**Medicinal Plants with Antibacterial and Wound Healing Activity: A Review**

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**Abstract**

The rising prevalence of drug-resistant diseases necessitates the identification and isolation of novel bioactive components from medicinal plants utilizing standardized modern analytical methods. Understanding the molecular and cellular mechanisms that occur during normal wound healing has progressed significantly. Wound healing, whether accidental or surgical, necessitates the complex interactions of blood cells, tissues, soluble mediators, cytokines, and a plethora of growth factors. The fundamental goal of wound therapy is to either reduce the amount of time necessary for healing or to limit the negative outcomes. Because of the presence of various essential active phytoconstituents, plants have immense potential for wound management and therapy. Plants have a solid reputation in the field of wound management and repair due to their long history of use, low cost, and safety, but actual proof supporting their wound healing capabilities is lacking. Healing is a survival strategy that attempts to preserve normal anatomical structure and function. Phytochemicals are known to have potential antibacterial as well as wound healing activities against sensitive and resistant pathogens *via* different mechanisms of action. Furthermore, various challenges and problems must be overcome in order to generate new antimicrobials and wound healing characteristics from plant extracts, while efforts have been undertaken to improve the antibacterial and wound healing activity of chemical compounds. In this review, we attempted to provide insight into the various plants that have potential antibacterial and wound healing qualities that could be valuable in therapeutic treatment.

Keywords: Wound healing, antibacterial, phytochemicals, bioactive compounds, pathogens.

**Introduction**

Several natural products and plant products, which are composed of active principles, such as alkaloids and flavonoids and biomolecules 1 have been reported to have healing properties 2,3. Many plants utilized in traditional medicine are now included in the modern world's health care system. To date, more than 11,000 species of herbal plants are used medicinally, with roughly 500 of these commonly utilized in Asian and other countries 4,5. The World Health Organization (WHO) has long promoted traditional medicines as safe treatments for diseases of both microbial and non-microbial origin 6. According to WHO, 80% of the developing world still benefits from using traditional medicines derived from medicinal plants 7,8,9.

Although synthetic antimicrobial drugs have been approved in many countries, the use of natural chemicals derived from microbial, animal, or plant sources has piqued the interest of many researchers 10,11. These chemicals have shown promising benefits in combating antibiotic resistance in bacterial infections 12. Plant-derived chemicals are a diverse class of chemical substances found naturally in plants. Based on their chemical structures, they are divided into many primary classes, which include alkaloids, tannins, terpenoids, and polyphenols. The bioactive compound which promotes antibacterial and wound healing events can be therapeutically used to improve the antibacterial and wound healing activity.

Plants include a diverse range of phytochemicals that can be used to generate innovative drugs with specific biological effects 13. Antimicrobial resistance has emerged as a result of widespread, improper, irregular, and indiscriminate antibiotic use, rendering many currently available medicines useless 14,15,16. As a result, there is an increasing demand for the discovery of novel antimicrobial agents capable of reducing antibiotic use and combating resistance development. Researchers have been urged to isolate and identify novel bioactive chemicals from plants to combat microbial resistance 17,18,19,20. And, as current antimicrobials fail to treat infectious diseases, many researchers have turned to natural products as a source of new bioactive compounds 21,22. Furthermore, due to the ineffectiveness of some drugs, severe side effects, and the high cost of existing medications, there has been a growth in the use of medicinal plants as a treatment for human health in recent years, as well as a significant interest in pursuing therapies that are less aggressive to the human body 23.

**Antibacterial Activity**

Long before civilization realized the existence of microbes, it was widely accepted that certain plants had healing properties, that they contained what we now call antibacterial principles. Plants have been utilized to cure common infectious diseases since antiquity, and some of these ancient remedies are still used in the routine treatment of diverse disorders 24. Antimicrobial resistance is now a serious global issue. It happens when infectious organisms including bacteria, viruses, fungi, and parasites develop resistance to traditional treatment, posing a public health risk by spreading infectious diseases and creating massive worldwide economic losses due to food spoilage and crop damage 25,26. In order to combat antimicrobial resistance, researchers are increasingly interested in medicinal plants due to their great diversity of secondary metabolites and phytochemicals 27.

