

# A Review on *Tinospora Cordifolia*: Immunity System

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**Abstract:** The herb known as guduchi, or *Tinospora cordifolia*, is a native of hot regions of the Indian subcontinent and has leaves with a heart-shaped shape. It is suggested to be helpful in treating a variety of ailments like skin conditions, various types of fever, jaundice, and gout in our traditional Ayurvedic scriptures. Guduchi also made claims about having properties that included being anti-oxidant, anti-hyperglycemic, anti-hyperlipidemic, hepatoprotective, cardiovascular protective, neuroprotective, osteoprotective, radioprotective, anti-anxiety, adaptogenic agent, analgesic, anti-inflammatory, antipyretic, athrombolytic agent, anti-diarrheal, anti-ulcer, antimicrobial, and anti-cancer. The current paper is an effort to compile data based on several experimental and clinical findings on *Tinospora cordifolia*'s immunomodulating effects.

Due to its general tonic, antiperiodic, antispasmodic, antiinflammatory, antiarthritic, antiallergic, and antidiabetic characteristics, *tinospora cordifolia*, also known as "Rasayana," is widely employed in many herbal remedies for the treatment of many diseases. Due to its capacity to strengthen the immune system and the body's resistance to infections, it is widely utilized in Ayurveda. One significant and widely used herb that is a component of many Ayurvedic, Unani, and Siddha system of medicines is *Tinospora cordifolia* (Gioly). The review paper provides details on *Tinospora cordifolia* cultivation, harvesting, chemical composition, and medicinal use. Anti-inflammatory, anti-cancer, anti-aids, anti-ulcer, and anti-diabetic. Anti-allergic effect. Guduchi's pharmacological effects, Which include nootropic, Antioxidant and immune system regulation in conditions like type 2 diabetes radioprotective and antioxidant properties. Alkaloids, glycosides, and steroids are primarily found in the plant. Sesquiterpenoids, an aliphatic molecule, an essential oil, and a combination of polysaccharides and fatty acids. Particle-induced X-ray imission technology has been used to conduct trace element investigations on the aqueous extract of these medicinal plants for their therapeutic use. The entire leaf sample's extremely high chloride, potassium, and calcium concentration Recent years have seen a rise in research on the use of natural immunomodulators to treat a variety of immune-related disorders. Among the pharmacological herbs. Due to its widespread usage in ethnomedicine to treat a variety of conditions connected to immune-associated disorders, *Tinospora* species (family Menispermaceae) are among the plants that have been extensively studied for their modulating effects on the immune system. However, the majority of their ethnopharmacological applications lack or have scant scientific support. As of right now, there is no precise treatment or vaccination to prevent this illness, which primarily targets the immunological system of the body. Existing disease-modifying and antiviral medications are being used to treat COVID-19. The development of specific immunomodulators, antiviral drugs, or vaccines for SARS-CoV-2 involves several -different sorts of research. In Ayurveda, the concept of an epidemic condition (Janapadodhwanasa) is described, and several measures are mentioned for their prevention and treatment, including Rasayan dravyas (drugs that modulate the immune system). Willd.'s *Tinospora cordifolia* one immune-modulating medication in Ayurveda is called Miers, and it is known to have qualities like antioxidant, immunomodulatory, anti-inflammatory, anti-antiallergic, antiviral, hyperglycaemic, etc. Glycosides, alkaloids, steroids, diterpenoid lactones, sesquiterpenoids, and aliphatic compounds are the main compounds

**Keywords:** *Tinospora Cordifolia*; Immune health, Phytochemistry, Ethnobotany, Pharmacological Aspects

## I. INTRODUCTION

The body's defense against infection is provided by the immune system, a complex network of organs, cells, and proteins that also safeguards the body's own cells. Every germ (microbe) that the immune system has ever eliminated is recorded, allowing it to promptly identify and eliminate the microbe if it re-enters the body. An organism's immune system is a network of biological organs and mechanisms that guards against disease. An immune system must be able to discriminate between the organism's own healthy tissue and a wide range of agents, including viruses and parasitic worms, in order to function correctly. Asthma, allergies, asthma, ulcerative colitis, cancer, parasitic disorders, and infectious diseases are only a few of the conditions that are caused by immune system malfunction. The majority of the chemotherapy drugs on the market today are cytotoxic and primarily have immunosuppressive effects, but they also have a number of additional side effects. Plant compounds are becoming increasingly important as immunomodulators as a result. Despite being utilized as immunostimulants, cytokines like interleukins and interferons are not very successful over the long run due to their expense and side effects. [1] The species was one of the most commercially valuable plants in the pharmaceutical industry, according to the task force on conservation and sustainable use of medicinal plants. This plant's extracts have been found to have a wide range of medicinal benefits, including general tonic, anti-inflammatory, anti-arthritis, anti-malarial, aphrodisiac, anti-allergic, anti-antidiabetic, and antipyretic. [2] Although the *Tinospora cordifolia* active ingredients that provide therapeutic benefits are not fully understood, phenyl propanoid glycosides such as cordifolioside A, cordifolioside B, and syringin have been reported to be the plant's primary immunomodulatory active ingredients. [3] A-o-glucan, a plant compound extracted from the stem, has also been demonstrated to boost the immune system. [4] Utilizing studies on the phagocytic function of polymorphonuclear neutrophils the immunomodulatory effect of various fractions and extracts of *Tinospora cordifolia* stem was examined in the current study. [1] Many health-conscious people have changed their mindset from one that is "treatment-centric," i.e., heavily dependent on pharmaceutical interventions, to one that incorporates measures and routines that promote disease prevention and resilience, as the incidence of and susceptibility to acute and chronic diseases continuously rise. Preclinical and clinical data that substantiate the immunomodulatory-related structure function claims of herbal preparations derived from numerous well-known medicinal plants, such as Echinacea, Curcuma, and Camellia, are abundant in the ethnomedicine literature, which includes traditional Chinese and Ayurvedic medicine. The need to investigate and identify other, lesser-known medicinal plants with alleged anti-inflammatory and immunomodulatory potential has been sparked by the rising focus on human illness prevention and resilience. [5] Using natural ingredients to make herbal medicines, condiments, spices, nutrients, nutritional supplements, and boosting preparations for immunity is a widespread trend in the pharmaceutical, nutraceutical, and food industries. The body's defense mechanism, immunity, is one of the most intricate systems since it consists mostly of innate and adaptive immunities. When a pathogen is neutralized by innate or natural immunity, the acquired immune system is then further activated to kill or destroy the infection. [6] Research on *Tinospora Cordifolia* is being done because of its immunomodulatory abilities. Various compounds are isolated from it and investigated for potential immunomodulatory effects. Since the dawn of time, medicinal plants have been used to treat human ailment.

