

A REVIEW ON TINOSPORA CORDIFOLIA IMMUNITY BOOSTER

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ABSTRACT

Tinospora cordifolia (Goly) is one of important as well as very common herb which ingredient in various Ayurvedic Unani and siddha system of medicines. The review article information on Cultivation, Harvesting, Chemical constituent of *Tinospora cordifolia* and the therapeutic uses. Antiulcer, Antidiabetic, Antiinflammatory, Anticancer, Antiaidsand, Antiallergic activity. The pharmacological activity's of Guduchilike nootropic, Antioxidant, Antiaging in immune modulation in condition like diabetes mellitus Antioxidant, Radioprotective properties. The plant mainly contains Alkaloids, Glycosides, Steroids, Sesquiterpenoids, Aliphatic compound, essential oil, mixture of Fatty acid and Polysaccharides. The trace element studies on aqueous extract of these medicinal plant have been carried out using particle induced X ray imission technic for their medicinal

uses. The very high concentration of chloride, potassium, calcium in all the leaf sample Appreciable levels of Mn and high Zn content in *Tinospora cordifolia* plant.

KEYWORDS: *Tinosporacordifolia*, Guduchi, evidences, trace element.

INTRODUCTION

Tinospora Cordifolia is a climbing shrub belongs to family Menispermaceae. It is commonly known as Guduchi, Amrita, Gurach, *Tinospora*. It is a large, glabrous deciduous climbing shrub. The stems are rather succulent with long filiform fleshy aerial roots form the branches. The bark is gray brown and watery. The leaves are membranous and cordate. The flowers small and greenish yellow. This herb is found throughout tropical asia ascending to a height of 300 mts.

Pharmacognosy of *Tinospora Cordifolia*

1. **Stems** - Fleshy
2. **Roots** - long thread like, aerial, arise from branches.
3. **Bark** - Thin, greyish or creamy white in colour, when peeled fleshy stem is exposed.
4. **Leaves** - Cordate (heart shaped), membranous, juicy.
5. **Flowers** - Bloom during summer
 - a) **Male flower** - Small, yellow or green coloured occur in clusters.
 - b) **Female flower** - Occur singly.
6. **Fruits** - Pea shaped, fleshy, shiny turn red when boiled. Occur in winter
7. **Seeds** - curved, pea sized.
8. **Parts Used:** Stems, Roots
9. **Distribution:** The plant occurs throughout tropical regions of India extending from Kumaon to Assam and Myanmar, Bihar, Konkan to Sri Lanka. It is a large climber which grows over the highest trees in the forests and throws out aerial roots which reach the length of 10 metres, though not thicker than packthread.
10. **Cultivation:** Soil And Climate: It grows well in almost any type of soils and under varying climatic conditions.
11. **Nursery raising and planting:** The plant is cultivated by stem cutting in the month of May-June. It requires some support preferably Neem and Mango trees, such plants are supposed to possess better medicinal values.
12. **Weeding and Hoeing:** Periodical hoeing is done, both in the nursery and field as per requirement.
13. **Manures, Fertilisers and Pesticides:** The medicinal plants have to be grown without chemical fertilizers and use of pesticides. Organic manures like, Farm Yard Manure (FYM), Vermi-Compost, Green Manure etc. may be used as per requirement of the species. To prevent diseases, bio-pesticides could be prepared (either single or mixture) from Neem (kernel, seeds & leaves), Chitrakmool, Dhatura, Cow's urine etc.
14. **Irrigation:** The field after plantation should be irrigated periodically as and when required.
15. **Weekly or fortnightly**
16. **Harvesting/Post Harvesting Operation:** Mature plants are collected, cut into small pieces and dried in shade.
17. **Yield:** Approximately 8-10 q./ha.

18. Economics: The rate for a kg. of dried stem ranges from Rs. 15-20. (YEAR-2001)^[1]

19. Chemical Constituents: The plant mainly contains alkaloids, glycosides, steroids, sesquiterpenoid, aliphatic compound, essential oils, mixture of fatty acids and polysaccharides. The alkaloids include berberine, bitter gilonin, non-glycoside gilonin gilosterol.^[2]

The major phytoconstituent in *Tinospora cordifolia* include tinosporine, tinosporide, tinosporaside, cordifolide, cordifol, heptacosanol, clerodane furano diterpene, diterpenoid furanolactone tinosporidine, columbin and b-sitosterol. Berberine, Palmatine, Tembertaine, Magniflorine, Choline, and Tinosporin are reported from its stem.^[3-6]

Table 1: Vernacular Names.

