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WOUND HEALING HERBS

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Abstract

As old as humanity, wounds are clinical entities that frequently cause issues in therapeutic practice. Naturally, there has always been an inquisitive curiosity to advance healing. It has been difficult to produce new therapeutic agents and stay up to date with the issues faced, despite the extensive study that has been planned to create better ones. The Ayurveda describes a number of medications with the ability to heal wounds, including those derived from plants, minerals, and animals. The majority of these medications come from plants. A few of these plants have undergone scientific screening in order to assess their capacity to heal wounds using various pharmacological models. In experimental models, it was discovered that a few Ayurvedic medicinal plants, including Lawsonia inermis, Boerhaavia diffusa, Argemone mexicana, Catharanthus roseas, Diospyros cardifolia, Eclipta alba, Ficus religiosa, Hypericum perforatum, and Swertia chirata, were useful. The contraction that starts a few days after damage and lasts for several weeks has a significant role in how quickly wounds heal. In this review, many features of wound healing are attempted to be understood in terms of wound closure %, time to complete epithelialization, tensile strength, histology, and weight of granuloma in various wound models.

Introduction

With regard to its natural resources, India is the most lavish country on the planet. A greater portion of the general public and network has relied on customary prescription since ancient times. Research has shown that a significant supply of bioactive substances with antibacterial and anticancer capabilities is found in plants (Mallik, et al., 2014). Due to their many pharmacological characteristics, plants have great therapeutic value for people. Many different plants are now used to make a large number of drugs that are effective against a variety of issues.

Despite being widely used, synthetic drugs can cause certain unfavorable side effects in their users. Herbal remedies are effective at that stage since they are not harmful and germs do not develop a resistance to them (Sarkar, et al., 2013). In light of this, there is a growing desire to discover new herbal remedies for the treatment of incurable illnesses.

A wound is just the collapse of the skin's and tissues' ability to protect. Its infection is the result of one or more microorganism species invading the tissues. Numerous therapeutic plants are incredibly effective in healing wounds. When compared to synthetic treatments, the medications made from these medicinal plants are said to be safer and more affordable, making them excellent pharmaceuticals.

Certainly! Here are 15 names of herbs that are commonly used in wound healing:

1) Aloe vera (Aloe barbadense)
2) Calendula (Calendula officinalis)
3) Chamomile (Matricaria chamomilla or Chamaemelum nobile)
4) Comfrey (Symphytum officinale)
5) Lavender (Lavandula angustifolia or Lavandula officinalis)
6) Plantain (Plantago major or Plantago lanceolata)
7) Yarrow (Achillea millefolium)
8) Echinacea (Echinacea purpurea or Echinacea angustifolia)
9) Witch hazel (Hamamelis virginiana)
10) St. John's Wort (Hypericum perforatum)
11) Myrrh (Commiphora myrrha)
12) Ginger (Zingiber officinale)
13) Neem (Azadirachta indica)
14) Turmeric (Curcuma longa)
15) Licorice (Glycyrrhiza glabra)

1.Aloe vera (Aloe barbadense)

Aloe vera (Aloe barbadense) has been used for ages to aid in the healing of wounds, and current scientific study confirms this use's effectiveness. Numerous bioactive substances, such as polysaccharides, anthraquinones, glycoproteins, vitamins, minerals, and enzymes, are present in aloe vera and contribute to its medicinal qualities. Here is a thorough examination of aloe vera's function in wound healing from a pharmacognostic standpoint, complete with references to studies demonstrating its effectiveness:

- Polysaccharides:

Polysaccharides found in aloe vera, particularly acemannan, have the ability to modulate the immune system and promote wound healing. Acemannan promotes collagen formation and tissue healing by activating fibroblasts and macrophages.Additionally, these polysaccharides have anti-inflammatory properties that speed up the healing process by lowering inflammation at the location of the lesion[(1)]

- Anthraquinones:

Aloin and emodin, two anthraquinones present in aloe vera, have antibacterial and anti-inflammatory qualities. They aid in wound healing by lowering inflammation and preventing infection at the location of the wound.

Furthermore, anthraquinones may promote tissue regeneration by increasing collagen deposition and fibroblast proliferation.[(2)]

- Glycoproteins:

Glycoproteins with anti-inflammatory and analgesic qualities, such as aloctin A and aloctin B, are found in aloe vera. They facilitate comfort and quicker healing by assisting in the reduction of pain and inflammation brought on by wounds.

