



Pharmacological Aspects of *Tinospora cordifolia* (Giloy): A Review

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Abstract Since the beginning of human civilization, plants have been a major source of medicines. The demand for herbal drugs, health goods, drugs, food supplements, cosmetics, etc. is rising. The present study reviews pharmacological effect of chemical components contained in various sections of *Tinospora cordifolia*. *Tinospora cordifolia* is a frequent application of Ayurvedic shrub. The article conforms with the data supplied through a wide range of diverse phytochemical and pharmacological methods, even though reviews of this plant have been published before. The notable medicinal features include anti-diabetic, antispasmodic action, anti-malarial activity, anti-inflammatory activity, anti-arthritis, anti-oxidants and anti-allergies.

Keywords *Tinospora cordifolia*, medicinal qualities, therapeutic uses, giloy, antispasmodic action

Introduction

Only 1 of 3.69,000 known vascular plant kind on Earth is *Tinospora cordifolia* (giloy). It is intriguing that 31,128 single species in this huge pool have recognized uses (human, vine, or natural demands are satisfactory) yet just 103 species meet more than 90% of human food needs [1]. Herbal treatment is one of the main traditional medicine specialties in the globe. Medicinal plants that have a higher reputation as individuals must be investigated to encourage their use and to evaluate their potential as sources of novel medications [2-3]. The largest subset of useful plants with over 17,000 species contribute to human health and are recognized everywhere as restaurant plants. With this careful collecting, *T. cordifolia* (TC) has a place. Those who possessed research skills, observation and procedures in order to convey information to subsequent eras, in the previous societal hierarchies or even before their establishment [4]. It's a statement to the human ability to locate a hard thing! The reality of the fact that countless people actually rely on medicinal plants by means of the traditional medication scheme (TSM) underlines their importance even though today's medicines are produced or biosimilar [5]. At the moment, several plant species are at risk of destruction due to over- and stress in their areas, and the rising threat of environmental change will also impact TSM and its people [6].

One of the major health sources is plants. Currently there are a large range of medications from plants such as *Papaver somniferum* morphine, *Withania somnifera* Aswagandha, *Belladonna* atropine and *Rauwolfia serpentina* Reserpine, etc [7-8]. Medicinal plants are rich in medicinal secondary metabolites and essential oils (which are possible medication sources). For treatment of medicinal plants under different conditions, the major advantages are their safety, economic efficiency and simple availability [9-10]. Due to these benefits, traditional medical practitioners have utilised the medicines extensively in their daily practice.



The future of higher crops as medicinal sources in disease research, prevention and treatment is likewise highly promising. Natural sources have provided some of the most life-saving medications used in the arsenal of today's medicine. Only 6% of the biological activities were studied and 15% phytochemically researched of the estimated 250,000-400,000 plant species. This implies that a phyto-pharmacological evaluation is required for planned actions [11]. The purpose of this article is to offer an outline of the chemical elements and pharmacological effects of the different components of *Tinospora cordifolia*.

Plant Profile

Tinospora cordifolia (Giloy) is feedy; in Subtropical India the leaf falls on winter (from mid October to end-November) and in spring there are new leaves (February). The flora begins with the beginning of the foliage and goes on until April through May [12]. In some other places (Bangalore), the warm environment continues to blossom between August and January. It has male and female flores on several plants. *Tinospora cordifolia* is a dioecious plant. Pollination by insects is entomophile, and the plants carry a little beer like fruits in grape-like bunches [13]. The fruit is green, unripe and when mature, it becomes light crimson and beautiful. Mature fruit is bitter in flavour, and birds consume it, which also contributes to its spread. As the plant has huge regeneration potential, the major approach is vegetative propagation. The whole plant is used as a medicine; however the stem is favored above the remainder [14].

The stem is bitter, astringent, sweet, thermogenic, anthelmintic, antiperiodic, aperitif, anti-inflammatory and antipyretic, carminative, carcinogenic, aphrodisiac, constipating, cardiogenic, purifying and hematinic, expectorant and rejuvenating [15-17]. In several vitiated conditions like burning sensations, hyperdipsia, helminthiasis, dyspepsia, flatulence, stomach algia, chronic fever, inflammation, drowsiness, vomiting, heart weakness, skin disorders, leprosy, anaemia, cough, general weakness, jaundice, seminal weakness and splenopathy it is useful [18].