Telugu	Tippateege, Guricha
Sanskrit	Guduchi, Amrita
Hindi	Gulanacha,
Kannada	Amrutaballi, Madhuparni,
Malayalam	Amrytu, Chittamritam
Gujarati	Gulvel
Bengali	Golancha
Oriya	Gulochi
Tamil	Amudam, Chindil
Urdu	Gilo, Satgilo.
Marathi	Gulvel



Fig.1: Tinospora cordifolia Fruit.

Synonyms

Guduchi: That which protects.

Amruta: That which can act similar to the celestial nectar which can make the person immortal.

Chakrangi, Chakralakshanika: Referring to the radiating medullary rays visible on transverse section.

Chinnaruha, Chinnodbhava: Referring to its propagation by stem cuttings ^[7, 8]

Table 2: Taxonomy.

Kingdom	Plantae – Plant
Subkingdom	Tracheobionta Vascular plant
Super division	Spermatophyta-Seed bearing plant
Division	Magnoliophyta Flowering
Class	Magnoliopsida – Dicotyledons
Sub-class	Polypetalae – Petals are free
Series	Thalamiflorae – Many stamens and flower hypogynous Order Ranales
Order	Ranales
Family	Menispermaceae;
Genus	Tinospora;
Species-	T.Cordifolia



Fig.2: Tinospora cordifolia.

Modern aspect of Guduchi

Taxonomical Classification^[9]

Kingdom-Plantae; Division-Magnoliophyta; Class-Magnoliopsida; Order -Ranunculales;

Chemical Constituents

A large number of chemicals have been isolated from *T. cordifolia*, belonging to different classes such as alkaloids, diterpenoidlactones, glycosides, steroids, sesquiterpenoid, phenolics, aliphatic compounds and polysaccharides. Leaves of this plant are rich in protein (11.2%), calcium and phosphorus.^[10] Four new clerodane furano diterpene glucosides

(amritosides A, B, C and D) have been isolated as their acetates from stems. The structures of these compounds were established on the basis of spectroscopic studies.^[11] The glycosylated component of a polysaccharide from *T. cordifolia* has been isolated, purified, methylated, hydrolyzed, reduced and acetylated. The partially methylated alditol acetate (PMAA) derivative thus obtained has been subjected to Gas Chromatography-Mass Spectrometry (GCMS) studies. The following types of linkages were reported: terminal-glucose, 4-xylose, 4-glucose, 4, 6-glucose and 2, 3, 4, 6-glucose.^[12,13] Callus and cell suspension cultures have been established from the stem explants of the plant. Accumulation of berberine and jatrorrhizine (protoberberine alkaloids) was observed in both callus and cell suspension cultures.^[14] The signaling mechanism of the novel (1, 4)- α -D-glucan (RR1) isolated from *T. cordifolia* was investigated in macrophages to evaluate its immuno stimulating properties.^[15] An arabinogalactan has been isolated from the dried stems and examined by methylation analysis, partial hydrolysis and carboxyl reduction. Purified polysaccharide showed polyclonal mitogenic activity against B-cells; their proliferation did not require macrophages.^[16] Detailed chemical constitution of *T. cordifolia* is given in^[17] Phytochemical characterization includes a test for one of the Phytochemical components, namely, tinosporaside (limits, 0.03% to 0.04%).^[18-19]

Table 3: Chemical constituent of *Tinosporacordifolia*.

TYPE	Active principal	Parts in which present.
Alkaloids	Berberine, Palmatine, Tembetarine, Magnoflorine, Choline, Tinosporin, Isocolumbin, Palmatine, Tetrahydropalmatine, Magnoflorine ^[21-26]	Stem & root
Glycosides	Furanoid diterpene glucoside, Tinocordiside, Tinocordifolioside, Cordioside, Cordifolioside A, Cordifolioside B, Syringin, Syringin- α -glucosylglycoside, Palmatosides C31, Palmatosides F31, Cordifolioside A, Cordifolioside B2, Cordifolioside C2, Cordifolioside D2, Cordifolioside E2 ^[27-33]	Stem
Diterpenoid Lactones	Clerodane derivatives Tinosporon, Tinosporides, Jateorine, Columbin ^[34-35]	Whole plant.
Steroids	b-sitosterol, d-sitosterol, b-hydroxyecdysone, Ecdysterone, Makisterone, Giloinsterol. ^[36-37]	Stem & aerial plant.
Sesquiterpenoid Aliphatic compound Miscellaneous	Tinocordifolin, Octacosanol, Heptacosanol, Nonacosan-15-one 3, (a,4-dihydroxy-3-	Whole plant

