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A Review on Pharmacological Activities of Tridax Procumbens

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ABSTRACT

Tridax procumbens is a species with significant medicinal potential, known for its anti-anemic, anti-inflammatory, anti-diabetic, and anesthetic properties. Originating in Central and South America, this plant has a rich history of traditional use across various communities. A comprehensive literature review was conducted to explore the medicinal properties, biological activities, and phytochemical components of T. procumbens. The findings underline the need for further research to fully understand the therapeutic benefits of T. procumbens' secondary metabolites, emphasizing its potential as a valuable ethno botanical resource for medicinal and preventive treatments, particularly in tropical regions where it is native and widespread. This herb, typically located in India, includes a huge variety of secondary metabolites which includes tannins, alkaloids, and flavonoids that have substantial pharmaceutical ability. The evaluation emphasizes the want for similarly studies to completely recognize the healing ability of T. procumbens and highlights its fee as an ethno botanical resource. With its numerous medicinal houses and affordability, this plant should provide powerful remedies for a number of ailments, specifically in areas wherein it's far local and abundant.

KEYWORDS: *Tridax procumbean, Botanical Description, Physical characteristic, Pharmacological properties*

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INTRODUCTION

Nature has been a source of inspiration for humans throughout history, and people of all backgrounds and beliefs hold nature in high regard. For thousands of years, nature has provided us with a vast array of medicinal plants, from which a significant number of modern drugs have been derived. The World Health Organization (WHO) reports that nearly 65% of the global population use herbal medicines as a primary form of healthcare. [(1)]

Herbal treatment or folklore medicines are widely used for the treatment of many diseases in both developed and developing countries. But with the passage of time and advancement in the field of technology and development, synthetic Medicines have started replacing natural medicines irrespective of the fact that former have certain side effects as well. According to the reports about 8% of hospital admissions in the United States of America are due to adverse side effects of synthetic drugs and About 100,000 people each year die due to these toxicities[(2)]. Tridax procumbens, also known as “coat buttons” is a perennial plant from the Asteraceae family, native to Central and South America. [(3-4)]It’s a green perennial plant with a woody base that occasionally sprouts roots at the nodes and can be found growing naturally in numerous tropical nations. In Central American and Caribbean medicine, Tridax procumbens is noted to be utilized against anemia, colds, inflammations, and liver disorders. [(5)] The leaves possess medicinal properties and are utilized in the treatment of catarrh, dysentery, and diarrhea. Various leaf extracts serve as antiseptics for treating fresh cuts, wounds, and burns in anemic individuals. [(6)] Tridax procumbens is also used as treatment for boils, blisters, and cuts by local Healers in parts of India. [(7)]

Fig.1: Tridax Procumbence Plant

LITERATURE REVIEW

1. **Samantha Beck, January, 2018:** This study shows the importance and need for more research on plants known for use in traditional medicine, which can lead to the discovery and creation of new conventional medicines. Tridax procumbens has a long history of traditional use, but the isolation and evaluation of each phytochemical is not correctly correlated with its pharmacological properties and may present difficulties in reproducibility after isolation and evaluation.
2. **Talele Swati G., Oct 2015:** Herbal medicine has become of global importance, both medically and economically. Although the use of these medicinal herbs has increased, their quality, safety and efficacy are serious concerns in both industrialized and developing countries. Herbal remedies are increasingly supported by patients because they are free from the typical side effects of allopathic medicines.
3. **Dewashish Kaushik, September-2020:** T. procumbens Linn. although native to tropical America, is also found in India, tropical Africa, Asia, Australia and India as a climbing weed. T. procumbens has been traditionally used in the Ayurvedic system for centuries and has many pharmacological properties including healing, antioxidant, antibacterial, antifungal, immunomodulatory, anti-inflammatory, and antidiabetic, vasorelaxant, antihyperlipidemic, analgesic, antiplasmodial, anticoagulant and anticoagulant.
4. **Bhosale. P. B., October 2023:** Medicinal plants are rich in natural medicines for the treatment of pathogenic diseases and other diseases. The Tridax procumbent plant belongs to the Asteraceae family. It is known as "Ghamara", in English usually called "coat button" and distributed under the name "Bhringraj" by some Ayurveda practitioners. Tridax procumben is the most preferred remedy that is recycled in many researches included in Ayurvedic literature.
5. **VC Bhagat, June 2019:** It is rich in carotenoids, saponin, oleanolic acid and ions such as calcium, magnesium, potassium, sodium and selenium. Luteolin, glucoluteolin, quercetin and isoquercetin have been reported in its flowers. Tridax procumbens is known pharmacologically for its antiviral, antioxidant, hepatoprotective, antibiotic, curative, insecticidal, curative, antidiabetic, hypotensive, immunomodulatory, anti- bronchial, dysentery, diarrhea and hair loss prevention properties. It pr omotes hair growth and its antimicrobial activity against gram-positive and gram-negative bacteria, its anticancer, anti-inflammatory and antituberculosis activity.

BOTANICAL DESCRIPTION

The taxonomical classification of T. procumbens L. is shown in Table 1.

Kingdom	Plantae
Subkingdom	Tracheobionta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Asteridae
Clade	Angiosperms
Order	Asterales
Clade	Eudicots
Family	Asteraceae
Tribe	Heliantheae
Genus	Tridax
Species	T. procumbens
Binomial name	Tridax procumbens

Table 1. Taxonomical Classification [8]

Tridax procumbens (family Asteraceae) is known by different names throughout the world (Table 2).

Country/ Language	Vernacular Names
Chinese	Kotobukigiku
English	Coat buttons, Tridax daisy
French	Herbe Caille
Latin	Tridax procumbens (Linn.)
Malayalam	Chiravanak
Marathi	Dagadi Pala
Oriya	Bishalya Karani
Sanskrit	Jayanti Veda
Spanish	Cadillo, Chisaca
Telugu	Gaddi cheanthi
Tamil	Thata poodu
Australia	Tridax daisy
Brazil	Erva de Touro
Burma	Mive Sok Ne-gya
Burundi	Agatabi
Colombia	Cadillo Chisaca
Cuba	Romerillo de Loma, Romerillo
Dominican Republic	Piquant Jambe
El Salvador	Hierba del Toro
Fiji	Wild Daisy
Ghana	White-dirty Cream, Nantwi bini
Guatemala	Bull Grass, Bull's herb
Hawaii	Tridax
Honduras	Hierba del Toro
India	Bisalyakarmi, Mukkuthipoo, Phanafuli, Tunki, Ghamara, Javanti Veda, Dhaman grass, Vettukkayapoondu, Vettu kaaya
Indonesia	Gletang, Gletangan, Sidowlo, Tar Sentaran
Jamaica	Bakenbox
Japan	Kotobukigiku
Java	Songgolangit
Madagascar	Anganiay
Malaysia	Coat Buttons, Kanching Baju
Mauritius	Herbe Caille
Mexico	Flor Amarilla, Panquica, Rosilla, t'ulum
Nigeria	Igbalobe, Muwagun, Muriyam pachila, Jayanti, Vettukkaaya-thala
Puerto Rico	Tridax
Taiwan	Kotobuki-giku
Thailand	Teen Tuk Kae
Trinidad	Railway Weed
United States	Tridax daisy

Table 2. Common names of T. procumbens found throughout the world.

