

Formulated Phytomolecules for Wound Healing Activities: A Review

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Abstract:

In ancient times various medicinal plants were used for wound healing as well as other diseases. In such way, now many medicinal plants are subjected to show the wound healing properties. The medicinal plant shows wound potential via activation of NF-Kb, favoring pro-inflammatory cytokines, increased expression of inducible nitric oxide synthase, alpha 1 and 1 collagen, anti-oxidant activity and angiogenesis. The present review is about the treatment of cuts and wounds includes the usage of plants and the plant extract. The extracts are taken from the plants and their explants by using different solvents (water, ethanol etc) and by using different techniques (infusion, decoction, percolation etc). Many studies were conducted to evaluate the extract of plants for wound healing properties. Wound healing process can be classified into two class, they are basic science aspect of wound healing and practical aspect wound healing. The basic science aspect of wound healing deals with the four phases of wound healing and the practical aspect of wound healing are subdivided into acute and chronic wounds. This review validate the traditional claims and development of safe, effective and globally accepted medicinal plants for cuts and wounds. From this, we report various medicinal plant that can be used as wound healing agent around the world.

Key words: Herbal Phytomolecules, Formulation, Wound healing,

Introduction

The survival of human beings need the medicinal plants in many ways. In worldwide, there are 35000 to 70000 of medicinal plant species, in those 7500 plant species are grown in India. From this medicinal plants, many of them shows wound healing activities in several types of wounds. Skin is the largest organ of the body and act as a barrier which contains 3 layers such as Epidermis (outermost layer of skin), Dermis (underlying connective tissue of skin) and Hypodermis (a subcutaneous layer composed of adipose tissue). Skin also known as cutis or integument. Wound is a rapid onset of injury which breaks the skin or other parts of body include tissues. It is either physical or figurative. It is commonly happened because of an accident, but also sutures, surgery and stitches can cause wounds. Wound can be classified as Incised wound (a cut caused by sharp edge), Laceration (a wound caused by crushing force or tearing), Abrasion (a wound caused by scraping force or friction), Puncture (a wound caused by sharp, stabbing object) and others such as acute wound, closed wound, open wound, penetration wound, gunshot wound, chronic wound etc.



DIABETIC WOUND

PUNCHUR WOUND

CUT WOUND

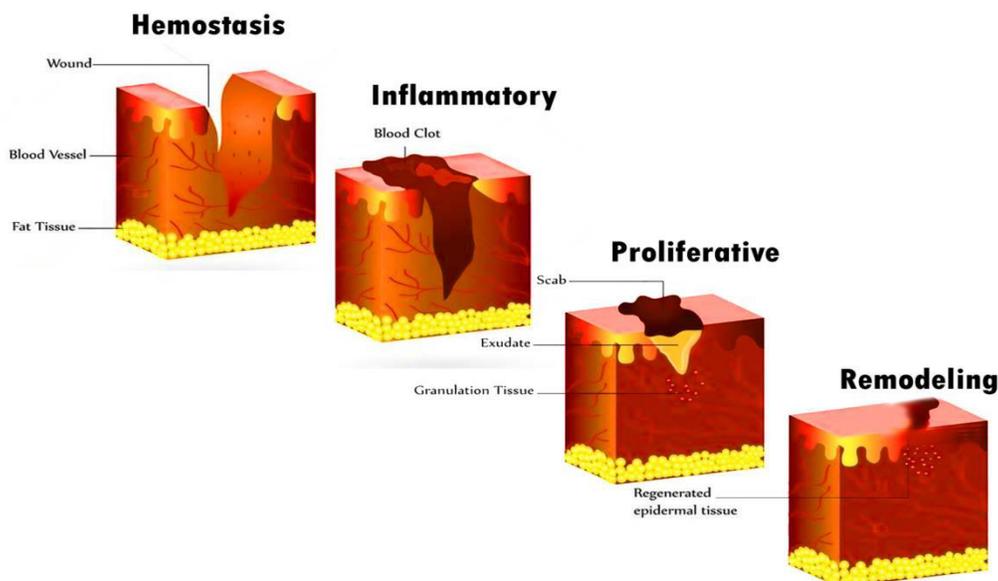
BURN WOUND

Healing of wounds

Generally, the wounds heal within 4 to 6 weeks by cells regeneration and with the help of blood clotting factors, and without using any medicaments. But the chronic wounds are failed to heal within the timeframe. These wounds was healed only by medicament. The wound healing occurs in four phases such as haemostasis phase, inflammation phase, proliferation phase and remodeling phase.

1. Haemostasis: In this stage formation of clots occurs to stop the bleeding.
2. Inflammation: In this phase the wound exudates and become swell, warm and reddish in colour.
3. Proliferation: In this phase many cells are accumulated together and profuse to form new tissue.
4. Remodelling: In this stage the wound gets fully closed and the formation scar occur.

