Review Article

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MEDICINAL HERBS HAVING INCREDIBLE WOUND HEALING EFFECTS

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ABSTRACT

The vast field of traditional system of medical science is gaining more importance and popularity across the globe because of its amazing therapeutic values. In olden days man lived very close to nature and whenever he got indisposed he cured himself by the resources and materials provided by nature, which is nothing but the herbs. Right from very olden days it is believed that Ayurvedic herbs are supposed to give a solution for all kinds of diseases which was even considered impossible by other field of medical science. The sages in olden days were mainly involved in experimenting the different kinds of herbs and then the preparation of Ayurvedic medicine from them. The Ayurvedic treatment is entirely based on herbs, which have certain medicinal value or property to heal a number of health related problems and diseases. A wound may be defined as a breakdown in the protective function of the skin; the loss of continuity of epithelium, with or without loss of underlying connective tissue. A wound is a type of injury which happens relatively quickly in which skin is torn, cut or punctured or where blunt force trauma causes a contusion. It specifically refers to a sharp injury which damages the dermis of the skin. Healing is the process of the restoration of health to an unbalanced, diseased or damaged organism. With physical damage or disease suffered by an organism, healing involves the repair of living tissue, organs and the biological system as a whole and resumption of normal functioning. Wound healing is a process by which tissue regeneration occurs. Plants and their extracts have immense potential for the management and treatment of wounds. Several drugs of plant origin are described in the Ayurveda for their wound healing properties under the term Vranaropaka. Some of these plants have been examined during research work by many scholars for the evaluation of their wound healing activity. Some Ayurvedic medicinal plants, namely, Manjistha (*Rubia cordifolia*), yastimadhu (*Glycyrrhiza glabra*), Haridra (*Curcuma longa*), Daruharidra (*Berberis aristata*), Shigru (*Moringa oleifera*), etc. were found to be very effective as Wound healing herbs. These herbs induce healing and regeneration of the lost tissues. This review is an attempt to highlight some important medicinal herbs having wound healing properties which could be beneficial in therapeutic practice.

Keywords: Wounds, wound healing, majishtha, yastimadhu, haridra, daruharidra, shigru.

INTRODUCTION

Wound is discontinuity or break in the surface epithelium. A wound is simple when only skin is involved. It is complex when it involves underlying nerves, vessels, tendons etc.

In Ayurveda, the wound (Vrana) has been described as a main subject in Sushruta Samhita by Sushruta. He has described the wound from its different aspects right from the definition, causes etc. to the treatment of the scar tissues. Vrana (wound) is stated as-“Vrana gatravichurne” i.e. destruction and discoloration of viable tissue due to various etiology. Acharaya Charaka expanded the knowledge of wound and gave its detailed description including classification, sign, symptom, prognosis and thirty six Upakrama (essential procedures) for its management. In Charak Samhita, many formulations are described for vrana-ropak karma. Example – Nyagodhradhi ropan kwatha, Kampilakadi taila, Prapondrikadi taila etc. According to Sushruta, Aragwadhadhi gana, Arkadi gana, Sursadi gana, Lakshadi gana has the properties of Vranashodhak karma, Eladi gana has the properties of Vrana-prasadan karma and the properties of Vrana-ropak karma are present in Priyavadi gana & Ambashthadi gana of Sushruta. So,

from the 37 Ganas described by Sushruta, many of them have the wound healing properties. So, in Ayurveda, many plants having the wound healing properties are described. Out of which, some plants are described below that could prove beneficial in therapeutic practice.

TYPES OF WOUND

Ayurveda classifies the Vrana into two types-

(a) **Dushta vrana:** (i.e. chronic wound/Non-healing ulcers) are the contaminated wounds which require specific purification, called Vrana shodhana, without which healing cannot be initiated in the wounds¹.

(b) **Shuddha vrana:** The cause of such Vrana is generally a surgeon's knife & this type of Vrana does not require any specific treatment except its protection from various contaminations².

