



CODEN [USA]: IAJ PBB

ISSN : 2349-7750

INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES
SJIF Impact Factor: 7.187

Available online at: <http://www.iajps.com>

Review Article

PHARMACOLOGICAL AND WOUND HEALING PROPERTIES OF TRIDAX PROCUBENS

Kalyani N. Sadafale*, Tejal P. Bute*, Aditya A. Unhale¹, Dr. Swati P. Deshmukh²

*Shraddha Institute of Pharmacy, Kondala Zambre, Washim Maharashtra India 444505

¹Department of Pharmacy Shraddha Institute of Pharmacy, Washim Maharashtra India

²Department of Pharmacology Shraddha Institute of pharmacy Washim Maharashtra India

Abstract:

Wound healing is a complex biological process involving the restoration of cellular, anatomical, and functional integrity following injury. The process can be hindered in certain conditions, such as diabetes mellitus, which is known to impair wound healing, resulting in chronic wounds. This poses a significant health burden globally. While traditional treatments exist, their effectiveness is not always guaranteed, and there is a growing need for more reliable therapeutic alternatives. This paper explores the potential repurposing of existing drugs—such as dipeptidyl peptidase 4 (DPP4) inhibitors, metformin, statins, and phenytoin—as treatment options for chronic wounds, based on preclinical and clinical findings.

In addition to pharmaceutical approaches, traditional herbs have been widely utilized for wound healing, with *Tridax procumbens* (TP) emerging as a promising candidate. Known for its antimicrobial, anti-inflammatory, and antioxidant properties, TP accelerates wound healing through various mechanisms. TP has shown potential in treating a wide range of conditions, including infections, inflammation, and skin wounds. Its chemical constituents, such as flavonoids (quercetin, luteolin, apigenin), contribute to its wound-healing properties by reducing oxidative stress and inflammation. TP's medicinal uses extend beyond wound care, encompassing liver protection, pain relief, antidiabetic effects, and antimicrobial activity, among others.

Key Points :- Wound Healing Process, Chronic Wounds, *Tridax Procumbens* (TP), Wound Healing Mechanisms, Antimicrobial & Antidiabetic

INTRODUCTION:

A wound is the breakage of normal alignment of body cells with or without destroying them, which may impair or stop their function. Wound is a breach formed in the normal continuum of the cellular and molecular structure of the body, thereby creating a disruption in the cellular, anatomic and as well as in their functional continuity. Wound healing or wound repair is an intricate process in which the skin or organ or tissue repairs itself after injury [1]. Wound can be healed as spontaneous process in the organism through a cascade of events, which starts by switching on various chemical signals in the body. While partial thickness wound heals by mere epithelialization, the healing of full thickness wound which extends through the entire dermis involves more complex well-regulated biological events. Chronic wounds often occur in patients with diabetes mellitus due to the impairment of wound healing. This has negative consequences for both the patient and the medical system and considering the growing prevalence of diabetes; it will be a significant medical, social, and economic burden in the near future. Hence, the need for therapeutic alternatives to the current available treatments that, although various, do not guarantee a rapid and definite reparative process, appears necessary. We here analyzed current treatments for wound healing, but mainly focused the attention on few classes of drugs that are already in the market with different indications, but that have shown in preclinical and few clinical trials the potentiality to be used in the treatment of impaired wound healing. In particular, repurposing of the antidiabetic agents dipeptidyl peptidase 4 (DPP4) inhibitors and metformin, but also, statins and phenytoin have been analyzed. All show encouraging results in the treatment of chronic wounds, but additional, well-designed studies are needed to allow these drugs. Diabetic patients have a 15–25% lifetime risk of developing diabetic foot ulcers, of which 40–80% become so severely infected it involves the bone, leading to osteomyelitis [4]. Global epidemiological studies suggest a higher prevalence in North America. A high number of cases of foot ulcerations require hospitalization and surgical intervention with amputation of the interested body part. In addition, the rate of recurrence of a foot ulcer is greater than 50% after 3 years from the first episode [6]. For this reason, impaired wound healing in DM represents a major healthcare issue and a significant economic burden [7, 8]. Notably, costs for diabetic foot ulcerations treatment are additive with general costs for diabetes care, and are on the rise with the increased incidence and prevalence of pathology.

