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Original Article

A Review on Wound Healing and Harnessing the Healing Power of Herbs

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ABSTRACT
A wound is any injury or damage to the skin caused by external or internal factors that impacts the soft tissue. Wound healing is a complex physiological activity to restore the damage of affected tissue or skin. In Ayurveda, the traditional medicinal system of India, various herbs are recommended for their anti-inflammatory properties and wound-healing abilities with minimal side effects. Certain herbs, such as Gotu Kola and pot Marigold have shown promise in promoting rapid clot formation and enhancing the initial response to injury. Turmeric contains curcumin, a compound with potent anti-inflammatory effects that can help to modulate the inflammatory response and reduce swelling. Similarly Echinacea have demonstrated the ability to mitigate inflammation and enhance the overall healing environment. Herbal treatments such as Aloe vera is known for its soothing and moisturizing properties, which facilitate faster tissue regeneration, while honey has natural antibacterial properties that prevent infection and create an optimal healing environment. Herbs like Rosemary have been found to aid in collagen synthesis and tissue remodeling. Harnessing the healing power of such herbs presents a valuable complement to conventional wound care strategies. Therefore this article explores the potential of such beneficial herbs to accelerate the wound healing process.

Keywords-Wounds, Wound healing, Herbs, Herbal medicine, Herbal remedies , Traditional medicine

1.INTRODUCTION
The largest organ in the body, the skin serves two main purposes for protection and sense as the main line of defence[1]. The natural structure and function of the skin are disturbed by wounds, which are injuries that cause cracks or openings in the skin[2]. Trauma resulting from chemicals, heat, microbes, or the immune system can all cause them[1]. A complex interaction of biochemical and cellular processes is involved in wound healing, with the goal of regaining the structural and functional integrity of the injured tissue[3]. Delays in this healing process can be caused by conditions like diabetes, lymphatic blockage, bacterial infections, and poor blood circulation[4,5]. It is well known that Ayurvedic botanicals greatly speed up the healing of wound[6]. When it comes to encouraging natural repair processes without creating discomfort or adverse effects, herbal treatments are frequently more effective[7]. Increasingly, the significance of natural remedies is being acknowledged in this field[7].Herbs have been employed for their medicinal properties across numerous civilizations throughout history[8].The multifaceted benefits of herbs contribute to their efficacy in wound management. Specifically, certain herbs possess antibacterial properties that can mitigate or prevent infection, a frequent complication in wound care. Additionally, other herbs may facilitate improved healing by reducing inflammation or promoting tissue regeneration[9].
Moreover, including herbal medicine into wound care can provide a more comprehensive strategy that addresses both physical and psychological components of healing while encouraging
General wellbeing[10,11,12].Herbal treatments aid in wound care by promoting debridement, sanitizing and preserving a moist atmosphere all of which hastens the healing process[13].Natural plant extracts

make for about 70% of Pharmaceutical wound care products[14].This article examines the benefits of these herbaceous medicine, fusing the traditional knowledge with new scientific discoveries to provide a better treatment for wound healing.

2.TYPES OF WOUNDS[13,14]

Open wounds-When the skin or tissue is ripped or cut, an open wound develops, enabling blood to escape the body. The degree of this bleeding varies and is frequently apparent. If left untreated, open wounds can cause discomfort, edema, and an increased risk of infection in addition to the obvious blood loss.

Closed wounds-Closed wounds occur when blood escapes from the circulatory system but remains confined within the body due to intact skin. These wounds are often identified by visible bruising, which results from blood pooling under the skin. While the external surface may appear unbroken, closed wounds can still cause pain, swelling, and tissue damage.

Incised wounds-Incised wounds contain little tissue loss or damage and are typically created by sharp-edged instruments like knives or scalpels. Depending on the force and type of sharp item used, these wounds can vary in depth and extent in injury.

