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Review Article

# A Review: Investigating the Pharmacognostic, Phytochemical and Therapeutic Properties of *Tridax procumbens* from the *Asteraceae* Family

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**ABSTRACT**

The common weed *Tridax procumbens* has a broad range of pharmacological actions that make it a promising subject for Pharmacognostical and phytochemical study. Identifying the plant and examining its physical characteristics and chemical makeup are the main objectives of this research. Comprehensive phytochemical analyses uncover the existence of many bioactive substances. The inflammation-inhibiting, antibacterial, antioxidant and healing characteristics of *Tridax procumbens* have been shown by pharmacological research. This study highlights *Tridax procumbens*'s potential for therapeutic use and makes a case for its incorporation into contemporary Ayurvedic pharmacopeias by clarifying its phytochemical composition and Pharmacognostical features.

**Keywords:** Ghamra, *Tridax procumbens*, Anti-juvenile hormone activity, Phytochemical.

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## INTRODUCTION

*Tridax procumbens*, commonly known as coat buttons, is a prevalent weed that has garnered attention for its medicinal properties. Traditionally used in Indian folk medicine, this plant exhibits a range of therapeutic activities. This review aims to consolidate knowledge on *Tridax procumbens*, focusing on its Pharmacognostical characteristics, phytochemical composition, and diverse pharmacological activities. Detailed Pharmacognostical studies provide insights into the plant's identification and anatomical features.[1,2] Phytochemical analyses have identified numerous bioactive compounds which contribute to its medicinal properties. The pharmacological profile of *Tridax procumbens* includes significant anti-inflammatory, antimicrobial, antioxidant, and wound-healing activities, highlighting its potential for integration into modern therapeutic practices. This review underscores the importance of *Tridax procumbens* in both traditional and contemporary medicine, advocating for further research and application in Ayurvedic pharmacopeias.[3,4]

## Pharmacognostic Investigation

### *Synonym*

**Hindi:** Ghamra, Khal muriya,

**English:** Coat buttons,

**Marathi:** Gaddi chemanthi,

**Oriya:** Dagadi pala,

**Tamil:** Vettukaya thalai,

**Sanskrit:** Jayanti Veda.[2]

## Morphology

*Tridax procumbens* (Figure 1) was a perennial herbaceous plant in the *Asteraceae* family, sometimes referred to as coat buttons or *Tridax daisy*. Although this species originated in tropical America, its resilience and invasiveness have allowed it to spread rapidly across tropical and subtropical climates globally.[5]

## Growth Habit

*Tridax procumbens* often develop up to 50 cm long stems when in a prostrate or decumbent posture. The plant could efficiently grow across the ground because of its thin, pubescent stems that were rooted at the nodes when in contact with soil.[6]

## Leaves

*T. procumbens* has opposing, simple leaves that may have a variety of shapes, including ovate and lanceolate ones. Their length ranged

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from 2 to 7 cm, while their breadth was 1 to 4 cm. The surface of the leaf had a rough feel due to the tiny hairs covering it and the coarsely serrated or crenate edges. The plant is drought-tolerant because its leaves are carried on short petioles and have trichomes on both sides, which aid in preventing water loss.[7]

## Flowers

The inflorescence consisted of a single, terminal head (capitulum) held aloft by a long, thin, glabrous peduncle. Ray and disc florets could be seen in each capitulum, which had a diameter of 1-2 cm. The yellow, tubular, bisexual disc florets in the center were surrounded by female, ligulate, and typically white ray florets. The *Asteraceae* family was typified by this composite structure, which enhanced the plant's ability to reproduce and attracted pollinators.[8,9]

## Fruits and Seeds

*T. procumbens* produced oblong, ribbed, bristle-covered achenes as its fruit. The pappus on the achene, which was two to three millimeters in length, contained fluffy white bristles that aided in wind dispersal. The seeds' extensive dispersal was made possible by this modification, which increased the species' capacity for invasion.[10]

*Tridax procumbens* has a fibrous root structure that allowed for effective soil absorption of water and nutrients as well as anchoring. Additionally, the ability of the roots to generate adventitious roots at the stem nodes improved the plant's ability to colonize new locations.[11]

## Ecological Adaptations

*T. procumbens* showed several morphological modifications that allowed it to flourish in a range of conditions. Its prostrate growth habit prevented harm from herbivory and water loss, while its profuse pubescence on leaves and stems provided protection against pests and desiccation. The capacity of the plant to take root at the nodes guaranteed quick vegetative growth and survival in environments that had been damaged.[12]

## Microscopical characteristics

It was necessary to identify and examine *Tridax procumbens*, sometimes referred to as coat buttons or *Tridax daisies*, because of their unique microscopical features.

The following list includes this plant's precise microscopical characteristics:

## Leaf

The adaxial and abaxial surfaces of the *Tridax procumbens* leaf were seen to possess an epidermal layer when examined under a microscope. Cuticle, a thick, waxy coating that coated the epidermis was present. To give the leaves their rough texture, both surfaces were covered in large numbers of multicellular, uniseriate trichomes. Because the surrounding cells were identical to other epidermal cells, making it impossible to discriminate between them, anomocytic of stomata were present on the abaxial surface (Figure 2).[13,14]

## Stem

A circular contour with an outermost epidermal layer was seen in the transverse section of the stem. There was a visible, supporting structure under the epidermis, a cortex made of collenchyma cells. With phloem on the outer side and xylem on the inner, the vascular bundles were of the collateral type and organized in a circle. In addition, the middle of the stem was seen to have a distinct pith consisting of parenchyma cells (Figure 3).[15,16]

## The root's outermost layer

The piliferous epidermis was visible under a microscope. This layer included root hairs, which are crucial for the absorption of water and nutrients. Casparian strips were seen in the endodermis, which was layered with parenchymatous cells after the cortex. The central xylem core of the vascular cylinder, or stele, was encircled by phloem, and the pericycle separated the stele from the cortex (Figure 4).[17,18]

## Powder analysis

It was deep green, finely milled, mild bitter flavor. Which contained stem glandular trichomes, stem latex cells, leaf vessels, and root medullary rays (Figure 5).[19]

Preliminary phytochemical Screening: Previous researchers found the presence of various phytoconstituents in different extracts of *Tridax procumbens*. The observations are summarized in Table 1.

## Chemical Constituents

Various phytoconstituents found in *Tridax procumbens* reported by previous researchers are summarized in Table 2.

## Pharmacological Activity

The reported pharmacological activities of *Tridax procumbens* are presented in Figure 6.

The tropical plant of Ghamara was widely used and has drawn interest due to its anti-diabetic properties. Research indicates that by increasing insulin production and improving cell absorption of glucose, extracts from this plant may lower blood sugar levels. Preliminary human trials and animal models have shown encouraging results in research. Furthermore, *Tridax procumbens* has antioxidant qualities that may help mitigate oxidative stress, a component that leads to difficulties associated with diabetes, and therefore help manage diabetes. To confirm these results and establish the best doses in terms of both safety and effectiveness, further thorough clinical studies are needed.[37]

