Research & Reviews in Pharmacy and Pharmaceutical Sciences e-ISSN:2320-1215

A Review on Medicinal Importance of *Tridax Procumbens* Linn

Himanshu C. Chaudhari*, Kiran P. Patil

P.S.G.V.P. Mandal's College Of Pharmacy, Shahada, Maharashtra, India 425409

Review Article

Received: 17-Jan-2022, Manuscript No. JPPS- 22-51723; **Editor assigned:** 19-Jan-2022, PreQC No. JPPS- 22-51723 (PQ); **Reviewed:** 02-Feb-2022, QC No JPPS- 22-51723; **Revised:** 07-Feb-2022, Manuscript No. JPPS-22-51723(R); **Published:** 14-Feb-2022, DOI: 10. 2320-0189.11.1.001

***For Correspondence:**

Himanshu C. Chaudhari, Kiran P. Patil, P.S.G.V.P. Mandal's College Of Pharmacy, Shahada, Maharashtra, India 425409

E-mail:

himanshuchaudhari53028@gmail.com

Keywords: Metabolites, Phytoconstituent, Antioxident, Hepatoprotective, Anti-inflammatory, Antidiabetic, Antimicrobial, Phytoconstituent, Antihypertensive, Antioxidant

ABSTRACT

A medicinal plant *Tridax Procumbens* commonly known as coat button or kansari (Hindi) or Ghamara belonging to family *Asteraceae*. It is a plant used majorly in Indian traditional medicine and also use by different communities. It is a very promising species that produces secondary metabolites such as alkaloid, steroids, carotenoid, flavonoid (catechins, centaurein and bergenins), fatty acid, phytosterols, tannins and minerals reported to have a variety of medicinal uses including antioxidant, antibacterial, anti-inflammatory, antimicrobial, vasorelaxant, antileishmanial, antianemic, immunomodulatory, hepatoprotective and mosquitocidal activities which have been scientifically screened. Still there is shortage in the studies on isolation, characterization and evaluation of active principle from the extract. This study aims to review the scientific literature regarding medicinal properties, taxonomy, morphology, geographical distribution, phytoconstituents and pharmacological activities to prove and attempt to compile and review them in order to heighlight its medicinal importance and making it a promising ethnobotanical resourse. Also, this study provides comprehensive information of this species and indicates that this species could be an effective, safe and affordable treatment for some ailment especially in tropical areas where this plant is native and widely distributed.

INTRODUCTION

Tridax Procumbens Linn is medicinal plant commonly known as coat button or kansari (Hindi) or Ghamara (in local language) and belongs to family *Asteraceae* or *Compositae*, *T. balbisioides* and *Tridax procumbens*. A medicinal plant *Tridax procumbens* is commonly known as Coat Button or Kansari (Hindi) or trilobata are the other species of the genus. It is a plant majorly used in Indian traditional system. It is an annual or perennial weed from Central America and found throughout in India especially in Maharashtra, Madhya Pradesh and Chhattisgarh regions as weed. It is often rooting at nodes with solitary, long stalked, yellow composite, heterogamous, bisexual flowers with

white flowering heads and very hairy, coarsely toothed, petislate, ovate or lanceolate leaves. Whole arial part is useful medicinally, leaves possess wound healing, insecticidal, antisecretory and hypotensive action while seeds are used to control bleeding [1]. Also has various pharmacological properties including but not limited to: immunomodulatory, anti-oxidant, anti-hepatotoxic, analgesic, antidiabetic, anti-inflammatory, antifungal, and antimicrobial activities (Tables 1-3). Since ancient times, this species has been used in Ayurveda in India. Different substances such as oils, teas and skin poultices, among others, have been manufactured using this species. The utility of the species is most likely due to the plant defense mechanism, secondary metabolites such as flavonoid, alkaloids, tannins, carotenoids, and saponins which have been scientifically screened [2].

The diverse biological activities are due to various phytochemicals present in the plant. The aim of this review is to critically evaluate *T. Procumbens* as an important medicinal plant with emphasis on the *in-vivo* properties of the phytochemicals and their roles in signalling pathways that can be manipulated for specific pharmacological actions. The aim of this review is to highlight the importance of this species as a valuable medicinal plant (Figure 1) [3].

Figure 1. Whole plant of *Tridax Procumbens* Linn.

Table 1. Classification of *Tridax Procumbens* Linn.

Classification	
Divisions	**Classing**
Kingdom	*Plantae*–Plants
Sub kingdom	Tracheobionta–Vascular plants
Division	Spermatophyta
Subdivision	*Magnoliophyta*–Flowering plants
Class	*Magnoliopsida*–Dicotyledons
Subclass	*Asteridae*
Order	*Asterales*
Family	*Asteraceae*–Aster family
Genus	*Tridax L.*–*Tridax*
Species	*Tridax procumbens L.*–Coat buttons

Table 2. Synonyms of *Tridax Procumbens* Linn.

Synonyms
Chrysanthemum procumbens
Balbisia canescens
Balbisia divericata
Balbisia peduncalata
Tridax procumbens var. Canescenes
Tridax procumbens var. ovatifolia[4]

Table 3. Vernacular names of *Tridax Procumbens* Linn.

Vernacular names	
Language	**Names**
English	Coat Buttons and *Tridax* Daisy
Hindi	Ghamra
Sanskrit	Jayanti Veda
Marathi	Dagadi Pala
Telugu	Gaddi Chemanthi
Tamil	Thata poodu
Malayalam	Chiravanak
Spanish	Cadilp Chisaca
French	Herbe Caille
Chinese	Kotobukigiku [5]

LITERATURE REVIEW

Plant morphology

Appearance-*Tridax procumbens* is a perennial herb that has a creeping stem which can reach from to 8-30 inches (20-75 cm) long.

Foliage-The leaves of *Tridax procumbens* are opposite, pinnate, oblong to ovate, and 1-2 inches (2.5-5 cm) long with cuneate bases, coarsely serrate margins, and acute apexes.

Flowers-*Tridax procumbens* flowers have white rays and yellow disk flowers. They are about 0.4-0.6 inches (1-1.5 cm) wide, and held on a 4-12 inches (10-30 cm) long stalk. Flowering occurs in spring. The plant flowers are looking like daisy. The flower is tubular, yellow centered white or yellow flowers with three-toothed ray florets. Inflorescence is capitulum. It has two types of flowers: ray florets and disc florets with basal palcentation. Sometimes the flowers are 3 lobed with long, penduncled heads. Achene's black narrowly obconnical, 2.0-2.5 mm long with feathery pappus. Flowering- Fruiting throughout the year.

Fruits-Fruits are achenes that are dark brown to black in color, oblong, and 0.08 inches (2 mm) long, each with a head of pappus bristles that vary from 0.12-0.24 inches (3-6 mm) long. Fruit is a hard achene covered with stiff hairs and having a feathery. At one end It has plume like white pappus. The plant is invasive in part because it produces so many achenes and each achene can catch the wind in its pappus and be carried some distance.

Seeds-*Tridax procumbens* seed germinate at higher temperature (35/25 and 30/20) in the presence of 58 to 78 % light. This is very sensitive to salt concentration and water stress the chromosome number are 36 (diploid) and 18 (haploid) in gametes. The production is through spreading steam and seed production (Figure 2).

Figure 2. Seed of *T. Procumbens.*

Figure 3. Stem, Flowers, leaves of T. *Procumbens.*

Calyx-It is represented by scales or reduced to pappus.

Leaves-Leaves are irregularly toothed and generally arrow head shaped. They are simple, ovate, opposite, exstipulate, and lanceolate and they are 3-7 cm. Wedge shaped base leaf, shortly petioled, hairy on both surfaces (Figure 3).

Stem and root- Stems are cylindrical, hispid, covered with multi-cellular hairs of mm; tuberculation at the base root is a strong taproot system. The plant stem is ascending 30-50 cm height, branched, sparsely hairy, rooting at nodes (Figure 4).

Figure 4. Stem and Root of *T. Procumbens.*

Flowers -The plant flowers are looking like daisy. The flower is tubular, yellow centered white or yellow flowers with three-toothed ray florets. Inflorescence is capitulum. It has two types of flowers: ray florets and disc florets with basal palcentation. Sometimes the flowers are 3 lobed with long, penduncled heads. Achenes black narrowly obconical, 2.0-2.5 mm long with feathery pappus. Flowering- Fruiting throughout the year (Figure 5) [5,6].

Figure 5. The Plant flowers of *T. Procumbens.*

Genetics-the chromosome numbers of *Tridax procumbens* has been registered as 2n-36 [7].

Botanical description

The plant has an average height of around 20-60 cm and is branched; Leaves are 4-8 cm long, simple, opposite and stipulate. Inflorescence is around 12-32 cm, oval shaped and held by peduncle, with ray florets and disc florets. Flowers are daisy like with yellow centred white or yellow petals. Numerous, tubular disc florets are surrounded by a ring of short, strap-shaped ray florets. Fruit is cypsela, black or brown in colour at maturity and surrounded with feathery bristles [2]. The stem is cylindrical. and covered with hairs of about 1 num with tap root system[3]. The registered number of chromosomes present in *Tridax* are 36 (2n) [4]. Growth of plant takes place during monsoon season as it requires abundant water for growth and sustenance (Table 4).

Table 4. *Tridax procumbens* (family *Asteraceae*) is known by different names throughout the world.

