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PHYTOCHEMICAL AND PHARMACOLOGICAL REVIEW OF TRIDAX PROCUMBENS L.

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ABSTRACT

Tridax procumbens (Asteraceae) a weed is promosing drug in Ayurveda used to cure liver disorder and wound very effectively. It contains Lutelin, Glucoluteolin, Neophytadiene, Hexadecanoic Acid, Bis–Bithiophene, Tridbisbithiophene Oleanolic Acid, α and β Pinenes, Sabinene, L–Phellandrene, Quercetin and Kaempferol. It possesses Cardiovascular Effects, Analgesic, Antipyretic, Urolithiatic, Antibacterial, Anti Cancer, Wound Healing, Antidiabetic, and Hepatoprotective, Hair growth, Repellent activity and act as Bioadsorbent. This review provides detailed information about phytochemicstry and pharmacology of *T. procumbens* which may prove to be useful for the investigators and ayurvedic scholars to establish scientific basis of uses of the plant.

KEYWORDS: *Tridax procumbens*, Hepatoprotective, Pinenes, Wound Healing, Ayurveda.

INTRODUCTION

The family Asteraceae consists of about 1400 species, out of which 674 species are found in India. *Tridax procumbens* is a common spreading annual herb, best known as a widespread weed and pest plant. It is native to Central America (tropical America) but it has been introduced to tropical, subtropical and mid temperate regions worldwide. In many countries, it is known to occur throughout Mexico, West Indies; Guatemala to South America; introduced in Florida, India, and Mauritius. *T. procumbens* is commonly known as Dhaman grass, Tikki Kasa in Hindi, Akal Kohdi. It is denoted by different names; in English as Mexican Daisy, in ayurvedic as Jayanti, in siddha/tamilas Vettukkaaya–thalai.[1] The present article is an attempt to summarized pharmacological investigation carried out on *T.*

procumbens which helps in understanding scientific basis of clinical application mention in Ayurveda classics.

classification

Taxonomy	:	
Division	:	Spermatophyta
Subdivision	:	Angiospermae
Class	:	Dicotyledoneae
Subclass	:	Cotyloideae
Order	:	Asterales
Family	:	Asteraceae
Common Name	:	Coatbuttons, Railway Weed.
Botanical Name	:	Tridax procumbens L.

Morphological features

T. procumbens is a small decumbent perennial herb having short, hairy blade like leaves. Corolla is yellow in colour. It is a semi prostate, annual, creeper herb.

1. **Leaf:** The colour of the leaf was green, with characteristic odour and acrid taste., Leaves are 3–6 cm long and 1–4 cm wide, shape was simple, opposite, lanceolate to ovate or elliptic– rhomboid; more hairy on lower surface than upper surface., often deeply lobed serrate or dentate., Appearance of leaf is rough and scabrous with irregularly toothed margin, acute apex and wedge shaped base with a cuneate base, obtuse or sub acute, acute, fleshy and pubescent
2. **Petiole** is short and easily fractured.
3. **Root:** Tridex procumbems having a tap root system.
4. **Stem:** The stem was more or less ascending, 30–50 cm high, herbaceous, decumbent branched, round, cylindrical, sparsely to very high.
5. **Flower:** Flowers are of two types:

i. Disc flowers many, the corolla narrow– campanulate, 8 mm long, bright yellow and hairy at the top, with spreading pappus of plumose hairs. Disc flowers bright yellow.

ii. Ray flowers or Marginal flowers 5 or 6, 0. 3 cm long ligules; female, with narrow corolla tube and brown ligulate limb, white or pale yellow.

iii. Heads solitary, 1. 2–1. 5 cm across, on erect, 10–30 cm long peduncle involucral bracts very hairy, the outer shorter, receptacle convex, pileate. Flowering and fruiting throughout the year.

