A REVIEW ON MEDICINAL PLANTS HAVING WOUND HEALING PROPERTIES

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Summary

Herbal drugs have always been of keen interest for the researchers. Up till now lot many researches have been made in this field because herbal drugs have very less or no side effects as compared to the synthetic medicines. They have been used since decades for curing many diseases. Still today herbal drugs have proved their worth in curing many diseases which still can't be cured by synthetic medicines. A single herbal drug possesses many medicinal properties. Keeping this thing in mind we are summarizing the plants which are used in the wound healing. Article contain different plants used in the wound healing, their properties, active constituents by which they are showing the respective activity.

Introduction

India has a rich tradition of plant-based knowledge on healthcare. A large number of plants/plant extracts/ decoctions or pastes are equally used by tribal and folklore traditions in India for treatment of cuts, wounds, and burns. The present review thus attempts to analyze the knowledge base for treatment of cuts and wounds which includes a usage of plants, methods employed by tribal and folklore practices prevailing in India. The pharmacological validation on Indian medicinal plants is very limited. Current estimates indicate that nearly six million people suffer from chronic wounds worldwide. Demographic study has projected market expenditure of over US$7 billion world wide for provisions of wound healing properties. Research on wound healing agents is one of the developing areas in modern biomedical sciences. Medicinal plants have been used since time immemorial for treatment of various ailments of skin and dermatological disorders especially cuts, wounds and burns. "Wound is defined as the disruption of the cellular and discontinuity of a tissue". Wound can be produced by physical, chemical, thermal, microbial or immunological exposure to the tissue. The mechanism of healing of wound is integrated cellular and biochemical events leading ton establishment of structural and functional integrity with gaining the strength of injured tissue [1]. Wound treatment can be done by administration of drugs either topically or orally or either parenterally. Antibiotics can be used as an topical agents .There are certain wound healing promoters such as Tretinoin, *aloe vera* extract, honey, *chamomilia* extract, dexpanthenol, comfrey, benzoyl peroxide tetrachlordecaxide solution, clostebol acetate and the experimental cytokines which may help in wound healing. There are various growth factors like platelet derived growth factor, macrophage derived growth factor, monocyte derived growth factors which are necessary for the initiation and promotion of the process of wound healing. There are many substances which act as pro healing effect like tissue extracts, vitamins& minerals and number of plant products.

Wound healing herbals having property to encourage blood clotting and accelerate the wound healing [2].

Plants Showing Wound Healing Properties

	Name of the plant	**Family**	**Plant part used**
1	Ageratum conyzoides	Asteraceae	Leaf
2	Arrabidaea chica	Bignoniaceae	Leaf
3	Clerodendrum infortunatum	Verbenaceae	Rhizomes And Tubers
4	Carica papaya	Caricaceae	Fruit
5	Catharanthus roseus	Apocynaceae	Leaf
6	Calotropis gigantea.	Asclepiadaceae	Root
7	Dendrophthoe falcate	Loranthaceae	Fresh Leaf And Stem
8	Flabellaria paniculata.	Malpighiaceae	Leaf
9	Hypericum perforatum	Hypericaceae	Latex
10	Mimosa pudica	Fabaceae	Leaf
11	Ocimum sanctum	Lamiaceae.	Herb
12	Pentas lanceolata	Rubiaceae.	Latex
13	Plagiochasma appendiculatu	Aytoniaceae.	Leaf
14	Tephrosia purpurea	Fabaceae.	Root & Bark, Leaf
15	Datura alba	Solanaceae	Leaf, Fruit
16	Mangifera indica	Anacardiaceae	Rhizomes
17	Ocimum santum	Labiatae	Leaf
18	Celosia argentea	Amaranthaceae	Leaf
19	Cinnamomum zeylanicum	Lauraceae	Bark
20	Nelumbo nucifera	Nelumbonaceae	Rhizome
21	Phyllanthus emblica	Euphorbiaceae	Fruit
22	Plumbago zeylanica	Plumbaginaceae	Root & Bark
23	Pterocarpus Santalinus	Fabaceae	Fruit & Bark
24	Terminalia arjuna	Combretaceae	Bark
25	Terminalia chebula	Combretaceae	Fruit
26	Abrus precatorius L.	Fabaceae	Leaf
27	Agave cantala roxb.	Agavaceae	Leaf
28	Annona squamosa l.	Annonaceae	Leaf
29	Ardisia solanacea Roxb	Myrsinaceae	Root & Bark
30	Aristolochia bracteolate	Aristolochaceae	Leaf & Whole plant
31	Bergenia ciliate	Saxifragaceae	Root & Rhizome
32	Blumea lacera	Asteraceae	Leaf
33	Euphorbia hirta	Euphorbiaceae	Whole Plant