Country/ Language	Vernacular names	Source
Chinese	Kotobukigiku	Ankita and Jain 2012
English	Coat buttons, Tridax daisy	USDA, Ankita and Jain 2012, Kumar et al., 2012; Chauhan and Johnson, 2008; Ravikumar et al., 2005b, Bhagwat et al., 2008.
French	Herbe Caille	Ankita and Jain 2012
Latin	*Tridax procumbens (Linn.)*	Ankita and Jain 2012
Malayalam	Chiravanak	Ankita and Jain 2012
Marathi	Dagadi Pala	Ankita and Jain 2012
Oriya	Bishalya Karani	Ankita and Jain 2012
Sanskrit	Jayanti Veda	Ankita and Jain 2012
Spanish	Cadillo, Chisaca	ITIS, ND, Ankita and Jain 2012
Telugu	Gaddi Chemanthi	Ankita and Jain 2012
Tamil	Thata poodu	Ankita and Jain 2012
Australia	Tridax daisy	Holm et al., 1997
Brazil	Erva de Touro	Holm et al., 1997
Burma	Mive Sok Ne-gya	Holm et al., 1997
Burundi	Agatabi	Byavu et al., 2000
Colombia	Cadillo Chisaca	Holm et al., 1997
Cuba	Romerillo de Loma, Romerillo	Holm et al., 1997
Dominican Republic	Piquant Jambe	Holm et al., 1997
El Salvador	Hierba del Toro	Holm et al., 1997
Fiji	Wild Daisy	Holm et al., 1997
Ghana	White-dirty Cream, Nantwi bini	Holm et al., 1997; Komlaga et al., 2015
Guatemala	Bull Grass, Bull's herb	Vibrans 2009, Gamboa-Leon et al., 2014
Hawaii	Tridax	Holm et al., 1997
Honduras	Hierba del Toro	Holm et al., 1997
India	Bisalyakarmi, Mukkuthipoo, Phanafuli, Tunki, Ghamara, Javanti Veda, Dhaman grass, Vettukkayapoondu, Vettu kaaya	Holm et al., 1997; Kumar et al., 2012; Kethamakka and Deogade, 2014; Pareek et al., 2009; Ravikumar et al., 2005b, Bhagwat et al., 2008, Silambarasan and Ayyanar, 2015, Yabesh et al., 2014.
Indonesia	Gletang, Gletangan, Sidowlo, Tar Sentaran	Holm et al., 1997
Jamaica	Bakenbox	Mitchell and Ahmad, 2006
Japan	Kotobukigiku	Holm et al., 1997
Java	Songgolangit	Petchi et al., 2013
Madagascar	Anganiay	Holm et al., 1997
Malaysia	Coat Buttons, Kanching Baju	Holm et al., 1997
Mauritius	Herbe Caille	Holm et al., 1997
Mexico	Flor Amarilla, Panquica, Rosilla, *t'ulum*	Holm et al., 1997, Gamboa-Leon et al., 2014
Nigeria	Igbalobe, Muwagun, Muriyam pachila, Jayanti, Vettukkaaya-thala	Olowokudejo et al., 2008; Soladoye et al., 2013, Sureshkumar et al., 2017
Puerto Rico	Tridax	Holm et al., 1997
Taiwan	Kotobuki-giku	Holm et al., 1997
Thailand	Teen Tuk Kae	Holm et al., 1997
Trinidad	Railway Weed	Holm et al., 1997
United States	Tridax daisy	Holm et al., 1997

T. procumbens is found in tropical and sub-tropical areas of the world growing with annual crops, along roadsides, pastures, fallow land, and waste areas. The species has a diploid number of 36. It has herbaceous, semi-prostrate habit, and can grow anywhere from 15-40 cm in height. The leaves are elongated, opposite, ovate with serrated margins, hirsute on the abaxial and adaxial sides. The inflorescence is a capitulum with three-toothed white ligulate ray florets female and disc inner flowers yellow, tubular, bisexual, with corolla 6 mm long.

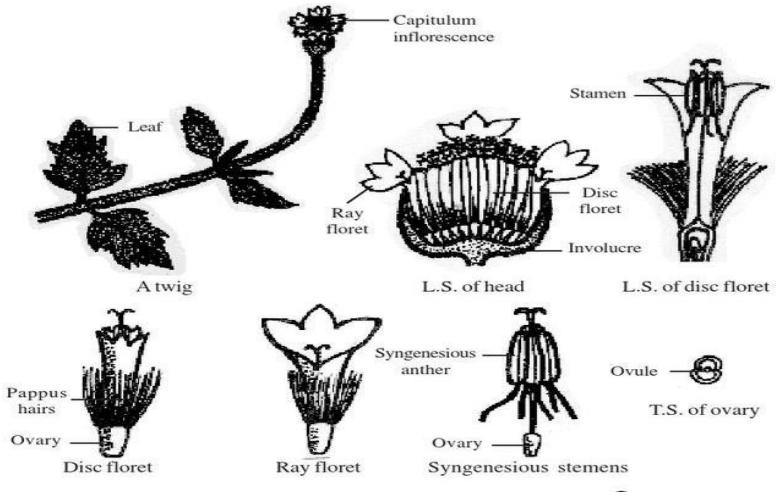
T. procumbens is classified as a noxious weed in Alabama, Florida, Minnesota, North and South Carolina and Vermont. It is quarantined in California and Oregon and prohibited in Massachusetts (U. S. Department of Agriculture).

In Guatemala, *T. procumbens* is a weed that has a wide range of growth and can be found in either dry or damp soil, usually on previously cultivated ground from sea level to 2300 m [2.3].

Origin and distribution

Tridax procumbens Linn is native of tropical America and naturalized in tropical Africa, Asia, Australia and India. This wild herb is distributed throughout India. Coat buttons are found on roadsides, waste grounds, railroads, dykes, riverbanks, meadows, and dunes. Its widespread distribution and importance as a weed are because of its spreading stems and plentiful seed production (Figure 6) [4].

Figure 6. Microscopy of *T. Procumbens.*



Macroscopic characters of leaf, flower, stem and root

Leaves are 3-6 cm long and 1-4 cm wide, lanceolate to ovate shaped, hairy, opposite, often deeply lobed with irregularly toothed margin and an acute apex. Flowers were of two types, disc flowers, the corolla narrow-campanulate, 8 mm long, bright yellow and hairy at the top, with spreading pappus of plumose hairs. Ray flowers 5 or 6, female with narrow corolla tube and brown ligulate limb, white or pale yellow, flowering and fruiting throughout the year. The Stem was herbaceous, cylindrical, decumbent and branched. *Tridax procumbens* having a tap root system [4].

Phytoconstituent

In various research studies, it was showed that the plant has different phytochemical compounds. From the phytochemical screening, it was observed that alkaloids, carotenoids, saponins, flavonoids, and tannins are present in this medicinal plant. The proximate characteristics showed that *Tridax procumbens* is rich in sodium, potassium, and calcium. In an earlier research study, it has been estimated that the leaf of the plant mainly contains crude proteins 26%, crude fiber 17%, soluble carbohydrates 39%, and calcium oxide 5%. On the other hand, luteolin, glucoluteolin, quercetin, and isoquercetin have been reported from its flowers. Fumaric acid, β-sitosterol also has

been reported in the plant. Oleanolic acid which was obtained in reasonable amounts from this plant found to be a potential anti-diabetic agent when tested against alpha-glucosidase.

The plant shows different chemical constituents such as 2,6-dihydroxyacetophenone 2-O-β-D-glucopyranoside, echioidinin, pinostrobin, dihydroechioidinin, tectochrysin 5-glucoside, methyl salicylate glucoside, 5,7,8-trimethoxyflavone, skullcapflavone I 2-methyl ether, androechin, tectochrysin, 5,7,2-trimethoxyflavone, echioidin, skullcapflavone, 5,7-dimethoxyflavone, andrographidine. From the aerial parts of *Tridax procumbens*, a new flavonoid named as procumbenetin has been isolated and characterized by chemical means and spectroscopic techniques. Two new flavones named as 8, 3-dihydroxy-3, 7, 4-trimethoxy-6-O-D-glucopyranosyl and 6, 8, 3-trihydroxy-3, 7, 4-trimethoxy were isolated and characterized based on chemical analysis and spectral methods. Apart from it, four known compounds puerarin, esculetin, oleanolic acid, and betulinic acid were also isolated from the plant parts.

A new bisbithiophene named tri-bisbithiophene along with four known terpenoids such as taraxasteryl acetate, β-amyrenone, lupeol, and oleanolic acids were isolated from the ethyl acetate soluble part of hexane decoctions of this plant. With the help of graded ethanol precipitation followed by mild delignification and size-exclusion chromatography, two water-soluble polysaccharide fractions, WSTP-IA and WSTP-IB were purified from the leaves of *Tridax procumbens.*

In a research study, the plant pigments of *Tridax procumbens* along with some other ethno medicinal plants were estimated. The study showed that total chlorophyll content was 1.424 mg/g tissue and total carotenoids content was 0.724 mg/g tissue in this plant. Other two plant pigment research studies observed that these plant pigments content may fluctuate due to the various environmental or other biogeochemical factors like effects of air pollution and it may differ with seasonal changes [7].

The leaf and other parts of *T. procumbens L*. are reported to have flavonoids, alkaloids, carotenoids, hydroxycinnamates, lignans, benzoic acid derivatives, phytosterols, tannins, crude proteins, crude fiber, soluble carbohydrates and calcium oxide. The presence of fumaric acid, β-sitosterol and the pentacyclic triterpenoid oleanolic acid have also been reported. Luteolin, glucoluteolin, quercetin, and isoquercetin have been reported in flower extracts. Some of the other phytochemicals present abundantly in T. procumbens are 2,6-dihydroxyacetophenone, 2-O-β-D-glucopyranoside, echioidinin, pinostrobin, dihydroechioidinin, tectochrysin-5-glucoside, methyl salicylate glucoside, 5,7,8-trimethoxyflavone, skullcapflavone-2-methyl ether, androechin, tectochrysin, 5,7,2'-trimethoxyflavone, echioidin, skullcapflavone ii, 5,7-dimethoxyflavone and andrographidine.