**Medicinal plants with antibacterial activity**

Extracts derived from medicinal plants have been shown to have a variety of biological actions, including antibacterial, anti-inflammatory, and antioxidant properties 28. Antimicrobial chemicals derived from medicinal plants may limit the growth of bacteria, fungus, viruses, and protozoa via mechanisms distinct from those utilized by currently available antimicrobials, and they may have significant clinical benefit in the treatment of resistant microbial strains 29. Chemically complex molecules have high therapeutic promise since they have fewer side effects than synthesized medications and have a low likelihood of developing resistance 30,31. Furthermore, the effectiveness of medicinal plant extracts in inhibiting bacterial growth is connected to the synergistic action of the extracts' active components 32. Medicinal plants contain a wide range of chemical components that have been shown *in vitro* to have antibacterial properties 33. Many investigations have shown that both natural and synthetic coumarin derivatives have antibacterial activity 34,35,36. Various scientifically evident plants used for management of antibacterial activity are given below:

**Acalypha indica Linn. (Euphorbiaceae):**

Acalypha indica Linn. is a common weed plant that has been used to cure pneumonia, asthma, rheumatism, and a variety of skin disorders. The presence of flavonoids, kaempferol, glycosides, mauritianin, ciltoria, and nictiflorin in Acalypha indica leaves and flowers resulted in antioxidant activity*.* Raja et al. demonstrated the antibacterial activity of aqueous and acetone extract of plant leaves 37.

***Ageratina adenophora***

Manandhar *et al,* confirmed that the methanolic extracts of *Ageratina adenophora* exhibited antibacterial activities against *Escherichia coli*, *Staphylococcus aureus Salmonela Typhi*, *Citrobacter koseri* and *Klebsiella pneumoniae* 38.

***Artemisia vulgaris***

Methanolic extracts of *Artemisia vulgaris* exhibited antibacterial activities against the five tested microorganisms like *Klebsiella pneumoniae*, *Escherichia coli*, *Salmonela Typhi*, *Staphylococcus aureus*, and *Citrobacter koseri*. This was demonstrated in the study done by Manandhar *et al* 38*.*

***Cinnamomum tamala***

The methanolic extracts of *Cinnamomum tamala* was experimented for its antibacterial activities against *Escherichia coli*, *Salmonela Typhi*, *Klebsiella pneumoniae*, *Staphylococcus aureus*, and *Citrobacter koseri*. The result showed that the extract possesses antibacterial activity against all the microorganisms used in the study 38.

***Ferulago campestris***

Basile *et al*. 39 discovered that some coumarins and pyranocoumarins which is isolated from the roots of *Ferulago campestris* shown substantial antibacterial action against both gram-positive and gram-negative bacteria. Particularly, aegelinol 40 and agasyllin 41 were more active against ATCC strains of *Enterobacter aerogenes*, *Staphylococcus aureu*s, *Salmonella enterica* and *Enterobacter cloacae* (MIC = 32 μg/mL for agasyllin and 16 μg/mL for aegelinol).

***Hypericum olympicum***

The primary components of *Hypericum olympicum* include E-anethole, farnesene, and spathulenol, with other components including E-caryophyllene, germacrene D, terpenes, and a new form of acylphloroglucinol. The crude methanol extract of *Hypericum olympicum* demonstrated a wide range of extremely potent antibacterial activity, with the maximum activity found against *Klebsiella pneumoniae* and *Salmonella enteritidis* 42.

***Ocimum kilimandscharicum***

*Ocimum kilimandscharicum* is an aromatic undershrub in the Laminaceae family with pubescent quadrangular branchlets. It is a traditional medicine used to treat a number of diseases such as cough, bronchitis, viral infections, anorexia, and wounds. According to Mahesh *et al,* it contains tannins, flavonoids, proteins, and other essential elements. Flavonoids have antioxidant and free radical scavenging properties, as well as wound healing and antibacterial properties 43.

