



## A COMPREHENSIVE REVIEW ON WOUND HEALING PROPERTIES OF MEDICINAL PLANTS

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### ARTICLE INFO

### ABSTRACT

#### Key Words

Wounds; inflammation;  
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Herbal plants are known to be potent means of source for many essential chemical constituents who may be used to treat various diseases and ailments. On the other hand human kind from its beginning is suffering and in search for a remedy which may give a positive results along with less or minimal side effects. One of the major causes of problems associate to the human beings is inflammation. Inflammation is resultants of injuries to skin that disrupt the other soft tissue and associated with wounds. Wounds are various types like injuries, burns, cuts, ulcers etc., The aim of the present review is to explore the different origins of plant sources for the easy identification and assessment of natural sources which may be used in treatment of various ailments.

### INTRODUCTION

In a various biological process wound healing is a complication one. It involves a series of events including hemostasis, inflammation, cell proliferation & differentiation, neo vascularization, granulation tissue formation, collagen synthesis, epithelialization and wound contraction. In animals and humans normal and abnormal angiogenesis and tissue repair are regulated by vascular endothelial growth factor (VEGF) and basic fibroblast growth factor (BFGF). Angiogenesis or vasculogenesis, vascular permeability, endothelial cell proliferation and migration as well as the adhesion of leukocytes are promoted by VEGF. Epithelialization and collagen deposition in the wound are also

promoted by VEGF <sup>(1)</sup>. Wound healing process is promoted by a large FGF family. It is a member of BFGF. It includes angiogenesis, endothelial cell and fibroblast proliferation <sup>(2)</sup>.

#### Marketed Drugs used for wound healing:

##### Neomycin/ Polymyxin B /Bacitracin:

Brand name: Neosporin

1. Used to prevent infections.
2. Preventing infections in minor skin trauma.
3. Used to treat scratches, cuts and minor skin infections.

Side effects: External use only. It is not recommended for children under the age of

two. It should not be applied near mucous membrane such as eyes or mouth.

**Iodosorb gel:** It is used to treat open wounds, stalled wounds and infected wounds.

Side effects:

1. It should not be used during pregnancy or breast feeding.
2. Because iodine can enter breast milk and cross the placenta, affecting the baby.

**Medihoney gel:** It is used to treat open wounds

Side effects:

1. It is used to treat or prevent many infections caused by susceptible bacteria such as skin and soft tissue infections.
2. Diarrhoea, Vomiting, nausea, thrush and skin rash.

**Traumeel:** It is used as pain relief gel. Side effects: Only a very small fraction of the medicine gets to the spot you want to treat,

**Povidone:** Side effects: Eye pain, Allergic reaction, Dizziness, Trouble breathing.

**Gentamicin:** Side effects: Skin irritation, redness, itching.

**Sulfa thiazole:** Side effects: Irritation, burning, itching, allergy, increased need to urinate.

**Chlorhexidine:** Side effects: Irritation , sensitization , Dyspnea, Nasal congestion.

**Silver sulphadiazine :** Side effects: Burning, itching, rash, necrosis of the skin, Aplastic anaemia.

**Antibiotics used for wound infections:**

1. Amoxicillin – clavulanate (Augmentin, Augmentin-duo)
2. Cephalexin (Keflex)
3. Clindamycin (Cleocin)
4. Dicloxacillin
5. Doxycycline ( Doryx)

6. Trimethoprim Sulphamethoxazole (Bactrim, Septra) –

Due to the above mentioned side effects in the current medication system it is the alarming time to think about the alternate method of medicine system which may be natural sources because of the following statements.

1. Because plants are more potent healers as they promote the repair mechanisms in the natural way. More than 70% of wound healing pharma products are plant based, 20% are mineral based and remaining containing animal products as their base material <sup>(3)</sup>.
2. The plant based materials are used first aid – antiseptic, coagulants and wound wash <sup>(4)</sup>.
3. Mainly ayurvedic plants have a very important role in the process of wound healing <sup>(3)</sup>.

