

Review Article



Medicinal Plants with Potent Wound Healing Property

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ABSTRACT

A damage or an injury to skin leads to the wound. A wound may be the consequence of many factors like accidents, burns, trauma etc. Wounds can be generally termed as acute wounds and chronic wounds as per the time required for complete healing of the injury. An acute wound is described as the one that heals within 5-10 days through normal healing pathway sustaining the anatomical and physiological function of the affected organs. A chronic wound is the one that extends the normal healing time and results in incomplete healing. The substances or the agents that boost up or fastens the rate of wound healing are termed as wound healing agents or wound healers. Wound healing mechanism is a natural phenomenon occurring throughout the body. The process of healing undergoes tissue repair and regeneration and proceeds immediately following an injury. The rate of wound healing can be fastened by reducing the time required for wound healing and the associated consequences. Medicinal plants have been used since many years due to their therapeutic properties. Synthetic wound healing agents can be replaced with the potent traditional medicinal plants.

Keywords: Wound, Wound healing, Acute wound, Chronic Wound, Physiology of Wound, Regeneration.

INTRODUCTION

Medicinal plants are used since many years due to their therapeutic and healing potential in many health conditions. These plants heal through natural healing mechanism without any adverse effects on the affected organs. Medicinal plants are natural, potent wound healing agents. Skin is considered as one of the largest organ of the body. It acts as a barrier between the external environment and the internal organization of the body and encloses all the organs of the body thereby offering protection to the body, regulates the body temperature, generates vitamin D and hinders the exchange of fluids through it.¹ Damage or an injury to the skin leads to the wound. Wound exposes the internal tissues and organs and holds the highest risk of bacterial and fungal attack.² Wound healing is normally the ability of the body to regain the destructed or damaged tissues and involves a series of interrelated events. It is actually a complex process that requires certain mediators and activators to heal the wound and can be basically termed as the combination of repair and regeneration of the lost organs and tissues. The well-known healing cascade begins the next second the injury occurs and continues till the wound is closed perfectly. This process occurs in a well-coordinated manner in four different stages.

TYPES OF WOUNDS

Depending upon the Wound creation and based on physiology, wounds can be classified as follows:

I. Depending upon Wound Creation:

1. Open Wounds

In this type of wound, bleeding can be clearly seen, which flows out of the body. Additionally, open wounds can be divided into

- i. Abrasions or superficial wounds
- ii. Penetration wounds
- iii. Incision wounds
- iv. Tear or laceration wounds
- v. Gun shots
- vi. Puncture Wounds

2. Closed Wounds

In this type of wounds, blood remains inside the body even though the blood escapes the circulatory system.

Additionally, it is divided into

- i. Crush injury
- ii. Bruises or contusion
- iii. Blood tumor or hematomas etc.³

II. Depending on Physiology of wound healing:

1. Acute Wounds

Acute Wounds can be defined as those whose repair occurs normally according to its time and healing pathway. As a result, both the biological and functional



features of wounds are regained which takes around 5-10 days or 30 days.^{3,4}

Etiology:

- Surgical Procedure
- Traumatized Tissue Loss (Soft tissue could be damaged bone fracture could occur).⁵

2. Chronic Wounds

Chronic wounds can be defined as those wounds which cannot be repaired in timely or orderly pathway.^{4,6}

Etiology:

- Arterial insufficiency
- Burns
- Neuropathy
- Vasculitis
- Venous insufficiency.⁷

III. Complicated Wounds:

Complicated Wounds are different from others as they may result due to both infections and deformities in tissue.⁸

Etiology:

The causes of complicated wounds include

- Post infectious etiology
- Wound tissue resection

Signs and Symptoms:

- Heat
- Edema
- Pain
- Loss of function (Limited) in the affected area
- Redness

The rate of wound being infected relies on the site of wound and surgical techniques involved.⁹

WOUND HEALERS

The substances or the agents that boost up or fastens the rate of wound healing are termed as wound healing agents or wound healers. They have the capacity to reduce the usage of other antibiotics as well as replace the bacteriostatic and bactericidal agents and their associated side effects.² Wound healing agents consist of topical, oral and parenteral formulations and their combination. These agents can be of natural or synthetic origin.

