



Review Article

www.ijrap.net

(ISSN Online:2229-3566, ISSN Print:2277-4343)



MEDICINAL PROPERTIES OF GUDUCHI (*TINOSPORA CORDIFOLIA*): A SYSTEMATIC REVIEW

Himanshu Rawat ^{1*}, Anju KP ¹, Nisha Kumari Ojha ²

¹ PG Scholar, PG Department of Kaumarbhritya-Balroga, National Institute of Ayurveda, Jaipur, India

² Associate Professor and HOD, PG Department of Kaumarbhritya-Balroga, National Institute of Ayurveda, Jaipur, India

Received on: 21/04/22 Accepted on: 15/06/22

*Corresponding author

E-mail: himanshu.r1919@gmail.com

DOI: 10.7897/2277-4343.1305143

ABSTRACT

In traditional medicine, *Guduchi* is considered to have a status of the highest order in natural medicine and Ayurveda. *Guduchi* is derived from a Sanskrit word called “*Amrita*” due to its medicinal and therapeutic properties. *In vitro* and *in vivo* studies around the world proved the medicinal value of *Tinospora cordifolia*. *Guduchi*'s medicinal therapeutic effect was identified: antioxidant property, antimicrobial property, anticancer activity, antihepatotoxic effects, anti-inflammatory activities, antistress and memory enhancement, antidiabetic property, anti-osteoporotic effect, analgesic activity, and wound healing. This paper is produced by systematically reviewing the scientific literature and comprehensive summary of the medicinal properties of *Guduchi*.

Keywords: *Tinospora cordifolia*, *Guduchi*, *Amrit Valli*, Ayurveda.

INTRODUCTION

Guduchi (*Tinospora cordifolia*) is a medicinal plant with many medicinal properties and belongs to the Menispermaceae family. It has a wide range of biological activities like antioxidative, antimicrobial, antihyperglycemic, anti-inflammatory, osteo-productive, hepatoprotective, ant-cancerous, antistress etc. While considering its chemical composition *Guduchi* is the richest source of proteins, micronutrients, alkaloids, diterpenoids, clerodane norditerpenoids, sesquiterpenoids, phenolics, steroids, aliphatic compounds, polysaccharides, essential oils and fatty acids. These all contribute to various biological actions, including immunomodulatory activity. The whole plant of *Guduchi* is helpful in multiple diseases; for example, powdered leaves and their decoction are reported to treat gout, ulcers, jaundice, and fever and control blood glucose along with milk, stem extract with honey is helpful as a tonic in jaundice, bark along with milk is used to treat cancer. Roots are used as an emetic for visceral obstruction and are beneficial in diarrhoea and dysentery.

From time immemorial, mankind has depended on nature and its product for sustenance and wellbeing and the pages of evolution in the lifestyles of humankind have been supported by the ever-since presence of medicinal plants. Medicinal plants are those plants which exhibit their medicinal properties and therapeutic properties through their biologically active compounds that are incorporated into the plant parts like leaves, flower seeds or bark.

In India, *Tinospora cordifolia* is widely used in traditional Ayurvedic Medicine because of its chemical and medicinal properties of anti-inflammatory, antioxidant, antidiabetic, anti-spasmodic, antineoplastic activities, antistress, hepatoprotective, anti-allergic and anti-arthritis activity, immunomodulatory effect, antimicrobial activity, hypolipidemic property, gastrointestinal and anti-ulcer effect.

Tinospora cordifolia is a deciduous woody climbing shrub widely distributed throughout India, China, and Africa. It is an extensively spreading and climbing shrub with multiple elongated twining branches. Different morphology is as follows:

- (a) Root: They are aerial thready, long filiform and arise from the mature branches. Microscopic observation of aerial roots is characterized by tetra to pent-arch primary structure. The dried aerial roots are light grey-brown or creamy white, odourless and bitter taste. Starch is present throughout the parenchyma of the root.
- (b) Stem: Stem is succulent with long, filiform, fleshy and climbing in nature. The transverse section of the stem shows a wheel-like structure. The stem powder is greenish brown to dark in colour with a bitter taste. The starch obtained is termed *Guduchi-satva*.
- (c) Leaves: leaves of the plant are membranous, simple, alternate and round pulvinate, heart shape. Leaves are intensively green in colour and bitter in taste.
- (d) Flowers: flowers are small, unisexual and greenish yellow.
- (e) Seeds: seeds are white, bean-shaped and curved.

It is a potential Ayurvedic drug used extensively in treating fever, diabetes, urinary tract disorders, anaemia, jaundice, asthma, and cardiac problems.

Acharya Charaka included *Guduchi* under *Medhyarasayana* (intellect promoting). *Swarasa* of *Guduchi* is administered to get the benefits of *Rasayana*. *Guduchi* is *tikta* rasa, in potency, it is *ushna* and in *vipaka* it is *Madhura*, its guna includes *laghu* and *snigdha*. It balances *tridoshas* in the body or *tridoshahara* as its *pittahara* may be due to its *tikta* rasa, *kaphahara* may be due to *ushnaveerya*, *vatahara* may be due to *Madura vipaka*, it has a *prabhava* that is *vatarakthahara* (rheumatic or gouty arthritis).

The most important property of *Guduchi* is *deepana*; even though it is *pittahara*, it is because it contains *tikta rasa*. *Tikta rasa* is *pittahara*, and therefore it causes *tiktapachana* this way, *Koshtagni* will increase, which in turn correct *Dhatuagnimandya* indirectly; it corrects *Ama* (accumulated toxic substances) in both *Koshta* and *Dhatu* levels. Therefore, it is the best drug of choice when *Ama* is associated with *Pitta dushiti* (*Pitta* predominant *Ama* may be arising due to increased *dravata* of *pachakpitta*). That means if inflammation (*Raag, Toda*), the drug of choice is *Guduchi*. In most diseases, there is an inflammatory pathology either at *Koshta* or *Dhatu* level. While considering the wide range of uses, this drug must be analysed.

