



Comprehensive Pharmacology Review of *Guduchi* [*Tinospora cordifolia* (Willd.) Miers]

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ABSTRACT

Aim: This review aims to explore various pharmacological studies carried out on *Tinospora cordifolia* and exploit the therapeutic utility to combat different diseases.

Background: *Guduchi* [*Tinospora cordifolia* (Willd.) Miers] is a precious medicinal plant in Ayurveda, the Indian system of medicine. The plant has long been used in Indian traditional medicine by the tribal and nontribal communities for treating a variety of diseases.

Results: Different pharmacology studies of *Guduchi* illustrated in this review show that this medicinal plant possesses antidiabetic, antioxidant, cognition, anti-inflammatory, analgesic, and wound-healing, anticancer, antimalarial, immunomodulatory, and hepatoprotective activities.

Conclusion: The present review confirms the effectiveness of *Guduchi* (*Tinospora cordifolia*) in the prevention and treatment of different health ailments. However, an extensive research and development work on the herb targeting drug characterization and exploring their mechanism of action is essential for validating its potential in preventing and treatment of diseases.

Clinical significance: *Tinospora cordifolia* showed excellent antihyperglycemic, hypoglycemic, anti-inflammatory, and hepatoprotective activity. It also has beneficial effects on immune modulation for diabetic foot ulcer healing.

Keywords: Analgesic, Anti-inflammatory, *Guduchi*, Medicinal properties.

How to cite this article: Upadhyay S, Bora M, Kawlni L, Mukherjee K, Hazra J. Comprehensive Pharmacology Review of *Guduchi* [*Tinospora cordifolia* (Willd.) Miers]. *J Drug Res Ayurvedic Sci* 2018;3(1):48-52.

Source of support: Nil

Conflict of interest: None

BACKGROUND

"*Guduchi*," also commonly known as *Giloy* [*Tinospora cordifolia* (Willd.) Miers], is an important Ayurvedic herb

used as *Rasayana*. The herb is used for the treatment of various diseases like jaundice, urinary problems, rheumatoid arthritis, skin diseases, dyspepsia, dysentery, chronic diarrhea, and leprosy. The plant also possesses antistress and immunomodulatory properties. The medicinal uses of *Guduchi* are well documented in various classical texts, viz. *Charak Samhita*, *Sushrut Samhita*, and *Ashtang Hridaya*.^{1,2}

REVIEW RESULTS

Antidiabetic Activity

Guduchi extracts showed *in vitro* glucose uptake stimulatory activity in Ehrlich ascites tumor cells model.³ *Guduchi* at the dose of 200 µg/mL was similar to insulin and greater than standard drug pioglitazone.⁴ Aldose reductase inhibition of aqueous extract of *Guduchi* stem was observed with an IC₅₀ of 103 µg/mL in rat lens *in vitro*.⁵ Both alcoholic and aqueous extracts of *Guduchi* stem in the doses of 200 and 400 mg/kg body weight significantly reduced the fasting blood glucose levels after 10 and 30 days of treatment in streptozotocin-induced diabetic rats and had an efficacy of 40 to 80% compared with insulin.⁶ Oral administration of *Guduchi* roots extract for 6 weeks showed significant reduction of glucose and lipids in serum in alloxan-induced diabetic rats.⁷ The plant at 1 or 2% concentration as dietary supplements attenuated embryopathy in streptozotocin-induced diabetic pregnant rats and showed protection against maternal and fetal diabetes-induced oxidative stress.⁸ Aqueous extract of *Guduchi* in the dose of 400 mg/kg per day after 3 and 15 weeks of treatment showed reduction of blood glucose in diabetic mice.⁹ Oral dosing of alcoholic extract of *Guduchi* whole plant at 20 mg/kg body weight twice daily half an hour prior to feeding from day 2 to 30 significantly decreased blood sugar level in alloxan-induced diabetic rats.¹⁰ Sedimental extract of *Guduchi* in the dose of 1000 mg/kg *per os* for 30 days showed decrease in blood glucose level in streptozotocin-induced type 2 diabetic rats.¹¹ Stem extract of *Guduchi* at 500 mg/kg body weight, orally for 15 days showed antidyslipidemic and antidiabetic activity in alloxan-induced diabetic rats.¹² Alcoholic extract of *Guduchi* roots in the oral dose of 400 mg/kg prevented alloxan-induced diabetic cataract in rats.¹³ *Guduchi* plant extracts (200 mg/kg orally for 40 days) improved renal damage and prevented