According to reports, immuno-modulating drugs restore the immune competency of compromised hosts without overstimulating healthy individuals because they work largely on cellular immune responses rather than humoral immune responses. [7] its approval in has been used to treat malignancies of the oesophagus, stomach, colon, rectum, lung, breast, and blood. This medication helps patients live much longer. The goal of the current study was to look into how medicinal plants affected mice's immune system responses. It is referenced in Ayurvedic literature as an ingredient in a number of compound formulations intended to treat fever, urinary disorders, dyspepsia, and general debility. The extract from *T. cordifolia* leaves works similarly to insulin and can significantly lower blood sugar levels. The root is utilized for visceral blockage and has potent emetic properties. [8]

### Two types of immunity-

#### Active Immunity-

When our own immune system defends us against a pathogen, this is known as active immunity. Active immunity is the result of the immune system producing antibodies against a disease after being exposed to the disease organism. Active immunity can be acquired either naturally or as a result of vaccination.

Examples of active immunity include a person's resistance to strep throat from a prior infection or their immunity to polio from receiving the polio vaccine.<sup>[9]</sup>

**Passive Immunity-**

When a person receives antibodies to a disease rather than creating them through his or her own immune system, passive immunity is provided. Through the placenta, a newborn child gains passive immunity from its mother. The duration of passive immunity is only a few weeks or months. It is created by introducing external antibodies into the host.<sup>[10]</sup>

- Kingdom- Plantae – plant
- Subkingdom -Tracheobionta: Vascular plant
- Super Division- Spermatophyta: Seed bearing plant
- Division: Magnoliophyta – Flowering
- Class- Magnoliopsida – Dicotyledons
- Sub-class- Polypetalae – Petals are free
- Series- Thalamiflorae – Many stamens and flower hypogynous
- Order- Ranunculales
- Family- Menispermaceae - The Moonseed
- Family- Tinosporeae
- Genus -Tinospora Species T. cordifolia<sup>[12]</sup>

There are several plants that are utilized in medicine for medicinal or preventative purposes. Active compounds such as alkaloids, flavonoids, glycosides, vitamins, tannins, and coumarins are responsible for the medical characteristics of medicinal plants. The human body is physiologically affected by these natural substances, which interact with pathogens to stop their growth at various phases of development and cause disease.

**Parts:-**

Leaves  
Stem  
Root  
Flowers  
Fruit

**Leaves:**

The leaves are cordate and membranous. Small and greenish yellow blooms.

**Size :** 10-20 cm in Diameter

**Shape:** cordate

**Colour :** Dark Green

**Odour :** Indistinct

**Taste :** Bitter

**Uses :** Fever , Jaundice , Cancer



**Fig no-1**

**Stem:**  
**Size:** 2cm  
**Colour:** dark brown  
**Odour:** characteristic  
**Taste:** unpleasant  
**Uses:** snake bite