Moreover, glycoproteins boost immunological response, which improves the body's capacity to fight infection and quicken tissue healing.[(3)]

Because of its complex pharmacognostic profile, aloe vera is a useful natural treatment for wound healing. Numerous preclinical and clinical investigations have shown that it can decrease inflammation, prevent infection, aid in tissue healing, and ease pain. Nonetheless, additional investigation is necessary, especially through carefully planned clinical studies, to clarify its modes of action and maximize its therapeutic uses in wound care.

2.Calendula (Calendula officinalis)

Has been utilized for millennia due to its therapeutic qualities, especially for the treatment of wounds. Numerous bioactive substances in its pharmacognostic profile support its therapeutic actions. This is a summary of the pharmacognostic role of calendula in wound healing, backed by references:

- Flavonoids and Triterpenoids:

Flavonoids (such as quercetin and rutin) and triterpenoids (such as faradiol esters) found in calendula have anti-inflammatory and antioxidant qualities.By lowering oxidative stress and inflammation at the wound site, these substances help to create an environment that is conducive to tissue healing.(4)

- Mucilage and Polysaccharides:

Mucilage and polysaccharides found in calendula have emollient and moisturizing qualities that serve to keep the region around the wound wet and protected. These compounds also form a barrier around the site that keeps microorganisms out and encourages wound closure (5).

- Saponins:

Saponins, found in calendula, are surfactant and detergent-like substances. By encouraging tissue regeneration and eliminating debris, these substances aid in the cleansing of wounds.Additionally, saponins exhibit a slight antibacterial activity that aids in preventing wound infection.(6)

- Essential Oils:

Calendula essential oil has volatile chemicals such limonene, Î²-pinene, and Î±-pinene that have antibacterial and anti-inflammatory qualities.These essential oils aid in wound healing, inflammation reduction, and infection prevention.(7)

Calendula is a useful natural wound healing treatment due to its wide range of bioactive chemicals. Numerous preclinical and clinical investigations have shown its capacity to lower inflammation, encourage tissue regeneration, fend off infection, and shield wounds. To further understand its mechanisms of action and maximize its therapeutic uses in wound care, more research is necessary.

3.Chamomile (Matricaria chamomilla or Chamaemelum nobile)

Is a well-known plant that has been used for many medicinal purposes, including wound healing, in traditional medicine. Chamomile's pharmacological effects are attributed to a number of bioactive substances, including flavonoids, apigenin, bisabolol, and chamazulene. Below is a summary of chamomile's pharmacognostic role in wound healing, coupled with references that attest to its effectiveness:

- Chamazulene:

A strong anti-inflammatory substance present in chamomile essential oil is called chamazulene. It lessens inflammation at the wound site by inhibiting inflammatory mediators such prostaglandin and leukotrienes. Chamazulene speeds up the healing process and creates an environment that is conducive to wound healing by reducing inflammation.(8)

- Apigenin:

The flavonoid apigenin, which has anti-inflammatory and antioxidant qualities, is present in chamomile flowers. It promotes wound healing by scavenging free radicals, lowering oxidative stress, and modifying inflammatorypathways.

Furthermore, apigenin promotes fibroblast and keratinocyte proliferation, which improves tissue regeneration and re-epithelialization.(9)

- Bisabolol:

Chamomile essential oil contains a sesquiterpene alcohol called bisabolol. It has antibacterial, anti-inflammatory,and wound-healing qualities.

Bisabolol is helpful for wound treatment because it quickens wound closure, lessens the production of scars, and calms skin irritation.(10)

Because of its broad range of pharmacological properties, chamomile is an effective natural treatment for wound healing. Numerous preclinical and clinical investigations have shown that it can reduce inflammation, scavenge free radicals, promote tissue regeneration, and ease skin irritation. But further investigation is required to completely understand its mechanisms of action and maximize its therapeutic uses in wound care—especially well-designed clinical studies.

4.Comfrey (Symphytum officinale)

is a medicinal herb that has been used for generations to lessen inflammation and encourage the healing of wounds. Allantoin, rosmarinic acid, tannins, and mucilage are among the bioactive substances that give it its pharmacological properties. Below is a summary of comfrey's pharmacognostic role in wound healing, coupled with references that attest to its effectiveness:

- Allantoin:

One important ingredient in comfrey that has keratolytic, moisturizing, and wound-healing qualities is allantoin. It promotes quicker wound closure by accelerating tissue regeneration and cell proliferation. Additionally, allantoin has anti-inflammatory properties that help to lessen wound pain and inflammation at the location of the wound.(11)

- Rosmarinic Acid:

A phenolic molecule with anti-inflammatory and antioxidant qualities that is present in comfrey is called rosmarinic acid. It promotes wound healing by scavenging free radicals, lowering oxidative stress, and modifying inflammatorypathways.