According to modern

Wounds are classified as open wounds and closed wounds on the basis of underlying cause of wound creation

OPEN WOUNDS

Though an open wound blood escapes the body and bleeding is clearly visible. Open wound is further classified

in to various types according to the object that occur the wound³.

Incised wounds

They are caused by sharp objects like knife, blade, glass etc. This type of wound has a sharp edge and is less contaminated. Primary suturing is ideal for such wounds.

Lacerated wounds

They are caused by blunt objects like fall on stone or due to road traffic accidents. Edges are jagged. The injury may involve only skin and subcutaneous tissue or sometimes deeper structures also. Due to the blunt nature of the object, there is crushing of the tissues which may result in haematoma, bruising or even necrosis of the tissue.

Penetrating wounds

They are not uncommon now a days. Stab injuries of abdomen are very notorious. It may look like an innocent injury with a small, one or two cm long cut. But internal organs like intestines, liver, spleen or mesenteric blood vessels might have been damaged.

Crushed or Contused wounds

They are caused by blunt trauma due to run over by a vehicle, wall collapse, earthquakes, or industrial accidents. These wounds are dangerous as they may cause severe haemorrhage, death of the tissues and crushing of blood vessels. These patients are more prone for gas gangrene, tetanus etc⁴.

CLOSED WOUNDS

In closed wounds blood escapes the circulating system but remain in the body. It includes Contusion or bruises, haematomas or blood tumor, Crush injury etc⁵.

Contusion

Contusion can be minor soft injury without break in the skin or sometimes it can be major due to run over by a vehicle. Generally it produces discolouration of skin due to collection of blood underneath.

Abrasion

In this wound, epidermis of the skin is scraped away thus exposing dermis. They are painful as dermal nerve endings are exposed. These wounds need cleaning, antibiotics and proper dressing.

Haematoma

This refers to collection of blood. It follows injury or spontaneously as in patients who have bleeding tendencies such as **haemophilia**. Depending upon the site, it can be subcutaneous, intramuscular or even subperiosteal.

COMPONENTS OF WOUND HEALING

Epithelialisation

Epithelialisation occurs mainly from the edges of the wound by a process of cell migration and cell multiplication. This is mainly brought about by marginal basal cells. Thus, within 48 hours entire wound is re-epithelialised.

Wound contraction

It starts after 4 days and is usually completed by 14 days. It is brought about by specialized fibroblasts. Because of their contractile elements, they are called myofibroblasts. It is the nature's way of reducing the size of defect thereby helping the wound healing.

Connective tissue formation

Formation of granulation tissue is the most important and fundamental step in wound healing. Injury results in the release of mediators of inflammation, mainly histamine from platelets, mast cells and granulocytes. This results in increase capillary permeability. Later kinin and prostaglandins act and they play a chemotactic role for white cells and fibroblasts. In the first 48 hours, polymorphonuclear leukocytes dominate. They play the role of scavengers by removing the dead and necrotic tissue. Between 3rd and 5th day, polymorphonuclear leukocytes diminish in number but monocytes increase. They are specialized scavengers. By 5th or 6th day, fibroblasts appear, proliferate and eventually give rise to a procollagen which is converted into collagen in the presence of an enzyme procollagen hydroxylase. O₂, ferrous ions and ascorbic acid are necessary for this step. Fibroplasia along with capillary budding give rise to granulation tissue. Secretion of ground substance – mucopolysaccharides by fibroblasts. These are called proteoglycans. They help in binding of collagen fibres.

Scar formation

Following changes takes place during scar formation

- Fibroplasia and laying of collagen is increased.
- Vascularity becomes less.
- Epithelialisation continues.
- Ingrowth of lymphatics and nerve fibres takes place.
- Remodelling of collagen takes place with cicatrisation, resulting in a scar.

