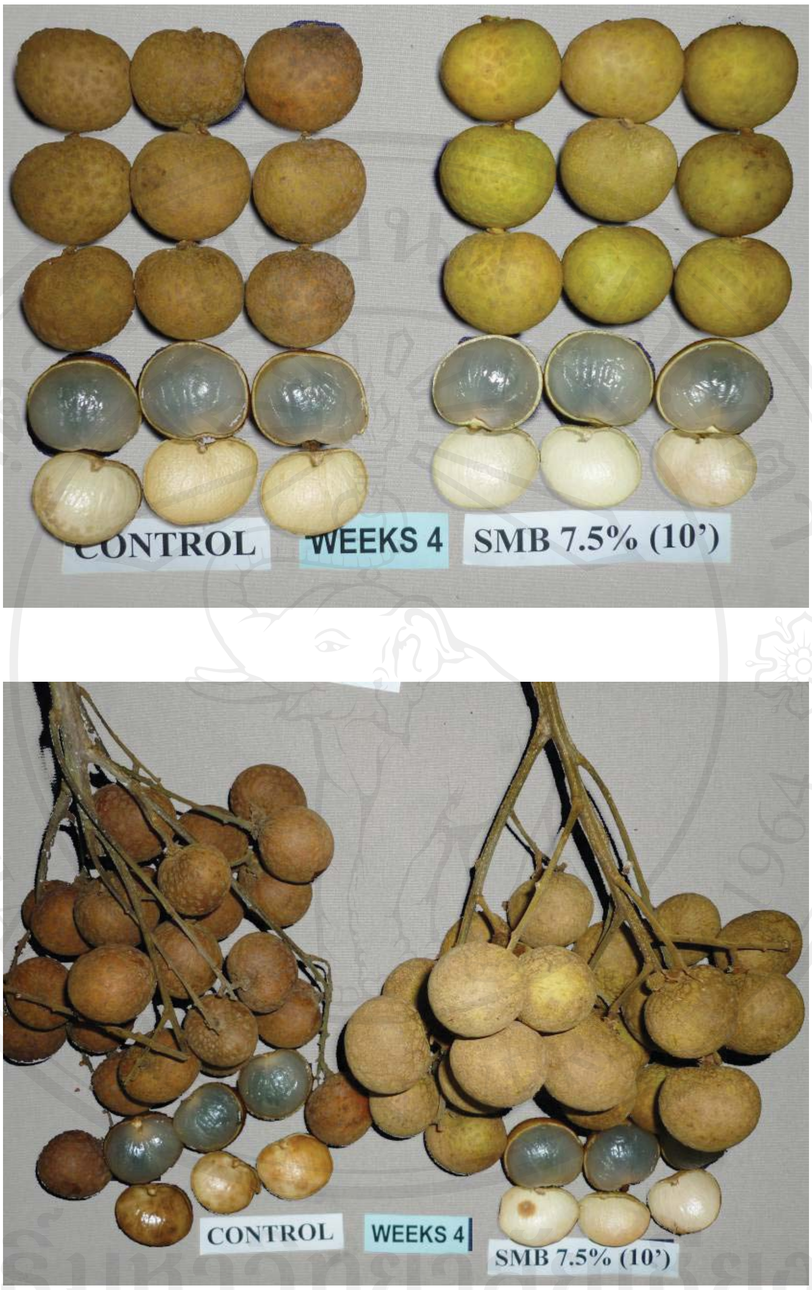

Figure 5.13 Individual longan fruits and bunches of longan fruit cv. Long of the best treatment after 28 days in storage.

5.3.6. The postharvest quality and storage life of individual longan fruits cv. Long after stored at 5ºC for 28 days, and then transferred to 25ºC

The BI of the fruit pericarp increased significantly during the first five days in storage, and the fruits were acceptable by day 3 in storage because the BI was 2.0 (**Figure 5.15**). Similar to the BI, the FCI of the longan fruit also increased with increasing storage time, and fruits were acceptable on day 3 in storage because they had an FCI below 2.0 (**Figure 5.16**). This is meant that after the 'Long' longan fruit had been stored at 5ºC for 28 days, they could then be kept at 25 ºC for three days whilst maintaining a good appearance for marketing purposes. This result is consistent with the findings reported by Apai (2010), who recorded that fruits were acceptable for marketing purposes for 3 to 4 days at 25ºC after stored at 5ºC for 45 days.

