CHAPTER V

CONCLUSION AND SUGGESTION

Quaternized *N*-alkyl chitosan films having different alkyl chain length were successfully prepared via a heterogeneous two-step process: reductive alkylation using selected aldehydes which are acetaldehyde, propionaldehyde, butyraldehydes and benzaldehyde followed by quaternization with methyl iodide. The extent of surface modification can be tailored by varying the reaction time and reagent concentration. After quaternization, it was found that the surface of *N*-alkyl chitosan films became more hydrophilic due to the presence of positive charge on the chitosan surface Data from ^{1}H NMR, ATR-FTIR analyses and zeta potential measurement confirmed the success of reaction and charge characteristic of the surface.

Antibacterial activity of the quaternized *N*-alkyl chitosan films were evaluated using 2 methods: Shake flask method and Plate counting method. Data from an optical density (OD_{600}), scanning electron microscopy (SEM) image and viable cell counting method shows that all surface-modified chitosan films exhibited higher antibacterial activity against *Staphylococcus aureus* (gram positive bacteria) and *Escherichia coli* (gram negative bacteria) than the virgin chitosan film at pH 7. It was also found that the degree of quaternization has a considerable influence on the antibacterial activity. The additional positive charge and hydrophobicity introduced to the chitosan film after surface quaternization apparently make the quaternary ammonium-containing chitosan film a more favorable substrate for interacting with the negatively-charged membrane of the bacteria, leading to a higher antibacterial activity. However, the correlation between the size of alkyl group and the antibacterial activity cannot yet be identified.

Cytotoxicity of the quaternized *N*-alkyl chitosan films is a subject of future investigation in order to assure the applicability in the field of biomaterials or biomedical applications. In addition, the future plan covers the preparation of quaternized *N*-alkyl chitosan particles and the determination of their antibacterial activity in real time using AFM analysis. Also, ones should be able to determine the

minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) values which are quantitative measures of the antibacterial activity of the quaternized *N*-alkyl chitosan particles. It is believed that the antibacterial activity of the particles should be superior to the films due to the greater surface area of the particles, and the ability to penetrate into the bacteria membrane if the particle size is appropriately small, particularly in the nanometer range. It is anticipated that these quaternized *N*-alkyl chitosan particles may be used as antibacterial fillers for many materials.