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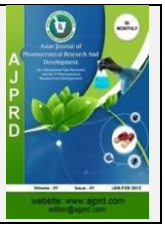

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Review Article

An Overview of Medicinal Plant of Tinospora Cordifolia

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A B S T R A C T

Tinospora cordifolia, or "Guduchi" or "Giloy," is a big deciduous climbing shrub belonging to the family Menispermaceae. With genetic variability. it is extremely widespread in india and neighbouring countries and thrives in tropical areas. it is gently valued traditional medicines, especially Ayurveda, owing to its broad-spectrum therapeutic properties. The plant is characterized morphologically by its coiling branches, fleshly stem, heart-shaped leaves, racemose inflorescences, curved seeds, and aerial roots with special tetra- to penta-arch vascular patterns.Here in this review, explores the genetic diversity**,** morphological features**,** chemical composition**,** and medicinal value of *T. cordifolia*. Various are considred.some of the bioactive constituents such as alkaloids**,** glycosides, diterpenoid lactones, steroids, phenolics, and polysaccharides have been reported from its root, stem, leaves, and whole plant. These molecules are accountable for wide range of pharmacological activities including anti-diabetic, antioxidant, anti-inflammatory, immunomodulatory, hepatoprotective, anti-stress, anti-allergic, anti-microbial**,** and anti-cancer effect**.** Ethnopharmacological confirmation establishes its efficacy in curing of dieases including diabetes, fevers, respiratory diseases, liver abnormalities, dermatological disorders, and cognitive dysfunction. There is also existing pharmacological evidence of its adaptogenic and immunostimulatory effects and incresing interest towards its anticancer activity l. This present review discusses available information on *T. cordifolia*, calling attention to its clinical importance and likely applications within both traditional and modern medicine.

KEY WORDS: Guduchi, Giloy, Tinospora cordifolia, Antimicrobial.

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INTRODUCTION

Tinospora cordifolia, otherwise known as "Guduchi"in Sanskrit,is a big,deciduous climbing shrub of the Menispermaceae family with an extensive genetic constitution. Its most frequently encountered at high elevations and is distinctively marked with its characteristic greenish-yellow coloured flowers. The plant is well known for its medicinal properties and has been employed for a number of therapeutic application in such ancient medical systems like Ayurveda.[1] The female flowers are solitary, while the male flowers are grouped in racemes or racemose panicles.During summer and winter season, the flowering duration is longer. [2] Alkaloids, steroids, diterpenoid lactones, aliphatics, and glycosides are some ofthe many active compound obtained from Tinospora cordifolia.it is due to these bioactive compounds that the therapeutic properties and traditional medicinal use of the plant are possible [2] various active constituent, such as steroids, diterpenoid lactones, and alkaloids.

1. The reported **genetic diversity** in the plant.
2. The **biological activity** of the plant's active components in animal and human.
3. The **active substances** derived from the plant.

Table 1: Common name of Plant *Tinospora cordifolia(willd.)*

Hindi	Giloya,Guduchi
Bengali	Gulancha
Telugu	Thippateega
Tamil	Shindilakodi
Marathi	Gulvel
Gujarathi	GaloKannada Amritaballi,Madhupa

CommonName:-

Latin	*Tinospora cordifolia(willd.)*
English	Gulancha/IndianTinospora
Sanskrit	Guduchi,Madhuparni,Amrita,Chinnaruha,Vatsadaani,Tantrika, Kundalini & chakralakshanika

Table 2: Taxonomic classification

Kingdom: Plantae	Plants
Subkingdom	Tracheophyta–Vascular Plants
Super-division	Spermatophyta-Seed bearing plants
Division	Magnoliophyta-Flowering
Class	Magnoliopsia-Dicotiledons
Subclass	Polypeptalae-Petalsarefree
Series	Thalamiflorae-Manystamens and flower hypogynous
Order	Ranunculales
Family	MenispermaceaeTribe: Tinosporeace
Genus	Tinospora
Species	Cordifolia

