Review Article

Review on Pharmacological Profile of Medicinal Vine: *Tinospora cordifolia*

Abstract

Tinospora is highly distributed in the tropical and subtropical region of India. This climbing deciduous shrub widely reported in China, Bangladesh and Srilanka. The plant is rich in many phytoconstituents that are useful in drug designing. It is highly used against cancer, tumour suppression, and act as an anti-allergic compound. It is commonly known as gudhuchi, belongs to the family Menispermeaceae. *Tinospora* is most valuable herb known for its medicinal properties from vedic periods and cure various diseases such as malaria, asthma and urinary disorders. The genus *Tinospora* consists many classes of chemicals such as alkaloids, diterpenoids lactones, steroids, aliphatic compounds and polysaccharides. It is the best remedy for both children as well as adults against respiratory tract diseases. Plant shows various antioxidant, anti-hyperglycemic, anti-neoplastic and hepatoprotective properties. In this review article medicinal property, chemical constituents and full description has been explored.

Key Words: *Tinospora*, Gudhuchi, Diterpenoids, Antioxidant, Anti-neoplastic, Steroids

1. Introduction:

Guduchi or *Giloya* is the most commonly used plant which contains a large number of valued products. It has a wide history in the Indian medicinal system and considered one of the best *Rasayana* and is unusual in its potent versatility. In recent years, significant progress has been attained for its biological activity and medicinal applications. It is a semi-woody climbing shrub that is deciduous and perennial. This herbaceous vine grows on hedges and trees described as

"one which protects the body". It is often seen growing up Mango or Neem trees. Herbalist Sebastian Pole writes that "those growing up neem trees are said to be the best as the synergy between these two bitter plants enhances *guduchi*'s efficacy." It is indigenous to areas of India, Myanmar, and Sri Lanka (1). *Guduchi* typically grows in deciduous and dry forests at elevations up to 1000 ft. The leaves are heart shaped (*cordifolia*) and mucilaginous. Its stems, when fresh, have a green succulent bark covered by a thin brown bark and are studded with warty lenticels. When dry, the stem shrinks and the bark separate from the wood. The roots are long narrow aerial roots that arise from the branches. The stems, leaves, and roots are used in medicine. All three parts should be collected in the summer when the bitter qualities are most abundant and, if not used fresh, dried in the shade. *Guduchi* grows well without fertilizer or pesticide making it simple to grow. It is easy to recognize and can be propagated by cuttings. Guduchi is a large glabrous deciduous climbing shrub belonging to the family *Menispermaceae*. It is distributed throughout tropical Indian subcontinent and China, ascending to an altitude of 300 m. In Hindi the plant is commonly known as Giloya or Amrita which is a Hindu mythological term that refers to the heavenly elixir that have saved celestial beings from old age and kept them externally young (2). The stem of *T. cordifolia* is rather succulent with long filliform fleshy aerial roots from the branches. The bark is creamy white to grey, deeply left spirally, the space in between being spotted with large rosette like lenticel. The leaves are membranous and cordate. The flowers are small and yellow or greenish yellow (3). In auxiliary and terminal racemes or racemose panicles, the male flowers are clustered and female are usually solitary. The drupes are ovoid, glossy, succulent, red and pea-sized. The seeds are curved and pea-sized (4). Fruits are pea-shaped, fleshy, shiny turn red when boiled. Guduchi is used as a rasayana due to its potency of enhancing longevity and vitality. It is widely used in ayurvedic for a variety of purposes

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associated with inflammation allergies, neurology and glucose metabolism, general debility, fever, diabetes, dyspepsia, urinary infection, jaundice and skin diseases. In the today's world of modern medicine, it is also called as magical herb due to its property to treat a lot of diseases.

2. Classification:

KINGDOM: Plantae

DIVISION: Magnoliophyta

CLASS: Magnoliopsida

ORDER: Ranunculales

FAMILY: Menispermaceae

GENUS: Tinospora

SPECIES: cordifolia

2.1 Total Species: Some observers found that there are total 15 species and out of these some of the medicinally important species are *T. cordifolia*, *T. crispa*, *T. cordifoli, T. malabarica*, *T. tomentosa*, *T. uliginosa* etc (1).

