THE MULTI-ACTIVITY HERBACEOUS VINE - TINOSPORA CORDIFOLIA

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ABSTRACT

Tinospora cordifolia (Willd.) Miers ex Hook. F. and Thoms is a large deciduous, climbing shrub found throughout India, especially in the tropical parts ascending to an altitude of 300 m and also in certain parts of China (Anonymous). It belongs to the family Menispermaceae. It is known as heart-leaved moonseed plant in English, Guduchi in Sanskrit, and Giloy in Hindi. It is known for its immense application in the treatment of various diseases in the traditional ayurvedic literature. T. cordifolia, also named as “heavenly elixir,” is used in various ayurvedic decoctions as panacea to treat several body ailments. (Mehra R.) Its root stems, and leaves are used in Ayurvedic medicine. T. cordifolia is used for diabetes, high cholesterol, allergic rhinitis (hay fever), upset stomach, gout, lymphoma and other cancers, rheumatoid arthritis, hepatic cirrhosis, peptic ulcer disease, fever, gonorrhea, syphilis, and to boost the immune system (WebMD).

Keywords: Tinospora cordifolia, Heavenly elixir; Guduchi, Tippa-Teega, Tinosporic acid.

INTRODUCTION

Tinospora cordifolia, commonly called as “GUDUCHI,” Amrta, and Ginnodbhava in Sanskrit; Glow in Punjabi; Tippa-Teega in Telugu; Shindilakodi in Tamil; Amruthu in Konkani; Hogunilot in Assamese; and Gurjo in Sikkhim, belongs to the family Memispermaceae. It is genetically large, diverse climbing shrub with flowers of greenish-yellow color and the flowering season expands over summer and winter. It is indigenous to topical areas of India, Myanmar, Sri Lanka. It is used in the treatment of various diseases and infections such as diabetes, high cholesterol, allergic rhinitis, Gout, upset stomach, lymphoma, and some cancers also.

MORPHOLOGICAL CHARACTERISTICS

Tinospora is a glabrous twiner. Its older stems are up to 2 cm diameter and have a corky bark. Stems and branches are with white vertical lenticels. Bark is gray-brown or creamy white, warty and paper-thin, and peels off easily. Leaves are ovate, acute, and long petiolate, with multicoted reticulate venation [1]. It has thread-like aerial roots. When roots are young, they are membranous and become more or less leathery with age.

This herb contains unisexual flowers - clustered male flowers and solitary female flowers. Fruits are drupe shaped that ripen on ripening. Flowers grow during summer and fruits during winter.

CULTIVATION AND COLLECTION

Tinospora is distributed toward topical regions of India that are located 1200 m above sea level from Kumaon to Assam. In India, it is easily available in Bihar, West Bengal, Kerala, and Karnataka. It commonly grows in deciduous and dries a forest which grows over hedges and small tree [2].

This herb prefers growing in large variety of soils but prefers red soil or medium black soil [3]. The soil should be well drained with sufficient organic matter and moisture as required. It can be propagated by seeds and vegetable cutting, but viability of seeds is very less and seeds germination is major problems related with clonal propagation. The plant is very rigid and can be grown in subtropical and tropical climate but mainly in warm and rainy climate. It does not tolerate high rainfall and waterlogged conditions.

As Tinospora is a climber, it requires support for its growth (fast-growing species such as neem, jatropha, and moringa). For example, T. cordifolia growing with neem (Azadirachta indica) is called as NEEM GILOY.

CHEMICAL CONSTITUENTS

Columnin, tinosporaside, jatrorhizine, palmatine, berberine, tembeterine, tinosorfolioside, phenylpropane disaccharides, choline, tinosporic acid, tinosporal, tinosporon, tinosporine, sitosterol (beta sitosterol), and waterlogged conditions.

