



Antimicrobial and phytochemical properties of *Tinospora cordifolia* Stem extract

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Abstract

Natural products with medicinal value are gradually gaining importance in clinical research due to their well-known property of no side effects as compared to synthetic drugs. *Tinospora cordifolia* (Willd.) commonly named as “Guduchi” is known for its immense application in the treatment of various diseases in the traditional Ayurvedic literature (Saha and Ghosh., 2012).

In the present study the aqueous, methanol, ethanol and acetone extract of *Tinospora cordifolia*, stem extract was screened for the presence of phytochemical components and tested for antifungal activity against five pathogens such as *Candida albicans*, *Aspergillus niger*, *Aspergillus fumigatus*, *Microsporum gypseum* and *Trichophyton rubrum* results revealed the presence of alkaloids, flavonoids, saponins, tannins, glycosides, Steroids, Anthraquinones and phenolic compounds. The acetone extracts had wide range of antibacterial activity against bacterial pathogens than the ethanol and methanol extract, where as aqueous extract were slightly higher antibacterial activity as ethanol extract. Antifungal activity of stem extract of *Tinospora cordifolia*, would lead to the establishment of some compounds that could be used to formulate new and more potent antimicrobial drugs of natural origin.

Key words: Phytochemical Screening, Antifungal activity, *Tinospora cordifolia*, stem extract.

Introduction

A large number of plants are being used in medicine for therapeutic or prophylactic purposes. The therapeutic properties of medicinal plants are attributed owing to the presence of active substances such as alkaloids, flavonoids, saponins, tannins, glycosides, Steroids, Anthraquinones and phenolic compounds. These natural compounds physiologically affect the body of human beings, interact with the pathogens and interrupt their growth at different stages of development and make the body disease free. Young stems of *Tinospora cordifolia* green with smooth surfaces and swelling at nodes, older ones show a light brown surface marked with warty protuberances due to circular lenticels, transversely smoothed



surface shows a radial structure with conspicuous medullary rays traversing porous tissues, taste bitter (Fig-1).

The use of plants and plant products as medicines could be traced as far back as the beginning of human civilization. It is Ayurveda, the foundation of medicinal science of Hindu culture, in its eight division deals with specific properties of drugs and various aspects of science of life and the art of healing (Rastogi and Mehrotra, 2002). Plants are the richest resource of drugs of traditional systems of medicine, modern medicines, nutraceuticals, food supplements, folk medicines, pharmaceutical intermediates and chemical entities for synthetic drugs (Hammer *et al.*, 1999). Emergence of multidrug resistant pathogens has been reported to be one of the leading causes of death world (Reddy *et al.*, 2009). wide with infectious diseases responsible for 68% of all deaths globally in 2012 (WHO, 2000). Many infectious microorganisms' are resistant to synthetic drugs and it has become the major concern for health institutions, pharmaceutical companies and governments all over the world; thus there is need for an alternative therapy (Tambekar and Dahikar, 2011).

It is widely used in Ayurveda for a variety of purposes associated with inflammation, allergies, neurology and glucose metabolism. The pharmaceutical significance of this plant is mainly stem and roots, which contain various bioactive compounds such as alkaloids, flavonoids, saponins, tannins, glycosides, Steroids, Anthraquinones and phenolic compounds, having various medicinal importances. Some of the important applications are *viz.* immunomodulatory or immunostimulatory, anti-neoplastic, anti-oxidant, anti-hyperglycemia, anti-hyperlipidemia, antituberculosis, hepatoprotection, anti-osteoporotic, anti-angiogenic, anti-malarial and anti-cancer.

Tinospora cardifolia (Giloe) is perhaps the most useful traditional medicinal plant. Every part of the plant has been used as traditional medicine for household remedy against various human ailments. The tree is still regarded as “Village dispensary” in India. Most of the parts of the plant such as leaves, stem and root contain compounds with proven antiseptic, antiviral, antipyretic, anti-inflammatory, antiulcer and antifungal properties. It has made an important contribution to the modern research due to its large number of medicinal properties. Different parts of the plant have shown antimicrobial, anti-inflammatory, analgesic, antipyretic, antiulcer, antidiabetic, antioxidant and anticancer activity. *Tinospora cardifolia* is a large deciduous climbing shrub found throughout India.

