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THE PLANT TINOSPORA CORDIFOLIA IS A MEDICINAL RESERVOIR - A REVIEW

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ABSTRACT

Tinospora cordifolia also called as “Guduchi” having application in the treatment of various diseases in the traditional ayurvedic system. The purpouse of review presents a detailed survey & literature on traditional and modern knowledge about Tinospora cordifolia for our health benefit. It is a glabrous, succulent, woody climbing shrub native to India. It thrives well in the tropical region, often attains a maximum height and climbs up the trunk of large trees. Which is isolated from Tinospora cordifolia belong to several classes such as alkaloids, diterpenoid lactones, glycosides, steroids, sesquiterpenoid, phenolics, aliphatic compounds and polysaccharides etc. In the history of traditional medicine using Tinospora cordifolia has revealed it to have Pharmacological benefits as Hypoglycemic, anti-inflammatory, hepatoprotective, immune-modulator activity, anti-oxidant, antitumour activity, Antineoplastic and has antifertility activity. As per WHO, around 80% of the world‟s 5.86 billion inhabitants depend on traditional medicine for their primary health care treatments, majority of which use plant or their active principles. The important thing is being needed to the importance of rotation in medicinal plant or between medicinal herbs and other crops. Their eight-yearly output accounted for more than 100.0% global publication share during 2001-2008 which decreased to 98.53% during succeeding 8-year period 2009-2020. The plant family Menispermeaceae consists of about 70 genus &more than 350 species that are found in tropical regions. It is found throughout the India as well as in parts of Sri Lanka, Bangladesh and China.

KEYWORD: Tinospora cordifolia, WHO, Menispermeaceae, Menispermeaceae, AETC, METC.

INTRODUCTION

Herbal medicines represents is one of the very important fields of traditional medicine all over the world. To promote the use of herbal medicine & to determine their potential as a source for new drugs, it is necessary to study medicinal plants which have folklore reputation in a more intensified.[1] Tinospora cordifolia also called as "Guduchi" is known for its immense application in the treatment of various diseases in the traditional ayurvedic literature. Recently the development of active components from the plant and their biological activity in disease control has led to active interest in the plant across the globe.[2] Guduchi" is a common name which is belonging to family Menispermaceae is a genetically diverse, large, deciduous climbing shrub with greenish yellow typical flowers, found at higher altitude (25) India is bestowed with enormous biodiversity of medicinal plants. Medicinal plants have been used as natural medicines, since prehistoric times: (i) Used as crude extract directly in medicines, because of the presence of natural chemical constituents such as berberine, morphine, psilocin, vincristine etc. and (ii) Use of phytocompounds for the synthesis of drugs such as tubocurarine, colchicine, nicotine, quinine etc. for therapeutic purpose by folk people(4) Tinospora cordifolia is widely used in traditional ayurvedic medicine because of its biological activities A variety of constituents have been isolated from different parts of Tinospora cordifolia, actively contains alkaloids like Aporphine alkaloids, clerodane diterpenes, berberine, palmatine, tembertarine, tinosporin, magniflorine, choline, Berberine, Palmatine, Tembetarine, Magnoflorine Choline, Tinosporin etc. and Glycoside like Tinocordiside, Tinocordifolioside, steroids, essential oils, mixture of fatty acids and polysaccharides are found in Gulancha plant.[21] This review presents all over survey of the literature on traditional and modern knowledge of Tinospora cordifolia for health benefit. It is largely used as a main ingredient of different natural medicine and traditionally use for numerous aliment like fever, vomiting, diabetes, jaundice, anaemia, polyuria and skin diseases etc. It has hypoglycemic, antipyretic, anti-allergic, Antineoplastic, anti-inflammatory, antioxidant, and immuno modulatory properties. (25-26)

Botanical description

It is high, deciduous, extensively-spreading, climbing shrub with various elongated twining branches. The leaves are alternate, simple and exstipulate with long petioles having 15 cm (6 in) long which are roundish and pulvinate, both at the base and apex with the basal one longer and twisted partially and half way around. It gets its name heart-leaved moonseed by its heart-shaped leaves and its reddish fruit. Lamina are broadly ovate or ovate cordate, 10–

20 cm (4–8 in) long or 8–15 cm (3–6 in)broad, seven nerved and deeply cordate at base, membranous, pubescent above, whitish tomentose with a prominent reticulum beneath. This plant flower is having a unisexual, small on separate plants and appearing when the plant is leafless, greenish-yellow on axillary and terminal racemes while male flowers are clustered, but female flowers are usually solitary. The plant having a six sepals in two series of three each. The outer ones are smaller than the inner. While it having a six petals which are smaller than sepals, obovate, and membranous. The fruits aggregate in clusters of 1-3. They having a ovoid smooth drupelets on thick stalks with sub terminal style scars, scarlet or orange in colored.