**Fig No-2**

**Flower-**  
**Size:** 2mm  
**Shape:** axillary racemes  
**Colour:** greenish yellow  
**Odour:** non fragrant

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Fig No-3

**Fruit:**

**Size:** large pea

**Colour:** red

**Shape:** ovoid and succulent



Fig No-4

**Seed-**  
**Size:** 2mm  
**Shape:** curved shape  
**Colour:** brown



Fig No-5

**Plant Parts and its Ethanobotanical Uses:**

Sr No	Plant parts	Ethanobotanical Uses
1	Leaves	- Effective for treating ulcers and gout <sup>[14]</sup>
2	stem	The stem's bitter taste promotes bile output, improves blood quality, treats jaundice, and is helpful for skin conditions. The juice can help with diabetes, vaginal discharge, and urethral discharge. a swollen spleen and mild fevers <sup>[15]</sup> (Stem as an infusion) drunk as a vermifuge, jaundice, and against intestinal worms (Stem as a decoction) washed painful eyes and syphilitic sores, antipyretic, and antimalarial. To treat intestinal issues and enhance digestion, starch (statue) made from stems is used for persistent chronic dysentery and some types of obstinate chronic diarrhea. <sup>[16]</sup>
3	Stem+root	snake bite and scorpion sting remedies that are combined with other medications. <sup>17-18</sup>
4	fruit	Dried fruit combined with ghee or honey is used as a tonic and a remedy for rheumatism and jaundice <sup>14</sup> .
5	Bark	anti-leprotic, anti-spasmodic, and anti-allergy <sup>19,20</sup>
	Not specify	Skin conditions, syphilis, bronchitis, urinary conditions, <sup>21</sup>
	Not specify	prolong life and strengthen the body's defenses. <sup>22</sup> increase immune system activity. <sup>23-24</sup>

**HISTORY AND AYURVEDIC ASPECTS**

Ayurveda, a 5,000-year-old medical practice, refers to three elemental substances called Kapha, Vata, and Pitta that have their origins in the Indian scriptures known as The Vedas. T. cordifolia is known as Amara, Amritvalli,

Chinmarruha, Chinnodebha, and Vatsadani among other names, and is most frequently known as Guduchi or Amrita according to Ayurvedic texts such as Ashtang Hridaya and Sushrut, Charak, and other treaties like Bhava Prakash and Dhanvantri Nighantu.

Guduchi was included in the Bengal Pharmacopoeia of and was regarded as an important source of medicine by European doctors practicing in India, including tonic, diuretic, and antiperiodic. *T. cordifolia* is a key ingredient in formulations used to treat a number of ailments, including dyspepsia, problems of the urinary system, debility, and fever, according to Ayurvedic literature. *T. cordifolia* was used to create a number of imperative formulations, including Guduchi taila, Sanjivani vati, Kanta-Kari avaleha, Guduchyadi churna, Chyavnaprasha, Guduchu ghrita, Guduchi satva, Brihat guduchi taila, Amrita guggulu, and amritashtaka churna.<sup>[11]</sup>

#### **Origin and Habitat-**

*T. cordifolia* is a climbing shrub that climbs many different kinds of trees and is native to lower elevation tropical regions of the Indian subcontinent<sup>[25]</sup>. It requires a moderate amount of soil moisture and prefers a variety of soil types, including acid and alkaline soil<sup>[14]</sup>.

#### **The Genus-**

There are roughly 32 species of the genus *Tinospora* Miers (Menispermaceae), which are found in tropical Africa, Madagascar, Asia, Australia, and the Pacific Islands.<sup>[26,28]</sup> The genus is represented in India by four species, two of which, *T. cordifolia* (Thunb.) Miers and *T. sinensis* (Lour.) Merr., are known to occur in South India. The other two, *T. crispa* (L.) Hook.f. & Thomson and *T. glabra* (Burm.f.) Merr. Are claimed to occur in other parts of the country from the Andaman Islands and Northeast India, respectively<sup>[28]</sup>.

#### **Nutritive Composition of *Tinospora cordifolia*-**

*T. cordifolia* has a high fibre content (15.9%), enough protein (4.5%-11.2%), enough carbohydrates (61.66%), and little fat (3.1%). It has 292.54 calories in every 100 grams of nutritional value. It has sufficient iron (0.28%), high potassium (0.845%), high chromium (0.006%), and calcium (0.131%), all of which are crucial for a variety of regulatory processes.<sup>[29]</sup>

#### **Growth Requirement-**

The plant may be cultivated practically anywhere but prefers a warm climate because it is quite stiff. Planting often takes place from July through August, when it rains. It needs support to grow because it is a climber. To assist its growth, fast-growing species like *Jatropha* (*Jatropha curcas*), *Neem* (*Azadirachta indica*), and *Moringa* (*Moringa oleifera*) have been planted. NEEM is the name for a species of *Tinospora cordifolia* that grows with neem (*Azadirachta indica*). GILOY exhibits better therapeutic qualities and has a chemical makeup that is comparable to neem and giloy. *T. cordifolia* prefers to be grown in medium-black or red soil. Giloy can be grown in a wide range of soil types, from sandy to clay loam, with success. Although the soil should be healthy.<sup>[13]</sup>

#### **Threats to This Plant –**

Due to the plant's abundant therapeutic benefits, both pharmaceutical corporations and the general public overused it to create traditional treatments, which has resulted in a severe shortage of the plant needed to fulfill current demand. The National Medicinal Plant Board, New Delhi, Government of India, has identified 29 highly priority medicinal plants in India's agroclimatic zone 8 (Rajasthan, U.P., and M.P.) due to the strong demand for *T. cordifolia*. Additionally, this plant has been included in NMPB's list of 178 medicinal plant species with High Volume Trade in New Delhi, India [6]. In order to inform the public and scientific community on morphology, growth restrictions, and a variety of other topics, this plant has been chosen for the review paper.<sup>[13]</sup>

