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# A COMPREHENSIVE REVIEW ON *TINOSPORA CORDIFOLIA*: A PANACEA TREATMENT STRATEGY

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## ABSTRACT:

As the population is rising, number of diseases have been increased worldwide. The modern/allopathic system of medication is in great account but it lacks in terms of side effects and development of resistance. Due to increasing side effects of these medications, traditional systems of medication came into existence. Traditional systems of medication include Ayurvedic, Homeopathic, Siddha and Unani medicines. Plants are good resources when it comes to health and illness and have been used as medication for the treatment of many diseases since ancient period of time. This review article describes the significant and classical role of a medicinal plant *Tinospora cordifolia* (Giloy) in therapeutics for the ailment of various diseases such as diabetes, memory impairment, bacterial infections, toxicities, helminthiasis, ulcer, pain, fever, inflammation, hyperuricemia and diarrhea. This also unfolds the information about taxonomical description, chemical constituents and pharmacognostical characteristics of the plant along with uses and threats to this plant.

**Keywords:** *Tinospora cordifolia*, Giloy, chemical constituents, pharmacological potentials.

## 1. INTRODUCTION

WHO reports that 80% of the global population relies mostly on traditional medicines that incorporate plant extracts or their active constituents. There is a solid basis for the use of numerous plants in general healthcare and the treatment of the common diseases that people suffer thanks to India's mega-biodiversity and awareness of its rich traditional medical systems (Pandey et al. 2008). When it comes to alleviating human suffering, plants play a crucial role. All around the world, people have turned to a broad variety of plants in the quest to cure illness. One of the medicinal plants used for years to treat a wide variety of illnesses is

the *Tinospora cordifolia*. The Menispermaceae family, of which this plant is a part, includes about 70 genus and 450 species (Spandana, et al. 2013). *T. cordifolia* is a well-known Indian bitter remedy used to treat a wide range of illnesses. It has also been proposed as a treatment for helminthiasis, leprosy, and heart illness. The stem extract acts as a source of starch, which is both very nutritious and easily digested (Kirti et al. 2004).

*Tinospora cordifolia* is a Rasayana drug which comes in ayurvedic system of medicine and widely used for the treatment of various diseases. *Tinospora cordifolia* has different names in different languages: *Giloya* (Hindi), *Gulantha* (Bengali), *Sindal* (Tamil), *Gulvel* (Marathi) and *Somida* (Telugu). In ayurveda, different dosage formulations of *Tinospora cordifolia* have been described, these includes *Kalka* (paste of fresh stem, 10g/day), *Churna* (powdered dry stem, 1-3g/day), *Swaras* (juice of fresh stem, 10-20ml/day). Three main pharmacological activities of *Tinospora cordifolia* plant are rasayana (improvement of learning and memory), *deepan* (facilitation of metabolism) and *jwaranashan* (alleviation of fever). Other activities shown by this plant are relief of thirst, works as appetizer and digestive ailment (Panchabhai, et al; 2008).



**Fig 1. *Tinospora cordifolia* plant (John et al. 2019)**



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## 2. PLANT PROFILE

### 2.1 Common names (Sharma et al; 2010)

Hindi- Giloya, Guduchi

English- Indian tinospora

Tamil- Shindilakodi

Gujarati- Galo

Kannada- Amrita balli

Bengali- Gulancha

Telugu- Tippatiga

### 2.2 Taxonomical description (Spandana, et al; 2013)

Kingdom- Plantae

Order- Ranunculales

Family- Menispermaceae

Genus- Tinospora

Species- *T.cordifolia*

### 2.3 Distribution

The plant is distributed to various parts of the world in different countries and they are India, Indonesia, Myanmar, Burma, Sri Lanka, North Africa, Malaysia, Thailand, China, Philippines, Borneo, Bangladesh, South Africa, West Africa and Vietnam. In India, it is widely distributed to West Bengal, Karnataka, Bihar, Kerala, Assam and Uttarakhand (Sinha, et al; 2004).

