



# Plant Archives

Journal homepage: <http://www.plantarchives.org>  
DOI Url : <https://doi.org/10.51470/PLANTARCHIVES.2021.v21.no2.024>

## TINOSPORA CORDIFOLIA: A MAGICAL WAND WITH IMMENSE MEDICINAL APPLICATIONS

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(Date of Receiving : 28-01-2021; Date of Acceptance : 04-05-2021)

### ABSTRACT

*Tinospora cordifolia*, a herb with a potential of boosting the immune system of a person is fully packed with nutrition be it carbohydrates, vitamin C, protein, fat, bioactive phytochemicals etc which one can have for relieving the person from illness and providing significant health benefits. When it comes to healthy herbs and plants *Tinospora cordifolia* never fails as a choice to cure the diseases and the symptoms associated with it. It helps in the treatment and management of diabetes, cancer, HIV-AIDS, toxicity from aflatoxins, osteoporosis, inflammation, leprosy, arthritis etc by the helps of various phytochemicals present in it. Alkaloids like Tinocordiside, Palmatine, Magnoflorine helps in cancer, syringin works as a great anti-allergen, magnoflorine as an anti-inflammatory etc.

**Keywords :** *Tinospora cordifolia*, phytochemicals, diabetes, inflammation, alkaloids, glycosides.

### INTRODUCTION

The modern time of industrialization and globalisation we live in where the disease like diabetes, hepatic diseases or immunity suppression is so common that it is of utmost importance that our body gets to works efficiently so as we lead a healthy life (Dhama *et al.*, 2017). Medicinal trees and herbal plants seem to have a major role play in lives of people when it comes of diseases and the therapeutic use of these plants from long time ago in ayurveda, folk, tribal etc (Sharma *et al.*, 2010) because of the side effects of antibiotics (Dhama *et al.*, 2017) and their reducing effectiveness with time (Srivastava, 2011). Acc to WHO it was reported that almost 70% of the people use ayurveda over synthetic drugs because of lesser side effects (Jabiullah *et al.*, 2018). Due to this growing usage of ayurveda and herbal plants *Tinspora cordifolia* caught our attention. *Tinospora Cordifolia* also known as Giloe in Hindi, is a deciduous, perennial, succulent climbing shrub present in Asia, Africa and Australia at the height of 1000fts mainly in its tropical and sub-tropic regions (Sankhala *et al.*, 2012) (Choudhary *et al.*, 2013) (Chi *et al.*, 2016). It can grow both in acidic and alkaline soil range (Meshram *et al.*, 2013) in 25-45°C (Tiwari *et al.*, 2018).

It was seen that the dried sample of *Tinospora cordifolia* contains 232.61kcal/100grams energy having Carbohydrate (46.11%), Protein (8.06%), Fibre (26.99%), crude fat (1.77%), Moisture (10.01), Ash (7.05), Vitamin C (3.17mg/100g) (Modi *et al.*, 2021).

It has a plethora of bioactive phyto-chemicals (Srivastava and Singh, 2021) in different parts of plant say

alkaloids, glycosides, sesquiterpenoids etc in stem, alkaloids in roots, steroids in aerial part of the plant and aliphatic compounds in whole plant (Kumar *et al.*, 2017) having anti-oxidant, anti-diabetic, anti- neoplastic, anti-stress, anti-dote, anti- spasmotic, anti-pyretic, anti-allergic, anti-leprotic anti-inflammatory, anti-hyperlypidaemia, anti-cancer, Immunomodulatory properties (Mittal *et al.*, 2014).

### MEDICAL APPLICATIONS

It was seen that every part of the plant be it stems, roots, leaves, flowers, whole plant are useful because of the presence of the bioactive phytochemicals in it as shown in Figure 1.

Each plant part have phytochemicals of their own which makes every plant part a unique element for treating various ailments some of which are described in Table 1.

**STEMS-** Its stems are green and succulent with bark having colour appearance of cream white to gray with rosette like lenticels. Long filliform aerial roots having tetra to pentarch primary structure (Mittal *et al.*, 2014) arises from the long dirty greyish white branches (Shefali and Nilofer, 2013). Stems extracts of *Tinospora cordifolia* seem to possess Anti-diabetic, Anti-cancer, Anti-Pyretic properties etc (Parida and Bagartee, 2020).

