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Review Article

Ethnopharmacological Relevance and Phytochemical Basis of *Tridax procumbens* L.

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Abstract

A coat button is a perennial medicinal herb called *Tridax procumbens* L., belonging to the family Asteraceae and commonly used to treat inflammatory diseases, infectious diseases, metabolic diseases and wounds, in many parts of tropical and subtropical areas. The current review provides a synthesized, systematic description of the botanical characteristics, the phytochemical biodiversity, analytical characteristics and pharmacological properties of the plant with the aim of synthesizing the available scientific findings and pointing out future research directions. *T. procumbens* has been observed to contain a large number of secondary metabolites, namely flavonoid, phenolic acids, alkaloids, terpenoids, steroids, saponins, tannins and glycosides whose composition, both qualitative and quantitative, is found to greatly vary with factors such as extraction methods, solvent systems, which parts of the plant are used, seasonal variations and geographical regions. Pharmacological experiments have shown that *T. procumbens* have very wide range of biological activities such as anti-inflammatory, antioxidant, antimicrobial, antidiabetic, anticolithiatic and anticancer activities that are mostly due to high phenolic and flavonoid levels that affect oxidative stress processes, inflammatory reactions, microbial inhibition, glucose control and cell growth regulation. Nevertheless, in spite of the expanded *in vitro* and *in vivo* results, a number of limitations still exist including lack of standardized extract preparations, deficient treatments of bioavailability and pharmacokinetics, reduced toxicological tests, and lack of rigorously designed clinical trials. Also, more research interest is being directed towards the nutraceutical and cosmeceutical potential of *T. procumbens* due to its antioxidant potential, metabolic-modulating actions, wound-healing effects, and skin-protective effects, stressing the importance of using multidisciplinary and integrative research approaches in supporting the claims made by the nutraceutical as well as the delivery of its products as valid pharmaceutical, nutraceutical, and cosmeceutical products.

Keywords: *Tridax procumbens* L; Phytochemistry; Phenolic Acids; Alkaloids

Introduction

Tridax procumbens L. is a creeping and perennial Asteraceae medicinal herb largely distributed in the tropical and subtropical regions in the Asian, African, and American continents and commonly named as coat buttons or Tridax daisy and call it Ghamra, commonly found as a weed on the roadsides, wastelands, and open fields. Even though it is commonly regarded as an unwanted weed, the plant has received extensive scientific attention due to its ancient usage in traditional and folk medicine (to treat wounds, fever, skin infections, gastrointestinal problems, and respiratory issues) due to its vast ecological plasticity, which makes it included in multiple ethnomedicinal systems, including Ayurveda and traditional African medicine [1,2]. Phytochemical researches have shown that *T. procumbens* possess a wide range of bioactive secondary metabolites with flavonoid luteolin, quercetin and catechins, alkaloids, carotenoids and saponins, tannin, sterols (mostly b-sitosterol), essential oils, phenolic compounds and mineral elements group showing the high biochemical density and therapeutic potential. Primary phytochemical screenings have documented powerful antioxidant, radical scavenging, and ability of its extracts to modulate foundation enzymatic pathways of the kind involved in the inflammatory processes [3,4]. Moreover, numerous pharmacological studies have corroborated most of its traditional medicinal effects using *in vivo* and *in vitro* experimental models and have suggested the following antimicrobial, anti-inflammatory, hepatoprotective, antidiabetic, wound-healing, analgesic, hypolipidemic, anticancer and immunomodulatory activity which are intensively connected to its phytochemical composition. Nevertheless, although they show some promising results, the lack of well-designed clinical trials, standardized extract preparations, and insufficient mechanistic and toxicological analyses all limit the clinical translation of *T. procumbens* to warrant a more in-depth and systematic study to prove its safety and therapeutic value [1].

Botanical description

Tridax procumbens L. is a herbaceous plant of annual or perennial growth, which has a creeping to spreading (procumbent) form of growth and has decumbent stems that frequently root at the point of contact with soil. The plant usually reaches a height of 15-50 cm, and its stems are rough and hairy (scabrid-pilose), which allow vegetative propagation by means of nodal rooting [5,6]. The leaves are petiolate, opposite and simple, with a shape, which is generally ovate or lanceolate in shape with a length of about 2-7 cm and width of 1-4 cm. The margins of the leaves are coarsely serrated or dentate, and the surfaces are rough and hairy. The base of the leaf is generally cuneate and the apex is acute to acuminate [7].