1. **Topical formulations:** They offer antibacterial action and are intended to destroy necrotic tissue, restrict microbial hindrance, conduction

of wound discharge, regulation of exposed wound edges and facilitate a protective microenvironment. Eg. Antibiotics, antiseptics, disinfectants.

2. Oral formulations
3. Parenteral formulations.

FACTORS DELAYING WOUND HEALING:

- I. Debris
- II. Infections
- III. Necrosis
- IV. Hypoxia
- V. Tumors
- VI. Metabolic disorders(Eg.Diabetes mellitus)
- VII. Insufficient protein intake
- VIII. Inadequate vitamins
- IX. Mineral deficit diet
- X. Few drugs.¹

Local Factors:

Some of the local factors that delays wound healing:

- Microbial attacks leading to infections
- Insufficient blood supply
- Mobilization of infected parts
- Ionizing radiations exposure postponed granulation
- Entry of foreign bodies at wound site

Systematic Factors:

Some systemic factors responsible to delay wound healing mechanism:

- Rate of wound healing is prolonged in geriatrics patients when compared to young men.
- Lack of zinc and vitamin C
- Hematological deformity
- Anti-inflammatory agent.

PATHOPHYSIOLOGY

Wound healing mechanism is a natural phenomenon occurring throughout the body.¹⁰ It is a continuous process that intends to assist the physiological process and reconstitutes the anatomical continuity and functions in the body.³ The process of healing undergoes tissue repair and regeneration proceeds immediately following an injury.¹¹ The quick response to a wound is bleeding followed by vasoconstriction, coagulation, haemostasis, dehydration and scar formation respectively.¹²



Series of coordinated events collectively constitutes the healing process such as haemostasis, coagulation, inflammation, proliferation and remodeling.

- **Haemostasis:** Reflex vasoconstriction is mainly responsible to cease bleeding. Intrinsic and extrinsic clotting mechanisms enable platelet aggregation and clot formation to regulate the excess blood loss from the body. The blood clot supports cell migration thereby acting as a provisional matrix in the simultaneous phase of haemostasis and inflammation.^{13, 14}
- **Inflammation:** Inflammation occurs in an early (within 24-36 hours of injury) and the late phase (48-72 hours of injury). The early phase releases neutrophils that functions in phagocytosis brought about by proteolytic enzymes and oxygen derived free radicals.¹⁵ The late phase releases macrophages that undergoes cleaning process of debridement and tends to synthesize growth factors such as cytokines, interleukins, platelet derived growth factors (PDGF), transforming growth factors (TGF's) and tumor necrosis factors (TNF).¹²

- **Proliferation (3rd day-2 weeks):** This phase shows migration of fibroblast, deposition of extracellular matrix (newly synthesized) and excess synthesis of granulation tissue.¹⁶ Various processes that occur during inflammatory phase are migration of fibroblast, synthesis of collagen, production of new epithelial cells and granulation tissue, protrusion of cells, adhesion of cells, traction of cells and epithelialization.¹⁰
- **Remodeling (1-2 years):** The last stage of wound healing process where scar tissue is formed.¹⁷ New epithelial cells are formed along with maturation of intracellular matrix, expansion of collagen bundles diameter, elevated and degraded levels of hyaluronic acid and fibronectin respectively.⁴ Collagen fibers formed helps to regain the maximum amount of tensile strength but not as the original one. The wound margins are folded inwards as a result of contraction of connective tissue leading to fibroblast and extracellular matrix interactions.¹⁸

