



TINOSPORA CARDIFOLIA: ONE OF THE AYURVEDIC PLANT OF CORONIL FORMULATION FOR COVID-19

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Article Received on 11/06/2020

Article Revised on 01/07/2020

Article Accepted on 21/07/2020

ABSTRACT

Now a days giloy is used to fight certain symptoms associated with covid -19. Patanjali product Coronil for covid treatment contain the Giloy, Tulsi & Ashwagandha. Natural products with medicinal value are gradually gaining importance in clinical research due to their well-known property of no side effects as compared to allopathy drugs. It is commonly used in combination with other substances or sometimes alone. *Tinospora cordifolia* is one of the most important medicinal plant commonly known as Giloy / guduchi/ Gulvel belonging to family Menispermaceae. *T. Cordifolia* is commonly used shrub in Ayurvedic medicine. The chemical constituent of this shrub belong to different classes such as alkaloid, lactone, steroid, phenolic, aliphatic compound, glycosides, polysaccharide compound. The notable medicinal properties are Antidiabetic, Anti-inflammatory, Anticancer, Anti AIDS, Antiallergic, Antioxidant, Anti-stress, anti-spasmodic, anti-arthritis, anti-leprotic, anti-malarial, hepatoprotective, immunomodulatory activities. The aim of this article to cover the Morphology, phytochemistry, biological activities reports of *Tinospora cordifolia*. The future scope of the review remains in exploiting the biochemical and signaling pathways affected by the compounds isolated from *Tinospora* so as to enable new and effective formulation in disease eradication. It is helpful in potentiating other substance in the form of "Sodhan-Vidhi". It is considered an essential herbal plant of Indian system of medicine (ISM)

KEYWORDS: *T. Cordifolia*, Guduchi, Ayurvedic Medicine, Phytochemistry, Pharmacological effects.

INTRODUCTION

Herbal formulations are medicinal preparation of one or more herbs present in specified quantities to give the benefits meant for cosmetic, diagnose and to mitigate diseases of human beings or animals.^[1] It is also known as botanical medicine or phytomedicine. Earlier in the twentieth century, herbal medicine was the prime medication system as antibiotics or analgesics were not available. Increasing use of an allopathic system of medicine due to its fast therapeutic action and herbal medicine gradually lost their popularity among the people. For example, Curcuma is used in Traditional Chinese Medicine for more than two thousand years to treat anti-inflammatory and robust antioxidant.^[2, 3] About 70–80% of people are still using herbal medicine for their primary health because of the less side effect and better compatibility with the human body.^[4] Herbal medicine has gained momentum and is more effective as compared to synthetic drugs.

Tinospora cordifolia known as *Gulvel* or *Guduchi*, has been an extensively used and investigated plant from

family Menispermaceae for its varied activities. It is a deciduous, fleshy, robust climber growing with support of mango or neem trees and is also known as *Cocculus cordifolius* Dec, *Menispermum cordifolium* Willd., and *Tinospora glabra* Merr.^[5] plant refers in Hindu mythology to a heavenly elixir used to stay off the aging and to stay young forever. The Sanskrit name **Guduchi means one protect from illnesses**. Hence the words "**Rejuvenator**" or "**adaptogen**" seem to have appeared in literature.^[6]

Recent Information of Giloy

Baba Ramdev's Patanjali Launches Ayurvedic medicine Coronil for Covid -19 Treatment. Patanjali has claimed that the new evidence based Ayurvedic medicine can cure covid -19 patient within 5 to 14 days. Coronil launched on June 23 2020. The made in India medicine which comes in the pack of three is made from ayurvedic element such as Tulsi, Giloy & Ashwagandha & claims 100% favourable result. Consuming Giloy juice can help you get rid of fever which is one of the signs of COVID-19. Its anti-inflammatory properties help in reduce

respiratory problem like cough, cold & breathing problem. These are also major signs of the novel corona virus infection.