1. Flavonoids

A recent study has demonstrated the presence of twenty-three flavonoids in *T. procumbens* with total content around 65 g/kg. Kaempferol and catechin and its derivatives (-)-epicatechin, (+)-catechin, (-)-eigallocatechin, (+)-gallocatechin, (-)-Epigallocatechin-3-Gallate (EGCG) and (-)-Epicatechin-3-Gallate) account for about 17.59% and 26.3% respectively. The remaining 56.11% represent sixteen flavonoids namely biochanin, apigenin, naringenin, daidzein, quercetin, butein, robinetin, baicalein, nobiletin, genistin, ellagic acid, luteolin, myricetin, baicalin, isorhamnetin and silymarin [8].

Test for flavonoids and flavones

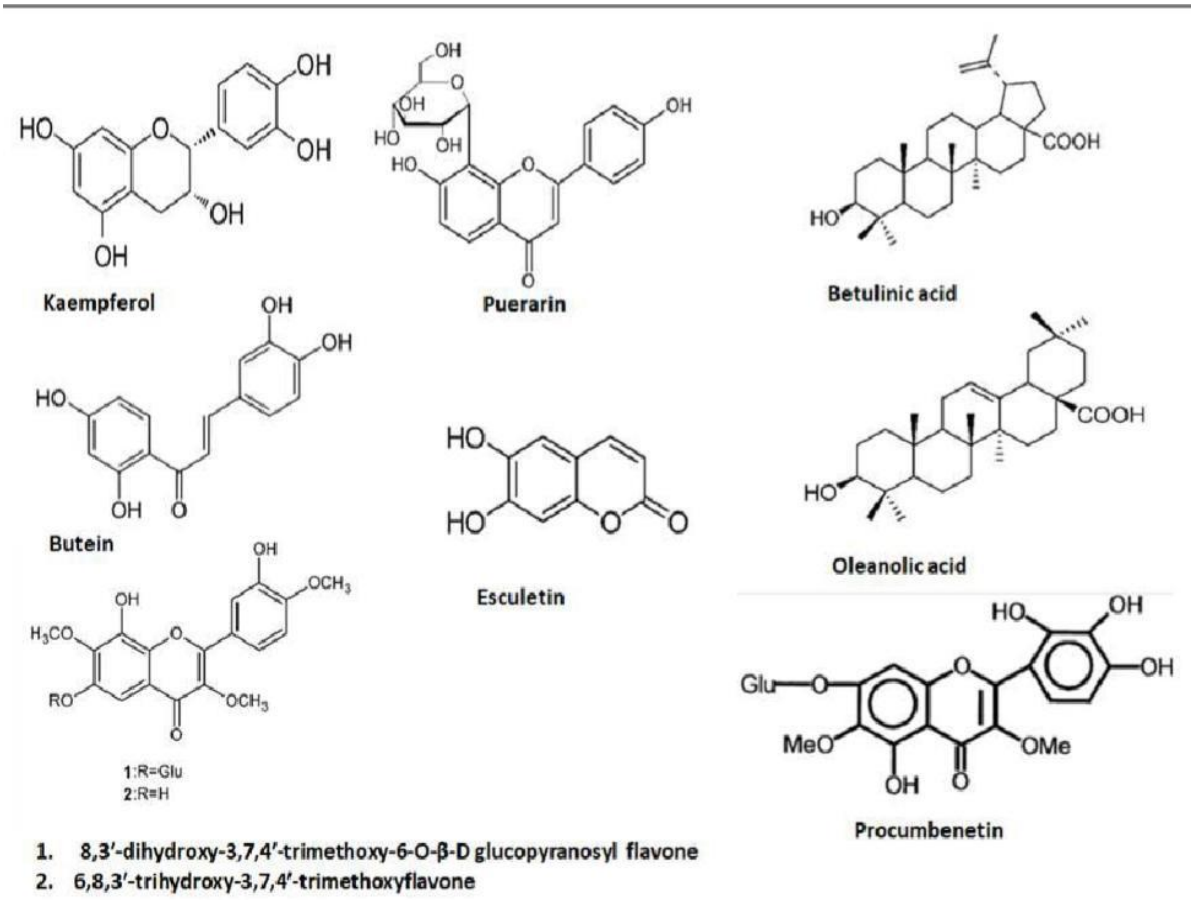
4 ml extracts were treated with 1.5 ml of 50% Methanol solution, solution was warmed and metal magnesium was added, then 5-6 drops of concentrated hydrochloric acid was added. Flavonoid solution shows red colour and flavones solution show orange colour [9].

Shinodas Test (Mg/HCl): Dissolved a small amount of the extract in methanol or ethanol, a few magnesium turnings and a few drops of 5m HCl were also added. Development of deep red or magenta colour indicated the presence of flavanones and dihydroflavanols [8].

The flavonoids detected in *T. procumbens* are known to mediate pharmacological activities including free radical scavenging, antiinflammatory, antiallergic, antiplatelet aggregation, and antimicrobial, antiulcer, antiviral, antitumor and antihepatotoxicity. Two new flavones, 8,3′-dihydroxy-3,7,4′-trimethoxy-6-O-β-D-glucopyranosylflavone and 6,8,3′-trihydroxy-3,7,4′-trimethoxyflavone were isolated from the whole plant along with four known compounds puerarin, esculetin, oleanolic acid and betulinic acid (Figure 1) exhibiting antioxidant activity new flavonoid procumbenetin, from the aerial parts of *T. procumbens,* has been characterized as 3,6-dimethoxy-5,7,2',3',4'-pentahydroxyflavone 7-O-β-D-gluco-pyranoside based on spectroscopic techniques and by chemical means. Kaempferol is the main

flavonoid found in the leaves of *T. procumbens L*, the structure of which is shown in Figure 1. Preclinical studies have shown that kaempferol and its glycosidic derivatives exhibit wide range of medicinal properties such as antioxidant, analgesic, antiinflammatory, antimicrobial, antifungal, anticancer, cardioprotective, neuroprotective, hepatoprotective,antidiabetic,hypocholesterolemic,hypotriglyceridemic, antiosteoporotic, estrogenic/antiestrogenic, anxiolytic and antiallergic activities (Figure 7) [11-14].

Figure 7. Structure of flavonoid identified in *T. Procumbens.*



Kaempferol has many beneficial effects on inflammatory diseases by mediating antiinflammatory or immunomodulatory activities. It inhibits various signalling pathways and suppresses matrix degrading enzymes[3].

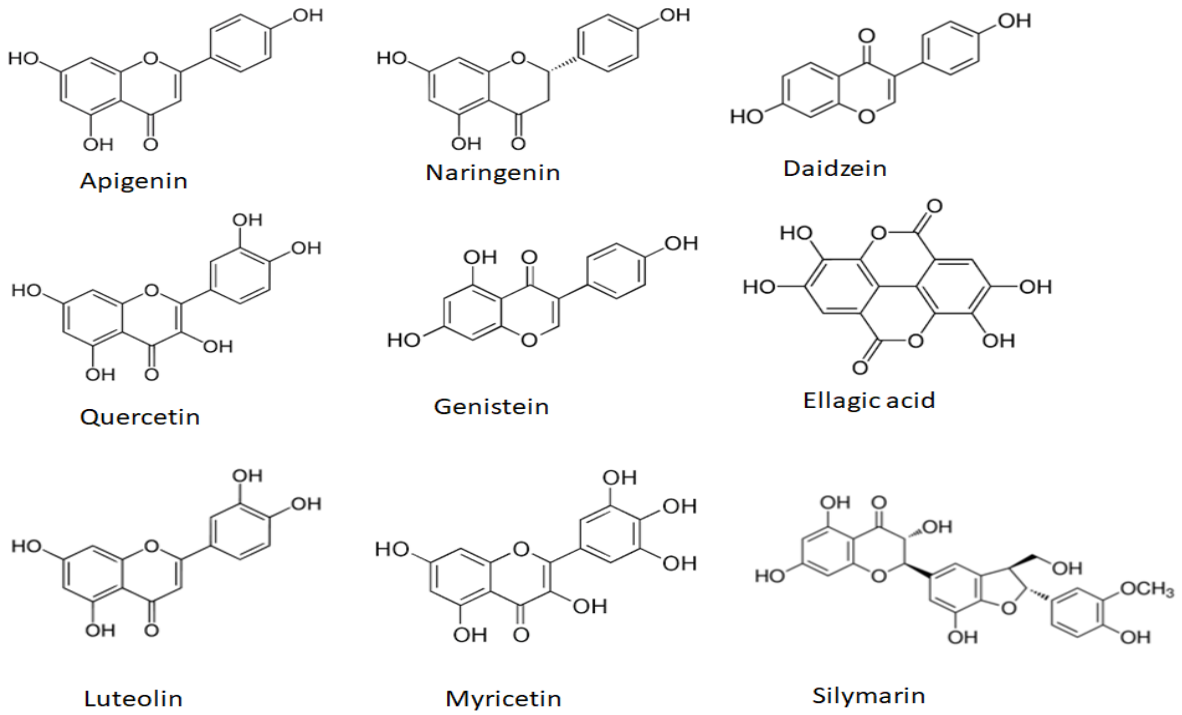
2. Alkaloids

A recent study by Ikewuchi et.al demonstrated that the total alkaloid content in the leaves of *T. procumbens L* were 102.421 g/kg and 10.191 g/kg of dry and wet weight respectively [3].

Alkaloids are defined as any class of nitrogenous organic compounds of plant origin that have pronounced physiological effects on humans. The presence of some alkaloids has also been reported in *T. procumbens*. In a phytochemical screening analysis, using aqueous extraction of the leaves, thirty-nine alkaloids were present, mainly Akuamidine (73.91%) and Voacangine (22.33%). Besides alkaloids, the extract contained sterols and tannins. Alkaloids of the pedicle and buds of *T. procumbens* showed antimicrobial activity against *Proteus mirabilis* and Candida albicans ; alkaloids from buds showed activity against *E. coliand* Trichophyton mentagrophytes. The total

amount of alkaloids in the pedicle was 32.25 mg/gdw in the pedicles and 92.66 mg/gdw in the buds. The presence of these alkaloids points once more to the great potential of this plant (Figure 8) [2].

