

Tinospora cordifolia: Multipurpose Medicinal Plant

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Abstract: Traditional systems of medicine such as Ayurvedic, Uninai, Siddha and Homeopathy 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.

Index terms: Medicinal Plants, Plant Extract, Tissue Culture, Natural Products, Biodiversity.

I INTRODUCTION

India is bestowed with enormous biodiversity of medicinal plants. Among them *Tinospora cordifolia* has a wide array of bioactive principles as well as it has been proven medicinally important plant, have not received considerable scientific attention. 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. and natural compounds for the synthesis of drugs such as tubocurarine, colchicine, nicotine, quinine etc. Many modern medicines such as digitalis, vinblastine, aspirin, quinine and paracetamol had their origin from the natural compounds of medicinal plants. 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.

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. It is known as heart leaved Moonseed plant in English, Guduchi in Sanskrit and Giloy in Hindi.

II RESERCH METHODOLOGY

2.1 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 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 has chemical composition as similar as neem as well as giloy and show better therapeutic properties. *T. cordifolia* prefers medium black or red soil for its cultivation. Giloy can also be successfully grown in large variety of soils, ranging from sandy to clay loam. However, the soil should be well drained with sufficient moisture and rich with organic matter for its growth.

2.2 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. Viability of seeds is very less, poor seed set and germination of seeds are the main problems associated with its clonal propagation. Vegetative

cuttings are also not suitable due to less productivity and also dependent upon weather conditions for its further growth. Keeping in view the Growth constraints, plant tissue culture techniques may be suitable methods for its large scale production in a lesser time and space.

III RESULT & DISCUSSION

3.1 Morphological Description

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

3.2 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 (Figure 1A).

3.3 Aerial Root:

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

3.4 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 (Figure 1B).



Fig 1: Morphology of different parts of *T. cordifolia* A. Stem, B. Leaf, C. Fruit, D. Inflorescence, E. Flower, F. Aerial Roots.

3.5 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 (Figure 1D AND 1E).

3.6 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 (Figure 1C).

3.7 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.

3.8 Natural Products

A variety of chemical constituents such as alkaloids, diterpenoid lactones, steroids, glycosides aliphatic compounds, polysaccharides have been reported from different parts of *Tinospora cordifolia*. Various natural products (active compounds) isolated from different plant parts along with their biological activities have been given here for readers reference (Table-1).

3.9 Biological Activities

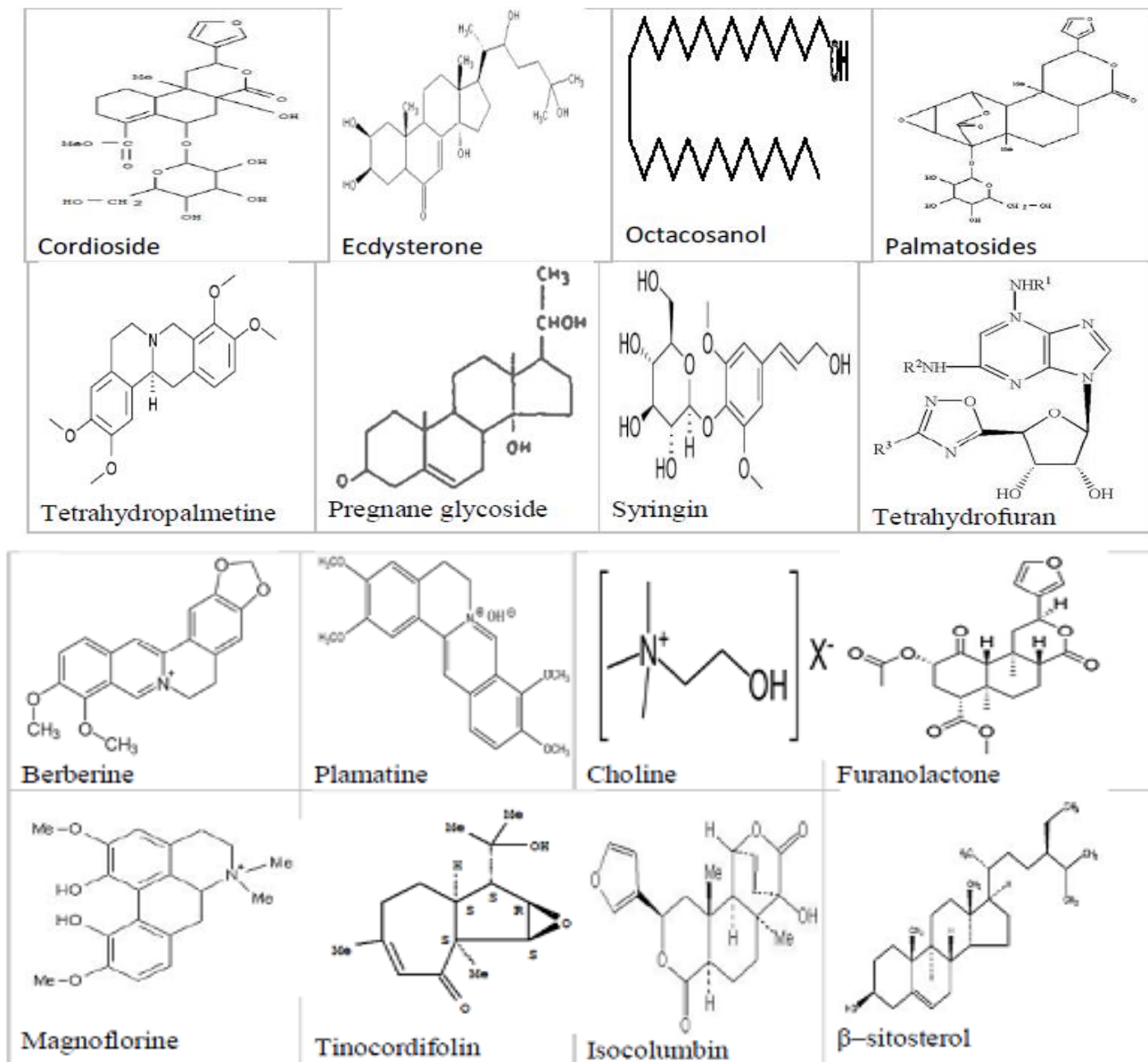
The major biological activities of *Tinospora cordifolia* summarized in the following manner