To further enhance its anti-inflammatory properties, rosmarinic acid also stifles the activity of enzymes linked to inflammation, including lipoxygenase and cyclooxygenase.(12)

- Tannins and Mucilage:

Mucilage and tannins, which have astringent and emollient qualities, respectively, are found in comfrey. These substances support tissue healing, decrease exudate, and shield the wound. Additionally, tannins possess antibacterial qualities that aid in wound healing and infection prevention.(13) Due to its pharmacognostic profile, comfrey is an effective natural wound healing therapy. Numerous preclinical and clinical investigations have shown that it can protect the wound, encourage tissue regeneration, decrease inflammation, and boost cell proliferation. However, internal usage of comfrey is not advised due to concerns of hepatotoxic pyrrolizidine alkaloids; caution should be exercised with external applications, particularly on open wounds or for extended periods of time.

5.Lavender (Lavandula angustifolia or Lavandula officinalis)

A fragrant herb with relaxing scent and healing qualities. It has been used historically for a number of uses, such as the healing of wounds. The pharmacological properties of lavender are attributed to a number of bioactive substances, including cineole, linalyl acetate, linalool, and camphor. Below is a summary of the pharmacognostic role of lavender in wound healing, coupled with references that attest to its effectiveness: Antimicrobial Properties:

Broad-spectrum antibacterial action against bacteria, fungi, and viruses is demonstrated by lavender essential oil. Because of its antibacterial qualities, it helps to keep the wound site free of infections and fosters a healing environment.

The main ingredients in lavender oil that have antibacterial properties are linalool and linalyl acetate.(14) Effects against Inflammation:

The anti-inflammatory actions of lavender are ascribed to substances such as linalyl acetate and linalool. These substances lessen pain, lessen inflammation at the location of the wound, and block inflammatory pathways.

Lavender reduces inflammation, which speeds up the healing of wounds and improves tissue restoration.(15) Support of Granulation and Epithelialization: Research has demonstrated that lavender oil supports the development of granulation tissue and epithelialization, two crucial processes in the healing of wounds. It quickens the migration of fibroblasts and keratinocytes, which causes the wound to close more quickly.

Linalool and linalyl acetate are two compounds that help lavender oil's skin-regenerating properties.(16) Lavender is an effective natural treatment for wound healing due to its pharmacognostic profile. The compound's antibacterial, anti-inflammatory, and regenerative characteristics facilitate faster wound closure and improved tissue healing.

6.Plantain (Plantago major or Plantago lanceolata)

Is a medicinal herb that has been used for generations for its healing qualities, which include the ability to heal wounds. Aucubin, allantoin, mucilage, and flavonoids are among the bioactive substances it contains that contribute to its pharmacological effects. Below is a summary of the pharmacognostic role of plantains in wound healing, along with references that attest to its effectiveness:

• Cucurbitin: A significant bioactive component present in plantain leaves is cucurbitin. It has antibacterial, anti-inflammatory, and wound-healing qualities.

- Aucubin promotes the growth of fibroblasts and keratinocytes, which quickens tissue regeneration and speeds up wound closure.(17)

- Allantoin: A substance present in plantains that stimulates tissue regeneration and cell proliferation to aid in wound healing. It facilitates wound healing by softening the skin and encouraging the removal of dead skin cells.
- Mucilage
- Mucilage, a gel-like material found in plantains, acts as a barrier to shield wounds. This barrier aids in tissue regeneration, inflammation reduction, and infection prevention.[18]
- Additionally, mucilage keeps wounds wet, which is necessary for fibroblast growth and granulation tissue production.[19]

Flavonoids: Plantains contain flavonoids with anti-inflammatory and antioxidant qualities, such as luteolin and apigenin. They facilitate quicker healing by lowering pain, inflammation, and oxidative stress at the site of the lesion.

