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MEDICINAL IMPORTANCE OF TINOSPORA CORDIFOLIA

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Abstract:

Tinospora cordifolia (Guduchi) is an available and well known herb all over the world. It is traditionally used for various ailments like fever, vomiting, diabetes, jaundice, anaemia, Polyuria and skin diseases etc. It is indicated as Medhyarasayana (brain tonic), digestive, appetite stimulant and carminative for Digestive system. It has potent rejuvenative, neuroprotective, Hypoglycemic, immuno modulatory, anti-inflammatory effect. Though various indications are found in classical text, Experimental and controlled trials are needed to determine its real Efficacy. The Guduchi plant, its properties, mechanism of action and clinical uses are briefly reviewed in this article.

Keywords: *Tinospora Cordifolia*, phytoconstitutions, Pharmacological activity.

Introduction-

The World Health Organization (WHO) estimated that upto 80% of people still rely mainly on traditional remedies such as medicinal plants for their medicines. Since the beginning of human civilization, plants have been used as natural medicines. Recently, scientists are showing a great interest in the development of new drugs from traditional medicinal plants. India with its vast bio-diversity and huge knowledge of ancient traditional systems of medicine Such as Ayurveda, Siddha, Unani, Amchi and provide a strong base for the utilization of a large Number of plants in general healthcare and common ailments of the people. *Tinospora cordifolia* commonly named as “Guduchi” in Sanskrit belonging to family Menispermaceae is a genetically diverse, large, deciduous climbing shrub with greenish yellow typical flowers, found at higher altitude in racemes or racemose panicles, the male flowers are clustered and female are solitary. The flowering season expands over summers and winters. A variety of active components derived from the plant like alkaloids, steroids, diterpenoid lactones, aliphatics, and glycosides have been isolated from the different parts of the plant body, including root, stem, and whole plant. 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. The stem of *Tinospora cordifolia* are 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. 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. Fruits are pea-shaped, fleshy, shiny turn red when boiled. Recently, the plant is of great interest to researchers across the globe because of its reported medicinal properties like anti-diabetic, anti-periodic, anti-spasmodic, anti-inflammatory, anti-arthritic, anti-oxidant, anti-allergic, anti-stress, anti-leprotic, anti-malarial, hepatoprotective, immunomodulatory and anti-neoplastic activities. In this review, we focus our attention to: (i) the reported genetic diversity in the Plant (ii) biological roles reported in humans and animals and active components from the plant. (iii) biological roles reported in humans and animals.

TINOSPORA CORDIFOLIA

(Common names gurjo, heart-leaved moonseed, guduchi or giloy) is a herbaceous vine of the family Menispermaceae indigenous to tropical regions of the Indian.

Synonyms- guduchi, amrita, cinnodbhava, jwarari, jwarnashini, kundali, guduchika, jivantika, tantrika, dhara, nagakanyaka, bhishakpriya madhuparni, somvalli.

Vernacular Names: The common names are Giloe (Arabic); Amarlata (Assamese); Gadancha, Guluncha, Giloe (Bengali); K'uan chu Hsing (Chinese); Culancha (French); *Tinospora* (English); Gado, Galo, Gulo (Gujerati); Giloe, Gulbel, Gurcha (Hindi); Amrytu, Sittamrytu (Malayalam); Ambarvel, Giroli, Gulvel (Marathi), Garjo (Nepali); Gulancha (Oriya); Gulbel (Persian); Giloe (Punjabi, Kashmiri), Amrita, Guduchi, (Sanskrit); Gurjo (Sikkim); Amridavalli, Niraidarudian (Tamil); Guduchi, Iruluch (Telugu) and Guruch (Urdu)

Scientific classification.

Kingdom: Plantae Clade: Tracheophytes

Clade: Angiosperms Clade: Eudicots Order: Ranunculales Family: Menispermaceae



Habitat and description

As described in the classification, *T. cordifolia* belongs to the Menispermaceae family and the shrubaceous deciduous plant that grows to about 3–4 feet in height and is about 1 foot in width. The Climbing plant is seen to bear lots of spreading slender branches which grab on to the nearby objects for support. The leaves that are seen are simple, alternate, and exstipulate, with petioles up to 15cm in length, bearing roundish and pulvinate leaves at apex and basal region; the basal region being much longer and partially twisted half way around. The flowers that are seen are observed to be small and unisexual; female and male flowers are seen in different plants. On the flowering season, the plants bear no leaves and the flowers bear yellowish green color and the flowers are positioned at the apex and terminal racemes. The differentiations in the sexes are seen in the form that the male flowers are usually clustered and the female flowers are solitary in positioning.