Tinospora cordifolia contains Phyto active compounds such as steroids, alkaloids, glycosides, diterpenoid lactones, sesquiterpenoid, aliphatic compounds and polysaccharides.

a) *Tinospora cordifolia* contains alkaloids like Berberine, magnoflorine, choline, palmatine, tinosporin, etc. in the stem and roots, which gives the properties of anticancer, antidiabetic, antiviral and immunomodulatory.

b) *Tinospora cordifolia* has steroids like 20 beta-hydroxyecdysone, alpha-sitosterol, beta-sitosterol, and makisterone A in the shoot, which helps in the inhibition of TNF alpha, IL-1, IL-6, Cox-2 and inflammatory arthritis.

c) *Tinospora cordifolia* contains Glycosides and Tinocordioside, Tinocordifolioside, Cordioside, 18- norclerodane glycoside etc. in the stem that acts against cancer cells, treats neurological disorders like ALS, Parkinson's, Dementia.

Table 1: Anticancer activity

Researcher/Author	Tested In	Outcome
Ali et.al.[1]	Administration of alkaloid palmatine of <i>Tinospora cordifolia</i> in animal models	Anticancer potential in 7,12-dimethylbenz(a)anthracene-induced skin cancer model.
Mishra et.al [2]	50% Ethanolic extract of <i>Tinospora cordifolia</i>	Anti-brain cancer potential using C6 glioma cells significantly induced differentiation in C6 glioma cells and reduced cell proliferation.
Kuldeep Dharma et.al [3]	Palmatine alkaloid	Reduce tumour size.
	GI - 4A	Stimulate Bone marrow-derived dendritic cells to activate cytotoxic T cells.
	Ethanolic Extract	Reduce the population of cancer stem cells.
Ganesh Chandra Jagetia [4]	Methanolic methylene chloride aqueous stem extract of <i>Guduchi</i> in HELA Cells (Cell line and culture)	<i>Guduchi</i> inhibited cell division. <i>Guduchi</i> can distribute fidelity of the genome, causing damage to DNA expressed as an MN after one cell division.
Avnish K Upadhyay et al. [5]	Intraperitoneal injection of Alcoholic extract of <i>Guduchi</i> on Mice bearing Daltons Lymphoma.	Stimulate macrophage functions like phagocytosis, antigen-presenting ability and secretions of IL-1 and TNF.
Ganesh Chandra Jagetia, Shaival Kamalaksha Rao [6]	Dichloromethane extract of <i>Tinospora cordifolia</i> administered intraperitoneally in mice transplanted with EHRlich Ascites carcinoma	<i>Tinospora cordifolia</i> shows antineoplastic activity in mice.
R. Verma, H.S Choudhary [7]	Anticarcinogenic and antimutagenic effect of <i>Tinospora cordifolia</i> in experimental animal	50% methanolic extract of <i>Tinospora cordifolia</i> to C57 BI mice for 30 days at a dose of 750 mg/ the tumour size reduced life span.

Table 2: Anti Hepatotoxic Effects

Researcher/Author	Tested In	Outcome
Sharma et al. [8]	<i>Tinospora cordifolia</i> water extract	Protective effect in hepatic and gastrointestinal toxicity and normalized liver function.
Kuldeep et al. [9]	Paracetamol induced Hepatotoxicity in Mice	The hepatoprotective effect is observed.
	CCL4 induced Hepatotoxicity in Goat.	Clinical and hematobiochemical improvement is observed.
Avnish K. Upadhyay et al. [10]	Clinical Study	Normalization of altered liver function.
	Tested in Goats	Hepatoprotective activity. CCL4 induced liver damage. Significant improvement in functional capacities of Peritoneal Macrophages. Prevent the antitubercular drugs and bile salts induced Hepatic damage.
	Extract of <i>Guduchi in-vitro</i>	Inactivating property against hepatitis B and E surface antigens in 48-72 hours.
Biswadev Bishayi, Shubhashree Roychowdhary [11]	<i>In-vivo</i> administration of <i>Tinospora cordifolia</i> extracts in tetra chloride intoxicated rats.	Significant reduction in serum levels of SGOT, SGPT, ALP, and Bilirubin.
Sharma et al [12]	Stem and leaves extract in Swiss Albino mice	Hepatoprotective effect against Lead Nitrate induced toxicity.

Table 3: Anti-inflammatory activities

Researcher/Author	Tested In	Outcome
Biswajyoti Patgiri [13]	Carrageenan-induced paw oedema models in rat	Oedema is reduced and shows an anti-inflammatory property.
Sheena Philip [14]	The <i>in-vitro</i> evaluation was conducted in RAW 1264.7 macrophages were pre-intubated with chloroform extract of <i>Tinospora cordifolia</i>	The LPS-induced upregulation of pro-inflammatory biomarkers was significantly prevented by chloroform extract of <i>Tinospora cordifolia</i> .
Hariram Birla [15]	The anti-inflammatory activity of <i>Tinospora cordifolia</i> aqueous extract (TCAE) in 1-Methyl - 4- phenyl-1,2,3,6-tetra hydro pyridine (MPTP) intoxicated Parkinsonian mouse model.	The neuroprotective function of TCAE against MPTP induced DL Neurodegeneration in Parkinsonian mouse model.
Avnish K. Upadhyay, Arvind Kumar [16]	Alcoholic extract of <i>Tinospora cordifolia</i> Model of adjuvant-induced arthritis Aqueous extract of <i>Guduchi</i>	Anti-inflammatory actions in models of acute and subacute inflammation. Significant inhibition of primary and secondary phases of inflammation. Significant anti-inflammatory effect in the cotton pellet granuloma and formalin-induced arthritis model.

