CHAPTER 7
CONCLUSIONS

7.1 Overall conclusions

1. Dipping fresh longan fruit in 1-3% citric acid (CA) mixed with 1-1.2% (w/v) chitosan (Cts) and packed in foam tray wrapped with 11 μm PVC films significantly delayed pericarp browning better than other treatments when stored for 5 and 27 days at ambient temperature (25-32°C) and at 5°C, 95% RH. The delay in pericarp browning for the control treatment and fruits treated with CA was less than 20 and 5 day, respectively. Titratable acidity (TA) as citric acid content in pericarp homogenate correlated with the pericarp pH and browning index ($r > 0.70$). 1.2% Chitosan mixed with 1.0% CA gave the best results to prevent TA degradation in the pericarp and maintained low pericarp pH in comparison with 1.0% CA treatment. In addition, low PPO activity, high total phenol content and low weight loss percentage were found when 1.0% CA was applied with 1.2% chitosan during storage in comparison with control fruit. It also did not effect changes in total soluble solid, pH, TA in the flesh and no anaerobic metabolites (ethanol content) or off-flavors (taste panel). However, there was some incidence of disease.

2. Application of 0.3% (w/v) potassium sorbate (PS) in the 1.2% Cts coating dissolved with 3.0% CA provided a fruit decay control by reducing the yeast and mold populations. It decreased disease incidence for 15 days when compared with 6 days for control fruits during storage at 10°C. In addition, sorbic acid residue was not detected in the flesh and it had no effect on the pericarp color after application of more than 0.3% PS in the coating material.

3. The effects of Cts, CA and PS on the growth of *Lasiodiplodia theobromae* LP20 *in vitro* and *in vivo* trials were investigated. The inhibition of spore germination and radial growth of *L. theobromae in vitro* increased as their concentrations increased. Abnormalities of hypha subjected to each component were found under

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microscopic observation: light microscope and SEM. *In vivo* trials showed that 1.2% Cts+0.3% PS+3.0% CA combination showed high efficacy in delaying the lowest disease development comparing to those treated with PS+CA and PS. SEM observation on mycelial characteristics at the inoculation site after 24 hrs showed swelling with some sign of collapse. With regards to the Cts component on pathogenesis-related proteins (PR-proteins): chitinase; and ß-1, 3-glucanase activity, it was found that PR-proteins were slightly induced but not sufficient to delay disease development. The enzyme induction was mostly related to wounding and pathogenic infection. Chitosan along with PS+CA maintained the highest amount of sorbic acid content in the pericarp, which is known to be of great importance in longan resistance to this fungus.

4. The effect of storage temperature on discoloration and fruit decay after coating with Cts + CA + PS at pH 2.8, packaged in 11 µm PVC film wrapped foam trays was assessed when storing the fruits at 2, 5˚C and 20˚C. Longan fruits kept at 5˚C showed more reduction in chilling injury (CI) than at 2˚C. Coating the fruits at 5˚C delayed the occurrence in CI for 20 days in comparison with 2˚C for 10 days (BI > 3.0). It delayed low electrolyte leakage of pericarp, weight loss and discoloration. Coating the fruits and stored at low temperature significantly produced the highest efficacy in disease control at 2˚C followed by 5˚C and 20˚C respectively. The coated fruits delayed the total phenol loss and PPO activity at the beginning but not the end of storage.

5. The effects of PR-proteins (chitinase and ß-1, 3-glucanase) in relation to the pathogenic incidence, chilling injury and marketing shelf life after coating were studied and compared with SO_2 at 4±1˚C, 90% RH. It was revealed that PR-proteins related to chilling injury tolerance (L* value and pericarp pH; r > 0.70) more than pathogenic response. SO_2 clearly showed the highest amount of PR-proteins over other treatments in accordance with the highest efficacies in CI tolerance and disease control more than 32 days. SO_2 reduced the lowest pericarp pH, PPO and total phenol loss. Cts + CA + PS at pH 3.3 significantly delayed pericarp browning. This conclusion was indicated by the lowest browning index and the highest pericarp color values (L*, C* and h˚) after 32 days of storage. The delay in pericarp browning for fruits treated with Cts + CA + PS at pH 2.8, fruits treated with CA+PS and the

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untreated fruit was 24, 20 and 28 days respectively. Fruits dipped in Cts + CA + PS at pH 3.3 exhibited a decrease in fruit decay, pericarp pH, percentage of weight loss, PPO activity and total phenolic content loss. Chitosan along with CA + PS (pH 3.3) could well prevent sorbic acid degradation in the pericarp when compared with the application of CA + PS. It also retained excellent fruit color and eating quality during cold storage, followed by holding at ambient shelf life conditions. In contrast, the fruits fumigated with SO_2 showed the poorest eating quality due to off-odor after 4 days of storage.

7.2 Future works

The commercial scale treatments with 1.2% Cts+3.0% CA+0.3% PS-pH 3.3 will be investigated.

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