MEDICINAL PROPERTIES

T. cordifolia is used in ayurveda as an antiperiodic, antispasmodic, anti-inflammatory, antipyretic, antiarthritic, antipyretic, antiallergic and anti-diabetic, antidiabetic, and anticancer herb (Wikipedia).
Pharmacological activities

**Immunomodulatory property**
Vaibhav et al. reported that studies have found that there was distinct increase in footpad thickness after treatment with *T. cordifolia* alcoholic extract which indicates immunomodulatory effect of *T. cordifolia*, and there was enhancement in the bone marrow cellularity as well as α-esterase activity in the rats groups treated with alcoholic extracts of *T. cordifolia* which evidently show that these drugs have immunomodulatory activity. Studies revealed that the alcoholic extracts of *T. cordifolia* obtained from the dried ripe fruits possess good immunomodulatory activity. In order to explore the cellular changes and other pharmacological changes in male wistar rat the research is under progress [4].

Chemical constituents responsible for this activity are cordifoliside A, tino cordiside, and syringin.

**Antidiabetic activity**

*T. cordifolia* is an effective antihyperglycemic drug that can be used in the treatment of diabetes mellitus. Several experiments were conducted to prove the antidiabetic activity in TC. Attempts were made to investigate the antidiabetic activity in TC.

Stem extracts both aqueous and alcoholic in different doses (200 and 400 mg/kg b.w.) in streptozotocin-diabetic albino rats. The drug was given orally for 10 days and 30 days in different group of animals and the results were observed. The study clearly showed that TC has significant (p<0.05) antidiabetic activity in diabetic animals and has an efficacy of 40–80% compared to insulin. TC administration in diabetic animals did not cause any increase in serum insulin levels or regeneration of pancreatic β cells but caused increased hepatic glycogen synthase and decreased glycogen phosphorylase activity. It was shown that the antidiabetic activity of TC is not through the insulin secretion by pancreatic beta-cells, but it may be due to the increased entry of glucose into the peripheral tissues and organs like the liver. The study strongly suggested that TC may not act like sulfonlyureas, but like other oral antihyperglycemic drugs and indicated that treatment with TC may be an alternative to some of the present available drugs, which have some adverse effects [5].

Chemical constituents responsible for this activity are berberine, choline, tem betarine, palmitine, and jatrorrhizine.

**Antitoxin activity**

*Tinospora* scavenges the free radicals produced during aflatoxicosis. Some of the toxins present in *Tinospora* showed aflatoxin-induced nephrotoxicity. Oral administration of plant extracts (stem and leaf) prevented the occurrence of lead nitrate-induced liver damage, this antitoxic activity reported by the Saha et al. [6].

**Anti-HIV activity**

Root extract of *Tinospora* shows anti-HIV effect by indicating reduction in eosinophil count, stimulation in B-lymphocytes, macrophages, hemoglobin levels, and polymorphonuclear leukocytes. [7]. Ethyl acetate extract shows 85% of HIV-1 RT inhibition activity at a concentration of 20 mg/ml [8].

**Antimicrobial activity**

*T. cordifolia* shows antibacterial activity mainly its methanolic extract. Ethanolic activity has significant antibacterial activity against *Escherichia coli*, Proteus vulgaris, Enterobacter faecalis, *Salmonella typhi*, *Staphylococcus aureus*, and *Serratia marcescens* [9]. Chemical constituents responsible for this activity are furanolactone, tinosporon, isocolumbin, and palmatine.

**Antioxidant activity**

Ethanol-induced models. The antiulcer activity was further confirmed by histopathological examination of rat stomach [13]. Whole plant or ethanol aqueous extracts are used to identify this activity.

**Anticlastogenic potential**

Evidence has shown that the test plant stem extract may have antimutagenic or antiklastogenic property so it is noteworthy in the preventive aspect of chemical carcinogenesis and several types of disorders caused by genetic damages due to arsenic toxicity and *T. cordifolia* may be used as a preventive herbal drug against chemical or arsenic toxicity [14].

**Neuroprotective activity**

The experiment conducted shows that *T. cordifolia* ethanolic extract on 6-hydroxy dopamine-induced Parkinson's disease by protecting dopaminergic neurons and reducing iron accumulation. Aerial parts or ethanolic extracts are used to estimate this activity.