Distribution

It is indigenous to areas of India, Sri Lanka, China, Myanmar, Thailand, Philippines, Indonesia, Malaysia, Borneo, Vietnam, Bangladesh and South Africa. It is found throughout tropical Asia to an ascending height of 300 m.^[7,10]

Origin and habitat

It is a native plant of tropical and subtropical regions of India. Also found primarily in rainforests. It grows in a wide range of soil, acid to alkaline and it needs moderate level of soil moisture. It has a long history of being used by practitioners of Ayurvedic medicine, since 2000 B.C. It is being used by the practitioners for treating convalescence from severe illness.^[11]

Morphology of plant

Tinospora cordifolia is a glabrous, succulent, woody climbing shrub native to India. It thrives well in the tropical region, often attains a great height and climbs up the trunk of large trees.

The **stem** is gray and creamy white, deeply cleft spirally and longitudinally, with the space between spotted with large rosette like lenticels.

The **wood** is white, soft and porous and the freshly cut surface assumes a yellow tint when exposed to air.

Leaves are simple, alternate, exstipulate, long petiolate, chordate in shape showing multicoated reticulate venation. Long thread like aerial roots come up from the branches.

Flowers are small and unisexual. Male flowers are in clusters, female flowers are solitary. Six sepals arranged in two whorls, they are obovate and membranous.

Aggregate **fruit** is red, fleshy with many drupelets on thick stalk with subterminal style scars, scarlet coloured.^[12, 13]

Taxonomy^[12,13,14]

Kingdom: Plante-plants

Subkingdom : Trachephyta – Vascular plant.

Division: Magnoliopsida- Flowering

Super division : Spermatophyta – seed bearing plant

Class: Manoliopsida-Dicotyledons

Subclass : Polypeptalae –petal are free

Order: Ranunculales

Tribe :Tinosporeace

Family: Menispermaceae – The Moonsee family

Genus: *Tinospora*

Species: *T.cordifolia*

Microscopy of stem

Microscopic Description Transverse section of plant stem showed cork, cortex and vascular bundles.

Cork: The cork comprises of an outer zone of thick-walled brownish compressed cells and an inner zone of thin walled colorless, tangentially arranged cells. The cork tissue is broken at some places due to lenticels.^[15,16]

Cortex: Cortex is wide and multilayered. The outer zone of cortex consists of 3 to 5 rows of irregularly arranged tangentially elongated chlorenchymatous cells and the cells situated towards the inner side are polygonal in shape filled with abundant starch grains. The starch grains are simple, ovoid, several secretory cells found scattered in the cortex. Pericyclic fibres lignified are associated with a large number of crystal fibres containing a single prism in each chamber.^[15,16]

Vascular Bundles: The vascular zone is composed of discrete vascular strands with 10 to 12 or more wedge shaped strips of xylem, externally surrounded by semi circular strips of phloem alternating with wide medullary rays; phloem parenchyma contain calcium oxalate crystals; cambium is of 1-2 layers; xylem consists of vessel element, tracheids, parenchyma and fibres. Vessel elements cylindrical in shape bearing bordered pith. Medullary rays 15 to 20 cells wide. Pith mostly made up of large thin walled cells containing starch grains.^[15,16,17]

Pharmacognosy & Ethnomedicinal folk & Tribal Uses of *Tinospora Cordifolia*^[18]

Table 1: Pharmacognosy and ethanomedical folk and tribal uses of Gulvel.