**Graphical Abstract-**

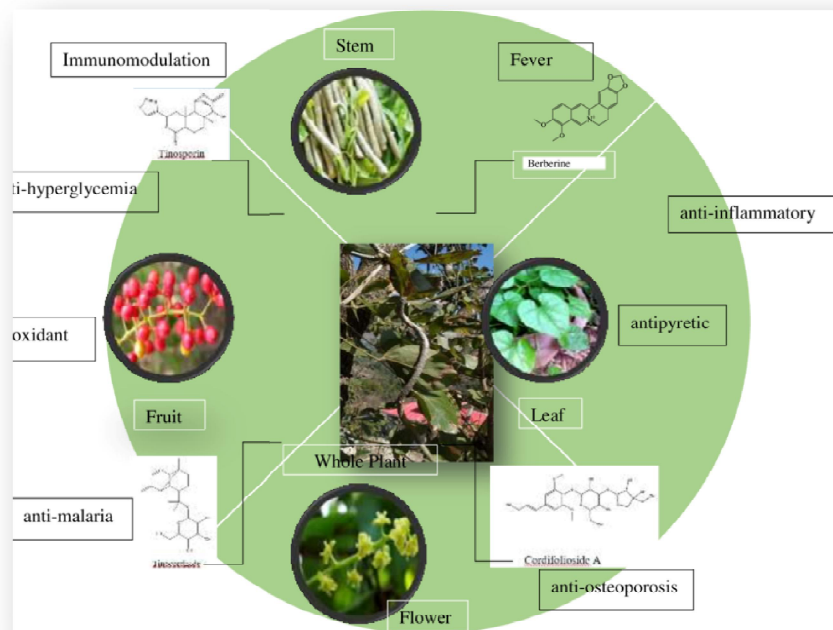


Fig no-6

**Phytochemistry-**

Alkaloids, diterpenoid lactones, glycosides, steroids, sesquiterpenoids, phenolics, aliphatic chemicals, and polysaccharides are some of the constituent classes that *Tinospora cordifolia* belongs to

**Stem and root-**

**Active Element-** Berberine,

**Biological function** (In Human beings)- Neurological, immunomodulatory, and mental health disorders, as well as antiviral infections, cancer, diabetes, and inflammation.<sup>[12]</sup>

**Stem-**

**Active Element-** Glycosides

**Biological function** (in humans)- treats neurological conditions like ALS, Parkinson's, dementia, motor and cognitive impairments, and loss of neurons in the hypothalamus and spine, Immunomodulation, It inhibits NF and functions as a nitric oxide scavenger to exhibit anticancer properties.<sup>[12]</sup>

**Shoot-**

**Active Element** –Steroids

**Biological function** (in humans) - Glucocorticoid-induced IgA neuropathy.<sup>[12]</sup>

**Whole Plant-**

**Active Element-** Diterpenoid Lactones

**Biological function** (in humans)- Vasorelaxant: Relaxes contractions brought on by norepinephrine, prevents Ca<sup>++</sup> influx, and has anti-inflammatory, antimicrobial, antihypertensive, and antiviral properties. Caspase-3 and Bax are activated, causing leukemia to undergo apoptosis while BCL-2 is inhibited.<sup>[12]</sup>





Whole Plant-

Active Element- Aliphatic compound

Biological function (in humans)- anti-inflammatory and anti-nociceptive. Protection from the rat parkinsonisms caused by 6-hydroxyl dopamine.