compounds	methoxy- benzyl)-4-(4-hydroxy-3-methoxy-benzyl)- tetrahydrofuran ^[38-39]	Whole plant
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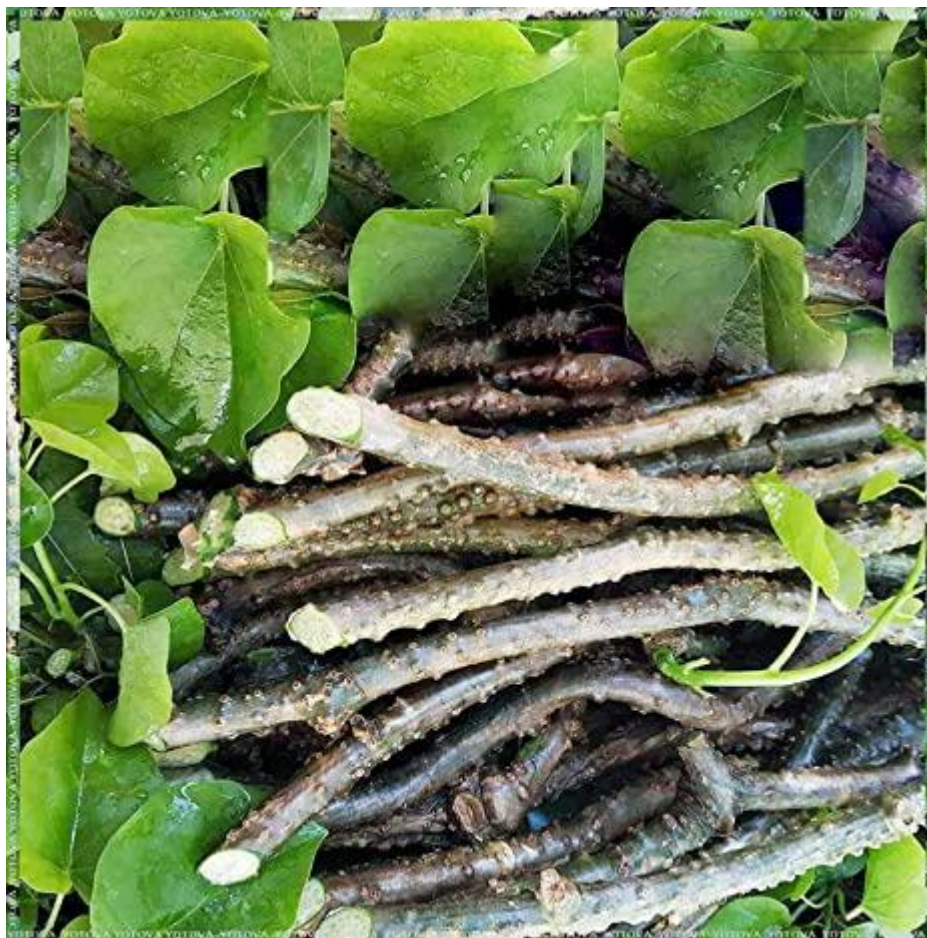


Fig. 3: Tinospora cordifolia Stem.

Element Tinosporacordifolia (stem aqueous extract) are present Cl K Ca Cr Mn Fe Ni CuZn Br Trace Element Studies: Traditionally, Tinospora cordifolia used medicinal plant in India for curing ailments ranging from common cold, skin diseases, and dental infections to major disorders like diabetes, hypertension, jaundice, rheumatism, etc. To understand and correlate their medicinal use, trace element studies on the aqueous extract of these medicinal plants have been carried out using particle-induced X-ray emission technique. A 2-MeV proton beam was used to identify and characterize major and minor elements namely Cl, K, Ca, Ti, Cr, Mn, Fe, Co, Ni, Cu, Zn, Br, and Sr in them. The very high concentrations of Cl, K, and Ca in all the leaf samples, appreciable levels of Mn and high Zn content in T. cordifolia(20). The concentration of trace element Evidences and mechanisms of action.

