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COMPREHENSIVE REVIEW ON TRIDAX PROCUMBENS :PHYTOCHEMISTRY, TRADITIONAL USES AND PHARMACOLOGICAL ACTIVITIES

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Abstract: The perennial plant Tridax procumbens is a member of the Asteraceae family and is nonwoody. It is frequently seen near roadsides and in waste areas. Additionally, this plant is utilised ethnopharmacologically to treat a number of diseases. The plant exhibits a variety of pharmacological advantages, such as anti-diabetic, anti-cancer, medicine, anti-rheumy activity, anti-inflammatory, immunomodulatory effects, anti-ulcer activity, inhibitory, and hepatoprotective action. Early phytochemical investigation led to the discovery of flavonoids, saponins, alkaloids, carotenoids, and tannins. This article provides a summary of Tridax procumbens' pharmacological properties. Additionally, this study gives in-depth details on this species and suggests that it may work as an affordable, secure, and effective treatment for a variety of illnesses, particularly in tropical regions where it is a natural and common plant. We also give a current description of Tridax's phytochemistry, traditional use, and pharmacological properties.

Keywords :

Tridax Procumbens, Medicinal plant, Phytochemistry, Metabolites, Antioxidant, Phytoconstituent.

I. Introduction:

Tridax procumbens (L.), often known as coat button or leaf flower, is a plant with medicinal properties that has been actively applied in traditional medicine around the world. It belongs from the Asteraceae family and is a native of South America, however it is now found well around tropical and subtropical regions of the world. It flourishes in open spaces like grassy fields, farms, lawns, and ditches near roads [1]. The plant is used to cure a wide range of illnesses, including fever, diarrhoea, constipation, diabetes, and many others [2]. It is well known for its many health advantages. In India, In addition to being used to treat wounds, Tridax procumbens has an extensive background of usage as an antifungal, anticoagulant, and insect repellent [3]. In traditional medicine, its leaf extracts were used to cure infectious skin problems. It is a well-known ayurvedic medicine for liver disorders or having a hepatoprotective tendency, in addition to treating indigestion and heartburn. Therefore, it would be suggested to use trusted, efficient, and traditional ayurvedic herbal medicinal formulations. Therefore, research into these drugs and their effective formulation is required for increased patient acceptance [4]. We describe an updated review of Tridax procumbens' phytochemistry, traditional use, and pharmacological features in this article.

1.1. Vernacular names:[5]

Table.1 Vernacular names of tridax procumbens

English	Coat buttons, tridax daisy, tantani
Hindi	Ghamra
Marathi	Dagadi Pala and Ghav Pala,
Sanskrit	Jayanti Veda.
Telugu	Gaddi Chemanthi
Tamil	Thatapoodu
Malayalam	Chiravanak
Chinese	Kotobukigiku
French	Herbe cailli
Latin	Tridax procumbens Linn.
Kannada	Jayanthi
Spanish	Cadillo chisaca
Bengali	Tridhara
Oriya	Bishalya karani
Malayalam	Chiravanak
Gujarati	Ghaburi
Japanese	Kotobukigiku
Nigeria	Igbalobe, muwagun, muriyam pachila, jayanti, Vettukkaaya-thala
United states	Tridax daisy

1.2. Taxonomical classification

Table.2 Taxonomical classification of tridax procumbens

Kingdom	Plantae
Subkingdom	Viridiplantae
Superdivision	Spermatophytina
Class	Magnoliopsida
Superorder	Asteranae
Order	Asterales
Family	Asteraceae
Genus	Tridax L-tridax
Species	*Tridax procumbens* L.

II. Morphology:[5,6,7,8]

Table.3 Morphology of tridax procumbens

Stem	Creeping at the base, branching, pilose (densely hairy), suberect, or trailing above.
Leaf	Simple, opposite, acute apex, elliptic-rhomboid, orovate-lanceolate, orbicular, cuneate base, plainly hispid, serrated to the coarsely dentate border, 2.5-7cm long.
Flower	Bisexual, pentamerous, actinomorphic, solitary heads have 1.2–1.5 cm wide, tubular-campanulate involucres containing disc florets that are commonly yellow. The peduncle grows 10 to 30 cm.
Calyx	reduced to pappus and characterised by scales
Fruit	Hard achene fruit with stiff hairs and a white pappus that resembles a feather at one end.
Seed	There is no endosperm in plant seeds since they have a pendulous embryo.
Root	Taproot system

III. Description:

The plant has three toothed ray petals on its white or yellow flowers. The leaves are usually anchor-shaped and toothed. Its fruit is an achene that is rigid in nature covered in stiff hair, and has a white pappus that is feathery and plume-like on one end. Scales or a pappus-like representation of the calyx are used. Up to 1500 of these achenes can be produced by a single plant, and each one can catch the wind in its pappus and travel a short distance, which is one of the reasons the plant is invasive. In regions with tropical or semitropical climates, this weed can be found in fields, grasslands, farm lands, disturbed areas, lawns, and roadside. Tannins, flavonoids, glycosides, isoflavonoids, steroids, saponins, lipids, phospholipids, resins, sterols, reducing sugars, phenols, anthraquinone, and catechol were isolated, according to a review of the literature.[9,10]

Fig.1 Whole plant of Tridax Procumbens

Fig.2 Flowers of Tridax Procumbens.

