REVIEW ON INDIAN PLANTS USE AS WOUND HEALING ACTIVITY

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Abstract: Dermal fibroblasts move into the wound bed and multiply, making "granulation tissue" wealthy in extracellular network proteins and supporting the development of modern blood vessels. Eventually, this is rebuilt over an amplified period, returning the harmed tissue to a state comparative to that some time recently harm. Dysregulation in any stage of the wound recuperating cascade delays recuperating and may result in different skin pathologies, counting nonhealing, or constant ulceration. Innate and conventional medications make broad utilize of common items and subordinates of normal items and give more than half of all drugs expended nowadays all through the world. Perceiving the imperative part conventional pharmaceutical proceeds to play, we have attempted an broad study of writing announcing the utilize of restorative plants and plant-based items for cutaneous wounds. We portray the dynamic fixings, bioactivities, clinical employments, definitions, strategies of arrangement, and clinical esteem of 36 therapeutic plant species. A few species Curcuma longa, Azadirachta indica, Aloe barbadensis, Withania somnifera, Boswellia serrata, Embilica officinalis stand out, counting, which are well known wound recuperating items utilized by a few societies and ethnic bunches. The ubiquity and prove of proceeded utilize clearly demonstrates that there are still lessons to be learned from conventional hones. Covered up in the bunch of characteristic items and subordinates from normal items are undescribed reagents, unexplored combinations, and aide compounds that seem have a put in the modern helpful stock.

Index Terms: Amla, Turmeric, Ashwagandha, Therapeutic uses, Wound healing.

I. INTRODUCTION

Ayurveda, the Indian traditional system of medicine, is based on empirical knowledge of the observations and the experience over millennia. More than 1200 diseases are mentioned in different classical Ayurvedic texts. Management in various forms of these diseases is made with more than 1000 medicinal plants (89.93%); 58 minerals, metals, or ores (5.24%); and 54 animal and marine products (4.86%).1 Healing of wounds is an important area of clinical medicine explained in most of the Ayurvedic texts since about 5000 BC under the heading "Vranaropaka." The wound as a medical problem was first discussed by Maharshi Agnibesha in Agnibesha Samhita (later known as Charaka Samhita) as "Vrana."2 India has a rich tradition of plant-based knowledge on healthcare.

A large number of plants/plant extracts/decoctions or pastes are equally used by tribals and folklore traditions in India for treatment of cuts, wounds, and burns.A wound is a disruption of living tissue's cellular, anatomical, and functional integrity caused by physical, chemical, electrical, or microbial threats to the tissue.

Wound healing is defined as a complex process occurring by regeneration or reconstruction. The use of medicinal plants for treating various ailments has been a part of traditional Indian medicine for centuries. Indian medicinal plants are known for their therapeutic properties and have been used to treat a wide range of diseases and injuries, including wounds. Wound healing is a complex process that involves multiple stages and requires proper care and treatment to avoid complications. In recent years, there has been a growing interest in using Indian medicinal plants for wound healing due to their effectiveness and minimal side effects. This review aims to explore the various Indian medicinal plants that have been studied for their wound healing activity and their potential use in the coming years.

Indian Medicinal Plants with Wound Healing Activity

Table 01: List of Medicinal Plants with their Scientific Names

Sr. No.	Common Name	Source and Family
1	Turmeric	Curcuma longa Zingiberaceae
2	Neem	Azadirachta indica Meliaceae
3	Aloe/kumara	Aloe vera, Aloe barbadensis Liliaceae
4	Ashwagandha	Indian ginseng Withania somnifera Solanaceae
5	Saalai	Indian frankincense Boswellia serrata Roxb. Burseraceae
6	Amla	Embilica officinalis Euphorbiaceae

1. Turmeric (Curcuma longa): Turmeric, also known as haldi, is a common spice used in Indian cooking and has been used in Ayurveda for its medicinal properties. It contains a compound called curcumin, which has anti-inflammatory, antioxidant, and antimicrobial properties.