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polyuria and renal hypertrophy in mice.¹⁴ Administration of aqueous extract of *Guduchi* roots for 6 weeks in the doses of 2.5 and 5.0 gm/kg body weight showed significant antidyslipidemic activity in diabetic rats.¹⁵ Alcoholic extract of *Guduchi* in the oral dose of 20 mL/kg of body weight, twice daily showed significant antihyperglycemic activity in diabetic animals.¹⁰ Petroleum ether, methanol, and aqueous extracts of *Guduchi* administered at the dose of 400 mg/kg orally for 28 days significantly reduced blood glucose, triglyceride, and total cholesterol level in streptozotocin-induced diabetic rats.¹⁶ Oral administration of aqueous extract of the plant at the dose of 42.34 mg/kg decreased the blood glucose level by 24.93% in diabetic rats.¹⁷

Osteoprotective Activity

Guduchi extract in the dose of 10 mg/kg body weight showed osteoprotective effect in rats. Bone loss in the tibia of rats was slower as compared with controls, while serum osteocalcin and cross-lap levels were significantly reduced following extract treatment.¹⁸

Anti-inflammatory and Analgesic Activity

Aqueous extracts of *Guduchi* significantly inhibited inflammation and pain on cotton pellet granuloma and formalin-induced arthritis models which was comparable to indomethacin.¹⁹ Administration of leaf and leaf callus ethanolic extracts of *Guduchi* in the dose of 100 mg/kg body weight showed significant reduction in paw volume on carrageenan-induced hind paw edema in albino rats.²⁰

Hepatoprotective Activity

Aqueous extract of aerial parts of *Guduchi* orally up to 30 days demonstrated significant protection against carbon tetrachloride (CCl₄)-induced hepatotoxicity in rats.²¹ Oral administration of petroleum ether, ethanol and aqueous extracts of leaf, stem, and roots of *Guduchi* at the doses of 200 mg/kg body weight exerted significant hepatoprotective activity in Wistar rats.²²

Cognition Activity

Oral administration of alcoholic as well as aqueous extract of *Guduchi* whole plant at the doses of 200 and 100 mg/kg for 10 days decreased learning scores and retention memory in rats.²³

Antioxidant Activity

Methanolic extracts of *Guduchi* stem exhibited antioxidant activity and decreased the activity of superoxide dismutase and glutathione peroxidase in diabetic rats.⁷

Guduchi leaf extracts showed alpha-glucosidase inhibiting and hydroxyl radical scavenging activities.²⁴ It also produced protective effect against aflatoxin-induced nephrotoxicity.²⁵ The aqueous extract of *Guduchi* also showed radio protective activity in mice.²⁶ Ethanol and methanol extracts of *Guduchi* stem showed *in vitro* anti-oxidant activity in DPPH assay.²⁷

Antimicrobial Activity

Guduchi showed antimicrobial activity against different strains of bacteria.²⁸ *In vitro*, *Guduchi* inhibited the growth of *Escherichia coli*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Proteus vulgaris*, *Salmonella typhi*, *Shigella flexneri*, *Salmonella paratyphi*, *Salmonella typhimurium*, *Pseudomonas aeruginosa*, *Enterobacter aeruginosa*, and *Enterobacter aerogenes*.^{29,30}

Immunomodulatory Activity

Guduchi possesses immunomodulatory activity.³¹ Various active compound or substances present in *Guduchi* are responsible for its excellent immunomodulatory activity.³² Variety of compounds present in this plant enhanced phagocytic activity of macrophages³³ and increased production of reactive oxygen species (ROS) in human neutrophil cells.³⁴

Wound-healing Activity

Methanolic extract of *Guduchi* showed excellent wound-healing activity by increasing granulation tissue tensile strength, and decreasing epithelialization period in excision and incision wound model in mice.³⁵

Anticancer Activity

Alcoholic extract of *Guduchi* slowed down the tumor growth and increased the lifespan of Dalton's lymphoma-bearing mice and was also effective in Ehrlich ascites carcinoma in mice.^{36,37}

EFFECTS ON CENTRAL NERVOUS SYSTEM

Petroleum ether and ethanol extracts of leaf, stem, and *Guduchi* roots decreased the locomotor activity of mice after 2 hours of oral administration. Both aqueous and ethanol extracts of *Guduchi* reduced spontaneous locomotor activity in rats.³⁸ Ethanolic extract of *Guduchi* has been shown to have antipsychotic activity in amphetamine-challenged mice model.³⁹

Clinical Pharmacology

Aqueous leaf digest of *Guduchi* showed a significant ability to reduce blood sugar levels in human subject.⁴⁰