Fig.3 Leaves of Tridax Procumbens

IV. Extraction of plants

Plants can be used directly or indirectly in a number of different therapeutic procedures. The therapeutically important parts of a plant's medicinally active constituent can be extracted through the use of selective solvents using normal techniques in order to remove rid of undesirable stuff. The amount of product produced depends on the time of the extraction process, temperature, kind of solvent employed, concentration, polarity, and amount of plant material to be extracted. The many solvent types that are usually used for extraction include water, acetone, alcohol, chloroform, ether, dichloromethanol, and hexane.

V. Phytochemistry:

The leaves of Tridax procumbens are the most commonly used parts of the plant in traditional medicine. They are rich in phytochemicals such as flavonoids, tannins, alkaloids, saponins, terpenoids, carotenoids and phenolic compounds. Some of the major compounds isolated from the plant include triterpenoids such as lupeol and β-amyrin, flavonoids such as quercetin and kaempferol, and phenolic acids such as caffeic acid and ferulic acid.

5.1 Alkaloids: Several alkaloids, including echinatine, triterpene glycoside, and inulin, are present in Tridax procumbens. These alkaloids have analgesic and anti-inflammatory effects. According to a recent study by Ikewuchi et al., the total alkaloid content of T. procumbens L leaves was 102.421 g/kg of dry weight and 10.191 g/kg of wet weight, respectively [9]. Any class of nitrogenous organic compounds with notable physiological effects on people are referred to as alkaloids. T. procumbens has also been said to contain certain alkaloids. Thirty-nine alkaloids were found in the leaves after an aqueous extraction for a phytochemical screening examination, with the two predominant ones being akuamidine (73.91%) and voacangine (22.33%). The extract also included sterols and tannins in addition to alkaloids. T. procumbens' pedicle and buds contained alkaloids that demonstrated antibacterial efficacy against Proteus mirabilis and Candida albicans, as well as E. coli and Trichophyton mentagrophytes. Alkaloids made up 32.25 mg/gdw of the pedicles' total content and 92.66 mg/gdw of the buds. These alkaloids provide as another evidence of the plant's enormous potential [10].

Test for alkaloids:

A few drops of Mayer's reagent were added to 1 ml of plant extract. Immediately after application, a white-yellowish precipitate formed, indicating the presence of alkaloids. By using Mayer's reagent, alkaloids can be precipitated from neutral or slightly acidic solution [11].

Mayer test

The acidified plant extract received a drop or two of Mayes' reagent. Alkaloids were visible as a white precipitate. The Mayer reagent – A solution of 5 g of KI in 10 ml of water was combined with 1.36 g of HgCl2 that had been dissolved in 60 ml of distilled water. The solution must be made noticeably acidic with HCl or H2SO4 because this reagent only reacts with the salts of the alkaloids.

Wagner's test: With wagers reagent, alkaloids produced a brown flocculent precipitate. 1.27 g of iodine and 2 g of KI were dissolved in 5 ml of distilled water, and the solution was then diluted with distilled water to a final volume of 100 ml to create Wagner's reagent.[12]

5.2 Flavonoids:

Kaempferol, quercetin, and luteolin are the flavonoids present in Tridax procumbens. Twenty-three flavonoids, with a total amount of about 65 g/kg, have been found in T. procumbens, according to a recent study. About 17.59% and 26.3%, respectively, are made up of kaempferol, catechin, and its derivatives (-)-epicatechin, (+)-catechin, (-)-eigallocatechin, (+)-gallocatechin, (-)-Epigallocatechin-3-Gallate (EGCG), and (-)-Epicatechin-3-Gallate). 16 flavonoids, including biochanin, apigenin, naringenin, daidzein, quercetin, butein, robinetin, baicalein, nobiletin, genistin, ellagic acid, luteolin, myricetin, baicalin, isorhamnetin, and silymarin, make up the remaining 56.1% [12].

Test for flavonoids and flavones

1.5 ml of a 50% methanol solution was added to 4 ml of extracts, the solution was warmed, metal magnesium was added, and then 5–6 drops of strong hydrochloric acid were added. Flavonoid and flavone solutions exhibit red and orange colours, respectively [11].

Test Shinodas (Mg/HCl): A tiny amount of the extract was dissolved in methanol or ethanol along with some magnesium turnings and a few drops of 5m HCl. Flavanones and dihydroflavanols were present when a rich crimson or magenta tint developed [11].

The flavonoids found in T. procumbens have been linked to pharmacological effects like free radical scavenging, anti-inflammatory, anti-allergic, anti-platelet aggregation, anti-microbial, anti-ulcer, antiviral, anti-tumor, and anti-hepatotoxicity. The entire plant was used to identify two new flavones, 8,3′-dihydroxy-3,7,4′ trimethoxy-6-O-D-glucopyranosylflavone and 6,8,3′ trihydroxy-3,7,4′ trimethoxyflavone, as well as four previously identified compounds having antioxidant activity: puerarin, esculetin, oleanolic acid, and betulinic acid. Based on spectroscopic methods and chemical means, the novel flavonoid procumbenetin, from the aerial portions of T. procumbens, has been identified as 3,6-dimethoxy-5,7,2',3',4'-pentahydroxyflavone 7-O--D-gluco-pyranoside. The primary flavonoid present in T. procumbens L. leaves is kaempferol. Preclinical research has demonstrated that kaempferol and its glycosidic derivatives have a wide range of therapeutic effects, including anti-inflammatory, anti-microbial, anti-fungal, anti-cancer, cardioprotective, neuroprotective, hepatoprotective, anti-diabetic, anti-cholesterolemic, anti-triglyceridemic, anti-osteoporotic, anxiolytic, and antiallergic activities [13]. By influencing anti-inflammatory or immunomodulatory properties, kaempferol has a variety of positive effects on inflammatory illnesses. It stifles matrix-degrading enzymes and blocks a number of signalling pathways[14].

