Pharmacological potential of *Tinospora cordifolia* (Willd.) Miers ex hook. & Thoms. (Giloy): A review

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Abstract

Various kinds of bioactive molecules form the basis of designing of various kind of pharmacologically important drugs. *Tinospora cordifolia* (Willd.) Miers ex Hook. & Thoms. (Giloy) is very important medicinal plant, belonging to the family Menispermacae, acting as one of the main sources of new pharmaceuticals and health care products. The innumerable medicinal qualities and therapeutic uses of Giloy as well as its phytochemical investigations prove its importance as a valuable medicinal plant. It is reported to possess anti-inflammatory, anti-oxidant, anti-spasmodic, anti-allergic, anti-HIV and anti-cancer properties. Its main part stem is bitter, stomachic, diuretic, stimulate bile secretion and cures jaundice. This present review article put special emphasis on pharmacological potential of *T. cordifolia* along with the phytochemicals responsible for its pharmacological properties.

Keywords: *Tinospora cordifolia*, Giloy, pharmacological potential, phytochemicals.

1. Introduction

In the recent years, interest in usage of medicinal plants in pharmaceutical and cosmetic industries have overgrown due to their easy availability, less side effects, less cost, inadequate supply of drugs to larger portion of population in developing nations, prohibitive cost of treatment, side effects of several allopathic drugs and development of resistance to allopathic drugs used for treatment of diseases. According to WHO estimates, 80 % of people depend on traditional remedies such as medicinal plants for curing or prevention of ailments. Plants produce a diverse range of bioactive molecules, making them a rich source of different types of oxidants. Free radicals or reactive oxygen species are formed in our body as a result of biological oxidation. The overproduction of free radicals such as hydroxyl radical, superoxide anion radical, hydrogen peroxide can damage the body and contribute to oxidative stress [1]. Medicinal plants are naturally very good antioxidant source where antioxidant activity is ascribed due to presence of phenolics, flavonoids, vitamins and secondary metabolites [2]. Use of antioxidants in our diet protect against free radicals by scavenging them. Hence, there is an increasing interest to study the effects of various extraction factors on the phytochemical substances including phenolics, flavonoids, active ingredients, essential oil, amino acids and carotenoids [3].

*Tinospora cordifolia* (Willd.) Miers ex Hook. & Thoms which belongs to Menispermacae family is a large, deciduous, climbing shrub found throughout India and also in Sri Lanka, Bangladesh and China. It is known as Giloy (in Hindi), Guduchi (in Sanskrit) and Moonseed (in English). It contains flavonoids, glycosides, saponins and some amount of phytosterols. These active constituents alone or in combination are responsible for antioxidant activity. Leaves of Giloy are rich in protein and are fairly rich in Ca and P [4]. Different chemical constituents such as giloin, columbin, chasmanthin, palmatine, isocolumbin, tembetaryne, syringing, ecdysterone, cordioiside, tinosorfolin, tincordifoliside, cordifolioside A, palmarin, tinosporin and tinosporic acid have been isolated from different parts of Giloy [5]. (Fig. 1). It is known to possess anti-spasmodic, anti-inflammatory, anti-allergic, anti-periodic, anti-arthritic, anti-leprotic, anti-diabetic, antioxidant, hepatoprotective and immunomodulatory [5].

Phytochemical Profile of Various Parts of *T. cordifolia*

Leaves are rich in protein, calcium, and phosphorus [5]. Methanol extract of leaves is rich in flavonoids, alkaloids and glycosides [7]. A post harvest experiment has revealed that mechanical drying of the herb at 40 °C provides the highest alkaloid (tinosporin) content (0.045%). However, the content decreases (0.033%) with drying at 60 °C or in direct sunlight. Further, the dried stem bits packed in polyethylene lined gunny bag retain the highest alkaloid content (0.042%) as compared to storage under ambient conditions [8].
These findings suggest that tinosporin may be either photosensitive and/or thermo labile. Herbal extracts in various forms like infusion, decoction, strong decoction, tinctures, syrups and maceration etc. are commonly used since ancient time for medicinal effects. Cold infusion of Giloy prepared using stem is given in chronic conditions of fever. The juice extract from the stem of Giloy is highly effective for treatment of gout as it helps to neutralise the increased uric acid levels in the body. Strong decoction of Giloy with basil leaves offer resistance against swine-flu.

![Phytochemicals from T. cordifolia](image)

**Fig 2: Important phytochemicals from T. cordifolia**

### Main chemicals present in T. cordifolia parts and their pharmacological potential

<table>
<thead>
<tr>
<th>Phytochemicals Class</th>
<th>Compounds isolated</th>
<th>Plant Part</th>
<th>Pharmacological Potential in Human beings</th>
<th>References</th>
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<tr>
<td>Alkaloids</td>
<td>Berberin, choline, tembetarime, magnoflorine, tinosporin, palmetin, isocolumbin, aporphine, jatrorrhizine, tetrahydropalmatidine</td>
<td>Stem, root</td>
<td>Antiviral, anti-cancer, ant diabetic, antiinflammtory, immunomodulatory</td>
<td>[10-13]</td>
</tr>
<tr>
<td>Diterpenoid Lactones</td>
<td>Furanolactone, clerodane derivatives, tinosporin, tinosporides, jateorine, columbin</td>
<td>Whole Plant</td>
<td>Vasorelaxant: relaxes norepinephrine induced contractions, inhibits calcium ion influx, anti-inflammatory, antimicrobial, antiviral.</td>
<td>[14-16]</td>
</tr>
<tr>
<td>Sesquiterpenoid</td>
<td>Tinoscoridifolin</td>
<td>Stem</td>
<td>Antiseptic</td>
<td>[17]</td>
</tr>
<tr>
<td>Glycosides</td>
<td>Tinoscoridifolin, tinoscoridifolioside, cordioside, syringing, syringing-apiosylglycoside, pregnane glycoside palmatosides</td>
<td>Stem</td>
<td>Treats dementia, motor and cognitive deficits and neuron loss in spine and hypothalamus. immunomodulator</td>
<td>[18, 19]</td>
</tr>
<tr>
<td>Others</td>
<td>Jatrorrhizine, cordifol, giloin, tinosporic acid</td>
<td>Roots, whole plant</td>
<td>Protease inhibitors for HIV</td>
<td>[20]</td>
</tr>
</tbody>
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### Anti-diabetic potential of T. cordifolia parts

