**ABSTRACT**

*Tinospora cordifolia* is a medicinal ayurvedic herb having vast benefit to human health. It is come under the climbing shrub, which belongs to family Menispermaceae and is inherent to India and some extent to China also, and some parts of Australia and Africa. Other names used for *Tinospora cordifolia* are Guduchi or Amrita or Giloy. Not a single part but whole plant has its own pharmacological effect for human well-being. *Tinospora cordifolia* has chemical constituents like terpenoids, alkaloids, steroids, lignans, flavonoids and glycosides. It has many pharmacological activities such as immunomodulation, anti-diabetic, antifungal, in hepatotoxicity (hepatic disorder), anti-cancer, anti-HIV potential, antitoxic effect, and in Parkinson disease. This review paper will discuss about the various properties/activities of the plant.

Keywords: *Tinospora cordifolia*; pharmacological activity; Giloy; immunity; amrita; anti-diabetic; chemical constituents.

**ABBREVIATION**

BMI: Body Mass Index  
GPx: Glutathione Peroxide  
SOD: Superoxide Dimultase  
GSH: Glutathione

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1. INTRODUCTION

In today's world of globalisation and modernization, the increase in risk of a no. of diseases like infectious and non-infectious are because of the change in life style (stress, work pressure, change in climate) or food habits (unhealthy dietary habits) of human beings [1-3]. Beside from this, ailments like heart problem, cholesterol, stress, diabetes, rheumatoid arthritis, blood pressure have also increased. People losing interest in allopathy and seeking towards ayurvedic or natural drug sources because of increasing antimicrobial resistance from antibiotics, adverse effect and the cost of chemical drugs also decrease in their potency. In this situation researches have been going on for alternative to these medicines for betterment of human and animal health[4].

Herbal preparation comprises of one or more herbs in given quantity for provide aesthetic, diagnostic, and mitigation benefits to humans and animals [1]. Botanical medicine, or phytomedicine, is another name for it.

1.1 Tinospora Cordifolia

A climbing shrub of Menispermaceae family found commonly in India, China and some parts of Australia.

It has many vernacular names as; in English: Tinospora; in Punjabi: Gilo; in Oriya: Guluchi; in Marathi: Gulvel; in Malayalam: Chittamrutu; in Kashmiri: Amrita, Gilo; in Haryana: Giloy; in Bengali: Gulancha; in Sanskrit: Chakralakshanika; in Hindi: Gurcha; in Gujrati: Garo,Galac.

2. MORPHOLOGY

It's a huge erratic, widely spreading climbing shrub with numerous coiled branches of various morphologies. The plant's stem is filamentous, ample, and climbs; the bark of this plant have color white to grey in [6]. Stem powder is creamish brown or light brown in shading, has a particular scent, and a harsh taste. It is utilized to treat a few issues [7]. The "Guduchi-satva" stem is utilized for separating starch. It's a nutritious food that is likewise simple to process.

It is long-petioled, basic (around 15 cm) leaves with a roundabout, pulvinate, heart-formed shape that is curved outwards. The lamina is oval fit, 10–20 cm long, seven nerved, and exceptionally membranous [8]. Blossoms are unisexual, axillaries, and greenish-yellow in shading, with 2–9 cm long handout branches. Male and female blossoms have a qualification of accumulation and single respectively [9]. It has single-cultivated natural products that age in the colder time of year and blossom in the late spring [10]. The aeronautical roots have a tetra to penta curve fundamental design [11], are string like, elevated, squairshin, and now and then continually covers earth [12]. The seeds have a bended construction [13], and the endocarp is ornamented from numerous
points of view, giving significant ordered attributes.

2.1 Significance in Ayurveda

This plant is being consumed traditionally and each part of it have significant role in improvement of human health. It has been utilized as a constituent of a few people and Ayurvedic arrangements as juices, decoctions, glue, powders and pills to serve general weakness, fever, illnesses of skin, persistent the runs, jaundice, asthma and bone-crack, which were portrayed in old texts like Ras Ayana, Sangrahi, Balya, Agnideepana, Tridoshshamaka, DahnaShaka, Mehnashaka, Kasa-swasahara, Pandunasahaka, Kamla-Kushtha-Vataraktanashaka, Jwarbara, Krimihara, Prameha, Arshinashaka, and Kricch-HridoganaShaka [14]. Amrita used as a blood purifier, eliminating flawed and harmed red platelets from fringe blood flow. Due to its high alkaloidal substance, the Ayurvedic Pharmacopeia of India has recognized the stem of amrita as a medicine [15].

Leaves: Powder of leaves and their decoction, joined with cow's milk, have been utilized to fix gout, ulcers, jaundice, fever, and wounds, just as to oversee blood sugar [16].

Bark: for disease its underlying foundations and stem are utilized in North Gujrat (India) [17].

Stem extricate is utilized as mystical pill in jaundice fever, derma problems and fever while stem-starch (satva) is utilized as a tonic. As a remedy to wind chomp and scorpion sting, a mixture of root + stem is suggested [18].

Roots are recommended as an emetic in the treatment of visceral blockages, leprosy, diarrhoea, and dysentery [19, 20].

2.2 Chemical Constituents

*Tinospora Cordifolia* contains various classes of mixtures: Di-terpenoid lactones, alkaloids, steroids, glycosides, poly saccharides, aliphatic synthetics, phenols, and sesquiterpenoids are a portion of the parts.

| Class of Chemical | Constituent | Reference |
|------------------|-------------|-----------|
| Terpenoides      | Tinosporide, Furanolactone diterpene, Furanolactone clerodane diterpene, Furanoid diterpene, Tinosporaside, ecdysteronemakosterone and several glucosides isolated as poly acetate, phenylpropene disaccharides cordifolioside A, B and C, cordifoliside D and E, Tinocordioside, cordioside, palmasosides C and F, Sesquiterpene glucoside tinocordifolioside, Sesquiterpene tinocordifolin | [21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31] |
| Alkaloid         | Tinosporine, (S), Magnoflorine, (S), Berberine, (S), Choline, (S), Jatrorrhizine, (S), 1,2-Substituted pyrrolidine(S), Alkaloids, viz. jatrorrhizine, palmatine, beberine, tembeterine, choline. | [32, 33, 34, 35, 36] |
| Diterpenoid lactones | Diterpenoid (S), tinosporoncolumbin (S), clerodane derivatives (W), tinosporon (W), tinosporisides (W), jateorine (W), columbin (W), tinosporal, tinosporide. | |
| Glycoside        | 18 Nonderodane glycoside (S), furanoid diterpene glycoside (S), tinocordiside (S), tinocordifoliside (S), | |
3. PHARMACOLOGICAL EFFECT