#### **FACTORS AFFECTING WOUND HEALING:**

**SYSTEMIC FACTORS:** These include good nutritional status and general health, infection, impaired immunity, poor blood supply and systemic conditions.

Eg. Diabetes Mellitus and Cancer, Reduce the rate of wound healing.

**LOCAL FACTORS:** Local factors that facilitate wound healing include a good blood supply to provide oxygen and nutrients and remove waste products and freedom from contamination by,

Eg. Microbes, foreign bodies or toxic chemicals.

**METHODOLOGY:** The Information provided in this review, was a result of an extensive bibliographic investigation by analyzing classical textbooks, scientific journals, consulting worldwide accepted databases. The peer reviewed papers were gathered from different databases like SCOPUS, PUBMED, Google Scholar etc. overall 45 plants were reviewed or their

wound healing properties along with their possible mechanisms of actions, parts used, family and animals used. Additionally, those plants whose phytoconstituents have demonstrated wound healing activity were considered <sup>(6)</sup>.

### **PATHOPHYSIOLOGY OF WOUND HEALING:**

Wounds are physical injuries that result in an opening (or) break of the skin. Healing is a complex and intricate process initiated in response to an injury that restores the function and integrity of damaged tissues.

The 3 main stages of healing are Inflammation repair (which may be further subdivided into proliferation and organization) and maturation (regeneration).

Proliferation takes place through the actions of fibroblasts, epithelial and endothelial cells and is largely dependent on growth factors and collagen cross linking and collagen degradation increasing scar strength as scar formation occurs <sup>(7)</sup>.

### **STAGES OF WOUND HEALING:**

**Hemostasis** (blood clotting): Within the first few minutes of injury, platelets in the blood begin to stick to the injured site. This activates the platelets, causing a few things to happen. They change into amorphous shape, more suitable for clotting, and they release chemical signals to promote clotting. This results in the activation of fibrin, which forms a mesh and acts as “glue” to bind platelets to each other. This makes a clot that serves to plug the break in the blood vessel, slowing/preventing further bleeding.

**Inflammation:** During this phase, damaged the dead cells are cleared out, along with bacteria and other pathogens or debris. This happens through the process of phagocytosis, where white blood cells “eat” debris by engulfing it. Platelet-derived growth factors are released into the wound that cause the migration and

division of cells during the proliferative phase.

**Proliferation (growth of new tissue):** In this phase, angiogenesis, collage deposition, granulation tissue formation, epithelialization and wound contraction occur. In angiogenesis, vascular endothelial cells form new blood vessels. In fibroplasias and granulation tissue formation, fibroblasts grow and form a new, provisional extracellular matrix(ECM) by excreting collagen and fibronectin. Concurrently, re-epithelialization of the epidermis occurs, In which epithelial cells proliferate and ‘crawl’ a top the wound bed, providing cover for the new tissue. In wound contraction, myofibroblasts decreases the size of the wound by gripping the wound edges and contracting using a mechanism that resembles that in smooth muscle cells. When the cells rolls are close to complete, un needed cells undergo apoptosis.

### **MATURATION (Re modeling):**

During maturation and remodeling, collagenase realigned along tension lines, and cells that are no longer needed are removed by programmed cell death or apoptosis

### **CLASSIFICATION OF WOUNDS:**

Wounds are classified as open and closed wound on the underlying cause of wound creation and acute and chronic wounds on the basis of physiology of wound healing <sup>(8)</sup>.

- Open wounds, Closed wounds
- Acute wounds, Chronic wounds

Open wounds are further classified as

- Incised wound
- Abrasions or superficial wounds
- Laceration wounds or tears wounds
- Puncture wounds, Gunshot wounds
- Penetration wounds

Closed wounds are further classified as

- Contusions or bruises, Hematomas or blood tumor, Crush injury.

