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EVALUATING A NOVEL PHYTO-THERAPEUTIC ANTI-BACTERIAL GEL

Patel Riddhiben Ashokkumar[1]*, Chaudhari Archi Maneshkumar[2], Ms. Vaishali Pardhe[3]

*[1,2]Students, B. Pharmacy College Rampura, Kakanpur.

[3]Assistant Professor B. Pharmacy College Rampura, Kakanpur.

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***Corresponding Author**

Patel Riddhiben Ashokkumar

Students, B. Pharmacy College Rampura, Kakanpur.

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ABSTRACT

This study focuses on the formulation and evaluation of a plant-based phyto-therapeutic antibacterial gel using an herbal drug delivery system. Herbal formulations have gained increasing attention because of their safety, biocompatibility, and reduced side effects compared to synthetic agents. Topical formulations are particularly important because they provide localized drug action, improve patient compliance, and minimize systemic exposure. The skin acts as a protective barrier; however, appropriate formulation strategies can enhance drug permeation across the stratum corneum. In this study, a phyto-therapeutic gel was developed using the ethanol extract of Calotropis gigantea flowers as the active pharmaceutical ingredient (API), known for its antimicrobial properties. The gel dosage form offers advantages such as ease of application, non-greasiness, and better patient acceptability. The formulation was evaluated for its antibacterial activity against common bacterial skin infections such as folliculitis, furuncle, and carbuncle, primarily caused by Staphylococcus aureus and Pseudomonas aeruginosa. Antimicrobial efficacy was assessed using the zone of inhibition method. The formulated gel exhibited a zone of inhibition measuring 12 mm against the gram- negative bacterium Pseudomonas aeruginosa and 20 mm against the gram-positive bacterium Staphylococcus aureus, indicating significant antibacterial activity. These results suggest that the developed phytotherapeutic gel is a promising topical formulation for the management of bacterial skin infections, combining the benefits of herbal medicine with effective drug delivery.

KEYWORDS: Phytotherapeutic gel; Calotropis gigantea; Antibacterial activity; Carbopol 940; Topical drug delivery; Staphylococcus aureus; Pseudomonas aeruginosa.

INTRODUCTION

- **Background**

In recent years, there has been a significant shift toward the use of herbal drug delivery systems because of their improved safety, efficacy, and patient compliance. Medicinal plants have been used for centuries in traditional systems, such as Ayurveda, Siddha, and Unani, and continue to play a vital role in modern therapeutics. Herbal drugs are rich in bioactive constituents, such as flavonoids, alkaloids, glycosides, and phenolic compounds, which exhibit diverse pharmacological activities, including antimicrobial, anti-inflammatory, antioxidant, and wound healing properties. Compared to synthetic drugs, herbal formulations are considered safer, cost-effective, and associated with fewer side effects.

The incorporation of herbal actives into modern dosage forms has led to the development of novel drug delivery systems that enhance therapeutic efficacy and patient acceptability. Topical drug delivery systems have gained considerable attention for the treating dermatological disorders, particularly bacterial skin infections.

- **Herbal Drug Delivery System**

Herbal drug delivery systems refer to formulation approaches that incorporate plant-derived active constituents into suitable carriers to improve stability, bioavailability, and therapeutic performance. These systems combine traditional knowledge with modern pharmaceutical methods. Herbal formulations are advantageous due to their lower toxicity, biocompatibility, cost-effectiveness, and synergistic action of multiple phytoconstituents. The global acceptance of herbal medicines highlights their importance in modern healthcare.

- **Importance of Topical Drug Delivery**

Topical drug delivery systems are widely used for the localized treatment of skin diseases. They deliver drugs directly to the site of action, thereby reducing systemic absorption and minimizing adverse effects. This route is particularly beneficial for treating infections, inflammation, and wounds. Topical formulations, such as gels, creams, and ointments, are commonly used, with gels being preferred because of their non-greasy nature, ease of application, better spreadablity, and enhanced drug release.