Table 4: Anti Stress and Memory enhancing effect

Researcher/Author	Tested In	Outcome
D. N. K. Sharma [17]	Ethanol extract of <i>Tinospora cordifolia</i> at a dose of 100mg/kg	Antistress activity in all parameters compared with standard drug diazepam (2.5mg/kg)
P. Baghel [18]	Clinical research	It showed improved IQ levels of the patient.
Kuldeep et.al [19]	50% Ethanol extract in Mice	Sleep-induced anxiety and mood disorders corrected.
Avnish K Upadhyay, Kaushal Kumar [20]	Various extracts of <i>Tinospora cordifolia</i> in mice 21 days randomized, double-blind placebo-controlled study of aqueous extract of <i>Guduchi</i> <i>Tinospora cordifolia</i> extracts in cyclosporine treated rats.	Exhibited comparable antistress activity. Increase verbal learning and logical memory. Reverse cyclosporine-induced memory deficit, i.e., it protects neurodegenerative changes.

Table 5: Antidiabetic Property

Researcher/Author	Tested In	Outcome
Mathewuet.al [21]	<i>In-vivo</i> studies of different extracts of plants in DM patients and also in albino rats.	Antidiabetic activity in diabetic animals and efficacy 50-70% compared to insulin.
Prashant et.al [22]	Diabetic pregnant rats in the root extract of <i>Guduchi</i> are administered. The root extract of <i>Guduchi</i> in alloxan-induced DM model. <i>Guduchi</i> extract in DM animals and normal animals.	Antidiabetic and lipid-lowering activity. Antihyperglycemic effect is observed. The activity of the alpha glucoside enzyme is inhibited, and hypoglycemic action is in both DM and normal animals.
Kuldeep Dharma et.al [23]	Methanolic extract of <i>Tinospora cordifolia</i> in diabetic rat. Stem extract	Beta Cell regenerative potential. Enhance the glucose uptake in the cell Reduces postprandial hyperglycemia by reducing pancreatic amylase. Inhibit Glucosidases
Avnish K. Upadhyay et al. [24]	Alloxan-induced diabetic rats	Reduction in blood sugar. Increase Glucose tolerance. Increase glucose metabolism Inhibitory effect on adrenaline-induced hyperglycemia.
D. Singh, P K Choudhary [25]	Taken root extract of <i>Tinospora cordifolia</i> .	Root extract showed an antihyperglycemic effect in the alloxan-induced diabetic model by decreasing its excess glucose level in urine and normal.
M.M Shivanjappaet.al [26]	Streptozotocin-induced diabetic rat.	<i>Tinospora cordifolia</i> root extracts attenuated the brain-mediated lipid level and downregulated the blood glucose and urinary glucose levels, emphasizing its antidiabetic activity.

Table 6: Antioxidant Activity

Researcher/Author	Tested In	Outcome
R. Mehra et al. [27]	Evaluated Antioxidant activity by DPPH (1-diphenyl-2-picrylhydrazyl) free radical scavenging method.	Antioxidant Activity.
M. George et al. [28]	Methanolic, Ethanolic extract of <i>Tinospora cordifolia</i>	Antioxidant Activity.
R. Premanath [29]	Dried leaves of <i>Guduchi</i> powdered and extracted with chloroform, methanol, ethanol, hexane and water.	Antioxidant Activity.
S. M Prince et al. [30]	Alcoholic extract of <i>Tinospora cordifolia</i> roots in chemical-induced diabetes in rats.	It decreases the level of free radical species in diabetic rats and up-regulates the antioxidant enzyme.
R. Jayaprakash et al. [31]	Ethanolic extract of <i>Tinospora cordifolia</i> on N-nitrosodimethylamine induced liver cancer in male Wistar albino rats.	Restoring the normal level of lipid peroxidation enzymatic and non-enzymatic antioxidants.
Avnish K. Upadhyay et al. [32]	Alcoholic extract of <i>Guduchi</i> on a diabetic rat. By electron paramagnetic resonance spectroscopy Extract of <i>Guduchi</i> in alloxan-induced Diabetic model.	Normalize the antioxidant status of the brain and heart. Strong free radical scavenging properties against reactive oxygen and nitrogen species. Demonstrate Antioxidant Activity.

Table 7: Immunomodulatory effect

Researcher/Author	Tested In	Outcome
Kapil et al. [33]	<i>In vitro</i> study by syringing (TC4) and cordial (TC7) isolated from <i>Tinospora cordifolia</i> in sheep erythrocyte by Guinea Pig Serum	Significant increase in IgG antibodies in Guinea Pig Serum. Inhibited the <i>in vitro</i> immune hemolysis of antibody-coated sheep erythrocytes. Cordioside, cordiofolioside and cordial activated macrophages with an increasing incubation period.
Avnish K. Upadhyay et al. [34]	Novel (1,4) alpha D- Glucan Aqueous Ethanolic extract <i>in vivo</i> <i>Tinospora cordifolia</i> extract in HIV patients.	Activate the immune system through activation of macrophages via TLR 6 signalling. Increase antibody production. Significant reduction in eosinophil counts with an increase in Hb.