6. Seed have pendulous embryo, endosperm is absent.[2]

Nutritional value

T. procumbens can serve as a good source of plant protein 26%, crude fiber 17%, soluble carbohydrates, 39% calcium oxide 5%and is rich in sodium, potassium and calcium supplement, saponin content as well as being potential source of provitamin A (carotenoids) Therefore leaves are edible in many parts of country. Vitamin B1 (thiamine), Vitamin B 2 (riboflavin), Vitamin B3 (Niacin), Vitamin B6 (pyridoxine), Vitamin C Biotin Folic acid, Vitamin A, Vitamin E, Vitamin K are reported ftom the *T. procumbens.*[3] *T. procumbens* is also known be rich in anti–oxidant minerals such as Iron (Fe: 21 mg), Copper (Cu: 0. 53 mg), Manganese (Mn: 2. 38 mg) and Zinc (Zn: 2. 25 mg) besides other trace minerals such as Magnesium (Mg: 0. 73 mg), potassium (K: 3. 35 mg) and Calcium (Ca: 4. 0 mg) etc.[4]

Chemical constituents

Isolated compound	Extract	Reference
1.7% Fumaric Acid, β–Sitosterol, Alkalodies, Tannin		[5,6]
Lutelin and Glucoluteolin	Flowers	[7]
A–Pinenes		[8,9]
Methyl 14– Oxooctadecanoate, Methyl 14–Oxononacosanoate, 3–Methylnonadecylbenzene, Heptacosanyl Cyclohexane Carboxylate, L (2, 2–Dimethyl–3–Hydroxypropyl)–2–Isobutyl Phthalate, 12–Hydroxytetracosan–15–One, 32–Methyl–30–Oxotetratriacont– 31–En–L–Ol and 30–Methyl–28–Oxodotriacont–29–En–L–Oic Acid Dotriacontanol, B–Amyrone, A Δ^2–Dehydrolupen–3–One, B–Amyrin, Lupeol, Fucosterol, 9–Oxoheptadecane, 10–Oxononadecane and Sitosterol		[10]
Campesterol, Stigmasterol, And Beta–Sitosterol, C12– C22 Saturated and Unsaturated Fatty Acids.	Unsaponitiable fraction of Pet. Ether fraction	[11,12]
Two Water–Soluble Polysaccharide Fractions WSTP–IA, WSTP–IB and Linolenic Acid WSTP–IA Is An L–Arabino–D–Galactan With A Beta– (1–>6)–D–Galactan Main Chain In Which At Least One In Every Two D–Galp Residues Carries Single Residues Of Either L–Araf (Alpha–/Beta–) Or Beta–D–Galp End–Group As Substituents At O–3. WSTP–IB Is A Linear Beta– (1–>6)–D–Galactan	Ethanol leaves	[13]
A New Flavones Glycoside:5, 7, 4'–Trihydroxy–6, 3'–Dimethoxy Flavones 5–O–A–L–Rhamnopyranoside ($C_{23}H_{24}O_1$)	Leaves	[14]

