

CHAPTER I

INTRODUCTION

Chitosan is a high-molecular-weight polysaccharide, which is obtained by deacetylation of naturally occurring chitin derived from skeletal of arthropods and mollusks. It is generally prepared by partial deacetylation of chitin in a hot alkali solution. Because of several unique and interesting biological properties such as biocompatibility, bio-degradability, toxicity, chitosan has been considered for the development of membranes, gel, beads and fibers for fiber industries [1, 2].

Electrospinning technique has been investigated extensively to easily and inexpensively produce nanoscaled fibers. The electrospun nanofibers have been investigated for many applications, such as templates, reinforcement, filtration, catalysis, biomedical and pharmaceutical applications, and electronic and optical devices [3-5]. Especially in the area of filtration, electrospun nanofibers have shown distinctive characteristics and superiority. In recent years, filtration process has received increasing interest in industries. Immobilization of bacterial cells onto the filtration media has also been developed for the application in biofiltration. Some researchers have studied and developed support materials, particularly with regard to porosity and the shape of the material including fibers. Thus, the chitosan nanofibers fabricated by electrospinning techniques could result in higher efficiency of cells immobilization and can be used as support materials in the future. Nevertheless, it has been known that it is difficult to produce chitosan nanofibers via electrospinning technique because of the repulsion of cations. Many polymers such as PVA or PEO have been mixed with chitosan, as the spinning aid, to shield this repulsion and the composite fibers could be spun. However, durability and compatibility of these spinning aids toward the use as biofiltration might not be as good as chitosan [6, 7].

Interaction between chitosan and bacterial cell is due to its cationic nature to bind with sialic acid in phospholipids. Nevertheless, some researchers have suggested that the mechanism of the chitosan-bacteria interaction depends on whether the bacteria are Gram-positive or Gram-negative [8, 9]. Furthermore, the selection of the appropriate support materials has been largely fortuitous and has relied upon the organism's own ability to attach to the surface. Cells have been enclosed in a polymer matrix which is porous enough to allow the diffusion of substrate to the cells. Because of these limited attention has been paid to the efficiency and control of the immobilization of live cells on support materials or to the physiological activity of individually immobilized bacteria.

In this research, chitosan nanofibers, as well as nanofibers of chitosan blended with PVA, were fabricated by electrospinning. Effects of various factors, including chitosan molecular weight and blending ratio, on formability and morphology of the fibers as well as the application in cell immobilization were investigated.

Objective of this thesis are as follows:

- 1.1.1 To study the feasibility of pure chitosan nanofibers fabrication and to compare the formation of electrospun nanofibers using pure chitosan to that with the addition of poly (vinyl alcohol) (PVA) and to that using hydrolyzed chitosan.
- 1.1.2 To study the feasibility of cell immobilization on chitosan nanofubes.
- 1.1.3 To compare the capability of cells attachment on chitosan nanofibers fabricated by electrospinning with that on chitosan films.

This thesis is divided into five chapters as follows:

Chapter I provides an overview of this thesis.

Chapter II explains the basic theory about this work such as introduction of chitosan, electrospinning process, cell immobilization methods and the general bacteria characteristics. Literature reviews of the previous works related to this research are also presented.

Chapter III shows the chemical reagents and experimental procedures.

Chapter V shows the experimental results and discussion.

Chapter VI, the last chapter, shows overall conclusions and recommendations for future research.