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A REVIEW OF TRADITIONAL INDIAN MEDICINAL PLANTS WITH POTENTIAL WOUND HEALING ACTIVITY

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ABSTRACT

The molecular and cellular processes involved in normal wound healing have been better understood in the last few decades. Whether from an accident or a surgical procedure, wound healing requires intricate interactions between blood cells, tissues, soluble mediators, cytokines, and other growth factors. The heightened cellular activity of injured tissue intensifies pharmacological therapy and metabolic demands. The primary goal of wound care is to reduce undesired effects or the amount of time needed for the healing process. Because of their abundance of beneficial active phytoconstituents, plants have enormous potential for wound care and treatment throughout time.Ayurveda, Siddha, Unani, and all other traditional medical systems explain how to treat and cure wounds using medications derived from plants, minerals, and animals. Through a variety of processes, herbal medications promote tissue regeneration and repair. Plants have established a reputable position in the field of wound treatment and repair due to their traditional application, affordability, and safety; yet, there is a dearth of scientific evidence supporting their capacity to promote wound healing. The goal of this review is to identify some Indian ethnomedical herbs that have yet to be scientifically proven to be effective in healing wounds. This research also highlights the role of plants in wound care, pharmacological activities, the natural wound healing process, and the metrics used to assess wound healing.

KEYWORDS: Wound Healing**,** Phytoconstituents, Traditional Medicine, Herbal Therapy.

INTRODUCTION

The body's exterior is covered in skin. The skin produces several beneficial substances, including vitamin D, aids in thermoregulation, repels water, and—above all—acts as a barrier to protect internal tissue from the outside world.[1] A wound is defined by the medical lexicon as a breach of skin or underlying tissue brought on by an accident, violent act, or surgical procedure.[2] The skin's ability to repair after an injury is amazing. In order to restore epidermal continuity after an injury to the skin, the damaged tissue must be removed and a fresh extracellular matrix (ECM) must be applied.[3] To encourage tissue regeneration and repair, wound healing must take place in a physiological setting. Clinically important factors known to impede wound healing include hypoxia, infection, malignancies, metabolic disorders such as diabetes mellitus, the presence of necrotic tissue and debris, some medications, and a diet deficient in vitamins, minerals, and protein.[4]

According to current estimates, chronic wounds affect about 6 million persons globally.[5] Studies on the epidemiology of wounds are quite rare in India. In the population under study, the prevalence of wounds was 15.03 per 1000. While the frequency of acute wounds was almost doubled at 10.5 per 1000 people, the prevalence of chronic wounds in the community was reported to be 4.5 per 1000 population.[6] These days, the fundamentals of topical wound care include removing necrotic tissue, managing bacterial loads, controlling wound exudates, keeping proliferative wound margins open, and providing a moist and protective surface for the wound.[7] In an effort to promote wound healing, medical treatment for wounds involves the administration of medications topically, orally, or parenterally, or both.[8] Disinfectants, antiseptics, and antibiotics are examples of antimicrobial dressings that are used topically to provide a wide range of non-selective antibacterial activity.[9] The antiseptic products that are most commonly used in clinical practice are sodium hypochlorite, alcohol, triclosan, hydrogen peroxide, boric acid, silver nitrate, silver sulfadiazine, povidone-iodine combination, and chlorhexidine. Topical antibiotics are commonly administered in clinical settings for wounds, cuts, and burns due to their ability to treat localized cutaneous infections. However, problems including the formation of resistance organisms, might result from overuse and frequent topical antibiotic treatment. This page provides a thorough explanation of the normal wound healing process. The plant phytoconstituents involved in wound treatment are also explained in this paper. It also covers several traditional Indian medicinal herbs that are used to treat wounds and provides information on the metrics used to assess wound healing.