During the five days in storage, the L* and b* values of the fruit pericarp decreased significantly, from 47.9 to 42.8, and from 27.1 to 21.7 for b* values, during 5 days in storage. In contrast, the a* values significantly increased after 5 days in storage from 12 to 16.9 (**Figure 5.14** and **Appendix Table C9**).

The percentage of fruit decay increased during the 5 days in storage (from 3.6 by day 2 to 75.6 by day 5) (**Figure 5.17**). Apai (2010) also reported that disease incidence strongly increases with increasing storage time, when fruits stored at 5ºC for 45 day, then transferred to 25º for 7 days.

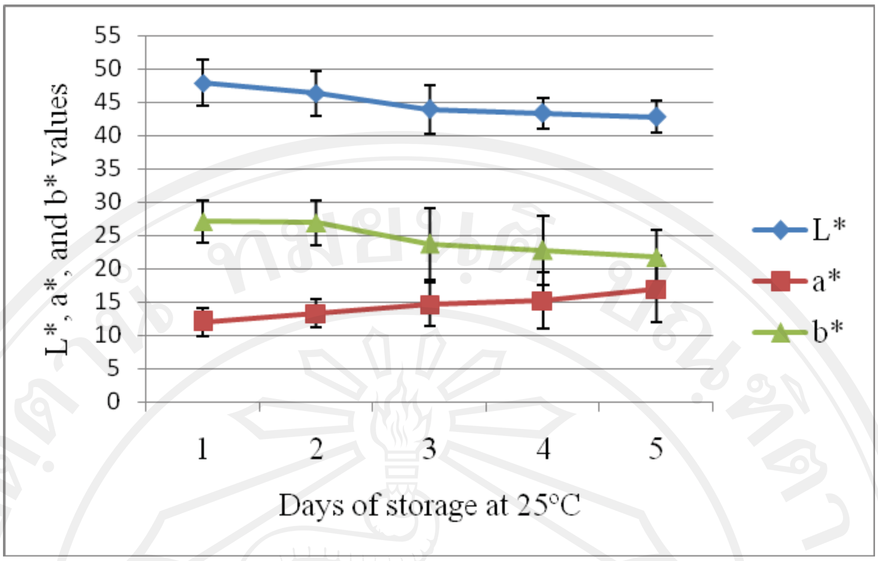

Figure 5.14 The changes in L*, a*, and b* values of pericarp color of individual 'Long' longan fruits were soaked in 7.5% sodium metabisulfite for 10 minutes and stored at 5ºC for 28 days, and transferred to 25ºC.

Vertical bars represent standard deviations for each value.

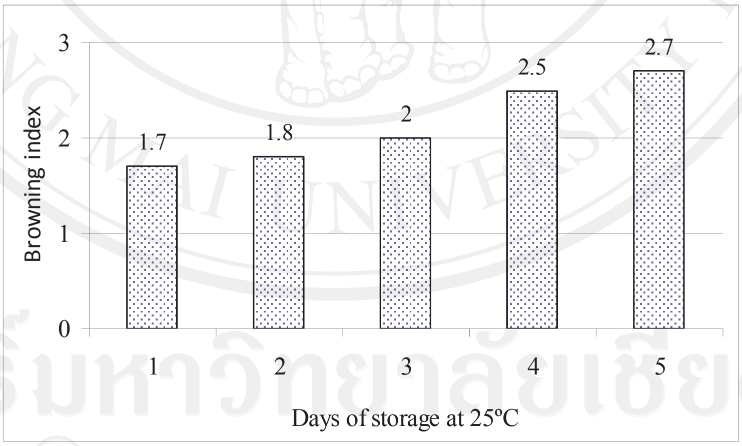

Figure 5.15 Changes in visual appearance expressed as browning index (BI) of individual longan fruits were soaked in 7.5% sodium metabisulfite for 10 minutes and stored at 5ºC for 28 days, and transferred to 25ºC for 5 days.