It is a small achene, approximately 1.6-2.5 mm long, dark brown to black, with thick pubescence on it. It has a pappus of finely plumose bristles, thus enabling seeds to be dispersed successfully by the wind [5,6]. The inflorescence is made up of solitary capitulations (flower heads) suspended on long hairy peduncles. The capitulum normally has 2-6 ligulate ray florets, pale yellow to cream or white, with three toothy apices, and surrounded by a mass of yellow tubular disc florets. The involucre is made of various rows of hairy green bracts, which offer structural support to the flower head [7].

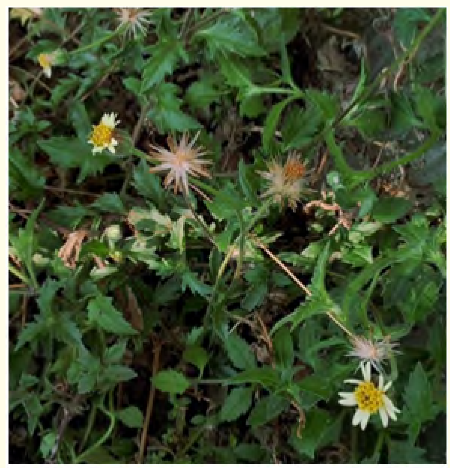

Figure 1: *Tridax procumbens* L.

Phytochemistry

Phytochemical diversity of *Tridax procumbens* L.

Tridax procumbens L. (Asteraceae) is a medicinally significant plant known to have a very diverse phytochemical composition and which forms the basis of its broad range of pharmacological activity. It is an extensively studied herb with lots of secondary metabolites, such as polar and non-polar compounds, in leaves and aerial parts, which support its traditional and therapeutic properties [7,8]. The plant contains flavonoids (e.g., quercetin, luteolin), as well as, phenolic acids, major antioxidants and anti-inflammatory and antimicrobial agents. Terpenoids, triterpenes and phytosterols play a hepatoprotective, anticancer and immunomodulatory role. Also, alkaloids, tannins, saponins, glycosides, essential oils and fatty acids enhance its therapeutic effect such as wound healing, antimicrobial, antifungal, and cytotoxic actions [8,9].

Phytochemical classes of importance

The characteristic of *Tridax procumbens* is the existence of different phytochemical groups which in combination support the broad spectrum of its pharmacological action. The most studied type is the flavonoids, which are primarily localized in the leaf and aerial structures of the plant; quercetin, luteolin, isoquercetin, and derivatives of flavone are the well known examples. These substances are closely related to antioxidant, anti-inflammatory, antimicrobial, and wound-healing properties, and mostly by processes of scavenging of free radicals, chelation of metal ions, inhibition of lipid peroxidation, and resistance of cells against oxidative damage [10]. Phenolic compounds which often co-exist with flavonoid include several phenolic acids and polyphenols and contribute significant anti-oxidant activity of the plant, and a number of studies have shown a positive correlation between overall phenolic content and antioxidant activity. In addition to antioxidant effect, phenolics exhibit anti-inflammatory, anti microbial and cytoprotective effects, thus contributing to the age-old use of *T. procumbens* in injury management and inflammatory diseases [11].

The non-polar and semi-polar extracts contain terpenoids and triterpenes in great quantities and compounds like oleanolic acid, lupeol, taraxasterol and their analogs have been identified. These are highly characterised by anti-inflammatory, hepatoprotective, anticancer, and immunomodulatory effects of these metabolites and their chemical diversity significantly helps to add to the therapeutic relevance of the plant [12]. Achieved were anti-inflammatory, lipid-lowering, and anticancer effects of phytosterols, in particular, b-sitosterol and its glycosidic forms, which are structurally related to cholesterol, and are suggested to contribute to the maintenance of membrane stability and regulation of immune responses and, consequently, can be used as a treatment of metabolic and inflammatory diseases [13].

Though at relatively smaller proportions, the alkaloids are always found in *T. procumbens* and they are relevant in its anti microbial, analgesic and cytotoxic effects adding to the overall chemical and pharmacological repertoire of the species [14]. Antimicrobial, anti-inflammatory, and wound-healing effects have been correlated with saponins, which are hydrophobic glycosidic compounds that are surface active [14,15]. Besides, both the hydrolysable and condensed tannins have astringent, antimicrobial, and antioxidant acts, which are even more applicable in wounds mending and treatment of skin infection [12-15]. Less dominating ones including fatty acids, volatile compounds, carotenoids, and polysaccharides that are determined by mostly the GC-MS and other sophisticated analysis tools can also add nutritional, anti-inflammatory, and immunomodulatory effects and be used to synergize in the overall activity of *T. procumbens* [13-15].