5,3 Saponins:

Triterpenoids and sterols are one of the saponins found in Tridax procumbens. These saponins are good for the health of the skin as well as decreasing cholesterol.

In particular, a steroidal saponin and pB-Sitosterol-3-O-D-xylopyranoside have been found in T. procumbens' flowers. Saponins are steroidal glycosides with pharmacological and therapeutic characteristics. Another investigation found that the sodium glucose co-transporter-1 (S-GLUT-1) in the intestines of male Wistar albino rats was inhibited by saponins from an ethanolic extract of T. procumbens[15].

Test for saponins (foam test):

A test tube containing 1 ml of the extract and 2 ml of distilled water was agitated for a few minutes. The presence of saponins is detected by a 1 cm layer of foam for 10 minutes[11]. When a plant extract that is both aqueous and alcoholic is shaken in a test tube, persistent foam indicates the presence of saponins.[12]

5.3 Tannins:

Tridax procumbens tannins have astringent qualities and are useful for treating diarrhoea, dysentery, and other gastrointestinal conditions.

Tannins are water-soluble polyphenols that are present in plants naturally. Tannins possess anti-microbial, anti-carcinogenic, and anti-mutagenic qualities, which may be related to their antioxidant capacities. Numerous academics have discussed the tannin content of T. procumbens. T. procumbens leaf extracts were shown to contain tannins by acetone-water or chloroform-water tests. The pedicle and buds of T. Procumbens contain tannins [15].

5.4 Carotenoids

Carotenoids are fat-soluble pigments that are present in the leaves and serve three major purposes for plants: light absorption, defence against photooxidative damage, and insect attraction. It has been suggested that carotenoids can protect DNA from oxidative stress. Many different kinds of these secondary metabolites, such as beta-carotene, which may be turned into vitamin A and is crucial for maintaining epithelial tissues, have been identified from T. procumbens. A lack of vitamin A can lead to Xerophthalmia, night blindness, and impairment of the immune system and hemopoiesis. Carotenoids like beta-carotene and lutein have demonstrated efficacy in lowering UV-induced erythema. The antioxidant qualities of carotenoids and the photoprotective capabilities have also been related [15].

5.5 Terpenoids:

Triterpenes and diterpenes are the terpenoids found in Tridax procumbens. These terpenoids have antibacterial and antifungal effects.

5.6 Primary metabolites

All plants have primary metabolites that are active in metabolic processes. Several particular primary metabolites have been isolated from T. procumbens, including: Lipids are critical components of all living things; they have an impact on how cells communicate with one another, determine the structure of individual cells, and provide the body with energy. The T. Procumbens plant includes typical Asteraceae family fats. Additionally, this species has a few lipids that offer the plant distinct qualities and potential medical use.These distinct fats have been extracted, and they include sitosterol, 12-hydroxytetracosan-15-one, 32-methyl-30-oxotetratriacont-31-en-1-ol, and 30-methyl-28-oxodotriacont-29-en-1-oic acid dotriacontanol. These substances are all common to several species and all play crucial roles in plants [15].

5.7 Secondary metabolites

Secondary metabolites are substances made by plants that play a significant part in defence mechanisms, communication, stress reactions, and other processes but are not necessary for the regular growth and development of the plant. Bioactive substances found in secondary metabolites frequently have valuable and significant therapeutic capabilities. Compounds include glycosides, nitrogenous organic compounds, fat-soluble compounds, polyphenolic compounds, and minerals procumbens secondary metabolites contain some of the most significant bioactive substances for therapeutic usage [15].

5.8 Additional phytochemicals

The leaves of T. procumbens also contain tannins, caffeic acid, ferulic acid, stigmasterol, and lutein, among other beneficial compounds. Caffeic acid and ferulic acid have been proven through in vitro research to have antioxidant, anti-inflammatory, anti-cancer, and antibacterial properties.

Numerous health advantages include lower risk of cardiovascular disease, anticancer, antidiarrhea, antiobesity, antibacterial, antiviral, antifibrotic, and neuroprotection of tannins such tannic acid and other hydrolysable tannins. The suppression of Ca2+ activated Cl- channels is one of the molecular processes ascribed to tannin's health advantages. Pharmacological effects of stigmasterol include anti-osteoarthritic, anti-hypercholesterolemic, cytotoxic, anti-tumor, hypoglycemic, anti-mutagenic, antioxidant, anti-inflammatory, and analgesic properties. A type of xanthophyll carotenoid known as lutein has been shown to be effective in preventing age-related macular degeneration (AMD), age-related cataract (ARC), retinitis pigmentosa, retinal detachment, uveitis, diabetic retinopathy, lung and breast cancers, heart disease, and stroke [14]. Numerous studies on the phytochemistry of T. procumbens have been made possible by the plant's widespread use as a traditional medicine around the globe. The development of novel medications for the treatment of various diseases may result from the discovery of novel bioactive substances. The following sections [15] will cover various extraction methods utilised to separate different chemicals identified in T. Procumbens. Oleanolic acid, Fumeric acid, fl-sitosterol, and tannin are the chemicals that are naturally present in plants. Alkaloids, carotenoids, flavonoids (catechins and flavones), saponins, and tannins are found in leaf extract. Oleanolic acid, fumeric acid, fl-sitosterol, and tannin are the chemicals found in plants. Alkaloids, carotenoids, flavonoids (catechins and flavones), saponins, and tannins are found in leaf extract. Minerals found in leaves include selenium, potassium, sodium, calcium, and magnesium. Flowers contain luteolin, glucoluteolin, quercetin, and isoquercetin. Leaf has 26 percent crude proteins, 17 percent crude fibre, 39 percent soluble carbs, and 5 percent calcium oxide. According to reports from pharmaceutical chemistry, T. procumbens contains a variety of isolated constituents, including polysaccharides like -sitosterol, puerarine, dexamethasone, esculetin, oleanolic acid, lupeol, quercetin, and isoquercetin as well as saturated and