Additionally, flavonoids promote the synthesis and deposition of collagen, which strengthens and preserves the integrity of the newly produced tissue.[20]

7.St. John's Wort (Hypericum perforatum)

Is a medicinal herb that has been used for a variety of therapeutic purposes, including wound healing. It contains a number of bioactive compounds, such as hypericin, hyperforin, flavonoids, and tannins, which all contribute to its pharmacological effects. The following is a summary of the role that St. John's Wort plays in wound healing from a pharmacognostic perspective, along with references that support its efficacy: • Hyperforin and hyperhypericin: Hyperforin and hypericin are two major bioactive compounds found in St. John's Wort. These compounds have antimicrobial, anti-inflammatory, and wound healing properties. They also inhibit the growth of bacteria, fungi, and viruses, which prevent infections at the wound site and promote healing. Finally, these compounds modulate inflammatory pathways, which reduce inflammation and and pain associated with wounds.and pain associated with wounds.[21]

Flavonoids: St. John's Wort includes flavonoids with anti-inflammatory and antioxidant qualities, including hyperoside, rutin, and quercetin.By scavenging free radicals, lowering oxidative stress, and controlling inflammatory responses, flavonoids aid in tissue regeneration and repair.[22] Tannins: St. John's Wort contains tannins that have astringent qualities and act as a barrier to prevent wounds.

Additionally, tannins possess antibacterial properties that hinder the development of microorganisms and lower the likelihood of infection.[23] St. John's Wort is an effective natural treatment for wound healing due to its pharmacognostic profile. Its antibacterial, anti-inflammatory, and antioxidant qualities aid in tissue restoration, inflammation reduction, and infection prevention. But more study is required, especially well-designed clinical studies, to completely understand its mechanisms of action and maximize its therapeutic potential.

8.Yarrow (Achillea millefolium)

Is a therapeutic herb that has been used for many years for a variety of reasons in traditional medicine, including the healing of wounds. Its pharmacological effects are attributed to a number of bioactive components, including flavonoids, sesquiterpene lactones, alkaloids, tannins, and volatile oils. Below is a summary of yarrow's pharmacognostic role in wound healing, coupled with references that attest to its effectiveness:

• Flavonoids: Flavonoids with anti-inflammatory and antioxidant qualities, such as quercetin, luteolin, and apigenin, are found in yarrow.By scavenging free radicals, lowering oxidative stress, and controlling inflammatory responses, flavonoids aid in tissue regeneration and repair.[24]

- Sesquiterpene Lactones: Yarrow has sesquiterpene lactones that have anti-inflammatory and wound-healing qualities, such as achillin and achillicin.
- These substances support tissue regeneration, lessen inflammation, and quicken wound healing.[25]

Alkaloids found in yarrow, like achilleine, have antibacterial and wound-healing qualities. Alkaloids prevent infections at the wound site and promote healing by inhibiting the growth of bacteria, fungus, and other microorganisms.[26] Tannins: Yarrow has tannins, which are astringent substances that form a protective barrier to help shield the wound.

Additionally, tannins possess antibacterial properties that hinder the development of microorganisms and lower the likelihood of infection.[27]
Thanks to its pharmacognostic profile, yarrow is an effective natural wound healing therapy. Its astringent, anti-inflammatory, antibacterial, and antioxidant qualities aid in tissue restoration, inflammation reduction, and infection prevention. But further investigation is required to completely understand its mechanisms of action and maximize its therapeutic uses in wound care—especially well-designed clinical studies.

9.Echinacea (Echinacea purpurea or Echinacea angustifolia)

Is a well-liked medicinal herb with immune-stimulating qualities. Because of its many bioactive components, it aids in wound healing even though its main usage is in immunomodulatory treatments. Below is a summary of the pharmacognostic role of Echinacea in wound healing, coupled with references that attest to its effectiveness:
• Alkamides: Research has demonstrated that the alkamides found in echinacea, such as echinacoside and echinacein, have anti-inflammatory and immunomodulatory qualities.
These substances have the ability to lessen inflammation at the location of the wound, creating an atmosphere that is favorable for healing.[28]
Polysaccharides: Polysaccharides found in echinacea, such as heteroxylans and arabinogalactans, have immunostimulatory properties and may help wound healing indirectly by boosting immune function.
These polysaccharides have the ability to increase the synthesis of immune mediators like as cytokines that are implicated in tissue.

10.Witch hazel (Hamamelis virginiana)

Is a plant that is well-known for its anti-inflammatory and astringent qualities, which make it a popular choice for treating a variety of skin ailments, including wound healing. Flavonoids, volatile oils, and tannins are components of its pharmacognostic profile that support its therapeutic benefits. The following provides a pharmacognostic review of witch hazel's involvement in wound healing, along with references that attest to its effectiveness:

• Tannic acids: Witch hazel has a lot of tannins, especially condensed tannins, which have an astringent effect.