The sepals and petals are 6 in number and are usually free or grouped in 2 or 3 numbers. The fruits are found in an aggregate of 1–3 drupes with scarlet or orangish coloring. The seeds are curved and pea sized and are transverse dehiscent in nature. The roots which are present in this plant are seen in both underground and aerial form. History and vedic references... use of this medicinal plant has been described in detailed manner in Vedic and ayurvedic scriptures. The plant is known as Guduchi or Amrita in Sanskrit which points to the nature of this plant in the rejuvenating and the retainment of youth and life span of the consumer. In other words, the fountain of life force is an apt title for this medicinal plant. The Caraka Samhita, Sushruta Samhita, Bhela Samitha,

Kashyapa Samhita and

Ashatanghrdayam are few of the noted works that have detailed description of the medicinal plants in the field of spiritual and health field of the biological system that they are introduced to. The influence of Persian, Arabic, folk medicines in the life style of man along with the Vedic and Ayurvedic practices has heavily influenced the normal household life along with the scientific know-

how in the molecular level with the biochemical and phytochemical composition of the plant and the plant compounds has done a great deal in the understanding of this miraculous plant. The traditional and folk medicine with no scientific basis has been strongly advocating the regular use of the medicinal plants in the dietary form or in supplementary form; this is credited to the observational knowledge and the information which is passed from godly beings to the sages and to general bodies through gurus (teachers). The abundant medicinal plants and the Vedic scriptures that point to the correct usage of these plants for the optimum beneficial effect has spiked the interest of the science bodies and the further research on these plants on the scientific platform has inadvertently pointed to the same results that have been preached from time immemorial by the traditional forms of medicine.

Morphology....



Morphology of *Tinospora cordifolia* A) stem B) root C) leaves D) flower E) fruit F) seed.

Root

Roots are aerial, thread like, long filiform, threadlike, squarish, which arise from the mature branches or cut bits of stems grow downward and by continuously lengthening sometimes reach the ground. Microscopic observations of aerial roots are characterized by tetra to penta-arch primary structure. However, cortex of root is divided into outer thick walled and inner parenchymatous zone. The dried aerial roots are light grey-brown or creamy white in colour, odourless and bitter taste. Starch is present throughout the parenchyma of the aerial root.

Stem

Stem of this plant is rather succulent with long, filiform, fleshy and climbing innature. Aerial Roots arise from the branches. Dried stem is cylindrical, slender, slightly twisted in shape. Outer bark is thin and papery which is brown to greyish incolour. The stem when sectioned Transversely shows a wheel like structure. Lenticels are circular and prominent. The stem Powder is creamish brown to dark brown in colour with characteristic odour and bitter taste. The Stem is used in dyspepsia, fever and urinary diseases .The starch obtained from the stem Knownas “Guduchi-satva” is highly nutritive and digestive and used for many diseases.

Leaves

Leaves of this plant are membranous, simple, alternate, with long petiole approximately 15cm Which is round, pulvinate, heart shaped, twisted partially and half way round. Leaves are seen in bulk intensely green in colour but over mature leaves are yellowish green To yellow colour. Leaves are bitter and have anindistinct odour. Lamina is ovatecordate, 10-20 cm long, 8-15cm broad .Leaves are rich in protein, calcium and phosphorus .

