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Formulation, Development and Evaluation of Giloy Candy as a Novel Approach for Antimalarial Therapy

Aishwarya S. Patil[1*], Rani A. Puri[2], Mohini S.Mane[3], Pranali P. Kalyankar[4], Priyanka A. Panmand[5], Disha Arora[6]

[1]*Department of Pharmaceutics, Vilasrao Deshmukh Foundation, Group of Institution VDF School of Pharmacy, Latur, India*

[2]*Departmentof Quality Assurance, Vilasrao Deshmukh Foundation, Group of Institution VDF School of Pharmacy, Latur, India*

[3]*Department of Pharmaceutical Chemistry, School of Pharmacy, SRTMU University, Nanded*

[4]*Department of Quality Assurance, School of Pharmacy, SRTMU University, Nanded*

[5]*Krishanrao Bhegade Institute of Pharmaceutical Education & Research, Talegaon Dabhade, Pune*

[6]*Faculty of Pharmaceutical Sciences, The ICFAI University, Baddi, Himachal Pradesh*

Corresponding Author*: Aishwarya Shivkumar Patil,

[1]Department of Pharmaceutics,, Vilasrao Deshmukh Foundation,
Group of Institution VDF School of Pharmacy,
Latur, India.
Email-aishwarya06patil@gmail.com

ABSTRACT

Known by many names, including Guduchi or *Giloy, Tinospora cordifolia* (Willd.) Miers ex Hook F.& Thomson is a well-known medicinal herb that is widely utilized in traditional medical systems, especially in India and other Asian nations. Numerous medicinal uses for this plant have been shown, including the treatment of diabetes, cardiovascular disease, cancer, immune system abnormalities, metabolic disorders, and infectious infections. This study examines *Tinospora cordifolia's* potential as an antimalarial, focusing on its aqueous extract, and evaluates its effectiveness against the synthetic antimalarial medication chloroquine. Despite having a 75.8% efficacy rate in treating malaria, the development of widespread resistance has limited the clinical usage of chloroquine. this study investigates the antiplasmodial action of *giloy,* emphasizing its capacity to impede the growth of malaria-causing Plasmodium parasites. The antimalarial properties of *Giloy* have been reported and are attributed to its abundant content of bioactive substances, such as flavonoids, glycolides, and alkaloids. According to these results, *Tinospora cordifolia* may prove to be a useful and less harmful therapy option for malaria, possibly improving immune function and causing fewer adverse effects than traditional medicine.

KEYWORDS- *Giloy*, antimalarial, antioxidant, candy, immunomodulation.

INTRODUCTION

Tinospora cordifolia (*Giloy*) is a climbing shrub in the Menispermaceae family that goes by the names Heart-leaved Moonseed, *Guduchi*, and *Giloy* [1]. This plant, which is indigenous to Sri Lanka, Myanmar, and tropical and subtropical parts of India, has long been a mainstay of traditional Indian medical practices like Unani and Ayurveda [2] Its Ayurvedic classification as a Rasayana highlights its highly regarded function in boosting immunity and vitality[3]. *Tinospora cordifolia* is a wonderful medicinal plant that has been detected in over 34 species worldwide. It is useful in treating a variety of illnesses, including fever, diabetes, skin problems, urinary disorders, indigestion, jaundice, chronic diarrhea, and dysentery[4].The rich nutrient profile of the herb's starchy stem extract is especially regarded for its ability to support overall health and digestion[5]. Numerous bioactive substances,