Diabetes Mellitus, a metabolic disorder which is affecting the people of every life phase is a condition of disturbed metabolism either due to lack of insulin secretion or insulin action called as Type-1(insulin dependent) and Type-2 (non-insulin dependent) diabetes mellitus respectively (Singh *et al.*, 2019). The bioactive compounds

of *Tinospora cordifolia* like alkaloids, glycosides, flavonoids, saponins etc seems to possess anti-diabetic potential (Bhardwaj, 2019). A study was conducted where Ilogen-excel having *Tinospora cordifolia* as one of the herb when given in a dosage of 50mg/kg and 100mg/kg for continuous 60days it leads to decrease in the blood glucose levels and increase in the plasma levels of insulin in the body (Sharma *et al.*, 2015).

In an another study on mice the pharmacodynamic interactions between TC extracts and anti-diabetic drugs [Metformin(MET), sitagliptin(SITA), glibenclamide(GLI)] was studied and seen that the combination of TC extract in dosage 400mg/kg with each of this drug (MET-90mg/kg, SITA-10mg/kg, GLI-1mg/kg) leads to the reduction of blood glucose levels in fasting. It is also seen to normalise the symptoms of dyslipidemia by reducing the levels of total cholesterol and triglycerides (Vora *et al.*, 2020).

Cancer a life threatening disease with uncontrolled and abnormal growth of cells is affecting the population in millions, most common types of which are breast, mouth, cervical, colorectal, oral, stomach lung etc (Verma and Khan, 2018). Various bioactive compounds like saponins, alkaloids like Tinocordiside, Palmatine, Magnoflorine etc seems to possess anti-cancer activities. The methanolic stem extract (50%) of *Tinospora cordifolia* was made and the cell viability and cytotoxicity was tested against the human breast cancer cell line MDA-MB-231 and normal Vero epithelial cell line. The extracts were found to be potentially cytotoxic to MDA-MB-231 cells with IC 50 value being recorded at 50±2.01 µg/ml in 0.5% DMSO and 59±4.05 µg/ml in 0.25% DMSO (Ahmed *et al.*, 2015).

**FLOWERS-** *Tinospora cordifolia* is dioecious as it bears male and female flowers separately (Choudhary *et al.*, 2013). Flowers are small yellowish-green in colour, where the female flowers are generally seen in singular form and male flowers are seen clustered, and they blossom in summer in the month of March to June (Jabiullah *et al.*, 2018).

Flowers of *Tinospora cordifolia* seem to possess anti-inflammatory and anti-toxic properties etc (Parida and Bagartee, 2020).

*Tinospora cordifolia* showed the presence of many phytochemicals mainly alkaloids (choline, tinosporin, isocolumbin, palmatine, tetrahydropalmatine, and magnoflorine) which show anti-toxic nature against the nephrotoxicity caused by aflatoxins. These alkaloids helps in the scavenging the free radicals species produced by these aflatoxins. It decreases the thiobarbituric acid reactive substances (TBARS) and increases the GSH, ascorbic acid and the activities of anti-oxidant enzymes viz., SOD, CAT, GPx, Glutathione S-transferase (GST) and glutathione reductase (GR) in kidney (Gupta *et al.*, 2011). Another study was conducted on Swiss albino mice with lead nitrate hepatotoxicity. It was observed that the decreased level of SOD, CAT in hepatotoxicity were seen to increase when administrated with Aq. Extracts of stems and leaves of *Tinospora cordifolia* and similarly increased level of aspartate aminotransferase (AST), alanine aminotransferase (ALT), ALP, and ACP enzymes seems to decrease by TCE (Sharma *et al.*, 2010).

Anti-inflammatory activity if *Tinospora cordifolia* was seen due to its potential of reducing the levels of pro-

inflammatory cytokines such as IL-1β, TNF-α, IL-6, IL-17 etc (Sannegowda *et al.*, 2015).

**ROOTS AND LEAVES-** Leaves are simple, heart shaped, exstipulate with lower part pale and upper part glaucous (Gupta, 2019) dark green coloured, having multi-coated reticulate venation. Lamina is ovate. Leaves of Giloy were seen to be a good cattle fodder (Mittal *et al.*, 2014).

The root and leaves extracts are useful as anti-microbial, anti-ulcerative, anti-arthritis, hypoglycemic etc (Parida and Bagartee, 2020).

