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A Review of 50 Herbs for Wound Healing: Traditional Use and Modern Evidence

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Abstract

Herbal medicine is the use of plants or plant-based substances to treat various health conditions, including wounds. Wounds are injuries that damage the skin or other body tissues. Wound healing is a complex process that involves four phases: hemostasis, inflammation, proliferation, and remodeling. Herbal medicine can enhance wound healing by providing anti-inflammatory, antimicrobial, antioxidant, and analgesic effects. Herbal medicine can also stimulate cellular regeneration and collagen production, which are essential for tissue repair. In this review, we introduce 50 herbs that have been reported to be effective for wound healing. These plants have a long history of use based on experience, but they have also been confirmed to be effective in wound healing by modern medical methods. However, herbal medicine should not replace conventional medical care for severe wounds. These plants can be a good source for researchers to design and make more effective drugs with less side effects for wound healing.

Introduction

Medicinal plants are widely used to treat various diseases because of their therapeutic effects. They are rich sources of phytochemicals that have potential therapeutic effects when applied directly as raw materials. They also contribute to the development of new medicines(1). Herbal medicines are natural compounds that people can obtain from different parts of plants, such as leaves, bark, roots, seeds, or flowers, and are used for medicinal purposes. They have a long history of use, dating back to ancient times, before the advent of conventional medicine. Plants are one of the most important sources of novel pharmacologically active compounds for the pharmaceutical industry. They have a long history of use in treating various diseases. More than one-third (39.1%) of all drugs approved by the Food and Drug Administration (FDA) are of natural origin. According to some estimates, there are between 35,000 and 70,000 plant species that have been tested for their medicinal use (2). Herbal medicine involves using plants or plant-based substances to treat various health conditions, including wounds. An ethnobotanical analysis in the Balkan region, Southeast Europe, revealed that people used 128 plant species for wound healing. They applied these plants externally in different forms, such as decoctions, tinctures, oil, ointments, balms, or directly on the skin(3). In traditional Persian medicine, 65 herbs used in the treatment of wounds were identified, and their anti-inflammatory, antioxidant, antimicrobial, and wound healing activities were investigated (4).

Researchers in Iranian traditional medicine introduced and verified 23 natural compounds that had wound healing effects (5). Researchers in traditional Chinese medicine reported that they found 23 herbal extracts or active constituents that could effectively treat diabetic wounds. (6). People in Russia used "banya mould" to treat wounds and prevent wound infection, which was an ancient practice of using penicillin-like substances seven centuries before its discovery in the United Kingdom(7). In India, 64 plants were reported with wound healing activities for treating a variety of wounds, such as cuts and burns (8). Skin is a natural barrier that protects us from the environment and performs various essential functions. When skin is damaged by acute or chronic injuries, the body starts a complex and dynamic process at the wound site to heal the tissue and restore the skin's function. The main goal in wound repair is to achieve tissue integrity and balance. The natural process of wound healing has four phases that overlap but are well-defined: hemostasis, inflammation, proliferation, and remodeling.

Herbal agents for wound healing have two or more of these properties: antimicrobial, antioxidant, and anti-inflammatory effects. They also help with blood clotting, fibroblast growth, protein expression, and collagen formation. These properties have significant effects on different stages of the wound healing process (3). This review introduces 50 herbs that have demonstrated their efficacy for wound healing in various studies.

The following plants are not only based on traditional knowledge and experience but also supported by scientific evidence for their beneficial effects on wound healing.

1. Turmeric (Curcumin):

Turmeric is an herbaceous plant that belongs to the same family as ginger. It has a long history of use as a spice and a natural dye in Indian and Chinese cuisines (9,10). Curcuminoids and essential oils are the major components of turmeric, which have shown various bioactivities and promising results in various research investigations(11). Curcumin became commonly used in Indian traditional medicine in the treatment of biliary disorders, cough, diabetic ulcers, hepatic disorders, rheumatism, and wound healing (12,13). An optimum wound healing dressing or agent protects the wound tissue from bacterial infection, reduces inflammation, and induces cell proliferation (14). It would ideally also act as an anti-oxidant (15). antiinflammatory (16), anti-infectious(17) (18) and anti-oxidant ((19) (20) activities. collagen deposition (21). fibroblast proliferation and vascular density (22) (23)(24).

Curcumin as an available and inexpensive herbal was shown to be a suitable substitute in the healing of burn wounds especially when a 2% concentration was applied (25). curcumin indeed possessed powerful inhibition against hydrogen peroxide damage in human keratinocytes and fibroblasts able to wound healing(26). Ethanolic extract of Turmeric was found to have a better and faster wound healing effect than the standard drug Povidone Iodine ointment on excision wound model (27).

2. *Birch Bark (*Betula *spp.):*

Birch Bark and its other derivatives are found in various plant species, especially in the Betulaceae family. Factors such as species, geographical location, age, and climate have been shown to influence the dry weight content of betulin (10–45%) in plants(28). The wound healing properties of Birch Bark have been elucidated at the molecular level and positively affect all three phases of wound healing (the inflammatory phase as well as migration and differentiation phase of keratinocytes) (29). The first clinical evidence for the wound healing (30). Subsequently, several multicentric, controlled, randomized clinical studies on superficial wounds and second degree burns were performed with betulin oleogel (31–33). In 2016, the European Medical Agency (EMA) approved betulin oleogel as a drug for the topical treatment of superficial wounds and burns (34).

3. Banya mold:

One of the greatest medical events of that time was the appearance of the anthology (1073) of Grand Kniaz Svyatoslav Yaroslavovich (1027-1076), which described plants that grew in the Russian territories and that were most commonly used for medical purposes. The chronicles of Novgorod also describe the use of "banya mold" to treat wounds and the way it would prevent infection from setting in, predating the discovery of penicillin in the UK by seven centuries (35). In 1581, Tsar of All Russia Ivan the IV (1530-1584) ordered the establishment of the first pharmacy, which would supply the court of the tsar, as well as the foundation of the Pharmacist's House, which was responsible for the collection of medicinal plants that grew in the Russian lands(7).

4. Onion (Allium cepa (L.):

Onion (Allium cepa) is a vegetable that belongs to the Amaryllidaceae family and is one of the most widely cultivated species of the genus Allium. Onion contains numerous chemical compounds with

quercetin, fisetin, and other sulfurous compounds (e.g., diallyl disulfide and diallyl trisulphide). These compounds are derived from the breakdown of alkylcysteine sulphoxides by the enzyme allinase. Onion and its main components have shown many benefits for health, including free-radical scavenging and antioxidant properties, anticholesterolemic, anti-heavy metals toxicity, anti hyperuricemia, antimicrobial, anti-gastric ulcer, and anticancer effects(36).

A systematic review published in 2017 evaluated the efficacy of onion extract as an anti-scarring agent. The review included 11 studies with a total of 779 patients who had various types of scars, such as keloids, hypertrophic scars, surgical scars, and burn scars. The review found that onion extract was effective in improving the appearance, texture, redness, and itching of scars. Onion extract also reduced the height and size of keloids and hypertrophic scars. The review concluded that onion extract is a safe and useful option for scarring management. (29,37). A study tested the effect of onion extract on scar formation in 58 patients who had minor skin surgeries. The patients applied onion extract or placebo on their scars for 10 weeks after initial healing. The study found that onion extract improved the scars' appearance, smoothness, texture and redness better than placebo. Onion extract is a beneficial treatment for skin scars (38).