- **Skin Structure and Drug Permeation**

The skin is the largest organ in the human body and acts as a protective barrier against environmental hazards. It consists of three main layers: the epidermis, dermis, and hypodermis(subcutaneous tissue). The outermost layer of the epidermis, the stratum corneum, is the primary barrier to drug permeation. It is composed of dead keratinized cells embedded in a lipid matrix; that restricts the penetration of most drugs.

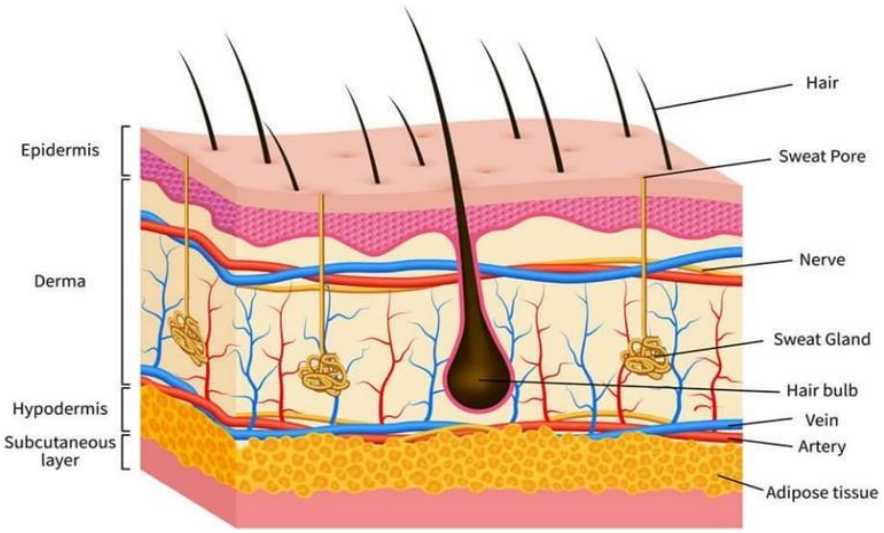


Fig. 1: Skin anatomy.

Drug permeation through the skin is influenced by several factors, including molecular size, lipophilicity, skin hydration, and concentration gradient. Smaller and more lipophilic molecules tend to penetrate the skin more easily. The use of penetration enhancers, such as ethanol, can disrupt the lipid structure of the stratum corneum and improve drug absorption.

- **Phyto-therapeutic Gel**

Phyto-therapeutic gels are semi-solid dosage forms that incorporate plant extracts as active ingredients. These gels combine the advantages of herbal medicines with modern pharmaceutical technologies. They are widely used in dermatology because of their ability to deliver drugs effectively at the site of action while ensuring better patient compliance and minimal side effects.

- **Gel Formulation**

Gels are semi-solid systems consisting of a three-dimensional network of polymers that entraps a liquid phase. They are transparent, non-greasy, and easily spreadable, making them highly suitable for topical applications. Common ingredients used in gel formulation include Carbopol

940 as a gelling agent, ethanol as a solvent and penetration enhancer, glycerin as a humectant, triethanolamine as a neutralizer, methyl paraben as a preservative, and distilled water as a vehicle. These components work together to provide stability, consistency, and effective drug delivery.

Fig. 2: Gel formulation.

- **Common Bacterial Skin Infections**

Skin infections are commonly caused by bacteria, such as Staphylococcus aureus and Pseudomonas aeruginosa. These infections can range from mild to severe and often occur when the skin barrier is compromised.

- **Infections caused by *staphylococcous aureus* and *pseudomonas aeuginosa* ….:-**

› **FOLLICULITIS**

Folliculitis is a common skin condition that happens when hair follicles become inflamed. It is often caused by bacteria infection.

At first, it may look like small pimples around the tiny pockets from where each hair grows (hair follicles).