Flowers

Flowers are small and unisexual which are greenish yellow in colour. Male flowersare Clustered and female flowers exist in solitary. Sepals are six in two series of three each. Outer Ones are smaller than the inner sepals. Petals are also six, smaller than sepals, free and Membranous. Flowering is seen during summer (March to June)

Different types of Tinospora leaves



T. cordifolia



T. sinensis



T. glabra



T. crispa



T. formanii



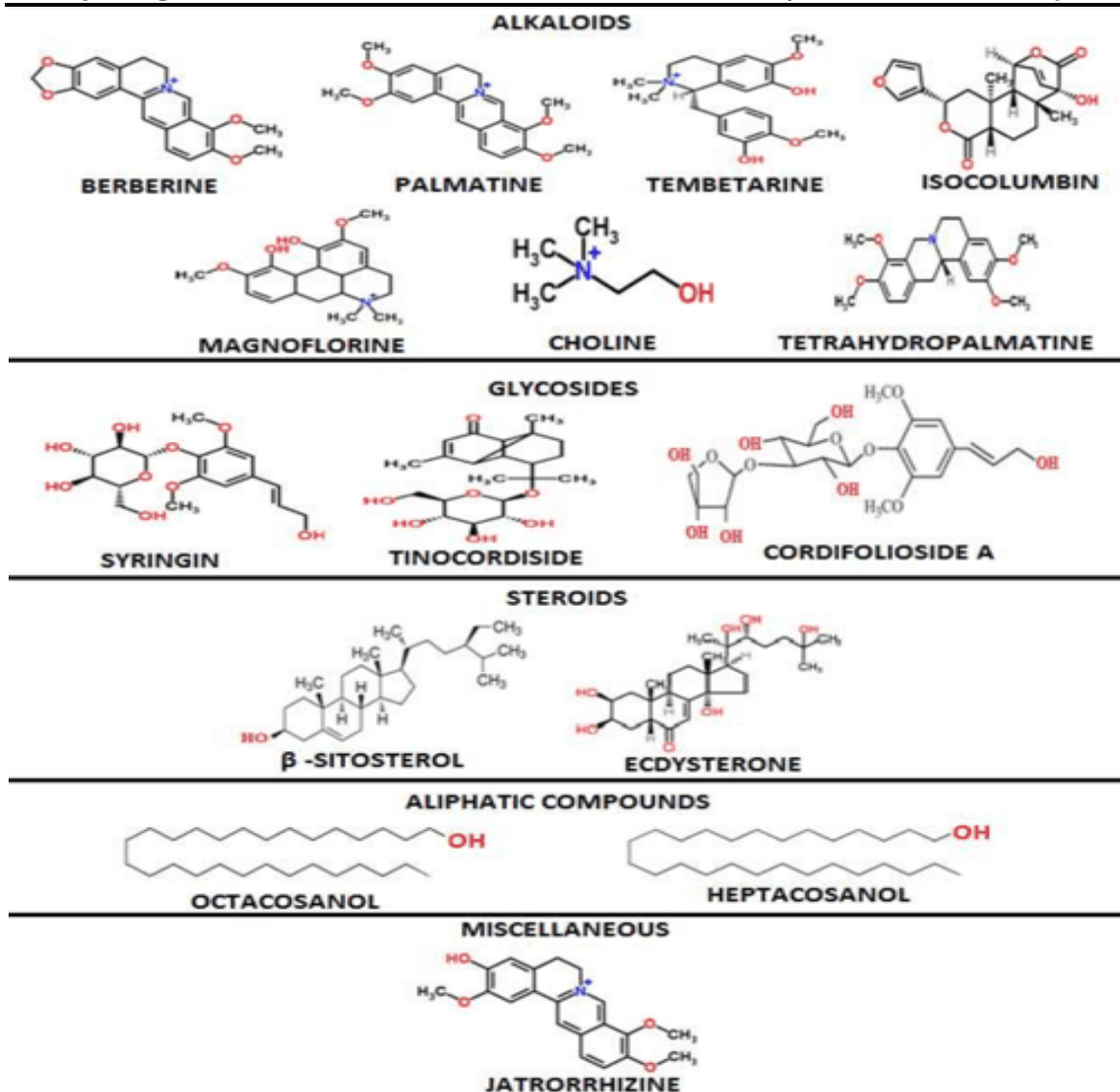
T. smilacina

Chemical Constituents

Diterpene, diterpenoid furanolactone tinosporidine, columbin, and b-sitosterol are the primary Phytoconstituents found in *Tinospora cordifolia*. Its stem contains berberine, palmatine.