Table 8: Antimicrobial Activity

Researcher/Author	Tested In	Outcome
R. Jeyachandran et al. [35]	Stem extracts <i>in vitro</i> analysis	Work against Gram-positive and Gram-negative bacteria
A.S. Narayanan et al. [36]	Use of Multiple antibiotic-resistant uropathogens.	Reported antibacterial activity against <i>E. coli</i> etc.
K. Singh et al. [37]	Silver nanoparticles from the stem of <i>Tinospora cordifolia</i> .	Antibacterial activity against different strains of bacteria.
Prasad [38]	Phenolic extract	Antioxidant and antimicrobial activity.
K.S. Allemailem et al. [39]	Aqueous extract of <i>Tinospora cordifolia</i>	Antifungal activity against <i>Aspergillus flavus</i> and <i>Aspergillus niger</i> .
Kuldeep Verma et al. [40]	Ethyl acetate extract of the plant Ethanolic extract on mammalian cell lines. Polysaccharide GI4A Silver nanoparticles prepared from its aqueous leaf extract Aqueous Ethanolic Extract	Inhibit Bio filling formation in <i>Acinetobacter baumannii</i> and virulence factors in <i>Pseudomonas aeruginosa</i> . Inhibitory effect on methicillin-resistant <i>Staphylococcus aureus</i> . Effective against <i>M. tuberculosis</i> Effective against larvae of Malaria parasite. Showed anti-helminthic activity against <i>Eisenia fetida</i> .
V. Shanti et al. [41]	Aqueous, Ethanol and acetone extract of <i>Tinospora cordifolia</i> .	Antimicrobial Activity against urinary pathogens <i>Klebsiella pneumonia</i> and <i>Pseudomonas aeruginosa</i> .

Table 9: Hypolipidemic Property

Researcher/Author	Tested In	Outcome
P.P.M. Stanley et al. [42]	Aqueous extract of the root of <i>Tinospora cordifolia</i> on the rats weighing 2.5 and 5 gm/kg at 6 weeks. Alloxan Diabetic rat	Decrease in tissue cholesterol. Reduction in serum phospholipid and free fatty acid.
Kuldeep et al. [43]	<i>Guduchi</i> roots on administration in alloxan diabetic rats <i>Guduchi-Swaras</i>	Reduce lipid in brain tissue Hyperlipidemia is reduced in case of chronic alcohol consumption.

Table 10: Anti Osteoporotic effect

Researcher/Author	Tested In	Outcome
G. Abiramasundari et al. [44]	<i>In vitro</i> study of alcoholic extract of <i>Tinospora cordifolia</i>	Stimulate the growth of osteoclast and increase the differentiation of the cells.
L. Gao, G. Cai [45]	Beta ecdysterone from <i>Tinospora cordifolia</i> extract 20- OH-Beta Ecdysone isolated from <i>Tinospora cordifolia</i> .	Induce a significant increase in cartilage thickness of joints. Induce the osteogenic differentiation in mouse mesenchymal stem cells. Shows Anti-osteoporotic Effect.
Avnish K Upadhyay et al. [46]	<i>Tinospora cordifolia</i> extract in rats	Bone loss in TIBIA was slower than in control serum

Table 11: Analgesic Activity

Researcher/Author	Tested In	Outcome
Bhomik Goel, Nishant Pathak [47]	Administered <i>Guduchi</i> extract on albino rats, and analgesic activity was evaluated by hot plate and abdominal writhing.	Commercially available extract of <i>Guduchi</i> is found to possess analgesic activity.

Table 12: Gastrointestinal and Anti-Ulcer Activity

Researcher/Author	Tested In	Outcome
Avnish K Upadhyay et al. [48]	Formulation containing <i>Guduchi</i> in pylorus ligated rats in the ethanol-induced gastric mucosal injury.	Reduce the ulcer index total acidity with increased pH of gastric fluids.

Table 13: Wound Healing property

Researcher/Author	Tested In	Outcome
T. Shanbhag, S Shenoy [49]	Alcoholic extract of <i>Tinospora cordifolia</i> and its effect on dexamethasone suppressed healing.	Increased tensile strength may be attributed to the promotion of collagen synthesis. Did not reverse Dexamethasone suppressed wound healing.

PHARMACOLOGICAL ACTIVITIES

Anticancer Activity

There were 07 different studies evaluating the *in-vitro* anticancerous action of *Tinospora cordifolia* Table 1 summarizes the findings of these studies. Accordingly, *Tinospora cordifolia* has shown potential anti-cancerous activity against a wide variety of cancer, especially skin carcinoma and bone marrow carcinoma.

Antihepatotoxic Effects

There were 05 different studies evaluating the antihepatotoxic action of *Tinospora cordifolia* Table 2 summarizes the findings of these studies. Accordingly, *Tinospora cordifolia* has shown promising antihepatotoxic effects against CCL₄, Lead Nitrate, antitubercular drug and bile salt-induced liver damage. *Tinospora cordifolia* also indicates a significant reduction in serum levels of SGOT, SGPT, ALP, and Bilirubin and a protective effect on hepatic and gastrointestinal toxicity and normalized liver function.

Anti-inflammatory activities

There were 04 different studies evaluating the anti-inflammatory activity of *Tinospora cordifolia* Table 3 summarizes the findings of these studies. Accordingly, *Tinospora cordifolia* has significantly inhibited inflammation's primary and secondary phases.

Anti-Stress and Memory enhancing effect

There were 04 different studies evaluating the antistress and memory-enhancing effect of *Tinospora cordifolia*. Table 4 summarizes the findings of these studies. Accordingly, *Tinospora cordifolia* has shown better antistress action as compared to Diazepam. Avnish K Upadhyay et al. also confirmed that *Tinospora cordifolia* reverses cyclosporine-induced memory deficit, i.e., it protects against neurodegenerative changes.

Antidiabetic Property

There were 05 different studies evaluating the effect of antidiabetic properties. Table 5 summarizes the findings of these studies. Kuldeep Dharma et al. demonstrated that methanolic extract of *Tinospora cordifolia* in diabetic rats shows beta cell regenerative potential and enhances the cell's glucose uptake, followed by post-reduction postprandial hyperglycemia by reducing pancreatic amylase.