The ayurvedic name of the plant is Guduchi, Giloe or Amrita. In India, the extract of the plant is used as a remedy for many diseases including diabetes, hepatitis etc., The plant finds a special mention for its use in tribal or folk medicine in different parts of the country. The drug has been subjected to extensive phytochemical, pharmacological and clinical investigations and many interesting findings have been reported (Nadkarni, 2005).



Fig-1 *Tinospora cordifolia* (Willd.)

Many researchers had studied antimicrobial activity of other parts of plant like stem and root of *Tinospora cordifolia*, which are used to cure many infectious diseases in traditional system of medicine but still very, less work has been done on antibacterial activities of stem of *Tinospora cordifolia*. To prove the validity of traditional medicine the present work has been undertaken to evaluate the antimicrobial screening of stem of *Tinospora cordifolia* against the human bacterial pathogens.

Materials and Methods

Sample Collection

Fresh plant of *Tinospora cordifolia* (Willd.) were collected from G.B.Pant University of Agricultural & Technology, Pantnagar, (U.K). It was identified by Dr. Anju Pal, Scientist, G.B. Pant University of Agriculture And Technology, Pantnagar, Uttarakhand.

Chemicals & Hi-Media

Chloroform, hexane, methanol, Acetone, ethanol, ferric chloride, magnesium, petroleum ether, ethyl acetate, HCL, H₂SO₄, glacial acetate, Mayer's reagent, ammonia chloride, were from Merck Uttarakhand, (India).

Sabouraud dextrose media, Potato Dextrose broth, were from Hi-media laboratories, Mumbai, India.

Preparation of plant material

Stem was collected and dried at room temperature. The dried samples were powdered separately. 100gm each of the sample was extracted separately with different solvents starting with polar to non polar solvents



in the order of aqueous, ethanol, methanol and acetone. The crude residues were obtained by removing the solvents in rotary evaporator and each of the extracts were resuspended in the respective solvents for further study.

Preparation of extracts: Solvent extraction method 30 gm of dried powder of *Tinospora cordifolia*, stem was extracted with aqueous, ethanol, methanol and acetone using soxhlet apparatus for 48 hrs. The collected extracts were filtered with Whatman No.1 filter paper and used for estimation of phytochemicals and antibacterial activity.

Phytochemical screening: Phytochemical screening of *Tinospora cordifolia*, stem extract qualitatively to test for the presence of alkaloids, flavonoids, saponins, tannins, glycosides, phenolic compound, Steroids and Anthraquinones were carried out with the following methods (Khandelwal, 2001).

Test for Alkaloids: To 4 ml of extract filtrate, a drop of Mayer's reagent was added along the sides of test tube. Creamy yellow or white precipitate indicates that the test is positive.

Test for Flavonoids: A volume of 1.5 ml of 50 % methanol was added to 4 ml of the extracts. The solution and magnesium metal was added and warmed. Then, 5 to 6 drops of concentrated hydrochloric acid was added to the solution and observed for red coloration.

Test for Saponins: Two ml of distilled water was added to 2 ml of the test solution shaken well and observed for frothing.

Test for Tannins: To 0.5 ml of extract solution, 1 ml of distilled water and 1 to 2 drops of ferric chloride solution was added, observed for blue or green black coloration.

Test for Glycosides: To 4 ml of extract solution and add few drops of glacial acetic acid, few drops of ferric chloride and concentrated sulphuric acid and observed for a reddish brown coloration at the junction of 2 layers and bluish green colour in upper layer.

Test for phenolic compounds: Two ml of extract was diluted to 5 ml with distilled water. To this a few drops of neutral 5 % ferric chloride solution was added. A dark green colour indicates the presence of phenolic compounds

Test for Steroids (Salkowski's test): Five drops of concentrated sulphuric acid (H₂SO₄) was added to 2 ml of each extract and observed for red coloration.

Test for Anthraquinones: 1 gm of powdered plant material was taken and extracted with 10 ml of hot water for five minutes and filtered. Filtrate was extracted with 10 ml of CCl₄ then CCl₄ layer was taken off. Five ml water and 5 ml dilute ammonia solution was added. No free anthraquinones were revealed as

absence of appearance of pink to cherry red colour. 1 gm of second sample of the same plant material was extracted with 10 ml of ferric chloride solution and 5 ml of hydrochloric acid then it was heated on water bath for 10 minutes and filtered. Filtrate was cooled and treated as mentioned above.

