

A Comprehensive Review of the Ethnobotany, Phytochemistry and Pharmacological Application of *Tridax Procumbens*

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ABSTRACT

Tridax procumbens L. (Asteraceae), commonly known as coat buttons, is a widely distributed medicinal herb valued in traditional medicine for its diverse therapeutic applications. Ethnobotanically, it has been used to manage wounds, fevers, skin infections, and gastrointestinal and cardiovascular disorders. Phytochemical studies have identified numerous bioactive constituents, including flavonoids, alkaloids, carotenoids, tannins, and saponins, which contribute to its pharmacological potential. Experimental findings reveal that *T. procumbens* exhibits antioxidant, anti-inflammatory, antimicrobial, wound-healing, hepatoprotective, antidiabetic, and anticancer activities. These properties support many of its traditional uses and highlight its potential as a source of novel therapeutic agents. This review summarizes the ethnobotanical relevance, phytochemical profile, and pharmacological applications of *T. procumbens*, emphasizing the need for further studies on its mechanisms of action, toxicity, and clinical efficacy to promote its development as a scientifically validated herbal medicine.

Keywords: *Tridax procumbens*, ethnobotany, phytochemistry, pharmacological activity, medicinal plants, bioactive compounds

INTRODUCTION

Tropical and subtropical areas are home to *Tridax procumbens* (L.), a creeping perennial plant belonging to the Asteraceae family. Known by a number of regional names, including "Ghamra," "Jayanti Veda," and "coat buttons" in English, it is regarded as a wasteland plant yet has important ethnomedical use. Traditionally, the herb has been used as a hair tonic and to heal wounds, fevers, coughs, and dysentery¹⁻². Numerous secondary metabolites, such as flavonoids, carotenoids, saponins, tannins, alkaloids, and essential oils, have been found by phytochemical research; many of these compounds are involved in its pharmacological actions. Numerous preclinical investigations that show *T. procumbens*'s antioxidant, antibacterial, hepatoprotective, anti-inflammatory, and wound-

healing qualities support its bio efficacy³⁻⁴. *T. procumbens* is applied locally to wounds and ulcers and taken orally to treat diabetes, stomach problems, and liver problems in traditional medicine. Its medicinal flexibility is demonstrated by its incorporation in Ayurveda formulations such as liver tonics and wound-healing ointments⁵⁻⁶. Current pharmacological standardization and confirmation are still lacking. Clinical studies, standardization of extract dosages, and molecular mechanistic insights are rarely discussed in papers. In order to give a comprehensive understanding of *T. procumbens*, identify information gaps, and recommend future research approaches, this review attempts to compile data from ethnobotanical, phytochemical, and pharmacological investigations⁷.

Botanical Description:

Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Table.1: Botanical Description of *T. Procumbens*⁸

Character	Description
Scientific name	<i>Tridax procumbens</i> (L.)
Family	Asteraceae
Common names	Coat buttons, Ghamra, Jayanti Veda
Habitat	Tropical and subtropical regions; roadsides, wastelands
Habit	Creeping, perennial herb with slender branches
Leaves	Opposite, coarsely serrated, ovate-lanceolate, hairy surface
Flowers	Yellow disc florets, white ray florets forming daisy-like heads
Fruit	Achenes with pappus for wind dispersal
Roots	Taproot system with fibrous branches
Flowering season	Throughout the year in tropical climates
Part used	Leaves, stem, flower, and root

**Fig.1: *T. Procumbens*****Phytochemical Constituents:****Table.2: Phytochemical Constituents of *T. Procumbens*⁹**

Class of Compound	Major Identified Constituents	Reported Activity
Flavonoids	Quercetin, Luteolin, Apigenin	Antioxidant, anti-inflammatory
Terpenoids	Lupeol, β -sitosterol	Anti-inflammatory, hepatoprotective
Alkaloids	Tridaxin, β -carboline derivatives	Antimicrobial, cytotoxic
Tannins & Phenolics	Gallic acid, Catechin	Antioxidant, antimicrobial
Steroids	Stigmasterol, Campesterol	Membrane stabilization
Fatty acids	Palmitic acid, Linoleic acid	Nutritional, antioxidant
Saponins	Not specified	Wound healing, immune modulation
Essential oils	Caryophyllene, Limonene	Insecticidal, antimicrobial