***Oxalis corniculate***

The methanolic extracts of *Oxalis corniculate* was studied for its antimicrobial activities against different microorganisms which include *Citrobacter koseri,* *Escherichia coli*, *Salmonella Typhi*, *Staphylococcus aureus* and *Klebsiella pneumoniae* 38. And the result indicates that the methanolic extracts of *Oxalis corniculate* exhibit antimicrobial activities in all the tested microorganisms.

**Punica granatum**

Pomegranate (*Punica granatum*) consumption has increased due to its multifunctionality and nutritional benefits in the human diet, as it is high in bioactive compounds, particularly those belonging to the phenolic compound’s family, such as tannins and anthocyanins. Alexandre *et al. 44* observedthat the antioxidant activity and phenolic component concentration were shown to be highly associated to antimicrobial activity in a study of antimicrobial action on pomegranate peel extracts. As a result, high-pressure pomegranate peel extracts could be used to generate high-value bioactive compounds for antioxidant and antibacterial applications. Mostafa *et al.* 45 also investigated the antimicrobial activity of ethanolic extracts of Punica granatum and found that it is potentially effective with variable efficiency against the tested bacterial strains.

***Syzygium aromaticum***

For its antibacterial action, an ethanolic extract of *Syzygium aromaticum* proved possibly beneficial with varying effectiveness against the examined bacterial strains. In the study conducted by Pundir *et al.* 46 the ethanolic extracts of *Syzygium aromaticum* inhibited the development of all the examined food-associated bacteria, with the diameter of the zone of inhibition ranging from 25 to 32mm. It had the largest zone of inhibition diameter of 32mm against Escherichia coli, followed by Staphylococcus aureus (31mm) and Bacillus subtilis (30mm). The *Syzygium aromaticum* ethanolic extract showed similar zone of inhibition of 28 mm in diameter against Bacillus megaterium and Bacillus sphaericus. Sulieman *et al.* 47 also shown antibacterial activity of *Syzygium aromaticum* ethanolic extract against *Escherichia coli, Staphylococcus aureus*, and *Bacillus subtilis*, with the highest antibacterial activity against *Escherichia coli*. *Syzygium aromaticum* antibacterial effect is linked to the presence of eugenol (2 methoxy-4 allyl-phenol)48. Its high tannin content (10-19%) gives further antibacterial properties 49.

***Thymus vulgaris***

At a dosage of 10 mg/ml, Mostafa *et al.* 45 studied the antibacterial activity of *Thymus vulgaris*, which was possibly effective with varying efficiency against the tested bacterial strains.

**Ziziphus nummularia**

Zizyphus nummularia contains a high concentration of phytochemical substances, mainly cyclopeptide alkaloids. In 1983, one of the first investigations revealed the isolation of two new cyclopeptide alkaloids, nummularine-M and nummularine-N, as well as the existence of a dozen cyclopeptide alkaloids in the plant's root bark 50. Cyclopeptide alkaloids are natural macrocyclic molecules with intriguing chemical and biological properties that are abundant in the Rhamnaceae family, particularly in the *Ziziphus* genus 51,52. Beg *et al.* used several extraction solvents to assess the antibacterial activity of *Ziziphus nummularia* extracts from fruits, leaves, and bark against the gram-positive bacterium *Staphylococcus aureus* and the gram-negative strain *Escherichia coli*. 53. The results showed that the methanolic extract of the fruits, followed by hexane and chloroform extracts, had the strongest antibacterial activity against both of the tested strains; the aqueous extract of all plant sections had no antimicrobial activity 53. Interestingly, the fruit of the plant was shown to have significant antibacterial action against various gram-positive strains tested 54.

Another study found that the ethyl acetate and chloroform fractions of *Ziziphus nummularia* were efficient against both gram-positive and bacteria gram-negative, but the methanol and aqueous fractions had no activity against any of the microorganisms examined 55. Gautam *et al.* found that ethanolic and aqueous *Ziziphus nummularia* extracts had significant activity against *Staphylococcus aureus* and *Pseudomonas aeruginosa* but no activity against *Bacillus subtilis*, with the ethanolic extract being more active than the aqueous extract 56. Sharma *et al.* ascribed *Ziziphus nummularia's* antibacterial activity to the presence of flavonoids, alkaloids, saponins and glycosides in the plant's leaf extracts, indicating that leaf extracts could be a viable treatment for a variety of ailments 57.