Reduce VEGF expression and prevent TFN- from binding to DNA.<sup>[12]</sup>

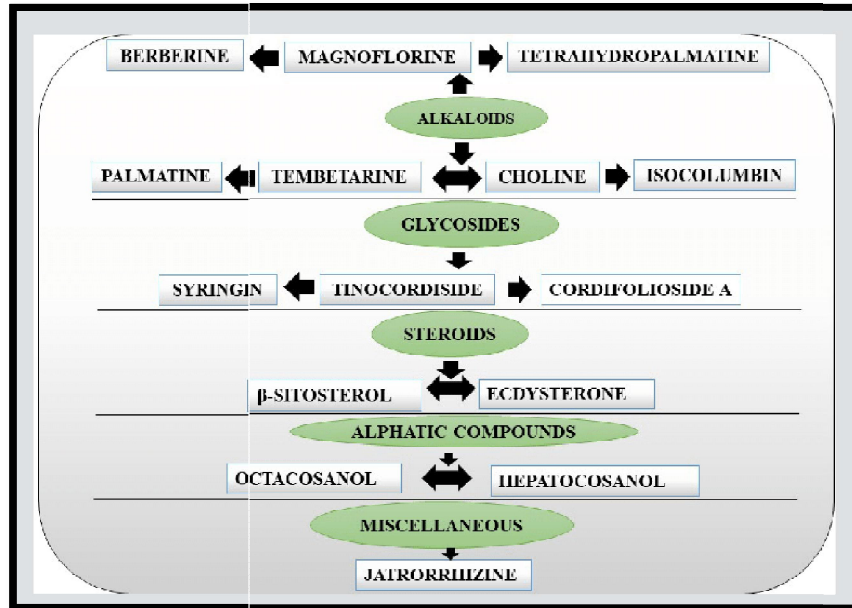


Fig no -7

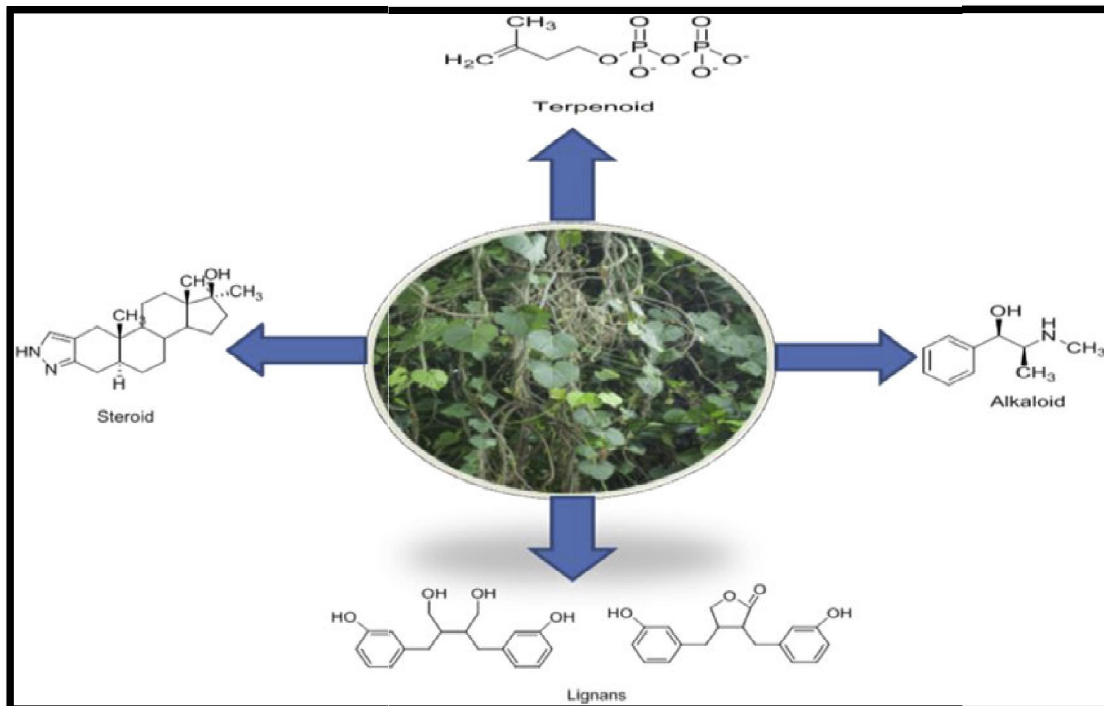


Fig no-8

**PHARMACOLOGICAL ASPECTS: –**

Due to its spasmolytic, allergen-free, and anti-diabetic properties, *T. cordifolia* has been acknowledged as the most widely utilized plant in traditional systems of medicine for centuries. Immune system is greatly enhanced by the herb. Numerous beneficial qualities exist in this plant.

**ANTI-CANCER/ANTI-TUMOR ACTIVITY:-**

*T. cordifolia* exhibits anti-cancer action, which is primarily demonstrated in animal models. Due to a substantial rise in body weight, tissue weight, and tubular diameter, *T. cordifolia* root extract has been proven to have radioprotective properties. *T. cordifolia* dichloromethane extracts is cytotoxic due to lipid peroxidation, LDH release, and a decrease in GST.<sup>[30]</sup> Root extract had a significant impact on radiation in pre-irradiating rats, causing a spike in lipid levels. GSH levels in testes decreased due to peroxidation. The anti-cancer properties of secondary metabolites (such as magnoflorine, palmatine, jatrorrhizine, yangambin, etc.) extracted from guduchi were examined in various types of tumor cells, with "palmatine" and "yangambin" reported to be effective against KB cells and "tinocordiside" for colon cancer. *Tinospora cordifolia* polysaccharide fractions are excellent at lowering the ability of melanoma cells to metastasize.

**Anti-microbial activity**

It has been shown that *T. cordifolia*'s methanolic extract is effective against microbial infection. *T. cordifolia* extract has been tested for its antibacterial activity against *Escherichia coli*, *Staphylococcus aureus*, *Klebsiella pneumonia*, *Proteus vulgaris*, *Shigella flexneri*, *Salmonella paratyphi*, *Salmonella typhimurium*, *Pseudomonas aeruginosa*, *Enterobacter aeruginosa*, and *Enterobacter aerogene*.<sup>[31,32]</sup> *Tinospora cordifolia* Hook leaf and stem extracts in aqueous, ethanol, and acetone. Against clinical isolates of the urinary pathogens *Klebsiella pneumonia* and *Pseudomonas aeruginosa*, F. Thoms had the highest inhibitory efficacy. *Tinospora cordifolia* components could serve as a source for brand-new anti-infective treatment methods. When isolated from patients with burns, *Pseudomonas aeruginosa* strains that are multidrug resistant, silver nanoparticles made from the stem of *Tinospora cordifolia* exhibit very strong antibacterial activity<sup>[12]</sup>.