S.NO	BIOLOGICAL NAME	COMMON NAME	FAMILY	PARTS USED	CHEMICAL CONSTITUENTS	ANIMAL USED	NO.OF GROUPS, DRUGS,DOSE[mg/kg]	METHOD USED	REFERENC E
1	Abelmoschus Esculentus	Okra, Lady's fingure	Malvaceae	Fruit	67.5% a-cellulose 15.4% Hemicellulose 7.1% dignin 3.4% Pectic matter 3.9% Fatty and waxy matter 2.7% Aqueous extract	Wistar albino rats	Group-1: control group: Did not receive any treatment.  Group-2 : Receive application of standard drug ointment i.e., framycetin topical (1% w/w).  Group-3: Received application of aqueous extract of Abelmoschus Esculentus (200 mg/kg/day).	Excision wound model	10
2	Allamanda Cathartica Linn. and Laurus nobilis L.	Golden Trumpet, Trumpet vine, Bay tree	Apocyanaceae and Lauraceae	Leaves	Flavanoids and ariterpenoids  Alkaloids and monoterpenoids	Sprague dawley rats	Group-1:control-untreated.  Group-2: standard group-Treated with Sulphathiazole ointment.  Group-3 and Group-4: Treated with Aqueous extract of allamanda cathartica (150mg/kg/day) and laurus nobilis (200mg/kg between/day) respectively for 14 days.	Excision wound model and Incision wound model	11
3	Argemone Mexicana	Mexican poppy, Mexican Prickly	Papavaraceae	Leaves and Latex used as topical applicati on on	Isoquinoline alkaloids  Leaves- Flavanoids, sterols, Tannins, Alkaloids and glycosides, Tirpenese.	Albino Wistar rats (150-250gms)	Group-1: control group (vehicle) simple ointment I.P.  Group-2: Nitro Furazone (0.25w/w) mg/kg  Group-3: Petroleum ether, chloroform, methanol or	Excision wound model, Incision wound model and dead space	12

				wound			Aqueous extracts of Argemone Mexicana at a concentration of 10% w/w.	model	
4	Acacia suma Rox B leaf	White thorn	Fabaceae	Leaves	Triterpenoids, Flavanoids, Tannins	Wister Albino rats	Group-1: Control  Group-2: Povidone Iodine (0.2%).  Group-3: Chloroform extract(10% w/w).  Group-4: Ethanol extract(10% w/w).  Group-5: Aqueous extract(10% w/w).	Excision wound model and Incision wound model	13
5	Alternanthera Brasiliana Kuntz	Penicillin, Brazilian Joyweed	Amaranthaceae	Leaves	Alkaloids, Steroids, Triterpenes	Sprague Dawley rats	Invivo model: 3 groups of six animals each  Group-1: Control  Group-2: Receive Topical application of 5% ointment of A.Brassiliana (w/w).  Group-3: Received the topical application of Himax ointment as standard drug.	Excision wound model, Incision wound model, Invivo wound model, In vitro wound model	14
6	Azadiractha Indica	Neen nintree	Meliaceae	Leaves	Tetranotriterpenoid,  Isomeldenin, Nimbin, Nimbandiol,  Immobile, Quercetin, Beta-Sitosterol.	Albino & Wistar rats (170-210g)	Group-1: Control-Animals were topically applied with simple ointment base.  Group-2: Topically applied with povidone iodine ointment.  Remaining groups were	Excision wound model, Incision wound model.	15

							topically treated with 200 mg/kg of test substance mixed with ointment base.		
7	Brassica juncea	Mustard	Brassicaceae	Fruits	Carbohydrates, Tannins, Proteins, Glycosides, Flavanoids	Male wistar rats	<p>Group-1: Base(2% Sodium alginate gel).</p> <p>Group-2: Standard drug Povidone Iodine.</p> <p>Group-3: 10% gel was applied on wounds</p> <p>Group-4: 20% gel was applied on wounds.</p>	Excision wound model, Incision wound model and Burn wound model.	16
8	Brugmansia suaveolens Bercht & Presl leaves	Brazil white angel trumpet, Angel's tears	Solanaceae	Leaves	Phenyl Ethyl Alcohol (1-3%), Nerolidone (5-6%), Benzoids- Methyl benzoate (18.7%)	Wistar albino rats	<p>Group-1: Received no treatment- Control.</p> <p>Group-2: Received application of standard drug ointment i.e., Povidone Iodine cream (5%).</p> <p>Group-3: Topical application- Test sample 30mg/kg.</p> <p>Group-4: Received application of test sample (50mg/kg).</p>	Excision wound model, Incision wound model and dead space model	17
9	Catharanthus roseus flower	Rose periwinkle	Apocyanaceae	Flowers	Vinblastine, Vincristine, Rosinidine is an anthocyanidin pigment found in the flowers of C.roseus	Sprague Dawley rats	<p>Excision wound model:</p> <p>Group-1: Topically treated with carboxy methyl cellulose as placebo control.</p> <p>Group-2: Received topical application of the ethanol extract of C. roseus at a dose of</p>	Excision wound model, Incision wound model and dead space model.	18