### 2.4 Active constituents (Mittal, et al. 2014)

It has numerous traditional uses due to presence of different active constituents. Various studies have exhibited the following mentioned active constituents of *T. cordifolia* (Giloy)-

**Table 1. Active constituents of *T. cordifolia* plant**

Compound	Active constituents	Parts of plant
Alkaloids	Berberine, Palmatine, Magnoflorine, Choline, Tinosporin, Isocolumbin, Tetrahydropalmatine	Stem and Root
Glycosides	Tinocordifolioside, Syringin, Palmatosides C, Palmatosides F, Cordioside	Stem
Steroids	$\beta$ Sitosterol, Ecolysterone, Makisterone A, Giloinsterol	Aerial Part and Stem
Diterpenoid lactones	Tinosporides, Jateorine, Columbin, Tinosporin	Whole Plant
Sesquiterpenoid	Tinocordifolin	Stem
Aliphatic Compounds	Octacosanol, Heptacosanol	Whole Plant

Below figure depicts the structures of alkaloids, glycosides, steroids, aliphatic and miscellaneous compounds-

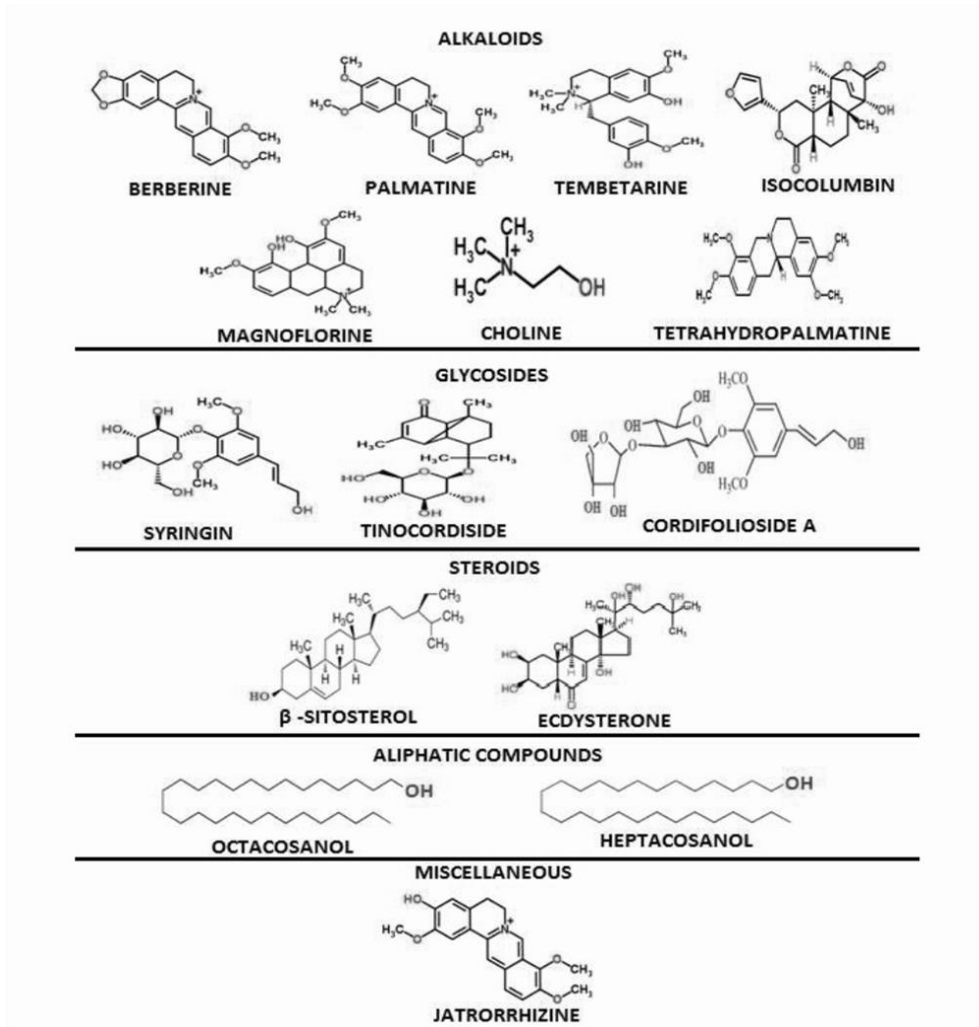


Fig 2. Structures of active moieties (Reddy & Reddy, 2015)