5. Cocos nucifera L:

Cocos nucifera Linn, commonly known as coconut, is a stately palm that belongs to the Arecaceae family. It thrives in the tropical zone and is cultivated in many countries, such as India, Sri Lanka, Malaysia, and Indonesia. Coconut oil, extracted from the kernel or meat of mature coconuts, is composed of about 90% saturated fat. The main fatty acids in coconut oil are lauric acid (44.6%), myristic acid (16.8%), and palmitic acid (8.2%). Coconut oil also contains small amounts of monounsaturated fatty acids (5.8%) and polyunsaturated fatty acids (1.8%). Coconut oil has been used for various purposes, such as cooking, cosmetics, medicine, and biofuel. However, the health effects of coconut oil are controversial and depend on the type and quality of the oil. Lauric acid present in the oil can kill some bacteria. It is also known to have antibacterial and antifungal activity.(39,40) A study shows that extra virgin coconut oil is as effective and safe as mineral oil when used as a moisturizer, with the absence of adverse reactions(41). Coconut, a tropical plant, has been used for wound healing in traditional medicine. Animal studies have shown that its fruit juice and extract can improve the wound healing process by increasing the cell thickness, reducing the wound area, and changing the wound characteristics. The fruit extract also has antibacterial activity against wound infections. However, more human studies are needed to confirm its effects and safety(42).(43).

6. Commiphora mukul:

Commiphora mukul Hook, also known as guggul, is a plant that belongs to the genus Commiphora, which comprises about 190 species. These plants are native to southern Arabia, India, and Sri Lanka. Guggul has been used in traditional medicines of India and many Arabian countries for various purposes, such as treating inflammation, obesity, blood clots, infections, and atherosclerosis. It also has a wide range of pharmacological effects, such as killing cancer cells, lowering cholesterol levels, relieving pain, and regulating blood sugar levels. The resin of guggul is the main source of its medicinal properties. Phytochemical analysis of the resin has revealed the presence of many bioactive compounds, such as lignans, sterols, triterpenes, oligosaccharides diterpenoids, and sesquiterpenes (44).

Commiphora mukul, has been used for various purposes in traditional medicine. Some of the properties of guggul resin are enhancing milk production, healing wounds in the mouth and throat, and reducing inflammation(44). Its anti-inflammatory properties have been related to COX1 inhibition(45). Essential oil of this oleo-gum-resin has antimicrobial effect against a range of Gram-positive and negative bacteria (46). Commiphora mukul has been used for wound healing in traditional Persian medicine. A clinical study found that mouthwash made from guggul resin was effective in treating wounds in the mouth and throat, such as ulcers, sores, and burns(47). Commiphora mukul gum extract increased VEGF and significantly improved skin elasticity and Wound healing potential (44).

7. Gentiana lutea L:

Gentiana belongs to the family Gentianaceae and is considered as an important medicinal herb comprising 400 species distributed worldwide. According to studies of Iranian traditional medicine texts(48). Secoiridoidal and iridoid glycosides such as gentiopicroside, xanthones, monoterpene alkaloid; polyphenol, and flavones are the constituents that have been shown the pharmacological activities in different gentian species. Gentiana lutea L, also known as yellow gentian, is a plant that has been used for its anti-inflammatory and wound healing properties in traditional medicine.

The study found that yellow gentian extract reduced the inflammation and accelerated the healing process of the wounds. The extract also increased the collagen synthesis and tensile strength of the wounds. The study suggested that yellow gentian extract has the potential to be used as a natural remedy for wound healing, but more research is needed to confirm its efficacy and safety in humans (49) (48).

Gentian is applied to the skin for treating various types of wounds and fungal infections. It has been shown to kill harmful bacteria and improve blood flow to wounds or damaged tissue(50). An analysis of the antibacterial activity of Gentiana macrophylla extract against bacteria isolated from burn wound infections revealed that it can be a valuable source of antioxidants and antimicrobials, which may be used for wound burn management(51) . Although Gentiana lutea has been reported to be useful in treating many ailments, there is no scientific evidence to support its anti-inflammatory and wound healing activity. Therefore, the anti-inflammatory and wound healing activity of extracts of Gentiana lutea were studied using different animal models (52).

8. Teucrium polium L:

Teucrium polium (TP) is a wild plant belonging to the Labiate family, found in Southwest Asia, Europe, and North Africa. It includes more than 340 species worldwide. The biological activities of this plant have been reported as having anti-inflammatory, antioxidant, antimicrobial, and anti-diabetic properties. Also, in recent studies on animals, the anti-inflammatory and pain-relieving effects of this plant have been examined, and positive effects have been reported(53). The genus Teucrium has been shown to be rich in terpenic and phenolic components and show promising healing potential in second degree's burns via the increase of wound closure rate, re-epithelialization, densely collagen biosynthesis and deposition and highly decrease of lipid peroxides. (54). Teucrium polium L. is widely used in traditional medicine to treat hypertension and diabetes or as a wound-healing agent(55). Seemingly, a mixed form of Teucrium polium and A. vera could improve wound healing in diabetic mice(56). In one study, the topical application of Teucrium polium L extract accelerated healing of burn wounds(57). Inhibition of carrageenan-induced inflammation in an animal study showed the anti-inflammatory effect of this plant (58). Its ethanol and ethanol extracts have been shown to be effective on veterinary pathogens(59).

9. Punica granatum L:

Pomegranate (Punica granatum L.), a fruit belonging to the family Punicaceae, contains crude fiber, sugars, pectin, anthocyanin, several tannins, and flavonoids in their juice and seed oil. The polysaccharides present in pomegranate peel have significant antioxidant potential in 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging, hydroxyl radical scavenging, and superoxide anion radical scavenging in vitro(60).

Pomegranate peel has traditionally been considered agricultural waste. However, it is a rich reservoir of antioxidants, polyphenols, dietary fiber, and vitamins, which contribute to its remarkable bioactivity. Studies have demonstrated the anti-inflammatory, cardioprotective, wound healing, anticancer, and antimicrobial properties of pomegranate peel owing to the presence of phytochemicals such as gallic acid, ellagic acid, and punicalagin. Pomegranate peel has wound healing properties due to the presence of polyphenols and flavonoids. Bioactive compounds from pomegranate peel have the potential to promote wound contraction, collagen production, and expression of growth factors(61). In a recent study, the potential of Punica granatum peel extracts formulation therapy on dermal wound healing was illustrated. The tentative mechanism of action was related to improved collagen deposition, epithelialization, and reduced inflammatory reaction(62). This has been linked to the elevation of several growth factors, including transforming growth factor–β1, vascular endothelial growth factor, and epidermal growth factor, as well as increased hydroxyproline and nitric oxide production and activity in wound tissues(63). (64).