The traditional Indian medical system known as Ayurveda is founded on empirical information gathered from millennia of observations and experience. Various traditional Ayurvedic writings mention about 1200 ailments. The many kinds of these illnesses are treated using almost 1000 medicinal plants (89.93%), 58 minerals, metals, or ores (5.24%), and 54 animal and marine items (4.86%). One Since around 5000 BC, most Ayurvedic literature have addressed wound healing, a key clinical medicine topic, under the heading "Vranaropaka." In his Agnibesha Samhita (later renamed Charaka Samhita), Maharshi Agnibesha first discussed the wound as a medical concern under the title "Vrana." In India, the use of plants as medicine has a long history. Indian tribal people and their folklore traditions use a variety of botanicals, plant extracts, decoctions, or pastes to cure cuts, burns, and wounds.

When physical, chemical, electrical, or microbiological challenges compromise the cellular, anatomical, and functional integrity of living tissue, the result is a wound. Wound healing is described as a complicated process that involves reconstruction or regeneration. Traditional Indian medical practice has long included the use of medicinal plants to treat a range of illnesses. Indian medicinal plants have long been used to treat wounds and a variety of other illnesses and injuries due to their well-known therapeutic qualities.In order to prevent complications, wound healing is a multi-stage, intricate process that needs to be properly cared for and treated. The use of Indian medicinal herbs for wound healing has gained popularity in recent years because of its efficiency and low risk of adverse effects. Examining the numerous Indian medicinal plants that have been investigated for their capacity to heal wounds and their possible applications in the years to come is the goal of this review.

Normal wound healing process

The loss or disruption of cellular, anatomical, or functional continuity of live tissue as a result of physical, chemical, thermal, microbiological, or immunological abuse of the tissues is referred to as a wound.[13,14] A major clinical concern, wound healing abnormalities are likely to worsen when linked to conditions including diabetes, high blood pressure, and obesity. Furthermore, as life expectancies rise, more people will experience these conditions, making wounds an inevitable part of life.[15] The physiological process of wound healing is intricate and multi-step, involving several cells and events. Blood cells, extracellular matrix, parenchymal cells, and soluble mediators are all involved in this dynamic, interactive process. It depends on several interconnected elements.[16,17]

The epidermis, the skin's outermost layer, and the dermis, its innermost layer, normally work together to create a barrier that protects the skin from the outside world. In order to restore the damage, a series of intricate biochemical processes known as wound healing occur in a highly sequential fashion if this protective barrier is breached by any type of injury.[19] illustrates the four continuous, overlapping, and well-planned processes that often characterize normal wound healing: hemostasis (blood clot formation), inflammation, proliferation or granulation, and remodeling or maturation (scar creation). Figure 1

