



A REVIEW ON MEDICINAL PLANTS AND THEIR WOUND-HEALING ABILITIES

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ABSTRACT Wound healing is a biological process and it is achieved through programmed cellular and molecular phases. The four significant & overlapping phases are haemostasis, inflammatory, proliferative and remodelling. In each phase the tissues undergo enormous changes and these changes may or may not occur in proper sequence and time frame depends on various factors. The wound healing is a natural process where in the medications applied on the wound site may reduce the rate of healing. Nature has gifted us enormous plant based drugs with potential to wound healing. Plants play a vital role in wound therapy, there are several plants in nature have wound healing properties such as *Aloe vera*, *Angelica sinensis*, *Centella asiatica*, *Curcuma longa*, *Euphorbia hirta*, *Ginkgo biloba*, *Helianthus annuus* and *Rosmarinus officinalis*. The drugs in the present market are the synthetic formulations obtained from natural plants and these products exhibit possible side effects. This article reviews on medicinal plants and its wound healing benefits.

KEYWORDS : wound, wound healing, medicinal plants, wound therapy.

1. INTRODUCTION

Wound healing is a biological process in human body and it recovers the damaged tissues to normal function^{[1][2]}. Human body heals by itself without any medications. The natural healing is a slow process and there is a risk of microbial infections which may even lead to death in few cases. Plant based medical treatment for various illnesses have been in practise for more than thousands of years. The nature is the only source for upcoming threats in medical division. The medicinal values in plants rely on its phytochemicals and which is responsible for their anti-inflammatory, antimicrobial and cell-stimulating properties^[3].

Wound is an injury that takes place in the skin or in any part of body tissues. The origin of wound is accident or surgery. Methods of wound management have changed dramatically in recent decades. Health benefits are more while integrating ayurveda with allopathy. The primary challenge of any wound is decreasing healing time. The plant based medications and its ayurvedic properties may blend well with the natural metabolic activity of human tissues^[4]. So, the study focuses on the wound healing potentiality of plants and its medicinal benefits^[5].

2. Wound

A wound is described as a breakdown in a tissue's cellular, anatomical, or functional continuity. There were wounds attributable to physical, biological, thermal, microbial or immunological tissue disturbance. When skin is torn or cut it is termed as an open wound and when blunt force trauma causes a contusion, it is called closed wounds^[6]. Based on physiology of wound, it is classified as acute and chronic wounds^{[7][9]}. In open wound blood escapes from the body and bleeding is clearly visible. Wound is categorised as incised cut, laceration or tear wound, puncture wounds, penetration wounds and bullet wounds, abrasions or superficial wounds. Blood escapes the circulatory system in closed wounds but remains in the body. This is visible in the form of a contusion. Closed wounds have fewer categories but are similar to open wounds^[9]. Acute wound is a tissue injury that normally precedes an orderly and timely repair process that results in a sustained restoration of anatomical and functional integrity. Acute wounds are usually caused by cuts or surgical cuts and complete the wound healing process within the expected time frame^[8]. Wounds that have not gone through the usual stages of healing are referred to as chronic wounds. Local infections, hypoxia, trauma, foreign bodies and systemic problems such as diabetes mellitus, malnutrition, immunodeficiency or drugs are the most common causes of chronic wounds^[7].

2.2 Wound healing process

This process can be categorized into four stages [figure 1]: Haemostasis phase, inflammatory phase, proliferative phase and finally the remodelling phase, it strengthens the appearance of the healed tissue in a timely manner^[8].

2.2.1. Haemostasis phase

The haemostasis phase [coagulating] occurs in first few seconds after injury and last approximately 1 hour. The fast recruitment of neutrophils to the injured tissue followed through the first 24 hours. Microvascular damage and extravasation of blood into the wounds are the major class of tissue injuries. Loss of structural integrity initiates the coagulation cascade and constriction of vessel walls; the resulting clot formation and platelet aggregation limits further blood loss^[11].

2.2.2. Inflammatory phase

The inflammatory phase [removal of bacteria] starts between 24 to 48 hrs and may persist for up to 2 weeks in some cases^[9]. In this stage it causes the blood vessels to become leaky, releasing the surrounding tissue with plasma and neutrophils^[12]. The inflammatory phase launches the haemostatic mechanisms to immediately stop blood loss from the wound site^[9].

2.2.3. Proliferation phase

The third phases [formation of granulation tissue and collagen synthesis] of wound healing is the proliferative phase that last up to 2 days to 3 weeks after the inflammatory phase, depending on the extent of the wound and the patient's health^[9]. Fibroblasts and endothelial cells promote angiogenesis, fibroblast proliferation [collagen deposition] formation of granulation tissue and wound contraction. Proliferation is clinically detected by the presence in the wound base of pebbled red tissue or collagen and requires replacement in deeper wounds of dermal tissues and occasionally sub-dermal tissues, as well as contraction of the wound^[12].