## 2.5 Pharmacognostical characteristics (Bharathi, et al; 2018)

It's a big climbing shrub that loses its leaves in the winter, and it has green leaves and a greenish-yellow stem. This plant has many distinct components, each of which -

The plant's leaves have a heart shape, are simple, have a petiole, are spherical and pulvinate, and are around 15 centimetres in length. When young, they have a membranous texture, but as they age, they develop a leathery one.

Approximately 10–12 cm in length and 8–15 cm across, the lamina is oval in shape.

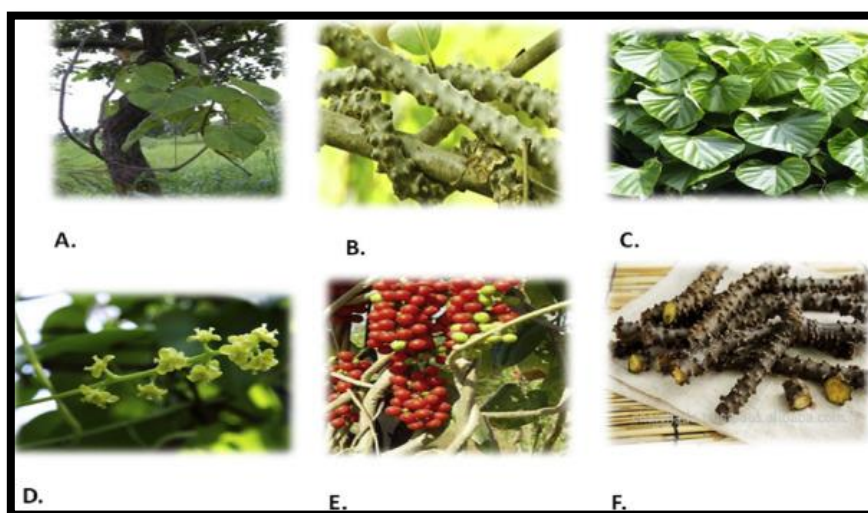
Unisexual, tiny (less than 2 mm in diameter), and less showy than the leaves, the blooms of this plant are barely noticeable. The female flowers stand alone, while the male blooms are grouped together. Summer is typically flower season (May-June).

The fruit is shaped like a pea, is orange in colour, and has one large, round seed. September and October are the fruiting months.

The stem is made up of pericyclic fibres and bicollateral vascular bundles. Parenchyma of the stem contains starch. The corky bark and larger diameter of older stems can reach 2 centimetres.

The basic structure of a plant's aerial roots consists of tetrahedrons and pentagons. The cortex has an inner layer and an outer layer. Secretory canals are found in the inner zone, while velaman are found in the outer zone. The plant's bark and roots are used to combat cancer.

Fruit-like and rounded, the seed is a fatty treat.



**Fig.2. Morphology of *Tinospora cordifolia* plant (Sharma et al. 2019)**



## 2.6 Uses

*Tinospora cordifolia* is commonly used for (Khan, et al; 2016)-

- Fevers
- Infectious skin diseases
- Syphilis
- Gastrointestinal disturbances
- Tuberculosis
- Cancers
- Tumors
- Malaria
- Anxiety
- Depression
- Memory impairment

## 2.7 Threats to this plant

India has biodiversity of medicinal plants. *Tinospora cordifolia* is one of these plants which has potent therapeutic activity. This plant is in existence since ancient times. The plant is used for the treatment of diabetes, cancer, HIV, microbial infection. The leaf extract of the plant is used as antioxidant whether aqueous extract of the plant shows anti toxic properties, the natural compounds present in the plant are believed to show immunomodulatory properties. Since its tremendous medicinal properties, this plant is being overexploited by various pharmaceutical companies by the group of people who utilizes plants to prepare traditional medicines. This overexploitation may lead to extinction of this plant in order to meet present need. Due to its high demand, the plant is listed among 29 highly prioritized medical plants of agro climatic zone 8 (Uttar Pradesh, Madhya Pradesh and Rajasthan) of India as identified by NMPB, New Delhi, Government of India (Mittal, et al; 2014).