Figure 1: Images of *Tinospora cordifolia* (Giloy)

Natural Habitat and Distribution

In India, during botanical explorations the plant was identified in the year 1806. Semi-arid, tropical and subtropical areas have been identified and up to 1,000 M of Western Himalayas have been documented [19,20]. In the provinces of India, TC's cultural assimilation is widespread and wide. More than 100 names demonstrate its scope throughout the population of this plant. More popular and extensively used are Sanskrit names such as Amrita (Nectar) and Guduchi (the protector). Amrita/Guduchi is one of Ayurvedic treatments' most renowned herbs. In the Philippines, in Thailand, it is Boraphet; it is K'uan Chu Hsing; and it is Sindone-ma-new in Myanmar, there are different names of local plant in countries like Indonesia: it is Brotowali, Andawali and Putrawali. The common name of the English is "cordifolia" based on the form of the leaf. The leaf was ultimately used as a nomenclature. Lord Shiva is served Amrita wines, along with bilva, bhans (*Cannabis indica*), tulsi and lotus flowers (*Nelumbo nucifera*) [21].

Pharmacological Uses

Investigations into this plant have indirect signatures, as the first publication was published by Pendse and Dutt in 1932 in the Indian Journal of Medical Research and the second one is not yet available. Pendse has reported the first documented anti-inflammatory action. On the basis of Pubmed, the publishing year on TC is back in 1986, and



papers have started with a rising trend and the spring is continuing on about 2010. It should also be noted that most of the findings came from India [22]. The progress made in instruments that permit analyses of raw extracts or even complete tissue/organ have provided a further push to (re)visiting plants as a key source of human well-being. Pendse revealed the anti-inflammatory, analgesic, and antipyretic activities in albino rats and their immunosuppressive influence on albino rabbit in neem (*Azadirachta indica*) aqueous extract of TC strains. Stem bark was shown to be anti-allergic, anti-inflammatory and antileprotic. TC stalk bark has an analgesic effect and stalk extract is shown to be helpful in treating skin disorders [23]. Stem activity was demonstrated as antidiabetic, cytotoxic, hepatoprotective and immunomodulatory [24]. TC leaves the alloxane rats with antidiabetic activity and shows insulin like action [25]. Ahmed found that TC aqueous extract was effective in treating urinary and rheumatic disorders [26]. TC stem utilised for its anti-inflammatory, antiperiodic, antipyretic and antispasmodic action is used in nutraceuticals in tonic form [27]. In the treatment of jaundice and TC fruit is shown to be active [28]. TC roots are strong which may be used as antistress, antiulcer, hypoglycemic and for visceral blockage [29]. The complete TC plant (country known as the Panchang in Ayurveda) has antioxidants, antifreezes, and hepatoprotective properties, including leaves, stem, roots, flowers, and fruits [30]. The principal target areas in which TC activity is high are kidney, liver and spleen. Treatment with TC extract in mice and rats has shown protection from infections caused and was not harmful in people as well [31,32]. The chemical components largely contribute to the plant's therapeutic properties, especially alkaloids, bitter chemicals and lipids [33]. The TC stem is the official Ayurvedic drug mentioned in India's ayurvedic drug [34]. TC is one of the most versatile revitalising herbs for long life and is thus also known as Vayastha or Amrita [35]. The whole plant and other plants are also utilised in commercial formulation for veterinary, folk and ayurvedic medicine. Guduchi satva, traditionally derived from TC stem growing on a neem tree, is more effective; however, confirmation is required.

Anti-inflammatory, anti-arthritic, anti-lepritical, anti-allergic and anti-diabetes characteristics are used for general tonic, anti-spasmodic and anti-inflammation [36].

The plant enhances the immune system and the body's disease resistance. The root of the plant is stress control and also for malaria prevention [37]. It is a bitter, diuretic, stomachy trunk that supports bile flushing, reduced appetite, enriches blood and cures jaundice. The stem extract is helpful for skin problems. The roots and stems of *Tinospora cordifolia* are used in combination with other remedies to prevent snakebites and scorpions [38]. It is also helpful in the treatment of lesions, pneumonia, asthma and tobacco. *Cordifolia* possesses anti-cancer, immunological stimulation, protective activity of the nerve cell, anti-diabetic effect, reduction of the cholesterol and protection of the liver. *Tinospora cordifolia* also reduces radiation-induced tissue damage, harmful chemotherapy effects and quickly heals diabetic footulcers [39,40].

