

Article Review: on *Tinospora Cordifolia* Chemical Constituents and Medicinal Properties

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Abstract

Traditional systems of medicine such as Ayurvedic, Uninai, Siddha and Homeopathy (AYUSH) have been in practice in a great account. Owing to population rise, inadequate supply of drugs, prohibitive cost of treatments, side effects of several allopathic drugs and development of resistance to currently used drugs for diseases have led to increased emphasis on the use of plant materials as a source of medicines for a wide variety of human ailments as witnessed by the use of folk medicines in the present scenario. This review article describes the prominence of a medicinal plant *Tinospora cordifolia* in therapeutics such as use of crude extract of plant for the amelioration of various diseases, morphology, growth constraints, biochemical composition, biological activities, research work done, projects sanctioned to this plant species and the future prospects of this important neglected plant species for research in the field of plant tissue culture, natural products and nano-biotechnology. *Tinospora cordifolia* is a widely used shrub in folk and Ayurvedic systems of medicine all over India. Though almost all of its parts are used in traditional systems of medicines, leaves stem and roots are the most important parts which are used medicinally. *Tinospora cordifolia* is a versatile resource for all forms of life. It belongs to family Menispermaceae. It contains many different chemicals that affect the body. The present review aims to summarize the information concerning the chemical constituents and medicinal aspects of the *Tinospora cordifolia* plant.

Keywords: Medicinal plants, *Tinospora cordifolia*, pharmacology, Herbal drugs

INTRODUCTION

Tinospora Cordifolia commonly called as guduchi is a natural herbal shrub that belongs to the mooseed family menispermaceae this plant is useful in treatment of several disease like jaundice, skin disease, goat diabetes etc. which has been established in the history of traditional medicine practices.(1)

Medicinal plants have been used as natural medicines. This practice has been in existence since prehistoric times. There are different ways in which plants have been found useful in medicines such as crude extract of plants has been used directly because of the presence of natural chemical constituents such as berberine, morphine, psilocin, vincristine etc.(2) and natural compounds for the synthesis of drugs such as tubocurarine, colchicine, nicotine, quinine etc. for therapeutic purpose by folk people. Many modern medicines such as digitalis, vinblastine, aspirin, quinine and paracetamol had their origin from

the natural compounds of medicinal plants viz., foxglove (*Digitalis purpurea*), madagascar periwinkle (*Vinca rosea*), willow bark (*Salix* spp.), quinine bark (*Cinchona officinalis*), respectively (3). 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, glycosides, vitamins, tannins, and coumarins (4). 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. *Tinospora cordifolia* (Willd.) Miers ex Hook. f. and Thoms belonging to the family Menispermaceae, is a large, deciduous, climbing shrub found throughout India, especially in the tropical parts ascending to an altitude of 300 m. and also in certain parts of China (5). It is known as heart leaved Moonseed plant in English, Guduchi in Sanskrit and Gilroy in Hindi.

1. Growth Requirement

The plant is very rigid and it can be grown in almost all climates but prefers warm climate. Planting is usually done during rainy season (July to August). As it is a climber so it requires support for its growth. Fast growing species such as Neem (*Azadirachta indica*), Jatropha (*Jatropha curcas*) and Moringa (*Moringa oleifera*) have been planted to provide support for its growth. *Tinospora cordifolia* growing with Neem (*Azadirachta indica*) is called as NEEM GILOY. It has a chemical composition similar to neem as well as giloy and shows better therapeutic properties (6). *T. cordifolia* prefers medium black or red soil for its cultivation.

2. Growth Constraints

T. cordifolia can be propagated by seeds and vegetative cuttings. However, both the ways are not suitable for large scale production and having problems in traditional methods of propagation.

3. Morphological Description

Tinospora cordifolia is a large deciduous, extensively spreading climbing shrub with a number of coiling branches. Different parts of *Tinospora* have the following type of morphology.