							100mg/kg body weight/ day. Incision and dead space model: Group-1: Normal saline Group-2: Extract orally at a dose of 100mg/kg/day.		
10	Cynodon Dactylon	Arugampul	Poaceae	Leaves	Tannins, Flavanoids	Swiss albino mice	Group-1: Control mice wound was untreated for 8 days. Group-2: Mice were treated with sodium alginate(2%) for 8days. Group-3: Mice were treated with povidone iodine ointment (1%) for 8 days. Group-4: Treated with extract(2.5% w/w of cynodon dactylon for 8 days.	-	19
11	Calotropis Gigantea	The swallon - wort (or) Milk weed	Asclepiadaceae	Latex of calotropis gigantia	Cardaic glycosides, Calactin, Calatopin, Uscharin, Gigantin	Wistar albino rats	Group-1: Received no treatment and served as control. Group-2: Standard drug ointment i.e., framycetin sulphate cream (1% w/w). Group-3: Received application of latex of calotropis gigantia (200mg/kg/day).	Excision wound model, Incision wound model.	20

12	Ceylon Cinnamon	Cinnamon cassia, Cinnamon Zeylanicum	Lauraceae	Whole plant	Volatile oils (cinnamaldehyde, eugenol, cinnamic acid and weitherhin) Mucilage Diterpenes Proanthocyanidins	Wistar rats	Group-A: An Ointment comprising 1.5% cinnamon. Group-B: An Ointment of 3% cinnamon. Group-C: As the control group-untreated. Group-D: Reference Standard group received the blank placebo.	Excision Wound Model	21
13	Cyperus Rotundus	Mustaka	Cyperaceae	Tubers	Beta-sitosterol, sesquiterpene 4- $\alpha$ , Cyperenone, mustakone (a new sesquiterpene ketone)	Male wistar rats(150-180g)	Group-1: Control simple ointment base. Group-2: Reference standard 0.2% w/w nitrofurazone (NFZ) ointment. Group-3,4,5: Treated with 0.5, 1 & 2% w/w of extract ointment respectively.	Excision wound model, Incision wound model and dead space model	22
14	Datura stramonium	Apikan	Solanaceae	Leaves	Hyosiamine(scopolamine) atropine, Protein, Albumin	Wister albino rats(150-180g)	Group-1: Control(simple ointment Base B.P). Group-2: Povidone Iodine ointment (U.S.P). Group-3: Datura stramonium ointment (10%).	Excision wound healing model	23
15	Delonix regia Raf	Royal Poinciana flamboyant	Fabaceae	Flower	Beta-sitosterol, dupeol, Stigmasterol, squalene.	Albino rats.	Group-1: Control excision wound model and normal saline (Incision wound model)	Excision wound model, Incision wound	24



