CHAPTER 1
INTRODUCTION

1.1 MEDICAL TEXTILES

The combined development of textile technology and medical sciences has brought into a new field called medical textiles. New areas of application for medical textiles have been identified with the development of new fibers and manufacturing technologies for yarns and fabrics. The main objective in the development textile field, both natural or manmade textiles, is to enhance the comfort to the users. Development of medical textiles can be considered as one such development, which is really meant for converting the painful days of patients into the comfortable days. Recently biodegradable textile systems have found to be getting importance in the designing of surgical device, artificial organs, drug delivery system and wound dressing bandages.

Even in the large area of these systems, the demand is placed on designing the dressings for healing of wounds to a large extent (Kucharska et al. 2008). Textiles with antimicrobial properties are gaining interest. There is a great demand for textiles with antimicrobial or self-cleaning properties. With the growing concern for the environment, the use of natural products to impart various functions to textiles has attracted increasing attention (Angspatt et al. 2011).
1.2 WOUND

Wound is the result of disruption of normal anatomical structure and function (Lazarus et al. 1994, Priyanka Agrawal et al. 2014) and also wounds can be classified according to their tissue loss i.e., wounds without tissue loss (eg, in surgery) and wounds with tissue loss (which includes burn wounds, wounds caused by trauma and diabetic ulcers). Normally wound dressings have been used to cover wounds and absorb bleeding (Shuk-fan Tong et al. 2015).

1.3 WOUND-HEALING

Wound-healing process consists of four highly integrated and overlapping phases: hemostasis, inflammation, proliferation, and tissue remodeling or resolution (Guo & DiPietro 2010, Gosain & DiPietro 2004). There are many factors that can affect wound healing which interfere with one or more phases in this process, thus causing improper or impaired tissue repair (Gosain & DiPietro 2004).

1.4 WOUND DRESSING

In earlier days the role of wound dressings were very minimum in healing of wounds (Yannas & Burke 1980, Yueh-Sheng Chen et al. 2008). An ideal wound dressing should protect the wound from bacterial infection, provide a moist and healing environment, and be biocompatible. Wound dressings are used to encourage the various stages of wound healing and create better healing conditions for said healing. The plan of wound care should always concentrate on using the appropriate wound dressing material and treatments to reduce dressing frequency. A wound dressing material should provide a suitable environment to the wound dressing interface, as
well as mechanical and bacterial protection that allows gaseous and fluid exchanges (Yueh-Sheng Chen et al. 2008).

1.5 APPLICATION OF BAMBOO FIBRE IN MEDICAL TEXTILES

Bamboo fibre with its unique properties make it ideal for textile processing. One of the property of the bamboo is its antibacterial property which make it quite suitable for wound care treatments. The highlighted property of the fibre is its water absorbency, which absorbs water three times of its weight. The properties such as natural effect on sterilization, moisture vapour transmission and easy drying makes its more valuable. With all these properties it can be concluded that the bamboo fibre can be used in the development of wound dressing materials.

1.6 NATURAL PRODUCTS ON WOUND DRESSING

The emergence of resistance to newly introduced antimicrobial agents indicates that even new families of antimicrobial agents will have a short life expectancy (Coates et al. 2002). In this regard, researchers are increasingly turning their attention to herbal products (Braga et al. 2005). For thousands of years, natural products have been used in traditional medicine all over the world and predate the introduction of antibiotics and other modern drugs. The antimicrobial efficacy attributed to some plants in treating diseases has been beyond belief. It is estimated that local communities have used about 10% of all flowering plants on Earth to treat various infections, although only 1% have gained recognition by modern scientists (Kafaru 1994). Due to the potential toxicity to humans, and environmental concerns about the use of some of these biocides, naturally-occurring and biocompatible compounds are preferred for use in wound dressings and other medical textile applications.
1.7 CURCUMIN EXTRACT IN WOUND TREATMENT

Curcumin is a herbal compound found in turmeric (Curcuma longa L). The World Health Organization (WHO) and Food and Agriculture Organization (FAO) have verified its safety as a Natural Food Colorant (C.I. Natural Yellow) (Penwisa Pisitsak & Uracha Ruktanonchai 2015, Han & Yang 2005).

1.8 ALOE VERA EXTRACT IN WOUND TREATMENT

Aloe vera has been used for many centuries for its curative and therapeutic properties and although over 75 active ingredients from the inner gel have been identified, therapeutic effects have not been correlated well with each individual component (Josias H. Hamman 2008, Habeeb et al. 2007).

1.9 CHITOSAN AND CURCUMIN IN WOUND TREATMENT

Chitosan–curcumin formulations are already being successfully used as part of a biological sponge, which is used as a medical device for wounds and swellings during dislocation healing. The chitosan was responsible for the swelling reduction and wound healing, at the same time as the curcumin influenced the increasing growth of collagen and other connecting tissues (Lidija Fras Zemljic et al. 2014, Xu et al. 2009).

1.10 CALOTROPIS EXTRACT IN WOUND TREATMENT

Calotropis is used as traditional medical plant with unique properties. Traditionally it is used alone or with other medicinal to treat common disease such as fever, indigestion, cough, cold, asthma, vomiting, diarrhea. According to Ayurveda dried while plant is a good tonic, expectorant, depurative and anthelmintic. The dried fibre is a substitute for
ipecacunta. The fiber is febrifuge anthelminthic, depurative, expectorant and laxative (Ajay Kumar Meena et al. 2011).