34	Ficus racemosa	Moraceae	Bark & Fruit
35	Moringa oleifera	Moringaceae	Leaf
36	Piper betel	Piperaceae	Petiole & Leaf
37	Rheum emodi wall	Polygonaceae	Root
38	Stepania japonica	Menispermace	Leaf & Root

(1) AGERATUM CONYZOIDES

Ageratum conyzoides L. is an annual herbaceous plant belonging to the family Asteraceae, with a long history of traditional medicinal uses in several countries of the world and also has bioactivity with insecticidal and nematocidal activity. This tropical species appears to be a valuable agricultural resource. A. conyzoides is widely utilized in traditional medicine by various cultures worldwide, although applications vary by region. It is used to cure wounds and burns [3]. A. conyzoides has quick and effective action in burn wounds and is recommended by Brazilian Drugs Central as an antirheumatic .The wounds treated with aqueous leaves extract in combination with honey and with solcosery ointment significantly accelerate wound healing process and the rates of wounds sterility compared to wounds treated with honey alone.

(2) ARRABIDAEA CHICA

Arrabidaea chica Verlot. belonging to the family Bignoniaceae, popularly known as Crajiru, has been traditionally used as wound healing agent. Allantoin was discovered by Vanquelin and Buniva in 1800 and synthesized by Grimax in 1876. This compound is a white, nontoxic, nonirritating, no allergenic powder that has been reported to promote epithelial stimulation and decrease pain. It is used as healing agent and detected in *Sympthom officinalis*, traditionally used in wound healing [4].
Arrabidaea chica crude extract increased collagen production in a similar way of allantoin and vitamin C. The vitamin C is necessary for the hydroxylation of praline and lysine residues in pro-collagen, which is necessary for collagen release. Hydroxyproline also stabilizes the collagen triple-helix structure. In addition to collagen production, vitamin C enhances neutrophil function, increases angiogenesis, and has a powerful antioxidant effect [5].

(3) CLERODENDRUM INFORTUNATUM

Clerodendrum infortunatum L. is one of the commonly used plants in ethno-medicine for its various medicinal properties belonging to the family Verbenaceae.

Leaves of the plant are prescribed for tumors, certain skin diseases and scorpion stings. The medical practitioners are using the tender leaf paste to cure cut wounds and leprosy since long time. Genus Clerodendrum has a high content of secondary metabolites including flavanoids and phenolic compounds. It is consented that the reactive oxygen species (ROS) are deleterious to wound healing process due to the harmful effects on cells and tissues [6].

The plant C. infortunatum is a rich source of phenolics and flavonoids. Therefore, the presence of these compounds in the plant extracts has exhibited strong antioxidant and wound healing activities. It enhanced contractile property of myofibroblast resulting in the increase of epithelialization. Thiem and Goslinska (2004) have reported that topical application of compounds with free radical scavenging properties in patients have shown to improve wound healing significantly and protect tissues from oxidative damage. The presence of phenolics in C. infortunatum also supports these results as phenolic compounds are known for free radical scavenging property [7].

(4) CARICA PAPAYA

The papaya is the fruit of the plant Carica papaya, belonging to the family Caricaceae. Carica papaya is traditionally used to treat various skin disorders, including wounds. It is widely used in developing countries as an effective and readily available treatment of various wounds, particularly burn. The latex from unripe papaya fruits contains a mixture of cysteine endopeptidases such as papain, chymopapain A and B, papaya endopeptidase II, papaya endopeptidase IV, and omega endopeptidase [8].

Papaya fruit is known to possess wound healing properties. Papaya latex applied to the burn wounds using hydrogel as a vehicle system is known to have superior properties. Dried papaya latex possesses burn-healing properties as depicted by the increment in the hydroxyl proline content, faster wound contraction and shortening of the epithelialization time. C. papaya contains high content of hydroxyproline which indicates increased collagen synthesis, which in turn leads to enhance wound healing [9].

