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Guduchi (Tinospora Cordifolia): A Promising Bioactive Agent In Modern Drug Research.

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Abstract:

Giloy, or Guduchi (Tinospora cordifolia), is a well-known therapeutic plant in both contemporary pharmacological study and Ayurveda. Its many therapeutic qualities, including as immunomodulatory, antioxidant, anti-inflammatory, hepatoprotective, antidiabetic, and anticancer activities, have drawn a lot of attention as a promising bioactive agent. Alkaloids, diterpenoid lactones, glycosides, steroids, and polysaccharides are among the many phytoconstituents found in the plant that contribute to its complex pharmacological actions. Guduchi is an effective immunotherapeutic and adaptogenic drug since recent research has shown that it can regulate the immune response by increasing macrophage activity and cytokine production. Its ability to prevent oxidative stress-related illnesses is further supported by its antioxidant and anti-inflammatory properties.Tinospora cordifolia, which bridges the gap between traditional knowledge and modern pharmacological science, is therefore a useful source for new drug discovery and development in contemporary medicine.

Keywords- Guduchi, Tinospora cardiofolia, Immunomodulator

Introduction:

The World Health Organization (WHO) estimates that about 75% of people worldwide receive their medical care through traditional medicines, which are primarily made from herbs. In actuality, plants and/or herbs were humanity's first companions. They serve as a remedy for a number of ailments in addition to providing food and shelter. Because of the negative consequences of synthetic items, herbal products are becoming more and more popular in the Indian market. One such plant, guduchi, is the most treasured herb in Ayurvedic medicine. The Sanskrit word "imperishable" is the source of the name Guduchi. Guduchi, Amrit in Sankskrit, Tippa teega in Telugu, Shindilakodi in Tamil, Amruthaballi in Kannada, Giloy in Hindi, Garo in Gujarati, Gulvel in Marathi, and Chittamrutu in Malayalam are some of the other names for this herb throughout the Indian subcontinent. Guduchi is a shrub that is indigenous to India. It is a member of the Menispermaceae family, which is found in low tropical climates and has roughly around 70 genra and species are 450. In Indian Ayurvedic pharmacies, it is a well-known medicinal plant.The medication has been the focus of numerous phytochemical, pharmacological, and clinical studies during the past 20 years. Tinospora cordifolia (Willd.) Miers ex Hook. F. & Thoms. (Family: Menispermaceae), also referred to as "Amrita" or "Guduchi," is a significant medication utilised in Indian Systems of Medicine (ISM) for ages. T. cordifolia, often known as Guduchi, is a naturally occurring herbal plant that is a member of the Menispermaceae family, which includes moonseeds. According to the history of traditional medicine, this plant can be used to cure a number of illnesses, including diabetes, gout, jaundice, and skin conditions. According to this viewpoint, guduchi is regarded as a nectar plant and is known in Sanskrit as amrita due to its cleansing, revitalising, and immune-boosting qualities. The plant has been thoroughly examined and

analysed in modern medicine, and the medication is most recently used to lessen the side effects of chemotherapy.

Fig 1. Tinospora cordifolia

Pharmacognostic Description:

Tinospora cordifolia

Synonym: ● Guduchi: The protective.

● Amruta: Something that has the power to make a person everlasting, much like celestial nectar.

● Chakrangi, Chakralakshanika: These terms describe the radiating medullary rays that can be seen in a transverse slice.

● Chinnaruha, Chinnodbhava: Stem cuttings are used to propagate it.

Vernacular Name:

Sanskrit: Amrita, Madhupar¸ Gu·£cik¡, Chinnobhav¡
Assamese: Siddhilata, Amarlata
Bengali: Gulancha
English: Moonseed
Gujrati: Galac, Garo
Hindi: Giloe, Gurcha
Kannada: Amrutaballi
Kashmiri: Amrita, Gilo
Malayalam: Chittamrutu
Marathi: Gulvel
Oriya: Guluchi
Punjabi: Gilo
Tamil: Seendal, Seendil kodi
Telugu: Thippateega
Urdu: Gilo

Biogenic Source:

Dried fragments of mature Tinospora cordifolia stems are used to make the medication Guduchi, also known as Amrita.

Family: Menispermaceae.