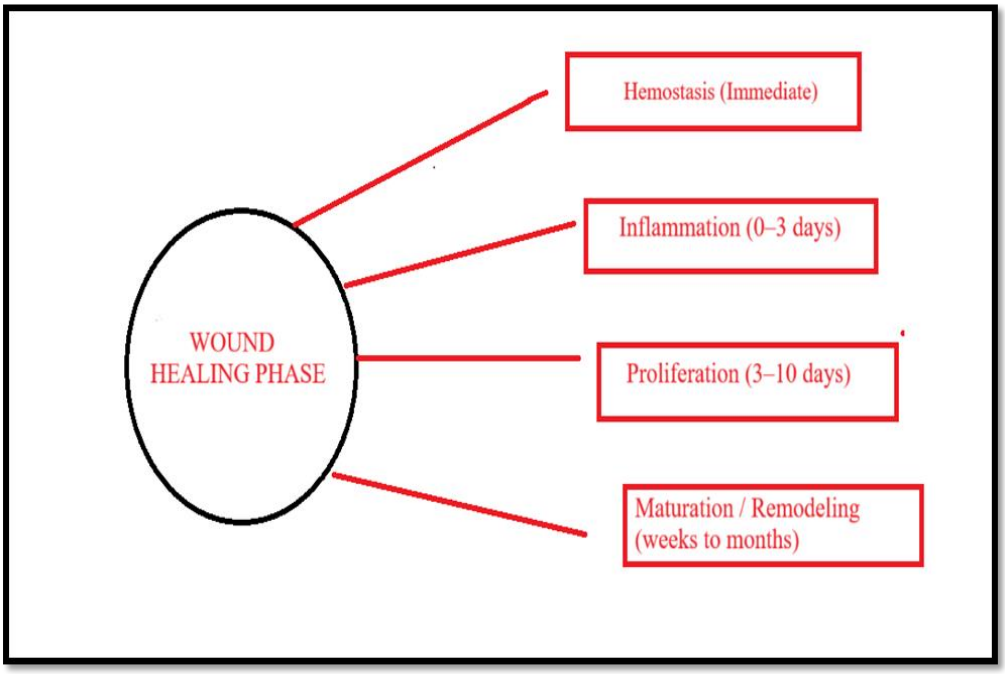

Figure. 1 The typical procedure for wound healing.

Table 1. Process of wound healing.

Phases	Cellular and Bio-physiological events
Hemostasis	Constriction of blood vessels Aggregation of platelets, degranulation, and production of fibrin (thrombus)
Inflammation	Infiltration of neutrophils Infiltration of monocytes and their development into macrophages Infiltration of lymphocytes
Proliferation	Repairing the epithelium Angiogenic The production of collagen development of extracellular matrix
Remodeling	Remodeling of collagen Vascular development and deterioration

Role of traditional medicines in wound healing

The majority of the world's population still relies on herbal remedies for their basic medical requirements, particularly in underdeveloped nations. Traditional medicine is used because it is easily accessible, reasonably priced, and deeply ingrained in people's religious beliefs.[23,24] Any nation can benefit much from traditional knowledge since it is essential to the country's progress and social transformation.[25] Traditional medicine refers to a compilation of various physicians' therapeutic experiences with indigenous or traditional medical systems.[26] "Traditional medicine refers to health practices, approaches, knowledge, and beliefs incorporating plant, animal, and mineral based medicines, spiritual therapies, manual techniques, and exercises, applied singly or in combination to treat, diagnose, and prevent illnesses or maintain well-being," said the World Health Organization. Natural medicine, herbal medicine, phyto-medicine, non-traditional medicine, indigenous medicine, folk medicine, ethnomedicine, supplementary and alternative medicine, and so forth are some of the names for traditional medicine.[27] People continue to treat a range of ailments with traditional plant-based knowledge, skills, and practices in rural places where access to modern healthcare facilities is still restricted.[28]

According to estimates, 70% of Ayurvedic medications for wound healing are derived from plants, 20% are derived from minerals, and the other 10% are derived from animal products.[29] In order to promote the creation of an environment that is conducive to the natural healing process, traditional wound care techniques include cleaning, debridement, and moisturizing the area.[30] In table .2 and table. 3 enlisted the plants common name, scientific name, and reported activity.

Table 2: Some plants name and reported activity.

Common Name	Scientific Name	Reported Activity / Mechanism	Reference
Aloe Vera	*Aloe barbadensis Miller*	Enhances fibroblast activity and collagen synthesis	[31]
Turmeric	*Curcuma longa*	Anti-inflammatory, antioxidant, promotes tissue regeneration	[32]
Neem	*Azadirachta indica*	Antimicrobial, anti-inflammatory, promotes granulation tissue	[33]
Gotu Kola	*Centella asiatica*	Promotes collagen production, increases tensile strength	[34]
Indian Pennywort	*Hydrocotyle asiatica*	Stimulates connective tissue and wound contraction	[35]
Triphala	*Emblica officinalis, Terminalia chebula,*	Antioxidant, anti-inflammatory, enhances healing	[36]

	Terminalia bellirica		
Tulsi (Holy Basil)	*Ocimum sanctum*	Anti-inflammatory, antimicrobial	[37]
Plantain	*Plantago major*	Promotes wound contraction and epithelialization	[38]
Ashwagandha	*Withaniasomnifera*	Increases fibroblast proliferation and collagen content	[39]
Jatyadi Oil Plants	Mix (e.g., *Wrightia tinctoria*, *Azadirachta indica*)	Classical Ayurvedic wound healer	[40]

Table 3: Scientifically evident plants used for wound healing activity.