2.2 Vernacular Names:

Assamese: *Siddhilata, Amaralata*

Bengali: *Gulancha*

English: *Heart leaf moonseed*

Gujarati: *Galac, Garo*

Hindi: *Giloe, Gurcha*

Kannada: *Amrutaballi*

Kashmiri: *Amrita, Gilo*

Malayalam: *Chittamrutu*

Marathi: *Gulvel*

Oriya: *Guluchi*

Punjabi: *Gilo*

Sanskrit: *Amrit*

Tamil: *Seendal, Seendi Kodi*

Telugu: *Thippateega*

Urdu: *Abb-e-Hyat*

3. Botanical Description: *T. cordifolia* is a large, perennial, deciduous, climbing shrub with succulent stem. The stem is fibrous and having wedge shaped wood bundles with large vessels. The bark is papery, creamish white in colour, left spirally and stem containing rosette like lenticles. The leaves are simple, alternate and cordate in shape also consist of 7-9 nerves on entire leaf (5). Flowers are axillary, small, cymose, yellow- greenish in colour. Male and female flowers are always originated on separate branches. Male flowers are present in cluster form while female flowers are in solitary form (6). The best time for growth of flower is during summer (7). Sometimes small yellowish flowers are also present on long spikes. Fruits of *Tinospora* are pea shaped shiny, druping and become red when fully grown. Fruits are generally single seeded and fleshy. The fruits get maturity in winter season. Seeds are hooked or curved in shape. The root portion is aerial, thread like, long, fleshy and is in branching form.

4. Habitat and Distribution: *T. cordifolia* prefers subtropical and tropical for growth. For better cultivation, light medium sandy loam soil rich in organic matter and with adequate drainage is suitable. This plant is highly grown tropical India, south Asia, Indonesia, Phillipians, Thailand and China. The plant is also observed from South East Asian continent such as Malaysia, Indonesia and Tamilnadu.

5. Climate and Soil: The plants preferred subtropical and tropical conditions for proper growth. For better cultivation, light medium sandy loam soil rich in organic matter and with adequate drain age is suitable. It shows low resistance towards high rainfall or waterlogged conditions. Stem cutting is the best method to enhance commercial use.

6. Floral and Fruit study: Inflorescence starts in summer season. The male flowers are small in size, yellow or green in colour, and occur in groups. While, female flowers are usually solitary and are green in colour. The fruit size and shape is like of a pea pod and turn green to red when ripe in winter.

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Table 1: Different part used and its benefits:

Part	Part used	Benefits
1.	Leaves	Juice or decoction of leaves is taken orally with honey in case of fever.
2.	Whole plant	Anti-pyretic
3.	Roots	The roots are used as anti-dote to snake bite and scorpion sting after combining with other drugs.
4.	Stem	It is bitter in taste, stimulates bile secretion, stomachic, diuretic, removing burning sensations, vomiting and also cure jaundice.

7. Chemical Constituents: A number of chemical constituents has been extracted from the different parts of *T. cordifolia.* These chemical constituents belong to different classes viz; alkaloids, diterpenoid lactones, steroids, glycosides aliphatic compounds, polysaccharides. The main constituents of this plant are tinosporone, tinosporic acid, cordifolisides A to E, syringe, berberine, gilonin (8). The chemical constituents in different parts and its uses are given in the following table:

Table 2: Plant part used, chemical constituents and effect on humans

Sr. No.	Part Used	Chemical Constituents	Uses	References
1.	Whole Plant	β-sitosterol, δ-sitosterol, 20-β-Hydroxy ecdysone, Furanolactone, Clerodane derivatives and [(5R,10R)-4R-8Rdihydroxy- 2S-3R:15,16-diepoxycleroda- 13 (16), 14-dieno- 17,12S:18,1S-dilactone] and Tinosporon, Tinosporides, and Jateorine, Columbin, Octacosanol, Heptacosanol, Miscellaneous- Nonacosan-15-one3, (α,4-di hydroxy- 3-methoxy-benzyl)-4-(4- hydroxy-3-methoxy-benzyl)-tetrahydrofuran, Tinosporidine, Cordifol, Cordifelone, N-transferuloyl tyramine as diacetate,Giloin, Giloinin, Tinosporic acid.	➢ Anti-stress activity ➢ Antidote to snake bite and scorpion sting, ➢ Analgesic and neuro-pharmacological activities, Diabetes, Rheumatoid arthritis, Gout, cancer, high cholesterol content Anti-asthmatic and chronic cough treatment, ➢ Antipyretic and anti-inflammatory	(9) (10) (11)

			activity, Anaemia, jaundice, normalization of altered liver function, ➢ Cardiac disorder, ➢ Anti-leprotic, ➢ Gastrointestinal and anti-ulcer activity ➢ Anti-fertility activity, Hepatoprotective activity	
2.	Root	3, (a,4-di hydroxy-3-methoxy-benzyl)-4-(4- hydroxy-3-methoxy-benzyl)-tetrahydrofuran, Jatrorrhizine, Tinosporidine, Cordifol, Cordifelone, Giloinin, Giloin, N-transferuloyltyramine asdiacetate, Tinosporic acid. compounds	➢ Anti-neoplasmic ➢ Anti-oxidant ➢ Anti-stress	(12)

		Berberine, Choline, Tembetarine, Magnoflorine, Tinosporin, Palmetine, Isocolumbin, Aporphine alkaloids, Jatrorrhizine, Tetrahydropalmatine, sitosterol		
3.	Stem	Tinocordifolin18-norclerodane, glucoside, Furanoid diterpene, glucoside, Tinocordiside, Tinocordifolioside, Cordioside, Cordifolioside, Syringin, Syringinapiosylglycoside, Pregnane glycoside, Palmatosides, Cordifolioside A, B, C, D and E, Glycosides Sesquiterpenoid Berberine, Choline, Tembetarine, Magnoflorine, Tinosporin, Palmetine, Isocolumbin, Aporphine, alkaloids, Jatrorrhizine, Tetrahydropalmatine,	➢ Respiratory tract infections ➢ Skin diseases ➢ Antidote to snake and scorpion sting ➢ Anti-hyperglycemic ➢ Enhance immune response ➢ Anti-carcinogenic ➢ Anti-inflammatory	(13)
4.	Shoot	β–sitosterol, δ-sitosterol,20 β-	➢ Anti-	(Singh et al.

		hydroxyecdysone, Ecdysterone, Makisterone A, Giloinsterol Steroids β–sitosterol, δ-sitosterol, 20 β-hydroxyecdysone, Ecdysterone, Makisterone A, Giloinsterol	carcinogenic ➢ Anti-pyretic	2003)
5.	Bark	Tinosporofuranol, tinosporafurandiol, tinosporaclerodanol and tinosporaclerodanoid, β-sitosterol	➢ Anti-inflammatory ➢ Antioxidant	(15)

It also contains various other chemicals like flavonoids, glycosides, saponins and little amount of phytosterols. These chemicals show antioxidant activity when these are combined with other drugs. These main constituents which are present in a very high amount are alkaloids and terpenes. The leaves are the rich source of protein, calcium as well as phosphorus.

8. Toxicolgy: In human beings toxic effects of *Tinospora* is very less known. But sometimes its high dose causes some harmful effects on body. It might lower blood sugar level, use it carefully if anyone has diabetes, it also increases the symptoms of autoimmune symptoms. It is also advised to avoid intake of Tinospora during pregnancy and breast feeding time (16).

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9. Ayurvedic Properties:

Ayurveda is one of the most ancient medical sciences of the world. Rasayana is one of the eight clinical specialties of classical ayurveda. The concept of rasayana therapy is not a single drug.