WOUND HEALING



Formulated Phytomolecules For Wound Healing Activities:

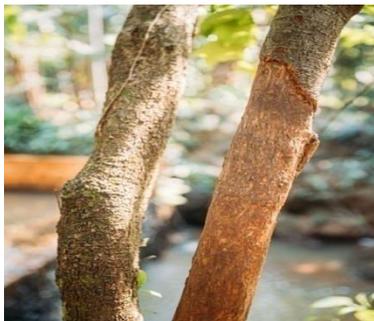
Many phytomolecules which are obtained from the medicinal plants have been reported to show the wound healing activity on several types of wounds. These phytomolecules are obtained from the medicinal plants and their explants by extraction process. The whole part of medicinal plant contain a many phytomolecules which has many uses. These medicinal plants synthesize many chemical compounds for various function such as defense and protection against microorganism, insects, and also for many diseases.

Calendula officinalis 	Biological name: Calendula officinalis	Parts of plant: Flower	Phytomolecules: Flavonoids
	Family : Asteraceae	Formulation: Ointment	Types of wounds: Cuts
Description: The Calendula officinalis has high quantity of flavonoids which helps to minimize the inflammation and speed up the healing process. ¹			
Camellia sinensis	Biological name: Camellia sinensis	Parts of plant: Leaves and leaf bud	Phytomolecules: Catechin, Phenolic compound and flavonoid
	Family : Theaceae	Formulation: Ointment	Types of wounds: Cuts

	<p>Description: The ointment formulated from the extract of green tea which shows the wound healing activity on post surgical wounds.²</p>
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<p>Cinnamomum verum</p> 	<p>Biological name: Cinnamomum verum</p> <p>Family : Lauraceae</p>	<p>Parts of plant: Bark</p> <p>Formulation: Cream and ointment</p>	<p>Phytomolecules: Cinnamaldehyde and quercetin</p> <p>Types of wound: Cuts and infected wounds</p>
<p>Description: Cinnamomum verum promotes the granulation tissue formation, balance the inflammatory cells infiltration and faster the process of wound healing.³</p>			
<p>Hypericum patulum</p> 	<p>Biological name: Hypericum patulum</p> <p>Family : Hypericaceae</p>	<p>Parts of plant: Leaf</p> <p>Formulation: Ointment</p>	<p>Phytomolecules: Flavonoids, terpenoids and steroid</p> <p>Types of wound: Excision wound and incision wound</p>
<p>Description: The wound healing property of the Hypericum patulum leaf extract may be as a result of the presence of mixture of phytomolecules which includes flavonoids, steroids and many others.⁴</p>			

<p>Catharanthus roseus</p>	<p>Biological name: Catharanthus roseus</p> <p>Family : Apocynaceae</p>	<p>Parts of plant: Leaf</p> <p>Formulation: Gel</p>	<p>Phytomolecules: Hydroxyproline</p> <p>Types of wound: Diabetic wounds</p>
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	<p>Description: The hydroxyproline content supports the management of wound healing and the wound contraction together by increasing the tensile strength.⁵</p>		
<p>Quercus infectoria</p> 	<p>Biological name: Quercus infectoria</p> <p>Family : Fagaceae</p>	<p>Parts of plant: Galls</p> <p>Formulation: Gel</p>	<p>Phytomolecules: Flavonoid and gallic acid</p> <p>Types of wound: Wounds and burns</p>
<p>Description: The wound healing efficacy of this plant is due to its action on antioxidant exzymes.⁶</p>			
<p>Sambucus ebulus</p> 	<p>Biological name: Sambucus ebulus L</p> <p>Family : Adoxaceae</p>	<p>Parts of plant: Leaves</p> <p>Formulation: Ointment</p>	<p>Phytomolecules: Quercetin 3-O-glucoside</p> <p>Types of wounds: Incision and excision wounds</p>
<p>Description: The wound healing effect of Sambucus ebulus is may due to the synergic effect of the phytomolecules present in the methanolic extract of this plant.⁷</p>			
<p>Cinnamomum zeylanicum</p> 	<p>Biological name: Cinnamomum zeylanicum</p> <p>Family : Lauraceae</p>	<p>Parts of plant: Bark</p> <p>Formulation: Gel</p>	<p>Phytomolecules: Volatile oil contains cinnamic aldehyde, eugenol and terpenes</p> <p>Types of wounds: Incision, excision and dead space wounds</p>
<p>Description: The ethanolic extract shows the crucial phases of healing such as collagagenation, wound contraction and epithelization.⁸</p>			
<p>Matricaria recutita</p>	<p>Biological name: Matricaria recutita</p>	<p>Parts of plant: Dried flowers</p>	<p>Phytomolecules: Hydroxyproline</p>

