

CHEMISTRY AND MEDICINAL PROPERTIES OF *TINOSPORA CORDIFOLIA* (GUDUCHI)

S.S. SINGH, S.C. PANDEY, S. SRIVASTAVA, V.S. GUPTA, B. PATRO,
A.C. GHOSH

Chembiotek Research International, Block-BN, Plot-7, Sector-V, Salt Lake Electronic Complex,
Kolkata-700 091.

Manuscript Received: 7.5.2002 Revised: 5.9.2002 Accepted: 9.9.2002

ABSTRACT *Tinospora cordifolia* (Guduchi) is a widely used shrub in folk and ayurvedic systems of medicine. This review presents a detailed survey of the literature on chemistry and medicinal properties of *Tinospora cordifolia*. The chemical constituents reported from this shrub belong to different classes such as alkaloids, diterpenoid lactones, glycosides, steroids, sesquiterpenoid, phenolics, aliphatic compounds and polysaccharides. The notable medicinal properties reported are anti-diabetic, anti-periodic, anti-spasmodic, anti-inflammatory, anti-arthritis, anti-oxidant, anti-allergic, anti-stress, anti-leprotic, anti-malarial, hepatoprotective, immunomodulatory and anti-neoplastic activities.

KEY WORDS Anti-diabetic anti-oxidant alternative medicine phytochemistry

Introduction

Guduchi [*Tinospora cordifolia* (Willd.) Miers ex Hook. F. & Thoms] is a large, glabrous, deciduous climbing shrub belonging to the family Menispermaceae^{1,2}. 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, which is a Hindu mythological term that refers to the heavenly elixir that have saved celestial beings from old age and kept them eternally young. The stem of *Tinospora cordifolia* are rather succulent with long filiform 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 lenticels. 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. Fruits are fleshy and single seeded. Flowers grow during the summer and fruits during the winter^{1,3}.

Guduchi is widely used in veterinary folk medicine/ ayurvedic system of medicine for its general tonic, anti-periodic, anti-spasmodic, anti-inflammatory, anti-arthritis, anti-allergic and anti-diabetic properties²⁻⁶. The plant is used in ayurvedic, "Rasayanas" to improve the immune system and the body resistance against infections. The root of this plant is known for its anti-stress, anti-leprotic and anti-malarial activities^{6,7}. Authors investigated earlier one of the plants of the family Menispermaceae and found that the constituents and activities were similar to other reports^{8,9}.

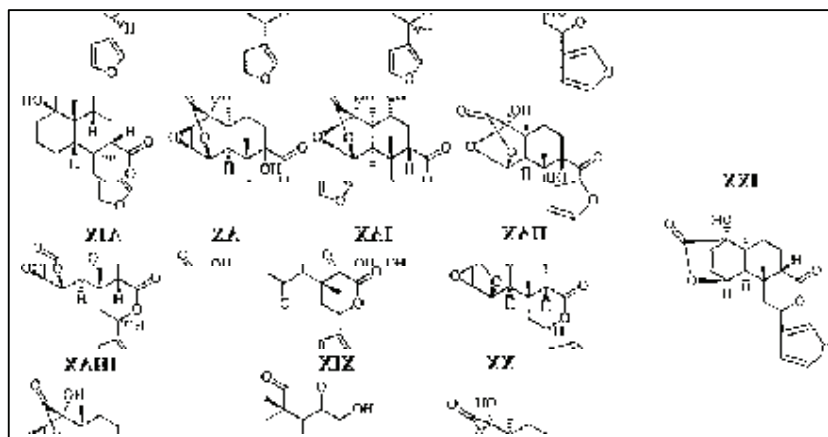
Chemistry

A variety of constituents have been isolated from *Tinospora cordifolia* plant and their structures were elucidated. They belong to different classes such as alkaloids, diterpenoid lactones, glycosides, steroids, sesquiterpenoid, phenolics, aliphatic compounds and polysaccharides.