3.1 Metabolism Increasing Properties

Greasy individual has a weight record body mass index (BMI) of more noteworthy than 25, and fat individuals have a BMI of more prominent than 30. To adjust the energy information and surge, great weight the executives is fundamental. Fat tissue secretes the chemicals adiponectin and leptin and assumes a part in controlling an assortment of physiological components. Low degrees of leptin advance food consumption, change the body's energy protection mode, and adjust neuroendocrine and immunological exercises. An ordinary leptin level brings down craving, but a stout individual's body with strangely high grouping of leptin, causing insulin obstruction like sort 2 diabetes. Adipocytes create and discharge adiponectin into the circulatory system. The counter diabetic, calming, against atherogenic, and cardioprotective properties of adiponectin are grounded [47]. Chatterji [49] has documented a patent application for a structure that brings down the leptin-to adiponectin proportion and advances weight reduction in individuals with corpulence/overweight issues. Gymnemic and boswellic acids are available in the recipe. Acetyl-keto-β-boswellic corrosive, a pentacyclic triterpenoid, advances lipolysis by upregulating lipolytic proteins, for example, adipocyte fatty oil lipase, just as bringing down perlipin articulation [50]. Gymnemic acids affect glucose assimilation in the gut [51]. Besides, they append to tongue receptors and forestall glucose retention [52]. In type 2 diabetes patients, it likewise initiates pancreatic β - cells to emit insulin and lessen glucose levels [53].

3.2 Antioxidant Activity

This present plant's cell reinforcement properties are inferable from a polysaccharide called arabinogalactan and a phenolic part called epicatechin [54, 55]. Its leaf extract powder has preferred cancer prevention agent properties over its stem separate powder [56]. In light of the counter oxidant activity of its alkaloid parts, its root separate secures against aflatoxin-prompted nephrotoxicit [57]. Cell reinforcement pointers including GPx, SOD, and GSH can be reestablished by taking Tinospora cordifolia root separates orally [59]. Tinospora cordifolia separates have been accounted for to lessen malondialdehyde and receptive oxygen species (ROS) levels while expanding GSH levels in diabetic rodents in maternal livers [60].

3.3 Anticancer Effect

Berberine has shown anti-cancer properties in the mice Ascites carcinoma Ehrlich inhibits topoisomerase II at the dose 10 mg/kg body weight [61, 62, 63]. Columbin, a furanolactone diterpenoid, on the other hand, has shown chemo preventive activity against human colon cancer [64]. Octacosanol, a long-chain aliphatic alcohol, inhibits cancer cells’ production of vascular endothelial growth factor into ascites fluid, as well as the activity of matrix metalloproteinases (MMPs) and the translocation of transcription factor NF kappa B to the nucleus (in vivo) [65].

Palmatine, the plant alkaloid, can suppress tumours by recovering GSH, SOD, and catalase levels, together with reducing DNA impairment [66]. G1-4A can activate cytotoxic T lymphocytes.
capable of destroying cancer cells by stimulating bone marrow-derived dendritic cells [67,68]. Its ethanolic extract can assist chemotherapy overcome such difficulties in cancer therapy by reducing the population which has cancer cells that are drug resistant (high in ATP-binding cassette transporters) [69]. Liver cells carcinoma induced by chemicals and MCF-7 breast cancer in human both can be prevented with ECD present in *Tinospora cordifolia* [70, 71]. ECD regulates the expression of Cdkn2A, p53, and the mdm2 gene in cancer cells, causing them to die [71]. This plant's octacosanol is an antiangiogenic drug that inhibits tumour growth and metastasis [72]. It exhibits therapeutic effect against neuroblastoma as it possesses the ability that can lead to pro-apoptosis and senescence but blocks signals that reverse apoptosis [73]. The extraction of this plant can be used in combination with chemotherapy medications to provide an adjuvant effect due to its ability to inhibit CYP3A4, a key enzyme in their metabolism. This could help to reduce the dose in medicines like those used to treat cancer and causes reduction in the harmful effects that can arise on cells in normal conditions [74]. Its capacity to regulate pro-inflammatory cytokines and GSH like TNF-α also aids in the prevention of anti-cancer treatment toxicity [75].

*Tinospora cordifolia*, which contains 17 to 23 percent *T. cordifolia*, has been patented as part of a herbal composition with eleven components for cancer treatment. When the conformation was as 450-480 mg of gelatinous capsule form TDS, a patient with pulmonary epidermoid carcinomas (which refused to take other treatments) experienced complete stoppage in haemoptysis and chest pain, as well as an improve the hunger and after one month of treatment. A patient suffering with third stage of pulmonary epidermoid carcinomas who had failed to respond to previous treatments, the same formulation was found to be successful as a tumoristatic medication [76].

### 3.4 Immunomodulator Activity

It has immunomodulatory properties because it stimulates non-specific immune mechanisms [77]. The compound which shows immunomodulatory activity is caused by a polysaccharide containing monomer units of glucose, fructose, and arabinose [78]. Other than this, immune-modulatory active components discovered in amrita include 11-hydroxymustakone, N-methyl-2-pyrrolidone, N-formylannainan, cordifolioside A, magnoflorine, tinocordiside, and syringin [79, 80]. Macrophage function is impaired in mice intoxicated with CCl4 (lower the capacity to kill bacteria-, decreased phagocytosis, decreased NO generation, etc.) and is re-established by providing extract of amrita plant [81]. This plant produces G1-4A, a TLR4 agonist which is a non-microbial. The receptor is located at macrophages and B-lymphocytes in response to G1-4A stimulation, resulting in activation of macrophages and proliferation of B cells. It increases the cellularity of T-cells, B cells, and macrophages, which causes an enlargement of spleen size in mice. Cell survival is also improved by increased production of anti-apoptotic genes [82]. It is one of those ingredients in the "Bala compound," that is administered in babies and cause increased immunoglobulin production [83]. Its one of the ingredients in the "Bala compound," which helps babies produce more immunoglobulin [83]. This plant produced superior outcomes when used with antiretroviral medication for HIV infection. In this circumstance, drug resistance can be combated by integrating guduchi into the equation [84]. Furthermore, it was observed that after guduchi treatment, macrophages improved their phagocytosis activity against non-infectious micro-organisms (heat-killed-meat) and E. coli (live-infective-bacteria) [85]. Rohatgi has been patented for an ayurvedic compound called LIVZON, which is used to prevent and treat diseases like hepatitis, liver sclerosis, AIDS, flu, and tuberculosis by increasing cellular and humoral immunity [86]. The lowered level of histamine is also reported by an antiallergic herbal combination containing guduchi, and Pushpangadan group has been granted the same patent [87].

