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FORMULATION AND EVALUATION OF TOPICAL NANO SILVER GEL OF *TINOSPORA CORDIFOLIA* (GUDUCHI)

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ABSTRACT

Tinospora cordifolia is one of the important medicinal plants, commonly referred as a rejuvenating herb. It has significant antimicrobial properties and that features found in stem, leaves, extract for microorganisms. *T.cordifolia* silver nanoparticles have significant antimicrobial activity, the alkaloids such as Berberine; present in the *T.cordifolia* herbal plant also gives the significant antimicrobial effects, which makes them a powerful source of antimicrobial agent. In the recent research findings, there are few topical gel formulations of AgNPs by green synthesis method and until now *T.cordifolia* silver nanoparticles incorporated in gel have not been formulated. Thus, the present research study aims to formulate and evaluate the Topical Nano silver gel of *T.cordifolia* (Guduchi) to minimize potential microbial infections. The green synthesis of silver nanoparticles was conducted by using *T. cordifolia* leaves and stem extract. The Preformulation studies were performed for the determination of presence of phytoconstituents such as alkaloids, flavonoids, glycosides etc. The characterization of *T. cordifolia* AgNPs was performed by UV spectroscopy studies, Percentage Entrapment efficiency, Fourier Transform Infrared Spectroscopy (FTIR). Particle size analysis; Zeta potential, SEM studies .The AgNPs of *T. cordifolia* and the extract was evaluated for Antimicrobial activity against *Staphylococcus aureus*& *E. coli*. The synthesized AgNPs of *T. cordifolia* was incorporated to gel base. That gel formulation evaluated for the physicochemical parameters such as pH, viscosity, spreadability, extrudability and also the antimicrobial activity against E. coli. The antimicrobial study of prepared Nano silver gel of *T. cordifolia* exhibited effective antimicrobial properties against *E. coli.* Hence; this study concluded that the formulated Nano silver gel of *T. cordifolia* can be used as an effective formulation for the treatment of antimicrobial infections.

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INTRODUCTION

Tinospora cordifolia (Family: Menispermaceae), commonly known as Guduchi. *Tinospora cordifolia*, a highly esteemed medicinal plant in Ayurveda, is renowned for its rejuvenating properties and is commonly referred to as a "rejuvenating herb".[1] The *T. cordifolia* herbal plant's antimicrobial, Anti-diabetic, antipyretic, antispasmodic, anti-inflammatory, anti-arthritic, and antioxidant, anti-allergic, anti-stress, anti-leprotic, antimalarial, hepatoprotective, immuno-modulatory, and anti-neoplastic activities are some of the potential therapeutic properties recorded by scientific research.[2,3] The chemical constituents present in *T. cordifolia* plant are contains a range of bioactive compounds, such as alkaloids, glycosides, steroids, flavonoids, and polysaccharides, Among the important active chemical constituents of *Tinospora cordifolia* are berberine, palmatine, magnoflorine, columbine, Jatrorrhizine, giloin, giloinin, tinosporaside, and cordifolioside.[4,5] Alkaloids, primarily berberine, are present in *Tinospora cordifolia's* stem and leaves as active components. Numerous pharmacological characteristics of these substances include Antimicrobial, immunomodulatory, anti-inflammatory, antioxidant, and anticancer effects. The presence of these chemical constituents in *Tinospora cordifolia* contributes to its potential therapeutic benefits. [6, 7] In the present work *T. cordifolia* extract was used as reducing agent for the green synthesis of silver nanoparticles. Many researchers given an extensive information about silver nanoparticles of *T.cordifolia* have significant antimicrobial activity, the alkaloids such as Berberine, present in the *T. cordifolia* herbal plant also gives the significant antimicrobial effects, which makes them a powerful source of antimicrobial agent[8,9]Furthermore, there has been limited exploration of the formulation and characterization of gel-incorporated silver nanoparticles and no Topical gels of Silver nanoparticles of *Tinospora cordifolia* species have been prepared. [10] The prepared silver nanoparticles cannot be directly used for the treatments of any targeted disease, Hence the present work emphasizes on the formulation characterization and evaluation of silver nanoparticles prepared by green synthesis, using *T. cordifolia* herbal extract, were incorporation of AgNPs in Carbopol gel base. This study carried out the evaluation of green synthesized nanoparticles for their characterization and also the gel incorporated of silver nanoparticles for their physicochemical evaluation parameters and antimicrobial activity. The current aim of this study was to systematically preparation of silver nanoparticles by using *T. cordifolia* plant extract by simple & eco-friendly method. These nanoparticles were incorporated into the gel base which was subsequently analysed for its physicochemical properties and antimicrobial activity. Additionally, the study evaluated the Nano silver gel of *T. cordifolia's* effectiveness in combating microbial activity.