their biological activities

Active Component	Compound	Plant Part	Biological Activity (In Human being)	References
Alkaloids	Berberine, Choline, Tembatarine, Magnoflorine, Tinosporin, Palmatine, Isocolumbin, Aporphine alkaloids, Jatrorrhizine, Tetrahydropalmatine,	Stem, Root	Anti-viral infections, Anti-cancer, anti-diabetes, inflammation, Neurological, immunomodulatory, psychiatric conditions	(12-17)
Diterpenoid Lactones	Furanolactone, Clerodane derivatives [(5R,10R)-4R-8R-dihydroxy-2S-3R:15,16-diepoxy-cleroda-13 (16), 14-dieno-17,12S:18,1S-dilactone], Tinosporon, Tinosporides, Jateorine, Columbin	Whole Plant	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.	(18-22)
Glycosides	18-norclerodane glucoside, Furanoid diterpene glucoside, Tinocordiside, Tinocordifolioside, Cordioside, Cordifolioside, Syringin, Syringin-apiosylglycoside, Pregnane glycoside, Palmatosides, Cordifolioside A, B, C, D and E	Stem	Treats neurological disorders like ALS, Parkinsons, Dementia, motor and cognitive deficits and neuron loss in spine and hypothalamus, Immunomodulation, Inhibits NF-kB and act as nitric oxide scavenger to show anticancer activities.	(23-29)
Steroids	β -sitosterol, δ -sitosterol, 20 β -hydroxyecdysone, Ecdysterone, Makisterone A, Giloinsterol	Shoot	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.	(30-32)
Sesquiterpenoid Aliphatic	Tinocordifolin Octacosanol,	Stem Whole	Antiseptic Anti-nociceptive and anti-	(33) (34-36)