Morphology of Plant

Tinospora cordifolia is a glabrous, succulent, woody climbing shrub close to India. It thrives well in the tropical region, often attains a great height and climbs up the trunk of large trees. The stem is gray and creamy white, deeply cleft spirally and longitudinally, with the space between spotted with large rosette like lenticels.[27] The plant wood is white, soft and porous and the freshly cut surface assumes a yellow tint when exposed to air. Leaves having a simple, alternate, exstipulate, long petiolate, chordate in shape showing multicoated reticulate venation. Long thread as similar to aerial roots come up from the branches.[28] Flowers are small and unisexual. Male flowers are in clusters, female flowers are solitary. Six sepals arranged in two whorls, they are obovate and membranous. Aggregate fruit is mainly red, fleshy with many drupelets on thick stalk with subterminal style scars, scarlet coloured (1)

Taxonomical classification

Kingdom: Plantae Division: Magnoliophyta

Class: Magnoliopsida,

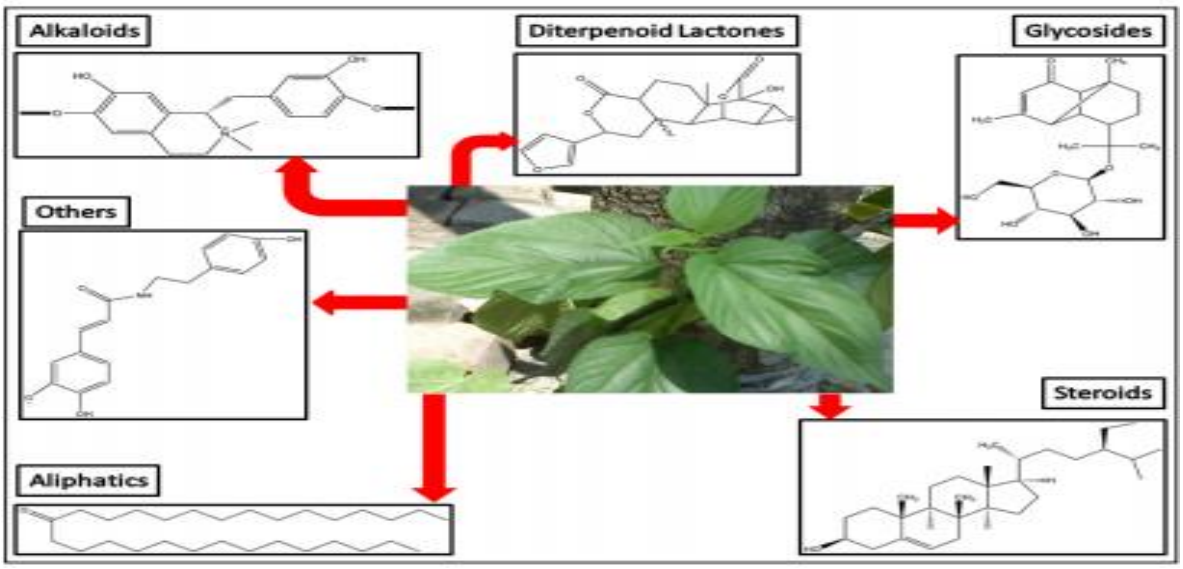
Order: Ranunculaceae

Family: Menispermeaceae.