unsaturated fatty acids, terpenoids, flavonoids, and lipids. Daucosterol and centaurein, two distinct compounds isolated from ethyl acetate extract, have also been found in the root of T. procumbens. Sitosterol-3-O-D-glucopyranoside (daucosterol) and 3′,5-dihydroxy-4′,3,6-trimethoxyflavone-7-O-glucopyranoside (centaurein). Dexamethasone is present in leaf juice. isolation of heptacosanylcyclohexane carboxylate, methyl 14-oxooctadecanoate, methyl 14-oxononacosanoate, and 3-methyl-nonadecylbenzene. acids such as arachidic, behenic, lauric, linoleic, linolenic, myristic, palmitic, and palmitoleic [16].

5.9 Test for others phytochemicals

5.9.1 Test for the detection of glycoside/reducing sugar:

Benedict's test - Benedict's reagent and the extract were combined in equal parts, and the mixture was heated for two minutes. The presence of glycoside was detected by the brown to red colour that appeared.

5.9.2 Test for protein

Xanthoprotein test:- When a small quantity of the extract was combined with 0.5 ml of concentrated HNO3, the presence of the protein was identified by the formation of a white or yellow precipitate.

5.9.3 Test: - In 0.5 ml of 4% sodium hydroxide solution, the extract was diluted with a drop of 1% copper sulphate solution. Protein was detected when the colour changed from violet to pink.

5.9.4 Test for carbohydrate

Molisch's test: Two drops of an alphanaphthol solution in 1% alcohol were added to 100 mg of the drug after it had been dissolved in 1 ml of water. A substantial coating of con.H2SO3 formed at the bottom of the test tube after 1 ml of the solution was applied along the tube's sides. At the liquid-liquid junction, a deep violet ring showed the presence of carbohydrates. Two whole plant extracts, acetone and methanol extracts, are subjected to phytochemical screening procedures. The presence of coumarins, quinines, steroids, alkaloids, tannins, resins, proteins, and carbohydrates may be seen in the acetone extract of the entire plant. Coumarins, tannins, alkaloids, quinines, flavonoids, resins, proteins, and carbohydrates were detected in methanol extracts of whole plants [12].

VI. Traditional uses:

Tridax procumbens has a long history of use in traditional medicine. The plant has been used to treat various ailments such as fever, diarrhea, dysentery, malaria, diabetes, and respiratory disorders. The plant is also used topically for wound healing and skin infections. Tridax procumbens has been extensively utilized in the Ayurvedic system of medication and is well-accepted medicine for a liver disorder. It's been found to possess significant medicinal properties against malaria; dysentery, diarrhoea, bronchial catarrh, blood pressure, hair fall, stomach ache, headache and hair fall. It also has wound healing properties and check hemorrhage from cuts and bruises. Antiseptic, insecticidal and parasiticidal properties were reported in flowers and leaves. The plant also possesses immunomodulatory, a.ntidiabetic, antihepatotoxic and anti-oxidant, anti-inflammatory, analgesic activity [17].

VII. Pharmacological properties:

Tridax procumbens has been found to possess a wide range of pharmacological activities, including antimicrobial, antioxidant, anti-inflammatory, analgesic, antidiabetic, anti-hyperlipidemic, and immunomodulatory effects. The plant has also demonstrated anticancer activity against various cancer cell lines. Additionally, the plant has shown protective effects against liver and kidney damage induced by toxic agents.

1. Wound Healing
2. Hepatoprotective and antioxidant activity
3. Immunomodulatory
4. Antidiabetic Activity
5. Antimicrobial Activity
6. Anti-Cancer Activity
7. Hypotensive
8. Repellency Activity
9. Anti-fungal Activity
10. Anthelmintic Activity

11. Anti-inflammatory Activity
12. Haemostatis AActivity
13. Antidiarrhoeal activity
14. Analgesic Activity
15. Anti-ulcer Activity
16. Anti-artrhitic Activity
17. Anti-parkinsonian Activity
18. Anti-bacterial Activity
19. Anti hypertensive Activity
20. Anti-lithiatic activity
21. Air growth promoting activity
22. Insecticidal activity
23. Anti-juvenile hormone activity
24. Antileishmanial activity
25. Antioxidant activities
26. Antihyperlipidemic activity
27. Anti-parasitic activity
28. Anti-obesity activity
29. Miscellaneous

VIII. Pharmacological reviews:

8.1. Wound Healing Activity:

Using a burn wound, excision, and incision model, a basic ointment base (5% and 2.5%w/w) made from an ethanolic extract of Tridax procumbens was tested for its ability to speed up the healing of wounds in diabetes (streptozotocin-induced) and non-diabetic rats. The epithelization period contraction rate and wound contraction (%) in the burn model were assessed. The excision wound model has been evaluated for total protein, epithelization duration, wound index, percent contraction area, DNA estimation, hydroxyproline content, and histopathological factors. Tensile strength was assessed in the incision wound model, as opposed to that. Animals treated with 5% and 2.5%w/w EETP had a significant improvement in wound index, epithelization time, and wound contraction. A potential ability to promote wound healing was noted in both diabetes and non-diabetic groups using a 5% weight-to-weight simple ointment base containing Tridax procumbens ethanolic extract. The non-diabetic group showed much greater and more impressive wound healing activity by 5% w/w T. procumbens ointment than the diabetes group [18].

