

TAXONOMIC DESCRIPTION

Kingdom:	Plantae
Division:	Magnoliophyta
Class:	Magnoliopsida
Order:	Ranunculales
Family:	Menispermaceae
Genus:	Tinospora
Species:	cordifolia

The family Menispermaceae

The plant family Menispermaceae consists of about 70 genera and 450 species that are found in tropical lowland regions. They are generally climbing or twining, rarely shrubs. Leaves are alternate or lobed, flowers small cymose, seeds usually hooked or reniform. This family is rich source of alkaloid and terpenes.

The genus Tinospora

Tinospora is one of the important genera of the family, consisting of about 15 species. Some medicinally important species includes *T. Cordifolia*, *T. Malabarica*, *T. Tementosa*, *T. Crispa*, *T. Uliginosa*, etc.

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The species *Tinospora cordifolia*

Tinospora Cordifolia (wild) Miers ex Hook. F and Thoms belonging to the family Menispermaceae is a large deciduous climbing shrub found throughout India and also in Srilanka, Bangladesh and China [Raghunath *et al.*, 2006] (Plate-2.1).

Common Names

Latin : *Tinospora cordifolia* (Willd.) Hook.f. & Thomson

English : *Tinospora* Gulancha / Indian *tinospora*

Sanskrit : Guduchi, Madhuparni, Amrita, Chinnaruha, Vatsadaani, Tantrika

Kundalini and Chakralakshanika

Hindi : Giloya, Guduchi

Bengali : Gulancha

Telugu : Tippaatigo

Tamil : Shindilakodi

Marathi : Shindilakodi

Gujarati : Galo

Kannada : Amrita balli

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Botanical Discription

A large, glabrous deciduous climbing shrub. The stems are rather succulent with long filiform fleshy aerial roots form the branches. The bark is grey 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 (Plate 2.2; Fig. A-D).

Stems- Fleshy

Roots- Long thread like, aerial, arise from branches.

Bark- Thin, greyish or creamy white in colour, when peeled fleshy stem is exposed.

Leaves- Cordate (heart shaped), membranous, juicy (Plate-2.2; Fig. A).

Flowers - Bloom during summer
Male flower - Small, yellow or green coloured occur in clusters (Plate-2.2; Fig. B).

Female flowers - Occur singly.

Fruits - Pea shaped, fleshy, shiny turn red when boiled. Occurs only in winter (Plate 2.2; Fig. C).

Seeds - curved, pea sized (Shetty *et al.*, 1987).

Taxonomic Discription

The plant *Tinospora cordifolia* comes under the class Magnoliopsida, order Ranunculales and belongs to the Menispermaceae family. The species is

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widely distributed in India, extending from the Himalayas down to the southern part of peninsular India. It is also found in neighboring countries like Bangladesh, Pakistan, and Srilanka. The plant is also reported from South East Asian countries such as Malaysia, Indonesia, and Thailand etc.

Habitat

Tinospora cordifolia prefers wide range of soil, acid to alkaline and it needs moderate level of soil moisture. Found throughout tropical India ascending to an altitude of 1000 feet and found in South Asia, Indonesia, Philippines, Thailand, Myanmar, China and in Srilanka worldwide.