	Family : Asteraceae	Formulation: Gel	Types of wound: Incision wounds, excision wounds and dead space wounds
Description: The presence of hydroxyproline content support the use of the Matricaria recutita in the management of wound healing. ⁹			
Curcuma longa 	Biological name: Curcuma longa Family : Zingiberaceae	Parts of plant: Rhizome (root) Formulation: Nanoparticles	Phytomolecules: Curcumin and curcuminoid Types of wound: Wounds, cuts and burns
Description: Curcumin has powerful effect on wound healing and reduce the time needed for wound healing. ¹⁰			
Azadirachta indica 	Biological name: Azadirachta indica Family : Meliaceae	Parts of plant: Leaves Formulation: Gel	Phytomolecules: Nimbidin and sodium nimbidate Types of wound: Cuts and infective wounds
Description: The nimbidin and sodium nimbidate contains excellent nutrition which involves in the formation of collagen and new capillaries thus it speed up the process of wound healing. ¹¹			
Aloe vera 	Biological name: Aloe vera Family : Liliaceae	Parts of plant: Leaves Formulation: Ointment	Phytomolecules: Glucmannans Types of wound: Surgical wounds, diabetic foot ulcer and burns
Description: It supports the wound healing process by enhancing the activity of glycolytic enzyme and by delivering energy for cellular restoration. ¹²			

<p>Cleome viscosa</p> 	<p>Biological name: Cleome viscosa</p> <p>Family : Capparaceae</p>	<p>Parts of plant: Seeds</p> <p>Formulation: Ointment</p>	<p>Phytomolecules: Hydroxyproline and triterpenoid</p> <p>Types of wound: Incision wound and excision wound</p>
<p>Description: The wound healing activity of Cleome viscosa is depending on the hydroxyproline content present in it.¹³</p>			
<p>Clematis gouriana</p> 	<p>Biological name: Clematis gouriana</p> <p>Family : Ranunculaceae</p>	<p>Parts of plant: Leaves</p> <p>Formulation: Paste</p>	<p>Phytomolecules: Ursolic acid and hydroxyproline</p> <p>Types of wound: Purulent wounds</p>
<p>Description: The wound healing occurs by increasing weight of granulation tissue and tensile strength.¹⁴</p>			
<p>Blumea Balsamifera</p> 	<p>Biological name: Blumea balsamifera</p> <p>Family : Asteraceae</p>	<p>Parts of plant: Leaves</p> <p>Formulation: Gel and oil</p>	<p>Phytomolecules: Flavonoids and Terpenoids</p> <p>Types of wound: Incision Wounds</p>
<p>Description: The wound healing activities of Blumea balsamifera can improved the wound contraction and closure and the hydroxyproline content was increased the contraction of the wound healing.¹⁵</p>			
<p>Amaranthus Spinousus</p> 	<p>Biological name: Amaranthus spinosus</p> <p>Family : Amaranthaceae</p>	<p>Parts of plant: Root and leaves</p> <p>Formulation: Powder dosage form</p>	<p>Phytomolecules: Flavonoids,Saponins, Phenolics and Tannins.</p> <p>Types of wound: Excision wound.</p>
<p>Description: The Amaranthus spinosis of `root occurs wound healing properties. Various phytomolecules involved tannin is responsible for wound contraction in the medicinal plant.¹⁶</p>			

<p>Ficus racemosa</p> 	<p>Biological name: Ficus racemosa</p> <p>Family : Moraceae</p>	<p>Parts of plant: Bark and roots</p> <p>Formulation: Gel</p>	<p>Phytomolecules: Lupeol, beta sitosterol and lupeol acetate</p> <p>Types of wound: Incision wounds</p>
<p>Description: It enhance the effect of wound healing by enhancing the cell proliferation and prevent the microbial invasion.¹⁷</p>			
<p>Bambusa vulgaris</p> 	<p>Biological name: Bambusa vulgaris</p> <p>Family : Poaceae</p>	<p>Parts of plant: Leaves</p> <p>Formulation: Gel</p>	<p>Phytomolecules: Ascorbic acid, vit B2, flavonoid and phenolic compounds</p> <p>Types of wound: Excision wound and inflammatory disorder</p>
<p>Description: The phytomolecules can be beneficial in the process of wound healing.¹⁸</p>			
<p>Bryophyllum pinnatum</p> 	<p>Biological name: Bryophyllum pinnatum</p> <p>Family : Crassulaceae</p>	<p>Parts of plant: Leaves</p> <p>Formulation: Gel</p>	<p>Phytomolecules: Flavonoids and phenolic content</p> <p>Types of wound: Cuts and wounds</p>
<p>Description: It supports the healing of wounds by decrease in inflammatory infiltration and develops the new vessels.¹⁹</p>			
<p>Chloroxylon swietenia</p> 	<p>Biological name: Chloroxylon swietenia</p> <p>Family : Rutaceae</p>	<p>Parts of plant: Leaves</p> <p>Formulation: Ointment</p>	<p>Phytomolecules: Alpha pinene, sabinene and octan-3-ol</p> <p>Types of wound: Excision wounds</p>
<p>Description: It supports the wound healing process by the presence of phytomolecules.²⁰</p>			

