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SYSTEMIC REVIEW: PHARMACOGNOSY, PHYTOCHEMISTRY, PHARMACOLOGY AND CLINICAL APPLICATIONS OF *TINOSPORA CODIFOLIA* WILLD.

Jasdeep Kaur*

Guru Nanak Institute of Technology, Hoshiarpur -144305 (Punjab), India.

Keywords:

Tinospora cordifolia, pharmacognosy, phytochemistry, pharmacology

For Correspondence:

Jasdeep Kaur

Guru Nanak Institute of Technology, Hoshiarpur - 144305 (Punjab), India.

E-mail:

jasdeep_kaur90@yahoo.com

ABSTRACT

Tinospora cordifolia Willd. (Guduchi) is widely used in folk medicine, ayurvedic system of medicine, also in ayurvedic 'Rasayanas' to improve the immune system and used as general tonic, anti-periodic, anti-spasmodic, anti-inflammatory, anti-arthritic and anti-diabetic agent. Numerous studies have been reported on the health benefits of individual parts or whole Guduchi plant. In contest of this, current review is the collection of all the literature i.e. pharmacognosy, phytochemistry and pharmacology of *Tinospora cordifolia* Willd.

INTRODUCTION

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.[1-2] *Tinospora cordifolia* Willd is a large, glabrous, deciduous climbing shrub, belongs to the family Menispermaceae, native to India but widely distributed throughout the tropical regions of South Asian countries to an altitude upto 1,000 m. It is widely used in veterinary folk medicine/ayurvedic system of medicine in a holistic system of diagnosis and treatment involving nutrition, hygiene and rejuvenation.[3-5] The plant is used in ayurvedic 'Rasayanas' to improve the immune system and the body resistance against infection. It is used as general tonic, anti-periodic, anti-spasmodic, anti-inflammatory, anti-arthritic, anti-allergic and anti-diabetic powerful immune modulator. Guduchi is much useful to enhance the memory have described the *Tinospora cordifolia* viscous sap has a light yellow colour and nauseating bitter taste and improves metabolic activity, even at a cellular level. [6-9] So far a variety of constituents have been isolated from *Tinospora cordifolia* Willd plants are well characterized as Alkaloids, Sterols, Lactones, Glycosides etc.[10] The studies on various extracts of leaf, stem and roots of *Tinospora cordifolia* Willd have shown hepatoprotctive effect, antioxidant effect, effect against infection, immunomodulatory activity, antistress activity, gastrointestinal protective activity, protection against toxicity of cancer chemotherapy, antineoplastic activity and other properties of therapeutic relevance, like learning memory, antiinflammatory and antiallergic properties, antipyretic, diuretic effect etc have been compiled.[11-12]

Habitat

Tinospora cordifolia Willd prefers wide range of soil, acid to alkaline and it needs moderate level of soil moisture. Found throughout tropical India ascending to an altitude of 1000 feet and in South Asia, Indonesia, Philippines, Thailand and Myanmar worldwide. The species is widely distributed in India, extending from the Himalayas down to the southern part of peninsular India. It is also found in neighboring countries like Bangladesh, Pakistan, and Srilanka.[13]

Taxonomical Classifications

Taxonomically it is classified as [13]

Kingdom: Plantae

Division: Magnoliophyta

Class: Magnoliopsida

Order: Ranunculales

Family: Menispermaceae

Genus: *Tinospora*

Species: *cordifolia*

Vernacular names

Vernacular names are as in English : *Tinospora Gulancha / Indian tinospora*, Sanskrit : *Guduchi, Madhuparni, Amrita,Chinnaruha, Vatsadaani, Tantrika Kundalini and Chakralakshanika,* Hindi : *Giloya, Guduchi*, Bengali : *Gulancha,* Telugu : *Tippaatigo,* Tamil : *Shindilakodi,* Marathi : *Shindilakodi,* Gujarati : *Galo ,* Kannada : *Amrita balli* [13]