Tannins have the ability to narrow blood vessels and lessen inflammation, which can aid with wound pain and swelling.[29]
• Flavonoids: Quercetin and kaempferol, two flavonoids with anti-inflammatory and antioxidant qualities, are also present in witch hazel.
Flavonoids promote the body's natural defenses against oxidative stress, scavenge free radicals, and regulate inflammatory reactions.Is a plant that is well-known for its anti-inflammatory and astringent qualities, which make it a popular choice for treating a variety of skin ailments, including wound healing. Flavonoids, volatile oils, and tannins are components of its pharmacognostic profile that support its therapeutic benefits. The following provides a pharmacognostic review of witch hazel's involvement in wound healing, along with references that attest to its effectiveness:

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Flavonoids promote the body's natural defenses against oxidative stress, scavenge free radicals, and regulate inflammatory reactions.Due to its astringent and anti-inflammatory qualities, witch hazel (Hamamelis virginiana) is a popular herb for treating a variety of skin issues, including wound healing. Flavonoids, volatile oils, and tannins are components of its pharmacognostic profile that support its therapeutic benefits. The following provides a pharmacognostic review of witch hazel's involvement in wound healing, along with references that attest to its effectiveness:

- Tannins: Condensed tannins, which have astringent qualities, are present in high concentrations in witch hazel.

- Tannins have the ability to narrow blood vessels and lessen inflammation, which can aid with wound pain and swelling.(31)

- Flavonoids: Quercetin and kaempferol, two flavonoids with antioxidant and anti-inflammatory qualities, are also present in witch hazel. Flavonoids aid in the healing process by scavenging free radicals, lowering oxidative stress, and controlling inflammatory reactions.(32)

- Volatile Oils: - Witch hazel has volatile oils that have antibacterial qualities and may help stop wound infections. These oils may have a slight calming impact on the skin in addition to adding to the plant's pleasant perfume.(33)

Witch hazel is an effective natural wound healing medicine because of its pharmacognostic qualities. Its astringent, anti-inflammatory, and antibacterial properties can aid in lowering inflammation, pain, and infection risk while accelerating the healing process as a whole. Witch hazel is generally regarded as safe for topical application, but before putting it on open wounds or delicate skin, it is imperative to conduct a patch test and speak with a healthcare provider.

11.Myrrh (Commiphora myrrha)

Traditional medicine has traditionally used myrrh (Commiphora myrrha), especially for skin care and wound healing. Sesquiterpenes, terpenoids, and phenolic compounds are among the bioactive substances that give it its pharmacological properties. The following provides a pharmacognostic summary of myrrh's involvement in wound healing, along with references that attest to its effectiveness:
1.Sesquiterpenes: Myrrh is a rich source of sesquiterpenes, which have anti-inflammatory and antibacterial qualities. These include myrrhadiene, curzerene, and furanodiene. These substances aid in the healing process by lowering inflammation and preventing infections at the location of the wound.(34)
2. Terpenoids: limonene and pinene, two terpenoids found in myrrh, have the ability to heal wounds and act as antioxidants.
- These substances aid in tissue healing, oxidative stress reduction, and free radical scavenging.(35)

3. Phenolic Compounds: Flavonoids and phenolic acids, two types of phenolic compounds found in myrrh, have anti-inflammatory and antioxidant qualities. The aforementioned substances facilitate the process of wound healing by mitigating inflammation, stimulating tissue regeneration, and providing protection against oxidative damage.(36)

Myrrh may have a part in wound healing, according to its pharmacognostic profile, which mainly highlights its anti-inflammatory, antibacterial, and antioxidant properties. For wound care, however, more thorough clinical trials are required to validate its advantages and best practices. Furthermore, when applying myrrh topically, people with documented allergies or sensitivities to it should use caution.

For generations, people have been aware of the medical benefits of garlic, or Allium sativum, which may include the ability to heal wounds. It has a number of bioactive ingredients that support its pharmacological actions, such as vitamins, flavonoids, sulfur compounds, and allicin. Below is a summary of the pharmacognostic role of garlic in wound healing, coupled with references that attest to its effectiveness:

- Allicin:

- Allicin is one of the key bioactive compounds in garlic responsible for its antimicrobial properties. It exhibits broad-spectrum antimicrobial activity against bacteria, fungi, and viruses.

- By inhibiting microbial growth, allicin helps prevent infections at the wound site, promoting a conducive environment for healing.(37)

- Sulfur Compounds:

- Garlic contains sulfur compounds such as diallyl sulfide, diallyl disulfide, and diallyl trisulfide, which exhibit antioxidant and anti-inflammatory properties.

- These compounds help reduce oxidative stress and inflammation at the wound site, promoting tissue repair and regeneration.(38)

- Flavonoids:

- Garlic contains flavonoids such as quercetin and kaempferol, which possess antioxidant and anti-inflammatory properties.

