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FT-IR ANALYSIS OF METHANOL EXTRACT OF LEAF OF *TINOSPORA CARDIFOLIA*

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Abstract:
Tinospora cordifolia (Seenthil kodi in tamil) is a deciduous woody climbing shrub belongs to the family Menispermaceae distributed throughout India, China, Africa. This plant has lot of medicinal uses such as Jaundice, fever, gout, urinary and upper respiratory infections and preventive measures against skin infections, chronic diarrhoea, bleeding piles, dysentery, itching and erysipelas. This plant has a peculiar character i.e., completely dried stem of this plant can germinate if favorable conditions come. Hence, the local siddha practitioners "Seenthil Sarkkarai" apowder taken from this plant is used to rejuvenate the destroyed cell present in human body due to disease and some other diseases. In the present study, the methanol extract of leaf of this plant was analyzed by FT-IR for their bioactive phytocompounds. The obtained results of fraction-I showed the existence of functional groups Cl-C=O in acid chlorides, C-I in indo compounds, Pyridines, C≡C-H in alkynes,- $(CH_2)_n$- in hydrocarbons, C-Cl in chloro compounds, CH_2 =C in vinilidenes, SO_3H in sulfonic acids, C-O-C in esters and lactones, SO_2 insulfonyl chlorides, C=O in β- diketones, C=O in ketones, C=C=C in allenes, C=C=C in allenes, -PH in phosphines, CH_3 and CH_2- in aliphatic compounds, CH_3 and CH_2- in aliphatic compounds, OH in alcohols and phenols and fraction –II has Cl-C=O in acid chloride,Napthalenes,Napthalenes,C-I in iodo compound,C≡C-H in alkynes,C-Cl alkyl chlorides,$CH=CH_2$ in vinyl compounds,SO_3H in Sulfonic ascid,C-O-C in ethers, Sulfonyl chlorides, Benzene in aromatic compounds, Pyridine derivatives,C=O in carboxylic acids,Substituted benzene rings,C=C=C in allenes,C≡C in allenes,C≡C in alkynes (Disubst),-PH Phosphines,-CH_3 and –CH_2 in aliphatic compounds,-OH in alcohols and phenols.

Key Words: Tinospora cordifolia, Seenthil kodi, Seenthil Sarkkarai, FT-IR

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INTRODUCTION:

Traditional medicine has been used by the majority of the world population for thousands of years (Seifu, 2004).The World Health Organization (WHO) reported that an estimated 80 % of the population in developing countries depend on traditionally used medicinal plants for their primary health care (WHO, 2007).In India, the knowledge of medicinal plants has been accumulated in the course of many centuries based on different medicinal system such as Ayurveda, Unani and Siddha (Fabricant and Farnsworth, 2001). The rural traditional practitioners and their patients know very well about the usage, dosage and application methods of herbal medicines, but they don't what type of compounds responsible for that disease cure and the scientific reasons behind that. A variety of active components such as alkaloids, steroids, diterpenoid lactones, aliphatics, and glycosides were documented from the different parts of the plant body, including root, stem, and whole plan of *Tinospora cordifolia*. Hence, in the present study, the methanol extract of leaf of *Tinospora cordifolia* were analyzed for their phytoconstituents by FTIR.

MATERIALS AND METHOD:

The fresh leaves of *Tinospora cordifolia* purchased from the Sunday market, Madurai, Tamilnadu were dried under shaded place for complete evaporation of moisture content. Thereafter, these dried leaves were grounded well in a mixy and make into fine powder. This fine powder of leaf was packed inside the thimble of the Soxhlet apparatus. The required amount of methanol was filled inside the bottom flask. The temperature of the solvent was set in the heating mantle. Few minutes after, the green colour extract come from the siphon was collected in a conical flask and dried under sunlight to evaporate the solvent. Then dried phytocompounds containing extract were stored for FT-IR study.

Biology of study plant

Tinospora cordifolia

The plant *Tinospora cordifolia* belongs to family ***Menispermaceae*.** In this family, ***Tinospora*** is one of the important genera which consists of about 15 species, among these, most of the species such as *T.cordifolia, T.malabarica, T.tomentosa, T.crispa, T.uliginosa etc* are medicinally important. In Indian traditional ayurvedic literature, plant *Tinospora cordifolia* is named as "Guduchi" a Sanskrit term because of its enormous application in the treatment of various diseases. In Hindi language, this plant is called by the Hindu mythological term "Giloya" that refers to the heavenly elixir that have saved celestial beings from old age and kept them eternally young.