including as alkanoids, glycosides, steroids, sesquiterpenoids, phenolics, aliphatic chemicals, and polysaccharides, are present in Tinospora cordifolia [6].Notably, the FDA has acknowledged it for both its therapeutic promise and safety. Its many chemical components, which give it a bitter flavor, are responsible for its many health advantages, including its alleged antibacterial, antioxidant, and anticancer properties[7]. *Tinospora cordifolia* is important since it is widely used in traditional medical systems and is known to be effective. *Azadirachta indica*) trees produce neem trees, which enhances giloy's therapeutic value and gives rise to its alternate name, *'Neem Giloy*.' *Giloy* is known as the "Nectar of Immortality" because to its revitalizing and longevity-promoting characteristics. The herb is an essential part of holistic treatment plans because of its capacity to boost immune system performance, fight a variety of infections, and improve general health [8]. Its potential in modern medicine is shown by the scientific assessment of its qualities, which connects conventional knowledge with new research. This article's goal is to examine and record *Tinospora cordifolia's* many therapeutic benefits.[9] This involves a thorough analysis of its physiological effects, chemical makeup, and potential medicinal uses. The article attempts to give a thorough explanation of Giloy's function as an antibacterial, antioxidant, and anticancer agent by analyzing recent research and scientific evaluations. In order to validate the herb's historical significance and encourage its continued use in health and wellbeing, it aims to emphasize the herb's potential contributions to modern medicine and its integration into contemporary therapeutic methods. [10-20]

Botanical Description Of *Tinospora Cordifolia (Giloy*)

Climbing shrub *Tinospora cordifolia* is either deciduous or semi-evergreen. It frequently grows on the trunks of big trees, like neem and mango. With enough hydration, the plant can tolerate a wide range of soil types, from basic to acidic. It has fleshy, thick stems from which huge aerial roots protrude from the branches. Older stems turn light brown, but younger stems are usually smooth and green. This shrub, which grows quickly and twines, has oval, juicy, membranous juvenile leaves with circular petioles that range in diameter from 5 to 14 cm [21-25].

(a) Stems of *Giloy* b) Leaves of *Giloy*

This species is native to tropical and subtropical regions of the Indian subcontinent, including India, China, Sri Lanka, and Myanmar. In India, it is found from the Kumaon region to Kanyakumari, thriving in a variety of temperatures and soil conditions, and has a long lifespan. It can grow at elevations up to 310 meters[25,26].

Active Constituents Of *Tinospora Cordifolia (Giloy)*

There are various active constituents of giloy plant obtained from various parts of plant like leaves, stems, roots etc .(table no 1)

Table no.1 Active Constituents of *Giloy* with Biological Response

Sr. No	Active Component Type	Compounds	Source	Biological Response
1	Alkaloids	Berberine, Choline, Palmatine Tembetarine, Magnoflorine, Tinosporin, Isocolumbin	StemRoot	Anticancer, Antiviral infections, Neurological Disorder andAnti-diabetic
2	Glycosides	Tinocordiside,Cordioside	Stem	Treat Neurological Disorderlike Parkinsons
3	Diterpenoid	Furanolactone	Whole Plant	Vasorelaxants, Antiinfammatory, Antimicrobial Antihypertensive, Antiviral
4	Steroids	Beta-Sitosterol	Stem aerial parts	Induce Osteoporosis in early inflammatory arthritis
5	Aliphatic Compound	Octacosanol	Whole plant	Anti-nociceptive and anti-inflammatory
6	Others	Giloin, Tinosporic acid	Root	Used to treat anxiety, Protease inhibitors for HIV

Theraputic Uses of *Tinospora Cordifolia (Giloy)*

Boost Immunity

Ayurveda's importance has increased in the fight against the devastating coronavirus outbreak that is sweeping the globe. In particular, *giloy* is an effective treatment for viral fevers because of its immune-stimulating qualities. According to research, people who are susceptible to the coronavirus should take 500 mg of giloy extract or 1-3 grams of giloy powder twice a day for 15–30 days with warm water together. Giloy combined with gokshura and amla may be more beneficial in reducing COVID-19 symptoms. Moreover, giloy is enhanced with antioxidants that support cellular health by scavenging dangerous free radicals. Its antimicrobial and detoxifying qualities help treat liver ailments and urinary tract infections while also helping to purify the blood [27].

Antimalarial Activity

Through its action on the parasites that cause malaria, *Tinospora cordifolia* (*Giloy*) demonstrates effective antimalarial efficacy. The ability of a material, such as a medication or chemical, to prevent or treat malaria infections is referred to as antimalarial activity. The deadly parasites that cause malaria are spread by mosquito bites. Antimalarial drugs function by concentrating on distinct phases of the parasite's life cycle. They either eradicate the parasite in mosquitoes or prevent it from proliferating in people. This aids in the efficient management and treatment of malaria infections [28].