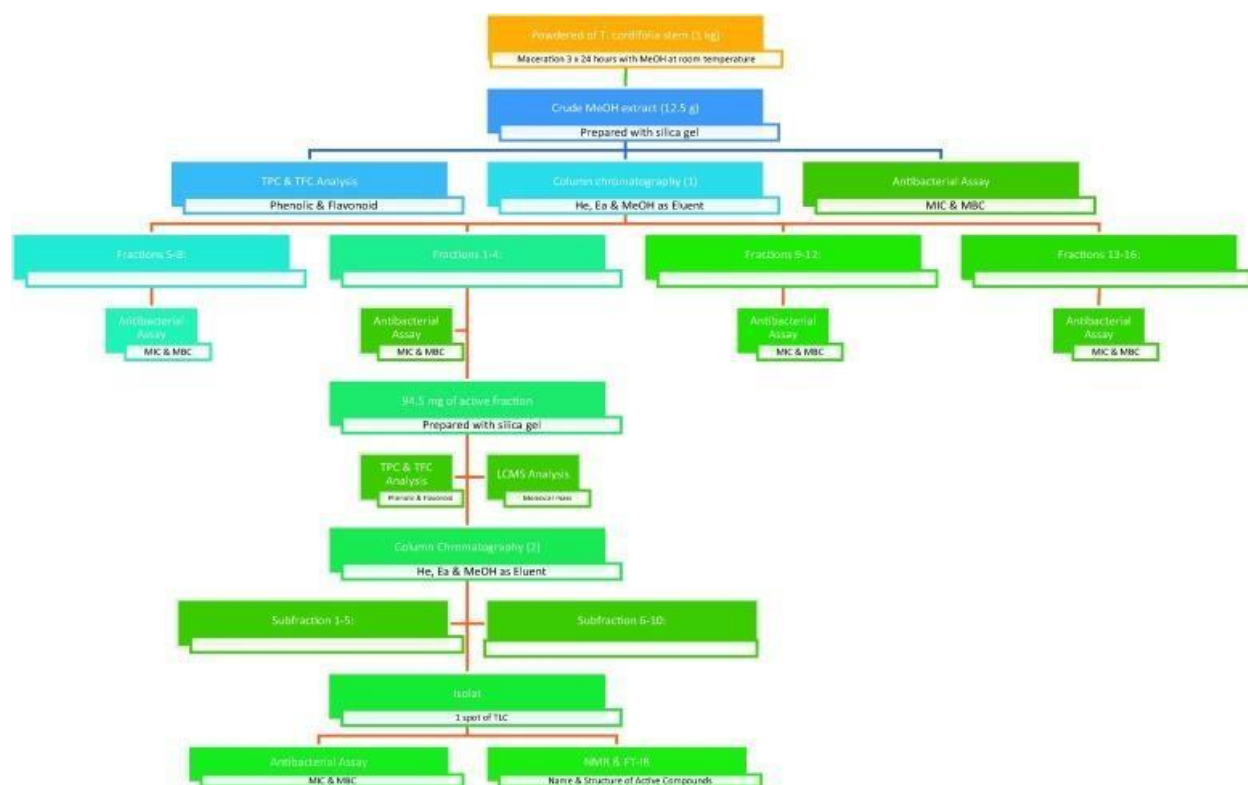


Isolation of the active compounds

The flow chart in Fig. 1 shows the process of isolating the active compound from the *T. cordifolia* plant extract. The extract was fractionated using column chromatography and solvents containing n-hexane, ethyl acetate, and methanol. After preparation, 12.5 g of crude stem extract was slowly added to the column. In this study, column chromatography used a flow rate of 2 mL/min with 100 mg/mL of concentration and 125 mL of volume. After that, the eluent was streamed and collected. The eluent was gradually changed from nonpolar to polar. A rotary vacuum evaporator was used to collect and evaporate the results of the column chromatographic elution. The fraction concentrates were then visualized, and aggregation was performed using the same thin-layer chromatography (TLC) profile.

The active fraction was then isolated using a two-stage column chromatography method. 94.5 mg of the active fraction was prepared with a volatile solvent, 90 mg of silica gel was added, and the mixture was loaded into the chromatography column. The column chromatography elution results were placed in a vial and dried in an oven. The isolates or subfractions were then separated using TLC to produce pure isolates and combinations based on the same TLC profile. The subfraction (isolate) was weighed and placed in a bottle, and its activity was determined. Furthermore, for pure isolates, the compound structure was analysed and identified.

Fig. 1. Flowchart of the isolation of bioactive compounds from *T. cordifolia* plants consisting of crude extract maceration, including initial column chromatography, secondary column chromatography with the most active fraction, and identification of the isolated compounds.



Medicinal properties.....

:In India *Tinospora cordifolia* is widely used in traditional ayurvedic medicine because of its Biological activities like anti-inflammatory, immunomodulatory, anti-Oxidant, anti-diabetic, anti-periodic, anti-spasmodic, anti-neoplastic activities, anti-stress, Anti-leprotic, anti-malarial,

Hepato-protective, anti-allergic and anti-arthritic activity and various other medicinal properties. *Tinospora cordifolia* use in various ailments fevers, asthma, Diabetes, dyspepsia, jaundice urinary problems, skin diseases and chronic diarrhoea and Dysentery. It also plays a key role in the treatment of heart diseases, leprosy, helmenthiasis and Rheumatoid arthritis.

Anti-Microbial Activity

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 marcescens* (Gram-positive bacteria). 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*. Silver nanoparticles Synthesized from stem of *Tinospora cordifolia* possess Very good antibacterial activity against

multidrugresistant strains of *Pseudomonas aeruginosa* isolated From burn patients .The active compound [(5R, 10R)-4R, 8R- Dihydroxy-2S, 3R:15, 16-diepoxycleroda13(16), 17, 12S, 18, 1S-dilactone] was isolated from Ethanol extract of *Tinospora cordifolia* stem showed Activity against bacteria and fungi. The lowest MIC Values were observed against *Enterococcus faecalis* (125 µg/ml) and *Bacillus subtilis*(200 µg/ml). The Compound also showed activity against fungi; the Lowest minimum inhibitory concentration values were Seen against *Trichophyton simii* (31.25 µg/ml), *Trichophyton rubrum*57 (62.5 µg/ml), *Trichophyton Rubrum* 296 (62.5 µg/ml) . Francesca Bonvicinia et Al study results indicate that constituents From *Tinospora cordifolia* exhibited a higher inhibitory Activity against reference microbial strains and clinical Isolates of methicillin-resistant *Staphylococcus Aureus* (MRSA) and carbapenemaseproducing *Klebsiella pneumoniae* [36]. Constituents From *Tinospora cordifolia* may be a potential source of New therapeutic strategies for infectious diseases.