Sr no.	Part of plant	Use	Image.
1	Leaves: cordate, Membranous, juicy	The leaves are beaten with honey and applied to ulcers and also treatment of gout and erysipelas (bacterial skin infection)	
2.	Root: long, thready like	The root is powerful emetic and used for visceral obstruction; its watery extract is used in leprosy. Antidote for snake bite	
3.	Stem : Fleshy	The stem is bitter stomachic, stimulates bile secretion, diuretic, enriches the blood, useful in skin diseases and cures jaundice; The juice is useful in diabetes, vaginal and urethral discharges, low fevers and enlarged spleen. Stem as an infusion used as a vermifuge, jaundice, against intestinal worms. Stem as decoction used for washing sore eyes and syphilitic sores, antipyretic, antimalarial. Stem used for chronic diarrhoea and some form of obstinate chronic dysentery, deal with intestinal problems and improves digestion.	
4.	Fruit: Pea shaped, fleshy.	Dried and powdered fruit, mixed with ghee or honey, is used as a tonic and also in the treatment of jaundice and rheumatism.	
5.	Bark: Thin, greyish or creamy white in colour	Anti-allergic, Anti-spasmodic, Anti-pyretic, Anti-leprotic.	
6	Whole plant	The whole plant is used in scabies in swine, diarrhoea and stomach trouble. Urinary diseases, syphilis, skin diseases, bronchitis, promote longevity and increase body's resistance. Stimulate the immune system.	

Phytochemistry^[19,20]

The chemical constituents of *T. cordifolia* belong to different classes such as alkaloids, glycosides, steroids, phenolics, aliphatic compounds, polysaccharides. **Leaves** are rich in protein (11.2%), calcium and phosphorus. The

stem contains clerodane furano diterpene glucoside (amritoside A, B, C, and D) and the structure has been established by different spectroscopic studies. Some of the essential constituents reported in Table 2 and major constituents in Fig. 1.