Que Bai et al. 2024, In this study they formulated curcumin loaded chitosan-based hydrogels accelerating s. aureus-infected wound healing in which curcumin was loaded with chitosan-based hydrogels was formed through phenylborate ether bonding and its properties and effected on s. aureus-infected wound was tested. This research work suggested that the developed multifunctional hydrogel might be a beneficial treatment for the infected wound healing.

Govindraj Sabarees et al. 2024, A study discovered that curcumin fused benzamidine hybrids have great potential as lead molecules in wound healing. This research focuses on creating new curcumin hybrids (SV01-SV20) for harnessing wound healing activities.

Amar Hamed et al. 2024, In this study the nanofibrous scaffold composed of PLA and encrisched with organic turmeric along with various nanoparticles including with various nanoparticles including Hap, Vivianite and Go, was meticulously fabricated using the electrospinning technique.

Mamtha Pillai et al. 2022, In present study, multifunctional bilayered dermal patches with antibacterial, antioxidant and anti-inflammatory properties were developed using solvent casting or electrospinning methods and compared for performance. Top layer was made up of polycaprolactone (PCL) and chitosan (CS) while bottom layer was made of polyvinyl alcohol (PVA) with curcumin nanoparticles and soluble egg shell membrane protein (SESM) as the wound healing agents. Curcumin nanoparticles showed reduction in the production of reactive oxygen species (ROS) and inflammatory cytokines and markers in mice T cells or human macrophages, confirming their antioxidant and anti-inflammatory properties while SESM improved migration of human adult dermal fibroblasts, suggesting its contribution to wound healing.

Nurul Mutia et al. 2021, The purpose of this study was to assess the effectiveness of yellow turmeric-infusa of 5% and 10% on the healing process of perineal wound grade II: The method used in this study is quasi-experiment with Pretest–Posttest Control Group design. In this research consisted of three experimental groups with two intervention groups and one control group, with the number of subjects group was 15 people. The results showed that on the 5th and 7th postpartum days, there were differences in redness, edema, and approximation of wounds in each group ($p < 0.05$) while the other REEDA parameters were not significantly different. There is also a difference in the time of perineal wound healing in each group, and it can be seen from the decrease and the total REEDA score. Turmeric infusa group 5% experienced healing on the 5th day postpartum, turmeric infusa 10% recovered on the 7th day postpartum, and the control group recovered more than 7 days. Giving turmeric was proven to eliminate redness, edema, accelerate the closure, and perineal wound healing time, as seen from the p-value ($p < 0.05$).

2. Neem (Azadirachta indica): Neem, also known as Indian lilac, has been used in traditional Indian medicine for its antibacterial and anti-inflammatory properties.

S. Villani et al. 2024, This work highlights the synergistic effect of BC and neem hypericum oil emulsion (naturally derived antibacterial agents) in creating a paste for wound healing application. Unlike pure BC, the paste showed

promising biofilm detachment properties in vitro and good biocompatibility activity in vivo, setting the stage for development new strategies for the treatment of chronic wound infections.

Arfa Nasrine et al. 2023, This study designed and assessed several properties of neem hydrogel formulations alone & combined with SF. The N-HG & N-SFB-HG proved exceptional biocompatibility, desirable stability, & satisfactory physical features. This implies that the N-SFB-HG might be used in the long term to design novel wound healing therapeutics to ensure conformance for both patients and the medical industry.

Baljit Singh et al. 2023, In this study explored neem gum in designing hydrogel dressings by covalent and supra molecular interactions for better wound healing. These hydrogel dressings were encapsulated with the antibiotic drug cefuroxime for better wound healing.

Preeti Maan et al. 2021, Water extricate of stem bark of AI is appearing noteworthy wound mending property in extraction as well as cut wound show consequently supporting its conventional utilize. In this manner, cream/paste detailing of water extricate of AI stem bark can be utilized as perfect dressing specialist for the treatment of wounds. In any case, assist examinations are required to uncover its correct mechanism(s) of activity and adequacy on diverse sort of wounds.

3. Aloe vera (Aloe barbadensis): Aloe vera is a succulent plant that has been used in traditional Indian medicine for its healing properties. It contains a compound called acemannan, which has been found to promote wound healing by stimulating collagen production and reducing inflammation.