Penetration wounds-Penetration wounds occur when a sharp object pierces through the skin and underlying tissues, creating a channel that can extend into deeper structures such as muscles, organs, or blood vessels. Unlike cuts or lacerations, penetration wounds involve both the entry and exit of the object, potentially leaving multiple wounds or channels.

Gunshot wounds-Gunshot wounds are inflicted when a bullet or similar projectile penetrates the skin, creating an entry wound and potentially causing significant internal damage depending on the trajectory and impact. These injuries often involve not just the skin but also underlying muscles, bones, and organs.

Bruises-Bruises result from blunt force trauma that disrupts blood vessels beneath the skin, causing blood to leak into the surrounding tissues. This can create discoloration and swelling at the site of impact.

Tear wounds-Tear wounds, also known as laceration wounds, occur due to trauma that causes a non-surgical injury resulting in the tearing or ripping of tissues. These wounds involve damage and loss of skin and underlying tissues, often characterized by irregular, jagged edges.

Puncture wounds-Puncture wounds occur when sharp objects, such as nails or needles, penetrate the skin, creating a deep, narrow injury. These types of wounds are particularly prone to infection because the object that caused the puncture can carry dirt and microbes deep into the wound.

Superficial wounds-Superficial or abrasion wounds occur when the skin is scraped or rubbed against a rough surface, such as during a fall. This type of injury removes the outermost layer of skin, known as the epidermis, and can expose the underlying nerve endings, leading to pain. Abrasions typically affect only the surface layers of the skin and are usually less severe than deeper wounds.

Acute wounds-Acute wounds cause tissue damage that advances through several phases and prompts the healing process, which eventually results in the long-term restoration of tissue integrity. Typically, cuts or surgical incisions cause these wounds.

Chronic wounds-In chronic wounds, the wound doesn't undergo proper healing phase which results into pathologic inflammation. They take extended time period for healing.

3.MECHANISM OF WOUND HEALING

Wound healing is an integrated process including several phases. They are mainly four steps through which the damage restoration occurs.

3.1.Homeostasis- The major goal of homeostasis is to prevent excessive blood loss and to halt blee ding as soon as an injury occurs. It is a reaction that happens right away. In order to lessen blood flo w, blood vessels constrict during this procedure, and platelets from the blood clot to seal the wound[18].

3.2.Inflammatory phase - This stage begins a few minutes after the damage and lasts for a few day s. The White Blood Cells (WBC) begin their defense againstany infection during this phase. Pain, s welling, heat, and redness
are the characteristics of this phase.[15,19,20]

3.3.Proliferative phase- This stage begins a few days following the injury. Three steps make up the proliferative phase:
A) Granulation: Fibroblasts make more collagen and create new capillaries.
B) Contraction: To lessen additional faults, contraction involves pulling the edges of the wounds closer one another.
C) Epithelialization: To heal the wound, epithelial tissues are created.[21,22,23]

3.4.Remodelling phase-
This is the last step and can extend anywhere from two weeks to two years. The tissue regains its strength, function, and originality during this phase. Because of wound healing, the scar tissue co uldn't be exactly the same as the surrounding tissue.[24]

4.FACTORS AFFECTING WOULD HEALING

Insufficient oxygen supply- Sufficient blood supply plays a major role in the healing. Cold, anxiety, excessive pain may cause local vasoconstriction and increase the length of healing period.[25] **Drugs-** glucocorticoids and chemotherapeutic agents shows interference in normal wound healing as they cause reduction in collagen synthesis and fibroblast proliferation.[26] **Age-** geriatrics experienced poor collagen production, fibroblast proliferation and function. Hence the old age individual experience delay in the healing process.[27] **Disease conditions-** Diabetic patient have slow wound healing process. In an experiment the infection rate in diabetic patients was observed 11% higher than general healthy individual. Acute or chronic liver disease may also delay the wound healing.[27]

5.HERBS USEFUL IN WOUND HEALING

They are listed below:

