CHAPTER I
INTRODUCTION

In present, fibers have an important role in daily life of human because it can be used in many applications such as clothing, composites, separation membranes and biomedicine. From all of the applications, biomedical application has the most impact. It has received significant attention in last few years which strongly contributed to the development.

Fibers for biomedical applications represented a new class of material as drug delivery systems, wound dressing, breathing mask and absorbable suture are usually made from biodegradable polymers such as poly(lactide) (PLA), poly(3-hydroxybutyrate) (PHB) and Poly[(*R*)-3-hydroxybutyrate-*co*-(*R*)-3-hydroxyvalerate] (PHBV) because they produces a biodegradable, biocompatible and non-toxic thermoplastic polyester with excellent functional properties comparable to many petroleum-based plastics. Further advantages are that they can be synthesized from renewable resources so it represents an interesting way to replace petroleum based polymer, especially from the viewpoint of environmental protection. But the all of above polymers have some disadvantage such as in PLA, it has glass transition temperatures above room temperature, rendering is hard and brittle but it has high tensile strength (M.E. Broz *et al.*, 2006). In PHB, it is poor in mechanical properties and it is brittle which may limit their applications in situations that require high tensile strength (Y. Furuhashi *et al.*, 2004). In PHBV, although it has poor mechanical properties but it is flexible. Thus, the mechanical properties of these polymers should be improved before using in some biomedical applications such as suture which require high tensile strength and high flexibility. The suitable technique for fitting this requirement is the blending technique which is used to prepare a novel blend polymer of two or more polymers in required properties without having to synthesize a totally new material. And to further improve their mechanical property, plasticizer is also added. The plasticizer used is poly(ethylene glycol) (PEG) because PEG is good in biocompatibility and blood compatibility. Moreover, it can act as a stabilizer and reducing agent (C. Luo *et al.*, 2005) which is suitable to use in

synthesis of metal nanoparticle in a polymer matrix. There are many researchers that have done studies on PDLLA/PEG (S. Muriel *et al.*, 2006), PHBV/PEG (Parra D.F. *et al.*, 2006) and PLA/PHBV/PEG (S. Wang *et al.*, 2008)

And the other development of these blending fibers to be used for a wider biomedical application is the addition of antimicrobial efficiency into blended fibers to prevent micro-organisms growth (Xiaoyi Xu *et al.*, 2006, Fahmina Zafar *et al.*, 2007), by using a powerful antimicrobial agent as silver, titanium, zinc compound in nanopractical size.

In the method to form fibers for biomedical applications, electrospinning technology has received much interest because this method is capable to produce fibers with high specific surface area. The fibers are collected as non-woven with a diameter ranging from 10 nm to 500 nm and small porous web which is suitable for biomedical such as tissue-engineering scaffolds (Xiaoyi Xu *et al.*, 2006). But electrospinning method has some disadvantages. It is that this method produces non-woven which inhibits the use of special process to improve mechanical properties of fibers (such as drawing). Also the poor mechanical properties of the fiber will limit the use of various biomedical applications such as suture or dental floss because suture and dental floss are always monofilament fiber and require high tensile strength. For solving this problem, melt spinning is alternative method to produce fibers which have high mechanical properties.

Melt spinning method can produce monofilament fibers with a micrometer of diameter and can produce high tensile strength fiber depending on process or materials such as two different speed of roll for drawing fibers and characteristic of each polymer.

The purpose of this work is to produce biodegradable blends as PDLLA/PHBV/PEG1000 containing silver nanoparticles for antibacterial function in biomedical applications by using melt spinning method.