FACTORS AFFECTING WOUND HEALING

General factors

- **Age:** In children, wounds heal faster. Healing is delayed in old age.
- **Debilitation** results in malnutrition. Wound healing is delayed probably because of Vitamin C deficiency. Following injury, vitamin C deficiency can occur after 3-4 weeks. Vitamin C is necessary for the synthesis and maintenance of collagen.
- In **diabetic** patients, wound healing is delayed because of several factors such as microangiopathy, atherosclerosis, decreased phagocytic activity, proliferation of bacteria due to high blood sugar etc.
- **Jaundiced** and **uraemic** patients have poor wound healing because fibroblastic repair is delayed.
- **Generalized infection:** Pus in some part of body delays wound healing.

Local factors

- **Poor blood supply:** Wound over the knee and shin of tibia heal very slowly but wound on the face heals fast.
- **Local infection:** Organisms eat away the suture material, destroy granulation tissue and cause slough and purulent discharge. Collagen synthesis is reduced and collagenolysis is increased.
- Haematoma precipitates infection.
- Faulty technique of wound closure.
- Tension while suturing.
- **Oxygen:** Killing property of macrophages and increased production of fibroblasts can occur due to oxygen. If contamination occur, antibiotics should be given immediately⁶.

WOUND HEALING PLANTS

Manjishtha (*Rubia cordifolia* Linn., Family- Rubiaceae)

Manjishtha is famous as Rakta shodhak (blood purifier) in traditional medicine⁷. According to Charak, Manjishtha churna is described under the dravayas of twakshuddhikar lepa for shodhana karma⁸. According to Sushruta, Manjishtha is described under Priyangwadi gana of sushruta which is useful for Vrana ropana karma⁹. The root of Manjishtha is useful in visha, shleshma sotha, yoni roga, netra roga, karna roga, raktatisara, kustha, rakta dosha, visarpa, vana, prameha¹⁰. A paste made by rubbing up the roots with honey is a valuable application for freckles and other discolouration of the skin; also in external inflammations, ulcers and skin diseases¹¹.

Chemical Constituents

The major chemical constituents of *Rubia cordifolia* are Antitumour cyclic hexapeptides RA-V and RA –VII along with RA-I-IV; anthraquin-ones munjistin, purpuroxanthin, rubiatril, rubicoumaric acid, rubifolic acid, pseudopurpurin, alizarin, rubiadin, rubimallin, purpurin, xanthopurpurine, ruberythric acid etc¹².

Research on wound healing activity of *Rubia cordifolia* Ethanolic extract of *Rubia cordifolia* roots was reported to possess highly encouraging wound healing activity in male wistars rats.

The animals were assigned into three groups, each group containing six animals. First group was untreated group which was taken as control (Group1). In Second group (Group 2) wounds received topical application of RC extract, while animals in Group 3 (Reference Standard) received treatment of Framycetine Sulphate Cream (FSC) in both excision and incision wound models. RC extract shows better and faster healing as compared to untreated group. During the initiation of the study day “0” the wound closure with RC extract was very slow as compared to FSC treated wounds. As the study progress the wound healing efficiency increases shows complete healing on day 24-25 which is same for Group 3 (wounds treated with FSC cream). But the untreated group took more time to complete wound closure¹³.

The gel and the extract of roots of the *Rubia cordifolia* showed the wound healing activity in mice. A better

healing pattern with complete wound closure was observed in mice treated within 15 days while it took about 25-30 days in control mice with different concentration of gel of ethanol extract. There was a significant reduction in wound area from day three onwards in treated mice and also on later days the closure rate was much faster than when compared with control mice. Histological evaluation shows there was a marked infiltration of the inflammatory cells, increased blood vessel formation and enhanced proliferation of cells as a result of treatment with *Rubia cordifolia* gel and extract. This study thus demonstrates the wound healing activity of ethanolic extract and its gel formulation of the roots of the plant *R. cordifolia* and found to be effective in the functional recovery of the healing of wounds¹⁴.