Treatment but it is a comprehensive and specialized regimen capable of producing healthful longevity and improved mental facilities. Several medicinal plants have been described as rasayan in ayurveda (17).

Guduchi is considered one of the best Rasayans and it is unusual potent versatility. Guduchi is known to be a rich source of trace elements (Zinc & Copper) which act as antioxidants & protects cells from the damaging effects of oxygen radicals generated during immune activation. Rasayan effect of Guduchi can be used to heal & prevent infections. Rasayana used as a universal vaccine for any diseases. Rasayan chikitsa is mainly used for maintain the health of individuals although it can be used for diseased also.

Rasa- Tikta, Katu.

Guna- Laghu, Snigha.

Veerya- Ushna.

Vipaka- Madhura

Doshaghnata- Tridoshashashamaka

Rogaghnata- Kushtha, vatarakta, Netraroga

Karma- Kusthaghna, deepana, Sangrahi, Balya

Prabhava- Tridoshanara, Vishaghna, cure

Rasa- Taste appreciation of the substances by chemical receptors on tongue, sweet, sour, salt, bitter, pungent and astringent.

Guna- Ten pairs of opposite or mirror image attributes, attribute or property of any substance.

Veerya- Potency, Ushna-hot, Sheeta-cold, Vipakaintestinal digestion and tissue metabolism, Madhuraneutral, Amla-acidic, Katu-alkaline, Prabhava-specificaction through specialized receptors.

145 **Figure I. Schematic representation of different parts of *Tinospora* plant and their folk uses.**

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148 ***Table 3: Various chemical constituents, part used, active components and Biological roles of***

149 ***Tinospora cordifoliain humans:***

Sr. No.	Active component	Compound Names	Effects in humans	Part used	References
1.	Alkaloids	➢ Berberine ➢ Choline ➢ Palmatine	Anti-cancer, antiviral infections,	Stem, root	(10) (18)

		➢ Tembetarine ➢ Magnoflorine ➢ Tetrahydroplamatine ➢ Tinosporin ➢ Isocolumbin ➢ Jatrorhhizine ➢ Aporphine alkaloids	Inflammation, and immune-modulatory roles Neurological, Psychiatric Conditions Anti-diabetes		(19) 20)
2.	Glycosides	➢ 18‑norclerodane glucoside ➢ Furanoid diterpene glucoside ➢ Tinocordiside ➢ Tinocordifolioside ➢ Cordioside ➢ Palmatosides	Treats neurological disorders like ALS, Parkinsons', dementia, motor and cognitive deficits, and neuronloss in spine and hypothalamus. Immunomodulation: IgG increase and macrophage activation. Inhibits NF‑κB and act as nitric oxide scavengers to show anti‑cancer	Stem	(21) (22)

			activities		
3.	Steroids	➢ β-sitosterol ➢ hydroxy ecdysone ➢ Ecdysterone ➢ Giloinsterol	IgA neuropathy, glucocorticoid induced osteoporosis in early inflammatory arthritis, induce cell cycle arrest in G2/M phase and apoptosis through c-Myc suppression. Inhibits TNF-α, IL-1 β, IL-6 and COX-2. Activates NF-κB	Stems, aerial parts	(23) (24)
4.	Aliphatic compounds	➢ Octacosanol ➢ Heptacosanol ➢ Nonacosan-15-one dichloromethane	Anti-nociceptive and anti-inflammatory. Protection against 6-hydroxydopamine induced	Whole plant	(25) (26)

			parkinsonism in rats. Down-regulate VEGF and inhibits TNF-α from binding to the DNA		
5.	Diterpenoid lactones	➢ Furanolactone ➢ Clerodane derivatives ➢ [(5R,10R)-4R-8R-dihydroxy-2S-3R: ➢ 15,16-diepoxy-clerod a-13 (16), ➢ 14-dieno-17,12S: 18,1S-dilactone] ➢ Tinosporides	Vasorelaxant: relaxes Norepinephrine induced contractions. Inhibits Ca^{++}influx. Anti-inflammatory, anti-microbial, anti-hypertensive, anti-viral. Induce apoptosis in leukemia by activating caspase-3 and bax, inhibits bcl-2	Whole plant	(27) (28)
6.	Others	➢ 3, (a,4-di hydroxy-3-methoxy-	Protease inhibitors for HIV and	Root	(29) (30)