Names in various languages

Bengali: Gulancha, English: Gulancha/ Indian tinospora, Gujarathi: Galo, Hindi: Giloya, Guduchi, Kannada: Amrita balli, Latin: *Tinospora cordifolia*, Sanskrit: Guduchi, Madhuparni, Amrita, Chinnaruha, Vatsadaani, Tantrika, Kundalini and Chakralakshanika. Tamil: Shindilakodi, Telugu: Tippatiga, Marathi: Shindilakodi

Classification

Kingdom:Plantae
Division:Magnoliophyta
Class:Magnoliopsida
Order:Ranunculales
Family:Menispermaceae
Genus:*Tinospora*
Species: *T. cordifolia*

Description

Tinospora cordifolia is a large climbing shrub. It has fleshy stems several elongated twining branches and a long thread like aerial branches of roots. It has a simple, alternate leaves with exstipulate, long petioles up to 15cm long, roundish, pulvinate, both at the base and apex with the basal one longer and twisted partially and half way around. This plant contains broadly ovate or ovate cordate lamina with 10-20 cm long or 8- 15 cm broad, 7 nerved and deeply cordate at base, membranous, pubescent above, whitish tomentose with a prominent reticulum beneath. The flowers are greenish yellow in colour and bloom during summer, axillary and terminal positioned racemes type and unisexual. Male flowers are small, yellow or green colored occur in clustered and female flowers are usually single and solitary. Fruits are pea shaped, fleshy and single seeded. The seeds are curved and pea sized.

Distribution

The plant *Tinospora cordifolia* is distributed to South Asia, Indonesia, Philippines, Thailand, Myanmar, China and in Srilanka. In India, this plant grows throughout the tropical regions from Himalaya to Kanyakumari. This plant mostly prefers wide range of soil from acid to alkaline and moderate level of soil moisture.

Chemical Constituents

Various parts such as root, stem, leaf, flower, fruit and seeds of the plant *Tinospora cordifolia* has been subjected to chemical investigations extensively by different research groups and scientists to find out the chemical constituents that are reported the presence of some important constituents.

Terpenoids
Tinosporide, Furanolactone diterpene, Furanolactone clerodane diterpene, furanoid diterpene, Tinosporaside, ecdysterone makisterone and several glucosides isolated as poly acetate, phenylpropene disaccharides cordifolioside A, B and C, cordifoliside D and E, Tinocordioside, cordioside, palmatosides C and F, Sesquiterpene glucoside tinocordifolioside, Sesquiterpene tinocordifolin.

Alkaloids
Tinosporine (S), Magnoflorine (S), Tembetarine (S), Berberine (S), Choline (S), Palmatine (S), Jatrorrhizine (S), 1, 2-Substituted pyrrolidine (S), Alkaloids, viz. jatrorrhizine, palmatine, beberine, tembeterine, and choline.

Lignans
3(a, 4-dihydroxy-3-methoxybenzyl)-4-(4-hydroxy-3-methoxybenzyl), (S).

Steroids
Giloinsterol (S), ß-Sitosterol (S) an 20a- Hydroxy ecdysone (S).

Others
Giloin (S), Giloinin (S), Tinosporan acetate (S), Tinosporic acid (S), Tinosporal acetate (S), Tinosporidine (S), Heptacosanol (S), Cordifolone (S), Octacosanol (S), Tinosponone, Tinosporic acid, tinosporal, tinosporon, 20-hydroxyecdysone, two phytoecdysones, an immunologically active arabinogalactan and Cycloeuphordenol Cyclohexyl-11-heneicosanone 2-Hydroxy-4-methoxy-benzaldehyde

Products from *Tinospora cordifolia* and their medicinal importance
Now days, various medicinal products are prepared from the plant *Tinospora cordifolia*. They are "Shila pravang" to treat the premature ejaculation, erectile dysfunction, to enhance the sexual stamina; "Guduchi tablets" for general infections, immune disease, hepatitis, arthritis and anti- cancerous; "Madhu Mehari" to cure dryness of mouth, numbness debility, relieves frequent urination, fatigue, excessive thirst and maintains the blood sugar, safe herbs anemia, vaginal discharge and helpful to decrease sexual debility; "Mussaffen" for purify the blood and to cure the skin disease; "Rebuild" to decrease stress and increase the anti- oxidant activity; "Septilin" to decrease the upper respiratory tract infection; "Tonplex" to increase immunity and vitality of body joint and "Muscle Excellence tablets" to eliminate the toxins of joints and "Natadadrol" to increase the muscle power.