Figure 8. Structure of Some Other Flavonoid Present in *T. Procumbens.*



Test for alkaloids:

1 ml plant extract was treated with a few drops of Mayer's reagent. White–yellowish precipitate produced immediately which indicated the presence of alkaloids. Alkaloids are precipitated from neutral or slightly acidic solution by Mayer's reagent [9].

Mayer's test: One or two drops of Mayes's reagent were added to the acidified plant extract. A white precipitate indicated the presence of alkaloids. Mayer's reagent: - HgCl2 (1.36 g) was dissolved in 60 ml distilled water and mixed with a solution of 5 g of KI in 10 ml water. As this reagent reacts only with the salts of the alkaloids, the solution made distinctly acidic with HCl or H_2SO_4.

Wagner's test: Alkaloids gave brown flocculent precipitate with wagers reagent. Wagner's reagent: - 1.27 g of iodine and 2 g of KI were dissolved in 5 ml of distilled water and the solution was made up to 100 ml with distilled water.[8]

3. Saponins

Saponins are steroidal glycosides that contain pharmacological and medicinal properties and have been detected in *T. procumbens*, specifically a steroidal saponin and pB-Sitosterol-3-O-β-D-xylopyranoside in the flowers of the species. Another study determined that saponins from an ethanolic extract of *T. procumbens* could potentially contain antidiabetic properties by inhibiting the sodium glucose co-transporter-1 (S-GLUT-1) in the intestines of male Wistar albino rats[2].

Test for saponins (foam test):

1 ml of the extract was added to 2 ml of distilled water and shaken for few minutes in a test tube. 1 cm layer of foam for 10 minutes indicates the presence of saponins[9].

Shaken an aqueous/ alcoholic plant extract in a test tube and apersistent foam indicates the presence of Saponins [8]

4. Tannins

Tannins are naturally occurring water-soluble polyphenols found in plants. Tannins have anti-microbial properties, as well as anti-carcinogenic and anti-mutagenic properties, potentially because of their antioxidant capabilities. Several researchers have described the presence of tannins in *T. procumbens*. Acetone-water or Chloroform-water showed the presence oftannins in leaf extracts of *T.procumbens*. Tannins are present in the pedicle and buds of *T. procumbens* [2].

5. Carotenoids

Carotenoids are fat-soluble pigments found in the leaves that have three main functions in a plant: light-harvesting, protection from photooxidative damage, and pigmentation to attract insects. Carotenoids have been postulated to prevent damage to DNA by oxidative stress. Many types of these secondary metabolites have been isolated from *T. procumbens* including beta-carotene, which can be converted to vitamin A, which is important for maintenance of epithelial tissues. Vitamin A deficiency can result in impairment of immunity and haematopoiesis, night blindness, and Xerophthalmia. Carotenoids such as beta-carotene and lutein have shown activity in the reduction of UV-induced erythema. The photoprotective properties have also been linked with the antioxidant properties of carotenoids [2].

6. Primary metabolites

Primary metabolites involved in metabolic pathways present in all plants. There are a few specific primary metabolites that have been extracted from *T. procumbens:* Lipids are essential in living organisms; they influence the communication between cells, the cellular makeup, and act as an energy source for the organism. T. procumbenscontains common fats found in the *Asteraceae* family. This species also exhibits some lipids that give the plant unique properties and promising medicinal uses.These unique fats have been extracted and include: methyl 14-oxooctadecanoate, methyl 14 oxononacosanoate, 3-methylnonadecylbenzene, heptacosanyl cyclohexane carboxylate, 1(2,2-dimethyl-3-hydroxypropyl)-2-isobutyl phthalate, 12-hydroxytetracosan-15-one, 32-methyl-30-oxotetratriacont-31-en-1-ol and 30-methyl-28-oxodotriacont-29-en-1-oic acid dotriacontanol, β-amyrone, Δ12-dehydrolupen-3-one, β-amyrin, lupeol, fucosterol, 9-oxoheptadecane, 10-oxononadecane and sitosterol. All these compounds play essential roles in plants and are common to many species [2].

7. Secondary metabolites

Secondary metabolites are compounds produced by plants that are not essential for the normal growth and development of the plant, but play an important role in plant defenses, communication, stress responses and others. Secondary metabolites contain bioactive compounds that often have useful and important medicinal properties. Some of the most important bioactive compounds for medicinal usesare found in compounds such asglycosides, nitrogenousorganic compounds, fat-soluble compounds, polyphenolic compounds, and minerals procumbens secondary metabolites [2].

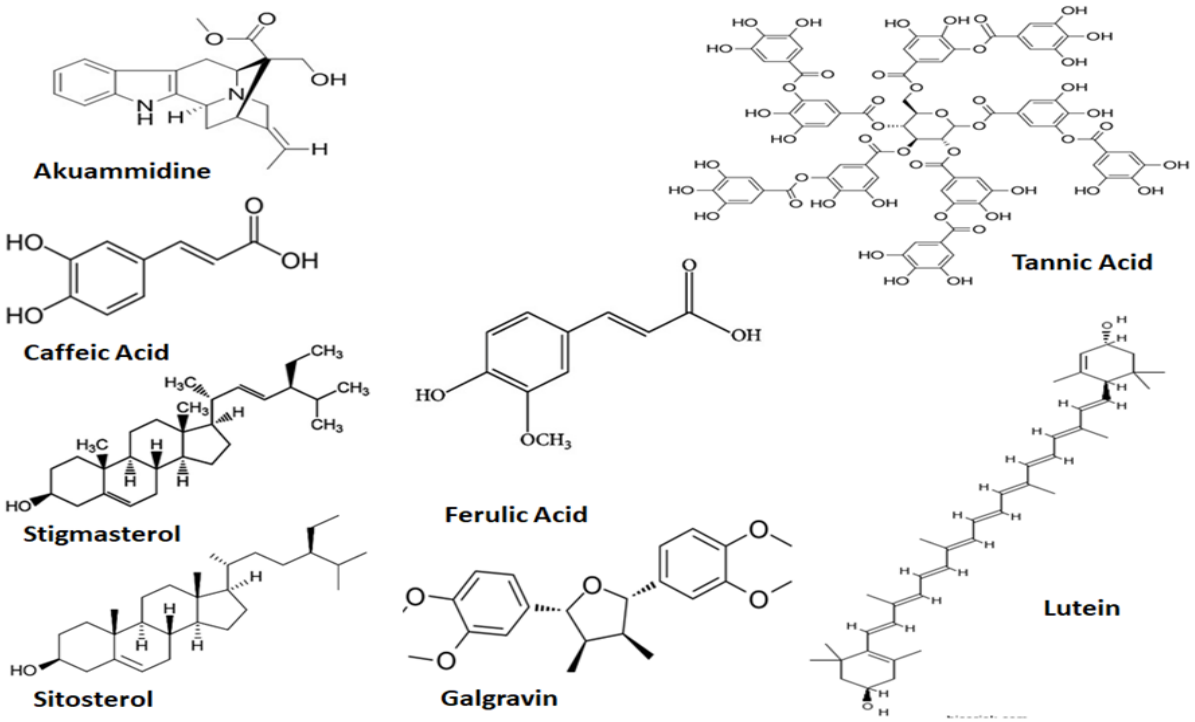
8. Other phytochemicals

The other bioactive molecules in the leaves of *T. procumbens* include caffeic acid, ferulic acid, tannins, stigmasterol and lutein. *In vitro* studies have shown that caffeic acid and ferulic acid have antioxidant, antiinflammatory, anticancer and antimicrobial activities. Tannic acid and other hydrolysable tannins have multiple health benefits including reduced risk of cardiovascular disease, anticancer, antidiarrheal, antiobesity, antibacterial, antiviral, antifibrotic and neuroprotection. One of the molecular mechanisms attributed to tannin's health benefits is the inhibition of Ca^{2+} activated Cl- channels. Stigmasterol has pharmacological activities such as antiosteoarthritic, antihypercholestrolemic, cytotoxicity, antitumor, hypoglycaemic, antimutagenic, antioxidant, antiinflammatory and analgesic. Lutein, a type of xanthophyll carotenoid has beneficial effects against Age-related Macular Degeneration (AMD), Age-Related Cataract (ARC), ischemic/hypoxia induced retinopathy, light damage of the retina, retinitis pigmentosa, retinal detachment, uveitis and diabetic retinopathy, lung and breast cancers, heart disease and stroke [3].

T. procumbens use as a traditional medicine throughout various regions of the world has led to many publications on its phytochemistry. The discovery of new bioactive compounds can lead to the development of new drugs for the

treatment of various ailments. Different extraction techniques used to isolate various compounds found in *T. procumbens* will be discussed in below [2]. The components of chemical present in plant are the oleanolic acid, fumeric acid, fl-sitosterol and tannin. In leaf extract contains alkaloids, carotenoids, flavonoids (catechins and flavones), saponins and tannins (Figure 9).