	benzyl)-4- ➢ (4-hydroxy-3-methoxy-benzyl)-tetrahydrofuran ➢ Jatrorrhizine ➢ N-trans-feruloyl tyramine ➢ Giloin ➢ Tinosporic acid	drug resistant HIV. Tyramine is a neuro-modulator. Used to treat anxiety and depression by inactivating neurotransmitters

Abbreviations: NF-κB-Nuclear factor-kappa-B, VEGF-Vascular endothelial cell growth factor, TNF-Tumor necrosis factor, IL-Interleukin, COX-Cyclooxygenase, ALS-Amyotrophic, Lateral Sclerosis, IgG-Immunoglobulin G, IgA-Immunoglobulin A.

Figure II. Pharmacological property of *Tinospora cordifoila.*

10. Medicinal Properties:

1. **Immunomodulatory activity:** The alcoholic extract of *T. cordifolia* showed significant immunomodulatory effects. At standard dose, extract increased the α- amylase activity and cellularity of bone marrow in rats. It had been observed by some researchers that some active compounds viz; 11‑hydroxymustakone, N‑methyl‑2‑pyrrolidone, N‑formylannonain, cordifolioside A, magnoflorine, tinocordiside and syringing showed immunomodulatory activity (31)
2. **Anti-inflammatory activity:** The water extract of stem part showed anti-inflammmatory role in case albino rats. It has significantly suppressed acute inflammatory response caused by carrageenin when applied orally (15).

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3. **Hepato-suppression:** the extract of whole plant showed protection against CCl_4 because it causes hepato-cellular changes after forming proteins or by forming bioaction of CCl_4 and accelerated toxification. It also showed potential to reduce the effect of free radicals and antioxidant activity with the suppression of lipid peroxidation, therefore this plant considered as hepatoprotective agent (32).
4. **Anti-HIV activity:** TCE reduced the recurrent resistance of HIV virus and enhancing the therapeutic outcome (33). Anti-HIV effects of TCE was revealed by reduction in eosinophil count, stimulation of B lymphocytes, macrophages and polymorphonuclear leucocytes and hemoglobin percentage thus, revealing its promising role of application in management of the disease (34).
5. **Anti-cancer activity:** The anti-cancer effects of *T. cordifolia* are mostly studied in animal models. TCE have been shown to have a radioprotective role by significantly increase in bodyweight, tissue weight, testes-body weight ratio and tubular diameter and inhibit the harmful effects of sub-lethal gamma radiation on testes in male Swiss albino mice. In pre-irradiating mice, TCE significantly affected radiation induced rise in lipid peroxidation and resulted in the decline of GSH concentration in testes. Pre-treatment of HeLa cells by TCE have been shown to decrease the cell viability, increase LDH and decrease in GSH S-transferase activity (35).

11. Conclusion: The present study explores the detailed information of *T. cordifolia* and its therapeutic efficiency about the medicinal uses explained in medicinal systems. The phytochemical, pharmaceutical and biological investigation of *T. cordifolia* reports the versatility and explains its diverse role. It is concluded that this miracle herb had been used traditionally among the various communities across the tribal region of worldwide for ailment of urinary,

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gastrointestinal, skin, pulmonary, hepatics, gynecological, inflammatory and infectious diseases. In addition to this, the species is also well known to treat allergy, tumor and cancer by the traditional and local medicinal practitioners. Almost all parts of the plant are used for curing different but the most frequent part used is rhizome followed by root. In recent times, the old traditional practices are at gradually decline very rapidly and under risk due to rapid modernization hence there is urgent need for documentation of such tribal species and help to find innovative ways for untap its efficiency used for human welfare in future.

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