								model.	
16	Eucalyptus citriodoralin	Eucalyptus	Myrtaceae	Oil	Alkaloids, Flavanoids, Saponin, Tannins, Carbohydrates, Glycosides	Wister albino rats(130-200g)	<p>Excision wound model:</p> <p>Group-1: Negative control simple ointment applied topically.</p> <p>Group-2: 5% w/w Povidone Iodine Ointment.</p> <p>Group-3: 10% EAEEC in Ointment applied topically.</p> <p>Group-4: 10% EEEC in ointment applied topically.</p> <p>Incision wound mode:</p> <p>Group-1: Controlled simple ointment applied topically.</p> <p>Group-2: 5% w/w Povidone Iodine ointment.</p> <p>Group-3: 10% EAEEC in ointment applied topically.</p> <p>Group-4: 10% EEEC in ointment applied topically.</p>	Excision wound model, Incision wound model and dead space model.	25
17	Gossypium herbaceum	Algodonero herbceo	Malvaceae	Leaves	Steroids, Flavanoids, Saponin, Mucilage, Tannin, Phenolic compounds.	Wister albino rats(150-200g)	<p>Group-1: Negative control administer saline 2ml/kg orally.</p> <p>Group-2: Standard drug povidone iodine ointment</p>	Excision wound model, Incision wound model and dead space	26

							applied topically. Group-3: Receive MEGM 200mg/kg orally.	model.	
18	Heliotropium indicum Linn.	Indian Turn sole	Boraginaceae	Leaves	Steroids, Flavanoids, Saponins, Tannins, Mucilages, Carbohydrates, Proteins.	Wister albino rats.	Excision wound model: Group-1: Treated with the vehicle (simple ointment I.P) the positive control. Group-2: Applied with 0.2% w/w nitro furazone in simple ointment. Other groups of animals treated with petroleum ether, chloroform, methanol or aqueous extract of H.Indicum at a Concentration of 10% w/w in simple ointment I.P.	Excision wound model, Incision wound model and dead space model.	27
19	Holarrhena Antidysenterica wall.	Pandhra Kuda	Apocynaceae	Leaves	Alkaloids, Carbohydrates, Flavanoids, Glycosides, Fixed oils and Fats, Terpenoids, Tannins.	Adult female rats.	Group-1: Control group- Treated with gel base (1% w/w of carbopol 934) for 20 days. Group-2: Standard group- Treated with 5% of povidone iodine ointment for 20 days . Group-3: Test group-1 treated with 2.5% gel made by using ethanolic extract of the leaves of Holorrhoea antidysenterica wall for 20 days. Group-4: Test group-2 treated	Excision wound model	28

							with 5% gel made by using ethanolic extract of the leaves of the Holorrhena-antidysenterica wall for 20 days.		
20	Jasminum Grandiflorum Linn.	Jasmine	Oleaceae	Leaves	Flavonoids, Terpenoids, Tannins.	Male albino rats(150-200g)	Excision wound model: Animals were distributed into 3 groups of six each. Group-1: control treated with 0.25% cellulose. Group-2: Reference standard-Treated with sulfathiazole ointment. Group-3: Experimental-Treated with extract of J.grandiflorum leaves (250mg/kg/day) till complete epithelialization.	Excision wound model and dead space wound model.	29
21	Jatropha curcas L.	Physic nut	Euphorbiaceae	Leaves	Alkaloids, Saponins, Tannins, Steroids, Glycosides	Albino rats	Group-1: Saline control without wound. Group-2: Animals treated with extract in the dose of 2ml/kg body weight with wound.	Excision wound model, Incision wound model and dead space model	30
22	Kaempferia rotunda Linn.	Bhuichampaka	Lingiberaceae	Leaves	Flavanoids, Crotepoxid, Chalcones, Quercetin,	Albino rats	Animals were divided into 2 groups of 6 in each Test samples were applied topically models at 2 different	Excision wound model and Incision wound	31

					Protocatechuic acid, Beta-Sitosterol.		dose levels of 250 & 500 mg/kg body weight.	model.	
23	Kaempferia Galanga	Aromatic Ginger, Sand ginger	Zingiberaceae	Shade dried rhizome	Ethyl para methoxy cinnamade - 31.77%,  Methyl Cinnamade - 23.23%, Carbone- 11.3%, Eucalyptus- 9.59%, Pentadecane – 6.41%.	Wistar rats	Animals were divide into 4 groups of 8 animals.  Group-1: Received 2ml of gum acacia 2% (E.Merck India Ltd.) pore through intra gastric  tube. Group-2: Received K.galanga 300mg/kg.  Group-3: Received Dexamethasone, 0.17 mg/kg in.  Group-4: Received Dexamethasone (0.17 mg/kg IM).	Excision wound model, Incision wound model and dead space model	32
24	Lantana Camara	Common Lantana Red sage	Verbenaceae	Leaves	Saponin, Tannin, Alkaloids.	Induced diabetic rats	Normal control and diabetic control received vehicle (simple ointment base) applied topically.  3 treatment groups received the topical extract ointment in the dose 10%, 15%, 20%.  5 groups of 6 in each Normal control group A-Untreated  Normal treated group B-	Excision wound model	33