Neophytadiene and Hexadecanoic Acid	N–hexane extracts flowers and the aerial parts	[15]
A New Flavonoid Procumbenetin (3, 6–Dimethoxy–5, 7, 2', 3', 4'–Pentahydroxyflavone 7–O–B–Glucopyranoside)	Aerial parts of plant	[16]
Bis–Bithiophene: Tridbisbithiophene Four Terpenoids: Taraxasteryl Acetate, Beta–Amyrenone, Lupeol and Oleanolic Acid	Ethyl acetate soluble part of hexane extract	[17]
(3S)–16, 17–Didehydrofalcarinol Isanoxylipin		[18]
Tridaxidone, A New Flavone Glycoside and Two Bergenin Derivatives	Ethyl acetate soluble portion of the ethanolic extract of	[19]
α and β Pinenes, Sabinene, and L–Phellandrene	Essential oil	[20]
Steroidal Saponin, Characterized As β–Sitosterol 3–O–B–D–Xylopyranoside, ($C_{34}H_{58}O_5$, M^+	Flowers	[21]
Steroids And Phlobatannins		[22]
1, 2–Dihydrodendroarboreol B, (3*S*, 5*R*, 6*S*, 7*E*)–3–Tetradecanoate–5, 6–Epoxy–B–Ionone, Quercetagetin–3, 6, 4′–Trimethoxy–7–*O*–Neohesperidoside	Etoh extract of the aerial parts	[23]
Two New Flavones, 8, 3′–Dihydroxy–3, 7, 4′–Trimethoxy–6–O–B–D–Glucopyranosyl Flavone and 6, 8, 3′–Trihydroxy–3, 7, 4′–Trimethoxyflavone Four Known Compounds Puerarin, Esculetin, Oleanolic Acid And Betulinic Acid		[24]
3′, 5, 7–Trihydroxy–4′, 3, 6–Trimethoxyflavone (Centaureidin, 1) ; 3′, 5–Dihydroxy–4′, 3, 6–Trimethoxyflavone–7–O–B– D–Glucopyranoside (Centaurein); and Bergenin		[25]
Apigenin (29.00%), Quercetin (21.67%), Kaempferol (11.20%), (–)–Epicatechin (6.38%), Naringenin (4.82%), (+)–Catechin (3.28%), Biochanin (3.21%), Robinetin (3.13%), Diadzein (2.57%), Nobiletin (2.07%). (+)–Gallocatechin, Genistein, Butein, Luteolin, (–)–Epigallocatechin, (–)–Epicatechin–3–Gallate, (–)–Epigallocatechin–3–Gallate, Isorhamnetin, Robinetin, Ellagic Acid, Myricetin, Baicalein, Baicalin, Silymarin	Flavonoid fraction of the aqueous crude extract of leaves,	[26]
73.91 % Akuamidine, 22.33 % Voacangine, 1.27 % Echitamine, 0.55 % Echitamidine, 0.36 % Lupanine, 0.27 % Crinamidine, 0.23 % Augustamine and 0.10 % 6–Hydroxypowelline. Tannic Acid and α–Sitosterol Alkaloid Fraction Choline, Trigonelline, Angustifoline, Sparteine, Ellipcine,	Alkaloid fraction of an aqueous extract of	[27]

Lupanine, 13–A–Hydrorhombifoline 9–Octadecenamide Dihydro–Oxo–Demethoxyhae–Manthamine Augustamine Oxoassoanine Cinchonidine Cinchonine Crinane–3α–Ol Buphanidrine Indicine–N–Oxide Powelline Undulatine Ambelline 6–Hydroxy– Buphanidrine Acronycine Monocrotaline 6–Hydroxypowel–Line Nitidine Crinamidine 1β, 2β–Epoxy– Ambelline 6–Hydroxy– Undulatine Epoxy–3, 7–Dimeth–Oxycrinane–11–One Akuamidine Echitamidine Voacangine Mitraphylin Camptothecin Echitamine Colchicine Emetine Tetrandrine Thalicarpin Paclitaxel	the leaves	
Cathechin, 3, 7 Dihydroxyflavone, 3–Hydroxyflavone and Quercetin		[28]
α–Pinene, β–Pinene, B–Ocimene, 1, 3, 6–Octatriene, Aromadendrene. Camphene, Gama–Elemene, L–Limonene, Phellandrene, Sabinene, Spathulenol, Torreyol Trans–Beta–Ocimene, Trans–Caryophyllene	Essential oil of Leaf	[29]
Quercetin and Kaempferol	Methanolic extract	[30]

Pharmacological activity

1. Cardiovascular effects

T. procumbens has the hypotensive and the bradycardiac effects on the cardiovascular system in normal as well as salt loaded rat. The aqueous extract from the leaf of *T. procumbens* were administrated intravenouslly to anaesthetized Adult male albinos Sprague–Dawley rat at 3, 6, and 9 mg/Kg caused significant decreases in the mean arterial blood pressure and heart rate in a dose–related manner. The mechanism of its action is because the hypotensive effect of *T. procumbens* through activation of muscarinic cholinergic receptors as the pretreatment with atropine sulfates (1mg/kg) inhibits the action of extract.[31] In another model the aqueous extract of the leaves at 200 mg/kg dose, immediately lowered the systolic, diastolic pressure and mean arterial pressures of the sub chronic salt–loaded rats. However, the 150 mg/kg dose produced an immediate increase which continued to the 24th hr, before falling. The 200 mg/kg dose immediately lowered the diastolic pressure of the rats, an effect that continued through the 24th hr (when it was significant) to 72nd hr when it rose before finally falling by the 192nd hr. The extract prevented the salt–loading induced upsurge in pulse pressure which implies that the extract may probably manage hypertension by alteration of the systolic and pulse pressures.[32]

