

Medicinal Properties of *Tridax Procumbens* - Review

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Abstract: *Tridax procumbens* Linn. (Compositae) is a weed found throughout India. The plant is native of tropical America and naturalized in tropical Africa, Asia, and Australia. Local people known it as “Ghamara”, in English popularly called ‘coat buttons’ and is dispensed for “Bhringraj” by some of the practitioners of Ayurveda. The medicinal plant *Tridax procumbens* Linn. belongs to the family Compositae & it is found to be effective against various disorders especially cuts, wounds and burns. It is also a tonic. Considering the wide range of medicinal properties it can serve as nutraceutical in this era of pandemic.

Keywords: *Tridax procumbens*; Ethanolic extract; wound healing activity



Fig. 1



Fig. 2

INTRODUCTION : Wound is a physical trauma where the skin is torn, cut or punctured. On exposure to air, microorganisms enter the wound which leads to wound contamination and finally development of infection. It is a process that is fundamentally a connective tissue response. Initial stage of this process involves an acute inflammatory phase followed by synthesis of collagen and other extracellular macromolecules that helps in the formation of a scar. This intricate process is initiated in response to an injury restores the function and integrity of damaged tissues. Herbal therapy predominates in traditional medicine as well as in alternative medicine practiced in the developing and the developed countries. The widespread interest in drugs derived from plants is because of the belief that plants are safe and dependable, and with lesser side effects.



Fig. 3

Review of literature reveals that traditional plant drugs are beneficial for several skin related problems and for wound healing . World Health Organization (WHO) as well as our country has been promoting use of traditional medicine because they are less expensive, easily available and comprehensive, especially in developing countries .song with wound healing it possesses many more medicinal activities such as anti microbial, anti fungal, antibacterial, antiparasitic, antioxidant, anticancer, hepatoprotective, immunity inhancer, etc. It is a plant with vast varieties of benefits.

CLASSIFICATION: The Plant classification details are :

Kingdom.	:	PlantaePlants
Subkingdom.	:	TracheobiontaSeed plants
Division.	:	Magnoliophyta Flowering plants
Class.	:	MagnoliopsidaDicotyledons
Subclass.	:	Asteridae
Order.	:	Asterales
Family.	:	Asteraceae
Genus.	:	Tridax L.
Species.	:	Tridaxprocumbens (L.) coat buttons

VERNACULAR NAMES

Region/Language	Vernacular Name
Hindi	Gharma
Sanskrit	Jyantiveda
Oriya	Bishalyakarani
Marathi	Dagadipala
Telugu	Gaddichemanthi
Tamil	Thatapoddu
Malayalam	Chiravanak
Spanish	Cadilipchisaca
French	Herbecaille
Chinese	Kotubukigiku
Latin	TridaxProcumbens Linn.

Chemical Constituents:

T. procumbens contains flavone glycosides, chromone Glycosides, sterols and polysaccharides with a Beta- 1,6-D-galactan main chain. Unsaponifiable fraction of Petroleum ether fraction revealed the presence of Campesterol, stigmasterol and beta- sitosterol by GC-MS (Gadre and Gabhe, 1992).The ethyl acetate soluble part of hexane extract Yielded a new bithiophene named tri-bisbithiophene Along with four terpenoids: taraxasteryl acetate, beta-Amyranone, lupeol and oleanolic acid (Ali and Jahangir,2002). A new flavonoid (Procumbenetin) isolated from Arial part of T. Procumbens has been characterized as 3,6-dimethoxy-5, 7, 2', 3', 4'-pentahydroxy flavones, 7-O-beta-3- glucopyranoside (Ali and Ramachandram,2001). Eight new compounds, isolated from Tridax Procumbens, have been characterized as methyl 14-Oxoctadecanoate, methyl 14-oxononacosanoate, 3-Methylnonadecylbenzene, heptacosanyl cyclohexane Caprylate, 1(2,2-dimethyl-3- hydroxypropyl)-2-isobutyl Phthalate, 12-hydroxytetraacosan-15-one, 32-methyl-30oxotetriacont-31-en-1-ol and 30-methyl-28-Oxodotriacont-29-en-1-oic acid by spectral data andChemical studies. Nine known compounds isolated forThe first time from the plant, were identified as Dotriacontanol, β -amyronone, Δ 12-dehydrolupen-3-one, β -Amyrin, lupeol, fucosterol, 9-oxoheptadecane, 10-Oxononadecane and sitosterol (Verma and Gupta, 2004).