							<p>Treated with Lantana camara.</p> <p>Ethanollic extract twice a day.</p> <p>Diabetic control group C- Untreated</p> <p>Diabetic control group D- Treated with Lantana camara ethanollic extract twice a day and</p> <p>Positive control group E- Standard group available in market is bacitracin ointment.</p>		
25	Leucas hirta		Labiataceae	Leaves	<p>Flavanoids, Alkaloids, Tannins, Saponins, Glycosides, Steroids and Triterpenoids</p>	Wistar rats	<p>Group-1: Control</p> <p>Group-2: Reference standard and treated with 1% w/w framycetin sulphate cream.</p> <p>Group-3 and 4: 50mg of ointment gel prepared from aqueous and methanol leaf extracts of leucas hirta respectively.</p>	Incision wound model	34
26	Mirabilis jalapa	<p>Marvel of peru Four o'clock flower</p>	Nyctaginaceae	<p>Leaves, Flowers and Tubers</p>	<p>Flavanoids, Tannins, Alkaloids, Saponins, Phenolics, Glycosides.</p>	<p>Male Sprague Dawley rats</p>	<p>Group-A: Control (topically applied with base petroleum jelly)</p> <p>Group-B: Treated with silver sulfadiazine ointment served as reference standard.</p> <p>Group-C,D and E:1%, 5% and</p>	<p>Invitro chick chorioallauto ic membrane (CAM) model</p> <p>Excision wound model and</p>	35

							10% w/w respectively in petroleum jelly.	Dead space wound model.	
27	Mimusops elengi	Bakul	Sapotaceae	Leaves	Alkaloids, Tannins, Flavanoids, Steroids, Triterpenoids, Saponins.	Wistar albino rats	Excision wound model Group-1: Negative control Group-2: Positive control (applied topically Betadine 5% w/w in ointment I.P) Group-3: Treated with extract ointment topically (5% w/w).	Excision wound model, Incision wound model and dead space model.	36
28	Napoleona vogelli	Napoleona	Lecythidaceae	Methanolic extract of leaves	Glycosides, Alkaloids, Tannins, Saponins, Proteins, Carbohydrates,		Group-1: Topically treated with petroleum jelly alone Group-2: Topically applied 400mg/ml w/v of the reference drug neobacin. Group-3 and 4: Topically applied with 5-50 mg/ml w/v of the plant extract respectively.	Incision wound model	37
29	Ocimum Basilicum Linn. & Barkey Ficus Benghalensis Linn.	Basila and Banyan fig	Lamiaceae and Moraceae	Aerial parts of Basilicum and bark of Benghalensis	Phenolics, Flavanoids, Tannins.	Albino rats	Group-1: Kept as control group which received simple vehicle. Group-2: Kept as test-1 which received extract of aerial part of O.basilicum formatin. Group-3: Kept as test-2 which received extract of F.benghalensis formulation. Group-4: kept as test-3 which	Excision wound model, Incision wound model and dead space model	38