**Fig.2: Stem, Flowers, Leaves of *T. Procumbens***

Pharmacological Activities:¹⁰⁻¹¹

- **Antimicrobial:** Broad-spectrum activity against *Staphylococcus aureus* and *E. coli*.
- **Anti-inflammatory:** Inhibition of COX and LOX pathways in animal models.
- **Antioxidant:** Strong DPPH and FRAP radical scavenging capacity.
- **Wound healing:** Promotes collagen synthesis and tissue regeneration.
- **Hepatoprotective:** Reduces ALT, AST, and bilirubin in paracetamol-induced liver injury.
- **Antidiabetic:** Lowers blood glucose via α -amylase inhibition.
- **Anticancer:** Induces apoptosis and inhibits cell proliferation in MCF-7 and HepG2 cells.
- **Immunomodulatory:** Enhances macrophage activity and antibody production.
- **Antimalarial / insecticidal:** Effective against *Anopheles* larvae.
- **Antihypertensive:** Mild vasorelaxant effect reported in animal studies.

Pharmacological Application :

Several preclinical investigations have shown *T. procumbens* pharmacological adaptability.

1. Antimicrobial Action- *T. procumbens* extracts exhibit broad-spectrum antibacterial and antifungal action against *Candida albicans*, *Escherichia coli*, *Pseudomonas aeruginosa*, and *Staphylococcus aureus*. The flavonoid and tannin-rich ethanol and methanol extracts damage microbial cell membranes and prevent the enzymatic processes necessary for microbial viability. This validates the herb's historic application in the treatment of wounds and skin infections¹².

2. Inhibition of Inflammation- The flavonoid and terpenoids content of *T. procumbens* has been identified as the primary source of its anti-

inflammatory properties. These substances reduce the production of prostaglandins and leukotrienes by blocking the cyclooxygenase (COX) and lipoxygenase (LOX) pathways¹³.

3. Activity of Antioxidants- A number of diseases are caused by oxidative stress and free radicals. Strong DPPH and FRAP radical scavenging activity has been demonstrated by the methanolic extract of *T. procumbens*, suggesting that it can neutralize ROS and boost endogenous antioxidant enzymes such as glutathione peroxidase, catalase, and superoxide dismutase.

4. Activity for Healing Wounds- One of *T. procumbens*'s most well-known pharmacological characteristics is its ability to heal wounds. Its leaf extract applied topically increases collagen deposition, speeds up wound contraction, and encourages epithelialization. Enhanced hydroxyproline content, which indicates enhanced collagen production, and fibroblast proliferation stimulation mediate these effects. Additionally, the extract has antibacterial properties at the site of the wound, which helps to promote tissue regeneration and prevent infection¹⁴.

5. Hepatoprotective Action- Animal models of hepatotoxicity caused by carbon tetrachloride and paracetamol have shown the hepatoprotective properties of *T. procumbens*. Serum indicators like bilirubin, ALT, and AST are decreased by the Ethanol extract, indicating better liver function. Hepatoprotective function is mechanistically explained by stabilizing hepatic cell membranes, preventing lipid peroxidation, and regulating liver enzyme activity.

6. Activity Against Diabetes- *T. procumbens* extracts have been shown to reduce blood glucose levels in rats with diabetes induced by streptozotocin and alloxan. The process involves inhibiting the enzymes α -amylase and α -glucosidase, which causes a delay in the absorption of glucose and the digestion of carbohydrates. Furthermore, the plant's flavonoids support its historic usage in diabetes by improving pancreatic β -cell function and insulin sensitivity¹⁵.

MECHANISMS OF ACTION:¹²⁻¹³

- ROS inhibition and free radical scavenging.
- Suppression of inflammation caused by NF-KB.
- Increase in the amount of collagen deposited at wound sites.
- Liver enzyme modification for detoxification.
- A-glucosidase and α -amylase enzyme inhibition.
- TNF- α and COX-2 expression are downregulated.
- Apoptotic induction by mitochondrial mechanisms.
- Increase in the phagocytic activity of macrophages.
- Alteration of vascular tissues' calcium ion channels.
- Defence of DNA from oxidative damage.