2. Analgesic Activity

The analgesic activity is evaluated by two analgesic and one inflammatory in-vivo pain models using male mice and male Sprague-Dawley rats. In the Formalin induced persistent pain (Biphasic pain), extract demonstrated significant inhibition in late phase (start about 20 min and lasts about 40 min to 60 min) which is appears to be caused by tissue and functional changes in the dorsal horn of the spinal cord, suggests that they contain active analgesic

principles acting centrally. In the Acetic acid induced writhing test (Peripheral pain) (abdominal constriction test), *T. procumbens* extract dose dependently and significantly reduced the abdominal writhing. In complete Freund's adjuvant (CFA) induced hyperanalgesia in rat (Inflammatory pain) extract significantly reduced mechanical hyperanalgesia.[33]

Pretreated animals with TPEE (Ethanolic extract) and TPEAE (Ethyl Acetate extract) at 300mg/kg dose inhibit the Acetic acid induced writhes up to 68.2% and 30.8% respectively as compared the writhes of control group. NaCl induced greater intensity of writhes in rats as compared to acetic acid which were inhibited up to 71.2% by 300mg/kg *T. procumbens* ethanolic extract and 22.8% by 300mg/kg *T. procumbens* ethyl acetate extract as compared with the writhes of control group. The 300mg/kg dose of *T. procumbens* ethanolic extract shows significant ($P<0.01$) analgesic activity and less significant ($P<0.05$) at 200 mg/kg while its ethyl acetate extract was less significant ($P<0.05$) at 300mg/kg and not significant ($P>0.05$) at 200mg/kg dose as compared to the negative control group.[34]

3. Antipyretic activity

TPEE and TPEAE start lowering the body temperature in Typhoid vaccine induces "pyrexia" in rabbits from 1.5 hour, while between 2nd and 3rd hour both the extract showed significant.[34] Analgesic and Antipyretic activity might be due to the inhibition of prostaglandin synthesis by flavanoids and other polyphenols which are known to target prostaglandins involved in the late phase of acute inflammation, pyrexia and pain perception. Flavonoid reduces lipid peroxidation by preventing or slowing the onset of cell necrosis and by increasing the vascularity. The anti–inflammatory activity due to COX–1, COX–2 enzyme inhibition and free radical–scavenging activities which may be due to the presence of flavonoids and other polyphenols in the extracts.[35] Bergenin exhibited the highest inhibition of COX–1 and COX–2 followed by centaureidin; whereas centaurein exhibited very weak inhibition of COX–1and COX–2.[25] Centaureidin is reported to exhibit anti–inflammatory, COX, lipoxygenase (LOX) inhibition and inhibitory effect on inducible COX–2 and nitric oxide synthase.[36,37]

4. Urolithiatic Activity

Ethanolic extract of *T. procumbens* was evaluated against 0.75% v/v ethylene glycol and 2% w/v ammonium chloride induced calcium oxalate urolithiasis and hyperoxaluria induced oxidative stress in male albino rats. Treatment with the extract was able to dose dependent

reduction in caluculogenesis induced urinary excretion and renal deposition of calcium & oxalate and restored urinary pH (6.5–7.5), indicates ETP prevented urinary supersaturation of CaOx indicates prevention of CaOx stone formation. The decrease in the elevated urinary creatinine reflects improved renal function. Studies indicate that mucoproteins exhibit significant affinity for CaOx surface, thus promote the growth of crystals and cement them.[38] Grases *et al* 1993 have reported that saponins disintegrate the mucoprotiens there by prevent CaOx excretion and deposition.[39] The antiurolithiatic effect of ETP may be attributed to its saponin principles (lupane type pentacyclic triterpene saponin derivative from *T. procumbens.*[10] as saponins were reported to decrease CaOx crystal adhesion to renal epithelial cells by pre–coating the crystals.[40]