Clinical study of Manjishthadi Ghrita in “vrana ropana”, showed that the drug Manjishthadi Ghrita possesses high efficacy in “vrana ropana” with fine scaring without producing any adverse effect. In this study, a total of 45 patients attending the OPD/IPD of dept. of Shalya Tantra, I.P.G.T.R.A., Jamnagar were studied, with 24 patients in group-A (manjishthadi group) and 21 patients in group-B (povidone iodine group). Patients were selected with Shuddha vana formed after cut-through of ligated kshara sutra in different cases like piles and fissure, excised cyst, excised pilonidal sinus, excised corn, etc.

From this study, It can be concluded that the wounds healed within 21 days with good results in the form of normal colored scar formation without any complication in the trial group, which proved the vaikritapaham property of the compound drug. Local application of Manjishthadi ghrita provided good result by reduction of the wound size and promotion of healing, and it proved to be cosmetically effective with least scar formation also. Pigmentation similar to that of skin was found as another updating effect which was not seen in povidone iodine group¹⁵.

Yastimadhu (*Glycyrrhiza glabra* Linn. Family – Fabaceae)

Brihatrayi used this herb extensively in therapeutics but Charaka included it in many of his Kshayaya vargas¹⁶. According to charak, Lepa of Chandan, padyak, Daruharidra twak, Utpal, Meda, Mahameda Murva, Yastimadhu is useful for vana ropana. (C.Ci 25/88). The oil made from Prapondrik, Mulethi, Kakoli, Kshirkakoli, Chandan, Rakta chandan is found to be very effective for wound healing¹⁷. Sushruta has mentioned maduk under Ambashthadi gana which is useful for Vrana ropana karma¹⁸. According to Bhavaprakash, Yastimadhu is shukral, keshya, swarya, pitta-anil-asrajit and Yastimadhu is also very effective in Vrana, shotha, visha, chardi, trishna, glani, kshya roga¹⁹.

Chemical constituents

The main chemical constituents of *Glycyrrhiza glabra* are Glycyrrhizin, glycyrrhizic acid, glycyrrhetic acid, liquirtin, isoliquirtin, neoisoliquirtin, isoliquiritogenin, glabrine, glabranine, licuraside, licochalcones A & B, hispaglabridin A & B, licoricidin, glabrene, liquiritic acid, glabrolide etc²⁰.

Research on Wound Healing Activity of *Glycyrrhiza glabra*

Pharmacological Investigation on the Wound Healing Effects of Glycyrrhizic Acid Ammonium Salt in Rats

The results of study showed that the GA ointment effectively stimulates wound contraction; increase tensile strength of incision group and excision group as compared to control group. These finding could justify the inclusion of this drug in the management of wound healing²¹.

Healing potential of liquorice root extract on dermal wounds in rats

In this study, the healing potential of aqueous Liquorice Extract on dermal wounds was evaluated. The study was carried out on 45 male Spragne-Dawly rats. Two uniform 7mm diameter skin defects were created on the back of each animal by 7mm skin punch (total of 90 wounds). LE was applied once daily on half of the wounds for 7 days, after which the animals were sacrificed for histopathological, biochemical (hydroxyproline content) and biomechanical studies. The ultimate surface area of the wounds was also measured. LE caused a significant increase in the number of fibroblasts and capillary buds, collagen contents and tensile strength of the wounds. The wound surface area in the treatment group was also significantly less than the control group. It can be concluded that LE is an effective herbal remedy in wound healing²².

Anti-Staphylococcal and wound healing activities of *Ganoderma praelongum* and *Glycyrrhiza glabra* formulation in mice

In this study, evaluation of topical gel preparations of *Ganoderma praelongum* and *Glycyrrhiza glabra* aqueous extracts alone and in combination for antimicrobial and wound healing activities in MRSA - infected excision and incision wound models in mice was done. In excision wound model, a significant increase in wound healing activity was observed in animals that were treated with the combination gel as compared to the control group. In incision wound model, the breaking strength of the wounds treated with different formulations was observed. In this study, data showed that the combination gel of *G. praelongum* and *G. glabra* significantly increased wound contraction by 96.96% in excision wound as compared to the control group (90.05%); and shortened the period of epithelialization nearly by two days. Data demonstrates that the combination gel of *G. praelongum* and *G. glabra* has antimicrobial activity and wound healing activity on MRSA - infected wounds in mice²³.