The plant has an average height of about 20 to 60 cm and is branched. The leaves are 4 to 8 cm long, simple, opposite and defined. The inflorescence is about 12 to 32 cm, oval in shape and held by a peduncle, with ray flowers and disk flowers. The flowers look like daisies with white or yellow petals with yellow centers. The numerous tubular disk flowers are surrounded by a ring of short strap-like flowers. The fruit is a cypselae, black or brown in color when ripe and surrounded by feathery hairs. [9]

Tridax procumbens is an annual or short, tall, climbing plant with stems up to 50 cm long. Yellow pearl flowers grow between white or yellow flowers and three-toothed ray flowers. Blooms all year round. Diameter of ornament 1-1.5 cm, ray 4 mm. The leaves are soft, toothed, arrow-shaped, entire, and slightly pinnate. The stem is long and strong. The leaves are lanceolate-oval in shape and the tip of the petiole is serrate, the base of the petiole and the edge of the leaf is toothed. Petiole up to 2 cm; There is maturity on both sides. The edges are rough and

often deep. The result is a hard, smooth or slightly curved horn covered with stiff hairs, with pappus-like white feathers at one end. Fruits are pale, hairy, and gray-brown in color. Fruits throughout the year. Fruit narrow to cylindrical, tapering at the base, 1.5-2.5 mm long, 0.5-1.4 mm wide. [10-11]

PHYSICAL CHARACTERISTICS

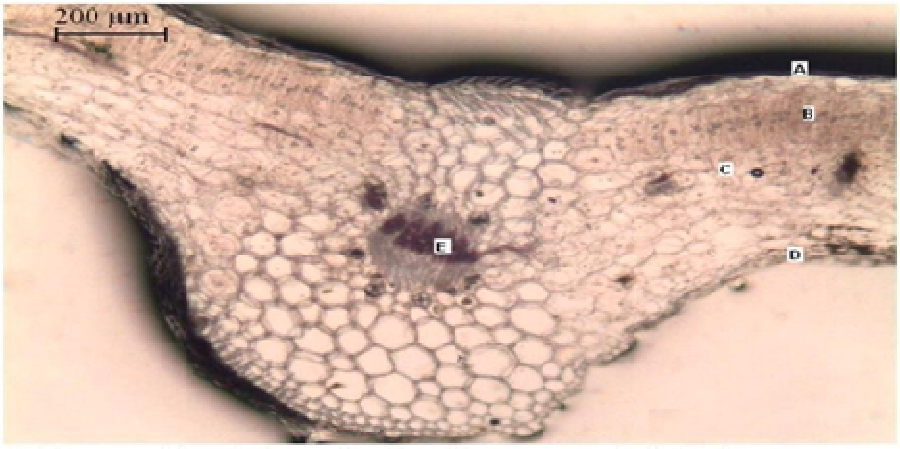
- **Leaves**: The leaves of Tridax procumbens are simple, toothed and arranged in a rosette at the base of the plant. They are often lobed or divided, which gives the plant a unique appearance.
- **Flowers**: The flowers are the most distinctive feature of Tridax procumbens. They look like daisies, with a central yellow flower surrounded by white, yellow or pink flowers. The flowers are usually small and numerous, forming branches at the ends of the branches.
- **Stem**: The trunk of the plant is prostrate or trailing, often reaching up to 50 cm in length. They can take root at the nodes, which allow the plant to spread and form dense mats.
- **Fruits and seeds**: After pollination, disc flowers produce small cylindrical fruits called achenes. Each achene contains a single seed and is covered with a tuft of white hairs called pappus. This cloth helps to disperse the seed by the wind.[12]

Fig.2: Leaves & Flower of T. Procumbence Plant

Fig.3: Stem & Fruits of T. Procumbence Plant

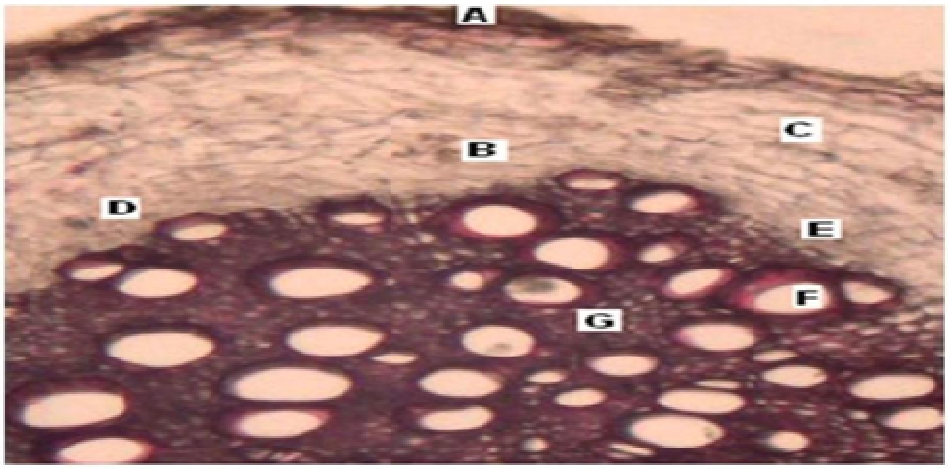
HISTOLOGICAL STUDIES

1. Leaf Structure: The leaves typically exhibit a simple structure with an epidermis covered by a cuticle. The mesophyll is divided into palisade and spongy parenchyma, aiding in photosynthesis.
2. Stem Anatomy: The stem has a well-defined epidermis, collenchyma for support, and vascular bundles arranged in a ring, contributing to its structural integrity.
3. Flower Structure: The flowers are composed of numerous ligulate florets, with an intricate arrangement of cells in the corolla and a central receptacle containing vascular tissue.
4. Root Anatomy: Roots show a typical dicot structure, with an epidermis, cortex, and a central vascular cylinder. [13-16]