**Figure 1:** Plant of *Tridax procumbens.*

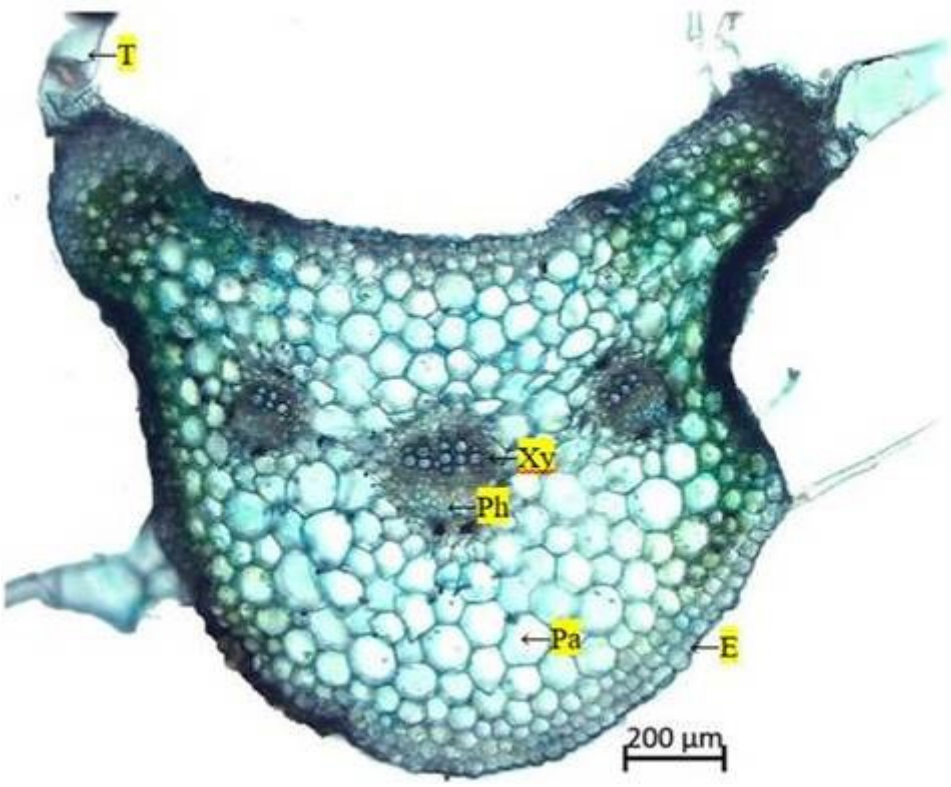



**Figure 2:** T.S Leaf (*Tridax procumbens*).

## Antifungal activity

Common root disease, seedling disease, dark spot disease, leaf spot, and flower blight were all caused by *Bipolaris sorokiniana* in wheat and barley. In milder growing regions, the fungus was a significant contributor to productivity losses for both commodities and was one of the most hazardous foliar disease restrictions.[38] The current study's objective was to investigate the *Tridax procumbens* Linn leaf extracts' antifungal efficacy in both aqueous and ethanolic forms.[39] Antifungal activity was determined using the agar diffusion assay. of *Tridax procumbens* Linn extract against *Bipolaris sorokiniana* and *Curvularia eragrostidis* fungus. Phytochemical research revealed the following components in *T. procumbens* Linn. leaf extract: proteins, sugars, tannins, steroids, alkaloids, flavonoids, and purines. Bipolaris sorokiniana exhibited greater sensitivity to the aqueous alcohol extract than *Curvularia eragrostidis. Tridax procumbens* leaf may be utilized to cure illnesses brought on by the examined fungus, according to the study's findings.[40]

## Anti-inflammatory activity

At concentrations of 0.2 and 0.4 g/kg, the ethanolic extract *Tridax procumbens* significantly reduced the inflammation induced by Irish Moss. Following 3 hr, the 400 mg/kg dosage markedly decreased inflammation by 48%; 3 additional hour later, the impact increased to 52 percent.[41] Anti-inflammatory activity was shown by both *Tridax procumbens* and Indomethacin (10 mg/kg). Leaf extract containing 200 and 400 mg $kg^{-1}$ of ethanol (EtOH) from *Tridax procumbens* showed significant anti-inflammatory activity. Seven days later, a much lower average weight of granulomatous surrounding tissue was administered to the *Tridax procumbens* extraction group as opposed to the comparative group. The 0.4 gm/kg dose proved to be the more potent of the two, resulting in a reduction in fibrotic lesion formation. The granuloma weights were significantly reduced by doses of 0.2 gm/kg and 0.4 mg/kg of extract, with values recorded at 34.58±0.04 and 38.16±0.04, respectively. The reduction in granuloma weight was slightly greater with the lower dose of 0.4 gm/kg than with the standard drug dexamethasone.[42,43]

## Anti-arthritic activity

*Tridax procumbens* ethanolic extract included alkaloids, tannins, flavonoids, and saponins, according to a preliminary phytochemical investigation.[44] Rats with FCA-induced arthritis were greatly reduced by *Tridax procumbens* at doses of up to 0.5 g/kg. This was seen as shrinkage of the paws' volume. The animals used as controls for arthritis weighted much lower than that of the non-arthritic control animals. Animals exposed to *Tridax procumbens* demonstrated dose-dependent reductions in arthritis and body weight. Simultaneously, *T. procumbens* markedly modified the biochemical and hematological alterations brought

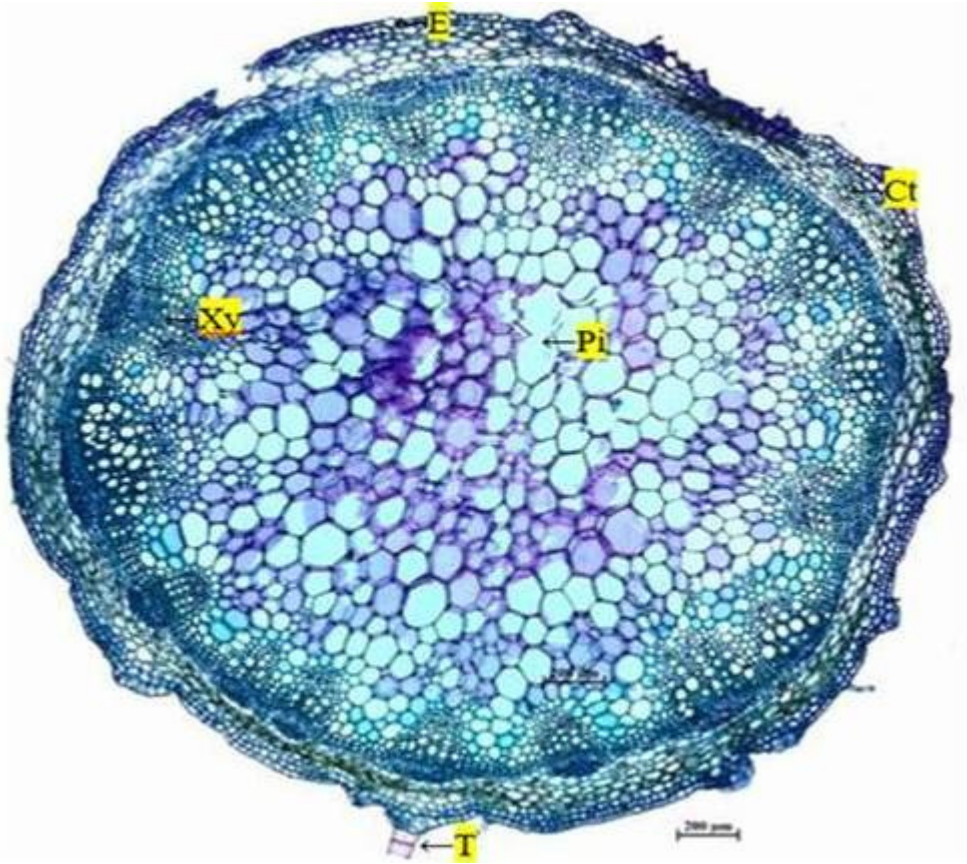



**Figure 3:** T.S of stem (*Tridax procumbens*).

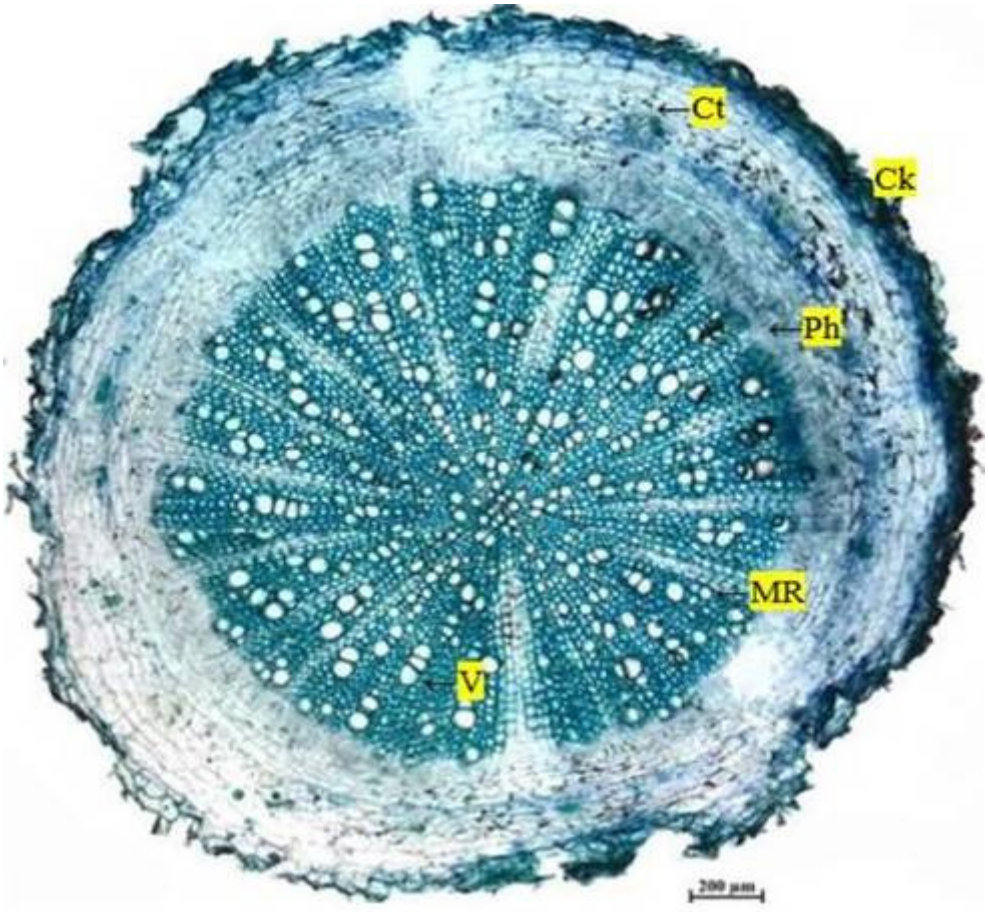



**Figure 4:** T.S of root (*Tridax procumbens*).

about by FCA ($p<0.05$). Domethacin and *Tridax procumbens* both have similar anti-arthritic effects.[33,45]