Genus: Tinospora

Chemical Constituents

Isolated from Tinospora cordifolia belong to different classes such as alkaloids, diterpenoid lactones, glycosides, steroids, sesquiterpenoid, phenolics, aliphatic compounds and polysaccharides Other compounds that have been isolated from Tinospora cordifolia are tinosporone, tinosporic acid, cordifolisides A to E, syringen, berberine, 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, tetrahydropalmaitine, jatrorrhizine respectively.[29] It also contains Flavonoids, glycosides, saponins and some amount of phytosterols. These active constituents alone or in combination may be responsible for the observed antioxidant activity.[21] This family is rich source of alkaloids and terpenes. Leaves of this plant are rich in protein (11.2%) and are fairly rich in calcium and phosphorus.[30]



Phytoactive compounds of Tinospora carifolia-(26-34)

Sr No	Class	Chemical constituents	Activity	Plant part
1	Alkaloids	Berberine, Magnoflorine, CholinePalmatin, Tembetarine, Tinosporine, Isocolumbin, Aporphine alkaloids, Jatrorrhizine, Tetrahydropalmatine	Anti-viral infections Neurological, Immunomodulatory anti-diabetes, Anticancer	Stem & Root
2	Steroids	20 δ -Hydroxyecdysone, δsitosterol, β –sitosterol , GiloinsterolEcdysterone,	Inhibits TNFα, IL-1 β, IL-6 and COX2. inflammatory	Shoot

		Makisterone A	arthritis, IgA neuropathy	
3	Glycosides	Tinocordiside, Tinocordifolioside, Cordioside, 18-norclerodane glucoside, CordifoliosideSyringin, Syringinapiosylglycoside, Furanoidditerpene Glucoside ,Palmatosides, Cordifolioside A, B, C, D and E, Pregnane glycoside.	anticancer activities Treats neurological disorders like ALS, Parkinsons, Dementia	Stem
4	Diterpenoid lactones	Furanolactone ,Tinosporon, Tinosporides , Columbin, Clerodane derivatives, Jateorine	Anti-inflammatory, anti-microbial, anti-viral. Anti-hypertensive, VasorelaxantInduce apoptosis in leukemia by activating caspase-3and bax, inhibits bcl-2.	Whole plant
5	Sesquiterpenoid	Tinocordifolin.	Antiseptic	Stem
6	Aliphatic compounds.	Heptacosanol, Octacosanol, Nonacosan-15-one dichloromethane	anti-inflammatory, Protection against 6-hydroxydopamineinduced parkinsonisms in rats	Whole plant
7	Miscellaneous compound:	3,(α,4-di hydroxyl-3-methoxybenzyl)-4-(4- Compounds hydroxyl-3-methoxy-benzyl)- tetrahydrofuran ,Giloinin, Tinosporic acid, Tinosporidine, Cordifol, Cordifelone, Jatrorrhizine, Ntrans-feruloyltyramine as diacetate.	Protease inhibitors for HIV and drug resistant HIV.	Whole plant & Root

Preparation of Extraction

The stems converted in powdered, and aqueous and methanolic extract of *T. cordifolia* (AETC and METC) was prepared as described previously [21], 25 grams of powder was soaked in 250 ml of methanol for 12 hours with continuous stirring. Then the suspensions were refluxed under the reduced pressure for 6 hours and filtered through the Whatman filter paper The filtrates containing methanol were concentrated using a rotary evaporator, whereas aqueous extracts were dried using a water bath.

Medicinal Properties

Tinospora cordifolia is widely used medicinal plant in Ayurvedic system for its general tonic, antiperiodic, anti-spasmodic, anti-inflammatory, antipyretic, anti-arthritic, anti-lepritic, anti-allergic and anti-diabetic properties.[24] The plant is used to increase the immune system and the body resistance against infections. The root of this plant is known for its anti-stress and antimalarial activities. The stem is bitter, stomachic, diuretic, stimulates bile secretions, allays

thirst, enriches the blood and cures jaundice. The extract of the stem is useful in skin problems. The root and stem of Tinospora cordifolia is prescribed in combination with other drugs as an antidote to snakebite and scorpion.[24] The plant is also used in the treatment of wounds, pneumonia, asthma and cough. Tinospora cordifolia has anti-cancer, immune stimulating, nerve cell protecting, antidiabetic, cholesterol-lowering and liver-protective actions. Tinospora cordifolia is also responsible for decreasing the tissue damage caused by radiation, the side effects of some forms of chemotherapy and speeding healing of diabetic foot ulcers.[25]