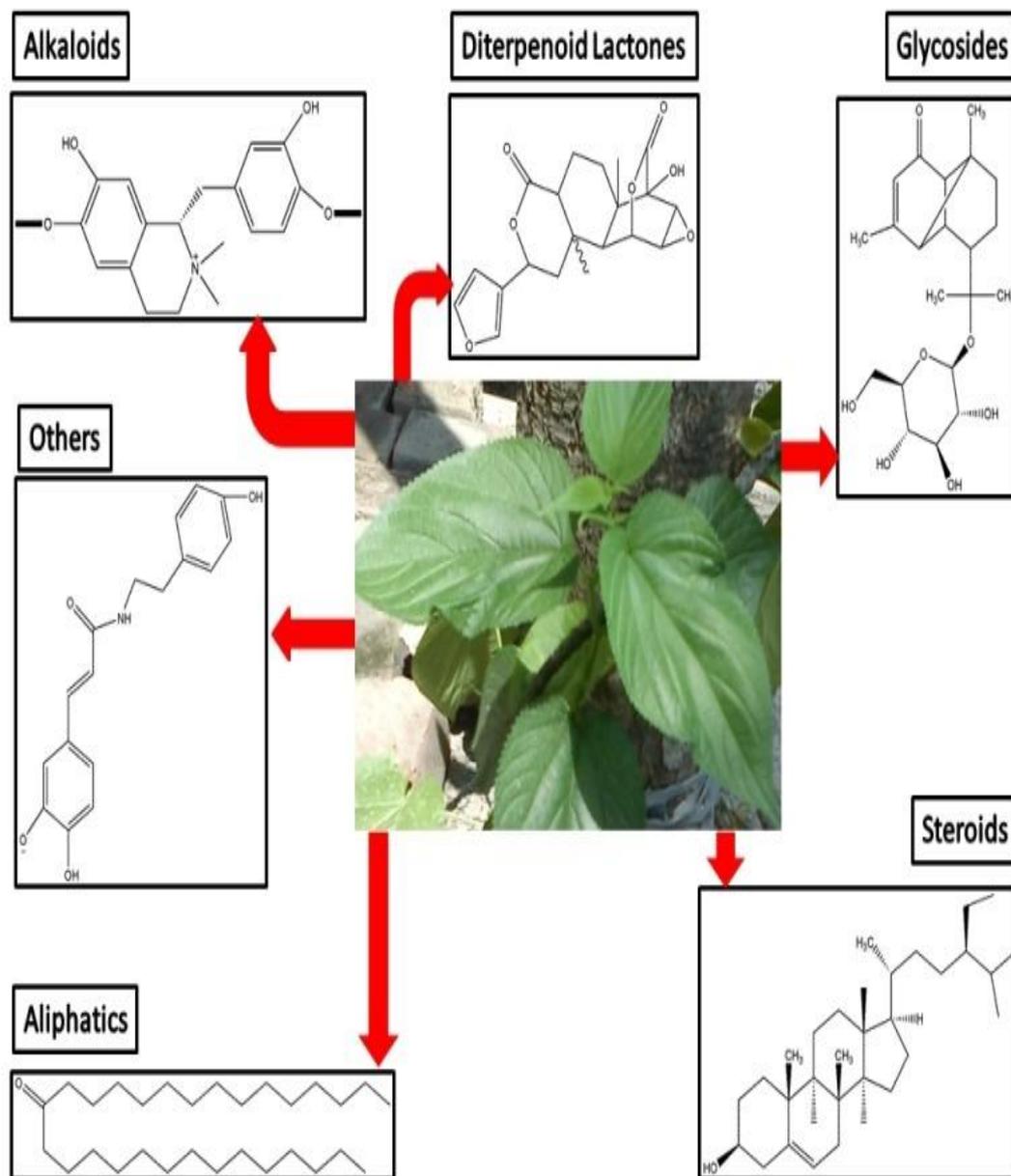


Figure 1: Major categories constituents present in Guduchi.

Table 2: Some of the essential constituents of *T. cordifolia* and its pharmacological effect. ^[19,20,21]

Active Component	Parts of the plant	Compounds	Pharmacological Potential in Human beings
Diterpenoids and lactone	Whole plant	Tinosporide, Furanolactone diterpene, Furanolactone clerodane diterpene, furanoid diterpene, Tinosporaside, ecdysterone makisterone and several glucosides isolated as poly acetate, phenylpropene disaccharides cordifolioside A, B and C, cordifolioside D and E, Tinocordioside, cordioside, palmatosides C and F, Sesquiterpene glucoside tinocordifolioside, Sesquiterpene tinocordifolin.	Vasorelaxant: relaxes norepinephrine induced contractions, inhibits calcium ion influx, anti-inflammatory, antimicrobial, antiviral.
Alkaloids	Stem & Root	Tinosporine, (S), Magnoflorine, (S), Berberine, (S), Choline, (S), Jatrorrhizine, (S), 1,2-Substituted pyrrolidine(S), Alkaloids, viz. jatrorrhizine, palmatine, beberine, tembeterine, choline.	Antiviral, anti-cancer, anti diabetic, antiinflammatory, immunomodulatory
Lignans	Root	3 (a, 4-dihydroxy-3-methoxybenzyl)-4-(4-hydroxy-3-methoxybenzyl), (S)	
Steroids	Aerial parts stem	Giloinsterol (S), β -Sitosterol (S), 20a-Hydroxy ecdysone (S).	Glucocorticoid induced osteoporosis in early inflammatory arthritis. Induce cell cycle arrest in G2/M phase and apoptosis through c-Myc suppression.
Glycosides	Stem	18-norclerodane glucoside, Furanoid diterpene glucoside, Tinocordioside, Tinocordifolioside, Cordioside, Cordifolioside A, Cordifolioside B, Syringin, Syringin-apiosylglycoside, Palmatosides C, Palmatosides F, Cordifolioside A, Cordifolioside B, Cordifolioside C, Cordifolioside D, Cordifolioside E	Treats dementia, motor and cognitive deficits and neuron loss in spine and hypothalamus. immunomodulator
Others	Whole plant	Giloin, Tinosporan acetate, Tinosporal acetate, Tinosporidine, Heptacosanol, Octacosanol, sinapic acid, Tinosponone, two phytoecdysones, an immunologically active arabinogalactan.	Protease inhibitors for HIV