METHODOLOGY

Materials:

Tinospora cordifolia was collected from the Botanical garden (Pune, India) and authenticated at, Botanical Survey of India, Western Regional centre,7,Koregaon Park ,Pune-411001, Silver nitrate was obtained from Research lab ,Mumbai. Nutrija Life sciences Pvt.Ltd. Provided BerberineHCl.Both Carbopol 940 and glycerol were purchased from Research Lab Fine Chem Industries in Mumbai. All of the chemical reagents used were analytical-grade materials, and all other compounds were pharmaceutical-grade.

Preparation of *T. cordifolia* Aqueous extract:

The leaves and stem of *Tinospora cordifolia* plant were dried and milled into powder with blender. Extraction done by using Soxhlet apparatus with Distilled water and the filtrate was collected. 10-12 gm. of *T. cordifolia* leaf and stem powder was weighed and mixed with distilled water in a clean RBF flask attached to Soxhlet apparatus, and then this extract was heated by using Heating mantle for 2 hours. Whatman filter paper No. 1 was used to filter the extract. After the extraction, filtrate was taken out and stored at 4ºC for further use. [9, 10, 11]

Synthesis of Silver nanoparticles:

For the synthesis of silver nanoparticles The 10 ml of aqueous extract of *T. cordifolia* was added to the 90 ml of 1Mm $AgNO_3$. The solution was heated at 80^0C for 20 minutes with stirring for half an hour.

During the reduction of silver nitrate, a change in colour was observed. The colour was initially yellowish orange before it was transformed into reddish brown, indicating the development of AgNPs. [10, 12, 13]

Characterization of Silver nanoparticles:

UV Visible spectroscopy studies-

UV-Visible spectral analysis is used to determine the formation and completion of *T. cordifolia* silver nanoparticles. The reduction of silver ions is observed by measuring the UV-Visible spectrum of the reaction medium in the range of 400-800 nm, with distilled water used as a reference by using UV-visible spectrophotometer (Jasco Corporation UV V-360).[14]

% Entrapment efficiency –

The entrapment efficiency (EE, % w/w) was calculated using the centrifugation method. An accurately weighed of 0.5g of freshly prepared *T. cordifolia* silver nanoparticles was taken and diluted with distilled water. The mixture was then subjected to centrifugation at 4000 rpm and 25°C for 20 minutes**.** After centrifugation, the supernatant was taken out and subjected to spectrophotometric analysis. At 422 nm, absorbance readings were taken. [15]

The % EE was calculated by following equation-

$$\%EE = \frac{\text{(Actual weight of drug-weight of unbound drug)}}{\text{(Actual weight of drug)}} \times 100\%$$

The Results are presented in the Table 3, for the % Entrapment efficiency.

Fourier Transform Infrared Spectroscopy (FTIR) Studies-

Samples of dried silver nanoparticles from *T. cordifolia*, weighing about 100mg, together with 100 mg of higher quality KBr, were mixed and hydraulically crushed into discs. Within the 4000-400 cm-1 region, FTIR spectra were collected. The FTIR studies were performed in order to determine the biomolecules in charge of stabilizing and capping the synthesized metal nanoparticles. [16]The results are depicted in the Figure 2 and Table 4 for the FTIR studies of AgNPs.

Particle size analysis-

Particle size analysis and Polydispersity index were determined for the green synthesized silver nanoparticles using a Malvern Particle size analyzer.This analyser allowed for the study of particle size, their range, and the degree of distribution. To perform the analysis, the colloidal solution was diluted 10-fold with Millipore water. The diluted solution was then utilized for the measurement. The particle size was determined based on the scattering of laser light by the particles, and the angular intensity of the scattered light was measured using a series of photosensitive detectors. The resulting map of scattering intensity versus angle provided the primary data used to calculate the particle size. [17] The Figure 3 shows the obtained results about particle size analysis and polydispersity index of *T. cordifolia* AgNPs.

Zeta potential Measurement-

Zeta Potential plays a vital role in assessing the surface charge and stability of colloidal dispersions. In the case of *T. cordifolia* AgNPs, the zeta potential was determined using the Malvern zetasaizer instrument. For the analysis, a 1 ml sample of *T. cordifolia* suspension was carefully filled into a transparent disposable zeta cell, ensuring there were no air bubbles present. The system was then set to a temperature of 25°C, and the test could be conducted. [18] The Results are presented in the Figure 4.

SEM Analysis-

The particle size of the *T. cordifolia* nanoparticles (AgNPs) was observed and captured using a scanning electron microscope (SEM).The colloidal solution of AgNPs was diluted and placed on a glass slide with a diameter of 20x20mm. The slide was then attached to an aluminium stub using double-sided carbon tape. The solution was allowed to slowly evaporate at room temperature. Once completely dried, the sample was coated with a layer of gold using a sputter coating unit under a vacuum of 10 Pascal for 10 seconds, achieving a thickness of 100A°. The SEM mode was used to capture the image of the sample at the desired magnification. [17] The Figure 5 depicted the results for the SEM studies of *T.cordifolia* AgNPs.