Various phytoconstituents isolated from different parts of T. cordifolia are responsible for cure of diabetes mellitus. These phytochemicals include alkaloids, tannins, cardiac glycosides, flavonoids, saponins and steroids [21, 11]. It has the magical potential of lowering the blood sugar level in human beings. The isquinoline alkaloid rich fraction from stem, includes palmitane, jatrorrhizine and magnoflorine which show insulin mimicking and insulin releasing effect both in vitro (using rat pancreatic β-cell line, RINm5F) and in vivo [22]. Another isquinoline alkaloid ‘berberin’ is reported to be highly effective for curing human diabetes. It lowers elevated glucose level as effectively as metformin. It also improves hepatic metabolism during insulin resistance and metabolic syndrome by inhibiting FOXO1 which integrates mitochondrial function with insulin signaling. By adenosine monophosphate-activated protein kinase activation, it decreases the blood sugar and cholesterol level and maintains the blood pressure [23, 24, 25, 26]. Besides, tinosporin, isocolumbin, palmitane, tinoscorid, cordioside and β-sitosterol compounds present in stem and root are also reported to possess ant diabetic, antihyperlipidemic and antioxidant properties as shown in Fig. 2 [27]. Due to presence of major and minor essential minerals such as Zn, Mn, Cl, K, Ca, Fe, Co, Ni and Cu and proteins and fibres in T. cordifolia parts, it helps in health restoration and in alleviation of degenerative processes in diabetes [28, 29]. Crude values for food content in Tinospora cordifolia include high fibre (15.19%), sufficient protein (4.5%-11.2%), sufficient carbohydrate (61.66%), and low fat (3.1%). Nutritive value is 292.54 calories per 100 g. It has high potassium (0.845%) (regulatory function of nerve impulses), high chromium
(0.006%) (regulation of carbohydrate utilization pathophysiological alterations in diabetes), sufficient iron (0.28%) (to improve haematopoietic functions especially in diabetic nephropathy where erythropoietin release from kidney is compromised), and sufficient calcium (0.131%) (regulatory functions in nervous, cardiovascular, and musculoskeletal systems) [30].

Fig 2: Phytochemical antidiabetic virtues of T. cordifolia. Antioxidant potential of T. cordifolia parts

Premanath and Lakshmidevi (2010) determined the antioxidant activity of T. cordifolia leaves in different solvent extracts (ethanol, methanol, chloroform, hexane, aqueous) using standard methods and reported that ethanol extract had the highest total phenols & flavonoids contents i.e. 5.1 and 0.52 mg/g, respectively and also exhibited highest DPPH radical scavenging activity (EC50 value: 0.5 mg/mL) [31]. Rajurkar and Hande (2011) reported that T. cordifolia have 0.23 mg GAE/g dw total phenolic content and 1.50 mg CE/g dw total flavonoids content They also reported that T. Cordifolia have 0.20 mg TEAC/g dw total antioxidant activity as measured by DPPH method [32]. These reports showed that T. cordifolia show significant antioxidant activity. It denotes its ability to scavenge the reactive oxygen species and free radical generates in our body. Radical scavenging activity in it is due to presence of phenols and flavonoids. Due to presence of alkaloids it shows protection against aflatoxin

Antimicrobial potential of T. cordifolia parts

The anti-bacterial activity of Tinospora cordifolia extracts has been assayed against Escherichia coli, Staphylococcus aureus, Klebsiella pneumoniae, Proteus vulgaris, Salmonella typhi, Shigella flexneri, Salmonella paratyphi, Salmonella typhimurium, Pseudomonas aeruginosa, Enterobacter aerogene, and Serratia marcesens (Gram-positive bacteria) [39]. Aqueous, ethanol and acetone extracts of leaves and stem of Tinospora cordifolia Hook. F. Thoms showed maximum inhibitory activity against on clinical isolates of urinary pathogens Klebsiella pneumoniae and Pseudomonas aeruginosa [40]. Silver nanoparticles synthesized from stem of Tinospora cordifolia possess very good antibacterial activity against multidrugresistant strains of Pseudomonas aeruginosa isolated from burn patients [41]. The active compound ([5R, 10R)−4R, 8R-Dihydroxy-2S, 3R:15, 16-diepoxycleroda-13(16), 17, 12S, 18, 13S-dilactone] was isolated from ethanol extract of Tinospora cordifolia stem showed activity against bacteria and fungi.

Conclusion

T. cordifolia is very important medicinal plant which holds a special position in Ayurvedic system of medicines for prevention and treatments of various human ailments. Because of presence of various kinds of phytochemicals in Giloy, it has found applications in pharmaceutical chemistry due to its antioestrogenic, hepatoprotective, immunomodulatory, antihyperglycemic, anti-tumor, anti-HIV properties.

References

7. Soni HP, Nayak G, Patel SS, Mishra K, Singh RP.


34. Sharma V, Pandey D. Protective role of Tinospora cordifolia against lead induced hepatotoxicity. Toxic Int 2010; 17:12-17.