Haridra (*Curcuma longa* Linn, Family – Zingiberaceae)

Haridra is being used in India since time immemorial in religious festivals and as a medicine²⁴. According to the Bhvapraksha, Haridra is bitter, hot, curative of kapha, and pitta doshas, improves the complexion (varnaya) and useful in skin diseases, act as a blood purifier and also useful in Prameha shotha, pandu roga and vrana²⁵. Juice of fresh rhizome is applied to recent wounds, bruises and leech-bites. Turmeric paste mixed with a little lime and salt

peter and applied hot is a popular application to sprains, bruises, wounds and inflammatory troubles of the joints²⁶.

Chemical constituents

In its chemical constituents, curcumene, curcumenone, curcione, curdione, cineole, curzerenone, epiprocurcumenol, eugenol, camphene, camphor, borneol, procumadiol, procumumenol, curcumins, ukonan, A, B & D, beta-sitosterol etc. are found²⁷.

Research on wound healing activity of *Curcuma longa*

Experimental studies proved that curcumin enhances cutaneous wound healing in rats and guinea pigs by increasing the formation of granulation tissue and biosynthesis of extracellular matrix proteins. Systemic treatment with curcumin in local muscle injury led to faster restoration²⁸.

The bactericidal properties of turmeric have been proved by clinical testing²⁹.

In an experimental study it is proved significant anti-ulcerogenic activity of the ethanol extract of turmeric in rats³⁰.

The wound-healing property of turmeric was investigated and observed that turmeric decreased the nitric oxide synthetase (NOS) levels and proved effective in chronic and acute wounds³¹.

The alcohol extract and essential oil from the *Curcuma longa* showed bactericidal activity whereas curcumin acted as a bacterio-static agent with respect to Staphylococci³².

The in-vitro screening of the oil against some representative bacteria and fungi, including plant and human pathogens shows that the oil has potent antimicrobial effect³³.

The alcoholic extract of *Curcuma longa* rhizomes showed lesser anti-bacterial activity against gram positive and gram negative organisms when compared to penicillin and streptomycin³⁴.

Daruharidra (*Berberis aristata* DC. Family – Berberidaceae)

Daruharidra is Katu (pungent), Tikta (bitter), Ruksha (rough) and Ushna Virya (hot in potency) dravya. It is curative of Kapha and Pitta dosha³⁵. Rasanjana (made from Daruharidra kwath) is very useful in Shleshma vikar, visha, netra vikar. Rasanjana is also very beneficial in Vrana dosha³⁶. The oil made from juice of Durva along with the paste of bark of Daruharidra is an efficacious remedy for wound healing and the oil made from juice of Kampillaka along with the paste of bark of Daruharidra is also very effective in wound healing³⁷. In wounds, oil cooked with Daruharidra, Vidanga and Kampillaka is useful³⁸. Darvi kwath is very effective as vrana shodhak kashyaya³⁹. A decoction of the root-bark of *Beberis aristata* is used as a wash for unhealthy ulcers and is said to improve their appearance and promote cicatrization⁴⁰. Rasaut mixed with honey is useful application to aphthous sores, abrasions and ulcerations of the skin⁴¹. Its active principle is berberine which is shown to be active against variety of microorganisms like bacteria, viruses, fungi, protozoa, helminthes and chlamydia⁴².

Chemical Constituents

The major chemical constituents of *Berberis aristata* are Karachine (a protoberberine alkaloid), taxilamine, berberine, palmatine, jatrorrhizine, oxycanthine⁴³.

Research on wound healing activity of *Berberis aristata*

Berberis aristata is used as wound healing agent. A study was conducted on male adult goat under which wound healing activity was evaluated on the basis of clinical observation, rate of healing and change in histomorphological features. Aqueous and alcoholic extract were used in form of ointment on open wounds and results are significant in wound healing⁴⁴.

