

An Overview on Pharmacological Activity of Tinospora Cordifolia

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ABSTRACT

Giloy, also known as *Tinospora cordifolia*, occupies a significant place among traditional medicine systems. This review is a complete embodiment of the diversity of the subject matter starting with its botanical meaning and refined taxonomy which are complemented by an introduction on vernacular names. In addition, it examines the intricate maze of giloy's chemical constituents thereby laying the groundwork for understanding its molecular structure. This review brings together literature on different preparations presenting a holistic view of how *Tinospora cordifolia* is used in therapeutic applications. The paper explores its pharmacological actions that are all-purpose and therefore seeks to find out whether these actions are effective in different areas including antioxidant effects, anti-cancer and anti-diabetic properties, immune modulation mechanisms, wound healing mechanisms. At the same time, the toxicological aspects of giloy are analyzed in order to provide an unbiased view on its safety concerns. Furthermore, potential adulteration issues and common adulterants have been thoroughly discussed while critically assessing challenges related to use of giloy. In summing up, this article not only compiles current knowledge but also discloses some light into what *Tinospora cordifolia* is now about and might be tomorrow in relation to medicine

Keywords: *Tinospora Cordifolia*, Giloy, Pharmacology, Constituents, Traditional Medicine, Formulation, Anti diabetic, Anti-cancer, Antioxidant, Antidiarrheal, Woundhealing, Toxicology

INTRODUCTION

India is Home to large number of Medicinal Plants. Among them is *Tinospora cordifolia* (giloy), which possesses a wide range of bioactive compounds and has been demonstrated to be a medicinally significant plant, has not gotten much scientific attention. Natural remedies have historically been made from medicinal plants. Since the Stone Age, people have been engaging in this practise. Plants have been shown to be effective in medicine in a variety of ways, including direct use of crude extracts due to the existence of natural chemical components including berberine, morphine, psilocin, vincristine, and others. (1) Research has been mostly concentrated on different plants that may be employed in a variety of ways to manage health care. In this context, *Tinospora cordifolia* (giloy), a medicinal plant, has lately attracted the attention of researchers as one of the most versatile rejuvenating shrubs with a variety of therapeutic uses, including immune-modulatory, anticancer, antihypertensive, antioxidant, hepatoprotective, etc. In ethnobotanical studies carried out by ethnobotanists, almost all plant components are claimed to be helpful. (2)

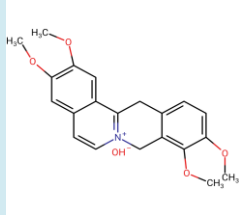
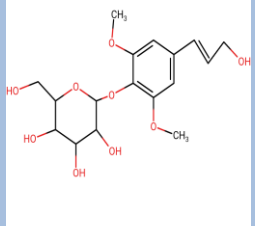
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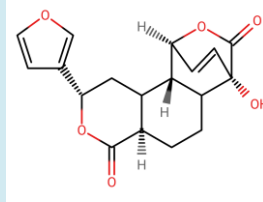
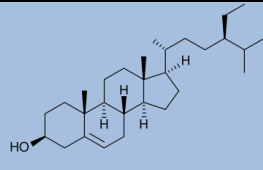
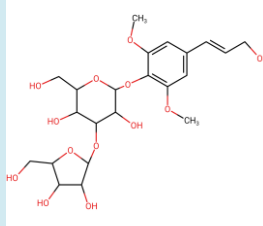
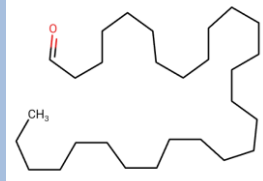
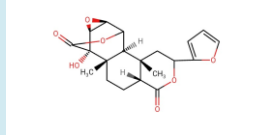
Kingdom: Plantae
 Subkingdom: Tracheophyta
 Super division: Spermatophyta
 Division: Magnoliophyta
 Class: Magnoliopsida,
 Subclass: Polypetalae
 Series: Thalamiflorae
 Order: Ranunculaceae
 Family: Menispermaceae.
 Genus: Tinospora
 Species : Cordifolia

VERNACULAR NAMES

Bengali	Gulanha
Arabic	Gilo
Hindi	Giloya, Guduchi
Urdu	Gilo
Sanskrit	Guduchi, Madhuparni, Amrita, Chinnaruha, Vatsadaani, Tantrika, Kundalini & Chakralakshanika
English	Gulanha / Indian tinospora
Telugu	Tippatiga
Tamil	Shindilakodi
Marathi	Gulvel
Gujarati	Galo

PHYTOCHEMICAL CONSTITUENTS

	Chemical Constituents	PARTS	Chemical Structure
Alkaloids	Berberine, Palmatine, Tembetarine, Magnoflorine, Choline, Tinosporin, Isocolumbin, Palatine, Tetrahydropalmatine, Magnoflorine (21-26)	Stem and root	
Glycoside	Furanoid diterpeneglycoside Tinocordiside, Tinocordifolioside, Cordioside, Cordifolioside A, Cordifolioside B, Syringin, Syringin- <i>apiosylglycoside</i> , Palmatosides C31, Palmatosides F31, Cordifolioside A, Cordifolioside B2, Cordifolioside C2, Cordifolioside D2, Cordifolioside	Stem	