4. Stem

Stem of this plant is rather succulent with long, filiform, fleshy and climbing in nature. Aerial roots arise from the branches. The bark is creamy white to grey in colour and deeply left spirally (7) (Figure 1A)

5. Aerial Root:

Aerial roots are present, these aerial roots are characterized by tetra to penta-arch primary structure. However, cortex of root is divided into outer thick walled and inner parenchymatous zone (8). (Figure 1F).

6. Leaves

Leaves of this plant are simple, alternate, exstipulate, long petioled approximately 15 cm, round, pulvinate, heart shaped, twisted partially and half way round. Lamina is ovate, 10-20 cm long, 7 nerved and deeply cordate at the base and membranous (9) (Figure 1B).



Fig1: Morphology of different parts of *T. cordifolia* A. Stem, B. Leaf, C. Fruit,

D. Inflorescence, E. Flower, F. Aerial Roots.

7. Flowers

Flowers are unisexual, racemes, greenish yellow in colour, appears when plant is leaf less. Male flowers are clustered and female flowers exist in solitary inflorescence. Sepals are 6 in 2 series of 3 each. Outer ones are smaller than the inner sepals. Petals are also 6, smaller than sepals, free and membranous. Flowering occurs during March to June (10) (Figure 1D AND 1E).

10. Fruit

They are orange-red in colour, fleshy, aggregate of 1-3 and ovoid, smooth, drupelets on thick stalk with a sub terminal style scars. Fruits develop during winter (11)(Figure 1C).

11. Seed

Curved seed have been reported in this species. Hence this family is named as moonseed family also. As seeds are curved in shape, embryo also turned in to curve shape automatically. Moreover, the endocarp is variously ornamented and provides important taxonomic characters.

Biological Activities

The major biological activities of *Tinospora cordifolia* summarized in the following manner

Active component	Compound	Plantpart	Biological Activity (Inhuman being)	References
Alkaloids	Berberine, choline, Tinosporin, Aporphine alkaloids	Stem, Root	Anti-viral infections, Anti- cancer, Anti-diabetes, inflammation	(12-17)

Diterpenoid Lactones	Furanolactone, Clerodane. Derivatives, Tinosporon Tinosporides	Whole Plant	Vasorelaxant : relaxes norepinephrine induced contractions, inhibits Ca ⁺⁺ , Anti-microbial	(18-22)
Glycosides	18-norclerodan glucoside, Furanooidditerpene glucoside, Tinocordisi de	Stem	Treats neurological disorders like ALS, Parkinson, demerntia	(23-29)
Steroids	Ecdysterone, Makisterone A, Giloinsterole	Shoot	IgA neuropathy, glucocorticoi dinduced osteoporosis in earlyinflammatoriory arthritis	(30-32)
Sesquiterpenoid	Tinocardifolin	Stem	Antiseptic	(33)
Aliphatic Compound	Octacosanol, Heptacosanol Nonacosan-15-onedichloromethane	Whole Plant	Anti- nociceptive, Anti-inflammatory	
Others	Tinosporidine, Cordifol, Cordifelone, Giloinin	Root, whole Plant	Protease inhibitors for HIV and drug resistant HIV.	(37-38)

Table 1: Major and sub groups of natural products present in different parts of *Tinospora cordifolia* and their biological activities

HISTORY

Ayurveda a 5,000-year-old system of medicine, names three elemental substance such as Kapha, Vata and Pitta rooted in Indian scriptures known as The Vedas. As per Ayurvedic text viz: Ashtang Hridaya and Sushrut, Charak and other treaties like Bhava Prakash and Dhanvantri Nighantu *T. cordifolia* named as : Amara, Amritvalli, Chinmarruha, Chinnodebha and Vatsadani etc, and most commonly recognised as Guduchi or Amrita.(39-43). In Sushurta Samhita, under Tikta-SakaVarga, it is traditionally claimed for the treatment of several diseases like Svasa (asthma), Maha Jvara (fever), Aruci (anorexia) and kusta (leprosy).(44)