Isolation and characterization studies

The study on the isolation and structural characterization of the phytoconstituents of *Tridax procumbens* has been instrumental in identifying the compounds responsible behind the various pharmacological effects of *Tridax procumbens*. To extract the bioactive molecules, most studies investigated the leaves and aerial parts of the plant using systematic extraction methods and the subsequent chromatographic separation of the extract followed by advanced spectroscopic methods of their identification [16]. The isolation process usually starts with the solvent extraction with a series of solvents of different polarity levels (hexane, petroleum ether, chloroform, ethyl acetate, methanol, ethanol, and water, etc.). Liquids In liquid solvents, minimal extractive ability is exhibited by polar solvents, and minimal extractive ability is observed in non-polar ones. Terpenoids, sterols and fatty acids are extracted by solvents with low polarity, whereas flavonoids, phenolic compounds, alkaloids and glycosides are extracted by solvents with high polarity. The most frequently used extraction methods are Soxhlet extraction, maceration, and reflux, which is determined by the chemical characteristics and thermal stability of the metabolites of interest [16,17].

Extraction has prompted the use of chromatographic purification of individual compounds. The most commonly reported techniques are column chromatography with silica gel as the stationary phase and the elution is done by using a solvent system of increasing polarity. Preliminary screening, monitoring fractionation and the purity of compounds are regularly determined by the use of thin-layer chromatography (TLC) whereas the purification of flavonoids and phenolic compounds, their identification, and quantification are often conducted using high-performance liquid chromatography (HPLC) [17,18]. Via these methods, a number of bioactive compounds have been managed to be isolated in *T. procumbens*, with particular flavonoids being quercetin, luteolin, and their glycosides, triterpenes, and phytosterols being oleanolic acid, lupeol, taraxasterol acetate, and b-sitosterol. Chemical diversity of the plant is also further emphasized by the isolation of new flavones [16-18].

Isolates Structural elucidation of isolated compounds is based on a combination of spectroscopic methods. Preliminary identification of flavonoids and phenolics is usually done with the help of UV-visual spectroscopy, and the functional groups are revealed with the infrared (IR) spectroscopy. The structural characterization is performed in some detail with the help of the nuclear magnetic resonance (NMR) spectroscopy, and the mass spectrometric techniques are used to verify the molecular weights and fragmentation patterns with the help of the GC-MS and LC-MS methods [18,19]. In general, GC-MS proves very effective in profiling volatile and semi-volatile compounds, such as fatty acids, hydrocarbons, and terpenoids, whereas LC-MS is being increasingly used to analyze complex polar compounds that are not necessary isolated but instead produce full chemical fingerprints of extracts [17-19].

Also, along with the isolation studies, qualitative and quantitative phytochemical analysis is part of the process of phytochemical assessment of *T. procumbens*. Qualitative screening based on standard chemical tests confirms the existence of large categories like flavonoid, phenolics, alkaloid, saponin, tannin, terpenoid, sterols and glycoside and polar extracts contain larger quantities of flavonoid and phenolics and non-polar extracts are richer in terpenoid and sterols [20]. Quantitative methods, namely, of total phenolic content (TPC) and total flavonoid content (TFC) by Folin-Ciocalteu and aluminum chloride colorimetric procedures indicate that the amounts are greater in both methanolic and ethanol extracts. Recent methods like HPLC, LC-MS and GC-MS can be used to accurately determine the amount of individual marker compounds and volatile constituents which are important to extract standardization, quality control and correlation of phytochemical content with biological activity [21,22].

Analytical study of *Tridax procumbens*

There is a significant diversity of different analytical techniques used to probe the phytochemical profile *of Tridax procumbens*, where methods as rudimentary as simple qualitative screening and methods as sophisticated as chromatographic and spectroscopic methods used to identify and isolate and quantify and characterize the bioactive constituents. The choice of the analysis techniques is much related to the chemical character of the desired compounds and the exact task of the work. Initial qualitative screening of phytochemical exploration by standardized pharmacogenostic assays is usually done to identify major groups of secondary metabolites which might include flavonoid, phenolic compounds, alkaloids, saponins, tannins, terpenoids, steroids and glycosides. Such quick and inexpensive analyses offer important background data, help to select the solvent, and help to design extraction and follow-up analytical methods.

TLC is traditionally used in preliminary separation, chemical fingerprinting and fraction monitoring during isolation. The visualization with the visible and ultraviolet light frequently including particular detecting reagents has found significant use in recognizing flavonoid and phenolic compounds and determining the complexity and purity of the extract. Column chromatography is still considered a major method of preparation, the isolation, and purification of single constituents usually as a stationary phase using silica gel and solvent systems of increasing polarity through which flavonoids, terpenoids, phytosterols, and triterpenes can be separated before spectroscopic analysis.