#### 3.5 Anti-Ulcer and Anti-Diarrheal Effect

This activity was tried in rodents, which showed a portion subordinate enemy of diarrheal impact just as a decrease in ulcer record. There was likewise a decline in stomach volume and an ascent in stomach pH [88]. PGE2, mitigating cytokines (IL-4, IL-10) and proangiogenic factors (VEGF, EGF) are totally expanded by epoxyclerodane-diterpenes got from amrita [89]. Its concentrate gave defensive impacts in an 8-hour immobilization stress prompted ulceration mouse model, with results comparable to diazepam [90].

#### 3.6 Hepatoprotective Effect

Due to its capability to rummage free ROS, amrita has been shown to be a successful
hepato-protective specialist, upgrading its liver recovery sway [91]. A few polyherbal plans for the therapy of different liver sicknesses are at present available, a few of which have T. cordifolia. The separated root of T. cordifolia have additionally been exhibited to shield the liver from rifampicin and pyrazinamide-incited liver damage[92]. T. cordifolia likewise showed against CCL4 impacts by bringing down the statement of liver catalysts AST, ALP and ALT just like complete bilirubin forestalling stringy multiplication, and enacting tissue recovery [[93, 94].

In male Swiss pale skinned person mice, Tinospora cordifolia leaf and stem watery concentrates have solid hepatoprotective properties against lead nitrate poisoning [95,95]. As per the investigations, lead nitrate harming incited a reduction in SOD and catalase levels while expanding ALT, AST, and ALP levels. Simultaneous dosing of T. cordifolia stem and leaf watery concentrate improved these boundaries[96].

3.7 Antidiabetic Effect

Anti-diabetic activities are attributed to alkaloids (Magnoflorine, Palmetine, and Jatrorrhizine), saponins, cardiac glycosides, tannins, saponins, and other substances [97]. The alpha-glucosidase enzyme was studied in crude extracts of the stem in, dichloromethane (CDM), chloroform, ethyl acetate, and hexane. Giloy Prasant et al. identified anti-diabetic alkaloids, tannins, steroids, cardiac glycosides, saponins, flavonoids, and from Guduchi Prasant et al. Insulin-mediated effects were seen in alkaloids from this plant due to insulin hormone [98]. GSH levels and other reactive species can rise as a result of gestational diabetes, posing a risk to both the mother and the foetus. Giloy was added into the everyday diet of a pregnant rat with diabetes (model used: streptozocin-induced diabetes) and by lowering the oxidative load, it has a protective impact, limiting the relative occurrence of illnesses and any birth defect [99].

Guduchi root extract had an antihyperglycemic effect in an alloxan-induced diabetes animal, lowering extra glucose levels in urine along with in normal blood [100]. Certain herbal medicines, such as amrita like Ilogen-Excel, Hyponidd, and Dihar, were found showing anti-diabetic impact in diabetic rat models. Ilogen Excel's actions lower blood glucose levels and improve insulin efficiency by boosting insulin levels in the systemic circulation.

Hyponidd was found to lower the glucose-mediated haemoglobin count while maintaining the oxidative burden via lowering reactive species. When ‘Dihar’ was tested in a streptozotocin-induced diabetic mouse for one and a half months, it lowered urea and creatinine levels in the blood while enhancing enzyme activity [101-104].

3.7 Protective Effect on CVS

It's because this plant contains berberine (an alkaloid), which enhances vascular health by lowering endothelial inflammation [105]. This plant has also been discovered to influence lipid metabolism by blocking cholesterol and glucuronides in the case of impaired lipid metabolism caused to alcohol use [106]. It also protects against cadmium-induced cardiotoxicity via regulating antioxidants (superoxide dismutase, catalase, glutathione, glutathione peroxidase, and glutathione-S-transferase), glycoproteins, kinase, and lactate dehydrogenase levels (hexose, hexosamine, fucose, and sialic acid). Amrita can also help to normalise atrial and ventricular fibrillation, which is caused by calcium chloride [108]. Its antioxidant characteristics can defend the heart from infarction which is induced by ischemia reperfusion injury, which is most commonly caused by oxidative stress [109].

3.8 Antistress Effect

In comparison to the typical medicine diazepam (at dosage 2.5 mg per kg), S arma et al. found that EtOH-extract of amrita at a dose of 100 mg per kg has considerable anti-stress effect [110]. A modest degree of behaviour abnormalities and mental impairment reaction is produced by the plant extract. Patients’ I. Q levels improved as a result of the clinical investigation. It functions as a Medhya Rasayana, or brain tonic, in Ayurveda, by improving mental abilities for example memory and recall [111].

3.8.1 Analgesic, antipyretic, anti-inflammatory effect

Its effects have been scientifically proven [112-114]. Both a peripheral and a centrally mediated mechanism has been shown to be responsible for analgesic effect [115]. Its anti-inflammatory properties have also been demonstrated the case of autoimmune arthritis, caused by a decrease in cytokines of pro-inflammation
production. This plant is often used to alleviate swelling, fever and pain and cytokines such, TNF-\(\alpha\), IL-1 and IL-17 [116]. Pushpangadan et al. developed and filed a patent for a synergistic antipyretic composition to treat fever [117].

3.8.2 Other beneficial effect

_Tinospora cordifolia_ have many more effects other then the effect shown above. it also has nephroprotective action, neuroprotective effect, osteoprotective effect, radioprotective effect, thrombolytic effect, antianxiety effect, antiparasitic effect, and also shows anti Parkinson effect[118].

Guduchi leaf powder improves the organoleptic, nutritional, and rheological properties of wheat flour by mixing it into it. Its addition boosts the amount of protein, fibre, beta-carotene, calcium, and iron in cookies, as well as increasing radical scavenging activity [118]. Drinking Amrita-based whey is a great keeping quality at both ambient and refrigerated temperatures [119]. Besides, _Tinospora cordifolia_ has been shown to hasten wound healing and reduce the number of days required for Excision wound epithelization [120].