Marta Sánchez et al 2021, Aloe vera-based hydrogels have developed as promising stages for the conveyance of restorative operators in wound dressings due to their biocompatibility and interesting wound-healing properties. The show think about gives a comprehensive outline of later propels in the application of Aloe vera-based hydrogels for wound recuperating. The blend strategies, auxiliary characteristics, and properties of Aloe vera-based hydrogels are examined. Instruments of helpful specialists discharged from Aloe vera-based hydrogels, counting dissemination, swelling, and corruption, are too analyzed. In expansion, the helpful impacts of Aloe vera-based hydrogels on wound recuperating, as well as the decrease of irritation, antimicrobial movement, and tissue recovery, are highlighted. The joining of different restorative operators, such as antimicrobial and anti-inflammatory ones, into Aloe vera-based hydrogels is looked into in detail.

Aleksandra Shedoeva et al. 2022, portray the dynamic fixings, bioactivities, clinical employments, definitions, strategies of arrangement, and clinical esteem of 36 restorative plant species. A few species stand out, counting Centella asiatica, Curcuma longa, and Paeonia suffruticosa, which are well known wound recuperating items utilized by a few societies and ethnic bunches. The notoriety and prove of proceeded utilize clearly demonstrates that there are still lessons to be learned from conventional hones. Covered up in the horde of common items and subordinates from normal items are undescribed reagents, unexplored combinations, and aide compounds that might have a put in the modern restorative stock.

R. H. Davis et al. 2020, The influence of Aloe vera, orally and topically, on crack healing was studied. Injuries were induced on both sides of the vertebral column of ICR mice using a dissection punch. For the oral study, experimental brutes entered A. vera in their drinking water for 2 months, whereas the control brutes entered only water. Injuries were induced on both sides of the vertebral column of ICR mice using a dissection punch. For the oral study, experimental brutes entered A. vera in their drinking water for 2 months, whereas the control brutes entered only water. In the topical study, experimental brutes were given 25A. vera in Eucerin cream topically. The control brutes entered cream only. A62.5 reduction in crack fringe was noted in mice entering 100 mg/ kg/ day oral. A. vera and a50.8 reduction was recorded in brutes entering topical 25 A. vera. These data suggest that A. vera is effective by both oral and topical routes of administration.

S. K. Purohit et al. 2022, Indian Aloe (Aloe Vera) takes off mash is utilized for therapeutic purposes, counting treatment of clogging, colitis, asthma, bad tempered bowel disorder, diabetes, peptic ulcer, irritation, heart burn, stretch etc. The show think about was embraced on test assessment of Indian Aloe (Aloe Vera) clears out mash on wound recuperating movement through topical course on extraction wound show. The movement was compared with standard sedate Povidone Iodine treatment (5% w/w). Indian Aloe (Aloe Vera) takes off mash was found to have superior and quicker wound recuperating impact than standard medicate Povidone Iodine treatment on extraction wound demonstrate.

K. C. Haritha Yadav et al. 2022, Aloe vera gel of 50 and 96.4 were tested for its crack mending exertion by topical operation in experimental rats. The effect of Aloe vera gel on crack mending was estimated by crack excision model and histopathology was used to study the effect on crack mending. The effect produced by Aloe vera gel with reference to crack compression, crack check, drop in face area of crack, towel rejuvenescence at the crack point and histopathological characteristics were significant in treated rats. The effect of Aloe vera gel on biochemical studies revealed significant increase in collagen and dropped hexosamine content and malondialdehyde situations when compared with control. The present study therefore handed scientific explanation for the traditional use of Aloe vera gel for operation of injuries.

4. Indian ginseng: Indian ginseng, also known as ashwagandha, is a popular herb in Ayurvedic medicine.

Akshay Sharma et al. 2021, Modern equations, dressings, and therapeutic plant composition are being investigated by analysts for creating fetched viable, proficient, steady, and feasible conveyance framework for the management/treatment of wounds. With the coming of nanotechnology and accessibility of novel materials, wound administration is getting to be more effective and patient-centric. More current advances like 3D printing are moreover giving beneficial alternatives for creating distinctive medicate conveyance frameworks for managing wounds. Tissue designing and regenerative medicines are the cutting edge see of innovations for developing wound recuperating frameworks. Way better quality control techniques for distinguishing proof, screening, and measurement herbal components along with well-designed pre-clinical and clinical ponders will open modern inquire about doors in wound care administration.

