INTRODUCTION -CHAPTER 1

1.1. Statement of the problem

Skin is the largest body organ which protects the body against toxins, microorganisms, dehydration and mechanical injuries on to the body surface. It is composed of two layers; outer epidermis and inner dermis layer. Loss of skin integrity due to injury or illness may result in substantial physiologic imbalance, disability or even death. According to an estimate, each year nearly 6 million people suffer from chronic skin injuries worldwide. The frequency of chronic wounds in India has been reported as 4.5 per 1000 population, whereas that of acute wounds is nearly double, at 10.5 per 1000 population [Sasidharan et al., 2010; Gupta et al., 2004]. An annual wound care cost of the US healthcare system is around $50 billion with an average cost to heal per wound between $3.349–9.358.4 [Gainza et al., 2015]. Moreover, in scientific view the current therapies are far from adequate healing, so the health care resources are being ineffectively used leading to increased health care expenditure worldwide [Gainza et al., 2015].

For wound healing; conventional practice is to prescribe a broad spectrum antibiotic to the patients for oral intake along with direct application of an antiseptic agent or wound dressing to the local wound area. However, this approach leads to undesirable effects onto the normal beneficial microflora of human body as well as on human health. It is also required to apply the antimicrobial agent multiple times to the local wound site which is undesirable. Moreover, the local direct application of antibiotics does not provide any support for the rapid growth of new cells. So it is clear that direct application of antibiotics can prevent the delay in wound healing due to bacterial infection but it cannot accelerate the healing process. Therefore, improvement in the wound treatments has become a major need; hence, the scientific community has focused on finding new treatments for wound healing.

1.2. Biopolymeric scaffolds: A probable solution

1.2.1. Biopolymers as biomaterials

In this modern age, application of biomaterials in biological systems has opened new avenues of solutions for various scientific and biomedical challenges. Biomaterials have the capability to mingle with living systems to evaluate, treat or replace any tissue organ or function of the body [Williams 1999]. Some of the prominent applications of biomaterials are in the area of tissue engineering, wound healing, prosthesis, joint replacement, angiogenesis, vascular grafts for cardiovascular replacement, artificial skin, drug delivery systems and many more [Dhandayuthapani et. al., 2011]. Biomaterials may be composed of synthetic or biopolymers. Biopolymers are the polymers of biological origin.

1.2.2. Biopolymeric scaffolds

Scaffold is a three-dimensional structure which is capable of provideing the support to some system. In bioengineering scaffolds are fabricated by different biopolymers or synthetic polymers and used for various biological applications. As discussed above that direct local application of antibiotics and conventional dressing are unable to provide any support for the rapid cell growth which results to slow wound healing.

Antibiotic drug loaded scaffolds of biodegradable biopolymers could be an excellent solution for slow wound healing. On one hand the loaded antibiotic in the scaffold can prevent the local infection at wound site while on other hand it is also capable to provide a supporting system for cell growth. Fairly designed scaffolds are also capable to biomimmic the extra cellular matrix (ECM) of the body which provides them an extra beneficial edge over conventional wound dressings. Many biological and synthetic polymers have been attempted yet for the scaffold construction and drug delivery [Tomlins, 2016]. Chitosan, silk fibroin, gellan gum, gelatin, cellulose, collagen, galactomannan, xanthan, starch chondroitin sulfate, hyaluronan, and alginate are some main examples of biopolymers utilized for scaffold construction, drug delivery and other bio-applications [Dhandayuthapani et al., 2011, Vlierberghe et al., 2011].

1.3. Rationale of the study

From above discussion it is clear that scaffolds can act as an excellent wound dressing and could also biomimmic the ECM of the body.

Blending of two or more polymers can lead to production of new materials with the desired physicochemical, thermal, mechanical and biological properties and these materials can be used for the fabrication of scaffolds. Silk fibroin (SF) chitosan (CS) are two of the most extensively explored polymers for scaffold construction and their other biomedical applications [Bhardwaj et al., 2011; Correia et al., 2011; Gregory et al., 2002; Ronald et al., 2004]. SF is a protein whereas CS is natural polysaccharide biopolymer. Both of these biopolymers have attractive biomedical properties such as biocompatibility, haemocompatibility, biodegradability and physiochemical properties similar to the native host tissue [Gobin et al., 2005; Maghdouri-White et al., 2015]. Blending of these two polymers can provide an excellent biomemmic scaffold system for cell growth [Teimouria et al., 2015; Wenk et al., 2011]. Gellan gum (GG) is another emerging polysaccharide biopolymer for the delivery of various drugs and biomolecules [D'Arrigo et al., 2014; Kumar et al., 2012; Osmałek and Tasarek; 2014].

On the ground of above facts, this research was attempted to design an effective wound dressing using drug loaded biopolymeric scaffold. Different polymers and their mutual blends were investigated for the fabrication of suitable scaffold. The suitability of scaffold for wound healing application was decided on the basis of different properties; such as porosity, swelling ratio, degradability, ultrastructure, drug loading and release characteristics, mechanical properties, surface roughness, haematocompatibility, dehydration rate, antimicrobial effectivity etc. After getting the suitable scaffold it was utilized to design the wound dressing. Finally the designed dressing was evaluated for its healing potential in an *invivo* system.