Table 1: Potent wound healing medicinal plants and the parts used

S.No	Medicinal plants	Family	Parts used
1.	<i>Adhatoda vasica</i> N.	Acanthaceae	Leaves. ¹⁹
2.	<i>Andrographis paniculata</i>	Acanthaceae	Pet ether and ethanolic. ²⁰
3.	<i>Adhatoda vasica</i> Linn.	Acanthaceae	Leaves, stem. ¹⁹
4.	<i>Adhatoda zeylanica</i> M	Acanthaceae	Leaves. ²¹
5.	<i>Barleria prionitis</i> L	Acanthaceae	Leaves. ²²
6.	<i>Blepharis maderaspatensis</i>	Acanthaceae	Leaves. ²³
7.	<i>Mikania micrantha</i>	Asteraceae	Leaves. ²⁴
8.	<i>Sphaeranthus indicus</i> L.	Asteraceae	Leaves. ^{25,26}
9.	<i>Calendula officinalis</i>	Asteraceae	Flower. ²²
10.	<i>Cirsium sinense</i> CBC	Asteraceae	Roots. ²⁷
11.	<i>Cirsium verutum</i> Spreng	Asteraceae	Roots. ²²
12.	<i>Eupatorium Odoratum</i> L.	Asteraceae	Leaves. ²³
13.	<i>Tridax procumbens</i> L.	Asteraceae	Leaves. ²²
14.	<i>Gymnema sylvestre</i> R.Br.	Asclepiadaceae	Leaves. ²⁸
15.	<i>Calotropis gigantea</i> L.	Asclepiadaceae	Stems. ²³
16.	<i>Calotropis procera</i> Br.	Asclepiadaceae	Leaves. ²²
17.	<i>Catharanthus roseus</i>	Apocyanaceae	Flowers. ^{29, 30}
18.	<i>Alstonia scholaris</i> R.Br.	Apocyanaceae	Latex. ²⁷
19.	<i>Nerium indicum</i> Mill.	Apocyanaceae	Leaves. ²²
20.	<i>Cordia dichotoma</i> Forst F	Boraginaceae	Flowers. ³¹
21.	<i>Heliotropium indicum</i>	Boraginaceae	Leaves. ³²
22.	<i>Arnebia densiflora</i> Ledeb	Boraginaceae	Roots. ³³
23.	<i>Begonia fallox</i> DC.	Begoniaceae	Stem. ²³
24.	<i>Betula alnoides</i> B.H.	Betulaceae	Bark. ²²
25.	<i>Brassica juncea</i> L.	Brassicaceae	Fruits. ²³
26.	<i>Buxus wallichiana</i>	Buxaceae	Bark. ²²
27.	<i>Commithora mukul</i> Engl.	Burseraceae	Bark. ²¹
28.	<i>Terminalia bellirica</i> Roxb.	Combretaceae	Fruit. ³⁴
29.	<i>Combretum flagrocarpum</i>	Combretaceae	Leaves. ²⁷