	E2 (27-33)		
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 and aerial plant	
Sesquiterpenoid	Tinocordifolin.	Whole plant	
Aliphatic compound	Octacosanol, Heptacosanol, Nonacosan-15-one, Dichlormethane.	Whole plant	
Others	3,(a,4-di hydroxy-3-methoxy-benzyl)-4-(4-compounds hydroxy-3-methoxy-benzyl)-tetrahydrofuran, Tinosporidine, Giloin, N-transferuloyltyramine as diacetate, tinosporic acid.	Whole plant	

FORMULATION :

Gilo one of the main ingredients of some herbal medicine items that are used to treat a variety of ailments. A few well-known products with Gilo as a main ingredient include Hamdard Sufoof-E-Satt-E-Gilo, Safoof Ziabetes, Kapiva Wild Tulsi Giloy Juice, Guduchi ghrita, Brihat guduchi taila, Dashmoolarishtha, Sanjivani vata, Chyavanparasha and Giloy Ghana Vati. (BNUF, 2010)

RECOMMENDED DOSE :

Gilo Tablet/Ghanavati : 1-2 tablets twice a day after food

Gilo Churna : 1-2 teaspoon twice daily after food

Gilo Juice 2-3 teaspoons in morning empty stomach.

Gilo Powder 3-6gm daily

Name of market product	Roles
Tinospora cordifolia pellets	Helps in number of diseases
Guduchi	Acts as immunity booster and increases body’s resistance to infection
Cirrholive Capsules	Hepatoprotective
Brave Heart Capsule	Cures anemia and sexual disabilities
MadhuMehari	Cures urinary problem, fatigue

PHARMACOLOGICAL ACTIVITY

1. Anticancer -

Using response surface methodology (RSM), Ali et al. investigated the anticancer efficacy of T. cordifolia palmatine extract in animal models. The extract demonstrates the anticancer potential in a mouse skin cancer model generated by 7,12-dimethylbenz(a)anthracene (DMBA) (5)

Rahul et al. synthesized the extract in a dose-dependent manner at concentrations of 200, 400, and 600 mg/kg dry weight. the tumor growth decreased life duration when given to C57 BI mice for 30 days at a dose of 750 mg/kg body weight of cordifolia 50% methanolic extract . Using C6 glioma cells, Mishra et al. demonstrated the anti-brain cancer potential of T. cordifolia (TCE), which dramatically induced differentiation in C6 glioma cells and decreased cell proliferation .

In a study conducted by Manju Bala et al., four different human cancer cell lines—KB (human oral squamous carcinoma), CHOK-1 (hamster ovary), HT-29 (human colon cancer), SiHa (human cervical cancer), and murine primary cells—were tested against eight secondary metabolites from Tinospora cordifolia. Only palmatine, tinocordiside, and yangambin were shown to be effective against KB and HT-29, KB, and CHOK-1 cells, respectively. All extracts and fractions were effective against KB and CHOK-1 cells. (5)(6)(13)

2. Anti diabetic

Ayurvedic medicine frequently uses the plant Tinospora cordifolia to treat diabetes. Diabetes is treated by regulating blood sugar levels using tinospora cordifolia stems was reported by[Sangeetha MK, 2011]. It functions as an anti-diabetic medication by inhibiting gluconeogenesis and glycogenolysis and decreasing oxidative stress, which promotes insulin secretion. A plant's root extract lowers blood sugar levels was reported by [Umamaheshwari S, 2007]. Identified anti-diabetic alkaloids, cardiac glycosides, saponins, flavonoids, tannins, and steroids from Guduchi Prasant et al. The insulin hormone caused the alkaloids from this plant to exhibit insulin-mediated effects. Increased levels of GSH and other reactive species, which pose a risk to both the mother and the fetus, can occur as a result of gestational diabetes. The research was based on the use of T in pregnant rats. (7)(8)

A diabetic pregnant rat (with streptozocin-induced diabetes) was given cordifolia as part of their daily diet, and this exhibited a protective effect by lowering the oxidative load and avoiding the relative occurrence of illnesses as well as any birth defects. Guduchi root preparations from T. cordifolia decreased brain-mediated lipid levels in diabetic rats while also lowering blood sugar and urine glucose levels.