Pharmacological activity

Anti-diabetic potential of *T. cordifolia* parts

Various phytoconstituents isolated from different parts of *T. cordifolia* are responsible for cure of diabetes mellitus. These phytochemicals include alkaloids, tannins, cardiac glycosides, flavonoids, saponins and steroids.^[22] It has the magical potential of lowering the blood sugar level in human beings. The isoquinoline alkaloid rich fraction from **stem**, includes palmatine, jatrorrhizine and magnoflorine which show insulin mimicking and insulin releasing effect both *in vitro* (using rat pancreatic β -cell line, RINm5F) and *in vivo*.^[23] Another isoquinoline alkaloid 'berberin' is reported to be highly effective for curing human diabetes. It lowers elevated glucose level as effectively as metformin. It also improves hepatic metabolism during insulin resistance and metabolic syndrome by inhibiting FOXO1 which integrates mitochondrial function with insulin signaling. By adenosine monophosphate-activated protein kinase activation, it decreases the blood sugar and cholesterol level and maintains the blood pressure.^[24,25,26,27] Besides,

tinosporin, isocolumbin, palmatine, tinocordioside, cordioside and β -sitosterol compounds present in **stem and root** are also reported to possess anti diabetic, antihyperlipidemic and antioxidant properties.^[28] Due to presence of major and minor essential minerals such as Zn, Mn, Cl, K, Ca, Fe, Co, Ni and Cu and proteins and fibres in *T. cordifolia* parts, it helps in health restoration and in alleviation of degenerative processes in diabetes.^[29,30] Crude values for food content in *Tinospora cordifolia* include high fibre (15.19%), sufficient protein (4.5%-11.2%), sufficient carbohydrate (61.66%), and low fat (3.1%). Nutritive value is 292.54 calories per 100 g. It has high potassium (0.845%) (regulatory function of nerve impulses), high chromium (0.006%) (regulation of carbohydrate utilization pathophysiological alterations in diabetes), sufficient iron (0.28%) (to improve haematopoietic functions especially in diabetic nephropathy where erythropoietin release from kidney is compromised), and sufficient calcium (0.131%) (regulatory functions in nervous, cardiovascular, and musculoskeletal systems).^[31]

Anti-HIV potential of *T. cordifolia* parts

Root extracts of Giloy have shown significant effect in modulating the immune system positively in HIV positive patients. This immunomodulatory response of extracts of Giloy **stem** are due to its ability to reduce eosinophil count, stimulation of B lymphocytes, macrophages, level of haemoglobin and polymorphonuclear leucocytes.^[32, 33]

Antimicrobial potential of *T. cordifolia* parts

The anti-bacterial activity of *Tinospora cordifolia* extracts has been assayed against *Escherichia coli*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Proteus vulgaris*, *Salmonella typhi*, *Shigella flexneri*, *Salmonella paratyphi*, *Salmonella typhimurium*, *Pseudomonas aeruginosa*, *Enterobacter aerogene*, and *Serratia marcescens* (Gram-positive bacteria)^[34]. Aqueous, ethanol and acetone extracts of **leaves and stem** of *Tinospora cordifolia* showed maximum inhibitory activity against on clinical isolates of urinary pathogens *Klebsiella pneumoniae* and *Pseudomonas aeruginosa*^[35].

Silver nanoparticles synthesized from **stem** of *Tinospora cordifolia* possess very good antibacterial activity against multidrug resistant strains of *Pseudomonas aeruginosa* isolated from burn patients^[36]. The active compound [(5R, 10R)-4R, 8R-Dihydroxy-2S, 3R:15, 16-diepoxycleroda- 13(16), 17, 12S, 18, 1S-dilactone] was isolated from ethanol extract of *Tinospora cordifolia* stem showed activity against bacteria and fungi.

Wound healing

The wound healing profile of alcoholic extract of *T. cordifolia* and its effect on dexamethasone suppressed healing. Incision, excision, and dead space of the wound models were employed to investigate the wound healing potential of the plant increased tensile strength extract of *T. cordifolia* may be attributed to the promotion of collagen synthesis. The extract did not reverse dexamethasone suppressed wound healing.^[37]

Parkinson's disease

T. cordifolia extract is highly attractive against the Parkinsonism. They observed the anti-inflammatory activity of aqueous extract in 1-methyl-4-phenyl-1, 2, 3, 6-tetra hydropyridine (MPTP) intoxicated Parkinsonian mouse model. The extract reversed the behavior of the target MPTP intoxicated mice and its suggest that *T. cordifolia* protected dopaminergic neurons by suppressing neuroinflammation in MPTP-induced Parkinsonian mouse model.^[38]