5. Antibacterial activity

On the other hand the methanol extracts of *T. procumbens* showed significant activity against coagulase positive *S. aureus* (8.0±0.707). But only least antibacterial activity was observed on other selected bacterial strains. The aqueous extracts of *T. procumbens* showed no pronounced antibacterial activity against *Streptococcus uberis* and *K. pneumonia*.[41] *T. procumbens*, which inhibited 16 out of 20 test microorganism with 8–14mm zone of inhibition.[42]

6. Anti cancer activity

Many phytochemicals are used to prevent and treat cancer by inhibiting angiogenesis and thereby preventing metastasis.[43] Various other studies also have demonstrated that the extracts, natural pigments, essential oils, fowers, fruits exert anti–carcinogenic and anti–proliferative effects.[44] *T. procumbens* was investigated *in vivo* and *in vitro* both for it's anticancer efficacy. 50µg of the essential oil of *T. procumbens* shows 70.2% cytotoxicity of cancer cell in MTT assay within 24hrs. TUNEL assays also demonstrated a signifcant increase in the number of apoptotic positive cells after the treatment. TUNEL is a common method for detecting DNA fragmentation that results from apoptotic signaling cascades.[45] Significant Expression of P_{53} and caspase–3 was observed in the essential oil treated group than the normal and cancer group. P_{53} mutations are common in lung cancer and range from 33% in adenocarcinomas to 70% in small cell lung cancers.[46] Furthermore, the tumor–suppressor protein P_{53} protects against cancer by regulating the cellular response to DNA damage, apoptosis, and oncogene activation.[47] P_{53} has many mechanisms for anticancer function, and plays a role in apoptosis, genomic stability and inhibition of angiogenesis. In

vivo oil treatment signifcantly inhibited tumor nodule formation by 71.7% when compared with untreated mice. Neovascularization due to tumor was also found to be inhibited to about 39.5%. Results showed signifcant effects of the essential oil of *T. procumbens* in preventing lung metastasis by B16F–10 cell line in C57BL/6 mice.[48] As the essential oil of *T. procumbens* has revealed to have α–pinene, β–pinene l–phellandrene and Sabinene as their major bioactive compounds as identifed by GC–MS by us, we intend to study its preventive/chemotherapeutic effect on experimentally induced lung cancer development.[49] Some specifc studies have shown that the β–pinene, along with α–pinene and other terpenes are cytotoxic on cancer cells.[50] The α– and β–pinenes were strongly reported for its cytotoxic activity on several cell lines like breast cancer and leukemic cell lines.[51] This may because of the major bioactive compounds present in the essential oil such as monoterpenes like α and β pinene which have been reported to inhibit the formation of new blood vessel and thereby arresting the metastasis.[52] In a study reduction in the body weight, increase in WBC and decrease in haemoglobin in cancer group has been observed which are prevented in essential oil treated group. The essential oil of *T. procumbens* has a signifcant anti–angiogenic effect in B16F–10 injected tumor model with 39.47% inhibition on formation of tumor directed blood vessels.[53] The anti–cancer activity was studied on human prostate epithelial cell line PC3 cell viability by MTT assay showed that the flower extract of acetone causes 82.28% cancer cell death with in 24hrs and aqueous extract exhibited a very weak anti–cancer activity.[54]

7. Wound healing activity

T. procumbens is widely used for dermal wounds, wounds healing and burns in the folk medicine in both orally and topically form by the tribal communities of various countries.[55–57] Tridax is effective in burn wound management. It enhances the potency of dexamethasone in burn cases. Aqueous extract of *T. procumbens* plant extract gave large extent of relief against wound infections like *Escherichia coli*, *Staphylococcus aureus*.[58, 59]