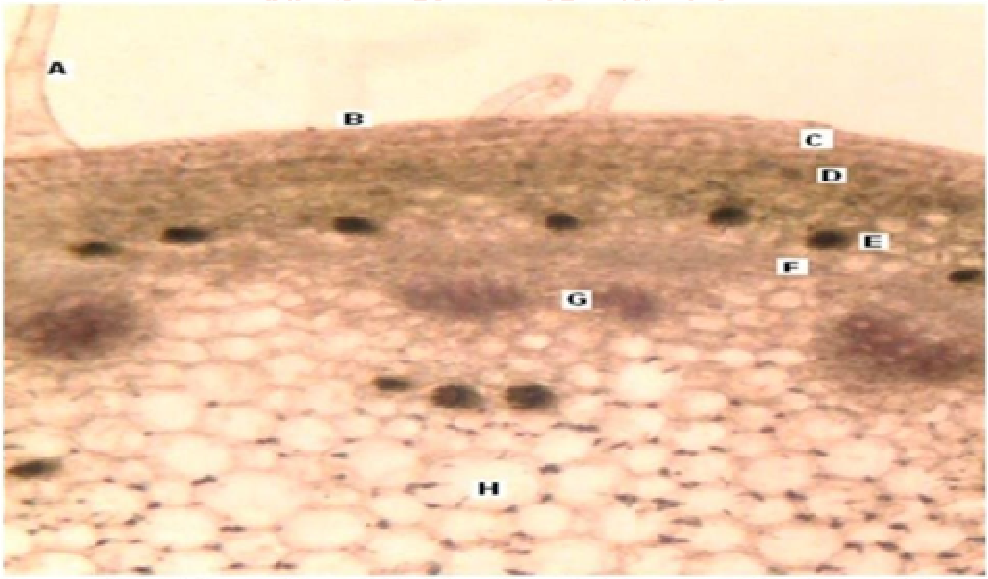
A: Upper epidermis, **B:** palisade cells, **C:** mesophyll, **D:** lower epidermis, **E:** vascular bundles

Fig 4: TS of Leaf of Tridax procumbens X40



A: exodermis, **B & C:** phelloderm, **D:** pericycle, **E:** phloem, **F:** xylem, **G:** medullary rays

Fig 5: TS of Root of Tridax procumbens X40



A: covering trichome, **B:** cuticle, **C:** epidermis, **D:** cortex, **E:** primary phloem, **F:** cambium, **G:** primary xylem, **H:** pith

Fig 6: TS of Stem of Tridax procumbens X40

CHEMICAL CONSTITUENTS

The purpose of using plants as a source of medicinal products depends on many forms, such as biological compounds that can be isolated for direct use medicinal products or for the manufacture of biological compounds

as medical devices, i.e. Use the whole plant and its parts as herbal medicine [17]. Number active chemical constituent were isolated & Reported from the plant Tridax procumbens. As a alkaloids, Flavonoids, carotenoids, β-sitosterol, fumeric acid, Luteolin, Quercetin, oxoester, lauric acid, myristic, palmitic, arachidic, Linoleic acid and tannin etc [18-19].

Some of the other abundant phytochemicals present in T. procumbens are 2, 6- dihydroxyacetophenone, 2-O-β-D-glucopyranoside, echioidin, pinostrobin, dihydroechioidin, tectochrysin-5-glucoside, salicylate methyl glucoside, 5, 7, - trimethoxyflavone., skullcapflavone-2 methyl ether, androechin, tectochrysin, 5, 7, 2'-trimethoxyflavone, echioidin, skullcapflavone ii, 5, 7-dimethoxyflavone and andrographidine. [20]

Different extraction techniques Used to isolate various compounds found in T. procumbens will be discussed.

Extraction	Compounds/activity	Plant organ	References
Aqueous	Antidiabetic compounds	Aerial parts	Caceres et al., 1998 Ikewuchi, 2012[21]
Chloroform, Acetone	Tannins, condensed catechic	Leaves	Sawant and Godhate 2013[22]
Ethyl acetate, aqueous, ethanol	Flavonoids, kaempferol, (-)-Epicatechin, Isoquercetin, and Glucoluteolin	Leaves, Stem, Root, and Flowers	Kumar et al., 2012; Harborne, 1994.[23]
Aqueous	Alkaloids, Akuammide and Vaucangine	Leaves.	Ikewuchi 2012.[24]
Methanol-dichloromethane	Bioactive components for antifungal activity against Dermatophytes.	Aerial parts.	Policegoudra et al., 2014.(25)
Ethanol- acetic acid	Alkaloids for antimicrobial activity, against human pathogens, antioxidant, Hepatoprotective	Pedicle and buds.	Jindal and Kumar 2012. Hemalatha 2008.(26)
Petroleum Ether	Antioxidant uses against DPPH.	Dried plants.	Saxena et al., 1977.
Distilled Water-ethanol	Immuno-modulatory effects in rats	Aerial parts.	Tiwari et al., 2004
methanol -n-butanol	Isolation of antioxidant chemicals, mostly flavonoids and saponins	Dried leaves.	Saxena et al., 2013
n-hexane	Antimicrobial against Mycobacterium smegmatis, Escherichia coli, Salmonella spp.	Flowers and aerial Parts.	Kethamakka and Deogade, 2014.(27)
Ethanol	Saponin B-Sitosterol-3-O-β-D-xylopyranoside.	Flowers	Saxena and Albert, 2004(28).
Petroleum ether, ethanol	Anti-ulcerogenic effects	Leaves	Jhariya et al., 2015(29)
Hydro- distillation	Essential oil, anti- microbial and anti-inflammatory	Leaves.	Manjamalai et al., 2012b(30)
	Effects. Terpenes, alpha and beta pinenes		
Ethanolic extract	Phytochemical screening: alkaloids, glycosides	Whole plant dried.	Kamble and Dahake, 2015(31)

Table 3. Phytochemicals found in Tridax procumbens.