Its extract has been proven to be helpful in avoiding HIV infection, as it is indicated a decrease in eosinophil count (induced by B-lymphocytes, macrophages, and polymorphonuclear leucocytes) and an increase in haemoglobin percentage [121, 122].

Plant-based medicines are generally harmless, and Giloy is no exemption. Though, its water extract has been shown action that reduce blood pressure (temporarily), rise in ventricular contraction force, and cause bradycardia in dogs [123], therefore it ought to be used with care in cardiac patients. Minofil, a non-hormonal medication including Giloy and other plant extracts, showed minimal negative effects in women with postmenopausal syndrome [124] and could be used instead of hormone replacement treatment. This plant has been the subject of much research, but no adverse effects have been reported [125], and it is regarded safe at the dosages listed [126].

Another study found that leaf powder of Giloy has significant effects on growth parameters and possesses immune-stimulatory capacity in Amur carp [127]. It has been shown to have androgenic impact on prostate cancer cell line [128], hence it can affect prostate gland growth. Nanoparticles of _Tinospora cordifolia_ stem extract in prostate cancer cells have been shown to have no substantial apoptosis induction but do limit cancer cell proliferation [129].

Nanoparticles are gaining popularity in medical science for a variety of applications (imaging, medication administration, diagnostics, gene delivery, and so on). The physical or chemical manufacturing of nanoparticles consumes a lot of energy and produces harmful pollutants. The recently developed biomimetic technology is mainly depend upon the ability of microorganisms, algae, or plants to synthesis nanoparticles in an environmentally acceptable manner at ambient temperature and pressure. Because of the presence of alkaloids, Guduchi has been used as a bio-agent to synthesise gold (Au) nano-particles, which have been proven to be very steady [130].

Due to a variety of ongoing health-related threats, such as the increasing rate of drug failures, emerging anti-microbial resistance, and side-effects of chemical-based medicines, herbs like amrita got a huge attention in recent years as a safer and natural alternative to chemical-based medicines. so many new advancements in biotechnology, molecular tools, and nanotechnology are allowing herb and phytomedicine researchers to be more effective.

There have been several pre-clinical and clinical studies have looked at the cyto-protective, immune-modulatory, and immune-adjuvant potential of Ayurvedic drugs. The guduchi's unique, comprehensive, and systems approach advancements can serve as a potent search engine for novel, safer, and more affordable pharmaceuticals. This can even visualize the amritas practical application for combating aforementioned health-related concerns.

4. CONCLUSION

The plant Amrita (_Tinospora cordifolia_) is well-known, specifically in old-style remedy, and is one of the pharmaceutical industry's most commercially exploited species. Anti-oxidant, hepato-protective, anti-microbial, anti-hyperglycemic, anti-pyretic, antihyperlipidemic, cardiovascular-protective, anti-inflammatory, osteo-protective, neuro-protective, anti-anxiety, analgesic, anti-diarrheal, and anti-stress qualities are only a few of its benefits. It is a commercially low-cost and effective herbal supplemental
medication due to its abundance in subtropical Asian countries. *Tinospora cordifolia*‘s biological studies and clinical trials indicate its safety or less side effect and significant healing value as a commercially important as health supplement, along with a repository forthcoming drug advancement in essential conditions where current therapies have slight therapeutic potential.

**CONSENT**

It is not applicable.

**ETHICAL APPROVAL**

It is not applicable.

**COMPETING INTERESTS**

Authors have declared that no competing interests exist.

**REFERENCES**

1. Dhamma K, Tiwari R, Chakraborty S, Kumar A, Karikalan M, Singh R, et al. Global warming and emerging infectious diseases of animals and humans: Current scenario, challenges, solutions and future perspectives- A review. Int J Curr Res. 2013; 5(7): 1942-58.

2. Tiwari R, Chakraborty S, Dhamma K, Rajagunalan S, Singh SV. Antibiotic resistance- An emerging health problem: Causes, worries, challenges and solutions- A review. Int J Curr Res. 2013; 5: 1880-92.

3. Dhamma K, Chakraborty S, Tiwari R, Verma AK, Saminathan M, Amarpal, et al. A concept paper on novel technologies boosting production and safeguarding health of humans and animals. Res Opin Anim Vet Sci. 2014; 4(7): 353-70.

4. Tiwari R, Chakraborty S, Dhamma K, Wani MY, Kumar A, Kapoor S. Wonder world of phages: Potential biocontrol agents safeguarding biosphere and health of animals and humans - current scenario and perspectives. Pak J Biol Sci. 2014; 17(3): 316-28.

5. Olabiyl AS, Nkemehule FE, Odukoya OA, Samuel TA, Ogbonnua SO. Inhibition of glycosylation as an index of activity in plants with antidiabetic potentials, Biochem. Pharmacol. 2013;2:181.

6. Upadhyay AK, Kumar K, Kumar A, Mishra HS, Tinospora cordifolia (Wild.) Hook. f. and Thoms. (Guduchi)–Validation of the ayurvedic pharmacology through experimental and clinical studies, Int. J. Ayurveda Res. 2010;1:112–121.

7. Tiwari P, Nayak P, Prusty SK, Sahu PK. Phytochemistry and pharmacology of Tinospora cordifolia, Syst. Rev. Pharm. 2018;9:70–78.

8. Gupta AK, Anonymous:Quality Standards of Indian Medicinal Plants, NewDelhi, 1sted. 2003:1:212–218.

9. Arul V, Miyazaki S, Dhananjayan R, Studies on the anti-inflammatory, antipyretic and analgesic properties of the leaves of Aegle marmelosCorr, J. Ethnopharmacol. 2005;96:159–163.

10. Spandana U, Liakhat Ali SL, Nirmala T, Santhi M, Babu SD. A review on Tinospora cordifolia, IJCPR 4 :2013:61–68.

11. A. Sinha, H.P. Sharma, A medicinal plant: micropropagation and phytochemical screening of Tinospora cordifolia (Wild.) Miers ex Hook F &Thoms, IJAPBC. 2015;4:114–121.

12. Singh SS, Pandey SC, Srivastava S, Gupta VS, Patro B, Ghosh AC. Chemistry moreover, medicinal properties of Tinospora cordifolia (Guduchi), Indian J. Pharmacol. 2003;35:83–91.

