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Review Article

HERBAL BOON FOR WOUNDS

MITTAL ARUN[1]*, SARDANA SATISH[1], PANDEY ANIMA[2]

[1]Hindu College of Pharmacy Sonipat, Haryana (131001) India, [2]Birla Institute of Technology Mesra, Jharkhand 835215, India.
Email: mittalarun07@rediffmail.com

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ABSTRACT

Wounds are simply defined as the disruption of cellular and anatomic continuity of a tissue. These are prime cause for physical disabilities. Plants and their extracts have a tremendous potential in the management and treatment of wounds. The phyto-medicines for wound healing are not only cheap and cost-effective but also reportedly safe as compared to allopathic drugs in context of hypersensitive reactions. The presence of various life sustaining constituents in the plants has also urged scientist to examine these plants with a view to determine their potentiating wound healing properties. Worldwide, there is an immense need for the collection of ethno-botanical data regarding wound healing activity. The present review is a sincere attempt to analyze and compile various pharmacological reports of Indian medicinal plants employed in wound healing.

Keywords: Wound, Open wound, Close wound, Mechanism, Medicinal plants.

INTRODUCTION

Wound is an injury, especially one in which the skin or another external surface is torn, pierced, cut or otherwise broken with disruption of normal continuity of structures[1]. Wounds are the unavoidable events of life. It may be produced by physical, chemical, thermal, microbial or immunological insult to the tissue[2]. They result in the loss of continuity of epithelium with or without the loss of underlying connective tissue. Wounds represent a significant burden on the patients and health care professionals worldwide. They not only affect physical and mental health of millions of patients but also impose significant cost on them. Current estimates indicate that worldwide nearly 6 million people suffer from chronic wounds[3]. Unhealed wounds constantly produce inflammatory mediators that produce pain and swelling at the wound site. Chronic wounds may even lead to multiple organ failure or death of the patient[4].

Healing is a survival mechanism and represents an attempt to maintain normal anatomical structure and function. Wound healing is the normal response of an organism to wound/injury which is either regeneration (complete restoration of damaged part) or repair (the reconstruction of the injured region). When skin is wounded the dermis responds primarily to repair while the epidermis responds to regeneration; collective response of the skin to injury/ wound is termed as 'Wound Healing'. It involves continuous cell-cell and cell-matrix interaction allowing process to proceed[3]. Basic principle involved in wound healing is to minimize tissue damage and provide adequate tissue perfusion, oxygenation, proper nutrition and moist wound healing environment to restore the anatomical continuity and function of the affected part[5].

Today ample numbers of drugs are being procured from plants having huge potential against a number of diseases. The world health organization (WHO) estimated that about 80% of the world's population still relies on plant based medicines for their primary health care. In the ancient times, our ancestors made novel discoveries of the healing power of plants through trial and error. The majority of drugs involve the isolation of the active ingredient found in a particular medicinal plant and its subsequent modification. Since ancient times, herbal medicines are the basic prerequisite of therapeutic experience essential for generation of physicians practicing indigenous systems of medicine. Herbal medicines are also in huge demand in the developed world for primary health care because of their efficacy, safety and lesser side effects. Many medicinal plants have been reported to possess wound healing activity and found useful in the treatment of wounds.

This article outlines wound, its types, factors affecting wound healing, mechanism(s) of wound healing along with roles of different activities, vitamins and phyto-constituents contributing to wound healing potential.

Wound

Wounds have been defined as a disruption of normal anatomical structure and more importantly function. Therefore, healing is the complex and dynamic process that results in the restoration of anatomical continuity and function

Classification of Wound

Wounds are classified as open and closed wound on the underlying cause of wound creation and also as acute and chronic wounds on the basis of physiology of wound healing[6].

On the basis of cause of wound creation

Open wounds- In this case, blood escapes the body and bleeding is clearly visible. It can be further classified into various types as: Incised wound, Laceration or tear wound, Abrasions or superficial wounds, Puncture wounds, Penetration wounds and Gunshot wounds[6,7,8].

Incised wounds- It is an injury with no tissue loss and minimal tissue damage. It is caused by a sharp object such as a scalpel or knife. Bleeding in such cases can be profuse, so immediate action should be taken.

Laceration wounds or Tear wounds- This is non-surgical injury in conjuction with some type of trauma, resulting in tissue loss and damage.

Abrasions or Superficial wounds- Abrasion is caused by a sliding fall onto a rough surface. During abrasions the topmost layer of the skin i.e., epidermis is scraped off that exposes nerve endings resulting in a painful injury. Blood loss similar to a burn can result from serious abrasions.

Puncture wounds- They are caused by an object puncturing the skin, such as a nail or needle. Chances of infection in them are much higher because dirt can enter into the depth of the wound.

Penetration wounds- Penetration wounds are caused by an object such as a knife entering and coming out from the skin.