Antistress activity

Ethanol extract of *T. cordifolia* at the dose of 100 mg/kg gives significant anti-stress activity in all parameters compared with standard drug diazepam.^[39] The plant extract gives a moderate degree of behavior disorders and mental deficit response. The clinical research showed the improved I. Q level of patients. In

Ayurveda, it acts as Medhya Rasayana or brain tonic by increasing mind power like memory and recollection.^[40]

Anticancer activity

The anticancer activity of *T. cordifolia* palmatine extract in animal models, alkaloid using response surface methodology (RSM). The extract indicates the anticancer potential in 7, 12-dimethylbenz(a) anthracene DMBA induced skin cancer model in mice.^[41] The extract of 200, 400, 600 mg/kg dry weight in a dose depend upon manners. 50% methanolic extract of cordifolia to C57 BI mice for 30 days at a dose of 750 mg/kg body weight the tumor size reduced life span.^[42] The anti-brain cancer potential, 50% ethanolic extract of *T. cordifolia* (TCE) using C6 glioma cells significantly induced differentiation in C6 glioma cells, and reduced cell proliferation.^[43]

Hepatic disorder

Protective Effects of *Tinospora cordifolia* water extract (TCE) on Hepatic and Gastrointestinal Toxicity was reported. A significant increase in the levels of gamma-glutamyl transferase, aspartate transaminase, alanine transaminase, Triglyceride, Cholesterol, HDL and LDL in alcoholic sample whereas their level get down regulated after TCE intervention, patients showed the normalized liver function of *T. cordifolia* stand to relieve the symptoms.^[44]

Hypolipidemic effect

The hypolipidemic effect of an aqueous extract of the **root** on the rats weighing 2.5 and 5.0 g/kg body weight on sixth weeks, that resulted in decrease tissue cholesterol, reduction in serum, phospholipids, and free fatty acid in alloxan diabetic rats. The dose of root extract 5.0 g/kg body weight showed the highest hypolipidaemic effect. When the level of serum lipids in diabetes increased, they represented coronary heart disease, lower the serum lipids level decreased the risk of vascular disease.^[45]

Antioxidant activity

Evaluation of guduchi containing formulation for its antioxidant activity by DPPH (1-diphenyl-2-picrylhydrazyl) free radical scavenging method. They estimated the total flavonol and total phenolic content. Using the result of the formulation showed potent antioxidant activity and inhibitory concentration (IC₅₀) at 5 µg/ml as compared to standard drug ascorbic acid.^[46] The methanolic, ethanolic, and water extracts of *T. cordifolia* for their antioxidant activity, in which the **stem ethanol** extract increased the erythrocytes membrane lipid peroxide, catalase activity and decrease the superoxide dismutase, glutathione peroxidase in alloxan-induced diabetic rats. The **leaves extract** of methanol, partitioned in water with ethyl acetate and butanol at 250 mg/ml, and showed their antioxidant activity, extracts of methanol phosphomolybdenum and metal chelating activity were high followed by ethyl acetate, butanol, and water extract.^[47] It also decrease

level of free radical species of diabetic rat and up-regulate the anti-oxidant enzyme,^[48,49,50] scavenging activity for free radical of methanol extract was high compared with phenol extract.^[51] This plant modifies the different enzymatic system which controls the production of these reactive species and maintains the oxidative load by regulating the lipid peroxidation process and glutathione level.^[52,53] **Dried leave** of *T. cordifolia* and powdered and extracted with chloroform, methanol, ethanol hexane, and water. Antioxidant assay by different *in-vitro* models, lipid peroxidation inhibitory activity, DPPH radical scavenged and superoxide radical scavenging activity. Other solvent extracts showed weak antioxidant activity, whereas ethanol extract had high antioxidant activity. The results suggested that the antioxidant compound are better in ethanol extract, and there is a direct correlation between the total polyphenols extracted and its anti-oxidant activity.^[54]