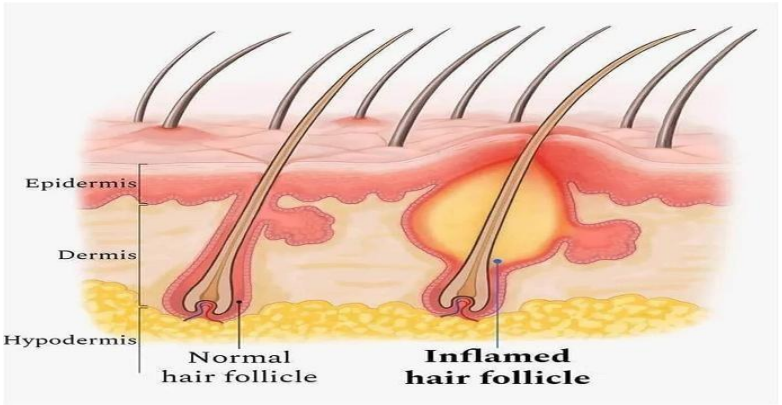


Fig. 3: Folliculitis.

The condition can be itchy, sore, and embarrassing. The infection can spread and develop into crusty sores.

Symptoms

The signs and symptoms of Folliculitis include:

› Clusters of small bumps or pimples around hair follicles

› Pus-filled blisters that break open and crust over

› Itchy, burning skin

› Painful, tender skin

› An inflamed bump

Bacterial folliculitis

This common characterized by itchy, pus-filled bumps.

It occurs when hair follicles become infected with bacteria, usually Staphylococcus aureus. Staphylococcal bacteria are constantly present on the skin.

And they can cause problems when they enter the body through a cut or other wound.

› **FURUNCLE**

A furuncle, or boil, is a deep infection of the hair follicle. It goes through the dermis into the subcutaneous tissue, creating a small abscess.

It looks like a painful, swollen nodule around a hair follicle.

Furuncles can pop up anywhere but are more common in sweaty, friction-prone areas. They show up as red, swollen, and filled with pus.

› **CARBUNCLE**

A carbuncle is a bigger, more serious infection.

It involves multiple hair follicles and is like a bunch of furuncles together. It’s a big, painful lump under the skin with many pus drainage points.

Carbuncles are rarer but more serious than furuncles.

They can cause a lot of pain and problems if not treated right.

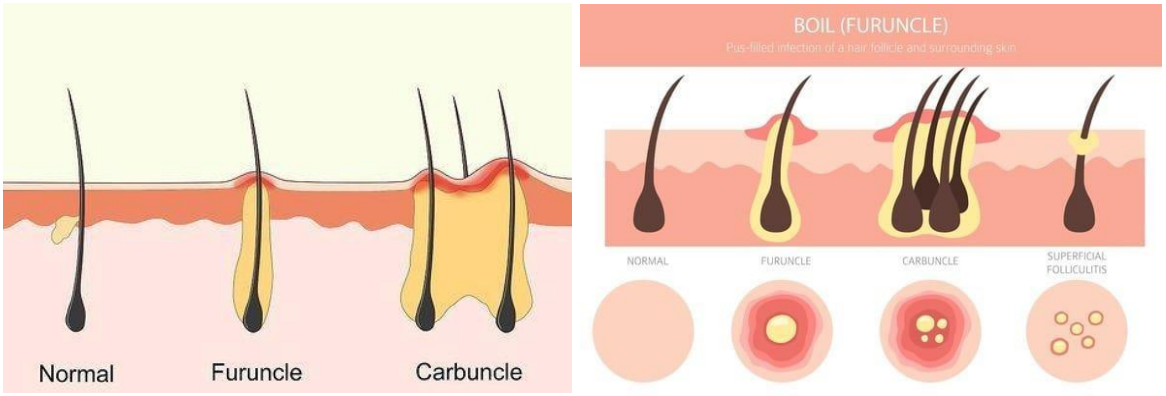


Fig. 4:- Furuncle, Carbuncle.