(5) CATHARANTHUS ROSEUS

Catharanthus roseus also known as Vinca rosea, belonging to family Apocynaceae is native to the Caribbean Basin and has historically been used to treat a wide kind of diseases. The ethanol extract of C. roseus demonstrated a significant increase in the hydroxyproline content of the granulation tissue indicating increased collagen turnover. Collagen, the major component which strengthens and supports extracellular tissue is composed of the amino acid, hydroxyproline, which has been used as a biochemical marker for tissue collagen. The phytochemical constituents present in C. roseus may be responsible for the wound-healing activity. Plant extracts have shown that phytochemical constituents like flavanoids [10] and triterpenoids [11] are known to promote the wound-healing process mainly due to their astringent and antimicrobial properties, which appear to be responsible for wound contraction and increased rate of epithelization. The wound-healing property of C. roseus may be attributed to the phytoconstituents present in the plant, and the quicker process of wound healing could be a function of either the individual or the additive effects of the phytoconstituents.

The ethanol extract of C. roseus has properties that render it capable of promoting wound-healing activity compared with placebo. Wound contraction, increased tensile strength and increased hydroxyproline content support the wound healing promoting effect of C. roseus in treatment of wounds.

(6) CALOTROPIS GIGANTEA

Calotropis gigantea is a perennial under shrub belonging to the family (Asclepiadaceae). The plant *Calotropis gigantea* is also used in some parts of India for wound healing in combination with other plants [12].

Calotropis gigantean possesses a prohealing action. The alcoholic extract of the root bark of *Calotropis gigantea* showed significant increase in wounds by enhanced epithelization. This enhanced epithelization may be due to the effect of *Calotropis gigantea* extracts on enhanced collagen synthesis. Deposition of newly synthesized collagens at the wound site increases the collagen concentration per unit area and hence the tissue tensile strength [13].

The higher breaking strength indicates better healing of wounds. Higher hydroxyproline content was seen with extract treatment. The increased amount of hydroxyproline in test groups underlines increased collagen content, since hydroxyproline is the direct estimate of collagen synthesis it supports the wound healing activity of *Calotropis gigantea* [14].

Phytochemical constituents like flavonoids [15] and triterpenoids [16] are known to promote the wound healing process mainly due to their astringent and antimicrobial properties, which appear to be responsible for wound contraction and increased rate of epithelialization.

(7) DENDROPHTHOE FALCATA

Dendrophthoe falcata belonging to family Loranthaceae of the order Santalales, is used ethnomedicinally for treating ulcers, asthma, impotence, paralysis, skin diseases, and wounds. The aerial parts are used in wounds, menstrual troubles, asthma, psychic disorders, pulmonary tuberculosis, in consumption and mania by the tribal of India [17].

Topical applications of compounds with free-radical-scavenging properties in patients have shown to significantly improve wound healing and protect tissues from oxidative damage. The antioxidant activity was also studied to understand the mechanism behind the wound healing activity [18].

Topical application of Dendrophthoe falcate at the wound site produced significant wound healing activity, which may be due to its angiogenic and mitogenic potential. Its prohealing activity was marked, as all the parameters observed were significantly affected. A healing tissue synthesizes collagen, which is a constituent of growing cell. Concentration of hydroxyproline is a measure of concentration of collagen. Higher concentration of hydroxyproline indicates faster rate of healing wound [19].

(8) FLABELLARIA PANICULATA

Flabellaria paniculata Cav is a climbing shrub belonging to the family Malphighiaceae with grey silky branches. It is an herb indigenous to the Tropical Western African. It is known in Yoruba as "Ajidere" [20].

The plant is used ethnobotanically for the treatment of skin infections and wounds. In Southern Nigeria, the leaves are applied to wounds and sores [21]. The chloroform fraction of Flabellaria paniculata leaf extract has shown to posses anti-infective and pro-healing actions. Wound healing potential exhibited by the chloroform fraction in both the infected groups and non infected group may be due to presence of tannins and other astringents in this plant.

The chloroform fraction of the methanolic extract of Flabellaria paniculata leaf has demonstrated significant wound healing activity when administered in rat abdominal excision and also showed good potency on wounds inoculated with pathogenic organisms. These findings support the folkloric use of the plant sample for the treatment of skin diseases and wounds [22].

(9) HYPERICUM PERFORATUM

Olive oil extract of the flowering aerial parts of Hypericum perforatum L. belonging to family Hypericaceae is a popular folk remedy for the treatment of wounds in Turkey. Aerial parts of Hypericum perforatum possess remarkable wound healing and anti inflammatory activities supporting the folkloric assertion of the plant in Turkish folk medicine. Flavonoids, isoquercitrin, rutin and (−)-epicatechin and naphthoquinones (hypericins) were found as the active components of Hypericum perforatum. Hyperforin was postulated as the active component responsible for the wound healing effect of this oily extract, based on chromatographically data only.

The first aim of the wound management is to keep the wound free of infections and complications. The agents, which help to heal the wound as quick as possible, are always needed for the contribution of a rapid healing [23].