The plant increases granulation and hexosamine formation and hydroxyproline content of the granulation tissue of the excision wound which means it promotes rapid collagen formation. Aqueous extract posses prohealing activity by increasing lysyl oxidase, protein content, specific activity, and breaking strength but to a lesser degree than whole plant extract in dead space wound model.[60, 61] Moreover the plant is found to be effective promoter of wound healing normal as well as immunocompromised (steroid treated) rats in dead space wound

model. The plant increased not only lysyl oxidase but also, protein and nucleic acid content in the granulation tissue, probably as a result of increase in glycosaminoglycan content.[62, 63]

A topical preparation, (1 mg/g) increases collagen synthesis and fibroblast proliferation as well as neovascularization. In addition it retards scar formation and granulation. The effect was dose dependent, higher dose may show opposite effect.[64] *T. procumbens* antagonized anti–epithelization and tensile strength depressing effect of dexamethasone (a known healing suppressant agent) without affecting anticontraction and antigranulation action of dexamethasone *T. procumbens*(TP) both orally and topically affects steroid depressed burn wound. It the increases rate of contraction, tensile strength and fasten epithelization the burn wound by increasing biochemical tissue markers like Hydroxyproline, Collagen and Hexosamine. Histopathologically increase in granulation and rapid collagen turnover, reduced polymorphonuclear leukocytes (PMNLs), congestion, oedema, mononuclear leukocyte infiltration and increase in the dermal collagen content were observed.[65]

8. Antidiabetic activity

50% methanol extract of whole plant (250 mg/kg b.wt. and 500 mg/kg b.wt.) was investigated for acute and sub–chronic anti–hyperglycemic activity in alloxan induced diabetic rats and for acute toxicity test among normal rats. Both the doses did not alter the sugar level in normal rat but a sharp decline is observed in diabetic rat. During the long term therapy treated diabetic animals showed sign of recovery in body weight gain. TP decreses fasting blood glucose level in diabetic rat not in normal rat. It also shows better glucose tolerance in normoglycemic animals.[66] Leaves of TP showes dose–dependent decline in plasma glucose, triglyceride, very low density lipoprotein cholesterol, total bilirubin, urea, blood urea nitrogen; plasma alkaline phosphatase, alanine and aspartate transaminases, and ocular superoxide dismutase activities, and lymphocyte count in Alloxan induced diabetic rat.[67] Orally administration of aqueous and alcoholic extracts (200 mg/kg) from leaves of *T. procumbens* significantly decrease in the blood glucose level in the model of alloxan–induced diabetes in rats. Petroleum extract exhibits very weak anti–diabetic activity.[68]

T. procumbens has the hypoglycemic, hypolipidemic and antioxidant properties in its leaf extract at a dose of 400 mg/kg b.w. in alloxan induced experimental diabetic rats. Normalizes alteration in blood glucose, glycosylated hemoglobin, plasma insulin, urea, uric acid, creatinine, protein, lipid peroxides, enzymatic, lipid profile produced by alloxan.[69] Whole plant extract (125 mg/kg BW) showed a significant improvement in OGTT in normal rats and

alloxan–diabetic rats. It exhibited no significant effect on FBSL of normoglycemic rats. it was found that only ether fraction a significant lowering effect on blood sugar levels.n–butanol, emulsion and aqueous fractions.[70] Oleanolic acid and its derivative dihydroxy–olide was obtained from *T. procumbens* is potential antidiabetic agent when tested against α–glucosidase (α–Glucosidase is a membrane–bound enzyme at the epithelium of the small intestine, that hydrolyses the cleavage of glucose from disaccharides and oligosaccharides.[71]