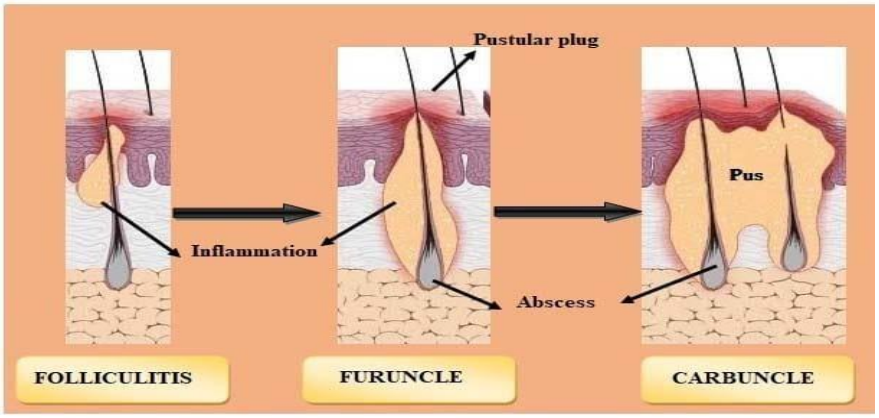


Fig. 5: Folliculitis, Furuncle, Carbuncle.

- **PLANT PROFILE**

› INTRODUCTION TO *CALOTROPIS GIGANTEA LINN*

Calotropis Gigentea is a well-known medicinal herb commonly known as has been used in Unani, Ayurveda, and Siddha system of medicine for years.

Fig. 6: Calotropis Gigantea Linn.

Apocynaceae Juss. Commonly called as the dogbane family, comprises 357 genera and about 5100 species of flowering plants including herbaceous or shrubby climbers.

Calotropis is a succulent and xerophytic shrub or small laticiferous tree up to 2.5 m, commonly known a "milkweed" or "Crown flower" The stem usually simple and branched at the base, woody covered with a corky bark, leaves simple, opposite, sub- sessile, white and purple-coloured flowers and not scented.

Inflorescence is a dense, multiflowered, umbellate cyme, highly cross-pollinated through insects such as monarch butterflies, simple, follicle fruit. Following figure shows the purple and white coloured flowers and follicle fruit of Calotropis found in Sri Lanka. Calotropis species are most diverse in tropical and subtropical parts of Asia and South East Asia (Bangladesh, Cambodia, Burma, China, India, Indonesia, Malaysia, Pakistan, Philippines, Sri Lanka and Thailand) and extend into temperate areas. Calotropis is a versatile tree used for different purposes Calotropis Gigentea species are evergreen perennial shrub reaching 2.4-3 m high; bark yellowish white, furrowed, rough, corky; branches stout, terete, less or more covered with fine appraised cottony pubescence. Leaves are opposite-decussate, sessile, elliptic oblong or obviate-oblong, acute, thick and pale in green, clothed beneath and less or more above with fine cottony tomentum, about 10-20 by 3.8-10 cm, base narrow, chordate.

Flowers are regular, bisexual, purple or light greenish yellow with faint Odor, 3.8-5 cm dia. In umbellate lateral cymes; periodicals are much longer than the flowers, the, pedicels are overspread with cottony wool, buds ovoid, calyx divided to the base, consist 5 white sepals 4mm, ovate, acute, cottony, corolla 2 cm long, lobes of the corona 1.3cm long, broadly in 5mm at the middle, smaller than the column, slightly thickened margin, the apex rounded with two obtuse auricles just below it. Follicles are 9-10 cm in length, wide, abundant, plump ventricose, green. Green colour spongy fruits consist of light brown seeds 6 x 5 mm. Ovate, flattened, arrow margined, minutely tomentose, brown; coma 2.5-3.2 cm long and the hairs at the one end. The roots are deep plump taproot with less lateral roots near surface.

Tab. 1: Plant Profile Taxonomical.

SCIENTIFIC CLASSIFICATION	
KINGDOM	PLANTAE
ORDOR	GENTIANALES
FAMILY	APOCYNACEAE
SUBFAMILY	ASCLEPIADACEAE

GENUS	**CALOTROPIS**
SPECIES	**C. GIGANTEA**

Tab. 2: Vernacular Names.