Botanical description

Tinospora cordifolia Willd is a glabrous climbing shrub with a succulent stem and papery bark that is creamy white to grey in color. The shrub shoots out aerial roots, usually on neem and mango trees, which could be as long as 30 meters. It bears heart-shaped leaves. The yellow flowers are axillary and long-stalked racemes. The fruit is pea-sized, subglobose drupe and red colored on maturity. Flowers can be seen in June, while fruits occur in November. *Tinospora cordifolia* Willd is found in deciduous and dry forests throughout India.[14]

Pharmacognostical characteristics

Morphology of the Plant

Tinospora cordifolia Willd is a glabrous, succulent, woody climbing shrub native to India. (Fig.1) It is also found in Burma and Sri Lanka. It thrives well in the tropical region, often attains a great height, and climbs up the trunks of large trees. The stem is gray or creamy white, deeply cleft spirally and longitudinally, with the space between spotted with large rosette-like lenticels. The wood is white, soft, and porous, and the freshly cut surface quickly assumes a yellow tint when exposed to air. Leaves are simple, alternate, estipulate, long petiolate, chordate in shape showing multicoated reticulate venation. Long thread-like aerial roots come up from the

branches. Flowers are small and Unisexual. Male flowers are in clusters female flower are solitary. Six sepals arranged in two whorls of three each. Six petals arranged in two whorls, they are obovate and membranous. Aggregate fruit is red, fleshy, with many drupelets on thick stalk with sub terminal style scars, scarlet colored. Fig. 2 shows the (i) bark (ii) flowers (iii) leaves (iv) and fruits of *Tinospora codifolia* Willd. [15-16]

Macro-microscopy studies

Macro-microscopic characteristics are the simplest and cheapest methods to start with establishing the correct identity of the source materials.

Leaf

Morphology showed that leaves are simple, alternate and estipulate. The leaf blade is broadly ovate to roundish cordate, 5 to 12 cm in diameter with smooth surface. Lower surface is slight pale colored, the upper surface is glaucous. The tip is acute or sharply acuminate and the base has a broad sinus. The leaves when seen in bulk look intensely green but over mature leaves are yellowish green to yellow color. The leaves are bitter and have indistinct odour. The cross section passing through mid rib region shows slight convexo at upper side, broad hump at lower side and single median well developed collateral vascular bundle. The cross section of lamina shows a dorsiventral structure with its mesophyll. Palisade ratios range lies from 4-12. The epidermal cells are angular in surface view with an average density 1000-1500 mm^2 and comprise of unicellular trichomes with an average density 1-4mm^2 measuring 115-145µm length and 18-36µm width. Anomocytic stomata vary from 200-600mm^2 measuring 36-54µm length and 18-36µm width. Venation is reticulate with a number of principal veins. Veins are multicostate and prominent on dorsal side. Vein islet number and vein termination number are 1-3mm^2 and 6-16mm^2 respectively. The petiole is slender and fairly long ranging from 3-9cm. the base of the petiole is pulvinate and slightly twisted at base. Transverse section of petiole is more or less circular in outline. It shows single layered endodermis, wavy arrangement of 3-4 layers of fibrous pericycle and 8-10 vascular bundles arranged in a ring and broad zone of central parenchymatous pith.[17]

Stem

Morphology of stems showed grayish green with smooth surfaces and swelling at nodes, older ones show a light brown surface marked with warty protuberances due to circular lenticels. Dried