High-performance liquid chromatography (HPLC) is widely applied in both qualitative and quantitative analysis, such as determining the total content of phenolic compounds and flavonoid as well as identifying the marker compounds, e.g., quercetin and luteolin. It is very sensitive and precise, and this feature makes HPLC important in extract standardization and quality control. Widely used Gas chromatography-mass spectrometry (GC-MS) has been used to profile volatile and semi-volatile constituents such as fatty acids, esters, hydrocarbons and terpenoids with qualitative and semi-quantitative information provided by spectral fragmentation and library matching. On the contrary, LC-MS and LC-MS/MS are specifically quite appropriate to study polar and thermolabile substances like flavonoid glycosides and phenolic acids without any prior separation. Structural characterization would not be possible without spectroscopic methods such as UV-visible, infrared, NMR, and mass spectrometry techniques, and the synergistic combination of chromatographic and spectroscopic approaches has made extravagant contributions to the phytochemical characterization of *T. procumbens*, standardization of extracts, and pharmacological validation of this herb [23-25].

Pharmacological activities

Anti-inflammatory activity

Coat buttons which is *Tridax procumbens* L. (Asteraceae) is largely utilized in traditional medicine to treat wounds, pain, swelling and inflammatory diseases. Ethnomedical reports on the use of the plant give an account of the leaves used topically and orally to relieve inflammation and thereby heal the tissue. These traditional claims have been proved correct by the experimental studies conducted with the help of animal models. Both aqueous and ethanolic leaf extracts had a potent impact on reducing carrageenan-induced inflammation in rats and mice, which is inhibition of the initial histamine- and serotonin-mediated stage of inflammation and an inhibition of the subsequent prostaglandin-mediated stage of inflammation [26,27]. The extracts reduced the formation of granuloma and proliferation of fibroblast along with the leukocyte infiltration and tissue architecture in models of chronic inflammation like the granuloma that was formed by the use of cotton pellet. Inhibiting key pro-inflammatory cytokines (TNF-a, IL-1b and IL-6) and cyclooxygenase enzymes involved in the production of prostaglandins, *T. procumbens* acts in the same way at the molecular level. Such effects have mostly been ascribed to flavonoid, tannins, alkaloids, and triterpenoid that have diverse effects on inflammatory signalling pathways and oxidative stress [26-28].

Antioxidant activity

The antioxidant property of *Tridax procumbens* has been recorded performed well and associated with the rich phytochemical composition of *Tridax procumbens*. Methanol, ethanol, and aqueous leaf extracts have been found to exhibit high dose-dependent free radical scavenging activity as indicated in DPPH, ABTS and nitric oxide tests, indicating that the extracts have high hydrogen- and electron-donating strength, similar to the mainstream antioxidants [29,30]. The extracts also showed great ferric reducing antioxidant activity, as an attribute that proves the capability of the extracts to stabilize reactive intermediates and stop free radical chain reactions [31]. These findings are further confirmed in a study carried out *in vivo*, in which treated animals exhibited elevated endogenous antioxidant enzyme levels, superoxide dismutase, catalase and glutathione as well as lower levels of lipid peroxidation as proved by malondialdehyde levels. This is mainly due to the fact that flavonoids (quercetin, luteolin), phenolic acids, tannins, carotenoids, and even alkaloids all preve09nt cells against the effects of oxidative and nitrosative stress [30-32].

Antidiabetic and antiurolithic effects

Diabetes mellitus is a chronic metabolic disease, which is caused by a disturbance in carbohydrate, lipid, and protein metabolism, and is characterized by prolonged hyperglycemia caused by insulin secretion impairment, insulin sensitivity, or both. Such abnormalities most of the times lead to serious complications like neuropathy, nephropathy, retinopathy and cardiovascular diseases. Medicinal plants have become an important issue within the recent years because they are used as complementary or alternative medicine with various therapeutic effects and fewer side effects as compared to conventional medicine. The traditionally used medicinal herb is *Tridax procumbens* L., which has widely been researched on the use of the herb on antidiabetic properties [33]. Alloxan induced diabetic rodent models and streptozotocin induced STZ diabetic rodent models have shown that the methanol and ethanol extracts of the whole plant have significant antihyperglycemic effects. *T. procumbens* positively influenced the glucose tolerance, weight gain, and glucose levels in fasting models after the administration of alloxan that damaged pancreatic b-cells using oxidative stress, indicating possible protection of b-cells. Likewise, in models induced with STZ, the extracts lowers blood glucose and lipid profiles showing a preservation of b-cell bearing with potential increase of endogenous insulin release [3,27,33].