Boosts immunity

This herb activated the immune system of our body and increase vitality in a person. Include Giloy juice or kadha in your diet twice a day can improve your immunity. It is full of antioxidants and helps to release toxins from the body. Giloy juice also detoxifies your skin and improves your skin. Giloy is also used for liver diseases, urinary tract infections, and heart-related issues.

Immune-modulation

Immune-modulation by Gulvel has been established in obstructive jaundice, tuberculosis, and cancer in human and animal studies^[40,41,42,43,44,45,46,47,48] Syringin and cordial, isolated from Gulvel showed inhibition of C3-convertase in classic complement pathway, enhancement of humoral and cell-mediated immunity, increased IgG antibodies, and increase in granulocyte-macrophage colony-forming units. Macrophage activation by cordioside, cordiofolioside, and cordiol isolated from Gulvel, led to leucocytosis and enhanced neutrophil function.^[49] Protective effects of Gulvel in *Escherichia coli*-induced peritonitis in mice showed improved phagocytic capacities of neutrophils. Cholestasis-induced immunosuppression in rats was significantly improved by Gulvel, suggesting its role as immune-modulator in obstructive jaundice.^[46,50] Immunologically active substances, arabinogalactan^[19], and the novel (1,4)-alpha-D-glucan derived from Gulvel were shown to activate immune system through macrophage activation via toll-like receptor-6 (TLR6) signaling, nuclear factor kappa B (NFkappa-B) translocation, and cytokine production.^[20,51] Antiangiogenic activity was shown through elevation of interleukin-2 (IL-2) and tissue inhibitor of metalloprotease-1 (TIMP-1)^[52] Immune-modulatory effects have implications in liver damage due to tuberculosis and anti-tuberculosis drugs, cancers and anticancer drugs, and malaria. Immune-modulation is also a likely basis for its claimed use as bone marrow stimulant, hematinic, tonic or rejuvenator, and the supposed beneficial effects in general debility and old age¹, due to additional antioxidant property. Supposed uses for prevention and management of recurrent infections including ear-nosethroat infections and symptomatic treatment of pruritus¹⁰ also are related to immune-modulation.

Medicinal Properties

A myriad of biologically active compounds have been isolated from different parts of the plant body. These compounds have been reported to have different biological roles in disease conditions.

Anti-diabetic activity

The stem of this plant is generally used to cure diabetes by regulating level of blood glucose. It has been reported to act as anti-diabetic drug through explanatory oxidative stress, promoting insulin secretion by inhibiting gluconeogenesis and glycogenolysis.^[51]

Anti HIV activity

Root extract of this plant has been shown a decrease in the regular resistance against HIV. This anti HIV effect was exposed by reduction in eosinophil count, stimulation of B lymphocytes, macrophages, level of hemoglobin and polymorphonuclear leucocytes.^[52]

Anti cancer activity

T. cordifolia shows anti-cancer activity, this activity is mostly shown in animal models. Root extract of *T. cordifolia* has been shown radio protective role due to extensively increase in body weight, tissue weight, tubular diameter. Dichloromethane extracts of *T. cordifolia* shows cytotoxic effects owing to lipid peroxidation and release of LDH and decline in GST. In pre-irradiating mice, root extract has widely affected radiation, induced rise in lipid peroxidation and resulted in the decline of GSH in testes.^[53]

Anti microbial activity

Methanolic extract of *T. cordifolia* has been reported against microbial infection. Antibacterial activity of *T. cordifolia* extract has been bio assayed against *Escherichia coli*, *Staphylococcus aureus*, *Klebsiella pneumonia*, *Proteus vulgaris*, *Salmonella typhi*, *Shigella flexneri*, *Salmonella paratyphi*, *Salmonella typhimurium*, *Pseudomonas aeruginosa*, *Enterobacter aeruginosa*, *Enterobacter aerogene*.^[54]

Antioxidant Activity

Anilakumar K R et al. has studied the in-vitro antioxidant activity of *Tinospora cordifolia*. It has been observed that *Tinospora cordifolia* exhibited excellent antioxidant activity in methanol, ethanol and water extracts. The observed high antioxidant activities of the extracts indicate the potential of the stem as a source of natural antioxidants or nutraceuticals to reduce oxidative stress with consequent health benefits.^[55]