Mental Disorder

You might benefit from conventional therapies in terms of your physical and mental health. *Giloy*, however, is praised for its therapeutic properties in Ayurveda and is considered a healing elixir. On the other hand, it has been demonstrated to reduce anxiety and tension. Furthermore, Giloy's benefits show that it has a strong protective effect on the neurological system. It improves memory, encourages bodily relaxation, and helps repair damaged brain cells. *Giloy* is essential for improving brain function because it protects dopaminergic neurons and balances antioxidant enzymes in the brain. Giloy also works wonders as a health tonic when mixed with other herbs because it helps clear the body of toxins, improve memory, and soothe the mind." [29]

Helps With Breathing Problems

Due to *giloy's* anti-inflammatory and cough-suppressing qualities, it is frequently used to treat a variety of respiratory conditions, including tonsillitis, the common cold, and persistent cough. Reducing Asthma Symptoms: Breathing difficulties, chest tightness, coughing, and wheezing are some of the symptoms of asthma, which is a chronic illness that can be difficult to treat. Because of this, medical experts and dietitians frequently advise people with asthma to consume giloy root—either by chewing it or by consuming its juice[30].

Anticancer Activity

The active ingredients in *T. cordifolia (Giloy)* effectively strengthen the host's immune system by increasing blood leukocyte and immunoglobulin levels and stimulating stem cell growth. These characteristics allow for a 58.8% reduction in the size of solid tumors, which is on par with the well-known chemotherapy medication cyclophosphamide. These immune-stimulating properties could avoid immunosuppression caused by tumors and could be a good treatment for many kinds of cancer [31].

Antidiabetic Activity

In diabetic rats, the stem extract of *Tinospora cordifolia (Giloy)* ameliorates the abnormalities in lipid metabolism brought on by diabetes. Oral administration of several extracts (hexane, ethyl acetate, and methanol) from the stem of Tinospora cordifolia was found to have strong anti-diabetic effects, as evidenced by the reduction of blood sugar levels in streptozotin-induced diabetic rats at a dose of 250 mg/kg. Eight different herbs, including *Syzygiumcumini, Momordica charantia, Emblica officinalis, Gymnem asylvestre, Enicostemmalittorale, Azadirachta indica, Tinospora cordifolia (Giloy), and Curcuma longa*, are included in the polyherbal formulation Dihar. In diabetic rats induced by streptozotocin, this formulation significantly lowers lipid peroxidation levels and increases the activity of antioxidant enzymes. The alpha-glucosidase inhibitory activity of several extracts (ethyl acetate, dichloromethane, chloroform, and hexane) of *Tinospora cordifolia* stem was measured; the dichloromethane extract was the most efficient, obtaining 100% inhibition. While saponarin isolated from *Tinospora cordifolia* leaves showed hypoglycemic effect at doses ranging from 20 to 80 mg/kg, the ethanol extract of the plant shows androgenic characteristics. Furthermore, in diabetic rats induced

by alloxan, hydroalcoholic and chloroform extracts of the stem of *Tinospora cordifolia* demonstrate noteworthy anti-diabetic activities in a dose-dependent manner at dosages of 250 and 500 mg/kg[32-35].

Antiallergic Activity

Research has been done on *Tinospora cordifolia's* (*Giloy*) ability to combat allergies. Comparing T cordifolia to a placebo, studies have demonstrated a significant reduction in symptoms such as sneezing, nasal discharge, nasal blockage, and nasal itching. Examination nasal smear results showed consistent improvements."

As an Immunomodulator and against Hepatic Amoebiasis

Youvraj R. Sohni et al. evaluated the efficacy of a crude extract formulation in an experimental amoebic liver abscess in golden hamsters. *Boerhaviadiffusa, Tinospora cordifolia, Berberisaristata, Terminaliachebula, and Zingiber officinale* were the five herbs that made up the concoction. When administered at a dose of 800 mg/kg/day, the formulation reduced the average degree of infection in the control group from 4.2 to 1.3, achieving a maximum cure rate of 73% in hepatic amoebiasis. Higher haemagglutination titers in immunomodulation trials indicate an increase in humoral immunity. Leukocyte migration inhibition experiments revealed an improved cell-mediated immune response, despite no change in T-cell numbers [35].