WOUND HEALING

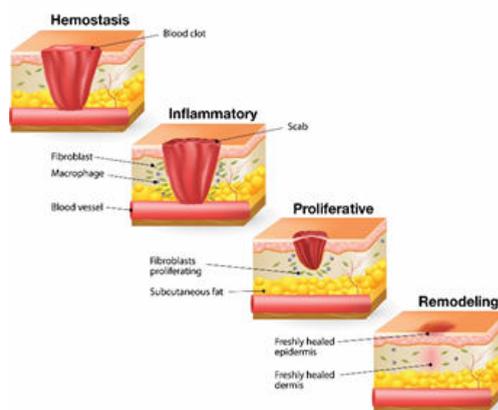


Figure 1: Schematic representation of the wound healing process.^[10]

2.2.4. Remodelling/cellular differentiation phase

Remodelling phase [new tissue regenerate] last for 3 weeks to 2 years. New collagen is formed in this phase. Tensile strength in tissue is increased due to intermolecular cross-linking of collagen via vitamin-C dependent hydroxylation. The scar flattens and scar tissues become 80% as stronger than the original one^[13].

3. Role of medicinal plants

Currently entire world is suffering from Covid-19 infection which has forced many countries to follow lockdown procedure to ensure safety of their peoples and no permanent cure or vaccine is available for this infection. It is also reported that some traditional medicinal plants proposed to fight against Covid-19^[14]. A stabled balance nervous system relies on good health and this system does not function in isolation. The endocrine system and immune system controls the ability to resist infection and to recover from illness and injury. Many herbs interact with the immune, nervous and endocrine systems to help the body to adopt for stresses and strains of all kinds more effectively^[15]. Plants improve stamina, helps the nervous system function properly, provide a good supply of vitamin B and sustain normal bowel function^[16]. Herbal medicines facilitate blood flow to the surface of the body. Others enable the heart to pump more effectively, while others relax the muscles of the BP-lowering arteries. Some herbal medicines improve the body ability to remove toxins and the body is able to spend more energy in restoring and rebuilding damaged tissues and compromised organs until the toxic load is reduced^[17].

Medicinal plants such as Tulsi, Neem, Datiwan and Clove are traditionally used to treat inflammation, wound healing, carminative, coughing, toothache, expectorant antiseptics, stomatitis and some fungal infections such as candidiasis^[18]. Antiseptic plants fight with infection and vulnerary [wound healing] herbs such as comfrey botanical name is *Symphytum officinale* facilitate blood clotting and help to improve the speed of wound healing^[19]. Neem Leaves have been used in Wound healing; aqueous extract of these leaves has shown a significant reduction in the longest diameter of wounds. Wound healing properties of aqueous neem leaf extracts are supposed to act biochemically through inflammatory response and neovascularisation^[20]. Honey has been used for healing for thousands of years to treat a wide range of medical problems, including wounds, burns, cataracts, and skin ulcers^[21]. Turmeric is used as a disinfectant in wounds especially for cuts and burns. Antiseptic and antibacterial properties in turmeric support the wound healing and also reinforce the damaged skin. Curcumin is an active ingredient in turmeric that has been shown to have a wide range of therapeutic effects^[22].

Aloe vera

Aloe vera botanical name is *Aloe barbadensis miller*. It belongs to *Asphodelaceae* family. *Aloe vera* has been used in several cultures for medicinal purposes for centuries, especially in Greece, Egypt, India, Mexico, Japan and China^[23]. *Aloe vera* extracts are commonly used in healthcare, skincare and medical industries as active ingredients for extra-therapeutic, hygienic, rejuvenating and health enhancement. Bioactive compounds of the plant have potential properties such as astringent, haemostatic, antidiabetic, antiulcer, antiseptic, antibacterial, anti-inflammatory, antioxidant and anticancer agent^[24]. *Aloe vera* is often touted as the "burn plant" and it is also used in burn wound healing^[25].

Angelica sinensis

Angelica sinensis, commonly known as *dong quai*. It belongs to family *Apiaceae* and has been used in medicine for more than two thousand years in East Asia, including China, Japan, Korea, and India^[26]. *A. sinensis* polysaccharides had various bioactivities, such as hematopoiesis, anti-tumor, antioxidant, anti-ulcer and radioprotection. This plant has been shown to have multiple properties including the regulation of the immune system and as antioxidant, anti-inflammatory and anticancer. It has been used historically as a tonic, hematopoietic and anti-inflammatory agent for the treatment of gynecological diseases such as menstrual disorders, amenorrhea and dysmenorrhea for thousands of years^[27]. Studies have been proved to cure second degree burn wounds in rat^[28].

