

## CHAPTER I

### INTRODUCTION

Chitin, poly- $\beta$ -(1,4)-2-acetamido-D-glucose, is the second most abundant polysaccharide found in nature next to cellulose. Large amount of chitin is annually accessible as a crustacean shell waste. Chitosan is derived from chitin by deacetylation in the presence of alkali. Therefore, chitosan is a copolymer consisting of  $\beta$ -(1,4)-2-acetamido-D-glucose and  $\beta$ -(1,4)-2-amino-D-glucose units with the latter unit usually exceeding 80% [Onsoyen *et al.*, 1990]. The main driving force in the development of new applications for chitosan lies in the reason that the polysaccharide is not only naturally abundant, but it is also nontoxic and biodegradable. Moreover, chitosan is a renewable resource that can be further enhanced by artificial culturing. [Li *et al.*, 1992]

Chitosan has drawn more attention than other natural polymers because of the presence of reactive amino groups which are responsible for its ability to form specific complexes with number of metal ions or dyes as well as specific complexes with organic molecules such as cholesterol, fats, and proteins. It might be said that chelation is one of the most useful properties of chitosan. For example, Bassi *et al.* (2000) reported that chitosan flakes can effectively bind with metal ions and had a maximum sorption capacity for copper ions. Due to its chelating ability, chitosan has been applied to the area of food industries, health care, water treatment, and pharmaceuticals. However, the application of chitosan was limited owing to its poor solubility in organic solvents due to their rigid crystalline structure through intra- and intermolecular hydrogen bonds [Tokura *et al.*, 1983]. Generally, chitosan is soluble in dilute acid solutions due to the protonation of the nitrogen atoms of its amino groups. Acetic acid and hydrochloric acid are the most common acids used for its dissolution. To improve the soluble property of chitosan in

organic solvents, chemical modification to introduce hydrophobic nature to chitosan is required [Zong *et al.*, 2000].

Chitosan is susceptible to chemical modification owing to the presence of the amino group at the C2 position and the primary and secondary hydroxyl groups at the C6 and C3 positions, respectively [David, 1996]. It is known that the introduction of acyl or alkyl groups to chitosan enhances its solubility property in organic solvents [Tokura *et al.*, 1983]. Fujii *et al.* (1980) and Grant *et al.* (1990) have reported on the acyl modification of chitosan conjugated with long-chain acyl chloride to improve its organic solubility. However, the amino group at the C2 position is needed to be remain in order to retain the chelating property of chitosan. To achieve both objectives of improving solubility in organic solvents and retaining the chelating property, the degree of substitution of acyl groups on amino groups of chitosan must be controlled or amino groups must be protected before further selective modification is carried out. The protection of amino group in chitosan using phthalic anhydride was selected to enhanced solubility of chitosan in some organic solvents and retained its chelating property [Nishimura *et al.*, 1991]. Furthermore, the N-phthalimido chitosan is readily transformed into a variety of soluble synthetic precursors. This protective group is also easily removed by reacting with hydrazine monohydrate.

This research work is directed on chemical modification of chitosan to prepare an organic solvent soluble derivative of chitosan with metal ion chelating property. The hexanoyl chitosan were prepared in two different ways. 1) The hexanoylation was carried out without any protection of amino groups. In this method the effect of degree of substitution on the solubility and metal ion absorption of hexanoyl chitosan were studied. 2) Hexanoylation with protection of amino groups, the work consisted of three steps of modification which are protection of amino group, hexanoylation of protected chitosan and deprotection of chitosan derivatives. Chemical structure and

properties of the product were characterized. The solubility and metal ions adsorption of the derivatives were investigated.