Phytochemical studies demonstrated that the antidiabetic effect of *T. procumbens* might be through flavonoids, phenolic compounds, alkaloids, tannins, and saponins. The insulin sensitivity, oxidative stress, and preservation of pancreatic tissue are promoted by flavonoids and phenolics. Also, these compounds might share the digestion of carbohydrates with a-amylase and a-glucosidase, thus reducing postprandial hyperglycemia. Early clinical trials of *T. procumbens* based extracts have demonstrated the lowering of fasting and postprandial blood glucose in diabetic type 2 patients (and few adverse effects) [34]. *T. procumbens* is also antiurolithic especially against calcium oxalate stones. *In vitro* research revealed that crystal nucleation, growth and aggregation are all inhibited by methanolic, ethanol and aqueous extracts, equivalent to the normal drug Cystone. Interferences with stone formation are believed to occur with phytochemicals such as flavonoids, tannins and saponins [35]. *In vivo* experiments performed in rodents that were induced with ethylene glycol and ammonium chloride resembled that, oral administration of ethanolic extracts lowered the urinary calcium, oxalate and creatinine levels, lessened deposition of crystals in the kidneys, and enhanced antioxidant enzyme activities. The renal tubular damage was less marked, and the normal kidney structure was preserved, and a sign of renoprotective effects [36].

On the whole, antidiabetic and anti urolithic effects of *T. procumbens* have multi factorial mechanisms that include b-cell protection, decrease in oxidative stress, regulation in carbohydrate enzymatic activities, prevention of crystal formation, and antioxidative defense of the kidneys. These results endorse its possible application as a treatment modality in the control of diabetes and urolithiasis.

Anti-cancer and cytotoxic effects

Tridax procumbens L. has received a lot of attention due to its anticancer and cytotoxic effect and several studies have confirmed that this plant can suppress the growth of cancerous cells, cause cell death and block tumor proliferation in an experimental model *in vitro* and *in vivo* [1,2]. These biological effects were largely linked to its wide variety of phytochemical makeup comprising flavonoids, coumarins, polyacetylenes and essential oils which were able to regulate highly relevant cellular signal transduction in cancer formation [3-5].

An *in vitro* cytotoxicity analysis of *T. procumbens* with human cancer cells lines demonstrated that ethanolic and acetone extract of the *T. procumbens* leaf exerted a potent antiproliferative effect. It is important to note that these extracts had a great inhibitory effect on the growth of A549 (human lung carcinoma) and HepG2 (human hepatocellular carcinoma) cells in MTT and trypan blue exclusion assays which means that cell viability and cell death are reduced [1-5]. The anti-cancer activity of organic solvent extracts was always more than that of aqueous extracts probably because of better extraction of lipophile bioactive compounds [37].

This was followed by the isolation of a new coumarin related derivative of the methanolic extract of *T. procumbens* which had strong cytotoxic effects against the cell lines of the breast cancer MCF-7 and MDA-MB-249 with low IC50 values in the micromolar range. These results indicate a high antiproliferative effect and offer the mechanism understanding in the occurrence of the coumarins as the main anticancer parts of the plant.

Preliminary screening of crude extracts and solvent fractions of *T. procumbens* revealed cytotoxic action in a large number of diverse human and experimental cancer cell models, such as prostate (PC-3), colon (COLO-205), melanoma (A431), and leukemia (K562) ones. Other fractions were very potent and solvent fractionation was underscored as useful in purifying bioactive compounds that are selectively anticancer active [38].

As evidenced by *in vivo* experiments, bioactive constituents of *T. procumbens* especially its essential oil showed a significant inhibitory effect in the formation of tumor nodules and lung metastasis in mice that were introduced with B16F-10 malignant melanocytes. These effects were linked to high levels of apoptosis as was manifested by high levels of expression of apoptotic markers like p53 and caspase-3. Also, the essential oil suppressed angiogenesis that is associated with tumors, which suggests a multi-targeted approach that entails the inhibition of proliferation, metastasis, and vascular sustenance of tumors.

The anticancer effects of *Tridax procumbens* are thought to work by a mechanism of induction of programmed cell death, cell cycle checkpoints, and oncogenic signaling path way inhibition and angiogenesis and metastatic development. The cumulative effect of *in vitro* cytotoxic tests and the *in vivo* tumor models establish that T. procumbens would be an excellent candidate in further studies in cancer chemoprevention and the development of maytasides [37,38].