Antioxidant Activity

There were 06 different studies evaluating the effect of antioxidant activity. Table 6 summarizes the findings of these studies. Avnish K Upadhyay et al. demonstrated that alcoholic extract of *Tinospora cordifolia* normalizes the antioxidant status of the brain and heart along with strong free radical scavenging properties against reactive oxygen and nitrogen species.

Immunomodulatory effect

There were 02 different studies evaluating the immunomodulatory effect. Table 7 summarizes the findings of these studies. Avnish K Upadhyay et al. demonstrated that aqueous ethanolic extract activates the immune system through activation of macrophages via TLR 6 signalling and increases antibody production, resulting in a significant reduction in eosinophil counts with an increase in Hb.

Antimicrobial Activity

There were 07 different studies evaluating the antimicrobial activity. Table 8 summarizes the findings of these studies. R. Jeyachandran et al. studied that stem extract of *Tinospora cordifolia* work against Gram-positive and Gram-negative bacteria.

Hypolipidemic Property

There were 02 different studies evaluating the hypolipidemic property. Table 9 summarizes the findings of these studies. P.P.M Stanley *et al.* also confirmed that aqueous extract of the root of *Tinospora cordifolia* in the alloxan diabetic rats' results in a decrease in tissue cholesterol level and reduction in serum phospholipid and free fatty acid.

Anti-Osteoporotic Effect

There were 03 different studies evaluating the anti-osteoporotic effect. Table 10 summarizes the findings of these studies. G. Abiramasundari *et al.* performed *in vitro* study of alcoholic extract of *T. cordifolia*, which confirms that *Tinospora cordifolia* stimulates the growth of osteoclast and increases the differentiation of the cells.

Analgesic Activity

There was 01 study evaluating the analgesic activity. Table 11 summarizes the findings of this study. Bhomik Goel *et al.* administered *Guduchi* extract on albino rats is found to possess Analgesic Activity.

Gastrointestinal and Anti-Ulcer Activity

There was 01 study evaluating the analgesic activity. Table 12 summarizes the findings of this study Avnish K. Upadhyay *et al.* used the *Guduchi* compound in pylorus-ligated rats, which resulted in a reduction of the total acidity with an increase in the pH of gastric fluids.

Wound Healing property

There was 01 study evaluating the analgesic activity. Table 13 summarizes the findings of this study. T. Shanbhag and S. Shenoy studied the Alcoholic extract of *Tinospora cordifolia* and its effect on dexamethasone suppressed healing which suggests that increased tensile strength may be attributed to the promotion of collagen synthesis.

DISCUSSION

The available *in vitro* and *in vivo* evidence suggests that *Tinospora cordifolia* has antimicrobial, immunomodulatory, anti-osteoporotic, and analgesic properties, antidiabetic, anticancer, antihepatotoxic, antistress and memory enhancement, antioxidant, anti-inflammatory, wound healing, Gastrointestinal and anti-ulcer, analgesic properties.

The different parts of *Tinospora cordifolia* contain various alkaloids in varying proportions. This chemical diversity is mainly the medical and therapeutic benefits achieved.

The antimicrobial property of *Tinospora cordifolia* against Streptococcus mutants is due to the secondary metabolites and the photo-chemicals present in it, such as Quinines, polyphenols, alkaloids, flavonoids, tannins, coumarins, terpenoids, polyphenols and tannins that results in membrane disruption and form metal ion complexes, thus inactivating the bacteria.

The immunomodulatory property of *Tinospora cordifolia* is by virtue of macrophage activation. In actively respiring cells, superoxide and hydrogen peroxide can be activated, which generates reactive oxygen species (ROS). These ROS would result in extensive damage to DNA protein and lipids. Macrophages do a variety of complex microbicidal functions, which include surveillance, chemotaxis, phagocytosis and destruction of targeted organisms.

The lipid-lowering effect is due to the action of Cholic acid. Cholic acid increases cholesterol absorption and gradually suppresses Cholesterol 7 alpha-hydroxylase activity, decreasing

cholesterol excretion rate. Cholic acid causes cholesterol absorption by virtue of its emulsifying property.

The wound healing in the initial phase is due to the regulating effect on VEGF (through IL-2) by *Tinospora cordifolia*, which dominates over its effect in other cytokines, which promotes angiogenesis and healing. Also, the enhanced closure rate can be explained based on increased wound contracture.

The *in vivo* study represents that the alcoholic extract of *Guduchi* is found to improve the rate of proliferation of the osteoblast cells of both humans and rats. It also participates in the calcification process by increasing the minerals in this bone-forming cell model to regulate bone mineralization. A steroid, "Beta Ecdysone or 20-hydroxyecdysone", isolated from *Tinospora cordifolia*, seems to promote muscle tissue building in the mesenchymal stem cells model of mice preventing the occurrence of osteoporosis.

The treatment of HELA cells with methanolic aqueous and methylene chloride extracts causes dose-dependent cell killing, evidenced by the continuous reduction in cell survival. Many drugs of plant origin, such as vinca alkaloids, epipodophyllotoxins and taxol, have been reported to induce doses depending on cell killing.

The oral administration of *Tinospora cordifolia* alcohol extracts shows a significant degree of antidiabetic effect to alloxan diabetic rats by enhancing the glucose metabolism, which is evidenced by an apparent suppression in plasma glucose level, brain lipid values, serum acid phosphatase, alkaline and lactate dehydrogenase and hepatic glucose-6-phosphate.

The effect of extract of stem of *Tinospora cordifolia* is studied on the contractile response based on various agonists. The known mechanism of antagonistic action of *Guduchi* is due to an uptake blocking effect of *Tinospora cordifolia* or inhibition of metabolism by COMT since MAO inhibition would also produce potentiation of 5-HT responses.