- **Flavonoids**

A recent study has shown the presence of twenty-three flavonoids in T. procumbens and the whole tissue of the species. 65. g/kg kaempferol and catechin and its derivatives (-)-epicatechin, (+)-catechin, (-)-gallocatechin, (+)-gallocatechin, (-) - epigallocatechin-3-gallate (EGCG) and (-)-epicatechin-3-gallate) about 17.59% and 26.3%. This 56.11 percent of the rest represent sixteen flavonoids, namely biochanin, apigenin, naringenin, daidzin, quercetin, butein, robintin, baicalein, nobiltin, genistein, ellagic acid, luteolin, myristicin, baicalin, isoramantin and silymarin

Tridax procumbens contains various flavonoids, including:

- Procumbenetin: A newly identified flavonoid with potential health benefits.

- Quercetin: Known for its antioxidant properties.
- Isoquercetin: A glycosylated form of quercetin, also exhibiting antioxidant effects.
- Luteolin and Glucoluteolin: Flavones with anti-inflammatory and antioxidant activities.
- 6, 8, 3′-Trihydroxy-3, 7, 4′-trimethoxyflavone: A newly isolated compound with notable antioxidant activity.

These flavonoids contribute to the plant's medicinal properties, including antioxidant and antibacterial effects

- **Alkaloids**

Tridax procumbens contains several alkaloids, which are bioactive compounds known for their medicinal properties. Key alkaloids identified include:

- Akuammidine: A prominent alkaloid contributing to various pharmacological effects.
- Vaucagine: Known for its potential therapeutic applications.
- Other Alkaloids: Additional alkaloids such as those isolated from different plant parts have shown antimicrobial and antioxidant activities.

These alkaloids, along with other phytochemicals, contribute to the plant's traditional uses in herbal medicine.

- **Tannins**

Tridax procumbens contains tannins, which are polyphenolic compounds known for their astringent properties and various biological activities.

- Presence: Tannins have been identified in the methanolic extract of Tridax procumbens, contributing to its medicinal properties.
- Biological Activities:

1. Antimicrobial: Tannins exhibit antibacterial and antifungal properties, enhancing the plant's use in traditional medicine for treating infections.
2. Antioxidant: They help in scavenging free radicals, thus protecting cells from oxidative damage.
3. Anti-inflammatory: Tannins may reduce inflammation, supporting the plant's use in treating wounds and other inflammatory conditions.

- Phytochemical Significance: The presence of tannins, alongside other phytochemicals like flavonoids and alkaloids, contributes to the overall therapeutic potential of Tridax procumbens in herbal medicine.

These properties make tannins an important aspect of the pharmacological profile of Tridax procumbens.

- **Carotenoids**

Tridax procumbens contains carotenoids, which are pigments known for their antioxidant properties and health benefits. Key carotenoids identified in the plant include:

- Lutein: The predominant carotenoid, accounting for approximately 62.6% of the total
- carotenoid content.
- Carotene: Contributes to the plant's color and nutritional value.
- Antheraxanthin: A xanthophyll that plays a role in photosynthesis.
- Neoxanthin: Another xanthophyll involved in light harvesting.
- Violaxanthin: Contributes to the plant's protective mechanisms against light stress.

These carotenoids enhance the nutritional profile of Tridax procumbens, supporting its traditional uses in herbal medicine for their potential health benefits, including anti- inflammatory and antioxidant effects

- **Saponins**

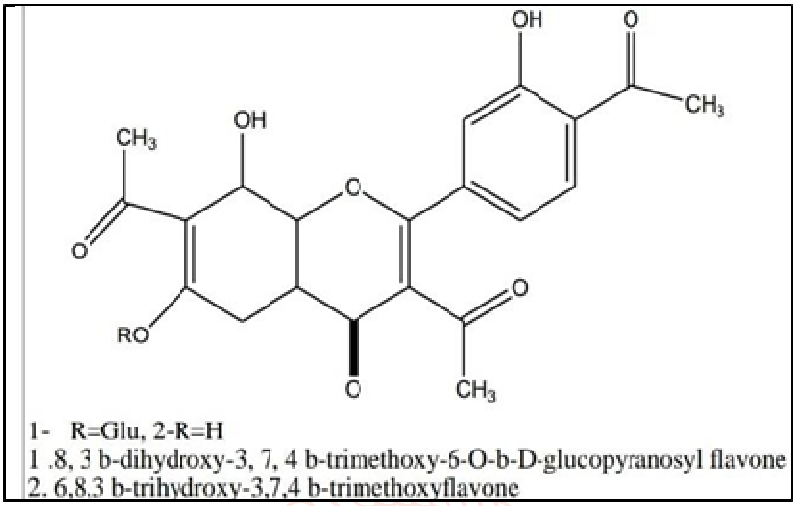
Tridax procumbens contains saponins, which are glycosides known for their diverse biological activities.

- Presence: Saponins have been identified in the phytochemical screening of Tridax procumbens, contributing to its medicinal properties.
- Biological Activities:

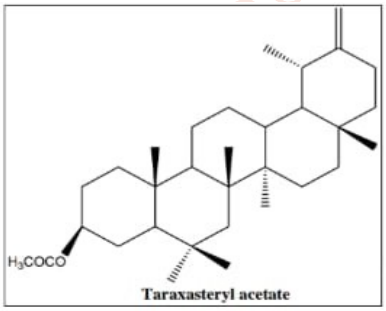
1. Antimicrobial: Saponins exhibit antibacterial and antifungal properties, enhancing the plant's effectiveness against infections.
2. Hemolytic Activity: Some saponins can disrupt cell membranes, which may contribute to their antimicrobial effects.
3. Immunomodulatory Effects: They may enhance immune response, making them beneficial in traditional medicine.

- Phytochemical Significance: The presence of saponins, along with other phytochemicals like flavonoids and alkaloids, supports the plant's use in herbal remedies for various ailments, including wound healing and respiratory issues.