Gunshot wounds- They are caused by a bullet or similar projectile driving into or through the body.

Avulsions- It occurs when an entire structure or part of it, is forcibly pulled away. Such as the loss of a permanent tooth or an ear lobe, animal bites may also cause avulsions.

Cuts- These are slicing wounds made with a sharp instrument leaving even edges. They may be as minimal as a paper cut or as significant as a surgical incision.

Fish-hook wound- An injury caused by a fish-hook becoming embedded in soft tissue.

Closed wounds- In closed wounds blood escapes the circulatory system but remains in the body. It includes Contusion or bruises, hematomas or blood tumor, Crush injury etc [3].

Contusions or Bruises- These are the results of a forceful trauma that injures an internal structure without breaking the skin. Blows to the chest, abdomen or head with a blunt instrument (e.g. football or fist) can also cause contusions.

Hematomas or Blood tumor- They are caused by damage to a blood vessel that consequently causes blood to collect under the skin.

Crush wound- Crush wound is caused when great or extreme amount of force is applied on the skin over a long period of time.

On the basis of physiology of wound healing

Acute wounds- It is a tissue injury that normally progresses through an orderly and timely reparative process that results in sustained restoration of anatomic and functional integrity[6,9]. Acute wounds are usually caused by cuts or surgical incisions and complete the wound healing process within the expected time frame.

Chronic wounds- Wounds that have failed to progress through the normal stages of healing and enter a state of pathologic inflammation are chronic wounds[10]. They either require a prolonged time to heal or reoccur frequently[11]. Local infection, hypoxia, trauma, foreign bodies and systemic problems such as diabetes mellitus, malnutrition, immunodeficiency or medications are the most frequent causes of chronic wounds[3,4].

THE WOUND HEALING MECHANISM

Wound healing, is an intricate process in which the skin or another organ-tissue repairs itself after injury[12]. In normal skin, the epidermis (outermost layer) and dermis (inner or deeper layer) exists in steady-state equilibrium, forming a protective barrier against the external environment. Once the protective barrier is broken, the normal (physiologic) process of wound healing is immediately set in motion. The entire wound healing process that begins at the moment of injury can continue for even months or years[6]. The main phases of wound healing phases are briefly discussed here and shown in figure1.

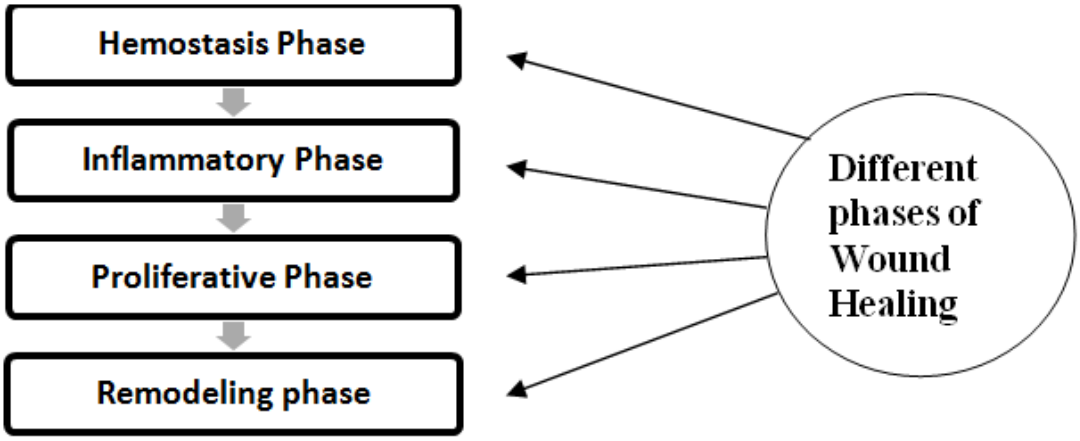

Fig. 1: Phase of WoundHealing

Hemostasis Phase- Within a minute of injury to the skin, a set of complex, bio-chemical events takes place in a closely orchestrated cascade to repair the damage, termed Hemostasis. Hemostasis occurs within minutes of the initial injury unless there are underlying clotting disorders. This phase consists of two major processes: development of a fibrin clot and coagulation. The blood vessels themselves constrict in response to injury but this spasm ultimately relaxes. In this phase, damaged blood vessels are sealed by platelets. The platelets secrete a vasoconstrictive substance to aid this process; but their prime role is to form a stable clot for sealing the damaged blood vessels. Under the influence of ADP (Adenosine-di-phosphate)- leaking from damaged tissues the platelets aggregates and adheres to the exposed tissue[13]. They also secrete factors which interact and stimulate intrinsic clotting cascade through the production of thrombin which in turn, initiates the formation of fibrin from fibrinogen. The fibrin mesh strengthens the platelets aggregates into a stable hemostatic plug.

