



PHARMACOLOGICAL RICHNESS OF *Tinospora cordifolia*

Anuradha Gautam¹, Anamika Singh² and Dr. Kapila Kumar^{1*}

¹Manav Rachna International Institute of Research and Studies

²Maitreyi College, University of Delhi

ARTICLE INFO

Article History:

Received 14th February, 2020

Received in revised form 29th

March, 2020

Accepted 05th April, 2020

Published online 28th May, 2020

Key words:

Tinospora cordifolia, pharmacological value, Ethnobotany, phytochemistry, Secondary metabolites.

ABSTRACT

Tinospora cordifolia, commonly called as “Giloy” in Hindi belongs to the family Menispermaceae. It is known as Amrita in Ayurveda due to its immense medicinal value and is used to cure a number of diseases and disorders. It is a deciduous woody climber and almost all parts of this medicinal herb constitute pharmacological properties. It is widely used in India and its neighboring countries as a medicinal plant since decades due to the presence of secondary metabolites such as alkaloids, glycosides, steroids, lactones, polysaccharides, flavonoids etc. Some of the medicinally important compounds commonly found in this plant are Columbin, Beta sitosterol, Palmatine, Tinosporin, Berberine, Hexadecanoic acid, Alpha tocopherol, Magnoflorine and Phytol (Gautam *et al*,2020). Further studies on pharmacological importance of this plant and detailed analysis of its phytochemicals would be helpful in the drug discovery process.

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INTRODUCTION

Tinospora cordifolia, a well-known medicinal plant in our ancient ayurvedic literature, commonly called as Guduchi in sanskrit is definitely one of the most important herbs found in nature (Upadhyay and Mishra, 2010). This medicinal herb grows commonly in many Asian countries such as Sri Lanka, Thailand, India, China, Philippines and Malaysia. In India, it is found in almost all parts of India extending from Kumaon Mountains located in the North to Kanyakumari in the South. *Tinospora cordifolia* has been given many National and International names such as Gulvel in Punjabi, Gilo in Orissa, Amariata in Assamese, Gulbel in China and Amritu in Marathi (Upadhyay and Mishra, 2010; Singh *et al*,2005; Gautam *et al*,2020).

Giloy is usually grown as an ornamental plant and can be easily grown with the help of stem cuttings. As Giloy is a climber basically, it is especially made to grow on other plants like Neem tree that can support the climber well. It is usually propagated easily with the help of cuttings as it is found to grow slower by sowing seeds in monsoon (Srivastav, 2011; Papitha *et al*,2016; Singh *et al*,2019). It normally grows in all kinds of climate but it prefers warm climate and its planting is usually done at the time of rainy season. It is found to grow in all types of soils but for its cultivation purpose, usually black or red soil is preferred (Shefali *et al*, 2013). *Tinospora cordifolia* is found to be of immense medicinal value and

possess numerous medicinal properties like anti-diabetic, anti-cancer, anti-oxidant, memory enhancement, hepatoprotective, immunomodulatory, anti-inflammatory and anti-neoplastic characteristics. Giloy is often designated as Rasayana in Ayurveda (Gautam *et al*,2020; Albinjose *et al*,2015).

Morphological Description

Giloy is a deciduous perennial climbing woody plant with alternate, cordate and heart shaped leaves (Upadhyay and Mishra, 2010). The lamina of the leaf of Guduchi is Simple, Alternate, entire, about 7- 9 nerved and membranous. Its stem is found to be fleshy and succulent in nature. It possesses long filiform fleshy aerial roots and its bark is greyish or whitish in colour with rosette like lenticels (di sotto *et al*, 2010; Naik *et al*,2010; Narayan *et al*,2014). Fruits are orangish red in color and seen usually at the time of winter season (Singh *et al*,2003; Narayan *et al*,2014). Small sized flowers are present in *Tinospora cordifolia* with male flowers occurring in clusters and female flowers are seen as solitary. There are six sepals that are arranged in two whorls and are yellowish green in colour (Gautam *et al*. 2020; Zhong *et al*, 2015). This plant is generally known as an immunomodulatory herb and is used to build up the immune system of the body. It has no side effects and toxicity but Ayurvedic literature suggests that it causes constipation if taken regularly for longer period in considerably higher doses (Shefali *et al*,2013).