<p>Eucalyptus</p> 	<p>Biological name: Eucalyptus</p> <p>Family : Myrtaceae</p>	<p>Parts of plant: Leaves</p>	<p>Phytomolecules: Phellandrene, beta eudesmol and luteolin</p>
<p>Formulation: Nanoemulsion</p>		<p>Types of wound: Boils, sores and cuts</p>	
<p>Description: The nanoemulsion of eucalyptus used to support the healing of various types of wounds.²¹</p>			
<p>Aegle marmelos</p> 	<p>Biological name: Aegle marmelos</p> <p>Family : Rutaceae</p>	<p>Parts of plant: Seeds</p>	<p>Phytomolecules: Aegeline, flavonoids and marmeline.</p>
<p>Formulation: Ointment</p>		<p>Types of wound: Wounds, boils and cuts</p>	
<p>Description: The substance like quercetin are mainly responsible for the healing of incision and excision wounds.²²</p>			
<p>Simmondsia chinensis</p> 	<p>Biological name: Simmondsia chinensis</p> <p>Family : Simmondsiaceae</p>	<p>Parts of plant: Seed</p>	<p>Phytomolecules: Liquid wax, sterol and vitamins</p>
<p>Formulation: Oil</p>		<p>Types of wound: Sun burn</p>	
<p>Description: In the scratch wound experiment it shows the activity of healing in various types of wounds.²³</p>			
<p>Lindera erythrocarpa</p>	<p>Biological name: Lindera erythrocarpa</p> <p>Family : Lauraceae</p>	<p>Parts of plant: Fruits</p>	<p>Phytomolecules: Lucidone</p>
<p>Formulation: Gel</p>		<p>Types of wound: Cuts and wounds</p>	

	<p>Description: Lucidone supports the wound healing process by preventing the free radicals induced oxidative stress and inflammation in human skin.²⁴</p>		
<p>Malva sylvestris</p> 	<p>Biological name: Malva sylvestris</p> <p>Family : Malvaceae</p>	<p>Parts of plant: Flowers</p> <p>Formulation: Ointment</p>	<p>Phytomolecules: Malvin, glycoside and folic acid</p> <p>Types of wound: Diabetic foot ulcer</p>
<p>Description: The malva sylvestris supports the wound healing by contraction of wounds.²⁵</p>			
<p>Punica granatum</p> 	<p>Biological name: Punica granatum</p> <p>Family : Punicaceae</p>	<p>Parts of plant: Flower</p> <p>Formulation: Ointment</p>	<p>Phytomolecules: Polyphenolic compounds and ellagic acid</p> <p>Types of wound: Diabetic wounds</p>
<p>Description: The punica granatum stimulate the contraction of wounds in the treatment of wound healing.²⁵</p>			
<p>Vitis vinifera</p> 	<p>Biological name: Vitis vinifera</p> <p>Family : Vitaceae</p>	<p>Parts of plant: Seed</p> <p>Formulation: Ointment</p>	<p>Phytomolecules: Flavonoids, tannins and catechin</p> <p>Types of wound: Burns</p>
<p>Description: Vitis vinifera showed the healing activity by enhancing TGF-Beta 1, VEGF, as well as Type 1 collagen.²⁶</p>			
<p>Euphorbia hirta</p>	<p>Biological name: Euphorbia hirta</p>	<p>Parts of plant: Whole plant</p>	<p>Phytomolecules: Flavonoids and tannins</p>

	Family : Euphorbiceae	Formulation: Cream	Types of wound: Burn wound
	Description: The cream of Euphorbia hirta manifested the wound healing activity with the use of euphorbia hinta plant. ²⁷		

Allium sativum 	Biological name: Allium sativum	Parts of plant: Garlic Bulb	Phytomolecules: Flavonoid, alliin and allicin
	Family : Liliaceae	Formulation: Jelly	Types of wound: Minor open wounds
Description: The plant part of garlic which combined with honey gives the jelly form to produce healing propertie of minor open wound. ²⁸			

Carica papaya 	Biological name: Carica papaya	Parts of plant: Fruits	Phytomolecules: Hydroxyproline
	Family : Cariaca papaya	Formulation: Tablet	Types of wound: Excision and dead space
Description: The fruit of carica papaya promotes the wound healing and extent of wound closure.The hydroxyproline content in wound is delayed to healing process. ²⁹			

Rosemary officianalis 	Biological name: Rosemary officianalis	Parts of plant: Flower	Phytomolecules: Flavonoids
	Family : Lamiaceae	Formulation: Gel	Types of wounds: Diabetic wound
Description: The flower part of Rosemary officianalis occurs in healing the diabetic wound and Gel formulation can reduce the inflammation,wound contraction and collagen disposition can be detected as wound healing treatment. ³⁰			