Inflammatory Phase- The second phase is the inflammatory phase, which starts immediately after the injury and usually lasts between 24 and 48 h and may persist for up to 2 weeks in some cases[14]. In this inflammatory stage of wound healing which involves erythema, swelling and warmth associated with pain, bacteria and debris are phagocytosed and factors PDGF (Platelet derived growth factor) and TGFβ (Tranforming growth factor beta) are released which causes the migration and division of cells involved in the proliferative phase[15]. This phase usually lasts upto 4 days of post injury.

Proliferative Phase- The third phase is the proliferative phase that lasts upto 2 days to 3 weeks after the inflammatory phase. It is usually characterized by angiogenesis (new blood vessel growth from endothelial cells), collagen deposition, tissue formation, epithelialization and wound contraction. In the wound healing analogy once the site has been cleared of debris, proliferative phase come into existence. In this phase fibroblasts migrate in, to begin the proliferative phase and deposit new extracellular matrix. Fibroblasts are the cells which secret the collagen framework in which further dermal regeneration occurs[16].The new collagen matrix then becomes cross linked and organized during the final remodeling phase. The 'pericytes' cells which regenerate the outer layer of capillaries and the endothelial cells which produce the lining. In the final stage of epithelialization 'Keratinocytes' differentiate to form the protective outer layer.

Remodeling Phase- This phase lasts for 3 weeks to 2 years. New collagen is formed in this phase[17,18]. Tissue tensile strength is increased due to inter-molecular cross-linking of collagen via vitamin C-dependent hydroxylation. The scar flattens and scar tissues become 80% as strong as the original tissue.

FACTORS AFFECTING WOUND HEALING

Wound healing is a normal biological process in the human body. Many etiological factors can adversely affect this process and lead to improper and impaired wound healing. A thorough understanding of these factors and their influence on wound healing is essential for developing better therapeutic options for wound treatment[19].

Improper diet- Wound healing is an anabolic process that requires both energy and nutritive substrates. It is reported that serum albumin level of 3.5 gm/dl or more is necessary for proper healing[20]. Protein is essential for collagen synthesis on wound site. A state of malnutrition may provide an inadequate amount of protein and this can result in the decreased rate of collagen synthesis wound tensile strength or an increased chance for infection[21,22].

Infection at the wound site- Wound infection is probably the most common reason for impaired wound healing[9]. *Staphylococcus aureus, Streptococcus pyogenes, Corynebacterium* sp., *Escherichia coli* and *Pseudomonas aeruginosa* are some important organisms causing wound infection[23].

Insufficient oxygen supply and tissue perfusion to the wound area- Adequate blood supply and tissue perfusion is extremely important for proper wound healing. Excessive pain, cold or anxiety can cause local vasoconstriction and increased healing time[24]. Smoking and use of tobacco decrease tissue perfusion and oxygen tension in wounds [25].

Drugs- Many drugs are known to impair wound healing. Chemo-therapeutic drugs used in cancer are the largest group well known to delay wound healing[26]. Systemic glucocorticoids interfere in the normal healing process by reducing collagen synthesis and fibroblast proliferation.

Elderly age- Elderly age is found to be associated with delayed wound healing. It is reported that fibroblast growth and activity diminishes leading to slowing of collagen production and wound contraction in injured older individuals[27].

Diabetes and other disease conditions- Diabetic patients are more susceptible to wound infection. In a study, wound infection rate was found 11% higher in diabetic patients than in the general patient population[28]. Acute and chronic liver diseases are also associated with delays in wound healing. Patients with altered immune function have an increased susceptibility to wound infection.

Role of certain Pharmacological activities in wound Healing

Anti-inflammatory Activity- The acute inflammatory response during the early stages of injury generates factors that are essential for tissue growth and repair [29]. However the prolonged, chronic inflammation can be detrimental, preventing wound remodeling and matrix synthesis, leading to delay in wound closure and an increase in wound pain[30]. Thus, it is possible that an anti-inflammatory effect could facilitate wound healing and improve patient comfort, although traditional texts and animal studies indicate that extracts having anti-inflammatory effect also possess wound healing activity[31,32,33].

Anti-oxidant Activity- The production of free radicals at or around the wound bed may contribute to delay in wound healing through the destruction of lipids, proteins, collagen, proteoglycan and hyaluronic acid. Agents that demonstrate a significant anti-oxidant activity may, therefore, preserve viable tissue and facilitate wound healing[34].

Anti-microbial Activity- Wound healing can also be delayed when microorganisms are present in large numbers[35]. Therefore, reducing the bacterial load of a wound may be necessary to facilitate wound healing as well as to reduce local inflammation and tissue destruction. An ideal agent for prevention and control of wound infection should directly destroy the pathogens while also stimulating immune activity[36].

