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Tinospora cordifolia: A medicinal plant: A review

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Abstract
Natural products with medicinal value are gradually gaining importance in clinical research due to their well-known property of no side effects as compared to drugs. Plants have been one of the important sources of medicines since the beginning of human civilization. There is a growing demand for plant based medicines, health products, pharmaceuticals, food supplements, cosmetics etc. A review of chemical constituents present in various parts of *Tinospora cordifolia* and their pharmacological actions is given in the present article. *Tinospora cordifolia* commonly named as "Guduchi" is known for its immense application in the treatment of various diseases in the traditional ayurvedic literature. Guduchi (*Tinospora cordifolia*) is a popular medicinal plant spread across the tropics. Its effectiveness in therapy is well known globally. Lesser known are its dietary benefits. Guduchi [*Tinospora cordifolia* (Willd.) Hook. F. Thoms] is being used in Diet by various tribal people of India and it also forms a part of traditional Indian cuisine. Ayurveda also states its dietary utility. Recently the discovery of active components from the plant and their biological function in disease control has led to active interest in the plant across the globe. The future scope of the review remains in exploiting the biochemical and signaling pathways affected by the compounds isolated from *Tinospora* so as to enable new and effective formulation in disease eradication. This review can be used for further research as well as clinical purpose.

Keywords: *Tinospora cordifolia*, phytochemicals, leaves, flowers, anti-diabetic activity, alkaloids

Introduction
Man has been fascinated by nature since he evolved from his primitive ancestors, the apes. To start with, he hunted for food mainly by killing the wild animals, but if there was anything on which he could depend with any confidence towards its availability, it was the plant which provided him with food and they provided him with curative medicine and shelter. Because of this the primitive man was in love with the nature especially with plants because plants were the only source to fight with various diseases. From the plants they found various medicines and treatment practices to treat many diseases which put way for the modern treatment systems to save the human race [1]. Today in this world traditional medicine plays a vital role in providing health care to large section of population, especially in developing countries. Medicinal plants are the important source for the production of synthetic and herbal drugs. The medicinal plants or the herbal drugs are used in many ways by the human [2].

The traditional systems of treatment such as Ayurveda, Unani, Siddha, western herbal medicine, traditional Chinese medicine and homeopathy use herbs for the treatment. Many researchers has prescribed about the importance of herbal medicine in the treatment of various diseases and because of the accessibility and cost effectiveness herbal treatment is still in practice by large number of practitioners. The Importance of plants on human health began to arise in 1897, when Friedrich Bayer and Co. introduced synthetic acetyl salicylic acid (aspirin) to the world. Aspirin is a safer synthetic analogue of salicylic acid which is an active ingredient of willow bark, and was discovered independently as a remedy for aches and fever. Same like aspirin, digoxin (from foxglove), quinine (from cinchona bark), and morphine (from the opium poppy) are the other conventional drugs are obtained from the plants. As per WHO around 70% of the word population rely on plant drugs than synthetic drugs. The herbal drugs are used by mankind in treating various disease conditions such as, malaria, chicken pox, cholesterol, heart diseases, lung diseases diarrhea, psoriasis, skin disorders, fever, jaundice, asthma, diabetes etc. Herbal medicine tends to have a greater demand as a primary health care system because of their lesser adverse effects, efficacy, safety etc. [3, 4].

Tinospora cordifolia (Wild.) (family: menispermaceae) commonly known as "amrita "or" Guduchi climbing shrub found throughout India. *T. cordifolia* is an endangered rasayana herb. *Tinospora cordifolia,* which is known by the common names heart-leaved moonseed, guduchi and giloy, is an herbaceous vine of the family Menispermaceae indigenous to the tropical areas of India, Myanmar and Sri Lanka. In Ayurvedic system of medicine, it has a special place as an effective adaptogen and aphrodisiac. The drug is well known and prescribed for fevers, diabetes, jaundice, urinary problem, skin diseases anemia etc. It is used for anti-periodic, anti-spasmodic, anti-inflammatory immunomodulatory, anti-tumor, anti-allergic and anti-pyretic properties. The extract of stem, bark, roots, leaves shows strong antioxidant activity. The climbing shrub has shown great potential for the development of biopharmaceuticals products for the treatment of various diseases [5, 6].

Table 1: Vernacular Names

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

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
Family	Menispermaceae – The Moonseed family
Tribe	Tinosporeae
Genus	*Tinospora*
Species	*T. cordifolia*

Fig 1: *Tinospora cordifolia*

Fig 2: *T. cordifolia* plant

Growth requirement

The plant is very rigid and it can be grown in almost all climates but prefers warm climate. Planting is usually done during rainy season (July to August). As it is climber so it requires support for its growth. Fast growing species such as Neem (*Azadirachta indica*), Jatropha (*Jatropha curcas*) and Moringa (*Moringa oleifera*) have been planted to provide support for its growth. *Tinospora cordifolia* growing with Neem (*Azadirachta indica*) is called as NEEM GILOY has chemical composition as similar as neem as well as giloy and show better therapeutic properties. *T. cordifolia* prefers medium black or red soil for its cultivation. Giloy can also be successfully grown in large variety of soils, ranging from sandy to clay loam. However, the soil should be well drained with sufficient moisture and rich with organic matter for its growth [9-11].