These potentially effective plant extracts could be used as natural alternative preventives to control food poisoning illnesses and preserve food while avoiding the health concerns associated with the use of chemically antibacterial agents.

**WOUND HEALING**

Wounds are physical injuries that induce an opening or break in the skin, causing disruption in the normal architecture and function of the skin. They cause epithelial continuity loss, with or without loss of underlying connective tissue 58. Following an injury, the skin has an amazing ability to regenerate itself. Wound healing is a complex (but orderly) phenomenon that involves a number of processes such as wounding inducing an acute inflammatory process, regeneration of parenchymal cells, migration and proliferation of both parenchymal and connective tissue cells, synthesis of extracellular matrix proteins, connective tissue remodelling, and wound strength acquisition. Any changes to any of these processes can cause a delay in healing or even the inability to heal entirely 59.

According to current estimates, approximately 6 million people worldwide are affected by chronic wounds 60. Wound epidemiology research is extremely limited. Medical treatment of wounds comprises the injection of drugs either locally (topical) or systemically (oral or parenteral), or both, in an attempt to aid wound repair 61. Disinfectants, antiseptics, and antibiotics have a broad spectrum of non-selective antibacterial effect when administered topically 62. Topical antibiotics are frequently used in clinical settings in wounds, cuts, and burns to treat localized skin infections. However, overuse of topical antibiotics might result in consequences such as the development of resistant organisms 63. As a result, efforts should be aimed toward developing an agent that can expedite wound healing when it is normal or when it is hindered by various agents such as corticosteroids, anti-neoplastic, or non-steroidal anti-inflammatory drugs 64.

Cutaneous wound healing is a crucial physiological process that consist of the collaboration of a number of cell strains and their products 65. The target of thisliterature review is to highlight the biological processes that involved during the process of wound healing, which emphasize on the cells, growth factors, and cytokines that participate in the tissue repair process.

**Stages of wound healing**

**Inflammatory stage**- The lesioned blood vessels constrict and the released blood coagulates during a vascular inflammatory reaction, contributing to the vessel's integrity. Coagulation is the aggregation of thrombocytes and platelets in a fibrin network, which is dependent on the action of particular stimuli *via* the activation and aggregation of these cells 66. Inflammatory cells aid in wound healing by releasing lysosomal enzymes and reactive oxygen species, as well as facilitating the removal of different cell detritus 67.

**Proliferative stage**- The proliferative stage's goal is to reduce the lesioned tissue area by contraction and fibroplasia, thereby generating a viable epithelial barrier to activate keratinocytes. This stage is in charge of the lesion's closure, which involves angiogenesis, fibroplasia, and reepithelialisation. These processes begin in the lesion's microenvironment within the first 48 hours and can continue until the 14th day after the beginning of the lesion 68. Around four days after the injury, granulation tissue begins to grow. Its name derives from the granular appearance of newly created tissue, which imparts this property to the nascent stroma. According to Calin *et al.* 69 granulation tissue is formed *via* the following mechanisms: increased fibroblastic proliferation; collagenous and elastic biosynthesis, which results in the formation of a three-dimensional extracellular network of connective tissue; and fibroblast production of chemotactic factors and IFN-beta. Medrado *et al.* discovered that the wound contraction process begins at this stage, which is carried out by myofibroblasts, which are rich in alpha smooth muscle actin 70.

**Remodelling stage**- Remodelling is the third stage of healing, which begins two to three weeks after the onset of the lesion and can last a year or more. The remodelling stage's primary goal is to attain maximum tensile strength by extracellular matrix reconfiguration, breakdown, and resynthesis. In this final stage of lesion healing, an attempt is made to restore normal tissue structure, and the granulation tissue is gradually modified, resulting in scar tissue that is less cellular and vascular 71 and has a progressive rise in collagen fibre concentration.