*Corresponding author: Dr. Kapila Kumar

Maitreyi College, University of Delhi











Figure 1 Showing *Tinospora cordifolia* herb

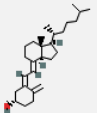
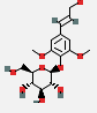
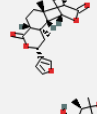
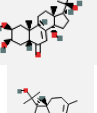
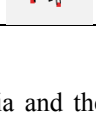
Nutrient Value of *Tinospora Cordifolia*: *Tinospora cordifolia* is an evergreen woody climber with high medicinal value which has been designated as Rasayana in Ayurveda due to its significant pharmacological importance. It is highly nutritious as it consists of high quantity of fibre in it that is about 15.9% and sufficient amount of protein (4.5-11%) in it. It possesses low fat content with a nutritive value of 292.54 calories per 100 gms (Choudhary N *et al* 2013).

Phytochemistry

Basic Phytochemical analysis showed the presence of Carbohydrates, Proteins, Tannins, Saponins, Glycosides, Terpenoids and Alkaloids in methanolic extracts of *Tinospora cordifolia* (Gautam *et al*, 2020; Singh *et al*, 2019). GCMS analysis of methanolic extract shows the presence of some important phytochemicals such as Hexadecanoic acid, Squalene, Alpha tocopherol, beta sitosterol, calciferol, magnoflorine, palmatine, berberine, tinosporin etc (Singh *et al*. 2019; Gautam *et al*. 2020). A list of phytochemicals present in *Tinospora cordifolia* is given in Table 1 with their biochemical properties.

Table 1 Showing various biochemical components identified in *Tinospora cordifolia*

S No	Name of compound	Chemical formula	Molwt. (g/mol)	Class	Plant part	Structure
1	Berberine	C ₂₀ H ₁₈ NO ₄	336.4	Alkaloid	Stem, root	
2	Tinocordiside	C ₂₁ H ₃₂ O ₇	396.5	Glycoside	stem	
3	Furanolactone	C ₂₆ H ₃₀ O ₈	470.5	Diterpenoid lactone	Whole plant	
4	Beta sitosterol	C ₂₉ H ₅₀ O	414.7	Steroids	stem	
5	Magnoflorine	C ₂₀ H ₂₄ NO ₄	342.4	Alkaloid	Stem, root	
6	Palmatine	C ₂₁ H ₂₂ NO ₄	352.4	Alkaloid	Stem, root	
7	Ecdysterone	C ₂₇ H ₄₄ O ₇	480.6	Steroids	Shoot	
8	Columbin	C ₂₀ H ₂₂ O ₆	358.4	Diterpenoid lactones	Whole plant	

9	Calciferol	C ₂₇ H ₄₄ O	384.6	Steroid	Whole plant	
10	Syringin	C ₁₇ H ₂₄ O ₉	372.4	Glycosides	Stem	
11	Isocolumbin	C ₂₀ H ₂₂ O ₆	358.4	Alkaloid	Stem, root	
12	Makisterone	C ₂₈ H ₄₆ O ₇	494.7	Steroids	Shoot	
13	Tinocordifolin	C ₁₅ H ₂₂ O ₃	250.33	Sesquiterpenoids	stem	

Traditional and tribal uses

As more than 400 tribal communities exist in India and they have their own language, culture, traditions, beliefs and knowledge about medicinal herbs occurring in their areas. According to the ethnobotanical surveys conducted by various ethnobotanists, almost all parts of this plant have been documented to be useful. (Gautam *et al*, 2020, Chaudhary *et al*. 2013; Kavya *et al*, 2015)