13. B. Misra, B. Prakash, Study of Medicinal Plant and Drug, Bhava Prakash Nighantu, 1, 1969, p. 26.

14. Upadhyay AK, Kumar K, Kumar A, Mishra HS. (2010) Tinospora cordifolia (Wild.) Hook. f. and Thoms. (Guduchi)-validation of the Ayurvedic pharmacology through experimental and clinical studies. International Journal of Ayurveda Research, 1, 112-121.

15. Anonymous. The Ayurvedic Pharmacopoeia of India. Part I. 1st ed. Vol. 1, Department of AYUSH, Ministry of Health and FW, New Delhi. 2001:53-55

16. Reddy CS, Reddy KN, Murthy EN, Raju VS. Traditional medicinal plants in Seshachalam hills. Journal of Medicinal and Plant Research.; 2009;3:408-412.

17. Bhatt RP, Sabin SD. (1987) Contribution to the ethnobotanics of Khedbrahma region of North Gujrat. Journal of Economic and Taxonomic Botany, 9, 138-145.
18. Singh SS, Pandey SC, Srivastava S, Gupta VS, Patro B, Ghose AC. (2003) Chemistry and medicinal properties of Tinospora cordifolia (Guduchi). Indian Journal of Pharmacology. 35: 83-91.

19. Anonymous. Wealth of India. Raw Materials. Council of Scientific and Industrial Research, New Delhi, 1976;10:251-252.

20. Basha SKM, Umamaheswari P, Rambabu M, Savitramma N. (2011) Ethnobotanical study of Mamandur forest (Kadapa-Nallamali range) in Eastern Ghats, Andhra Pradesh, India. Journal of Phytology, 3, 44-47.

21. Khuda MQI, A. Khaleque, N. Ray, Tinospora cordifolia constituents of plants fresh from the field, Sci. Res. 1964;1: 177–183.

22. J.B. Hanuman, R.K. Bhatt, B.K. Sabata, A diterpenoid furanolactone from Tinospora cordifolia, Phytochemistry 1986;25: 1677–1680.

23. R.K. Bhatt, J.B. Hanuman, B.K. Sabata, A new clerodane derivative from Tinospora cordifolia, Phytochemistry. 1988;27: 1212–1216.

24. Hanuman JB, Bhatt RK, Sabata B, A clerodane furano-diterpene from Tinospora cordifolia, J. Nat. Prod. 1988;51:197–201.

25. Bhatt RK, Sabata BK, A furanoid diterpene glucoside from Tinospora cordifolia, Phytochemistry 28 (1989):2419–2422.

26. Khan MA, Gray IA, Waterman PG. Tinosporasides an 18-norclerodane glucoside from Tinospora cordifolia, Phytochemistry 28:1989:273–275.

27. V.D. Gangan, P.P. Arjun, T. Sipahimalan, A. Banerji, A. Cardifolisides, C. B, Norditerpenefuron glucoside from Tinospora cordifolia, Phytochemistry 37 (1994) 781–786.

28. R. Maurya, S.S. Handa, Tinoscorfolin, a sesquiterpene from Tinospora cordifolia, Phytochemistry 44 (1998) 1343–1345.

29. V.D. Gangan, P.P. Arjun, A.T. Sipahimalani, A. Banerji, Norditerpenefuron glucoside from Tinospora cordifolia, Phytochemistry 39 (1995) 1139–1142.

30. V. Wazir, R. Maurya, R.S. Kapil, A clerodane furano diterpene glucoside from Tinospora cordifolia, Phytochemistry 36 (1995) 447–449.

31. V.D. Gagan, P. Pradhan, A.T. Sipahimalan, A. Banerji, F. Palmatosides C, Diterpene furan glucosides from Tinospora cordifolia-structural elucidation by 2D NMR spectroscopy, Indian J. Chem. 35B (1996) 630–634.

32. N. Choudhary, M.B. Siddiqui, S. Azmat, S. Khatoon, Tinospora cordifolia: ethnobotany, phytopharmacology and phytochemistry aspects, IJPSR 4 (2013) 891.

33. N.G. Bisset, J. Nwaiwu, Quaternary alkaloids of Tinospora species, Planta Med. 48 (1983) 275–279.

34. V.R. Mahajan, C.I. Jolly, K.M. Kundnani, A new hypoglycaemic agent from Tinospora cordifolia, Indian Drugs 23 (1985) 119–120.

35. D.N.K. Sarma, R.L. Khosa, J.P.N. Chansauria, A.K. Ray, The effect of Tinospora cordifolia on brain neurotransmitters in the stressed rat, Fitoterapia 66 (1995) 421–422.

36. A.K. Pathak, A.K. Agarwal, D.C. Jain, R.P. Sharma, O.W. Howarth, NMR studies of 20 hydroxyecdysones, a steroid isolated from Tinospora cordifolia, Indian J. Chem. 34 (1995) 674–676.

37. Hanuman JB, Mishra AK, Sabata B. A natural phenolic lignan from Tinospora cordifolia Miers, J. Chem. Soc. 1986:1181–1185.

38. Kidwai AR, Salooja KC, Sharma VN, Siddiqui S. Chemical examination of Tinospora cordifolia, J. Sci. Indian Res. (1949)8:115–118.

39. A. Khaleque, M.A.W. Maith, M.S. Huq, B. K Abul, Tinospora cordifolia IV. Isolation of heptacosanol, β sitosterol and three other compounds tinosporine, cortol and cordifolone, Pakistan J. Sci.Industry Res. 14 (1970) 481–483.

40. Dixit SN, Khosa RL. Chemical investigations on Tinospora cordifolia (wild.) miers, Indian. J. Appl. Chem. 1971;34:46–47.

41. Pathak AK, Jain DC, Sharma PR. Chemistry and biological activities of the genus Tinospora, Int. J. Pharmacogn. 33 (1995)277–287.

42. Khuda MQ, A. Khaleque, K.A. Basar, M.A. Rouf, M.A. Khan, N. Roy, Studies on...
Tinospora cordifolia II: isolation of tinosporine, tinosporic acid and tinosporol from the fresh creeper, Sci. Res. 196:6: 9–12.

43. Khaleque A, MAW, Maith, M.S. Huq, K.A. Tinospora cordifolia III, Isolation of tinosporine, heptacosanol, β sitosterol, Pakistan J. Sci. Industry Res. 14 (1971) 481–483.