BI: 1 = 0%; 2 = 1-25%; 3 = 26-50%; 4 = 51-75%, and; 5 = 76-100% pericarp browning area. Fruits with BI above 2.0 were considered as unacceptable.

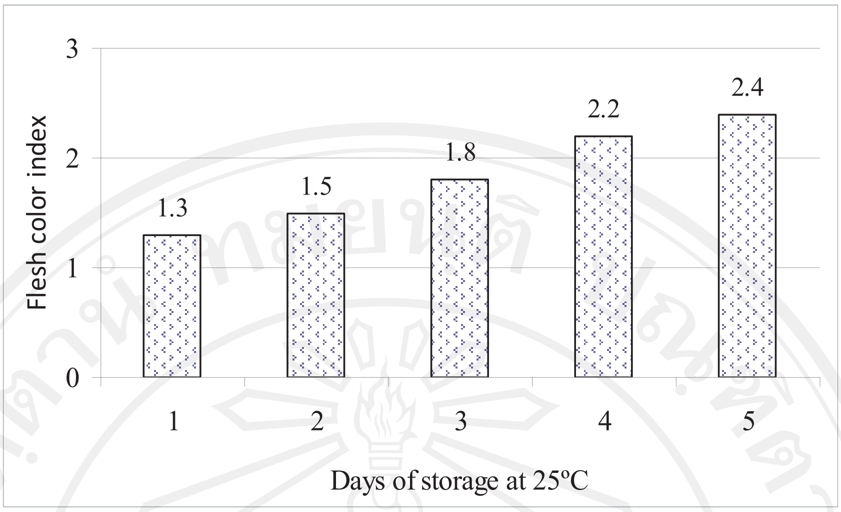

Figure 5.16 Changes in visual appearance expressed as flesh color index (FCI) of individual longan fruits were soaked in 7.5% sodium metabisulfite for 10 minutes and stored at 5ºC for 28 days, and transferred to 25ºC for 5 days. The index shown is: 1 = normal color; 2 = slightly abnormal color, but still acceptable; 3 = moderately abnormal color and unacceptable, and; 4 = severely abnormal color. Fruits with FCI above 2.0 were considered as unacceptable.

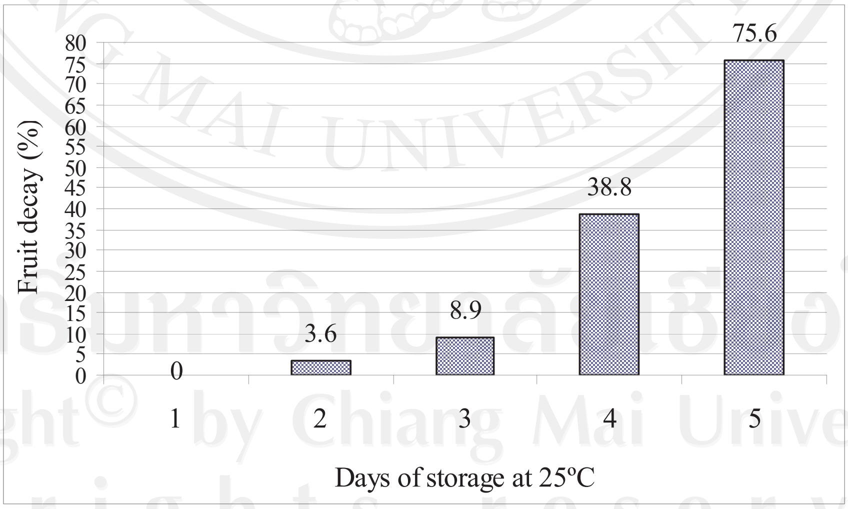

Figure 5.17 Effects of SMB on the percentage of fruit decay of individual longan fruits were soaked in 7.5% sodium metabisulfite for 10 minutes and stored at 5ºC for 28 days, and transferred to 25ºC for 5 days.