<p>Laurus nobilis</p> 	<p>Biological name: Laurus nobilis</p> <p>Family : Lauraceae</p>	<p>Parts of plant: Leaf</p> <p>Formulation: Gel</p>	<p>Phytomolecules: Flavonoids and Triterpenoids</p> <p>Types of wound: Incision and Excision wound</p>
<p>Description: Laurus nobilis in the leaf part shows the better wound healing properties. Various constituents flavonoids is responsible for wound contraction.³¹</p>			
<p>Glycyrrhizin glabra</p> 	<p>Biological name: Glycyrrhizin glabra</p> <p>Family: Fabaceae</p>	<p>Parts of plant: Root</p> <p>Formulation: Gel</p>	<p>Phytomolecules: Glycyrrhizin and thymoquinone</p> <p>Types of wound: Excision wound</p>
<p>Description: The root part can promote the wound healing activities through the inhibition of nitric oxide and accelerate wound closure.³²</p>			
<p>Fenugreek</p> 	<p>Biological name: Trigonella foenum graecum</p> <p>Family : Fabaceae</p>	<p>Parts of plant: Seed</p> <p>Formulation: Hydrogel</p>	<p>Phytomolecules: Flavonoids</p> <p>Types of wound: Incision and Excision wound</p>
<p>Description: The Trigonella foenum graecum contains the constituents flavonoids and triterpenoids shows the great wound healing activities and also have antimicrobial properties.³³</p>			
<p>Datura alba</p> 	<p>Biological name: Datura alba</p> <p>Family : Solanaceae</p>	<p>Parts of plant: Leaves</p> <p>Formulation: Ointment</p>	<p>Phytomolecules: Flavonoids, Alkaloids and Terpenoids</p> <p>Types of wound: Incision, Excision and Dead space model.</p>
<p>Description: The Datura alba of leaf part shows the wound contraction and wound healing activities.³⁴</p>			

Gmelina arborea 	Biological name: Gmelina arborea	Parts of plant: Leaves	Phytomolecules: Alkaloids,Flavonoid and hydroxyproline.
	Family : Lamiaceae	Formulation: Powder	Types of wound; Incision and excision.
	Description: The Gmelina arborea leaf part have the phytomolecules such as hydroxyproline, flavonoids is used for the treat the wound. ³⁵		

Centella asiatica 	Biological name: Centella asiatica	Parts of plant: Aerial parts	Phytomolecules: Triterpenoids and asiaticosides
	Family : Apiaceae	Formulation: Cream	Types of wound: Incision and excision wounds
	Description: Centella asiatica used in the treatment of both incision and excision wounds. ³⁶		

Juglans regia 	Biological name: Juglans regia	Parts of plant: Whole part	Phytomolecules: Phenolic coumpound
	Family : Juglandaceae	Formulation: Gel	Types of wound: Cuts and wound
	Description: The aim of juglans regia is used as a natural wound healers and also it have a anti-inflammatory activity. ³⁷		

Morinda citrifolia	Biological name: Morinda citrifolia	Parts of plant: Leaves	Phytomolecules: Hydroxyproline, tannis and flavanoids
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	Family : Rubiaceae	Formulation: Gel	Types of wound: Excision and dead space wounds
Description: Morinda citrifolia increase the contraction rate of wounds, epithelialization rate and weight of granulation tissue. ³⁸			
Impatiens balsamina 	Biological name: Impatiens balsamina Family : Balsaminaceae	Parts of plant: Leaves Formulation: Gel	Phytomolecules: Polyphenols and steroids Types of wound: External wound
Description: Impatiens balsamina used to reduce the inflammatory cells and wider the area of collagen when compared with the control. ³⁹			
Lawsonia alba 	Biological name: Lawsonia alba Family : Lythraceae	Parts of plant: Leaves Formulation: Ointment	Phytomolecules: Sterol, lawsone, tannins and proteis Types of wound: Excision wound
Description: The ointment of lawsonia alba shows the better wound healing property compare to the oral form. ⁴⁰			
Radix astragali 	Biological name: Radix astragali Family : Fabaceae	Parts of plant: Whole part of plant Formulation: Gel	Phytomolecules: Astragaloside, NF3 and calycosin Types of wound: Diabetic foot ulcer
Description: Radix astragali had NF3 (nitrogen trifluoride) herbal which promote the healing of diabetic foot ulcer. ⁴¹			
Tridax procumbens	Biological name: Tridax procumbens	Parts of plant: Whole plant	Phytomolecules: Hydroxyproline

	Family : Asteraceae	Formulation: Gel	Types of wound: Excision and incision wounds
Description: Tridax procumbens medicinal plant which contains hydroxyproline to enhance the granulation tissue in the in excision and incision wounds. ⁴²			
Vernonia arborea 	Biological name: Vernonia arborea Family : Asteraceae	Parts of plant: Bark Formulation: Ointment	Phytomolecules: Phenolic resin Types of wound: Excision, incision and dead space wounds
Description: The phytomolecules present in the bark of venonia arborea faster the wound healing activity. ⁴³			

Terminalia chebula 	Biological name: Terminalia chebula Family : Combretaceae	Parts of plant: Fruits Formulation: Ointment	Phytomolecules: Tannins Types of wound: Cutaneous wound
Description: The tannins extracted from the fruit of terminalia chebula enhance the healing of cutaneous wound in rats which shows angiogenic and anti-bacterial activity. ⁴⁴			

Conclusion:

There are several herbal medicinal plant in this world which contain many phytomolecules it deal with number of diseases and resolved. These medicinal plants are used traditionally and also by tribal people. The extract of plant was obtained by the extraction method such as soxhlets, percolation, maceration, decoction and etc. From the extract some formulations such as ointment, gel, nanoemulsion and others was formulated and evaluated. Many medicinal plants are proven to show the wound healing activities from that

we had investigated about some plants such as *Calendula officianalis*, *Camellia sinensis*, *Cinnamon verum*, *Hypericum patulum*, *Catharanthus roseus*, *Quercus infectoria*, *Sambucus ebulus*, *Cinnamomum zeylanicum*, *Matricaria recutita*, *Curcuma longa*, *Azadirachta indica*, *Aloe vera*, *Cleome viscosa*, *Clematis gouriana*, *Blumea balsamifera*, *Amaranthus spinosus*, *Ficus racemosa*, *Bambusa vulgaris*, *Bryophyllum pinnatum*, *Chloroxylon swietenia*, *Eucalyptus*, *Aegle marmelos*, *Simmondsia chinensis*, *Lindera erythrocarpa*, *Malva sylvestris*, *Punica granatum*, *Vitis vinifera*, *Euphorbia hirta*, *Allium sativum*, *Carica papaya*, *Rosemary officianalis*, *Laurus nobilis*, *Glycyrrhizin glabra*, *Trigonella foenum*, *Datura alba*, *Gmelina arborea*, *Centella asiatica*, *Juglans regia*, *Morinda citrifolia*, *Impatiens balsamina*, *Lawsonia alba*, *Radix astragali*, *Tridax procumbens*, *Vernonia arborea* and *Terminalia chebula*. The goal of our review work is to study about these plants and their phytomolecules and also their activities on several wounds. The results that we had studies from the below references are reported in our review work.

References:

1. *Bharga deka, Bedanta bhattacharjee, Anshul shakya, Abu Md ashif ikbal, chayanika goswami. Mechanism action of wound healing activity of Calendula officinalis: Pharmaceutical and biosciences journal volume 9(1), page no. 28-44, 2021.*
2. *Sayyed Yazden Asadi, Pouya Parsaei, Mehrdad karimi, Sareh ezzati, Alaleh zamiri, Fereshteh mohammadizadeh. Effect of green tea (camellia sinensis) extract on healing process of surgical wound in rat. International journal of surgery. Volume 11(2013), page no.332-337.*
3. *Sayed gharani seyadahmadi, mohammad R. Farahpour, Hamed hamishekar. Topical application of Chinnamon verum Eseential oil accelerates infected wound healing process by increasing tissue antioxidant capacity and keratin biosynthesis. Kaohsiung journal of medical 2019(35) page. No.686-694.*
4. *Pulok K, Mukherjee, Rob verpoorate, B.Suresh, Evaluation of in-vivo wound healing activity of Hypericum patuluam leaf extract on different wound model in rats. Journal of Ethanopharmacology 70(2000) pageno. 315-321.*
5. *B.S.Nayak, M.Anderson, L.M. Pinto Pereira. Evaluation of healing potential Catharanthus roseus leaf extract in Rats, Fitoterapia 78(2007) page no. 540-544.*
6. *SP Umachigi, KN Jayavera, CK Ashok kumar, GS Kumar, BM Vrushabedra swamy, DV Kishore kumar. Studies of wound healing properties of Quercus infectoria, Topical journal of pharmaceutical research, volume 7(1), 2008: page no 913-919.*
7. *Ipek pesin suntar, Esra kupeli akkol, Funda nuray yalcin, Ufuk koca, Hikmet keles, Erdem yesilada. Wound healing potential of Sambucus ebulus leaves and isolation of an active component, quercetin 3-0-glucoside. Journal of ethanopharmacology 129(2010), page.no.106-114.*
8. *Jagadish V.Kamath, A.C.Rana and Anirban roy chowdhury, Prohealing effect of cinnamomum zeylanicum bark. Phytotherapy research phytother research 17(2003), page no.970-972.*
9. *B.Shivananda nayak, S.Sivachandra raju, AV.Chalapathi rao. Wound Healing activity of Matricaria Recutita L., Extract, Journal of wound care,voume 16(7), page no.*
10. *Dania akbik, Maliheh Ghadiri, Wojciech chrzanowski, Ramin rohanizadeh. Journal of life sciences volume 116(2014) page no. 1-7.*
11. *Naveen kumar chundran, Ike rostikawati husen,Irrarubianti. Effect of Neem leaves extract on wound healing. Althea medical journal 2015;2(2). Page no. 199-203.*
12. *Muhammad jamil. Muhammad mansoor, noman latif, ridaa naz. Effect of aloe vera on wound healing. Pakistan journal of scientific and industrial research, March 2020, volume 63(1), page no. 48-61.*