Pharmacological Evaluation of Honey, Daruhaldi and Shatdhaut ghrut on wound healing activity in excision model in rats

In this study the therapeutic potential of Honey, Daruhaldi and Shatdhaut ghrut and honey singly and in combination on experimental excision wound healing activity in rats was studied. Excision wounds of about 500 mm² and 2 mm depth were used for the study. Parameters studied were period of epithelization, rate of wound contraction and time required for 50% wound closure (CT-50). Rats treated with Honey + Daruhaldi combination showed better wound healing activity as compared to other test drugs. Effect of this combination on wound area was less as compared to povidone iodine. However effect of Honey + Daruhaldi & Povidone iodine were comparable in % wound contracture or % wound closure. In this Excision wound model shatdhaut Ghrut alone or in combination with Honey showed less wound healing activity as compared to povidone iodine. The improved wound healing potential and synergistic effect of Honey & Daruhaldi can be attributed to additive antioxidant potential of Honey and flavonoid moieties in Daruhaldi combination showed better wound healing potential than Honey & Daruhaldi alone⁴⁵.

Shigru (*Moringa oleifera* Lam., Family - Moringaceae)

Shigru is Katu (pungent), Tikshna (bitter), Madhur (sweet), Laghu (light), Katu in Vipak (pungent in post digestive effect) and Ushna Virya (hot in potency) dravya. Shigru is Sangrahi, Shukral, Hridya, Dipan, Rochana, aggravate Pitta and Rakta. It is Chakshushya, reduces kapha and vata, and subsides vidradhi, shvayathu, and krimi. It can cure Medo roga, Apachi, Visha, Pliha roga, Gulma, Galganda and Vrana⁴⁶. India's ancient tradition of ayurveda says the leaves of the Moringa tree prevent 300 diseases. There have been reports on significant antibiotic activity of this tree⁴⁷. In accidental wounds, one should apply paste of Shigru leaves and tila mixed with ghee is found very effective⁴⁸.

Chemical Constituents

The root bark of the plant contain two alkaloids, viz moringine, moringinine, stem of the plant contains 4 hydroxy mellein, beta- sitosterol, leaves of the plant contains aspartic acid, glutamic acid, glycine, alanine, lysine, flowers of the plant contains Kaempferol, quercetin and seeds contain glycoside moringine⁴⁹.

Research on wound healing activity of *Moringa oleifera* Evaluation of aqueous leaves extract of *Moringa Oleifera* Linn for Wound healing in albino rats

In this study aqueous extract of leaves of *Moringa oleifera* showed significant wound healing activity against excision, resutured incision and dead space wounds in albino rats. A significant increase in the tensile strength of drug treated group in incision wound model was observed. Tensile strength of the granuloma tissue, weight of this tissue and hydroxyproline content also were significantly increased in drug treated vs. control group in dead space wound model. Excision wound model showed significant decrease in the epithelialisation period. Epithelialisation was found to be enhanced significantly by the aqueous extract of *M.oleifera* as compared to control group. Increased granulation tissue along with well-formed fibrocollagenised tissue in aqueous extract treated group as compared to control group was found⁵⁰.

Effect of *Moringa oleifera* Lam. on normal and dexamethasone suppressed wound healing

The results of the present study revealed that aqueous extract of *M. oleifera* possesses a definite prohealing action in normal healing as well as in steroid suppressed wound healing. In excision wound healing model the aqueous extract of *M. oleifera* showed significant increase in percentage closure of excision wounds by enhanced epithelialisation. This enhanced epithelialisation may be due to the effect of *M. oleifera* extract on enhanced collagen synthesis. Similarly, the breaking strength of the incision wounds was increased in aqueous extract treated groups in incision wound healing model.

In dead space model there was a significant increase in granuloma tissue breaking strength in extract treated groups in dead space wound model. The higher breaking strength indicates better healing of wounds. Higher hydroxyproline content was seen with extract treatment. The increased amount of hydroxyproline in aqueous extract treated groups underlines increased collagen content, since hydroxyproline is the direct estimate of collagen synthesis it supports the wound healing activity of *M. oleifera*. The aqueous extract of the plant *M. oleifera* also antagonized the action of dexamethasone to some extent on collagen synthesis, maturation, deposition, period of epithelization and hydroxyproline content. Thus it has potential for antagonizing the anti healing effect of steroids in patient receiving steroid therapy⁵¹.