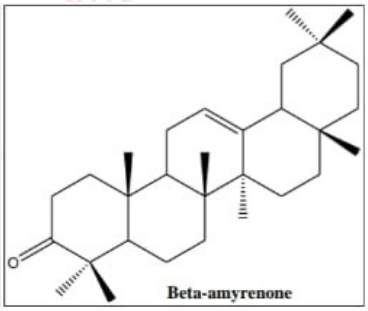
These attributes highlight the potential of Tridax procumbens as a source of bioactive compounds for therapeutic applications.[32-34]



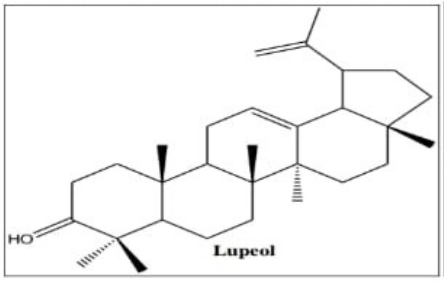
1- R=Glu, 2-R=H
1 .8, 3 b-dihydroxy-3, 7, 4 b-trimethoxy-5-O-b-D-glucopyranosyl flavone
2. 6,8,3 b-trihydroxy-3,7,4 b-trimethoxyflavone



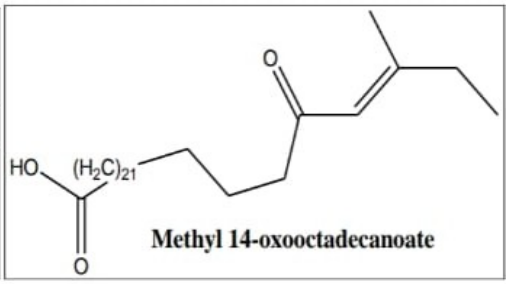
Taraxasteryl acetate



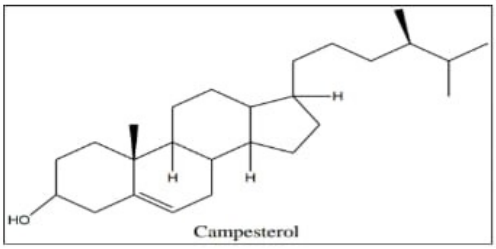
Beta-amyrenone



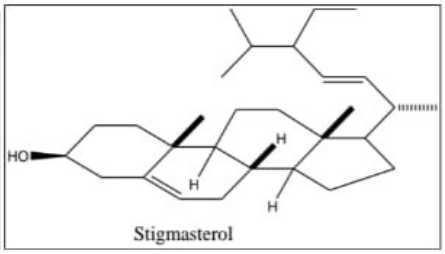
Lupeol



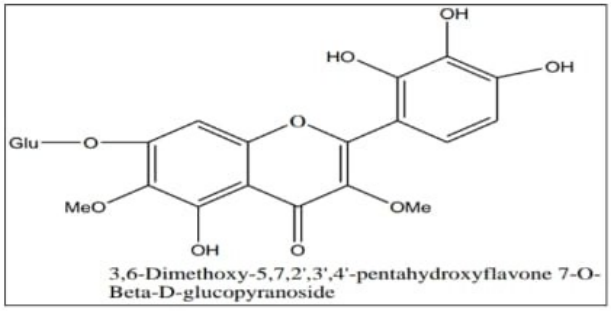
Methyl 14-oxooctadecanoate



Campesterol



Stigmasterol



3,6-Dimethoxy-5,7,2',3',4'-pentahydroxyflavone 7-O-Beta-D-glucopyranoside

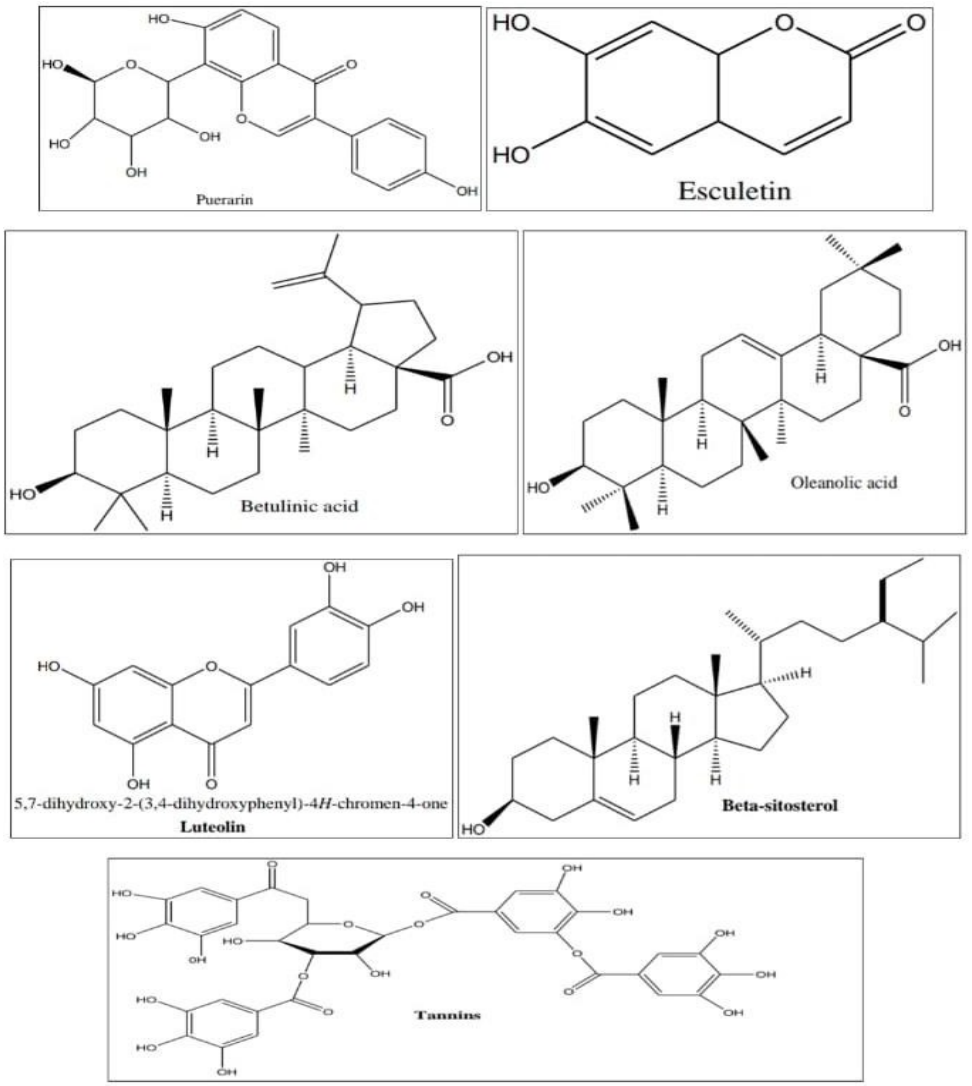


Fig 7: Structures of Compounds of Tridax Procumbens

PHARMACOLOGICAL ACTIVITIES

The wide variety of secondary metabolites in Tridax indicate the potential pharmacological properties of this species, however, we have also seen its use in allopathic medicine. These compounds have been used for their properties in preventing anemia, protecting the liver, strengthening immunity, antioxidant activity, anticarcinogenic, antibacterial, antifungal, antiparasitic, antiplasmodial and antiviral. This species can serve as a bridge between traditional and western medicine because of its pharmacological potential. There is a need to further isolate and characterize the active ingredients. No research shows whether there are changes in activity during the preparation and isolation of pharmacological compounds.