In context of Ashtang Hridaya and Charak Samhita, there is also a great evidence for the treatment of different diseases like Jvara (fever), Vat Rakta (gout) and Kamala (jaundice). Guduchi has been considered by European practitioners in India as a major source of medicament like tonic, diuretic and antiperiodic and further it was comprised in Bengal

Pharmacopoeia of 1868.19 According to Ayurvedic literature *T. cordifolia* is a major constituent of formulations, used for the treatment of several disease such as dyspepsia, urinary related diseases debility and fever. Some of the imperative formulations prepared from *T. cordifolia* are: Guduchi taila, Sanjivani vati, Kanta-Kari avaleha, Guduchyadi churna, Chyavnaprasha, Guduchu ghrita, Guduchi satva, Brihat guduchi taila, Amrita guggulu, amritashtaka churna(45)



Fig 2

The family Menispermaceae The plant family Menispermaceae consists of about 70 genera and 450 species that are found in tropical lowland regions. They are generally climbing or twining, rarely shrubs. Leaves are alternate or lobed, flowers small cymose, seeds usually hooked or reniform. This family is rich source of alkaloid and terpenes.

The genus Tinospora *Tinospora* is one of the important genera of the family, consisting of about 15 species. Some medicinally important species includes

T. Cordifolia, *T. Malabarica*, *T. Tementosa*, *T. Crispa*, *T. Uliginosa*, etc.

The species Tinospora cordifolia *Tinospora Cordifolia* (wild) Miers ex Hook. F and Thoms belonging to the family Menispermaceae is a large deciduous climbing shrub found throughout India and also in Srilanka, Bangladesh and China (46).

TOXONOMIC CLASSIFICATION

Kingdom : plantae - plants

Subkingdom : Tracheophyta - Seed bearing plants;

Division : magnoliophyta - Dicotyledons; **Class** : Magnoliopsida - Dicotyledons; **Subclass** : polypetalae - Petals are free ;

Series : thalamiflorae -Many stamens and flower hypogynous

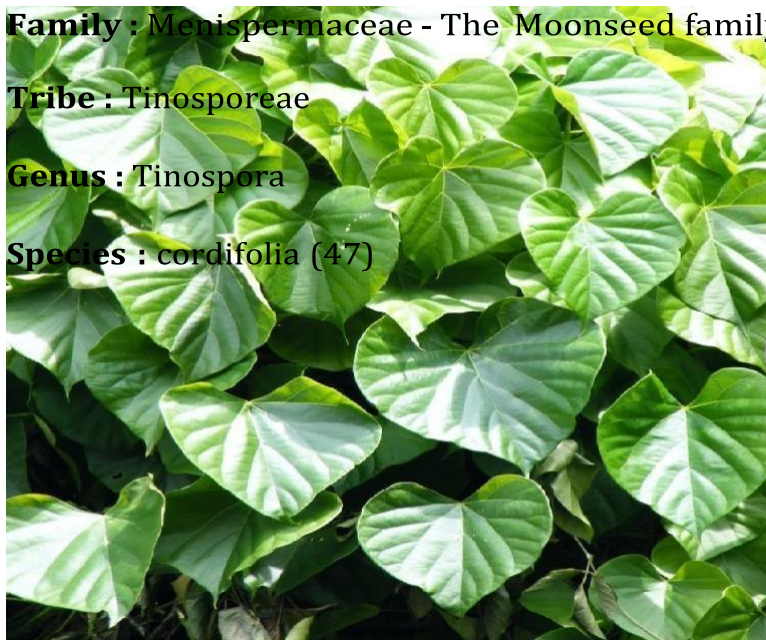
Order : Ranales

Family : Menispermaceae - The Moonseed family

Tribe : Tinosporeae

Genus : Tinospora

Species : cordifolia (47)



BOTANICAL CLASSIFICATION

The plant is popularly known as Guduchi, is an herbaceous vine belonging to the Menispermaceae and is found normally in deciduous and dry forests. The botanical classification of the medicinal herb is given below:

Kingdom : plantae **Division :** magnoliophyta **Class :** Magnoliopsida **Order :** Ranunculales

Family : Menispermaceae **Genus :** Tinospora **Species :** cordifolia (48)

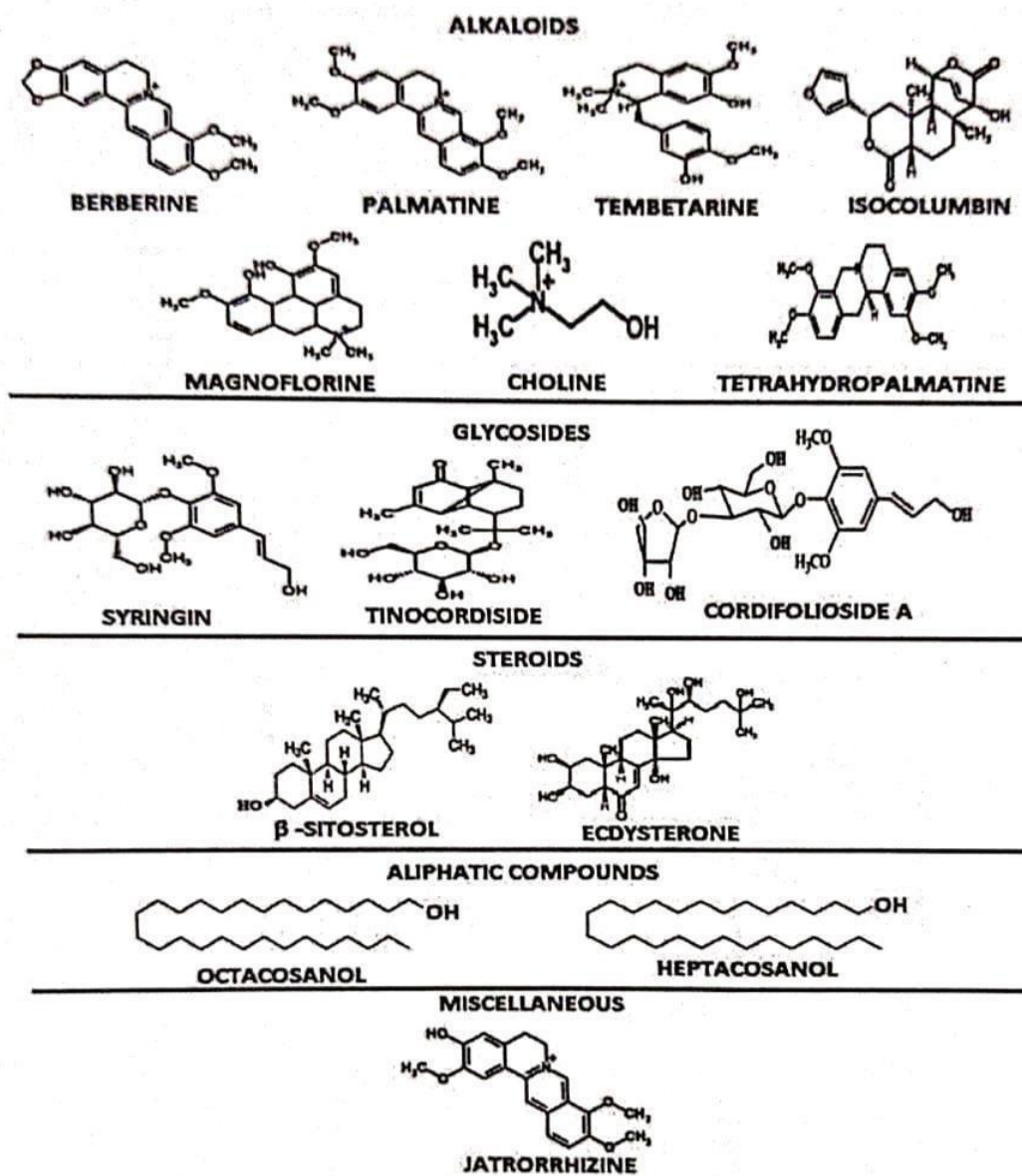


Fig. 4

CHEMICAL CONSTITUENTS

Tinospora cordifolia belongs to different classes of constituents such as alkaloids, diterpenoid lactones, glycosides, steroids, sesquiterpenoid, phenolic aliphatic compounds and