Geographical Source:

Guduchi is a glabrous, perennial deciduous vine that spreads widely throughout India, Myanmar, and Sri Lanka. It has succulent stems and papery bark. It is indigenous to India's tropical regions and grows up to 500 meters above sea level in temperatures between 25 and 45 degrees Celsius. The plant grows up to 1,200 meters above sea level in the tropical region of India, from Kumaon to Assam. In the north, it spreads across West Bengal, Bihar, Deccan, Konkan, Karnataka, and Kerala. Growing over hedges and small trees, it is a very common shrub in dry and deciduous woodlands. [5,6,7]

Table 1 Taxonomical Classification:

Kingdom	Plantae
Subkingdom	Tracheophyta
Super division	Spermatophyta
Division	Magnoliophyta
Class	Magnoliopsia
Subclass	Polypeptalae
Series	Thalamiflorae
Order	Ranunculales
Family	Menispermaceae
Tribe	Tinosporeace
Genus	Tinospora
Species	Cordifolia

Macroscopy:

Drug is found in pieces that range in thickness from 0.6 to 5 cm in diameter; young stems are green with smooth surfaces and swell at nodes; older stems have a light brown surface with warty protuberances caused by circular lenticels; the transversely smoothened surface has a radial structure with noticeable medullary rays passing through porous tissues; and the drug tastes bitter. Dried sections of mature Tinospora cordifolia stems are used to make the medication Guduchi, also known as Amrita. Leaves and roots are also therapeutic. The following are the diagnostic phramacognostical traits of medicinal parts:

● **STEM**: Bicollateral vascular bundles encircled by pericycle fibres are a characteristic of the stem. The cork develops into two to three layers in the sub-epidermal layers. All of the stem's parenchyma contains starch.

Fig 2. Stem of T. cordifolia

● **ROOT:**

The basic structure of the aerial root is tetra- to penta-arch. The cortex is separated into an inner parenchymatous zone that contains secretory canals and an exterior thick-walled zone that represents the velamen. All of the aerial root's parenchyma contains starch. The starch grains are oval or elliptical in shape, with a central hilum that resembles a point and a barely visible concentric striation. They are mostly simple but can occasionally be compound grains made up of two to five components.

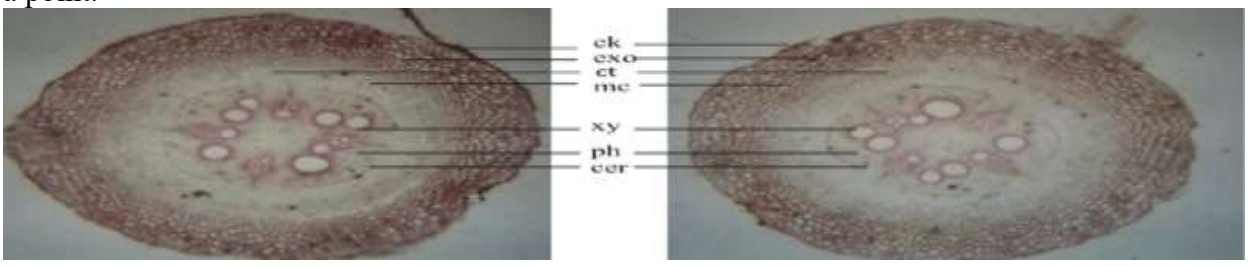
● **LEAF:**

In transverse section, the petiole's form is roughly round. There were no trichomes discovered. A single layer of epidermis and a broad cortical zone made up of three to four layers of endodermis are visible in the cross section. Radial rows of xylem make up the inner side of the vascular bundles, while a few rows of cambium cells and phloem make up the outside side. The palisade does not extend over the stellar tissue, and the mid-rib is about round in shape. With its mesophyll divided into palisade and spongy tissue, the lamina's cross section reveals a dorsiventral structure. The mesophyll is distinctly divided into a palisade layer consisting of a single row of columnar cells with thin walls that take up somewhat more than half of the mesophyll's width. Only the lower surface has glandular hairs. They have a club-like form and are unicellular. Four to five epidermal cells encircle the base. The tissue is filled with starch.