Anti-toxic effects

The extract to scavenge free radicals generated during aflatoxicosis. It showed protective effects of *T. cordifolia* on thiobarbituric acid reactive substances (TBARS) levels and increase the level of GSH, ascorbic acid, protein and the activities of anti-oxidant enzymes viz., Superoxide Dismutase (SOD), Catalase (CAT), GPx enzyme, Glutathione S-transferase (GST) and glutathione reductase (GR) in kidney. The alkaloids such as choline, tinosporin, isocolumbin, palmatine, tetrahydropalmatine, and magnoflorine present in the plant of *T. cordifolia* showed protection against aflatoxin-induced nephrotoxicity.^[55] Sharma et al., studied the **stem and leaves** extract of the plant has shown hepatoprotective effect in Swiss albino male mice against lead nitrate induced toxicity.^[56] Oral administration of plant extracts prevented the occurrence of lead nitrate induced liver damage.^[57] They also checked the decreased level of SOD, CAT and increased level of aspartate aminotransferase (AST), alanine aminotransferase (ALT), alkaline phosphate (ALP) and acid phosphates (ACP).^[57] Synergistic administration of aqueous extract of stem and leaf increased the activities of SOD and CAT and decreased the levels of AST, ALT, ALP, and ACP enzymes.^[57] Protective role of aqueous extract of the plant stem and leaves overcoming the toxic effects was also reported by them.^[56]

Anti-arthritis, anti-osteoporotic effects

Single or synergistic formulations of *Tinospora cordifolia* with *Zingiber officinale* has been used in rheumatoid arthritis treatment in traditional medicine.^[58] *Tinospora cordifolia* have been reported to affect the proliferation, differentiation and mineralization of bone like matrix on osteoblast model systems *in vitro* and hence finds potential application as an anti-osteoporotic agent. Alcoholic extract of *Tinospora cordifolia* have been shown to stimulate the growth of osteoblasts, increasing the differentiation of cells into osteoblastic lineage and also increasing the mineralization of bone like matrix.^[59] Ecdysteroids isolated from the plant have

been reported of protein anabolic and anti-osteoporotic effects in mammals. Beta-Ecdysone (Ecd) from *Tinospora cordifolia* extracts have been reported to induce a significant increase in the thickness of joint cartilage, induce the osteogenic differentiation in mouse mesenchymal stem cells.^[60] and to relieve osteoporosis in osteoporotic animal models.^[60] Further 20-OH- β -Ecd isolated from *Tinospora cordifolia* has been reported of its anti-osteoporotic effects.^[59] thus highlighting the role of *Tinospora cordifolia* in the treatment of osteoporosis and osteoarthritis.^[61]

Anticomplement activity and immunomodulating activity

The syringin (TC-4) and cordiol (TC-7) isolate from *T. cordifolia* inhibited the *in-vitro* immune hemolysis of antibody coated sheep erythrocytes by guinea pig serum. Immune hemolysis was reduced due to inhibition of the C3-convertase of the classical complement pathway. The compounds of *T. cordifolia* rise to significant increases in IgG antibodies in guinea pig serum. Cordioside (TC-2), cordiofolioside. A (TC-5) and cordiol (TC-7) activated macrophase with increasing incubation times.^[62] It has been isolated and characterised different classes of active compounds reported their immunomodulatory activity.^[63]

Anti-inflammatory activity

To study the anti inflammatory activity of alcoholic extract of *T. Cordifolia* on carrageenan - induced hind paw oedema and cotton pellet granuloma models in male wistar rats. The hind paw oedema was produced by subplantar injection of carrageenan and the paw volume was measured plethysmographically at 0, 1, 2, 3, 4 and 5 hr. In sub acute model, Cotton pellet granuloma was produced by implantation of 50 \pm 1 mg sterile cotton in axilla under ether anaesthesia. The animals were fed with ethanolic extract at various dose levels (125, 250, 375 and 500 mg/ kg). Diclofenac sodium was used as a standard drug. The alcoholic extract (375 and 500 mg/kg showed maximum inhibition of oedema by 66.72% and 83.21% at the end of 3 hr in acute model of inflammation, respectively using a chronic test, the granuloma pouch in rats, the extract exhibited a 51.25% and 60.21% reduction in granuloma weight. *Tinospora cordifolia* possesses anti-inflammatory effects in both acute and sub - acute inflammation.^[64]

