THE MULTI-ACTIVITY HERBACEOUS VINE - *TINOSPORA CORDIFOLIA*

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**ABSTRACT**

*Tinospora cordifolia* (Willd.) Miers ex Hook. F. and Thoms is a large deciduous, climbing shrub found throughout India, especially in the tropical parts ascending to an altitude of 300 m and also in certain parts of China (Anonymous). It belongs to the family Menispermaceae. It is known as heart-leaved Moonseed plant in English, Guduchi in Sanskrit, and Giloy in Hindi. It is known for its immense application in the treatment of various diseases in the traditional ayurvedic literature. *T. cordifolia*, also named as "heavenly elixir," is used in various ayurvedic decoctions as panacea to treat several body ailments. (MehrA R). Its root stems, and leaves are used in Ayurvedic medicine. *T. cordifolia* is used for diabetes, high cholesterol, allergic rhinitis (hay fever), upset stomach, gout, lymphoma and other cancers, rheumatoid arthritis, hepatitis, peptic ulcer disease, fever, gonorrhea, syphilis, and to boost the immune system (WebMD).

**Keywords:** Tinospora cordifolia, Heavenly elixir, Guduchi, Tippa-Teega, Tinosporic acid.

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**INTRODUCTION**

*Tinospora cordifolia*, commonly called as "GUDUCHI," Amrta, and Ginnodhvara in Sanskrit; Głow in Punjabi; Tippa-Teega in Tagalog; Shindilakodi in Tamil; Amruthu and Chittamruthu in Malayalam; Amruthbaali in Kannada; Bändaul pich in Khmer; Raakinda in Sinhala; Boraphét in Thai; Guduchi and Galvel in Marathi; Guruch and Guluncha in Urdu; Ningthou kholong in Manipuri; Theisawthung in Mizo; Guluncha in Bengali; Giloy in Odia; Gimeo in Nepal; Gour in Gujarati; Giloy, Guruch, and Guruch in Hindi; Amritvel in Konkani; Hognital in Assamese; and Gour in Sikkhim, belongs to the family Memispermaceae. It is genetically large, diverse climbing shrub with flowers of greenish-yellow color and the flowering season expands over summer and winter. It is indigenous to topical areas of India, Myanmar, Sri Lanka. It is used in the treatment of various diseases and infections such as diabetes, high cholesterol, allergic rhinitis, Gout, upset stomach, lymphoma, and some cancers also.

**MORPHOLOGICAL CHARACTERISTICS**

*Tinospora* is a glabrous twiner. Its older stems are up to 2 cm diameter and have a corky bark. Stems and branches are with white vertical lenticels. Bark is gray-brown or creamy white, warty and paper-thin, and peels off easily. Leaves are ovate, acute, and long petiolate, with multicoated reticulate venation [1]. It has thread-like aerial roots. When roots are young, they are membranous and become more or less leathery with age.

This herb contains unisexual flowers - clustered male flowers and solitary female flowers. Fruits are drupe shaped that turn red on ripening. Flowers grow during summer and fruits during winter.

**CULTIVATION AND COLLECTION**

*Tinospora* is distributed toward topical regions of India that are located 1200 m above sea level from Kumaon to Assam. In India, it is easily available in Bihar, West Bengal, Kerala, and Karnataka. It commonly grows in deciduous and dries a forest which grows over hedges and small tree [2].

This herb prefers growing in large variety of soils but prefers red soil or medium black soil [3]. The soil should be well drained with sufficient organic matter and moisture as required. It can be propagated by seeds and vegetable cutting, but viability of seeds is very less and seeds germination is major problems related with clonal propagation. The plant is very rigid and can be grown in subtropical and tropical climate but mainly in warm and rainy climate. It does not tolerate high rainfall and waterlogged conditions.

As *Tinospora* is a climber, it requires support for its growth (fast-growing species such as neem, jatropha, and moringa). For example, *T. cordifolia* growing with neem (*Azadirachta indica*) is called as NEEM GILOI.