Fig 3. Leaves of T. cordifolia

Microscopy:

The stem's transverse section reveals the outermost layer of cork, which differentiates into an outer zone of thick-walled, brownish, compressed cells and an inner zone of thin-walled, colourless cells arranged tangentially in three to four rows. The cork is broken in some places due to lenticel openings, and then there are five or more rows of secondary cortex, with the outer rows' cells being smaller than the inner ones. Groups of Sclereids are located just within the lenticel opening. of two to ten cells in the secondary cortex region; the outer zone of the cortex is made up of three to five rows of irregularly arranged, tangentially elongated chlorenchymatous cells; cortical cells are located towards the inner side and are polygonal in shape and filled with plenty of starch grains; simple, ovoid, or irregularly ovoidelliptical, sometimes compound of two to four components; several secretory cells are scattered throughout the cortex; pericyclic fibres lignified with a large number of crystal fibres with a single prism in each chamber; the vascular zone is made up of 10 to twelve wedge shaped strips of phloem that alternate with wide medullary rays. Some of them have calcium oxalate crystals; the cambium is made up of one to two layers of tangentially elongated cells in each vascular bundle; the xylem is made up of vessels, tracheids, parenchyma, and fibres; the primary xylem has relatively narrow vessels without tyloses; the secondary xylem elements are thick-walled, lignified, cylindrical vessels with bordered pits on their walls. Some big vessels have many tyloses, transverse septa, and medullary rays. Starch grains of 5.5-11.20 µ in diameter and 611.28 µ in length make up the pith, which is made up of big, thin-walled cells that are at least 15-20 cells broad, round, hemispherical, oblong, ovoid, with barely defined concentric striations and a central hilum that seems like a point.



(A) (B)

Fig 4. Microscopy of Tinospora cordifolia, aerial root (A) Male plant, (B) Female plant. Abbreviations: cer: ceratenchyma; ck: cork; ct: cortex; exo: exodermis; mc: mucilage canal; ph: phloem; tc: tannin containing cell; xy: xylem

Table 2 Chemical Constituents:

Phytochemical Class	Phytoconstituents
1)Alkaloids	Berberine, Tembeterine, Choline, Aporphine alkaloids, Jatrorrhizine, Magnoflorine, Tetrahydropalmatine, Tinosporin, Palmetine, Isocolumbin.
2) Terpenoids	Tinosporide Furanolactone diterpene, Furanolactone clerodane diterpene, phenylpropene disaccharides cordifolioside A, B and C, cordifoliside D and E, Tinocordioside, cordioside, palmatosides C and F, furanoid diterpene, Tinosporaside, ecdysterone makisterone and several glucosides isolated as poly acetate
3) Glycosides	norclerodane glucoside,furanoid diterpene glucoside, cordiofolioside A, cordiofolioside B, palmatosides C, palmatosides P1, cordiofolioside C,cordiofolioside D, cordiofolioside E
4)Sesquiterpene	Tinocordifolin
5) Steroids	β–sitosterol, δ-sitosterol, 20 β- hydroxyecdysone, Ecdysterone, Makisterone A, Giloinsterol

Cultivation, collection and preparation for Market:

● **SOIL AND CLIMATE:** It thrives in nearly all soil types and climates.
● **PROPAGATION**: Guduchi can be grown in the field using both direct transplanting of stem cuttings and seedling transplantation. It needs some support, ideally from neem and mango trees, which are thought to have greater therapeutic benefits. [14]
● **NURSERY RAISING & PLANTING**: In May and June, the plant is grown by cutting its stems. These plants can spend up to 1.5 months in the nursery. In June and July, pencil-thick, semi-hard wood cuttings with four to eight nodes are planted. They are first planted in slanted polybags with two soil nodes. This climber requires the growth of a support plant during the first year.Cuttings must be put next to the plants when they are around a year old.
● **THROUGH STEM CUTTINGS**: During May and June, the plant is grown by cutting its stems. It needs some support, ideally from mango and neem trees. It is so simple to propagate that, within a few years, a twig placed on a tree branch grows into a massive climber. Soaking seeds in cold water for a full day causes them to sprout quickly. In May and July, the treated seeds are sown in polybags. With an 80–90% success rate, germination occurs in 10–12 days. Only 30 to 35 percent of new seeds that have not been pre-soaked germinate. [18]
● **HOEING AND WEEDING**: As needed, hoeing is done on a regular basis in both the field and the nursery.
● **MANURES, FERTILISERS, AND PESTICIDES**: Chemical fertilisers and pesticides must not be used while cultivating medicinal plants. Depending on the needs of the species, organic manures such as Farm Yard Manure (FYM), Vermicompost, Green Manure, etc. may be employed. Neem (kernel, seeds, and leaves), Chitrakmool, Dhatura, cow's urine, and other materials can be used to make biopesticides, either alone or in combination, to prevent illnesses.
● **IRRIGATION**: Following plantation, the field should get weekly or biweekly irrigation as needed.
● **HARVESTING/POST HARVESTING OPERATION**: Mature plants are gathered, chopped into little pieces, and allowed to dry in the shade.
●**YIELD**: 6 to 8 QTLs per hectare.