PLANT PROFILE:-

Figure 1: Plant Of *Tinospora Cordifolia*

PLANT DESCRIPTION

Tinospora is a large, deciduous, glabrous perennial herb that occurs widely in India, especially in tropical regions up to an altitude of 1,200 meters above sea level. It also grow in neighboring A countries,like China, Sri Lanka, Bangladesh, Pakistan, and Myanmar. *Tinospora* species prefer to grow primarily in warm conditions and are best adapted to medium-black or red soils. However, they can be grown fairly well in a wide range of soil, from sandy to clay loam, provided the soil is well-drained, well moistended, and is rich in organic matter. *Tinospora cordifolia* which is One of the. most widely known species, is commonly referred to as Guduchi, Giloy, Amrita, or the heart-leaved moonseed. It is also regarded as a sacred plant, popularly associated with divine nectar or "ambrosia" of Lord Indra in Hindu mythology. Another species, *Tinospora crispa*, locally known as Faridbel, is a woody, tall, and completely glabrous climber. The herb is found in both temperate and tropical regions of India. A third species, Tinospora sinensis (also known as T. malabarica),or Malabar Gulbel, is a large climber with its shiny,pale- colored stem, big orbicular-cordate leaves (larger than T. cordifolia), dioecious flowers, and aerial roots that radiate from its branches [6]

Morphological Features Of *Tinospora Cordifolia*

Tinospora cordifolia, the "queen of all herbs," is a climbing shrub bearing multiple twistedstems. The plant may be divided into various parts: stem, leaves, flowers, and fruits (Fig. 1). Aerial roots, lamina, and seeds are also available. Aerial roots contain tetra- to penta-arch structures, the most important distinguishing characters. The root cortex consists of a thick outer wall and an inner parenchymatous tissue. The lamina is ovate, 10–20 cm long, and as wide as 15 cm. The base of the leaf is deeply cordate in shape,membranous in texture, pubescent insurface, and whitish tomentose on the leaf. A typical reticulate venation is present on the dorsal side of the leaf.The Seeds are usually curved,and the embryo is also naturally curved. The endocarp is ornamented with tiny details, which are significant taxonomic characters used in the identification and classification of the species[6]

Ethanopharmacological Importance Of *Tinospora Cordifolia*

Tinospora cordifolia has a long-standing reputation in traditional medicine, especially in South Asia, and is a valuable plant in ethnopharmacology. The plant,and especially the stem, is very well known for its medicinal properties and is used to treat a variety of diseases. The stem of *T. cordifolia* is used primarilyfor its bitter, stomachic, and astringent properties. It is traditionally usedforthetreatment of thirst, vomiting,burning,and tostrengthen the blood. It is alsodiuretic, thermogenic,and bile secretion stimulant hence constipation and jaundice are prevented.Apart from this, the stem is native source of medicine that has anti-diabetic, immunomodulatory, anti-hepatotoxic, and antipyretic activity. Its extract is useful in the treatment of skin disorders.*T. roots cordifolia are* also ofhold immense medicinal value, having anti-stress and anti-ulcer properties.the root and stem are routinely prescribed along with other herbal drugs as anantidote for snakebites and scorpion stings.The dried plant bark exhibite a wide range of therapeutic activity,with anti-inflammatory, antiallergic, antipyretic, antispasmodic, and antileprotic properties

Several scientific studies have validated the different uses of *T. cordifolia* in Ayurvedi medicine. It is especially renowned for its immunomodulatory activity, which enhances the body's natural defense system and enhances overall immunity.

It has traditionally been used to cure a variety of fever disorders, both viral and bacterial infections, in reliving symptoms and supporting the body in its fight against infections. The plant is also renowned for its strong antioxidant and anti-inflammatory properties, thereby being used in the treatment of arthritis and reducing oxidative stress.

Tinospora cordifolia also contributes to digestive wellbeing, lessening acidity, improving digestion, and improving overall gastrointestinal wellbeing. It works as a protective agent within liver wellbeing, shielding the liver from various forms of damage.

Of interest, *T. cordifolia* is frequently used for control of diabetes, because it is believed to help stabilize blood glucose levels and enhance insulin sensitivity. Its anti-inflammatory and antimicrobial activity also contribute to its broad therapeutic index.*Tinospora cordifolia* also possesses much potential for the control of various skin diseases such as eczema, psoriasis, and skin infections because of its anti-inflammatory, antimicrobial, and healing activities. In addition, it is also frequently employed to treat respiratory conditions such as asthma, bronchitis, and chronic cough,it is believed to be a bronchodilator and anti-asthmatic drug.

In Ayurvedic medicine, *T. cordifolia* isa Rasayana or adaptogen—a class of herbs that are purported to enhance energy,reduce physical and mental stress, and promote general well-being. Its classical classification attrests to its role of promoting longevity, rejuvenation, and overall wellbeing.