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

Active Component	Compound	Plant Part	Biological Activity (In Human being)	References
Alkaloids	Berberine, Choline, Tembetarine, Magnoflorine, Tinosporin, Palmetine, Isocolumbin, Aporphine alkaloids, Jatrorrhizine, Tetrahydropalmatine,	Stem, Root	Anti-viral infections, Anticancer, anti-diabetes, inflammation, Neurological, immunomodulatory, psychiatric conditions	(12-17)
Diterpenoid Lactones	Furanolactone, Clerodane derivatives [(5R,10R)-4R-8Rdihydroxy-2S-3R:15,16-diepoxy-cleroda-13 (16), 14-dieno-17,12S:18,1Sdilactone], Tinosporon, Tinosporides, Jateorine, Columbin	Whole Plant	Vasorelaxant: relaxes norepinephrine induced contractions, inhibits Ca ⁺⁺ influx, anti-inflammatory, anti-microbial, antihypertensive, anti-viral. Induce apoptosis in leukemia by activating caspase-3 and bax, inhibits bcl-2.	(18-22)
Glycosides	18-norclerodane glucoside, Furanoid diterpene glucoside, Tinocordiside, Tinocordifolioside, Cordioside, Cordifolioside Syringin, Syringinapiosylglycoside, Pregnane glycoside, Palmatosides, Cordifolioside A, B, C, D and E	Stem	Treats neurological disorders like ALS, Parkinsons, Dementia, motor and cognitive deficits and neuron loss in spine and hypothalamus, Immunomodulation, Inhibits NF-kB and act as nitric oxide scavenger to show anticancer activities.	(23-29)
Steroids	β -sitosterol, δ -sitosterol, 20 β -hydroxyecdysone, Ecdysterone, Makisterone A, Giloinsterol	Shoot	IgA neuropathy, glucocorticoid induced osteoporosis in early inflammatory arthritis, induce cell cycle arrest in G2/M phase and	(30-32)

			apoptosis through c-Myc suppression. Inhibits TNF- α , IL-1 β , IL-6 and COX-2.	
Sesquiterpenoid	Tinocordifolin	Stem	Antiseptic	(33)
Aliphatic compound	Octacosanol, Heptacosanol Nonacosan-15-one dichloromethane	Whole plant	Anti-nociceptive and anti-inflammatory. Protection against 6-hydroxydopamine induced parkinsonisms in rats. Down regulate VEGF and inhibits TNF- α from binding to the DNA.	(34-36)
Others	3,(a,4-di hydroxy-3-methoxy-benzyl)-4-(4-compounds hydroxy-3-methoxy-benzyl)-tetrahydrofuran, Jatrorrhizine, Tinosporidine, Cordifol, Cordifellone, Giloinin, Giloin, N-transferuloyltyramine As diacetate, Tinosporic acid.	Root, Whole Plant	Protease inhibitors for HIV and drug resistant HIV.	(37-38)

The chemical structures of medicinally potent chemical compounds reported in this plant are being depicted here, which would help researchers to identify these chemicals from the same or different plant resources. The structures of important natural products are as follows:



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