CHAPTER I

INTRODUCTION

Silk fibers are the natural fibers. Generally they are produced from silkworm, which needs to produce fibers because it wants to protect larvae. In fact, many organisms can produce silk fibers, however, silkworm and spiders are two main producers of silk. The silk fibers of spiders have small size and it is hard to culture, therefore, silk fibers produced from silkworm are well-known. The silkworm can be divided into two types as the domesticated *Bombyx mori* silk and wild silk (e.g. Tussah silk). Among silkworms, the former silk is well known because it can be cultured. Silk fiber usually consists of two protein types as silk fibroin and sericin. Silk fibroin is a core structural protein and is coated by sericin, a family of glue-like proteins that hold the fibroin core fibers together. Silk fibroin is a fibrous protein unlike sericin is a globular protein.

Silk fibers have excellent mechanical properties, therefore, they have been used in textile production. Besides the advantages of mechanical properties, they have the other outstanding properties such as biocompatibility, biodegradability, good oxygen and water vapor permeability, and little or no immunological reactions. From these reasons they have been interested to be widely used in biomedical applications such as sutures, tissue engineering, and wound dressing, etc.

Electrospinning is an attractive method for obtaining fibers because it is easy to use, cost-effective process, and simple equipment setting. It is a fiber spinning technique driven by a high-voltage electrostatic field using a polymeric solution or liquid that produces polymer fibers with diameters ranging from several micrometers down to 100 nm or less. The small fibers diameters and the porous structure of electrospun nonwoven result in a high specific surface area. These properties make electrospun nonwoven interesting candidates for various applications including reinforcement in composites, membranes, wound dressing, tissue scaffolding, and other biomedical applications. Particularly, as-electrospun nonwoven has gained a lot of attention from many researchers in biomedical field.

Tissue engineering involves seeding a three dimensional scaffold with cells, expanding the cell population, and then implanting the engineered tissue construct in vivo. Ideal scaffolding should be mimic the structure and biological functions of the

extracellular matrix (ECM) in vivo and then support cell regeneration. Since porous structure of electrospun nonwoven which is fabricated by electrospinning technique has three dimensions structure; therefore, this technique has been widely used in biomedical applications for producing scaffolding materials.

Hyaluronic acid (HA) or hyaluronan is present in every tissue of the body. HA can be found in the synovial joint fluid, the vitreous humor of the eye, the cartilage, blood vessels, extracellular matrix, skin, and the umbilical cord. The most important biological function of HA is the retention of water.

In the skin, HA is a component of extracellular matrix and involved in a variety of tissue functions: skin repair, regeneration, and restoration. HA has been found to play a role in enhancing cell growth, cell differentiation, and it is found naturally in skin's ECM where it maintains the structure of soft tissue. Because hyaluronic acid has an unusually high affinity for water and is a natural film-former, it has been successfully used in skin and hair care products to moisturize, protect, and give body to some otherwise thin formulas.

The objectives of this research were to find the suitable conditions for producing electrospun silk fibroin by electrospinning technique and to investigate the potential of HA coating on the electrospun silk fibroin fibers as scaffolding materials for keratinocyte and fibroblast cells. Silk fibroin films were prepared for comparing the ability of cell culture with as-prepared and HA coating electrospun silk fibroin fibers. In addition, as-prepared and HA coating electrospun silk fibroin fibers including silk fibroin films were used as the scaffolding materials for investigating cell cytotoxicity, cell attachment, and cell proliferation by culturing keratinocyte and fibroblast cells onto the scaffolding materials. The morphology, thermal properties, and surface characteristic of as-prepared and HA coating electrospun silk fibroin were investigated by SEM, TGA, and ATR-IR, respectively.