The leaves of Hypericum patulum and Hypericum hookerianum have been used in India for the purpose of wound healing. Previous studies have shown that Hypericum species possess significant antibacterial and antiviral properties, which might be involved in the wound healing activity. This plant has an antiseptic action, relieves inflammation and promotes healing when used externally on cut surfaces of the body. The tincture of *Hypericum* spp. when given orally has a remarkable effect in lacerated and suppurated wounds with restoration of tissue vitality. The oily preparation of Hypericum perforatum is effective in wound healing as popularly practiced in Turkish folk medicine [24]. Olive oil itself as a vehicle for the preparation was also shown to possess a remarkable wound healing activity.

(10) *MIMOSA PUDICA*

Mimosa pudica, commonly known as Lajjalu (Hindi), is an annual or perennial herb belonging to family Mimosaceae. *Mimosa pudica*, commonly known as touch-me-not, is used in folklore medicine in arresting bleeding and in skin disease [25].

Mimosa pudica has been reported to contain mimosine (an alkaloid), free amino acids, sitosterol, linoleic acid and oleic acid. The drug is also found to be rich in tannins and the total tannin content was reported to be 10%. It can be proposed that, the high content of tannins in the roots of Mimosa pudica may be responsible for wound healing activity, probably due to astringent property of tannins [26].

(11) PENTAS LANCEOLATA

Pentas lanceolata, or egyptian stars, is a perennial herb or sub-shrub native from tropical east africa to southern arabia belonging to the family Rubiaceae. The search of ayurvedic literature revealed the uses of P. lanceolata in wound healing. Since inflammation precedes the process of healing, drugs affecting inflammation are known to slow down the healing.

The ethanol extract of the flowers of P. lanceolata was evaluated for wound healing activity. Wound contraction and tensile strength measurements were used to evaluate the effect of P. lanceolata on wound healing. The estimated increase in hydroxyproline content of the granulation tissue of the excision wounds indicated rapid collagen turnover thus, leading to rapid healing of wounds [27]. The presence of triterpenoids was responsible for the effective wound-healing activity of P. lanceolata [28].

(12) *TEPHROSIA PURPUREA*

Tephrosia purpurea belonging to family Leguminosae, commonly known in Sanskrit as Sharapunkha is a highly branched, suberect, herbaceous perennial herb [29]. According to Ayurveda literature this plant has also given the name of "Sarwa wranvishapaka" which means that it has the property of healing all types of wounds [30]. The phytochemical investigations on Tephrosia purpurea have revealed the presence of glycosides, rotenoids, isoflavones, flavanones, chalcones, flavanols, and sterols [31]. Tephrosia purpurea have also been reported to contain some flavonoids, which may be one of the potential mechanisms contributing to enhanced wound healing.

The antioxidant enzymes (superoxide dismutase and catalase) are known to quench the superoxide radical and thus prevent the damage of cells caused by free radicals [32]. So scavenging effect might be one of the most important components of wound healing. Also plant is reported to have antioxidant activity [33] which may be responsible to support wound healing. Thus the enhanced wound healing

may be due to the free radical scavenging action of the plant as well as enhanced antioxidant enzyme level in granuloma tissues.

(13)TRICHOSANTHES DIOICA ROXB

Trichosanthes dioica Roxb is a dioecious plant belonging to the family Cucurbitaceae. The methanolic extract of TDR increased cellular proliferation and collagen synthesis at the wound site as evidenced by increase in total protein and total collagen contents reflected by hydroxyproline content of granulation tissues.

The glycosaminoglycans are a major component of the extra cellular matrix of skin, joints, eyes and many other tissues and organs. In spite of its simple structure, it demonstrates remarkable visco-elastic and hygroscopic properties which are relevant for dermal tissue function. Biological activities in skin are due to its interaction with various binding proteins. Due to an influence on signaling pathways, hyaluronic acid and hydroxyproline is involved in the wound-healing process and scarless fetal healing. In clinical trials, topical application of hyaluronic acid has improved the healing of wound [34]. Phytochemical constituents like flavanoids [35], triterpenoids [36] and tannins [37] are known to promote the wound-healing process.
In addition, the muco-polysaccharide hyaluronic acid protects granulation tissue from oxygen free radical damage and thereby stimulates wound healing [38].

Among the glycosaminoglycans, hydroxyproline, dermatan sulfate and dermatan have also been implicated in wound

repair and fibrosis. Its chemical constituents mainly consist of oils and fats, org. acids, flavonoids, triterpenes, steroids, sterols, and proteins [39].

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