Wound Healing Activity

Wound healing involves a complex interaction between epidermal and dermal cells, the extra cellular matrix, controlled angiogenesis and plasma-derived proteins all coordinated by an array of cytokines and growth factors [19]. Tridax antagonized antiepihelization and tensile strength depressing effect of dexamethasone (a known healing suppressant agent without affecting anticontraction and antigranulation action of dexamethasone). Aqueous extract was also effective in increasing lysyl oxidase but to a lesser degree than whole plant extract. Further it has been shown that extract of leaves of this plant also promotes wound healing in both normal and immunocompromised (steroid treated) rats in dead space wound healing model. The plant increase not only lysyl oxidase but also, protein and nucleic acid content in the granulation tissue, probably as a result of increase in glycosamino glycan content.

Antimicrobial Activity

Antimicrobial screenings have been done, but additional studies are needed to corroborate some of the results. Various species of bacteria and fungi have shown sensitivity to the antimicrobial properties of *T. procumbens*.

More recently, callus of stem and leaf has shown to be useful for the synthesis of silver nanoparticles that showed some antimicrobial activity against *E. coli*, *V. cholerae*, *A. niger*, and *A. flavus* (Bhati-Kushwaha and Malik, 2014). However, this activity was lower than the activity shown by silver nitrate so these results are not conclusive. Petroleum, ether and ethanolic extracts of leaves of *T. procumbens* showed antibacterial activity against *Bacillus faecalis*. This activity was reported to be probably due to the presence of alkaloids. The chloroform extracts showed antibacterial activity against *B. faecalis*, *B. subtilis*, *E. coli*, and *Pseudomonas aeruginosa* (Christudas et al., 2012) but the experiments need better controls and descriptions of the procedures. Essences from *T. procumbens* show the presence of alpha and beta pinenes, used in small quantities can help in treating bacterial and fungal infections (Manjamalai et al., 2012b). There are some contradictory results about the antimicrobial activity of this species (e.g. Policegoudra et al., 2014; Taddei and Romero, 2002). Some studies did not include significant biological activity compared to the antibiotic control (e.g. Jhample et al., 2015) but there is evidence for the potential of this species as anti-microbial so more studies need to be done in this area.

Antifungal Activity

Antifungal activity of *T. procumbens* has been investigated. Different extraction methods have been used to find the optimum zone of inhibition from different fungal strains including *Microsporum fulvum*, *Microsporum gypseum*, *Trichophyton mentagrophytes*, *Trichophyton rubrum*, *Candida albicans*, and *Trichosporon beigeli*. Extracts of the aerial parts of this plant have shown activity against dermatophytes with zones of inhibition ranging from 17 to 25mm with dichloromethane (DCM) fraction resulting in the best response (Policegoudra et al., 2014). However, the authors do not describe which ones are the bioactive compounds responsible for the antifungal properties. The authors suggest that these compounds could be fatty acid derivatives and constituents but no evidence is given about this statement.

Antibacterial Activity

Tridax procumbens has shown to have antibacterial activity. It is one of the most common plants for treating bacterial infections in rural parts of the world (Taddei and Rosas-Romero, 2000). *Tridax* extracts have shown to be effective against a variety of bacteria. N-hexane extracts have activity against *Mycobacterium smegmatis*, *E. coli*, *Klebsiella* sp., *Salmonella* group C, and *Salmonella paratyphi*. The ethyl acetate extract was effective against Gram-positive bacteria such as *Bacillus cereus*, *Mycobacterium smegmatis*, *Staphylococcus aureus*, and Gram-negative bacteria such as *Klebsiella* sp. (Taddei and Rosas-Romero, 2000). The essential oil extract of *T. procumbens* shows significant activity against Gram-positive bacteria: *Staphylococcus aureus* and *Streptococcus pneumoniae* (Manjamalai et al., 2012b). There are some differences in how the studies were conducted so even though there seem to be strong support for the antibacterial activity of this species, more comprehensive research needs to be done.