- Flavonoids scavenge free radicals, reduce oxidative stress, and modulate inflammatory responses, supporting the healing process.(39)

Garlic's pharmacognostic properties make it a potential natural remedy for wound healing. Its antimicrobial, antioxidant, and anti-inflammatory effects contribute to the prevention of infections, reduction of inflammation, and promotion of tissue repair. However, further research, particularly well-designed clinical trials, is needed to fully elucidate its mechanisms of action and optimize its therapeutic applications in wound care.

12.Ginger (Zingiber officinale)

The well-known spice and medicinal herb ginger (Zingiber officinale) has a variety of pharmacological qualities, some of which may be advantageous for the healing of wounds. Ginger's medicinal properties are attributed to a number of bioactive substances, including flavonoids, shogaols, gingerols, and paradols. Below is a summary of the pharmacognostic role of ginger in wound healing, coupled with references that attest to its effectiveness:

Anti-inflammatory Effects: - By blocking pro-inflammatory cytokines and enzymes such as cyclooxygenase (COX) and lipoxygenase (LOX), gingerols and similar chemicals in ginger have strong anti-inflammatory effects.
- Ginger has the potential to promote wound healing by lowering inflammation, since too much inflammation might impede the healing process.(40)

Antioxidant Activity: Flavonoids and gingerols, two types of antioxidants found in ginger, aid in reducing oxidative stress and neutralizing free radicals.
- Ginger may aid in the healing process by preventing oxidative damage to cells and encouraging tissue regeneration.(41)

Antibacterial Properties: Because ginger contains bioactive chemicals including zingerone and gingerol, it has antibacterial activity against a variety of bacteria, fungi, and viruses.
- Ginger may help promote wound healing by lowering the risk of subsequent infections by avoiding microbial infections.(42) Improved Blood Circulation: Studies have shown that ginger can enhance blood circulation, which may help carry nutrients and oxygen to the location of the lesion, hastening its healing process.

- Toxins and waste materials can be removed from the wound region by improved circulation, which will speed up the healing process.(43)

Although ginger has demonstrated encouraging pharmacological qualities that may aid in wound healing, further investigation is required to determine the best dosage and level of efficacy, especially in clinical trials. Ginger may also interact with anticoagulant drugs, therefore people with bleeding disorders or those taking them should use caution when consuming it. It is best to speak with a healthcare provider before utilizing ginger to cure wounds.

13.Neem (Azadirachta indica)

The adaptable medicinal plant neem (Azadirachta indica) has been used for many diseases, including wound healing, in traditional medicine for a very long time. Its wide range of bioactive substances, including polyphenols, alkaloids, flavonoids, triterpenoids, and limonoids, are part of its pharmacognostic profile and contribute to its medicinal benefits. Below is a summary of neem's pharmacognostic role in wound healing, coupled with references that attest to its effectiveness:

- Limonoids: - Neem has limonoids that have antibacterial, anti-inflammatory, and wound-healing qualities. Examples of these include azadirachtin, nimbin, and nimbidin. Limonoids help reduce

inflammation and promote tissue regeneration, which speeds up the healing process. They also limit the growth of bacteria, fungi, and other microorganisms, preventing infections at the wound site.[44]

- Triterpenoids: Triterpenoids, like gedunin and azadirachtin, are found in neem and have immunomodulatory and anti-inflammatory properties. Triterpenoids hasten the healing process by lowering pain, swelling, and inflammation brought on by wounds.[45]
- Flavonoids and Polyphenols: Quercetin, Epicatechin, and other polyphenols, along with their antioxidant and anti-inflammatory qualities, are found in neem.

- In order to promote the healing process, flavonoids and polyphenols scavenge free radicals, lower oxidative stress, and regulate inflammatory responses.[46]

Neem is a useful natural treatment for wound healing because of its pharmacognostic qualities. Its antibacterial, anti-inflammatory, antioxidant, and immunomodulatory properties aid in tissue repair, infection prevention, and inflammation reduction. But further investigation is required to completely understand its mechanisms of action and maximize its therapeutic uses in wound especially well-designed clinical studies.

