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TRIDAX PROCUMBENS PHARMACOLOGICAL POTENTIAL: A REVIEW

Prabu. K*

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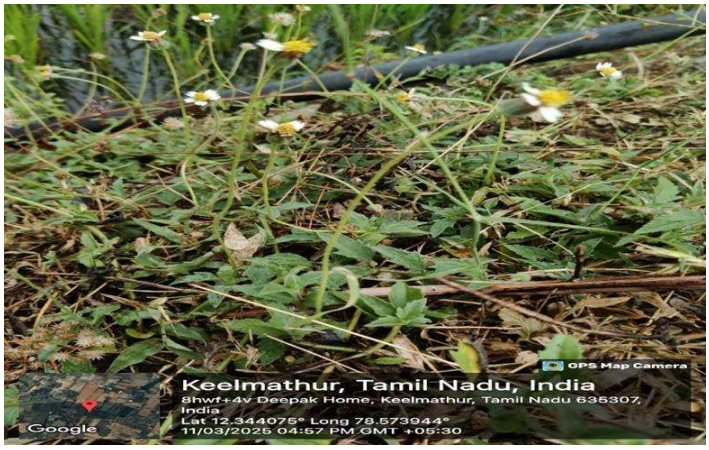
Abstract

A perennial herbaceous plant of the Asteraceae family, Tridax procumbens, sometimes referred to as "coat buttons," is found in tropical regions of the world, including Central and South America. It has been used for insect repellent, fungal infection treatment, and wound healing in Indian Ayurveda. Anti-inflammatory, antifungal, anticancer, antioxidant, and antibacterial qualities are only a few of the many biological benefits that recent pharmacological research has confirmed. Secondary metabolites such as flavonoids, alkaloids, saponins, carotenoids, and tannins exemplify these processes. Despite promising in vitro and in vivo results, varied techniques and a lack of standardization necessitate more thorough phytochemical, toxicological, and clinical studies. This review highlights the significance of combining traditional wisdom with contemporary scientific validation in order to properly utilize T. procumbens' medicinal potential.

Keywords: Tridax procumbens, secondary metabolites, antimicrobial activity, antioxidant, anticancer.

1 Introduction

Tridax procumbens, a flowering plant species in the Asteraceae family, is sometimes referred to as coat buttons or tridax daisy. It is primarily recognized as a common weed and nuisance plant. Though it was brought to tropical, subtropical, and mild temperate climates across the world, it is native to the tropical Americas, especially Mexico. In nine states, it is considered a nuisance and is categorized as a noxious weed in the US. Tridax procumbens has been used historically in India as an insect repellent, anticoagulant, antifungal, and for wound healing [1]. In animal experiments, Tridax procumbens Linn. has demonstrated potent analgesic and anti-inflammatory properties [2]. According to the Encyclopedia of Life, it is also used by indigenous healers in several regions of India to treat cuts, boils, and blisters. From the aerial portions of Tridax procumbens, the flavonoid procumbenetin has been identified [3]. Additional chemical components found in the plant include polysaccharides, fatty acids, pentacyclic triterpenes, sterols, and alkyl esters [4]. Despite the discovery of several major active chemical components, there is still a lack of toxicological understanding, suggesting that more research on this plant is necessary [5].



Scientific classification

Kingdom: Plantae

Clade: Tracheophytes

Clade: Angiosperms

*Corresponding author: Email kprabhu.cas@gmail.com
*Department of Chemistry, Sacred Heart College (Autonomous), Tirupattur-635601, Tamilnadu, India.

Clade: Eudicots

Clade: Asterids

Order: Asterales

Family: Asteraceae

Genus: Tridax

Species: T. procumbens

Binomial name

Tridax procumbens L.