Figure 9. Other phytochemicals present in *T. procumbens.*



The components of chemical present in plant are the oleanolic acid, fumeric acid, fl-sitosterol and tannin. In leaf extract contains alkaloids, carotenoids, flavonoids (catechins and flavones), saponins and tannins. Calcium, magnesium, potassium, sodium and selenium are the composition of minerals present in leaves. Luteolin, glucoluteolin, quercetin and isoquercetin in flowers. Leaf contains crude proteins–26 percentage, crude fiber-17 percentage soluble carbohydrates–39 percentage calcium oxide-5percentage. Reports from pharmaceutical chemistry showed that there were many isolated constituents from T. procumbens, including: saturated and unsaturated fatty acids, terpenoids, flavonoids, lipids, polysaccharides, such as β-sitosterol, puerarine, dexamethason, esculetin, oleanolic acid, lupeol, quercetin, isoquercetin, fumaric acid, centaureidin, and luteoline. Two different Compounds isolated from ethyl acetate extract named β-sitosterol-3-O-β-D-glucopyranoside (daucosterol) and 3′,5-dihydroxy-4′,3,6-trimethoxyflavone-7-O-β—glucopyranoside (centaurein) daucosterol and centaurein also reported in the rootof *T. procumbens*. Leaves juice contains dexamethasone. Isolation of methyl 14-oxooctadecanoate, methyl 14-oxononacosanoate, 3-methyl-nonadecylbenzene, heptacosanylcyclohexane carboxylate. Arachidic, behenic, lauric, linoleic, linolenic, myristic, palmitic, palmitoleic and stearic acids (Table 5) [5].

Table 5. Compounds/activity of *T. procumbens.*

Extraction	Compounds/activity	Plant organ
Aqueous	Antidiabetic compounds	Aerial parts
Chloroform, Acetone	Tannins,condensed catechic	Leaves
Ethyl acetate, aqueous, ethanol	Flavonoids, kaempferol, (-)-Epicatechin, Isoquercetin, and Glucoluteolin	Leaves, Stem, Root, and Flowers
Aqueous	Alkaloids, Akuammide and Vaucangine	Leaves.
Methanol-dichloromethane	Bioactive components for antifungal activity against dermatophytes.	Aerial parts.
Ethanol-acetic acid	Alkaloids for antimicrobial activity, against human pathogens, antioxidant, Hepatoprotective	Pedicle and buds.
Petroleum Ether	Antioxidant uses against DPPH.	Dried plants.
Distilled Water-ethanol	Immuno-modulatory effects in rats.	Aerial parts.
methanol -n-butanol	Isolation of antioxidant chemicals, mostly flavonoids and saponins	Dried leaves.
methanol-ethyl acetate	Isolation of antioxidant chemicals for testing: mostly Flavonoids and saponins.	Dried leaves.
Ethanol	Saponin B-Sitosterol-3-O-β-D-xylopyranoside.	Flowers
Petroleum ether, ethanol	Anti-ulcerogenic effects	Leaves
Hydro-distillation	Essential oil, anti-microbial and anti-inflammatory effects. Terpenes, alpha and beta pinenes	Leaves.
Ethanolic extract	Phytochemical screening: alkaloids, glycosides	Whole plant dried.

Test for others phytochemicals

Test for the detection of glycoside/reducing sugar:

Benedict's test - The extract was mixed added with Benedict's reagent in equal amount and the mixture was heated for 2 minutes. The appearance of brown to red colour indicated the presence of glycoside.

Test for protein

Xanthoprotein test:- A small amount of the extract was mixed with 0.5 ml of concentrated HNO_3, appearance of white or yellow precipitate revealed the presence of the protein.

Test: - A small amount of the extract was added to 0.5 ml of 4% sodium hydroxide solution followed by a drop of 1% copper sulphate solution. The development of violet to pink colour indicated the presence of protein.

Test for carbohydrate

Molisch's test: 100 mg of the substance was dissolved in 1 ml water and 2 drops of 1% alcohols solution of alpha-naphthol was added to it. 1 ml of con.H_2SO_3 was added along the sides of the test tube, so that it formed a heavy layer at the bottom. A deep violet ring at liquid junction indicated the presence of carbohydrate. Phytochemical screening tests are done in 2 extracts of whole plant *viz* acetone and methanol extracts. Acetone extract of whole plant shows the presence of coumarins, quinines, steroids, alkaloids, tannins, resins, proteins and carbohydrates.

Methanol extracts of whole plants showed the presence of coumarins, tannins, alkaloids, quinines, flavonoids, resins, Proteins and carbohydrates [8].

Medicinal uses and traditional uses

Aqueous leaves extract possesses cardiovascular effect and significantly reduces heart rate and blood pressure. Lyophilized aqueous leaf extract showed anti-inflammatory action comparable to ibuprofen and aspirin. Whole arial parts have hepatoprotective, antisecretory (antidiarrheal) activity. It is active against bacteria, protozoa and fungi. Leaf juice is useful in dead space wound healing. Seeds are used to check all types of bleeding. Aqueous extract of whole arial part is used as immunomodulator. Dry extract showed antibiotic activity even when formulated in mineral base [1].

Traditional and complementary medicine is being increasingly recognized as an integrative approach to health care in many countries (WHO, 2013). The use of plants for medicinal purposes may date back to the Middle Palaeolithic age, approximately 60,000 years ago. *T.procumbens* isfound throughout the world and it has been used to treat anemia, colds, inflammation, and hepatopathies in Central America in Guatemala, T. procumbens is used as an antibacterial, antifungal, and antiviral treatment as well as for vaginitis, stomach pain, diarrhea, mucosal inflammations, and skin infections. The leaf juice is used to treat wounds and stop bleeding. A study done in Chiquimula, Guatemala, showed that lactating pregnant women suffering from anemia could reduce their symptoms by using *Tridax*. This species is also used in the treatment of gastrointestinal and respiratory infections, high blood pressure, and diabetes. In Guatemala, the entire plant is used for the treatment of protozoal infections, including malaria, leishmaniasis and dysentery. Aqueous extracts of *T. procumbenshave* strong anti-plasmodial activity against chloroquine-resistant *P. falciparum* parasites it has activity against *Trypanosoma brucei*, antibacterial and wound-healing properties. Scientific support for several of these traditional uses will be discussed later.

Traditional uses

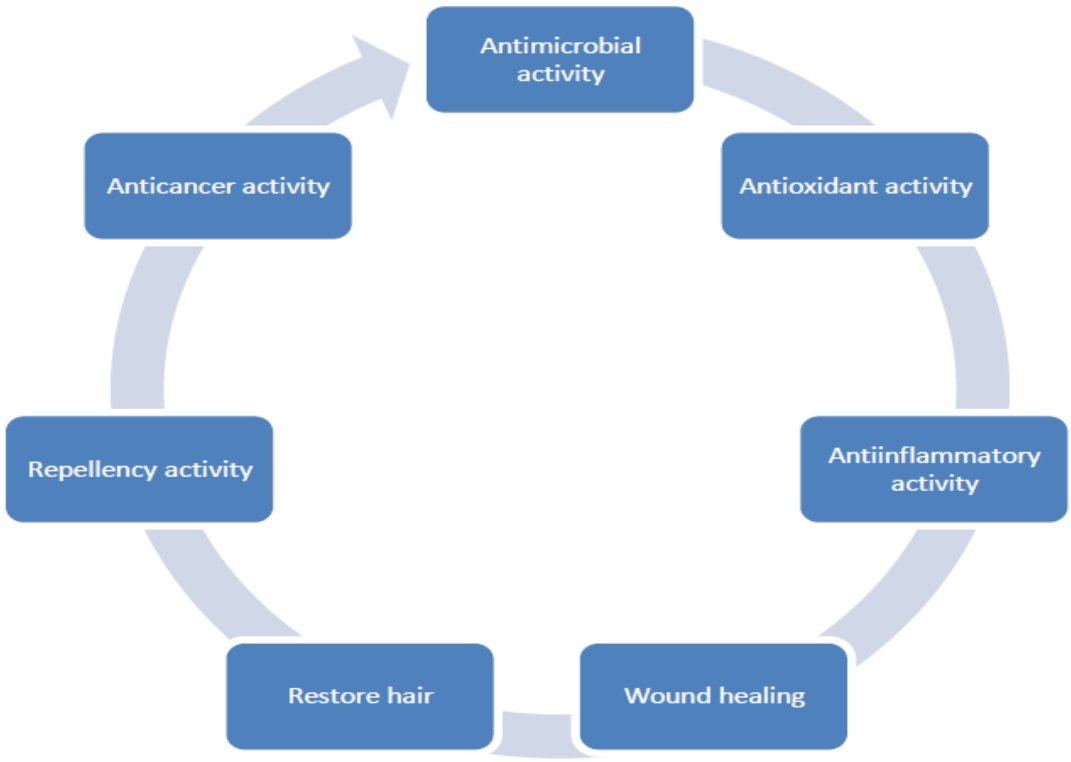
In Nigeria, the entire plant is used to treat typhoid fever, cough, fever, stomachache, backache, diarrhea and epilepsy. Farmers in Africa use the plant for treatment of livestock for example, Tridax is used along *Vigna parkeri* to treat chronic mastitis by grinding both plants, and adding salt and water and applying to the udder studied the antibacterial effect of *Tridax* against mastitis-causing bacteria and found that the ethanolic extract had significant activity against Staphylococcus aureus. However, there was little or no activity from the aqueous extracts against *Streptococcus uberis* and *Klebsiella penumonia*, in comparison with *Spathodea campanulata* extracts. In Benin, breeders complement the feed of rabbits or other livestock combining with other plants; although rabbits consume it in lower amounts than other fodder, probably due to low palatability. In Togo, the fresh, crushed leaves are used for dressing wounds. The decoction of the leaves is used against pain, to treat malaria, and against abdominal and gastrointestinal mycosis. In India it is known as an insect repellent, used to treat diarrhea, and to help check for hemorrhages. In addition, some reports include the use as a cure for hair loss. A study in Tamilnadu, India, revealed that native inhabitants apply the juice from the leaves for the healing of wounds. The same study also infers that T. procumbens is one of the most useful traditional medicinal plants. It has also been shown to have many minerals like calcium, selenium, magnesium, potassium and sodium. The people in Udaipur, India, have traditionally ingested powdered *T. procumbens* leaves, along with other herbs, to treat diabetes. The species has shown to be a great source of potassium, which is used for the treatment of cramps and a safe source ingredient for future medicinal uses. These traditional uses demonstrate the potential uses of this plant [2].