Antifungal activity using disc diffusion method:

Fungal cultures: The standard pathogenic fungal cultures were procured from IMTECH, Chandigarh, India and used in the present study (Table 1). The fungal culture rejuvenated in Sabouraud dextrose media, (Hi-media laboratories, Mumbai, India) incubate at 37 °C for 18h and then stocked at 4 °C in Sabouraud Dextrose Agar (SDA). Subcultures were prepared from the stock for bioassay. A loopful of culture was inoculated in 10 ml of sterile Potato Dextrose broth and incubated at 37 °C for 24h. Turbidity of the culture was standardized to 10⁵ CFU with the help of Turbidometer.

Table 1: Fungal cultures used in study (IMTECH, Chandigarh, India).

Sr.No.	Fungal Cultures	MTCC Number
1.	<i>Candida albicans</i>	183
2.	<i>Aspergillus niger</i>	478
3.	<i>Aspergillus fumigates</i>	870
4.	<i>Microsporum gypseum</i>	7675
5.	<i>Trichophyton rubrum</i>	296

The modified paper disc diffusion was employed to determine the antifungal activity of solvent extract of stem of *Tinospora cordifolia*. For antifungal properties, 0.1 ml fungal suspension of 10⁵ Cfu/ml was uniformly spread on Potato Dextrose Agar (PDA) plate to form lawn cultures. The petroleum ether, chloroform, ethyl acetate and methanol extracts were prepared in their respective solvents in such a manner that ultimate amount (in dry form) in each disc came to 10mg, 8mg, 6mg, 4mg and 2mg. The blotting paper discs (10mm diameter) were soaked in various diluted extract, dried in oven at 60 °C to remove excess of solvent and tested for their antifungal activity against fungal pathogens by disc diffusion technique. After incubation of 24 h at 37 °C, zone of inhibition of growth was measured in mm. The antifungal activity was classified according to the zone of inhibition such as strong (19-22mm), moderate (15-18mm) and mild (11-14mm). Griseofulvin 10mcg (Hi-Media disc) was used as positive control while discs soaked in various organic solvents and dried were placed on lawns as negative control.

Results and Discussion



Phytochemical screening revealed presence of alkaloids, flavonoids, saponins, tannins, glycosides and phenolic bioactive compound suggesting it to be a potential medicinal plant.

The medicinal plant of Giloe, is being used traditionally for the treatment of inflammation, wound healing, carminative, cough, toothache, antiseptics expectorant, stomatitis and some fungal infection like candidiasis. In this context, natural, multifunctional, stable, non-toxic and natural compounds from plants which are pharmacologically effective or with low or no side effects are preferred for use in preventive Ayurvedic medicine and in food industry (Sati *et al.*, 2010).

The antibacterial activity has been attributed to the presence of some active constituents in the extracts. The phytochemical analysis of *Tinospora cordifolia* extract had earlier been reported. Phytochemical screening of the stem extract of *Tinospora cordifolia* in the present study also revealed presence of alkaloids, flavonoids, saponins, tannins, glycosides, Steroids, Anthraquinones and phenolic compounds. Study suggested a number of active constituents might be present in the *Tinospora cordifolia*, stem extract to control gastroduodenal ulcers.

However, a glycoside appeared to be the major bioactive component that offers antisecretory and antiulcer effects. Plant glycosides, which are not normally toxic when ingested orally, are known to inhibit chloride transport in the stomach. Phytochemical screening of the stem extract of *Tinospora cordifolia* in the present study also revealed presence of alkaloids, flavonoids, saponins, tannins, glycosides and phenolic compounds.

Table 2: Phytochemical analysis of stem extract of *Tinospora cordifolia*.

Sr.NO.	Phytochemical Constitutes	Aqueous Extract	Ethanol Extract	Methanol Extract	Acetone Extract
1.	Alkaloids	+ve	+ve	+ve	+ve
2.	Flavonoids	+ve	+ve +ve	+ve +ve	+ve +ve +ve
3.	Glycosides	+ve	+ve	+ve	+ve
4.	Saponins	-ve	+ve +ve	+ve +ve	+ve
5.	Steroids	-ve	+ve	+ve	+ve
6.	Tannins	+ve	+ve +ve	+ve +ve +ve	+ve +ve +ve
7.	Anthraquinones	-ve	+ve	+ve	+ve
8.	Phenolic compounds	-ve	+ve +ve +ve	+ve +ve +ve	+ve +ve +ve

-ve : absent, +ve: present in low concentration, +ve+ve: present in moderate concentration, +ve +ve +ve: present in high concentration.