							received poly herbal formulation of both extracts.		
30	Pomegranate granatum	Pomegranate granats Grenade Punica apple	Lythraceae	Fruit peel, Pulp and arils	—	Male rats	Group-1: (Eucerin) Group-2: Phenytoin Group-3: Hydro alcoholic extract of the pomegranate peel. Group-4: Hydro alcoholic extract of the pomegranate pulp. Group-5: Hydro alcoholic extract of the top layer of pomegranate (peel pulp).	—	39
31	Plumbago Zeylanica	Chitrak White lead wort plumbago	Plumbaginaceae	Roots	Tannins, Alkaloids, Reducing sugars, Sterols in the methanolic root extract	Wistar albino rats	Group-1: Served as vehicle control and applied simple ointment. Group-2: 2% w/w framycetin ointment applied. Group-3: Normal ointment base. Group-4: 10% w/w root extract ointment is applied.	Excision wound model.	40
32	Polygonatum Odoratum	Solomon's seal	Lilliaceae	Leaf extracts	Flavanoids found in the leaf of this plant were Rutin, Catechin, Quercetin, kaempferol, Isorhamnetin.	Sprague Dawley rats	36 animals (18 males and 18 females). 3 groups labelled as vehicle (Gum acacia in normal saline) 2 and 5 kg of P.odoratum in	Induced Excision wound model	41

							vehicle respectively.		
33	Plagiochilla Beddomei steph	Liver wort (Bryophyte)	Plagiochiaceae	Fruit thallus	Flavanoids, Polyphenols, Saponins, Tannins,  Phenols.	Sprague dawley rats	30 animals were divided into 4 groups.  Group-1: Control  Group-2: Received methanolic extract topically.  Group-3:Received aqueous extract.  Group-4:Received reference standard drug.	Excision and Incision wound model	42
34	Pupalia Lappacea	Forest burr or creeping	Amaranthacea e	Aerial parts and leaves	Sterols, Glycosides, Saponins, Anthracene, Tannins, Alkaloids	Male Sprague dawley rats (180- 220g)	Nine groups containing each 5 rats.  Group-1: Untreated (Negative control)  Group-2:Treated with aqueous cream base (vehicle).  Group-3: Treated with 1% w/w silver sulphadiazine.  Group-4,5&6:Treated with 0.25, 0.5 and 1.0% w/w pupalia lappacea creams respectively.  Group-7,8&9: Treated with 2.5, 5.0 and 10% w/w pupalia lappacea creams.	Excision wound healing model	43
35	Piper Betle	Nagballi	Piperaceae	Leaves and	Terpinen-4-ol sotrole,	Wistar albino	Group-1: Consists of 5 rats untreated for 21 days and set as	Excision wound	44



		Tamalapaku		Stem	allyl pyro catechol monoacetate eugenol,  Eugenyl acetate chavibetol, Tannins,  Alkaloids,  Amino acids.	adult female rats (150-250g)	negative control.  Group-2: Treated with 10% povidone iodine for 21 days and set as positive control.  Group-3: Consists of 5 rats treated with 10% piper betle stem for 21 days.  Group-4: consists of rats treated with 10% piper betle stem for 21 days.	model	
36	Quercus Infectoria Olivier	Aleppo oak	Fagaceae	Galls	Tannins, Phenolic compounds	Wistar albino rats	Six groups were fed with increasing doses (1, 2, 4 and 8gm/kg body wt) of the ethanol extract.	Excision wound model, Incision wound model and dead space model.	45
37	Radix paeoniae	Peony root	Poeonaceae	Roots	Glycosides, Flavanoids, Tannins, Resins, Terpenoids	Wister albino rats (180-200g)	Excision wound model: 3 groups – 5 animals each were used.  Incision wound model: 3 groups – 5 animals each were used.	Excision wound model, Incision wound model and dead space model.	46
38	Rubia cordifolia L.	Manjishta Indian madder	Rubiaceae	Roots	Anthraquinone, Glycosides, Saponins,	Mice	Excision wound model:  Group-1: Treated with plane base, gels of different	Excision wound model	47