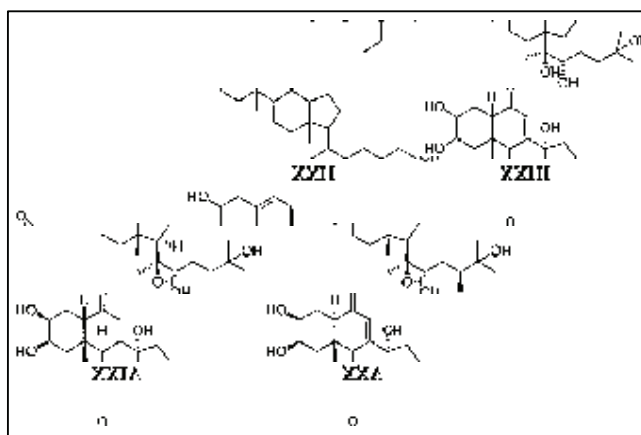
Leaves of this plant are rich in protein (11.2%) and are fairly rich in calcium and phosphorus^{6,10}. Studies

Correspondence: S.S. Singh
e-mail: singh_ss@hotmail.com

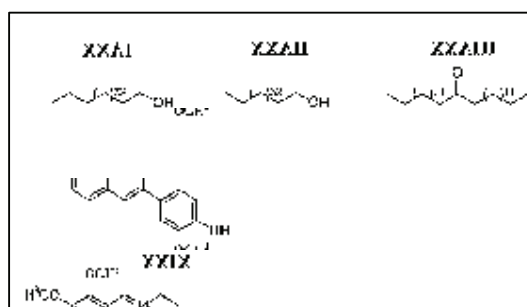
Type of Chemical	Active principle with references	Part in which present
Diterpenoid Lactones	Furanolactone XIV ³³ , Clerodane derivatives XV, XV ^β ^{4,35} and XVII [(5R,10R)-4R-8R-dihydroxy-2S-3R:15,16- diepoxy-cleroda-13 (16), 14-dieno-17, 12S: 18,1S-dilactone] ³⁶ and Tinosporon ³⁷ , Tinosporides XVIII ^{1,22,38-43} and XIX ^{1,22,38-43} , Jateorine (XX) ^{1,38-43} , Columbin (XXI) ^{1,22,38-43}	Whole plant



Steroids	β -sitosterol (XXII) ⁴⁴⁻⁴⁷ , δ -sitosterol ⁴⁴⁻⁴⁷ , 20 β - hydroxy ecdysone (XXIII) ⁴⁴⁻⁴⁷ .	Aerial part
	Ecdysterone (XXIV) ⁴⁸⁻⁵⁰ , Makisterone A (XXV) ⁴⁸⁻⁵⁰ , Giloinsterol ⁴⁸⁻⁵⁰ .	Stem



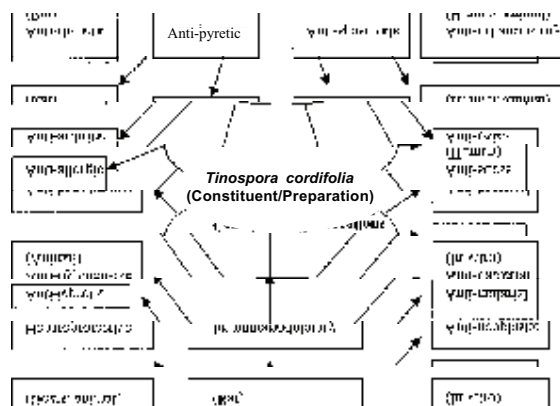
Type of Chemical	Active principle with references	Part in which present
Sesquiterpenoid	Tinocordifolin ⁵¹ .	Stem
Aliphatic compound	Octacosanol (XXVI) ⁴⁵⁻⁴⁷ , Heptacosanol (XXVII) ⁴⁵⁻⁴⁷ , Nonacosan-15-one (XXVIII) ⁴⁵⁻⁴⁷	Whole plant
Miscellaneous compounds	3, (α , 4-dihydroxy-3-methoxy-benzyl)-4-(4-hydroxy-3-methoxy-benzyl)-tetrahydrofuran ⁴⁵⁻⁴⁷ . Jatrorrhizine (XXIX) ⁵² . Tinosporidine ^{17,47,53} , Cordifol ^{17,47,53} , Cordifellone ^{17,47,53} , N-trans-feruloyl tyramine as diacetate ⁵⁴ , Giloin ^{48,55} , Giloinin ^{48,55} , Tinosporic acid ^{48,55} .	Whole plant Root Whole plant



on the physical characteristic and chemical composition of the starch obtained from Guduchi Satwa (extract) were carried out and the polysaccharide was found to consist chiefly of 1→4 linked glucan with occasionally branched points^{11,12}. Its similarities and differences from amylose were elucidated. An arabinogalactan had been isolated from the dried stems of *T. cordifolia*¹³.