Mohanjit et al. (2014) observed that in both ulcer models, the first line ROD defence mechanism has significantly increased the amount of antioxidant enzymes such as catalase or GHG by supplying extracts. *T. cordifolia* has been shown to be a traditional anti-diarrhenic and antiulcer medication. There was pharmacological evidence. The future research scope continues to employ the signalling pathways to active components of *Tinospora* to effectively target illnesses [41].

It was discovered by Bhomik et al. (2014) that the extract of *Tinospora cordifolia* ($p < 0.05$) considerably increases the reaction time, reducing correspondingly, in comparison to a control group, the number of writhes in hot plates and abdominal writhing technique. The Author stated moreover that the results above show that the Guduchi extract (*T. cordifolia*) has analgesic effects which are available for marketing. The analgesic effect presumably includes both peripheral and central pathways, because in the hot plate and abdominal writh technique it shows an analgesic Activity [42].

Evidence of isolation and characterization of seven immunomodulative active compounds from distinct classes by Sharma et al., (2012), showing the possible synergistic impact of a group of compounds on immunomodulatory activity in *Tinospora cordifolia* [43].

Biswajyoti et al., (2014) noted the strong anti-inflammatory effect of conventionally prepared Guduchi Ghana. Although Guduchi Ghana's market sample was comparable, its impact was considerably smaller. Compared to the



market sample, classical technique was significantly better found. These test findings showed Guduchi Ghana's anti-inflammatory activity [44].

Tiwari et al., (2018) concluded that *T. cordifolia*, a resourceful plant, is a multitude of documented therapeutical biologically active chemicals. Reporting of the therapeutic and remedying role of this plant in the battle against various illnesses is available in pharmacologic and clinical research. Approximately as an immunomodulator and anti-oxidant agent, various bioactive compound(s), including alkaloids, steroids, glycosides, sesquiterpenes, etc. Different research on *T. cordifolia* shows that it is a good medication and has no harmful impact until now. Overall, the review contains information on *T. cordifolia* traditional antimicrobial activity and may be used for further study in development of new medication, anti-toxin, antidiabetic, anticancer, antioxidant and antimicrobial activities [45]. Indomethacin was discovered to have high UI and Myeloperoxidase activity (MPO) levels. Antonisamy et al. (2014) observed that in both ulcer models, the first line ROD defense mechanism has significantly increased the amount of antioxidant enzymes such as catalase or GHG by supplying extracts. *T. cordifolia* has been shown to be a traditional antidiarrhenic and antiulcer medication. There was pharmacological evidence. The future research scope continues to employ the signalling pathways to active components of *Tinospora* to effectively target illnesses. He reached a conclusion that the ECD's anti-ulcer action is reinforced by defensive aspects and offensive elements are reduced [46].

Hepatoprotective efficacy was assessed in various *Tinospora cordifolia* extracts against induced liver injury to rats by carbon tetrachloride (CCl₄) by B T et al. (2011), orally assessed using Wistar rat, and Silymarin as standard of reference for pet ether, the dose of 200mg/kg body weight, ethanol and aqueous extracts from different plant components such as leaf, stem, and root. Ethanolic extract of all parts exhibited a substantial hepatoprotection. ALT, Alkaline Phosphatase (ALP) and bilirubin decrease in the blood is a selectable result, followed by aqueous and pet extracts (TBL). Plant chemical products in many different groups include alkaloids, flavanoids, glycosides, steroids, terpenoids, phenolics and saponins. Total experimental results show that the significant hepatoprotective effect can be generated from physiologically active components such as flavonoids in the *Tinospora cordifolia* ethanol extract. The results thus justify the use of *Tinospora cordifolia* as a hepatoprotective agent [47,48].