30.	<i>Terminalia chebula</i>	Combretaceae	Leaves. ²²
31.	<i>Commelina benghalensis</i>	Commelinaceae	Stem. ²³
32.	<i>Cyanotis villosa</i> Spreng	Commelinaceae	Stem. ²³
33.	<i>Cassia alata</i> L.	Caesalpinae	Leaves. ²²
34.	<i>Cassia auriculata</i>	Caesalpinae	Leaves, bark. ²²
35.	<i>Chenopodium album</i> L.	Chenopodiaceae	Leaves. ²²
36.	<i>Calophyllum inophyllum</i>	Clusiaceae	Leaves, bark. ³⁵
37.	<i>Bryophyllum pinnatum</i>	Crassulaceae	Aqueous and alcoholic extract of leaves. ³⁶
38.	<i>Calendula officinalis</i>	Compositae	Flower. ³⁷
39.	<i>Helianthus annuus</i>	Compositae	Leaves, seeds, flowers, roots. ³⁸
40.	<i>Cyperus rotundus</i>	Cyperaceae	Tubers. ³⁹
41.	<i>Euphorbia hirta</i> L.	Euphorbiaceae	Leaves. ⁴⁰
42.	<i>Acalytha indica</i> L.	Euphorbiaceae	Leaves. ⁴⁰
43.	<i>Euphorbia antiquorum</i> L.	Euphorbiaceae	Stem. ²³
44.	<i>Euphorbia hirta</i> L.	Euphorbiaceae	Latex. ²³
45.	<i>Euphorbia pilosa</i>	Euphorbiaceae	Latex. ²²
46.	<i>Jatropha gossypisolia</i> L.	Euphorbiaceae	Resin. ²³
47.	<i>Jatropha curcas</i> L.	Euphorbiaceae	Bark. ²⁷
48.	<i>Euphorbia neriifolia</i>	Euphorbiaceae	Latex. ⁴¹
49.	<i>Phyllanthus embilca</i>	Euphorbiaceae	Fruits. ⁴²
50.	<i>Hippophae rhamnoides</i> L.	Elaeagnaceae	Fruits, leaves. ^{43,44}
51.	<i>Quercus infectoria</i>	Fagaceae	Roots. ⁴⁵
52.	<i>Pongamia pinnata</i> Vent.	Fabaceae	Leaves. ²²
53.	<i>Butea monosperma</i> Lam.	Fabaceae	Areca nut. ⁴⁶
54.	<i>Desmodium triquetrum</i> L.	Fabaceae	Fruit latex. ⁴⁷
55.	<i>Mimosa pudica</i> L.	Fabaceae	Leaves, stem, flower. ⁴⁸
56.	<i>Indigofera anil</i>	Fabaceae	Aerial parts. ⁴⁹
57.	<i>Entoda africana</i>	Fabaceae	Leaves. ⁵⁰
58.	<i>Tephrosia purpurea</i>	Fabaceae	Latex. ⁵¹
59.	<i>Ginkgo biloba</i>	Ginkgoaceae	Stem. ⁵²
60.	<i>Gentian lutea</i> L.	Gentianaceae	Fruit. ⁵³
61.	<i>Aloe vera</i>	Liliaceae	Leaves. ⁵⁴
62.	<i>Polygonatum officinale</i> A.	Liliaceae	Roots. ²²
63.	<i>Allium sativum</i>	Liliaceae	Bulb. ⁵⁵
64.	<i>Ocimum sanctum</i> L.	Labiatae	Leaves. ⁵⁶
65.	<i>Mentha viridis</i> L.	Lamiaceae	Leaves. ²³
66.	<i>Lycopodium serratum</i>	Lycopodiaceae	Leaves. ⁵⁷
67.	<i>Dendrothea falcata</i> L.F.	Loranthaceae	Stem. ²³
68.	<i>Thepsia populnea</i>	Malvaceae	Fruits. ⁵⁸
69.	<i>Hibiscus rosasinesis</i>	Malvaceae	Leaves, roots. ⁵⁹
70.	<i>Sida acuta</i> Burm.F.	Malvaceae	Leaves. ²³
71.	<i>Thespesia populnea</i> Soland	Malvaceae	Fruit. ²²
72.	<i>Ficus bengalensis</i> L.	Moraceae	Leaves. ²³
73.	<i>Ficus religiosa</i> L.	Moraceae	Bark. ²²
74.	<i>Jasminum auriculatum</i>	Oleaceae	Leaves, flowers, rhizome. ^{60,61}
75.	<i>Boschniakia himalaica</i>	Orobanchaceae	Whole plant. ²²
76.	<i>Sesamum indicum</i> L.	Pedaliaceae	Seeds. ^{62,63}
77.	<i>Argemone mexicana</i> L.	Papaveraceae	Latex. ²²
78.	<i>Aristida etacea</i> Retz.	Poaceae	Leaves. ²³
79.	<i>Morinda pubescens</i>	Rubiaceae	Leaves. ²³
80.	<i>Ophiorrhiza mungos</i> L.	Rubiaceae	Whole plant. ²³

CONCLUSION

Identification of the type of wound and its management may provide an advantage to patient at earliest to prevent further damage and complications. It is understood that 50% of time taken for wound healing could be decreased by adjusting the dose of the herbal drug used in the therapy. The plants mentioned above are having wound healing activity. As described in Ayurvedic and Unani literature that plants can be used as herbal drugs and are safer than allopathic drugs, wounds can be managed or treated with herbal therapy. This treatment offers several advantages over conventional form of therapy. It is more economical, easily available efficacious with less side effects and overall tolerated. New plants are being investigated for their wound healing capacity from different fields.

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