polysaccharides etc. structures of same phytoactive compounds from *Tinnsora cordifolia* are illustrate in figure 3.(49)



PHYTOCHEMISTRY

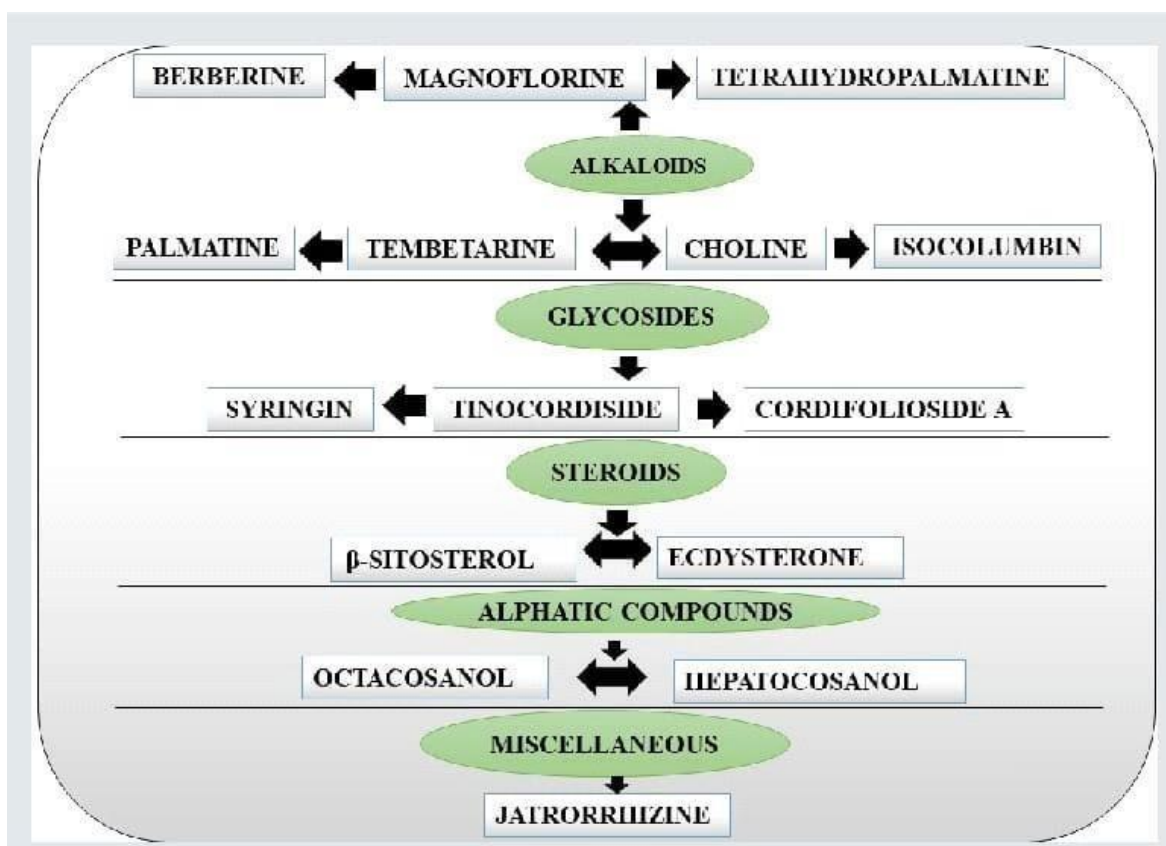
T.cordifolia (Guduchi) mainly consists of alkaloids, glycosides, steroids, aliphatic compounds, essential oils, mixture of fatty acid, calcium, phosphorous, protein and polysaccharides (Figure 4).(50)