10. Plantago major L:

Plantago major L. (P. major) is a perennial plant that belongs to the Plantaginaceae family. It is native to Europe and is the most commonly used species in both traditional and modern medicine (65). The plant contains various phytochemical components, such as polysaccharides, lipids, derivatives of caffeic acid, flavonoids, iridoid glycosides, and terpenoids. These components offer anti-inflammatory, antioxidant, analgesic, immunomodulatory, anti-ulcer, and antibiotic properties(66). The wound-healing capacity of the leaf extract has been proved by “in vivo” tests with animals and humans, using different pharmacology forms, such as ointment (67) and topical gel(68). Amini et al. (2010) investigated the healing properties of the hydroalcoholic extract of P. major L. in burns. The researchers conducted in vivo tests on rats, varying the concentration of the extract. The histological analyses showed that the extract has a promising role in wound healing(69). Recent years have seen significant advancements in the electrospinning technique for skin wound healing, leading to the production of fibrous matrices mats. These mats

promote cell growth, regulate inflammatory factors, and improve collagen deposition in the wound, ultimately accelerating the healing process (70).

11. Adiantum capillus-veneris L:

Adiantum capillus-veneris Linn., commonly known as Maidenhair fern, is a tufted fern that belongs to the Pteridaceae family. It is widely distributed across various regions, including Southern Europe, the Atlantic coast as far as Ireland, from the south to the southern Alpine valleys regions, from Central to South America, Australia, and Iran. The plant has been studied for its pharmacological effects and has revealed various chemical constituents such as tannins, terpenoids, flavonoids, alkaloids, and steroids. These chemical constituents have been found to exhibit anti-diabetic, anticonvulsant, analgesic, hypocholesterolemic, goitrogenic, anti-thyroidal, antibacterial, antifungal, wound healing, antiobesity, anti hair loss, antiasthmatic, anti-inflammatory, antidiarrheal and antispasmodic properties in modern medicine(71).

During an in vitro study, wound healing property of A. capillus-veneris was evaluated. The water extract of the plant improved angiogenesis significantly by using both capillary-like tubular formations and proliferation of endothelial cells. (72). Extracts of this plant showed significant antibacterial and antifungal activities against most of the multidrug-resistant bacterial and fungal strains(73). Besides, aqueous and butanol fractions revealed significant protection against damage to fibroblasts by oxygen free radicals. In another research, an ointment that consists of Maidenhair fern, Aloe vera, Henna and Myrrha cured wounds in diabetic rats (74,75). the aqueous partition of A. capillus-veneris could be locally applied for prevention of late-radiation-induced injuries after radiation therapy and healing of external wounds similar to bedsores and burns(75).

12. Aloe vera (L) Burm f:

Aloe vera is a plant that belongs to the Aloeacea or Liliaceae family and has over 400 identified species. It is often referred to as A vera Linne or A barbadensis Miller and First recorded by the Egyptians and Greeks, aloe vera gel has been used for centuries in many cultures for a variety of ailments, particularly burns and chronic wounds(76). The A vera leaf contains several chemical compounds, including acetylated mannans, polymannans, anthraquinone C-glycosides, anthrones, anthraquinones, and lectins. These compounds have been traditionally used in many cultures for their therapeutic properties. The mucilaginous gel from the leaf pulp of A vera has been incorporated into many cosmetic and alternative medicines for rejuvenation, wound healing, and other dermatologic conditions(77). Aloe vera gel used in a dose-dependent fashion demonstrated increased tissue levels of collagen and glycosaminoglycans compared with controls. Aloe vera gel modulated wound inflammation, increased wound contraction, wound epithelialization, decreased scar tissue size, and increased alignment and organization of the scar tissue.(76). Hydro-alcoholic extract of Aloe vera (L) Burm f leafs decrease burn healing time (78). The gel increases wound contraction, epithelialization, alignment, and organization of the regenerated scar tissue. (79). It exerts antimicrobial and antifungal properties(80). and also has positive effects on the regulation of ECM factor synthesis, which open up new perspectives for the wound repair activity of Aloe vera polysaccharide at molecular level(81).

13. Potentilla reptans L:

The Potentilla has been traditionally used in Asia, Europe, and North America is rich in bioactive secondary metabolites, including tannins, flavonoids, triterpenoids, and phenolic acids, in its root extracts. However, Potentilla species may be considered as useful sources of natural products by their enzyme inhibitory and antioxidant effects and anti-inflammatory effects in the pharmaceutical field (82)(83). Its antibacterial effect on Pseudomonas aeruginosa and Escherichia coli, which have been proven in modern research, suggests that it may be effective for treating wound infections(84,85). Extracts Extracts were prepared with water, milk, honey and alcoholic solutions and were applied for wound-healing(86).

14. Aristolochia:

Aristolochia is a significant genus that has been widely cultivated and has long been known for its extensive use in traditional Chinese medicine. The genus Aristolochia comprises approximately 500 species, with the majority of these species distributed in the tropical region. However, some species range as far north as Canada, Scandinavia, and Northern Japan(87). Aristolochia rotunda is a plant that has been used in traditional Persian medicine for its wound-healing properties. While there is no conclusive evidence to support its antioxidant, antimicrobial, and anti-inflammatory properties, it has been studied for its positive effect on the wound-healing process. Studies using collagen zymography and atomic force microscopy have demonstrated its collagenase activity(88).

Aristolochia bracteolata, a member of the Aristolochiaceae family, is a common medicinal plant that has been traditionally used to treat fever, inflammatory diseases, and insect bites. It is also known as "worm killer" due to its supposed anthelmintic activity and trypanocidal effect. A study has shown that A. bracteolata has a distinctly positive effect on wound healing by increasing the level of powerful antioxidant enzymes. Additionally, it possesses potent anti-allergic activity (89).

A study conducted on Aristolochia bracteolata extract showed that it has significant wound healing activity in an in vitro model. The plant extract's wound healing effect may be due to synergistic active principles. A. bracteolata has anti-inflammatory, anti-oxidative, and anti-bacterial properties, and it stimulates fibroblast proliferation, making it an appropriate stimulus for healing. The plant extract has potential wound healing activity due to a combination of fibroblast stimulation and inhibition of the inflammatory phase of wound healing. This is demonstrated by reduced levels of inflammatory cytokines from macrophage cells by increasing collagen type I and IV (90).

15. Gum tragacanth (Astragalus genus):

Tragacanth Gum (TG) is a natural gum that is extracted from the stems and branches of certain trees found in India, Turkey, and Iran's western and northern regions. It is a complex mixture of polysaccharides that contains D-galacturonic acid, D-galactopyranose, L-fucose (6-deoxy-L-galactose), D-xylopyranose, L-arabinofuranose, and a very small amount of L-rhamnose. The acidic components are largely present as calcium, magnesium, and potassium salts. The gum also contains trace amounts of amino acids and their derivatives. Tragacanth is considered to contain two primary constituents, tragacanthin, and bassorin. Both are insoluble in alcohol and have high molecular weights. The major component, bassorin, though insoluble in water, has the capacity to swell and form a gel. It is believed to contain polymethoxylated acids that yield tragacanthin upon demethoxylation. Gum tragacanth swells in cold water to give extremely viscous colloidal solutions. (91–93). TG is a type of anionic polysaccharide that is viscous, odorless, and tasteless. It is not mutagenic. TG has been used to create wound dressings in the form of creams, hydrogels, and films. These materials have been shown to speed up wound closure and expedite the healing process of damaged tissues. TG-based materials have also been utilized in drug delivery, tissue engineering, cell therapy, and wound healing(94,95). (96). efficacy of gum tragacanth as an effective, facile to prepare, and yet safe, biocompatible, cheap, and readily available agent for wound dressing. Hence, tragacanth-containing formulations could be considered as efficacious preparations in chronic and slow-healing wounds such as diabetic foot ulcers, bed sores, and ischemic wounds(97).