## 3. PHARMACOLOGICAL POTENTIALS

Various pharmacological potentials of *Tinospora cordifolia* plant are as follows-

### 3.1 Immunomodulatory

The immunomodulatory effects of the *Tinospora cordifolia* plant are well-known. The chemicals magnoflorine, syringin, 11-hydroxymuskatone, cordifolioside A, and tinocordioside are responsible for the cytotoxic and immunomodulatory effects (Sharma, et al; 2011). *Tinospora cordifolia* aqueous extract impacted immune effector cell cytokine



generation, stimulation, mitogenicity, and activation (Upadhyaya, et al; 2011). The efficacy of the *Tinospora* lotion formulation was demonstrated in an experiment where blood serum samples were used to evaluate IL-1, IL-6, & IL-8. Since *tinospora* lotion reduces interleukin levels, it is more effective against scabies.

### 3.2 Anti-bacterial

The *tinospora cordifolia* plant possesses antimicrobial properties that may be effective against a range of microorganisms. Pathogenic isolates of *Pseudomonas* spp., *Proteus* spp., and *E. coli* were all inhibited by *Tinospora cordifolia* plant extracts. *Tinospora cordifolia* plant extracts showed a minimum bactericidal concentration (MBC) between 1.29 and 22.73mg/ml (Mishra, et al; 2013).

A different study by Francesca Bonvicinia and colleagues found that *Tinospora cordifolia* components inhibited methicillin-resistant *Staphylococcus aureus* and carbapenemase-producing *Klebsiella pneumoniae* more effectively than reference microbiological strains (Francesca et al. 2014).

### 3.3 Anti-toxic

Levodopa is believed to be standard in the treatment of Parkinson's disease but it leads to death of surviving dopaminergic neurons in CNS. To overcome this problem, crude powder of *Tinospora cordifolia* plant was coadministered which reported to protect the surviving dopaminergic neurons on comparison with sham operated controlled group. Crude powder of *Tinospora cordifolia* plant reduced the toxicity of Levodopa in Parkinson's disease (Antony, et al; 2010).

Choline, tinosporine, isocolumbin, palmetine, tetrahydropalmatine, and magnoflorine are only few of the alkaloids found in *Tinospora cordifolia* that have been shown in prior research to protect against the nephrotoxicity caused by aflatoxin. *Tinospora cordifolia* extracts have been proven to quench free radicals, which are a byproduct of aflatoxicosis. Kidney GSH, ascorbic acid, protein, and the anti-oxidant enzymes superoxide dismutase, catalase, glutathione peroxidase, and glutathione reductase were all elevated, and thiobarbituric acid reactive substances were decreased (Gupta & Sharma, 2011).

### 3.4 Anti-oxidant

The *Tinospora cordifolia* plant may be useful as a food additive and a component of nutraceuticals due to its high antioxidant capacity. *Tinospora cordifolia* plant extracts derived from ethanolic, methanolic, and aqueous solvents were found to have significantly stronger anti-oxidant effects than those derived from other solvents. They had decreased power activity and could chelate metals (Bhawya & Anilakumar, 2010). Neha Upadhyay et al. found





that ethanol extracts from *Tinospora cordifolia* bark had a higher phenolic content and greater free radical scavenging action than methanol extracts. By administering an ethanolic extract of *Tinospora cordifolia* to male Wistar albino rats, researchers were able to restore lipid peroxidation (LPO) and enzymatic and nonenzymic antioxidant levels that had been reduced by Nitrosodiethylamine, a chemical known to cause liver cancer (Reddy & Reddy, 2015).