Tinospora cordifolia extract contact can be brought about by the transport of particles via the blood or lymph to the sites of phagocytic cells. *Tinospora cordifolia* extract level in the blood may further increase the number of cells in the peritoneum and alter the ability of those that remain to function normally. Extracting CCL4 intoxicated rats may increase myelopoiesis monocyte, macrophage differentiation and expression and release of cytokinin and stimulate tumoricidal and microbicidal activities.

Tinospora cordifolia is rich in antioxidants which inhibit the free radicals, including superoxide radicals, peroxide, and hydroxyl radicals, in a biological system and rejuvenate the body function. The bleaching of DPHH absorption by a sample illustrates its capacity to scavenge free radicals.

CONCLUSION

The available *in-vitro* and *in-vivo* research were systematically reviewed, and the results indicate that *T. cordifolia* has antimicrobial, anti-parasitic, antioxidant, and free radical scavenging activities. *T. cordifolia* also reduces blood pressure, serum cholesterol, and blood glucose levels, indicating positive cardiovascular effects. Randomized controlled human trials will nevertheless be required to ascertain whether these effects have any implications for public health.

REFERENCES

- Huma Ali, Savita Dixit. Extraction Optimization of *Tinospora cordifolia* and Assessment of the Anticancer Activity of Its Alkaloid palmatine. The Scientific World Journal, 2013;10:2013
- Mishra, R., and Kaur, G. (2013). Aqueous ethanolic extract of *Tinospora cordifolia* as a potential candidate for differentiation-based therapy of glioblastomas. PLoS one, 8(10), e78764.
- Dhama, K., Sachan, S., Khandia, R., Munjal, A., Iqbal, H., Latheef, S. K., Karthik, K., Samad, H. A., Tiwari, R., and Dadar, M. (2017). Medicinal and Beneficial Health Applications of *Tinospora cordifolia* (*Guduchi*): A Miraculous Herb Countering Various Diseases/Disorders and its Immunomodulatory Effects. Recent patents on endocrine, metabolic and immune drug discovery, 10(2), 96–111.
- Jagetia, G. C., Nayak, V., and Vidyasagar, M. S. (1998). Evaluation of the antineoplastic activity of *Guduchi* (*Tinospora cordifolia*) in cultured HeLa cells. Cancer letters, 127(1-2), 71–82.
- Upadhyay, A. K., Kumar, K., Kumar, A., and Mishra, H. S. (2010). *Tinospora cordifolia* (Willd.) Hook. f. and Thoms. (*Guduchi*) - validation of Ayurvedic pharmacology through experimental and clinical studies. International journal of Ayurveda research, 1(2), 112–121.
- Jagetia, G. C., and Rao, S. K. (2006). Evaluation of the antineoplastic activity of *Guduchi* (*Tinospora cordifolia*) in Ehrlich ascites carcinoma bearing mice. Biological and pharmaceutical bulletin, 29(3), 460–466.
- Verma, R., Chaudhary, H.S. and Agrawal, R.C. (2011) Evaluation of Anticarcinogenic and Antimutagenic Effect of *Tinospora cordifolia* in Experimental Animals. Journal of Chemical and Pharmaceutical Research, 3, 877-881.
- Bhawana Sharma, Rajesh Dabur, Protective Effects of *Tinospora cordifolia* on Hepatic and Gastrointestinal Toxicity Induced by Chronic and Moderate Alcoholism, *Alcohol and Alcoholism*, Volume 51, Issue 1, 1 January 2016, Pages 1–10
- Dhama, K., Sachan, S., Khandia, R., Munjal, A., Iqbal, H., Latheef, S. K., Karthik, K., Samad, H. A., Tiwari, R., and Dadar, M. (2017). Medicinal and Beneficial Health Applications of *Tinospora cordifolia* (*Guduchi*): A Miraculous Herb Countering Various Diseases/Disorders and its Immunomodulatory Effects. Recent patents on endocrine, metabolic and immune drug discovery, 10(2), 96–111.
- Upadhyay, A. K., Kumar, K., Kumar, A., and Mishra, H. S. (2010). *Tinospora cordifolia* (Willd.) Hook. f. and Thoms. (*Guduchi*) - validation of the Ayurvedic pharmacology through experimental and clinical studies. International journal of Ayurveda research, 1(2), 112–121.
- Bishayi, B., Roychowdhury, S., Ghosh, S., and Sengupta, M. (2002). Hepatoprotective and immunomodulatory properties of *Tinospora cordifolia* in CCl4 intoxicated mature albino rats. The Journal of toxicological sciences, 27(3), 139–146.