There is a growing scientific interest in the anticancer activity of *T. cordifolia*. Preliminary studies suggest that the plant will be cytotoxic to certain cancer cell lines, and hence potentically useful in the prevention and treatment of cancer. However, further clinical studies will be required to confirm and realize this potencial.

Traditionally, *T. cordifolia* has been used to enhance mental function. It is believed to have neuroprotective effects and therefore is beneficial in enhancing memory, concentration, and protecting the nervous system from degenerative disorders.

Due to its wide range of pharmacologically activity, *T. cordifolia* is traditionally used as a health tonic in medicine. It is valued because it invigorates promote general health, and prolongs life[6]

MORPHOLOGICAL DESCRIPTION

Tinospora cordifolia is a large, deciduous, spreading climbing shrub with numerous coiling branches and

robust vigorous growth behavior. The plant is composed of various morphological parts, each one of them having structural characteristics:

1. Stem

The stem of *T. cordifolia* is succulent,elongated , filiform, and fleshy,with a well-developed climbing habit. Typically, aerial roots emergence from branches is characteristic, which help in its climbing habit. bark is yellowish white to grey with typical deep spiral fissuring [7] (Figure 1A)

2. Aerial Roots

Aerial roots are a unique feature of the plant. Aerial roots are contain a tetra- to penta-arch primary vascular structure.The anatomy of the root cortex consists of two zones: an outer thick- walled and an inner parenchymatous zone [8] (Figure 1F).

3. Leaves

simple, alternate, and exstipulate leaves, with long petioles measuring approximately 15 cm in length.laminaisovate,measuring10–20cminlength and upto15cminround, pulvinate,heart shaped, twisted half way round and partially. Lamina is ovate, measuring 10-20 cm.

4. Flowers

The flowers of *Tinospora cordifolia* are unisexual and found in racemose inflorescences. The flowers are borne when the plant is barren. The male flowers are often in a cluster, whereas the female flowers arein solitary inflorescences. The flower structure is as follows:

- Sepals:6 sepals arranged in 2 series each consisting of 3sepals.The outer sepals are minute compared to the inner ones.
- Petals:6 petals,minute compared to the sepals,free and membranous.

The flowering period for *T.cordifolia* range from Marchto June[10](Figure1Dand 1E).

5. Fruits

T. cordifolia fruits are orange-red, fleshy, and contain an aggregate of 1–3 ovoid drupelets. The drupelets are smooth and have a thick stalk with sub-terminal styles cars.The fruiting season is normally during winter [11] (Figure 1C).

6. Seeds

The seeds of *T. cordifolia* are curved and are a result of the species belonging to the moonseed family. The seeds are long,and possesses 7 prominent nerves and are base-deeply cordate. The seeds are membranous, and since they curve, the embryo within also does so. The endocarp is also or namented,in a different manner, which comprises useful taxonomic characters. [6].

Figure 2: Parts of plants used for medicinal

CHEMICAL CONSTITUENT

Tinospora cordifolia contains a wide range of bioactive molecules that are accountable for its diverse pharmacological action. *Tinospora cordifolia* is classified into different major classes, like alkaloids, glycosides, steroids, phenolics, aliphatic compounds, and polysaccharides based on their chemical constituents.*T. cordifolia* posses a high concentration of proteins (11.2%), along with essential minerals such as calcium and phosphorus [22]stem was discovered to be a valuable source of clerodane-type furanoditerpene glucosides, especially amritoside A, B, C,and D. Their molecular structures were analyzed by using spectroscopic techniques, like NMR and mass spectrometry [23, 24, 25].

Other significant constituents are listed in Table 1,and the major bioactive compounds are illustrated in Figure 2. These have major secondary metabolites that are reported to be responsible for the therapeutic action of plant. The structural framework of the active constituents also supports the irrole in the immunomodulatory, anti-inflammatory, anti-diabetic, and antioxidant activities of *T.* cordifolia [7].

Table 3: Chemical constituents of *T.* cordifolia

Active Component	Compounds
Alkaloids	Tinosporine,(S),Magnoflorine,(S),Berberine,(S),Choline,(S), Jatrorrhizine,(S),1,2-Substituted pyrrolidine(S), Alkaloids, viz. jatrorrhizine, palmatine, beberine, tembeterine, choline.
Lignans	3(a,4-dihydroxy-3-methoxybenzyl)-4-(4-hydroxy-3-methoxybenzyl), (S)
Steroids	Giloinsterol,(S),ß-Sitosterol,(S),20a-Hydroxyecdysone,(S).
Others	Giloin,Tinosporan acetate,Tinosporal acetate, Tinosporidine, Heptacosanol, Octacosanol, sinapic acid, Tinosponone, two phytoecdysones, an immunologically active arabinogalactan.