Antioxidant Activity

In a scientific environment, Anil a kumar K R and associates studied *Tinospora cordifolia's* antioxidant capabilities. The findings showed that the water, ethanol, and methanol extracts of Tinospora cordifolia demonstrated notable antioxidant properties. These encouraging antioxidant properties of the extracts demonstrate the plant stem's potential as a natural source of nutraceuticals or antioxidants that can successfully fight oxidative stress [36].

Mental Disorder

Traditional therapies such as using the entire plant and the juice of the leaves have been proven to be useful in treating mental illnesses, which can be a difficult issue for many people. These herbal medicines are considered to be among the greatest psychotropic medications available in India. This age-old method of treating mental illness has been handed down through the years and is still helpful to people who are dealing with a variety of mental illnesses. The ability of nature to cure the mind is absolutely amazing, and using plant-based medications can provide a kind and comprehensive approach to mental health [37].

Materials And Methods

Plant Materials

Fresh thumb sized stems of fresh *Giloy* plants were collected from rural area Of Latur District.

Preparation Of *Giloy* Satva

To prepare *Giloy* Satva, fresh *Giloy* stems were collected, cleaned, and dried. Approximately 5 kg of stems, cut into 2-3 inch pieces, were pounded into a paste. This paste was soaked overnight in four times the amount of water. The next day, the mixture was macerated for an hour and then sieved through cotton cloth. The liquid was allowed to settle, and the clear portion was removed, leaving a white starchy residue. This residue, rich in Giloy Satva, was air-dried and stored in airtight glass containers to maintain quality.

Table.2.Giloy Candy Preparation Methods For Batches F1,F2,F3 And F4

Sr.no	Ingredients	F1	F2	F3	F4
1	Giloy Satva	100mg	300mg	500mg	700mg
2	Sugar	10g	20g	30g	40g
3	Water	25ml	25ml		25ml
4	Methyl Paraben	0.002 mg	0.002 mg	0.002 mg	0.002 mg
5	Vanilla Essence	2-3 Drops	2-3 Drops	2-3 Drops	2-3 Drops

Preperation Of *Gilloy* Candies

Three different batches of *Giloy* candies (F1, F2, F3, and F4) were prepared with varying amounts of Giloy Satva. The process began by combining water and sugar in a large saucepan or bowl. The mixture was heated over medium heat until it reached a boil, stirring continuously with a wooden spoon or spatula to ensure uniformity. Giloy Satva was then gradually added to the boiling sugar-water mixture, with continuous stirring to achieve a homogeneous blend. Vanilla essence was added for flavor. The mixture was stirred thoroughly to ensure the flavoring was well incorporated. The candy mixture was then poured into greased candy molds, ensuring each cavity was filled adequately. The molds were left to cool on racks or trays, allowing the candies to solidify. Once fully cooled and hardened, the Giloy candies were carefully removed from the molds and stored in airtight containers in a cool, dry place [38].

Phytochemical Evaluation of *Giloy* Candies

1. Detection Of Alkaloids

a. Mayer's test**:** Mayer's reagent was added to five ml extract. The presence of a creamy white precipitate in the sample indicated the presence of alkaloids.

b. Dragendroff's test: Five ml of extract were mixed with two ml of Dragendorff's reagent. The presence of alkaloids is established by the reddish brown colour precipitation.

2. Detection Of Glycosides

a. Borntrager's test: Filtered (2 mL) extract was mixed with 3 mL $CHCl_3$ and 10% ammonia solution, yielding a pink colour that indicated glycoside presence.

3. Detection of Saponins

a. Froth Test: 20 mL distilled water was used to dilute the extracts for around 15 minutes, the diluted extracts were shaken in a graduated cylinder. Saponins are present when a one-centimeter layer of foam forms.

b. Foam Test: In a test tube, around 0.5 gram of the extracts were diluted with 2 ml of water. Saponins were detected by the presence of foam that lasted for around ten (10) minutes after being shaken.

4. Detection of phytosterols

a. Salkowski's test**:** In a test tube, around 0.5 gram of the extracts was diluted with 2 ml of water. Saponins were detected by the presence of foam that lasted for around ten minutes after being shaken.