### 3.5 Anti-diabetic

Also, the *Tinospora cordifolia* plant has been shown to have anti-diabetic effects. *Tinospora cordifolia* leaves extract exhibits strong anti-diabetic action with an efficacy of 50-70% as compared to insulin when given orally in doses of 200 and 400mg/kg (b. w.) for 10 days and 30 days in streptozocin-induced diabetic albino rats (Singh, et al; 2013).

Additional research found that the protective effects of *Tinospora cordifolia* root extract were improved by increasing the concentration of antioxidant molecules and enzymes. Extensive studies have shown that the oxidative stress caused by diabetes in the mother's liver can be significantly mitigated by supplementing the diet with *Tinospora cordifolia* root extract (Shivananjappa & Muralidhara, 2012).

### 3.6 Anti-cancer

There may be anti-cancer properties from the *Tinospora cordifolia* plant. Mice with preexisting micronuclei in their bone marrow were protected against developing new ones after receiving 200, 400, or 600 milligrammes per kilogramme of dry weight of *Tinospora cordifolia* extract 24 hours before intraperitoneal administration of cyclophosphamide (50 mg/kg). It was discovered that C57 B1 mice whose lifespan was extended and whose tumour size was decreased by administering a 750mg/kg body weight dose of a 50% methanolic extract of the *Tinospora cordifolia* plant for 30 days had a smaller tumour (Verma, et al; 2011).

Treatment of mice with *Tinospora cordifolia* extract at 200, 400, or 600mg/kg dry weight 24 hours prior to intraperitoneal administration of cyclophosphamide (50mg/kg) significantly suppressed micronucleus generation in bone marrow. C57 B1 mice were administered 750 mg/kg of body weight of a 50% methanolic extract of *Tinospora cordifolia* for 30 days, and compared to the control group, they lived significantly longer and developed significantly smaller tumours (Rahul et al. 2011).

### 3.7 Analgesic Activity

Analgesics are the drugs which are used to relieve pain. *Tinospora cordifolia* has analgesic activity with no side effects as compared to other synthetic and semi synthetic drugs. *Tinospora cordifolia* extract was given to albino rats at a dose of 300mg/kg orally. It was



found that *Tinospora cordifolia* extract decreased number of writhes and increased response time in abdominal writhing method and hot plate method respectively (Goel, et al; 2014).

### **3.8 Anti-inflammatory & anti-pyretic**

Inflammation and fever are typically treated with nonsteroidal anti-inflammatory medications (NSAIDs). Herbal medicines have been introduced to counteract the negative effects of these manmade drugs. As a result of its many therapeutic properties, the *Tinospora cordifolia* plant has found widespread application. In addition to its potential for analgesic and antipyretic effects, it may also reduce inflammation and fever. Anti-inflammatory activity was determined using the histamine- and carrageenan-induced paw edoema models in rats, and ante-pyretic activity was determined using the Brewer's yeast-induced pyrexia model in rats. Doses of 1.25, 2.5, and 5gm/kg of *Tinospora cordifolia* stem aqueous extract were given to the animals. *Tinospora cordifolia* aqueous extract was found to have strong anti-pyretic and anti-inflammatory action, on par with the widely used medicines paracetamol and diclofenac sodium, respectively (Sumanlata, et al. 2019).

### **3.9 Anthelmintic**

*Tinospora cordifolia* stem extracts were tested in-vitro against *Eisenia foetida* at doses of 10, 25, 50, and 100mg/ml to determine their anthelmintic activity. Both the time at which worms die and the time at which they become paralysed were calculated. Both the aqueous and ethanolic extracts demonstrated considerable activity at 100 mg/ml, when compared to the gold standard medication piperazine citrate (10 mg/ml). Aqueous extract had a longer time to death (15.83 0.60) and a shorter time to paralysis (9.16 0.30) than ethanolic extract (10.83 0.60) (Tiwari, et al; 2011).