14.Turmeric (Curcuma longa)

Curcuma longa, also known as turmeric, is a popular spice and medicinal herb that has been used for a very long time in traditional Chinese and Ayurvedic medicine. Turmeric's primary bioactive ingredient, curcumin, is what gives it many of its medicinal qualities. Below is a summary of the pharmacognostic role of turmeric in wound healing, coupled with references that attest to its effectiveness:

Anti-Inflammatory Properties: - By blocking a number of inflammatory pathways and mediators, including NF-kB, COX-2, and cytokines, curcumin has strong anti-inflammatory properties.Turmeric helps facilitate wound healing by lowering inflammation, since too much inflammation might impede the healing process.[47]

Antioxidant Activity: - Curcumin is a strong antioxidant that lowers oxidative stress, a common occurrence, and scavenges free radicals.

Research have demonstrated that the main ingredient in turmeric, curcumin, speeds up the migration and proliferation of fibroblasts and keratinocytes—cells necessary for tissue repair—thereby promoting wound healing. Additionally, turmeric may promote collagen synthesis, which would help scar formation and wound closure.[48]

Turmeric's promise as a natural wound care treatment is supported by its pharmacognostic profile, which includes its anti-inflammatory, antioxidant, and wound healing capabilities. Even while turmeric is usually regarded as safe for topical application, it's crucial to conduct a patch test and speak with a medical practitioner, particularly if applying it to delicate skin types or open wounds. Furthermore, additional investigation is required to clarify its mechanisms of action and maximize its therapeutic uses in wound care, especially through well planned clinical studies.

15.Licorice (Glycyrrhiza glabra)

Traditional medical systems have traditionally used licorice (Glycyrrhiza glabra), a medicinal plant, for a variety of ailments, including wound healing. Glycyrrhizin, flavonoids, saponins, and polysaccharides are a few of the bioactive substances found in licorice that support its pharmacological actions. Here is a summary of licorice's pharmacognostic significance in wound healing, coupled with references to studies that attest to its effectiveness:

Glycyrrhizin: Research has demonstrated that glycyrrhizin, one of the primary bioactive components of licorice, has anti-inflammatory, antibacterial, and immunomodulatory effects. Glycyrrhizin can aid in wound healing by lowering inflammation at the location of the lesion, preventing the growth of germs, and regulating immunological responses.[49]

Flavonoids: Flavonoids with antioxidant and anti-inflammatory qualities, such as glabridin, isoliquiritigenin, and liquiritigenin, are found in licorice.

Saponins: Glycyrrhizic acid, one of the saponins found in licorice, has anti-inflammatory and wound-healing qualities. These saponins have the ability to speed up wound closure, encourage tissue regeneration, and lessen inflammation.(50)

Polysaccharides: Polysaccharides are found in licorice, and they have immunomodulatory properties. They may also help wound healing indirectly by boosting immune activity.The synthesis of cytokines and other immune mediators involved in tissue repair processes can be stimulated by these polysaccharides.(51)

Licorice may have an impact on wound healing due to its anti-inflammatory, antibacterial, and immunomodulatory properties, according to its pharmacognostic profile. Although licorice has long been used to treat wounds, more thorough scientific investigation—especially clinical trials—is required to confirm its effectiveness and safety in this context. Furthermore, different people may react differently to licorice, so caution should be used, particularly in those who are on medication or have specific medical issues.

16.Echinacea (Echinacea purpurea or Echinacea angustifolia) is a popular medicinal herb known for its immune-boosting properties. primarily used for its immunomodulatory effects, it also plays a role in wound healing due to its various bioactive compounds. an overview of the role of Echinacea in wound healing from a pharmacognostic perspective, along with references supporting its efficacy:

 Alkamides:

Echinacea contains alkamides, such as echinacoside and echinacein, which have been shown to possess anti-inflammatory and immunomodulatory properties. These compounds can help reduce inflammation at the wound site, promoting a conducive environment for healing.(28)

Polysaccharides:

Echinacea contains polysaccharides, including arabinogalactans and heteroxylans, which have immunostimulatory effects and may indirectly support wound healing

by enhancing immune function. These polysaccharides can stimulate the production of cytokines and other immune mediators involved in tissue repair processes.(29)

 Flavonoids:

Echinacea contains flavonoids, such as quercetin and kaempferol, which possess antioxidant and anti-inflammatory properties. These compounds can help reduce oxidative stress and inflammation, which are

crucial factors in the wound healing process.(30)

Echinacea's pharmacognostic profile suggests its potential role in wound healing, primarily through its anti-inflammatory and immunomodulatory effects. However, while some preclinical studies and anecdotal evidence support its efficacy, more robust clinical trials are needed to confirm its benefits in wound care. Additionally, individual responses to Echinacea may vary, and caution should be exercised,

particularly in individuals with autoimmune conditions or allergies.

