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Review

A Review Of Indian Plants With Wound Healing Property

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Abstract

Wounds are caused by damage to the outermost layer of the skin that affects the epidermal tissue. The Wound Healing Society defines a wound as physical injury that induces an opening or break in the skin, disrupting its normal structure, function, and mechanism. Wound healing is defined as a complicated, dynamic process that restores anatomic continuity and function. This process often involves the use of various plants that possess antibacterial, antioxidant, antiseptic, and healing properties. Most of the pharmaceuticals used for the wound healing process are derived from plants, which have substantial potential for wound management and treatment. India offers a diverse range of plants with potential wound-healing properties. This review aims to compile specific Indian plants documented for their wound healing properties, along with their botanical name, family, part used, and wound model.

Keywords: Excision, incision, burn, wound, extract.

INTRODUCTION

The wound is referred to as a damage in the outermost layer of the skin or an injury to living tissue. These are the primary causes of physical disabilities. Wounds are the disturbed condition of tissue caused by biological, physical, chemical, immunological, or microbiological assaults, often resulting in loss of function. Wound Healing Society defines a wound as a physical injury that induces a break or opening in the skin, disrupting its normal structure and function [1]. A wound's genesis may be unintentional or deliberate, or it may be a result of medical procedure or disease process [2]. Several different kinds of wounds, including incised wounds, excised wounds, burns, lacerated, abrasive, contusions, and ulcers [3]. Reconstruction of skin and physiological conditions requires the use of proper healing techniques. As soon as possible after the damage, the wound starts to heal [4]. The intricate process of healing entails the skin or injured organs and repairing themselves back to normal. To restore skin damage, a series of complex biochemical processes occur in a precisely coordinated sequence. The four primary phases of healing process are hemostasis, inflammatory, proliferative, and remodeling phases [5]. The

wound healing mechanism restores injured tissue and maintains tissue homeostasis. New tissue creation is a complex process that includes inflammation, angiogenesis, granulation tissue production, re-epithelialization, and ECM rebuilding. When the skin is injured, immune cells such as fibroblasts, keratinocytes, and macrophages travel to the area to begin the healing process. The migration of cells to the wound is a crucial step in the healing process [6].

After an injury occurs, hemostasis and coagulation take place in the wound site. The main aim of hemostasis is to prevent exsanguination. Following the hemostasis phase, inflammatory phase starts as promptly as possible following the injury and extends for 24 to 48 hours, although in certain situations, it may extend a maximum of fourteen days. The inflammatory phase triggers a hemostatic mechanism to instantly reduce bleeding and form blood clots at the wound site by the constriction of blood vessels and aggregation of platelets, followed by dilation of blood vessels and phagocytosis to cause inflammation at the injury site, which are the hallmarks of this stage [7].

Third phase is the fibroblastic phase, which can extend for 2 to 3 weeks. It consists of three primary stages: the granulation stage, contraction stage, and epithelialization. During the process of granulation stage, new capillaries are created, and fibroblasts create a collagen bed. Collagen and glycosaminoglycans are two of the several materials produced by fibroblasts that are necessary for wound healing [8].

Finally, the remodeling stage can extend from two weeks to two years. This stage promotes collagen synthesis and the formation of scar tissue. Collagen is cross-linked between molecules through hydroxylation, depending on vitamin C, which increases tissue tensile strength. Scar tissues grow 80% stronger than the original, and the scar flattens.

The wound healing process is greatly aided by numerous types of Ayurvedic botanicals. Because they encourage the repair mechanisms naturally, plants are more effective healers [9]. More than 70% of pharmaceuticals used in wound healing are obtained from plants, 20% are obtained from minerals, and the remaining are from animal products [10]. The purpose of this review is to generate a list of Indian plants that have been previously documented. This list includes the botanical name, family, part used, and wound model for several medicinal plants that can cure wounds which are emphasized here.

***Abutilon indicum* L.**

Abutilon indicum (Malvaceae) consists of alkaloids, flavonoids, steroids, saponins, and amino acids. The ethanolic extract of *Abutilon indicum* showed a substantial increase in tissue breaking strength, rate of wound contraction, tissue granuloma strength, and decreased epithelization period in the incision, excision, and dead space wound models in Albino rats. [11].

***Acalypha indica* L.**

Acalypha indica leaf *(*Euphorbiaceae) revealed that saponins, tannins, terpenoids, flavonoids, and cardiac glycosides, as well as cyanogenic glycosides and polyphenol compounds, are all effective anti-oxidants. In *Mus musculus* mice, the ethanolic leaf extract of *Acalypha indica* increased the wound contraction rate, shortened the epithelization period, and promoted the healing process in incision wound models [12].

