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A Review of Different Source of Natural Compounds for Wound Healing

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Abstract

The process of recovery from a wound involves the replacement of injured, malfunctioning cellular components. Since ancient times, natural substances have been frequently used to cure wounds. Many published papers reviewed natural remedies for treating wounds applications, which distinguished amongst the methods according to traits, bioactivities, and mechanisms of action. Current research, however, examines natural substances that are only derived from plants or animals. In this study, we present a thorough analysis of natural substances derived from both plants and animals that target several bioactivities of wound healing and aid in wound resolution. Anti-inflammation, anti-oxidant, anti-bacterial, and collagen promotion were the four primary divisions into which the chemicals were divided. These topics were primarily covered in recent research between 1992 and 2022. These substances are listed.

Keywords: Traditional, Indian Origin, Pharmacological Properties, Wound Healing

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Introduction

Since the first chemicals were identified from plant material in the 1960s, a strategy to finding individual physiologically active molecules has been known as ethnopharmacology. It should be emphasised that using plants for purposes other than purely medical ones may lead to the development of new medications. As a result, compounds used as pesticides, poisons, in agriculture, as cosmetics, during fermentation processes, and for religious purposes may also include active ingredients that can be employed as leads for the development of new drugs. But due to public interest, which is larger than expected given that, according to the WHO, 80% of the world's population currently lives in developing nations, the article merely details traditional plants of Bangladesh and their application.

Accidental or surgical trauma, as well as a number of different medical problems, can result in wounds. This wound frequently results in pain, inflammation, and loss of function, which have an impact on the patient's quality of life and cost [1]. Acute wounds are one category of wounds.or persistent wounds. The intricate process of rebuilding tissue layers and damaged and malfunctioning cellular components is known as wound healing [2]. Acute wounds heal in stages, and after four weeks, the healing process is clearly visible. Chronic wounds do not heal normally over the course of four weeks and do not advance through the stages of healing. It can be argued that variables at the wound site, systemic mediators, the type of injury, or any underlying diseases affect how a wound heals [3]. Wound\treatment Here, we provide a review of natural substances (both from plants and animals) that are significant in the healing of wounds, as well as their healing methods and practical use restrictions. Based on how well those chemicals target bioactivities for wound healing, we categorised them. We detailed the most recent developments in the use of natural substances. We offered data tables so that readers could look up natural compounds according to their bioactivity, source, and phases of targeting in wound healing.

The Healing Process for Wounds

Hemostasis is the initial step in wound healing. During this stage, the lymphatic tubes are damaged, and blood drains out to flush out microbes and antigens [14]. The body will cause thrombocytes to aggregate by exposed collagen and activate various clotting pathways.

In order to stop blood loss and replace tissue gaps in damaged arteries with blood clots containing cytokines and growth factors, platelets simultaneously trigger vasoconstriction [15]. The clot is a reservoir of growth factors that stabilise blood clots and prevent bleeding. It contains the molecules fibrin, fibronectin, vitronectin, and thrombospondin, which form a temporary matrix as a scaffolding structure for the migration of leukocytes, keratinocytes, fibroblasts, and endothelial cells.

Inflammation Phase

The second phase of wound healing is inflammation which focuses on cleaning the wound and preparing for new tissue formation in the wound. This stage has the appearance of neutrophils and lasts about 2–5 days from when the wound becomes infected. Neutrophils can phagocytize and secrete proteases (elastase, cathepsin G, proteinase 3) that help destroy bacteria in the wound and deco remove debris. Neutrophils also release mediators (TNF-α, IL-1 and IL-6) to amplify the inflammatory response, stimulating VEGF and IL-8 to respond to repair during wound healing [16]. The macrophage process then supports the ongoing process by phagocytosis of the debris and secretion of growth factors, chemokines, and cytokines [17]. Macrophages promote and address inflammation, eliminate apoptotic, and support cell proliferation and tissue recovery after injury [18]. In the inflammatory phase, there are often symptoms of edema, erythema and pain.