Analgesic Activity- Given that open wounds can generate pain and subsequent disability, it is important that the dressing applied does not increase pain, and if possible, it should lessen the pain[37].

Role of Nutrients in wound healing

Vitamin A- Enhances early inflammatory phase of wound healing, required for epithelial cell differentiation, bone tissue development, improve localization and stimulation of immune response[38].

Vitamin C- Necessary for synthesis of collagen, proteoglycans and other organic components of the intracellular matrix of tissue, tissue anti-oxidant, support immune response[38].

Vitamin E- Major lipid- soluble antioxidant, preventing peroxidation of lipids[38].

Bromelain- Reduce edema, brushing, pain and healing time following trauma and surgical procedure[38].

Glucosamine- Appears to be the rate limiting substrate for hyaluronic acid production in the wound[38].

Zinc- Required for DNA synthesis, cell division and protein synthesis[38].

Protein- Prevents delayed healing and complications after surgery[38].

Arginine- Essential for efficient wound repair and immune functions[38,39].

Glutamine- Required in the process of Proliferation and tissue repair[38].

Role of Phyto-constituents in wound healing

Tannins- Promote wound healing due to their astringent and anti-microbial property. These also act as free radical scavengers[40,41].

Flavonoids- Flavonoids are known to reduce lipid peroxidation not only by preventing or slowing the onset of cell necrosis but also by improving vascularity. Hence, any drug that inhibits lipid peroxidation is believed to increase the viability of collagen fibrils by increasing the strength of collagen fibres, increasing the circulation, preventing the cell damage and by promoting the DNA synthesis. Flavonoids also known to promote the wound-healing process mainly due to their astringent and anti-microbial property, which seems to be responsible for wound contraction and increased rate of epithelialisation[40-43].

Saponins- Saponins are effective due to their anti-oxidant and anti-microbial activity, which appears to be responsible for wound contraction and elevated rate of epithelialization[40,41,44].

Sterols & Poly phenols- Sterols & Poly phenols are responsible for wound healing due to their free radical scavenging and anti-oxidant activity, which are known to reduce lipid per oxidation, thereby reduce cell necrosis and improving vascularity[40,41,45].

Tri-terpenoids- Promote wound healing due to their astringent and anti-microbial property which seems to be responsible for wound contraction and increased rate of epithelialisation[40,41,46].

HERBAL REMEDIES FOR HEALING OF WOUNDS

Ayurveda, the Indian traditional system of medicine, is based on the empirical knowledge of the observations and experience over millennia. More than 1200 diseases are mentioned in different Ayurvedic texts. Management in various forms of these diseases is made with more than 1000 medicinal plants (89.93%); 58 minerals, metals or ores (5.24%) and 54 animal and marine products (4.86%) [47]. It has been estimated that 70% of the wound healing ayurvedic drugs are of plant origin, 20% of mineral origin and the remaining 10% consisting of animal products. The process of wound healing is promoted by several natural products as discussed above. These agents usually influence one or more phase of the healing process and are also involved in disinfection, debridement and providing a moist environment to encourage the establishment of a suitable environment for the natural healing process[48].

Plants or chemical entities derived from plants need to be identified and formulated for treatment and management of wounds. In this direction a number of herbal products are being investigated at present. Various herbal products have been used in management and treatment of wounds over the years. Plants used traditionally as wound healing and also validated scientifically are tabulated in Table No.1.