Tridax procumben has various potential restorative activities such as antimicrobial activity, antioxidant activity, antibiotic activity, wound healing activity, insecticidal, anti-inflammatory, diarrhea and dysentery activity.[35] Tridax procumbent shows other activities such as antidiabetic, anticarcinogenic, cardiovascular effects, anti-juvenile hormonal activity, leishmanicidal activity, anti-tuberculosis potential, etc.

➢ Antimicrobial Activity

The ethyl acetate and methanolic extracts of Tridax procumbens were evaluated against different bacterial strains using Disc diffusion and Agar well diffusion methods. The ethyl acetate extracts were more effective compared to the methanolic extracts in both methods. Specifically, the ethyl acetate extract exhibited a larger zone of inhibition against Staphylococcus aureus, Salmonella typhi, and Bacillus cereus, while the methanolic extract only showed significant inhibition against Escherichia coli in the Disc diffusion method. In the Agar gel diffusion method, the methanolic extract displayed antimicrobial activity against Staphylococcus aureus, Klebsiella pneumoniae, Salmonella typhi, and Escherichia coli, whereas the ethyl acetate extract had significant inhibition zones against Staphylococcus aureus, Klebsiella pneumoniae, Salmonella typhi, Escherichia coli, and Bacillus cereus. The ethyl alcohol-extracted Tridax procumbens leaf was identified as the most effective antimicrobial

agent against Pseudomonas vulgaris. The ethanol extract exhibited strong antibacterial activity against various Gram-negative and non-fermentative agents, including drug-resistant Pseudomonas strains associated with nosocomial infections. Plant compounds like flavonoids and tannins found in the extract contribute to its antibacterial actions, such as inhibiting DNA gyrase, cytoplasmic membrane function, and energy production.(36)

In one study, n-hexane extract of T. procumbens was effective against pathogens such as Mycobacterium smegmatis, Klebsiella species and Salmonella species, the ethyl acetate extract active against Mycobacterium smegmatis and Staphylococcus aureus. These different antibacterial activities may be due to the presence of Carbon dioxide mixture in n-hexane extracts such as neophytadine and long chain fatty acids such as hexadecanoic acid. Inside cases of ethyl acetate extract, fatty acids, aromatic compounds, polyaromatic carboxylic acids, polysubstituted phenols and thiols were reported. (37)

Endophytic microorganisms, including fungi or bacteria, have been documented to produce antifungal agents. Such as pseudomycins, ecomycins(38-39) and antibacterial agents such as indole terpene compounds.(40) Fungi or bacteria Endophytes (BE) are considered a potential source of new antibiotics. In a recent study, improving the tests Dermatophyte lesions caused by T. procumbens plant extract demonstrate the existence of an antifungal principle for treatment. Dermatophytosis.(41) In addition, this plant is also known for its antibacterial properties.(42-43) Analysis of fifty books Endophytes from the leaves and stems of T. procumbens showed association with the bacillus species Cronobacter sakazakii. Enterobacter species, Bacillus spharicus Lysini, Pantoea species, Pseudomonas species. And Terribacillus saccharophilus and growth.(44) Bacterial endophytes associated with the roots of T. procumbens can be used for the bioavailability of heavy metals.(45) Mushroom Endophytes have antibacterial activity against T. procumbens. In experimental research, outside of Six endophytic fungi (TP-1 to TP-6) were isolated from T. procumbens leaves, TP-1 was Alternaria sp. has been shown High antibacterial activity against Escherichia coli, Salmonella typhi, Bacillus sp., Pseudomonas aeruginosa, Staphylococcus aureus and Klebsiella pneumonia. (46)

- **Antifungal Activity**

The proliferation study of Tridax on a Linn plate was carried out against two infectious pathogens. The minimum inhibitory concentration (MIC), the minimum fungicidal concentration (MFC) and the absolute movement were also evaluated to ensure the antifungal capacity of each dynamic concentration. Flavonoid extracts showed surprising activity against

A. Niger, although alkaloid extracts were considered inert against two parasites tested. A remarkable antifungal potential was recorded with the expectation of a complementary flavonoid from the stem and a related flavonoid from the stem and flower. A study on A.niger showed that Tridax procumben can be used as a source of antifungal drug formulation for the treatment of diseases caused by A.niger. (47) The effectiveness of Tridax procumbens in treating fungal infections has not been fully confirmed. If considering the use of Tridax procumbens or its extracts for medical purposes, it is recommended to consult with a healthcare professional for advice and to use it in conjunction with traditional antifungal treatments. Tridax procumbens contains a variety of phytochemicals such as flavonoids, alkaloids, tannins, saponins, and terpenoids, some of which are thought to contribute to its medicinal properties, including its antifungal effects.(48-49) However, the authors do not describe which bioactive compounds are responsible for the antifungal properties of. The authors suggest that these compounds may be derivatives and components of fatty acids, but it is not proven for this.

- **Antibacterial activity**

Tridax procumbens extracts have broad-spectrum antibacterial activity, meaning they can inhibit the growth of or kill a wide range of Gram-positive and Gram-negative bacteria. This includes pathogenic bacteria responsible for various infections

- Some potential mechanisms by which Tridax procumbens may have antidiabetic properties include:
- Insulin secretion: Some studies suggest that Tridax procumbens may help stimulate insulin secretion from pancreatic beta cells. Insulin is a hormone that helps regulate blood sugar levels.
- Glucose absorption: It is possible that the compounds in Tridax procumbens can increase the absorption of glucose by cells, thereby helping to lower blood sugar levels

The antimicrobial activity of Tridax procumbens is attributed to the presence of bioactive compounds, including flavonoids, alkaloids and tannins.(50-51) there are some differences in how the studies were conducted so even though there seem to be strong support for the antibacterial activity of this species, more comprehensive research needs to be done.

➢ **Antiparasitic Activity**

Tridax procumbens exhibits notable antiparasitic activity, particularly against helminths and protozoa. Its ethanolic extract has demonstrated significant anthelmintic effects, comparable to the standard drug albendazole, causing paralysis and death in earthworms used as a model for intestinal roundworms2. Additionally, a mixture of T. procumbens with garlic extracts has shown efficacy against Leishmania mexicana, suggesting its potential as a natural treatment for cutaneous leishmaniasis without significant toxicity4. These findings highlight the plant's promise in developing alternative antiparasitic therapies.