**Medicinal plants with wound healing potential**

Traditional medicine has been called as an alternative medicine, phyto-medicine, complementary medicine, natural medicine, herbal medicine, non-conventional medicine, indigenous medicine, folk medicine, ethno medicine etc 72. It is estimated that 70% of wound healing Ayurvedic medications are plant-based, 20% are mineral-based, and the other 10% are animal-based 73.The following are the scientifically proven plants used for wound healing management:

**Acalypha indica Linn. (Euphorbiaceae):**

Acalypha indica L. is a weed plant that has been reported to be useful in treating asthma, pneumonia, rheumatism and several other skin ailments. The presence of flavonoids, kaempferol, glycosides, mauritianin, ciltoria, and nictiflorin in A. indica leaves and flowers resulted in antioxidant activity. The ethanolic extract of A. indica dried leaves has been used to treat bedsores and wounds 74,75.

***Ageratum conyzoides*:**

*Ageratum conyzoides*, a member of the Asteraceae family, is a prevalent weed known as goat weed and white weed. According to Chah *et al.'*s research, when the leaves are put to wounds, they function as an antiseptic and heal the wounds76.

***Aloe vera* Linn. (Liliaceae):**

Davis investigated the wound healing property of *Aloe vera*. *Aloe vera* Linn. (Liliaceae) is one of the world's oldest healing plants. Topically, it is used to treat cuts, burns, insect stings, bruises, acne and blemishes, poisoning, welts, skin lesions, eczema, and sunburns. Wound diameter was reduced by 62.5% in mice receiving 100 mg/kg/day oral *Aloe vera* and by 50.80% in animals receiving topical 25% *Aloe vera*. These findings indicate that *Aloe vera* is useful in wound healing. *Aloe vera* leaf contains vitamins C and E, as well as amino acids, which are necessary for wound healing 77.

***Anthocephalus cadamba* Roxb. (Rubiaceae):**

Triterpenes, saponins, indole alkaloids cadambine, 3adihydrocadambine, cadamine, isocadamine, and isodihydrocadambine are the main elements of the bark of *Anthocephalus cadamba* Roxb. (Rubiaceae). Umachigi *et al.* investigated wound healing activity and discovered that when hydro-alcoholic *Anthocephalus cadamba*ointment was applied, the epithelization period was reduced, as was the scar area. Tensile strength and hydroxyproline content both increased significantly. The crude hydro-alcoholic extract encouraged wound contraction substantially. As a result, the plant extract may be effective as a wound healing agent 78.

***Argemone mexicana* Linn.:**

Various extracts of *Argemone mexicana* Linn. (Family: Papaveraceae) leaves were tested for wound healing activities in rats using excision and incision wound models. The wound closure rate, period of epithelialization, skin breaking strength, weights of the granulation tissue, determination of hydroxyproline, superoxide dismutase (SOD), catalase, and histopathology of the granulation tissues were used to assess the effects of test samples on the rate of wound healing. For the activity comparison, Nitrofurazone (0.2% w/w) in Simple ointment I. P. was utilized as the reference standard. The study's findings revealed that rats treated with methanol and aqueous extracts of *A. mexicana* healed faster than those treated with other extracts. The chloroform extracts of the selected plants yielded encouraging results as well, but to a lower extent than the comparable methanol and aqueous extracts. The petroleum ether extract yielded no noteworthy findings. The wound healing potential of chloroform, methanol, and aqueous extracts may be attributed to the presence of phytoconstituents in the extracts such as alkaloids, triterpenoids, tannins, and flavonoids, which are known to promote wound healing due to their astringent, antioxidant, and antimicrobial properties. The current study supports the use of *A. mexicana* leaves for wound healing, as reported in folkloric literature 79.

***Arnebia densiflora*:**

*Arnebia densiflora* roots steeped in butter are used to treat local wounds. This plant's roots have been shown to contain alkannin derivatives such as dimethylacrylalkannin, teracrylalkannin, isovalerylalkannin, and methyl-n-butylalkannin. According to Kosger *et al.* rats given *Arnebia densiflora* healed faster than the control group. Wound closure and collagen production were accelerated, and healing occurred on the 14th day following injury80.

