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Phytoconstituents and Formulations for Wound Healing: A Review

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Abstract

Use of herbal drugs to treat disease is almost universal and more affordable as there is widespread availability of herbs in the Himalayas. The number of aspects are associated with applications of herbal medicines in wound healing. With proper identification, phytochemical screening and performing toxicological studies, herbal medicine possesses various advantages such as reduced side effects, effective with chronic conditions, cost effective, and widespread availability. Besides these, it can be made a promising novel medicine with the use of Targeted drug delivery system. In view of this a detailed review of literature was carried out on different formulations and phytoconstituents responsible for wound healing activity, with special emphasis on different stages of wound healing, which could be of prodigious help in managing and treating various types of wounds**.**

Keywords: Targeted drug delivery, Toxicological studies, Novel medicine, Phytoconstituents, Wound healing

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Introduction

Wound can be referred to as an injury, usually involving division of tissue or rupture of the integument or mucous membrane, due to external violence or some mechanical agency rather than disease. It is a defect or break in the skin caused from any physical or thermal damage or as a result of the presence of an underlying medical or physical condition. Wounds can be of two types open or closed. Open wounds have exposed body tissue in the base of the wound (such as puncture wounds, surgical wounds, burns, bites and stings, and abrasions)[1] whereas closed wounds are the injury that occurs without the underlying body tissue exposure (such as contusions, blisters, seroma, hematoma). Based on the underlying reason of wound creation, they can be classified as acute or chronic wounds.[2] The prevalence of chronic wounds in the community was reported as 4.5/1000 population where as that of acute wounds was nearly doubled at 10.5/1000 population (Kumar, 2007). Skin is composed of a predominantly cellular epidermis and an underlying dermis, which is composed of fibers of connective tissue relatively sparsely populated with cells. They play an important role in the injury of the skin.[3] When the skin is injured, our body sets into motion of an automatic series of events, often referred to as the "cascade of healing," to repair the injured tissues. Wound healing is defined as body's natural process of restoration of tissue architecture and function after an injury. The cascade of healing or wound healing is divided into these four basic phases: Hemostasis, inflammatory, proliferative, and re-modelling phase.[4]

Wound Healing Potential of Plants

Plants have been used for treating several ailments of skin and dermatological conditions especially cut, wounds, burns from the early period (Kumar, 2007). Furthermore, it has been evaluated that 80% of the developing countries population is not able to pay for or avail pharmaceutical drugs and depend on traditional herbal remedies to take care of their primary health care needs (Survase and Raut, 2011). Many plants can be cited in the literature showing different degrees of wound healing potentials when taken through different wound healing models. Table 1 shows examples of medicinal plants refer to have been used to treat wounds.

Phytomedicines consist of many chemical constituents with complex pharmacological effects on the body. The

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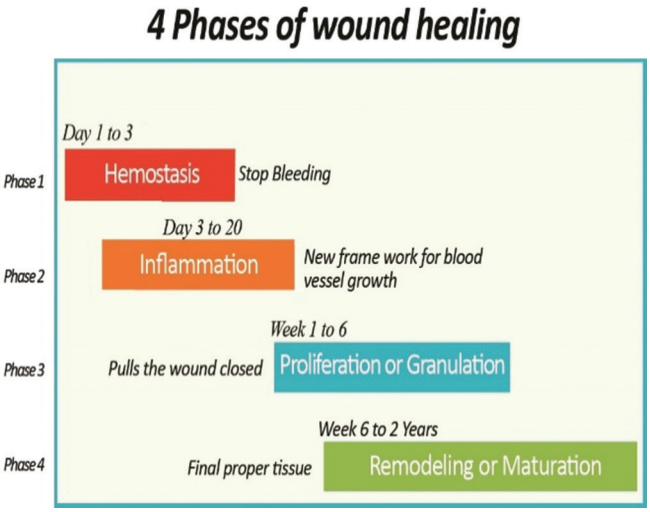