PHARMACOLOGICAL ACTIVITIES OF *TINOSPORA CORDIFOLIA* (T.cordifolia)

Anti-diabetic Activity

Pharmacological studies have consistently demonstrated the in vivo antidiabetic activity of many extracts purified from *Tinospora cordifolia*. Antidiabetic action is mediated by a wide range of bioactive phytoconstituents spread throughout the whole plant,e.g, alkaloids, tannins, cardiac glycosides, flavonoids,saponins, and steroids [5]. They exhibit different mode of actions on biological targets for diabetes and are a candidate source of value added medicine both as an experimental drug and clinical therapeutics.

A study by Kannadhasan R and Venkataraman S demonstrated that oral administration of sedimental extract of *Tinospora cordifolia* (SETc) at 1000 mg/kg for 30 days in diabetic patient showed significant antidiabetic activity and contributed towards anti-obesity effects [6].Furthermore, an ethanolic extract of *T. cordifolia* leaves, extract administered orally in doses of 200 and 400 mg/kg body weight over 10 and 30 days,exhibited significantly reduction of blood glucose in streptozotocin-induced diabetic albino rats. The extract was 50% to 70% effective as insulin, with proof of strong antidiabetic activity [7]. Borapetoside C, a compound isolated from *Tinospora crispa*, administered at 5 mg/kg intraperitoneally, significantly reduced plasma glucose in diabetic mice. It promote glucose uptake, delayed the onset of insulin resistance, and enhanced insulin sensitivity. These effects were accompanied by the activation of the insulin signaling pathway, the IR-Akt-GLUT2 pathway in the liver [8].

Additionally,stem isoquinoline alkaloid-enriched fractions containing members like palmatine, jatrorrhizine, and magnoflorine were also found to exert insulin-mimetic as well as insulin- releasing properties in vitro as well as in vivo [9].

In studies using Ehrlich ascites tumor cells,*T. cordifolia* extracts composed of water, ethanol, and methanol induced glucose uptake,further confirming its role of regulating glucose metabolism [10]. *T. cordifolia* root extract has been found to reverse diabetic induced oxidative stress. It does so by reducing malon dialdehyde and reactive oxygen species (ROS),but increasing glutathione and total thiols levels, particularly in the mother's liver during diabetic pregnancy conditions [11]. Finally, oral administration of *T. cordifolia* extract at 100 and 200 mg/kg body weight for 14 days showed that its antidiabetic action is most probably exerted through a variety of mechanisms: inhibition of gluconeogenesis and glycogenolysis,stimulation of insulin release and suppression of oxidative stress.[13]

Anti-Cancer Activity

Tinospora cordifolia has exhibited remarkable anti-cancer activity, primarily in animal models and in vitro studies. This activity is attributed to a cascade of bioactive compounds, namely alkaloids and secondary metabolites,influencing cancer cell growth, differentiation, and survival.

One of the significant finding is the isolation of alkaloid palmatine from *T. cordifolia* through response surface methodology (RSM). The alkaloid exhibited strong anticancer activity in a7,12-dimethylbenz(a) anthracene (DMBA)-induced skin cancer model in mice, indicating its chemoprevention potential [13]. In one study,single dose administation of *T. cordifolia* extract in 200, 400, and 600 mg/kg (dry weight)dose, administered 24 hours prior to cyclophosphamide (50 mg/kg, i.p.),efficiently blocked micronucleus induction in mice bone marrow of mice in a dose-dependent manner, exhibiting genoprotective actions.

C57BL mice, after being treated with a 50% methanolic extract of *T. cordifolia* at 750 mg/kg body weight for 30 days, had increased lifespan and decreased tumor size when compared to the control group, further confirmingthe anti-tumor activity of extract [14]. In a study by Mishra et al., the 50% ethanolic extract was examined on C6 glioma cells, a brain cancer model. The extract displayed significantly inhibition of cell growth in a dose-dependent manner and induced cellular differentiation, pointing towards its potential use in neuro-oncology [15].Manju Bala et al. eight secondary metabolites isolated from *T. cordifolia* against four different human cancer cell lines:

- KB(humanoralsquamouscarcinoma)
- CHOK-1(hamsterovary)
- HT-29(humancoloncancer)
- SiHa (human cervical carcinoma) and murine primary cells. Of the extracts and fractions, screened there was significant cytotoxic activity particularly against KB and CHOK-1 cells.of specific mention:
- Palmatine was active towards KB and HT-29
- Tinocordiside was effective towards KB and CHOK-1
- Yangambin showed selectively activity towards KB cells[16].