**CHEMICAL CONSTITUENTS**

Columbin, tinosporaside, jatrorhizine, palmatine, berberine, tembeterine, tinocordifolioside, phenylpropene disaccharides, choline, tinosporic acid, tinosporol, tinosporine, sitosterol (beta form), tinosporic acid, magnesium are the therapeutically active chemical constituents present in *Tinospora* (Wikipedia).

**PLANT PROFILE**

| Family                  | Menispermaceae |
|------------------------|----------------|
| Ayurvedic name         | Amrita, Guduchi|
| Unani name             | Giloy          |
| Hindi name             | Giloy, Gurchua |
| Trade name             | Giloy          |
| Parts used             | Stem, root (whole plant sometimes) |

**TAXONOMIC CLASSIFICATION**

| Kingdom           | Plantae                  |
|-------------------|--------------------------|
| Subkingdom        | Tracheophyta-Vascular plants |
| Superdivision     | Spermatophyta            |
| Division          | Magnoliophyta            |
| Class             | Magnoliosida             |
| Subclass          | Polyphyleae              |
| Series            | Thalamioreae             |
| Order             | Ranales                  |
| Family            | Menispermaceae           |
| Tribe             | Tinospora                |
| Genus             | Cordifolia               |

**MEDICINAL PROPERTIES**

*T. cordifolia* is used in ayurveda as an antiperiodic, antispasmodic, anti-inflammatory, antipyretic, antiarthritic, antipyretic, antiallergic and anti diabetic, antiasthmatic, and anticancer herb (Wikipedia).
Pharmacological activities

Immunomodulatory property

Vaibhav et al. reported that studies have found that there was distinct increase in footpad thickness after treatment with *T. cordifolia* alcoholic extract which indicates immunomodulatory effect of *T. cordifolia*, and there was enhancement in the bone marrow cellularity as well as α-esterase activity in the rats groups treated with alcoholic extracts of *T. cordifolia* which evidently show that these drugs have immunomodulatory activity. Studies revealed that the alcoholic extracts of *T. cordifolia* obtained from the dried ripe fruits possess good immunomodulatory activity. In order to explore the cellular changes and other pharmacological changes in male wistar rat the research is under progress [4].

Chemical constituents responsible for this activity are cordifolioside A, tinosordiside, and syringin.

Antidiabetic activity

*T. cordifolia* is an effective antihyperglycemic drug that can be used in the treatment of diabetes mellitus. Several experiments were conducted to prove the antidiabetic activity in TC. Attempts were made to investigate the antidiabetic activity in TC.

Stem extracts both aqueous and alcoholic in different doses (200 and 400 mg/kg b.w.) in streptozotocin-diabetic albino rats. The drug was given orally for 10 days and 30 days in different group of animals and the results were observed. The study clearly showed that TC has significant (p<0.05) antidiabetic activity in diabetic animals and has an efficacy of 40–80% compared to insulin. TC administration in diabetic animals did not cause any increase in serum insulin levels or regeneration of pancreatic β-cells but caused increased hepatic glycogen synthase and decreased glycogen phosphorylase activity. It was shown that the antidiabetic activity of TC is not through the insulin secretion by pancreatic beta-cells, but it may be due to the increased entry of glucose into the peripheral tissues and organs like the liver. The study strongly suggested that TC may not act like sulfonylureas, but like other oral antihyperglycemic drugs and indicated that treatment with TC may be an alternative to some of the present available drugs, which have some adverse effects [5].

Chemical constituents responsible for this activity are berberine, choline, tembetarine, palmitine, and jatrorrhizine.

Antitoxic activity

*Tinospora* scavenges the free radicals produced during aflatoxicosis. Some of the toxins present in *Tinospora* showed aflatoxin-induced nephrotoxicity. Oral administration of plant extracts (stem and leaf) prevented the occurrence of lead nitrate-induced liver damage, this nephrotoxicity. Oral administration of plant extracts (stem and leaf) prevented the occurrence of lead nitrate-induced liver damage, this nephrotoxicity.

Antioxidant activity

*Staphylococcus aureus* shows anti-HIV effect by indicating reduction in eosinophil count, stimulation in B-lymphocytes, macrophages, hemoglobin levels, and polymorphonuclear leukocytes. [7]. Ethyl acetate extract shows 85% of HIV-1 RT inhibition activity at a concentration of 20 mg/ml [8].