Table 1: Plants having wound healing potential

S.no.	Name of plant	Plant part	Mechanism/models studied	Reference
1	*Alkanna tinctoria* (*Boraginaceae*)	Root	Excellent wound healing, partial thickness and hot olive oil burn wound	[5,6]
2	*Buddleja globosa* (*Loganiaceae*)	Leaves	Improved growth of fibroblasts *in vitro*	[7]
3	*Terminalia arjuna* (*Combertaceae*)	Bark	Excision and Incision wounds	[8]
4	*Lawsonia alba* (*Lythraceae*)	Leaves	Excision and Incision wounds	[9]
5	*Gentiana lutea* (*Genitianaceae*)	Whole plant	Incision, excision and dead space wound	[10]
6	*Anogeissus latifolia* (*Combretaceae*)	Bar	Decreased epithelization period increase in tensile strength and hydroxyproline content	[11]
7	*Ocimum sanctum* (*Lamiaceae*)	Leaves	Incision, excision and dead space wound	[12]
8	*Biophytum petersianum* (*Oxalidaceae*)	Aerial parts	Complement fixing activity	[13]
9	*Pentas lanceolata* (*Rubiaceae*)	Flowers	Increased granulation tissue weight, tensile strength, hydroxyproline and glucosaminoglycan content	[14]
10	*Hylocereus undatus* (*Cactaceae*)	Leaves, and, fruit pulp and flowers	Incision, excision wound and nature of granulation tissue	[15]
11	*Datura alba* (*Solanaceae*)	Leaves	Proepithelization and improved burn wounds	[16]
12	*Portulaca oleraceae* (*Portulacaceae*)	Leaves	Prohealing activity by decreasing wound area and increasing tensile strength	[17]
13	*Desmodium triquetrum* (*Leguminosae*)	Leaves	Enhanced epithelization, increased tensile srtrength and hydroxyproline content	[18]
14	*Dodonaea viscosa* (*Sapindaceae*)	Leaves	Facilitated wound contraction and epithelization process	[19]
15	*Indigofera enneaphylla* (*Papilionaceae*)	Aerial parts	Incision and excision wound	[20]
16	*Hyptis suaveolens* (*Labiatae*)	Leaves	Incision, excision and dead space wound	[21]
17	*Hippophae rhamnoides* (*Elaeagnaceae*)	Leaves	Cutaneous excision punch wound model	[22]
18	*Pterocarpus santalinus* (*Papilionaceae*)	Wood	Punch and burn wound model in normal and diabetic rat	[23]
19	*Eleusine coracana and Paspalum scrobiculatum* (*poaceae*)	Flour paste	Increased protein and collagen content and decreased lipid peroxides	[24]
20	*Punica granatum* (*Punicaceae*)	Peels	Excision wound mojdel	[25]
21	*Curcuma longa* (*Zingiberaceae*)	Rhizome	Effect of curcumin on wound healing activity exposed to whole body Gamma radiation	[26]
22	*Ageratum conyzoides* (*Asteraceae*)	Leaves	Wound dressing– increased wound contraction	[27]
23	*Aloe vera* (*Liliaceae*)	Gel of leaves	Burn wounds, Re-epithelization, Decreased the wound diameter, improved tensile strength, Increased the collagen content of the granulation tissue and degree of cross linking	[28-44]
24	*Thymus vulgaris* (*Lamiaceae*)	(Thymus oil)	Essential oil Burn wound	[45]
25	*Cinnamomum zeylanicum* (*Lauraceae*)	Bark	Incision, excision wound and dead space wound	[46]
26	*Aristolochia bracteolate* (*Aristolochiaceae*)	Leaves	Incision, excision wound and dead space wound	[47]
27	*Hamelia patens* (*Rubiaceae*)	Whole plant	Double incision wound	[48]
28	*Musa paradisiac* (*Musaceae*)	Leaf	dressing Partial thickness burn wound	[49]
29	*Apple and beet*	Fruit pectins	Burn wounds (II-IIIA)	[50]
30	*Lithospermum erythrorhisonsss*	Root	Healing impaired diabetic mice	[51]
31	*Oxalis corniculata* (*Oxalidaceae*)	Whole plant	Excision, incision and dead space wound model	[52]
32	*Argyreia speciosa* (*Convolvulaceae*)	Root	Incision, Excision and dead space wound.	[53]
33	*Centella asiatica* (*Apiaceae*)	Leaves	Increased the percentage of collagen in human skin fibroblasts, Increased cellular proliferation and collegen synthesis at wound site in open wounds	[54-60]
34	*Calendula officinalis* (*Compositae*)	Flower	Stimulated regeneration and epithelization of tissue at the wound site	[61]
35	*Calotropis procera* (*Asclepiadaceae*)	Latex	Increased collagen, DNA, protein synthesis and epithelization	[62]
36	*Allamanda cathartica* (*Apocynaceae*) and *Laurus nobilis* (*Lauraceae*)	Leaves	Excision Incision wound	[63]
37	*Sphaeranthus indicus* (*Asteraceae*)	Arial parts	Enhanced the rate of wound contraction and period of epithelization	[64]