**Antidiarrheal activity**

Whole plant and ethanol or aqueous extracts are used for the estimation of antidiarrheal activity. The *in vivo* activity of extracts was assessed using castor oil (induces diarrhea by inducing nitric oxide, stimulating prostaglandin synthesis, and increasing peristalsis) and magnesium sulfate (prevents reabsorption of water and promotes cholecystokinin release from duodenal mucosa) induced diarrhea by means of evaluating onset of diarrhea, frequency if wet and total stools, weight of wet stool, and total weight of stools [15].
Analgesic, anti-inflammatory, and antipyretic activity
Whole plant or ethanol extract is used for analgesic activity. It was assessed by hot plate and abdominal writhing method in albino rats [16].

Stem or aqueous extract is used for anti-inflammatory activity. It was exhibited significantly in the carrageenan-induced inflammation test (paw edema model in rats). Chemical constituents responsible for this activity are furanolactone, tinosporin, tinosporide, jateorine, columbin, and clerodane derivatives.

Formulation guduchi ghrita is used to estimate antipyretic activity. Experiment was conducted in albino rats against yeast-induced pyrexia.

Aphrodisiac activity
Aqueous and hydroalcoholic extracts were used to estimate the activity. This activity was studied on male Wistar albino rats. The study gives the mount frequency, mount latency, intromission frequency, intromission latency, anogenital sniffing, and genital grooming [17].

Chemical constituents responsible for this activity are berberine, palmatine, tembatarine, magnoflorine, tinosporin, and isocolumbin.

Antidysslipidemic activity
The part used for estimation is stem extract. Alloxan-induced diabetic male adult rats of Charles Foster strain were used to carry out the experiment. Chemical constituent responsible for this activity is Berberine [18].

Gastroprotective activity
Whole plant is used to estimate this activity. Epoxyclerodane diterpene isolated from T. cordifolia Miers (Guduchi) on indomethacin has induced gastric ulcer in rats as extracellular domain exerts its antulcer activity by reinforcement of defensive elements and diminishing the offensive elements. Epoxyclerodane diterpene is the chemical constituent responsible [19].

NOOTROPIC EFFECT
Whole plant or ethanol extract is used to estimate the nootropic effect of Tinospora. The nootropic property of n-butanol fraction (TBF) of the ethanolic extract of T. cordifolia stem which contains saponin was evaluated by Amnesic rats using radial arm maze task performance and Barnes maze test. The result showed decreased in AChE concentration which indicates the involvement of cholinergic system in nootropic activity of TBF [20].

Cardioprotective activity
Whole plant or alcoholic extract of the herb is used here. The effect of Tinospora was dose dependent; as the dose was increased, the extract showed the increased effect as reflected by progressive decrease in plasma calcium and sodium levels and increase in potassium levels at higher doses when compared to that of verapamil. Hence, cordifolia is used for the treatment of atrial and ventricular fibrillation, flutter, and ventricular tachyarrhythmias [21]. Chemical constituents are furanolactone, tinosporin, tinosporide, jateorine, columbin, and clerodane derivatives.

Radioprotective and cytoprotective activity
Stems or ethanolic extracts of Tinospora cordifolia are used for the experimentation. The stem extract contains cordifolioside-A which is a primary active constituent (terpenoid) of TBF of T. cordifolia against 4 Gy-γ radiation in mice and cyclophosphamide-induced genotoxicity [22].

Root extract of T. cordifolia (TCE) used for evaluating the possible radioactive potential against 2.5 Gy gamma radiation in adult Swiss albino mice. Mice were divided into four groups. Each group was administered differently with double distilled water and exposed to 2.5 Gy gamma radiation, and biochemical alterations were noted in the blood of mice at various post-irradiation intervals. Results have shown that there is considerable decrease in the level of total proteins, glutathione (GSH), CAT, and superoxide dismutase activity along with significant increase in cholesterol, lipid peroxidation due to irradiation of mice. There is enhanced activity of various antioxidant enzymes and reduction of the radiation-induced variations in total proteins, cholesterol, and LP0 levels in the blood serum in TCE before irradiation. The investigation indicated that T. cordifolia root extract reduces the bioeffects of gamma radiation in mammals [23].