Antiparasitic Activity

Treatment of some diseases caused by protozoal infections like malaria (Appiah-Opong et al., 2011; Komlaga et al., 2015), dysentery, colic, and vaginitis have been assessed with *T. procumbens* through a bioassay guided fractionation with a methanol extract to isolate an active compound, (3S)-16,17-Didehydrofalcariol (an oxylipin). *Tridax* seemed to have anti-leishmanial activity when using crude extracts from the whole plant (Martín-Quintal et al., 2009). A study done in Ghana tested the antiplasmodial effect of aqueous, chloroform, ethyl acetate, and ethanolic extracts from the flowers, leaves, and stem of *T. procumbens*. There is evidence that the aqueous and ethanolic extracts from the species have anti-plasmodial properties; a study using the tetrazolium-based colorimetric assay showed that *T. procumbens* helped protect red blood cells from *P. falciparum* damage (Appiah-Opong et al., 2011). *Tridax* shows a great potential against a disease that kills millions of people around the world.

Antioxidant Activity

Free radicals are molecules that have an unpaired electron in an atomic orbital making them highly reactive. Some of these free radicals include reactive hydroxyl radicals (OH), superoxide anion radicals, hydrogen peroxides, reactive oxygen species (ROS), and peroxy. The instability of these radicals can damage many biologically important molecules like DNA and macromolecules, thus leading to cell damage and homeostatic disturbance. An antioxidant or a free radical scavenger is used to reduce this activity by preventing the oxidation within a biological system. Agrawal et al. (2009) analyzed the antioxidant activity of *T. procumbens* and found significant activity (comparable to the activity of Ascorbic acid) in the ethyl acetate and n-butanol fractions obtained from methanolic extracts, when using the 1,1-diphenyl-2-picrylhydrazyl (DPPH) method. Saxena et al., (2013) also reported a high antioxidant activity of *Tridax* when using n-butanol and ethyl acetate fractions from methanolic extracts. Habila et al., (2010) found

a 96.7% antioxidant activity at a concentration of 250 µg/mL. The authors report a high reductive potential in Tridax (0.89 nm) compared to the standard (0.99nm) and postulate that this strong antioxidant activity could be due to the high phenol content of the plant, making this plant a good natural source of antioxidants with potential medicinal value. *T. procumbens* is also said to reduce lipid peroxidation as well as induce enzymatic and non-enzymatic antioxidants. The hepatoprotective nature of the plant may be due to flavonoids, which have been known hold free radical scavenging properties (Ravikumar et al., 2005b). The strong antioxidant activity of *T. procumbens* is due to the high content of phenols, flavonoids, anthraquinone, carotenoids and vitamins A and C (Nisha, 2011). All the studies report strong support for the antioxidant properties of Tridax. The essential oils of *T. procumbens* have shown antioxidant activity by reducing the levels of oxidative stress when using the DPPH assay. These essential oils seem to have higher antioxidant activity than ascorbic acid and increasing the concentration of the essential oil seemed to increase the antioxidant power. It is postulated that this characteristic of *T. procumbens* makes it a great candidate for the treatment of inflammation and cancer with less toxic effects (Manjamalai and Grace, 2004) but these claims are not properly researched and documented. For example, *T. procumbens* has shown to reduce inflammation when applied as a leaf poultice and it has shown to be effective in the treatment of neuropathic and inflammatory pain in rodent models (Sawant et al., 2014). Extract from the leaves of the plant decreased the severity of carrageenan-induced rat paw inflammation. *T. procumbens* extract at dosages of 100mg/kg, 200mg/kg, and 400mg/kg did a better job of reducing edema than aspirin at the same dosages. The plant extract did not produce ulceration and proved to be safer than aspirin and phenylbutazone (Diwan et al., 1989). Another study done more recently showed similar results. *T. procumbens* aqueous extract from the leaves showed to reduce carrageenan-induced paw inflammation. In this study the plant extract was compared to Ibuprofen instead of aspirin (Awasthi et al., 2009), but both studies show the positive effect of Tridax in reducing inflammation without the potential issues that could arise from the use of Aspirin or Ibuprofen.