Fig 1. Plant Tinospora cordifolia with crowded leaves

RESULTS AND DISCUSSION:

This plant is called "Amrita" signifies its use for revitalization and its importance in Ayurveda. In Hindi, this plant is commonly called as *Glio (Bhandari, 2006).* In Hindu mythological the term *Glio* means,the heavenly elixir that has saved celestial beings from old age and kept them eternally young. This plant has various notable medicinal properties such as anti-diabetic, anti-spasmodic, anti-malarial, anti-inflammatory, anti-arthritic, anti-oxidant, anti-allergic, anti-stress, anti-leprotic, hepatoprotective, immunmodulatory & anti-neoplastic activities. The present FT-IR analysis of the fraction I of leaf extract of plant species in *Tinospora cordifolia* showed the presence of functional groups related to Iodo Compounds, alcohol, benzene, sulfonic acids, hydrocarbon, sulfonyl chloride, Aliphatic compounds, Carboxylic acid salts, carboxylic acids, phosphines, aliphatic compounds and phenols. Smilarly, the fraction II of leaf extract of plant species *Tinospora cordifolia* showed the presence of bands related to functional groups such as acid chlorides, Napthalenes, sulfones, primary aliphatic amines, aromatic nitro compounds, Carboxylic acids, vinyl ethers, alcohols and phenols. Many of the research in this plant *Tinospora cordifolia* suggested the presence of active phytocompounds compounds of alkaloids such as Berberine (I) Palmatine (II), embetarine (III) , Magnoflorine (IV, 0.075%) Choline (V)1 Tinosporin, Isocolumbin, Palmatine, Tetrahydropalmatine (VI) and Magnoflorine (Kumar *et al*., 2000, Bisset *et al.*, 1983, Pachaly *et al.*, 1981, Qudrat-I-Khuda *et al*., 1964, Padhya *et al*., 1986 and Sarma, 1998), Glucosides such as 18-norclerodane glucoside (VII),Furanoid diterpene glucoside(VIII and IX) Tinocordiside (X),Tinocordifolioside (XI)Cordioside, Cordifolioside A, Cordifolioside BSyringin (XII), Syringin- apiosylglycoside, Palmatosides C,, Palmatosides F, Cordifoliside A (XIII), Cordiofoliside B,,Cordifoliside C,, Cordifoliside D, Cordifoliside E (Khan *et al*., 1989, Bhatt and Sabata,1989, Swaminathan *et al*., 1989, Ghosal *et al.*, 1997, Maurya *et al*., 1995, 1996 and 1997, Wazir *et al.*, 1995, Gangan *et al*., 1994,1995 and 1996, Sipahimalani *et al*., 1994 and Kapil and Sharma,1997), Diterpenoid (Hanuman *et al*., 1986),Lactones such as Clerodane derivatives (5R,10R)-4R-8R-dihydroxy-2S-3R:15, 16-diepoxy-cleroda-13 (16), 14-dieno-17, 12S: 18,1S-dilactone, Tinosporon, Tinosporides, Jateorine and Columbin (Hanuman *et al*., 1988,Bhatt *et al.*,1988, Swaminathan *et al*.,1988, Qudrat-I-Khuda *et al.*, 1966 and Ahmad *et al.*, 1978), Steroids such as b - sitosterol , d-sitosterol, 20b - hydroxy ecdysone Ecdysterone , Makisterone A and Giloinstero(Pathak *et al*., 1995, Dixit and Khosa,1971, Hanuman *et al.*, 1986, Khaleque *et al.*, 1970, Kidwai *et al.*, 1949., Pradhan *et al.*, 1997 and Gangan *et al.*, 1997), Aliphatic compounds such as Octacosano, Heptacosanol, Nonacosan-15-one(Dixit and Khosa, 1971., Khaleque *et al*., 1970 and Maurya and Handa, 1998),Sesquiterpenoid (Maurya and Handa, 1998).