Besides, two molecules (designated as T1 and T2) isolated from the hexane and methanol fractions of *T. cordifolia* were evaluated in MCF-7 breast cancer cells. T1 was more active compared to T2 in inhibiting growth,migration and invasion. Moreover, epithelial–mesenchymal transition (EMT)-specific genes such as Twist and Snail were down regulated, while expression

Of E-cadherin a marker of epithelial integrity was up regulated,suggesting that T1 may inhibit cancer metastasis by modulating EMT pathways.

Immunomodulatory Activity

Tinospora cordifolia has been well recognized for its potent immunomodulatory activity, which have been experimental and clinically established.certain bioactive molecules such as 11- hydroxymustakone,N-methyl-2-pyrrolidone,N-formylannonain,cordifolioside A,magnoflorine, tinocordiside, and syringin have demonstrated significant immunomodulatory and cytotoxic effects [18]. A study by Vaibhav Aher et al. study established the immunomodulatory action of ethanolic extract of *T. cordifolia* stem (100 mg/kg, orally). The extract was found to:

- Regulateantioxidantenzymelevels
- EnhanceT-cell andB-cellactivity
- Enhanceantibodyproduction
- Enhancemelatonin levelinthepinealgland
- Enhancecytokinelevels,includingIL-2,IL-10,andTNF-α,allofwhichplay fundamental roles in immune regulation [19].

Reddy NM et al.,state that aqueous extracts of *T. cordifolia* influence cytokine production, mitogenicity, and activation of immune effector cells, such lymphocytes and macrophages [20]. The plant also activates polymorphonuclear leukocytes (PMNs)—very significant components of the body'sinnate immune defense. Invitro studies showed that *T.cordifolia* extracts enhanced phagocytic activity of PMN cells against Candida albicans by employing a slide method for phagocytosis testing [21]. Oral administration of *T. cordifolia* alcoholic extracts (100 mg/kg) maximally stimulated the footpad thickness, white blood cell counts, and bone marrow cell proliferation in animal models, indicating that it possesses a strong stimulatory effect on the hematopoietic system and overall immune function [22]. Bharti Umretia et al. reported that Guduchi Ghana (a classical, concentrated aqueous extract of *T. cordifolia*)possesses pronounced immunostimulatory activity, justifying its traditional use in medicine as an immunoboosting agent [23]. Immunomodulatory activity was also assessed in a randomized, controlled pilot clinical study of a lotion formulation of Tinospora. Interleukin-1,Interleukin-6,and Interleukin-8 in blood serum samples of patients infested with scabies wereas sayed.The lotion was able to downregulated IL-1, IL-6, and IL-8, leading to decreased hyperkeratosis and less infiltration of inflammatory cells in scabietic lesions. These results indicate the topical immunomodulatory and anti-inflammatory potential of *T. cordifolia* in skin diseases.

Anti-Oxidant Activity

Tinospora cordifolia possesses good antioxidant activity,and hence can be utilized for use in food systems as a natural preservative and in biological systems as a nutraceutical. Methanolic, ethanolic, and aqueous extracts of the plant have been reported to contain good free radical scavenging, metal chelation, and reducing power activities [25]. V. Sivakumar et al.have carried out a study where oral feeding of *T. cordifolia* stem methanolic extracts in alloxan-induced diabetic rats resulted in:

- Increased concentration of lipid peroxide and catalase activity in erythrocyte membranes
- Decreased activities of key antioxidant enzymes such as superoxide dismutase (SOD) and glutathione peroxidase (GPx), suggesting modulatory effects on oxidative stress [26].

In aflatoxicosis, *T. cordifolia* was found to scavenge free radicals and protect against aflatoxin- induced nephrotoxicity, a property which is attributed to the alkaloids such as choline, tinosporin, isocolumbin, palmatine, tetrahydropalmatine, and magnoflorine [27]. Neha Upadhyay et al. compared the antioxidant activities of different bark extracts and concluded that ethanolic extracts possessed the maximum free radical scavenging activity, equating to higher total phenolic content compared to methanol extracts [28]. ethanolic extract of *T. cordifolia* (EETC) treatment in N-nitrosodiethylamine (DEN)-induced liver cancer in male Wistar albino rats was found to restore:

- Lipid peroxidation (LPO) levels
- Both enzymatic (SOD,catalase) and non-enzymatic (glutathione,vitaminC) antioxidants to normal levels,indicating an evident antioxidant and protective effect [29].