**Anti-Diabetic Activities:-**

Due to its alkaloids, diterpenoids, and glycosidic components, *T. cordifolia* is classified as a herbal antidiabetic medicine. By controlling blood glucose levels, the stem of this plant is typically used to treat diabetes. It has been claimed to function as an anti-diabetic medication through reducing oxidative stress, boosting insulin production by inhibiting gluconeogenesis and glycogenolysis.<sup>[33]</sup> This plant species' anti-diabetic benefits are linked to the presence of alkaloids (Magnoflorine, Palmetine, and Jatrorrhizine), tannins, cardiac glycosides, flavonoids, saponins, steroids, and cardiac glycoside-related compounds<sup>[34]</sup>. These substances have the potential to be used in both experimental and clinical research because it has been documented that they cover a variety of target activities in diabetic circumstances. *Tinospora cordifolia* is given orally for 14 days at doses of 100 and 200 mg/kg body weight to exert its anti-diabetic effects by reducing oxidative stress, enhancing insulin production, and also by blocking gluconeogenesis and glycogenolysis.<sup>[35]</sup>

**Anti-HIV Activities:-**

This plant's root extract has been demonstrated to reduce HIV resistance that is often present. This anti-HIV action was demonstrated by eosinophil count reduction, stimulation of B lymphocytes, macrophages, hemoglobin levels, and polymorphonuclear leucocytes.<sup>[36]</sup> *T. cordifolia*'s anti-HIV action reveals how it can be used to manage the illness by raising CD4 T-cell counts and lowering eosinophil counts in HIV-positive patients. Significantly increased intracellular and phagocytic bactericidal activity was demonstrated by *T. cordifolia* extract.<sup>[12]</sup>

**Anti-Oxidant Activities:-**

*Tinospora cordifolia* may be used as a nutraceutical and/or as an antioxidant in food systems and biological systems. *Tinospora cordifolia* extracts in methanolic, ethanolic, and water demonstrated substantial antioxidant potential when

compared to other solvents, as well as metal chelation and reducing power activities<sup>[41]</sup>. The alpha-glucosidase inhibitor saponarin, discovered in the leaf extract of *T. cordifolia*, was also found to exhibit strong antioxidant and hydroxyl radical scavenging action<sup>[37]</sup>. Due to the presence of alkaloids, it exhibits protection against nephrotoxicity brought on by aflatoxin<sup>[38]</sup>. The radioprotective effect of *T. cordifolia* aqueous extract increases the survival of mice against a sub-lethal dose of gamma radiation<sup>[39,40]</sup>. In a rat model, the polysaccharide component 'arabinogalactan' from plants has antioxidant activity via protecting against free radicals. According to reports, *T. cordifolia* modifies the levels of several enzyme systems, which in turn regulates the lipid peroxidation process and glutathione level to control the creation of these reactive species and maintain the oxidative load. Due to this plant's anti-oxidant qualities, which prevent lipid peroxidation caused by ferrous sulphate, the mice are also protected from -radiation. Pepticare, a herbomineral mixture used in Ayurvedic medicine that contains *T. cordifolia*, has also been shown to have strong antioxidant effects in rat models. When liver cancer was caused by Nnitrosodiethylamine in male Wister albino rats, the administration of an ethanolic extract of *Tinospora cordifolia* returned the levels of lipid peroxidation and enzymatic and nonenzymatic antioxidants to nearly normal.

#### **Cardiovascular protection:-**

The cardioprotective activity uses an alcoholic extract of *Tinospora cordifolia* (Giloy). When compared to verapamil, the effect of *Tinospora cordifolia* on cardioprotection is dose-dependent; as the dose rises, the extract exhibits a greater effect as seen by a progressive decline in plasma calcium and sodium levels and an increase in potassium levels.<sup>[12]</sup>

#### **Anti-osteopathic activities:-**

It has been discovered that the alcoholic guduchi extract increases the level of osteoblast cell proliferation and differentiation in both rats and humans. In addition, these bone-forming cell models contribute to the calcification process by creating minerals that control the mineralization of the bone.<sup>[41]</sup>

#### **Anti-toxic Activity:-**

This plant's aqueous extract has already been noted to exhibit scavenging action due to the presence of antioxidants that fight the free radicals produced during aflatoxicosis. Additional *T. cordifolia* alkaloids from the plant showed protection against aflatoxin-induced nephrotoxicity, including choline, tinosporine, isocolumbin, palmetine, tetrahydropalmatine, and magnoflorine.<sup>[12]</sup> Guduchi may be able to scavenge free radicals and exhibit a protective effect via changing certain hormone and mineral levels.

*T. cordifolia* has been shown to significantly increase the hormone level (such as glutathione) and enzyme activity (such as catalase, glutathione reductase) and decrease reactive oxygen species in the kidneys of Swiss albino mice, reversing the harmful effects of aflatoxin.

And the plant's alkaloids are principally responsible for this anti-toxin effect. Leucocyte and erythrocyte counts in blood serum are decreased in Swiss albino mice with lead nitrate poisoning.<sup>[12]</sup>

#### **Wound healing-**

Increased tensile strength extract of *T. cordifolia* may be ascribed to the encouragement of collagen synthesis. Wound models with incision, excision, and dead space were used to explore the plant's potential for healing wounds. *T. cordifolia* extract did not restore dexamethasone-suppressed wound healing<sup>[12]</sup>.