ENGLISH	**AAK,MADAR,SHIVE, SWETA AAK**
HINDI	MILKWEED, CROWN FLOWER
FRENCH	MERCURE VEGETAL
SANSKRIT	RAK

Geographical Sources: India, China, Bangladesh, Pakistan, Sri Lanka

Part used of plant: Root, Leaves, Stem, Bark

Phytochemical Constituents: Sterols, Resin, Alkaloids, Glycosides, Carbohydrates, Protin, Quinones, Anthraquinone, phenol, Tannins, Flavonoids

Medicinal uses: Asthma, Abortifacient, Anti-cancer, Anthelmintic, CNS activity, Epilepsy, Eczema Expectorant, Fever, Leprosy, Migraine. Finally, the result of these things useful of ethanol extract of Calotropis gigantean, The plant is purgative, anthelmintic, alexipharmic, cures leprosy, leucoderma, ulcers, tumors, piles, diseases of the spleen, the liver, and the abdomen; the juice is anthelmintic and leucoderma, tumors, ascites, diseases of the abdomen, The leaves are applied to paralyzed parts, painful joints, swellings; heal wounds. The tincture from the leaves used as antiperiodic in cases of intermittent fevers. Inflammations, tumors, rat-bite, good in ascites. The milk is biter, heating, purgative; Laxative; cures piles. The root bark is diaphoretic; cures asthma and syphilis. The flower is sweet, bitter, anthelmintic, analgesic.

- **Significance of the Study**

The present study focuses on the formulation and evaluation of a plant-based phyto-therapeutic antibacterial gel using Calotropis gigantea flower extract. This formulation aims to provide an effective, safe, and economical alternative for the treatment of bacterial skin infections. The integration of herbal medicine with modern gel formulation enhances drug delivery, improves skin permeation, and ensures better therapeutic outcomes.

- **Rationale of the Study**

The increasing prevalence of bacterial skin infections, coupled with the rising issue of antibiotic resistance, has created a need for alternative and effective therapeutic approaches. Conventional antibiotics, although widely used, are often associated with adverse effects, reduced efficacy over time, and the emergence of resistant microbial strains. This has led to growing interest in plant-based therapies that offer safer and more sustainable treatment options.

Calotropis gigantea is a well-known medicinal plant with reported antibacterial, anti-inflammatory, and wound healing properties. Despite its traditional use, there is limited scientific data on its formulation into modern topical dosage forms such as gels. The use of an ethanol-based extract enhances the extraction of active phytoconstituents and improves their penetration through the skin, thereby increasing therapeutic effectiveness.

Topical gel formulations provide several advantages, including localized drug delivery, improved patient compliance, ease of application, and enhanced drug release. Incorporating Calotropis gigantea flower extract into a gel base can potentially improve its stability, bioavailability, and antimicrobial activity.

Therefore, the present study is designed to formulate and evaluate a phyto-therapeutic antibacterial gel using Calotropis gigantea flower extract. The study aims to bridge the gap between traditional herbal medicine and modern pharmaceutical technology by developing an effective, safe, and economical treatment for common bacterial skin infections such as folliculitis, furuncle, and carbuncle.

MATERIAL AND METHOD EXTRACT COLLECTION

The extract of Calotropis Gigantea Flower were collected from a VEDIKA BRAND, extraction ratio – 10:1.

FORMULATION OF GEL

1g of Carbopol 940 was dispersed in 50ml of distilled water with continuous stirring. 5% ethanol extract of the herbal formulation were dissolved in 15ml of ethanol with continuous stirring. This ethanol extract solution was added into the polymer solution and mixed well. Methyl paraben is added as a preservative into the mixture and mixed well by magnetic stirrer. After complete dispersion of the extract and preservative the pH was adjusted to neutral by using sodium hydroxide. Glycerin 10ml was added and mixed well in a magnetic stirrer. Distilled water was added and made up-to 100ml.

Fig. 6: Gel Base.

Fig. 7: Gel.

Fig. 8: Formulated Gel.

Tab. 3: Ingredients and quantity used for preparation of phyto-therapeutic anti-bacterial gel.

INGREDIENTS	QUANTITY
Carbopol 940	1 %
Extract	1.5%
Ethanol	15%
Glycerin	10%
Triethanolamine	q.s.
Methyl Paraben	0.5%
Distilled water	q.s. up-to 100ml

EVALUATION PARAMETERS

- **PRELIMINARY PHYTOCHEMICAL SCREENING OF EXTRACT**

For the purpose of identifying the phytochemical components present in the alcoholic extracts, various qualitative tests were carried out. For the presence of carbohydrates, tannins, flavonoids, steroids, glycosides, alkaloids, saponins, and other substances, several tests were carried out.

