CHAPTER I
INTRODUCTION

Tissue engineering is the new approach field of science that applies the principles of engineering and the life sciences towards the development of biological substitutes that restore, maintain, or improve tissue function. In contrast to classic biomaterial approach, Tissue engineering is based on the understanding of tissue formation and regeneration, and aims to regenerate new functional tissues, rather than just to implant new spare parts (Salgado *et al.*, 2004). Therefore, harvested cells, signalling molecules (e.g. protein, and growth factor) and biocompatible scaffolds are the main components of tissue engineering. For the restoration of large tissue defects, scientific efforts have demonstated the utility of implanting tissue scaffolds, to which allow cell attachment, growth and proliferation. In bone tissue engineering need to develop a suitable bone scaffold with sufficient mechanical strength and porosity to allow the ingrowth of new tissue, enhancing growth and proliferation results in good integration with surrounding tissue. Accordingly, the following discussion examines novel, degradable, polymeric scaffolds developed to act as a temporary matrix for cell growth and extracellular matrix deposition, with consequent bone in-growth until the new bony tissue is totally restored or regenerated (Hutmacher D. W., 2000).

Thermoplastic aliphatic polyesters such as polylactide, polyglycolide, polycaprolactone and especially the copolymers of lactide and glycolide such as poly(lactide-co-glycolide) have generated interest for bone regeneration because of their excellent biocompatibility, biodegradability, and mechanical strength. PCL was chosen as a model polymer due to its lack of toxicity, low cost and slow degradation.(Yoshimoto *et al.*, 2003) The challenge in tissue engineering is the design of scaffolds that can mimic the structure and biological functions of the natural extracellular matrix (ECM). Electrospinning has drawn a lot of attention recently as a suitable method to fabricate scaffolds, owing to its simple process, its increased surface areas, ability to mimic the extracellular matrix (Venugopal *et al.*, 2008), its versatility to create fibrous scaffolds from a wide range of starting materials, and as a carrier to deliver clinically relevant proteins like growth factors.

It has been known that certain surface characteristics of polymer can influence the interactions between cells and material. The hydrophobic surface of PCL was not adequate for cell attachment and growth. Therefore, it is important to develop different physical and/or chemical methods to modify the scaffold surface for cytocompatibility improvement for cell attachment and proliferation. It has been reported that several methods (such as plasma treatment, ozone or photoinduced grafting and surface oxidation) have been employed to introduce hydrophilic compounds onto polymeric scaffold surfaces. Moreover, biomaterials can be coated with extracellular matrix (ECM) proteins (such as collagen, fibronectin, laminin), which usually have promoted cell adhesion and proliferation (Zhu *et al*, 2002).

In this study, PCL scaffolds were prepared by electrospinning techniques followed by immobilization of gelatin, bovine serum albumin (BSA), and crude bone protein extracted from pork bone via chemical surface modification method to promote cell behavior including their adhesion, growth, differentiation. The potential use of these electrospun fibrous scaffolds was further evaluated *in vitro* with MC3T3-E1 in terms of cytotoxicity, attachment, proliferation, alkaline phosphatase activity (ALP), and mineralization of the cells that were cultured directly on the scaffolds, in comparison to those of the cells on a tissue-culture polystyrene plate (TCPS).