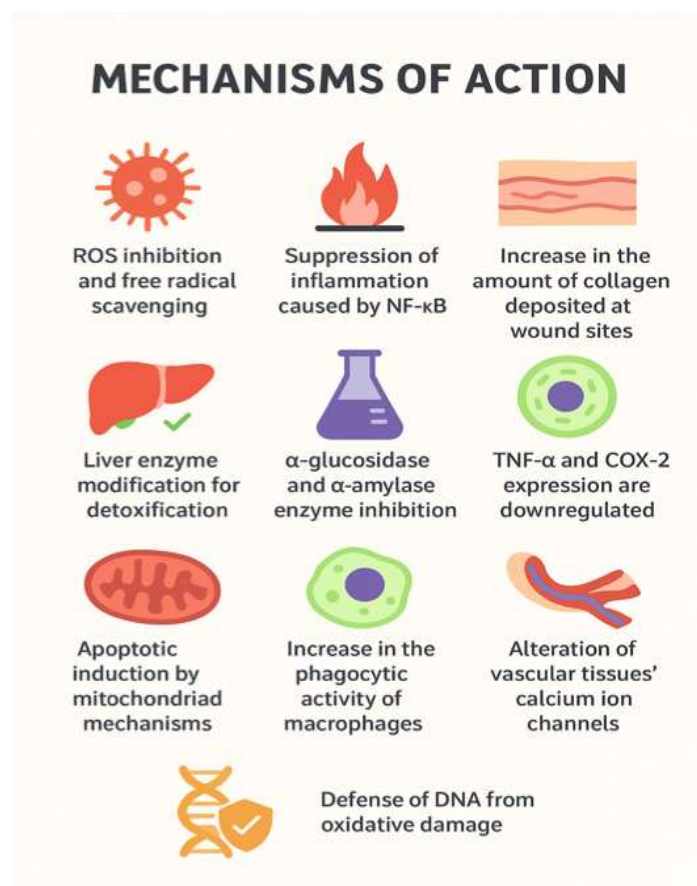


Fig.3: Mechanism of Action

Marketed Formulations of *T. procumbens*.

Table.3: Marketed Formulations of *T. procumbens*.

Product Name	Formulation Type	Major Use	Manufacturer / Region
Tridax Herbal Ointment	Topical cream	Wound healing	Ayurvedic Pharmacies (India)
Coat Button Extract Capsules	Oral capsules	Liver tonic, antioxidant	Local herbal brands
Tridax Leaf Juice	Fresh extract	Skin infections, hair tonic	Folk preparations (India, Nigeria)
Tridax–Aloe Vera Gel	Topical gel	Burns and cuts	Herbal cosmetic brands
Tridax Syrup	Liquid formulation	Liver and digestive aid	Ayurvedic manufacturers

Toxicological Studies and Safety Profile:¹⁷⁻¹⁸

- In rats, acute oral LD₅₀ > 5000 mg/kg denotes safety.
- At therapeutic dosages, there are no significant histological alterations in the kidney or liver.
- Only at extremely high doses was cytotoxicity seen in vitro.

- In the Ames test, non-mutagenic.
- At high dosages, some stomach discomfort has been noted.
- There was no evidence of neurological toxicity.
- Topical use in models of wound healing is safe.
- RBC count slightly decreases at dosages more than 2000 mg/kg (reversible).
- There is no discernible organ harm from long-term use.
- Overall toxicity is thought to be minimal and reversible.