5. Detection of tannins: After dissolving the plant extraction 5mL of distilled water, 1 per cent gelatin solution and 10% NaCl were added. The presence of tannins was revealed by the formation of white precipitate.

6. Detection of Resins: One ml of extract was dissolved in acetone before being added to distilled water. The presence of resins was suggested by the presence of turbidity

Table 3:Phytochemical screening of methanolic and water extract of *giloy* stems

Phytochemicals	Methnolic extract	Water extract
	Alkaloids	
Mayers Test	+ve	+ve
Dragondroff's Test	+ve	+ve
	Glycosides	
Borntragers Test	+ve	+ve
	Saponins	
Froth Test	-ve	+ve
Foam test	-ve	+ve
	Phytosterols	
Salkowski's Test	+ve	+ve
	Tannins	
Gelatin Test	+ve	+ve
	Resins	
Acetone-water Test	-ve	+ve

Moisture Content

The moisture content of the candy was determined using the hot-air oven technique. A 5 g sample was subjected to a temperature of 100±5°C in a hot air oven for duration of 4 hr.

Subsequently, it was allowed to cool in desiccators and then weighed again. Readings were taken in triplicate. The difference in weight indicated the amount of moisture present in the sample. % of moisture content was determined using following formula:

Moisture content (%) = ---------- × 100

Where, W1= Wt of Dish and Candy before drying (g); W2 = Wt of Dish and Candy in gm after drying (g); W = Weight of the empty dish (g).

Ash content

To determine the ash content, a precise weight of 2g of the candy sample was measured. The sample was then heated in a crucible using a muffle furnace set at 560°C for duration of 6 hr. After ash formation, the sample was allowed to cool in desiccators and subsequently weighed. The resulting ash should have a grayish-white color. Readings were taken in triplicate. The ash content was calculated using the following formula:[38]

Ash content (%) $\frac{W1 - W2}{\text{----------}} \times 100$.

Where, W1=Wt of crucible+Candy before ash (g);

W2=Wt of crucible+candy ash (g);

W=Weight of the empty crucible (g).

pH measurement

The pH measurement was conducted using a digital PH meter.A 5 g sample was taken and finely ground before being mixed with 30 mL of distilled water to form a pulp. The mixture was thoroughly blended using a homogenizer and subsequently filtered. PH of the filtrate was measured using pH paper. Readings were taken in triplicate.

Antioxidant Assay Of *Giloy* Satva

DPPH Assay

Prepared *giloy* satva candies were analyzed for antioxidant effect by DPPH method using UV Spectrophotometer. Giloy Satva candies were crushed. Approximately 12 mg of DPPH was dissolved in 100 mL ethanol in a volumetric flask and placed in dark covered with aluminum foil. A stock solution of 1 mg/ mL was prepared by solublising 10 mg crushed candy in 10 mL ethanol. Serial dilutions of 10, 20, 30, 40 and 50 mg/mL were prepared from the stock solution. Ascorbic acid was used as standard drug. The assay was conducted as follows: 3 mL of each dilution was taken in a test tube. 2 mL of DPPH was added to the sample and the test tube was kept in dark for 30 min. After 30 min, the absorbance of each sample was taken at 520 nm on UV against the blank. The percentage of free radical scavenging by samples was determined by the following formula

$$\%RSA = \frac{\text{Abs of blank} - \text{Abs of Sample}}{\text{Abs of blank}} \times 100$$

Anti-malarial Activity Of *Giloy* Candy

Samples were generated by dissolving 1 mL of the sample or 1 mg/mL of the standard in 1 mL of DMSO in order to measure the hemozoin concentration. One milliliter of 1 M HCl, 10 mM oleic acid, and three milliliters of 3 mM hematin were added to each reaction mixture. Next, using sodium acetate buffer at pH 5, the final volume was adjusted to 10 mL. The produced samples were gently shaken constantly while being incubated at 37°C for the entire night. To extract the hemozoin pellet, the materials were centrifuged at 14,000 rpm for 10 minutes at 21°C after incubation. The pellet was incubated for 15 minutes at 37°C with frequent shaking, and then repeatedly washed with 2.5% (w/v) SDS in phosphate-buffered saline. Using 1 mL of 0.1 M sodium bicarbonate, this washing procedure was carried out three to eight times until the supernatant turned clear. (4,14,38)Following the last wash, the pellets were dissolved in 1 milliliter of 0.1 M NaOH while the supernatant was disposed of. Next, using a UV/Vis spectrophotometer to measure the absorbance at 400 nm, the hemozoin content was ascertained. The results were recorded as % inhibition (I%) of heme crystallization compared to negative control (DMSO) and Chloroquine diphosphate was used as a positive control using the following equation**:**