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 [4].

Pharmacological activities

Tridax procumbens having various potential therapeutic activities like antimicrobial activity, anti-oxidant, antibiotic efficacies, wound healing activity, insecticidal, anti-inflammatory activity, diarrhea and dysentery. Leaf juice is used to cure fresh wounds,to stop bleeding, as a hair tonic. In India, *Tridax procumbens* mainly used for wound healing, as anticoagulant, antifungal and insect repellent. In folk medicines leaf extract were known to treat infectious skin diseases. It is a well-known medicine for liver disorders or hepatoprotective nature besides gastritis and heart burn. Tridax procumbens is used as bioabsorbent for removal of harmful Cr (VI) from the industrial waste water (Figure 10)[5].

Figure 10. *Tridax procumbens* having various potential therapeutic activities.



1. Antibacterial activity- The *Tridax procumbens* having antibacterial activity which was tested against the *Pseudomonas aeruginosa*. Pseudomonas is the nosocomial strain which was isolated from ventilator associated with pneumonia patient secretions like tracheal secretions and broncho alveolar lavage. This study reported that the ethanolic extract showed very good anti-bacterial activity against *Pseudomonas aeruginosa*. Increased zone of inhibition is at the concentration of 5 mg/ml. The strain was compared to some control antibiotics like augmentin, ciprofloxacin, cephotaxime and even ticarcillin showed resistant whereas the sensitivity only to imipenem. This report was a statistically significant because the ethanol extract of *tridax* having inhibition zone against the leading gramnegative bacteria associated with nosocomial infections.

Whole plant of *Tridax* is having antibacterial activity. In this whole plant extract with two Gram positive (*Bacillus subtilis, Staphylococcus*) and two Gram negative *(Escherichia coli and Pseudomonas aeruginosa)* bacteria. This report showed that the effective antibacterial activity of *Tridax* whole plant only against with *Pseudomonas aeruginosa* by the method of Disc diffusion.The leaf extract of *Tridax procumbens* used for the analyzing of antibacterial activity by using various solvents like hexane, chloroform, butanol, ethanol and water.

Antibiotic test carried out with *Escherichia coli, Pseudomonas aeruginosa, Micrococcus sp., Staphylococcus aureus, Proteus vulgaris, Klebsiella pneumoniae, Bacillus subtilis, Citrobacter sp.and Serratia marcescens* by disc diffusion method. Gram negative bacteria showed the more zone of inhibition reported in this study. Antibacterial activity was carried out with different solvent extracts *Tridax procumbens* leaf against *Staphylococcus aureus*, *Escherichia coli, Proteus mirabilis* and *Vibrio cholerae*. In this study 5 different solvents like hexane, petroleum ether, chloroform and methanol were used. Antibacterial activity tested against both gram positive (*Staphylococcus aureus* and *Bacillus subtilis*) and gram negative (*Enterobacter aerogenes*) by using Agar well diffusion method. Results indicated that more bioactive compound present in methanol than in hexane extract. Three different enteropathogens are tested against methanol extract of *Tridax procumbens* by disc diffusion method. The methanol extract showed highest activity against *Salmonella typhi, Shigella flexneri* and least activity against *Escherichia coli* [5].

2. Antifungal Activity– Antifungal activity of *Tridax procumbens* with whole plant extract used against the phytopathogenic fungi, Aspergillus niger and the leaf extract was tested against *Fusarium oxysporum* and the results showed that good antifungal activity. Essential oil extracted from *Tridax procumbens* have reported to antifungal activity against 3 different fungi *Candida albicans, Candida tropicalis and Candida parapsilosis* about 12

–15 mm zone of inhibition. The bioactive compound of flavonoids from *Tridax procumbens* tested for potential antifungal activity against *niger, Aspergillus flavus, Candida albicans an Trichophyton* sp. and the report showed higher sensitivity of *Candida albicans* indicating the antifungal potential of flavonoids from the plant.

Methanol extract of *Tridax procumbens* prepared from different parts of plant like leaf, stem, flower and root showed significant inhibitory activity against *Candida albicans* (MTCC 227 and MTCC 3017). The inhibition zone ranging is from 8 mm to 13 mm at 100 mg/ml concentration. The methanol extract of root exhibited antifungal activity against *Candida tropicalis* and *Candida glabrata*. While the methanol leaf extract of *Tridax procumbens L,* exhibited the susceptibility of *Candida albicans* and *Candida tropicalis*. This evidence supports for the presence of bioactive compounds in the root extract of methanol possess the better and effective anti-candidial drug in future. By using natural fungicidal agents, we reduce the usage of commercial chemical fungicides and its hazardous side effects. In future the extract of *Tridax procumbens* become effective therapeutic management of *Candida* infections [5].

3. Hypotensive effect- The hypotensive effect of *Tridax procumbens* leaf was investigated on anaesthetized Sprague-Dawley rat. They showed that leaf of aqueous extract having cardiovascular effect and it has ability to cause significant dose dependant decreases in the mean arterial blood pressure. The higher dose indicates significant reduction in heart rate whereas lower dose did not cause any changes in the same. They were reported that leaves of *Tridax procumbens* Linn. possess hypotensive effect [5].

4. Immunomodulatory- The ethanol leaf extract of *Tridax* have immunomodulatory effect which wascarried out in Albino rats dosed with *Pseudomonas aeruginosa* also inhibits proliferation of same *Tridax procumbens* aqueous extract tested for immunomodulatory activity. Phagocytic index, leukocyte count and spleenic antibody secreting cells are significantly increased which was reported to aqueous extract of *Tridax* in ethanolic insoluble fraction. Stimulation of humoral immune response was also observed along with elevation in heamagglutination antibody titer. Also, this study reveals that *Tridax* influences both humoral as well as cell mediated immune system [5].

5. Antidiabetic activity- The alcohol and water extract of *Tridax procumbens* Linn. leaves having antidiabetic activity which is significantly decrease in the blood glucose level. Antidiabetic activity tested in the model of alloxan induced diabetis in rats *T. procumbens* methnol extract of 50 percent of acute and sub chronic dose administrated by oral shows to reduces fasting blood glucose levels in diabetic rats. This plant material does not affect the sugar levels in normal rats [5].

6. Anti-inflammatory- The anti-inflammatory activity of *Tridax procumbens* extract was assessed oncarrageenin induced paw edema along with standard drug, Ibuprofen. The inhibition zone was comparable with extract of *Tridax* and. The *Tridax* extract increased the inhibition of edema if treated with standard drug Ibuprofen. Drug Ibuprofen with extract of *Tridax* showed significant anti-inflammatory activity. Water soluble powder of *Tridax* leaf extract was administrated orally at different doses to rats. The results demonstrated that the extract possessed analgesic activity. *Tridax procumbens L*. dose reduced the abdominal writhing *Tridax* alcoholic and hydro alcoholic extract of anti-inflammatory activity by using the rat-paw edema assay and showed edema inhibition in the percentage of 10.82, 16.80 and 11.39 [5].

7. Antioxidant activities- The *T. procumbens* having the total phenol expressed as Gallic Acid Equivalent (GAE) show a high phenolic content of 12 mg/g GAE. The result indicates that having some relationship between the content of phenols in medicinal plants and antioxidant activity. Many of the earlier reports support this finding that plant secondary metabolites like flavonoids, tannins, catechins and other phenolic compounds possesses potential antioxidant activity. The unique bio active compounds played a preventive role in the development of cancer, heart and age-related diseases. They have also been reported to be chemo-preventive agents by lowering cholesterol and repairing damage cells. The DPPH is relatively stable Nitrogen centered free radical that easily accepts an electron or hydrogen, it reacts with suitable reducing agents as a result of which the electrons become paired off and the solution losses color depending on the number of electrons taken up. The *Tridax procumbens* extracts were evaluated for *in vitro* antioxidant activities. DPPH method provides a suitable assessment for the evaluation of in *vitro* antioxidant activity. It is based on reaction between antioxidant (AH) with nitrogen centered free radical i.e., DPPH (1, 1-diphenyl, 2- picryl hydroxyl). In the methanol extract of ethyl acetate and n-Butanol fractions have shown significant activity. 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