CAUSES & TYPES OF WOUNDS

Wound causes can be internal or external in origin. Wounds of internal origin are mainly due to impaired circulation, neuropathy or medical illness. Wounds of external origin are due to an outside force or trauma that causes open or closed wounds.

Impaired circulation: This can be from either ischemia or stasis. Ischemia is the result of reduced blood supply caused by the narrowing or blockage of blood vessels, which leads to poor circulation. Stasis is caused by immobilization (or difficulty moving) for long periods or failure of the regulating valves in the veins, which leads to blood pooling and failing to flow normally to the heart. •

Neuropathy: This is seen mostly in cases of prolonged uncontrolled diabetes mellitus, where high blood sugars, derivative proteins and metabolites accumulate and damage the nervous system. The patients are usually unaware of any trauma or wounds, mainly due to loss of sensation in the affected area.

Medical illness: When chronic and uncontrolled for long periods (such as hypertension, hyperlipidemia, atherosclerosis, diabetes mellitus, AIDS, malignancy, morbid obesity, hepatitis C virus, etc.), medical illnesses can lead to impairment of the immune system functions, diminishing the circulation and damaging other organs and systems.

Contusions: These are a common type of sports injury, where a direct blunt trauma can damage the small blood vessels and capillaries, muscles and underlying tissue, as well the internal organs or bone. Contusions present as a painful bruise with reddish to bluish discoloration that spreads over the injured area of skin.

Hematomas: These include any injury that damages the small blood vessels and capillaries resulting in blood collecting and pooling in a limited space. Hematomas typically present as a painful, spongy rubbery lump-like lesion. Depending on the severity and site of the trauma, hematomas can be small or large, deep inside the body or just under the skin. **Crush injuries:** These are usually caused by an external high-pressure force that squeezes part of the body between two surfaces. The degree of injury can range from a minor bruise to a complete destruction of the crushed area of the body, depending on the site, size, duration and power of the trauma. In cases of open wounds, the skin is cracked open, leaving the underlying tissue exposed to the outside environment.

Crush injuries: These are usually caused by an external high-pressure force that squeezes part of the body between two surfaces. The degree of injury can range from a minor bruise to a complete destruction of

the crushed area of the body, depending on the site, size, duration and power of the trauma. In cases of open wounds, the skin is cracked open, leaving the underlying tissue exposed to the outside environment.

Incisions: These are most likely the result of a surgical procedure or skin cut with a sharp object such as a scalpel or knife. Incisions are mostly linear in shape with smooth, even edges. Depending on the depth and site of the wound, an incision can be life threatening and cause serious damage, especially if it involves vital organs, major blood vessels or nerves.



Fig no 1.-Incision.

Abrasions

These are shallow irregular wounds of the upper skin layers, due to brushing against either a rough surface

or a smooth surface at high speed. Abrasions usually present with minor to no bleeding, and some pain that subsides shortly after the initial injury.



Fig.no.2 Abrasion

Lacerations: These wounds are tear-like wounds with irregularly torn edges that are usually deeper than abrasions and cause more pain and bleeding. Lacerations are generally caused by trauma or contact with an object, as might result collisions.

Punctures: These are small rounded wounds that result from objects with thin pointed tips, such as needles, nails or teeth (in cases of human or animal bites). The wound size, depth, bleeding and pain are directly related to the size and force of the causative object.