$I\% = [(AN - AS)/AN] \times 100$

where, AN is absorbance of negative control

AS is absorbance of test samples**.**

RESULT AND DISCUSSION

Preperation *Giloy* Satva Candies

Giloy satva was derived from the fresh stems of T. cordifolia using a traditional technique, resulting in a 36.4% yield. Batches F1, F2, F3 and F4, were each supplemented with,100mg, 300 mg, 500 mg, and 700 mg of *Giloy* satva, respectively, to determine the optimal amount for candy formulation. The physicochemical characteristics of all four batches were evaluated according to the AOAC 930.15

guideline. After a 28-day storage at room temperature, the candies were examined for the final formulation study. Physicochemical evaluation of the *Giloy* Satva Candies In organoleptic evaluation, all four batches of candy, F1, F2 ,F3and F4, were analyzed for color, odor, taste and appearance. The outcomes of organoleptic evaluation are as shown in (Table 4).Batch F2 found to be comparatively more bitter in taste and rough in appearance than remaining three batches F1, F3 and F4, Moisture content of prepared candies of all batches was monitored in between storage of candies. Estimation of moisture content is an important parameter from stability and microbial contamination during storage point of view. In all batches, moisture of the candies found to be decreased when stored for longer period of time might be due to evaporation (Table 4).Candies of F2 batch found more brittle as compared to F1, F3 and F4 batch candies when examined on 28th day of storage. The Average Ash value content in Giloy Satva candies of batches F1, F2, F3 and F4 was found to be ranging from 4.78% to 5.4%(Table 4). The PH values of all four batches of candies were found to be in the range of 4.7-5.0. According to previous studies, PH is inversely proportional to the concentration of sugar in candies.The antioxidant activity of Giloy satva candies was evaluated in relation to its hepatoprotective and immunomodulating effects. The study revealed that the free radical scavenging activity of Giloy satva was moderate compared to Ascorbic acid. *Giloy*satva contains approximately 0.31% Alkaloid, suggesting that the antioxidant properties may be linked to the presence of alkaloids. Furthermore, the percentage of free radical inhibition was directly correlated with the quantity of *Giloy* satva in the candy.(table 4).Thus, from overall study, *Giloy* Satva Candies of F3 batch is found to be appropriate based on , physicochemical evaluation and Anti-oxidant activity and finalized for the further studies before commercialization.

Table 4: Organoleptic, Physicochemical, sensory evaluation and Antioxidant study outcomes of *Giloy* satva candy batches F1, F2, F3&F4.

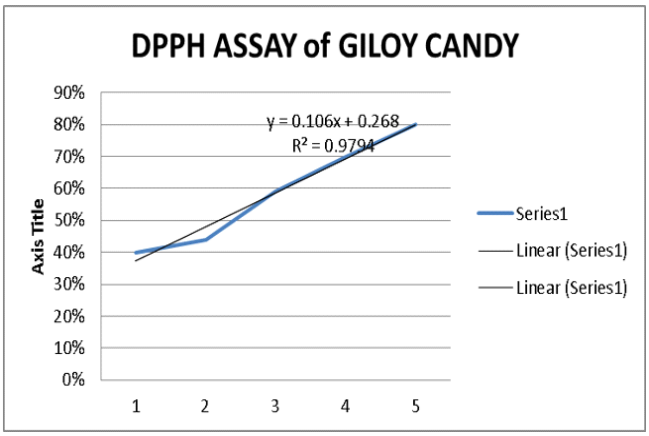
Sr.no	**Parameters**	**Batches**											
		F1			**F2**			**F3**			**F4**		
1	Organoleptic Evaluation												
	Colour	Brown			Brown			Brown			Brown		
	Taste	Sweet			Sweet			Sweet			Sweet		
	Flavour	Vanilla			Vanilla			Vanilla			Vanilla		
	Consistency	Solid (hard)			Solid (hard)			Solid (hard)			Solid (hard)		
	Shape	Round			Round			Round			Round		
2	Moisture Content%	1st	14th	28th	1st	14th	28th	1st	14th	28th	1st	14th	28th
		0.22%			0.14%			0.12 %			0.16 %		
3	Ash Content%	4.786%			4.742%			4.73%			5.4%		
4	pH	4.7 ±0.56			4.8 ±0.32			4.9 ±0.10			4.9 ±0.76		
5	Phytochemical Screening By Chemical Test	Carbohydrate, Alkaloids.			Carbohydrates, Alkaloids.			Carbohydrates, Alkaloids.			Carbohydrates, Alkaloids.		
6	% Free radical inhibition at 50 µg/mL concentration	46.70			48.75			51			52.01		