Table 3: Antifungal activity of *Tinospora cordifolia*, stem extracts against fungal pathogens (Zone of inhibition of growth in mm, average of 3 readings).

Plant	Solvent Extract	<i>Candida albicans</i>	<i>Aspergillus niger</i>	<i>Aspergillus fumigatus</i>	<i>Microsporium gypseum</i>	<i>Trichophyton rubrum</i>
Tinospora Cordifolia	Aqueous	25 mm	20 mm	29 mm	6 mm	24 mm
	Ethanol	22 mm	18 mm	27 mm	18 mm	26 mm
	Methanol	26 mm	24 mm	29 mm	22 mm	28 mm
	Acetone	26 mm	28 mm	29 mm	23 mm	28 mm
Positive control	Griseofulvin (10mcg) Hi-media disc.	30 mm	25 mm	22 mm	18 mm	20 mm
Negative Control	Water	-ve	-ve	-ve	-ve	-ve
	Ethanol	-ve	-ve	-ve	-ve	-ve
	Methanol	-ve	-ve	-ve	-ve	-ve
	Acetone	-ve	-ve	-ve	-ve	-ve

According to Antifungal activity of *Tinospora cordifolia*, stem extracts against fungal pathogens (Zone of inhibition of growth in mm, average of 3 readings) Table 3, shown the petroleum ether extract exhibited strong inhibitory activity against *Candida albicans* and *Aspergillus niger*, but had a moderate antifungal activity against *Aspergillus fumigatus*, *Microsporium gypseum* and mild antifungal activity against *Trichophyton rubrum*. Chloroform extract showed moderate antifungal activity against *Candida albicans*, *Aspergillus fumigatus*, and mild antifungal activity against *Aspergillus niger*, *Microsporium gypseum*, *Trichophyton rubrum*. Ethyl acetate extract showed moderate antifungal activity against *Candida albicans*, *Aspergillus fumigatus*, and mild antifungal activity against *Aspergillus niger*, *Microsporium gypseum* and *Trichophyton rubrum*.

Ethanol extract showed strong antifungal activity against *Aspergillus fumigatus*, *Trichophyton rubrum*, but moderate antifungal activity against *Candida albicans* and mild antifungal activity against *Aspergillus niger*, *Microsporium gypseum*. Methanol extract showed strong antifungal activity against *Aspergillus fumigatus*, *Trichophyton rubrum* but had moderate antifungal activity against *Candida albicans* and mild antifungal activity against *Aspergillus niger*, *Microsporium gypseum*.

Plant extracts of *Tinospora cordifolia* have been reported to have potential against microbial infections. The anti-bacterial activity of *Tinospora cordifolia* stem extracts has been assayed against various Gram



positive and Gram negative organisms. The antimicrobial activity of *Tinospora cordifolia* stem extracts was investigated against bacteria causing UTIs viz. uropathogens, *Escherichia coli* and *Staphylococcus aureus*.

The study conducted using disc diffusion method showed that all three solvent extracts of *Tinospora cordifolia* reveal different antibacterial activity against both uropathogenic isolates with decreasing order as ethanolic (maximum) > methanolic (moderate) > aqueous (poor) (Priyanka *et al.*, 2015). The larger zones of inhibition exhibited by *Tinospora cordifolia* stem extract. against *A. niger* may be due to the presence of variety of active compounds. This is well known, since tannins and saponins are important plant metabolites which is responsible for their antimicrobial activity. From the results obtained, the stem extract of *Tinospora cordifolia* showed antifungal activity among the entire fungal organism. This suggests that *T. cordifolia* contains more of the active compounds and has high potency. In the present study the biological activity of the acetone extract of *Tinospora cordifolia* can be attributed to the synergistic effect of the combination of flavonoids, steroids, terpenoids and saponins. Phenolic compounds are widely found in the secondary products of medicinal plants, as well as in many edible plants (Hagerman *et al.*, 1998).