- Bhawana Sharma, Rajesh Dabur, Protective Effects of *Tinospora cordifolia* on Hepatic and Gastrointestinal Toxicity Induced by Chronic and Moderate Alcoholism, *Alcohol and Alcoholism*, Volume 51, Issue 1, 1 January 2016, Pages 1–10
- Patgiri, B., Umretia, B. L., Vaishnav, P. U., Prajapati, P. K., Shukla, V. J., and Ravishankar, B. (2014). Anti-inflammatory activity of *Guduchi Ghana* (aqueous extract of *Tinospora cordifolia* Miers.). *Ayu*, 35(1), 108–110.
- Philip, S., Tom, G., and Vasumathi, A. V. (2018). Evaluation of the anti-inflammatory activity of *Tinospora cordifolia* (Willd.) Miers chloroform extract - a preclinical study. The Journal of pharmacy and pharmacology, 70(8), 1113–1125.
- Birla, H., Rai, S. N., Singh, S. S., Zahra, W., Rawat, A., Tiwari, N., Singh, R. K., Pathak, A., and Singh, S. P. (2019). *Tinospora cordifolia* Suppresses Neuroinflammation in Parkinsonian Mouse Model. *Neuromolecular medicine*, 21(1), 42–53
- Upadhyay, A. K., Kumar, K., Kumar, A., and Mishra, H. S. (2010). *Tinospora cordifolia* (Willd.) Hook. f. and Thoms. (*Guduchi*) - validation of the Ayurvedic pharmacology through experimental and clinical studies. International journal of Ayurveda research, 1(2), 112–121.
- Sarma, D.N.K., Khosa, R.L., Chaurasia, J.P.N. and Sahai, M. (1996) Antistress Activity of *Tinospora cordifolia* and *Centella asiatica* Extracts. *Phytotherapy Research*, 10, 181-183.
- Baghel, P. (2017) Plant of Versatile properties of *Tinospora cordifolia* (*Guduchi*). *International Journal of Agriculture Innovations and Research*, 5, 751-753.
- Dhama, K., Sachan, S., Khandia, R., Munjal, A., Iqbal, H., Latheef, S. K., Karthik, K., Samad, H. A., Tiwari, R., and Dadar, M. (2017). Medicinal and Beneficial Health Applications of *Tinospora cordifolia* (*Guduchi*): A Miraculous Herb Countering Various Diseases/Disorders and its Immunomodulatory Effects. Recent patents on endocrine, metabolic and immune drug discovery, 10(2), 96–111
- Upadhyay, A. K., Kumar, K., Kumar, A., and Mishra, H. S. (2010). *Tinospora cordifolia* (Willd.) Hook. f. and Thoms. (*Guduchi*) - validation of the Ayurvedic pharmacology through experimental and clinical studies. International journal of Ayurveda research, 1(2), 112–121.
- Priyanka Sharma, Bharat P. Dwivedi, Dheeraj Bisht, Ashutosh K. Dash, Deepak Kumar. The chemical constituents and diverse pharmacological importance of *Tinospora cordifolia*, *Heliyon*, Volume 5, Issue 9, 2019, e02437, ISSN 2405-8440.
- Priyanka Sharma, Bharat P. Dwivedi, Dheeraj Bisht, Ashutosh K. Dash, Deepak Kumar. The chemical constituents and diverse pharmacological importance of *Tinospora cordifolia*, *Heliyon*, Volume 5, Issue 9, 2019, e02437, ISSN 2405-8440.
- Dhama, K., Sachan, S., Khandia, R., Munjal, A., Iqbal, H., Latheef, S. K., Karthik, K., Samad, H. A., Tiwari, R., and Dadar, M. (2017). Medicinal and Beneficial Health Applications of *Tinospora cordifolia* (*Guduchi*): A Miraculous Herb Countering Various Diseases/Disorders and its Immunomodulatory Effects. Recent patents on endocrine, metabolic and immune drug discovery, 10(2), 96–111.
- Upadhyay, A. K., Kumar, K., Kumar, A., and Mishra, H. S. (2010). *Tinospora cordifolia* (Willd.) Hook. f. and Thoms. (*Guduchi*) - validation of the Ayurvedic pharmacology through experimental and clinical studies. International journal of Ayurveda research, 1(2), 112–121.
- Singh, D., and Chaudhuri, P. K. (2017). Chemistry and Pharmacology of *Tinospora cordifolia*. *Natural product communications*, 12(2), 299–308.
- Shivananjappa, M. M., and Muralidhara (2012). Abrogation of maternal and fetal oxidative stress in the streptozotocin-induced diabetic rat by dietary supplements of *Tinospora cordifolia*. *Nutrition* (Burbank, Los Angeles County, Calif.), 28(5), 581–587.
- Ract, A., Mehra, R., Naved, T., Arora, M., Madan, S., and Adv, J. (2013). Standardization and Evaluation of Formulation Parameters of *Tinospora cordifolia* Tablet.
- Mathew George, Lincy Josepha, Minu Mathew. A Research on screening of learning and memory enhancing activity of whole plant extract of *Tinospora cordifolia* (Willd). *Pharma Innovation* 2016;5(7):104-107.