stem is cylindrical, slender, slightly twisted shape, 6-12 cm diameter with rough surface due to longitudinal fissures of cracks along the rows of lenticels. Outer bark is thin and papery brown to grayish in color. Lenticels are circular and prominent. Transversely cut smoothened surface shows a wheel like structure, a characteristic feature of family menispermaceae. Fracture is fibrous, taste bitter and odorless. Microscopy of stem shows 2-3 layers of cork followed by 4-5 layered phellogen. Outer most layer of cork is differentiating into outer zone of thick walled brownish and compressed cells, inner zone of thin walled colorless, tangentially arranged 3-7 rows of cells. Cork is broken at some places due to opening of lenticels. Cortex is wide parenchymatous zone contain large columnar type cells filled with inner one, just within the openings of lenticels, groups of sclerids consisting of 2-8 cells found in this region, outer zone of cortex consists of 2-4 rows of irregularly arranged, tangentially elongated chlorenchymatous cells, cortical cells situated towards inner side, polygonal in shape and filled with plenty of starch grains. Starch grains are simple, ovoid, or irregularly ovoid-elliptical, occasionally compounds of 2-4 components. Several mucilage canals are found scattered in the cortex along with tannin containing cells. Transversally cut surface of stem show secondary anomalous growth. Xylem is stellate in structure. Xylem is united at the centre, thereby completely obliterating the pith and giving xylem a stellate appearance with phloem at the ends of the radii. Stem is characterized by the presence of bicollateral vascular bundles with wedge shaped strips of xylem externally surrounded by semi circular strips of phloem surrounded by semi circular strips of phloem surrounded by pericycle fibers. Pericycle is 10-12 celled layer associated with a large number of crystal fibers containing a single prism in each chamber. Wide medullary rays 16-20 cells, with alternating vascular zone composed of 15-16 or more wedge shaped strips of xylem, externally surrounded by semi-circular strips of phloem 8-12 cells which composed of dense ceratenchyma. Pith mostly made up of large thin walled parenchymatous cells.[17]

Aerial roots

The young aerial roots are long filiform, thread like, squaish, which arise from the mature branches or cut bits of stems grow downward and by continuously lengthening sometimes reach the ground. The maturate aerial root are fleshy which is very similar in structure with young aerial stem except for the presence of nodal swellings. The dried aerial roots are 3-6cm in diameter, surface light grey-brown or creamy white in color, fracture, short, odorless and taste

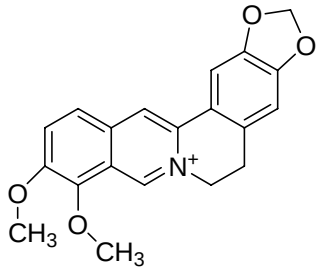
bitter. Microscopy showed characterization of aerial root by tetra-to-penta-arch primary structure. The cortex is divided into outer thick walled zone representing the velamen and inner parenchymatous zone containing mucilage cells and tannin containing cells. Starch is present throughout the parenchyma of the aerial root.[18]

Powder

Stem and aerial root powder is creamish brown to dark brown with characteristic odor and bitter taste. Under the microscope it shows vessels with reticulate secondary wall thickening, tracheids and tracheidal fibers with bordered pits and horizontal perforations: starch grains oval, ovoid elliptical, oval to rounded, or elliptical in shape, mostly simple but sometimes as compound grains of 2-5 components, marked concentric striation and central hilum appearing like a point. Diameter of vessels and tracheids are smaller in case of stem comparatively to aerial root.[18]

Phytochemistry

Literature survey indicated the presence of alkaloids, diterpenoid lactones, steroids, glycosides aliphatic compounds, polysaccharides etc in various parts of the plant. Some constituents have been isolated from plant mainly they are tinosporone, tinosporic acid, cordifolisides, syringen, berberine, giloin, gilenin, crude giloininand, arabinogalactan polysaccharide, picrotene, bergenin, gilosterol, tinosporol, tinosporidine, sitosterol, furanolactone, tinocordifolin, cordifol, heptacosanol, octacosonal, tinosporide, columbin, chasmanthin, palmarin, palmatosides, diterpene, tinosporone, tinosporic acid, amritosides, cordioside, tinosponone, ecdysterone, makisterone A, sitosterol, magnoflorine, tembetarine, glucan polysaccharide, isocolumbin, palmatine, tetrahydropalmaitine, N-Formylannonain Following are the chemical structures of few important compounds (1-36) isolate from plant *Tinospora cordifolia* Willd.[19]



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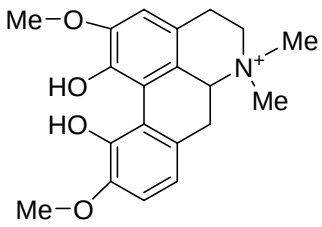

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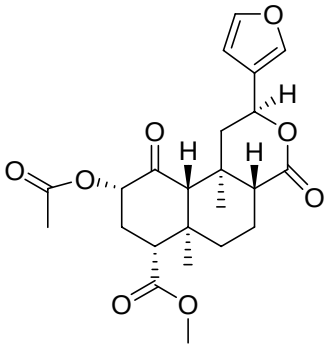