## Wound Healing activity

Extensive study has been conducted on wound healing, which is widely acknowledged as a difficult process. Historically, natural sources of plant-based remedies for wound healing have been used.[46] Silver nanoparticles have become available as a novel pharmacological method to improve wound healing as a result of recent breakthroughs in nanotechnology.[47] Because of their great catalytic activity, chemical stability, capacity to heal wounds, and antibacterial nature, these nanoparticles were shown to be useful agents for drug targeting. The present work used *Tridax procumbens* leaf extract to synthesis silver nanoparticles. Utilizing scanning electron microscopy and UV-vis absorption spectroscopy, the nanoparticles were described. We looked at the Pangasius hypothalamus to see whether the artificially produced silver nanoparticles might promote wound healing.[48]

Researchers discovered a time- and money-saving biosynthetic process for silver nanoparticles using an extract of plant leaves. Results showed that the *Tridax procumbens* generated silver nanoparticles were just as efficient in wound healing as the silver nitrate and leaf extract alone.[46] Research using silver nanoparticles made from *Tridax procumbens* showed that wounds treated with these particles saw fibrosis and collagen deposition development at far earlier stages. In addition, compared to treatments with silver nitrate and *Tridax procumbens* leaf extracts, these artificially produced silver nanoparticles demonstrated enhanced fish tissue regeneration activity, markedly appearance of the lesion, and enhancing the epithelialization.[49]

## Hepatoprotective Activity

The *Tridax procumbens* aerial parts show hepatoprotective activity. In rats, it was investigated for its efficacy in treating hepatitis induced by both d-Galactosamine and Lipopolysaccharide (d-GalN/LPS). Both chemicals are capable of damaging liver cells and causing toxicity to the liver. There are similarities between the human lesion of viral hepatitis and the multifocal necrosis caused by DGalN. The lesion caused by viral hepatitis in humans is identical to DGalN generated multisite necrosis within 8 hr of therapy, this amino sugar fulminates hepatitis due to endotoxin poisoning. Additionally, indirectly it decreases hepatic protein production and specifically suppresses transcription.[50] Hepatic injury models, both acute and chronic, were examined, with morphological, metabolic, histological, and biochemical parameters recorded. The antihepatotoxic effect of *Tridax procumbens* justifies its use in liver disease. The only fractions

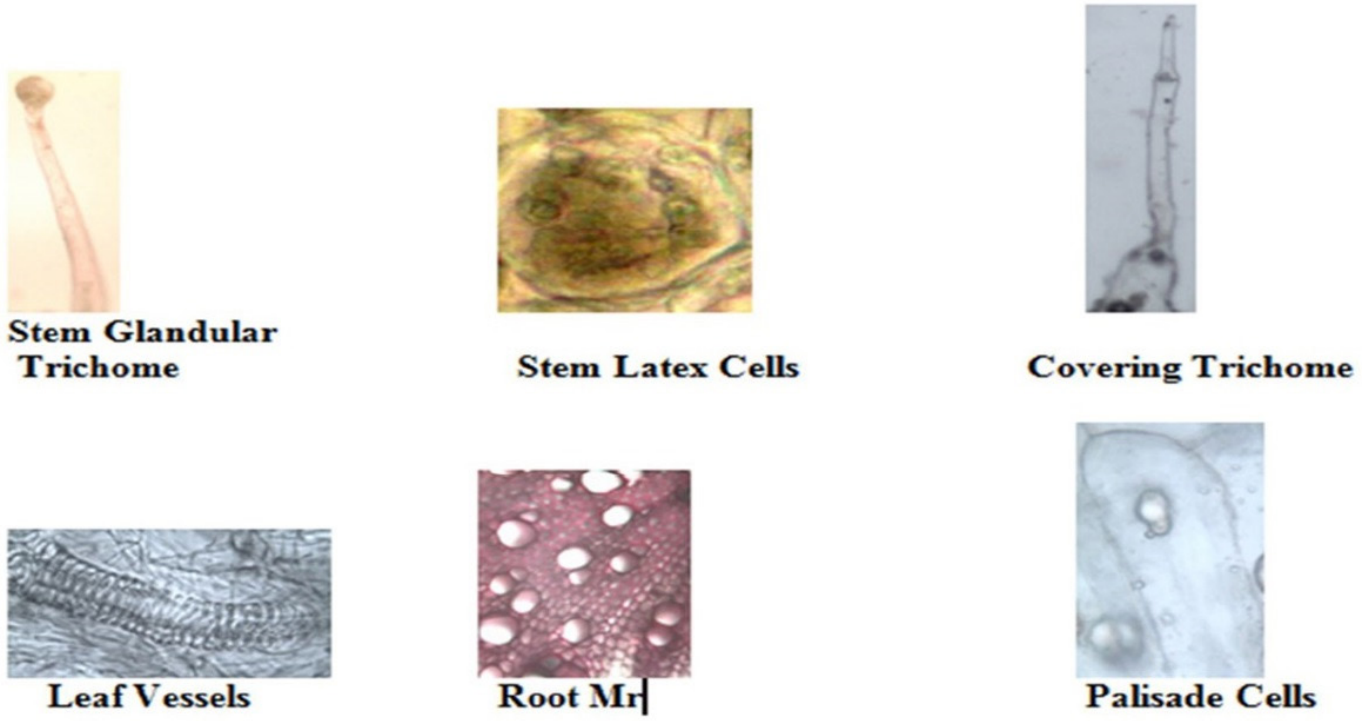



**Figure 5:** Powder characteristics of *Tridax procumbens*.

with hepatoprotective efficacy were the ethanolic extract and the chloroform insoluble fraction.[51]

## Cardioprotective Potential

This study aimed to assess *Tridax procumbens* methanolic extract's preclinical effectiveness in the context of Doxorubicin (DOX)-induced cardiotoxicity.[52] It contained four groups like control, doxorubicin (0.0015 g/kg, i.p.), Middle ear total pressure (0.2 and 0.4 g/kg,) and conventional Digoxin were the five groups to which the animals were randomly assigned for 14 days. The 13$^{th}$ and 14$^{th}$ days of treatment were the days on which all groups received DOX therapy. Rats given DOX revealed increased levels of cardiac indicators in their blood, as well as reduced antioxidant levels in cardiac tissue. METP therapy (0.2 and 0.4 g/kg) returned the abnormal biochemical level to baseline. This means that the study's findings indicate that METP's membrane-stabilizing and antioxidant effects mediated potential cardioprotective action in DOX-induced heart injury.[53,54]

## Anti-diabetic activity

The beta cytotoxin Alloxan causes diabetes by producing free radicals, which cause the islets of Langerhans to severely reduce the quantity of β-cells that secrete insulin.[55] This lowers endogenous insulin release and opens the door for a decrease in the tissue's ability to utilize glucose. Glibenclamide is a commonly used reference medication in oral sulphonyl urea anti-diabetic preparations for tests of anti-diabetic action.[56]

The fasting blood glucose levels were remarkably decreased in rats that had diabetes mellitus. When oral *Tridax procumbens* extract at acute and sub chronic dosages (0.25 and 0.5 g/kg) was administered; normal rats did not demonstrate a similar fall in blood sugar levels. During the 6 hr, the diabetic rats in the acute research showed the highest percentage lowering the blood glucose. Body weight as well as the OGTT confirmed the drug's antihyperglycemic activity, and the effects were dosage independent. In this activity, Glibenclamide was used as a standard drug.[57,58]