Tridax procumbens, commonly referred to as "coat buttons," is a perennial plant indigenous to Central and South America that belongs to the Asteraceae family [6-7]. This species has long been utilized in Indian Ayurvedic medicine. Various products, including oils, teas, and skin care products, have been produced with this species [8]. Antioxidant, anti-hepatotoxic, analgesic, antidiabetic, anti-inflammatory, antifungal, and antibacterial activity are only a few of the many pharmacological characteristics of T. procumbens. The defense mechanisms of the plant, as well as secondary metabolites including flavonoids, alkaloids, tannins, carotenoids, and saponins, are probably what give the species its adaptability. Although Tridax has a wide range of secondary metabolites, which indicate the species' potential pharmacological qualities, we have not yet seen its application in allopathic treatment. These substances' antiviral, anticancer, antioxidant, liver protection, immuno-enhancement, antibacterial, antifungal, antiparasitic, antiplasmodial, and anemia prevention qualities have led to their use. This species' pharmacological potential may serve as a link between traditional and western treatment. Further separation and description of the active ingredients are required. Whether there are alterations in activity throughout the pharmaceutical compounds' production and isolation has not been studied. Although Ali et al. (2001) explain the extraction of flavonoids from aerial parts, there is no association between the antifungal activity and the flavonoid procumbenetin. This means that validation in table 4 is still necessary. In other instances, 26 compounds with suspected antifungal activity were reported [9], however the phytochemicals causing the activity were not mentioned. Taddei and Romero's (2002) findings contradicts that of Policegoudra and associates because it shows no antibacterial activity against Candida albicans. This can be because of the various methods or the kinds of bacteria that were employed. In their seven-day three-extraction approach, Taddei and Romero utilized dichloromethane (1:1; 3x 1000 ml) and n-hexane and ethyl acetate to extract the aqueous layer. They also used paper disks for analysis and did not identify the source of the bacterial strains. Using known bacterial strains and the agar-well diffusion method, Policegoudra separated the methanol extract using dichloromethane. That means more effort has to be done to fix the problem then [10].

Antimicrobial Activity

Screenings for antibiotics have been conducted, however more research is required to validate some of the findings. Many types of fungus and bacteria have demonstrated susceptibility to T. procumbens' antibacterial qualities. The creation of silver nanoparticles with some antibacterial action against E. coli, V. cholerae, A. niger, and A. flavus has recently been demonstrated to benefit from the callus of stem and leaf [11]. Nevertheless, these results are not definitive because this activity was lower than that of silver nitrate. Extractions of T. procumbens leaves in petroleum, ether, and ethanol shown antibacterial activity against Bacillus faecalis. According to reports, the presence of alkaloids is most likely what caused this behavior. Better controls and technique descriptions are needed for the tests, however the chloroform extracts shown antibacterial action against B. faecalis, B. subtilis, E. coli, and Pseudomonas aeruginosa [12]. Alpha and beta pinenes, which are present in T.

procumbens essences, can be utilized in tiny amounts to treat bacterial and fungal infections [13]. Regarding this species' antibacterial activity, there are some conflicting findings [9-10]. More research is required in this area because certain studies [22] did not include substantial biological activity when compared to the antibiotic control; yet, there is indication that this species may have antimicrobial properties.

Action Against Fungi The antifungal properties of T. procumbens have been studied. The ideal zone of inhibition from several fungal strains, such as Microsporum fulvum, Microsporum gypseum, Trichophyton mentagrophytes, Trichophyton rubrum, Candida albicans, and Trichosporon beigelii, has been determined using a variety of extraction techniques. Using the dichloromethane (DCM) fraction, extracts of the plant's aerial portions have demonstrated effectiveness against dermatophytes with zones of inhibition ranging from 17 to 25 mm, yielding the best response [9]. The authors do not, however, specify which bioactive substances give qualities that are antifungal. Although the authors make the suggestion that these chemicals might be components and derivatives of fatty acids, they provide no supporting data.

Antiparasitic Activity

A bioassay guided fractionation with a methanol extract has been used to evaluate T. procumbens in the treatment of certain diseases caused by protozoal infections, such as malaria [14-15], dysentery, colic, and vaginitis, in order to isolate an active compound, (3,S)-16,17-Didehydrofalcarinol (an oxylipin). According to Martín-Quintal et al. (2009), Tridax appeared to show anti-leishmanial efficacy when administered in crude extract form. T. procumbens flowers, leaves, and stem were used in a Ghanaian study to investigate the antiplasmodial properties of aqueous, chloroform, ethyl acetate, and ethanolic extracts. Evidence of anti-plasmodial qualities in the species' aqueous and ethanolic extracts has been found; a study employing a tetrazolium-based colorimetric assay revealed that T. procumbens assisted in shielding red blood cells from P. falciparum damage [14]. Against a disease that kills millions of people worldwide, Tridax exhibits remarkable promise.