Nutraceutical and cosmeceutical potential

Tridax procumbens L. is a highly exploited medicinal plant in traditional medicine, which has been heralded due to its wound-healing, antibacterial, and anti inflammatory effects. Scientific studies over the past decades have proven several of these ethnomedicinal assertions to be true and it has shown rising potential as a nutraceutical, as well as a cosmeceutical resource. The plant also contains bioactive constituents such as flavonoids, phenolic acid, terpenoids, sterols, and alkaloids which all help in the treatment of the plant. These are the compounds that have been reported to regulate oxidative stress, inflammatory, metabolic and microbial growth such that positioning *T. procumbens* as promising positioning in functional foods, dietary supplements or herbal cosmetic products [32]. Under the nutraceutical mechanism of action, antioxidant potential of *T. procumbens* is the predominant determinant of health-promoting attributes. Oxidative stress, which is a consequence of a disequilibrium between reactive oxygen species and native antioxidant defenses, is an influential factor in the chronical pathologies of diabetes, cardiovascular and neurodegenerative diseases, as well as early aging. It has been established that experimental studies show that T. *procumbens* extract is effective in scavenging free radicals, lipid peroxidation in addition to inhibiting lipid peroxidation, and has been reported to be effective in enhancing endogenous antioxidant enzyme activities [32,33]. The plant is also antidiabetic in nature. Research on diabetic animal models indicates that *T. procumbens* extracts lower blood glucose, enhance insulin sensitisation, and restore normal carbohydrate metabolism, implying that it can be used as a functional food ingredient or dietary supplement to induce glycemic control using fewer adverse effects compared to conventional drugs [33]. Its anti-inflammatory and hepatoprotective effects also enhance the nutraceutical profile. The plant could be used to reduce chronic low-grade inflammation related to metabolic and lifestyle-related diseases by inhibiting pro-inflammatory cytokines and preventing lesions to liver caused by chemicals [33,34]. Its immunomodulatory effect, with the stimulation of both the adaptive and the innate immune responses, also helps it in immune-boosting preparations.

T. procumbens has a great potential in cosmetic sphere beyond nutrition. The rising need of natural elements in skincare has attracted the attention to its antioxidant, antimicrobial, and tissue-regenerative effect [34-37]. The antioxidant of the plant is also applicable in the anti-aging creams, serums and sunscreens due to its counteracting of the skin aging and photo-damage effects [38-43]. Topical applications enhance epithelialization, synthesis of collagen, growth of fibroblasts, and enhance tensile strength of skin, and they are used in wound management, reduction of scarring, and treatment of acne vulgaris [43]. Antimicrobial effect against pathogenic microorganisms is also useful to use it as a natural alternative to synthetic preservatives in cosmetic industry. *T. procumbens* is commercially desirable because it has a broad distribution network, versatility, minimal cultural requirements, and sustainability especially in the subtropical and tropical areas. Nonetheless, to effectively use them in industries, standardization, quality assurance, toxicological assessment, and clinical assessment have to be conducted to be able to predict their consistent efficacy, safety, and confidence in the consumer [44,45].

Conclusion

The *Tridax procumbens* L. is a popular perennial medicinal herb that has got a lot of ethnopharmacological significance as well as a wide distribution. It is associated with a wide range of biological effects, including anti-inflammatory effects, antioxidant effects, antimicrobial effects, anti-diabetic effects, anti-colonithiatic effects, and anti-cancer effects, which has been made possible by its rich phytochemical profile, which comprises flavonoids, phenolics, alkaloids, terpenoids, and other secondary metabolites. Although *T. procumbens* has a significant amount of *in vitro* and *in vivo* evidence, the therapeutic potential of the selected product remains limited by the fact that it does not yet have standardized extracts, systematic lack of pharmacokinetic and bioavailability research, limited toxicological studies, and the absence of well-designed clinical trials. The research to be done in the future should aim at standardizing extracts, conducting in depth mechanistic studies, clinically validating it, and investigating its nutraceutical and cosmeceutical applications, using methodologies that are multidisciplinary in nature and hence will enable the full tapping of the pharmacological and commercial potential of this compound.

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Conflict of Interest

The author(s) do not have any conflict of interest.

Bibliography

1. Bhandare P., *et al*. "A Comprehensive Review of the Ethnobotany, Phytochemistry and Pharmacological Application of *Tridax procumbens*". *International Journal of Scientific Research and Technology* 2.11 (2025): 657-663.