***Carica papaya* Linn.:**

*Carica papaya* Linn. is a member of the Caricaceae family. Azarkan *et al.* discovered that papaya fruit includes a combination of cysteine endopeptidases like papain. Chympopapain A and B, papaya endopeptidase II and IV, omega endopeptidase, chitinase, protease inhibitors, and proteins are all found in papaya. Due of the wound healing capabilities of papaya fruits, papaya latex was applied to the burn wound utilizing hydrogel as a carrier system81.

***Centella asiatica* (Linn.) Urban (Apiaceae):**

*Centella asiatica* commonly known as Asiatic Pennywort is an herbaceous, perennial plant belonging to the family Apiaceae is known as Brahmi in Unani medicine and Mandookaparni in Ayurvedic medicine system 82. Saponins containing triterpens, such as asiatic acid, madecassic acid, asiaticoside, and madecassoside, have been shown to be the most active therapeutic biomarker molecules in plants 83. A cream containing 1% *Centella asiatica* extract has been shown to promote chronic wound healing 84.  Shukla *et al*. investigated the wound healing activity of asiaticoside topical treatment in both normal and diabetic mice. The rate of wound healing in normal animals was dramatically accelerated due to an increase in collagen synthesis and wound tissue tensile strength 85.

Liu explored the effect of madecassoside on wound healing through a variety of mechanisms such as antioxidative activity, collagen synthesis, and angiogenesis 86.

***Curcuma longa* Linn.:**

*Curcuma longa* Linn. belonging to family Zingiberaceae, has been reported to possess antibacterial, antifungal and anti-inflammatory activities in the study by Rao. Rhizomes are employed, and it contains curumin (diferuloyl methane), turmeric oil or turmerol, and 1,7-bis, 6-hepta-diene-3, 5-dione. Curcumin contains anti-inflammatory and analgesic properties. *Curcuma longa* volatile oil has antibacterial and anti-inflammatory properties as well. *Curcuma longa* also includes protein, lipids, and vitamins (A, B, C, and so on), all of which aid in wound healing and regeneration. *Curcuma longa* has been used to treat wounds in rats87.

***Euphorbia nerrifolia*Linn. (Euphorbiaceae):**

*Euphorbia neriifolia* L. flourishes in north, central, and southern India 88. Bigonia *et al.* investigated the wound healing activity of *E. neriifolia* leaf in an excision and dead space wound model. Increased protein and hydroxyproline concentration in *E. neriifolia* improved wound contraction and epithelialization 89. Gour *et al.* also investigated the anti-inflammatory and analgesic properties of plant hydroalcoholic leaf extract and discover positive results 90.

***Ficus racemosa*Linn. (Moraceae):**

*Ficus racemosa* Linn. large deciduous tree scattered all over India specifically in north India 91. Murti *et al.* investigated the wound healing activities of an aqueous and an ethanolic extract of *F. racemosa* roots on an incision and excision wound model. Because of improved epithialialization and collagen formation, aqueous root extract increased the percentage closure 92.

***Helianthus annus* Linn.:**

*Helianthus annus* Linn. belonging to the family Asteraceae is an ornamental annual herb, with erect, rough and hairy stem commonly found in swampy areas. Tribals utilize the herb in traditional medicine to treat eye inflammation, sores, dysuria, colic, tiger bites, and bone fractures. Deshpande *et al.* found that using an alcoholic extract of the whole plant of *Helianthus annus* as an ointment to a rat's excised lesion resulted in a considerable reduction in total healing time. Histology verified this, as early fibroblast appearances were observed. Early emergence and increased build-up of mucopolysaccharides have been identified as indications of accelerated 93.

***Hygrophila auriculata:***

Dev & Roy 94 used an excision wound model to investigate the wound healing potential of the root of *Hygrophila auriculata* in Swiss albino mice. The animals in the study were separated into three groups of six (3 males and 3 females) apiece. Carboxymethyl cellulose (control) was applied topically to animals in group 1. Group 2 mice were given a reference medication (a positive control). Animals in Group 3 were given a root extract of *H. auriculata*. Healing was evaluated by measuring wound area, histomorphological observations, and protein and DNA content calculation. The results demonstrated that the extract-treated group had a smaller wound area than the control group. When compared to the control group, epithelialization was faster in the treated group. Protein and DNA levels were also higher in treated mice than in control mice. The extent of healing in the treated animals was equivalent to the positive control group. As a result, the findings indicate that the root of *H. auriculata* has wound healing capability.

