



Unveiling Nature's Pharmacy: A Comprehensive Review of Medicinal Plant: *Tinospora cordifolia*

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Abstract : A significant portion of the population receives treatment from traditional systems of medicine based on medicinal plants. A deciduous woody climbing shrub known as *Tinospora cardifolia* is found in India, China, and Africa. The plant is a member of the Menispermaceae family. The root, stem, and leaf of this plant are primarily responsible for its pharmacological significance. According to reports, the plant contains phytoactive substances like alkaloids, steroids, glycosides, and amine. *T. cardifolia* had a variety of pharmacological properties, including antioxidant, antidiabetic, cancer, and anti-Anxiety effects. The goal of this review is to provide a concise summary of the knowledge Active constituents and therapeutic properties of the *Tinospora cardifolia* plant .

Keywords : Active constituents , Part , Therapeutic activity , Therapeutic Applications

1. Introduction:

In Ayurveda, *Tinospora cordifolia*, a member of the Menispermaceae family, is commonly referred to as Guduchi. It is a significant medication that Ayurvedic doctors use to treat a variety of diseases as well as to maintain good health. Amruta is given to this medicine because of its health advantages and comparisons to the celestial nectar that grants immortality. It is a well-known rejuvenator and nootropic that is frequently used to treat illnesses like fever, diabetes, and skin conditions^[1] . It is also known as *Cocculus cordifolius* Dec, *Menisperm cordifolium* Wild, and *Tinospora glabra* (N.Br.) M. It is a climber that is fleshy, robust, and deciduous that grows with the support of mango or beech trees^[2] .

The leaves have a heart shaped form. The milky white to grey tint of the succulent bark is speckled with lenticles and has deep clefts. It often is an indigenous plant from India and is also known to be found in the Far East, mainly in rain forests. It produces long, slender aerial roots. It has a light grey papery bark on a stem that is about 6 cm in diameter. The leaves are widely oval or orbicular, 7.5–14 cm long, and 9–17 cm wide, with a deep heart-shaped base. Racemes of tiny greenish yellow flowers are seen. The outer layer of the 3+3 sepals in 7 blooms is modest, while the inner layer is huge. Six stamens are clearly visible^[3] .

It grows in a variety of soils, from acidic to alkaline, and only needs a tiny quantity of moisture to thrive. The guduchi plant is found throughout tropical India and can be found at elevations of 1000 feet in South Asia, Indonesia, the Philippines, Thailand, Myanmar, China, and Sri Lanka^[4] .

2. Active constituents of the *Tinospora cordifolia* :

| Sr. no | Type of active component | Plant part | Active ingredient | Biological activity | References |
|--------|----------------------------------|------------------------------|--|---|------------|
| 1 | Alkaloids | Whole plant | Berberine, tinosporin, palmitine, jatrorrhizine, tembeterine, magnoflorine, isocolmbin | Anti-diabetic, Antioxidant activity | [5,6,7] |
| 2 | Glycosides | Fruits and leaves | Cordifolioside A, Tinocordiside, Syrgin | Immunomodulatory activity, anticancer | [8] |
| 3 | Steroids | Whole plant | beta sitosterol, makisterone A, Giloinsterol, Hydroxyecdysone. Ecdysterone | Antiarthritic activity | [9] |
| 4 | Diterpene | Leaves and stem | Epoxyclerodane, Tinocardin, Tinosporide, Columbin, 8 hydroxy columbin | Gastroprotective activity | [10] |
| 5 | Alkaloids, terpenoids | Whole plant, Leaves and stem | Magnoflorine, palmetine, tinocordiside, Cordifolioside A | Anticancer | [11-13] |
| 6 | Diterpinoid lactones: | Whole plant | Furanolactone, tinosporin, jateorine, columbin | Antimicrobial activity | [14-18] |
| 7 | Amine | Whole plant | N-trans-feruloyl tyramine, giloin, tinosporic acid | Protease inhibitors, neuromodulator. Insulin mimicking and insulin releasing effect | [19] |
| 8 | Terpinoid | Leaves | Cordifoliosid eA | Immunestimulatory, radioprotective activity | [20,21] |
| 9 | Aliphatic compounds | Stem and root | Ootaosanol Heptacosanol Nonacosan-15-one | Radio-sensitizing activity, anti-tumor, anti-nociceptive and anti-inflammatory | [22] |
| 10 | Alkaloid, diterpinoids, lactone, | Leaves and stem | Epicatechin, tinosporin, tinosporide, jeteorine | Anti-inflammatory, antioxidant | [23,7] |

3. Part of *Tinospora cordifolia* :

- Stem :

Stem of this plant is rather succulent with long, fili form, fleshy and climbing in nature. Aerial roots arise from the branches. The bark is creamy white to grey in colour and deeply left spirally ^[24].