					Tannins, Phyto sterols		concentrations of extracts (0.2%,0.5%,1%) and extract respectively, once daily for 15 days.		
39	Salvadora persica	Miswak	Salvadoraceae	Twig	Tannins, Saponins, Flavanoids	Albino Wistar rats	<p>Group-1: Received with topical application of carbopol gel containing methanol extract of salvadora persica twig.</p> <p>Group-2: Positive control - Received topical application of standard drug ointment i.e., betadine.</p> <p>Group-3: Negative control (vehicle) – Received with topical application of plain carbopol gel.</p> <p>Group-4: Negative control – Animals were left without any treatment</p>	Excision wound model and Incision wound model	48
40	Sesamum Indicum L.	Sesame	Pedaliaceae	Seeds	Alkaloids, Phenols Flavanoids, Tannins Glycosides, Proteins  Carbohydrates,  Anthraquinones.	Wistar male rats (150-175g) approx.	<p>Excision wound model:</p> <p>Group-1: Control (untreated)</p> <p>Group-2: Control (treated)with ointment base (SOB).</p> <p>Group-3: Standard group treated with povidone iodine ointment USP (betadine ointment).</p> <p>Group-4: Treated with</p>	Excision and Incision wound model	49

							ethosomal gel.		
41	Tribulus Terrestris Linn.	Goats head, Bindii, Bull head, Caltrop.	Zygophyllaceae	Fruits	Tannins, Phenolic content	Swiss albino rats	Excision wound model: Group-1: Control (Treated with Vaseline). Group-2: Standard (Treated with povidone iodine 5% w/w ointment). Group-3: Test (Treated with tribulus terrestris ointment % strength)	Excision wound model	50
42	Tinospora Crispa	Heart -leaved, Moon seed, Giloy	Menispermaceae	Stems	Flavones, Alkaloids, Diterphenes	Albino rats	Excision wound model: Group: Control (untreated) Group-2: Standard drug (betadine) Group-3 and 4: Received ointment of methanol fraction and chloroform fraction.	Excision wound model	51
43	Terminalia chebula	Chebolic myrobalan	Combretaceae	Fruits	Tannins, Chebolic acid, Chebulagic acid	Sprague dawley rats	Excision wound model: Group-1: Normal controls-applied with ointment base 2 times a day. Group-2: 20% w/w ointment in soft paraffin base extract of terminalia chebula 2 times a day.	Excision wound model, Incision wound model and dead space model.	52

							<p>Group-3: Diabetic controls – were applied with ointment base 2 times a day.</p> <p>Group-4: Diabetic experimental rats applied 20% w/w ointment in soft paraffin base extract of T. chebula 2 times a day.</p> <p>Group-5: Positive control received an application of mupirocin ointment 2 times a day.</p>		
44	Taraxacum Officinale	Dandelion or Handh (Kashmir)	Asteraceae	Whole plant	Alkaloids, Saponins, Flavanoids, Terpenoids.	Wistar albino rats	<p>Group-1: Control - Received vehicle topically. Group-2: Standard – Received nitrofurazone 0.2% w/w. Group-3: Received 0.5% w/v herbal formulation. Group-4: Received 1% w/v herbal formulation.</p>	Excision wound model, Incision wound model and Burn wound model.	53
45	Wattakaka volubilis	Green milk weed climber	Asclepiadaceae	Leaves	Flavanoids, Triterpenoids.	Wistar albino rats (150-250g)	<p>Excision wound model:</p> <p>Animals 4 groups – each 6 rats                      Group-1: Served as untreated control. Group-2: served as standard group treated with framycetin sulphate cream.                      Group-3: Treated with aqueous extract (10% w/v). Group-4: Treated with alcohol extract (10% w/v).</p>	Excision wound model, Incision wound model and dead space model	54

**ROLE OF MEDICINAL PLANTS ON WOUND HEALING:**

It is expected that the number of chronic wounds will increase worldwide due to pathological conditions (Eg: diabetes). Current therapeutic agents have generally inadequate efficacy and number of serious adverse effects; the medicinal plants have been used in medicine since ancient times and are well known for their abilities to promote wound healing. Thus medicinal plants are potent wound healers <sup>(9)</sup>. The following is the list of plants claimed to be processing wound healing properties.

**CONCLUSION:**

Plants are more potent healers because they promote the repair mechanism in the natural way. Herbal drugs are much safer and promote the wound healing process with lower side effects than the allopathic drugs. This study exposed that traditional medicines are much more beneficial than the allopathic medicines.

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