44. Maurya R, V. Wazir, A, Tyagi, R.S. Kapil, Clerodane diterpene from Tinospora cordifolia, Phytochemistry. 1995;38: 659–661.

45. Pradhan P, VD Gangan, A.T. Sipahimalani, A. Banerji, Two phytoecdysones from Tinospora cordifolia: structural assignment by 2D NMR spectroscopy, Indian J. Chem. 36B (1997) 958–962.

46. Chintalwar G, Jain A, A, Sipahimalani, A. Banerji, P. Sumariwalla, R, Ramakrishnan, K. Sainis, An Immunologically active arabinogalactan from Tinospora cordifolia, Phytochemistry 1999;52: 1089–1093.

47. Lee B, Shao J. Adiponectin and energy homeostasis. Rev EndocrMetabDisord. 2014;15(2): 149-56.

48. De Rosa A, Monaco ML, Capasso M, Forestieri P, Pilone V, Nardelli C, et al. Adiponectin oligomers as potential indicators of adipose tissue improvement in obese subjects. Eur J Endocrinol 2013; 169(1): 37-43.

49. Chatterji, A.K. Preparation for weight loss management. US8936817 (2015).

50. Liu, JJ, Toy WC, Liu S, Cheng A, Lim BK, Subramaniam T, et al. Acetyl-keto--boswellic acid induces lipolysis in mature adipocytes. BiochemBiophys Res Commun 2013; 431(2): 192-6.

51. Pothuraju R, Sharma RK, Chagalamarri J, Jagnra S, Kumar K.P. A systematic review of Gymnemasyvestre in obesity and diabetes management. J Sci Food Agric 2014; 94(5): 834-40.

52. Sahu NP, Mahato SB, Sarkar SK, Poddar G. Triterpenoid saponins from Gymnemasyvestre. Phytochemistry 1996; 41: 1181-5.

53. Marles RJ, Farnsworth NR. Antidiabetic plants and their active constituents. Phytomedicine 1995; 2: 137-89.

54. Subramanian M, Chintalwar GJ, Chattopadhyay, S. Antioxidant properties of a Tinospora cordifolia polysaccharide against ironmediated lipid damage and ray induced protein damage. Redox Rep 2013; 7(3): 137-43.

55. Pushp P, Sharma N, Joseph GS, Singh RP. Antioxidant activity and detection of () epicatechin in the methanolic extract of stem of Tinospora cordifolia. J Food Sci Technol 2013; 50(3): 567-72.

56. Sarala M, Velu V, Anandharamakrishnan C, Singh RP. Spray drying of Tinospora cordifolia leaf and stem extract and evaluation of antioxidant activity. J Food Sci Technol 2012; 49(1): 119-22.

57. Gupta R, Sharma V. Ameliorative effects of Tinospora cordifolia root extract on histopathological and biochemical changes induced by Aflatoxin-B 1 in mice kidney. Toxicol Int 2011; 18(2): 94-8.

58. Subramanian M, Chintalwar GJ, Chattopadhyay S. (2002) Antioxidant properties of a Tinospora cordifolia polysaccharide against iron-mediated lipid damage and γ-ray induced protein damage. Redox Report, 2011;7:137-143.

59. Patel MB, S Mishra.. Hypoglycaemic activity of alkaloidal fraction of Tinospora cordifolia. Phytomedicine 18:1045-1052.

60. Shivananappa MM, Muralidhara.. Abrogation of maternal and fetal oxidative stress in the streptozotocin-induced diabetic rat by dietary supplement of Tinospora cordifolia. Nutrition. 2012;28: 581-587.

61. Jagetia GC, Rao SK. Evaluation of the antineoplastic activity of guduchi (Tinospora cordifolia) in Ehrlich ascites carcinoma bearing mice. Biological and Pharmaceutical Bulletin, 2006;29:460-466.

62. Jagetia GC, Baliga MS. Effect of Alstoniascholaris in enhancing the anticancer activity of berberine in the Ehrlich ascites carcinoma-bearing mice. Journal of Medicinal Food, 2004;7: 235-244.

63. Makhey D, Gatto B, Yu C, Liu A, Liu LF, Lavoie EJ. Coralyne and related compounds as mammalian topoisomerase II poisons. Bioorganic Medicinal Chemistry.,1996;4:781-791.

64. Kohno H, Maeda M, Tanino M, Tsukio Y, Ueda N, Wada K, Sugie S, Mori H, Tanaka T. A bitter diterpenoid furanolactonecolumbin from Calumbae radix inhibits azoxymethane-induced rat
colon carcinogenesis. Cancer Letters. 2002;183:131-139.

65. Thippeswamy G, Salimath BP. (2007) Induction of caspase-3 activated DNase mediated apoptosis by hexane fraction of Tinospora cordifolia in EAT cells. Environmental Toxicology and Pharmacology, 23, 212-220.

66. Ali H, Dixit S. Extraction optimization of Tinospora cordifolia and assessment of the anticancer activity of its alkaloid palmatine. Sci World J 2013; 2013(2013): 376216.

67. Pandey VK, Shankar BS, Sainis KB. G1-4A, an arabinogalactan polysaccharide from Tinospora cordifolia increases dendritic cell immunogenicity in a murine lymphoma model. Int Immunopharmacol 2012; 14(4): 641-9.

68. Maliyakkal N, Beeran AA, Balaji SA, Udupa N, Pai SR, Rangarajan A. Effects of Withania somnifera and Tinospora cordifolia extracts on the side population phenotype of human epithelial cancer cells toward targeting multidrug resistance in cancer. Integr Cancer Ther 2015; 14(2): 156-71.

69. Dhanasekaran M, Baskar AA, Ignacimuthu S, Agastian P, Duraipandiyan V. Cytotoxic potential of Epoxy clerodane diterpene from Tinospora cordifolia against diethylaminoethylamine-induced hepatocellular carcinoma. Invest New Drugs 2009; 27(4): 347-55.

70. Subash-Babu P, Alshammarri GM, Ignacimuthu S, Alshawi AA. Epoxy clerodane diterpene inhibits MCF-7 human breast cancer cell growth by regulating the expression of the functional apoptotic genes Cdkn2A, Rb1, mdm2 and p53. Biomed Pharmacother 2017; 87: 388-96.