- **Arial Root:**

Arial roots are present, these aerial roots are characterized by tetra to penta-arch primary structure. However, cortex of root is divided in to outer thick walled and inner parenchymatous zone ^[25].

- **Leaves :**

Leaves of this plant are simple, alternate, exstipulate, long petioled approximately 15 cm, round, pulvinate, heart shaped, twisted partially and half way round. Lamina is ovate, 10-20 cm long, 7 nerved and deeply cordate at the base and membranous ^[26].

- **Flowers :**

Flowers are unisexual, recemes, greenish yellow in colour, appears when plant is leaf less. Male flowers are clustered and female flowers exist in solitary inflorescence. Sepals are 6 in 2 series of 3 each. Outer ones are smaller than the inner sepals. Petals are also 6, smaller than sepals, free and membranous. Flowering occurs during March to June ^[27].

- **Fruit :**

They are orange-red in colour, fleshy, aggregate of 1-3 and ovoid, smooth, drupelets on thick stalk with a sub terminal style scars. Fruits develop during winter ^[28].

- **Seed :**

Curved seed have been reported in this species. Hence this family is named as moonseed family also. As seeds are curved in shape, embryo also turned in to curve shape automatically. Moreover, the endocarp is variously ornamented and provides important taxonomic characters.

4. Therapeutic activity of *Tinospora cordifolia* :

| SR. no | Activity | Part/Extract | Animal Model/Cell Lines | Reference |
|--------|----------------------------|--|--|-----------|
| 1 | Antiulcer activity | Whole plant/Ethanol and Aqueous extracts | Albino rats using pylorus ligation induced ulcer | [29] |
| 2 | Anti-inflammatory activity | Stem/Aqueous extract | Carrageenan induced paw edema model in rats. | [30] |
| 3 | Antioxidant activity | Whole plant/Ethanol extrac | N-nitrosodiethylamine induced liver cancer in male wistar albino rats. | [31] |
| 4 | Hypoglycemic activity | Stem/ Aqueous Extract | Insulin released effect was detected in vitro using rat pancreatic β -cell lines | [32] |
| 5 | Antimalarial activity | Stem/ Ethanolic extract | Microorganism used Plasmodium berghei on white swiss mice models. | [33] |
| 6 | Antibacterial activity | Stem/ Aqueous and Ethanolic Extrac | Microorganisms used: E. coli, P. vulgaris, E. faecalis, S. typhi, S. aureus, S. marcesenses. | [34] |
| 7 | Hepatocellular carcinoma | Aerial parts/ Ether extract | Diethyl nitrosamine induced hepatocellular carcinoma in male wistar rats | [33] |
| 8 | Anticancer activity | Aqueous and Ethanolic extract | IMR 32 human neuroblastoma cell lines as a model system | [34] |

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|----|---------------------------|-----------------------------|---|------|
| 9 | Gastroprotective activity | Whole plant | Indomethacin induced gastric ulcer in rats. | [35] |
| 10 | Immunomodulatory activity | Whole plant/Aqueous extract | Swiss male albino mice. | [36] |
| 11 | Hepatoprotective activity | Whole plant/Aqueous Extract | Bile duct ligation induced jaundice in rats. | [37] |
| 12 | Antidepressant activity | Petroleum ether extract | Swiss albino mice and activity was evaluated using tail suspension test and forced swim test. | [38] |
| 13 | Antineoplastic activity | Aerial parts/DCM extract | Mice transplanted with ehrlich ascites carcinoma. | [39] |

5. Therapeutic Applications :

Antioxidant effects :

Phenolic compounds in Gulvel are antioxidants^[40,41]. In vitro models showed nitric oxide and superoxide radical scavenging, inhibition of lipid peroxidation, reduction of ferric ions, and total antioxidant capacity^[42]. It reduced superoxide and hydroxyl radical generation and the toxicity induced by free radicals. Alleviation of toxic effects of cyclophosphamide in mice was evident by total white blood cell counts, bone marrow cellularity, and esterase-positive cells. It partially reduced elevated lipid peroxides in serum and liver, and serum alkaline phosphatase and serum glutamic-pyruvic transaminase (SGPT)^[43,44]. Its role in preventing oxidative stress associated with infections was suggested with reference to catalase, glutathione-s-transferase, glutathione peroxidase, glutathione reductase, superoxide dismutase, and polyphenoloxidase^[45]. These effects (alongwith immune-modulation) partially justify claims of benefit in general debility, fatigue, old age, and as hematinic, rejuvenator, tonic, and effects in chronic recurrent infections^[46].