Anticancer Activity

Tinospora cordifolia extracts are used in a radioprotective role to increase body weight, and tissue weight to inhibit the harmful effects of sublethal gamma radiations in male Swiss albino mice. *Tinospora cordifolia* extracts Rise lipid peroxidation and decrease the level of cell viability,decreasing the level of GSH S-transferase activity (Rao SK et al., 2008). Lipid peroxidation is important and related to cell death and causes the impairment of Membrane function through the increase the membrane permeability and membrane protein oxidation and cell Death.

Polysaccharide fractions from *Tinospora cordifolia* are effective in reducing the metastatic potential of Melanoma cells. *Tinospora cordifolia* extracts increased the levels of pro- inflammatory cytokines, including IL1 β , IL-6, TNF- α , granulocyte monocyte-colony stimulating factor and the vascular endothelial cell growth factor To increase the level of tissue inhibitor of metalloprotease-1 in the B 16- F10 extract (Leyon PV et al.,2004). The Effect of *Tinosporacordifolia* extract is better than doxorubicin treatment (Jagetia GC. Et al., 1998)

AntiAllergic

Tinospora Cordifolia has been studied for its antiallergic effect. It was found that *Cordifolia* provided significant relief from sneezing Nasal discharge, nasal obstruction, and nasal Pruritis compared with placebo with consistent Improvement on examination of nasal smears and Nasalmucosa. *Tinospora cordifolia* has been studied for its anti-allergic effect. It was found that T *cordifolia* provided significant relief from Sneezing, nasal discharge, nasal obstruction, and Nasalpruritus compared with placebo with Consistent improvements on examination of the Nasal smears and nasal mucosa.

TOXICITY

Amrita extracts have been said to eliminate. Liberated radicals brought on by Aflatoxinosis.Exhibited GSH, ascorbic acid, protein, and antioxidant activity enzymes like SOD, CAT, GPx,glutathione-S-transferase (GST), and glutathione reductase (GR) in the Kidney all have a protective impact. Thiobarbituric acid reactivity increased substances (TBARS) and GSH are alsoreduced, alkaloid choline, tinosporin, isocolumbin, palmatine, And Tetrahydropalmatine Amritashown defence against the production of aflatoxin.(25)Leafy Amrita extract showed hepatoprotective properties for lead nitrate-induced toxicity In male Swiss albino mice. Orally administering prevents lead nitrate from appearing in plant Extracts provoked liverdamage. SOD, CAT, and Increased levels of aspartate Aminotransferase (AST), alanine Aminotransferase(ALT), ALP

Antioxidant activity.

In diabetic rats, there was a considerable increase in the Concentration of thiobarbituric acid-reactive compounds (TBARS) in the brain, as well as a decrease in the heart. Treatment with *Tinospora cordifolia* reduced glutathione Reductase (GSH) concentrations and activity of superoxide Dismutase (SOD), catalase, and glutathione peroxidase (GPx)In diabetic rats' tissues.

T. *cordifolia* root alcoholic extract (TCREt) given orally to diabetic rats at a dose of 100 mg/kg For6 weeks restored the antioxidant state of the heart and Brain. Although insulin (6 units/kg) returned all parameters to Normal status, T. *cordifolia* root extract had a better effect Than glibenclamide (600/kg) (Prince et al., 2004) .The Fenton (FeSO₄) reaction and radiation- mediated 2-Deoxyribose degradation were both inhibited by aqueous Extract of T. *cordifolia* in adose-dependent manner, with an IC₅₀ value of 700/mL for both Fenton and radiation-

mediated 2-DR degradation. Similarly, at 500/mL and higher, it Displayed a moderate but dose-dependent suppression of Chemically produced superoxide anion, with an IC₅₀ value of 2000/mL (Goel et al., 2002). *T. cordifolia* has also been Shown to increase GSH levels, gamma-glutamylcysteine Ligase expression, and Cu-Zn SOD gene expression. Electron Paramagnetic resonance spectroscopy revealed that the herb Had high free radical-scavenging properties against reactive Oxygen and nitrogen species (Rawal et al., 2004) *Tinospora cordifolia* also contains components that reduce HIV recurrent resistance to antiretroviral therapy (ART) and Increase the medication's outcome. In the liver of Swiss Albino mice, the effect of a hydroalcoholic (80 per cent Ethanol: 20 per cent distilled water) extract of *Tinospora Cordifolia* aerial roots on carcinogen/drug metabolising phase I and phase-II enzymes, anti-oxidant enzymes, GSH content, LDH, and lipid peroxidation was demonstrated. *Tinospora Cordifolia*'s chemopreventive activity is suggested by Increased GSH levels and enzyme activities involved in Xenobiotic metabolism and cell anti-oxidant status (Singh et Al., 2006)

Immuno-modulatory Activity.