Medicinal properties

The stem of *Tinospora cordifolia* is one of the constituents of several ayurvedic preparations used in general debility, dyspepsia, fever and urinary diseases. The stem is bitter, stomachic, diuretic⁵⁶, stimulates bile secretion, causes constipation, allays thirst, burning sensation, vomiting, enriches the blood and cures jaundice. The extract of its stem is useful in skin diseases^{57,58}. The root and stem of *T. cordifolia* are prescribed in combination with other drugs as an anti-dote to snake bite and scorpion sting^{2,3,6}. Dry barks of *T. cordifolia* has anti-spasmodic, anti-pyretic⁵⁹, anti-allergic⁶⁰, anti-inflammatory^{61,62} and anti-leptotic⁶³ properties.



The aqueous extract of the stem antagonizes the effect of agonists such as 5-hydroxytryptamine, histamine, bradykinin and prostaglandins E1 and E2 on the rabbit smooth muscle, relaxes the intestinal, uterine smooth muscle and inhibits the constrictor response of histamine and acetylcholine on smooth muscle. Intravenous exposure to aqueous extract of *T. cordifolia* in doses of 5.0, 10.0 and 15.0 mg/kg body

weight produces a temporary but marked fall in blood pressure and bradycardia in anaesthetized dogs¹.

T. cordifolia is widely used in Indian ayurvedic medicine for treating diabetes mellitus⁶⁴⁻⁶⁶. Oral administration of an aqueous *T. cordifolia* root extract to alloxan diabetic rats caused a significant reduction in blood glucose and brain lipids. Though the aqueous extract at a dose of 400 mg/kg could elicit significant anti-hyperglycemic effect in different animal models, its effect was equivalent to only one unit/kg of insulin⁶⁷.

It is reported that the daily administration of either alcoholic or aqueous extract of *T. cordifolia* decreases the blood glucose level and increases glucose tolerance in rodents^{68,69}. Aqueous extract also caused a reduction in blood sugar in alloxan-induced hyperglycemia in rats and rabbits in the dose of 400 mg/kg. However, histological examination of pancreas has not revealed any evidence of regeneration of β -cells of islets of Langerhans and the possible mode of action of the plant is through glucose metabolism⁷⁰. The aqueous extract has also exhibited some inhibitory effect on adrenaline-induced hyperglycemia. Ethyl acetate extract of its roots has afforded a pyrrolidine derivative with hypoglycemic activity in rabbits⁷¹⁻⁷³. Another study has also revealed significant hypoglycemic effect of extract of leaves in normal and alloxan diabetic rabbits. However, the extract had no significant effect on total lipid levels in normal or treated rabbits^{74,75}.

T. cordifolia is reported to benefit the immune system in a variety of ways^{30,76,77}. The alcoholic and aqueous extracts of *T. cordifolia* have been tested successfully for immuno-modulatory activity⁷⁸⁻⁸⁴. Pre-treatment with *T. cordifolia* was to impart protection against mortality induced by intra-abdominal sepsis following coecal ligation in rats. It has also significantly reduced the mortality from *E. coli* induced peritonitis in mice. In a clinical study, it has afforded protection in cholestatic patients against *E. coli* infection. These activities are not due to its anti-bacterial activity as shown by the negative in-vitro anti-bacterial activity of the plant extract^{78,85}. It is reported that the treatment in rats had resulted in significant leucocytosis and predominant neutrophilia. It has been also observed that it stimulates the macrophages as evidenced by an increase in the number and % phagocytosis of

S. aureus by peritoneal macrophages in rats⁸⁶. Other workers have also supported these observations. The phagocytic and Intra-cellular killing capacity of polymorphs in rats, tested at 3.5 h after *E. coli* infection were significant^{87,88}.

The anti-stress and tonic property of the plant was clinically tested and it was found that it brought about good response in children with moderate degree of behaviour disorders and mental deficit. It has also significantly improved the I.Q. levels.

The hepatoprotective action of *T. cordifolia* was reported in one of the experiment in which goats treated with *T. cordifolia* have shown significant clinical and hemato-biochemical improvement in CCl₄ induced hepatopathy. Extract of *T. cordifolia* has also exhibited *in vitro* inactivating property against Hepatitis B and E surface antigen in 48-72 h⁸⁹.

The aqueous extract of *T. cordifolia* exerted a significant anti-inflammatory effect on cotton pellet granuloma and formalin induced arthritis models. Its effect was comparable with Indomethacin and its mode of action appeared to resemble that of a non-steroidal anti-inflammatory agent. The dried stem of *T. cordifolia* produced significant anti-inflammatory effect in both acute and subacute models of inflammation. *T. cordifolia* was found to be more effective than acetylsalicylic acid in acute inflammation. But in subacute inflammation, the drug was inferior to phenylbutazone⁹⁰. In a clinical evaluation, a compound preparation 'Rumalaya' containing *T. cordifolia* was reported to significantly reduce the pain in patients suffering from rheumatoid arthritis¹.