ACTIVE COMPONENTS AND THERAPEUTIC ACTIVITIES OF TINOSPORA CORDIFOLIA

Stem and root part of *T. cordifolia* contain alkaloids as active constituents. These are tembetarine, choline, magnoflorine, berberine, tinosporin, isocolumbin, palmetine, jatrorrhizine, aporphine alkaloids, tetrahy dropalmatine which showed anti-cancer, anti-diabetes, anti-viral, anti inflammatory, anti-psychiatric and immunomodulatory action.(51-56)

The different classes of compounds which are found in this plant are classed in groups like alkaloids, steroids, terpenoids, polysaccharides, glycosides and different aromatic and aliphatic compounds that are present in their phytoactive form that are responsible for the wide range of medicinal and therapeutic properties. The presence of these compounds is found in various plant parts but highly concentrated in the stem, leaves and root part of the plant.

The main compound of this plant is berberine and furanolactone and furthermore compounds like tinosporone, tinosporic acid, cordifolisides A to E, giloin, gilenin, crude giloininand, arabinogalactan polysaccharide, picrotene, bergenin, gilosterol, tinosporol, tinosporidine, sitosterol, cordifol, heptacosanol, octacosonal, tinosporide, columbin, chasmanthin, palmarin, palmatosides C and F, amritosides, cordioside, tinosponone, ecdysterone, makisterone A, hydroxyecdysone, magnoflorine, tembetarine, syringine, glucan polysaccharide, syringine apiosylglycoside, isocolumbin, palmatine, tetrahydropalmatine, jatrorrhizine are few of the compounds that have been isolated from the plant.(57)



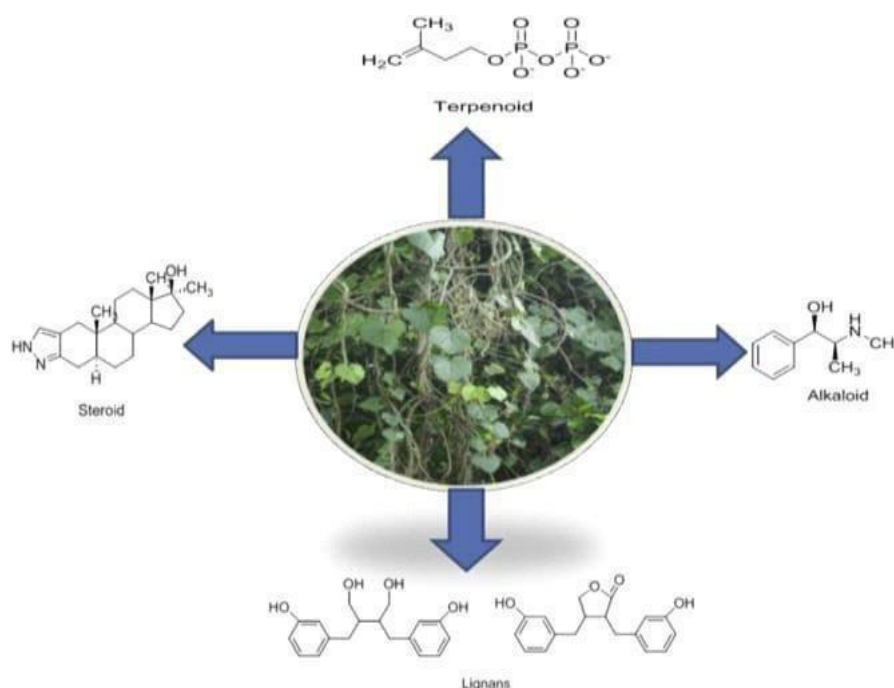


Fig. 6

Pharmacological aspects

A myriad of biologically active compounds have been isolated from different parts of the plant body. These compounds have been reported to have different biological roles in disease conditions. Anti-Diabetic Activity, Anti-Cancer Activity, Immunomodulatory Activity, Anti-Oxidant Activity, Anti-Toxic Activity, Anti - HIV activity.