The anti-bacterial activity of *Tinospora cordifolia* was checked against different gram-positive bacteria like *Escherichia coli*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Proteus vulgaris*, *Salmonella typhi*, *Shigella flexneri*, *Salmonella paratyphi*, *Enterobacter aerogenes*, *Pseudomonas aeruginosa*, *Enterobacter aerogene*, and *Serratia marcescens*. In mice it shows enhanced phagocytosis and better bacterial clearance (Saha and Ghosh, 2012).

*Tinospora cordifolia* with *Zingiber officinale* was seen to be a beneficial herbal treatment for the rheumatoid arthritis (Chopra *et al.*, 2010). *Tinospora cordifolia* at a dosage of 25µg/ml helps in the differentiation of cells of osteoblast, proliferation and mineralisation of bone like matrix thus can be used as an anti-osteoporotic (Abiramasundari *et al.*, 2012). β-Ecdysone from *Tinospora cordifolia* extracts induces a significant increase in the thickness of joint cartilage and seems to relieve osteoporosis in osteoporotic animals reporting its anti-osteoporotic activity (Gao *et al.*, 2008).

**WHOLE PLANTS-** The TC extracts of whole plants are used for curing many diseases like fungal infections, allergies, diabetes, HIV-AIDS, as an immune-modulator, anti-oxidant etc (Parida and Bagartee, 2020).

Human immunodeficiency virus called as HIV is a retrovirus which causes severe degradation of immune system. A study was conducted on 20 HIV patients. In which half of them were given ART treatment and the other half were given ART+ *Shilajatu Rasayana* (a capsule of 500mg) for 3months. It was observed that there was a significant change in the CD4+ cells which are one of the major cells of immune system and also the symptoms like weight loss, fever nausea etc were also seen to be improved (Gupta *et al.*, 2010). A phytochemical from giloy called Cordifolioside-A seem to work as a radioprotective and cytoprotective immunity boosting chemical which leads to increase in Haemoglobin content, white blood cells, B-lymphocytes etc (Patel *et al.*, 2013). Another study conducted by on 68 HIV patients also showed positive response of *Tinospora cordifolia* extract. It was observed that when TC extract was given to the patients for 6 months 3 times a day in the dosage of 300mg tablet it leads to increase in ESR, Lymphocytes and CD4 expression and decrease in Hb%, platelets, eosinophils, neutrophils, TLC (Kaliker *et al.*, 2008).

*Tinospora cordifolia* is also a great immune stimulator because of the presence if phytochemicals like 11-hydroxymustakone, N-methyl-2-pyrrolidone, N-formylannonain, cordifolioside A, magnoflorine, tinocordiside, syringine, ImP (immunomodulator protein), G1-4A, alfa-D glucan etc in it (Tiwari *et al.*, 2018). Out of these 11-hydroxymustakone, N-methyl-2-pyrrolidone, N-formylannonain, tinocordiside seem to enhance the

phagocytosis and phagocytic index, helps in the formation of ROS (Reactive oxygen species), NO production etc (Sharma *et al.*, 2012). Alfa-D- glucan helps in the cytokine synthesis like interferon- $\alpha$ , TNF- $\alpha$ , TNF- $\beta$ , interleukins etc (Koppada *et al.*, 2009) and also it was observed that they increases the B-cell, T-cell and NK cell activity by many times (Nair *et al.*, 2004). G1-4A played its role as adjuvant immune-stimulator with isoniazid which seems to spike up the INF-gamma level, IL- $\beta$ , IL-6, TNF- $\alpha$  etc in the mycobacterium tuberculosis infected cells (Gupta *et al.*, 2016). Magnoflorine in *Tinospora cordifolia* lead to the decrease in the levels of TNF- $\alpha$ , IL-1 $\beta$  and IL-6 in mice having acute lung injury (Guo *et al.*, 2018).

Syringin seems to play an important role in GDM in rats by increasing the TLR4, MyD88, NF-kB, NLRP3 which

helps with the insulin resistance. It also decreases the level of inflammatory cytokines like TNF- $\alpha$ , IL-1 $\beta$  (Shen *et al.*, 2020).