29. Premanath, R., and Lakshmidhevi, N. (2010). Studies on Antioxidant activity of *Tinospora cordifolia* (Miers.) Leaves using *in vitro* models.
30. Prince, P. S., Kamalakkannan, N., and Menon, V. P. (2004). Antidiabetic and antihyperlipidemic effect of alcoholic *Syzygium cumini* seeds in alloxan-induced diabetic albino rats. *Journal of ethnopharmacology*, 91(2-3), 209–213.
31. Jayaprakash, R., Ramesh, V., Sridhar, M. P., and Sasikala, C. (2015). Antioxidant activity of ethanolic extract of *Tinospora cordifolia* on N-nitrosodiethylamine (diethylnitrosamine) induced liver cancer in male Wister albino rats. *Journal of Pharmacy and bioallied sciences*, 7(Suppl 1), S40–S45.
32. Upadhyay, A. K., Kumar, K., Kumar, A., and Mishra, H. S. (2010). *Tinospora cordifolia* (Willd.) Hook. f. and Thoms. (*Guduchi*) - validation of the Ayurvedic pharmacology through experimental and clinical studies. *International journal of Ayurveda research*, 1(2), 112–121.
33. Priyanka Sharma, Bharat P. Dwivedi, Dheeraj Bisht, Ashutosh K. Dash, Deepak Kumar. The chemical constituents and diverse pharmacological importance of *Tinospora cordifolia*, *Heliyon*, Volume 5, Issue 9, 2019, e02437, ISSN 2405-8440.
34. Upadhyay, A. K., Kumar, K., Kumar, A., and Mishra, H. S. (2010). *Tinospora cordifolia* (Willd.) Hook. f. and Thoms. (*Guduchi*) - validation of the Ayurvedic pharmacology through experimental and clinical studies. *International journal of Ayurveda research*, 1(2), 112–121.
35. Jeyachandran, R., Xavier, T. F., and Anand, S. P. (2003). Antibacterial activity of stem extracts of *Tinospora cordifolia* (Willd.) Hook. f and Thomson. *Ancient science of life*, 23(1), 40–43.
36. Narayanan, A.S., Raja, S.S., Ponnuragan, K., Kandekar, S., Natarajaseenivasan, K., Maripandi, A., and Mandeel, Q.A. (2011). Antibacterial activity of selected medicinal plants against multiple antibiotic resistant uropathogens: a study from Kolli Hills, Tamil Nadu, India. *Beneficial microbes*, 2 3, 235-43.
37. Singh, K., Panghal, M., Kadyan, S., Chaudhary, U., and Yadav, J. P. (2014). Green silver nanoparticles of *Phyllanthus amarus*: as an antibacterial agent against multi drug resistant clinical isolates of *Pseudomonas aeruginosa*. *Journal of nanobiotechnology*, 12, 40.
38. Priyanka Sharma, Bharat P. Dwivedi, Dheeraj Bisht, Ashutosh K. Dash, Deepak Kumar. The chemical constituents and diverse pharmacological importance of *Tinospora cordifolia*, *Heliyon*, Volume 5, Issue 9, 2019, e02437
39. Alrumaihi, F., Allemailem, K. S., Almatroudi, A., Alsahli, M. A., Khan, A., and Khan, M. A. (2019). *Tinospora cordifolia* Aqueous Extract Alleviates Cyclophosphamide- Induced Immune Suppression, Toxicity and Systemic Candidiasis in Immunosuppressed Mice: *In vivo* Study in Comparison to Antifungal Drug Fluconazole. *Current pharmaceutical biotechnology*, 20(12), 1055–1063.
40. Dhama, K., Sachan, S., Khandia, R., Munjal, A., Iqbal, H., Latheef, S. K., Karthik, K., Samad, H. A., Tiwari, R., and Dadar, M. (2017). Medicinal and Beneficial Health Applications of *Tinospora cordifolia* (*Guduchi*): A Miraculous Herb Countering Various Diseases/Disorders and its Immunomodulatory Effects. *Recent patents on endocrine, metabolic and immune drug discovery*, 10(2), 96–111.
41. Shanthi, V. and Nelson, R. (2013) Antibacterial Activity of *Tinospora cordifolia* (Willd) Hook. F. Thoms on Urinary Tract Pathogens. *International Journal of Current Microbiology and Applied Sciences*, 2, 190-194.
42. Stanely Mainzen Prince, P., and Menon, V. P. (2003). Hypoglycemic and hypolipidemic action of alcohol extract of *Tinospora cordifolia* roots in chemical induced diabetes in rats. *Phytotherapy research: PTR*, 17(4), 410–413.
43. Dhama, K., Sachan, S., Khandia, R., Munjal, A., Iqbal, H., Latheef, S. K., Karthik, K., Samad, H. A., Tiwari, R., and Dadar, M. (2017). Medicinal and Beneficial Health Applications of *Tinospora cordifolia* (*Guduchi*): A Miraculous Herb Countering Various Diseases/Disorders and its Immunomodulatory Effects. *Recent patents on endocrine, metabolic and immune drug discovery*, 10(2), 96–111.
44. Abiramasundari, G., Sumalatha, K.R. and Sreepriya, M. (2012) Effects of *Tinospora cordifolia* (Menispermaceae) on the Proliferation, Osteogenic Differentiation and Mineralization of Osteoblast Model Systems in Vitro. *Journal of Ethnopharmacology*, 141,474-480.
45. Gao, L., Cai, G., and Shi, X. (2008). Beta-ecdysterone induces osteogenic differentiation in mouse mesenchymal stem cells and relieves osteoporosis. *Biological and pharmaceutical bulletin*, 31(12), 2245–2249.
46. Upadhyay, A. K., Kumar, K., Kumar, A., and Mishra, H. S. (2010). *Tinospora cordifolia* (Willd.) Hook. f. and Thoms. (*Guduchi*) - validation of the Ayurvedic pharmacology through experimental and clinical studies. *International journal of Ayurveda research*, 1(2), 112–121.
47. Goel, B., Pathak, N., Nim, D. K., Singh, S. K., Dixit, R. K., and Chaurasia, R. (2014). Clinical evaluation of analgesic activity of *Guduchi* (*Tinospora cordifolia*) using animal model. *Journal of clinical and diagnostic research: JCDR*, 8(8), HC01–HC4.
48. Upadhyay, A. K., Kumar, K., Kumar, A., and Mishra, H. S. (2010). *Tinospora cordifolia* (Willd.) Hook. f. and Thoms. (*Guduchi*) - validation of the Ayurvedic pharmacology through experimental and clinical studies. *International journal of Ayurveda research*, 1(2), 112–121.
49. Shanbhag, T., Shenoy, S., and Rao, M. C. (2005). Wound healing profile of *Tinospora cordifolia*. *Indian Drugs*, 42(4), 217-221.

Cite this article as:

Himanshu Rawat et al. Medicinal properties of Guduchi (*Tinospora cordifolia*): S systematic review. *Int. J. Res. Ayurveda Pharm.* 2022;13(5):143-150
<http://dx.doi.org/10.7897/2277-4343.1305143>

Source of support: Nil, Conflict of interest: None Declared

Disclaimer: IJRAP is solely owned by Moksha Publishing House - A non-profit publishing house, dedicated to publishing quality research, while every effort has been taken to verify the accuracy of the content published in our Journal. IJRAP cannot accept any responsibility or liability for the site content and articles published. The views expressed in articles by our contributing authors are not necessarily those of IJRAP editor or editorial board members.