16. Boswellia serrata gum resin (Olibanum):

Boswellia serrata, also known as frankincense or olibanum, is a medicinal plant with a rich history of use in Ancient Egypt and Ayurvedic medicine. It has several biological and pharmacological properties, including anti-inflammatory, immunomodulatory, antioxidant, antidiabetic, and anti-hyperlipidemic activities. In clinical practice, B. serrata is widely used to treat a variety of diseases such as psoriasis, arthritis, colitis, asthma, inflammation, and cancer.(98). A study reported that B. serrata had wound-healing properties against the rat model of diabetic foot ulcer. It exerted its wound healing action via modulation of oxidative, inflammatory, and angiogenic markers such as malondialdehyde (MDA), NO, TNF-α, IL-1β, IL-6, NF-κB, angiopoietin-1, Tie2, and vascular endothelial growth factor (VEGF) (99). In fact, in vivo evidence shows that alcoholic extracts of the resin of Boswellia serrata (B. ser- rata) present marked anti-inflammatory and antiphlogistic activity and can increase wound healing processes (100,101).

B. serrata reduce skin redness and irritation, and a formulation as a preventive agent against UV damage have been successfully used to treat the clinical manifestations of photo-aging on facial skin and radiotherapy skin damage in breast cancer patients (102–104). Boswellia serrata oleo-gum resin may have a beneficial influence on the various phases of wound healing like fibroplasia, collagen synthesis, and wound contraction, resulting in faster healing. the Boswellia serrata oleo-gum resin significantly stimulated wound contraction. These findings could justify, role of this plant material in the management of wound healing (105).

17. Brassica oleracea var. Capitata (Cabbage):

Brassica oleracea var. capitata L., commonly known as cabbage, is a vegetable that belongs to the family Brassicaceae. It is one of the most widely cultivated vegetables in the world. Cabbage is often referred to as green cabbage to distinguish it from red cabbage, which has the same scientific name. Cabbage has been used as an herbal medicine for centuries due to its antioxidant and anti-inflammatory properties. It has been used to treat gastrointestinal disorders such as gastritis, peptic and duodenal ulcers, and irritable bowel syndrome, as well as wounds and mastitis (106).

A study reported that an ointment made from cabbage helped mature the extracellular matrix in skin wounds of Wistar rats. The ointment was effective in stimulating the maturation of collagen, increasing cellularity, and improving the mechanical resistance of the newly formed tissue.(107). Studies have demonstrated that plaster made from the leaves of Brassica has an economically significant effect on the healing of skin wounds. In rats, treatment of skin wounds with Brassica oleracea resulted in a significant increase in the number of mature collagen fibers, that accelerated the healing process by promoting re-epithelialization and vascularization. (108).

18. Calendula officinalis (Marigold):

Calendula officinalis, or pot marigold, is a common garden plant belonging to the Compositae family. Native to Southern Europe, Calendula grows up to 60 cm in height and produces large yellow or orange flowers (109).

Calendula officinalis is a plant that has many pharmacological properties. It is used to treat skin disorders and pain and as a bactericide, antiseptic, and anti-inflammatory. The butanolic fraction of Calendula officinalis has significant antioxidant activity (110). Calendula officinalis (Asteraceae) L., or marigold, is an herbal plant that has been used to treat wounds since the 13th century in Europe, and nowadays is used virtually worldwide. This plant possesses several biological properties such as antimicrobial, antimetastatic, Antioxidant, and antiparasitic activity. seemed to modulate the inflammatory phase of wound healing (111). Calendula officinalis flowers are believed to be useful in reducing inflammation and wound healing. They are also used as an antiseptic to treat various skin diseases, ranging from skin ulcerations to eczema. Internally, Calendula officinalis has been used for stomach ulcers and inflammation. The plant contains flavonoids, which are responsible for its anti-inflammatory activity. Triterpene saponins may also be important. Additionally, Calendula officinalis contains carotenoids (112). A study conducted on animal models revealed that C. officinalis has anti-inflammatory and antibacterial properties, as well as angiogenic and fibroplastic properties that positively affect the inflammatory and proliferative phases of the wound healing process (113). C. officinalis tincture was found to promote fibroblast proliferation and migration in both murine and human systems via a specific signaling pathway involving FAK (114). Furthermore, it was found to potentiate wound healing by stimulating the expression of CTGF and α-SMA. Active compounds were also identified (115).

19. Ficus (carica and Racemosa):

Ficus carica L. is a tree that belongs to the mulberry family and is one of the oldest trees. It is widely distributed in the warmer regions of Asia, Africa, America, and Australia. The tree has both nutritional and medicinal benefits as it contains bioactive compounds such as ficin, proteases, lipodiastase, and amylase (116) (117,118) . The fig tree (Ficus carica) produces a high amount of latex in its fruit. This latex has been used in India since ancient times to treat mouth, lip, and tongue cracks due to its wound-healing properties. Fig latex has been shown to accelerate the healing process of diabetic wounds by directly affecting the survival of pathogenic bacteria and the formed biofilm. Moreover, fig latex has been found to improve the healing process by restoring the expression levels of β-defensin-1 and PECAM-1 and collagen formation. In addition, fig latex has been shown to regulate the expression levels of ZO-1 and CCL2 in diabetic mice, indicating that it could be an effective natural treatment for managing diabetic wounds(118). All parts F. racemosa are regarded medicinally important and have been used extensively in the treatment of biliary disorders, jaundice, dysentery, diabetes, diarrhea, and inflammatory conditions(116)(119). Various parts of this plant and its latex, either in raw form or as different preparations, have been used in Ayurveda to treat wounds (120) .

20. Lilium species:

The Easter lily (Lilium longiflorum Thunb.) is a versatile plant that is used for both medicinal and culinary purposes in many parts of Asia. It is also a popular ornamental plant worldwide. The lily bulb, in particular, is a common food ingredient in Asia and is believed to have medicinal properties. In China and Japan, the lily bulb is used as a general tonic to treat inflammation and lung conditions. Additionally, preparations containing bulbs from various Lilium species, including the Easter lily and the Madonna lily (Lilium candidum), have been used to promote the healing of skin abrasions, corns, burns, and wounds from surgery (120). Lily's edible bulbs have been analyzed for their chemical composition. The results show that they contain starch, protein, fat, cellulose, no-starch polysaccharides, saponin, and colchicine. In recent years, the polysaccharide from lily's edible bulbs has gained attention due to its antioxidant, hypoglycemic, and immunomodulatory properties (121,122). Transforming growth factor beta (TGF-β) is a transcriptional factor that is essential for the initiation of granulation tissue formation and cell migration. TGF-β stimulates fibroblast

proliferation, but its most important function during the post inflammatory stages of wound healing is to induce fibroblasts to secrete extracellular matrix material composed of collagen and fibronectin (123,124). Fractionated bulb extracts induced TGF -β receptor I mRNA expression in fibroblast cell culture. . activation of TGF-β signaling by lily bulb steroidal glycosides may play a beneficial role in the promotion of wound closure(120).