Table-1. Peak values, band type and functional group for FTIR (Fourier Transform Infrared Spectroscopy) spectra of fraction I methanol extract of *Tinospora cordifolia*

No	Peak value	Bonds	Functional group
1.	563.21	Chain deformation (two bands)	CnH_{2n+1} in alkyl groups
2.	644.22	O-C-O bend	O-C-O in esters
3.	723.31	CH_2 rocking in methylene chains; intensity depends on chain length	$-(CH_2)_n$ – in hydrocarbons
4.	850.61	Si-C in organosilicon compounds	Si-C stretch
5.	1068.56	SO_3H Sym stretch	SO_3H Sulfonic acids
6.	1255.66	C-O-C antisym stretch	C-O-C esters,lactones
7.	1381.03	SO_2 antisym stretch	SO_2 Sulfonyl chlorides
8.	14440.83	CH_3 antisym deformation	CH_3 Aliphatic compounds
9.	1631.78	C=O Stretch; enol form	C=O in β diketones
10.	1705.07	C=O Stretch ; fairly broad	C=O Carboxylic acids
11.	2357.01	-PH Stretch; sharp peak	-PH in phosphines
12.	2798.71	$-CH_3$ Stretching modes	$-CH_3$ attached to O or N
13.	2864.29	CH_3 and $–CH_2$ antisym and sym stretching	CH_3 and $–CH_2$ in aliphatic compounds
14.	2926.01	CH_3 and $–CH_2$ antisym and sym stretching	CH_3 and $–CH_2$ in aliphatic compounds
15.	3367.71	-OH Stretch (solids and liquids)	-OH in alcohol and phenols
16.	3687.9	-OH Stretch (solids and liquids)	-OH in alcohol and phenols
17.	378.41	-OH Stretch (solids and liquids)	-OH in alcohol and phenols
18.	3842.2	-OH Stretch (solids and liquids)	-OH in alcohol and phenols
19.	3861.49	-OH Stretch (solids and liquids)	-OH in alcohol and phenols
20.	3944.43	-OH Stretch (solids and liquids)	-OH in alcohol and phenols

Table-2. Peak values, band type and functional group for FTIR (Fourier Transform Infrared Spectroscopy) spectra of fraction I methanol extract of *Tinosporsa cordifolia*

No	*Peak value*	*Bonds*	*Functional group*
1.	433.98	Cl-C=O plane deformation	Cl-C=O in acid chlorides
2.	482.2	out of plane ring bending	Naphthalenes
3.	596	C-I stretch	C-I in iodo compounds
4.	651.94	C≡C-H bending	C≡C-H in alkynes
5.	831.32	C-Cl stretch	C-Cl in chloro compounds
6.	1095.57	Si-O-Si antisym stretch	Si-O-Si in siloxanes
7.	1257.59	C-O-C antisym stretch	C-O-C in esters, lactones
8.	1382.96	SO_2 antisym stretch	SO_2 in sulfonyl chlorides
9.	1436.97	in-plane OH plane bending	OH in carboxylic acids
10.	1612.49	ring stretch ; doublet	Pyridine derivatives
11.	1707	C=O stretch; fairly broad	C=O in carboxylic acids
12.	1903.74	Several bands from overtone and	Substituted benzene ring
13.	2121.7	C≡C stretch	C≡C in alkynes(monosubst)
14.	2208.49	C≡C stretch	C≡C in alkynes (disubst)
15.	2355.08	P-H stretch ;sharp peak	-PH in phosphines
16.	2872.01	CH antisym and sym stretching	-CH_3 and -CH_2- in aliphatic compounds
17.	2926.01	CH antisym and sym stretching	-CH_3 and -CH_2- in aliphatic compounds
18.	3396.64	OH stretch (Solids and Liquids)	OH in alcohol and phenols
19.	3782.41	OH stretch (Solids and Liquids)	OH in alcohol and phenols
20.	3938.64	OH stretch (Solids and Liquids)	OH in alcohol and phenols
21.	3986.86	OH stretch (Solids and Liquids)	OH in alcohol and phenols

Fig- 2.FTIR Pattern of fraction –I methanol extract of leaf of *Tinospora cordifolia*