8.2. Hepatoprotective and antioxidant activity

Against hepatic damage caused by the use of paracetamol (acetaminophen) in male albino rats, Tridax procumbens ethanolic extract was evaluated. Paracetamol (2gm/kg body weight) has been shown to produce hepatic damage as seen by decreased catalase and superoxide dismutase activities in liver tissue, a significant increase in the activity of aspartate aminotransferase, serum alkaline phosphatase, and alanine aminotransferase, and increased lipid peroxidation. Due to hepatic damage caused by the use of paracetamol, there was an increase in blood bilirubin as well as a significant decrease in total serum protein, hepatic glutathione, and glycogen content. After receiving different doses of Tridax procumbens ethanolic extract (100, 200, 300, and 400mg/kg body weight) orally for seven days, these abnormal parameters were restored to their original states. This demonstrates Tridax procumbens' ability to prevent liver damage brought on by paracetamol and to act as an antioxidant [19].

8.3. Immunomodulatory

Swiss male albino mice were used to evaluate the immunomodulatory activities of the Tridax procumbens Linn (TPEIF) aqueous extract. TPEIF was administered intraperitoneally, and we saw a considerable rise in the number of leukocytes, phagocytic index, and antibody-secreting cells in the spleen. Additionally, an increase in the haemagglutination antibody titer was seen along with humoral immune response activation. An elevated type IV (delayed) hypersensitivity reaction was described together with prominent information for cellular immune system activation. TPEIF also stimulates the humoral immune system in addition to the cell-mediated immune system. As a result, it promotes the development of an improved antibody response to specific clinical antigens [20].

8.4. Antidiabetic Activity

In Wistar rats (150–200 g), dried aqueous, alcoholic, and petroleum ether extracts of Tridax procumbens leaves were tested for hypoglycemic action. A digital glucometer was used to measure the blood sugar level. Taking leaf extracts orally at doses of 200 mg kg-1 significantly lowered blood sugar levels. This provided the framework for investigating the active ingredients in such anti-diabetic plants that are in charge of their hypoglycemic effects. Additionally, it supports the Mandesh region's historical claim that Tridax procumbens has anti-diabetic properties.[21]

8.5. Antimicrobial Activity

Antimicrobial tests have been conducted; however, more research is required to confirm some of the findings. T. procumbens has antibacterial capabilities that have been sensitive to a variety of bacterial and fungal species. More recently, it has been shown that the callus on stems and leaves is useful for the manufacture of silver nanoparticles that have some antibacterial activity against E. coli, V. cholerae, A. niger, and A. flavus. These results, however, are not definitive because this activity was lower than that shown by silver nitrate. Against Bacillus faecalis, T. procumbens leaf extracts in petroleum, ether, and ethanol shown antibacterial action. According to reports, alkaloids are most likely to blame for this action. The chloroform extracts shown antibacterial efficacy against B. faecalis, B. subtilis, E. coli, and Pseudomonas aeruginosa, although more thorough controls and method descriptions are required for future investigations. Alpha and beta pinenes are present in T. procumbens essences, which can be used sparingly to treat bacterial and fungal diseases. Regarding this species' antibacterial properties, certain results seem incongruous. There is evidence for this species' potential as an antibacterial, thus more research in this field is required [22]. Some investigations did not include considerable biological activity when compared to the antibiotic control.

8.6. Anti-Cancer Activity

The hydrodistillation method was used to extract the essential oils from fresh Tridax procumbens leaves and flowers, and they were then tested for anticancer activity using the MTT assay on the human breast cancer cell line (MCF-7). On the MCF-7 cell line, the essential oil shown concentration-dependent action. 96.6 g/ml was discovered to be the IC50 value. Due to the presence of important terpenes like -pinene and -pinene, Tridax procumbens essential oil has demonstrated to have substantial anticanceractivity[23].

8.7. Hypotensive

An anaesthetized Sprague Dawley rat was used to test the cardiovascular effects of the Tridax procumbens aqueous leaf extract. Blood pressure (mean arterial pressure) is significantly lowered after intravenous administration of an aqueous extract.At the greater dose, there was a discernible decrease in heart rate while there was none at the lower level. The bradycardia and hypotensive effects happened immediately. Atropine sulphate (1 mg/kg) pretreatment of the animals prevented Tridax procumbens' hypotensive effects. The hypotensive effect of Tridax procumbens leaves and its action, which is likely caused by the stimulation of the cholinergic muscarinic receptors mechanism, are therefore still justified by these data [24].

8.8. Repellency Activity

Tridax procumbens Linn leaves were steam-distilled to obtain the essential oils. The topical repellent properties of the extracted oil were tested in mosquito cages against the Anopheles stephensi malaria parasite. Three distinct concentrations (2%, 4%, and 6%) of all essential oils were examined. Tridax essential oils stood out among these because of their comparatively high repellency impact (>300 minutes at 6 % concentration), leading researchers to draw the conclusion that Tridax essential oils are effective repellents at 6 percentage concentration against Anopheles stephensi [25].