Antimicrobial study of *T.cordifolia* AgNPs and Extract

The agar well diffusion method was used to evaluate the antibacterial activity of the test samples against *Staphylococcus aureus* and *Escherichia coli.* Muller Hinton agar (medium) dissolved in distilled water and sterilized in an autoclave for 15min at 121°C at 15psi and then cooled at room temperature. Agar medium was poured into petri-plates and allowed to cool at room temperature until it gets solidifies. The agar plates are inoculated with standardized inoculum of *Staphylococcus aureus* and *Escherichia coli*. Aseptically holes were made on the surface of solidified media with the help of sterile corn borer of 8mm diameter and to it 100µl of sample was inoculated by micropipette using sterile tips. Plates were kept in Room Temperature for diffusion of sample for 30 min. The plates were incubated at 37 °C and examined after 24 h for the zone of inhibition, around the well. [19, 20, 21] The Figure 6 and Table 5 indicate the zone of inhibition of *T. cordifolia* extract and AgNPs against *Staphylococcus aureus* and *Escherichia coli* bacterial stain.

Formulation of gel incorporated with silver nanoparticles-

The gel formulation was made by combining an appropriate base powder Carbopol 940 with water and stirring with a magnetic stirrer at a speed of about 500 rpm for an entire night. In the pure base dispersion, silver nanoparticles were added. The pH was further adjusted to skin pH by adding NaOH as a neutralizer. A homogenizer was used to gently swirl the mixture during neutralization until a homogenous gel was formed.

Table 1 Composition of gel incorporated with *T. cordifolia* silver nanoparticles.

INGREDIENTS	FORMULATIONS								
	F1	F2	F3	F4	F5	F6	F7	F8	F9
Carbopol 940 (gms)	1.5	2	2.5	1.5	2	2.5	1.5	2	2.5
Glycerol(ml)	0.5	0.5	0.5	1	1	1	1.5	1.5	1.5
T. cordifolia AgNPs (mg)	3	3	3	3	3	3	3	3	3
NaOH q.s.(ml)	2	2	2	2	2	2	2	2	2
Distilled Water (ml)	100	100	100	100	100	100	100	100	100

EVALUATION PARAMETERS OF GEL FORMULATION:

Physical evaluation:

Physical characteristics like colour, appearance, and consistency were visually examined. The colours of several gel formulations were found to be a translucent white appearance and to be smooth on application**.**

pH Measurement:

A digital pH meter that had been calibrated and was used at a steady temperature was used to measure the formulation's aqueous solution (1%). The pH of F1 to F9 gel samples was measured using a digital pH meter. One gram of gel was dissolved in 100 ml of distilled water and allowed to sit for two hours. The pH measurement for each formulation was performed three times, and the average values were calculated [22].

Homogeneity–

All of the formed gels were visually examined for homogeneity after being set in the container. They were evaluated for the presence of any aggregates and for their appearance by visual inspection. [23]

Viscosity-

The viscosity of the formulated gels was measured at room temperature using a Brookfield Viscometer (Model CAP 2000+) with spindle no 1. The measurement was conducted at a speed of 5 rpm. Viscosity measurements were taken three times in triplicate**.** Every measurement was obtained once the sample reached equilibrium at the conclusion of a 2-minute period. [24]

Washability Measurement-

The formulated gels had been applied to the skin, after that its effectiveness during water washing was evaluated. [24]

Extrudability-

In this study, extrudability was evaluated by determining the weight (in grams) required to extrude at least 0.5 cm of gel from a collapsible tube made of lacquered aluminium in 10 seconds. After that, the extrudability was calculated using the formula below**.** [25]

$$\textbf{Extrudability} = \frac{\textbf{Applied weight to extrude gel from tube (in gram)}}{\textbf{Area (in cm2)}}$$

Spreadability Measurement-

A 300mg gel preparation was placed on a glass plate measuring 10cm in diameter. Another plate of the same size was then dropped from a distance of 5cm onto the gel. After duration of 1 minute, the diameter of the resulting spread circle was measured. Each formulation checked for its spreadability. [26]

% Drug content–

For each formulation, 1 gram was placed into a 50 ml volumetric flask and then filled to the mark with phosphate buffer at pH 6.8. The mixture was thoroughly stirred to dissolve the active ingredients in distilled water. After a period of 2 hours, the solution was filtered through Whatman filter paper. A volume of 0.1 ml from the filtrate was pipetted out and diluted to 10 ml with phosphate buffer at pH 6.8. The concentration of active constituents was determined using spectrophotometry by referencing a standard curve constructed at a wavelength of 446 nm. [26]

Antimicrobial Activity of gel formulation:

The agar well diffusion method was used to evaluate the antimicrobial activity of the gel incorporated with *T.cordifolia* AgNPs against *Escherichia coli.* Muller Hinton agar (medium) dissolved in distilled water and sterilized in an autoclave for 15min at 121°C at 15psi and then cooled at room temperature. Agar medium was poured into petri-plates and allowed to cool at room temperature until it gets solidifies. The agar plates are inoculated with standardized inoculum of *Escherichia coli*. Aseptically holes were made on the surface of solidified media with the help of sterile corn borer of 8mm diameter and to it 100µl of AgNP gel sample, 100µl of plain gel base and 15 µl of marketed preparation was inoculated by micropipette using sterile tips. Plates were kept in Room Temperature for diffusion of sample for 30 min. The plates were incubated at 37 °C and examined after 24 h for the zone of inhibition, around the well. [27]

RESULTS

Evaluation of Plant extract:

Phytochemical analysis-

The presence of phytochemical constituents in *Tinospora cordifolia* extracts was determined through chemical tests for qualitative analysis. The following procedures were followed, and the outcomes of these tests were documented.

Table 2 Phytochemical analysis for *T. cordifolia* aqueous extract.

Sr no	Phytoconstituents of Aqueous extract	Results
1.	Alkaloid	++++
2.	Flavonoid	+
3.	Carbohydrates	+
4.	Glycoside	++
5.	Protein and Amino Acid	++
6.	Tannins	-
7.	Saponins	+

Characterization of *T.cordifolia* AgNPs:

UV Visible spectroscopy studies:

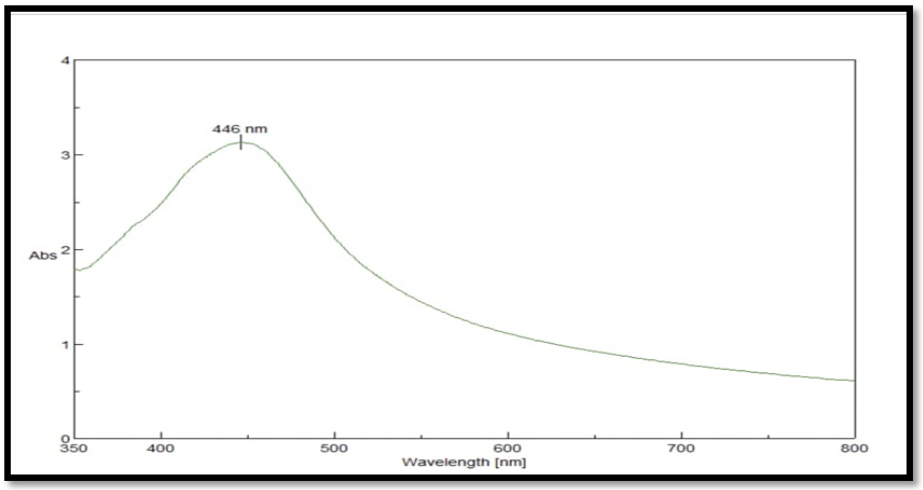


Figure 1 UV visible spectroscopy of *T. cordifolia* AgNPs.

% Entrapment efficiency:

Table 3 Percentage entrapment efficiency of *T. cordifolia* AgNPS.

Sr no	Formulation	% EE in w/w
1.	*T. cordifolia* AgNPs	75.69%±2

Fourier Transform Infrared Spectroscopy (FTIR) Studies-

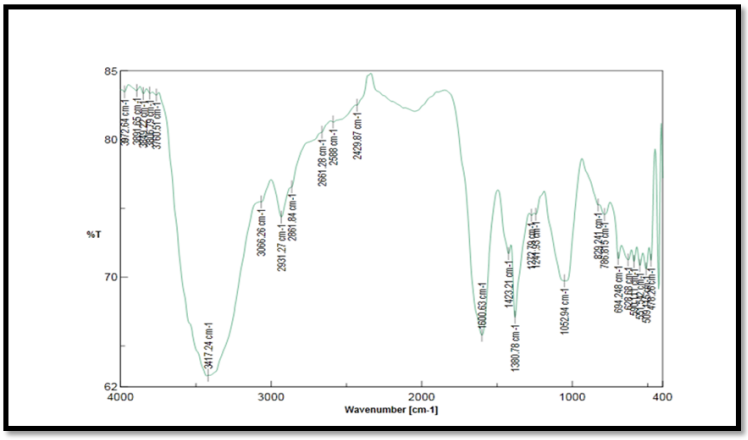


Figure 2 FTIR of *T. cordifolia* AgNPs.

Table 4 FTIR Interpretation of *T. cordifolia* Silver nanoparticles.

