**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, soluble mediators, tissues, 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 treatment 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. Through several mechanisms of action, phytochemicals are known to have potential antibacterial and wound-healing effects against susceptible and resistant microorganisms. 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 made an effort to shed light on the numerous plants that may be useful in therapeutic treatment because of their potential antibacterial and wound-healing properties.

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

**Introduction**

There have been several reports of the therapeutic effects of natural products and plant products 1,2 made of active principles such alkaloids, flavonoids, and biomolecules 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. 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 world's developing nations still reap the benefits of using conventional medications made from medicinal plants 7,8,9.

The utilization of natural substances obtained from microbial, animal, or plant sources has caught the interest of many researchers despite the fact that synthetic anti-microbial medications have been approved in many nations 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 compositions, they are divided into various 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. Due to widespread, incorrect, irregular, and indiscriminate antibiotic use, antimicrobial resistance has developed, rendering many currently available medications ineffective 14,15,16. As a result, there is a rising need for the development of innovative antimicrobial agents that can cut down on the use of antibiotics and stop the emergence of resistance. Researchers have been urged to isolate and identify novel bioactive chemicals from plants to tackle microbial resistance 17,18,19,20. And, as current antimicrobials fail to treat infectious diseases, a lot of 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 occurs when bacterial, viral, fungal, and parasitic infectious organisms become resistant to conventional treatments, posing a risk to the public's health by dispersing infectious diseases and causing enormous global economic losses owing to food spoilage and crop damage 25,26. Due to the wide variety of secondary metabolites and phytochemicals found in medicinal plants, researchers are becoming more and more interested in them as a means of combating antimicrobial resistance 27.

**Medicinal plants with antibacterial activity**

It has been demonstrated that extracts from medicinal plants have a range of biological effects, such as antibacterial, anti-inflammatory, and antioxidant capabilities 28. Antimicrobial chemicals derived from medicinal plants may prevent the growth of bacteria, fungus, viruses, and protozoa by different methods than those employed by antimicrobials already on the market. Additionally, they might be clinically beneficial for treating bacteria strains that are resistant to the present antimicrobials 29. Chemically complex molecules have high therapeutic promise since they have fewer adverse consequences than synthesized medications and have a low likelihood of developing resistance 30,31. Furthermore, the synergistic interaction of the extracts' active ingredients is what causes medicinal plant extracts to effectively prevent bacterial development 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):**

A. indica L. 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 A. 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 *A. adenophora* exhibited antibacterial activities against *Escherichia coli*, *Staphylococcus aureus Salmonela Typhi*, *Citrobacter koseri* and *Klebsiella pneumoniae* 38.

***Artemisia vulgaris***

Methanolic extracts of *A. vulgaris* exhibited antibacterial activities against the five tested microorganisms like *S. aureus*, *K. pneumoniae*, *S. Typhi*, *E. coli* and *C. koseri*. This was demonstrated in the study done by Manandhar *et al.* 38*.*

***Cinnamomum tamala***

The methanolic extracts of *C. tamala* was experimented for its antibacterial activities against *K. pneumoniae*, *E. coli*, *S. Typhi*, *C. koseri* and *S. aureus*. The findings demonstrated that the extract has antibacterial activity against all the microorganisms used in the study 38.

***Ferulago campestris***

Basile *et al*. 39 discovered that some pyranocoumarins and coumarins which is separated from the *F. campestris* roots shown substantial antibacterial action against both gram-positive and gram-negative bacteria. Aegelinol 40 and agasyllin 41 in particular were more active against ATCC strains of *E. aerogenes*, *S. aureu*s, *S. enterica* and *E. cloacae* (MIC = 32 μg/ml for agasyllin and 16 μg/ml for aegelinol).

***Hypericum olympicum***

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

***Ocimum kilimandscharicum***

*O. kilimandscharicum*, an aromatic undershrub in the Laminaceae family with pubescent quadrangular branchlets 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 has proteins, flavonoids, tannins and other essential elements. In addition to having antibacterial and wound-healing capabilities, flavonoids also have antioxidant and free radical scavenging activities 43.