Plant Name (Scientific / Common)	Family	Plant Part Used	Extract Type	Wound Model
Acorus calamus / Bach	Acoraceae	Green leaves	Ethanolic	Excision and incision[41]
Allium sativum / Garlic	Liliaceae	Bulb	Aqueous and Ethanolic	Excision, incision and dead space[42]
Adhatodavasica / Adalsa	Acanthaceae	Leaves	Methanolic, chloroform, diethyl ether	Excision[43]
Alternanthera Brasiliana / Gudaari saag	Amaranthaceae	Leaves	Methanolic	Excision, incision, chorioallantoic membrane[44]
Andrographis paniculata / Kalmegh	Acanthaceae	Whole plant	Ethanolic	Excision[45]
Areca catechu / Betel nut	Arecaceae	Areca nut	Ethanolic	Burn wound[46]
Butea monosperma / Palash	Fabaceae	Stem bark	Ethanolic	Excision, incision and dead space[47]
Cassia fistula / Amaltas	Caesalpinioideae	Leaves	Ethanolic	Incision[48]
Catharanthus roseus / Vinca rosea	Apocynaceae	Flower	Ethanolic	Excision, incision and dead space[49]
Carica papaya / Papya	Caricaceae	Fruit latex	Dried latex	Burn wound[50]
Cordia dichotoma / Lasura	Boraginaceae	Leaves	Ethanol, petroleum ether, butanol, ethyl acetate	Excision, incision and dead space[51]
Embeliaribes / Vayavidanga	Myrsinaceae	Leaves	Ethanol	Excision, incision and dead space[52]
Ficus religiosa / Peepal	Moraceae	Leaves	Hydroalcoholic	Excision and incision[53]
Gentiana lutea / Gentian	Gentianaceae	Rhizomes	Alcoholic and petroleum ether	Excision and Incision[54]
Glycyrrhiza glabra / Mulhatti	Leguminosae	Root	Aqueous	Excision[55]
Gymnemasylvestre / Gurmar	Asclepiadaceae	Leaves	Aqueous	Excision[56]
Heliotropium indicum / Siriyari	Boraginaceae	Whole plant	n-Butanol	In-vitro model[57]
Indigofera enneaphylla /	Leguminosae	Whole	Pet ether, ethyl	Excision and

Latahai		plant	acetate and ethanol	incision[58]
Jasminum auriculatum / Juhi	Oleaceae	Juice of leaves	Juice of leaves	Excision[59]
Kaempferia galangal / Chandramula	Zingiberaceae	Rhizomes	Alcoholic	Excision, incision and dead space[60]
Lycopodium serratum / Club moss	Huperziaceae	Whole plant	Ethanolic	Excision, incision and dead space[61]
Mimosa pudica / Chuimui	Fabaceae	Leaves	Ethanolic	Excision and burn wound[62]
Mimusopselengi / Mulsari, Bakula	Sapotaceae	Stem bark	Methanolic	Excision, incision[63]

CONCLUSION

Ancient Indian literature has long recorded the usage of plants for medical purposes because they are vital to human survival. In India, traditional medicine is widely practiced. A sizable section of the populace, primarily from rural areas, still relies on traditional medicine for a variety of medical conditions. It is obvious that no healthcare system can meet the public's demands for healthcare on its own. As a result, traditional and cultural medical knowledge helps to meet the demands of health care. Many plants have been reported to have the ability to heal wounds because they contain valuable phytoconstituents. In the majority of these investigations, plants or extracts are randomly screened for their ability to heal wounds.

Since all of the plant items listed in the table have demonstrated effective outcomes in real-world testing and use, there is a greater need to identify and look into each active component that contributes to the healing process. Better medications for wound healing with fewer side effects can be created by combining traditional and modern expertise. Such traditional plant knowledge can serve as the foundation for innovative drug delivery systems for wound healing goods as well as therapeutic, medicinal, and pharmacological applications.

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