1. The stem of this plant is used to treat not only skin diseases, jaundice, bile secretion, antipyretic, antimalarial but it also improves digestion and treats intestinal issues.
2. It is used to treat diarrhea in the traditional medicinal system of Thailand.
3. Its leaves dried in shade and collected in the powdered form and later mixed with hot water is used to cure diabetes by the local people living in Tamilnadu, India.
4. The local people staying in Natore district in Bangladesh take its crushed root and leaf powder orally along with brown sugar at night as an effective aphrodisiac.
5. The leaves of *Tinospora cordifolia* are used in the treatment of gout and ulcer.
6. In Karnataka, some folk people use *Tinospora cordifolia* to cure hyperacidity and indigestion.
7. Its root and stem combination is used as an antidote to dangerous snakebites.
8. The local people staying in Bagalkot district of Karnataka use *Tinospora cordifolia* to cure hiccups.
9. *Tinospora cordifolia* is known to promote longevity and improves immunity.
10. The dried fruit of Giloy along with ghee or honey is used as a tonic to cure rheumatism.
11. The bark of *Tinospora cordifolia* is commonly utilized as an antiallergic, anti-spasmodic and anti-leprotic.
12. Giloy is used to cure urinary disorders and syphilis.
13. Its root aqueous extract is used to cure leprosy (Choudhary *et al*, 2013).

Pharmacological Importance

India possesses a rich heritage of traditional plant-based medicinal systems (Sami *et al*, 2008). As the traditional medicines from herbs have been an important part of our healthcare system since ages due to minimum or no side effects, the market demand for medicinal herbs like *Tinospora cordifolia* has increased drastically in recent years. *Tinospora*

cordifolia belonging to the family Menispermaceae is an effective medicinal herb and is used to cure many diseases and disorders such as fever, dengue, chikengunea, pain, diabetes, skin infections, heart and liver related issues. The current study was formulated to identify the phytoconstituents present in the leaves of *Tinospora cordifolia* (Gautam *et al*,2020; Singh *et al*, 2019). Using detailed pharmacological analysis, some significant phytoactive chemicals found in *Tinospora cordifolia* are tabulated in Table 2.

Table 2 Showing some phytochemicals present in Giloy along with their medicinal properties.

S No	Name of Compound	Class of Compound	Medicinal Value
1	Berberine	Alkaloid	Anti-diabetic as given by Yin <i>et al</i> in 2008
2	Alpha-tocopherol	Tocotrienols	Antioxidant property as given by Suzuki <i>et al</i> in 1993
3	Squalene	Triterpenoids	Protects skin according to Narayan Bhilwade <i>et al</i> in 2010.
4	Phytol	Acyclic Diterpenoids	Antioxidant activity (P Costa <i>et al</i> ,2016).
5	Beta psi carotene	Vitamin A precursor	Antioxidant property as given by Mcarty <i>et al</i> in 1995
6	Hexadecanoic acid	Long chain fatty acid	Antioxidant activity as given by Beeharry <i>et al</i> 2003.
7	Columbin	Diterpenoid furanolactone	Anti-inflammatory according to Abdelwahab <i>et al</i> ,2012.
8	Gama sitosterol	Triterpenoid	Hypoglycemic effect and Ameliorative property as given by qluwatosin in 2017
9	Stigmasterol	Steroid	Anticancer property according to Namdev <i>et al</i> ,2015.
10	Calciferol	Vitamin D	Osteoporosis (Thakur and Mahesh,2015)
11	Tinosporin	Alkaloid	Antibacterial as given by Jeyachandran <i>et al</i> , 2003.

Some of the important pharmacological properties of *Tinospora cordifolia* are as follows

1. Anti-cancer-The isolation of anti-cancer compounds has been reported by Tungpradit *et al* in 2010 from *Tinospora cordifolia* and *Coscinium fenestratum*.
2. Immunomodulatory- A number of studies in the past show that Giloy plant has immense immunomodulatory properties according to some studies done by Sharma *et al*,2012. It's a versatile plant and has been shown to stimulate the immunity as given by Diwanay *et al*,2004 and Kalikar *et al*,2008.
3. Anti-pyretic- Researchers have already confirmed the antipyretic properties of Giloy plant as given by Vedavathi and Rao in 1991.The stem of Giloy plant is often used to cure different kinds of fever like dengue and chikungunya as given by Sanjuna *et al*,2019.
4. Anti-diabetic-The oral administration of stem extract of *Tinospora cordifolia* stem was found to have significant anti-diabetic effect on rats as given by various researchers like Rajalakshmi *et al*,2009; Prince PS *et al*,2004 and Gautam *et al*,2020.
5. Anti-oxidant-*Tinospora cordifolia* is well known for its antioxidant potential and has shown significant results against the reactive oxygen species.Antioxidant activity