2. Jangid T., *et al*. "A Comprehensive Review on Traditional Uses, Phytochemical Constituents, and Pharmacological Properties of *Tridax procumbens"*. *Journal of Phytopharmacology* 14.4 (2015)223-246.

3. Pandey A and Tripathi S. "A Review on Pharmacognosy, Pre Phytochemistry and Pharmacological Analysis of *Tridax procumbens*". *PharmaTutor* 2.4 (2014): 78-86.

4. Dattaray D. "Traditional Uses and Pharmacology of Plant *Tridax procumbens*: A Review". *Systematic Reviews in Pharmacy* 13.7 (2022): 476-482.

5. Lucid Central. "*Tridax procumbens* morphological details and inflorescence description. Rainforest Plants of Southeast Queensland and Northern New South Wales: Factsheet for *Tridax procumbens*". Lucidcentral.org. (2025).

6. South African National Biodiversity Institute (SANBI). "*Tridax procumbens* L. — Morphological description including capitulum and florets". *Biodiversity Advisor.*

7. Royal Botanic Gardens Kew. "*Tridax procumbens* L. — Stem, leaf and flower morphology; distribution information". *Plants of the World Online*.

8. Saxena VK and Albert S. "β Sitosterol 3 O β D xylopyranoside from the flowers of *Tridax procumbens* Linn". *Journal of Chemical Sciences* 117.2 (2005): 263-266.

9. Kumar S and Pandey AK. "Chemistry and biological activities of flavonoids: An overview". *The Scientific World Journal* (2013): 1-16.

10. Baile SB and Parmar GR. "A review: Investigating the pharmacognostic, phytochemical and therapeutic properties of *Tridax procumbens* from the Asteraceae family". *Pharmacognosy Research* 17.1 (2025): 18-30.

11. Venkatesh S., *et al*. "Antioxidant and free radical scavenging activities of *Tridax procumbens*". *Journal of Pharmacy Research* 4.8 (2011): 2871-2873.

12. Sharma RK., *et al*. "Phytochemical screening and evaluation of antimicrobial and antioxidant activities of *Tridax procumbens* Linn". *International Journal of Pharmaceutical Sciences Review and Research* 31.1 (2015): 221-226.

13. Rajeshwari V and Andallu B. "GC-MS analysis and pharmacological significance of bioactive compounds from *Tridax procumbens*". *Asian Journal of Pharmaceutical and Clinical Research* 11.5 (2018): 246-250.

14. Oladunmoye MK and Kehinde FY. "Ethnobotanical survey of medicinal plants used in treating viral infections among Yoruba tribe of South Western Nigeria". *African Journal of Microbiology Research* 5.19 (2011): 2991-3004.

15. Anilkumar KK. "A comprehensive review of the morphology, phytochemistry and medicinal applications of Asteraceae family plants". *Journal of Survey on Fish Science* 8.2 (2022): 685-692.

16. Saxena VK and Mondal S. "Isolation and characterization of phytoconstituents from *Tridax procumbens* Linn". *Indian Journal of Chemistry* 51B (2012): 1092-1096.

17. Pandey A and Tripathi S. "Concept of standardization, extraction, and phytochemical screening of herbal drugs". *Journal of Pharmacognosy and Phytochemistry* 2.5 (2014): 115-119.

18. Harborne JB. "Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis". 3.0 London: Chapman & Hall3 (1998): 1-302.

19. Kushwaha P., *et al*. "Phytochemical screening and GC-MS studies of the methanolic extract of *Tridax procumbens"*. *International Journal of Pharmaceutical Sciences and Research* 10.5 (2019): 2492-2496.

20. Trease G E., *et al*. "Pharmacognosy (16th ed.)". London: Saunders Elsevier. This edition provides comprehensive coverage of the medicinal plants, their phytochemistry, pharmacological activities, and applications in traditional and modern medicine. 16.0 London: Saunders Elsevier (2009): 1-784.

21. Singleton VL., *et al*. "Analysis of total phenols and other oxidation substrates by means of Folin-Ciocalteu reagent". *Methods in Enzymology* 299 (1999): 152-178.

22. Skoog D A., *et al*. "Principles of Instrumental Analysis (6th ed.)". Belmont, CA: Cengage Learning. This edition covers fundamental concepts and techniques in analytical chemistry, including spectroscopic, chromatographic, and electrochemical methods widely used for qualitative and

quantitative analysis of chemical substances. 6.0 Belmont, CA: Cengage Learning (2007): 416-432.