8.9. Antifungal activity:

The presence of numerous bioactive substances in T. procumbens, including phenols, flavonoids, saponins, sterols, and fatty acids, may be the cause of its antifungal properties. According to Joshi RK and Badakar V (2012), the essential oils extracted from the flowers of Tridax procumbens L. were found to be effective against the tested fungus. Zones of inhibition ranging from 17 to 25 mm against a variety of fungal strains, including Microsporum fulvum (MTCC 8478), Microsporum gypseum (MTCC 8469), Trichophyton mentagrophytes (MTCC 8476), Trichophyton rubrum (MTCC 8477), and Candida albicans (MTCC 854), have been produced by fractionating methanol extract with dichloromethane. C. albicans was the species that was most vulnerable to it. Among all other species C. albicans was highly susceptible.Unsaturated fatty acids, 5-cholestane, and other siloxanes may all contribute to the DCM fraction’s anti-dermatophytic effect (Policegoudra RS, et al., 2014). In addition, Tridax procumbens has antifungal properties against Helminthosporium oryzae, Rhizoctonia

solani, and Pyricularia oryzae, three phytopathogenic fungi. The tested plant pathogen Fusarium oxysporum can be effectively inhibited by the flowers. The fungi's spore germination has also been fully prevented by free flavonoids and sterols found in T. procumbens (flower) (Sharma B, Kumar P, 2009).[26]

8.10. Anti-inflammatory Activity

In the carrageenan-induced mice model, the anti-inflammatory efficacy of an ethanol extract of Tridax procumbens leaves was tested. Histopathology and inflammatory oedema parameters were measured and compared to those of a control group. At 24 hours, the histology in the treated groups had recovered, and the inflammation in the mouse paws had significantly decreased. Cyclooxygenase (COX2) and Tumour Necrosis Factor (TNF) gene expression levels at the inflammatory site were examined using reverse transcription quantitative polymerase chain reaction (qPCR) and polymerase chain reaction (PCR) analyses to look at molecular activity. In test groups, the PCR and relative quantity (RQ) values had declined with increasing doses. Real-time polymerase chain reaction (RT-PCR) results showed a significant decrease in the band density for the COX2 and TNF- gene expression levels in the treated group. As a result, Tridax procumbens has molecular anti-inflammatory activity [27].

8.11. Hemostatic activity:

By measuring the in vitro clotting times of 10 human volunteers, several extracts from Tridax procumbens leaves, including ethanolic extract, fresh leaf, and petroleum extract, were tested for hemostatic activity. The ethanolic Extract was one of them, and it showed positive action by uniformly decreasing the clotting time in the blood samples from all the individuals (Kale MA, et al., 2008). Aqueous leaf extract may be employed as a potent hemostatic agent because it has also demonstrated improved blood coagulation activity. [28]

8.12. Antidiarrhoeal activity

Researchers have tested the antidiarrheal effects of petroleum ether, dichloromethane, and an ethanolic extract of the entire Tridax procumbens plant on enteropooling, gastrointestinal motility, and castor oil-induced diarrhoea in experimental mice. By lowering the amount of intestinal fluid in the prostaglandin-E2 induced diarrhoea model, the lower dose of petroleum ether extract exhibits greater anti-diarrheal efficacy than the larger dose. By lowering the propulsion of charcoal meal in the gastrointestinal motility test model and lowering the frequency of defecation and the total weight of wet diarrhoea in the castor oil-induced diarrhoea model compared to the control group, all extracts of Tridax procumbens were found to have dose-dependent anti-diarrheal activity [29].

8.13. Analgesic Activity

Rats were used to evaluate the analgesic effects of lyophilized decoctions of Tridax procumbens leaves using the Writhing test, Formalin-induced persistent pain, and Complete Freund's adjuvant (CFA)-induced hyper analgesia. The Acetic acid-induced abdominal constriction test revealed a significant and dose-dependent reduction in the abdominal writhing. In the Formalin test, extract administration greatly reduces the late phase of moderate pain. Rats that had received CFA injections and were given the extract orally showed a considerable reduction in mechanical hyperalgesia. Thus, the findings demonstrated Tridax procumbens' analgesic capability, which may derive from both centrally and peripherally mediated processes [30].

8.14. Anti-ulcer Activity

In rats with ethanol-induced ulcers, 400 mg/kg of Tridax procumbens ethanolic leaf demonstrated dose-dependent reduction of ulcer lesion index, changes in gastric pH, and volume alterations. Large fibroblast cells are also restored by the extract, which also lowers glutathione (GSH), catalase, and superoxide dismutase (SOD) levels in the rat stomach. Thus, these findings demonstrated Tridax procumbens' therapeutic potential [31].

8.15. Anti-artrhitic Activity

At dosages of 250 and 500 mg/kg, the ethanolic extract of the Tridax procumbens entire plant significantly reduced the arthritic activity of Freund's Complete Adjuvant (FCA)-induced arthritis in female Sprague Dawley (SD) rats. By noticing a decrease in the paw volume, it is proven. In comparison to control animals without arthritis, a considerable drop in body weight has been seen in control animals with arthritis. Animals receiving Tridax procumbens therapy experienced a dose-dependent increase in body weight. Indomethacin, a common medication, and Tridax procumbens extract were evaluated for anti-arthritic efficacy. Tridax procumbens extract considerably changed the haematological and biochemical alterations brought on by FCA [32].

8.16. Anti-obesity Activity

Atherogenic diet-induced obesity rats were given methanolic extracts of Tridax procumbens. Triglycerides, total cholesterol, HDL cholesterol, total protein, and free fatty acids were among the parameters measured. In rats fed with the extract, there was an increase in HDL cholesterol and a significant decrease in triglycerides, total cholesterol, total protein, and free fatty acids. Tridax procumbens therefore demonstrated notable anti-obesity efficacy [16].