Wavenumber	Interpretation
3417.24	O-H Bond
3066.26 cm-1	C-H stretching alkyenes
2931.27 cm-1	C-H Stretching in alkanes
2861.84 cm-1	C-H Bond
1600.63 cm-1	C=C
1423.21 cm -1	(N-H)
1330.78 cm-1	NO2
1241.33 cm-1	C-O
1062.94 cm-1	C-N
829.24 cm-1	C-H Bend
766.81 cm-1	C-Br
694.55cm-1 to 575.01	OH-CH, C=O, C-O

Particle size analysis-

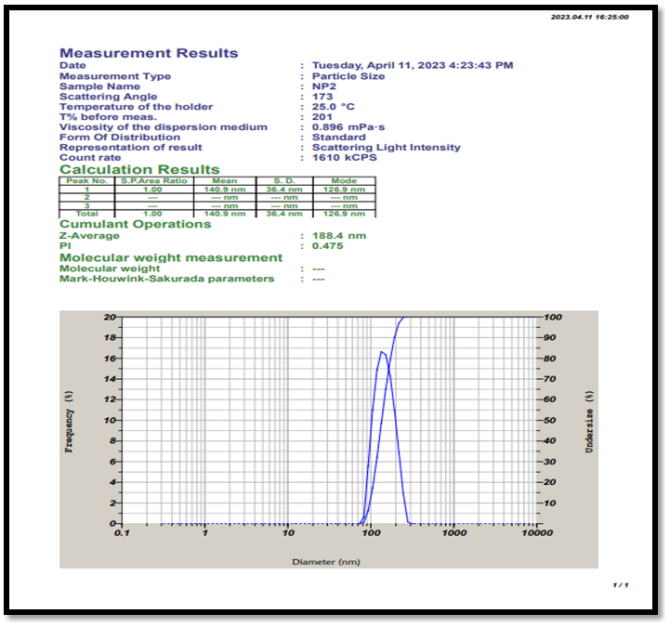


Figure 3 Particle size and Polydispersity index of *T. cordifolia* silver nanoparticles.

Zeta potential analysis-

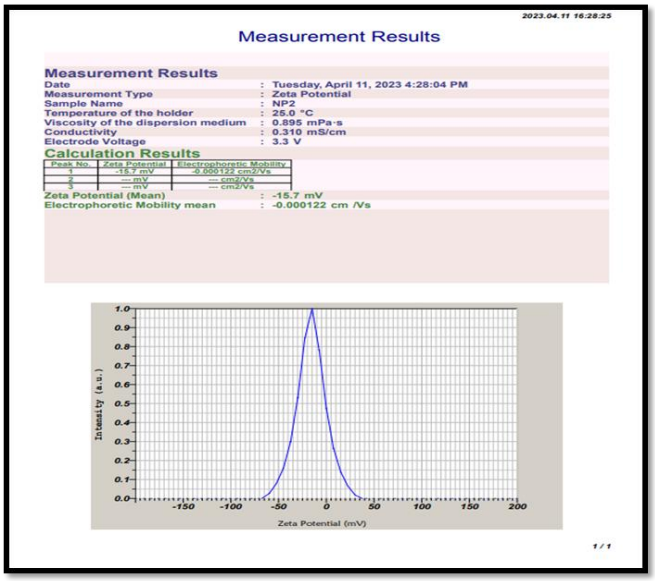


Figure 4- Zeta potential of *T. cordifolia* silver nanoparticles.

SEM Study-

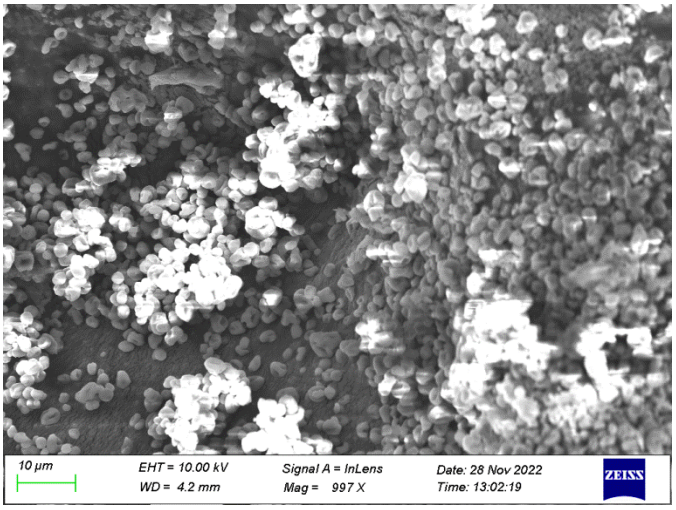
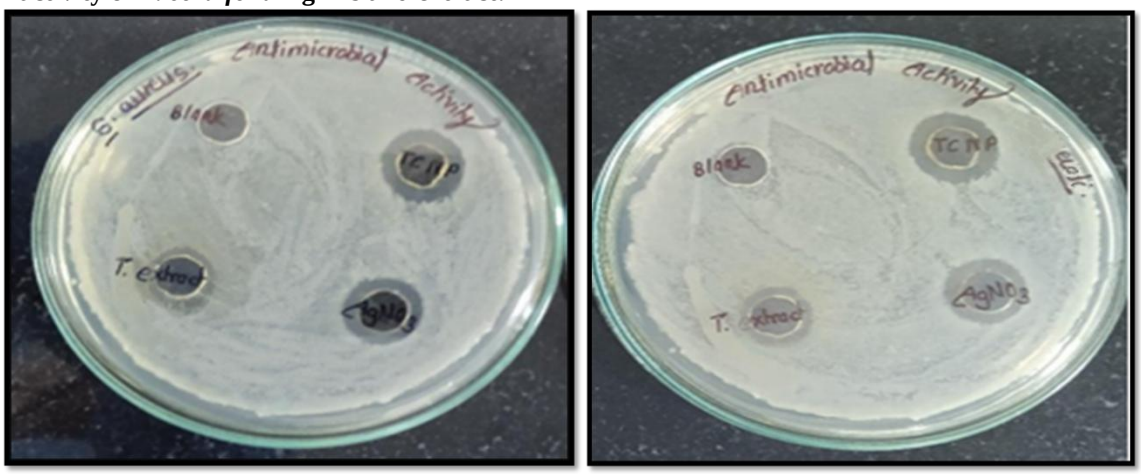