Anticancer Activity

Cancer is a multifactorial disease. Only until recently has the anticancer activity of *T. procumbens* been researched. Crude flower aqueous and acetone extracts were tested on prostate epithelial cancerous cells (PC3). Very weak anticancer activity was observed with the aqueous extract. The acetone extract showed an 82.28% activity against cancer cells within 24 hours of treatment (Vishnu et al., 2011). The viability was analyzed using the MTT assay. The authors don't explain the toxicity analysis so the results are inconclusive since the only extract that had effect was the acetone extract and the controls are not clearly indicated in the publication. This study also does not compare the results to standard therapeutic drugs and there is no report of the selectivity index. Significant inhibition of tumor nodule formation in the lungs was observed when using *T. procumbens*, probably due to the inhibition of formation of new blood vessels in response to monoterpenes (alpha and beta pinenes). There was also an increase of expression with P53 and caspase; indicating that the oils of this plants could induce apoptosis. Different studies have indicated that *T. procumbens* shows promise in the treatment of cancer, but more research needs to be done in order to understand the molecular mechanisms involved in this activity (Manjamalai et al., 2012a). In addition, none of the work done on anticancer activity followed the proper protocols for research in this area so the research is inconclusive.

Hepatoprotective Activity

Many models have been used to evaluate the effect that *T. procumbens* has on reducing oxidative stress in the liver, which leads to liver injury, and the hepatoprotective activity of different extracts. The chloroform insoluble fraction of an ethanol extract is effective for alleviating liver stress caused by pharmacological agents that create the same pathologies as viral hepatitis, drug intoxication, and lipid peroxidation from a reactive oxidative species (Hemalatha, 2008). A different study showed that the chloroform insoluble extract of the ethanol extract reduced hepatotoxic activity by reducing the amounts of different enzymes in rats that had been treated with CCl₄ (Saraf and Dixit, 1991). Research done on male albino rats evaluated the use of *T. procumbens* as a treatment for liver damage caused by Paracetamol (acetaminophen). It was determined that when the ethanolic extract from *T. procumbens* was administered orally at varying dosages, it lowered the levels of serum Aspartate aminotransferase, serum Alanine aminotransferase, serum Alkaline phosphatase, and serum bilirubin, resulting in hepatoprotection (Wagh and Shinde, 2010). Petroleum ether, methanol, and chloroform water extracts from flowers showed protection against hepatotoxicity in Male Wister Albino Rats, with the methanolic extract showing the best effect (Patel et al., 2014). Aqueous extracts of leaves have shown hepatoprotective activity in rats because of the antioxidant activity of these extracts, due to the active free radical scavenging (Nwanjo, 2008). An ethanolic extract from leaves of *T. procumbens* that was fractionated with chloroform showed good hepatoprotective activity in rats that had induced hepatitis by d-Galactosamine Lipopolysaccharide. The study suggests that pretreatment with the plant extract may have caused parenchymal cell regeneration in the liver. The rats that were pretreated also restored their lipid levels to normal after being treated with d-Galactosamine Lipopolysaccharide. Rats that were treated with only the *T. procumbens* extract showed to no adverse reactions, suggesting that the plant has little to no toxicity in rats. The hepatoprotective activity appeared to be from the presence of flavonoids (Ravikumar et al., 2005a). The hepatoprotective properties of Tridax seem to be promising and warrants future research.

Immuno-enhancement Activity

Various bioactive compounds have aided in normalization of immune response to assuage certain diseases. An adaptogen of Tridax *procumbens* has shown to enhance the body's nonspecific resistance against pathogens. Various tests in mice evaluated the effect of Tridax in stimulating the immune system, including the use of Swiss Albino Mice treated with immunomodulators present in *T. procumbens* and shown to activate the immune system. This work compared the Delayed-type hypersensitivity (DTH) in the animals fed with the extracts versus the controls to evaluate cell-mediated immunity.