T. cordifolia is used to improve the immune System and the body resistance against Infections. The alcoholic and aqueous Extracts of *T. cordifolia* have been tested successfully for immuno-modulatory Activity. Pretreatment with *T. cordifolia* Reduced mortality in mice injected with *E. Coli* intraperitoneally. This was associated with significantly improved bacterial Clearance as well as improved phagocytic And intracellular bactericidal capacities of Neutrophils in the *T. cordifolia* treated Group. According to Desai et al. (2002) the Dry stem crude extract (DSCE) of *T. Cordifolia* contained a polyclonal B cell Mitogen, G1-4A which enhance the immune Response in mice. Treatment of *T. cordifolia* extract also Deleted the immunosuppressive effect of CCl₄. There was significant increment in the Functional capacities of rat peritoneal Macrophages.

Treatment by *T. cordifolia* extract may be the critical remedy for the Adverse effect of CCl₄ in liver function as Well as immune functions (Bishayi et al., 2002). In clinical study, it has afforded Protection in cholestatic patients against *E. Coli* infection (Dhuby, 1997). The water Extract of *T. cordifolia* was found to be more Potent than other extract (Manjreker et al., 2000). According to Atal et al. (1986) *T. Cordifolia* improves the phagocytic function without effecting the humoral or cell Mediated immune system.

Anti-Diabetic Activity.

Pharmacological studies have proven in vivo Antidiabetic potential of various extracts of *T. Cordifolia*. It has been reported to mediate its antidiabetic potential through myriad of biologically active Phytoconstituents isolated from different parts of plant, Including alkaloids, tannins, cardiac glycosides, Flavanoids, saponins and steroids . These compounds Have been reported to encompass different target Activities in diabetic conditions, thus enabling the

Potential application in experimental and clinical Research. Kannadhasan R and Venkataraman S study Reported that 30 days treatment of Sedimental extract of *Tinospora cordifolia* (SETc) (1000mg/kg/p.o) on Diabetic subjects was proven for its efficacy and clearly Establishes the antidiabetic activity with antiobese body Built . The Ethanolic extract of *Tinospora*

cordifolia Leaves in different dosages (200 and 400 mg/kg b.w.) Administered orally for 10 days and 30 days in Streptozotocin diabetic albino rats. It is clearly showed That TC has significant antidiabetic activity in diabetic Animals and has an efficacy of 50% to 70% compared to Insulin Borapetoside C isolated from *Tinospora Crispa* (5 mg/kg, i.p.) attenuated the elevated plasma Glucose in diabetic mice, increased glucose utilization, Delayed the development of insulin

resistance and then Enhanced insulin sensitivity. The activation of insulin induced IR-Akt-GLUT2 expression in liver and the Enhancement of insulin sensitivity may have Contributed to the hypoglycemic action of borapetoside C. The isoquinoline alkaloid rich fraction from stem,

Including, palmatine, jatrorrhizine, and magnoflorine Have been reported for insulin-mimicking and insulin-releasing effect both in vitro and in vivo . In Ehrlich Ascites tumor cells model, water, ethanol and methanol Extracts of the herb showed glucose uptake-stimulatory Activity . The protective effects of *Tinospora Cordifolia* root extract were reported in presence of Higher levels of anti-oxidant molecules and enzymes. *Tinospora cordifolia* root extract has been shown to Significantly counterbalance the diabetes-associated Oxidative stress in the maternal liver by lowering the Levels of malondialdehyde and reactive oxygen species

And the increased levels of glutathione and total thiols. Oral treatment of *Tinospora cordifolia* (100 and 200 mg/kg body weight) for 14 days mediates its antidiabetic potential through mitigating oxidative stress Promoting insulin secretion and also by inhibiting Gluconeogenesis and glycogenolysis.