MEDICINAL PROPERTIES OF TINOSPORA CORDIFOLIA

Anti-Diabetic Activities

The stem of this plant is generally used to cure diabetes by regulating level of blood glucose (58) It has been reported to act as anti-diabetic drug through explanatory oxidative stress, promoting insulin secretion by inhibiting gluconeogenesis and glycogenolysis. The anti-diabetic properties exhibited by this plant species are attributed due to the presence of alkaloids (Magnoflorine, Palmetine, Jatrorrhizine) (59) tannins, cardiac glycosides, flavonoids, saponins, steroids etc. (60) The crude extract of stem in ethyl acetate, dichloromethane, chloroform and hexane inhibits the enzymes like salivary, amylase and glucosidase resulting increase in post-prandial glucose level and shows potential activities against Diabetes mellitus disease (61).

The root extract of this plant has also been reported to have anti-diabetic properties which decrease the level of glycosylated haemoglobin, hydroperoxidase and vitamin E (62).

Anti-Microbial Activities

Methanolic extract of *T. cordifolia* has been reported against microbial infection (63) Anti bacterial activity of *T. cordifolia* extract has been bio assayed against *Escherichia coli* *Staphylococcus aureus*, *Klebsiella pneumonia*, *Proteus vulgaris*, *Salmonella typhi*, *Shigella*

flexneri, Salmonella paratyphi, Salmonella typhimurium, Pseudomonas aeruginosa, Enterobacter aeruginosa, Enterobacter aerogene.(63-65) Further, T. cordifolia extract has been reported against bacterial growth and improved phagocytic and intracellular bacterial capacities of neutrophils in mice (66)

Anti-HIV Activities

Root extract of this plant has been shown a decrease in the regular resistance against HIV (67). This anti HIV effect was exposed by reduction in eosinophil count, stimulation of B lymphocytes, macrophages, level of hemoglobin and polymorphonuclear leucocytes (67-68).

Anti-Oxidant Activities

Methanolic extract of stem of T. cordifolia has been reported to anti-oxidant activity, by increasing the erythrocytes membrane lipid peroxide and catalase activity. It also decreases the activity of SOD, GPx in alloxan induced diabetic rats (69-70) Extract of T. cordifolia has been reported its free radical scavenging properties (71) Leaf extract of T. cordifolia reported to have an alpha-glucosidase inhibitor, characterized as saponarin was found to be also significant anti oxidant and hydroxyl radical scavenging activity (72) Due to the presence of alkaloids it shows protection against aflatoxin-induced nephrotoxicity (73) T. cordifolia aqueous extract has a radio protective activity, enhancing the survival of mice against a sub-lethal dose of gamma radiation (74).

CONCLUSION

The various compounds found in T. cordifolia have been discussed in this re view. Some of these include antioxidant, antimicrobial, anti-HIV, analgesic, anti-fungal, antiproliferative and anti-epileptic. Its properties have been acknowledged as effective in treating various diseases. Isolating pure lead compounds from the plant part as well as from endophytic fungi isolated from different parts

could pave a way in future to combat different pathological conditions. This re view, therefore, can be used for further research investigations as well as a clinical purpose in the development of novel

REFERENCES

1. Preeti S. Tinospora cordifolia (Amrita)-a miracle herb and lifeline too many diseases. Int J Med Aromat Plants. 2011;1(2):57-61.
2. Balandrin MF, Klocke JA, Wurtele ES, Bollinger WH. Natural Plant Chemicals: Sources of Industrial and Medicinal Materials. Science 1985; 228:1154-1160.
3. Briskin DP. Medicinal Plants and Phytomedicines, Linking Plant Biochemistry and Physiology to Human Health. American Society of Plant Physiology 2000; 124:507-514.
4. Daniel M. Medicinal Plants: Chemistry and Properties. vol.2, Science Publication,2006, 24-36.
5. Anonymous. Wealth of India: Raw materials. CSIR, New Delhi, 1976, 10.