Antidiabetic Properties

Diabetes has become a worldwide epidemic; interestingly, *T. procumbens* has shown antidiabetic properties. Streptozotocin-induced Male Wistar albino diabetic rats were given ethanolic extracts from the whole plant of *T. procumbens*. The study showed that the extract had antidiabetic activity that is comparable to the drug Glibenclamide used to treat diabetes mellitus type 2. The drug works by increasing the amount of insulin produced by the pancreas (Petchi et al., 2013). This study included proper controls and two different concentrations of whole plant extract of *Tridax* (250 mg/Kg and 500 mg/Kg). ANOVA and Dennett's post hoc test showed significant antidiabetic activity compared to the controls. The extracts also showed a positive effect against hyperlipidaemia associated with diabetes mellitus. Another study showed that Alloxan-induced diabetic male albino rats responded better to methanolic extracts of *T. procumbens* than to the common drug Glibenclamide. The plant extracts were given to rats in 250 or 500 mg/kg doses, while the Glibenclamide was given at a 10 mg/kg dose. The results showed that either dosage of the plant extract lowered the blood glucose levels in the rats by 10.96%-13.74% better than the conventional drug after 6 hours of treatment. The plants extracts also showed an improvement in the fasting blood glucose levels of the Alloxan-induced diabetic rats. There was also no evidence of adverse side effects of *Tridax*'s methanolic extracts on the diabetically-induced animals. The effects of the plants on the rat's body weight was also studied (Pareek et al., 2009). In a study done by Bhagwat et al. (2008), oral administration of aqueous and alcoholic extracts from the leaves of *T. procumbens* significantly decreased blood sugar levels in Alloxan-induced Wistar diabetic rats. The rats were given the extract for seven consecutive days at a dosage of 200mg/kg. The authors do not specify the mechanism of action of the *Tridax* extracts but this study corroborates other studies on the antidiabetic properties of this species. *T. procumbens* slowed the rate of both alpha amylase and alpha glucosidase enzymes with ether, methanol, and chloroform extracts showing a significant reduction, enough to resemble common drugs used to slow the enzymes in diabetes treatment (Sonawane et al., 2014). Alpha-amylase and the Alpha-glucosidase enzymes are responsible for the breakdown of carbohydrate molecules, by slowing their breakdown rate, allowing the body to digest these carbohydrates in lower doses and therefore slowing the need for insulin, which is the main chemical affected in diabetes mellitus (Sonawane et al., 2014). All these studies demonstrate the great pharmacological potential of *Tridax* against diabetes and the importance of further research and clinical studies that could evaluate the effect in humans.

Antihypertensive Activity

For adults over 20, hypertension, or high blood pressure, is any measurement where the systolic number is above 140 mmHg, and the diastolic reading is above 90 mmHg. The CDC also characterized people who were taking medications to lower their pressure as individuals with hypertension. From 2009-2012, 30% of Americans, over the age of 20, had high blood pressure (National Center for Health Statistics). In Benin and other countries, *Tridax procumbens* has been traditionally used for the treatment of hypertension (Salami et al., 2017; Adjagba et al., 2015). Because of its traditional history, a study was done looking into its antihypertensive activity. The aerial parts of the plant were used to make cyclohexane, micellar, dichloromethane, and ethyl acetate fractions from a crude aqueous extract. Rats were treated with 20 mg/kg of N (G)-Nitro-L-Arginine-Methyl Ester (L-NAME) for seven days to induce hypertension; they were then treated with the different extracts for seven more days. The ethyl acetate and dichloromethane fractions were most effective in lowering the mean arterial pressure of the rats. The data was comparable to the effect that the common drug captopril had on the rats. Both the ethyl acetate and dichloromethane fractions contained alkaloids and flavonoids, potentially showing that those phytochemicals are responsible for the lowering of the blood pressure.

Conclusion

The mentioned uses have shown the traditionally used plant, in india, doesn't only imited to wound healing but also many more health benefits. In the era of allopathic medicine we are loosing our natural and traditional type of treatment. In today's pandemic one have to put their health priority. And hence considering the activities of *tridax procumbence*, it can be taken as tonic for our health.

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