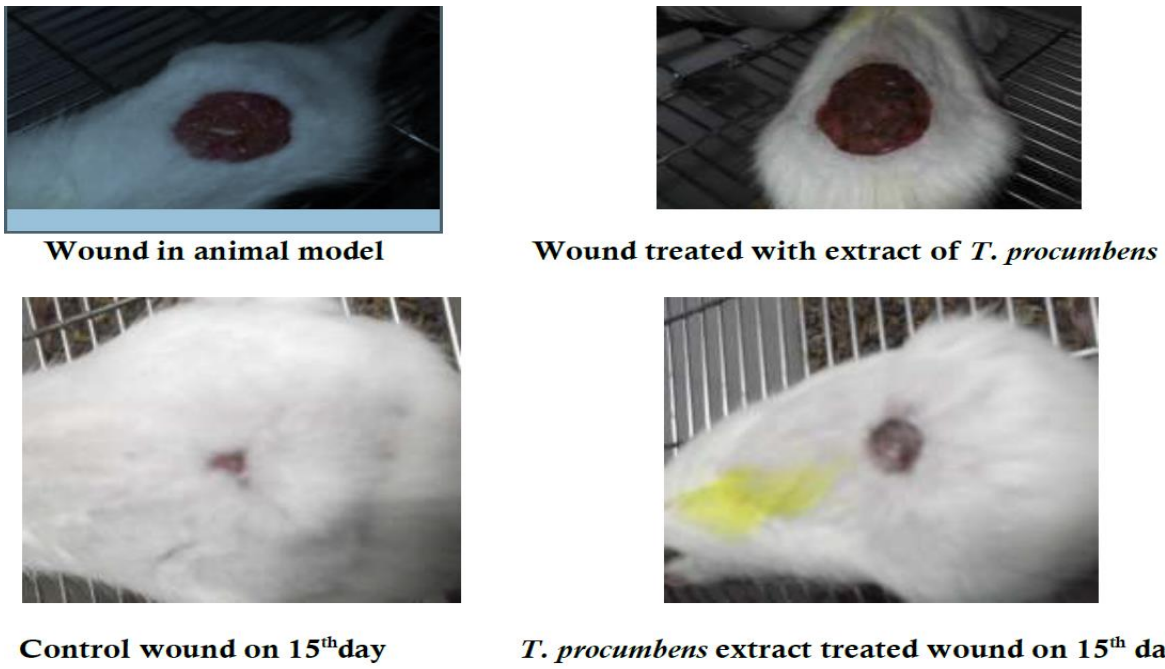
8. Hepatoprotective activity- The aerial parts of *Tridax* shows hepatoprotective activity. The plant posse's significant protection in alleviation of D-Galactosamine/Lipopolysaccharide (DGalN/ LPS) induced hepatocellular injury. D-GalN/LPS have been proposed to be hepatotoxic due to its ability to destruct liver cells. The multifocal necrosis produced by D-GalN and the lesion of viral hepatitis in humans are similar. This amino sugar is known to selectively

block the transcription and indirectly hepatic protein synthesis and as a consequence of endotoxin toxicity, it causes fulminant hepatitis within 8 hrs after administration [5].

9. Wound healing activity- Wound healing is a complex and dynamic process has the ability to restore the cellular structures and tissue layers. Whole plant of *Tridax procumbens L*. Water extract has ability to set the normal and immune compromised wound healing in rats. Tridax antagonized antiepithelization and tensile strength depressing effect of dexamethasone (a known healing suppressant agent) without affecting anticontraction and antigranulation action. The mechanism of wound healing process of this plant material involves complex interaction between dermal and epidermal cells, the extra cellular matrix, controlled angiogenesis and plasma-derived proteins all coordinated by an array of cytokines and growth factors.

The plant not only increase lysyl oxidase but also, protein and nucleic acid content in the granulation tissue, probably due to increase of glycosamino glycan content. Wound healing property of *Tridax procumbens* aqueous and ethanol extract of whole plant by using animal models. In this study both excision and incision wounds are treated with both extracts of plant. Incision wound treated with extract for 14 days. On 14th day after wound healing capacity is measured by using Tensiometer. A small portion of the incised skin was sent for histopathological examination for assessing reepithelization and collagen formation. In excision wound treated with plant extract for 15 days. Every three days once the changes in wound area were monitored. The wound area was evaluated by using graph paper. *Tridax procumbens* showed significant increase in Hydroxyproline, Collagen and Hexosamine content which shows the effective wound healing action (Figure 11) [5].

Figure 11. Wound healing activity of *Tridax procumbens.*



10. Anti-cancerous activity- The anticancer activity of *Tridax procumbens* was tested on prostate epithelial cancerous cells PC3. *Tridax flowers* were extracted with water and acetone. Anticancer activity was determined by MTT assay with cell viability. Both extracts were tested on cell viability assay. In this experiment the basic process based on the yellow soluble salt MTT changed into to purple blue insoluble Formazan precipitate. This process carried out by the mitochondrial succinate dehydrogenase which is produced by viable cells. Viable cells are quantified spectrophotometrically at 570 nm. The acetone flower extract showed 82.28 % cancer cell death within 24 hrs and water extract exhibited a very weak anticancer activity. The results of this analysis revealed the fact that flower crude extract has anti-cancer activity [5].

11. 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 [5].

12. Hemostatic activity- *Tridax procumbens* leaves of different extract were tested for hemostatic activity. This process carried out by studying the clotting time of 10 human volunteers by *in vitro* method. Ethanol extract of plant showed positive activity. The ethanolic extract of the *Tridax procumbens* leaf reduces the clotting time uniformly in the blood samples. This study showed that the hemostatic activity, thus affecting haemostasis [5].

13. Anti-arthritic activity- The inflammatory disorder which involves damage to one or more joints is known as Arthritis. It is increasing due to the low consumption of fluids, as a result of the hectic lifestyle. Many studies have been done to report the arthritic effect of *Tridax procumbens* ethanol extract at dose of 250 mg/kg and 500 mg/kg. Indomethacin (10 mg/kg) was used as the standard. The whole plant extract of *Tridax procumbens* showed significant anti-arthritic activity in the Freud"s Complete Adjuvant model. The results were comparable with that of Indomethacin [5].

14. Anti-juvenile hormone activity- Topical application of fraction of petroleum ether extract of *T. procumbens* showed remarkable effect on metamorphosis of Dysdercus and were found to be notable in generating abnormalities in adults due to juvenile hormone activity. Of fifteen plants tested, five plant extracts showed anti-juvenile hormone like activity against laboratory colonized late fourth instar larvae and adult female mosquitoes. Petroleum ether extract of *Eichhornia crassipes* and acetone extracts of *Ageratum conyzoides*, *Cleome icosandra*, *Tagetes erectes* and *T. procumbens* showed growth inhibitory and juvenile hormone mimicking activity to the treated larvae of *C. quinquefasciatus*. Larval pupal intermediates, demalanised pupae, defective egg rafits and adult with deformed flight muscles were few noticeable changes. Biting behavior was observed to be affected only in ageratum, cleome and *T. procumbens* extracts. Loss of fecundity was observed in the treated mosquitoes but no sterilant effects could be seen. Adults, obtained from larvae exposed to the plant extracts produced significantly shorter egg-rafits than in control [1].

15. Antidiarrheal/Antisecretory activity - Alcohol, hexane, chloroform, butanol and aqueous extract of different parts of 31 indigenous medicinal plants of India were screened for their antisecretory activity against *E. coli.* The extract of *T. procumbens* showed highly significant antisecretory activity [1].

16. Air growth promoting activity - The ethanolic extract aerial parts *T. procumbens* was investigated for hair growth promoting properties. It was administrated albino rats as 10% ointment as well as orally (100 mg/kg/day) for 20 days both treatments were effective. To total the activity in extract function with different solvents are undertaken and the fraction evaluated for this property petrol fraction was found active. Column chromatography of petrol function and screening of same suggested the activity in initial function. Animals are divided in three groups of 25 animals. The rats those receives oral dose of ethanolic extract shows increased growth of the hairs whereas rats of control group remained almost devoid of hair. Some observations were recorded in the animals, which were treated with ointment. It was also observed that till 10th day of treatment there was no activity at all the process of hair growth started by 14th day and was almost complete in 21 days [1].

17. Insecticidal activity- The essential oils isolated from *T. procumbens* exhibited insecticidal activities against house flies, mosquito larvae, Dysdercus similes and cockroaches. Essential oils of *T. procumbens* are highly potent, exhibits strong insect repellent activity, when tested against three varieties of ants. It was observed during the collection of *T. procumbens* that the plant is neither attacked by nor grazed by cattle's suggesting that the plants posses' insect repellent or insecticidal activity [1].

18. Antimicrobial activity– Antimicrobial screenings have been done, but additional studies are needed to corroborate some of the results. Various species of bacteria and fungi have shown sensitivity to the antimicrobial properties of *T. procumbens*. More recently, callus of stem and leaf has shown to be useful for the synthesis of silver nanoparticles that showed some antimicrobial activity against *E. coli, V. cholerae, A. niger,* and *A flavus*. However, this activity was lower than the activity shown by silver nitrate so these results are not conclusive. Petroleum, ether and ethanolic extracts of leaves of *T. procumbens showed antibacterial* activity against *Bacillus faecalis.*This activity was reported to be probably due to the presence of alkaloids. The chloroform extracts showed antibacterial activity against *B. faecalis, B. subtilis, E. coli,and Pseudomonas aeruginosa* but the experiments need better controls and descriptions of the procedures. Essences from *T. procumbens* show the presence of alpha and beta pinenes, used in small quantities can help in treating bacterial and fungal infections. There are some contradictory results about the antimicrobial activity of this species. Some studies did not include significant biological activity compared to the antibiotic control but there is evidence for the potential of this species as anti-microbial so more studies need to be done in this area [2].

19. Antiparasitic activity- Treatment of some diseases caused by protozoal infections like malaria dysentery, colic, and vaginitis have been assessed with *T. procumbens* through a bioassay guided fractionation with a methanol extract to isolate an active compound, (3,S)-16,17-Didehydrofalcarinol (an oxylipin). *Tridax* seemed to have anti-leishmanial activity when using crude extracts from the whole plant. A study done in Ghana tested the antiplasmodialeffect of aqueous, chloroform, ethyl acetate, and ethanolic extracts from the flowers, leaves, and stem of *T. procumbens*. There is evidence that the aqueous and ethanolic extracts from the species have anti-plasmodial properties; a study using the tetrazolium-based colorimetric assay showed that *T. procumbens* helped protect red blood cells from *P. falciparum* damage. *Tridax* shows a great potential against a disease that kills millions of people around the world [2].

20. Anti-ulcer activity- The antiulcer activity of methanolic extracts of *Tridax procumbens* was screened by Aslam Pathan et al. During this study albino rats were treated with methanol extract 100 mg/kg of *Tridax procumbens* Linn and ulcer protection activity using myeloperoxidase activity was evaluated. The results revealed that the myeloperoxidase activity of methanol extract 100 mg/kg (2.74 U/g) is lower than experimental control (4.74 U/g). From this study, it can be concluded that the methanolic extract (100 mg/kg) of the whole plant of *Tridax procumbens* Linn possesses ulcer prevention and protection activity and should be helpful for the hindrance of ulcerative colitis [4].