The aqueous extract of roots of *T. cordifolia* has shown the anti-oxidant action in alloxan diabetes rats. The administration of the extract of *T. cordifolia* roots (2.5, 50 mg/kg body weight) for 6 weeks resulted in a significant reduction of serum and tissue cholesterol, phospholipids and free fatty acids in alloxan diabetic rats⁹¹.

Jagetia *et al.*, have found that guduchi killed the HeLa cells very effectively *in vitro* and thus it indicates that guduchi needs attention as an anti-neoplastic agent⁹². In this study exposure of HeLa cells to 0, 5, 10, 25, 50 and 100 μ g/ml of guduchi extract (methanol, aqueous and methylene chloride) resulted in a dose dependent but significant increase in cell killing when compared to non drug treated controls.

Ether extract of the stem distillate of aerial part of *T. cordifolia* has inhibited the *in vitro* growth of *Mycobacterium tuberculosis* at 1:50,000 dilution⁹³. Its ethanolic extract has exhibited significant antipyretic activity in experimental rats. 'Septilin' syrup, a compound preparation containing *T. cordifolia* (7.82% in 5 ml of syrup) was found to elicit good clinical response in children suffering from upper respiratory tract infection and chronic otitis media⁹⁴.

The Ayurveda literature reports that it can cause constipation, if taken regularly in high doses; it has no side effect and toxicity. Yet the safety and the potential indications in human beings have to be established using modern methods.

REFERENCES

- Anonymous. Wealth of India: Raw materials, Vol X. New Delhi: CSIR; 1976.
- Nadkarni KM, Nadkarni AK, editors. Indian Materia Medica, Vol 1. 3rd ed. Mumbai: M/S Popular Prakasan Pvt. Ltd; 1976.
- Kirtikar KR, Basu BD, editors. Indian Medicinal Plants, Vol 1. 2nd ed. New Connaught Place, Dehra Dun: M/S Bishen Singh, Mahendra Pal Singh; 1975.
- Chopra RN, Nayar SL, Chopra IC, editors. Glossary of Indian Medicinal plants. New Delhi: CSIR; 1956.
- Chopra RN, Chopra LC, Handa KD, Kapur LD, editors. Indigenous Drugs of India. 2nd ed. Kolkata: M/S Dhar VN & Sons; 1982.
- Zhao TF, Wang X, Rimando AM, Che C. Folkloric medicinal plants: *Tinospora sagittata* var. *cravaniana* and *Mahonia bealei*. *Planta Med* 1991;**57**:505.
- Nayampalli S, Ainapure SS, Nadkarni PM. Study of anti-allergic acid Bronchodilator effects of *Tinospora cordifolia*. *Indian J Pharm* 1982;**14**:64-6.
- Agarwal SK, Singh SS, Verma S, Kumar S. Two picrotoxin derivatives from *Anamirta cocculus*. *Phytochemistry* 1999;**50**:1365-8.
- Agarwal SK, Singh SS, Verma S. Antifungal principle of sesquiterpene lactones from *Anamirta cocculus*. *Indian Drugs* 1999;**36**:754-5.
- Khosa RL, Prasad S. Pharmacognostical studies on Guduchi (*Tinospora cordifolia* Miers). *J Res Ind Med* 1971;**6**:261-9.
- Mehra PN, Puri HS. Studies on Gaduchi satwa. *Indian J Pharm* 1969;**31**:180-2.
- Rao EV, Rao MV. Studies on the polysaccharide preparation (Guduchi satwa) derived from *Tinospora cordifolia*. *Indian J Pharm Sci* 1981;**43**:103-6.
- Chintalwar G, Jain A, Sipahimalani A, Banerji A, Sumariwalla P, Ramakrishnan R, et al. An immunologically active arabinogalactan from *Tinospora cordifolia*. *Phytochemistry* 1999;**52**:1089-94.
- Kumar S, Verma NS, Pande D, Srivastava PS. *In vitro* regeneration and screening of berberine in *Tinospora cordifolia*. *J Med Arom Plant Sci* 2000;**22**:61.
- Bisset NG, Nwaiwu J. Quaternary alkaloids of *Tinospora species*. *Planta Medica* 1983;**48**:275-9.
- Pachaly P, Schneider C. Alkaloids from *Tinospora cordifolia* Miers. *Arch Pharm (Weinheim Ger)* 1981;**314**:251-6.
- Qudrat-I-Khuda M, Khaleque A, Ray N. *Tinospora cordifolia*. I. Constituents of the plant fresh from the field. *Sci Res (Dacca)* 1964;**1**:177-83.
- Padhya MA. Biosynthesis of isoquinoline alkaloid berberine in tissue cultures of *Tinospora cordifolia*. *Indian Drugs* 1986;**24**:47-8.
- Sarma DNK, Padma P, Khosa RL. Constituents of *Tinospora cordifolia* root. *Fitoterapia* 1998;**69**:541-2.
- Khan MA, Gray AI, Waterman PG. *Tinosporaside*, an 18-norclerodane glucoside from *Tinospora cordifolia*. *Phytochemistry* 1989;**28**:273-5.
- Bhatt RK, Sabata BK. Furanoid diterpene glucoside from *Tinospora cordifolia*. *Phytochemistry* 1989;**28**:2419-22.
- Swaminathan K, Sinha UC, Bhatt RK, Sabata BK, Tavale SS. Structure of tinosporide, a diterpenoid furanolactone from *Tinospora cordifolia* Miers. *Acta Crystallogr C* 1989;**45**:134-6.
- Ghosal S, Vishwakarma RA. Tinocordiside, a New Rearranged Cadinane Sesquiterpene Glycoside from *Tinospora cordifolia*. *J Nat Prod* 1997;**60**:839-41.
- Maurya R, Wazir V, Tyagi A, Kapil RS. Clerodane diterpenoids from *Tinospora cordifolia*. *Phytochemistry* 1995;**38**:559-61.
- Maurya R, Dhar KL, Handa SS. A sesquiterpene glucoside from *Tinospora cordifolia*. *Phytochemistry* 1997;**44**:749-50.
- Wazir V, Maurya R, Kapil RS. Cordioside, a clerodane furanoid diterpene glucoside from *Tinospora cordifolia*. *Phytochemistry* 1995;**38**:447-9.