Figure 5 SEM Study of *T. cordifolia* AgNPs

Antimicrobial activity of *T. cordifolia* AgNPs and extract:



a) **b)**

Figure 6- Zone of inhibition of Test sample against a) *Staphylococcus aureus b) E. coli.*

Table 5- Zone of Inhibition of *Staphylococcus aureus* and *Escherichia coli.*

Sample No.	Sample Name	*Staphylococcusaureus*	*Escherichia coli*
1	Blank	No zone of Inhibition	No zone of Inhibition
2	T extract	8mm	7mm
3	$AgNO_3$	12mm	13mm
4	TCNP(AgNP SolutionTC)	14mm	14mm

Evaluation of Gel incorporated with *T. cordifolia* AgNPs:
Physical description:

Table 6 Physical Description of Gel.

Characterization	Description for gel
Colour	White
Appearance	Smooth and translucent
Odour	Odourless

Physiochemical Properties:

For various physiochemical evaluation all the formulation were subjected. The result of homogeneity, viscosity, washability, extrudability, spreadability, and drug content are shown as Table 7 and Table 8.

Table 7 Results of Evaluation of gel Batch F1 to F5.

Evaluation	FORMULATIONS				
	F1	F2	F3	F4	F5
pH	5.8	5.2	5.4	5.1	5.7
*Homogeneity	Homogenous	Homogenous	Homogenous	Homogenous	Homogenous
Viscosity (Cp)	10082	9562	9272	11912	12085
Washability	Good	Good	Good	Good	Good
Extrudability(gm/cm^2)	11.3	12.2	12.8	13.2	9.4
Spreadability(cm)	3.7	3.1	3.8	3.4	4.2
Drug content (%)	88.80	89.50	87.23	86.50	90.24

*n=3 Average of three determinations

Table 8 Results of Evaluation of gel BatchF6 to F9.

Evaluation	FORMULATIONS			
	F6	F7	F8	F9
pH	5.3	5.5	5.7	5.6
* Homogeneity	Homogenous	Homogenous	Homogenous	Homogenous
Viscosity (Cp)	12195	13084	13343	12081
Washability	Good	Good	Good	Good
Extrudability(gm/cm^2)	13.6	14.9	14.7	14.2
Spreadability(cm)	2.6	2.9	3.2	2.5
Drug content (%)	85.30	85.29	83.19	82.36

*n=3 Average of three determinations.

Antimicrobial Activity of gel

Table 9 Antimicrobial activity of gel incorporated *T.cordifolia* AgNPs.

Sample No.	Sample Name	*Escherichia coli* Zone of inhibition(mm)
1	Gel base	No zone of Inhibition
2	Standard	7mm
3	Gel incorporated with *T.cordifolia* AgNPs	6mm

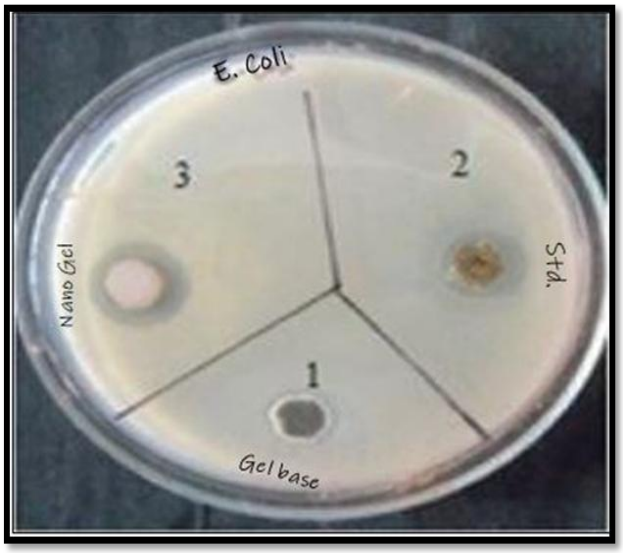


Figure 7- Antibacterial activity of gel formulation against *E. coli.*

DISCUSSION

Phytoconstituents analysis of *T.cordifolia* extract:

The presence of phytochemical constituents in *Tinospora cordifolia* extracts was determined through chemical tests for qualitative analysis. The sample of *Tinospora cordifolia stems* and leaves parts aqueous extract underwent a series of chemical tests to determine whether alkaloids, tannins, glycosides, flavonoids, proteins, and saponins were present. Results are shown in the subsequent Table -2.

UV visible spectroscopy:

For the purpose of analysing the formation and completion of silver nanoparticles, a UV-visible spectrophotometer is used. Using pure water as a reference, the UV-Visible spectrum of the reaction mixture in the wavelength range of 200-800 nm is measured in order to monitor the reduction of silver ions. A change in colour from yellow to brown indicates the conversion of Ag+ to Ago, which is aided by the active biomolecules included in the *T. cordifolia* extract. A Plasmon absorption band in the visible spectrum is present in silver nanoparticles as a result of the electrons' collective oscillations in resonance with light waves. Free electrons in these metal nanoparticles contribute to the surface Plasmon resonance absorption band. When it comes to silver nanoparticles, their UV-visible absorption is commonly seen between 380-450nm. The absorption bands of *T. cordifolia* silver nanoparticles were specifically observed around 446 nm in aqueous solvent which is showed in fig 1.

% Entrapment efficiency:

% Entrapment efficiency of *T. cordifolia* silver nanoparticle was found to be 75.69% that indicates that the amount of active ingredients that is successfully entrapped The *T. cordifolia* silver nanoparticles evaluated for % entrapment efficiency, as mentioned in the following Table -3.

FTIR Analysis:

FTIR spectroscopy was utilized to determine the biomolecules accountable for the encapsulation and stability of the synthesized *T. cordifolia* silver nanoparticles. The IR spectrum of the nanoparticles derived from *T. cordifolia* exhibited the following interpretations indicated in Table no 4.

Particle size analysis:

The particle size is one of the most important parameters for characterization nanoparticles. The average particle size of *Tinospora cordifolia* silver nanoparticle was found to be 140.9 nm to 188.4 nm. The particle size analysis showed the presence of nanoparticle with Polydispersity index value 0.475. The result obtained was 0.475 for the green synthesized nanoparticle which is within the range from 0-1.Value 0 signifies monodisperse and 1 signifies polydisperse. Thus the obtained result signifies that the synthesized AgNPs were present in monodisperse phase. Percentage intensity of particle size distribution of biosynthesized *Tinospora cordifolia* silver nanoparticles were depicted in the Fig 3.

Zeta potential analysis:

The zeta potential measurement is an important parameter for assessing the stability of silver nanoparticles synthesized from *Tinospora cordifolia*. The zeta potential of the *Tinospora cordifolia* silver nanoparticles was determined to be -15.7 mV, with a peak area showing 100%.These values indicate that the nanoparticles are effectively stabilized.

SEM Study:

Tinospora cordifolia silver nanoparticles that have been synthesized are found to have a distinct and spherical shape after analysis was done to evaluate their morphology.

Antimicrobial activity of *T. cordifolia* AgNPs and extract:

The antimicrobial study of the provided test sample was carried out by agar well diffusion method. The provided test sample was observed for zone of inhibition. The test sample ($AgNO_3$, TCNP (AgNP Solution of TC) and T extract)) have shown a positive zone of inhibition against the tested bacteria *Staphylococcus aureus and Escherichia coli.* The results depicted in table no-5 and fig no 6.

Physiochemical properties:

The detailed results for the evaluation of physiochemical properties are shown in Table 7 and Table 8. The discussion about the evaluation tests carried are discussed below.

Physical evaluation:

Visual Examination of the completed gel formulations indicated that they were all very homogeneous and well-looking smooth translucent and odourless.

pH Measurement:

The pH range of the gel formulations was found between 5.1 and 5.8, which is similar to the pH range of the skin and would not irritate the skin.

Homogeneity:
The Homogeneity of all prepared batches was evaluated and found to be homogenous.

Viscosity:
For all the formulation batches the viscosity was found to be in the range of 9272 Cp to 13343Cp.

Washability Measurement:
For all the formulation batches evaluated for washability, gel containing *T. cordifolia* silver nanoparticles, a little amount of it was applied to the hand and then washed off with warm water and no soap. Each of the nine formulations was simple to wash.