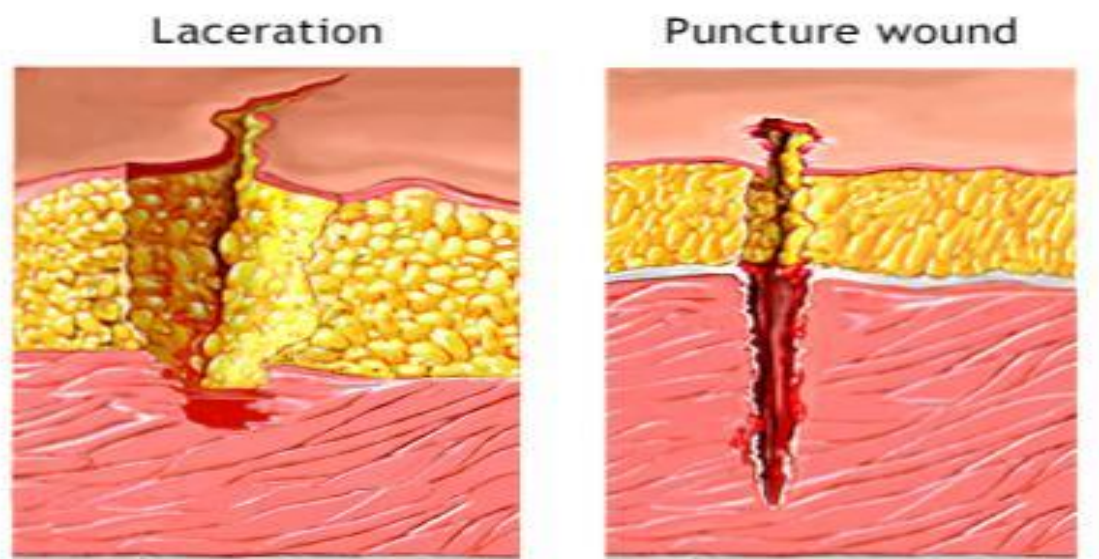


Fig.No.3-laceration and puncture wound

Penetrating: This type of wound can be caused by any object or force that breaks through the skin to the underlying organs or tissue. A penetrating wound has variable sizes, shapes and presentations depending on the cause. Penetrating wounds can be life threatening, causing serious injury, especially if involving vital organs, major blood vessels or nerves

COMPLICATIONS

Internal wound complications:

Impaired circulation: In cases of both ischemia and stasis, the supply of blood, oxygen and nutrients, as well as flushing of extra waste products, is impaired. This results in tissue death and wound formation that may develop later to venous and arterial ulcers, or gangrene.

Neuropathy may give rise to: Diabetic foot ulcers: The part of nervous system responsible for sweating and moisturizing the skin is impaired, leaving the skin on the feet dry and vulnerable to cracks and injuries. Due to the reduced sensation of that area, many skin cuts, cracks or injuries can go unnoticed and progress to ulcers. Charcot or neuropathic joints: The part of nervous system that controls the muscle of the leg and foot is damaged, leading to improper distribution of force and pressure while performing routine activities. This can eventually cause joint dislocation, deformity, fracture and injury. • Medical illness: A weakened immune system and other malfunctioning or diseased systems decrease the ability of the human body to defend itself against infections, inflammations, ulcers or wounds. A weakened immune system can also delay or prevent wound healing.

Externally caused closed wounds can be complicated by:

- Severe bleeding
- Large bruises
- Nerve damage
- Bone fractures
- Internal organ damage

Compartment Syndrome: This syndrome involves the lower and/or upper limbs (especially the legs and forearms), where the damage causes swelling and increased pressure in the fascia that surrounds the muscles, nerves and blood vessels in that area. The increased pressure can block the blood supply to the affected limbs, causing severe damage to the muscles and nerves. The damage can be permanent, leading to loss of function, and may necessitate amputation.

Infections: Except for surgical incisions, most open wounds are caused by dirty, contaminated objects that carry different types of bacteria and organisms. An

infected wound may present with a foul odor, pus or yellowish drainage, fever and pain.

Inflammation: This can result from the body's immune response to a foreign material that caused a wound. Inflammation can make the wound area red, hot, swollen and painful.

Loss of Function: Whether because of the pain or the trauma itself, loss of function can be temporary or permanent, depending on the extent of the wound and the damage to the affected limb or area.

Scarring: Many open wounds will leave a scar after healing, and some may even cause a deformity of the affected area, especially with penetrating, gunshot or deep laceration wounds. The healing process begins with the clotting of blood and is completed with remodelling of the cellular layers of the skin. The whole process can broadly be classified into 5 overlapping phases, namely, inflammation, granular tissue formation, re-epithelialization, matrix production and remodeling. 2 Tissue injury results in local vascular injury. The ensuing bleeding floods the wound with mediators of the coagulation cascade. Factors are released to attract platelets to the site of injury. These include mediators such as platelet-derived growth factor and transforming growth factor beta. Macrophages are attracted to the site of injury by these factors, debride local necrotic tissue and orchestrate the wound healing process by releasing cytokines such as stimulate, via these cytokines, fibroblasts to begin collagen production and smooth muscle and endothelial cells to proliferate for angiogenesis. As the collagen matrix and new vessels bridge the wound, the surface undergoes epithelialization. These processes continue until contact inhibition causes it to stop. Throughout this healing and for many months after the wound has closed, collagenase breaks down the newly formed collagen while new collagen is deposited. This balanced process of collagen production and collagen destruction results in wound remodeling.