Figure 5.18 Individual fruits of the best treatment after stored at 5ºC for 28 days, and transferred to 25ºC.

A: 1 day; B: 2 days; C: 3 days; D: 4 days; E: 5 days.

5.3.7. The postharvest quality and storage life of individual longan fruits cv. Long after stored at 5ºC for 28 days, and then transferred to ambient temperature

The BI of fruit pericarp markedly increased after 3 days storage at ambient temperature (37-39ºC), and the fruits were only acceptable within 1 day, because by day two the BI was higher than 2.0 (**Figure 5.20**). Similar to the BI, the FCI of longan fruit also significantly increased with increased storage time, and the fruits were only acceptable on day one in storage; after that the FCI rose above 2.0 (**Figure 5.21**). The fruits had a short storage life at ambient temperature due to the significant difference in temperatures between the cold room and the ambient conditions. For consumer retailing purposes, fruits should continue to be stored in refrigerators after having been stored in the cold room.

The L* and b* values of the fruit pericarp decreased significantly after 3 days storage in ambient temperatures (decreasing from 46.4 to 41.5 for the L* values, and from 26.4 to 20.6 for the b* values). In contrast, the a* values increased significantly after 3 days in storage, rising from 13.3 to 17.4 (**Figure 5.19** and **Appendix Table C10**).

The percentage of fruit decay increased quickly, and there was 100% fruit decay by day 3 in storage at ambient temperature (**Figure 5.22**).

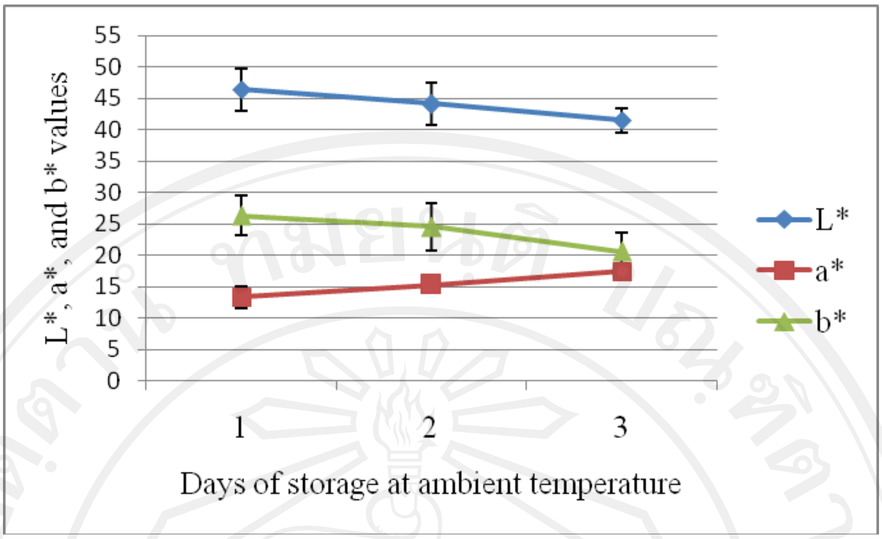

Figure 5.19 The changes in L*, a*, and b* values of pericarp color of individual longan fruits were soaked in 7.5% sodium metabisulfite for 10 minutes and stored at 5ºC for 28 days, and transferred to ambient temperature. Vertical bars represent standard deviations for each value.

