# CHAPTER I

# INTRODUCTION

## 1.1 Background

Traditionally, severe burn which causes full thickness wound must be treated by using cadaver skin (allograft) or animal skin (xenograft) or own patient skin (autograft). Obviously, these treatments bring to the issues of immune rejection and availability of skin source. Synthetic skin substitute constructed from biocompatible polymers, a novel method used instead of the traditional treatments, has being developed for full thickness wound healing. The advantages of synthetic skin substitute are to reduce the scar forming and to accelerate the wound healing without any infection. The main function of synthetic skin substitute is the pretending as an extracellular matrix scaffold in dermis that the surrounding cells can migrate into and perform their biological activities. If the cells recognize synthetic skin substitute as the dermis, they will not try to recover new tissue in the wrong direction, which cause to the scar forming. The migrated cells will secrete the cytokines and finally induce the tissue regeneration. This is the reason why synthetic skin substitute is efficient for full thickness wound healing.

Synthetic skin substitute requires many characteristics in order to heal the wound perfectly. Firstly, it should mimic the natural dermis as much as possible. Synthetic skin substitute should have extracellular matrix (ECM) structure, which consists of type I collagen and glycosaminoglycans (GAGs), like in the natural dermis. Secondly, it should positively interact with cells including enhancing cell adhesion, growth, migration, and differentiated function, that is, biocompatibility. Thirdly, it should have high surface area, which found in highly porous scaffold, for cell attachment. Fourthly, it should have enough mechanical integrity which is suitable for treatment handling. Finally, it is necessary for the synthetic skin substitute to be produced from biodegradable materials. The degradation rate of the synthetic skin substitute is required to match the rate of tissue formation.

From the characteristics of skin substitute described above, biocompatible polymers play an important role in tissue engineering as scaffolds for cells. In an effort to find suitable biomaterial candidates for fabricating scaffolds, gelatin was chosen in this study because it is a derivative of collagen the major constituent of skin, bones and connective tissue. Gelatin does not exhibit antigenicity, and practically, it is one of the most convenient proteins to use because it is much cheaper and easier to obtain the solution than collagen. Generally, gelatin is divided into 2 types that are type A gelatin and type B gelatin. The difference between both gelatin types is the producing process. Type A gelatin is produced from acid process while type B gelatin is produced from alkaline process. The different processes lead to the differences in isoelectric point (pI) and pH of gelatin.

Therefore, the first aim of this study was to compare type A and type B gelatin scaffolds. The effects of the concentration of gelatin solution and gelatin type were studied. The morphology, chemical, physical and biological properties of the scaffolds were investigated.

The second aim of this study focused on the improvement of the cell response of gelatin scaffolds. Gelatin scaffolds were modified by blending with collagen to improve biocompatibility of the scaffold [1]. The effects of blending composition and the concentration of blended solution were studied. Also, the morphology, chemical, physical and biological properties of collagen/gelatin scaffolds, including crosslinking degree, swelling ratio, compressive modulus, degradation rate, cell attachment, and cell proliferation, were studied.

## 1.2 Objectives

1.2.1 To study the effects of gelatin type on the physical and biological properties of gelatin scaffolds for dermal regeneration.

1.2.2 To study the effects of collagen blending on the physical and biological properties of collagen/gelatin scaffolds.

## 1.3 Scopes of work

1.3.1 Evaluate gelatin types used in scaffold fabrication.

Two types of gelatin are:

1.3.1.1 Type A gelatin

1.3.1.2 Type B gelatin

1.3.2 Determine the optimum concentration of gelatin solution and optimum conditions used for fabrication process.

1.3.2.1 Solution concentration: 0.4wt%, 0.6wt%, 0.8wt% (total solid).

1.3.2.2 Duration for dehydrothermal crosslinking at 140°C: 24, 48, 72 h.

1.3.3 Modify gelatin scaffold by blending with collagen.

The mass ratios of collagen/gelatin are: 0/100, 10/90, 20/80, 30/70, and 100/0

1.3.4 Chemical characterization.

1.3.4.1 Crosslinking degree by TNBS method

1.3.5 Physical test.

1.3.5.1 Morphology by scanning electron microscopy (SEM)

1.3.5.2 Compressive modulus

1.3.5.3 Phosphate buffer saline (PBS) swelling property

1.3.6 Biological test.

1.3.6.1 *In vitro* biocompatibility by cell culture

a) Cell attachment

b) Cell proliferation

1.3.6.2 *In vitro* biodegradation by lysozyme