Radiation Therapy

A study published in "Evidence-Based Complementary and Alternative Medicine" demonstrated that giloy may help prevent negative side effects of radiation treatment. The

experiment, which was conducted on adult male mice, focused on the damaging testicular effects of radiation treatment in males. Male mice who underwent treatment with giloy and were exposed to radiation suffered from fewer testicular lesions and other negative side effects than those who were not treated with giloy. These studies suggest that giloy may be effective in preventing infertility and related problems in men who undergo radiation treatment.^[56]

Anti Allergic Activity

Tinospora cordifolia has been studied for its anti allergic effect. It was found that *T cordifolia* provided significant relief from sneezing, nasal discharge, nasal obstruction, and nasal pruritus compared with placebo with consistent improvements on examination of the nasal smears and nasal mucosa.^[57]

As an Immunomodulator and against Hepatic Amoebiasis

The activity of a crude extract formulation was evaluated in experimental amoebic liver abscess in golden hamsters and in immunomodulation studies by Youvraj R Sohni et al. The formulation comprises the following five plants *Boerhavia diffusa*, *Tinospora cordifolia*, *Berberis aristata*, *Terminalia chebula* and *Zingiber officinale*. The formulation had a maximum cure rate of 73% at a dose of 800 mg/kg/day in hepatic amoebiasis reducing the average degree of infection (ADI) to 1.3 as compared to 4.2 for sham-treated controls. In immunomodulation studies humoral immunity was enhanced as evidenced by the haemagglutination titre. The T-cell counts remained unaffected in the animals treated with the formulation but cell-mediated immune response was stimulated as observed in the leukocyte migration inhibition (LMI) tests.^[58]

Anti-inflammatory Activity

A study was conducted by Siddalingappa C M et al. It has been observed that *Tinospora cordifolia* showed significant increase in the reaction time (pain threshold) in doses of 100 mg/kg, 200 mg/kg, 100 mg/kg with 5 mg/kg of diclofenac after 30, 60 and 90 minutes of administration. In the same above doses, *Tinospora cordifolia* showed 32.63%, 36.63% and 40.5% inhibition of paw edema respectively at the end of three hours.^[59]

Antiulcer Activity

D. N. K. Sarma et al. has studied the antiulcer activity by using the ethanolic extracts of the roots of *T. cordifolia* and was observed that, it induces a marked protective action against an 8 h restraint stress induced ulcerization, which is comparable to that of diazepam.^[60]

Anti aging

Guduchi (*Tinospora cordifolia*). The aqueous extract of the root contains Alkaloids (berberine, palmatine, magnoflorine, tinosporin, isocolumbin), glycosides steroids, Phenolic compounds, Polysaccharides. Leaves of this plant are rich in protein (11.2%) and are fairly rich in calcium and phosphorus. It has been found to possess strong free radical scavenging properties against reactive oxygen and nitrogen species diminishing the expression of iNOS gene (their high levels create an opportunity to react with superoxide leading to cell toxicity). Significant reduction in thiobarbituric acid reactive substances and an increase in reduced glutathione catalase and superoxide dismutase (anti-oxidant) activity were also observed. It has shown to increase Monoamine oxidase (MAO-A and MAO-B) activities, the elevated levels of which have increased levels of brain monoamines leading to significant antidepressant activity.^[61]

Free radical scavenging acti Anti-inflammatory activity

The water extract of the stem of *Tinospora cordifolia* has been checked for anti-inflammatory activity in albino rats. It has significantly inhibited acute inflammatory response evoked by carrageenin when administered orally and intraperitoneally.^[62]

Anti-stress

T. cordifolia is known as a medhya rasayana (learning and memory enhancer) in Ayurveda. It is also described to be useful for treatment of bhrama (Vertigo) in various Ayurvedic texts. Significant response has been found in children with moderate degree of behaviour disorders and mental deficit, along with improvement in IQ levels.^[63] The root of *T. cordifolia* is known to be used traditionally for its anti-stress activity.^[64] in a 21-day randomized, double-blind placebo-controlled study, the pure aqueous extract of the root was found to enhance verbal learning and logical memory.^[65]

T. cordifolia has also been shown to enhance cognition (learning and memory) in normal rats and reverse cyclosporine-induced memory deficit. Both the alcoholic and aqueous extracts of *T. cordifolia* produced a decrease in learning scores in Hebb William maze and retention

memory, indicating enhancement of learning and memory. The histopathological examination of hippocampus in cyclosporine-treated rats showed neurodegenerative changes, which were protected by *T. cordifolia*.^[67] Various extracts of the *T. cordifolia* exhibited comparable anti-stress activity in mice.^[68,69] cognition.