Pharmacological Activity:

Due to its spasmolytic, allergy-free, and anti-diabetic properties, T. cordifolia has long been acknowledged as the most widely used plant in traditional medicine. [20,21] The herb greatly strengthens the immune system. This plant has a lot of beneficial qualities. Its stem is utilised as a bitter stomachic and diuretic, while its root section is recognised for its antimalarial and stress-relieving qualities. [22] It improves blood quality, increases biliary output, and treats jaundice. The following are some of T. cordifolia's primary biological activities. [23,24]

● Anticancer/Antitumor activity: Tinospora cordifolia shows strong anticancer activity through its radioprotective, antioxidant, and cytotoxic effects. [25] Its extracts induce dose-dependent cancer cell death, enhance GSH and metabolic enzymes, and reduce free-radical formation. [26] Guduchi inhibits tumour

growth by promoting G1 phase arrest and Bax-mediated apoptosis, while also reducing tumour incidence in skin carcinogenesis models. Active compounds like palmatine, yangambin, and tinocordiside show potent action against various cancer cell lines. Overall, T. cordifolia is considered a safe and promising natural anticancer agent with minimal toxicity. [27,28]

● Antidiabetic activity: Synthetic oral anti-diabetic drugs can correct some metabolic abnormalities but may not address underlying biochemical defects and often produce side effects.[12] Diabetes mellitus, marked by persistent hyperglycemia, disrupts carbohydrate, protein, and fat metabolism and affects major organs like the liver, kidneys, and pancreas. [13] Long-term insulin therapy also has drawbacks, including insulin resistance and fatty liver. Many medicinal plants have shown antidiabetic potential, and Tinospora cordifolia (Guduchi) is among the 800 species with strong hypoglycemic properties. Widely used in Ayurveda, Guduchi is considered safe and effective, with its antidiabetic action linked to 1,2-substituted pyrrolidines from the stem. Continued research may further establish Guduchi as a powerful natural therapy for diabetes. [45,48]

● Antiallergic Activity: According to some Ayurvedicscriptures, T. cordifolia is used to treat swasa (asthma) and kasa (cough). Asthma has historically been treated using T. cordifolia, and the juice is also used to cure persistent coughs. In a clinical research, 83% of patients receiving T. cordifolia therapy reported 100% alleviation from sneeze. Similarly, 69% of respondents experienced relief from nasal discharge, 61% from nasal blockages, and 71% from nasal pruritus. Only 21% of patients in the placebo group reported alleviation from sneezing, 16.2% from nasal discharge, 17% from nasal blockage, and 12% from nasal pruritus. It was well accepted and considerably reduced all allergic rhinitis symptoms. [29,30] When an aqueous extract of the stem was tested for its anti-allergic and bronchodilator qualities on histamine-induced bronchospasm in guinea pigs, capillary permeability in mice, and mast cell disruption in rats, it was found to significantly reduce the number of disrupted mast cells, capillary permeability, and bronchospasm caused by 5% histamine aerosol. [31,32]

● Immunomodulatory Activity: Tinospora cordifolia is valued in Ayurveda for its rejuvenating, tonic, anti-aging, and immune-enhancing properties. [36] Its alcoholic and aqueous extracts show strong immunomodulatory effects, including protein protection during photosensitisation and macrophage activation through TLR6 mediated signalling. [37] The plant regulates cytokines such as IL-2 and TIMP-1 and enhances phagocytosis, antibody production, and antiangiogenic activity. Clinical studies report improved haemoglobin levels, reduced eosinophil counts, and symptomatic relief in HIV patients, as well as better wound healing in diabetic foot ulcers. [38] Pre-radiation treatment with T. cordifolia significantly restores spleen function, reduces apoptosis and DNA damage, boosts splenocyte proliferation, and enhances antioxidant potential, demonstrating strong radioprotective activity. It also increases GM-CSF levels and CFU-GM counts, indicating enhanced leukocyte and neutrophil activity. [39,40]