- Antiprotozoal Activity: Studies indicate that Tridax procumbens has antiprotozoal properties, making it effective against parasites like Plasmodium falciparum, which causes malaria. This effect is attributed to the presence of bioactive compounds like flavonoids, alkaloids, and saponins.
- Anthelmintic Activity: The plant shows activity against intestinal worms (e.g., helminths) in animal studies. Extracts of Tridax procumbens, particularly in ethanol, are noted for their ability to immobilize and kill worms, likely due to compounds such as tannins and glycosides.

The antiparasitic action of Tridax procumbens is thought to be due to its ability to damage parasite cell membranes, disrupt metabolic pathways, and interfere with their growth and reproduction cycles. Traditionally, Tridax procumbens is used in forms such as extracts, decoctions, or ointments, depending on the condition. However, for antiparasitic use, specific extraction methods and concentrations are being studied to maximize efficacy and safety.

➢ **Antioxidant Activity**

Tridox procumbens contains all phenols it is referred to as acetic acid equivalent (GAE). Phenolic content is above 12 mg/g GAE. This The result shows that there is a connection between phenol content in medicinal plants and antioxidant activity chloroform does not dissolve A fraction of Tridox autonol extract procumbens to D-galactosamine Lipopolysaccharide (Dgaln\LPS)-induced cancer. In procumbent Tridax mice it is very effective Oxidative reduction by D-galn\LPS Stress shows its antioxidant properties. [52] ONE Many historical reports confirm this Detection of plant-like selective metabolites Flavonoids, tannins, catechins and other phenols. This compound has the ability to enhance the cells work.[53]

Tridax procumbens, which helps protect cells from damage caused by oxidative stress, a process that affects many chronic diseases. and aging they work by eliminating harmful molecules called free radicals that can damage cells and The development of various health problems. They contain various biological compounds that exhibit antioxidant properties, including flavonoids. [54-55]

Mechanisms of Antioxidant Activity

- Free Radical Scavenging: Compounds in Tridax procumbens, such as flavonoids and phenolic acids, can neutralize free radicals (unstable molecules that can damage cells) by donating electrons, thereby reducing oxidative damage in cells and tissues.
- Reduction of Oxidative Stress: By reducing the buildup of free radicals, Tridax procumbens may help protect cells from oxidative stress, which is linked to chronic diseases such as cardiovascular disease, diabetes, and cancer.
- Enhancement of Antioxidant Enzymes: Some studies suggest that extracts of Tridax procumbens may boost the activity of natural antioxidant enzymes like superoxide dismutase (SOD), catalase, and glutathione peroxidase, enhancing the body's ability to manage oxidative stress.

The antioxidant activity of Tridax procumbens is largely due to its rich content of flavonoids, phenolic acids, and vitamins, which provide a natural defense against oxidative damage. These properties underscore its potential for therapeutic applications, though more clinical research is needed to establish effective dosages and applications in humans.

➢ **Anticancer Activity**

Anticancer activity of essential oil under laboratory conditions obtained from T. procumbens leaves were screened for the MCF-7 cell line using the MTT method, the results showed that essential oil was important the anticancer activity is related to the presence of the important factor Terpenes such as α-pinene and β-pinene. Blue and acetate lead flowers an extract from the plant Tridax procumbens was also tested against epiprostata. PC3 lellial cancer cells by measuring cell viability by the MTT method. particle for the correct object .The diagnosis is based on the activity of mitochondrial enzymes in living cells To reduce the yellow metal salt of MTT to blue

violet Sedimentation was determined by spectrophotometric method at 570 nm wavelength.The analytical results showed the anti-cancer activity of raw flower withdrawalAnticancer activity of essential oil under laboratory conditions obtained from T. procumbens leaves were screened for the MCF-7 cell line Using the MTT method, the results showed that essential oil was important . The anticancer activity is related to the presence of the important factor Terpenes such as α-pinene and β-pinene. Blue and acetate lead flowers an extract from the plant Tridax procumbens was also tested against epiprostata. PC3 lellial cancer cells by measuring cell viability by the MTT method. Particle for the correct object the diagnosis is based on the activity of mitochondrial enzymes in living cells to reduce the yellow metal salt of MTT to blue violet Sedimentation was determined by spectrophotometric method at 570 nm wavelength. The analytical results showed the anti-cancer activity of raw flower withdrawal.

Tridax procumbens has shown potential anticancer activity in preliminary studies due to its rich content of bioactive compounds, such as flavonoids, tannins, saponins, and phenolic compounds. These compounds may inhibit cancer cell growth and induce apoptosis (programmed cell death), making Tridax procumbens a promising plant for further anticancer research. Here's an overview:

Mechanisms of Anticancer Activity

- Induction of Apoptosis: Compounds in Tridax procumbens, such as flavonoids and phenolic acids, have been found to trigger apoptosis in cancer cells. This process involves activating pathways that lead to the controlled death of cancer cells, preventing their growth and spread.
- Ant proliferative Effects: Tridax procumbens extracts have been shown to slow down the proliferation of certain cancer cells, particularly in studies on breast, liver, and colon cancers. By inhibiting the rapid division of cancer cells, these extracts may help in controlling tumor growth.
- Free Radical Scavenging: Oxidative stress is a known factor in cancer development. The antioxidant properties of Tridax procumbens, thanks to its flavonoid and phenolic content, can help neutralize free radicals, which may reduce the risk of DNA damage and mutations associated with cancer initiation.
- Inhibition of Angiogenesis: Some studies suggest that Tridax procumbens may inhibit angiogenesis the process by which tumors develop their blood supply, which is essential for their growth. This may be due to specific compounds in the plant that interfere with the formation of new blood vessels around tumors.

Flavonoids and Phenolic: Known for their strong antioxidant and anticancer properties, flavonoids and phenolic acids may play a critical role in inducing apoptosis and inhibiting cancer cell growth.

Tannins and Saponins: These compounds are associated with antiproliferative effects, potentially preventing the spread of cancer cells.

Tridax procumbens shows promising anticancer activity through mechanisms such as apoptosis induction, inhibition of cell proliferation, and reduction of oxidative stress. While these effects are promising, especially in lab and animal studies, more extensive clinical trials are required to establish its efficacy and safety as an anticancer agent in humans.