Table 2: Phytoconstituents possessing wound healing potential

Name of the plant	*Plant part*	*Phytoconstituents*
Buddleja globose	Leaves	Verbascoside, Echinacoside, Linnamarin, Luteolin and 6-hydroxy luteolin
Lawsonia alba	Leaves	Lawsone
Anogeissus latifolia	Bark	(+)-Leucocyanidin, Ellagic acid, Flavellagic acid
Biophytum petersianum	Aerial parts	Rhamnogalacturonan, Xylogalacturonan
Calotropis gigantea	Latex	Cysteine proteases
Centella asiatica	Leaves	Asiaticoside, Asiatic acid, madecassic acid
Punica granatum	Dried peels	Phenolic compounds: gallic acid and Catechins
Curcuma longa	Rhizomes	Curcumin
Aloe vera	Gel/juice	Glycoprotein fraction (G1G1M1 D12)
Alkanna tinctoria	Roots	Alkannin esters of beta, beta-dimethyl acrylic acid, beta, acetoxy-isovaleric acid, isovaleric acid and angelic acid
Copaifera langsdorffi	Bark	Oleoresin
Vitis vinifera	Seeds	Reservatrol (Proanthocyanidin)
Panax ginseng	Roots	Ginsenoside Rb2
Scrophularia nodosa	Dried seed pods	Acylated irridoid glycosides: Scpolioside A, Schrophuloside A
Chromolaena odorata	Leaves	Phenolic acids; Protocatechuic acid, Phydroxy benzoic acid, P-coumaric acid, ferulic acid vannilic acid, Lipophilic flavanoid aglycones
Piperomia galiodes	Whole plant	Alpha-bisabolol and alpha terpeniol
Cumicifuga racemosa	Rhizomes	Fukinolic acid and Cimicifugic acids A B C
Plantago major	Leaves	Flavonoids, Caffeic acid derivatives, Long chained saturated primary alcohols, Pectic polysaccharides

Table 3: Herbal formulations for wound healing potential

S.no.	*Name of the formulation*	*Wound model/mechanism*
01	Darvhi Ghrita (Herbal formulation)	Incision and excision wound model
02	Mulathiadi Ghrita (Ghee-based herbal formulation)	Incision and excision wound model
03	Himax ointment and Lotion (Herbal formulation)	Incision and excision wound model
04	Septilin formulation (Proprietary preparation)	Incision and excision wound model
05	Hepatogard formulation (Phytopharmaceutical product)	Incision wound model
06	Aekol preparation (Artificial seabuck thorn oil)	Incision and excision wound model
07	Chandanadi Yamaka (Panchagavya-based formulation)	Incision and excision wound model, histological study reveals good keratinization, epithelization and angiogenesis

pharmacological action of crude drug is determined by the nature of its constituents. These chemical compounds including alkaloids, terpenoids, flavonoids, and glycosides are responsible for the desired therapeutic properties. These active moieties promote the process of wound healing by increasing the viability of collagen fibrils, by increasing the strength of collagen fibers either by increasing the circulation or by preventing the cell damage or by promoting the DNA synthesis.[65] Table 2 shows phytoconstituents possessing wound healing potential and Table 3 shows herbal formulations for wound healing potentials.

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