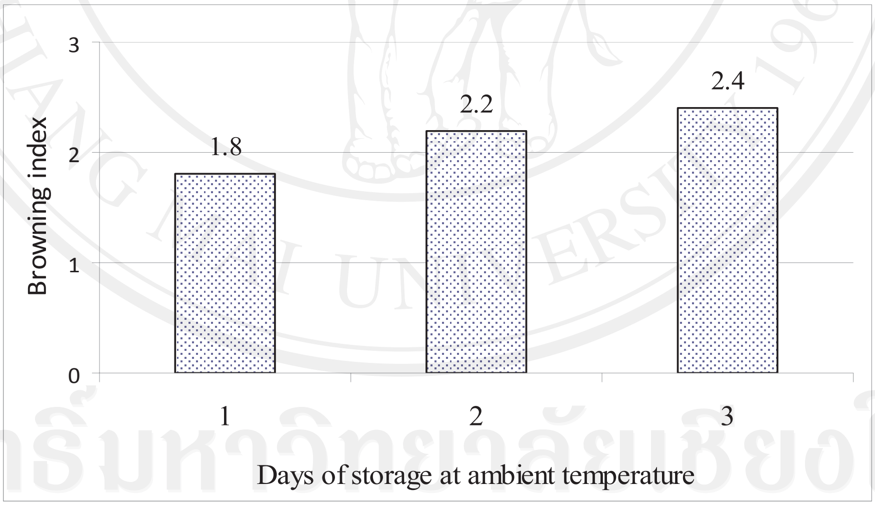

Figure 5.20 Changes in visual appearance expressed as browning index (BI) of individual longan fruits were soaked in 7.5% sodium metabisulfite for 10 minutes and stored at 5ºC for 28 days, and transferred to ambient temperature for 3 days.

BI: 1 = 0%; 2 = 1-25%; 3 = 26-50%; 4 = 51-75%, and; 5 = 76-100% pericarp browning area. Fruits with BI above 2.0 were considered as unacceptable.

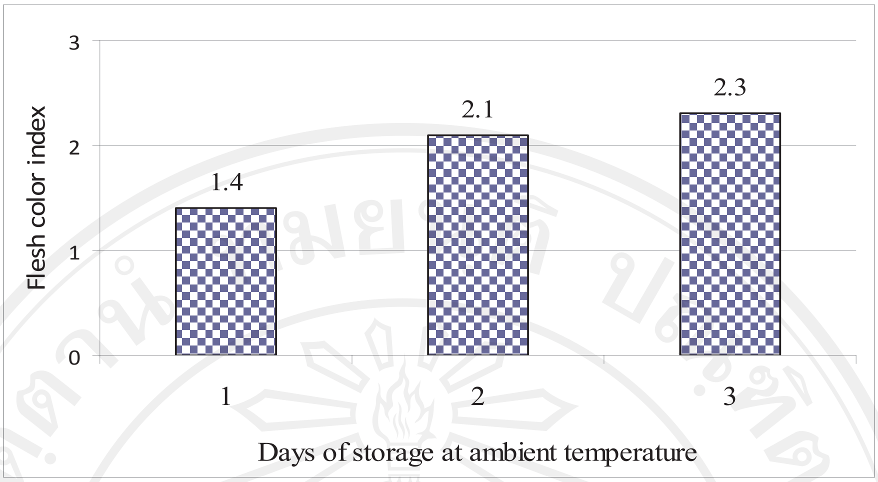

Figure 5.21 Changes in visual appearance expressed as flesh color index (FCI) of individual longan fruits were soaked in 7.5% sodium metabisulfite for 10 minutes and stored at 5ºC for 28 days, and transferred to ambient temperature for 3 days.

The index shown is: 1 = normal color; 2 = slightly abnormal color, but still acceptable; 3 = moderately abnormal color and unacceptable, and; 4 = severely abnormal color. Fruits with FCI above 2.0 were considered as unacceptable.