Suryamani Khanna et al. 2021, much research has been centered on wound care, with emphasis on new therapeutic methods and the advancement of acute and chronic wound treatment techniques in Ayurveda (herbal). New formulas, dressings, and medicinal plant composition are being explored by researchers for developing cost effective, efficient, stable, and sustainable delivery system for the management/treatment of wounds. With the advent of nanotechnology and availability of novel materials, wound management is becoming more effective and patient-centric. Newer technologies like 3D printing are also providing advantageous options for developing different drug delivery systems for managing wounds. Tissue engineering and regenerative medicines are the futuristic view of technologies for developing wound healing systems.

R. Seenivasagam et al. 2020, Withania somnifera (Ashwagandha or Indian ginseng) is a small woody shrub or condiment of the Solanaceae family. Ashwagandha is an condiment which can compare favourably to the world's most famed herbal mixers similar as ginseng (Panax ginseng), astragalus (Astragalus membranaceus) and South American suma(Pfaffia paniculata). All these have been held in high regard for its capability to increase vitality, energy, abidance and stamina. Korean ginseng (Panax ginseng) is used in China as a precautionary alcohol to stimulate the entire body to overcome stress, fatigue and weakness. It contains 13 different ginsenosides. Panaxans help to lower blood sugar, polysaccharides work to enhance the vulnerable system and its antioxidant parcels are vulnerable- stimulating to cover the body from complaint and stress. It balances the release of stress hormones by supporting the organs that produce them. This composition investigates the remedial and clinical goods of Indian and Korean ginseng.

Bhaskar Ganguly et al. 2018, Roots of Withania somnifera (WS) are a celebrated restorative fixing in Ayurvedic and numerous other innate frameworks of pharmaceutical. The display ponder examines the impact of the phytochemical composition of the extricates on their antioxidant and diminishing exercises. WS roots were extricated with water, acetone, watery methanol (1:1), and methanol:chloroform:water (1:1:1) to get watery, acetone, hydro-methanolic, and methanol–chloroform–water extricates. Phytochemical composition and antioxidant and diminishing exercises of the extricates were emphatically related with the utilize of natural solvents amid the extraction prepare. Alkaloids and flavonoids were the most imperative supporters in the antioxidant and lessening exercises of the extricates.

Gupta Abhishek et al. 2022, The recuperation of skin wounds is a complex natural handle including three fundamental components: fiery stage, re-epithelialization taken after by granulation and tissue remodeling. The intuitive between incendiary cells, fibroblasts, and keratinocytes initiate microenvironmental changes at the wound location. Tissue remodeling is started by matrix-producing proteins and protease proteins and collagen filaments in the dermis. A saponin extricated from ginseng, known as ginsenoside, has been appeared to quicken neovascularization in burn wounds in mice. Ginsenoside F1, an enzymatically altered subordinate of the ginsenoside Rg1, ensured HaCaT against UVB-induced apoptosis. Panax ginseng root extricate advances sort I collagen amalgamation in human dermal fibroblasts (HDF) by means of the Smad actuation pathway and shows antioxidant movement against free radicles counting diphenyl-p-picrylhydrazyl treatment. In expansion, ginsenoside Rb1 advances recuperating prepare of burn wound by improving angiogenesis. Among the different ginsenosides, ginsenoside Rb1 has been found to most powerful operator for wound recuperating.

5. Indian Frankincense: Indian frankincense, also known as boswellia, has been used in traditional Indian medicine for its anti-inflammatory properties. It contains a compound called boswellic acid, which has been found to promote wound healing by reducing inflammation and increasing collagen synthesis.