21. Myrtus communis:

Myrtle belongs to the same plant family as guava and eucalyptus. It grows in the Mediterranean area, where people call it by different names like Mersin, Murt, and Hambeles. It has many compounds that are good for health, such as phenolic acids, flavonoids, tannins, essential oils, and fatty acids. These compounds can help with many things, such as preventing oxidation and inflammation, relieving pain, protecting the liver and the skin, healing wounds, and lowering blood sugar(125). People in Turkey and other countries around the Mediterranean Sea use it for various medicinal purposes. Its oil has been used for a long time to treat various health problems, such as stomach ulcers, and skin infections, disinfect wounds, and diarrhea, lower blood sugar, fight cancer cells, protect the liver and the brain, and reduce inflammation and oxidative stress, stopping bleeding, making perfumes and flavorings, and treating colds and diabetes (126,127) . Myrtus communis extract helped heal wounds faster in mice, according to an animal study. This suggests that it could be used for wound healing in humans because it is safe, natural, and easy to get (128).

22. Plantago major:

Plantago major L. is a common and widespread medicinal plant in the world. It is a plant that lives for many years and belongs to the same family as snapdragons and foxgloves. P. major leaves and seeds can help with pain, inflammation, oxidation, immune system, fungi, cancer, and wound healing . Some recent studies have shown that some plants or natural substances from plants can heal skin wounds and repair tissues, and P. major is one of them.(129,130). The researchers made a dressing with nanofibers that had P. major extract inside them. They tested it on wounds and saw that it could help them heal faster. This shows that this dressing could be useful for wound healing(131).

23. Pomegranate (Punica granatum):

Pomegranate is planted across the country and remains one of the loved fruit, which is domestically and commercially available. The pomegranate plant and its fruit juice possess health benefits, nutritional benefits, therapeutic benefits, and several bioactive compounds. Pomegranates contain a high amount of bioactive compounds such as phenolics, tannins, anthocyanins, flavonoids, and organic acids and terpenoids (132)(133).

Wound healing and tissue repair need tannins and flavonoids, which are compounds found in some plants. One way to find the best plants for these compounds is to look for the local types of pomegranate that have the most tannin and phenolic compounds in their outer layer. One study found that different parts of the pomegranate layer affected wound healing differently in rats (134). Another study showed that the ethanol extract of Sweet Alac pomegranate layer had a lot of flavonoids, and said that it could be used to make natural drugs that reduce inflammation for wound healing. The same study also said that tannins were the main compounds that helped wounds shrink, skin grow, blood vessels form, and fibroblast increase (135). A different study used nanofibers with carboxymethyl chitosan (CMCS) and gelatin, and added mesoporous silica nanoparticles (MSNs) with myrtle water extract, to make wound dressings. They found out that these dressings were good for wound healing (136).

24. Quercus infectoria:

Quercus is a plant that has many uses in traditional medicine. It has substances like polyphenols and tannins that can help with bleeding, ulcers, dysentery, hemorrhoids, and throat problems. Its skin can also act as an antidote for some poisons, and help with skin diseases, eczema, and varicose veins (137) (138). A study showed that an ointment made from Quercus infectoria gall extract could heal open wounds faster in diabetic animals. It did this by reducing inflammation, causing cell death, increasing the expression of Bcl-2 and p53 genes, having antioxidant effects, and promoting cell growth, skin formation, and tissue formation. This herb could be a new way to treat diabetic wounds (139,140) . The researchers wanted to find out how Quercus infectoria could help with skin diseases. They hoped to discover natural substances that could treat them, and to include them in future plans to improve the health of people around the world who have skin problems(141).

25. Olive oil (OO):

Among edible vegetable oils, olive oil is one of the few consumed unrefined, which means that as well as its triglyceride composition it possesses other minor bioactive components such as sterols, vitamins, escualene, polyphenols, and others(142).

anti-cancer, antibacterial, anti-allergic, anti-aging, and immunomodulatory effects (160). Panax ginseng root extracts can protect the skin from UVB damage and enhance healing after laser burns and excisional wounds. Research shows that Panax ginseng extracts stimulate keratinocyte migration and proliferation and increase collagen production in human dermal fibroblasts in vitro. Moreover, ginsenoside Rb2, a compound isolated from Panax ginseng, promotes epidermal development in raft culture by increasing the expression of epidermal growth factor and its receptor, fibronectin and its receptor, keratin and collagenase I, which are all important for wound healing (161).

30. Burdock (Arctium lappa):

Burdock (Arctium spp.), commonly known as general or common burdock, grows in many regions of the world and it has anti-inflammatory and analgesic properties. Various components of burdock leaves, roots, and seeds are known to have antioxidant, anti-inflammatory, and antimicrobial actions, although much of the evidence for this comes from animal studies(162). Burdock is used in the treatment of sore throats and skin pathologies such as boils, rashes, and acne in North America, Europe, and Asia. In a clinical trial, the antioxidant, antimicrobial, anti-inflammatory, anti-diabetic, antiviral, anti-cancer, and hepatoprotective effects of Arctium lappa were detected. It has been shown that Burdock root extract greatly enhances dermal ECM metabolism, affects glycosaminoglycan turnover, and decreases visible in vivo wrinkles in human skin. Burdock has also been reported to control cell adhesion and gene expression in canine dermal fibroblasts, influencing the Wnt/β-catenin signaling pathway, known to be a key wound cure regulator and the data suggested that burdock has implications in cell adhesion and gene expression with the modulation of Wnt/β catenin signaling and Chondroitin Sulphate Biosynthesis that are particularly important for the wound healing process. (163). the care of burns using burdock leaf therapy, under standardized guidelines, appears to provide a suitable alternative treatment for first- and second degree burns(164). A case study in which honey and burdock leaves were applied to a wound resulting from a traumatic leg amputation surgery that had tissue necrosis. This treatment successfully healed the wound without requiring further surgery, which the patient did not want (165).

31. Neem (Azadirachta indica):

Neem (Azadirachta Indica), is a plant that is commonly used in India for various health purposes. Neem has many biological effects, such as fighting bacteria, inflammation, fungi, and viruses. Some of its active compounds, like nimbidin, nimbin, and nimbidol, help heal wounds faster. Many tribes have used neem for treating wounds, cuts, and skin diseases. (166,167). Medicinal properties of its leaves such as antioxidant and antimicrobial activity were contributed by the phytoconstituents present in them. The lavanoids present in them act as antioxidants that protect against free radicals that damage cells and tissues. The lavanoids present in them act as antioxidants that protect against free radicals that damage cells and tissues and also the tannins promote wound healing. Wound dressing material prepared using collagen isolated from chrome shavings impregnated with neem extract possesses both physical and biological properties required for an ideal dressing material(168). leave extracts of Azadirachta indica promote wound healing activity through increased inflammatory response and neovascularization (169,170).

