CHAPTER VII
CONCLUSIONS AND RECOMMENDATIONS

Chitin-chitosan is known as a potential biomaterial for various practical applications. However, most of applications are ended up with simple physical modification by employing some processing methods for films, beads, gels, etc. Although the chemical modification is an alternative way to materialize chitin-chitosan, the development to the commercialized products is still in the progress for more than three decades. This might be due to the high stability, or in other words; the inertness of chitin-chitosan to proceed the reaction to control of reproducibility.

Structurally, chitin-chitosan is a long chain polymer with high inter- and intra-molecular hydrogen bond network to stabilize the chain and block the performance of thermoplasticity. Based on this point of interest, the first part (Chapter II and III) dealt with the enhancement of the reactivity by chain degradation. Although there are various polymer degradation methods, the present work declared that the use of γ-ray is an effective one owing to the ease of the procedure and the large amount production. Here, γ-ray irradiation of chitosan was carried out to find the promising optimum condition for low molecular weight production without changing in the backbone structure. It was found that the decreasing in molecular weight of chitosan irradiated in solution state was more significantly than that in solid state. In the case of adding radical initiator, the degradation was enhanced to find the decreasing in molecular weight for 80% with about half amount of γ-ray to that of the condition without initiator. When chitosan was irradiated under homogeneous solution (in acetic acid) and heterogeneous (dispersing in water) with 2% $K_2S_2O_8$, the irradiated products showed the significant degradation in the main chain level. The reactivity of irradiated chitosan was found to be improved 50-60% as clarified from the model reaction using a conjugating reagent, i.e., *N,N'*-carbonyldiimidazole.

It should be noted that the irradiated mechanism was not succeeded even various aspects of ESR studies had been done. One of the reasons was that the

irradiated chitosan did not show hyperfine ESR spectra to determine g-value for indicating about radical species. The work was ended up at indirect characterization techniques, such as FT-IR, NMR, and UV to conclude that the degradation occurred at glycoside linkage with some terminal chain of carboxylic group.

The second part (Chapter IV, V and VI) focused on the chemical modification of chitin-chitosan by conjugation hydrophobic and hydrophilic groups. It was found that by introducing phthalimido group and poly(ethylene glycol) methyl ether onto chitosan chains, the products showed colloidal phenomena. The present work originally reported for the first time that the chitosan could be nanospheres without any specific processing technique but by simple reaction. The formation of nanospheres was concluded to be related to the self-assembly structure to give chitosan spheres with the sizes of 80-400 nm as observed from TEM.

Drug incorporation was one of the target applications for chitosan nanospheres. The work demonstrated the incorporation of stearylamine into chitosan nanospheres as a model case. Although, the studies did not include various types of model drugs, stearylamine was the case to confirm that the molecule was stabilized in the nanospheres.

Here, the work should be extended to the systematical studies of the nanosphere application as a material for drug delivery system. For example, the variation of drug size, polarity, ionic interaction ability, and H-bond possibility should be set up as variables for drug incorporation. Another point to be concerned is about biodegradability of chitosan nanospheres since this is the basic information for applying in life science. Toxicity of chitosan spheres was the most questioned among people in pharmaceutical field, thus the recommendation for the continuous work should cover toxicity test in order to develop practical application.