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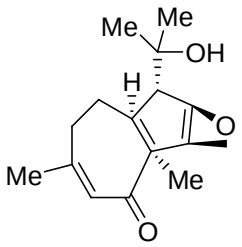

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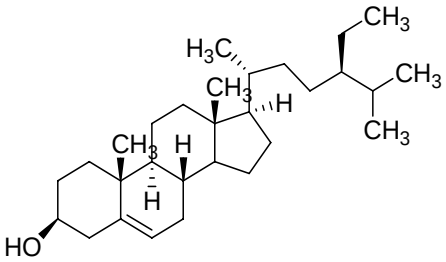

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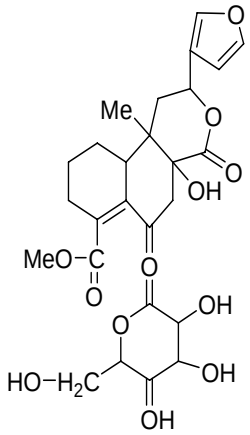

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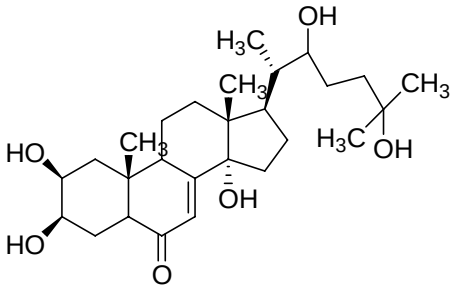

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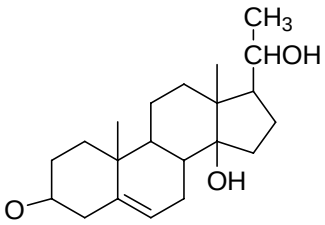

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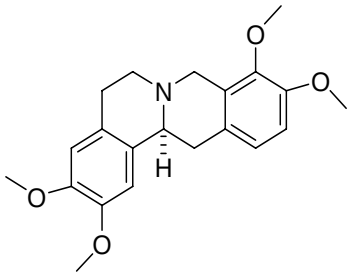

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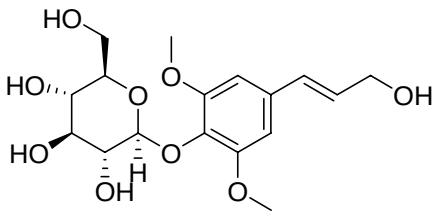

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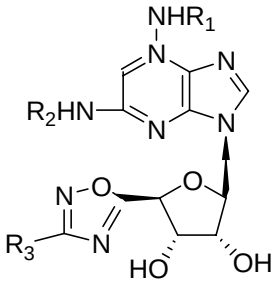

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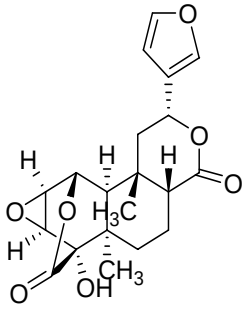

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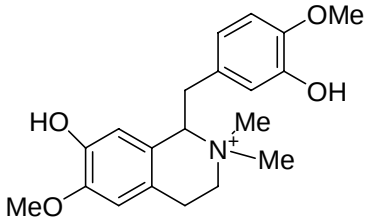

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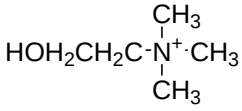

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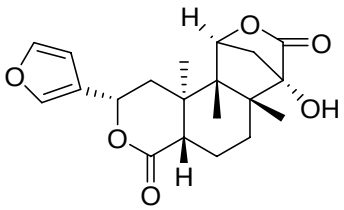

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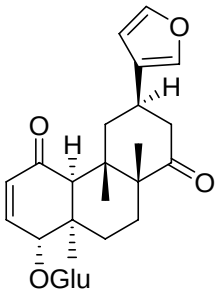

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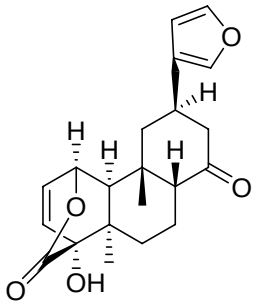