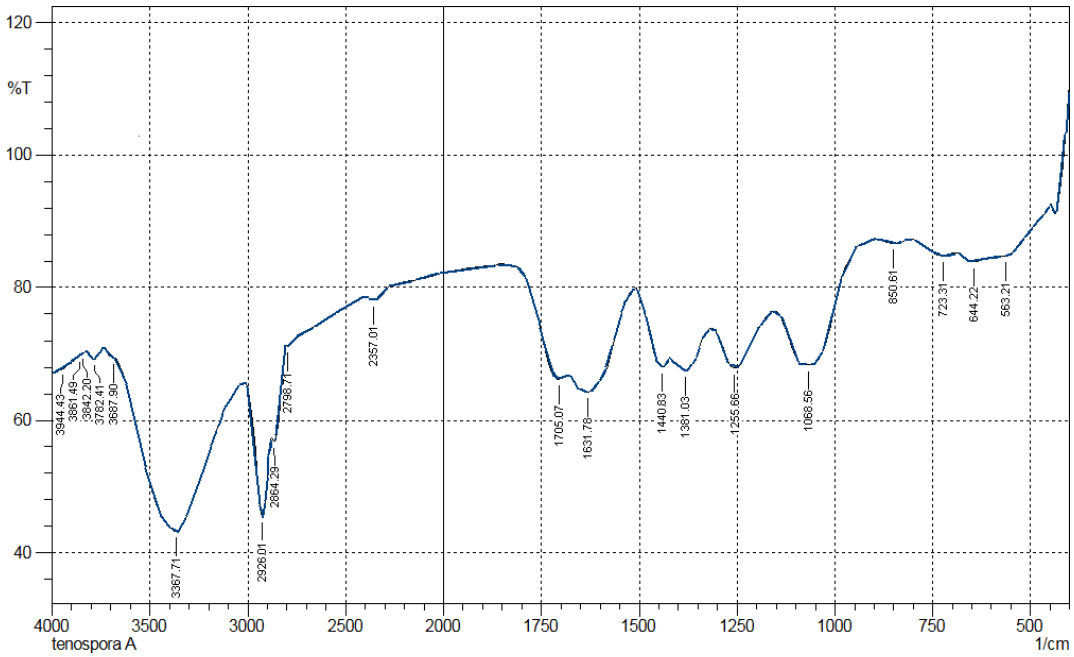
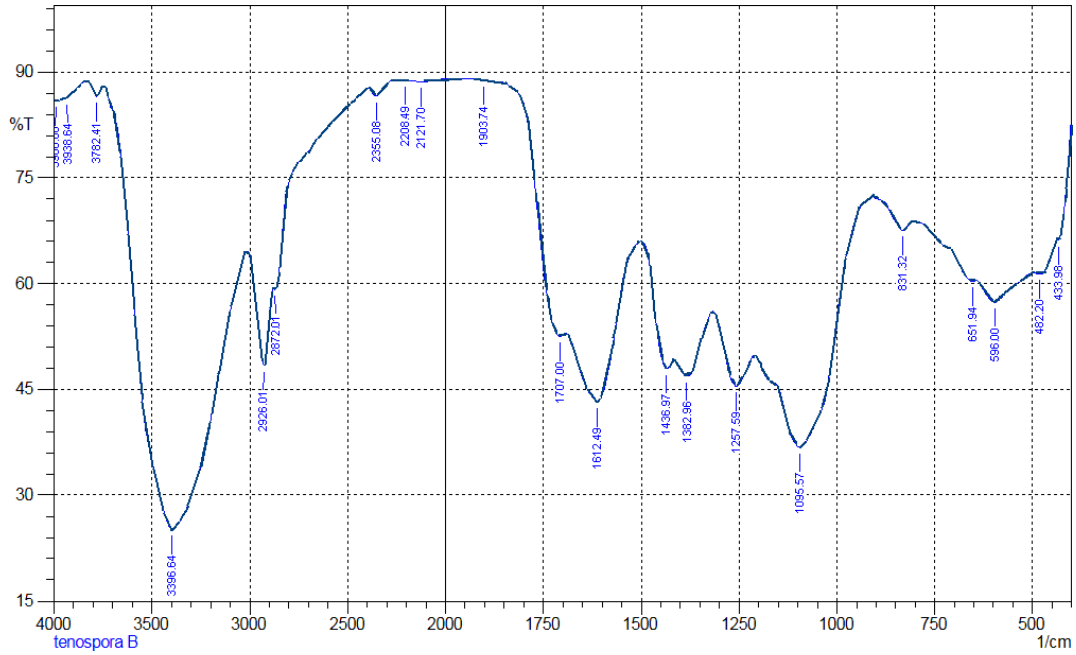


Fig-2.FTIR Pattern of fraction –II methanol extract of leaf of *Tinospora cordifolia*



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