CHAPTER I

INTRODUCTION

1.1 Background

Controlled release of drugs is a very important process to achieve highest therapeutic efficiency. As a result, much research has been carried out in order to develop new controlled release systems that are more efficient and, most importantly, more cost-effective. Most conventional controlled release systems provide a constant level of drugs in plasma. It, however, does not improve therapeutic efficiency of the drugs. In order to do so, the suitable controlled release systems should be able to administer drugs at a specified rate over a proper period of time during a treatment. To achieve such characteristics, complete understanding over either the physical or chemical properties is crucial for imparting such characteristics to controlled release vehicles of choice.

Electrospinning or electrostatic spinning is an interesting technique for making ultrafine fibers which could be used as drug delivery vehicles. Since electrospun fibers normally have diameters ranging from sub-micrometers down to nanometers, their surface area per volume ratios are very large. In pharmaceutical point of view, various techniques, such as dry milling, wet grinding, air-jet milling, and wet milling, have been utilized in order to decrease the dimension of the controlled release vehicles of choice. In electrospinning process, drugs can be incorporated in the polymeric fibers by directly mixing solutions of drugs in the polymer solutions. At right conditions, electrospun fibers result. Controlled release of drugs from electrospun fibers has been of increasing interests in recent years and the release kinetics should depend on the polymer/drug pairs as much as on the sizes of the fibers.

The principles of electrospinning process are the use of electrostatic force as the main driving force for fiber formation. In the process, a high voltage power supply is used to charge a polymer solution or melt through a metal contact, e.g. normally a

needle, across a metal collection screen. The applied potential is in the range of 5 to 30 kV, depending on the collection distance. A reservoir containing a polymer solution or melt is attached to the metal contact with the small opening. When the polymer solution or melt is charged, the Coulombic repulsion force destabilizes the hemispherical pendant droplet located at the tip of the small opening. At a critical condition, the destabilized, hemispherical droplet changes into a conical shape, which normally terms "the Taylor's cone." Further increase in the applied potential causes a charged jet to be ejected from the tip of the Taylor's cone. At right conditions, fibers are formed as a result.

This work can be divided into two main experimental parts. The first is the electrospinning of three methacrylate-based copolymers. In this part, the effect of applied potential on morphological appearance of as-spun fibers was thoroughly investigated, using scanning electron microscopy. The second is to study controlled release characteristic of the obtained fibers of selected diameters, using Indomethacin as the model drug.

1.2 Objectives

The objectives of this research work are:

1. To prepare electrospun fibers from methacrylic-based copolymers; and
2. To investigate the potential use of the as-spun fibers as controlled release vehicles.