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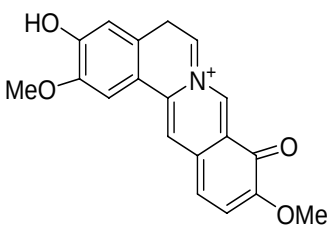

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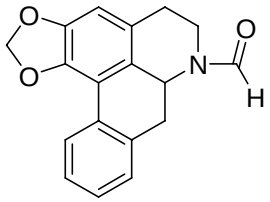

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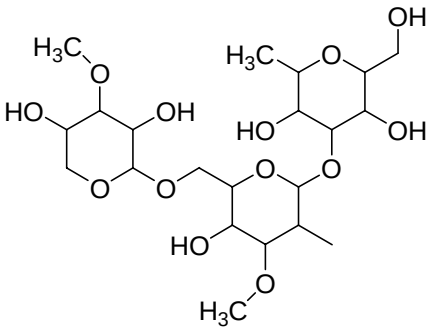

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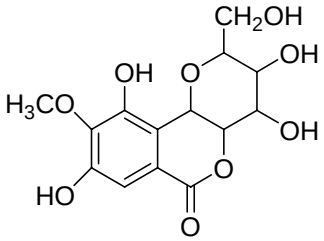

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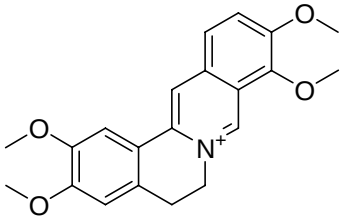

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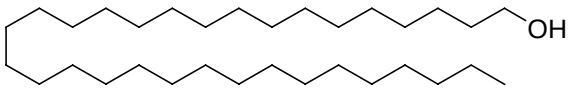

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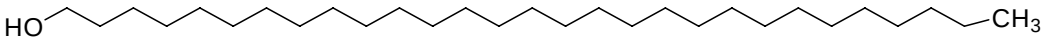

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Berberin (1), Magnoflorine (2), Furanolactone (3), Tinocordifolin (4), BETA –sitosterol (5), Cordioside (6), Ecdysterone (7), Pregnane glycosides (8), Tetrahydropalmetine (9), Syringin (10), Tetrahyrdrofuran (11), Chasmanthin (12), Tembetarine (13), Choline (14), Isocolumbin (15), Tinosporasid (16), Columbin (17), Jatororrhizine (18), N-Formylannonain (19) Arabinogalactan (20), Bergenin (21), Palmatine (22), Octacosanol (23), Heptacosonol (24). [20]

Spectroscopic Data of Some Important Compounds

Berberine [21]

M.P -163-172 °C.

IR (KBr) : 3056, 2938, 2911, 2845, 2224 (w, C≡N), 1603, 1502, 1389, 1363, 1338, 1276, 1233, 1168, 1092, 1038 cm^{-1}.

^{1}H-NMR (DMSO-d6): 2.75-2.90 (m, 2H, H5); 3.10-3.18 + 3.47-3.52 (m, 2H, H6); 3.83 (s, 3H, 10-OMe); 3.87 (s, 3H, 9- OMe); 5.97 (s, 1H, H8); 6.02 + 6.03 (2× s, 2H, OCH_2O); 6.35 (s, 1H, H13); 6.79 (s, 1H, H4); 6.89 (d, 8.4 Hz, 1H, H12); 7.05 (d, 8.4 Hz, 1H, H11); 7.35 (s, 1H, H1).

^{13}C-NMR (DMSO-d6): 29.1 (C5), 47.3 (C6), 49.5 (C8), 56.4 (10-OMe), 61.0 (9-OMe), 98.1 (C13), 101.5 (OCH2O), 104.2 (C1), 108.3 (C4), 114.7 (C11), 117.0 (C8a), 117.3 (CN), 119.9 (C12), 123.9 (C13b), 127. 1 (C12a), 129.1 (C4a), 138.5 (C13a), 144.4 (C9), 147.1 (C2), 147.8 (C3), 150.7 (C10).