CNS depressant activity

Effect on locomotor activity Most of the drugs acting on central nervous system influence locomotor activity in man and animals. The CNS depressant drugs such as barbiturates, alcohol and tranquillizers like chlorpromazine reduce the locomotor activity while, the CNS stimulants such as caffeine and amphetamines increase the activity. In other words, the locomotor activity can be an index of wakefulness (alertness) of mental activity. The locomotor activity can be studied using Actophotometer, which operates on photoelectric cells, connected in circuit with a counter. Among the different solvent extracts evaluated during our study, petroleum ether, ethanol extracts of *T. cordifolia* leaf, stem and root showed significant reduction in locomotor activity after 2 hours of oral administration. Whereas the aqueous extract of leaf and root also showed significant reduction in locomotor activity after 2 hours. However, the animal group administered with aqueous extract of *T. cordifolia* stem the percentage decrease of locomotor activity was negligible.^[70]

Anticonvulsant activity

The anticonvulsant activity was accessed by determining and comparing the test group with that of the standard drug treated group. The petroleum ether extract having the % inhibition of extension phase is 35.3% and the ethanolic extract having % inhibition phase of 61.1%. The ethanolic extract treated animals was found to be significantly good activity compared to standard drug treated cases (Murthy et al., 2012).

Anti-toxic Activity

The gold standard drug for the treatment of Parkinson's disease is L-DOPA, but various studies have proved that the treatment with L-DOPA leads to the death of surviving dopaminergic neurons in the CNS. The coadministration of *Tinospora cordifolia* crude powder protected the dopaminergic neurons when compared with Sham operated control group. The treatment with *Tinospora cordifolia* crude powder could reduce the toxicities of L-DOPA therapy for Parkinson's disease.^[68] *Tinospora cordifolia* alkaloids such as choline, tinosporine, isocolumbin, palmetine, tetrahydropalmatine and magnoflorine showed protection against aflatoxin induced nephrotoxicity. *Tinospora cordifolia* extracts have

been reported to scavenge free radicals generated during aflatoxicosis. It exhibited protective effects by lowering thiobarbituric acid reactive substances (TBARS) levels and enhancing the GSH, ascorbic acid, protein, and the activities of anti-oxidant enzymes viz., SOD, CAT, GPx, Glutathione S-transferase (GST) and glutathione reductase (GR) in kidney.^[69]

Cyclophosphamide an anti-cancer drug has been reported to reduce the glutathione content in both bladder and liver and lowered levels of cytokines Interferon- γ and IL-2 an increased levels of pro-inflammatory cytokine TNF- α . This effect could be reversed on *Tinospora cordifolia* treatment indicating the role of *Tinospora cordifolia* in overcoming Cyclophosphamide induced toxicities in cancer treatment. Leaf and stem extract of *T. cordifolia* has been reported to show hepatoprotective effect in male albino mice against lead nitrate induced toxicity. Similarly, oral dose of plant extract prohibited the lead nitrate induced liver damage.

CONCLUSION

The scientific research on *Tinospora cordifolia* suggests a huge biological potential of this plant. It is strongly believed that detailed information as presented in this review on the phytochemical and various biological properties of the extracts might provide detailed evidence for the use of this plant in different medicines. The phytochemical variations and efficacy of the medicinal values of *Tinospora cordifolia* is dependent on geographical locations and seasons. At the same time, the organic and aqueous extract of *Tinospora cordifolia* could be further exploited in the future as a source of useful phytochemical compounds for the pharmaceutical industry. Even though, there are many herbal plants in the world, Guduchi is considered to be having greater medicinal value. The pharmacological actions attributed to *Tinospora cordifolia* in Ayurvedic texts have evidences suggesting that this drug has immense potential in modern pharmacotherapeutics. Various crude extracts from various parts of guduchi have medicinal applications from time immemorial. *Tinospora cordifolia* can be a potential dietary component which can help in prevention of different diseases. The utility of Guduchi leaves in diet is advisable and is highly beneficial. The presented review summarizes the information concerning the botany, Ethnopharmacology, phytochemistry and biological activity of the *Tinospora cordifolia* plant. Future directions will entail studies on its pharmacology using animal models and isolated bioactive compounds. Further studies on this plant must be carried out to explore some other important, necessary and unknown benefits.

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