Histrological Background

The use of this medicinal plant has been described in detailed manner in Vedic and ayurvedic scriptures. The plant is known as Guduchi or Amrita in Sanskrit which points to the nature of this plant in the rejuvenating and the retainment of youth and life span of the consumer. In other words, the fountain of life force is an apt title for this medicinal plant. The Caraka Samhita, Sushruta Samhita, Bhela Samitha, Kashyapa Samhita and Ashatanghrdayam are few of the noted works that have detailed description of the medicinal plants in the field of spiritual and health field of the biological system that they are introduced to. The influence of Persian, Arabic, folk medicines in the life style of man along with the Vedic and Ayurveda practices has heavily influenced the normal household life along with the scientific know–how's in the molecular level with the biochemical and phytochemical composition of the plant and the plant compounds has done a great deal in the understanding of this miraculous plant. The traditional and folk medicine with no scientific basis has been strongly advocating the regular use of the medicinal plants in the dietary form or in supplementary form; this is credited to the observational knowledge and the information which is passed from godly beings to the sages and to general bodies through Gurus (teachers). The abundant medicinal plants and the Vedic scriptures that point to the correct usage of these plant for the optimum beneficial effect has spiked the interest of the science bodies and the further research on these plants on the scientific platform has in evidently pointed to the same results that have been preached from time immemorial by the traditional forms of medicine.

Medicinal applications

In India Tinospora cordifolia is widely used in traditional ayurvedic medicine because of its biological activities like anti- inflammatory, immunomodulatory, anti-oxidant, anti-diabetic, anti-periodic, anti-spasmodic, anti-neoplastic activities, anti-stress, anti-leprotic, anti-

malarial, hepato-protective, anti-allergic and anti-arthritic activity and various other medicinal properties.[36]

Tinospora cordifolia use in various ailments fevers, asthma, diabetes, dyspepsia, jaundice, urinary problems, skin diseases and chronic diarrhoea and dysentery. It also plays a key role in the treatment of heart diseases, leprosy, helmenthiasis and rheumatoid arthritis. The root and stem of T. cardifoliaas an antidote to snake bite and scorpion sting (35-37). The stem is bitter, stomachic, diuretic, stimulates bile secretions, allays thirst, enriches the blood and cures jaundice.[38] The juice of plant stem is useful in diabetes, dyspepsia, vaginal and urethral discharges.[39]

The bark of this plant acts as Anti-allergic, Anti-spasmodic, Anti-pyretic, Anti-leprotic.[40,42] The powder of root and stem is used along with milk for treatment of cancer (43) The whole plant of T.cardifolia used in scabies in swine, diarrhoea, Urinary diseases, syphilis, skin diseases, bronchitis, to promote longevity, increase body's resistance and Stimulate the immune system.[44,47] The dried fruit powder mixed with ghee or honey, is used as a tonic and also in the treatment of jaundice and rheumatism.[48]

The dry stem crude extract of this plant which was poly saccharide in nature shows a poly clonal B-cell mitogen activity and Active components of stem extract enhanced the humoral response in mice.[49]

Giloy (T.cardifolia) juice which is a mixture of Giloy herb and tulasi leaves is used against monkey malaria. The stem aqueous extract of T.cardifolia shows anti-inflammatory effect in both acute a sub-acute models of inflammation. T.cardifolia shows anti – allergic Rhinitis activity. Allergic rhinitis is the atopy disease implies hypersensitivity response exposure to pollens of grass, weeds, trees, dust etc. The T. cordifolia stem aqueous extract shows radio - protective activity. It is used in treatment of jaundice because it reduces body heat .The stem of this plant regulates the blood sugar level due to the presence of alkaloids.[50,54]

Pharmacological activity

1. Hypoglycemic activity

Oral administration of the water extract of Tinospora cordifolia root caused a significant reduction in blood glucose, brain lipid level, hepatic glucose-6-phosphatase, serum acid

phosphatase, alkaline and lactate dehydrogenase and increase in body weight, total haemoglobin and hepatic hexokinase in alloxanized diabetic rats.[31]

2. Anti-allergic activity

In a clinical study, 100% relief was reported from sneezing in 83% of the patients on treatment with T. cordifolia. Thus Tinospora cordifolia significantly decreased all symptoms of allergic rhinitis and was well tolerated.[32]

3. Cardioprotective activity

A dose-dependent reduction in infarct size and in serum and heart lipid peroxide levels was observed with prior treatment with Tinospora cordifolia in ischemia-reperfusion-induced myocardial infarction in rats.