Antifeedant activity
Whole plant or chloroform extract of Tinospora is used for the estimation of antifeedant activity. Tinospora is a potent source of natural antifeedant and activities against selected important agricultural lepidopteran pest Spodoptera litura, Helicoverpa armigera, Earias vittella, and Plutella xylostella. Least antifeedant activity was shown by hexane extract and significant activity by methanolic extract [24].

Chemical constituents responsible for the activity are tincordin, tinosporide, columbin, and 8-hydroxy columbin.

Ameliorative activity
Root or ethanol extract is used for the estimation of activity. T. cordifolia was found to show protective effect by lowering down the content of thiobarbituric acid reactive substances and enhancing the reduced GSH, ascorbic acid, protein, and the activities of antioxidant enzymes such as superoxide dismutase, CAT, GSH peroxidase, GST, and glutathione reductase in kidney. Protection against aflatoxin-induced nephrotoxicity is due to the presence of chemical constituents such as a choline, tinosporin, isocolumbin, palmatine, tetrahydropalmatine, and magnoflorine (alkaloids) in Tinospora cordifolia extract [25].

Hepatoprotective activity
Whole plant or aqueous extract is used for the estimation of the activity while experimentation. Ethanolic extract of all the parts of Tinospora showed hepatoprotective effect by reduction in serum enzymes alanine aminotransferase, aspartate aminotransferase, alkaline phosphatase, and total bilirubin accompanied by pet ether and aqueous extracts.

Some of the alkaloids and terpenoids such as magnoflorin, tinosporin, isocolumbin, palmatine, and tetrahydropalmatine present in the herb are responsible for hepatoprotective activity [26].

Antipsychotic activity
Aqueous and ethanol extracts are used here. Amphetamine challenged mice model has to be used for experimentation. Tinospora is an active central nervous system stimulant and helps in various neurological activities. Berberine, choline, tembatarine, magnoflorine, tinosporin, palmatine, isocolumbin, aporphine alkaloids, jatrorrhizine, and tetrahydropalmatine are the alkaloids responsible for the activity [27].

The other pharmacological activities of T. cordifolia include antidepressant (Swiss albino mice were used and activity was evaluated using tail suspension test and forced swim test), antiestrogenic (female Sprague-Dawley rats), antifertility (male rats), antiasthmatic (mice were sensitized with intraperitoneal ovalbumin followed by intranasal ovalbumin in vivo asthma model), diabetogenicity [streptozotocin-induced Wistar albino diabetic rats and in vitro adose reductase inhibition assay and in vivo results were analyzed with Mann-Whitney test], and allergic rhinitis (double-blind placebo controlled trial) [1].

NATURAL BINDER
Mucilage was extracted from the fresh stems of T. cordifolia which was characterized for physicochemical parameters. Using 2%, 4%, 6%, 8%, and 10% concentration of mucilage of T. cordifolia as natural binder, diclofenac sodium tablets (11-16) were prepared by dry granulation method. The results show that all the pre- and post-compression parameters of the formulated tabled were in compliance with pharmacoepial limits and the drug release mechanism from
formulation f1-f6 was found to be polymer disentanglement and erosion. Experimental findings revealed that T. cordifolia mucilage can be used as release retardant agent in the formulation of sustained release dosage forms [28].

INTERACTIONS

1. Usage of Tinospora along with diabetic medicines may lead to decline in the blood sugar level.
2. Taking Tinospora along with drugs that decrease the immune system may decrease the effectiveness of the medication.

CONCLUSION

T. cordifolia is an Indian ayurvedic medicine which is a plant having diverse roles. It has several chemical constituents such as steroids, lactones, terpenoids, alkaloids, flavonoids, and glycosides. It shows different pharmacological activities and better significant activity when compared to that of standard drugs. Based on this information, further research work can be explored, and T. cordifolia can be used for the treatment of various diseases and infections. This review is useful to study the T. cordifolia activities in a simple manner and it is helpful to further research work planning.

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AUTHORS’ CONTRIBUTIONS

All authors had equally contributed to the recitation of the article.

CONFLICTS OF INTEREST

The authors have declared no conflicts of interest.

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