32. Chamomile:

One of the oldest and largest used medicinal plants is chamomile (Matricaria recutita L.), whose necessary oil and flower extracts have secondary metabolites (171,172). Chamomile is a plant that has healing properties. It can kill germs, reduce inflammation, and protect cells from damage. These effects can help with diabetic wound healing. A study tested nanofibrous mats with chamomile extract for wound healing. The study looked at three factors: antibacterial, antioxidant, and cytotoxicity. The study used the hydroalcoholic extract of the flowers, which has flavonoids (quercetin and apigenin), coumarins, and terpenoids (αbisabolol and chamazulene)(173). Chamomile (Matricaria recutita) is a plant that has flowers with many terpenoids and flavonoids. These are chemicals that have medicinal effects. People have used chamomile extract and decoction to heal wounds.(174). Chamomile is a plant that can help wounds heal faster than some drugs. It can also prevent ulcers by blocking histamin2 receptors. These are receptors that can cause stomach acid. Chamomile can also help the skin recover and heal by blocking 5-hydroxytryptamine -2 (5-HT 2) receptors. These are receptors that can affect wound healing. Some studies have shown these effects of chamomile (175), and evaluated the efficacy of topical chamomile to enhance wound healing. They showed that chamomile is statistically efficacious in producing wound drying and in speeding re-epithelialization (176). (177)A study showed that chamomile gel with 10% concentration was more effective in healing wounds than gel and cream without chamomile. (178).

polyphenols, and others(142). OO has mostly oleic acid, some other fatty acids, and a little bit of other things, like polyphenols. The oleic acid and polyphenols in OO can stop oxidation and inflammation, which are bad for skin wound healing.(143). combination of OO reduces inflammation improves wound healing and shows positive effects on the size of wounds in burn patients(144).

26. Vinegar (Acetic acid):

Vinegar is commonly used as a home remedy for many skin problems, It is bacteriostatic or bactericidal to many gram-negative and gram-positive microorganisms, especially Pseudomonas. Dermatologists need to understand the evidence supporting its use in skin disease, as well as potential adverse effects, so they can properly counsel patients on the safe use of this widely available treatment. Vinegar possesses antimicrobial and antioxidant properties that provide utility in wound care as well as bacterial and fungal infections(145).

When the wound drainage is blue-green and the sloughing tissue is wet and yellow, it may be a good idea to use gauze soaked with acetic acid. This is based on a research work that studied this method (146). A clinical study used vinegar (acetic acid) soaks to help wound healing by secondary intent. Patients made the vinegar/acetic acid solution at home instead of buying expensive medical-grade acetic acid. The soaks lasted for 1 to 2 weeks, and all patients healed their wounds(147). A good way to treat burn wound infection is to use vinegar (acid acetic) on the skin. Vinegar can kill many germs and has been used for a long time. The WHO also says that vinegar is one of the best and safest medicines(148).

27. Centella (Centella asiatica):

Centella asiatica is a plant that grows in warm areas of Africa, Asia, Australia, and some Pacific islands. It belongs to the same family as carrots and parsley. It has substances called asiaticoside and hydroxyasiaticoside, which are types of triterpenoid glycosides. These substances can do many things for the body, such as reducing inflammation, oxidation, allergies, depression, anxiety, fibrosis, bacteria, arthritis, tumors, and damage to the heart, liver, and brain. They can also help heal wounds and improve the immune system. (149). Wound healing can be enhanced by using extracts from the aerial parts of Centella asiatica, a plant that has been used for centuries in traditional medicine. This plant contains compounds called asiaticoside and madecassoside, which have been proven to improve wound healing in various ways. Asiaticoside stimulates the growth of new skin cells and the formation of collagen, a protein that strengthens the skin. Madecassoside boosts the production of collagen and glycosaminoglycans, molecules that help retain moisture and elasticity in the skin. Madecassoside also increases blood vessel formation at the wound site, which improves oxygen and nutrient delivery. These effects help reduce the size, depth, and severity of chronic ulcers, which are wounds that do not heal easily.(150 –152). The efficacy of Centella asiatica in curing wounds has been substantiated through diverse wound models employing both systemic and topical methods (149).

28. Bay (Sphagneticola trilobata):

Sphagneticola trilobata, was originally native to the tropical Americas; however, it is now widespread in the tropics as one of the world's most invasive plants and belongs to the Asteraceae, a perennial herb native to tropical South America (153). The leaves of S. trilobata contain luteolin, a flavonoid that has many health benefits. It can protect the brain, fight cancer, boost the immune system, and reduce inflammation. People use the leaves to heal skin wounds because luteolin can lower the levels of inflammatory molecules that cause skin infections and psoriasis(154). A study tested the leaf extracts of S. trilobata and found that some parts of the extract can help skin cells grow and move faster (155). The extract can also kill bacteria that cause skin diseases. The leaf extract of S. trilobata has other properties as well. It can act as an antioxidant, a stress reliever, and a sedative. It may also help women with heavy menstrual bleeding (156). This plant can heal wounds by having compounds that kill bacteria, prevent oxidation, and stimulate skin cell growth. (157).

29. Ginseng (Panax ginseng):

Panax ginseng is a widely used medicinal plant in China, Japan, Korea, and Eastern Siberia. Most of the pharmacological activities are obtained based on steryl glycosides and saponins, even though polysaccharides that can potentiate immunity, triacylglycerol (trilinolein) that exerts antioxidation and proteins that show xylanase, ribonuclease, and anti-fungus activities are identified(158) There are few studies on the wound healing effects of the ingredients apart from Panax notoginseng saponins (159). Panax ginseng is believed to improve memory, immunity, and physical performance, and reduce fatigue. It is also used to treat depression, anxiety, and chronic fatigue disorders. Panax ginseng has various health benefits, such as dilating blood vessels, regulating blood lipids, reducing inflammation, and providing antioxidant,

33. Achillea millefolium L. (Yarrow):

Yarrow (Achillea millefolium) is a common and useful plant that belongs to the Asteraceae family. It grows in many parts of the world and has flowers that can be white, pink, or yellow. People have used yarrow for a long time to treat different health problems, such as stomach issues, liver diseases, breathing problems, joint pain, and lung infections (179). Yarrow has many chemicals that can fight germs and help wounds heal faster. A study showed that yarrow extract helped skin cells grow back after an injury (180). Yarrow has also been a popular remedy for bleeding and healing wounds, both inside and outside the body. People would apply fresh or dried yarrow leaves or juice on their cuts, bruises, ulcers, or sores (181–183).

34. Althaea officinalis L.:

Althaea officinalis Linn. (AO) is a herbaceous plant that has been used for medicinal and food purposes in Europe and Western Asia for a long time. One of the main components of AO is a bioactive substance that has various pharmacological activities, including antitussive, antioxidant, antibacterial, anticancer, wound healing, immunomodulatory, and infertility therapy effects. (184). AO's hydroethanolic extract can help reduce inflammation and improve wound healing. This extract has plant-based antioxidants, such as phenolic acids, flavones, and flavonols. These antioxidants can protect the body from diseases that are caused by oxidative stress. (185,186) Althaea officinalis L. extract was efficacious on gram-positive bacteria. The extract was also tested in the form of topical administration on an excision wound model in rats (24). AO can help wounds heal faster by increasing blood vessels, skin cells, and collagen in the wound area. However, more studies are needed to confirm how effective this herb is and how it compares to other treatments(187).

35. Arnica montana L.:

montana is a flowering plant that belongs to the Asteraceae family. It is native to the mountains of central Europe, but it is also grown in other regions of the world. People have used A. montana for centuries to heal wounds and relieve pain. It has anti-inflammatory and analgesic properties that can help with bruises, swelling, inflammation, and rheumatism (188). A. montana can help wounds heal faster after surgery by improving blood flow. This brings more oxygen and nutrients to the wound site through better circulation. (189) (190). Montana extract can help wounds heal better by increasing some key factors: FGF, VEGF, collagen, and the renin-angiotensin system. These factors are involved in tissue growth and blood vessel formation. The study shows how L. ericoides works at the molecular level in an animal model. This could be a new way to treat wounds with natural herbs(191).