Morphological Description

Tinospora cordifolia is a large deciduous, extensively spreading climbing shrub with a number of coiling branches. *Tinospora cordifolia* is a glabrous, succulent, woody climbing shrub native to India. It thrives well in the tropical region, often attains a great height and climbs up the trunk of large trees. Different parts of *Tinospora* have following type of morphology [12, 13].

Table 3: Morphological description

Stem	Stem of this plant is rather succulent with long, filiform, fleshy and climbing in nature. Aerial roots arise from the branches. The bark is creamy white to grey in colour and deeply left spirally.
Arial Root	Arial roots are present, these aerial roots are characterized by tetra to penta-arch primary structure. However, cortex of root is divided in to outer thick walled and inner parenchymatous zone**.**
Leaves	Leaves of this plant are simple, alternate, ex-stipulate, long petioled approximately 15 cm, round, pulvinate, heart shaped, twisted partially and half way round. Lamina is ovate, 10-20 cm long, 7 nerved and deeply cordate at the base and membranous.
Flowers	Flowers are unisexual, recemes, greenish yellow in colour, appears when plant is leaf less. Male flowers are clustered and female flowers exist in solitary inflorescence. Sepals are 6 in 2 series of 3 each. Outer ones are smaller than the inner sepals. Petals are also 6, smaller than sepals, free and membranous. Flowering occurs during March to June.
Seed	Curved seed have been reported in this species. Hence this family is named as moonseed family.
Fruit	They are orange-red in colour, fleshy, aggregate of 1-3 and ovoid, smooth, drupelets on thick stalk with a sub terminal style scars. Fruits develop during winter.

Phytochemistry

Literature survey of phytochemical analysis of plant reveals the presence of wide variety of phytoconstituents.

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. 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, Tembertarine, Magniflorine, Choline, and Tinosporin are reported from its stem. A rearranged cadinane sesquiterpene glycoside named tinocordiside, consisting of a tricyclic skeleton with a cyclobutane ring, has been isolated from the immunomodulatory aqueous fraction of the Indian medicinal plant *Tinospora cordifolia*. A new daucane-type sesquiterpene, tinocordifolin, has been isolated from the stem of *Tinospora cordifolia*. New sesquiterpene named as tinocordifolin, together with tinocordifolioside, N-trans-feruloyl tyramine.

Phytochemical investigation of the methanol extract of *Tinospora cordifolia* aerial parts led to the isolation of four new and seven known compounds. The two new aporphine alkaloids, N-formylasimilobine 2-O-β-D-glucopyranosyl-(1→2)-β-D-glucopyranoside (tinoscorside A) and N-acetylasimilobine 2-O-β-D-glucopyranosyl-(1→2)-β-D-glucopyranoside (tinoscorside B), a new clerodane diterpene, tinoscorside C, and a new phenylpropanoid, sinapyl 4-O-β-D-apiofuranosyl-(1→6)-O-β-D-glucopyranoside (tinoscorside D) [14-19].

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 [20].

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 [21].

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 [22].

Anti microbial activity

Methanolic extract of *T. cordifolia* has been reported against microbial infection. Anti-bacterial 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* [23].

Anti-oxidant activity

Methanolic extract of stem of *T. cordifolia* has been reported to anti-oxidant activity, by increasing the erythrocytes membrane lipid peroxide and catalase activity. It also decreases the activity of SOD, GPx in alloxan induced diabetic rats [24].

Table 4: Ethnomedicinal importance of *Tinospora cordifolia*

S. No.	Tissue	Activity
1	Aerial parts	Neuroprotective [25], and anti cancer effect [26].
2	Whole plant	Anti ulcer [27], anti diarrhoel [28], anti-oxidant [29]. Cardioprotective [30] and analgesic activity [31].
3	Stem	Anti-dyslipidemic [32], anti inflammatory [33[, anti bacterial [34], anti-diabetic [35] and anti malarial activity [36].
4	Root	Ameliorative effect [30].

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 pharmaco-therapeutics. 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.

Future Prospects

Traditions of plant-collection and plant based medications have been handed over from generation to generation. Plants

collected from different sources show wide disparity in therapeutic values. In the recent years there has been greater expansion of indigenous drug industry in India. Consequently the demand for the medicinal plants has enormously increased. According to latest estimate, there are about eight thousand licensed pharmacies of Indian Systems of Medicine in the country, engaged in the manufacture of drugs to meet the requirement of people. The total annual requirement of the raw materials of these pharmacies was estimated in tones. Presently, the increasing demand is fulfilled by cutting trees from their natural habitat and/or uprooting there trees/shoots/leaves on nominal charges or by illegal cuttings. This plant species has huge therapeutic potential; it has been over exploited by human activities. So there is an urgent need to conserve it. Plant tissue culture techniques are the alternative method to rapid propagation of this plant for its conservation and for the enhancement of secondary products.

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