17.Arnica (Arnica montana)

is a flowering plant that has been traditionally used in herbal medicine for its purported wound healing properties. While there is limited scientific evidence to support its efficacy, Arnica is believed to contain bioactive compounds such as sesquiterpene lactones, flavonoids, and phenolic acids, which may contribute to its

pharmacological effects. an overview of the potential role of Arnica in wound healing from a pharmacognostic perspective, along with references supporting its use:

 Sesquiterpene Lactones:

Arnica is rich in sesquiterpene lactones, such as helenalin and dihydrohelenalin, which possess anti-inflammatory and analgesic properties.

These compounds may help reduce inflammation, swelling, and pain associated with wounds and injuries, thereby promoting the healing process.(31)

Flavonoids:

Arnica contains flavonoids such as quercetin and kaempferol, which exhibit antioxidant and anti-inflammatory properties.

These flavonoids may help protect cells from oxidative damage, reduce inflammation, and support tissue repair during the wound healing process.(32)

 Phenolic Acids:

Arnica contains phenolic acids, including caffeic acid and chlorogenic acid, which have antioxidant and anti-inflammatory properties.

These compounds may help scavenge free radicals, reduce oxidative stress, and modulate inflammatory responses, thereby promoting wound healing.(33)

Hoffmann, D. (2003). Medical herbalism: The science and practice of herbal medicine. Healing Arts Press.

While Arnica has been traditionally used for wound healing, there is still a need for more rigorous scientific research to validate its efficacy and safety. Limited clinical studies have been conducted, and results have been mixed. Additionally, Arnica

preparations should be used with caution, as they may cause allergic reactions or other adverse effects in some individuals. It's essential to consult with a healthcare professional before using Arnica for wound healing or any other medicinal purposes.

18.Witch hazel (Hamamelis virginiana)

is a plant known for its astringent and anti-inflammatory properties, making it a popular choice for various skin conditions, including wound healing. Its pharmacognostic profile includes tannins, flavonoids, and volatile oils, which

contribute to its medicinal effects. an overview of the role of witch hazel in wound healing from a pharmacognostic perspective, along with references supporting its efficacy:

 Tannins:

Witch hazel contains high levels of tannins, particularly condensed tannins, which possess astringent properties.

Tannins help to constrict blood vessels and reduce inflammation, which can help alleviate pain and swelling associated with wounds.(34)

 Flavonoids:

Witch hazel also contains flavonoids, such as quercetin and kaempferol, which have antioxidant and anti-inflammatory properties.

Flavonoids help to scavenge free radicals, reduce oxidative stress, and modulate inflammatory responses, supporting the healing process.(35)

 Volatile Oils:

Witch hazel contains volatile oils, which have antiseptic properties and may help prevent infections in wounds.

These oils also contribute to the plant with pleasant aroma and may have a mild soothing effect on the skin

pharmacognostic properties make it a valuable natural remedy for wound healing. Its astringent, anti-inflammatory, and antiseptic effects can help

reduce pain, swelling, and the risk of infection, promoting the overall healing process. However, while witch hazel is generally considered safe for topical use, essential to perform a patch test and consult with a healthcare professional,

especially if using it on open wounds or sensitive skin.Witch hazel (Hamamelis virginiana) is a plant known for its astringent and anti-

inflammatory properties, making it a popular choice for various skin conditions,including wound healing. Its pharmacognostic profile includes tannins, flavonoids,and volatile oils, which contribute to its medicinal effects. an overview of the role of witch hazel in wound healing from a pharmacognostic perspective,along with references supporting its efficacy:

1. Tannins:

- Witch hazel contains high levels of tannins, particularly condensed tannins,which possess astringent properties.- Tannins help to constrict blood vessels and reduce inflammation, which can help alleviate pain and swelling associated with wounds.

2. Flavonoids:

- Witch hazel also contains flavonoids, such as quercetin and kaempferol, which have antioxidant and anti-inflammatory properties. - Flavonoids help to scavenge free radicals, reduce oxidative stress, and modulate

inflammatory responses, supporting the healing process.

3. Volatile Oils:

- Witch hazel contains volatile oils, which have antiseptic properties and may help prevent infections in wounds.
- These oils also contribute to the plant's pleasant aroma and may have a mild soothing effect on the skin.

Witch hazel's pharmacognostic properties make it a valuable natural remedy for wound healing. Its astringent, anti-inflammatory, and antiseptic effects can help reduce pain, swelling, and the risk of infection, promoting the overall healing process. However, while witch hazel is generally considered safe for topical use,

it's essential to perform a patch test and consult with a healthcare professional, especially if using it on open wounds or sensitive skin.

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