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Natural Compounds for Wound Healing

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Abstract

Many plants or plant-derived compounds with high levels of antioxidants and anti-inflammatory, immunomodulatory, and antimicrobial properties could be of great benefit for wound healing. Several studies have documented the use of plant extracts for the development of bioactive wound dressings. The purpose of this chapter is to give an update about the vegetal and bee products, which can be used as bioactive substances in wound dressings or in other formulations for wound healing. The adverse effects of plant and bee extracts, such as contact allergies, are also presented. In order to better exploit the huge reservoir of pharmacologically active plant-derived compounds and extracts, standardized methodology and clinical trials are necessary to give more concrete evidence supporting the use of traditional medicine in wound management.

Keywords: wound healing, essential oils, plant compounds, propolis, antimicrobial, immunomodulatory, antioxidant, wound dressings, dermatitis

1. Introduction

Wound healing is a complex and dynamic process which is not fully understood [1]. Leg ulcers are caused by circulatory problems and are characterized by the lack of skin substance, having a chronic evolution and delayed healing [2]. The causes of ulcers are (i) a prolonged or excessive inflammatory phase [3], (ii) persistent infections produced by microbial biofilms resistant to treatment, and (iii) failure of the epidermal or/and dermal cells to respond to the reparatory stimuli [4]. The characteristics of ulcers are an increased enzymatic activity of the matrix proteases, a low response to growth factors, and increased cell death [1].
Wounds and ulcers affect the patients’ life quality with an annual cost of $25 treatment [5].

Medicinal plants have been used for thousands of years, worldwide, as traditional treatments for numerous diseases. For example, 65 herbs were used in the traditional Persian medicine, a holistic system of medicine, providing valuable information on natural remedies [6]. Almost 80% of the population of developing countries, but also economy leaders as China and India, use traditional medicine for the treatment of a wide range of diseases [7, 8]. The naturally derived products from medicinal plants have proven to be an abundant source of biological active compounds, of which many have been used to start the development of new chemicals for the pharmaceutical industry.

There are approximately 500,000 species of plants in the world of which only 1% have been phytochemically analyzed demonstrating a great potential for the discovery of new bioactive compounds [9]. Phytochemicals are nonnutritive substances present in plants, enhancing tissue remodeling when applied on wounds and acting as pro-angiogenic agents for wound healing [7]. From the 1184 new chemical entities introduced between 1981 and 2006, approximately half of them (48%) were natural products, semisynthetic analogs of the natural products, or synthetic compounds based on the natural phamacophores. Over 70% of the therapeutic agents developed between 1981 and 2006 for bacterial and fungal infectious diseases have been derived from natural compounds [10, 11].

The therapeutic properties of vegetal extracts include the following effects, which are due either to some specific phytocompounds or to their synergic actions: anti-infectious, anticancer, antioxidant, immunomodulatory, actions on the central nervous system and on the cardiovascular system, and hemotropic activity.

Regarding the infectious diseases, the increased resistance of known pathogens to the currently used therapeutic agents, such as antibiotics and antiviral agents, has led to regaining the interest for the discovery of novel natural compounds with anti-infectious activity. The increasing appreciation of the different biological effects of the natural compounds has led to a reevaluation of the possible roles that these compounds play in plants, especially in the context of ecological interactions [12].

Besides the principal metabolites which assure the plant’s viability, the plants produce many organic compounds, known as secondary metabolites, which do not participate directly to the growth and development of the plants. These are distributed differently in the taxonomic groups of the plants regnum. Many of their functions are not known, although they are remarkable through the complexity of their chemical structures and the biosynthesis pathways.

Many of these compounds are recognized, presently, as being involved in the plant’s defense, having an insecticide, antimicrobial, and repellent effect; in reproduction, they have a role of attractant for pollinators and act as allelopathic agents. These ecological functions affect the survival of the plants and, apparently, the secondary metabolites of plants’ act, mainly, on other species, being known the fact that invasive plants produce compounds that stop the development of autochthonous species in the clonal area [12].

This chapter is a synthesis of original results published in the PhD works of the chapter coauthors and also of research articles available from PubMed, using the following key words:
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