Table 1: Scientifically validated Plants for Wound healing activity

S. No.	Plant	Part used	Extract	Model used	References
1.	*Acalypha langiana* (Euphorbiaceae)	Leaves	Aqueous	Excision	49
2.	*Acalypha indica* (Euphorbiaceae)	Whole plant	Ethanolic	Excision Incision	50
3.	*Achillea kellalensis* (Compositae)	Flowers	Aqueous	Excision	51
4.	*Achillea biebersteinii* Afan. (Asteraceae)	Aerial parts	Methanolic	Excision Incision	52
5.	*Achillea millefolium* (Asteraceae)	Aerial parts	Hydroalcoholic	----	53
6.	*Acorus calamus* (Acoraceae)	Leaves	Ethanolic	Excision Incision Dead space	54
7.	*Adhatoda vasica* (Acanthaceae)	Leaves	Methanolic	Excision	55
8.	*Aegle marmelos* (Rutaceae)	Seeds	Methanolic	Excision Incision	56
9.	*Ageratum conyzoides* (Asteraceae)	Leaves	Aqueous	Excision	57
10.	*Alangium salvifolium* (Alangiaceae)	Leaves	Ethanolic	Excision Incision Dead space	58
11.	*Allamanda cathartica* (Apocynaceae)	Leaves	Aqueous	Excision Incision	59
12.	*Allium cepa* (Liliaceae)	Bulbs	Chloroform Alcohol	Excision Incision Dead space	60
13.	*Aloe ferox* (Liliaceae)	Leaves	Juice	Excision	61
14.	*Alternanthera brasiliana* Kuntz (*Amaranthacea*)	Leaves	Methanolic	Excision Incision	62
15.	*Alternanthera sessilis* (Amaranthaceae)	Leaves	Pet.ether Chloroform	Excision	63
16.	*Andrographis paniculata* (Acanthaceae)	Whole Plant	Alcoholic Pet.ether	Excision	64
17.	*Anogeissus latifolia* (Combretaceae)	Bark	Ethanolic extract	Excision Incision	65
18.	*Anthocleista djalonensis* (Loganiaceae)	Roots	Methanolic	----	66
19.	*Areca catechu* (Areaceae)	Nuts	Alcoholic	Excision Dead space	67
20.	*Argemone mexicana* Linn (Papaveraceae)	Leaves	Ethanolic	Excision Incision Dead space	68
21.	*Argyreia nervosa* (Convolvulaceae)	Leaves	Ethanolic	Excision	69
22.	*Arisaema leschenaultii* Blume (Araceae)	Tubers	Ethanol	Excision Incision Dead space	70
23.	*Aristolochia bracteolate* (Aristolochiaceae)	Leaves	Ethanolic	Excision Incision Dead space	71
24.	*Arrabidaea chica* Verlot (Bignoniaceae)	Leaves	Ethanolic	Excision	72
25.	*Arnebia densiflora* (Nordm.) Ledeb. (*Boraginaceae*)	Roots	Extract in olive oil	Excision Incision	73
26.	*Asparagus racemosus* Wild. (Liliaceae)	Roots	Aqueous	Excision Incision	74
27.	*Astilbe thunbergii* (Saxifragaceae)	Rhizomes	Ethyl acetate Ethanolic	Excision	75
28.	*Azadirachta indica* (Meliaceae)	Twigs	Oil	Excision Incision Dead space	76
29.	*Berberis lyceum* Royle (*Berberidaceae*)	Roots	Aqueous Methanolic	Excision Incision Dead space	77
30.	*Blechanum orientale* (Blechnaceae)	Leaves	Aqueous	Incision	78
31.	*Brassica juncea* Linn(Brassicaceae)	Leaves	Aqueous	Excision	79
32.	*Bryophyllum pinnatum* (Crassulaceae)	Leaves	Alcoholic	Excision	80
33.	*Buchanania lanzan* (Anacardiaceae)	Fruits	Ethanolic	Excision Incision Dead space	81
34.	*Buddleja globosa* (Buddlejaceae)	Leaves	Aqueous Ethanolic	Excision	82
35.	*Butea monosperma* (Fabaceae)	Barks	Alcoholic	Excision	83
36.	*Calendula officinalis* (Asteraceae)	Flowers	-------	Excision	84
37.	*Calotropis gigantea* (Apocynaceae)	Latex Leaves	Methanolic	Excision Incision	85
38.	*Calotropis procera* (Asclepidiaceae)	Latex	----	Dermal wound	86
39.	*Canthium parviflorum* lam. (Rubiaceae)	Leaves	Ethanolic	----	87
40.	*Carallia brachiata* Merrill (*Rhizophoracea*)	Bark	Pet.ether, Ethylacetate Methanolic	Excision Incision	88
41.	*Carica candamarcensis* (Caricaceae)	Fruits	----	Excision	89
42.	*Carica papaya* Linn. (Caricaceae)	Roots	Aqueous	Excision Incision	90
43.	*Caryocar cariaceum* (Caryocaraceae)	Seeds	Fixed oil	Excision	91
44.	*Cassia fistula* (Fabaceae)	Leaves	Alcohol	Excision Dead space	92
45.	*Cassia occidentalis* (Fabaceae)	Leaves	Methanolic	Excision Incision Dead space	93
46.	*Catharanthus roseus* (Apocynaceae)	Leaves	Ethanolic	Excision Dead space	94
47.	*Centaurea sadleriana* Janka (Asteraceae)	Aerial parts	n-hexane fractionof methanolic extract	Excision	95
48.	*Centella asiatica* (Apiaceae)	Leaves	Hydro alcholic	Excision Burn wound	96
49.	*Centraurea iberica* (Loranthaceae)	Aerial parts	Ethanolic	Excision Incision	97
50.	*Cecropia peltata* L. (*Cecropiaceae*)	Leaves	Ethanolic Aqueous	Excision	98