27. Maurya R, Wazir V, Tyagi A, Kapil RS. Cordifoliosides A and B, two new phenylpropene disaccharides from *Tinospora cordifolia* possessing immunostimulant activity. *Nat Prod Lett* 1996;**8**:7-10.
28. Gangan VD, Pradhan P, Sipahimalani AT, Banerji A. Cordifoliosides A, B, C: Norditerpene furan glycosides from *Tinospora cordifolia*. *Phytochemistry* 1994;**37**:781-6.
29. Sipahimalani AT, Noerr H, Wagner H. Phenylpropanoid glycosides and tetrahydrofuranlignan glycosides from the adaptogenic plant drugs *Tinospora cordifolia* and *Drypetes roxburghii*. *Planta Med* 1994;**60**:596-7.
30. Kapil A, Sharma S. Immunopotentiating compounds from *Tinospora cordifolia*. *J Ethnopharmacol* 1997;**58**:89-95.
31. Gangan VD, Pradhan P, Sipahimalani AT, Banerji A. Palmatosides C, F: Diterpene furan glucosides from *Tinospora cordifolia*-Structural elucidation by 2D NMR spectroscopy. *Indian J Chem Sec B* 1996;**35**:630-4.
32. Gangan VD, Pradhan P, Sipahimalani AT, Banerji A. Norditerpene furan glycosides from *Tinospora cordifolia*. *Phytochemistry* 1995;**39**:1139-42.
33. Hanuman JB, Bhatt RK, Sabata BK. A diterpenoid furanolactone from *Tinospora cordifolia*. *Phytochemistry* 1986;**25**:1677-80.
34. Bhatt RK, Hanuman JB, Sabata BK. A new clerodane derivative from *Tinospora cordifolia*. *Phytochemistry* 1988;**27**:1212-6.
35. Hanuman JB, Bhatt RK, Sabata BK. A clerodane furanoditerpene from *Tinospora cordifolia*. *J Nat Prod* 1988;**51**:197-201.
36. Swaminathan K, Sinha UC, Bhatt RK, Sabata BK. Structure of a new clerodane derivative from *Tinospora cordifolia* Miers. *Acta Crystallogr Sect C, Cryst Struct Commun* 1988;**C44**:1421-4.
37. Qudrat-I-Khuda M, Khaleque A, Abdul Bashir Kh, Rouf K, Md A, Ray N, *et al.* Studies on *Tinospora cordifolia* II. Isolation of tinosporon, tinosporic acid and tinosporol from the fresh creeper. *Sci Res (Dacca)* 1966;**3**:9-12.
38. Ahmad M, Kazi AB, Karim R, Khaleque A, Miah MAW. Structure of tinosporide, a furanoid diterpene from *Tinospora cordifolia* Miers. *J Bangladesh Acad Sci* 1978;**2**:25-30.
39. Ahmad M, Khaleque A, Miah MAW. Structure of tinosporide, a new furanoid diterpene. *Indian J Chem Sec B* 1978;**16**:317-8.
