CHAPTER 1

Introduction

1.1 Background and Rationale

Electrospinning is an electrohydrodynamic technique that produces fine fibers by using electrostatic forces. This technique has attracted increasing attention as an efficient tool for the fabrication of polymer nanofibers. Various polymers can be electrospun into nanofiber matrices. A wide range of natural and synthetic polymers has been successfully studied to generate nanofibers through the electrospinning technique. Natural polymers exhibit better biocompatibility and low toxicity when compared with synthetic polymers. For example, natural polymers that are used in the electrospinning techniques are gelatin, silk fibroin, fibrinogen and polysaccharides, such as alginate, chitin and chitosan. In addition, synthetic polymers give more mechanical strength to fibers especially for the fabrication of nanofibrous scaffolds in tissue engineering, such as polylactic acid, polyglycolic acid, polyethylene-co-vinyl alcohol, polycaprolactone. Electrospun fibers ranging in size from nanometer to micrometer have a very large surface area to volume ratio, high porosity, various surface functionalities and good mechanical properties. There are various applications of electrospun fibers in many fields of industry. Electrospun nanofibers are used as tissue engineering scaffolds such as cartilages, dermal tissue engineering, bones, arterial blood vessels, and nerves. Using nanofibrous membranes as wound dressing provides desirable properties. It was found that microfibrous and nanofibrous structures of membrane improve their haemeostatic ability, their efficiency as bacteria barrier, the absorption ability of wound fluid; moreover, they have an appropriate vapor transmission rate, and adequate gaseous exchange ability. Electrospun polymer nanofibers are also used in skin care masks by the cosmetics industry. As for drug delivery systems, electrospun mats have the ability

to incorporate many drugs within their fibers. Many studies were undertaken to prepare nanofibers from various polymers with different drug-loading systems to arrive at drug delivery such as transdermal delivery, or fast dissolving or implantable drug delivery systems, depending on the type of polymers used to control drug release from nanofibers for rapid, immediate or delayed release [1-7].

In fast dissolving drug delivery systems, a solid dosage form disintegrates and dissolves quickly in the oral cavity, without requiring any water. There are many kinds of fast dissolving drug delivery systems, such as tablets, capsules, wafers and films [8]. By using a suitable water-soluble polymer, the technique can prepare electrospun polymer fibers that can be used as fast dissolving films. One of the applications of fast dissolving oral films is the wide use in oral care products, such as breath freshening strips, or antiseptic films for oral treatment.

For good oral hygiene, the microorganisms in the oral cavity are to be controlled. There are many kinds of microorganisms that cause dental plaque, bad breath, dental caries or infectious diseases in oral cavities. Controlling the number of these microorganisms is the way for oral cavity care or treatment of periodontal disease symptoms. Prevention of dental caries is achieved by using antimicrobial agents against cariogenic bacteria, including inhibited adhesion of cariogenic microorganisms on the tooth surface. Normally, commercial products of toothpastes or mouth rinses consist of anti-plaque and antimicrobial agents such as chlorhexidine, sodium fluoride or quaternary ammonium compounds [9-10]. In recent years, it has become attractive to use natural extracts as active ingredients in oral care products. Many kinds of plant extracts, such as green tea, Aloe Vera, and grapefruit seeds showed evidence for effective use in oral care products as anti-plaque and anti-caries agents.

Propolis is a natural substance collected by honeybees from plants. Many studies have given proof of the antibacterial, antifungal, antioxidant including anti-inflammatory properties of propolis. There is also evidence that the use of propolis has the potential of functioning as an antibacterial agent and anti-plaque formation for oral pathogens [11-12].

Thus, the process of electrospinning is an alternative method to produce oral fast dissolving fibers that are interconnected like a thin film. This is caused by the physical properties of the fibers, which have a small diameter ranging in size from nanometer to micrometer, and a large surface area with a very fast dissolving property. The use of suitable polymers may result in good fiber properties to achieve rapid dissolution, and renders agreeable feelings in the mouth while having good physical properties. For the development of an oral delivery system for oral care preparations, controlling the amount of microorganisms in oral cavities is the key factor of the formulation. Prevention of biofilm forming is another way to reduce tooth decay. A natural extract of propolis is incorporated in electrospun fibers as antimicrobial agent.

1.2 Purpose of the Study

The purpose of the study was:

1.2.1 To develop and characterize oral fast dissolving electrospun fibers that contain propolis to control microorganisms in oral cavities using the electrospinning technique.

1.2.2 To investigate the antimicrobial activities against *Streptococcus mutans* from propolis extract incorporated in polymer electrospun fibers.

1.2.3 To study the elimination of bacteria adhesion of prepared propolis-polymer electrospun fibers.

1.3 Application Advantages

The results of the study may have the following application advantages

1.3.1 The use of the electrospinning method as an alternative method to produce oral fast dissolving fibers as oral strips.

1.3.2 The synergistic effect of the use of a mixture of polymer, propolis extract and additives in electrospun fibers when controlling the amount of microorganisms in oral cavities.