***Oxalis corniculate***

The methanolic extracts of *O. corniculate* was studied for its antimicrobial activities against different microorganisms which include *C. koseri,* *E. coli*, *S. Typhi*, *S. aureus* and *K. pneumoniae* 38. And the result indicates that the methanolic extracts of *O. corniculate* exhibit antimicrobial activities in all the tested microorganisms.

**Punica granatum**

Due to its versatility and nutritional advantages in the human diet, *P. granatum* (pomegranate) consumption has increased. In particular, it is high in bioactive chemicals that belong to the phenolic compound family, like anthocyanins and tannins. 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 as well as antibacterial applications. Additionally, Mostafa *et al.* 45 examined the potential antibacterial activity of ethanolic extracts of *P. granatum* and discovered that it is variable in its efficacy against the tested bacterial strains.

***Syzygium aromaticum***

For its antibacterial action, an ethanolic extract of *S. aromaticum* proved possibly beneficial with varying effectiveness against the examined bacterial strains. In the experiment conducted by Pundir *et al.* 46 the ethanolic extracts of *S. aromaticum* inhibited the development of all the examined food-associated bacteria, with the diameter of the zone of inhibition ranging from 25 to 32 mm. Its zone of inhibition diameter against *E. coli* was the biggest, measuring 32 mm, and it was followed by *S. aureus* (31 mm) and *B. subtilis* (30 mm). Against *B. megaterium* and *B. sphaericus*, the *S. aromaticum* ethanolic extract exhibited a zone of inhibition with a similar diameter of 28 mm. The ethanolic extract of *S. aromaticum* has also been found by Sulieman *et al.* 47 to be antibacterial against *E. coli*, *S. aureus* and *B. subtilis*, having the highest antibacterial activity against *E. coli*. Eugenol (2 methoxy-4 allyl-phenol) is connected to the antibacterial properties of *S. aromaticum* 48. It has additional antibacterial qualities due to the high tannin content (10-19%) 49.

***Thymus vulgaris***

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

**Ziziphus nummularia**

Z. nummularia contains a high concentration of phytochemical substances, mainly cyclopeptide alkaloids. In one of the early studies, nummularine-N and nummularine-M, two new cyclopeptide alkaloids, as well as the presence of several other cyclopeptide alkaloids in the plant's root bark, were discovered in 1983 50. Cyclopeptide alkaloids are natural macrocyclic molecules with intriguing biological and chemical properties that are abundant in the family Rhamnaceae, particularly in the *Ziziphus* genus 51,52. Beg *et al.* used several extraction solvents to assess the antibacterial activity of *Z. nummularia* extracts from leaves, bark and fruits against the gram-positive bacterium *S. aureus* and the gram-negative strain *E. coli*. 53. The outcomes demonstrated that the methanolic extract of the fruits had the highest bacterial resistance against the two strains, followed by hexane and chloroform extracts, the aqueous extract of all plant parts exhibited no antimicrobial activity 53. Interestingly, the fruit of the plant was shown to have significant antibacterial action against the gram-positive strains examined 54.

Another research found that the ethyl acetate and chloroform fractions of *Z. nummularia* were efficient against the two gram-positive and bacteria gram-negative, however, the methanolic and aqueous fractions had no activity against any of the microorganisms examined 55. According to Gautam *et al*. the ethanolic extract of *Z. nummularia* was more effective than the aqueous extract at killing *S. aureus* and *P. aeruginosa* while having no effect on *B. subtilis* 56. Sharma *et al.* ascribed *Z. nummularia's* antibacterial activity to the presence of flavonoids, glycosides, saponins and alkaloids in the plant's leaf extracts, indicating that leaf extracts could be a viable treatment for a variety of ailments 57.

These potentially useful plant extracts could be employed as natural substitutes to chemically-based antibacterial treatments to prevent food poisoning and preserve food without posing any health risks.