Herb for Wound healing:-

Tridax Procumbens Tridax Procumbens (TP) has been proven to have the ability to heal skin infections TP possesses various properties, including anti-inflammatory, antimicrobial, antioxidant, and anticoagulant properties, which are believed to contribute to its potential for wound healing [5,6]. Tridax procumbens, commonly known as coatbuttons or tridax daisy, is a species of flowering plant in the family Asteraceae. It is best known as a widespread weed and pest plant. It is native to the tropical Americas including Mexico,[1] but it has been introduced to tropical, subtropical, and mild temperate

regions worldwide. It is listed as a noxious weed in the United States and has pest status in nine states. These properties help to reduce the time required for re-epithelization. Additionally, TP is also used as an insect repellent, hair tonic, anti-diabetic, diuretic, anti-cancer, and anti-diarrheal agent. TPE contains several phytoconstituents such as flavonoids, triterpenoids, alkaloids, phenolic compounds, and polysaccharides. Among all the phytoconstituents TPE is rich in flavonoids like quercetin, luteolin, apigenin, and kaempferol which exhibit antioxidant and anti-inflammatory properties and aid in wound healing by reducing oxidative stress and inflammation. To enhance the mechanical properties, achieve tailored drug release kinetics, improve processability, and tune biodegradability, the TPE is blended with other natural and synthetic polymers. This blending process enables the development of tailored biomaterials that can meet the requirements of various biomedical applications. Table 1 highlighted the Comparisons of previous research activities related to TP-based film.

Medicinal uses and traditional uses:-

Aqueous leaves extract possesses cardiovascular effect and significantly reduces heart rate and blood pressure. Lyophilized aqueous leaf extract showed anti-inflammatory action comparable to ibuprofen and aspirin. Whole arial parts have hepatoprotective, antisecretory (antidiarrheal) activity. It is active against bacteria, protozoa and fungi. Leaf juice is useful in dead space wound healing. Seeds are used to check all types of bleeding. Aqueous extract of whole arial part is used as immunomodulator. Dry extract showed antibiotic activity even when formulated in mineral base. Traditional and complementary medicine is being increasingly recognized as an integrative approach to health care in many countries (WHO, 2013). The use of plants for medicinal purposes may date back to the Middle Palaeolithic age, approximately 60,000 years ago. *T. procumbens* is found throughout the world and it has been used to treat anemia, colds, inflammation, and hepatopathies in Central America in Guatemala, *T. procumbens* is used as an antibacterial, antifungal, and antiviral treatment as well as for vaginitis, stomach pain, diarrhea, mucosal inflammations, and skin infections. The leaf juice is used to treat wounds and stop bleeding. A study done in Chiquimula, Guatemala, showed that lactating pregnant women suffering from anemia could reduce their symptoms by using Tridax. This species is also used in the treatment of gastrointestinal and respiratory infections, high blood pressure, and diabetes. In Guatemala, the entire plant is used for the treatment of protozoal infections, including malaria, leishmaniasis and dysentery. Aqueous extracts of *T. procumbens* strong

anti-plasmodial activity against chloroquine-resistant *P. falciparum* parasites it has activity against *Trypanosoma brucei*, antibacterial and wound-healing properties. Scientific support for several of these traditional uses will be discussed later.

Traditional uses :

In Nigeria, the entire plant is used to treat typhoid fever, cough, fever, stomach ache, backache, diarrhea and epilepsy. Farmers in Africa use the plant for treatment of livestock for example, Tridax is used along Vignaparkeri to treat chronic mastitis by grinding both plants, and adding salt and water and applying to the udder studied the antibacterial effect of Tridax against mastitis-causing bacteria and found that the ethanolic extract had significant activity against *Staphylococcus aureus*. However, there was little or no activity from the aqueous extracts against *Streptococcus uberis* and *Klebsiella pneumoniae*, in comparison with *Spathodea campanulata* extracts. In Benin, breeders complement the feed of rabbits or other livestock combining with other plants; although rabbits consume it in lower amounts than other fodder, probably due to low palatability. In Togo, the fresh, crushed leaves are used for dressing wounds. The decoction of the leaves is used against pain, to treat malaria, and against abdominal and gastrointestinal mycosis.