## Antioxidant activity

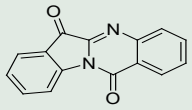
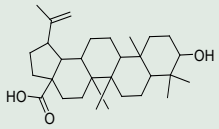
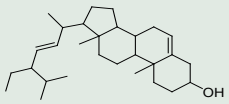
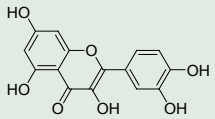
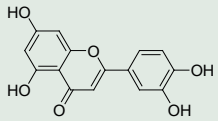
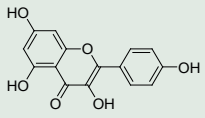
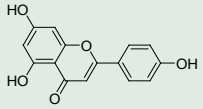
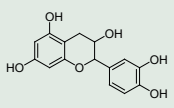
Many disease disorders have been linked to the pathophysiology of Free radical stress and a compromised free radical defense system. Numerous illnesses brought on by oxidative stress are treated using flavonoids and polyphenols.[59] Indigenous peoples have used *Tridax procumbens* as medicine for a range of conditions. This study used different extracts like methanol, ethanol, and *Tridax procumbens* leaf extracts were tested for their Oxidation inhibitor activity and phytochemical composition using aqueous extracts. *Tridax procumbens* leaf extracts were prepared in the aqueous, methanol, and ethanol phases, and phytochemical analysis was performed. The *In vitro* Oxidant-inhibiting activity was assessed using the DPPH assay, power test, reducing total flavanol, and polyphenol. The polyphenols, glycosides, carbohydrates, tannins, alkaloids, methanol, and ethanol extracts of *Tridax procumbens* were detected in the qualitative chemical analysis. Ethanol extracts showed better antioxidant activity. These findings provide

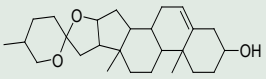
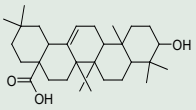
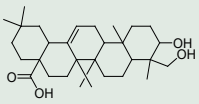
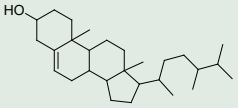
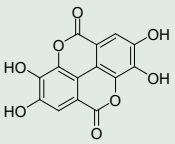
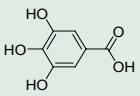
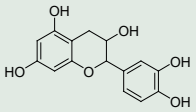
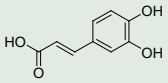
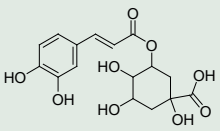
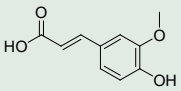
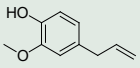
**Table 1: Preliminary phytochemical screening of various whole plant *Tridax procumbens*.[20]**

| Constituents | Pet. Ether | Chloroform | Ethanol | Aqueous |
|---|---|---|---|---|
| Carbohydrate | - | - | + | + |
| Anthraquinone glycoside | - | - | - | - |
| Alkaloids | - | - | - | - |
| Tannins | - | - | + | + |
| Flavonoids | - | - | + | - |
| Saponin | + | + | + | + |
| Phenolic group | - | + | + | + |
| Steroids | + | + | + | + |

+ indicate presence; - indicate absence.

**Table 2: Different chemical constituents isolated from *Tridax procumbens*.**

| Sl. No. | Chemical constituents | Chemical Unit | Mol. Formula | Chemical Structure | References |
|---|---|---|---|---|---|
| 1 | Alkaloid | Tryptanthrin | $C_{15}H_{18}N_2O_2$ |  | [21] |
| | | Betulinic Acid | $C_{30}H_{48}O_3$ |  | [22] |
| | | Stigmasterol | $C_{29}H_{48}O$ |  | [23] |
| 2 | Flavonoids | Quercetin | $C_{15}H_{10}O_7$ |  | [24] |
| | | Luteolin | $C_{15}H_{10}O_6$ |  | [25] |
| | | Kaempferol | $C_{15}H_{10}O_6$ |  | [26] |
| | | Apigenin | $C_{15}H_{10}O_5$ |  | [27] |
| | | Catechin | $C_{15}H_{14}O_6$ |  | [28] |

| Sl. No. | Chemical constituents | Chemical Unit | Mol. Formula | Chemical Structure | References |
|---|---|---|---|---|---|
| 3 | Saponins | Disogenin | $C_{27}H_{42}O_3$ |  | [29] |
| | | Oleanolic acid | $C_{30}H_{48}O_3$ |  | [30] |
| | | Hederagenin | $C_{30}H_{48}O_4$ |  | [31] |
| | | Campesterol | $C_{28}H_{48}O$ |  | [32] |
| 5 | Tannins | Ellagic acid | $C_{14}H_6O_8$ |  | [11] |
| | | Gallic acid | $C_7H_6O_5$ |  | [33] |
| | | Catechin | $C_{16}H_{14}O_6$ |  | [26] |
| 6 | Phenolic Compound | Caffeic acid | $C_9H_8O_4$ |  | [34] |
| | | Chlorogenic acid | $C_{16}H_{18}O_9$ |  | [35] |
| | | Ferulic acid | $C_{10}H_{10}O_4$ |  | [11] |
| 7 | Terpenoids | Eugenol | $C_{10}H_{12}O_2$ |  | [36] |

evidence of the extracts' antioxidant capabilities and could pave the way for new uses of these plants in medicine.[60,61]

## Antihypertensive effect

In the southern region of Nigeria, traditional medicine often uses *Tridax procumbens* to manage hypertension. Uncertainty surrounds the mechanism behind its antihypertensive qualities, however.[62,63] Investigations into the characteristics of the direct effects of *Tridax procumbens* leaf aqueous extract on smooth muscle mechanical responses in rat aortic ring preparations were conducted. When the aqueous extract was gradually added to the bathing fluid after being removed from non-hypertensive rats as well as pre-contracted with noradrenaline, the endothelium-intact aortic rings exhibited dose-dependent relaxation. The contractile responses to KCl were lowered and the concentration-response curve was moved to the right by the aqueous extract of plant. Furthermore, the concentration-response curve was shifted to the right by the extract, and serotonin-induced contractile responses were diminished. The study's findings suggest that *Tridax procumbens* leaf extract in water has vasodilatory effects on rat aortic smooth muscle. These findings led to the discussion of a potential mechanism for the extract's ability to relax vascular

smooth muscle. The findings of this research might provide traditional Nigerian medicine a solid scientific foundation for using this extract to treat hypertension.[64,65]

## Antidiarrheal Activity

This research aimed to investigate the phytochemical and antidiarrheal characteristics of *Tridax procumbens* leaves extracts in both aqueous and ethanolic forms.[66] A total of forty (40) albino Wistar rats, ranging in weight from 150 to 200 g, were borrowed for the purpose. There were two groups of 40 rats used in the various studies. Before the experiment started, the animals were kept in normal wire-meshed plastic cages at room temperature (28±5°C) for 7 days to gradually acclimate. Throughout the research, the animals were given an ordinary pellet meal and unlimited water.[67] Experiments on the phytochemistry of *Tridax procumbens* leaf extracts in both water and ethanol have identified bioactive compounds. In comparison to the ethanol.[68] Both the *Tridax procumbens* aqueous as well as ethanol leaf extracts significantly reduced diarrheal symptoms on gastrointestinal motility in the barium sulfate milk model. But in the diarrheal model caused by castor oil, the aqueous extract did not considerably lower the quantity of stool (wet feces) for 2 hr. when compared to the standard group treated with the Lomotil drug. However, in moist feces, the ethanol extract shows a statistically significant change. These results imply that the leaf extract could have antidiarrheal pharmacological qualities, which might explain the plant's historic medicinal usage.[67,69]

## Antimicrobial activity

*Tridax procumbens* extracts were the main subject of the research because of their antibacterial capabilities.[70,71] They were presented to be successful against a variety of microorganisms and fungal infections. *Tridax procumbens* extracts in both water and solvent showed antibacterial action against a diverse range of microorganisms.[72] Fatty acids, hydrocarbons, alkaloids, and tannins are among the different bioactive components found in the various solvent extracts that showed varying degrees of antimicrobial activity.

