CHAPTER I
INTRODUCTION

Chitin-chitosan is the second-most abundant natural biopolymer obtained from shell of crustaceans, cuticle of insects, and cell wall of some fungi and microorganisms. It shows specific properties especially bioactivity (Dumitriu *et al.*, 1989), biocompatibility (Chung *et al.*, 1994 and Richardson *et al.*, 1999), biodegradability (Deshpande, 1986 and Tomihata and Ikada, 1997), and non-toxicity (Chandy and Sharma, 1992 and Rao and Sharma, 1997). Chitosan is a derivative of chitin obtained from deacetylation. Comparing to chitin, chitosan has received much more attention from chemists as (i) it is soluble in acids and (ii) it has not only hydroxyl but also amino groups for functionalization. Based on the chitosan-acid solutions, simple materialization of chitosan can be achieved by solvent casting for films (Bégin *et al.*, 1999), spray drying for beads or spheres (Hoagland *et al.*, 1997), and cross-linking for gels or membranes (Zeng *et al.*, 1996). For functionalization, the materialization can be done by conjugating chitosan with specific molrcules for novel derivatives. Up to present, various derivatives e.g. water soluble chitosan i.e. *O*-carboxymethylchitosan (Chen *et al.*, 2003 and Kumar, 2004) or *N*-carboxymethylchitosan (Muzzarilli *et al.*, 1994), organo soluble chitosan i.e. *N*-phthaloylchitosan (Nishimura *et al.*,1991) including the reactions for novel derivatives have been reported.

Although chitosan products have been variously proposed such as powder for water treatment, solution for pre- and post-harvast, gel or film for wound healing, particles for food additives, it is recognized that the uses in pharmaceutical and biomedical fields (Kurita *et al.*, 1998) are the way to develop the most value-added chitosan. In the past, various chitosan materials aiming for biomedical and pharmaceutical fields, such as wound dressing gel (Shuichi *et al.*, 2003) and chitosan-drug derivatives (Prabaharan *et al.*, 2004) were reported, however, most cases are ended up as models and hardly to succeed in producing practical products. This is mainly because there might be toxicity of organic compounds, especially solvents and chemical reagents during the process and the difficulty in controlling the process to be reproducable. Thus, in the current years, the development of

chitosan for biomedical proposes has been challenging with the water-based system, non-organic solvent system, and the introduction of the bio-safety molecules via simple but effective reaction system.

Recently, our group succeeded in developing chitosan nanoscaffold from water-based system. This enables us to carry out the efficient surface reaction. In the past, Phongying *et al.* (2006) reported about the conjugation of chitosan and sugar which shows the soft-cotton like appearance. We also succeeded in developing conjugating reaction in water-based system which provides the possibility of linking organic molecules, especially drug or its derivatives, without the uses of organic solvent. Fangkangwanwong *et al.* (2006) reported effective model reactions of chitosan with carboxylic acid-based molecules.

The present work focuses on our previous successful development to propose a fundamental development from the viewpoints of chitosan nanoscaffold and chitosan conjugation in water system.

The work covers the use of chitosan nanoscaffold and water-based conjugation to introduce amino acid molecules onto chitosan chain which will be a good guideline when we consider chitosan for drug targeting system. The work also extends to the development of chitosan aerogel by simple crosslinking chitosan in water-based system combining with the concept of montmorillonite clay-based nanocomposite formation.