Figure 2(a)*Giloy*satva candies of F3 batch

DPPH Assay

Table 5. *DPPH Assay of giloy*candy (F3 batch)

calculation of %Radical Scavenging and IC50 from DPPH Assay of Giloy Candy				
	absorbance measurment data			
conc(µg/ml)	control	sample	%RSA	IC50
10	0.551	0.332	40%	60
20	0.551	0.31	44%	39
30	0.551	0.228	59%	37
40	0.551	0.213	70%	51
50	0.551	0.14	80%	120



Anti-malarial Activity Of *Giloy* Candy

Table no.6 Antimalarial activity of *giloy* candy (F3 batch)

Sr.no	Sample name	Absorbance readings			Average	Stdv	% RSD	% inhibition
NA	NA	Read1	Read 2	Read 3	NA	NA	NA	NA
1	Control (DMSO)	0.9181	0.9187	0.9281	0.9216	0.0056	0.6	NA
2	Chloroquine(standard positive control)	0.1961	0.1951	0.1909	0.1940	0.0027	1.4	78.9
3	Sample(Giloy extract)	0.2200	0.2223	0.2257	0.2227	0.0028	1.3	75.8

Giloy extract showed 75.8% antimalarial activity and inhibition (I%) of heme crystallization The *Giloy* extract demonstrates significant inhibitory activity, close to that of chloroquine, a known positive control. This suggests that *Giloy* extract may have potential as an inhibitory agent in the context of the assay being performed.

CONCLUSION

Tinospora cordifolia (*Giloy)* a plant known for its diverse roles, serves as a valuable resource for all living organisms. Previous discussions have highlighted the presence of active compounds such as alkaloids, glycosides, lactones, and steroids within the plant extracts. These compounds play crucial roles in modulating the immune system and various physiological functions, showcasing the plant's versatility. Further studies should explore how these active compounds interact with living systems, influencing structure-function relationships. By examining the crystal structures of membrane-bound receptors, downstream signaling cascades, and change in the surrounding environment, new insights

into nature can be gained. Exploring nature's vibrant source may uncover unique interactions among evolutionarily related organism groups. The future focus lies in investigating the biochemical and signaling pathways of Tinospora's active components to enhance targeted disease treatment. With its significant contributions to the field of medicine*, Tinospora* does possess antimalarial properties, but its specific effectiveness against chloroquine-resistant strains of malaria parasites and its comparative efficacy to chloroquine require further investigation. The result of present study paves a new sight in the treatment of drug induced malaria however ,large scale clinical trial is required to confirm the beneficial effect of *T.Cordifolia* extract for malaria treatment.

FUTURE SCOPE

Future studies on T. cordifolia (*Giloy)* should concentrate on determining how well it works in concert with other plants and prescription medications, pinpointing its exact mechanisms of action, and carrying out large-scale clinical trials to confirm its safety and therapeutic efficacy. Its resistance offers possibilities in agriculture to increase crop output, and its antioxidant and anti-aging qualities could be used in nutraceuticals and cosmetics. These fields are essential for developing T. cordifolia's uses across multiple industries and incorporating it into contemporary medical practices.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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