40. Bhatt RK, Sabata BK. Structure of tinosporide: Its identity in all respects with jateorin (1S, 2S, 3R, 4R, 5R, 8S, 10R, 12S)-4-hydroxy-2,3:15,16-diepoxycleroda-13(16), 14-dieno-17, 12:18, 1-biscarbolactone. *Indian J Chem Sec B* 1990;**29**:521-4.
41. Swaminathan K, Sinha UC, Ramakumar S. Structure of columbin, a diterpenoid furanolactone from *Tinospora cordifolia* Miers. *Acta Crystallogr, Sect C, Cryst Struct Commun* 1989;**C45**:300-3.
42. Swaminathan K, Sinha UC, Ramakumar S, Bhatt RK, Sabata BK. Structure of tinosporide, a diterpenoid furanolactone from *Tinospora cordifolia* Miers. *Acta Crystallogr, Sect C, Cryst Struct Commun* 1989;**C45**:134-6.
43. Akhila A, Rani K, Thakur RS. Biosynthesis of the clerodane furano-diterpene lactone skeleton in *Tinospora cordifolia*. *Phytochemistry* 1991;**30**:2573-6.
44. Pathak AK, Agarwal PK, Jain DC, Sharma RP, Howarth OW. NMR studies of 20 β -hydroxyecdysone, a steroid; isolated from *Tinospora cordifolia*. *Indian J Chem Sec B* 1995;**34**:674-6.
45. Dixit SN, Khosa RL. Chemical investigation of *Tinospora cordifolia*. *Indian J Appl Chem* 1971;**34**:46-7.
46. Hanuman JB, Mishra AK, Sabata BK. A Natural Phenolic Lignan From *Tinospora cordifolia* Miers. *J Chem Soc Perkin Trans* 1986;**7**:1181-6.
47. Khaleque A, Miah MAW, Huq MS, Abdul BK. *Tinospora cordifolia*. III. Isolation of tinosporidine, cordifol, heptacosanol and β -sitosterol. *Sci Res (Dacca)* 1970;**7**:61-2.
48. Kidwai AR, Salooja KC, Sharma VN, Siddiqui S. Chemical examination of *Tinospora cordifolia*. *J Sci Ind Res* 1949;**8**:115-8.
49. Pradhan P, Gangan VD, Sipahimalani AT, Banerji A. Two phytoecdysones from *Tinospora cordifolia*: Structural assignments by 2D NMR spectroscopy. *Indian J Chem Sec B* 1997;**36**:958-62.
50. Gangan VD, Pradhan P, Sipahimalani AT. Phytoecdysones from *Tinospora cordifolia*: Structural elucidation of Ecdysterone and makisterone A by 2D NMR spectroscopy. *Indian J Chem Sec B* 1997;**36**:787-92.
51. Maurya R, Handa SS. Tinocordifolin, a sesquiterpene from *Tinospora cordifolia*. *Phytochemistry* 1998;**49**:1343-6.
52. Sarma DNK, Khosa RL, Sahai M. Isolation of Jatrorrhizine from *Tinospora cordifolia* Roots. *Planta Med* 1995;**61**:98-9.
53. Khaleque A, Miah MAW, Huq MS, Abdul BK. *Tinospora cordifolia*. IV. Isolation of heptacosanol, β -sitosterol and three other compounds tinosporidine, cordifol and