#### **Antipyretic activity-**

Traditional medicine has recognized *T. cordifolia* for its jwarahara effect (antipyretic property). The water-soluble portion of a *T. cordifolia* extract made with 95 percent ethanol was found to be effective as an antipyretic. *T. cordifolia* has anti-infective and antipyretic effects, according to several research.<sup>[12]</sup>

#### **Anti-ulcer-**

*T. cordifolia* roots' antiulcer activity has been examined using ethanolic extracts, and it was found to have a marked protective effect against an 8-hour restraint stress-induced ulcerization that is comparable to diazepam's effects.<sup>[42]</sup>

**Anti-Allergenic Effect:-**

The anti-allergic properties of *Tinospora cordifolia* have been investigated. *T. cordifolia* was observed to significantly reduce nasal discharge, nasal obstruction, and nasal pruritus when compared to a placebo, and it consistently improved nasal smear and mucosal test results.<sup>[43]</sup>

**Anti-aging:-**

The cordifolious *Tinospora* alkaloids berberine, palmatine, magnoflorine, tinosporin, isocolumbin, glycosides steroids, phenolic compounds, and polysaccharides are all present in the root's aqueous extract. The plant's leaves have a high protein content (11.2%), and they also have a reasonable amount of calcium and phosphorus. It has been demonstrated to boost monoamine oxidase activity, and since brain monoamine levels are elevated as a result, there is a strong antidepressant effect.<sup>[44]</sup>

**Mechanism of action-**

The phytochemical components of *T. cordifolia* extracts and fractions have been the subject of dereplication study, which has greatly advanced our understanding of the plant's immunomodulatory mechanism(s). Early studies on *T. cordifolia* claim that the glycosides cordifoliosides A and B, which were extracted from the stem, have an immunopotentiating action, as evidenced by the increased IgG antibody production in Balb/c mice given a subcutaneous injection of sheep red blood cells.<sup>[45]</sup> Using the same mouse model, it was possible to see increased antibody production for cordifolioside A and other active *T. cordifolia* substances such as syringin, cordiol, and cordiside as well as an increase in peritoneal macrophage phagocytic activity in response to these substances.<sup>[46]</sup> Other researchers used dereplication techniques in response to the aforementioned discoveries to identify particular phytochemicals in *T. cordifolia* that are responsible for the plant's immunomodulatory effect. For instance, after extracting the substance with either hot water or methanol:water, fractionated *T. cordifolia* stem powder using n-hexane, ethyl acetate, chloroform, n-butanol, and water.<sup>[47]</sup> As evidenced by enhanced neutrophil phagocytosis, the hot water extract, ethyl acetate, chloroform, and water fractions all demonstrated immunomodulatory activity. Dereplication research was used to identify two previously unidentified phytochemicals (11-hydroxymuskatone and N-methyl-2-pyrrolidone) in a natural source, as well as five recognized phytochemicals (N-formylannonain, cordifolioside A, magnoflorine, tinocordiside, and syringin). Treatment of human neutrophils with magnoflorine, tinocordiside, 11-hydroxymuskatone, and N-methyl-2-pyrrolidone 4 C. R. Reactive oxygen species generation and enhanced phagocytosis are signs of elevated PMN activity.

Water and ethanol were used to extract the stem powder from *T. cordifolia*, which was then fractionated with n-hexane, ethyl acetate, n-butanol, and water.<sup>[57]</sup> Using the murine splenocyte proliferation assay as a proxy for immunomodulatory action, they showed that the water extract was the most potent component and that pure N-formylannonain and 11-hydroxymuskatone were responsible for the immunoenhancing effects of *T. cordifolia*. There are numerous polysaccharides that have been identified as phytochemical components of *T. cordifolia* that have immunomodulatory effect.<sup>[48]</sup> For instance, the polygenic mitogenic activity of the arabinogalactan polysaccharide G1-4A in B-cells was first identified in aqueous preparations of the stem of *T. cordifolia*.<sup>[49]</sup> Pretreatment with G1-4A in a later research reduced lipopolysaccharide-induced mortality in a mouse model of septicemia. Tumor necrosis factor-alpha response was slowed, circulating TNF receptor levels were up, and splenic adherent cell production of nitric oxide was down, all of which were associated with lower mortality. It has also been demonstrated that G1-4A has the ability to lessen host immune responses in a BALB/c mice model of drug-resistant *Mycobacterium TB*.<sup>[50]</sup> Following G1-4A therapy, a decrease in lung bacillary load was correlated with an increase in Th1 cytokines and a decrease in Th2 cytokines. Murine macrophages surface expression of Major Histocompatibility Complex-II (MHCII) and CD-86, markers of classically activated macrophages (M1), significantly increased after therapy. M1 macrophages, which often exhibit microbicidal activity, release more nitric oxide and pro-inflammatory cytokines.

Following the foregoing findings, researchers considered B-cells and macrophages as potential targets for G1-4A. For instance, fluorescence microscopy investigations showed that G1-4A targeted macrophages (major) and B-cells (minor), leading researchers to speculate that G1-4A and LPS shared a biological target.<sup>[51]</sup> The researchers demonstrated that G1-4A functioned as a TLR4 agonist and stimulated murine B-cells, boosting lymphocyte



proliferation and splenic cellularity using anti-toll-like receptor 4 antibodies. The researchers later found evidence to support this theory.<sup>[50]</sup> B-glucans, a subclass of polysaccharides, are also immunostimulatory in nature. To cause a Th1 cytokine response, B-glucans interact with the appropriate macrophage receptors.<sup>[58,59]</sup>