The fresh leaves of 50 mg/kg cordifolia and 10 mg p.o imipramine decreased the total immobility both in forced swimming and albino-mice tail suspension method was reported by Kalabharathi et al. (2014). The reduction in forced bathing immobility in comparison with control was 38.68 percent, whereas the decrease in immobility was 29.06% compared with control group in the tail suspension technique. It was shown that fresh *Tinospora cordifolia* leaves have considerable antidepressant effect compared with a control group in albino mice. More research would be required to assess in the antidepressant activity and observe the role of active chemical components [49].

It was determined by Dhingra et al. (2008) that *T. cordifolia* petroleum ether extract was probably active by MAO-A and MAO-B inhibitors which enhance monoamine values including noradrenaline, serotonin, and dopamine and reduce GABA concentrations. This was corroborated by the prior work, which revealed anti-stress efficacy in oil ether extract from *T. cordifolia*, the antidepressant action of petroleum ether extract, depending on the results from the phytochemical screening and literature, it can be because of the presence of berberine (alkaloid), as in action it was reported that the second molecule was antidepressant, but it is important to study the function of other constituents in antidepressant-like extracts of petroleum ether. *T. cordifolia* extract can therefore effectively treat depressive diseases [50].

Substantial reductions in the level of serum testosterone following ingestion of *Tinospora* extract. Compared to controls, the seminiferous tubular diameter, the nuclear area in the leydig cell was significantly diminished by Sertoli's cross-sectional surface cells. Biochemical indicators such as protein, sialic acid, and glycogen have significantly been decreased in the tests. Seminal vesicular fructose has also been lowered, while the levels of testosterone and testicular cholesterol have been significantly improved. The anti-fertility effects of extract *T. cordifolia* in male rats were found in these studies by Gupta et al. (2003) [51].

Saha et al. (2012) in their paper stated that a plant having such a diversified purpose is a flexible resource for all types of life as *Tinospora cordifolia*. There have already reports that active chemicals are present in the plant extracts like alkaloids, glycosides, lactones and steroids. The immunomodulatory and physiological effects of all



these active chemicals of different kinds demonstrate the plant's varied flexibility. Studies must also be carried out on how the active chemicals interact effectively with the biological system and impact connections between structure and function [52].

An herbal compound consisting of ten herbal extracts was Hyponidd (Momordica charantia, Melia azadirachta, Pterocarpus marsupium, *Tinospora cordifolia*, Gymnema sylvestre, Enicostemma littorale, Emblica officinalis, Eugenia jambolana, Cassia auriculata and Curcuma longa) by Babu et al.(2004). Hyponidd administration decreased levels of glycosylated haemoglobin, plasma thiobarbituric acid reactive substances, hydroperoxides, ceruloplasmin and alpha-tocopherol in diabetic rats. Plasma reduced glutathione and vitamin C were significantly elevated by oral administration [53].

Prathibha et al. (2012) reported that the DC group showed a decline in the reaction time (hyperalgesia) in comparison to NC whereas the reaction time with SC, TC2, TC 3 ($p < 0.05$) was significantly increased in comparison to DC group. In comparison to its baseline levels ($p < 0.05$), TC1 and TC2 demonstrated substantial weight loss. The quick blood glucose (FBS) in any of the groups has not changed substantially. TC inhibition with an IC_{50} of 103 mcg/ml *in vitro* aldose reductase was found. Concluded that *Tinosporic cordifolia* protects experimental diabetic neuropathy from hyperalgesia. It possesses an *in vitro* inhibitory action of aldose reductase that can help [54].

Studies by Palmieri et al. (2019) showed *T. cordifolia* extract can suppress many genes involved in the growth and progression of colon cancer. *T. cordifolia* therapy has well been linked to the pure BBR impact; this evidence shows that BBR mediates *T. cordifolia*'s main effects. Additional investigation on the use of these compounds to colorectal cancer reveals that genes that have an effect on proliferation, differentiation, cellular motility, and EMT are able to significantly reduce their expression [55].

Ahmad et al. (2015) determined in their investigation that 50% methanol extracts of TC stem are cytotoxic to the cell line of human breast cancer MDA-MB-231. The results show that TC methanol extract has anti-cancer action in cells with lower cytotoxic effects on ordinary cells in human breast cancer. Therefore, the possible anti-cancer effects of the bio-active phytochemicals may be further assessed and isolated. Authors also noted that this investigation demonstrated the huge therapeutic potential of stem of this plant. In future, they shall be working to assess *in vitro* the impact of TC on a panel of cancer and normal cell lines of methanol, ethanol, and aqueous Extract [56].