- **Antiinflammatory Activities**

Since inflammation is one of the three components of wound healing, T. procumbens was investigated for its anti-inflammatory properties. Potential a previous study showed that the aqueous extract of T. procumbens showed dose-dependent inhibition of paw volume. In rat paw edema induced by carrageenan and cotton pellet granuloma model, with significant decrease in cell migration Compared to control.[56] In another study, T. procumbens showed dose-dependent analgesic activity Pain samples were fixed by formalin, acetic acid and Freund's adjuvant (CFA) solution. This is a pain management technique it is said that the flavonoids and sterols present in the extract have the potential to produce effective analgesics.[57] Particle for the correct object. The anti-inflammatory activity of T. procumbens was also confirmed in a rat model of carrageenan in vivo. The standard extract of EtOAc, MeOH and 70% EtOH from aerial parts of T. procumbens showed anti-inflammatory effects. Potency at an average dose of 200 mg/kg and the highest activity of the EtOH fraction is comparable to the administration of ibuprofen at 100 mg/kg (% inhibition of paw edema in 5 hours: 2.2 41.2 vs. 52.2 1.5)[58] The EtOAc extract is a potent antioxidant Active against 1, 1-diphenyl-2-picrylhydrazyl (DPPH) and 2, 2'-azino-bis (3-ethylbenzthiazoline-6-sulfonic acid) (ABTS). The inhibitory activities of organisms with COX1 (cyclooxygenase 1) and COX2 (cyclooxygenase 2) were compared with MeOH and 70% EtOH extracts can be attributed to flavonoids and other polyphenols present in the extracts.[59] In a similar study, Anti-inflammatory activity was

demonstrated in a carrageenan-induced mouse model in which inflammation was reduced. The histopathological examination of rat paw, reduced the expression of TNF-α and COX2 gene in the paw of rats treated by EtOH. The T. procumbens extract was found to be comparable to the control.[60]

➢ **Wound Healing**

Traditionally, the juice of T. procumbens leaves has been used to heal skin wounds. The wound healing process involves three phases, namely inflammation, angiogenesis and collagen deposition. In a cut and incision wound model in Wistar rats, aqueous and ethanolic extracts of

T. procumbens increased the wound tensile strength compared to control rats. In addition, wound healing biomarkers such as hydroxyproline, collagen, and hexosamine were significantly increased.[61] The wound healing capacity was also confirmed by a topical ointment formulation based on T. procumbens leaf extract in a mouse model, where a dose- dependent improvement in cell proliferation and remodeling injury was observed.[62]

Pharmacological Activities	Effect	Phytochemical	Extraction
Antimicrobial Activity	Bacillus Faecalis, B. subtilis, E. coli, Pseudomonas aeruginosa, Antibacterial and fungal infections	Alpha and Beta Pinenes, Alkaloids	petroleum, ether and ethanolic extracts from leaves, essences
Antifungal Activity	dermatophytes, Microsporum fulvum, Microsporum gypseum, Trichophyton mentagrophytes, Trichophyton rubrum, Candida albicans, and Trichosporon beigelii	Flavonoids, Monoterpenes, and Alkaloids	Aerial parts- pedicle and buds
Antibacterial Activity	Bacillus cereus, Mycobacterium smegmatis, E. Coli, Staphylococcus aureus, Klebsiella sp., Salmonella group C, Salmonella paratyphi, and Streptococcus pneumoniae	Alpha and Beta Pinenes	N-hexane extracts, ethyl acetate extract, essential oil extract, chloroform extract
Antiparasitic activity	Malaria, dysentery, colic, and vaginitis, anti- Leishmaniasis activity	(3,S)-16, 17-Didehydr ofalcarinol oxylipin.	bioassay guided fractionation with a methanol extract
Antioxidant Activity	Antioxidant, anti-inflammatory, anti-cancer	High phenol content, Flavonoids (in water phase), Carotenoids (in lipid phase), Alkaloids	Ethyl acetate and n-Butanol fractions obtained from methanolic extracts, essential oils
Anticancer Activity	Potent cytotoxic activity against malignant tumor cells.	5(alpha)- cholestane, monoterpenes (alpha and beta pinenes)	Crude flower aqueous and acetone extracts, essential oil extract
Hepatoprotecti ve Activity	Reduction of oxidative stress, lowered levels of serum Aspartate aminotransferase, serum Alanine aminotransferase, serum Alkaline phosphatase, and serum bilirubin in rats	Alkaloids, Flavonoids	Flowers, leaves, and aerial parts. chloroform insoluble fraction of an ethanol extract, petroleum ether, methanol, and chloroform water extracts, Lipopolysaccharide chloroform- insoluble fraction, aqueous extracts
Immunoenhan ce ment Activity	Activation of the immune system with an increase of percent in neutrophils in rats	Sequesterpene and triterpenoids	No Data Found

Antidiabetic Properties	Antidiabetic activity that is comparable to the drug Glibenclamide in rats.	Saponins	Ethanolic extract of whole plants, pet ether, methanol, and chloroform extracts
Antihypertensi ve Activity	Antihypertensive activity comparable to the drug captopril in rats	Flavonoids and potentially alkaloids	ethyl acetate and dichloromethane fractions from the aerial parts of the plant

Table 4. Pharmacological Activities of Tridax Procumbens.

CONCLUSION

This is a comprehensive study that highlights the various phytochemicals identified in T. procumbens with their various pharmacological attributes. Since most of the molecules approved by the FDA are derived from plant sources, it is essential to systematically evaluate the plant to identify bioactive compounds that can lead to the discovery and development of new drugs against various diseases. Although T. procumbens has been used in many traditional medicines, scientific data linking its phytochemicals to published pharmacological properties is lacking. Many studies have used plant extracts followed by qualitative analysis of their phytochemical components. Researchers should try to use new principles of drug discovery, such as bioassay-guided phytochemical identification, phenotypic screening with relevant cell culture models, and, if possible, demonstrate pharmacokinetics-pharmacodynamics (PK-PD) to demonstrate the effectiveness of the preparation. Efforts are also made to identify active metabolites that mediate efficacy in vivo to ensure standardized preparation of the extract. Furthermore, a battery of enzyme targets can be identified for different diseases and partially purified bioactives can be screened for inhibitors or activators. The identification of new bioactives can serve as a chemophore or pharmacophore to be developed as a drug using molecular modeling, medicinal chemistry and bioinformatics approaches. Since T. procumbens is known to possess many pharmacological properties, researchers will try to evaluate its properties with modern technologies.

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