**WOUND HEALING**

A physical injury that causes an opening or breach in the skin's barrier function and normal architecture are called wound. They result in the loss of epithelial continuity, whether or not underlying connective tissue is also lost 58. Following an injury, the skin has an amazing ability to regenerate itself. Several processes are involved in the intricate (yet orderly) phenomenon of healing a wound, including the initiation of an acute inflammatory response by the wound, the regenerative process of parenchymal cells, the migration as well as proliferation of both parenchymal and connective tissue cells, the production of extracellular matrix proteins, the remodelling of connective tissues and the development of wound strength. Any modifications to any of these procedures may result in a delay in healing or even complete healing failure 59.

According to current estimates, approximately 6 million people worldwide are affected by chronic wounds 60. Wound epidemiology research is extremely limited. In order to aid in wound healing, medical therapy for wounds involves injecting medications either locally (topically), systemically (oral or parenterally), or both 61. Antiseptics, antibiotics and disinfectants and have a broad spectrum of non-selective antibacterial effect when administered topically 62. Topical antibiotics has been frequently used in clinical settings in cuts, wounds and burns to treat localized skin infections. However, overuse of topical antibiotics can 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.

A variety of cell strains and their by-products work together to repair cuts on the skin, which is an essential physiological activity 65. This literature review's objective is to draw attention to the biological mechanisms at work during the healing of wounds, with a focus on the cells, growth factors, and cytokines involved in the process of tissue repair.

**Stages of wound healing**

**Inflammatory stage**- During a vascular inflammatory reaction, the lesioned blood arteries compress and the blood that is discharged coagulates, maintaining the vessel's structural integrity. The activation and accumulation of thrombocytes and platelets into a fibrin network is known as coagulation, and it depends on the impact of specific stimuli on these cells 66. By releasing lysosomal enzymes and reactive oxygen species and enabling the elimination of various cell detritus, inflammatory cells promote the healing of wounds 67.

**Proliferative stage**- The proliferative stage’s goal is to minimize the lesioned muscle area by contracting and fibroplasia, thereby generating a strong epithelial barrier which will stimulate 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 of the lesion's formation and can last for up to 14 days 68. Granulation tissue appears four days after the wound and starts to expand. Its name is derived from the characteristic of the forming stroma, which is granular appearance of newly produced tissue. In accordance with Calin *et al*. 69 increased fibroblast proliferation, collagenous and elastic biosynthesis, which forms a three-dimensional extracellular network of connective tissue, and fibroblast production of chemotactic factors and IFN-beta are all necessary for the development of granulation tissue. The process of wound contraction, which is carried out at this stage by myofibroblasts, which are abundant in alpha smooth muscle actin, was found by Medrado *et al.* 67.

**Remodelling stage**- The third stage of healing, known as remodelling, begins two or three weeks after the lesion first appears and lasts for an entire year or more. Maximizing tensile strength through extracellular matrix reconfiguration, breakdown, and resynthesis is the main objective of the remodelling stage. The granulation tissue is gradually transformed during this last stage of lesion's recovery in an effort to bring back the native tissue structure, leading to scar tissue that is gradually becoming less cellular and vascular 70 and has a higher concentration of collagen fibres.

**Medicinal plants with wound healing potential**

Traditional medicine has been called as an alternative medicine, non-conventional medicine, phyto-medicine, complementary medicine, herbal medicine, natural medicine, indigenous medicine, ethno medicine, folk medicine etc 71. According to estimates, 70% of Ayurvedic medicines used to treat wounds are made from plants, 20% from minerals, and the other 10% are animal-based 72.The following are the scientifically proven plants used for wound healing management:

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

A. indica L. a weed plant, has been used to treat a number of skin disorders as well as pneumonia, asthma, and rheumatism. The presence of flavonoids, kaempferol, glycosides, mauritianin, ciltoria, and nictiflorin in A. indica leaves and flowers resulted in antioxidant activity. A. indica dried leaf ethanolic extract has been used to heal wounds and bedsores 73,74.

***Ageratum conyzoides*:**

*A. 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 wounds75.

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

Davis investigated the wound healing property of *A. vera*. One of the oldest medicinal plants in the world is *A. vera* Linn. (Liliaceae). It is applied topically to treat wounds, burns, insect bites, bruises, welts, skin lesions, eczema, and sunburns. When mice were given 100 mg/kg/day of *A. vera* orally, and when they were given 25% aloe vera topically, the size of the wound was reduced by 62.5% and 50.80%, respectively. These results suggest that *A.* *vera* aids in the healing of wounds. The amino acids and vitamins C and E found in *A. vera* leaves are essential for wound healing 76.