5.1.Chamomile (*Matricaria chamomilla)*

Chamomile is one of the most oldest medicinal herbs used since centuries by the humans belonging to the family *Asteraceae/Compositae* family.[28]The flowers of chamomile contain terpenoids , phenolic compounds, primarily the flavonoids apigenin, quercetin, patuletin, luteolin and their glucosides which are responsible for its therapeutic activities.[28,29] It possesses anti-inflammatory, antimicrobial, antispasmodic and sedative effects.[30]Many pharmaceutical products have chamomile as a key ingredient are used for benefits of mankind such as hay fever, inflammation, muscle spasms, menstrual disorders, insomnia, ulcers, wounds, gastrointestinal disorders, rheumatic pain and haemorrhoids.[28]

5.2.Rosemary (*Rosmarinus officinalis* L.)

Rosemary is a beneficial herb belonging to the family *Lamiaceae.*[31] Rosemary is native to the Mediterranean region from where it gradually spread to other regions of the world.[32]The Flavonoids and Terpenes are the chief chemical constituent responsible for its properties such as antifungal, antibacterial, antioxidant, and anti-inflammatory. Rosemary oil contains some phytochemicals like Alpha-pinene,1,8-cineole, borneol, camphor, camphene,β-pinene and limonene.[32]Rosemary oil is known to have antioxidant and antimicrobial properties.[33,34]Rosemary oil is to has been to decrease the levels of inflammatory cytokines showing the anti-inflammatory activity and promote the wound healing process in diabetic animal. [35,36]

5.3.Echinacea *(Echinacea purpurea)*

Echinacea is commonly known as purple cone flower which belongs to the family *Asteraceae*[37]. There are nine distinct species of echinacea; however, only three are considered therapeutically effect medicinal plants: *Echinacea angustifolia DC*, *Echinacea pallida* (*Nutt.*) *Nutt*., and *Echinacea*

purpurea (L.) Moench. [39] It is a herbal medicine used by native American for enhancing the human immune response.[37]It contain polysaccharides, flavonoids,
chicoric acid, alkyl amides, polyacetylenes and essential oils.[37] The genus *Echinacea* is a prominent anti-inflammatory agent used since ancient time.[38]Topical pharmaceutical products based on *Echinacea purpurea* (*L.) Moench* are useful in treating a variety of common dermatological conditions.[39]

5.4.Gotu-Kola *(Centella asiatica)*
Gotu kola is a slender, creeping plant that belonging to the family *Apiaceae (Umbelliferae)*.[43] It is use as traditional food and traditional medicine in South East Asia, Sri Lanka.[42] Phytochemicals present in gotu kola such as asiactic acid, asiatosides, polyphenolic compounds, etc. are proven for the beneficial therapeutic effect.[41]Gotu Kola have important health benefits like antidiabetic, wound-healing, antimicrobial, memory-enhancing, antioxidant, neuroprotecting activities that are proven by *In vitro* and *in vivo* studies.[42]Gotu Kola oil, derived from natural sources, has garnered significant study interest in recent years. It has been widely utilized in traditional medical systems, especially in Asian regions, for the management of various skin conditions including burns, ulcers, trauma and inflammatory skin diseases.[40]

5.5.Aloevera (*Aloe barbadensis miller)*
Aloe vera belongs to the family *Liliaceae* is a perennial herbaceous plant and has been known as "the healing plant" which is being used for traditional medical purposes in several cultures. [45]It is a commonly found in North Africa, Middle East of Asia , Southern Mediterranean, and Canary Islands. Aloe-vera contains some active ingredients such as Anthraquinones, Vitamins, Minerals, Sugars, amino acids, Enzymes, Fatty acids and has anti-microbial activity,
anti-inflammatory activity, wound healing ,anticancer, antioxidant, antidiabetic and antihyperlipidemic activity.[44] Many studies have shown that treatment with whole Aloe vera gel, extracts resulted in faster healing wounds and Several reports state that Aloe vera gel has a beneficial influence on the wound healing in both normal and diabetic rats.[45]