- cordifolone. *Pak J Sci Ind Res* 1971;**14**:481-3.
54. Gangan VD, Pradhan P, Sipahimalani AT, Bhawe VG, Patil KA. N-trans-Feruloyltyramine from *Tinospora cordifolia*. *Indian J Chem Sec B* 1997;**36**:837-9.
 55. Chatterjee A, Ghosh S. Tinosporin, the furanoid bitter principle of *Tinospora cordifolia*. *Sci and Culture* (Calcutta, India) 1960;**26**:140-1.
 56. Nayampalli SS, Ainapure SS, Samant BD, Kudtarkar RG, Desai NK, Gupta KC, *et al.* A comparative study of diuretic effects of *Tinospora cordifolia* and hydrochloro-thiazide in rats and a preliminary phase I study in human volunteers. *J Postgrad Med* 1988;**34**:233-6.
 57. Aiyer KN, Kolammal M, editors. Pharmacognosy of Ayurvedic Drugs, Series 1. 1st ed. Trivendram: The Central Research Institute; 1963.
 58. Raghunathan K, Mitra R, editors. Pharmacognosy of Indigenous Drugs. New Delhi: Central Council for Research In Ayurveda & Siddha; 1982.
 59. Ikram M, Khattak SG, Gilani SN. Antipyretic studies on some indigenous Pakistani medicinal plants: II. *J Ethnopharmacol* 1987;**19**:185-92.
 60. Nayampalli SS, Desai NK, Ainapure SS. Anti-allergic properties of *Tinospora cordifolia* in animal models. *Indian J Pharm* 1986;**18**:250-2.
 61. Rai M, Gupta SS. The deposition of the secondary salts over the five pellets in rats was inhibited by the aqueous extract of *T. cordifolia*. *J Res Ind Med* 1966;**10**:113-6.
 62. Pendse VK, Dadhich AP, Mathur PN, Bal MS, Madam BR. Anti-inflammatory, immunosuppressive and some related pharmacological actions of the water extract of Neem Giloe (*Tinospora cordifolia*)-A preliminary report. *Indian J Pharm* 1977;**9**:221-4.
 63. Asthana JG, Jain S, Mishra A, Vijaykanth MS. Evaluation of antileprotic herbal drug combinations and their combination with Dapsone. *Indian Drugs* 2001;**38**:82-6.
 64. Stanely M, Prince P, Menon VP. Antioxidant action of *Tinospora cordifolia* root extract in alloxan diabetic rats. *Phytother Res* 2001;**15**:213-8.
 65. Prince PS, Menon VP. Antioxidant activity of *Tinospora cordifolia* roots in experimental diabetes. *J Ethnopharmacol* 1999;**65**:277-81.
 66. Mathew S, Kuttan G. Antioxidant activity of *Tinospora cordifolia* and its usefulness in the amelioration of cyclophosphamide-induced toxicity. *J Exp Clin Cancer Res* 1997;**16**:407-11.
 67. Dhaliwal KS. Method and composition for treatment of diabetes. US Patent 5886029. 1999.
 68. Gupta SS, Varma SCL, Garg VP, Rai M. Antidiabetic effect of *Tinospora cordifolia*. I. Effect on fasting blood sugar level, glucose tolerance and adrenaline induced hyperglycemia. *Indian J Exp Biol* 1967;**55**:733-45.
 69. Grover JK, Vats V, Rathi SS, Dawar R. Traditional Indian anti-diabetic plants attenuate progression of renal damage in streptozotocin induced diabetic mice. *J Ethnopharmacol* 2001;**76**:233-8.
 70. Raghunathan K, Sharma PV. The aqueous extract of *T. cordifolia* caused reduction of blood sugar in alloxan induced hyperglycemic rats and rabbits. *J Res Ind Med* 1969;**3**:203-9.
 71. Mahajan VR, Jolly CI. A new hypoglycaemic agent from *Tinospora cordifolia* Miers. *Indian Drugs* 1985;**23**:119-20.
 72. Grover JK, Vats V, Rathi SS. Anti-hyperglycemic effect of *Eugenia jambolana* and *Tinospora cordifolia* in experimental diabetes and their effects on key metabolic enzymes involved in carbohydrate metabolism. *J Ethnopharmacol* 2000;**73**:461-70.
 73. Stanely M, Prince P, Menon VP. Hypoglycaemic and other related actions of *Tinospora cordifolia* roots in alloxan-induced diabetic rats. *J Ethnopharmacol* 2000;**70**:9-15.
 74. Wadood N, Wadood A, Shah SA. Effect of *Tinospora cordifolia* on blood glucose and total lipid levels of normal and alloxan-diabetic rabbits. *Planta Med* 1992;**58**:131-6.
 75. Basnet P, Kadota S, Pandey RR, Takahashi T, Kojima Y, Shimizu M, *et al.* Screening of traditional medicines for their hypoglycemic activity in streptozotocin (STZ)-induced diabetic rats and a detailed study on *Psidium guajava*. *Wakan Iyakugaku Zasshi* 1995;**12**:109-7.
 76. Nagarkatti DS, Rege NN, Desai NK, Dahanukar SA. Modulation of Kupffer cell activity by *Tinospora cordifolia* in liver damage. *J Postgrad Med* 1994;**40**:65-7.
 77. Rege NN, Bapat RD, Koti R, Desai NK, Dahanukar S. Immunotherapy with *Tinospora cordifolia*: A new lead in the management of obstructive jaundice. *Indian J Gastroenterol* 1993;**12**:5-8.
 78. Thatte UM, Dahanukar SA. Immunotherapeutic modification of experimental infections by Indian medicinal plants. *Phytother Res* 1989;**3**:43-9.
 79. Thatte UM, Chhabria S, Karandikar SM, Dahanukar SA. Immunotherapeutic modification of *E. coli* induced abdominal sepsis and mortality in mice by Indian medicinal plants. *Indian Drugs* 1987;**25**:95-7.