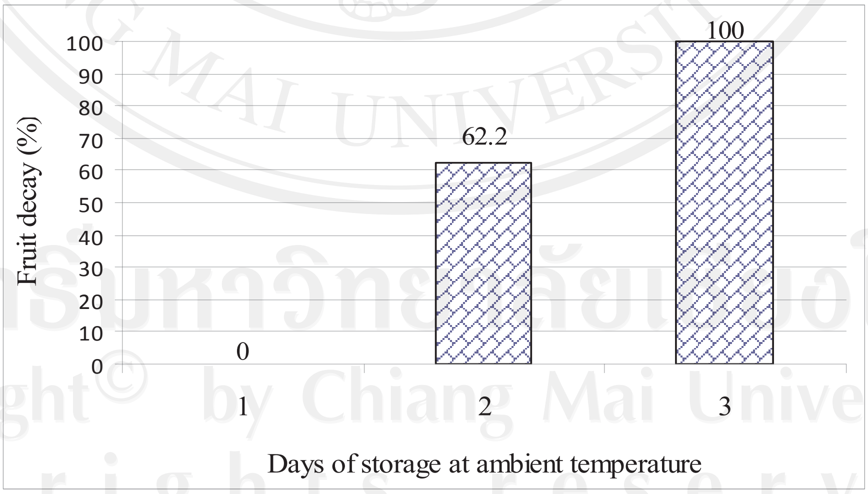

Figure 5.22 Effects of SMB on the percentage of fruit decay of individual longan fruits were soaked in 7.5% sodium metabisulfite for 10 minutes and stored at 5ºC for 28 days, and transferred to ambient temperature.

A

B

C

Figure 5.23 Individual fruits of the best treatment after stored at 5ºC for 28 days, and transferred to ambient temperature.

A: 1 day; B: 2 days; C: 3 days.

5.3.8. Storage life of 7.5% SMB treated longan fruit

Longan fruits under the control were not acceptable by day 7 in storage. The bunches of fruit soaked in 7.5% SMB solution for 10 minutes maintained their storage life with good quality for 21 days; whereas the individual fruits had a storage life with good quality of 28 days (**Table 5.3**).

Table 5.3 The storage life of 7.5% SMB treated and the control longan fruit at 5ºC.

Treatment	Storage life (days)	Cause of storage life limitation
Control	Less than 7	BI above 2.0, odor and flavor score above 1.5
7.5% SMB treated individual fruits	28	Maintained acceptable visual appearance and sensory quality, plus no fruit decay.
7.5% SMB treated bunches of fruit	21	BI above 2.0

BI: Browning index

Having been stored at 5ºC for 28 days, the individual 'Long' longan fruits maintained a visual appearance that was acceptable for consumer demand for another three days at 25ºC.

For the shelf-life at ambient temperatures, the individual fruits having been stored at 5ºC for 28 days, were then transferred for a marketing test. Due to the high ambient temperature (about 37 to 39ºC), the fruits were able to be sold for only one day because of the fruit decay.

5.4. Conclusion

The best treatment for commercial ‘Long’ longan fruit is to soak the fruits in 7.5% sodium metabisulfite solution for 10 minutes and store them at 5ºC. In the study, both the individual fruits and the bunches of fruit maintained high L*, b* values when compared to the control fruits. There was no significant difference in L*, b* and TSS content, nor sensory quality in the individual fruits and bunches of fruit during the 28 days in storage ($P \leq 0.05$).

During the first 28 days in storage, individual longan fruits maintained their visual appearance and sensory quality to levels acceptable for marketing purposes. There was no fruit decay evident.

The bunches of longan fruit kept their visual appearance for marketing purposes; their odor and flavor values were normal, there was no fruit decay, plus the percentage of fruit drop was only 5.1% during the first 21 days in storage.

In addition, the SO_2 residue detected in the flesh of the fruit after being treated and during storage time was 0 ppm; however, the level of SO_2 residue detected in the pericarp of the longan fruit by day 21 was 176.5 ppm, but no residue was detected by day 28 in storage.

The individual ‘Long’ longan fruits having been stored at 5ºC for 28 days, maintained a visual appearance acceptable for consumer demand for 3 days at 25ºC, and the rate of fruit decay was 8.9%.

In the case of shelf-life at ambient temperatures, having been stored at 5ºC for 28 days and then transferred for a marketing test, the individual ‘Long’ longan fruits were only acceptable for sales purposes within one day. Thereafter, the fruits decayed rapidly.