CHAPTER V

CONCLUSIONS

This present research study was to investigate the feasibility of spray dried pectic polysaccharide microparticles of various physicochemical properties for protein delivery through nasal route. The optimal pectic polysaccharide concentration of 0.2% w/v in water was selected by considering the appropriate particle size for nasal delivery. To find the suitable preparing condition, spray drying condition of inlet temperature, feed rate and volumetric air flow (% of maximum aspirator) was varied by using the formulation of pectic polysaccharide, maltodextrin, aerosil and propylene glycol. The selected condition of inlet air temperature of 120 °C, feed rate 5 ml/min and 90% aspirator had outlet temperature of 63°C, production yield of 50%, particle size of 6.67 μm, Carr's index of 26.99 and highest swelling index of 69.70.

After obtaining an appropriate spray drying condition, mannitol and lactose were used as additives in preformulation of spray dried pectic polysaccharide microparticles. Although the spray dried powder from the formulation of PP+MT+A+PG had small particle size of 6.67 μm and high production yield of 48%, the swelling property and mucoadhesion was lower than the other formulations and the morphology of more collapse than the others. When lactose was compared to mannitol, it was found that lactose was more suitable due to small and appropriate particle size and higher production yield. Then varying amount of colloidal silicon dioxide (Aerosil ®) was added to make the suitable physical properties of powder for nasal protein delivery. The selected formulation composed of lactose at the same amount of pectin and Aerosil® 0.12% w/v in water. Commercial pectins (0.2% w/v) including high methoxylated pectin and low methoxylated pectin were used to compare with pectic polysaccharide from durian rinds.

The model protein, BSA, was loaded to microparticles by varying the BSA:pectin ratio of 1:3, 1:5 and 1:10. All obtained BSA loaded spray dried pectin microparticles were analyzed. For both commercial pectins, BSA loading had smaller

particles than blank spray dried pectin whereas the particle size of BSA loaded pectic polysaccharide microparticle did not significantly differ from unloaded pectin microparticles. Moisture content of loaded and unloaded pectic polysaccharide microparticles ranged from 6.82 – 7.28% were higher than both commercial pectins which ranged from 5.00 – 6.47% due the different source of pectin. Swelling index of BSA loaded microparticles tended to be lower than unloaded microparticles due to the protein pectin interaction which reduced carboxyl group to form hydrogen bonding with water. Mucoadhesion property of all BSA loaded pectin microparticles as the force to detach microparticles from mucin soaking cellulose acetate membrane on texture analyzer were lower than unloaded microparticles.

From SEM photographs of all obtained BSA loaded microparticles seem to be round shape except PP but the smoothness of the microparticles was ranked 1:10 > 1:5 > 1:3. It could be concluded that BSA affected the surface of microparticles. The FTIR spectra of pectic polysaccharide showed that pectic polysaccharide from durian rinds was a high methoxylated pectin and protein-pectin complex was obtained from all types of pectin.

Protein loading of both commercial pectin was not significantly different at each BSA/pectin ratio and pectic polysaccharide microparticles was found to be the highest protein content. For HM pectin and pectic polysaccharide, BSA release from microparticles at all BSA:pectin ratio was not significantly different due to no difference in particle size of all BSA:pectin ratio. The BSA release from LM pectin microparticles was not more than 60% which was the lowest release may be due to the high molecular weight of LM pectin. The secondary structure of BSA before and after spray drying process were analyzed by using circular dichroism. The stabilty of BSA was also analyzed by using sodium dodecyl sulphate polyacrylamide gel. These results can conclude that stability of BSA was not change although it exposed to high temperature (inlet air temperature of 120 °C) of spray dryer. The formulation of pectic polysaccharide had higher toxicity than commercial pectin in case of containing Aerosil®. Transepithelial electrical resistance of nasal epithelial carcinoma cell cultured on polyester membrane as a confluent monolayer was not significantly different between before and after permeation experiment at all types of pectin. These

results and the photograph of nasal cell monolayer after permeation experiment stained with FITC-phalloidin indicated that commercial pectin and pectic polysaccharide from durian did not open the tight junction. However, the permeation of BSA from all obtained spray dried microparticles was detected. The cell viability with trypan blue of nasal cell after permeation experiment ranged from 79.32% to 82.13% and pectic polysaccharide had the lowest cell viability. These results were aligned with the data from cytoxicity experiment by using MTT assay.

Pectic polysaccharide is an extraction of natural product, thus prior to do research experiment the quality of raw material should be assumed such as percentage of pectin and impurity and pH. Good quality control of raw material leads to the similarly acquired physicochemical properties of product. Moreover, analysis of raw material will help to have an accurate interpretation on the results of research.