The study by Mishra et al. (2013) showed that several groupings of phytochemicals have been present in *T. cordifolia* extracts that show significant antibacterial, antioxidant and anticancer activity [57,58].

Sannegowda et al. (2015) summarized that arthritic rats' TCE therapy reduced two inter-related aspects of arthritis, namely inflammation and damage to the bones compared to control rats. These effects were the combined results of alterations in specified cytokines, chemokines and bone remodelling mediators caused by TCE, which are of vital importance in arthritis etiology. Based on findings, they proposed that TCE can be further investigated in combination with conventional medicines as possible anti-arthritis treatment in RA patients [59].

Chemical Constituents and Therapeutic Uses

For quite a while, useful experimental techniques have been used to evaluate plants. A variety of various types of substances such as norclerodane diterpenoids, essential oils, fatty acids were isolated from plant [60], furano diterpenoids [61], phenolic lignans, polysaccharides [62], alkaloids, sterols, and terpenoids. Many alkaloids, such berberine, palmatine, jatrorrhizine, tetrahydropalmatine, magnoflorine and tembetarine, have been reported from this plant [63]. Some aporphine glycoside alkaloids as tinocorside A and B [64], along with phenolic amide N-transferulovylytyramine, and quaternary saturated amine choline have also been discovered [65]. The plant is used to enhance the immunity of the body against disease and improve the immune system. The anti-malarial root of this plant is well recognized. It encourages bitter, stomachic, diuretic, bile exit, soothing hunger, enriching blood and ivory cures, and uses stalk. The stem extract is helpful for skin problems. Roots of *Tinoporia cordifolia* and stem in combination with other drugs are used as a snakebite and scorpion bite antidote. Injuries including pneumonia, asthma and cough are reported to everyone. *Tinospora cordifolia* having the ability to prevent cancer, to stimulate



the nerves, to reduce cholesterol and to protect the liver [66]. *Tinospora cordifolia* also causes reduction of radiation-induced tissue damage, adverse effects of some kinds of chemotherapy and the rapid healing of diabetic foot ulcers [67]. The major chemical components of the stem are many clerodane and norclerodane diterpenoids, which include their glycosides. Aerial parts were also reported for the presence of monoterpenoids, sesquiterpenoids and triterpenoids (cycloeuophordenol). Phenyl Propanoids, lignans (pinoresinoldi-O-glucoside, secosolaricresinol-9'-O- β -D-glucopyranosides, and three (α , four-dihydroxy-dri-methoxybenzyl) other chemicals have been identified. Tetrahydrofuran containing phenol compounds (i.e. 2,3,14,20,22,25-hexahydroxyl-5,-cholest-7-in-1-strength) and -3-methoxy-methoxybenzaldehyde, (-)epicatechine [68], steroids such as β -sitoesterole, 2,3,14,20,22,25-hexahydroxy-in stem. Aliphatic substances such methyl-9,12-octadecadienoate, methyl-9-octadecenoate, hexadecanoate, and methyl octadecanoate, glucose, arabinose, rhamnosis, xylose, and mannosis. Polysaccharides are also present [69,70].

Conclusion

Tinospora cordifolia (Giloy) stem is one of Ayurvedic medicine's most common herbs. It balances essential fluids and safeguards against illnesses. It is among the top 5 plants in the Indian medical system in terms of consumption and is utilised for its various biological characteristics. Demand for medical products has increased worldwide since allopathic medicines have more consequences on the side. This offers an excellent platform for additional phytochemical and pharmaceutical research on selected plants.

The pharmacology and clinical trials in this study confirm that *Tinospora cordifolia* has a medicinal value (Giloy). The presence of chemical components shows that the plant may be the "leading factor" in developing new disease agents in the years to come. Further researches are necessary in this respect to investigate the potential of *Tinospora cordifolia* (Giloy) in illness prevention and treatment. The current study therefore provides future researchers guidance for doing research on the plant in order to get certain medically essential medicines.

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Conflict of Interest

No conflicts of interest is declared by the author.

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