6. Chaudhari S, Shaikh N. Gaduchi-the best ayurvedic herb. The Pharma Innovation Journal 2013; 2(4):97-102.
7. Raghunathan K, Sharma PV. The aqueous extract of *T. cordifolia* used reduction of blood sugar in alloxan induced hyperglycemic rats and rabbits. J Res Ind Med 1969; 3:203-209.
8. Kirtikar KR, Basu BD. Indian Medicinal Plants. Edn 2, Vol. 1, M/S Bishen Singh, Mahendra Pal Singh; 1975.
9. Nadkarni KM, Nadkarni AK. Indian Materia Medica. Edn 3, Vol. 1, M/S Popular Prakasan Pvt.Ltd 1976.
10. Upadhaya AK, Kumar K, Kumar A, Mishra HS. *Tinospora cordifolia* (Willd.) Hook. F. and Thoms. (Guduchi)-validation of the Ayurvedic pharmacology through experimental and clinical studies. Int J Ayurveda Res 2010; 1:112- 121.
11. Rout GR. Identification of *Tinospora cordifolia* (Willd.) Miers ex Hook F & Thoms using RAPD markers. Z Naturforsch C 2006; 61:118-22.
12. Patel SS, Shah RS, Goyal RK. Anti hyperglycemic, anti-hyperlipidemic and antioxidant effects of Dihar, a poly herbal ayurvedic formulation in streptozotocin induced diabetic rats. Indian J Exp Biology 2009; 47:564-570.
13. Gupta R, Sharma V. Ameliorative effects of *Tinospora cordifolia* root extract on histopathological and biochemical changes induced by aflatoxin-b in mice kidney. Toxicol Int 2011; 18:94-98.
14. Jagetia GC, Rao SK. Evaluation of the antineoplastic activity of guduchi (*Tinospora cardifolia*) in ehrlich ascites carcinoma bearing mice. Biol Pharm Bull 2006; 29:460-466.
15. Patel MB, Mishra S. Hypoglycemic activity of alkaloidal fraction of *Tinospora cordifolia*. Phytomedicine 2011; 18:1045-1052.
16. Sriramaneni RN, Omar AZ, Ibrahim SM, Amirin S, Mohd ZA. Vasorelaxant effect of diterpenoid lactones from and rographis paniculata chloroform extract on rat aortic rings. Pharmacognosy Res 2010; 2:242-246.
17. Yang S, Evens AM, Prachands, Singh AT, Bhalla S, Devid K et al. Diterpenoid lactone and rographolide, the active component of and rographis paniculata. Clin Cancer Res 2010; 16:4755-4768.
18. Zhao F, He EQ, Wang L, Liu K. Anti-tumor activities of and reographolide, a diterpenefrom And rographis paniculata, by inducing apoptosis and inhibiting VEGF level. J Asian Nat Prod Res 2008; 10:467-473.
19. Kohno H, Maeda M, Tanino M, Tsukio Y, Ueda N, Wada K et al. A bitter diterpenoid furano lactone columbine from calumbae Radix inhibits azoxy methane-induced rat colon carcinogenesis. Cancer let 2002; 183:131-139.
20. Dhanasekaran M, Baskar AA, Ignacimuthu S, Agastian P, Duraipandiyan
21. V. Chemopreventive potential of Epoxy clerodane diterpene from *Tinospora cordifolia* against diethyl nitrosamine induced hepyocellular carcinoma. Invest New Drugs 2009; 27:347-355.
22. Ly PT, Singh S, Shaw CA. Novel environmental toxins: Steryl glycosides as a potential etiological factor for age- related neurodegenerative diseases. J Nruosci Res 2007; 85:231-237.