Furthermore, it was shown that methanolic leaf extracts had efficacy against *Staphylococcus aureus*, the causative agent of bovine mastitis. The research also emphasized the capacity of *Tridax procumbens* on bacteria and fungus, to synthesize antibacterial bioactive substances. Biological endophytes, such as Bacillus spp., and fungal isolates, such as Alternaria showed substantial antibacterial activity, indicating the possibility of discovering new antibiotics. Moreover, extracts from *Tridax procumbens* have shown potential in treating dermatophytosis, highlighting the plant's wide range of antibacterial properties.[73]

## Antiurolithiatic activity

The current study's objective was to assess, using *in vitro* techniques, The impact of *Tridax procumbens* extract on calcium phosphate as well as oxalate.[74,75] Using the hot maceration process, the leaves of *Tridax procumbens* were extracted one

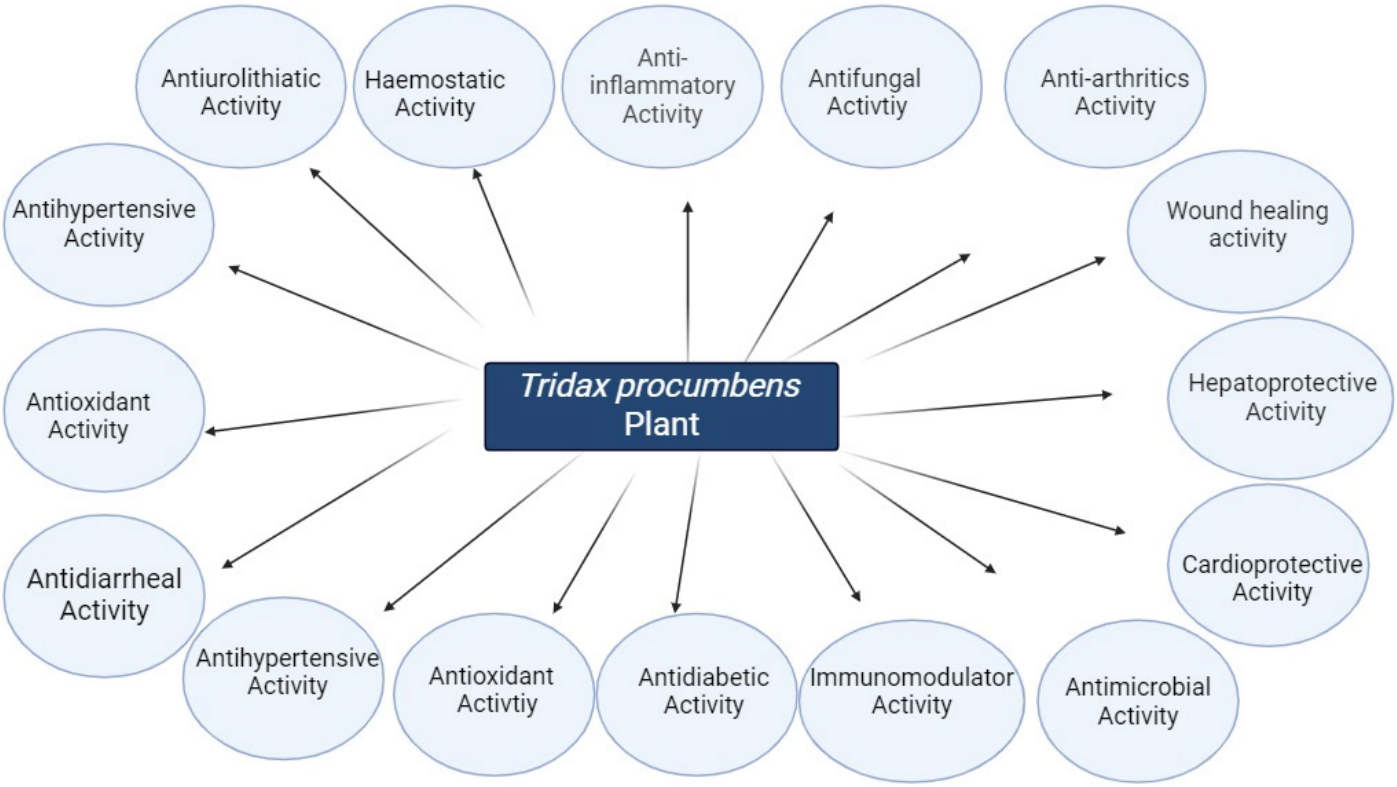



**Figure 6:** Different activities of *Tridax procumbens*.

at a time using different concentrations of water, ethanol, and hydroalcoholic solution. The resulting extract was tested for alkaloids, flavonoids, saponins, phenol, and triterpenoid saponins using phytochemical screening.[76] Calcium oxalate and calcium phosphate stones were generated Experimentally for the *in vitro* investigation and contrasted with regular medication. Cystone is a common medication. *Tridax procumbens* has a significant ability to solubilize calcium phosphate and oxalate.[77]

These flavonoids prevent the renal tubules from forming deposits of calcium oxalate and calcium phosphate. The leaf extract reduces the size of stones and has preventive and anti-urolithiasis therapeutic properties. The primary objective of the research is to determine if the herb *Tridax procumbens*, used to prevent help treat medical conditions including kidney stones, especially those caused by its leaves, these are more prevalent among younger individuals due to inadequate nutrition and lack of physical activity. The extract's capacity to remove tiny particles from the kidney and urinary system lowers the likelihood that these particles may get lodged there and turn into stones.[78]

## Immunomodulatory activities

The cellular and humoral immune responses influenced by bioactive compounds, whether via biology or pharmacology were reflected in their capacity to modulate immune response and alleviate certain illnesses.[79] Swiss male albino mice administered an aqueous extract of *Tridax procumbens* intraperitoneally showed significant immunomodulatory indexes increased leucocyte count, splenic antibody-secreting cells, and the phagocytic index. Furthermore, the injection improved the cellular and humoral immune response, as seen by the increased delayed-type hypersensitivity reaction and the hemagglutination antibody titer, respectively. Furthermore, in mice sensitized by bovine serum albumin, the aqueous extract prevented anaphylactic shock and decreased the number of animals exhibiting allergic symptoms. The aqueous extract's sesquiterpene and terpenoids may be the cause of the overall immunomodulatory reactions. Finding a specific anti-Tetanus Toxoid (TT) antibody in mice receiving TPEIF demonstrated a noteworthy increase in specific antibodies against TT. Aqueous extract as a vaccination adjuvant to lower the proportion of vaccine nonresponses in immunocompromised patients. Linn. in patients with impaired immune systems and as a booster shot to lower the proportion of vaccine no responders.[80] Extraction by methanol and subsequent delivery of the leftover Water-Soluble Fraction (RWSFTP) were the subjects of an alternative investigation, ethyl acetate fraction, and Chloroform Fraction (CFTP) showed positive responses in inducing immune responses (0.2 g/kg body weight) shown by Swiss Albino mice. Triterpenoid saponin and flavonoid-rich EFTP and NFTP fractions significantly altered immunological humoral and cell-mediated processes. Moreover, *Tridax procumbens* ethanolic extract induced phagocytosis and humoral reaction in Swiss albino rats and protected against the infection caused by Pseudomonas aeruginosa.[81]

## Bone Homeostasis Modulators:

It has been shown that flavonoids derived from plants may regulate bone homeostasis by either suppressing or encouraging the actions of osteoclasts and osteoblasts separately or together.[82] After being exposed to *Tridax procumbens* Fraction (TPF), primary osteoclastic cells verified a significant decrease in the differentiation of osteoclasts caused by Kappa-B activation in nuclear factors ligand-receptor, alongside the creation of pits. Proteins such as Gelatinase B and Collagenase-3, as well as osteoclast differentiation genes, are down-regulated, TPF treatment of primary osteoclast cells suggests that the drug may be a useful anti-bone resorption treatment for people with conditions like osteoporosis.[83] Comparing treated mice to control mice, TPF-treated animals exhibited substantially higher levels of Bone formation markers.[84] One possible explanation for the molecular processes behind TPF's prevention of osteoclast development is the dysregulation of transcription factors, including c-Fos, Activator Protein-1 (AP-1), and cytoplasmic nuclear factor of activated T cells 1.[85]

## Hemostatic activity

Lee White's approach was used to evaluate the *in vitro* clotting times of ten healthy human subjects to investigate the haemostatic properties of many leaf extracts, including ethanolic, fresh leaf, and petroleum extracts of *Tridax procumbens*. Of these, the ethanolic extract consistently reduced the clotting time in the blood sample from each patient, demonstrating good effectiveness. It is possible to utilize aqueous leaf extract as a strong haemostatic agent since it has also shown increased blood clotting activity.[86]

## Anti-juvenile hormone activity

Using a portion of *Tridax procumbens* petroleum ether extract significantly affected Dysdercus metamorphosis, resulting in abnormalities in adults because of juvenile hormone activity against adult female mosquitoes and late fourth instar larvae colonized in a laboratory. *Tridax procumbens* extract in petroleum ether shows both properties like juvenile hormone mimicking and growth inhibitory. Although there was no sterilant impact seen, the treated mosquitoes showed a discernible drop in fertility. Egg-refit times were significantly shorter in larvae exposed to plant extracts than in the control group.[87]

## Leishmanicidal activity

By preventing Leishmania mexicana promastigotes, the cause of cutaneous leishmaniasis, from growing, the methanolic extract of *Tridax procumbens* showed anti-leishmanial action. The extract showed an $IC_{50}$ of 3 µg/ml, or 50% inhibitory concentration.[88]

### Larvicidal activity

The research also showed that *Tridax procumbens* essential oil had insect-repelling properties. Strong larvicidal action was observed against *Dysdercus similis, Culex fatigans*, and *Musca domestica*. Furthermore, the study documented that the *Tridax procumbens* plant leaf extracts, including acetone, hexane, chloroform, and ethyl acetate, block emergence and have an adulticidal effect., against *Anopheles stephensi* Liston.[89]

## CONCLUSION

The well-known medicinal plant *Tridax procumbens* has a great deal of pharmacological potential, which is reinforced by the variety of phytochemicals it contains. The plant's pharmacognosy shows a wealth of bioactive substances, including saponins, alkaloids, and flavonoids, which support a variety of biological functions. Its efficaciousness in wound healing, antidiabetic, antioxidant, antibacterial, haemostatic, and immunomodulatory actions has been extensively researched. These results demonstrate *Tridax procumbence's* therapeutic value, making it a viable option for the creation of herbal medicines and pharmaceutical treatments. It is recommended that further research be done to fully understand its methods of action.

## CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

## ABBREVIATIONS

**DPPH:** 2,2-Diphenyl-1-picrylhydrazyl; **OGTT:** Oral Glucose Tolerance Test; **FCA:** Freund's Complete Adjuvant; **DOX:** Doxorubicin; **METP:** Methanolic Extract of *Tridax procumbens*; **d-GalN/LPS:** d-Galactosamine/Lipopolysaccharide; **TPF:** *Tridax procumbens* Fraction; **AP-1:** Activator Protein-1; **NFTP:** Non-Fractionated *Tridax procumbens*; **EFTP:** Ethyl Acetate Fraction of *Tridax procumbens*; **RWSFTP:** Remaining Water-Soluble Fraction of *Tridax procumbens*; **CFTP:** Chloroform Fraction of *Tridax procumbens*; **TT:** Tetanus Toxoid.

## SUMMARY

The plant has several bioactive substances that enhance its medicinal potential, including phenolic acids, alkaloids, terpenoids, and flavonoids. The pharmacological actions of these phytoconstituents include Antifungal, Anti-inflammatory, wound healing activity, antioxidant, and major activity like anticancer activity. In traditional medical systems across many cultures, *Tridax procumbens* is prized for both its ecological significance and its therapeutic uses. More investigation is required to completely clarify its modes of action and its therapeutic applications.

## REFERENCES


1. Uddin K, Rahman A, Islam A. Taxonomy and traditional medicine practices of *Polygonaceae* (smartweed) family at Rajshahi, Bangladesh. Int J Adv Res. 2014;2(11):459-69.
2. Dattatray D. Traditional uses and pharmacology of plant *Tridax procumbens*: a review. Syst Rev Pharm. 2022;13(5):511-7. doi: 10.31838/srp.2022.5.74.
3. Parekh J, Chanda S. *In vitro* antimicrobial activity and phytochemical analysis of some Indian medicinal plants. Turk J Biol. 2007;31(1):53-8. doi: 10.3906/biy-0701-5.
4. Amutha R, Sudha A, Pandiselvi P. *Tridax procumbens* (coat button)-A gift of nature: an overview. Pharmacol Benefits Nat Prod. 2019:193-212. doi: 10.1016/B978-0-12-816812-5.00011-5.
5. Kethamakka SR, Deogade MS, Veda J (*Tridax procumbens*)-Unnoticed medicinal plant by Ayurveda. J Indian Syst. Med. 2014;2(1):6-22.
6. Powell AM. Taxonomy of Tridax (Compositae). Brittonia. 1965;17(1):47-96. doi: 10.2307/2805391.
7. Harsha VH, Hebbar SS, Shripathi V, Hegde GR. Ethnomedicobotany of Uttara Kannada District in Karnataka, Indian plants in treatment of skin diseases. J Ethnopharmacol. 2003;84(1):37-40. doi: 10.1016/s0378-8741(02)00261-1, PMID 12499074.
8. Jain AJA, Jain AAJ. *Tridax procumbens* (L.): A weed with immense medicinal importance: a review. Int J Pharm Sci Res. 2020;11(8):1000-12. doi: 10.13040/IJPSR.0975-8232.11(8).1000-12.
9. Govindappa M. A review on the role of plant(s) extracts and its phytochemicals for the management of diabetes. J Diabetes Metab. 2015;6(7):1-5. doi: 10.4172/2155-6156.1000567.
10. Shabana HA, Gairola S, Mahmoud T. *Tridax procumbens* L. (*Asterales Asteraceae*), a new record to the flora of the United Arab Emirates. Biodiverse J. 2020;11(4):889-96. doi: 10.31396/Biodiv.Jour.2020.11.4.889.896.
11. Ikewuchi CC, Ikewuchi JC, Ifeanacho MO. Phytochemical composition of *Tridax procumbens* Linn. leaves: potential as a functional food. Food Nutr Sci. 2015;6(11):992-1004. doi: 10.4236/fns.2015.611103.
12. Satish S, Raveesha KA, Janardhana GR. Antibacterial activity of plant extracts on phytopathogenic Xanthomonas campestris pathovars. Lett Appl Microbiol. 1999;28(2):145-7. doi: 10.1046/j.1365-2672.1999.00481.x.
13. Zambare AV, Chakraborthy GS, Banerjee SK. Pharmacognostic studies of potential herb *Tridax procumbens* Linn. Int J Pharm Sci Res. 2010;1(9):58-62. doi: 10.13040/IJPSR.0975-8232.
14. Salahuddin M, Fuloria S, Pahwa S, Kumari S, Gupta SK. Studies on morpho-microanatomical evaluation of the leaves of *Tridax procumbens* Linn. (*Asteraceae*). J Sci Res. 2010;2(3):613. doi: 10.3329/jsr.v2i3.4775.
15. Fahmy GM. Leaf anatomy and its relation to the ecophysiology of some non-succulent desert plants from Egypt. J Arid Environ. 1997;36(3):499-525. doi: 10.1006/jare.1996.0217.
16. Sayed R, Said WM, Morsi FA. Morphological and anatomical studies on some dicot plant species collected from East Egypt desert. J Sci Res. 2017;34(1):602-10.
17. Wuhua C, Pepple II. Macro- and micro-morphological, anatomical, cytological and phytochemical properties of *Tridax procumbens* Linn. (*Asteraceae*). J Appl Sci Environ Manag. 2020;24(4):601-6. doi: 10.4314/jasem.v24i4.17.
18. Yadav P, Nayak S. Microscopic studies of *Tridax procumbens* Linn. Boll Pharm Res. 2011;1:25-32. doi: 10.22271/bpr.2011.v1.i1.3.
19. Kuldeep G, Pathak AK. Pharmacognostic and phytochemical evaluation of *Tridax procumbens* Linn. J Pharmacogn Phytochem. 2013;1(5):42. doi: 10.22271/phyto.2013.v1.i5.42.
20. Sawant RS, Godghate AG. Preliminary phytochemical analysis of leaves of *Tridax procumbens* Linn. Int J Sci Environ Technol. 2013;2(3):388-94. doi: 10.21276/ijset.2013.2.3.4.
21. Kaur M, Chopra DS. Green synthesis of iron nanoparticles for biomedical applications. Glob J Nanomed. 2018;4(4):68-76. doi: 10.19080/GJN.2018.04.555643.
22. Xu R, Zhang J, Yuan K. Two new flavones from *Tridax procumbens* Linn. Molecules. 2010;15(9):6357-64. doi: 10.3390/molecules15096357, PMID 20877227.
23. Kale MA, Dhake AS. Anti-inflammatory activity of phytosterols and their derivatives isolated from the leaves of *Tridax procumbens* Linn. J Curr. Pharm Res. 2013;4(1):1049. doi: 10.22271/jcpr.2013.v4.i1.2.
24. Pande PS, Mishra MN. Isolation and identification of quercetin and rutin from leaves of *Tridax procumbens* Linn. by HPLC analysis. Int J Chem Phys Sci. 2015;4:65-8. doi: 10.21376/ijcps.2015.01.53.
25. Lakhera S, Rana M, Devlal K, Celik I, Yadav R. A comprehensive exploration of pharmacological properties, bioactivities and inhibitory potentiality of luteolin from *Tridax procumbens* as an anticancer drug by *in silico* approach. Struct Chem. 2022;33(3):703-19. doi: 10.1007/s11224-022-01964-7.
26. Kaushik D, Tanwar A, Davis J. Ethnopharmacological and phytochemical studies of *Tridax procumbens* Linn.: A popular herb in Ayurveda medicine. Int J Eng Res Technol. 2020;9:758-68. doi: 10.17577/IJERTV9IS090139.
27. Jindal A, Kumar P. Antimicrobial flavonoids from *Tridax procumbens*. Nat Prod Res. 2012;26(22):2072-7. doi: 10.1080/14786419.2011.617746, PMID 22047191.
28. Bhagat VC, Kondawar MS. A comprehensive review on phytochemistry and pharmacological use of *Tridax procumbens* Linn. J Pharmacogn Phytochem. 2019;8(4):01-10.