8.17. Anti-parkinsonian Activity

To test the anti-Parkinson's effects of Tridax procumbens (EETP) leaves, fruit fly and rat models of haloperidol-induced catalepsy and locomotor impairment, respectively, were used. In the fruit fly model, rotenone (ROT) and EETP have been co-exposed on flies for 7 days. EETP treatment has greatly improved the efficiency of locomotor activity in flies as compared to ROT treated flies. The rats were given EETP and then haloperidol for 15 days as part of the catalepsy experiment. With EETP, a considerable reduction in catalepsy, a reduction in muscle rigidity, and an improvement in locomotor ability had been noted. With EETP, lipid peroxidation was decreased, and levels of reduced glutathione and catalase were noticeably elevated [33].

8.18. Anti-bacterial Activity

Agar well diffusion technique was used to investigate Tridax procumbens leaf extract for its antibacterial activity against various bacteria, including clinical isolates and some standard strains. The alcoholic extract had substantial antibacterial activity at a dosage of 5 mg/ml against Pseudomonas aeruginosa while the aqueous extract did not show any antibacterial activity. The ethanolic extract shown noticeable action against the nosocomial strains of Pseudomonas when compared to different antibiotics such augmentin, cefotaxime, and ciprofloxacin [34**].**

8.19. Anti-malarial Activity

In this work, essential oil was obtained using the steam distillation method from the leaves of Tridax procumbens L. Anopheles stephensi, the malarial vector, was tested for antimalarial action of essential oil in mosquito cages. There were three distinct oil concentrations for Tridax procumbens (2, 4, and 6%). At 6% concentration (> 300 minutes), a substantial repellent effect was comparative seen [35].

8.20. Anti-lithiatic activity

The plant's ethanol extract was also utilised to treat kidney stone conditions. It demonstrated action in animal models of calcium oxalate urolithiasis, hyperoxaluria-induced oxidative stress, and ethylene glycol- and 2% w/v ammonium chloride-induced urolithiasis. Treatment with the plant's decoctions was able to lessen calcium oxalate kidney deposits caused by callogenesis, and the resulting lipid peroxidation, showing anti-urolithiasis and anti-oxidant benefits [36].

8.21. Hair growth promoting activity

A way to promote hair growth in the T. procumbens aerial parts was examined. Both the oral (100 mg/kg/day) and 10% ointment administration methods were successful when used on albino rats over the course of 20 days. The portion of the sample evaluated for this a property, petrol, was shown to be active when extract function activity was totaled using various solvents. The activity in beginning function was indicated by column chromatography and screening of petrol function. There are three groups of 25 animals each. In contrast to the control group rats, those that receive an oral dose of the ethanolic extract have enhanced hair growth. The animals that received ointment treatment had some observations made about them. Additionally, it was noted that there was no activity at all until the 10^{th} day of treatment; however, the process of hair growth began on the 14^{th} day and was nearly finished in 21 days[37].

8.22. Insecticidal activity

House flies, mosquito larvae, Dysdercus similes, and cockroaches were all killed by the separated essential oils from T. procumbens. When tested against three different species of ants, T. procumbens essential oils shown considerable insect repellent efficacy. The fact that T. procumbens was neither attacked by cattle during collection or grazed by them during growth suggests that the plants may have insecticidal or insect repellant properties [37].

8.23. Anti-juvenile hormone activity

Topical administration of a fraction of T. procumbens' petroleum ether extract had significant effects on the metamorphosis of Dysdercus and was discovered to be particularly significant in producing abnormalities in adults due to juvenile hormone activity. Five plant extracts out of the fifteen plants studied exhibited antijuvenile hormone-like effects against late fourth instar larvae and adult female mosquitoes colonised in a lab. Ageratum conyzoides, Cleome icosandra, mTagetes erectes, and T. procumbens extracts in petroleum ether

and acetone shown growth inhibitory and juvenile hormone mimicking effect to the treated C. quinquefasciatus larvae. There were a few observable modifications, including larval pupal intermediates, demalanized pupae, flawed egg rafits, and adults with malformed flight muscles. Only the extracts of the plants ageratum, cleome, and T. procumbens were found to have an impact on biting behaviour. Although the treated mosquitoes lost their ability to reproduce, no sterilant effects were visible. When compared to controls, adults created from larvae treated to plant extracts generated noticeably shorter egg-rafits [37].

8.24. Antileishmanial activity

Together, the extracts from Tridax procumbens leaves and Allium sativum provide potent anti-Leishmania Mexicana effects. Mice were injected with Leishmania Mexicana promastigotes in order to conduct an in vivo test to measure antileishmanial activity. Tridax procumbens or Allium sativum extracts were administered to the mice for a total of 14 days. The 14th day effect was then observed and evaluated against the control group. The acute toxicity measure, as well as the liver damage, were calculated. Blood was taken after the infection had been present for 12 weeks, and total immune globulin levels were determined using a non-commercial indirect ELISA. Increased ratio of IgG2a to IgG1 in mice indicated a growing 1 type immune response, which is indicative of a predisposition to increase the immunological response. A promising natural cure for the serious illness cutaneous Leishmaniasis is a combination of Tridax procumbens and Allium sativum extract [16].