***Kigelia pinnata:***

*Kigelia pinnata*, a member of the Bignoniaceae family, is a tiny tree found in South, Central, and West Africa, as well as India. According to Sharma *et al.* the bark has been pharmacologically established to have antiamoebic, antifungal, antiulcer, antibacterial, antioxidant, and wound healing properties95.

***Lantana camara* Linn. (Verbanaceae):**

*Lantana camara* Linn. (Verbanaceae), a shrub native to tropical America, has become entirely naturalized as an ornamental plant in many parts of India. According to Kurian's research, the herb contains abortifacient, antimalarial, anti-inflammatory, and wound healing qualities. Wound contraction has been aided by hydro-alcoholic extract and fresh juice of leaves96.

***Lawsonia inermis* Linn. (Lythraceae):**

The leaves of *Lawsonia inermis* Linn. (Lythraceae), sometimes known as henna, are used in the treatment of burns, skin inflammations, wounds, and ulcers as a decoction or ointment. The leaves have antifungal and antibacterial properties as well. Henna is said to contain the natural colour naphthaquinone, lawsone. Sakarkar *et al.* discovered that both oral ingestion and topical application of ethanol extract of henna leaves with lawsone resulted in a significant healing response in both wound models. Furthermore, it was discovered that topical application of ethanol extract as well as separated lawsone was more efficacious than oral administration. Thus, a topical application of ethanol extract for wound healing can be successfully developed 97.

***Morinda citrifolia***

In the study by Nayak, animals treated with *Morinda citrifolia* extract showed a considerable improvement in wound-healing activity when compared to those given placebo control treatments. When compared to control rats given normal water, the extract-treated animals demonstrated a faster decrease in wound size and a shorter time to epithelialisation 87.

***Napoleona imperialis:***

*Napoleona imperialis* belongs to the plant family Lecythidaceae. It is a tall, woody shrub found primarily in tropical rain forests. The leaf is used as an analgesic, tonic, anti-tussive, anti-asthmatic, and wound dressing on a local level. The numerous ointments made with *Napoleona imperialis* displayed a good wound healing effect in the study by Esimone *et al.,* a standard antibiotic used in wound healing98.

***Ocimum sanctum*Linn. (Labiaceae):**

*Ocimum sanctum* Linn., sometimes known as 'Tulsi,' is a widely spread plant in India and other areas of the world. It has anti-inflammatory, analgesic, immunostimulatory, free radical scavenging, and antibacterial properties. Plant flavonoids' free radical scavenging action aids in wound healing. Asha *et al*. evaluated the topical wound healing activity of aqueous extract of leaves of *O. sanctum* 99. Goel *et al*. used an excision wound model in wistar albino rats to investigate the wound healing activities of a cold aqueous extract of *O. sanctum* as well as its effect on tumor necrosis factor- (TNF-). Due to increased TNF- production, wound healing was reported to be faster in *O. sanctum* extract treated rats compared to the control group 100.

***Resina draconis:***

Huihui *et al.* 101 used excision and incision wound models in rats to evaluate the wound healing potential of *Resina draconis* (Dracaena cochinchinensis). The percentage of wound contraction, epithelialization period, histological examinations, and expression of vascular endothelial growth factor (VEGF) and transforming growth factor-1 (TGF-1) were all noted. The study provides a scientific basis for the traditional usage of *Resina draconis* in wound care.

***Rubia cordifolia* L:**

Karodi *et al.* 102investigated the wound healing activity of a crude extract of *Rubia cordifolia* L. (Indian madder) in mice. The alcoholic extract and its hydrogel were evaluated for their healing effectiveness on an excision wound model in mice, and the work provides a scientific explanation for the traditional usage of this plant in wound management. More *et al.* and Umachigi *et al.* also investigated the presence of anthraquinone glycosides, saponins, tannins, and phytosterols in an ethanol extract of *Rubia cordifolia*. Tannins and anthraquinones are the primary phyto-constituents found in this plant, and they may be responsible for wound healing 103,78.