36. Echinacea:

Echinacea is a genus of plants that belong to the Asteraceae family. They are known for their medicinal uses. Out of the nine species of echinacea, only three are effective as herbal remedies: Echinacea angustifolia DC, Echinacea pallida (Nutt.) Nutt., and Echinacea purpurea (L.) Moench (192). Echinacea are plants that have many substances with medicinal properties. These substances belong to four groups: alkylamides, polysaccharides, glycoproteins, flavonoids, and phenolic compounds. Only one species, Echinacea purpurea (L.) Moench, has all of these groups. These substances are responsible for the health benefits of Echinacea species (193,194). People often use it to help with cold symptoms. Echinacea also has caffeic acid derivatives, which are good for skin care. (195). Echinacea is a plant that can help with skin problems and minor wounds. The European Medicines Agency says that people have used the parts of the plant that grow above the ground for these purposes. Echinacea extracts can be used in cosmeceuticals, which are products that have both cosmetic and medical benefits. They can help with antiaging and wound healing(196).

37. Hypericum perforatum L.:

Hypericum perforatum L. (Hypericaceae), known as St. John's wort (SJW). It is an herbaceous perennial plant native to western Asia, Europe, and northern Africa. The plant has been given its common name due to blooming in midsummer around St. John the Baptist's day in June. Klamath weed, Tipton's weed, Rosin-rose, Goat weed, etc., are the less common names (197). Hypericum perforatum is a plant that has many different chemicals in it. Some of these chemicals are volatile oils, flavonoids, anthraquinone derivatives (such as naphthodianthrones), prenylated phloroglucinols, tannins, xanthones, and others. Some products made from this plant can be applied to the skin to help with minor injuries and pains. These products have oil or tincture of the plant in them. They can be used for mild wounds, burns, sunburn, scratches, bruises, heat burns, fire, muscle aches, and more. (198). Synergistic effects of hypericin, isoquercitrin, rutin,hyperoside, and epicatechin may cause wound healing effects of this plant (198,199). Studies in the lab show that one way to heal wounds is by making more fibroblast collagen

cells are the ones that make new skin tissue. (200).

38. Melaleuca alternifolia (Tea tree oil (TTO):

Melaleuca alternifolia is also known as tea tree oil (TTO), Tea tree oil (TTO) is a type of essential oil that comes from plants that grow mostly in Australia. These plants are called Melaleuca alternifolia. TTO can kill germs and is used in many products that treat skin infections. TTO is a valuable plant for medicine and herbal products. People used to use the leaves of these plants to cure coughs or heal wounds.,(201) the infusion of the leaves is utilized in treating sore throats and skin ailments(202). Green tea contains high amounts of polyphenols, with the major polyphenolic compound being epigallocatechin-3-gallate (203). Green tea may help wounds heal faster by affecting how TGF-β1 works. TGF-β1 is a protein that helps skin cells grow and repair. Green tea can change how TGF-β1 interacts with fibroblasts, which are cells that make collagen. Collagen is a substance that gives strength and structure to the skin. Green tea can also influence how fibroblasts become myofibroblasts, which are cells that contract and close the wound. Green tea can also affect how fibroblasts produce connective tissue growth factor, which is a protein that stimulates wound healing. (176).

39. Mimosa:

imosa is a group of plants that belong to the Fabaceae family of legumes (subfamily: mimosoideae). They are native to different parts of the world, such as the Americas, eastern Africa, India, and Indochina. There are about 400 species of Mimosa plants, which can be shrubs or herbs. Two species are very interesting. One is Mimosa pudica, also known as touch-me-not, which closes its leaves when touched or heated. The other is Mimosa tenuiflora, which is used in some ayahuasca brews that have psychedelic effects. This is because its root bark has dimethyltryptamine, a powerful hallucinogenic drug (204). Mimosa tenuiflora is a plant that people use to treat wounds and burns in Middle and South America. They make water extracts from the plant and apply them to the skin. Some studies have shown that M. tenuiflora can make skin cells grow faster and better in vitro (205). Mimosa pudica is a plant that has been used in traditional medicine to heal wounds. The plant has methanolic and aqueous extracts that can help wounds heal faster in rats. A study showed that an ointment with 2% of each extract was effective in wound repair (206). Mimosa pudica is a plant that has been used in traditional medicine to stop bleeding and treat skin diseases. The plant extract has phenols, which are chemicals that can help wounds heal better. (207).

40. Jojoba:

Jojoba is a dioecious plant in the desert and semi-desert areas of America, Africa, and the Ismailia Desert in Egypt (208). JJBO contains 97% linear long-chain esters and other components including polyphenols, flavonoids, and alkaloids (209). JJBO is a traditional medicine that is used for skin care. It can help repair the skin barrier and heal wounds. It can also help with acne and psoriasis by reducing inflammation. JJBO is safe to use and does not have serious toxicity or side effects(210).

Jojoba oil is a unique plant-based liquid wax that makes up more than half of the weight of jojoba seeds. It has many uses in the pharmaceutical industry, especially for cosmetic products that improve the health and appearance of hair and skin. The leaf extract of jojoba can also be combined with other plant extracts to reduce inflammation and soothe irritated skin(211). Jojoba liquid wax is a substance that can help heal wounds by stimulating the production of collagen I, a protein that supports the skin structure, in fibroblasts, which are cells that make up the connective tissue. This effect was observed in a laboratory experiment using human skin cells. However, jojoba liquid wax did not affect the levels of matrix metalloproteinase-2 and matrix metalloproteinase-9, which are enzymes that break down collagen and other proteins in the skin. (212)(213) .

41. Rosemary:

Rosemary is a plant with a pleasant smell and needle-shaped leaves. It belongs to the same family as mint and sage. People use rosemary for its health benefits and its cosmetic effects. It has antioxidants and anti-inflammatory substances that can help with various problems. Some of the chemicals in rosemary are carnosol, carnosic acid, rosmarinic acid, ursolic acid, oleanolic acid, and micromeric acid. These chemicals can be applied to the skin and have been shown to help with inflammation, wound healing, tissue survival, and skin cancer prevention(214). Episiotomy wounds can get infected if they do not heal quickly. A clinical trial tested the use of rosemary essences on these wounds. The results showed that rosemary essences prevented bacterial growth and helped the wound healing process (215). Diabetic mice wound models were treated with rosemary oil on their wounds for three days. The treatment helped the wounds heal faster and better than the control group. The wounds had less inflammation, more skin growth, more tissue repair, more blood

vessels, and more collagen, which is a protein that makes the skin strong(216). The researchers wanted to see how rosemary oil in nano-sized carriers could help with both killing bacteria and healing infected wounds. They tested the rosemary oil carriers in vitro and on animals(217).

42. Soybean:

Soybeans are a common food source that can also help with skin healing. They have a lot of soybean protein that can act like human skin proteins and help the skin cells stick together, grow, and move. These are important steps for healing wounds on the skin. (218,219). Therefore, soybean protein, which has been studied extensively, has displayed excellent characteristics in hydrogels, films, and adhesives used in tissue engineering (220,221). Soy has been shown to help the immune system of burn patients. It activates different types of immune cells, especially T-helper lymphocytes, which help with healing, making antibodies, and reducing inflammation. Soy also has anthocyanins, which are pigments that give soybeans their black color. Anthocyanins have antioxidant and anti-inflammatory properties. They can help wounds heal faster and better in rats by protecting the cells, increasing blood vessel formation, and lowering inflammation.(176).