● Antimicrobial Activity: According to a study, silver nanoparticles made from T. cordifolia stems had strong antibacterial action against Pseudomonas aeruginosa, a bacterium present in burn patients. When tested against extracts of T. cordifolia, a variety of bacterial species, including S. typhi, K. pneumoniae, E. coli, Aeruginosa, and others, demonstrated potential antibacterial activity by either preventing their growth or reducing their very existence. According to reports, an active chemical compound from the stem of T. cordifolia is efficient against fungi like T. Simii and T. rubrum as well as bacteria like E. faecalis and B. subtilis. By increasing granulocyte activity, ahydroalcoholic extract of T. cordifolia was successful in reducing mammary inflammation in a bovine model.Since S. aureus infections cause mastitis, the plant's antimicrobial action was demonstrated by preventing this inflammation. This plant's stem and leaves had the strongest inhibitory efficacy against clinical urinary infections such Pseudomonas aeruginosa and Klebsiella pneumoniae. Urinary tract infections are thus avoided. As hydrolytic enzymes, carbapenamases hydrolyse β-lactam antibiotics, rendering them useless. Therefore, this plant's extract exhibits a higher rate of inhibition than the reference microbiological strain when tested against bacteria that produce the carbapenamase enzyme and penicillinase-resistant β-lactam antibiotic (methicillin). Ninety Guduchi has also been shown to be important in reducing urinary pathogen resistance to various antibiotic therapies and hence monitoring microbial infectivity.

● Antioxidant/ Hepatoprotective Activity: Tinospora cordifolia shows strong hepatoprotective activity, with crude extracts protecting against liver damage and immunosuppression caused by anti-tubercular drugs such as isoniazid, rifampicin, and pyrazinamide. [23] It is widely included in monoherbal and polyherbal formulations like Pepticare, HIMOLIV, and HP-1, which demonstrate notable anti-ulcer, antioxidant, and liver-protective effects in experimental models. Guduchi's antioxidant mechanism also contributes to neuroprotection, showing potent free-radical scavenging activity and reducing iNOS expression during oxygen–glucose deprivation. [24] In alloxan-induced diabetic rats, both alcoholic and aqueous root extracts improve antioxidant status in major organs more effectively than glibenclamide and insulin. Additionally, T. cordifolia reduces oxidative stress markers, enhances enzymatic antioxidants, and protects against hematological toxicity caused by cyclophosphamide, that highlights it's potential therapeutic activity. [48,49]

● Cardioprotective Activity: Numerous antioxidative plants have demonstrated cardioprotective effects in myocardial ischaemia reperfusion damage experimental models. Ethanol extracts of TC at different doses have been shown to reduce infarct size and serum and heart tissue lipid peroxide levels in a dose-dependent manner . An antioxidant, anticoagulant, platelet antiaggregatory, lipoprotein lipase releasing, antiinflammatory, and hypolipidemic effect was demonstrated in rats by the cardioprotective activity of a herbal formulation called "Caps HT2," which comprises methanol extract of TC as a component . In alloxan-induced diabetic mice, administering 2.5 and 5.0 g/kg body weight of aqueous root extract for six weekssignificantly lowers serum and tissue cholesterol, phospholipids, and free fatty acids.[50]

Conclusion:

In contemporary drug research, Guduchi (Tinospora cordifolia) stands out as a powerful medicinal plant with remarkable therapeutic promise. Numerous pharmacological properties, including immunomodulatory, antioxidant, anti-inflammatory, antidiabetic, hepatoprotective, antibacterial, and anticancer effects, are supported by its extensive phytochemical profile, which includes alkaloids, diterpenoids, glycosides, steroids, and polysaccharides. Its ancient Ayurvedic benefits are gradually being validated by modern research, which reveals processes supporting cellular protection, metabolic balance, and immunological modulation. Guduchi is remarkable natural resource with enormous promise for contemporary medication development. Tinospora cordifolia could make a substantial contribution to evidence-based herbal therapy and the creation of novel pharmaceuticals with thorough clinical validation, standardized growing procedures, and sophisticated formulation techniques. Its incorporation into contemporary healthcare may open the door to more secure, efficient, and comprehensive treatment options.

A. Guduchi Powder

B. Guduchi Diabetes Plus

C. Guduchi Tablets

D. Guduchi Satva Powder

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