### **3.10 Anti-diarrheal and anti-ulcer**

Anti-diarrheal and anti-ulcer effects of *Tinospora cordifolia* ethanolic and aqueous extracts were studied in rats. Castor oil and magnesium sulphate induced diarrhoea was used to evaluate *Tinospora cordifolia* extract for its anti-diarrheal action by measuring the time it took for diarrhoea to begin, the total number of stools passed, and the percentage of those that were wet.

Alternatively, ethanol and pylorus ligation generated ulcers were used to evaluate the extracts of *Tinospora cordifolia* for their anti-ulcer activity. *Tinospora cordifolia* extracts were more effective than the placebo in reducing the total quantity of stools in both models of diarrhoea, and they were also reported to have anti-ulcer activity, decreasing the ulcer index along with the gastrointestinal volume (Kaur, et al; 2014).



### 3.11 Learning & memory enhancing

Learning and memory can both be improved by using the *Tinospora cordifolia* plant (cognitive functions). *Tinospora cordifolia* was extracted with hydroalcohol using the Soxhlet process, which involved drying and powdering the entire plant. The Y maze was used to evaluate the impact of the plant extract on memory. The number of times an animal entered the Y maze and how long it stayed in each arm were used as indicators of spatial memory. Animals were given 100mg/kg of diazepam to cause amnesia. In the Y maze, the transfer latency was measured in terms of the inflexion ratio. There was a notable difference in transfer delay between the plant extract and the control group after 24 hours (George, et al; 2016).

### 3.12 Uricosuric

The uricosuric effects of *Tinospora cordifolia* extracts were studied in hyperuricemic albino Wistar rats caused by potassium oxonate. The concentration of uric acid in urine and blood were evaluated. The uricosuric effect of *Tinospora cordifolia* was tested using the phenol red dye excretion method. Blood phenol red concentrations were determined. Serum uric acid levels were reduced by galo satwa (*Tinospora cordifolia* starch) extracts in a variety of solvents in rats with hyperuricemia caused by potassium oxonate. In all cases, uric acid was excreted at higher rates after taking galo satwa extracts (Shah and Shah; 2015).

### 3.13 Anti-depressant

The ability of *Tinospora cordifolia* extract to alleviate depression in swiss albino mice was tested. Inhibiting amine reuptake in the brain is a potential antidepressant mechanism. There is evidence that doing so increases dopamine (DA), serotonin (5-hydroxytryptamine, or 5-HT), and norepinephrine (NE), while decreasing gamma-aminobutyric acid (GABA). Amines, especially norepinephrine and serotonin, have had their breakdown blocked, as well. G-protein-mediated signalling and antagonism of GABA-B receptors are two proposed methods. Enhancing mental performance in areas such as memory, focus, and concentration is mostly due to the central antioxidant and protecting qualities (Mutalik and Mutalik; 2011).

## 4. CONCLUSION

*Tinospora cordifolia* is a very useful plant in terms of health and illness since it has number of pharmacological activities. It has been used as herbal medication since ancient period of time. The chemical constituents present in this plant have been reported to have therapeutic potential. Various pharmacological and clinical studies suggested the significant role of this plant for the ailment of many diseases. The properties of the *Tinospora cordifolia* plant are



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reviewed here, including its immunomodulatory, antibacterial, antitoxic, antioxidative, antidiabetic, anticancer, analgesic, inflammatory, antipyretic, anthelmintic, diarrhetic, ulcerative, uricosuric, and memory-improving properties. In recent years, more and more people have become interested in learning about and researching medicinal plants. There has been a substantial amount of study on the chemical composition of *Tinospora cordifolia* over the past few decades. Although *Tinospora cordifolia* has been used effectively in Ayurvedic medicine for ages, more study and development of the plant and its compounds is required before it can be utilised effectively in commercial or therapeutic settings. It can be put to use in the pursuit of new knowledge that could lead to the creation of effective medicines for a wide range of illnesses.

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Nil.

#### CONFLICT OF INTEREST

None conflict of interest was declared by the authors.

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