Antioxidant Activity

Molecules with an unpaired electron in an atomic orbital are known as free radicals because they are extremely reactive. Among these free radicals are peroxyl, hydrogen peroxides, reactive oxygen species (ROS), superoxide anion radicals, and reactive hydroxyl radicals (OH). These radicals' instability can harm numerous biologically significant components, including DNA and macromolecules, which can result in cell injury and disruption of homeostasis. By blocking oxidation inside a biological system, an antioxidant or free radical scavenger lowers this activity. Agrawal et al. (2009) used the 1,1-diphenyl-2-picrylhydrazyl (DPPH) technique to investigate the antioxidant activity of T. procumbens and discovered substantial activity (similar to that of ascorbic acid) in the ethyl acetate and n-butanol fractions derived from methanolic extracts. When utilizing n-butanol and ethyl acetate fractions from methanolic extracts, Saxena et al. (2013) also observed that Tridax had a significant level of antioxidant activity. At a dosage of 250 µg/mL, Habila et al. (2010) discovered 96.7% antioxidant activity. The authors assert that Tridax has a high reductive potential (0.89 nm) in comparison to the norm (0.99 nm) and speculate that the plant's high phenol content may be the cause of its intense antioxidant activity, making it a good natural source of antioxidants with possible therapeutic uses. It's also claimed that T. procumbens induces both enzymatic and non-enzymatic antioxidants and lowers lipid peroxidation. Flavonoids, which are known to have free radical scavenging qualities, may be the cause of the plant's hepatoprotective qualities [7]. Due to its high concentration of phenols, flavonoids, anthraquinone, carotenoids, and vitamins A and C, T. procumbens exhibits

excellent antioxidant activity [20]. Strong evidence for Tridax's antioxidant qualities is reported in every study.

Anticancer Activity

Multifactorial illness is what cancer is. T. procumbens's anticancer properties have only lately been studied. The effects of crude floral aqueous and acetone extracts on prostate epithelial malignant cells (PC3) were examined. The aqueous extract exhibited very marginal antitumor efficacy. One day after treatment, the acetone extract exhibited 82.28% activity against cancer cells [21]. Utilizing the MTT assay, the viability was examined. Because the acetone extract was the only extract that had an effect and the controls were not made explicit in the publication, the results are inconclusive because the authors do not explain the toxicity analysis that was done. Additionally, there is no mention of the selectivity index and no comparison of the results to those of conventional therapeutic medications. When employing T. procumbens, there was a significant reduction in the production of tumor nodules in the lungs. This was likely caused by the monoterpenes (alpha and beta pinenes) inhibiting the formation of new blood vessels. The expression of P53 and caspase was also elevated, suggesting that the plant's oils may trigger apoptosis. T. procumbens has shown promise in treating cancer, according to many studies; nevertheless, further research is necessary to fully understand the molecular pathways behind this action [13]. Furthermore, none of the studies on anticancer activities adhered to the appropriate guidelines for this field of study, making the findings unconvincing.

Hepatoprotective Activity

Numerous models have been employed to assess the hepatoprotective activity of various extracts as well as the impact of T. procumbens on lowering oxidative stress in the liver, which causes liver damage. According to Hemalatha (2008), the chloroform insoluble fraction of an ethanol extract is useful for reducing liver stress brought on by pharmaceutical substances that produce ailments similar to drug intoxication, viral hepatitis, and lipid peroxidation from reactive oxidant species. The ethanol extract's chloroform insoluble extract decreased hepatotoxic activity by lowering the levels of several enzymes in rats treated with CCl4, according to a different study [24]. Male albino rats were used in studies to test T. procumbens' ability to treat liver damage brought on by paracetamol (acetaminophen). Serum levels of Aspartate aminotransferase, Alanine aminotransferase, Alkaline phosphatase, and Bilirubin were found to decrease when the ethanolic extract from T. procumbens was taken orally at different dosages, leading to hepatoprotection [23]. According to Patel et al. (2014), floral extracts in petroleum ether, methanol, and chloroform water demonstrated protection against hepatotoxicity in male Wister albino rats, with the methanolic extract having the greatest impact. The antioxidant activity of leaf aqueous extracts, which results from active free radical scavenging,

Table 1: Pharmacological activities and the therapeutic Potential of Tridax procumbens

Activity	Findings	Key Extracts/Substances	Comments
Antimicrobial Activity	Active against *E. coli*, *V. cholerae*, *A. niger*, *A. flavus*, *B. faecalis*, *B. subtilis*, *P. aeruginosa*. Silver nanoparticles showed activity but lower than silver nitrate.	Silver nanoparticles, petroleum ether, ethanol, chloroform extracts, alpha & beta pinenes	Conflicting results; more research with better controls is needed.
Antifungal Activity	Effective against dermatophytes (*Microsporum*, *Trichophyton*, *Candida albicans*, *Trichosporon beigelii*) with zones of inhibition (17–25 mm).	Dichloromethane (DCM) extract	Specific antifungal compounds not clearly identified.
Antiparasitic Activity	Anti-leishmanial and antiplasmodial activities shown; protects RBCs from *Plasmodium falciparum* damage.	(3,S)-16,17-Didehydrofalcarinol (oxylipin), aqueous and ethanolic extracts	Shows strong potential against malaria and protozoal infections.
Antioxidant Activity	Strong free radical scavenging ability; comparable to ascorbic acid; induces enzymatic/non-enzymatic antioxidants.	Phenols, flavonoids, anthraquinone, carotenoids, vitamins A and C, methanol extracts	Well-supported by multiple studies; potent antioxidant properties.
Anticancer Activity	Acetone extract reduced cancer cell viability (82.28% against PC3 cells); elevated P53 and caspase expression;	Acetone floral extract, alpha & beta pinenes	Results promising but inconclusive due to methodological flaws; further study required.