Extrudability:
Evaluating extrudability is important for determining exactly how simple it will be to remove and apply the formulation product. The extrudability of all formulation batches was found to be in the range 9.4-14.9 gm/cm^2.

Spreadability Measurement:
All formulations were evaluated for its spreadability and were found to be in the range of 2.6-4.2 cm.

% Drug Content:
The drug content of all prepared batches found to be in the range between 82.36 to 90.24%. This shows a near uniform drug content was noted for the similarity in all prepared batches.

Antimicrobial Activity of gel:
The anti-microbial activity of gel incorporated with silver nanoparticles of *T. cordifolia*, gel base and standard (Marketed gel) was evaluated by measuring the zone of inhibition against bacterial strain (*Escherichia coli*ATCC-8739) via agar well diffusion method. Result of antimicrobial test was found that gel incorporated with *T. cordifolia* silver nanoparticles most effective against bacteria when compared with the marketed antimicrobial gel preparation as standard. Maximum antimicrobial activity found to be against *E coli* is 6mm.

SUMMARY
In conclusion, this research paper aimed to formulate and evaluate topical silver Nano gel of *Tinospora cordifolia* for its antimicrobial activity. The formulation process involved preparation of *T. cordifolia* aqueous extract then the green synthesis of silver nanoparticles by using the same extract, after that the incorporation of *T. cordifolia* AgNPs into the gel base.. Various parameters such as determination of phytoconstituents , characterization of prepared AgNPs of *T. cordifolia* by Uv spectroscopy, % entrapment efficiency , FTIR,SEM, Zeta potential, particle size analysis , antimicrobial activity of AgNPs and extract against *Staphylococcus aureus and Escherichia coli* bacterial strains and physicochemical parameters of gel formulation , antimicrobial activity against *Escherichia coli* were evaluated. The results of the evaluation tests indicated that the formulated AgNPs exhibited desirable characteristics; including UV spectroscopy which showed maximum absorption peak at 446nm indicating preparation of AgNPs. FTIR measurements were conducted on *Tinospora cordifolia* silver nanoparticles to identify the biomolecules responsible for capping and stabilizing the synthesized metal nanoparticles. It was determined that hydroxyl and carboxyl groups serve as reducing and stabilizing agents. The particle size of the nanoparticles was analysed using a Particle Size analyser, revealing an average size ranging from 140.9 to 188.4 nm. Zeta potential measurements were performed for the *T.cordifolia* nanoparticles and that value were found -15.7mV with a peak area of 100% intensity, indicating the successful stabilization of the silver nanoparticles.SEM analysis was performed to examine the morphology of the synthesized *T. cordifolia* silver nanoparticles, revealing that they exhibit a discrete and spherical shape. In vitro antimicrobial activity assessments were conducted on both the *Tinospora cordifolia* aqueous extract and AgNPs the herbal aqueous extract and *T. cordifolia* silver nanoparticles both exhibited activity against Gram-positive organisms and gram negative organism. All nine formulations were evaluated for pH, spreadability coefficient, extrudability, drug content, Viscosity, Washability and results found satisfactory. Furthermore, the antimicrobial activity of the gel incorporated with silver nanoparticles of *T. cordifolia* was assessed against *Escherichia coli*. The prepared gel demonstrated potent antimicrobial effects, inhibiting the growth of *Escherichia coli* effectively. These findings suggest that the Nano silver gel of *T. cordifolia* could serve as an effective and convenient dosage form treating microbial infections. Overall, this research highlights the potential of topical silver Nano gel of *T. cordifolia* as a novel therapeutic approach to minimize potential microbial infection. The results obtained the applicability of Topical gel containing *Tinospora cordifolia* silver Nanoparticles as Antimicrobial agents.

CONCLUSION
It can be concluded that the Gel incorporated with silver nanoparticles of *Tinospora cordifolia* was formulated and evaluated for its Anti-microbial effect and the prepared silver nanoparticle incorporated gel was found to be effective. The formulation and evaluation processes have provided valuable insights into the development of novel Topical silver Nano gel of *T. cordifolia* for antimicrobial applications. The future prospects could be use of this *T. cordifolia* Nano silver gel formulation for the wound healing and also as anti-inflammatory.

Conflict of Interest:
There are no conflicts of interest.

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ABBREVIATIONS

AgNPs	Silver Nanoparticles
T. C	*Tinospora cordifolia*
TCNP-	*Tinosporacordifolia*nanoparticles
Cp-	Centipoise
%EE-	% Entrapment efficiency
SEM-	Scanning electron microscopy
UV-	Ultraviolet
FTIR-	Fourier transform infrared
mg-	milligram
ml-	millilitre
µl-	microliter
µg-	microgram
µm-	micrometre
kg-	kilogram
cm-	centimetre
°C-	degree Celsius

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