EIMS m/z (%): 362 (M, 63), 347 (18), 320 (52), 306 (27), 292 (28), 278 (47).

Magnoflorine [21]

Yellow powder

M.P -197-198^{o} C

UV max (MeOH) : 205, 227, 273.

IR (KBr) : ν_{max} 3435, 2932, 2365, 1634, 1440, 1384, 1310, 1249, 1066 cm^{-1}.

^{1} H-NMR (400 MHz, CD_3OD): δ 6.65 (1H, d, J = 6.5 Hz, H-9), 6.46 (1H, d, J = 6.5 Hz, H-8), 6.45 (1H, s, H- 3), 3.78 (3H, s, 10-OCH_3), 3.80 (1H, m, C-6), 3.80 (3H, s, 2-OCH_3), 3.45 (1H, m, H-5), 3.23 (1H, m, H-5), 3.23 (3H, s, N+ CH_3), 3.10 (1H, m, H-4), 2.93 (1H, dd, J = 3.2, 12.3 Hz, H-7), 2.77 (3H, s, N+ CH_3), 2.58 (1H, m, H-4), 2.42 (1H, br t, J = 12.3, 13.6 Hz, H-7).

^{13}C-NMR (100 MHz, CD_3OD): δ 151.9 (C-2), 150.5 (C-10), 149.4 (C-1), 148.4 (C-11), 124.8 (C-7a), 122.4 (C-11b), 122.3 (C-11a), 119.8 (C-6b), 115.9 (C-8), 114.7 (C-3a), 109.4 (C-9), 108.3 (C-3), 69.9 (C-6a), 61.12 (C-5), 55.1 (2-OCH_3), 54.8 (10-OCH_3), 52.7 (N+ CH_3), 42.8 (N+ CH_3), 30.5 (C-7), 23.5 (C-4).

FABMS m/z [%]: 342 [M+, 100].

Jateorrhizine [21]

^{1}H-NMR (400 MHz, CD_3OD) : δ 9.71 (1H, s, H-8), 8.74 (1H, s, H-13), 8.08 (1H, d, J = 8.0 Hz, H-11), 7.97 (1H, d, J = 8.0 Hz, H-12), 7.63 (1H, s, H-1), 6.84 (1H, s, H-4), 4.48 (2H, m, H-6), 4.18 (3H, s, 9-OCH_3), 4.09 (3H, s, 10-OCH_3), 4.00 (3H, s, 2-OCH_3), 3.18 (2H, m, H-5).

^{13}C-NMR (100 MHz, CD_3OD) : δ 150.6 (C-9), 150.5 (C- 2), 148.4 (C-3), 145.0(C-8), 144.5 (C-10), 139.1 (C-13a), 134.2 (C-12a), 129.1 (C-4a), 126.8 (C-12), 123.1(C-11), 122.0 (C-13b), 119.7 (C-13), 118.2 (C-8a), 114.7 (C-4), 108.8 (C-1), 61.3 (9-OCH_3), 55.7 (10-OCH_3), 56.4 (2- OCH_3), 56.2 (C-6), 26.4 (C-5).

Palmatine [22]

^{1}H-NMR (400 MHz, CD_3OD) : δ 9.78 (1H, s, H-8), 8.88 (1H, s, H-13), 8.10 (1H, d, J = 8.0 Hz, H-11), 8.00 (1H, d, J = 8.0 Hz, H-12), 7.63 (1H, s, H-1), 7.03 (1H, s, H-4), 4.87 (2H, m, H-6), 4.19 (3H, s, 9-OCH_3), 4.08 (3H, s, 10-OCH_3), 3.97 (3H, s, 2-OCH_3), 3.92 (3H, s, 3-OCH_3), 3.52 (2H, m, H-5).

^{13}C-NMR (100 MHz, CD_3OD) : δ 152.6 (C-3), 150.7 (C-10), 149.7 (C-2), 145.2(C-8), 144.5 (C-9), 138.6 (C-13a), 134.0 (C-12a), 128.9 (C-4a), 126.8 (C-12), 123.3(C-11), 122.1 (C-13b), 120.1 (C-13), 119.3 (C-8a), 111.0 (C-4), 108.7 (C-1), 61.3 (9-OCH_3), 56.4 (10-OCH_3), 56.1 (2-OCH_3), 55.8 (3-OCH_3), 55.4 (C-6), 26.6 (C-5).