has demonstrated hepatoprotective efficacy in rats [25]. A chloroform-fractionated ethanolic extract of T. procumbens leaves shown good hepatoprotective efficacy in rats that had d-galactosamine lipopolysaccharide-induced hepatitis. According to the study, pretreatment with the plant extract might have resulted in the liver's parenchymal cells growing again. After receiving d-galactosamine lipopolysaccharide treatment, the pretreated rats' lipid levels returned to normal as well. Only the T. procumbens extract caused no negative reactions in rats, indicating that the plant is not very hazardous to rats. It seemed that the presence of flavonoids was responsible for the hepatoprotective action [7]. Future research on Tridax's hepatoprotective qualities is warranted because they appear promising.

Antidiabetic Properties

T. procumbens has demonstrated intriguing antidiabetic qualities; diabetes has become a global epidemic. Ethanolic extracts from the entire plant of T. procumbens were administered to male Wistar albino diabetic rats suffering from streptozotocin. The results of the study demonstrated that the extract had antidiabetic action on par with Glibenclamide, a medication used to treat type 2 diabetes. The medication increases the quantity of insulin that the pancreas produces. Both appropriate controls and two distinct concentrations of Tridax whole plant extract (250 mg/kg and 500 mg/kg) were used in this investigation. Comparing the ANOVA and Dennett's post hoc test to the controls revealed considerable antidiabetic efficacy. Additionally, the extracts had a beneficial effect on hyperlipidemia linked to diabetes mellitus. Methanolic extracts of T. procumbens were shown to be more effective than the popular medication Glibenclamide in treating male albino rats with diabetes induced by alloxan, according to another study. Rats received dosages of 250 or 500 mg/kg of plant extracts and 10 mg/kg of Glibenclamide for the latter. Both dosages of the plant extract reduced the rats' blood glucose levels by 10.96%–13.74% more effectively than the standard medication after 6 hours of therapy, according to the data. In rats with Alloxan-induced diabetes, the plant extracts also improved the rats' fasting blood glucose levels. Additionally, there was no proof of any negative side effects from the methanolic extracts of Tridax on the animals that were given diabetes. An investigation was also conducted on how the plants affected the rat's body weight. Bhagwat et al. (2008) found that oral administration of alcoholic and aqueous extracts from T. procumbens leaves effectively reduced blood sugar levels in Wistar diabetic rats caused by Alloxan. The rats received 200 mg/kg of the extract for seven days in a row. Although the authors do not outline the Tridax extracts' mode of action, this work supports previous research on the species' antidiabetic qualities. As demonstrated by ether, methanol, and chloroform extracts, T. procumbens significantly reduced the rate of alpha amylase and alpha glucosidase enzymes, which is comparable to typical medications used to slow the enzymes in the treatment of diabetes. The enzymes alpha-amylase and alpha-glucosidase break down carbohydrates by slowing down the rate at which they are broken down. This enables the body to digest carbohydrates at lower levels and thereby reduces the need for insulin, the primary chemical impacted by diabetes mellitus [26].

Conflict of Interest

No Conflict of interest.

Conclusion

Tridax procumbens has pharmacological flexibility, which makes it a potentially useful medicinal plant because of its wide variety of bioactive compounds. Its traditional applications highlight its significance in wound care and anti-infective treatments, despite its broader range of actions, which include antibacterial, antifungal, antiparasitic, antioxidant, and anticancer properties. The fields of clinical validation, standardized

extraction methods, and bioactive component identification still have a lot of unanswered questions. Reliable experimental designs and controls are desperately needed because antibacterial and antifungal test findings vary so significantly. Future research should focus on identifying specific active components, understanding their mechanisms of action, and conducting comprehensive preclinical and clinical studies. With the right validation method, T. procumbens could transition from traditional medicine to modern therapeutic applications, potentially offering reasonably priced treatments for a range of ailments.

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