Guduchi attenuated altered liver functions and the herb was found to be safe for therapeutic usage in the dose of 500 mg/day for 21 days.⁴¹ *Guduchi* significantly decreased all symptoms of allergic rhinitis and demonstrated to have significant effect in wound healing on diabetic foot ulcers.^{42,43}

DOSE AND MODE OF ADMINISTRATION

Oral dose of *Guduchi* is 3 to 6 gm in powder form.⁴⁴

Safety and Toxicity

There was no change in body weight, food and water consumption, and no mortality recorded in Swiss mice following oral administration exposure of *Guduchi* aerial parts with a dose of 3, 5, 7, and 9 mL/kg decoction and 2, 4, 6, and 8 gm/kg body weight whole-plant powder.⁴⁵ Aqueous extract of *Guduchi* did not show toxicity administered orally up to 800 mg/kg to rats.²¹ Single-dose oral administration of aqueous extract of *Guduchi* at a dose of 150 mg/kg body weight showed no sign of toxicity.⁴⁶ No adverse effect and no mortality were recorded in rats following administration of aqueous and alcoholic extract of *Guduchi* whole plant.²³

Herb–drug Interactions

Pretreatment with *Guduchi* could not produce any significant effect on pharmacokinetics of cyclophosphamide and methotrexate. *Guduchi* showed reversal of immune suppression associated with cyclophosphamide.⁴⁷ Berberine extracted from *Guduchi* enhanced the effects of metformin and 2,4-thiazolidinedione.⁴⁸ *Guduchi* showed an antagonist effect when combined with insulin indicating a possible plant–drug interaction.⁴

CONCLUSION

Various preclinical and clinical pharmacological studies illustrated in the present review confirm the effectiveness of *Guduchi* (*Tinospora cordifolia*) in the prevention and treatment of different health ailments. However, an extensive research and development work on the plant targeting drug characterization and exploring its mechanism of action would help in exploring *Guduchi* for its potential in prevention and treatment of diseases.

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हिन्दी सारंश

गुडूची (*टिनोस्पोरा कॉर्डिफोलिया*) की विस्तृत भेषजगुण विज्ञानीय समीक्षा

लक्ष्य: यह समीक्षा गुडूची (*टिनोस्पोरा कॉर्डिफोलिया*) पर किए गए विभिन्न शोधों के निरीक्षण और रोगों से निपटने के लिए उसकी चिकित्सीय उपयोगिता का लाभ उठाने के लिए किया गया है।

पृष्ठभूमि: भारतीय चिकित्सा पद्धति, आयुर्वेद, में गुडूची (*टिनोस्पोरा कॉर्डिफोलिया*) एक बहुमूल्य औषधीय पादप है। देश के विभिन्न हिस्सों में *टिनोस्पोरा कॉर्डिफोलिया* व्यापक रूप से आदिवासी या लोक चिकित्सा में उपयोग किया जाता है।

परिणामों की समीक्षा: गुडूची के औषधीय गुणों पर विभिन्न समीक्षा के अध्ययन से पता चलता है कि यह औषधीय पादप मधुमेह रोधी, एंटीऑक्सिडेंट, अनुभूति (सीखने और स्मृति), शोधरोधी, दर्दनिवारक, व्रणरोपण, कैंसर रोधी, मलेरिया-रोधी, इम्यूनोमॉड्यूलेटरी और हिपेटोप्रोटेक्टिव चिकित्सीय गतिविधि से युक्त है।

निष्कर्ष: वर्तमान समीक्षा विभिन्न स्वास्थ्य संबंधित रोगों के उपचार में गुडूची (*टिनोस्पोरा कॉर्डिफोलिया*) के प्रभावकारिता की पुष्टि करता है। इसके अलावा एक व्यापक अनुसंधान और विकास कार्य किया जाना चाहिए ताकि रोगों को रोकने और उपचार करने में *टिनोस्पोरा कॉर्डिफोलिया* की क्षमता का पता लगाया जा सके।

आतुरीय महत्व: गुडूची में अतिशर्करारोधी, अल्पशर्करारोधी, शोधरोधी एवं यकृत सुरक्षा गतिविधि पाई गई। इसमें मधुमेह जन्य पादव्रणरोपण के लिए रोगप्रतिरोध क्षमतावर्धन में लाभदायक प्रभाव भी होता है।

शब्द कुंजी: गुडूची, एंटी इन्फ्लामेट्री, एनाल्जेसिक, औषधीय गुण।