29. Nwauche KT, Anacletus FC, Ighorodje-Monago CC. Assessment of fatty acid, proximate and quantitative phytochemical compositions of matured stem of costus after (bush cane). J Drug Deliv Ther. 2018;8(6):217-24. doi: 10.22270/jddt.v8i6.2057.
30. Thalkari AB, Karwa PN, Shinde PS, Gawli CS, Chopane PS. Pharmacological actions of *Tridax procumbens* L.: a scientific review. Res J Pharmacogn Phytochem. 2020;12(1):27-30. doi: 10.5958/0975-4385.2020.00006.0.
31. Nwodo NJ, Ibezim A, Ntie-Kang F, Adikwu MU, Mbah CJ. Anti-trypanosomal activity of Nigerian plants and their constituents. Molecules. 2015;20(5):7750-71. doi: 10.3390/molecules20057750, PMID 25927903.
32. Agrawal S, Mohale D, Talele GS. Pharmacological activities of *Tridax procumbens* (*Asteraceae*). Med Plants Int J Phytomed Relat Ind. 2010;2(2):73-8. doi: 10.5958/j.0975-4261.2.2.012.
33. Habila JD, Bello IA, Dzikwi AA, Musa H, Abubakar N. Total phenolics and antioxidant activity of *Tridax procumbens* Linn. Afr J Pharm Pharmacol. 2010;4(3):123-6.
34. Jeevitha M, Kaarthikeyan G, Yadalam PK, R PK, Kumar JK. Exploration of wound healing activity of phytocompounds from *Tridax procumbens* using computation approach. J Pioneer Med Sci. 2023;12(3):20-4. doi: 10.61091/jpms20231235.
35. Chinnappan BA, Krishnaswamy M, Bal T, Rajora AD. *In vitro, in vivo* wound healing efficacy of *Tridax procumbens* extract-loaded Carboxymethylcellulose film. Int J Biol Macromol. 2023;253(1):126695. doi: 10.1016/j.ijbiomac.2023.126695, PMID 37673143.
36. Akinola AO, Adelowo FE. Chromatographic and spectrophotometric determination of some phenolic compounds in *Tridax procumbens* Linn. Stem. Chem Afr. 2021;4(1):103-13. doi: 10.1007/s42250-020-00109-7.
37. Beck S, Mathison H, Todorov T, Calderón-Juárez EA, Kopp OR. A review of medicinal uses and pharmacological activities of *Tridax procumbens* (L.). J Plant Stud. 2018;7(1):19-35. doi: 10.5539/jps.v7n1p19.
38. Manjamalai A, Valavil S, Grace V. Evaluation of essential oil of *Tridax procumbens* L. for anti-microbial and anti-inflammatory activity. Int J Pharm Sci. 2012;4(3):356-63.
39. Rizvi SM, Zeeshan M, Khan S, Biswas D, Al-Sagair OA, Arif JM. Evaluation and distribution of antibacterial potential in the aerial parts of wild *Tridax procumbens*. J Chem Pharm Res. 2011;3(2):80-7. doi: 10.4314/jcpr.v3i2.64836.
40. Maldhure AK, Kalambe NA, Bhokare DD. Antifungal activity of extract from the leaves of *Tridax procumbens* Linn. Int J Res Biosci Agric Technol. 2017;5(2):962-4. doi: 10.21276/ijrbat.2017.5.2.14.
41. Patel JK, Patel PY. Botanical therapeutics: discovery, development and manufacture-prospects and constraints. J Nat Rem. 2007;7(1):19-30. doi: 10.18311/jnr/2007/1/3.
42. Prabhu VV, Nalini G, Chidambaranathan N, Kisan SS. Evaluation of the anti-inflammatory and analgesic activity of *Tridax procumbens* Linn. against formalin, acetic acid, and CFA-induced pain models. Int J Pharm Sci. 2011;3(2):126-30. doi: 10.22159/ijpps.2011.v3i2.246.
43. Sharma P. Investigation on photodecomposition of standardized ethyl acetate fraction of Katha. Pharmacogn J. 2020;12(4):815-20. doi: 10.5530/pj.2020.12.117.
44. Bendele A. Animal models of rheumatoid arthritis. J Musculoskelet Neuronal Interact. 2001;1(4):377-85. doi: 10.1016/S1474-4422(01)00043-5, PMID 15758488.
45. Berrington J. Biologic treatments for rheumatoid arthritis. J Orthop Nurs. 2006;10(3):159-65. doi: 10.1016/j.joon.2006.06.013.
46. Mishra M, Kumar H, Tripathi K. Diabetic delayed wound healing and the role of silver nanoparticles. Dig J nanomater bios. 2008;3(2):49-54. doi: 10.1007/s13203-008-0001-5.
47. Ravindran J, Arumugasamy V, Baskaran A. Wound healing effect of silver nanoparticles from *Tridax procumbens* leaf extracts on Pangasius hypothalamus. Wound Med. 2019;27(1):100170. doi: 10.1016/j.wndm.2019.100170.
48. Maulidya B, Rosidah J, Lili W. Effectivity of sambiloto extract as medicine for catfish (*Pangasius hypothalamus*) juveniles infected by *Aeromonas hydrophila*. Int J Fish Aquat Stud. 2017;5:236-41. doi: 10.22271/fish.2017.v5.i6.1428.
49. Wright JB, Lam K, Buret AG, Olson ME, Burrell RE. Early healing events in a porcine model of contaminated wounds: effects of nanocrystalline silver on matrix metalloproteinases, cell apoptosis, and healing. Wound Repair Regen. 2002;10(3):141-51. doi: 10.1046/j.1524-475X.2002.10308.x, PMID 12100375.
50. Adhvaryu MR, Reddy NM, Vakharia BC. Prevention of hepatotoxicity due to antituberculosis treatment: a novel integrative approach. World J Gastroenterol. 2008;14(30):4753-62. doi: 10.3748/wjg.14.4753, PMID 18720535.
51. Chowdhury A, Santra A, Bhattacharjee K, Ghatak S, Saha DR, Dhali GK. Mitochondrial oxidative stress and permeability transition in isoniazid and rifampicin induced liver injury in mice. J Hepatol. 2006;45(1):117-26. doi: 10.1016/j.jhep.2006.01.027, PMID 16545483.
52. Rochette L, Guenancia C, Gudjoncik A, Hachet O, Zeller M, Cottin Y, *et al.* Anthracyclines/trastuzumab: new aspects of cardiotoxicity and molecular mechanisms. Trends Pharmacol Sci. 2015;36(6):326-48. doi: 10.1016/j.tips.2015.03.005, PMID 25895646.
53. Damiani RM, Moura DJ, Viau CM, Caceres RA, Henriques JA, Saffi J. Pathways of cardiac toxicity: comparison between chemotherapeutic drugs doxorubicin and mitoxantrone. Arch Toxicol. 2016;90(9):2063-76. doi: 10.1007/s00204-016-1759-y, PMID 27342245.
54. Shanmugapriya A, Maneemegalai S. Cardioprotective Potential of *Tridax procumben* against isoproterenol Induced myocardial infarction in Experimental Rats. World J Pharm Res. 2018;7(10):885-93. doi: 10.20959/wjpr201810-13531.
55. Ali MS, Jahangir M. A bis-bithiophene from *Tridax procumbens* L. (*Asteraceae*). Nat Prod Lett. 2002;16(4):217-21. doi: 10.1080/10575630290020451, PMID 12168754.
56. Kumar JS, Menon VP. Peroxidative changes in experimental diabetes mellitus. Indian J Med Res. 1992;96:176-81. doi: 10.4103/ijmr.ijmr_149_20, PMID 1512041.
57. Vetrichelvan T, Jegadeesan M, Devi BA. Anti-diabetic activity of alcoholic extract of *Celosia argentea* Linn. seeds in rats. Biol Pharm Bull. 2002;25(4):526-8. doi: 10.1248/bpb.25.526, PMID 11995938.
58. Grover JK, Yadav S, Vats V. Medicinal plants of India with anti-diabetic potential. J Ethnopharmacol. 2002;81(1):81-100. doi: 10.1016/s0378-8741(02)00059-4, PMID 12020931.
59. Działo M, Mierziak J, Korzun U, Preisner M, Szopa J, Kulma A. The potential of plant phenolics in prevention and therapy of skin disorders. Int J Mol Sci. 2016;17(2):160. doi: 10.3390/ijms17020160, PMID 26901191.
60. Baba SA, Malik SA. Determination of total phenolic and flavonoid content, antimicrobial and antioxidant activity of a root extract of *Arisaema jacquemontii* Blume. J Taibah Univ Sci. 2015;9(4):449-54. doi: 10.1016/j.jtusci.2014.11.001.
61. Bravo L. Polyphenols: chemistry, dietary sources, metabolism, and nutritional significance. Nutr Rev. 1998;56(11):317-33. doi: 10.1111/j.1753-4887.1998.tb01670.x, PMID 9838798.
62. Salahdeen HM, Idowu GO, Yemitan OK, Murtala BA, Alada. ARA. The relaxant actions of ethanolic extract of *Tridax procumbens* (Linn.) on rat corpus cavernosum smooth muscle contraction. J Basic Clin Physiol Pharmacol. 2015;26(2):211-6. doi: 10.1515/jbcpp-2015-0028.
63. Bolton TB. Mechanisms of action of transmitters and other substances on smooth muscle. Physiol Rev. 1979;59(3):606-718. doi: 10.1152/physrev.1979.59.3.606, PMID 37533.
64. Salahdeen HM, Idowu GO, Salami SA, Murtala BA, Alada AA. Mechanism of vasorelaxation induced by *Tridax procumbens* extract in rat thoracic aorta. J Intercult Ethnopharmacol. 2016;5(2):174-9. doi: 10.22377/ijier.v5i2.919.
65. Salahdeen HM, Salami SA, Paul CO, Murtala BA, Alada AA. Biochemical parameters as indicators of the antihypertensive efficacy of leaf aqueous extract of *Tridax procumbens* Linn. in N-nitro-L-arginine methyl ester-induced hypertensive rats. J Mol Pathophysiol. 2017;6(2):31. doi: 10.5455/jmp.20170721110820.
66. Essawi T, Srour M. Screening of some Palestinian medicinal plants for antibacterial activity. J Ethnopharmacol. 2000;70(3):343-9. doi: 10.1016/s0378-8741(99)00187-7, PMID 10837997.
67. Ojewole JA. Evaluation of the analgesic, anti-inflammatory and anti-diabetic properties of *Sclerocarya birrea* (A. Rich.) Hochst. stem-bark aqueous extract in mice and rats. Phytother Res. 2004;18(8):601-8. doi: 10.1002/ptr.1503, PMID 15476310.
68. Muthusamy R, Vasu K, Kanagaraj L, Ponnampallam D, Wilson B. Phytochemical screening and antibacterial activity of methanol extract of *Tridax procumbens*. Int J Pharm Biol Sci. 2013;3(1):521-4. doi: 10.22376/ijpbs.2013.521-524.
69. Uzuegbu UE, Mordi JC, Ovuakporaye SI, Ewhre LO. Effects of aqueous and ethanolic extracts of *Tridax procumbens* leaves on gastrointestinal motility and castor oil-induced diarrhea in Wistar rats. Biokemistri. 2021;26(32):26-32. doi: 10.4314/bkres.v26i1.3.
70. Cowan MM. Plant products as antimicrobial agents. Clin Microbiol Rev. 1999;12(4):564-82. doi: 10.1128/CMR.12.4.564, PMID 10515903.
71. Joshi RK, Badakar V. Chemical composition and *in vitro* antimicrobial activity of the essential oil of the flowers of *Tridax procumbens*. Nat Prod Commun. 2012; 7(7):1934578X1200700736: 941-2. doi: 10.1177/1934578X1200700736, PMID 22908588.
72. Pai C, Kulkarni U, Borde M, Murali S, Mrudula P, Deshmukh Y. Antibacterial activity of *Tridax procumbens* with special reference to nosocomial pathogens. Br J Pharm Res. 2011;1(4):164-73. doi: 10.9734/BJPR/2011/882.
73. Dhanabalan R. *In vitro* phytochemical screening and antibacterial activity of aqueous and methanolic leaf extracts of *Tridax procumbens* against bovine mastitis isolated *Staphylococcus aureus*. Ethnobotanical Leafl. 2008;2008(1):144. doi: 10.3378/1548-9698(2008)3: 25.
74. Malviya V, Ladhake V, Gajbiye K, Satao J, Tawar M. Design and characterization of phase transition system of zolmitriptan hydrochloride for nasal drug delivery system. Int J PharmSci Nanotechnol. 2020;13(3):4942-51. doi: 10.37285/ijpsn.2020.13.3.8.
75. Malviya VR, Pande SD, Bobade NN. Preparation and evaluation of sustained release beads of zolmitriptan hydrochloride. Res J Pharm Technol. 2019;12(12):5972-6. doi: 10.5958/0974-360X.2019.01037.0.
76. Malviya V, Pande S. Development and evaluation of fast dissolving film of fluoxetine hydrochloride. Res J Pharm Technol. 2021;14(10):5345-50. doi: 10.52711/0974-360X.2021.00932.
77. Lin K, Wu C, Chang J. Advances in the synthesis of calcium phosphate crystals with controlled size and shape. Acta Biomater. 2014;10(10):4071-102. doi: 10.1016/j.actbio.2014.05.011.
78. Yadav M, Gulkari VD, Wanjari MM. *Bryophyllum pinnatum* leaf extracts prevent the formation of renal calculi in lithiatic rats. Anc Sci Life. 2016;36(2):90-7. doi: 10.4103/asl.ASL_90_16, PMID 28446830.
79. Wagner H. Search for plant-derived natural products with immunostimulatory activity: recent advances. Pure Appl Chem. 1990;62(7):1217-22. doi: 10.1351/pac199062071217.
80. Tiwari U, Rastogi B, Singh P, Saraf DK, Vyas SP. Immunomodulatory effects of aqueous extract of *Tridax procumbens* in experimental animals. J Ethnopharmacol. 2004;92(1):113-9. doi: 10.1016/j.jep.2004.02.001, PMID 15099857.