EIMS m/z 352 [M]+ 337, 322, 308.

Pregnane Glycosides [23]

M.P- 273-275 ^{0}C

I.R (ν_{max}) cm^{-1} : 1793, 1601, 2253, 2869, 2931.

^{1}H NMR($CDCI_3$) 1.05 - 1.03 [2H, m, 1β,1α], δ(ppm) 1.254 [2H, m, 2α, 2β], 2.279 [1H,m,3α], 5.12-5.26[anomeric proton m, H-1'], 1.573-1.593 [2H,m,4α,4β], 5.35 [1H,m,H-6], 1.497-1.477 [2H,m,7β,7α], 1.64[H,m,H-9α], 2.0-1.75[2H,m, 11α,11β] 1.72-1.71[2H,m,H-12α,12β],1.18- 1.17 [2H,m,15α,15β], 1.161[1H, m, H-16], 1.51[1H,m, H-

17], 0.75 [6H, S, H-18, 19], 0.87 [3H,m H-22], 0.95[3H,m,H-23], 3.81[1H,septetH-24], 1.23 [6H, d, H-25, 26], 2.1[1H, m, H-28] .

ESIMS : 604,559, 577 , 397, 382, 354,329, 301.

Bergenin [24]

Solid crystalline

MP- 238-240 º C.

[α]D 20 -37.0o , (c 0.20, MeOH).

IR (cm^{-1}): 3423, 3389, 3247, 3204, 2951, 2896, 1701, 1613, 1464, 1348, 1335, 1234, 1092, 1071, 991, 858 and 765.

^{1}H NMR (300 MHz, CD_3OD): δ 7.07 (s, H-9), 4.95 (d, J = 10.5 Hz, H-1), 3.35-4, 09 (m, H-11-14); 3.90 (s, H-15).

^{13}C NMR (75 MHz, CD_3OD): δ 119.37 (C-5), 117.24 (C-10), 152.28 (C-6), 142.21 (C-8), 149.38 (C-7), 111.04 (C-9), 165.79 (C-1), 74.19 (C-4), 75.58 (C-11), 81.34 (C-3); 71.82 (C-12), 82.98 (C-13), 62.63 (C-14), 60.93 (C-15).

PHARMACOLOGY ACTIVITY

1. Anti-Diabetic Activity

Aqueous extracts of *Tinospora cordifolia* has shown anti-diabetic activity in alloxan induced hyperglycemic rats and rabbits. Aqueous extracts of root at a doses of 50, 100, 200 mg/kg body weight had significantly reduced blood glucose and brain lipis. The root extracts also lowers hepatic glucose-6-phosphate, serum acid phosphatae, alkaline phosphatase and lactate dehydrogenase.[25-26]

2. Anti-inflammatory activity

Aqueous extract of *Tinospora cordifolia* has shown anti-inflammatory activity using carrageen induced hind paw oedema in rats. The extract of it at a dose of 100 to 600µg/mg has exhibited anti-inflammatory activity.[27]

3. Anti-oxidant activity

Methanolic extract of stem of *Tinospora cordifolia* has shown 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.[28-29]

4. Anti-toxic Activities

Aqueous extract of *Tinospora cardifolia* has shown show scavenge activity due to the presence of antioxidant against free radicals generated during aflatoxicosis. Further alkaloids such as choline, tinosporine, isocolumbin, palmetine, tetrahydropalmatine and magnoflorine from *Tinospora cordifolia* showed protection against aflatoxin induced nephrotoxicity. Furthermore *cordifolia* shows protective effect by lowering the concentration of thiobarbituric acid reactive substance and enhancing the glutathione, ascorbic acid, protein and the activities of antioxidant enzymes viz., superoxide dismutase, catalase, glutathione peroxidase, glutathione S-transferase and glutathione reductase in kidney.[30]