FACTOR THAT CAN CAUSE ACUTE WOUND PAIN

Acute wound pain can be influenced by several factors, which can vary depending on the type, severity, and location of the wound. Some of the main factors that contribute to acute wound pain include:

1. **Nerve Damage:** Injury to the sensory nerves during the wound process can cause sharp, burning, or stinging pain. Nerves in the skin and underlying tissues may be exposed or damaged, leading to discomfort.
2. **Inflammation:** When a wound is healing, the body initiates an inflammatory response, which involves the release of chemicals (e.g., prostaglandins, bradykinin) that make the area more sensitive. This results in pain, swelling, and redness.
3. **Tissue Trauma:** The level of mechanical damage to the skin, muscles, tendons, or bones affects the intensity of pain. Deeper or more complex wounds (e.g., lacerations, abrasions) tend to cause more pain due to the involvement of larger and more sensitive tissue structures.
4. **Infection:** If a wound becomes infected, it may cause increased pain, along with other symptoms such as redness, heat, and pus. Infection can delay healing and intensify discomfort.

5. **Pressure and Movement:** Pressure on the wound (from movement, dressing, or activity) can aggravate pain. Repeated motion or friction near the wound site can cause irritation and increase discomfort.
6. **Psychological Factors:** Emotional responses, such as anxiety, fear, or stress, can amplify the perception of pain. The individual's mental state often influences how intensely pain is felt and processed.
7. **Size and Depth of the Wound:** Larger and deeper wounds, especially those involving muscles or internal organs, often result in more severe pain due to the broader area affected and the involvement of various types of tissue.
8. **Wound Type:** Certain wounds, such as burns or punctures, have their own characteristic pain patterns. Burns often cause intense, throbbing pain due to nerve involvement, while punctures may cause a sharp, stabbing pain.
9. **Vascular and Circulatory Issues:** Poor circulation or compromised blood flow to the affected area can increase pain and slow healing, making the wound more painful.
10. **Treatment Interventions:** Pain may also result from interventions like dressing changes, debridement (removal of dead tissue), or suturing, all of which can irritate the wound site and cause temporary pain.

PHARMACOLOGICAL ACTIVITIES:

Analgesic and anti-inflammatory activity :- Tridax Procumbens having various potential therapeutic activities like antimicrobial activity, anti-oxidant, antibiotic efficacies, wound healing activity, insecticidal, anti-inflammatory activity, diarrhea and dysentery. Leaf juice is used to cure fresh wounds, to stop bleeding, as a hair tonic. In India, Tridax Procumbens mainly used for wound healing, as anticoagulant, antifungal and insect repellent. In folk medicines leaf extract were known to treat infectious skin diseases. It is a well-known medicine for liver disorders or hepatoprotective nature besides gastritis and heart burn. Tridax Procumbens is used as bio absorbent for removal of harmful Cr (VI) from the industrial waste water. An analgesic may be defined as a drug bringing about insensibility to pain without loss of consciousness [9]. Lyophilized extract of Tridax Procumbens was found to be potent analgesic. Tridax Procumbens has marked beneficial effects against centrally, peripherally and inflammatory pain model. **Hepatoprotective Activity** The hepatoprotective activity of aerial parts of Tridax shows significant protection in alleviation of D-Galactosamine/Lipopolysaccharide (D-GalN/LPS) induced hepatocellular injury [10]. D-GalN/LPS have

been proposed to be hepatotoxic due to its ability to destruct liver cells. The multifocal necrosis produced by D-GalN and the lesion of viral hepatitis in humans are similar. This amino sugar is known to selectively block the transcription and indirectly hepatic protein synthesis and as a consequence of endotoxin toxicity, it causes fulminant hepatitis within 8 hour after administration

Immunomodulatory Activity:- Ethanolic extracts of leaves of Tridax have immunomodulatory on Albino rats dosed with *Pseudomonas aeruginosa* also inhibits proliferation of same [11]. Also a significant increase in phagocytic index, leukocyte count and splenic antibody secreting cells has been reported to ethanol insoluble fraction of aqueous extract of Tridax. Stimulation of humoral immune response was also observed along with elevation in hemagglutination antibody titer. **Wound Healing Activity :-** Wound healing involves a complex interaction between epidermal and dermal cells, the extra cellular matrix, controlled angiogenesis and plasma-derived proteins.