In vitro and in vivo studies have shown that the isoquinoline alkaloid-rich portion of the stem, which includes palmatine, jatrorrhizine, and magnoflorine, has an effect that mimics and releases insulin.(9)(15)(16)

3. Anti-ulcer and anti-diarrheal

When this activity was tested on rodents, the results revealed a partial subordinate enemy of diarrheal impact as well as a decrease in ulcer record. Additionally, the volume of the stomach decreased, and its pH increased [88]. PGE₂, mitigating cytokines (IL-4, IL-10) and proangiogenic factors (VEGF, EGF) are entirely enlarged by epoxy-clerodane-diterpene obtained from amrita [89]. Its concentrate produced defensive affects in an 8-hour immobilization stress induced ulceration mice model, with results equivalent to diazepam.(17)(18)(19)

4. Activity of Antioxidants

Arabinogalactan, a polysaccharide, and epicatechin, a phenolic component, are inferred to have cell-reinforcing properties by this plant. Compared to its stem separate powder, its leaf extricate powder has better cancer prevention agent qualities. Its root separate protects against nephrotoxicity caused by aflatoxin due to the anti-oxidant activity of its alkaloid components. *Tinospora cordifolia* separates have been accounted for to lessen malondialdehyde and receptive oxygen species (ROS) levels while expanding GSH levels in diabetic rodents in maternal livers.(8)(20)(21)

5. PROTECTIVE EFFECT ON CVS

This is due to the presence of the alkaloid berberine in this plant, which improves vascular health by reducing endothelial inflammation. Additionally, it has been found that this plant affects lipid metabolism by blocking glucuronides and cholesterol in the presence of impaired lipid metabolism brought on by alcohol use [106]. It also protects against cadmium-induced cardiotoxicity via regulating antioxidants (superoxide dismutase, catalase, glutathione, glutathione peroxidase, and glutathione-S-transferase), glycoproteins, kinase, and lactate dehydrogenase levels (hexose, hexosamine, fucose, and sialic acid).

Due to its anti-oxidant properties, it can protect the heart against myocardial infarction that is brought on by ischemia reperfusion damage, which is most frequently brought on by oxidative stress.(24)

6. Wound healing activity

Among others, Shanbhag T. Examining the alcoholic extract of *T. cordifolia*'s wound-healing profile and its effects on dexamethasone-suppressed healing were the goals of the current work. *T. cordifolia* extract's increased tensile strength may be linked to the promotion of collagen synthesis. The ability of the plant to heal wounds was investigated using wound models with incision, excision, and dead space. *T. cordifolia* extract did not restore dexamethasone-suppressed wound healing.

7. Protective agent against SARS-CoV-2 (COVID-19)

According to molecular docking and ADME/T tests, six *T. cordifolia* constituents (1a, 1e, 2a, 2b, 4a, 4g, and 5a) are promising COVID-19 therapeutic candidates since they were able to successfully inhibit the interaction of the SARS-CoV-2 spike protein with the human receptor ACE2 protein. Berberine from *T. cordifolia* can block the major protease 3CL^{pro} protein activity, preventing the reproduction of the SARS-CoV-2 virus, according to in silico research employing network pharmacology and molecular docking methods. *T. cordifolia* phytoconstituents exhibit a strong affinity for the primary protease enzyme of SARS-CoV-2 and inhibit COVID-19 viral multiplication.

Tinocordiside, a molecule found in *T. cordifolia*, has been shown in other molecular docking and molecular dynamic simulation experiments to have a high affinity for the SARS-CoV-2 major protease.

In molecular docking investigations, phytochemicals from *T. cordifolia*, including tinosponone, xanosporic acid, cardiofolioside B, tembetarine, and berberine, substantially inhibit the major protease 3CLpro protein.

TOXICOLOGY

There is currently little accessible data on negative effects, so long as you take it at the dose recommended by a health professional or on the product label there are no proven risks related to Giloi's intake.

Although there are some reports of that Giloi can cause an autoimmune disease, like rheumatoid arthritis, lupus, or Crohn's disease. This can be due to its stimulating effects on the immune system.

Despite the fact that this aspect of research has already seen a number of tests on this plant, nothing notable has been done to date. According to Ayurveda, herbs are used in combination with other herbs to counteract the effects of one or to strengthen a specific impact of one herb with the assistance of the other.

DRUG INTERACTION

1. Drugs used to treat diabetes (antidiabetic medications) may interact with TINOSPORA CORDIFOLIA.

Possible blood sugar lowering effects of *Tinospora cordifolia*. Blood sugar levels could become dangerously low if *Tinospora cordifolia* is taken along with diabetes medications. Monitor your blood sugar close.

2. Medications that decrease the immune system (Immunosuppressants) interacts with TINOSPORA CORDIFOLIA

The immune system's activity can be elevated by *tinospora cordifolia*. Some drugs, such as those taken after a transplant, impair the function of the immune system. Combining these medications with *Tinospora cordifolia* may lessen their effects.

CONCLUSION

Tinospora Cordifolia(TC) is a highly adaptable Medicinal Plant that has variety of biologically active Chemical Constituent. Although there's not a lot of research available on the biological activity and it's vast potential medical uses, further study is required to unlock the full extent their therapeutic potential use in the treatment of disorders, hence more drug research programs should include chemical constituents of *Tinospora cordifolia*.

The classic pharmacological properties of *Tinospora cordifolia* ie, antioxidant, anti-diabetic, anti-cancer, antibacterial, immune-modulatory, and antitoxic are highlighted in this review. Through its journey through history, *Tinospora Cordifolia*(TC) has come to hold the illustrious position of a plant with extraordinary healing abilities in the present era.

Additionally, *Tinospora cordifolia*'s organic and aqueous extract may be further utilized in the future as a source of beneficial phytochemical components for the pharmaceutical sector.

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