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

The primary components of the bark of *A. cadamba* Roxb. (Rubiaceae) are saponins, triterpenes, and the indole alkaloids cadambine, 3adihydrocadambine, cadamine, isodihydrocadambine and isocadamine. Umachigi *et al.* investigated wound healing activity and discovered that when hydro-alcoholic *A. cadamba*ointment was applied, the epithelization period was reduced, as was the scar area. Both the hydroxyproline content and the tensile strength increased significantly. The unprocessed hydro-alcoholic extract encouraged wound contraction substantially. As a result, the plant extract may be effective as a wound healing agent 77.

***Argemone mexicana* Linn.:**

Employing excision and incision wound models, various *A. mexicana* L. (Family: Papaveraceae) leaf extracts were examined for their capacity to accelerate the healing of wounds in rats. The wound closure rate, epithelialization period, strength of skin breaking, the granulation tissue weight, hydroxyproline determination, superoxide dismutase, catalase, and tissues granulations' histology were used to assess the effects of test samples on the rate of healing of wound. For the activity comparison, Nitrofurazone (0.2% w/w) in Simple ointment I. P. was utilized as the standard. The study's findings showed that rats inoculated with methanolic and aqueous extracts of *A. mexicana* healed more rapidly 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 methanolic and aqueous extracts. The petroleum ether extract yielded no noteworthy findings. The ability of the extract to heal wounds may be credited to the existence of phytoconstituents in chloroform, methanol, and aqueous extracts, such as tannins, alkaloids, flavonoids and triterpenoids which have been shown to aid healing of wound due to their antimicrobial, antioxidant and astringent properties. The current study supports the use of *A. mexicana* leaves for wound healing, as reported in folkloric research 78.

***Arnebia densiflora*:**

*A. densiflora* roots steeped in butter were previously used to treat minor wounds. This plant's roots have been shown to contain alkannin derivatives such as methyl-n-butylalkannin, dimethylacrylalkannin, teracrylalkannin and isovalerylalkannin. According to Kosger *et al.* rats given *A. densiflora* healed faster compared to the control group. On the 14th day after the damage, the wound's closure and collagen formation accelerated and healing took place 79.

***Carica papaya* Linn.:**

*C. papaya* L. is a member of the Caricaceae family. Azarkan *et al.* discovered that papaya fruit includes a combination of cysteine endopeptidases like papain. Papaya contains chympopapain A and B, omega endopeptidase, chitinase, protease inhibitors, and proteins. It also contains papaya endopeptidases II and IV. Given that papaya fruits have the ability to cure wounds, papaya latex was administered to the burn wound using hydrogel as a carrier method80.

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

*C. asiatica* is also known as Asiatic Pennywort is a herbaceous, perennial herb in the Apiaceae family81. Saponins containing triterpens, such as madecassic acid, asiatic acid, madecassoside and asiaticoside have been shown to be the most active therapeutic biomarker molecules in plants 82. A cream containing 1% *C. asiatica* extract has been shown to promote chronic wound healing 83.  Shukla *et al*. examined the topical application of asiaticoside's wound-healing properties in mice with normal and diabetic blood sugar levels. The pace of wound healing in normal animals was noticeably speeded up due to an increase in collagen synthesis and wound tissue tensile strength 84.

Liu explored the impact of madecassoside on wound healing through a variety of mechanisms such as antioxidative activity, angiogenesis and collagen synthesis 85.

***Curcuma longa* Linn.:**

*C. longa* L. which belongs to the family Zingiberaceae, has been said to exhibits anti-inflammatory, antibacterial and antifungal activities in the study by Rao. It uses rhizomes and includes 1,7-bis, 6-hepta-diene-3, 5-dione, turmerol, and curumin (diferuloyl methane). Analgesic and anti-inflammatory effects are present in curcumin. *C. longa* volatile oil has antibacterial and anti-inflammatory properties as well. *C. longa* also includes protein, lipids, and vitamins (A, B, C and so on), which all aid in the regeneration and healing of wounds. *C. longa* has been used to treat wounds in rats86.