Preliminary phytochemical screening of ethanol extract of flower of Calotropis Procera linn.

1] Tests for Alkaloids

a). Dragendroff's Test: To 2-3 ml. filtrate, add few drops Dragendorff's reagent. Orange brown ppt is formed.

b). Wagner's Test: 2-3 ml. filtrate with few drops Wagner's reagent gives reddish brown ppt.

2] Tests for Flavonoids

a). Shinoda Test: To dry powder or extract, add 5 ml. 95% ethanol, few drops conc. HCI and 0.5 g magnesium turnings. Pink color observed.

b). NaOH Test: Addition of increasing amount of sodium hydroxide to the residue shows yellow coloration, which decolorizes after addition of acid

c). Lead Acetate Test: To small quantity of residue, add lead acetate solution. Yellow colored precipitate is formed.

3] Tests for Tannins and Phenols

a). 5% $FeCl_3$ Test: To 2-3 ml. of aqueous or alcoholic extract, add few drops of reagent and observed for the formation of deep blue-black color.

b). Lead Acetate Test: To 2-3 ml. of aqueous or alcoholic extract, add few drops of reagent and observed for the formation of white ppt.

c). Gelatine Solution: To 2-3 ml. of aqueous or alcoholic extract, add few drops of reagent and observed for the formation of white ppt.

d). Acetic Acid Solution: To 2-3 ml. of aqueous or alcoholic extract, add few drops of reagent and observed for the formation of red color solution.

4] Tests for Terpenoids

a). Salkowski Test: To 2 ml. of extract, add 2 ml. chloroform and 2 ml. conc. H_2SO_4. Shake well. Chloroform layer appears red and acid layer shows greenish yellow fluorescence.

5] Tests for Steroid

a). Liebermann-Burchard Test: Mix 2 ml. extract with chloroform. Add 1-2 ml. acetic anhydride and 2 drops conc. H,SO, from the side of test tube. First red, then blue and finally green color appears.

b). Salkowski Test: To 2 ml. of extract, add 2 ml. chloroform and 2 ml. conc. H_2SO_4. Shake well. Chloroform layer appears red and acid layer shows greenish yellow fluorescence.

6] Tests for Carbohydrates

a). Molish's Test: To 2-3 ml. aqueous extract, add few drops of alpha-naphthol solution in alcohol, shake and add conc. H_2SO_4 from sides of the test tube. Violet ring is formed at the junction of two liquids.

7] Tests for Cardiac Glycosides

a). Keller- Kiliani Test: To 2 ml. extract, add glacial acetic acid, one drop 5% $FeCl_3$ and conc. H_2SO_4. Reddish brown color appears at junction of the two liquid layers and upper layer appears bluish green.

b). Liebermann's Test: Mix 3 ml. extract with 3 ml. acetic anhydride. Heat and cool. Add few drops conc. H_2SO_4. Blue color appears.

8] Tests for Proteins

a). Biuret Test: To 3 ml. T.S. add 4% NaOH and few drops of 1% CuSO, solution, Violet or pink color appears.

b). Million's Test: Mix 3 ml. T.S. with 5 ml. Million's reagent. White ppt. Warm ppt turns brick red or the ppt dissolves giving red colored solution.

c). Precipitation Test

i). 5% Lead Acetate: The test solution gives white colloidal ppt with reagent.

- **FTIR SPECTRUM INTERPRETATION OF EXTRACT**

Fourier Transform Infrared (FTIR) spectroscopy was performed to identify the functional groups present in Calotropis gigantea flower extract.

- **Appearance and Homogeneity**

Visual inspections were done to check the physical appearance and the homogeneity of the prepared formulations.

- **pH Determination**

Prepared gel formulation's pH is measured using a digital pH meter. After dissolving 1 g of gel in 100 ml of distilled water, it was kept for 2 hours. In order to prevent any kind of skin irritation, the pH of the topical gel formulations was determined in the range of 6.8–7.1, which is close to the natural pH of the skin.

- **Viscosity Determination**

The Brookfield viscometer was used to measure the viscosity of the gel. Spindle number 64 was used to rotate the gels at 10 rpm, and the dial reading was recorded.