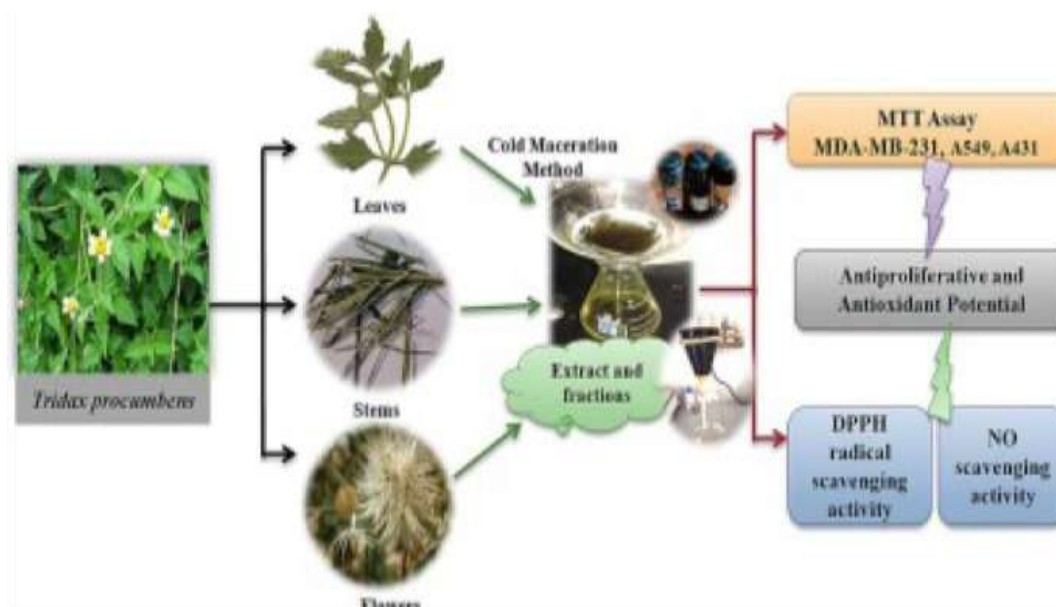


Fig.4: Anti-Proliferative and antioxidant potential

Formulations and Therapeutic Applications:¹⁹⁻²⁰

- **Traditional:** Wounds, sores, and bug bites are treated with fresh leaf juice.
- **Pharmaceutical:** Extract used in pills, gels, and ointments.
- **Cosmeceutical:** Used for its antioxidant qualities in anti-aging lotions and herbal shampoos.
- **Veterinary:** Used as an anti-parasitic wash and on cattle wounds.
- **Current research:** Polymer-based gels and Nano emulsion for improved medication delivery.

Future Prospects and Research Gaps:²¹⁻²²

1. The necessity of translational research and clinical validation- Despite the fact that *Tridax procumbens* has been extensively studied in preclinical contexts, the majority of research has been restricted to in vitro tests and animal models. There is still much to learn about how these discoveries may

be used in therapeutic settings. Its effectiveness, safety, and pharmacokinetic behaviour in humans have not been established by well-documented randomized controlled clinical studies.

2. Extract Standardization and Quality Assurance- The lack of standardization of raw materials and extracts is a significant obstacle in the study of herbal drugs. Geographical location, harvesting period, soil composition, and extraction techniques all have a substantial impact on the phytochemical profile of *T. procumbens*. Pharmacological consistency and reproducibility are impacted by this heterogeneity.

3. Clarification of Target Pathways and Molecular Mechanisms- The majority of research on *T. procumbens* reports pharmacological results without delving into the specific molecular or biochemical mechanisms at play. Its connections with certain signalling pathways, gene expressions, and protein targets are poorly understood. To find important molecular targets and comprehend the synergistic interactions among its bioactive components, sophisticated techniques including proteomics,

metabolomics, and network pharmacology can be used.

4. Creation of New Drug Delivery Systems and Formulations

-Traditional *T. procumbens* extract formulations frequently have poor bioavailability, low solubility, and restricted stability. With the use of nanotechnology-based systems including hydrogels, liposomes, nanoparticles, and Nano emulsions, contemporary pharmaceutical technologies provide chances to get beyond these restrictions. By improving the pharmacokinetic profile and targeted distribution of its active ingredients, these cutting-edge delivery methods can increase therapeutic efficacy.

5. Conservation, Sustainable Utilization, and Biotechnological Approaches

-The necessity for the conservation and sustainable use of *T. procumbens* resources is increasing due to their extensive but sometimes unregulated harvesting. Loss of phytochemical variety and genetic degradation might result from overexploitation of the wild. Using callus culture, metabolic engineering, and in vitro propagation methods might provide a steady supply of bioactive substances while maintaining natural populations.

CONCLUSION:

Tridax procumbens is a valuable medicinal plant with proven ethnobotanical importance and diverse pharmacological activities. Its rich phytochemical profile, including flavonoids, alkaloids, tannins, and saponins, underlies its antioxidant, antimicrobial, anti-inflammatory, and wound-healing properties. Scientific findings increasingly validate its traditional uses, highlighting its therapeutic potential. However, further studies are needed to isolate bioactive compounds, clarify mechanisms of action, and assess safety and efficacy through clinical research. Integrating traditional knowledge with modern pharmacological studies may establish *T. procumbens* as a promising source for novel, plant-based therapeutic agents.

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HOW TO CITE: Pratik Bhandare, Anil Panchal*, Vishal Madankar, A Comprehensive Review of the Ethnobotany, Phytochemistry and Pharmacological Application of *Tridax Procumbens*, *Int. J. Sci. R. Tech.*, 2025, 2 (11), 657-663.
<https://doi.org/10.5281/zenodo.17682828>