5.6.Basil (*Ocimum basilicum)*
Basil belongs to the family *Lamiaceae.*[46]It been widely grown throughout the world and commonly cultivated in Southeast Asia, Western Asia, India, Africa, Pakistan, Nepal[46,47].Basil leaves have abundant source of tannins like gallic acid, chlorogenic acid etc. and contain alkaloids, glycosides, and saponins along with the volatile oils.[47] The major active constituent of Holy basil leaves include ursolic acid which contains 70% eugenol, carvenol and eugenol-methyl-ether.[47]Basil leaves are also used in bronchitis, ringworm and other cutaneous diseases , earache, nerve tonic and to sharpen memory. Basil leaves are having good wound healing activity [47].

5.7.Pot marigold *(Calendula officinalis)*
Pot marigold belongs to the *Compositae* family[51]. It is a flowering herbaceous plant Native to Southern Europe.[50]It contains various phytochemical constituents including essential volatile oils, saponins, triterpenes, triterpenoids, esters, flavonoid, steroids, carotenoids, amino-acids and polysaccharides. It is used for its wide range of pharmacological actions such an analgesic, anti-diabetic, anti-ulcer and anti-inflammatory agent. [51] The flowers Of the herb used as medicine in the form of infusions, tinctures, liquid extracts, creams or ointments, or in one of number of skin and hair products available over-the-counter across the world.[50] It exerted many therapeutic effects including antibacterial, antifungal, anthelmintic, antiviral, antioxidant, hepatoprotective, cardioprotective and wound healing.[51]Pot marigold that has been utilized for the treatment of dermatological disorders including wound healing.[52]

5.8.Turmeric (*Curcuma longa*)

Turmeric belongs to the *Zingiberaceae* family[53] .Turmeric is a popular Indian spice that has been used for centuries in herbal medicines for the treatment of a variety of ailments such as rheumatism, diabetic ulcers, anorexia, cough and sinusitis. Curcumin (diferuloylmethane) is the main curcuminoid present in turmeric and responsible for its yellow colour.[54] Turmeric has been shown to possess significant anti-inflammatory, anti-oxidant, anti-carcinogenic, anti-mutagenic, anti-coagulant and anti-infective effects.[55] Curcumin has also been shown to have hasten wound healing properties. Turmeric stimulated the production of the growth factors involved in the wound healing process, and so curcumin also accelerated the management of wound restoration.Turmeric has anti-inflammatory properties because it inhibit the biosynthesis of inflammatory prostaglandins.[56,57]

6.CONCLUSION

In conclusion, harnessing the healing power of herbs presents a compelling and natural approach to wound care that could complement and enhance conventional medical treatments. The integration of traditional herbal remedies with modern medicine offers a promising avenue for improving wound healing outcomes, reducing recovery times, and minimizing complications. This approach taps into the rich historical and cultural use of herbs for their therapeutic properties, reflecting a growing interest in holistic and integrative health practices. Herbs have been used for centuries across various cultures to treat wounds and injuries. Their effectiveness in wound healing can be attributed to a range of bioactive compounds that possess antimicrobial, anti-inflammatory, and tissue-regenerative properties. For example, herbs like aloe vera and calendula are renowned for their ability to soothe and accelerate the healing of skin wounds. The growing body of evidence supporting the efficacy of herbal remedies underscores the need for a more comprehensive approach to wound care that incorporates these natural treatments. By integrating herbs into conventional wound management practices, healthcare providers can offer patients a broader range of option. This integrative approach also aligns with the increasing patient demand for natural and less invasive treatment options. However, it is crucial to approach herbal remedies with a balanced perspective. While the benefits of herbs are promising, they should not be viewed as a replacement for conventional treatments but rather as complementary tool. By exploring and validating the therapeutic potential of various herbs, we can enhance wound healing processes and offer patients more diverse and effective treatment options. As research progresses and the integration of herbal remedies into conventional care becomes more refined, we can look forward to a future where holistic and evidence-based approaches work to improve health outcomes and support the body's natural healing abilities.

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