Anti-HIV activity

Root extract of *Tinospora* shows anti-HIV effect by indicating reduction in eosinophil count, stimulation in B-lymphocytes, macrophages, hemoglobin levels, and polymorphonuclear leukocytes. [7]. Ethyl acetate extract shows 85% of HIV-1 RT inhibition activity at a concentration of 20 mg/ml [8].

Anticlastogenic activity

*T. cordifolia* show cytotoxic effects due to lipid peroxidation and release of lactate dehydrogenase and decline in glutathione-S-transferase (GST) [11]. Ethanol extract of TC has been shown to induce apoptosis in breast cancer cells but not necrosis. This extract of *Tinospora* has less cytotoxic effect over non-cancerous cells. *Tinospora* shows activity against breast, colon, lung, skin, prostate, oral, cervical cancer, and lymphoma. Aqueous and ethanol extracts are used for this activity estimation.

Chemical constituents responsible for this activity are magnoflorine, palmatine, tino cordiside, and cordifolioside A.

Anticancer activity

Dichloromethane extracts of TC show cytotoxic effects due to lipid peroxidation and release of lactate dehydrogenase and decline in glutathione-S-transferase (GST) [11]. Ethanol extract of TC has been shown to induce apoptosis in breast cancer cells but not necrosis. This extract of *Tinospora* has less cytotoxic effect over non-cancerous cells. *Tinospora* shows activity against breast, colon, lung, skin, prostate, oral, cervical cancer, and lymphoma. Aqueous and ethanol extracts are used for this activity estimation.

Chemical constituents responsible for this activity are magnoflorine, palmatine, tino cordiside, and cordifolioside A.

Antidiarrheal activity

Whole plant and ethanol or aqueous extracts are used for the estimation of antidiarrheal activity. The *in vivo* activity of extracts was assessed using castor oil (induces diarrhea by inducing nitric oxide, stimulating prostaglandin synthesis, and increasing peristalsis) and magnesium sulfate (prevents reabsorption of water and promotes choleystokinin release from duodenal mucosa) induced diarrhea by means of evaluating onset of diarrhea, frequency if wet and total stools, weight of wet stool, and total weight of stools [15].
Analgesic, anti-inflammatory, and antipyretic activity
Whole plant or ethanol extract is used for analgesic activity. It was assessed by hot plate and abdominal writing method in albino rats [16].

Stem or aqueous extract is used for anti-inflammatory activity. It was exhibited significantly in the carrageenan-induced inflammation test (paw edema model in rats). Chemical constituents responsible for this activity are furanolactone, tinosporin, tinosporide, jateorine, columbin, and clerodane derivatives.

Formulation guduchi ghrita is used to estimate antipyretic activity. Experiment was conducted in albino rats against yeast-induced pyrexia.

Aphrodisiac activity
Aqueous and hydroalcoholic extracts were used to estimate the activity. This activity was studied on male Wistar albino rats. The study gives the mount frequency, mount latency, intromission frequency, intromission latency, anogenital sniffing, and genital grooming [17].

Chemical constituents responsible for this activity are berberine, palmatine, tembatarine, magnoflorine, tinosporin, and isocolumbin.

Antidiabetic activity
Whole plant or alcoholic extract of the herb is used here. The part used for estimation is stem extract. Alloxan-induced diabetic male adult rats of Charles Foster strain were used to carry out the experiment. Chemical constituent responsible for this activity is Berberine [18].

Antioxidant activity
Whole plant or ethanol extract is used to estimate the nootropic effect of *Tinospora*. The nootropic property of n-butanol fraction (TBF) of the ethanolic extract of *T. cordifolia* Miers which contains saponin was evaluated by Amnesic rats using radial arm maze task performance and Barnes maze test. The result showed decreased in AChE concentration which indicates the involvement of cholinergic system in nootropic activity of TBF [20].