8.25. Antioxidant activities

The T. procumbens has a high phenol concentration of 12 mg/g GAE while total phenol is represented as gallic acid equivalent (GAE). The outcome suggests that there may be a connection between antioxidant activity and phenol levels in medicinal plants. This conclusion that plant secondary metabolites such flavonoids, tannins, catechins, and other phenolic compounds exhibit potential antioxidant activity is supported by a number of earlier investigations. The special bioactive substances helped to stave off the onset of diseases like cancer, heart disease, and ageing. By reducing cholesterol and healing damaged cells, they have also reportedly been found to be chemo-preventative medicines. The DPPH is largely constant. A free radical with a nitrogen centre that readily takes an electron or hydrogen reacts with suitable reducing agents to pair off its electrons, which causes the solution to lose colour to some extent depending on how many electrons it has taken up. Antioxidant properties in vitro were assessed in the Tridax procumbens extracts. A useful method for assessing the antioxidant activity in vitro is the DPPH method. It is based on the interaction of an antioxidant (AH) with DPPH (1, 1-diphenyl-2-picrylhydroxyl), a free radical with a nitrogen atom at its centre. Ethyl acetate and n-butanol fractions have demonstrated notable activity in the methanol extract. The free radicals scavenging activity of the Tridax procumbens fractions and Ascorbic acid was measured in terms of hydrogen donating or radical-scavenging ability by using the stable radical DPPH. Low absorbance of reaction mixture indicates higher free radical scavenging Activity[16].

8.26. Antihyperlipidemic activity

Tridax procumbens leave extract significantly decreased the accumulation of lipid Content. By the presence of antioxidant molecules in extract they are having the Antihyperlipidemic activity. This Activity tested on HepG2 cells. When the cells are treated with 20 mg/ml of extracts of Tridax procumbens and 1mM of oleic acid, no lipid accumulation observed in HepG2 cells. The leaves extract of Tridax procumbens had Significant effect to decrease lipid content in HepG2 cells when compared with the normal model control. Hepatic Lipid accumulation and oxidative stress affects leads to Non-Alcoholic Fatty Liver Disease (NAFLD). Thus, we analysed that the antihyperlipidemic of Tridax procumbens leaves would attenuate events leading to NAFLD. The Leaf extract of Tridax procumbens may be used as prophylactic agents to prevent the induced disorders such as Atherosclerosis and other. From this our results suggest the potential therapeutic uses of hydroethanolic extract of Tridax procumbens in the prevention and treatment of hyperlipidemia and related diseases [16].

8.27. Antiparasitic activity

Through a bioassay-guided fractionation with a methanol extract to isolate an active substance, (3,S)-16,17-Didehydrofalcarinol (an oxylipin), treatment of certain disorders like malaria, dysentery, colic, and vaginitis caused by protozoal infections have been evaluated with T. procumbens. When employing crude extracts from the entire plant, Tridax appeared to exhibit antileishmanial properties. A study conducted in Ghana examined the antiplasmodial effects of extracts from the flowers, leaves, and stem of T. procumbens in water, chloroform, ethyl acetate, and ethanol. A study utilising the tetrazolium-based colorimetric assay revealed that T. procumbens helped shield red blood cells from P. falciparum damage, providing evidence that the species'

aqueous and ethanolic extracts have antiplasmodial capabilities. Tridax exhibits excellent potential against a disease that claims the lives of millions of people worldwide [22].

8.28. Anti-obesity measures

A significant decrease in total cholesterol, triglycerides, total protein, free fatty acids, and an increase in high-density lipoprotein cholesterol were observed in an animal treated with plant decoctions in a research study [36].

8.29. Miscellaneous

On an anaesthetized Sprague-Dawley rat, the cardiovascular impact of an aqueous extract from the leaf of Tridax was examined. The mean arterial blood pressure was significantly decreased by the aqueous extract in a dose-related manner, meaning that the extract had a bigger effect at higher doses than at lower doses. Additionally, higher doses cause a considerable decrease in heart rate whereas lesser doses have no effect on it. It denotes that a Tridax leaf has a hypotensive effect. In one study, the topical effectiveness of essential oils steam-distilled from Tridax leaves against the malarial vector Anopheles stephensi (An. Stephensi) in mosquito cages was assessed. Three various concentrations of all essential oils (2, 4 and 6%). As a result, it was determined that Tridax essential oils are promising as repellents at 6% concentration against An. Stephensi 14 because they had a reasonably strong repellency impact (>300 minutes at 6% concentration) of these. When the DPPD (2,2 -diphenyl-1-picrylhydrazyl hydrate) and HET-CAM (Hen's egg chorioallanthoic membrane) assays were conducted, Tridax also reported for its anti-inflammatory and antioxidant properties. Tridax leaves are said to prevent hair from falling out and to encourage hair growth, however further study is needed to confirm these claims. Intriguingly, Tridax is employed as a bioadsorbent to remove Cr (VI) from industrial effluent using phytoremediation method. Additionally, Tridax has been used for bronchial catarrh, dysentery, and diarrhoea. In the tropical zone and West Africa sub-region, traditional healers and the local populations of these regions employ the plant's leaves as a treatment for conjunctivitis. One of the extremely hazardous ions emitted into the environment by the leather processing and chrome plating industries is chromium (VI). When 5 g of the bioadsorbent were utilised, 97 percent of the Cr (VI) was removed from the synthetic wastewater sample [13,38].

Conclusion:

In conclusion, Tridax procumbens is a medicinal plant with a long history of use in traditional medicine. The plant has various pharmacological properties that have been demonstrated through in vitro and in vivo studies. Further research is needed to fully understand the mechanisms of action and potential therapeutic applications of the plant. However, the available literature suggests that Tridax procumbens is a promising source of natural compounds with beneficial health effects.

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