80. Rege NN, Nazareth HM, Bapat RD, Dahanukar SA. Modulation of immunosuppression in obstructive jaundice by *Tinospora cordifolia*. *Indian J Med Res* 1989;90:478-83.
81. Manjrekar PN, Jolly CI, Narayanan S. Comparative studies of the immunomodulatory activity of *Tinospora cordifolia* and *Tinospora sinensis*. *Fitoterapia* 2000;71:254-7.
82. Dikshit V, Damre AS, Kulkarni KR, Gokhale A, Saraf MN. Preliminary screening of immunocin for immunomodulatory activity. *Indian J Pharm Sci* 2000;62:257.
83. Dahanukar SA, Thatte UM, Pai N, More PB, Karandikar SM, et al. Immunotherapeutic modification by *Tinospora cordifolia* of abdominal sepsis induced by caecal ligation in rats. *Indian J Gastroenterol* 1988;7:21-3.
84. Rege NN, Thatte UM, Dahanukar SA. Adaptogenic properties of six rasayana herbs used in Ayurvedic medicine. *Phytother Res* 1999;13:275-91.
85. Dhuley JN. Effect of some Indian herbs on macrophage functions in ochratoxin A treated mice. *J Ethnopharmacol* 1997;58:15-20.
86. Broker R, Bhatt JV. Symposium on antibacterial substances from soil, plants and other sources. XV. Phagocytic coefficient as a measure for evaluating plant antibiotics. *Indian J Pharm* 1953;15:309-10.
87. Thatte UM, Rao SG, Dahanukar SA. *Tinospora cordifolia* induces colony stimulating activity in serum. *J Postgrad Med* 1994;40:202-3.
88. Atal CK, Sharma ML, Kaul A, Khajuria A. Immunomodulating agents of plant origin. I: Preliminary screening. *J Ethnopharmacol* 1986;18:133-41.
89. Mehrotra R, Katiyar CK, Gupta AP. Hepatoprotective compositions and composition for treatment of conditions related to hepatitis B and E infection. US Patent 749296. 2000.
90. Jana U, Chattopadhyay RN, Shw BP. Preliminary studies on anti-inflammatory activity of *Zingiber officinale* Rosc., *Vitex negundo* Linn. and *Tinospora cordifolia* (Willid) Miers in albino rats. *Indian J Pharm* 1999;31:232-3.
91. Stanely M, Prince P, Menon VP, Gunasekaran G. Hypolipidaemic action of *Tinospora cordifolia* roots in alloxan diabetic rats. *J Ethnopharmacol* 1999;64:53-7.
92. Jagetia GC, Nayak V, Vidyasagar MS. Evaluation of the antineoplastic activity of guduchi (*Tinospora cordifolia*) in cultured HeLa cells. *Cancer Lett* 1998;127:71-82.
93. Gupta KC, Viswanathan R. Antituberculous substances from plants. *Antibiot & Chemother* 1956;6:194-5.
94. Vedavathy S, Rao KN. Antipyretic activity of six indigenous medicinal plants of Tirumala Hills, Andhra Pradesh, India. *J Ethnopharmacol* 1991;33:193-6.

SOUTHERN REGIONAL CONFERENCE OF THE INDIAN PHARMACOLOGICAL SOCIETY - 2003

Dates : 12 - 14 September, 2003

Venue : S.V. Medical College, Tirupati

For further details please contact:

Dr. N. Gopal Reddy
Professor & Head of the Department,
Department of Pharmacology,
Tirupati - 517 507.
Phone : 2233455