CNS depressant activity
Whole plant or alcoholic extract of the herb is used here. The effect of *Tinospora* was dose dependent; as the dose was increased, the extract showed the increased effect as reflected by progressive decrease in plasma calcium and sodium levels and increase in potassium levels at higher doses when compared to that of verapamil. Hence, *cordifolia* is used for the treatment of atrial and ventricular fibrillation, flutter, and ventricular tachyarrhythmias [21]. Chemical constituents are furanolactone, tinosporin, tinosporide, jateorine, columbin, and clerodane derivatives.

Antifeedant activity
Root or ethanol extract is used for the estimation of antifeedant activity. *T. cordifolia* was found to show protective effect by lowering down the content of thiobarbituric acid reactive substances and enhancing the reduced GSH, ascorbic acid, protein, and the activities of antioxidant enzymes such as superoxide dismutase, CAT, GSH peroxidase, GST, and glutathione reductase in kidney. Protection against aflatoxin-induced nephrotoxicity is due to the presence of chemical constituents such as a choline; tinosporin, isocolumbin, palmatine, tetrahydropalmatine, and magnoflorine (alkaloids) in *Tinospora cordifolia* extract [25].

Hepatoprotective activity
Whole plant or aqueous extracts are used for the estimation of the activity while experimentation. Ethanolic extract of all the parts of *Tinospora* showed hepatoprotective effect by reduction in serum enzymes alanine aminotransferase, aspartate aminotransferase, alkaline phosphatase, and total bilirubin accompanied by pet ether and aqueous extracts.

Some of the alkaloids and terpenoids such as magnoflorin, tinosporin, isocolumbin, palmatine, and tetrahydropalmatine present in the herb are responsible for hepatoprotective activity [26].

Antipsychotic activity
Aqueous and ethanol extracts are used here. Amphetamine challenged mice model has to be used for experimentation. *Tinospora* is an active central nervous system stimulant and helps in various neurological activities. Berberine, choline, tembatarine, magnoflorine, tinosporin, palmatine, isocolumbin, aporphine alkaloids, jatrorrhizine, and tetrahydropalmatine are the alkaloids responsible for the activity [27].

The other pharmacological activities of *T. cordifolia* include antidepresant (Swiss albino mice were used and activity was evaluated using tail suspension test and forced swim test), antistesporic (female Sprague-Dawley rats), antifeedant (male rats), antiasthmatic (mice were sensitized with intraperitoneal ovalbumin followed by intranasal ovalbumin in *in vivo* asthma model), diabetic neuropathy (*streptozotocin*-induced Wistar albino diabetic rats and *in vitro* adose reductase inhibition assay and *in vivo* results were analyzed with Mann-Whitney test), and allergic rhinitis (double-blind placebo controlled trial) [1].

**NATURAL BINDER**
Mucilage was extracted from the fresh stems of *T. cordifolia* which was characterized for physicochemical parameters. Using 2%, 4%, 6%, 8%, and 10% concentration of mucilage of *T. cordifolia* as natural binder, diclofenac sodium tablets (11-16) were prepared by dry granulation method. The results show that all the pre- and post-compression parameters of the formulated tablet were in compliance with pharmacopeial limits and the drug release mechanism from
formulation f1-f6 was found to be polymer disentanglement and erosion. Experimental findings revealed that *T. cordifolia* mucilage can be used as release retardant agent in the formulation of sustained release dosage forms [28].

**INTERACTIONS**

1. Usage of *Tinospora* along with diabetics medicines may lead to decline in the blood sugar level.
2. Taking *Tinospora* along with drugs that decrease the immune system may decrease the effectiveness of the medication.

**CONCLUSION**

*T. cordifolia* is an Indian ayurvedic medicine which is a plant having diverse roles. It has several chemical constituents such as steroids, lactones, terpenoids, alkaloids, flavonoids, and glycosides. It shows different pharmacological activities and better significant activity when compared to that of standard drugs. Based on this information, further research work can be explored, and *T. cordifolia* can be used for the treatment of various diseases and infections. This review is useful to study the *T. cordifolia* activities in a simple manner and it is helpful to further research work planning.

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**AUTHORS’ CONTRIBUTIONS**

All authors had equally contributed to the recitation of the article.

**CONFLICTS OF INTEREST**

The authors have declared no conflicts of interest.

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