13. Singh, S.Ali, N.A. Khan, A. Mishra. Wound Healing Potential of viscose L, seeds extract and isolation of active constituent. *South African journal of botany*, volume 112(2017), page.no. 460-465.
14. H.Raja naika, S.Bhavana, Jaime A. Teixeira da silva, K.Lingaraju, Vivek Chandra mohan, V.Krishna. In Silico and in-vivo wound healing studies of ursolic acid isolated from *Clematis gouriana* against GSK-3 beta. *Nusantara bioscience*, volume 8(2), November 2016, page no. 232-244.
15. Effect of volatile oil from *Blumea Balsamifera* (L.) DC. Wound healing in mice. *Journal of traditional Chinese medicine*, December 2014, volume 34(6), page no.716-724
16. Barku, V.Y.A.,Boye, A.,Adinortey, C.,Bobie-ansah, G. and Kwame-femi, E.K. Preliminary Phytochemical Screening, Anti-microbial examination & wound healing potential of the root extract of *Amaranthus spinosus*. *Journal of basic & applied sciences*, September 2014, volume 1(2), page no. 84-95.
17. Nisansala Swarnamali Bopage, G.M.Kamal Bandara Gunaherath, Kithsiri hector jayawardena, Sushila chandrani wijeyaratne, Ajita mahendra abeysekera and Seneviratne somaratne. Dual Function of Active constituents from bark of *Ficus racemosa*, in wound healing. *BMC Complementary and alternative medicine*, 2018, page no. 1-13.
18. Zahra ghanbarinasab, Mahnaz hosseini-bensenjan, Elaheh ziaei ziabari, Shiva aminnia, Roham borazjani, Mohammad rastegarian jahromi, Qasem asgari, Bahador sarkari, and Soheil ashkani-esfahani. Topical *Bambusa vulgaris* extract enhances wound healing in Cutaneous leishmaniasis. *Hindawi journal of pathogens*, volume 2021, page no. 1-4.
19. Edilane rodrigues dantas araujo, Jacinthia beatriz Xavier-santos, Valeria costa da silva, Juliana bessa figueiredo de lima, Jade schlamb, Matheus de freitas fernandes-pedrosa, Arnobio Antonio da silva junior, Thirumurugan rathinasabapathy, Marvin Mancada, Dibora Esposito, Gerlani Coelho bernardo Guerra and Silvana maria zucolotto. Gel formulated With *bryophyllum Pinnatum* Leaf extract promote skin wound healing in-vivo by increasing VEGF expression: A novel potential active ingredient for pharmaceuticals. *Frontiers in pharmacology*, January 2023, page no. 1-16.
20. D.Ramadevi, B.Ganga rao. In-vivo wound healing activity an leaf extract of *Chloroxylon swietenia* dc. *Journal of global trends in pharmaceutical sciences*. 2014, volume 5(3), page no.1930-1932.
21. Prawez alam, Faiyaz shakeel, Md Khalid anwer, Ahmed I. Foudah and Mohammed H.Alqarni. Wound healing study of *Eucalyptus* Essential oil containing nano emulsion in rat model. *Journal of oleo science*, 2018, volume 67(8), page no.957-968.
22. Ganesh N. Sharma, Susheel K. Dubey, Nitin sati, Jyotsana sanadya. Evaluation of Wound Healing Activity of *Aegli marmelos* seed., *Journal of Pharmacologyonline* 2, 2011, page no.171-178.
23. Elia ranzato. Wound healing propertis of *Jojoba* Liquid an in vitro study, *Journal of Ethanopharmacology*, 2011.
24. Hsin-ling yang, Yu-cheng tsai, Mallikarjuna korivi, Chia-ting chang, You-cheng hseu. The *Lucidone* promotes the Cutaneous wound healing process via activation of the PI3\AKT, Wnt\beta-catenin and NF-Kb signaling pathway. *Biochimica et biophysica acta* 1864, 2017, page no. 151-168.
25. Abdollah ghasemi pirabalout, Shaharзад azzizi, Abed Koohpayesh, Behzad hamedi, Wound healing activity of *malva sylvestris* and *punica granatum* in alloxan induced diabetic rats. *Acta poloniae pharmaceutica-drug research*, volume 67(5), page no. 511-516(2010).
26. Tarfah Al-Warhi, Eman maher zahran, Samy selim, Mohammad, Al-sanea, Mohammed M,Ghoneim. Sherif A. Maher, Yaser A. Mostafa; Antioxidantand woudhealing potential oF *vitis vinifera* seeds supported by phytochemical characterization and docking studies. *Antioxidants MDPI* volume 11(2022), page.no. 1-20.
27. Jaiprakash.B, Chandramohan, D.Narasimha reddy, Burn wound healing activity of *Euphorbia hirta*. *Ancient science of life*, volume 3&4(2006),page.no16-18.