T. Brendler et al. 2022, Compared to the vast body of available data on the ecology, status and trade of African frankincense species, published research on B. serrata is still scant and compounded by the regionality of existing assessments and lack of specific production, processing and trade data. More comprehensive assessments are needed to fully and conclusively evaluate the ecological status of the species and the sustainability of current management practices.

Mona M. Agwa et al. 2022, The perpetration of naturally available restorative composites or the application of green biopolymers especially artificial derivations, are lately applied to develop new topical phrasings for treating or managing skin injuries. In this study, frankincense (FRK) essential oil painting was uprooted from Bosolica papyrifera oliogum resin, and reprised into whey protein NPs using spray drying fashion. More importantly, when this film was applied in a full consistence beast crack model, it displayed remarkably bettered mending with enhanced collagen deposit associated

with decline in the gene expression of interleukin- 6(IL- 6) and an increase in the gene expression of transubstantiating growth factor- β1(TGF- β1) due to the capability of FRK essential oil painting to modulate inflammation and skin towel redoing, suggesting the excellent feasibility of this film as a largely effective crack dressing film.

Shaik Mannur Ismail et al. 2021, Different concentrations (25, 50, 75 and 100 mg /ml) was evaluated for the investigation of antimicrobial efficacy using Gram positive (Bacillus subtilis, Staphylococcus aureus and Streptococcus pneumonia) and Gram negative (E. coli, Klebsiella pneumonia, Enterobacter aerogenes, Pseudomonas aeruginosa and Proteus vulgaris) microbes. Inhibition halos were evaluated and compared with antibiotic Ciprofloxacin (5µg/ml) as positive control. DMSO was used as a negative control. Results demonstrated significant antimicrobial activity. In this assay, extracts of frankincense showed antimicrobial activity comparable with standard and can be used in combating the bacterial infested diseases caused by the studied bacterial strains.

Shaimaa Obaid Hasson et al. 2022, Moment, despite the actuality of colorful chemical and physical treatments for crack mending, the use of traditional drug including herbal drug is still extensively used in utmost developed and developing countries. The BC excerpt was prepared using alcohol 70. The chemical groups and excerpt composites were determined using Fourier transfigure infrared spectroscopy (FTIR) and high- performance liquid chromatography (HPLC) analysis, independently. The antimicrobial and crack- mending conditioning of different attention of BC excerpt and its combination with penicillin – streptomycin was assessed by agar well prolixity and infected crack model in albino rabbits, independently. Also, the combination of penicillin – streptomycin with BC excerpt showed synergistic antibacterial effect. The 5 attention of BC was the stylish crack- mending emulsion which healed the crack in 6 days and dropped the crack size 10 mm each day. This study demonstrated the implicit capacities of BC as an antibacterial and crack- mending medicinal factory. farther studies are needed to justify the in vivo use of this factory.

Tsung-Jung Ho et al. 2021, "Jinchuang ointment" is a conventional Chinese home-grown medication complex for treatment of chiseled wounds. For more than ten a long time, it has been utilized at China Therapeutic College Healing center (Taichung, Taiwan) for the treatment of diabetic foot diseases and decubitus ulcers. Three diverse cases are displayed in this ponderTwo in vitro cell based measure stages, wound mending and tube arrangement, were utilized to look at the organic action of this pharmaceutical. Our comes about appear that this home grown pharmaceutical has solid exercises counting incitement of angiogenesis, cell expansion, and cell relocation, which give the logical premise for its clinically watched corrective impacts on nonhealing diabetic wounds.

6. Amla: Amla is a small to medium sized deciduous tree, found in throughout India, Pakistan, Uzbekistan, Sri Lanka, South East Asia, China and Malaysia. It grows about 8-18m height with thin light grey bark, leaves are simple, light green, sub-sessile, closely set along the branchlets looks like pinnate leaves; flowers are greenish yellow; fruits are globose, fleshy, pale yellow with six obscure vertical furrows enclosing six trigonous seeds in two seeded three crustaceous cocci.