51.	*Chromolaena odorata* Linn. (Asteraceaes)	Leaves	Ethanolic Aqueous	Excision	99
52.	*Cinnamomum zeylanicum* (Lauraceae)	Barks	Methanolic	Excision Incision Dead space	100
53.	*Clerodendron splendens* (Verbenaceae)	Aerial parts	Methanolic	Excision Incision Dead space	101
54.	*Colebrookea oppositifola* (Lamiaceae)	Leaves	Alcoholic	Excision Incision	102
55.	*Colutea cilicica* (Fabaceae)	Fruits Leaves	Aqueous	Excision Incision	103
56.	*Copaifera longsdorffi* (Fabaceae)	Barks	Oleo-resin	Excision Incision	104
57.	*Coronopus didynamous* (Brassicaceae)	whole plant	Ethanolic Aqueous	Incision	105
58.	*Cordia dichotoma* (Boraginaceae)	Fruit	Alcoholic	Excision Incision Dead space	106
59.	*Crataeva nurvala* (Capparidaceae)	Root Barks	Ethanolic	Excision Incision Dead space	107
60.	*Croton bonplandianum* Baill (Euphorbiaceae)	Leaves	Ethanolic	Excision	108
61.	*Curcuma aromatica* (Zingiberaceae)	Rhizome, Leaves	Aqueous Ethanolic	Excision	109 110
62.	*Curculigo orchioids* (Hypoxidaceae)	Root	Methanolic	Excision	111
63.	*Cyperus rotundus* (Cyperaceae)	Leaves	Alcoholic	Excision Incision Dead space	112
64.	*Datura alba* (Solanaceae)	Leaves	Alcoholic	Excision Dead space Burn wound	113
65.	*Dendrophthae falcate* (Loranthaceae)	Aerial parts	Ethanolic	Excision Incision	114
66.	*Dissotis theifolia* (Melastomataceae)	Stem	Methanolic	Excision	115
67.	*Desmodium triquetrum* (Fabaceae)	Leaves	Ethanolic	Excision Incision	116
68.	*Echinacea pallida* (Asteraceae)	Leaves	Alcoholic	Excision	117
69.	*Echinops echinatus* (Asteraceae)	Roots	Ethanolic Aqueous	Excision Incision Dead space	118
70.	*Elaeis guineensis* (Palmae)	Leaves	Methanolic	Excision	119
71.	*Elephantopus scaber* (Asteraceae)	Leaves	Ethanolic	Excision Incision Dead space	120
72.	*Embelia ribes* (Myrsinaceae)	Leaves	Ethanolic	Excision Incision Dead space	121
73.	*Eucalyptus globulus* (Myrtaceae)	Leaves	Ethanolic	Excision Incision Dead space	122
74.	*Euphorbea heterophylla* (Euphorbiaceae)	Leaves	Ethanolic	Excision	123
75.	*Euphorbia neriifolia* (Euphorbiaceae)	Latex	Aqueous	Excision	124
76.	*Evolvulus numularius* (Convolvulaceae)	Leaves	Methanolic Aqueous	Excision	125
77.	*Ficus bengalensis* (Moraceae)	Barks	Ethanolic Aqueous	Excision Incision	126
78.	*Ficus religlosa* (Moraceae)	Leaves	Hydro-alcoholic	Excision Incision	127
79.	*Ficus deltoidea* (Moraceae)	Whole plant	Aqueous	Excision	128
80.	*Flabellaria paniculata* (Malphighiaceae)	Leaves	Methanolic Chloroform	Excision	129
81.	*Flaveria trinervia* (Asteraceae)	Leaves	Methanolic	Excision	130
82.	*Gentiana lutea* (Gentianaceae)	Rhizomes	Alcoholic Pet.ether	Excision Incision Dead space	131
83.	*Glyceyrrhiza glabra* (Fabaceae)	Roots	Oil	Excision	132
84.	*Glycosmis* arborea (Rutaceae)	Leaves	Ethanolic	Excision Incision	133
85.	*Gmelina arborea* Roxb. (Verbenaceae)	Leaves	Ethanolic	Excision Incision Dead space	134
86.	Gymnema sylvestre R.Br (Asteraceae)	Leaves	Ethanolic	Excision Burn wound	135
87.	*Heliotropium indicum* (Boraginaceae)	Leaves	Ethanolic Aqueous	Excision Incision	50, 136
88.	*Hemigraphis colorata* (Acanthaceae)	Leaves	----	Excision	137
89.	*Hibiscus rosa sinensis* L. (Malvaceae)	Flowers	Ethanolic	Excision Incision Dead space	138
90.	*Hippophae rhamnoides* (Elaeagnaceae)	Leaves	Aqueous	Excision Incision	139
91.	*Hoslundia opposita* (Lamiaceae)	Leaves	Methanolic	Excision Incision	140
92.	*Hylocereus undatus* (Cactaceae)	Leaves Fruits	Aqueous	Excision Incision	141
93.	*Hypericum hookerianum* (Clusiaceae)	Leaves Stems	Methanolic	Excision	142
94.	*Hypericum mysorense* (Guttiferae)	Leaves	Methanolic	Excision Incision	143
95.	*Hypericum patulum* (Hypericaceae)	Leaves	Methanolic	Excision Incision Dead space	144
96.	*Hyptis suaveolens* (Lamiaceae)	Leaves	Chloroform Pet.ether Alcoholic	Excision Incision Dead space	145
97.	*Indigofera enneaphylla* (Leguminosae)	Aerial parts	Alcoholic	Excision Incision	146
98.	*Ixora coccinea*	Flower	Alcohol	Dead space	147