4. Hepatoprotective

The hepatoprotective action of T. cordifolia was reported in one of the experiment in which goats treated with Tinospora 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 Hours.[33]

5. Anti-stress and tonic property

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 behavior disorders and mental deficit. It has also significantly improved the I.Q. levels.[34]

6. Anti-inflammatory

The alcoholic extract of Tinospora cordifolia has been found to exert anti-inflammatory actions in models of acute and subacute inflammation.[34]

7. Antineoplastic activity

Intraperitoneal injection of the alcoholic extract of Tinospora cordifolia has been shown to Dalton's lymphoma (DL) bearing mice stimulated macrophage functions like phagocytosis, antigen-presenting ability and secretion of Interleukin-1 (IL-1), tumour necrosis factor (TNF) and Reference Nutrient Intake (RNI) as well as slowed tumor growth and increased lifespan of the tumor-bearing host.[36]

8. Osteoprotective activity

Rats treated with Tinospora cordifolia showed an osteoprotective effect, as the bone loss in tibiae was slower than that in controls effectively. Serum osteocalcin and cross-laps levels were significantly reduced. This study demonstrates that extract of Tinospora cordifolia has the actively potential for being used as anti-osteoporotic agent.[35]

9. Antifertility activity

Oral administration of 70-75% methanolic extract of Tinospora cordifolia stem to male rats at a dose level of 100 mg/d for 60 days did not cause body weight loss but decreased the weight of testes, epididymis, seminal vesicle and ventral prostate in a significant manner.[31]

10. Anti-ulcer activity

Treatment with a formulation containing Tinospora cordifolia has been shown to reduce ulcer index total acidity, with to increase in the pH of gastric fluid in pylorus-ligated rats and in the ethanol-induced gastric mucosal injury in rats.[36]

11. Anti leprotic activity

Tinospora cordifolia is used for its kushtahara (anti-leprotic) properties, along with wide use in Kandu and visarpa (types of skin disorders) and has been shown to exert anti -leprotic activity in a combination formulation.[35]

Growth Regulatory Activities of Different Extracts of Tinospora cordifolia on Some Food Crops

There are different types of plant such as herbal or medicinal, fruit trees, woody, necrotic, herbaceous, shrubs, weeds etc. in plant kingdom. Most of them have effective medicinal values, growth regulatory, herbicidal and pesticidal effects and also toxic values. According to WHO, around 70-80 % of the world‟s 7.86 billion inhabitants depend on traditional medicine for their primary health care, majority of which use plant or their active principles The attention is being needed to the importance of rotation in medicinal plant or between medicinal herbs and other crops. Various types of extracts of T. cordifolia and Shial mutra having bioactive compound increase or decrease germination and growth rate of Aktar et al. (2014) investigated the growth regulatory activities of different extracts of Tinospora cordifolia on radish (Raphanus sativus), swamp cabbage (Impoea aquatica) and lady‟s finger (Hibiscus esculentus) with the attempt for chemical investigation of effective plant extract. The chloroform extract of Tinospora cordifolia significantly increased and enhanced

germination, growth of shoot length and root length of radish and lady‟s finger whereas and delayed germination, growth of shoot length and root length of swamp cabbage seeds compared with control. In the same way, ethanol extract of Tinospora cordifolia significantly increased germination, growth of shoot length and root length of swamp cabbage followed by control and chloroform extract. The different extracts of Tinospora cordifolia contain growth regulatory active principle. Among the extracts, chloroform extract showed better performance in terms of percent germination, growth of shoot and root length of radish and lady‟s finger whereas according to Singh et al. (2010) conducted to estimate the allelopathic effects of Tinospora cordifolia on food crops and obtained result that higher concentration of leaf and old shoot extracts inhibited the germination of Sesamum orientala and Eleusine coacana while higher concentration stimulate the germination of Cajanus cajan. The lower concentration of new shoots stimulates germination as compared to higher concentration. The higher concentration of leaf, new shoot and old shoot had suppressed radicle and plumule growth of all tested food crops as compared to lower concentration. On the other hand, according to Raoof and Siddiqui (2014) studied the allelopathic effects ofLeaf and stem aqueous extracts ofTinospora cordifolia weed on seed germination and seedling growth of weed plants (Chenopodium album L. Chenopodium murale L., Cassia tora L. and Cassia sophera L.) at 0.5 to 4.0% concentrations. Aqueous extracts from leaf and stem inhibited germination, root length, shoot length and dry weight of weed species decreased progressively when plants were exposed to increasing concentration (0.5, 1, 2 and 4%). Aqueous extract of leaves shows the maximum inhibition while stem shows the least effect on weeds.[55]

