CHAPTER 5

Conclusion and Recommendation

5.1 Properties of Active-Coated Papers

The CMC-coated paper exhibited higher value in thickness, coating weight, moisture content and WVP, but was lower tensile strength and percent elongation than chitosan-coated paper. At a given vanillin content, the coated paper is becoming more yellowish and the *b** value increased significantly with each incremental increase in vanillin. Proportionally decrease in moisture content was observed with increasing vanillin exceeding 1.0 % (w/v) due to the hydrophobicity of vanillin. Vanillin could promote the barrier property against water vapor of coated paper, increasing vanillin content led to a decreased in WVP. Moreover, tensile strength and percent elongation of coated paper decreased substantially when vanillin was added because the bulky structure of vanillin contributed to the loss of film's segmental mobility.

5.2 Efficacy of Active-Coated Papers against Mango Anthracnose Fungi

Chitosan-coated paper containing vanillin 1 % (w/v) was the most effective for inhibiting mycelial growth of *Colletotrichum* spp. Papers coated with vanillin-chitosan at all concentrations could completely inhibit conidiospore germination while paper coated with chitosan (without vanillin) caused the abnormal germination. However, uncoated paper and CMC-coated paper could not inhibit conidiospores germination. The result indicated that the antifungal effect might be attributed to the synergistic effect between chitosan and vanillin.

5.3 Efficacy of Active-Coated Papers Incorporating Activated Carbon or Zeolite on Ethylene Adsorptions

VCS 1.0 gave the highest PIRG value against *C. gloeosporioides* and greatly inhibited

the conidiospore germination. This formulation was used to prepare the coated paper incorporating with ethylene adsorbents including zeolite and activated carbon with various content (0.1, 0.2 and 0.4 %, w/v). The result demonstrated that the coated paper incorporating zeolite showed the best efficacy in the ethylene adsorptive activity compared with those of activated carbon for all concentrations. Although ZE 0.4 exhibited the greatest effect to remove the ethylene gas, but there was no significant difference in the amount of the ethylene remaining between ZE 2.0 and ZE 4.0. Due to the expensive price of zeolite, ZE 2.0 was selected to prepare active-coated paper against mango anthracnose accompanied with ethylene adsorption capacity.

5.4 Application of Active-Coated Papers by Wrapping on Mango Fruits

The antifungal effect of ZE 0.2 against mango anthracnose disease were evaluated by wrapping the inoculated mango fruit. The result demonstrated that there were no disease incidences appeared on the lesion of inoculated fruits wrapped with ZE 0.2 and VCS 1.0 during storage at 25 °C, 80 % RH for 10 days, whereas the unwrapped fruits and fruits wrapped with UNC had black circular spots on the lesion and some samples were infected at stem end. The SID value of fruits wrapped with ZE 0.2 stored at 13 °C, 90 % RH for 30 days was only 56.67 % compared to about 65 % for VCS 1.0 and 86 % for UNC and unwrapped fruits. For quality evaluation, fruits wrapped with ZE 0.2 showed the lower weight loss and higher firmness compared to others. However, changes in titratable acidity and total soluble solid of mango fruit wrapped with ZE 0.2 were not significantly different with other papers. In addition, the L^* value of mango had a tendency to decrease when increasing storage time, while the values of a^* and b^* were enhanced by increasing of storage time.

5.5 Release Properties of Vanillin from Active-Coated Papers

Under the different migration studies of vanillin, the mass fraction for all releasing conditions was plotted as a function of the square root of storage time. Increasing of temperature or RH caused an increase in the kinetics and diffusion coefficients of the vanillin release. Low temperatures (13 to 25 °C) showed a Fickian behavior with low diffusivity while increasing temperature to 37 °C exhibited a non-Fickian behavior with higher diffu-

sivity, involving an increment in the ability of chitosan-coating layer to transport vanillin through its network and the molecular mobility of diffusing molecules that are higher in the rubbery state. All RH showed a Fickian behavior with low diffusivity. On the contrary, an increase in pH value decreased the diffusivity of vanillin and all the pH values showed a non-Fickian behavior. Lower pH values caused film swelling and facilitated the release of vanillin due to weakened salt bonds. The highest release of vanillin from coated paper to food simulants was found at 3 % acetic, followed by 10 % ethanol, water and olive oil. The lowest release of vanillin was found at olive oil, which is a non-polar medium. Release of vanillin on mango fruits wrapped by active wrapping paper showed a Fickian behavior and was relatively slower, but it might be better for expanding the period of fungal inhibition in wrapped mango fruits.

5.6 Future Works

5.6.1 The effect of coated paper was not only obvious at the lesion level, but this also appeared at the top of the fruits. Therefore, this kind of study would have been more relevant on non-artificially contaminated mango. The inhibitory effect of active-coated paper against postharvest rot of mango fruit is interesting for further study.

5.6.2 Many studies have demonstrated the high potential of the direct application of antimicrobial edible coatings for preserving the quality of postharvest fresh fruits including mango. The study could provide any comparison between their results and those reported in the literature concerning the effects of edible coatings on postharvest quality of coated mango fruits to better elucidate the interest of coated paper compared to edible coatings.

5.6.3 Other nutritional parameters such as phenols, antioxidants and L-ascorbic acid of the wrapped fruit should be investigated.

5.6.4 Sensorial analysis should be carried out to evaluate the effect of the developed packaging systems not only to evaluate the quality attributes of the wrapped fruit but also to verify the complete absence of off-odors and off-flavors as well as the acceptance of the product by the consumer.