***Achyranthes aspera* L.**

Achyranthes aspera (Amaranthaceae) contains steroids, terpenoids, alkaloids, and flavonoids [13]. In several regions of Ethiopia, people have traditionally utilized the leaves of *Achyranthes aspera* to cure wounds [14]. *Achyranthes aspera* leaf aqueous and ethanol extracts substantially enhanced the skin breaking strength and wound closure rate in both the incision wound model and the excision wound model respectively, and showed significant healing properties in Wister rats [15].

***Adhatoda vasica* Nees.**

Adhatoda vasica (Acanthaceae) has alkaloids such as quinazoline, tannins, flavonoids, essential oil, and vasicinone [16]. In Swiss albino mice, methanolic leaf of *A. vasica'*s extract demonstrated enhanced healing activity in the excision wound model [17].

***Allamanda cathartica* L.**

A. cathartica L. *(*Apocynaceae) consists of alkaloids, phenolic compounds, steroids, flavonoids, terpenes, lactones, and carbohydrates [18]. In both the excision wound model and the incision wound model, *Allamanda cathartica's* aqueous leaf extract demonstrated potential wound healing activity by increasing the rate of wound closure, weight of granulation tissue, tensile strength, and decreasing the epithelialization period [19].

***Aloe barbadensis* Miller**

A. barbadensis (Liliaceae) is used for wound healing as well as for its anti-inflammatory and anti-ulcer properties. Aqueous extract of *A. barbadensis* accelerated wound healing and significantly increases the rate of wound contraction in the excision wound model [20].

***Annona squamosa* L.**

Annona squamosa L. (Annonaceae) contains Vitamin C and tannins which have inflammatory property, wound healing property, and insecticidal property. Methanolic leaf extract of *A. squamosa* increased tensile strength and wound contraction rate respectively, in both the incision and excision wound models, and showed significant wound healing activity [21].

Carica papaya

Carica papaya (Caricaceae) contains flavonoids, alkaloids, phenolic chemicals, and cyanogenetic substances. Aqueous and ethanolic seed extracts of *C. papaya* showed a greater rate of wound contraction and significantly improved the healing process in the excision wound model [22, 23].

***Cassia tora* Linn.**

Cassia tora Linn. (Leguminosae) contains anthrone, flavonoids, glycosides, tannin, cinnamaldehyde and essential oils found in plant extracts [24]. Methanolic leaf extract of *Cassia tora* demonstrated better wound closure rate, rapid epithelialization and increased skin breaking strength in excision and incision wound models, and had effective wound healing properties [25].

Centella asiatica (Linn.)

Centella asiatica (Apiaceae) has phytochemicals including alkaloids, tannins, phenolic compounds, saponins, flavonoids, and sterols [26]. Alcoholic leaf extract of *C. asiatica* significantly improved tissue tensile strength, epithelialization period, increased wound closure and tissue granulation weight in the incision, excision and dead space models [27].

***Daucus carota* L.**

Daucus carota (Apiaceae) has phytochemicals such as phenolics, carotenoids, ascorbic acid, and polyacetylenes [28]. *D. carota*'s ethanolic root extract decreased the wound area, epithelialization period and also enhanced the wound breaking strength and rate of wound contraction in the incision and excision wound models, respectively [29].

***Erythrina indica* Linn.**

Coral tree, or *Erythrina indica* (Leguminosae) contains phytoconstituents like proteins, lecithin, alkaloids, flavonoids, pterocarpans, triterpenes, and steroids [30]. In Wister albino rats, methanolic extract of *Erythrina indica* bark demonstrated potential wound healing activity in the excision wound model [31].

***Mimusops elengi* Linn.**

Mimusops elengi Linn (Saptaceae) bark contains a variety of triterpenoid saponins, alkaloid isoretronecyl tiglate, taraxerol, taraxerone, ursolic acid, etc. *Mimusops elengi's* methanolic extract efficiently encouraged the wound contraction rate, enhanced the tissue breaking strength in the incision wound model, and healed dead space wounds [1].

***Moringa oleifera* Lam.**

Moringa oleifera (Moringaceae) consists of antioxidant compounds such as phenolics, flavonoids, and carotenoids [32]. Ethanolic leaf extract of *Moringa oleifera* proved significant healing properties in the incision wound model and aqueous extract of *M. oleifera* leaf demonstrated increased wound closure rate, tensile strength, granuloma breaking strength and decreased scar area in the excision, incision, and dead space wound models [33, 34].

***Ocimum sanctum* L.**

Ocimum sanctum L. (Labiatae) stems and leaves contain biologically active elements such as saponins, flavonoids, triterpenoids, phenolic compounds, and tannins [35]. *O. sanctum* essential oil-based ointment improved tissue granulation, epithelization period, and tensile strength in Wistar Albino rats [36]. *O. sanctum's* antioxidant qualities may promote faster wound healing and help treat hypertrophic scarring [37].