9. Hepatoprotective activity

T. procumbens had a salubrious effect on the paracetamol–induced hepatotoxicity[72] d–Galactosamine/Lipopolysaccharide (d–GalN/LPS) induced hepatitis[73] in Wister rats. It reverses toward the normalcy the increase RBC, WBC count and cholesterol level, and decrese in blood urea leval. There was a decline in the activities of enzymic antioxidants such as superoxidedismutase (SOD), catalase (CAT), glutathione peroxidase (GPX), glutathione s–transferase (GST) and the levels of non–enzymic antioxidants namely reduced glutathione, vitamin C and vitamin E. These biochemical alterations were normalised upon pretreatment with chloroform insoluble fraction of ethanolic extract of TP extract (300 mg/kg body weight orally for 10 days).[74] Further Rats intoxicated with d–GalN/LPS alone developed hepatocellular damage as evident from a significant elevation in the serum activities of AST, ALT, ALP, LDH, GT and bilirubin level. There was a significant increase in the levels of cholesterol, triglycerides and free fatty acids in both, serum and tissue of rats. Chloroform insoluble fraction from ethanolic extract of *T. procumbens* reduced elevated cholesterol, triglycerides and free fatty acids etc.[75] *T. procumbens* exhibit antioxidant activity and lower the lipid peroxide production in chloroquine induced hepatic damage.[76]

Hepatoprotective activity of ethanolic extract *T. procumbens* (100, 200, 300 and 400mg/kg body weight, oraly) gradually reversed paracetamol (acetaminophen) (2gm/kg body weight) induced hepatic damage in male albino rats. Ethanolic extract exhibit significant reductuion in Hepatic lipid peroxidation (LPO) and increases activities of Superoxide dismutase (SOD), catalase (CAT) and glutathione and glycogen content in liver. Histopathological examination of liver sections supports effect of Ethanolic extract.[77]

Aqueous extract of the leaves of *T. procumbens* (100, 200, and 300 mg/kg) found to be effective against carbon tetrachloride (1 ml/kg body weight, subcutaneously) induced liver injury which was further confirm with histopathological studies.[27] The oxidative stress in paracetamol induced hepatic damage in rats was also reduced by T. procumbens.[78] The drug

also protected the liver against acute CCl4 toxicity.[79] Hepatoprotective effect of ethanolic extract of arial parts of *T. procumbens* and its chloroform soluble and insoluble fractions were studied on acute hepatitis induced by carbon tetrachloride.[80]

10. Hair growth activity

It was shown that the petroleum fraction of ethanolic extract of *T. procumbens* when administered orally as well as topically to the albino rats produced an effective hair growth.[81]

11. Repellent activity

Essential oil from leaves of *T. procumbens* (yields 3.8 ml/kg) exhibited relatively high repellency effect (>300 minutes at 6% concentration) against malarial vector *Anopheles stephensi* in mosquito cages.[82] It also possess larvicidal activity against the instar larvae of malaria vector, *A. subpictus* (LC50 = 51.57 mg/l, LC90= 226. 56 mg/l) and *Cx. tritaeniorhynchus* (LC50= 69. 16 mg/l, LC90= 287. 21 mg/l).[83]

12. Bioadsorbent

It is also used as bioadsorbent for chromium (VI) is one of the highly toxic ions released into the environment through leather processing and chrome plating industries.[84] The plant is a procumbent herb and isvalued for its pharmaceutical properties.[85]

CONCLUSION

Scientific evaluation of therapeutic uses of medicinal plants mention in Ayurveda classics is todays need. *T. procumbens* a weed is promosing drug in Ayurveda used to cure liver disorder and wound very effectively. It contains Lutelin, Glucoluteolin, Neophytadiene, Hexadecanoic Acid, Bis–Bithiophene, Tridbisbithiophene Oleanolic Acid, α and β Pinenes, Sabinene, L–Phellandrene, Quercetin and Kaempferol. It possesses Cardiovascular Effects, Analgesic, Antipyretic, Urolithiatic, Antibacterial, Anti Cancer, Wound Healing, Antidiabetic, and Hepatoprotective, Hair growth, Repellent activity and act as Bioadsorbent. This review provides detailed information about phytochemicstry and pharmacology of *T. procumbens* which may prove to be useful for the investigators and ayurvedic scholars to establish scientific basis of uses of the plant.

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