Ali Ikram et al. 2020, From old times, plants played a crucial part in the improvement of mankind and was a remarkable source of common medicine. The trouble of the generation of chemical drugs, their side impacts on security, and the cost of disobedience have driven analysts around the world to concentrate on restorative plant science. Pakistan has a expansive collection of different plant species, with around 5,000 plants claiming to have imperative restorative values. The sedate too has anti-cancer, upper, antidiabetic, injury healing, antiulcerogenic, and so on. The display survey article entireties up the phytochemical components and pharmacology of the Emblica officinalis plant and its conventional application. Amla phyto-chemicals, counting ellagic corrosive, emblicanine A, emblacani B, Gallic acid, phyllantine, quercetin and phyllantidine were found to have different organic exercises such as cancer prevention agents, antimicrobials, antiinlammative, antidiabetic, anti-radiation security, chemopreventive and recuperating of wounds.

Swetha Dasaroju et al. 2022, Amla fruit is widely used in the Indian system of medicine as diuretic, laxative, liver tonic, refrigerant, stomachic, restorative, anti-pyretic, hair tonic, ulcer preventive and for common cold, fever; as alone or in combination with other plants. Research reports on amla reveals its analgesic, anti-tussive, antiatherogenic, adaptogenic; cardio, gastro, nephro and neuroprotective, chemopreventive, radio and chemo modulatory and anticancer properties. Amla is also reported to possess potent free radical scavenging, antioxidant, anti-inflammatory, anti-mutagenic, immunomodulatory activities, which are efficacious in the prevention and treatment of various diseases like cancer, atherosclerosis, diabetes, liver and heart diseases.

Yogesh P Talekar et al. 2020, Dermatological clutters particularly cuts, wounds and burns are ubiquitously cured by utilizing medicimal plants from time immemorial. The objective of the think about displayed in this report was to screen the watery and ethanolic extricates of the bark of Emblica officinalis for its wound recuperating properties. The treatment bunch appeared a factually noteworthy decrease in the wound range as compared to control untreated gather ($P<0.05$). An increase in the epithelization of the entry point wound was observed as considerable ductile quality was required for shearing the recuperated tissue in the test sedate treated bunches. Based on the enhanced wound withdrawal and histological prove it can be recommended that the bark extricate of Emblica officinalis may have therapeutic benefits of wound recuperating.

Mrs. Manali. M. Bhide et al. 2022, Medicinal plants are natural gift to human lives to promote disease free healthy life. This article discuses and summarizes important medicinal values of Emblica officinalis (EO). Earlier it becomes a notable fruit for its rich amount of vitamin C, polyphenols such as tannins, gallic acid, ellagic acid, flavonoids like quercetin and rutin. Emblica officinalis (Amla) are widely distributed in tropical and subtropical areas and has therapeutic potential against deleterious diseases such as in cancer, diabetis, liver treatment, heart disease, ulcer, anemia and various other diseases. The use of EO as antioxidant, immunomodulatory, antipyretic, analgesic, cytoprotective, antitussive and gastroprotective are also reviewed. Its applications for memory enhancing, ophthalmic disorders, lowering cholesterol level are focused. The effects of EO in neutralizing snake venom and as an antimicrobial are also included.

Prasan R. Bhandari et al. 2021, Emblica officinalis Gaertn. or Phyllanthus emblica Linn, generally known as Indian gooseberry or Amla, is maybe the most important medicinal factory in the Indian traditional system of drug, the Ayurveda. Several corridors of the factory are used to treat a variety of conditions, but the most important is the fruit. numerous affections are treated by the fruit which is used either alone or in combination with other shops. These include common cold and fever; as a diuretic, laxative, liver alcohol, refrigerant, stomachic, restorative, alterative, antipyretic, anti-seditious, hair alcohol; to help peptic ulcer and dyspepsia, and as a digestive. officinalis is also reported to retain radiomodulatory, chemomodulatory, chemopreventive, free radical scavenging, antioxidant, anti-seditious, antimutagenic and immunomodulatory conditioning. These parcels are efficient in the treatment and forestallment of cancer. This review summarizes the results related to these parcels and also emphasizes the aspects that warrant unborn exploration establishing its exertion and mileage as a cancer preventative and remedial medicine in humans.

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