5. Anti-Cancer Activities:

Tinospora cordifolia shows anti-cancer activity, this activity is mostly shown in animal models. Root extract of *Tinospora cordifolia* has been shown radio protective role due to extensively increase in body weight, tissue weight and tubular diameter. Dichloromethane extracts of TC shows cytotoxic effects owing to lipid per oxidation and release of LDH and decline in GST. In pre-irradiating mice, root extract has widely affected radiation, induced rise in lipid per oxidation and resulted in the decline of GSH in testes. Most of the synthetic chemotherapeutic agents laid toxic side effects on the living organisms.[31]

6. Anti-Microbial Activities

Methanolic extract of *Tinospora cordifolia* has shown microbicidal activity. Antibacterial activity of *Tinospora 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.* Further, *Tinospora cordifolia* extract has been reported against bacterial growth and improved phagocytic and intracellular bacterial capacities of neutrophils in mice.[32-36]

7. Anti-HIV Activities

Root extract of this plant has been shown a decrease in the regular resistance against HIV. This anti HIV effect was exposed by reduction in eosinophil count, stimulation of B lymphocytes, macrophages, level of hemoglobin and polymorphonuclear leucocytes.[37-38]

8. Antistress activity

Ethanolic extract of the roots of *Tinospora cordifolia* has shown anti-stress activity. The ethanolic extract of it at a dose of 100mg/kg normalized stress induced biochemical changes in norepinephrin.[39]

9. Antiulcer activity

Ethanolic extract of the roots of *Tinospara cordifalia*, in combination with *Centella asiatica*, afforded significant induced ulcer formation. The activity was comparable to diazepam in rats.[40]

10. Immunomodulatory Activity

Tinospora cordifolia is well known for its immunomodulatory response. A large variety of compounds which are responsible for immunomodulatory and cytotoxic effects are 11-

hydroxymuskatone,N-methyle-2-pyrrolidone,N-formylannonain, cordifolioside A, magnoflorine, tinocordioside and syringing. These natural compounds have been reported to improve the phagocytic activity of macrophages, enhancement in nitric acid production by stimulation of splenocyte and production of reactive oxygen species in human neutrophil cells. [41-46]

Traditional uses

It is used in cancer prevention, cancer treatment support, high cholesterol and liver protection. It is used as strong anti-aging factor. Many natives use the fruits of Tinospora in face care. It has been used to treat convalescence from severe illness, arthritis, food allergies and anemia. According to some herbalists, Tinospora has adaptogen effects, a term that indicates it helps the body to adopt to stress. In children it is used in general debility, digestive disturbance, loss of appetite and fever. [47]

CONCLUSION

Tinospora cordifolia also having various pharmacological activity such as antiulcer, anti-cancer, antimicrobial, anti-oxidant etc. Parts of the plant have a wide range of chemical constituents and also having pharmaceutical approach towards various ailments. The plant is used in ayurvedic, "Rasayan" to improve the immune system and the body resistance against infection. It is also believed that the plant has effective properties against Swine flu H_1N_1 virus, although researches are in progress for proving this scientifically. Due to its deep rooted qualities and its ethnomedicinal uses its demand has been increasing tremendously.

Economic Products

Table 1: Various valuable economic products of *Tinospora cordifolia*. [48]

Product name	Cure
Guduchi Tablets	General infections, immune disease, Hepatitis, Arthritis and anti- cancerous
Shila Pravang	Premature ejaculation, erectile dysfunction, to enhance the sexual stamina
Madhu Mehari	Dryness of mouth, Numbness debility, relieves Frequent urination, fatigue, Excessive thirst and maintains the blood sugar.
Safe Herbs	Anemia, vaginal discharge and also helps in sexual debility
Mussaffen	Blood purifier and skin disease.
Septilin	Upper respiratory tract infection
Rebuild	Anti- stress and anti- oxidant
Tonplex	Increases immunity and vitality
Joint & Muscle Excellence Tablets	eliminate the toxins of joints
Natadadrol	potent muscle-building androgen

Fig.1: *Tinospora cordifolia* Willd

(i)

(ii)

(iii)

(iv)

Fig 2:*Tinospora codifolia* Willd. Bark *Tinospora codifolia* Willd. Flowers, *Tinospora codifolia* Willd. leaf, *Tinospora codifolia* Willd..fruits

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