- of Giloy was also seen on alloxan diabetic rats (Sengupta *et al*,2009; Subramaniam M *et al*,2002).
6. Anti-leprotic- *Tinospora cordifolia* has been known to exert anti-leprotic activity according to many researchers like Sharma and pandey,2010 as well as Asthana in 2001.
 7. Anti-allergic- Various studies on anti-allergic properties of Giloy on different animal models has been given by Nayampalli *et al*,2002 and Singh *et al* in 2003.
 8. Antibacterial acitivity – The antibacterial activity of different extracts of stem of *Tinospora cordifolia* against different types of microbes like Enterobacter faecalis, Samonella typhi, Staphylococcus sp., Escherichia coli, Proteus vulgaris etc was studied by Jeyachandran *et al* in 2003.
 9. Hepatoprotective- Different extracts of different parts of *Tinospora cordifolia* were evaluated against carbon tetrachloride induced liver damage in the rats to study the hepatoprotective property of Giloy (Kavitha *et al*,2011; Adhvaryu *et al*,2008).
 10. Anti-inflammatory- *Tinospora cordifolia* is a unique ayurvedic herb with immense pharmacological value and is a constituent of many ayurvedic formulations due to the presence of important secondary metabolites in it. It is used in the preparation of classical ayurvedic medicine “Guduchi Ghana” used to cure Madumeha , pandu, kamala etc due to its anti inflammatory activity. As given by Patgiri *et al*,2014; Gulati *et al*,1982).
 11. Anti-asthamatic- This climbing deciduous herb has anti asthamatic properties and is found to be useful in drug designing as given by Antul *et al*,2019.
 12. Obstructive jaundice-A study was performed to determine the immune status of patients with obstructive jaundice. Screening of 16 patients was done for phagocytic and microbicidal activity of polymorphonuclear cells(PMN) and *Tinospora cordifolia* extract was used and it revealed significant results. Research showed that cholestasis resulted in immunosuppression and thus indicated the need for an immunomodulator in the management of obstructive jaundice, as this plant seems to meet the need by consolidating host defence mechanism as given by Rege *et al*, 1993.
 13. Radioprotective– The radioprotective efficacy of *Tinospora cordifolia* was studied on male mice by giving gamma irradiations and significant results were obtained as given by Goel HC in 2002.
 14. Anti-depression and enhanced memory- Neuroprotective effects of *Tinospora cordifolia* have been mentioned in various ancient Ayurvedic literature like Charak samhita. Certain recent studies done by researchers also shows its role in controlling depression and memory enhancement as given by Mutalik and Mutalik, 2011 and Bairy *et al*, 2004.
 15. Anti-malarial- *Tinospora cordifolia* has been used in the treatment of malaria as an adjuvant drug (Singh RK, 2005; Singh *et al*, 2011).
- After studying its phytochemistry and ethnobotanical value and medicinal properties of this valuable woody climber, it seems to be truly said in our ancient Ayurvedic literature that this plant is no doubt a magical herb or Amrita or God's nectar (Singh *et al*.2019; Gautam *et al*,2020).

CONCLUSION

Tinospora cordifolia is widely used since ages in Indian Ayurvedic system of medicine for treating various diseases. Since it is known to have no side effects or bare minimum side effects according to Ayurveda and is reported to be beneficial for the immune system, further research on the phytochemicals present in this plant can lead to the treatment of many diseases (Gautam *et al*, 2020). Further, this plant can be used for the development of novel drug formulations for various diseases. *Tinospora cordifolia* extracts could further be exploited in future as a source of important bioactive phytochemicals that can be used in the pharmaceutical industries.

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How to cite this article:

Anuradha Gautam, Anamika Singh and Dr. Kapila Kumar (2020) 'Pharmacological Richness of *Tinospora cordifolia*', *International Journal of Current Advanced Research*, 09(05), pp. 22282-22287.
DOI: <http://dx.doi.org/10.24327/ijcar.2020.22287.4389>