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

*E. neriifolia* L. flourishes in north, central, and southern India 87. Bigonia *et al.* investigated the *E. neriifolia* leaf's capacity to heal wounds in an excision and dead space wound model. Contraction of wounds and epithelialization were enhanced by *E. neriifolia's* elevated protein and hydroxyproline content 88. Gour *et al.* also investigated the analgesic and anti-inflammatory properties of plant hydroalcoholic leaf extract and discover positive results 89.

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

*F. racemosa* L. is a huge deciduous tree scattered all over India specifically in northern India 90. Murti *et al.* investigated the wound healing activities of ethanolic as well as aqueous extract of *F. racemosa* roots using incision as well as excision model of wound. Aqueous root extract promoted epithelialization and collagen synthesis, which raised the percentage of wound closure rate 91.

***Helianthus annus* Linn.:**

An ornamental annual herb from the Asteraceae family, *H. annus* L. is typically found in swampy places and has an upright, rough, and hairy stem. Tribals utilize the herb in traditional medicine to treat colic, eye inflammation, dysuria, sores, bone fractures and tiger bites. Deshpande *et al.* found that using an alcoholic extract of *H. 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 92.

***Hygrophila auriculata:***

Dev & Roy 93 used an excision wound model to investigate the potential of wound healing of the *H. auriculata* root 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*. The evaluation of healing was done by measuring the area of wound, histomorphological findings and calculation of the content of both DNA and protein. The findings revealed that the extract-treated group's wound area was less than that of the control group. In comparison with the control group, epithelialization was quicker in the treated group. DNA and protein levels were also higher in experimented mice than in control mice. The level of recovery in the experimented animals was equivalent to the positive control group. As a result, the findings indicate that the root of *H. auriculata* has the capability to heal wounds.

***Kigelia pinnata:***

*K. pinnata*, a member of the Bignoniaceae family, is a tiny tree found in the Southern, Central and Western Africa, as well as India. According to Sharma *et al.* the bark has been pharmacologically established to have wound healing propertiesas well as antibacterial, antifungal, antiamoebic, antiulcer and antioxidant activity 94.

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

*L. camara* L. (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 wound healing qualities along with abortifacient, antimalarial and anti-inflammatory. Wound contraction has been aided by hydro-alcoholic extract and fresh juice of leaves95.

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

The leaves of *L. inermis* L. (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. Lawsone combined with an ethanolic extract of henna leaves produced a considerable healing response in both wound models, according to research by Sakarkar *et al*. Furthermore, it was discovered that topical application of ethanolic extract as well as separated lawsone was more efficacious than oral administration. Thus, application of ethanolic extract to the skin for wound healing can be successfully developed 96.

***Morinda citrifolia***

In the study by Nayak, animals treated with *M. 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 the size of wound and a shorter period of epithelialisation 86.

***Napoleona imperialis:***

*N. imperialis* belonging to the plant family Lecythidaceae is a tall, woody shrub found primarily in tropical rain forests. The leaf is employed as an analgesic, tonic, antitussive, anti-asthmatic, and wound dressing on a local level. The numerous ointments made with *N. imperialis* displayed a successful wound healing effect in the study by Esimone *et al.* a standard antibiotic employed in healing of wound97.

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

*O. sanctum* L. sometimes referred to as 'Tulsi' is extensively grown herb in India and other areas of the world. It has antibacterial, analgesic, immunostimulatory, anti-inflammatory, and free radical scavenging effects. Plant flavonoids' free radical scavenging action aids in wound healing. The topical wound healing properties of *O. sanctum* aqueous extract were examined by Asha *et al*. 98. Goel *et al*. used an excision wound model in wistar albino rats to investigate the wound healing activities of a cold *O. sanctum* aqueous extract as well as its impact on tumour necrosis factor- (TNF-). Wound healing was observed to occur more quickly in rats treated with *O. sanctum* extract in comparison with the control group as a result of enhanced TNF- production 99.