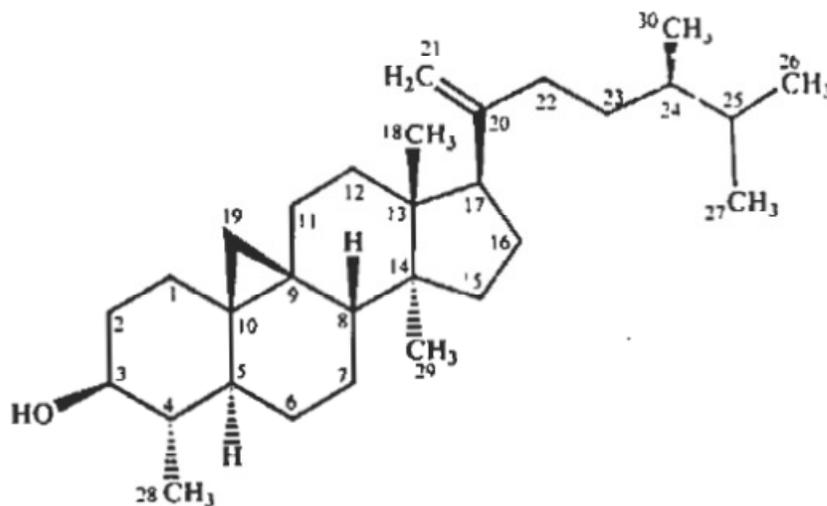
Chemical Composition

A variety of constituents have been isolated from different parts of *Tinospora cordifolia*. They belong to different classes such as alkaloids, diterpenoid lactones, steroids, glycosides aliphatic compounds, polysaccharides. Some important constituents have been isolated from plant mainly they are tinosporone, tinosporic acid, cordifolisides A to E, syringen, berberine, giloin, gilenin, crude giloininand, arabinogalactan polysaccharide, picrotene, bergenin, gilosterol, tinosporol, tinosporidine, sitosterol, cordifol, heptacosanol, octacosonal, tinosporide, columbin, chasmanthin, palmarin, palmatosides C and F, amritosides, cordioside, tinosponone, ecdysterone, makisterone A, hydroxyecdysone, magnoflorine, tembetarine, syringine, glucan polysaccharide, syringine apiosylglycoside, isocolumbin, palmatine, tetrahydropalmatine, jatrorrhizine respectively, [Singh *et al.*, 2003].

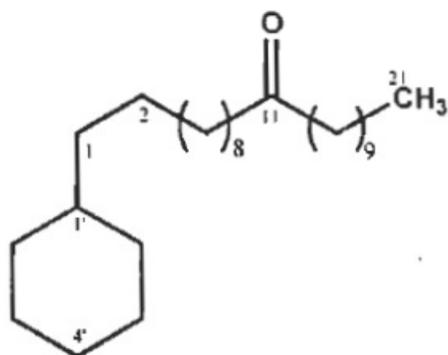
Bioprospecting Studies

Tinospora Cordifolia bioprocesses have revealed three constituents they are-

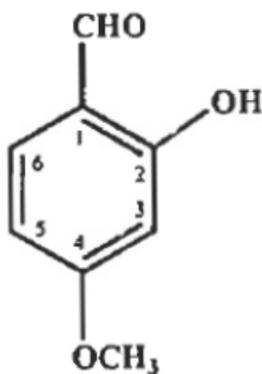
1. Cycloeuphordenol - This compound was isolated as colorless needles and formula is C₃₀H₅₀O and Cycloeuphordenol belongs to diterpenoid group. By the ¹H-NMR spectral data analyzing it was suggested that this compound was a known constituent previously also isolated from *Euphorbia tirucalli* (Khan *et al.*, 1988).



2. Cyclohexyl-11-heneicosanone – This compound was isolated as a colorless gum and formula is C₂₇H₅₂O. By the ¹H-NMR spectral data analyzing it was suggested that this compound was a known constituent previously also isolated from *Centella asiatica* (Yannai *et al.*, 2004).



3. 2-Hydroxy-4-methoxy-benzaldehyde – This compound was isolated also as a needle shaped crystal, formula is C₈H₈O₃ and compound is a benzene derivative. By the ¹H-NMR spectral data analyzing it was suggested that this compound was a known constituent previously also isolated from *Mondia Whytei* (Kavaka *et al.*, 2001).



Medicinal Property

The plant possesses anti-oxidant, anti-hyperglycemic, anti-neoplastic, anti-stress, anti-dote, anti-spasmodic, anti-pyretic, anti-allergic, anti-

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leprotic anti-inflammatory, antihyperlipidaemia, Immunomodulatory properties. Various parts of the plant contain immense medicinal properties.

Immunomodulatory property

Subramanian *et al.*, (2002) demonstrated the immunomodulatory property of *Tinospora cordifolia*. He studied some active compounds i.e. 11-hydroxymustakone, N-methyl-2-pyrrolidone, N-formylannonain, cordifolioside A, magnoflorine, tinocordiside and syringing which shows potential immunomodulatory and cytotoxic effects. In mice, *Tinospora cordifolia* extracts have shown to result in up-regulation of IL-6 cytokine, resulting in acute reactions to injury, inflammation, activation of cytotoxic T cells, and B cell differentiation (Sudhakaran *et al.*, 2006). Jahfar, (2003) has reported active compounds in aqueous extracts like alkaloids, diterpenoid lactones, glycosides, steroids, sesquiterpenoid, phenolics, aliphatic compounds or polysaccharides in experimental rat model for their cytotoxic action. Dry stem crude extracts of *Tinospora cordifolia* with a polyclonal B cell mitogen, G1-4A on binding to macrophages have been reported to enhance immune response in mice by inducing secretion of IL-1, together with activation of macrophages

Anti-diabetic property

Sangeetha *et al.*, (2011) proved the stem of *Tinospora cordifolia* for the therapy of diabetes by regulating the blood glucose. It has been reported to mediate its anti-diabetic potential through mitigating oxidative stress (OS), promoting insulin secretion and also by inhibiting gluconeogenesis and glycogenolysis, thereby regulating blood glucose. In this string P S *et*

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al., (2011) have reported alkaloids, tannins, cardiac glycosides, flavonoids, saponins, and steroids as the major phytoconstituents of *Tinospora cordifolia* which play an anti-diabetic role.

