

## CHAPTER VII

### CONCLUSIONS AND RECOMMENDATIONS

The present work stands on nanomaterialization of chitin-chitosan by either (i) molecular design based on supramolecular structured chitosan or (ii) changing in morphology of chitosan. In the case (i), the supramolecular structured chitosan was successfully prepared by conjugating a series of ethylene glycol and ethylene amine onto low molecular weight chitosan at hydroxyl group using CDI coupling agent. The compounds obtained showed the ion adsorption capacity through various types of metals (alkali, and transition metals) and was comparable to chitosan with crown ethers reported in the past implying the possibility that the compounds form supramolecular structure to adsorb ions. The studies on transition metal ion adsorption declared the selectivity for  $\text{Ag}^+$  with coexistence of  $\text{Cr}^{3+}$ ,  $\text{Cu}^{2+}$ , and  $\text{Ni}^{2+}$  in aqueous. The work proposed that instead of introducing the macrocyclic compounds to achieve ion interaction property, we can develop supramolecular structured chitosan by simple conjugating with oxy or aza alkyl chains.

In the case (ii), nanomaterialization of chitin-chitosan was carried out by changing morphology from chitin flake to chitin whisker via acid treatment, and from chitin whisker to chitosan nanoscaffold. Chitosan nanoscaffold was successfully prepared via a one pot deacetylation of chitin whisker. The branching of each chitin whisker initiated the nanoscaffold formation as observed by TEM. The lyophilization induced the packing of nanoscaffold to be a regular network as evidenced by SEM. The chitosan nanoscaffold showed the increase in the molecular weight and viscosity as compared to that of chitin whisker starting material. The aggregation of the scaffold could be controlled by the high ionic strength solvent. The studies on the dispersion in solvents with different solubility parameters confirmed that water can use as a well-dispersed system for chitosan nanoscaffold.

The surface functionalization of chitosan nanoscaffold with lactose and maltose in heterogeneous system at room temperature was originally proposed. The product obtained exhibited beautiful glossy tiny fibers of cotton ball appearance. The materials obtained were in nanoscaffold structure with mesopores as observed by the SEM and TEM micrographs.

Chitin whisker grafted poly(ethylene glycol) was successfully prepared by a simple water-based reaction using water-soluble carbodiimide as a coupling agent. The compound obtained not only showed a stable colloidal solution but also maintained a rod-like morphology in a bundle-like aggregated form as observed by TEM. After lyophilization, the chitin derivative showed well-redispersion ability in chloroform as compared to the starting chitin whisker.

The further works to be done are such as (i) Ion Adsorption Capacity of Amorphous Chitosan. In this work, the adsorption capacity of chitosan flake and its derivative are proposed; however, the morphology of chitosan derivatives are amorphous whereas that of chitosan flake is crystalline. The reliable data should be obtained from the chitosan derivatives and amorphous chitosan, (ii) Ion Adsorption Selectivity in Coexistence of  $\text{Ag}^+$ ,  $\text{Cu}^{2+}$ ,  $\text{Ni}^{2+}$ , and  $\text{Cr}^{3+}$ . The study on ion adsorption selectivity in the system containing one transition metal ion using equation to calculate selectivity were done. In practical use, the adsorption selectivity in coexistence of transition metal ions might give an accuracy data.