***Resina draconis:***

Huihui *et al.* 100 used the model of excision as well as incision wound in rats to investigate the wound healing potential of *R. draconis* (Dracaena cochinchinensis). In addition to histological exams, the expression of VEGF and TGF-1 and the percentage of wound contraction were all recorded. The study offers a rationale based on science for *R. draconis* conventional application in wound treatment.

***Rubia cordifolia* Linn:**

Karodi *et al.* 101investigated the ability of *R. cordifolia* L. (Indian madder) extract to treat mice's wounds. The ethanolic extract as well as its hydrogel were assessed for their healing effectiveness on an excision wound model in mice, and the work provides a scientific explanation for the folkloric usage of this plant in wound handling. More *et al.* and Umachigi *et al.* also investigated the existence of tannins, phytosterols, anthraquinone glycosides and saponins in an ethanol extract of *R. cordifolia*. Tannins as well as anthraquinones are the primary phyto-constituents found in this plant, and they might be in charge for the healing of wound 102,77.

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

*T. grandis* L. belongs to the Verabinaceae family and comprises primarily tannins, carbohydrates and anthraquinone glycosides. It is applied topically to treat burns and as an anti-inflammatory medication. It is primarily used to treat burns, inflicted wounds, and skin ulcers. According to Majumdar *et al.* *T. grandis* L. extract improved breaking strength, wound contraction, and collagenation when used topically or internally 103.

***Terminalia superba:***

Dougnon *et al.* 104 investigated the wound healing as well as antibacterial effects of *T. superba* bark ethanol extract. The ethanol extract's antibacterial activity and *in vivo* wound healing characteristics on lesions infected by reference strains of *E. coli* ATCC 25922 and *S. aureus* ATCC 25923 in wistar albino rats were also examined. *T. superba's* antibacterial qualities contribute to the development of a better traditional medicine.

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

*T. procumbens* L. (Asteraceae) is a tropical American native that has spread to tropical Africa, Australia and Asia particularly India. According to Diwan *et al.* the leaf of *T. procumbens* includes primarily crude protein, crude fibre (17%), soluble carbohydrate (39%), and calcium oxide (5%). Villagers use the juice of this plant's leaves to stop bleeding from animal cuts and bruises. This juice has the ability to accelerate two stages of healing: epithelialization and collagenization, while delaying scarring and granulation 105.

***Wedelia chinensis*:**

*W. chinensis* Merrill (Syn. Wedelia calendulaceae) (Asteraceae) is a renowned herbal remedy in both the Ayurvedic as well as Unani systems of medicine. Verma *et al*. 106 studied the efficiency of healing of wound in *W. chinensis* ethanolic leaf extract using the models of excision, incision and dead space wound. When compared to control treatments, mice treated with *W. chinensis* extract shown a substantial increase in wound-healing activity. The property of healing of wound in *W. chinensis'* might be related to the phytochemicals in the plant, and the rapid process of wound healing might 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 disorders, exhibiting intriguing antibacterial activity and wound healing against a variety of human pathogens. A number of these chemicals have both antibacterial action and the ability to change antibiotic resistance. While some of them are inefficient as antibiotics on their own, they can combat bacterial antibiotic resistance when used in combination with other antibiotics. Finally, because of their qualities, people have been more interested in herbal-based medications in recent years. To assure the safety of the extracts, numerous investigations on their methods of action, interactions with antibiotics or other medicinal plants or compounds, and their pharmacokinetic profile should be prioritized.

**FUTURE DIRECTIONS**

Combining conventional and modern knowledge can result in more efficient antibacterial and wound healing agents with less negative effects. The major challenge in the creation of novel phytochemicals has been the conversion of *in vitro* investigations to *in vivo* experiments, and then to human clinical trials. Natural antimicrobial drugs present a particular challenge since a variety of parameters, such as tissue penetration, maximum attainable plasma concentration, and bioavailability, might affect their activity. However, more investigation is required to have a better knowledge of the precise mechanisms as well as the pharmacological and pharmacokinetic attributes of the compounds.

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