Top 10 Most Productive Countries in Tinospora cordifolia

The global research output in the field of Tinospora cordifolia research had originated from 45 countries during 2001-2016, of which 41 countries contributed 1-10 papers, 3 countries 11-50 papers and 1 country 747 papers The top 10 most productive countries in Tinospora cordifolia research contributed 5 to 747 publications each during 2001-2016, and together accounted for more than 100% global publication and citation share during 2001- 2019. Their eight-yearly output accounted for more than 100.0% global publication share during 2001-2008 which decreased to 99.53% during succeeding 8-year period 2009-2020. Each of top 10 countries accounted for 0.58% to 86.36% global publication share during 2001-2016, with India accounting for the highest publication share (86.36%), followed by USA (5.66% share), Bangladesh, Pakistan, Malaysia and U.K. (from 1.04% to 1.97%) and Germany, Italy, Saudi

Arabia and Nigeria (from 0.58% to 0.81%) during 2001-2016. The global publication share in eight years increased by 3.04% in India, followed by 1.42% in Bangladesh, 1.41% in Pakistan, 0.93% in Saudi Arabia, 0.33% each in Italy and Malaysia, as against decrease by 6.42% in USA, 2.87% in U.K., 1.05% in Nigeria and 0.74% in Nigeria from 2001-2008 to 2009-2016. Three of top 10 countries scored relative citation index above the world average i.e. 1.02: U.K. (4.56), USA (2.11) and Bangladesh (1.25) during 2001-2016. The international collaborative share of top 10 countries in Tinospora cordifolia research in their respective national output varied from 0.0% to 100.0%, with highest share coming from Saudi Arabia (100.0%), followed by U.K. (88.89%), Malaysia (60.0%), USA and Germany (57.14% each), Bangladesh (35.29%), Italy (33.33%), Pakistan (23.08%), India (7.50%)and Nigeria (0.0%) during 2001-2016

Global Publication Share of Top 10 Most Productive Countries in Tinospora cordifolia Research during 2004- 2016.

S.No	Name of the Country	Number of Papers			Share of Papers			TC	CPP	HI	ICP	%ICP	RCI
		2001-08	2009-16	2001-16	2001-08	2009-16	2001-16	2001-2016					
1	India	185	562	747	84.09	87.13	86.36	11024	14.76	48	56	7.50	0.93
2	USA	23	26	49	10.45	4.03	5.66	1650	33.67	19	28	57.14	2.11
3	Bangladesh	2	15	17	0.91	2.33	1.97	338	19.88	7	6	35.29	1.25
4	Pakistan	1	12	13	0.45	1.86	1.50	147	11.31	7	3	23.08	0.71
5	Malaysia	2	8	10	0.91	1.24	1.16	79	7.90	3	6	60.00	0.50
6	U.K.	7	2	9	3.18	0.31	1.04	654	72.67	7	8	88.89	4.56
7	Germany	3	4	7	1.36	0.62	0.81	96	13.71	5	4	57.14	0.86
8	Italy	1	5	6	0.45	0.78	0.69	69	11.50	4	2	33.33	0.72
9	Saudi Arabia	0	6	6	0.00	0.93	0.69	25	4.17	3	6	100.00	0.26
10	Nigeria	3	2	5	1.36	0.31	0.58	38	7.60	4	0	0.00	0.48
	Total	227	642	869	103.18	99.53	100.46	14120	16.25	10.7	119	13.69	1.02
	World	220	645	865				13785	15.94				
	Share of 10 Countries in World Total	185	562	747									

TP=Total Papers; **TC**=Total Citations; **CPP**=Citations Per Paper; **HI**=h-index; **ICP**=International Collaborative Papers; **RCI**=Relative Citation Index

CONCLUSION

The present review focuses on the botanical description and medicinal importance of the plant Tinospora cordifolia. The plant, for its vast bio-diversity and traditional medicinal importance, it provides a new sight of challenging research for the scientists to isolate pharmacologically active and therapeutic components from the plant to treat several dreadful diseases.

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