## CONCLUSION

*Tinospora cordifolia*, thus in total is a power pack of phytochemicals be it flavonoids, alkaloids, saponins, steroids, glycosides etc which showed their immense applications in the field of science and health. It seems to cure many diseases like it is helpful in curing the diabetes by reducing the blood sugar levels and the associated symptoms, help in normalising the symptoms of nephrotoxicity, HIV-AIDS, cancer, arthritis and inflammation associated with it etc. Due to this wide and diversified use of *Tinospora cordifolia* there is a great future prospect to it.

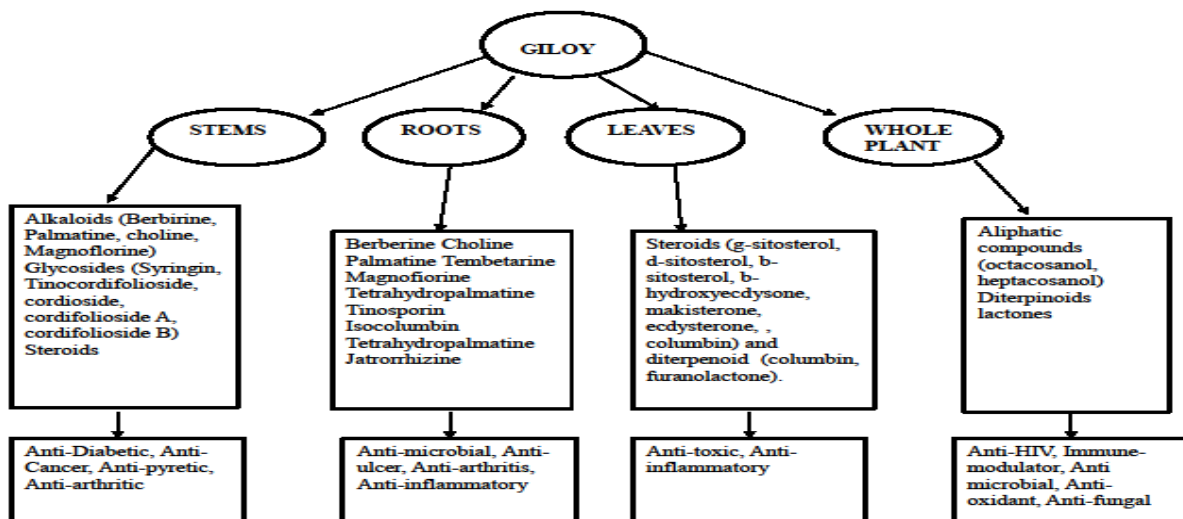


Fig. 1 : Plant part associated phytochemicals and their biological functions

Table 1 : Medicinal properties of different parts of *Tinospora cordifolia*

S.No	Plant part	Medicinal properties	Supporting studies	References
1	Stems	Anti-Diabetic, Anti-Cancer, Anti-pyretic, Anti-arthritic	Lower blood glucose levels Increases plasma insulin Reduces total cholesterol and triglycerides Cytotoxic to MDA-MB-231 cell lines	Parida and Bagartee, 2020 Sharma <i>et al.</i> , 2015 Vora <i>et al.</i> , 2020 Ahmed <i>et al.</i> , 2015
2	Flowers	Anti-Inflammatory, Anti-toxic	Reduces IL-1 $\beta$ , TNF- $\alpha$ , IL-6, IL-17 Reduce TBARS Increases the GSH, ascorbic acid Increases AST, ALP, ACP, ALT etc	Parida and Bagartee, 2020 Gupta <i>et al.</i> , 2011 Sharma <i>et al.</i> , 2010 Sannegowda <i>et al.</i> , 2015
3	Roots and leaves	Anti-microbial, Anti-ulcer, Anti-arthritis	Increases phagocytosis Better bacterial clearance Helps in differentiation, proliferation and mineralisation of bone Increment in thickness of joint cartilage	Parida and Bagartee, 2020 Saha and Ghosh, 2012 Abiramasundari <i>et al.</i> , 2012 Gao <i>et al.</i> , 2008
4	Whole plant	Anti-HIV, Immunomodulatory, Anti-microbial, Anti-oxidant, Anti-fungal	Change in CD4+ cells Increases Hb, WBC, B-cells Increased phagocytosis, ROS formation, NO production	Gupta <i>et al.</i> , 2010 Patel <i>et al.</i> , 2013 Kalikar <i>et al.</i> , 2008 Tiwari <i>et al.</i> , 2018 Sharma <i>et al.</i> , 2012

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