71. Thippeswamy G, Sheela ML, Salimath BP. Octacosanol isolated from Tinospora cordifolia downregulates VEGF gene expression by inhibiting nuclear translocation of NF-B and its DNA binding activity. Eur J Pharmacol 2008; 588(2): 141-50.

72. Mishra R, Kaur G. Tinospora cordifolia induces differentiation and senescence pathways in neuroblastoma cells. Mol Neurobiol 2015; 52(1): 719-33. [123] Singh N, Mahe

73. Patil D, Gautam M, Gairola S, Jadhav S, Patwardhan B. Effect of botanical immunomodulators on human CYP3A4 inhibition: Implications for concurrent use as adjuvants in cancer therapy. Integr Cancer Ther 2013; 13(2): 167-75.

74. Hamsa TP, Kuttan G. Tinospora cordifolia ameliorates urotologic effect of cyclophosphamide by modulating GSH and cytokine levels. Exp Toxicol Pathol 2012; 64(4): 307-14.

75. Solanki, R. Composition of eleven herbas for treating cancer. US6780441 (2004).

76. Alexander CP, Kirubakaran CJW, Michael RD. Water soluble fraction of Tinospora cordifolia leaves enhanced the non-specific immune mechanisms and disease resistance in Oreochromis mossambicus. Fish Shellfish Immunol 2010; 29(5): 765-72.

77. Sharma U, Bala M, Saini R, Verma PK, Kumar N, Singh B, et al. Polysaccharide enriched immunomodulatory fractions from Tinospora cordifolia (Willd) miers ax hook. F. &Thoms. Indian J Exp Biol 2012; 50(9): 612-7.

78. Pan L, Terrazas C, Rege N, Gallucci JC, Satoskar AR, et al. Cordifolide A, a sulfur-containing clerodane diterpene glycoside from Tinospora cordifolia. Org Lett 2012; 14(8): 2118-21.

79. Sengupta M, Sharma GD, Chakraborty B. Effect of aqueous extract of Tinospora cordifolia on functions of peritoneal macrophages isolated from CCl4 intoxicated male albino mice. BMC Complement Altern Med 2011; 11(1): 1.
83. Appaji RR, Sharma RD, Katiyar GP, Sai PA. Clinical study of the immunoglobulin enhancing effect of "bala compound" on infants. Anc Sci Life 2009; 28(3): 18.

84. Gupta GD, Sujatha N, Dhanik A, Rai NP. Clinical evaluation of ShilajatuRasayana in patients with HIV infection. Ayu 2010; 31(1): 28.

85. More P, Pai K. In vitro NADH-oxidase, NADPH-oxidase and myeloperoxidase activity of macrophages after Tinospora cordifolia (guduchi) treatment. ImmunopharmacolImmunotoxicol 2012; 34(3): 368-72.

86. Rohatgi, S. Ayurvedic composition for the prophylaxis and treatment of AIDS, flu, TB and other immuno-deficiencies and the process for preparing the same. US5529778 (1996).

87. Pushpangadan P, Rao CV, Rawat, A.K.S., Ojha, S.K., Reddy, G.D. Anti-allergic herbal formulation. US7344739 (2008).

88. Kaur M, Singh A, Kumar B. Comparative antidiarrheal and antiulcer effect of the aqueous and ethanolic stem bark extracts of Tinospora cordifolia in rats. J Adv Pharm Technol Res 2014; 5(3): 122.

89. Antonisamy P, Dhanasekaran M, Ignacimuthu S, Duraipandiyan V, Balthazar JD, Agastian P, et al. Gastroprotective effect of epoxy clerodane diterpene isolated from Tinospora cordifolia Miers (Guduchi) on indomethacin-induced gastric ulcer in rats. Phytomedicine 2014; 21(7): 966-9.

90. Sarma DNK, Khosa RL, Chansauria JPN, Sahai M. Antiulcer activity of Tinospora cordifolia and Gentella asiatica Linn extracts. Phytother Res 1995; 9: 589-90.

91. Kumar, V., P. K. Modi, and K. Saxena. Exploration of hepatoprotective activity of aqueous extract of Tinospora cordifolia experimental study. Studies. 2013; 1: 2

92. Adhvaryu MR, Reddy N, Parabia MH. Effects of four Indian medicinal herbs on isoniazid-, rifampicin-and pyrazinamide-induced hepatic injury and immunosuppression in Guinea pigs. World J. Gastroenterol. 2007;13:3199–3205

93. Kavitha B, Shruthi S, Rai SP, Ramachandra Y. Phytochemical analysis and hepatoprotective properties of Tinospora cordifolia against carbon tetrachloride-induced hepatic damage in rats. J. Basic Clin. Pharm. 2011;2:139.

94. Rege N, Dahanukar S, Karandikar SM. Hepatotoxic effects of Tinospora cordifolia against carbon tetrachloride induced liver damage. Indian Drugs. 1984; 21: 544.

95. Sharma V, Pandey D. Beneficial effects of Tinospora cordifolia on blood profiles in male mice exposed to lead. Toxicol. Int. 2010a ;17:8–11.

96. Sharma V, Pandey D. Protective role of Tinospora cordifolia against lead-induced hepatotoxicity. Toxicol. Int. 2010b ;17: 12–17.

97. Anonymous, the Ayurvedic Pharmacopoeia of India. Part I. first ed.. Vol. 1, Department of AYUSH, Ministry of Health and FW, New Delhi (2001) 53-55

98. M.B. Patel, S. Mishra, Hypoglycemic activity of alkaloidal fraction of Tinospora cordifolia, Pharma Innovation 5 (2016) 104.

99. M.B. Patel, S.M. Mishra, Magnoflorine from Tinospora cordifolia stem inhibits α-glucosidase and its antiglycemic in rats, J. Funct. Foods. 2012;4:79–86.

100. D. Singh, P.K. Chaudhuri, Chemistry and pharmacology of Tinospora cordifolia, Nat. Prod. Commun. 2017;12 :299–308

101. Prince SM, Menon VP. Hypoglycaemic and hypolipidaemic action of alcohol extract of Tinospora cordifolia roots in chemical induced diabetes in rats, Phytother Res. 2003;17:410–413

102. Umamaheswari S, Mainzen SPP, Antihyperglycemic effect of 'Ilogen-Excel,' an ayurvedic herbal formulation in streptozotocin-induced diabetes mellitus, Acta Pol. Pharm. 2007;64 :53–61.