Cancer :

Anticancer actions of a formulation containing *Tinospora cordifolia*, *Asparagus racemosus*, *Withania somnifera*, and *Picrorrhiza kurroo* were shown in mouse macrophages^[47,48]. Effects related to modulation of chemotaxis, interleukin-1 (IL-1), and tumor necrosis factor in ochratoxintreated macrophages. Aqueous, methanolic, and dichloromethane extracts of Gulvel showed dose-dependent increases in lethality to HeLa cells (maximum activity with dichloromethane extract)^[49]. Effects were related mainly to immune-modulatory functions. Antioxidant property also correlates with amelioration of cyclophosphamide toxicity^[43,44].

Antidiabetic

The *T. cordifolia* stems' antidiabetic properties are probably caused by a variety of substances, including alkaloids, tannins, flavonoids, and saponins^[50]. When the enzyme inhibited action in hypoglycemia diabetic animals and normal animals, the crude extract of the stem was tested in dichloromethane, ethyl acetate, chloroform, and hexane. Without the addition of *T. cordifolia* extract, the aqueous extract examined in rats increased sugar by 21.3%, insulin by 51.5%, triglycerides by 54.12%, and the glucose-insulin index by 59.8%.^[51]

In-vivo tests of several extracts have been conducted by Methew and his research team to identify associations with diabetic patients. Different concentrations of *T. cordifolia* leaf ethanolic plant (200 mg/kg and 400 mg/kg b.w.) were synthesised. Streptozotocin-induced diabetes albino rats received the doses orally for ten days and thirty days. When compared to insulin, *T. cordifolia*'s anti-diabetic action on test animals was between 50% and 70% effective^[52]. Due to the activity of the insulin hormone, alkaloids isolated from the plant *T. cordifolia* shown insulin-mediated activities^[53]. *T. cordifolia* was added to the diet on a daily basis up until diabetic pregnant mice (streptozocin-induced diabetes) and showed a protective effect by lowering the oxidative load and reducing the

overall occurrence of disease-conditions ^[54]. In a diabetic rat model, *T. cordifolia* decreased blood glucose and brain interposed cholesterol, suggesting that it may have antidiabetic and lipid-lowering properties ^[55]. Guduchi's root extract had an antihyperglycemic effect in the alloxan-induced diabetes model, as evidenced by a reduction in the excess glucose in urine ^[56]. In diabetic rodent models, a few natural remedies, including Guduchi, such as Hyponidd, Dihar, and Ilogen-Excel, have been used, and the antidiabetic effect of *T. cordifolia* was noted. The effect of Ilogen-Excel reduced the severity of systemic glucose overload and increased the effectiveness of insulin by increasing its quantity in blood circulation. It was discovered that hyponidd reduced the glucose-mediated haemoglobin count while preserving oxidative load via reducing reactive species. In a streptozotocin-induced animal model, "Dihar" was tested for 1.5 months; during that time, it decreased urea and systemic creatinine levels while increasing enzyme activity ^[57,58,59].

Anti-Anxiety Action :

In compared to normal diazepam (2.5 mg/kg), Sarma et al. discovered that a 100 mg/kg ethanolic extract of *T. cordifolia* exhibits notable anti-anxiety effect ^[60]. The patients' I.Q. level showed improvement in line with the clinical investigation. *T. cordifolia* preparation is used as a brain tonic in Ayurveda, and it is said to operate by enhancing mental faculties including memory and recall ^[61]. Hypolipidemic Effect Stanely et al. examined the hypolipidemic effects of an aqueous extract of the root on rats weighing 2.5 and 5.0 g/kg body weight on the sixth week, which resulted in diminished tissue cholesterol, diminished serum, diminished phospholipids, and diminished free fatty acid levels. These rats were alloxan diabetic rats. The greatest significant hypolipidemic effect was seen by the root extract at a dose of 5.0 g/kg of body weight. The ability of *T. cordifolia* root extract to reduce serum or tissue lipid levels in diabetic rats has never been studied before ^[62].

6. Conclusion :

T. cordifolia being a resourceful plant, contains a vast number of biologically active substances that have been suggested to have medicinal potential. There are reports in pharmacological and clinical investigations that support the plant's therapeutic and remedial functions in the treatment of various illnesses. The various bioactive substances, including as sesquiterpenoids, alkaloids, steroids, glycosides, and others, have been discovered to have potential applications, particularly as immunomodulators and antioxidants. Studies on *T. cordifolia* have been undertaken in a variety of ways. *T. cordifolia* demonstrates that it is a fantastic medication and has not yet had any negative or harmful consequences. In conclusion, this review provides details on *T. cordifolia*'s traditional antidiabetic, anticancer, antioxidant, and anti-anxiety action and can be employed for additional research studies in the creation of new drugs.

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