23. Wagner H and Bladt S. "Plant Drug Analysis: A Thin Layer Chromatography Atlas (2nd ed.)". Berlin: Springer-Verlag. This edition provides comprehensive guidance on the identification and analysis of the plant-derived drugs using thin layer chromatography and illustrations for various phytochemicals. Berlin: Springer-Verlag 2.0 (1996): 215-246.
24. Snyder L R., *et al*. "Introduction to Modern Liquid Chromatography (3rd ed.)". Hoboken, NJ: Wiley. This edition as in-depth explanation of modern liquid chromatography principles for complex mixtures. 3.0 Hoboken, NJ: Wiley (2010): 401-435.
25. Silverstein RM., *et al*. "Spectrometric Identification of Organic Compounds". 7.0 New York: Wiley (2005): 416-420.
26. Mahato RB and Chaudhary RP. "Ethnomedicinal study and antibacterial activities of selected plants of Palpa district, Nepal". *Scientific World* 3.3 (2005): 26-31.
27. Bhagwat DA and Killedar SG. "Anti-inflammatory activity of *Tridax procumbens*". *International Journal of Green Pharmacy* 2.2 (2008): 126-130.
28. Jain S and Jain DK. "Evaluation of anti-inflammatory activity of *Tridax procumbens* leaf extract". *International Journal of Pharmaceutical Sciences and Research* 2.3 (2011): 765-770.
29. Halliwell B and Gutteridge JMC. "Free radicals in biology and medicine". Oxford University Press 4th ed. (2007): 245-251.
30. Manjamalai A and Grace VM. "Evaluation of free radical scavenging activity of *Tridax procumbens*". *Asian Journal of Pharmaceutical and Clinical Research* 5.4 (2012): 126-129.
31. Gnanasekaran N., *et al*. "The comparative studies of the phytochemical levels and the *in vitro* antioxidant activity of *Tridax procumbens* L. from different habitats". *Free Radical Antioxidant* 7.1 (2017): 50-56.
32. Pareek H., *et al*. "Evaluation of hypoglycemic and antihyperglycemic potential of *Tridax procumbens* (Linn.)". *BMC Complementary and Alternative Medicine* 9.48 (2009): 1-8.
33. Vetrichelvan T., *et al*. "Hypoglycemic activity of *Tridax procumbens* leaves in alloxan-induced diabetic rats". *European Scientific Journal* 21.24 (2025): 57-65.
34. Petchi RR., *et al*. "Antidiabetic and antihyperlipidemic effects of an ethanolic extract of *Tridax procumbens* in streptozotocin-induced diabetic rats". *Journal of Basic and Clinical Pharmacy* 4.4 (2013): 88-92.
35. Satishchandra A., *et al*. "In vitro urolithiasis activity of *Tridax procumbens* methanolic extract on calcium oxalate crystals prepared by precipitation method". *Pharmacognosy Research* 15.4 (2023): 667670.
36. "Systematic review on traditional and pharmacological uses of *Tridax procumbens* including antiurolithiatic effects". *Systematic Reviews in Pharmacy* 13.7 (2022): 476482.
37. Jangid T., *et al*. "A comprehensive review on traditional uses, phytochemical constituents, and pharmacological properties of *Tridax procumbens*". *Journal of Phytopharmacology* 14.4 (2025): 223-246.
38. Manjamalai A., *et al*. "Essential oil of *Tridax procumbens* induces apoptosis and suppresses angiogenesis and lung metastasis of B16F10 cells in C57BL/6 mice". *Asian Pacific Journal of Cancer Prevention* 13.11 (2012): 5887-5895.
39. "Invitro antibacterial, antioxidant potentials and cytotoxic activity of the leaves of *Tridax procumbens*, including effects on A549 and MCF7 cell lines". *Saudi Journal of Biological Sciences* 27.2 (2020): 757761.
40. Patra JK., *et al*. "Nano based drug delivery systems: Recent developments". *Journal of Nanobiotechnology* 16 (2018): 71.
41. Izzo AA., *et al*. "A critical approach to evaluating clinical efficacy of herbal medicines". *Phytotherapy Research* 30.5 (2016): 691-700.
42. Date AA., *et al*. "Nanoparticles for oral delivery". *Advanced Drug Delivery Reviews* 91 (2016): 93-109.
43. Dureja H., *et al*. "Cosmeceuticals: An emerging concept". *Indian Journal of Pharmacology* 37.3 (2005): 155-159.
44. Ali M., *et al*. "Phytochemical screening of *Tridax procumbens* Linn". *International Journal of Chemical Science* 5.5 (2007): 2682-2686.
45. Mukherjee PK., *et al*. "Bioactive compounds from natural resources against skin aging". *Phytomedicine* 19.1 (2011): 64-73.