Antidiabetic Activity :- The aqueous and alcoholic extract of leaves of Tridax Procumbens Linn. Shows significant decrease in the blood glucose level and it shows antidiabetic activity in the model of aloxan induced diabetic in rats. [14]. **Antimicrobial Activity** Whole plant of Tridax has reported for its antimicrobial activity on various species of bacteria. A whole plant is squeezed between the palms of hands to obtain juice. Fresh plant juice is applied twice a day for 3-4 days to cure cuts and wounds. The extract of whole plant of Tridax showed antibacterial activity only against *Pseudomonas aeruginosa*. The disk diffusion method was used to test the anti-bacterial activity. Four strains of bacteria employed in test were two gram positive *Bacillus subtilis*, *Staphylococcus aureus* and two gram negative *Escherichia coli* and *Pseudomonas aeruginosa*. [15] **Antimalarial activity** The aqueous and ethanolic extracts have antiparasitic activity against chloroquine-resistant *P. falciparum* parasites. The extracts have considerably low toxicities to human RBCs. These results lend support to claims of herbalists that decoctions of either TP or PA are useful medicines. These notwithstanding, more comprehensive animal toxicity studies need to be carried out on the plants, especially since humans are currently using them to treat malaria and other diseases.

Anticancer activity :- Tridax Procumbens is a semi prostrate annual or short lived perennial herb. The phytochemicals in dried leaves of T. Procumbens have been investigated. T. Procumbens were tested for

cytotoxicity against human lung cancer by MTT assay. The compound of Rf value 0.66 showed 90% reduced cell viability. NMR, MS and IR spectra revealed the compound as Lupeol. The anticancer potential of the Lupeol against human lung cancer has been evaluated by colon genic survival determination, cell cycle control, Cell based assay for inhibition of COX-2 activity and DNA fragmentation analysis, an amount of 320 µg/ml concentration of Lupeol compound exhibited potential anticancer property

Antifungal activity :- Tridax Procumbens L. Disc diffusion assay was performed against two pathogenic fungal strains (*Aspergillus flavus* and *Aspergillus niger*). Minimum inhibitory concentrations (MIC), minimum fungicidal concentrations (MFC) and total activity were also evaluated for determination of antifungal potential of each active extract. The flavonoid extracts showed remarkable activity against *A. Niger* whereas alkaloid extracts were found inactive against both the test fungi. Excellent antifungal potential was recorded for free flavonoid of stem and bound flavonoid of stem and flower *A. Niger*. Study indicated that. Procumbens can be used as a source of formulations

Antibacterial Activity:- The herb Tridax Procumbens, found growing commonly in tropical countries, is endowed with antibacterial properties. Our study demonstrated that this activity was associated only with the ethanolic extract and was prominently seen only against *Pseudomonas aeruginosa* strains. Multi drug resistant nosocomial strains of *Pseudomonas* isolated from ventilator associated pneumonia, urinary tract infection as well as blood stream infection showed significant sensitivity to Tridax extracts. Our study corroborates the efficacy of Tridax as an anti pseudomonad agent and its value as a source of formulations for treatment of nosocomial infections caused by *Pseudomonas aeruginosa*

CONCLUSION: -

Tridax Procumbens, commonly known as “coat buttons,” is a medicinal plant with several pharmacological properties. Studies have revealed that it possesses antibacterial, anti-inflammatory, antifungal, antioxidant, hepatoprotective, and wound-healing properties, making it valuable in traditional and modern medicine. The antibacterial activity is attributed to bioactive compounds like flavonoids, saponins, and tannins, which help combat various pathogens. Its anti-inflammatory effects are useful in treating inflammatory disorders, possibly by inhibiting key enzymes and cytokines involved in inflammation. The plant’s antioxidant properties are beneficial for

protecting cells from oxidative damage, attributed to its phenolic compounds. Additionally, Tridax Procumbens exhibits hepatoprotective activity, which may aid in liver protection and recovery from toxicity or damage, possibly due to its antioxidant mechanisms. Its wound-healing abilities make it effective for external applications, as it promotes cell proliferation and collagen synthesis, speeding up the healing process.