Anti-arthritic, anti-osteoporotic effects

Single or synergistic formulations of *Tinospora cordifolia* with *Zingiber officinale* has been used in rheumatoid arthritis treatment in traditional medicine. *Tinospora cordifolia* have been reported to affect the proliferation, differentiation and mineralization of bone like matrix on osteoblast model systems in vitro and hence finds potential application as an anti-osteoporotic agent. Alcoholic extract of *Tinospora cordifolia* have been shown to stimulate the growth of osteoblasts, increasing the differentiation of cells into osteoblastic lineage and also increasing the mineralization of bone like matrix.

Ecdysteroids isolated from the plant have been reported of protein anabolic and anti-osteoporotic effects in mammals. Beta-Ecdysone (Ecd) from *Tinospora cordifolia* extracts have been reported to induce a significant increase in the thickness of joint cartilage, induce the osteogenic differentiation in mouse mesenchymal stem cells and to relieve osteoporosis in osteoporotic animal models. Further 20-OH- β -Ecd isolated from *Tinospora cordifolia* has been reported of its anti-osteoporotic effects [62] thus highlighting the role of *Tinospora cordifolia* in the treatment of osteoporosis and osteoarthritis.

Anti-Anxiety Action

Sarma et al. found that a 100 mg/kg ethanolic extract of *T. cordifolia* has noteworthy anti-anxiety action in comparison to standard diazepam (2.5 mg/kg) [74]. Patients' I.Q. level demonstrated improved level as per clinical investigation. In Ayurveda preparation of *T. cordifolia* is used as a brain tonic and thought to work by improving mental abilities such as memory and recall.

Hypolipidemic Effect

In alloxan diabetic rats, Stanely et al. analyzed the hypolipidemic impact of an aqueous extract of the root on rats weighing 2.5 and 5.0 g/kg body weight on the sixth week, which brought about a diminished tissue cholesterol, diminished serum, phospholipids, and free fatty acid. The root extract at a dose of 5.0 g/kg of body weight had the most noteworthy hypolipidaemic impact. *T. cordifolia* root extract's capacity to lower serum or tissue lipid level in diabetic rats had never been investigated earlier.

Wound Healing Property

The wound healing profile of alcoholic extract of *T. cordifolia* and its outcome on the wound healing was found suppressed by dexamethasone, as evaluated by Shanbhag T. et al. The injury mending capability of the plant showed expanded elasticity of the extract of *T. cordifolia* which might be credited to the advancement of collagen combination. The concentrate of *T. cordifolia* didn't invert dexamethasone stifled injury recuperating.

Anti-hiv action

Some of the research found that the root extract of *T. cordifolia* affects the immune system of HIV positive patient. It improves the therapeutic results by reducing the recurrent resistance of HIV virus. *T. cordifolia* extract shows the anti-HIV action by reducing the eosinophil count, stimulating the B lymphocytes, macrophages, and polymorphonuclear leukocytes and hemoglobin percentage, hence disclosing its auspicious role of application in the management of the disease.

COVID-19

Rais et al. stated that management of mild COVID-19 infection is possible with the use of *T. cordifolia*. COVID-19 is a recent occurred pandemic highlighted the importance of *Gurjo* in medicinal field. According to Ayurved and Yog Guru Baba Ramdev, Consuming the *T. cordifolia* along with ginger, tulsi, pepper, and turmeric will help in boosting immune system and prevent the corona virus. One study has stated that *T. cordifolia* is crucial in the prevention attachment of virus to the host cells.



Herbal Formulations

Conclusion

Guduchi (*T. cordifolia*) is a well-known plant, especially in traditional medicine and the unique source of various Types of compounds having diverse chemical structures. The present review spotlights the classical antidiabetic,

Anticancer, immunomodulatory, antioxidant, antimicrobial, and antitoxic claims of *Tinospora cordifolia* and their Validation by contemporary researchers. For the last few years, there has been an increasing trend and awareness in medicinal plant research. Quite a significant amount of research has already been carried out during the past few decades in exploring the chemistry of different parts of *Tinospora cordifolia*. While *Tinospora cordifolia* has been used successfully in Ayurvedic medicine for centuries, extensive research and development work should be Undertaken on *Tinospora cordifolia* and its products for their better economic and therapeutic utilization. This Review can be used for further research as well as clinical purpose.

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