*T. cordifolia* extracts show immunomodulatory effect in addition to the low molecular weight phytochemicals and polysaccharides that have previously been identified. For instance, guduchi immunomodulatory protein and immunostimulatory protein were found to be present in both fresh and dried *T. cordifolia* stem powder.<sup>[52]</sup> However, it was essentially absent in *T. cordifolia* leaf extracts. The guduchi immunomodulatory protein had mitogenic action on mice splenocytes and thymocytes. Guduchi Immunomodulatory protein also caused murine macrophages to become phagocytic and bactericidal without causing hemagglutination activity.<sup>[5]</sup>

#### **METHOD-**

It has been established that different extracts, fractions, and isolated compounds demonstrate immunomodulatory activity in relation to phagocytosis and the generation of reactive oxygen species in human neutrophil cells using the PMN phagocytic function tests, NBT, NO, and chemiluminescence assay.<sup>[1]</sup> The six principal *Tinospora* species, *T. cordifolia*, *T. crispa*, *T. sinensis*, *T. smilacina*, *T. bakis*, and *T. sagittata*, were the subject of this in-depth review, which was based on recent scientific databases. The distribution and classification of these species, their value in traditional medicine, identified key phytochemicals, and their powerful immunomodulating effects were the main areas of focus during the data inclusion process. Involving the Institute for Scientific knowledge, the knowledge was discovered through thorough literature searches.<sup>[53]</sup>

#### **Toxicity-**

Scientific investigations have revealed a significant biological potential for *Tinospora cordifolia*. The detailed proof for the use of this plant in various therapies is strongly believed to be provided by the extensive material provided in this review on the phytochemical and diverse biological properties of the extracts. In ayurvedic medicine, *T. cordifolia* is widely employed to treat a number of diseases.

It has been demonstrated that *T.cordifolia* extract has a beneficial immunomodulatory effect. It can help restore membrane damage brought on by free radicals. It also has hypolipidemic and hypoglycemic qualities. Additionally, it can shield the liver from a number of diseases. It was shown to be non-toxic in testing for acute toxicity. Numerous studies of various kinds have been conducted. Numerous studies on *T. cordifolia* have shown that it is an excellent drug that may be effective for treating a wide range of ailments in both people and animals. However, contemporary approaches must be used to establish the safety and any potential indicators in both humans and animals.<sup>[54]</sup>

#### **Evaluation parameter:-<sup>[55, 56]</sup>**

##### **1) Physical Parameter-**

Physical characteristics include color, Odour, appearance, clarity, viscosity, moisture content, pH, disintegration time, friability, hardness, and flowability.

Colour- Visual inspection was used to assess the color of the formulation.

Odour- After mixing the fragrance of the formulation was evaluated.

**a) Angle of repose-** It is the maximum angle possible between the pile and horizontal plane. It was easures by the formula-  $\tan\theta=h/r$ .

**b) Bulk density-** It is the ratio of mass of the blend to bulk volume. It was measured by pouring powder in measuring cylinder and measuring the volume occupied by powder.

Formula- Bulk density = mass/Bulk volume.

**c) Tapped density-** It is the ratio of mass of the blend to tapped volume. It was measured by digital tap densitometer by measuring the volume occupied by powder after 100 standard tapping.

Formula- Mass/Tapped Volume.

**d) Carr's index-** It was calculated using the formula below.

The formula for compressibility is:  $\% \text{compressibility} = \frac{\text{Tapped density} - \text{Bulk density}}{\text{Tapped density}} \times 100$

**e) Hausner's ratio (HR)-** Using the formula below, it was measured.

Formula-

$$\text{H.R} = \frac{\text{Tapped density}}{\text{bulk density}}$$

**Hardness and thickness test** -The thickness and hardness of 20 tablets for each formulation were measured. Vernier Calipers were used to measure the thickness of the tablets, and the Monsanto hardness tester was used to measure the test's hardness.

**Disintegration time** -The disintegration test only measured the amount of time needed for a group of tablets to separate into particles under a certain set of conditions. This test measured the amount of time needed for the tablet to separate into particles. This test was run to see whether a pill will disintegrate over a certain amount of time.

**Friability test-** The Roche friabilator can be used in a lab to test the friability of tablets. The friabilator consists of a rotating plastic container that drops the tablets through a six-inch gap into a then run the friabilator for 100 revolutions. The pills are weighed again. Compress pills that lose between 0.5% and 1.0% of their weight are acceptable.

## II. CONCLUSION

The plant guduchi (*T. cordifolia*), which is well-known in traditional medicine in particular, is a unique source of many different kinds of chemicals with varying chemical structures. The classic anti-diabetic, anti-cancer, immunomodulatory, antioxidant, antibacterial, and antitoxic properties of *Tinospora cordifolia* are highlighted in this review along with the modern research that supports them. There has been a rising trend and awareness in the study of medicinal plants during the past few years. The chemistry of several sections of *Tinospora cordifolia* has already been the subject of considerable research during the past few decades. Despite the fact that *Tinospora cordifolia* has been successfully utilized in Ayurvedic medicine for millennia, considerable research and development work on *Tinospora cordifolia* and its products should be performed for their greater commercial and therapeutic application.

This review can be applied clinically as well as for future research. A reduction in immunological competent cell numbers or function is the root cause of many malignant illnesses. By stimulating immunological-competent cells, immunomodulatory substances of both plant and animal origin improve the body's immune reactivity to infections. However, there is a need for thorough research on.

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