103. P.S. Babu, P.P.M. Stanely, Antihyperglycaemic and antioxidant effect of hyponid, an ayurvedic herb mineral formulation in streptozotocin induced diabetic rats, J. Pharm. Pharmacol. 56 (2004) 1435–1442.

104. Patel SS, Shah RS, Goyal RK. Antihyperglycemic, antihyperlipidemic, and antioxidant effects of Dihar, a polyherbal ayurvedic formulation in streptozotocininduced diabetic rats, Indian J. Exp. Biol. 2009;47:564–570
105. Cicero AF, Baggioni A. Berberine and its role in chronic disease. Adv Exp Med Biol 2016; 27-45.

106. Kumari S, Mittal A, Dabur R. Moderate alcohol consumption in chronic form enhances the synthesis of cholesterol and C-21 steroid hormones, while treatment with Tinospora cordifolia modulate these events in men. Steroids. 2016; 114: 68-77.

107. Priya LB, Baskaran R, Elangovan P, Dhiya V, Huang CY, Padma VV. Tinospora cordifolia extract attenuates cadmium-induced biochemical and histological alterations in the heart of male Wistar rats. Biomed Pharmacother 2017; 87: 280-7.

108. Sharma AK, Kishore K, Sharma D, Srinivasan BP, Agarwal SS, Sharma A, et al. Cardioprotective activity of alcoholic extract of Tinospora cordifolia (Willd.) Miers in calcium chloride-induced cardiac arrhythmia in rats. J Biomed Res. 2011; 25(4): 280-6.

109. Rao PR, Kumar VK, Viswanath RK, Subbaraju GV. Cardioprotective activity of alcoholic extract of Tinospora cordifolia in ischemia-reperfusion induced myocardial infarction in rats. Biol Pharm Bull 2005; 28(12): 2319-22.

110. D.N.K. Sarma, R.L. Khosa, J.P.N. Chaurasia, M. Sahai, Antistress activity of Tinospora cordifolia and Centella asiatica extracts, Phytother Res. 10 (1996) 181–184.

111. Baghel P. Plant of versatile properties of Tinospora cordifolia (Guduchi), IJAIR 5.2017:751–753.

112. [150] Hussain L, Akash MS, Ain NU, Rehman K, Ibrahim M. The analgesic, anti-inflammatory and anti-pyretic activities of Tinospora cordifolia. Adv Clin Exp Med 2014; 24(6): 957-64.

113. Patgiri B, Umreta BL, Vaishnav PU, Prajapati PK, Shukla VJ, Ravishankar B. Anti-inflammatory activity of Guduchi Ghana (aqueous extract of Tinospora cordifolia Miers.). Ayu 2014; 35(1): 108.

114. Ashok BK, Ravishankar B, Prajapati PK, Bhat SD. Antipyretic activity of Guduchi Ghrita formulations in albino rats. Ayu 2010; 31(3): 367.

115. Goel B, Pathak N, Nim DK, Singh SK, Dixit RK, Chaurasia R. Clinical evaluation of analgesic activity of guduchi (Tinospora cordifolia) using animal model. J Clin Diagn Res 2014; 8(8): 1.

116. Sansegowda KM, Venkatesha SH, Moudgil KD. Tinospora cordifolia inhibits autoimmune arthritis by regulating key immune mediators of inflammation and bone damage. Int J Immunopathol Pharmacol. 2015; 28(4): 521-31.

117. Pushpangadan, P., Rawat, A., Rao, C., Srivastava, S., Kharton, S. Synergistic antipyretic formulation. US20060141069 (2006).

118. Sharma P, Velu V, Indrani D, Singh RP. Effect of dried guduchi (Tinospora cordifolia) leaf powder on rheological, organoleptic and nutritional characteristics of cookies. Food Res Int 2013; 50(2): 704-9.

119. Sthavarmath S, Puranik DB. Development of Guduchi-whey based beverage. Int J Process Post Harvest Technol. 2016; 7(1): 111-6.

120. Hashilkar NK, Patil PA, Bagi JG, Patil SY, Angadi NB. Influence of Tinospora cordifolia on wound healing in wistar rats. Int J Basic Clin Pharmacol. 2016; 5(3): 923-8.

121. Kalikar MV, Thawani VR, Varadpande UK, Sontakke SD, Singh RP, Khiyani RK. Immunomodulatory effect of Tinospora cordifolia extract in human immuno-deficiency virus positive patients. Indian J Pharmacol. 2008; 40(3): 107-10.

122. Akhtar S. Use of Tinospora cordifolia in HIV infection. Indian J Pharmacol. 2010; 42(1): 57.

123. Singh KP, Gupta AS, Pendse VK, Mahatma OP, Bhandari DS, Mahawar MM. Experimental and clinical studies on Tinospora cordifolia. J Res Ind Med. 1975; 10(1): 9.

124. Prakash S, Rai NP. Role of Tinospora cordifolia (Willd.) Miers (Guduchi) in the treatment of infective hepatitis. J Res Ayu Siddha. 1996; 17(1-2): 58.

125. Gupta AK, Gupta N, Sharma M. Indian council of medical research quality standards of Indian medicinal plants. Indian Council of Medical Research, New Delhi. 2003; vol. (1): p. 212.

126. Upadhyay AK, Kumar K, Kumar A, Mishra HS. Tinospora cordifolia (Willd.) Hook.
and Thoms. (Guduchi)-validation of the Ayurvedic pharmacology through experimental and clinical studies. Int J Ayu Res. 2010; 1: 112-21

127. Dubey MK, Khati A, Chauhan RS. Immunostimulatory and growth promoting potential of Tinospora cordifolia (Thunb.) Miers on fingerlings of Amur carp. Indian J Exp Biol. 2016; 54(10) 659-63.

128. Kapur P, Pereira BMJ, Wuttke W, Jarry H. Androgenic action of Tinospora cordifolia ethanolic extract in prostate cancer cell line LNCaP. Phytomedicine. 2009; 16(6): 679-82.

129. Karuppath S, Snima KS, Ravindranath KC, Nair SV, Lakshmanan VK. Anti-proliferative effect of Tinospora cordifolia nanoparticles in prostate cancer cells. J Bionanosci. 2016; 10(2): 127-33.

130. Abbasi T, Anuradha J, Abbasi SA. Utilization of the terrestrial weed guduchi (Tinospora cordifolia) in clean-green synthesis of gold nanoparticles. Nanosci Technol. 2014; 1(3): 1-7.

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