Evaluation of *in vivo* Wound Healing Activity of *Moringa oleifera* Bark Extracts on Different Wound Model in Rats

Wistar albino rats of either sex weighing between 180 and 200 g were topically treated with aqueous and ethanolic extracts ointment (5% w/w) in excision, incision and dead space wound healing models. Rats of standard group were treated with povidone iodine ointment topically. In excision wound model, topical application of *Moringa oleifera* increased the percentage of wound contraction and completed wound healing by 20th day which indicates rapid epithelialisation and collagenization. The breaking strength of the incision wounds was increased in aqueous extract ointment and ethanolic extract ointment treated

groups to significant extent. In the dead space wound study, there was a significant increase in granuloma breaking strength in aqueous and ethanolic extract ointment treated groups. There was significant increase in hydroxyproline content in aqueous and ethanolic extract treated groups. The results are superior to Standard Povidone iodine ointment which also showed significant results as compared to control⁵².

Evaluation of Antimicrobial properties and nutritional potentials of *Moringa oleifera* Lam. leaf in South-Western Nigeria

In this study the antimicrobial activities of the leaf extract of *Moringa oleifera* on certain enteropathogenic and orthopaedics' wounds bacteria and fungi were investigated. The leaves extract demonstrated weak antibacterial activity on the enteropathogens as the growth inhibition zones were less than 1.5 mm. This indicates that *M. oleifera* leaf has little effect on these organisms at the concentration used. However, both the aqueous and methanolic extracts of the leaf showed appreciable antibacterial activity on the orthopaedics' wounds organisms, indicating its high antibacterial potential and effectiveness in the treatment of wound infections. In this study, the ethanolic extract of *M. oleifera* leaf showed significant antifungal activity particularly on *A. flavus*, *Penicillium sp.*, *Pullarium sp.* and *T. mentagrophyte*, whereas aqueous and methanolic extracts did not show any antifungal effect, except on *A. flavus* methanolic extract where a zone of growth inhibition of 12 mm was developed with methanolic extract⁵³.

Natural Healing Compound for the Treatment of Excision and incision wound in rats model

The ethanol extract of *Moringa olifera* leaves was prepared and evaluated for its wound healing potentials in Wistar rats using excision and incision wound models. The breaking strength and the hydroxyproline content of the wounds were also studied. The results indicated that the rate of wound healing in groups treated with *Moringa oleifera* leaves extract ranged from 32.2 ± 0.0 to 100.0 ± 1.1 % at 4 and 15 days respectively, while the groups that received nitrofurazone ointment exhibited 11.0 ± 1.0 to 77.2 ± 2.0 % wound healing at 4 and 15 days respectively. Batches A, B and C treated with varying concentrations of the leaves extract exhibited greater breaking strength and higher contents of hydroxyproline significantly different from the reference and the control groups ($p < 0.05$). Therefore, *Moringa oleifera* leaves extract exhibited faster wound healing rates than nitrofurazone ointment used as the reference drug⁵⁴.

CONCLUSION

Wound healing is an intricate process where the skin or other body tissue repairs itself after injury but a wound may fail to heal if one or more of the healing stages are interrupted. Factors that can slow the wound healing process include nutritional deficiency, local infections, haematoma, medical conditions such as diabetes, anaemia, some vascular diseases that restricted blood flow to the area etc. Many medicinal herbs are found very useful in

treating wounds. Plants and their extracts have immense potential for the management and treatment of the wounds. The wound healing through plants are inexpensive, affordable and safe as hyper sensitivity reactions are very rare with the use of these natural agents. These natural agents induce healing and regeneration of the lost tissue by multiple mechanisms. However, there is a need for scientific evaluation, standardization and safety evaluation of these herbs.

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