***Tectona grandis* Linn.*:***

According to Majumdar *et al.* *Tectona grandis* Linn. It belongs to the Verabinaceae family and comprises primarily carbohydrates, tannins, and anthraquinone glycosides. It is used as an anti-inflammatory drug and topically for the treatment of burns. It is primarily used to treat burns, inflicted wounds, and skin ulcers. The extract, when applied topically or orally, increased breaking strength, wound contraction, and collegenation 104.

***Terminalia superba:***

Dougnon *et al.* 105 investigated the antibacterial and wound healing effects of *Terminalia superba* bark ethanolic extract. The ethanol extract's antibacterial activity and *in vivo* wound healing characteristics on infected lesions by reference strains of E. coli ATCC 25922 and Staphylococcus aureus ATCC 25923 in wistar rats were also examined. *T. superba's* antibacterial qualities contribute to the development of a better traditional medicine.

***Tridax procumbens* Linn. (Asteraceae):**

*Tridax procumbens* Linn. (Asteraceae) is a tropical American native that has become naturalized in tropical Africa, Australia, and Asia, including India. According to Diwan *et al.* the leaf of *Tridax procumbens* includes primarily crude protein, crude fiber (17%), soluble carbohydrate (39%), and calcium oxide (5%). Villagers use the juice of this plant's leaves to stop bleeding from cuts and bruises in animals. This juice speeds up two phases of healing: epithelialization and collagenization, but it slows scar formation and granulation 106.

***Wedelia chinensis*:**

*Wedelia chinensis* Merrill (Syn. Wedelia calendulaceae) (Asteraceae) is a well-known herbal remedy in both the Ayurvedic and Unani systems of medicine. Verma *et al*. 107 investigated the wound healing efficiency of *Wedelia chinensis* ethanolic leaf extract in excision, incision, and dead space wound models. When compared to control treatments, mice treated with *Wedelia chinensis* extract shown a substantial increase in wound-healing activity. *Wedelia chinensis'* wound-healing property may be related to the phytoconstituents present in the plant, and the faster wound healing process may be a product of either the individual or additive actions of the phytoconstituents.

**CONCLUSIONS**

In conclusion, we believe that studying medicinal plants as antibacterial and wound healing agents is crucial for understanding medicinal flora and their true worth, but that using a standard technique of analysis is essential. Similarly, the concentrations or dilutions utilized must be suitable. There is a lot of evidence that medicinal plants are particularly efficient in treating infectious diseases because they are necessary for human survival. The plants have a lot of potential as a source of new antibacterial compounds. They are widely available, inexpensive, and nearly without side effects. Plant derivative substances, including phytochemicals, have even been used to treat a variety of infectious disorders, exhibiting intriguing antibacterial activity and wound healing against a variety of human pathogens. Some of these chemicals have both intrinsic antibacterial action and the ability to change antibiotic resistance. While some of them are ineffective as antibiotics on their own, when combined with antibiotics, they can overcome antibiotic resistance in bacteria. Finally, because of their qualities, people have been more interested in herbal-based medications in recent years. To assure its safety, many types of investigations on the mechanisms of action, interactions with antibiotics or other medicinal plants or substances, and the pharmacokinetic profile of the extracts should be prioritized.

**FUTURE DIRECTIONS**

Combining traditional and modern knowledge can result in more effective antibacterial and wound healing agents with fewer adverse effects. The major challenge in the creation of novel phytochemicals has been the translation of *in vitro* investigations to *in vivo* experiments, and then to human clinical trials. The problem is especially problematic in the case of natural antimicrobial agents since numerous factors can affect their efficacy, including tissue penetration, maximum plasma concentration achievable, and bioavailability. However, more research is needed to have a better knowledge of the exact mechanisms as well as the pharmacological and pharmacokinetic features of the compounds.

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