Proliferation Phase

The proliferation phase is the most important phase of the wound healing process and lasts from 6 to 21 days. During the proliferation phase of wound healing, the wound is healed with fresh collagen and extracellular matrix tissue. After that, the wound shrinks as new tissues develop. A new network of blood vessels must be created for granulation tissues to remain healthy and receive an adequate supply of nutrients and oxygen. The modulation of fibroblasts toward myofibroblasts promotes the formation of granulation tissue. The myofibroblasts are characterized by the capacity to produce force and synthesize extracellular matrix components that allow the contraction of granulation tissue [19]. By gripping the wound boundaries and pulling them together, myofibroblasts use a technique akin to that of smooth muscle cells to close the wound. In the initial stages of wound healing, granulation tissue appears pink or red and has an uneven texture. Furthermore, healthy granulation tissue is clot-resistant [20,21]. Dark granulation tissue may be brought on by an infection, ischemia, or insufficient perfusion. Near the conclusion of the proliferation phase, epithelial cells resurface the wound. Keeping wounds moist accelerates

epithelialization. Epithelialization occurs when occlusive or semi-occlusive dressings are applied within 48 h after the injury. This is because adequate tissue humidity is maintained. One accomplishment of the proliferation phase is replacing the temporary fibrin matrix with a new matrix made of collagen fibers, proteoglycans, and fibronectin to restore the structure and function of tissues. Another crucial stage of healing is angiogenesis, or the ingrowth of new capillaries to replace previously damaged vessels and restore circulation. The creation of granulation tissue and epithelialization are other important phenomena in this healing period. In the proliferation phase of healing, fibroblasts are the most important cells [22,23]. For fibroblasts to migrate in the extracellular matrix, they must first recognize and interact with particular matrix components.

Remodeling Phase

Closure of acute and chronic wounds is regarded as the wound healing endpoint in most clinical settings, yet wounds can continue to undergo remodeling or tissue maturation for months or even years [32,33]. This final stage of wound healing decides whether scarring will occur and whether the wound will reoccur. Regression of the neo vasculature, a periodic deposition to the ECM, and subsequent reconstruction of granulation tissue to scar tissue are all part of the remodeling phase [26]. Collagen III makes up the majority of granulation tissue, which is gradually replaced by the stronger collagen I as the wound heals. This occurs due to simultaneous collagen I production and collagen III lysis, followed by ECM remodeling [34]. In the remodeling phase, scar tissues are created, and it might take several months or years to complete, depending on the severity and location of the wound, and used therapeutic procedures. During this time, the new tissue gradually gets stronger and more flexible. Elasticity and tensile strength of the skin are both getting stronger because of collagen synthesis. After re-epithelialization, macrophages regain their phagocytic phenotype. Excessed cells and matrix no longer required for wound healing are phagocytosed by Mreg or M2c-like macrophages [24]

Classification of Natural Compounds for Wound Healing by Their Properties From the literature search, we collected a list of 137 research articles [30,35–170] relating natural compounds for wound healing. We classified them into groups regarding their bioactivities (i.e., anti-inflammation, anti-oxidant, antibacterial, collagen promotion, etc.) (Figure 2). The origin of those compounds (i.e., plant and animal) was also considered. Among bioactivities, anti-inflammation, anti-oxidant, anti-bacterial, and collagen promotion are studied the most. Therefore, in this study, we focused our

discussion on natural compounds regarding these bioactivities. A data table containing a list of those literature and the compounds were provided in the Supplementary Materials.

Conclusions

Hemostasis, inflammation, proliferation, and remodelling are the four overlapping phases that make up the complex biological process of regaining devitalized cellular structures during wound healing. Patients benefit greatly from effective natural wound healing treatments because they are inexpensive and easily accessible. Based on bioactivities from plants and animals, this work presented a thorough evaluation of natural products for wound healing, giving readers a general understanding of the relationship between the chemical origins of natural products and biological wound healing mechanisms. To categorise and examine the targeting phases, the main four primary bioactivities of natural products—anti-inflammation, anti-oxidant, antibacterial, and collagen promotion—are used. Readers could also access data tables with information on origin, bioactivity, targeted phase, experimental model, and type of wound.

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