Nephroprotective action

Gentamicin induced nephrotoxicity is a major contributor to Acute Kidney Injury (AKI) resulting from free radicals induced oxidative stress. the present study was designed to investigate the nephroprotective effect of aqueous extract of *Tinospora cordifolia* against gentamicin induced nephrotoxicity in albino rats. *Tinospora cordifolia* pre-treated groups exhibited significant limitation in rise in levels of BUN and serum creatinine in a dose dependent manner. Histopathological observations further corroborated the biochemical findings.

Table 3: Chemical constituents responsible for the bioactivity.^[66,69]

Activity	Chemical constituent	Class
Neuroprotective effect	Berberine, choline, Tembetarine, Tinosporin, Palmitine, Jatrorrhizine	Alkaloids
Aphrodisiac property	Berberine, Palmatine, Tembetarine, Magnoflorine, Tinosporin, Isocolumbin	Alkaloids
Immunomodulatory activity	Cordifolioside A, Tinocordiside, Syrigin	Glycosides
Antidyslipidemic activity	Berberine	Alkaloids
Antioxidant activity Anti-inflammatory activity	(-)Epicatechin, Tinosporin, Isocolumbin, Palmatine, Furanolactone, Tinosporin, Tinosporide, Jateorine, Columbin, Clerodane derivative	Alkaloid, Diterpenoid lactone Diterpenoid lactones
Gastroprotective activity	Epoxyclerodane diterpene	Terpenoids
Radioprotective & cytoprotective activity	Cordifolioside A	Terpenoid
Antifeedant activity	Tincordin, Tinosporide, Columbin, 8-hydroxy columbin	Terpenoid, Diterpenoid lactone
Ameliorative effect	Tinosporin, Isocolumbin, Palmatine, Magnoflorin, Tetrahydropalmatine	Alkaloids, Terpenoids
Cardioprotective effect	Furanolactone, Tinosporin, Tinosporide, Jateorine, Columbin, Clerodane derivatives	Alkaloids, Terpenoids
Hepatoprotective activity	Magnoflorin, Tinosporin, Isocolumbin, Palmatine, Tetrahydropalmatine	Alkaloids, Terpenoids
Antipsychotic activity	Tetrahydropalmatine, Berberine, Choline, Tembetarine, Magnoflorine, Tinosporin, Palmatine, Isocolumbin, Aporphine alkaloids, Jatrorrhizine, Tetrahydropalmatine	Alkaloids, Terpenoids
Antidepressant activity	Tinosporin, berberine, Jatrorrhizine	Alkaloids
Anticancer activity	Magnoflorine, palmatine, Tinocordiside, Cordifolioside A	Alkaloids, Terpenoids
Antiarthritic activity	B- sitosterol, Makisterone A, Giloinsterol	Steroids
Antidiabetic activity	Berberine, choline, Tembetarine, Palamtine, Jatrorrhizine	Alkaloids
Antimicrobial activity	Furanolactone, Tinosporon, Jateorine, Columbin	Diterpenoid lactones

CONCLUSION

T. cordifolia is very important medicinal plant which holds a special position in Ayurvedic system of medicines for prevention and treatments of various human ailments. The pharmacological and clinical studies reported in the present review confirm the therapeutic value of *Tinospora cordifolia*. Presence of chemical compounds indicates that the plant could serve as “lead” for development of novel agents for disorders in the coming years. In this regard, further studies need to be carried out to explore *Tinospora cordifolia* for its potential in preventing and treating diseases. The present review gives a direction for future investigators to carry out research on the plant so that they could get some medicinally important drug.

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