28. K.Sidik, A.A. Mahmood and I.Salmah. Acceleration of wound healing from the aqueous extract of *Allium sativum* in the combination with honey on cutaneous wound healing in Rats. *International journal of medicine advanced sciences*, volume 2(2), Page .no.231-235(2006).
29. B.Shivananda nayak, Lexleypinto Pereira and dale Maharaj, *Indian journal of experimental biology*, volume 45, page.no. 739-743(2007).
30. Keyvan Khezri, Mohammed Reza Farahpour & Shokoofeh Mounesi Rad. Accelerated infected wound healing by topical application of encapsulated rosemary essential oil into nanostructured lipid carriers. *Artificial Cell, Nano-medicine & Biotechnology an international journal*, volume 47(2019) page no. 980-988.
31. Sivananda Nayak, Porna nalabothu, stive sandiford, Vidyasagar boogadi and Andrew adogwa. Evaluation of wound healing Activity of *Alamanda cathartica* Lin., and *Laurus nobilis* L. extract on Rats. *BMC complementary and alternative medicine* volume 6, issue 12, page no.1-6.
32. Metar siriwattanasatorn, Arunporn itharat, Pakakrong thongdeeying, and Buncha ooraiikul. In vitro wound healing activity of three most commonly used Thai medicinal plants and their three markers. *Journal of Hindawi Evidence-based complementary and alternative medicine*, volume 2020, page no.1-11
33. A.D.Taranalli, I.J. Kuppast. Study Of wound healing activity of seeds of *Trigonella foenum graecum* in rats. *Indian journal of pharmaceutical science*, volume 58(3), 1996, page no.117-119
34. K.Shanmuga priya, A. Gnanamani, N. Radhakrishnan, Mary babu. Healing potential of *Datura alBa* In burn wounds in albino rats. *Journal of Ethanopharmacology*, volume 83, 2002, page no.193-199.
35. Bhagyalakshmi chengattu prakashbabu, Deepthi vijay, Saju George, Sameer kodiyl, Suresh narayanan nair, Ajithkumar karaparambil gopalan, Sanis Juliet and Reghu ravindran. Wound Healing and antiinflammatory activity in methanolic extract of *Gmelina arborea* and *Hemigraphis colorata* in rats. *International journal of current microbiology and applied sciences*, volume 6 number 8, 2017, page no.3116-3122.
36. N.S. Jagtap, S.S.Khadabadi, I.A. Farooqui, V.P. Nalamwar, H.A. Sawarkar. Development & Evaluation of herbal wound healing formulation: *International journal of harmTech research*, volume 1, December 2009, page no. 1104-1108.
37. Mohammad amir qureshi, Fehmeeda khatoon, and Shakeel ahmed. A overview on wounds their issues & natural remedies for wound healing. *Biochemistry and Physiology*, volume 4, issue 3 (2015), page no .1-9.
38. B. Shivananda nayak, Steve sandiford, and Anderson Maxwell. Evaluation of the wound healing activity in ethanolic extract of *Morinda citrifolia* L..., leaf. *Advance access publication*, volume 6(3), October 2007, page no. 351-356.
39. Hariyanto IH, Inarah fajriaty, Tanto wijaya, Muhammad hafizh. The Potential Ethnomedicine Plant of *Impatiens balsamina* leafes from Pontianak, West Kalimantan, Indonesia for wound healing. *Nusantara bioscience*, volume 2, number 1, February 2018, page no.58-64.
40. S.A.Mandawgade and Kalpana S.Patil. Wound healing potential of some active principles of *Lawsonia alba* leaves. *Indian journal of pharmaceutical sciences*, volume 65(4) 2003, page no.390-394.
41. Jacqueline chorwing tam, Kit man lau, Cheuk lun liu, Ming ho to, Hin fai kwo, Kwok kin lai, Ching po lau, Chun hay ko, Ping chung leung, Kwok pui fung, Clara bik san lau. The in-vivo and in-vitro diabetic wound healing effects of a 2-herb formula and its mechanisms of action. *Journal of ethnopharmacology*, volume 134 (2011), Page no.831-838
42. Yogesh p talekar, Biswadeep das, Tania paul, Deepaliy talekar, Kishori g apte, Pradeep B Parab. Evaluation on wound healing potential in aqueous and ethanolic extracts of *tridax procumbens* linn. in wistar rat. *Asian journal of pharmaceutical and clinical research*, volume 5(4) 2012, page no. 141-145.

43. D.Pradhan, P K Panda and G Tripathy. Wound healing activity of aqueous and methanolic bark extracts of *vernonia arborea buch.-ham.* in wistar rats. *Natural product radiance*, volume 8 (1) 2009, page no.6-11
44. Kun lee, Yunpeng Diao, Houli Zhang, Shouyu Wang, Zhen zhang, Bo yu, Shanshan huang and Hong yang. Tannin extrats from immature fruits of *terminalia chebula fructusrettz.* Promote cutaneous wound healingin rats. *Complementary and alternative medicine*, volume 11, issue 86(2011), page no. 1-9.
45. B.Kumar, M.Vijayakumar, R.Govindarajan, P.Pushpangadan. Ethno-pharmacological approaches of wound healing-exploring medicinal plants of india. *Journal of ethnopharmacology*, volume 114 (2007), page no. 103-113.
46. K.F.Chah, C.A.Eze, C.E. Emuelosi, C.O.Esimone. Anti-bacterial & wound healing properties of methanolic extracts of some Nigerian medicinal plants. *Journal of ethnopharmacology*, volume 104 (2006), page no. 164-167.
47. Sayeed mohammed firdous and Dippayan sautya. Medicinal Plants foR wound healing Potential. *A Journal of the Bangladesh Pharmacological society*, volume 13 (2018), page no. 41-52.
48. Akshay Sharma, Suryamani khanna, Gaganjot kaur and Inderbir sing. The medicinal plants & their components for wound healing applications. *Future journal of pharmaceutical sciences*, volume 7, issue 53 (2021), page no. 1-13.