21. Anti-obesity activity- In a research investigation, the animal receiving treatment with the plant decoctions showed a significant reduction in total cholesterol, triglycerides, total protein, free fatty acids and elevation of high-density lipoprotein cholesterol level [7].

22. Anti-malarial activity- The water and ethanol decoctions have anti-plasmodial properties against chloroquine-resistant Plasmodium falciparum. The decoctions have low toxicities to human RBCs though further animal toxicity studies need to be carried out on the plant [7].

The aqueous and ethanolic extracts of PA and TP have ant plasmodial activity against chloroquine resistant P. falciparum parasites. The extracts have considerably low toxicities to human RBCs. These results lend support to claims of herbalists that decoctions of either TP or PA are useful medicines. These notwithstanding, more comprehensive animal toxicity studies need to be carried out on the plants, especially since humans are currently using them to treat malaria and other diseases [10].

23. Antileishmanial activity- The *Tridax procumbens* leaves extract and the Allium sativum extract combined with produce effective action against *Leishmania Mexicana*. To analyse antileishmanial activity *in vivo* assay was performed on mice injected with *Leishmania Mexicana* promastigotes. The mice were treated with either *Tridax procumbens* extract or Allium sativum extract up to 14 days. Then, the 14th day effect was monitored and compared with control group. The liver injury and other acute toxicity parameter were determined by. After 12th week period of infection, the blood sample was collected and determine by non-commercial indirect ELISA with total immune globulins. The result showed an increasing 1 type immune response in mice increased ratio of IgG2a per IgG1 indicates a tendency to raise the immune response. The mixture of both *Tridax procumbens* and *Allium sativum* extract is a promising natural treatment for the crucial disease cutaneous Leishmaniasis [5].

24. Anti-lithiatic activitY– Ethanol extract of the plant was also used for treating kidney stone disorders. It showed activity against 0.75% v/v ethylene glycol and 2% w/v ammonium chloride induced calcium oxalate urolithiasis, and hyperoxaluria induced oxidative stress in animal models. Treatment with the decoctions of the plant was able to reduce callogenesis induced urinary excretion and renal deposition of calcium oxalate and resultant lipid peroxidation, indicating anti-urolithiasis and anti-oxidant effects [7].

25. Repellency activity- Essential oils were extracted by using steam distillation from leaves of *Tridax procumbens* Linn. The extracted oil was examined against malaria parasite *Anopheles stephensi* in mosquito cages for its topical repellency effects. All essential oils were tested at three different concentrations (2, 4 and 6 percentage). Of these, the essential oils of *Tridax* exhibited relatively high repellency effect (>300 minutes 6 percentage concentration) and concluded that *Tridax* are promising as repellents at the 6-percentage concentration against *Anopheles stephensi* [5].

26. Miscellaneous- The cardiovascular effect of aqueous extract from the leaf of *Tridax* was investigated on anaesthetized Sprague-Dawley rat. The aqueous extract caused significant decreases in the mean arterial blood pressure in a dose-related manner, i.e., the extract caused greater decrease in the mean arterial blood pressure at higher dose than at lower dose also higher dose leads to significant reduction in heart rate whereas lower dose did not cause any changes in heart rate. It means that a leaf of *Tridax* has hypotensive effect 9. In one study, essential oils extracted by steam distillation from leaves *Tridax* were evaluated for its topical repellency effects against malarial vector *Anopheles stephensi (An. Stephensi*) in mosquito cages. All essential oils were tested at three different concentrations (2, 4 and 6%). Of these, the essential oils of *Tridax* exhibited relatively high repellency

effect (>300 minutes at 6% concentration) and concluded that *Tridax* are promising as repellents at 6% concentration against *An. Stephensi* 14. *Tridax* also reported for its anti-inflammatory and anti-oxidant activity when DPPD (2,2 –diphenyl-1-picrylhydrazyl hydrate) and HET–CAM (Hen's egg chorioallanthoic membrane) assay were done 17. Leaves of *Tridax* are used for promotion of hair growth also it is reported for its preventing effect on falling of hairs but this part is open for research work 11, 12. Interestingly phytoremediation technology is used for the removal of Cr (VI) in industrial wastewater and *Tridax* used asbioadsorbent. Also, *Tridax* has been used for bronchial catarrh, dysentery, diarrhoea and in the West Africa sub-region and tropical zone of the world, Traditional medical practitioners and the native peoples of these areas use the leaves of the plant as a remedy against conjunctivitis 17 Chromium (VI) is one of the highly toxic ions released into the environment throughleather processing and chrome plating industries. 97 percent Cr (VI) removal in synthetic wastewater sample was achieved when 5 g of the bioadsorbent was used [10,11].

CONCLUSION

Tridax procumbens Linn. (*Compositae)* is a weed found throughout India, it is native of tropical America and naturalized in tropical Africa, Asia, and Australia. This plant widely distributed and it's each and every part having noble pharmacological activity. The work done till todate on its pharmacological activities like hepatoprotective effect, immunomodulating property, promising wound healing activity, antidiabetic, hypotensive effect, antimicrobial, insect repellent activity, anti-inflammatory and antioxidant, bronchial catarrh, dysentery, diarrhoea also prevent falling of hairs and leads to hair growth promotion. This plant also used as bioadsorbent for removal of Cr (VI) from the industrial wastewater. This is dispensed for "Bhringraj" by some of the practitioners of Ayurveda. In future, there is huge room for research in direction of more pharmacological activities of plant and to elucidate the mechanism of action of same. The studies on plant *Tridax procumbens Linn*. also desired development of novel therapeutic agents isolated from it, as isolation of oleanolic acid a single triterpenoid is reported from this plant. This is a comprehensive review that highlights the various phytochemicals identified in *T. procumbens* together with their diverse pharmacological attributes. Since, most of the small molecules approved by FDA are derived from plant sources, it is essential to evaluate the plant in a systematic manner to identify bioactive which could lead to the discovery and development of new drugs against various ailments. Though, *T. procumbens* has been used in many traditional medicines, scientific data relating their phytochemicals with published pharmacological properties are lacking. Many of the studies have used plant extracts followed by qualitative analysis of its phytochemical constituents. Researchers should try to employ new drug discovery principles like bio-assay guided phytochemical identification, phenotypic screening using relevant cell culture models and if possible, demonstrate Pharmacokinetic-Pharmacodynamic correlation (PK-PD) to show the efficacy of the preparation. Attempts should also be made to identify the active metabolites mediating the *in vivo* efficacy to ensure standardized extract preparation. In addition, a battery of enzyme targets can be identified for different diseases and the partially purified bioactive checked for inhibitors or activators. Identification of new bioactive may serve as a chemosphere or pharmacophore to be developed as a drug using Molecular Modeling, Medicinal Chemistry and Bioinformatics approaches. Since, *T. procumbens* is reported to have many pharmacological properties; researchers should try to evaluate their properties using modern technologies.

Tridax procumbens Linn. has enormous potential for botanical, phytochemical, nutritional and pharmacological properties. From the above review study and explanation, it is observed that the plant has been extensively used in the ancient system of medicine for various biological disorders and it possess various prominent psychopharmacological activities, as it is briefly discussed in the review article. There is vast scope for research in the direction of more pharmacological activities of this plant and to elucidate the mechanism of action of the same in the future. This medicinal plant can be a vital source of herbal drugs for the pharmaceutical industry in the future as well. The present review revealed that the plant *Tridax procumbens*, Possesses varied pharmacological properties. The phytoconstituents present in them are responsible for the biological activities. The diversity of phytochemicals present in this plant provides drug lead for the development of novel therapeutic agents.

REFERENCES

1. Surendra Agrawal, et al. Pharmacological activities of Tridax procumbens (Asteraceae) Medicinal Plants. Int J Phytomed Relat Ind. 2010; 2(2): 73-78.
2. Samantha Beck, et al. A Review of Medicinal Uses and Pharmacological Activities of Tridax Procumbens (L.). J Plant Stud.2018; 7(1): 19-35.
3. Dewashish Kaushik, et al. Ethnopharmacological and Phytochemical Studies of Tridax Procumbens Linn: A Popular Herb in Ayurveda Medicine. Int J Eng Res.2020; 9(9):758-768.
4. Syed Sagheer Ahmed, et al. Pharmacognostical and Pharmacological Review on Tridax procumbens Linn. Res. J. pahrmacol. pharmacodyn.2019;1(1):11-16.
5. R. Amutha, et al. Tridax procumbens (Coat Button) -A Gift of Nature: An Overview. Pharmacological Benefits of Natural Products First Edition. Chapter – 12. 2019; 193 - 212.
6. Vinod Gubbiveeranna, et al. Ethnomedical, phytomedical Constituent And Pharmacological Activities Of Tridax Procumbens: A Review. Int J Pharm Pharm Sci. 8(2):1-7.
7. P. Ghosh, et al. Ethno biological and Phytopharmacological Attributes of Tridax procumbens Linn. (Asteraceae): Int. j. sci. res. biol. sci. 2019; 6(2):182-191.
8. Seena K. K, et al. A Pharmacognostic Screening. International. Int J Curr Res. 2017; 9(11): 60239-60242.
9. Dr. S. G. Pawar, et al. A Review and Preliminary Phytochemucals Screening Of Tridax Procumbens L. As Important Medicinal Plants. Int J Botany. 2017; 6(11): 205-206.
10. Sneha Mundada, et al. Pharmacology of Tridax procumbens a Weed: Review. Int J Pharmtech Res. 2010; 2(2): 1391-1394.
11. Sujit S, et al. Tridax Procumbens: A Medicinal Gift Of Nature. Asian J. Pharm. ASIAN J PHARM SCI. 2014; 2(4): 159 - 162.