The single *T. cordifolia* leaf essential oil also exhibited considerable DPPH (2,2-diphenyl-1- picrylhydrazyl) radical scavenging activity with an IC5 0of 25 ± 0.3 µg/mL, as well as dose- dependent reducing power [30].

Further antioxidant assays conducted using leaf extracts in methanol, ethyl acetate, butanol, and water revealed that at 250 mg/mL, the methanol extract exhibited the highest antioxidant activity across all parameters:

- DPPH scavenging
- Reducing power
- Phosphomolybdenum assay
- Metal chelating activity

Even Though the antioxidant activity of BHT remained higher at all concentration levels, *T. cordifolia* extracts were also found to be highly active justifying its use as a natural antioxidant source.

Anti-stress Activity

Ethanolic extract of *T. cordifolia* (Guduchi) possesses significant anti-stress activity in comparison to diazepam. Clinical studies have also found a rise in IQ levels among treated patients.

Anti-osteoporotic Activity

Ethanolic extracts enhance rat osteoblast proliferation and differentiation and are part of bone calcification. Beta-Ecdysone (20-hydroxyecdysone),a*T.cordifolia* steroids inhibits osteoporosis.

Diuretic Activity

In animal and human studies, *T.cordifolia* has shown very good diuretic activity, and therefore it is used in Ayurvedic medicine for the treatment of urinary disorders.

Antileprotic Activity

T .cordifolia is traditionally used for its antileprotic activity and also extensively used in the treatment of skin diseases. Gastrointestinal and Anti-ulcer Activity

T.cordifolia preparations decrease ulcer indices,decrease gastric fluid capacity,and increase pH in pylorus-ligated and ethanol-induced ulcer models in rats.

Hepatoprotective Activity

Ayurvedic preparations containing *T.cordifolia* are used in the management of jaundice. Clinical research indicates the normalization of parameters of liver function tests such as ALT, AST, SGPT, SGOT, alkaline phosphatase, and serum bilirubin.

Antipyretic Activity

Historically, the water-soluble fractions of the 95% ethanolic extract have been effective as antipyretics in treating fever. the hexane and chloroform-soluble fractions of the stem have been shown to have antipyretic activity too.

Anti-inflammatory Activity

Very potent anti-inflammatory activity is exerted by the alcoholic extracts in both acute and subacute models:

- *T.cordifolia* grown on *Azadirachta indica* (neem) is highly efficient in inhibiting carrageenan-induced inflammation.
- Dry stem extracts were more potent than acetyls alicylic acid in acute inflammation models,but not as potent as phenylbutazone in subacute inflammation models.

Anti-allergic Activity

Used Traditionally to treat asthma and chronic coughing:

- 83% of patients in a clinical trial were relieved 100% from sneezing.
- Relief from nasal discharge was seen in 69%, nasal obstruction in 61%.[10]

CONCLUSION

Tinospora cordifolia, commonly known as Guduchi, is a highly valued medicinal plant that has been widely used in traditional systems of medicine, particularly Ayurveda. Its multi dimensional pharmacological profile is attributed to its many bioactive constituents, including alkaloids, glycosides, steroids, diterpenoid lactones, and polysaccharides in nature These have been reported o be endowed with potent **immunomodulatory, antioxidant, anti- inflammatory, anti-diabetic, hepatoprotective, and anticancer** activities, among others.

It's morphology, including its fleshy stem, aerial roots, heart-leaves, and rolled seeds, also facilitates its botanical identification and classification. Its adaptability to climatic and soil fluctuations, and its therapeutic plasticity render, *T. cordifolia* a treasure in both mainstream and modern-day pharmacology.

Scientific research has continued to validated numerous of its old application and disclosed new windows into its application in treatment of chronic and lifestyle-related diseases such as diabetes, cancer, and autoimmune disorders. For its potential as a natural remedy, further **clinical trials and pharmacological research** have to be done to explore and determine its effectiveness, safety, and mechanisms of action.

In short, *Tinospora cordifolia* is an excellent herbal remedy with tremendous scope for use in mainstream medicine, offering a holistic approach to health and wellness.

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