REFERENCES:

1. USDA. Tridax procumbens. Natural Resources Conservation Service PLANTS Database. 2015 Dec 15.
2. Tridax procumbens L. Encyclopedia of Life. Available from: https://en.wikipedia.org/wiki/Tridax_procumbens
3. Baker S, Sreedharamurthysatish. Bioprospecting of endophytic bacterial plethora from medicinal plants. Plant Sci Feed. 2013;3(3):42-45.
4. Wikipedia, the free encyclopedia. Tridax procumbens. Available from: https://en.wikipedia.org/wiki/Tridax_procumbens
5. Gamboa-Leon R, Vera-Ku M, Peraza-Sanchez SR, Ku-Chulim C, Horta-Baas A, Rosado-Vallado M. Antileishmanial activity of a mixture of Tridax procumbens and *Allium sativum* in mice. Parasite. 2014;21:15. Doi:10.1051/parasite/2014016.
6. Petchi R, Vijaya C, Parasuraman S. Anti-arthritis activity of ethanolic extract of Tridax procumbens (Linn.) in Sprague Dawley rats. Pharmacognosy Res. 2013;5(2):113-117. Doi:10.4103/0974-8490.110541.
7. Ali M, Ravinder E, Ramachandram R. A new flavonoid from the aerial parts of Tridax procumbens. Fitoterapia. 2001;72(3):313-315. Doi:10.1016/S0367-326X(00)00296-3.
8. Pathak AK, Saraf S, Dixit VK. Hair growth promoting activity of Tridax procumbens. Fitoterapia. 1991;62:307-313.
9. Deshmukh AS, Morankar PG, Kumbhare MR. Review on analgesic activity and determination methods. Pharmtechmedica. 2014;3(1):425-428.
10. Vilwanathan R, Shivashangari KS, Devak T. Hepatoprotective activity of Tridax procumbens against D-galactosamine/lipopolysaccharide-induced hepatitis in rats. J Ethnopharmacol. 2005;101:55-60.
11. Oladunmoye MK. Immunomodulatory effects of ethanolic extract of Tridax procumbens on Swiss Albino rats orogastrically dosed with *Pseudomonas aeruginosa* (NCIB 950). Int J Trop Med. 2006;1(4):152-155.

12. Bhat RS, Shankrappa J, Shivakumar HG. Formulation and evaluation of polyherbal wound treatments. *Asian J Pharm Sci.* 2007;2(1):11-17.
13. Nia R, Paper DH, Essien EE, Oladimeji OH, Iyadi KC, Franz G. Investigation into in-vitro radical scavenging and in-vivo anti-inflammatory potential of *Tridax procumbens*. *Niger J Physiol Sci.* 2003;18(1-2):39-43.
14. Bhagwat DA, Killedar SG, Adnaik RS. Antidiabetic activity of leaf extract of *Tridax procumbens*. *Int J Green Pharma.* 2008;2:126-128.
15. Mahato RB, Chaudhary RP. Ethnomedicinal study and antibacterial activities of selected plants of Palpa district, Nepal. *Sci World.* 2005;3(3):26-31.
16. Opong RA, Nyarko AK, Dodoo D, Gyang FN, Koram KA, Ayisi NK. Antiplasmodial activity of extracts of *Tridax procumbens* and *Phyllanthus amarus* in in-vitro *Plasmodium falciparum* culture systems. *Ghana Med J.* 2011;45(4):143-150.
17. Sankaranarayanan S, Bama P, Sathyabama S, Bhuvaneswari N. Anticancer compound isolated from the leaves of *Tridax procumbens* against human lung cancer cell A-549. *Asian J Pharm Clin Res.* 2013;6(2):91-96.
18. Jindal A, Kumar P. In vitro antifungal potential of *Tridax procumbens* L. Against *Aspergillus flavus* and *Aspergillus niger*. *Asian J Pharm Clin Res.* 2013;6(2):123-125.
19. Pai C, Kulkarni U, Borde M, Murali S, Mrudula P, Deshmukh Y. Antibacterial activity of *Tridax procumbens* with special reference to nosocomial pathogens. *Br J Pharm Res.* 2011;1(4):164-173.
20. Agrawal SS, Talele GS, Surana SJ. Antioxidant activity of fractions from *Tridax procumbens*. *J Pharm Res.* 2009;2(1):71-73.