	(Rubiaceae)				
99.	*Jasminum grandiflorum* (Oleaceae)	Flower	Ethanolic	Excision Incision Dead space	148
100.	*Jatropha curcas* (Euphorbiaceae)	Leaves	Methanolic	Excision Incision	149
101.	*Kaempferia galanga* (Zingiberaceae)	Rhizomes	Alcohol	Excision Incision Dead space	150
102.	*Kalanchoe pinnata* (Crassulaceae)	Leaves	Ethanolic	Excision	151
103.	*Lanata camara* (Verbenaceae*)*	Leaves	Ethanolic	Excision	152
104.	*Laurus nobilis* (Lauraceae)	Plant	Aqueous	Excision Incision	60
105.	*Lawsonia innermis* (Lythraceae)	Leaves	Pet. Ether	Excision Incision	153
106.	*Leucas hirta* (Lamiaceae)	Leaves	Aqueous Methanolic	Excision Incision Dead space	154
107.	*Limonia acidissima* (Rutaceae)	Fruit pulp	Hexane	Excision Incision Dead space	155
108.	*Lucas lavandulaefolia* (Labiatae)	Leaves	Methanolic	Excision Incision	156
109.	*Lycopodium serratum* (Lycopodiaceae)	Leaves	Ethanolic Aqueous	Excision Incision Dead space	157
110.	*Madhuca longifera* (Sapotaceae)	Leaves	Chloroform Ether	Excision Incision	158
111.	*Memecylon edule* (Melastomataceae)	Leaves	Methanolic	Excision Incision	159
112.	*Michelia champaca* (Magnoliaceae)	Plant	Aqueous	Excision Incision Dead space	160
113.	*Mimosa tenuiflora* (Fabaceae)	Barks	Aqueous	Excision	161
114.	*Mimosa pudica* (Fabaceae)	Roots	Methanolic Chloroform	Excision Incision Dead space	162
115.	*Mimusops elengi* Linn. (Sapotaceae)	Barks	Methanolic	Excision Incision Dead space	163
116.	*Momardica balsamina* (Cucurbitaceae)	Fruit pulp	Hexane Methanolic	Excision	164
117.	*Momordica charantia* (Cucurbitaceae)	Leaves	Benzene Ethanolic	Excision Incision	165
118.	*Morinda citrifolia* (Rubiaceae)	Leaves	Ethanolic	Excision Incision Dead space	166
119.	*Moringa oleifera* (Moringaceae)	Leaves Roots Bark	Aqueous	Excision	167
120.	*Mussaenda trondosa* (Rubiaceae)	Leaves	Alcoholic Aqueous	Excision Incision	168
121.	*Napoleona imperialis* (Lecythidaceae)	Leaves	Methanolic	Excision	169
122.	*Nelumbo nucifera* (Nymphaceae)	Rhizome	Methanolic	Excision Incision Dead space	170
123.	*Ocimum gratissimum* (Lamiaceae)	Leaves	Essential oil		171
124.	*Ocimum sanctum* (Labiatae)	Leaves	Methanolic	Excision Incision Dead space	172
125.	*Oncidium flexuosum* Sims (Orchidaceae)	Leaves	Hydro alcoholic	Incision	173
126.	*Onosma hispidum* (Boraginaceae)	Roots	Methanolic	Excision Incision Dead space	174
127.	*Oxalis corniculata* (Oxalidaceae)	Whole plant	Alcoholic Pet. ether	----	175
128.	*Pentas lanceolata* (Rubiaceae)	Flowers	Ethanolic	Excision	176
129.	*Phyllanthus niruri* (Euphorbiaceae)	Aerial parts	Methanolic	Excision Dead space	177
130.	*Piper betle* (Piperaceae)	Rhizome	Aqueous	Excision	135
131.	*Plagiochasma appendiculatum* Lehm.et Lind. (*Aytoniaceae*)	Leaves	Ethanolic	Excision Incision	178
132.	*Plantain banana* (Musaceae)	Fruits	Aqueous, Methanolic	Excision Incision Dead space	179
133.	*Plantago ovata* (Plantaginaceae)	Seeds	Ethanolic	Excision Incision	180
134.	*Plantago major* (Plantaginaceae)	Plant	Ethanolic	Excision	181
135.	*Plumbago zeylanicum* (Plumbaginaceae)	Plant	Ethanolic	Excision Incision	50
		Root	Methanol	Excision	182
136.	*Polyscias scutellaria* (Araliaceae)	Leaves	Chloroform	----	183
137.	*Portulaca oleracea* L. (Portulacaceae)	Aerial parts	Crude	----	184
138.	*Prosthechea michuacana* (Orchidaceae)	Bulbs, Aerial parts	Hexane Incision	Excision Incision	185
139.	*Psidium guajava* (Myrtaceae)	Leaves	Methanolic	Excision	67
140.	*Pterospermum acerifolium* Wild *(Malvaceae)*	Flowers	Ethanolic	Excision	186
141.	*Punica granatum* (Punicaceae)	Flowers	Ethanolic	Excision	51
142.	*Quercus infectoria* (Fagaceae)	Leaves	Ethanolic	Excision Incision Dead space	187
143.	*Radix paeoniae* (Paeoniaceae)	Roots	Aqueous	Excision Incision Dead space	188
144.	*Rafflesia hasseltii* (Rafflesiaeae)	Flowers	Methanolic	Induced wounds	189
145.	*Rheum officinale* (Asteraceae)	Roots	Ethanolic	Excision	190