Centella asiatica

Centella asiatica, commonly known as *gotu kola*, is an herbaceous plant of the *Mackinlayaceae* family. *C. asiatica* is mainly cultivated in wetlands in Asia^{[29],[30]}. It's a culinary vegetable as well as a medicinal plant. Properties including anticancer, antibacterial, antifungal, anti-inflammatory, antioxidant, wound healing, anti diabetic and

antidipresent^[31]. Antioxidants present in the plant help to prevent some forms of cancer, heart diseases and enhance the immune response to infections. *C. asiatica* herbal tea is a source of antioxidants that has many beneficial effects. Wound healing activities of sequential hexane, ethyl acetate, methanol and aqueous extracts. *C. asiatica* in incision and partial thickness burn wound models in rats^[32].

Curcuma longa

Curcuma longa, belongs to the family of *Zingiberaceae* and it's a perennial plant. *C. longa* extensively cultivated in Asia, mostly in India and China. Turmeric holds the properties such as anti-inflammatory, antioxidant, hepatoprotective, anti-carcinogenic, anti-diabetic, antimicrobial and antidepressant properties. In addition, it is also used in cardiovascular disease, gastrointestinal and neurological disorders. Turmeric has been used in Ayurvedic medicine particularly as an anti-inflammatory and for the treatment of jaundice, menstrual difficulties, hematuria, hemorrhage and colic^{[33],[34]} and it was traditionally applied on fresh cuts to stop bleeding by the rural and tribal population of India^[35].

Euphorbia hirta

Euphorbia hirta Linn. [family- Euphorbiaceae] is a medicinal weed also known as the Asthma herb. These medicinal herbs found in tropical and temperate parts of the world along with India, Bangladesh, Africa, and Australia^[36]. *Euphorbia hirta* has antioxidant, antimicrobial, sedative, anxiolytic, antiepileptic, anti-inflammatory, analgesic, antipyretic, antihistaminic, antiasthmatic, anticancer, wound healing, gastrointestinal, diuretic, antiparasitic, immunological, hepatoprotective, galactogenic, angiotensin converting enzyme inhibiting, and anti-dipsogenic properties^{[37],[38],[39]}. *E. hirta* is also used in itching, rashes, ulcers, acne, boils, calluses, hair loss, irritation, psoriasis, pustules, sunburn, whitlows and for antiseptic, disinfectant and emollient properties^[39]. Ethanol extract of whole plant is used in treating burn wound healing^[40].

Ginkgo biloba

Ginkgo biloba [*salisburia aduatifolia*] is known as maiden hair tree. Native to China, Ginkgo exhibits a variety of pharmacological activities, such as increase in blood fluidity, antioxidant, membrane stabilizing, improvement in cognition, and pro-healing^[7]. The active component in GBE [*Ginkgo biloba* Extract] from *Ginkgo* leaves improves blood circulation, reinforces the walls of the capillaries, discourages clot formation and protects nerve cells from harm when devoid of oxygen. Leaf extracts used to treat dementia disorders, such as concentration difficulties and memory impairment. The extract also possesses anti-asthmatic, antioxidant, wound healing, radical-scavenging and neuroprotective properties against neurodegenerative disorders like AD [alzheimer's disease]^[41] and the plant has been reported to be effective ischemic brain injury^[7].

Helianthus annuus

Helianthus annuus is the member of *Asteraceae* family. In traditional medicine sunflower seed and bud contain valuable antioxidant, antimicrobial, anti-inflammatory, antihypertensive, wound-healing and cardiovascular benefits found in its phenolic compounds, flavonoids, polyunsaturated fatty acids and vitamins. It is used to treat a variety of diseases in ethnomedicine, including heart disease, bronchial, laryngeal, and pulmonary infections, coughs and colds, and whooping cough^[42]. Sunflower has been used by Indian tribes for treating inflammation of the eyes, sores, tiger bites and to treat bone fractures^[43].

Rosmarinus officinalis

Rosmarinus officinalis [*Rosemary*] is household plant that belongs to the family of *Lamiaceae* and is grown in many parts of the world. The plant is scientifically proved to possess anti-inflammatory, antioxidant, antihepatotoxic, antinephrotoxic, antimicrobial, antitrypanosomal, antitumour, antiulcer, diuretic effects, antispasmodic effects, osteoclastic effects, enzyme induction, estrogenic effects, immune stimulant activity, carcinogenesis, mutagenesis, impairment of fertility. Rosemary leaves have lots of traditional uses based on their antibacterial and spasmolytic action. Used for the treatment of dyspeptic complaints^[44]. *R. officinalis* has used to treat headaches, poor circulation, mild analgesia and anti-inflammatory reactions. As far as the antioxidant properties of rosemary are concerned, it appears to be useful for burning wound healing^[45].

4. CONCLUSIONS

Wound healing is a biological process that starts with wound and ends with scar. Secondary metabolites of plants have various beneficial

effects on wound healing, including the enhancement of natural skin repair. Alternatives to manufactured medications are being developed through medicinal plants. Traditional and modern experience can be combined to create more effective wound healing drugs with fewer side effects. There are several drugs that support the medical industry that satisfy the medicinal urge and further R&D have to focus on utilization of these herbal plants for various cures.

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