***Solanum xanthocarpum* Schrad. And Wendl.**

Solanum xanthocarpum (Solanaceae) contains flavonoids, alkaloids, saponins, sterols, carbohydrates, and aminoacids [38]. Methanolic fruit extract of Solanum xanthocarpum showed a greatly increased rate of wound closure and breaking strength in the excision wound model and incision wound model respectively [39]

Below table lists a few Indian plants that are reported for their wound-healing properties.

Botanical name	Family	Part used	Wound model	Reference
Abelmoschus esculentus L.	Malvaceae	Fruit	Excision wound model	[40]
Aegle marmelos L.	Rutaceae	Fruit	Incision, Excision, & dead space	[41]
Allium cepa Linn.	Liliaceae	Pulp	Incision wound model	[42]
Anacardium occidentale L.	Anacardiaceae	Leaf	Excision wound model	[43]
Areca catechu L.	Arecaceae	Seeds	Burn wound model	[44]
Aristolochia bracteolata Lam.	Aristolochiaceae	Leaf	Excision, incision, and dead-space	[45]
Butea monosperma Lam.	Papilionaceae	Bark	Excision wound model	[46]
Calendula officinalis Linn.	Compositae	Flower	Excision wound	[47]
Calotropis gigantea Linn.	Asclepiadaceae	Root, bark	Incision, excision and dead space	[48]
Cassia fistula Linn.	Leguminosae	Leaves	Excision wound model	[49]
Catharanthus roseus L.	Apocyanaceae	Flower	Excision, incision & dead space	[50]
Cleome viscosa Linn.	Capparaceae	Seeds	Incision and excision wounds	[51]
Ficus benghalensis Linn.	Moraceae	Bark	Excision and incision	[52]
Ficus racemosa Linn.	Moraceae	Root	Incision and excision wounds	[53]
Heliotropium indicum Linn.	Boraginaceae	Leaves	Incision, excision and dead space	[54]
Hemidesmus indicus R. Br.	Apocynaceae	Roots	Excision wound model	[55]
Hibiscus rosa sinensis L.	Malvaceae	Flower	Incision, excision and dead space	[56]
Ixora coccinea L.	Rubiaceae	Leaves	Excision wound model	[57]
Jatropha curcas L.	Euphorbiaceae	Leaves	Excision wound model	[58]
Jasminum grandiflorum Linn	Oleaceae	Flower	Excision wound model	[59]
Lawsonia inermis Linn.	Lythraceae	Leaves	Excision, incision & dead space	[60]
Leucas lavandulaefolia Rees.	Lamiaceae	Whole plant	Excision and incision	[61].
Madhuca longifolia L.	Sapotaceae	Leaves, bark	Incision & excision wound models	[62]
Mimosa pudica Linn.	Fabaceae	Root	Excision, incision, burn, dead space	[63]
Morinda citrifolia L.	Rubiaceae	Leaves	Dead space and excision wounds	[64]
Morus alba Linn.	Moraceae	Leaves	Burn wound model	[65]
Nicotiana tabacum L.	Solanaceae	Stem	Excision wound model	[66]
Phyllanthus emblica L.	Euphorbiaceae	Bark	Incision and excision models	[67]
Pongamia pinnata Linn.	Fabaceae	Bark	Excision and incision wounds	[68]
Punica granatum L.	Lythraceae	Peel & pulp	Excision wound model	[69]
Quercus infectoria	Fagaceae	Galls	Incision, excision & dead space.	[70]
Rubia cordifolia Linn.	Rubiaceae	Root	Excision wound model	[71]
Sesamum indicum L.	Pedaliaceae	Seed & oil	Excision, incision, burn, dead space	[72]
Tephrosia purpurea Linn.	Leguminosae	Aerial parts	Excision, incision, & dead space.	[73]
Terminalia arjuna Roxb.	Combretaceae	Bark	Excision and incision	[74]
Terminalia catappa L.	Combretaceae	leaf	Incision wound model	[75]

Terminalia chebula Retz.	Combretaceae	Leaf	Excision & incision wound models	[76]
Thespesia populnea L.	Malvaceae	Fruit	Excision & incision	[77]
Vernonia arborea	Asteraceae	Bark	Excision, incision, and dead space.	[78]
Wedelia chinensis Merr.	Asteraceae	whole plant	Excision wound model	[79]
Ziziphus mauritiana Lam.	Rhamnaceae	Leaf	Excision wound model	[80]

CONCLUSION

The biological process of wound healing starts with injury and terminates with scar formation. The purpose of wound healing is to reduce complications that prevent the healing process and improve the healing mechanism, and also reduce the occurrence of infections caused by wounds. Wounds are naturally treated and prevented by using numerous herbs. In India, several plants and their parts have potential wound healing properties, and they are used in preventing and treating many kinds of wounds. Herbal drugs are becoming increasingly popular in both developed and developing countries since they are safer and better tolerated than allopathic drugs. This review unequivocally asserts that a great deal of herbal plants are more potent healers since they spontaneously activate the healing process. Thus, several Indian plants that have the ability to cure wounds were emphasized in this review.

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