Conclusion

In present study, *Tinospora cordifolia* has shown better potential antimicrobial activity. suggests that the identified phytochemicals may be the bioactive constituents responsible for the efficacy of stem extract of *Tinospora cordifolia*. It may be concluded from this study that *Tinospora cordifolia* stem extract has potential antimicrobial activity. This can explain that the host plant will gain some of the activities when they survive on medicinal plants. It is essential that research should continue to isolate and purify the active components of this natural herb and use in experimental animals.

The results obtained in this study reveals the different potential antimicrobial activity manipulations in prevention or control of diseases. Natural products from dietary components such as Indian species and medicinal plants are known to possess antimicrobial activity.

it is concluded that phytochemical components as flavonoids, saponins, tannins, glycosides, Steroids, Anthraquinones and phenolic compounds of *Tinospora cordifolia*, stem extract responsible for antimicrobial activity.

References

1. Badar, V.A., Thawani, V.R., Wakode, P.T., Shrivastava, M.P., Gharpure, K.J. and Hingorani, L.L. 2005. Efficacy of *Tinospora cordifolia* in allergic rhinitis. *Journal of Ethnopharmacology* **96**: 445-449.



2. Grover, J.K., Rathi, S.S. and Vats, V. 2002a. Amelioration of experimental diabetic neuropathy and gastropathy in rats following oral administration of plant (*Eugenia jambolana*, *Mucuna pruriens* and *Tinospora cordifolia*) extracts. Indian Journal of Experimental Biology **40**: 273-276.
3. Gupta, R.S. and Sharma, A. 2003. Antifertility effect of *Tinospora cordifolia* (Willd.) stem extract in male rats. Indian Journal of Experimental Biology **41**: 885-889.
4. Hanuman, J.B., Bhatt, R.K. and Sabata, B.K. 1986. A diterpenoid furanolactone from *Tinospora cordifolia*. Phytochemistry **25**: 1677.
5. 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**: 460-466.
6. 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**: 40-43.
7. Kapur, P., Jarry, H., Wuttke, W., Pereira, B.M. and Seidlova-Wuttke, D. 2008. Evaluation of the antiosteoporotic potential of *Tinospora cordifolia* in female rats. Maturitas **59**: 329-338.
8. Khaleque, A., Maith, M.A.W., Huq, M.S. and Basar, K.A. 1970. *Tinospora cordifolia* IV. Isolation of heptacosanol, β sitosterol and three other compounds tinosporine, cordifol and cordifolone. Pakistan Journal of Science and Industrial Research **7**: 61.
9. Khosa, R.L. and Prasad, S. 1971. Pharmacognostical studies on Guduchi *Tinospora cordifolia* (Miers). Journal of Research in Indian Medicine **6**: 261.
10. Manjreker, P.N., Jolly, C.I. and Narayanan, S. 2000. Comparitive studies of immunomodulatory activity of *Tinospora cordifolia* and *Tinospora sinensis*. Fitoterapia **71**: 254-257.
11. Mathew, S. and Kuttan, G. 1999. Immunomodulatory and antitumor activities of *Tinospora cordifolia*. Fitoterapia **70**: 35-43.
12. Nagaraja, P.K., Kammar, K.F. and Devi, S. 2007. Modulation of morphology and some gluconeogenic enzymes activity by *Tinospora cordifolia* (Willd.) in diabetic rat kidney. Biomedical Research **18**: 179-183.

13. Pachey, P. and Schneidir, J. 1981. Alkaloids from *Tinospora cordifolia* Miers. Archives of Pharmacology **314**: 251.
14. Patil, M., Patki, P., Kamath, H.V. and Patwardhan, B. 1997. Antistress ativity of *Tinospora cordifolia* (Willd) Miers. Indian Drugs **34**: 211-215.
15. Rajalakshmi, M., Eliza, J., Priya, E.C., Nirmala, A. and Daisy, P. 2009. Antidiabetic properties of *Tinospora cordifolia* stem extracts on streptozotocin induced diabetic rats. African Journal of Pharmacy and Pharmacology **3**: 171-180.
16. Singh, J., Sinha, K., Sharma, A., Mishra, N.P. and Khanuja, S.P. 2003. Traditional uses of *Tinospora cordifolia* (Guduchi). Journal of Medicinal and Aromatic Plant Science **25**: 748-751.