1.11  **EUCALYPTUS EXTRACT IN WOUND TREATMENT**

Eucalyptus species is an important source of many pharmacologically and medically important chemical used for various activities like analeric, antifungal, anti-inflammatory, anti-bacterial, anti-diabetic, anti-oxidative, cytochrome p450 enzymes inhibitor, anti-viral, anti-tumor, anti-cancer cytochrome p450 inhibitor and hepatoprotective properties (Hardel Danendra Kumar & Sahoo Laxmidhar 2011).

1.12  **SYZYGIUM AROMATICUM EXTRACT IN WOUND TREATMENT**

Syzygium aromaticum contain much properties like anti-fungal, anti-viral, anti-microbial, anti-diabetic, anti-inflammatory, anti-thrombotic an anesthetic. Syzygium aromaticum represents one of the natural antiseptic which consists of Eugenol which is used for various medical purposes (Parle Milind & Khanna Deepa 2011).

1.13  **PIPER BETEL EXTRACT IN WOUND TREATMENT**

Piper Betel belongs to a family of Piperaceae which is commonly termed as ‘Paan’. It is extensively grown in Sri Lanka, India, Thailand, Taiwan and other Southeast Asian countries. The important parts like leaves, roots, stems, stalks and fruits of Piper betel are utilized for multifunctional purpose. A broad antiseptic properties has been identified in the Betel leaf and also there is no negative reports in the literature on the occurrence of cases of allergy to the plant. The active substances in betel leaf are phenol and its derivatives. The phenolic derivatives contained in betel leaves have a five-

1.14 NEEM LEAF EXTRACT IN WOUND TREATMENT

Neem (Azadirachta indica) commonly termed as ‘India Lilac’ or ‘Margosa’, belongs to the family of Meliaceae, subfamily of Meloideae and tribe of Melieae. Neem is the most versatile in nature, heterogeneous trees of tropics, with enormous prospective properties. Neem gives a maximum number of useful non-wood products (leaves, bark, flowers, fruits, seed, gum, oil and neem cake) when compared with any other tree species. Neem is used in traditional medicine as a source of many therapeutic agents in the Indian culture and grows well in the tropical countries. In Indian sub-continent its branches which provide a chewing stick are widely used. Earlier studies on neem have showed that it contains active substances with multiple medicinal properties (Maragatharavelli et al. 2012). Aqueous extract of neem leaf exhibits good therapeutic potential (Mossadek & Rashid 2008, Patil et al. 2013).

The greatest benefit of an ideal antimicrobial treatment of textiles will be obtained only when it satisfies a number of requirements. The efficacy of the treated textile material should be very high against a broad spectrum of bacterial and fungal species with low toxicity, allergy or irritation to the end users. The surface properties of the product should not be changed after laundering, dry cleaning and hot pressing. The physical properties and the appearance of the textile should not change after finishing. The finishing process should be cost effective and it should not release any harmful substance to the user and the environment (Yuan Gao & Robin Cranston 2008).
In the present study a wound dressing material coated with natural extracts is developed and coated with rhEGF, and investigated for its drug-releasing efficacy on wounds. To gain further knowledge about the developed wound dressing material with respect to wound healing, in vivo study was also undertaken.

1.15 OBJECTIVES

The objectives of the research work are:

1. To develop natural fibre based wound dressing material coated with natural extracts of curcumin, aloe vera and chitosan solution enhanced with rhEGF (REGEN-D™).

2. To develop natural fibre based wound dressing material coated with natural extracts of calotropis gigantean, eucalyptus globules and buds of syzygium aromaticum solution enhanced with rhEGF (Burn - REGEN-D™ 60).

3. To develop natural fibre based wound dressing material coated with natural extracts of aloe vera, piper betel and neem leaf solution enhanced with rhEGF(REGEN-D™ 150).

4. To study the characterization of developed wound dressing materials.

5. To investigate the wound healing efficacy of wound dressing materials with different compositions using in vivo method.

1.16 ORGANIZATION OF THE THESIS

This thesis has been divided into six chapters. **Chapter One** comprises general introduction, discusses the need for undertaking the study, objectives of the research work and organization of thesis.
Chapter Two briefly discuss on various research studies conducted in the context of wound dressing in different countries. The research studies related with need of natural fibre based wound dressing coated with natural extracts was highlighted.

Chapter Three describes the development and characterization of wound dressing material coated with natural extracts of curcumin, aloe vera and chitosan solution enhanced with rhEGF(REGEN-D™). It also explains elaborately about the wound healing efficacy of the developed wound dressing materials through *in vivo* method.

Chapter Four deals with the development and characterization of wound dressing material coated with natural extracts of calotropis gigantean, eucalyptus globules and buds of syzygium aromaticum solution enhanced with rhEGF(Burn - REGEN-D™ 60). It also explains elaborately about the wound healing efficacy of the developed wound dressing materials on second degree burn wound through *in vivo* method.

Chapter five deals with the development and characterization of wound dressing material coated with natural extracts of aloe vera, piper betel and neem leaf solution enhanced with rhEGF(REGEN-D™ 150). It also explains elaborately about the wound healing efficacy of the developed wound dressing materials through *in vivo* method.

Chapter six deals with the summary, conclusion and demonstrates the scope and recommendations for future research.