81. Agrawal S, Khadase S, Talele G. Bioactive immunomodulatory fraction from *Tridax procumbens*. Pharm Biol. 2010;48(2):154-9. doi: 10.3109/13880200903140562.
82. Nash LA, Sullivan PJ, Peters SJ, Ward WE. Rooibos flavonoids, orientin and luteolin, stimulate mineralization in human osteoblasts through the Wnt pathway. Mol Nutr Food Res. 2015;59(3):443-53. doi: 10.1002/mnfr.201400592, PMID 25488131.
83. Al Mamun MA, Islam K, Alam MJ, Khatun A, Alam MM, Al-Bari MA, *et al.* Flavonoids isolated from *Tridax procumbens* (TPF) inhibit osteoclast differentiation and bone resorption. Biol Res. 2015;48:1-7. doi: 10.1186/s40659-015-0001-5.
84. Al Mamun MA, Hosen MJ, Khatun A, Alam MM, Al-Bari MA. *Tridax procumbens* flavonoids: a prospective bioactive compound increased osteoblast differentiation and trabecular bone formation. Biol Res. 2017;50:1-10. doi: 10.1186/s40659-017-0122-0.
85. Al Mamun MA, Asim MM, Sahin MA, Al-Bari MA. Flavonoid compounds from *Tridax procumbens* inhibit osteoclast differentiation by down-regulating c-Fos activation. J Cell Mol Med. 2020;24(4):2542-51. doi: 10.1111/jcmm.14948, PMID 31919976.
86. Kale MA, Shahi SR, Somani VG, Shamkuwar PB, Dhake AS. Hemostatic activity of the leaves of *Tridax procumbens* Linn. Int J Green Pharm. 2008;2(1). doi: 10.4103/0973-8258.39167.
87. Saxena RC, Dixit OP, Sukumaran P. Laboratory assessment of indigenous plant extracts for anti-juvenile hormone activity in *Culex quinquefasciatus*. Indian J Med Res. 1992;95:204-6. PMID 1398811.
88. Martín-Quintal Z, Moo-Puc R, González-Salazar F, Chan-Bacab MJ, Torres-Tapia LW, Peraza-Sánchez SR. *In vitro* activity of *Tridax procumbens* against promastigotes of *Leishmania mexicana*. J Ethnopharmacol. 2009;122(3):463-7. doi: 10.1016/j.jep.2009.01.037, PMID 19429313.
89. Zahir AA, Rahuman AA, Ba-gavan A, Elango G, Kamaraj C. Adult emergence inhibition and adulticidal activities of medicinal plant extracts against *Anopheles stephensi* Liston. Asian Pac J Trop Med. 2010;3(11):878-83. doi: 10.1016/S1995-7645(10)60211-8.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