The isoquinoline alkaloid rich fraction from stem, including, palmatine, jatrorrhizine, and magnoflorine have been reported for insulin-mimicking and insulin-releasing effect both *in vitro* and *in vivo* (Patel *et al.*, 2011). Oral treatments of root extracts have been reported to regulate blood glucose levels, enhance insulin secretion. The crude stem ethyl acetate, dichloromethane (DCM), chloroforms and hexane extracts of *Tinospora cordifolia* inhibited the enzyme's salivary and pancreatic amylase and glucosidase (Chougale *et al.*, 2009) thus increasing the post-prandial glucose level and finds potential application in treatment of diabetes mellitus.

Umamaheswari *et al.*, (2007) have reported oral administration of root extract of *Tinospora cordifolia*, it decreases the levels of glycosylated hemoglobin, plasma thiobarbituric acid reactive substances, hydroperoxides, ceruloplasmin and diabetic rats. Decreased concentration of GSH, GPx, and SOD, catalase activity has been reported in heart and brain of diabetic rats (Prince *et al.*, 2004).

Stanely *et al.*, (2000) have reported that *T. cardifolia* root extract (TCE), which increased the body weight, total hemoglobin and hepatic hexokinase and lowering the hepatic glucose-6-phosphatase, serum acid phosphatase (ACP), alkaline phosphatase (ALP), and lactate dehydrogenase (LDH) in diabetic rats thus showing hypoglycemic and hypolipidaemic effect.

Anti-HIV effects

Tinospora cordifolia extract has demonstrated a decrease in the recurrent resistance of HIV virus thus improving the therapeutic outcome. Anti-HIV effects of TCE revealed showing reduction in eosinophil count and stimulation of B lymphocytes, macrophages and polymorphonuclear leucocytes and hemoglobin percentage thus, revealing its promising role in management of the disease (Akhtar, 2010).

***Tinospora cordifolia*: Anti-microbial activity**

Sharma *et al.*, (2013) reported the methanol extracts of stem have potential against microbial infections. The anti-bacterial activity of *Tinospora cordifolia* extracts was assayed against *Escherichia coli*, *Staphylococcus aureus* and *Bacillus cereus* (Gram-positive bacteria), anti-fungal activity has been assayed against *A. niger*, *R. stolonifer*, *A. flavus*, *A. solani* and *F. oxisporum*.. In mice models, *Tinospora cordifolia* extracts have been reported to function in bacterial clearance and improved phagocytic and intracellular bactericidal capacities of neutrophils (Thatte *et al.*, 1992). However, TCE has immunostimulant properties on macrophages (Sengupta *et al.*, 2011).

***Tinospora cordifolia*: Anti-oxidant activity**

The anti-oxidant capacity of *Tinospora cordifolia* stem methanol extracts administered orally increased the erythrocytes membrane lipid peroxide and catalase activity. It also decreased the activities of SOD, GPx in alloxan-induced diabetic rats (Sivakumar *et al.*, 2010). Gacche *et al.*,

(2011) have reported extracts of *Tinospora cordifolia* showing possible inhibitors of aldose reductase and anti-oxidant agents, thereby reducing chemotoxicity induced by free radicals.

Tinospora cordifolia: Effects on other diseases

A dose dependent reduction in lipid peroxide levels of serum and heart tissue were observed with the prior treatment of stem extract of *Tinospora cordifolia* (Rao *et al.*, 2005). The activation of macrophages by cytotoxic T cells leads to increase in GM-CSF which leads to leucocytosis and improved neutrophil function (Thatte *et al.*, 1994). Octacosanol isolated from *Tinospora cordifolia* inhibits proliferation of endothelial cells and tumor cells, inhibits neovascularization induced by angiogenic factors in chick chorioallantoic membrane and rat cornea *in vivo* angiogenesis assays and also inhibits secretion of ascites fluid in the growing tumor cells *in vivo* by inhibiting activity of matrix metalloproteinases (MMPs) and translocation of transcription factor nuclear factor-kappa-B (NF- κ B) to nucleus (Thippeswamy *et al.*, 2008). Oral administration of 70% methanolic extract of *Tinospora cordifolia* stem reduces sperm motility and density, lowering of serum testosterone, protein, sialic acid, glycogen contents, and depletion of vesicular fructose of testes leading to reduction of male fertility in rats (Gupta *et al.*, 2003). The *in vivo* administration of alcoholic extract of *Tinospora cordifolia* has been reported to increase bone marrow derived macrophages (BMDM) in bearing Dalton's lymphoma (DL) (Singh *et al.*, 2006).