146.	*Rhizophora mangle* (Rhizophoraceae)	Barks	Aqueous	Excision	191
147.	*Rosmarinus officinalis* (Lamiaceae)	Aerial parts	Aqueous Essential oils	Dead space	192
148.	*Rubia cardifolia* (Rubiaceae)	Roots	Alcoholic	Excision Incision	193
149.	*Rubus sanctus* (Rosaceae)	Aerial parts	Chloroform Hexane Methanolic	Excision Incision	194
150.	*Sambucus ebulus* (Caprifoliaceae)	Leaves	Methanolic	Excision incision	195
151.	*Sesamum indicum* (Pedaliaceae)	Seeds	Oil	Excision Incision	196
152.	*Sesbania grandiflora* Linn.(Leguminosae)	Flowers	Ethanolic	Excision Incision	197
153.	*Sida spinosa* (Malvaceae)	Leaves	Ethanolic	Excision Incision	198
154.	*Sphaeranthus indicus* Linn. (Asteraceae)	Aerial parts	Ethanolic	Excision	199
155.	*Swertia chirata* (Gentianaceae)	Root	Ethanolic	----	200
156.	*Tagetes erecta* Linn.(Asteraceae)	Leaves	Ethanolic	Excision Burnwound	137
157.	*Tephrosia purpurea* (Papilionaceae)	Aerial parts	Ethanolic	----	201
158.	*Terminalia arjuna* (Combreteaceae)	Bark	Ethanolic	Excision Incision	202
159.	*Terminalia bellirica* (*Combreteaceae*)	Fruit	Ethanolic	Excision Incision	203
160.	*Terminalia chebula* (Combretaceae)	Leaves	Alcohol	----	204
161.	*Toddalia asiatica* (Rutaceae)	Stem bark	Ethanolic Petroleum ether	----	205
162.	*Thespesia populnea* (*Malvaceae*)	Fruit	Aqueous	Excision Incision	206
163.	*Tragia involucrate* (Euphorbiaceae)	Roots, Leaves	Methanolic	----	207
164.	*Tridax procumbens* Linn. (Compositeae)	Whole plant	Aqueous	Dead space	208
165.	*Trigonella foenum-graecum* Linn. (Fabaceae)	Seed	Aqueous	Excision Incision Dead space	209
166.	*Vanda roxburghii* (Orchidaceae)	Whole plant	Aqueous	Excision Incision Dead space	210
167.	*Vernonia arborea* (Compositae)	Leaves	Methanolic	----	211
168.	*Vernonia scorpioides* (Asteraceae)	Leaves	Ethanolic	Excision	212
169.	*Vitex trifolia* (Verbenaceae)	Leaves	Ethanolic	Excision Incision Dead space	213
170.	*Wedelia calendulacea* Linn. (Asteraceae)	----------	Aqueous	Excision Incision	214
171.	*Ziziphus nummularia* Linn.(Rhamnaceae)	Leaves	Ethanolic	Excision	215

CONCLUSION

Wound healing is a biological process that begins with trauma and ends with scar formation. The goals of wound care include reducing the risk factor that inhibit wound healing; enhancing the healing process and lowering the incidence of wound infection. Many medicinal plants have immense potential for the management and treatment of wounds. These natural agents induce healing and regeneration of the lost tissue by various mechanism. The medicinal property of these plants lies in bioactive constituents that produce definite physiological action on the human body. For the discovery of these bioactive principles more efforts are required to be made. This can be accomplished through phyto-chemical screening for identification of active constituents; the structure of those then can be elucidated and co-related with the biological activity. Combining the traditional and modern knowledge can lead to development of better drugs for wound healing with fewer side effects.

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