43. Comfrey (Symphytum officinale L.):

Comfrey is a plant that grows in many parts of Europe. It has been used for healing purposes for a long time. It can help with wounds, inflammation, broken bones, and pain in the joints and muscles. (222). Comfrey root contains some chemicals called pyrrolizidine alkaloids, such as intermedine, 7-acetylintermedine, 7-acetyllycopsamine, lycopsamine, symphytine, and symlidine. These chemicals also have a form with an extra oxygen atom, called N-oxides. These chemicals are the reason why comfrey root has some effects on the body., (223) Allantoin is regarded as the pharmacological active compound in this herbal agent (224). Allantoin is a chemical that has many effects on the body. It can help with healing by getting rid of dead tissue, making cells divide faster, and boosting skin growth(225). The wound healing time when using ointment containing comfrey extract was significantly shorter than when applying comparative preparations(225,226). Comfrey cream can help skin cells grow faster and better in the lab. It can make the skin cells look more normal and have different layers, such as the outer layer that has keratin and corneocytes. These are proteins that protect the skin. (227).

44. Papaya (Carica papaya Linn):

Papaya is a plant that has many medicinal uses. It can make use of different parts of the plant that are usually thrown away. These parts have chemicals called phytochemicals that can improve health. Some of these chemicals are phenolic acids, rutin, coumarin, and flavonoids. They can be found in the leaves, stems, seeds, and fruits of the papaya plant. (228). It has been Papaya can help heal burn wounds faster and reduce inflammation in rats. It can stop bacteria from making catalase, which is an enzyme that protects them from the body's defense. It can also help the body kill bacteria inside the cells. Papaya can also prevent oxidative damage to the tissues, which is caused by harmful molecules called free radicals(229). An animal study showed that the extract could help heal wounds faster in rat animal models. (230).

45. Oat (Avena sativa):

Oat (Avena sativa L.) stands out from other cereals because it has many valuable nutrients for human food, animal feed, health care, and cosmetics. This cereal provides carbohydrates, soluble fiber for digestion, and protein with a good balance of amino acids, fats, various phenolic compounds, vitamins, and minerals.(231,232) Oat is also the best and most cost-effective source of β-glucan. This is a type of starch made of glucose units, and it helps wounds heal faster by stimulating the growth of new tissue, the production and deposition of collagen by skin cells, and the formation of a new skin layer, as reported before. (233). In a study, The histopathological finding supported the outcome of healing activity on wound models (234). A study using a skin model in the lab also showed that a spray with oat extract helped the new skin layer form on the new tissue. (235).

46. Garlic:

Garlic (Allium sativum) is a common ingredient in traditional and alternative medicine. It contains allicin, which is a substance that can fight infections and inflammation. Many cultures have used garlic to treat wounds in the past(236).

Ejaz et al. studied how aged garlic solution affected the healing of chicken skin wounds. They used methods that involved looking at the tissue under a microscope and measuring it with a computer-based tool. They found that aged garlic solution helped the wounds heal faster by making new blood vessels grow from the old ones in different doses(237).

47. Ginkgo:

Ginkgo biloba leaf extract (GK) is a traditional Chinese medicine that has various beneficial compounds. These include bioflavonoids, which are plant pigments with antioxidant effects, ginkgolides, which are anti-inflammatory substances that protect the brain and nerves, and bilobalide, which is a neuroprotective agent that prevents cell death. (238). The compounds in GK have strong effects against microbes, oxidation, and bacteria. They could be useful for healing and treating wounds as potential drugs. (239). GK makes the tissue that grows during wound healing stronger and more abundant in collagen, a protein that gives structure and strength to the skin. It also reversed the harmful effect of cyclophosphamide, a drug that weakens the immune system. This could be because it can prevent cell damage caused by oxidation. GK helps wounds heal faster by increasing antioxidant and angiogenic activities, which improve wound closure and prevent infection. Ginkgo did not change fibrotic markers, which are involved in scar formation and tissue reshaping(240).

48. Ocimum:

Ocimum sanctum (L.) is a member of the Lamiaceae family and a well-known traditional Ayurvedic herb. It has long been recognized for its ability to fight against various kinds of bacteria with its antimicrobial properties. (241). Osanctum extract has many flavonoids such as orientin, vicenin, luteolin, tannin, saponins, carbohydrates, and protein. These are plant compounds that have antioxidant and anti -inflammatory effects. Eugenol and ursolic acid are two components that are especially effective for antibacterial and antiviral purposes(242,243). A study using Wistar albino rats showed that applying Ocimum sanctum extract helped the wounds heal faster. It did this by increasing the speed of epithelization and wound contraction. Epithelization is the process of forming a new skin layer over the wound, and wound contraction is the process of shrinking the wound size. (244). It may be advantageous in the management of abnormal healing such as keloids and hypertrophic scars [60]. An antibacterial wound dressing made from basil seed (Ocimum basilicum) mucilage–ZnO nanocomposite. Mucilage is a sticky substance that comes from plants, and ZnO is a type of metal oxide. (241,245,246). A study evaluated the ethanolic extract of Osanctum affected the healing of normal and dexamethasone-suppressed wounds in albino rats. Dexamethasone is a drug that reduces inflammation and immune response. They found that the wounds healed faster with the extract than without it. The new skin layer formed more quicker and the wound size shrank more compared to the control wounds. (241). Moreover, an increase in granulation tissue and hydroxyproline content was observed.

49. Lemon:

The lemon tree is a citrus plant that lives for many years. Its leaves are long, narrow, and have teeth on the edges. Its flowers are white inside and pink on the petal tips. Its fruit is a yellow, round, and thick-skinned citrus. It is grown for its fruit and as an ornamental tree in warm coastal areas. It is likely a descendant of the Citrus medica L. species.

(247).Lemon is an antioxidant that fights infections and diseases. It helps the immune system by producing white blood cells and antibodies. It heals wounds, bites, stings, and skin problems. It contains flavenoids, vitamin C, essential oil, caffeine, pectin, minerals, water, fibers, and sucrose. The effect of lemon juice on the healing of wounds in white rats was studied. The results showed that lemon juice reduced the blood levels of haemoglobin and red blood cells, but did not affect the number and types of white blood cells, which fight infections. Lemon juice also made the blood clot faster and stop bleeding sooner. The wounds healed faster with lemon juice, which might have some substances that influence the blood clotting process(248). People in Iran use lemon leaves to heal skin wounds. This may be because of the antioxidant substances in the lemon plant(249).

50. Cedrus deodara

Cedrus deodara , commonly known as deodar, is a species of western Himalayan cypress tree belonging to the Pinaceae family. It locally grows in eastern Afghanistan, northern Pakistan, northwestern India, southwestern Tibet, and western Nepal (250). Different parts of the plant have been traditionally used for the treatment of various diseases such as arthritis, asthma, gastric disturbances, inflammation, microbial infections, and neurological and skin disorders. The leaf and resin paste of the plant has been topically used for wound healing (251). Phytochemistry studies of *C. deodara* extracts and oils have indicated more than one hundred constituents including flavonoids, lignans, sterols, terpenoids, terpenes, sesquiterpene, and hydrocarbons(252).

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