- **Spread ability**

Spread ability can be quantified by measuring the time in seconds taken for a given area to be covered or by assessing the ease with which the gel spreads over the skin. A small amount of gel was placed between the two glass slides, and a definite amount of weight was placed on these glass slides to compress the glass slides of uniform thickness. The movement of the slide across the gel simulates spreading. A weight of 70 g was added and the time required to separate the two slides was noted. Spread ability was calculated using the

Formula

$$S = ML/T \quad S=50*5.5/6.05$$

$$=45.45g\ cm/s$$

Where,

M = Mass tied to upper slide, L = Length of glass slides,

T = Time taken to separate the slides

- **Washability**

formulation was applied on the skin and then ease and extent of washing with water and checked.

- **Stability study**

Physical stability test of the herbal ointment was carried out for the four weeks at various temperature conditions like 2℃, 25℃, 30℃the herbal ointment was found to be physically a different temperature i.e. 2℃, 25℃, 30℃.

- **Antimicrobial Activity (zone of inhibition)**

Prepare an agar plate and inoculate it with the microorganism (S. aureus, Pseudomonas aeruginosa). Apply a small quantity of the topical gel to a disk or directly to the agar. Incubate the plate under suitable conditions for a specified time. Measure the zone of inhibition around the sample.

- **FTIR SPECTRUM INTERPRETATION OF GEL**

The FTIR spectrum of the formulated phyto-therapeutic antibacterial gel was recorded in the range of 4000–400 cm^{-1} to identify the functional groups present and to confirm the compatibility of ingredients used in the formulation.

- **UV–VISIBLE SPECTRUM INTERPRETATION OF GEL**

The UV–Visible spectrum of the formulated phyto-therapeutic antibacterial gel was recorded in the wavelength range of 200–400 nm.

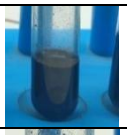
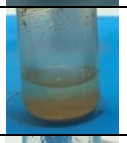
RESULTS

1. PRELIMINARY PHYTOCHEMICAL SCREENING OF EXTRACT

Tab. 4: Result of Preliminary phytochemical screening of ethanol extract of flower of Calotropis Gigantea linn.

S. N.	Phytochemical Constituents		Result	
	Class of Compounds	Test Performed		
1.	Tests for Alkaloids	a). Dragendroff's Test	Present	

		b). Wagner's Test	Present	
2.	Tests for Flavonoids	a). Shinoda Test	Present	
		b). NaOH Test	Present	
		c). Acetate Test	Present	
3.	Tests for Tannins and Phenols	a). 5% $FeCl_3$ Test	Present	
		b). Lead Acetate Test	Present	
		c). Gelatine Solution	Present	
4.	Test for Terpenoids	Salkowski Test	Present	
5.	Tests for Steroids	a). Liebermann- Burchard Test	Present	
		b). Salkowski Test	Present	

6.	Tests for Carbohydrates	Molish's Test	Present	
7.	Tests for Cardiac Glycosides	a). Keller- Kiliani Test	Present	
		b). Liebermann's Test	Present	
8.	Tests for Proteins	a). Biuret Test	Absent	
		b). Million's Test	Absent	
		c). Precipitation Test i). 5% Lead Acetate	Present	

2. FTIR SPECTRUM INTERPRETATION OF EXTRACT

Tab. 5: FTIR spectrum interpretation.

Wavenumber (cm^{-1})	Interpretation	Functional Group
3402.06	Broad peak	O–H stretching (alcohols/phenols)
2923.96, 2853.00	Medium peaks	C–H stretching (alkanes)
1732.61, 1713.13	Strong peaks	C=O stretching (esters, aldehydes, ketones)
1624.09	Medium peak	C=C stretching (alkenes/aromatic rings)
1450.94	Medium peak	C–H bending (alkanes)
1163.83	Medium peak	C–O stretching (alcohols/esters)
1078.66, 1031.81	Strong peaks	C–O stretching (primary alcohols)
881.26 – 69.63	Weak peaks	Aromatic C–H bending
517.77, 467.38	Low-frequency peaks	Fingerprint region

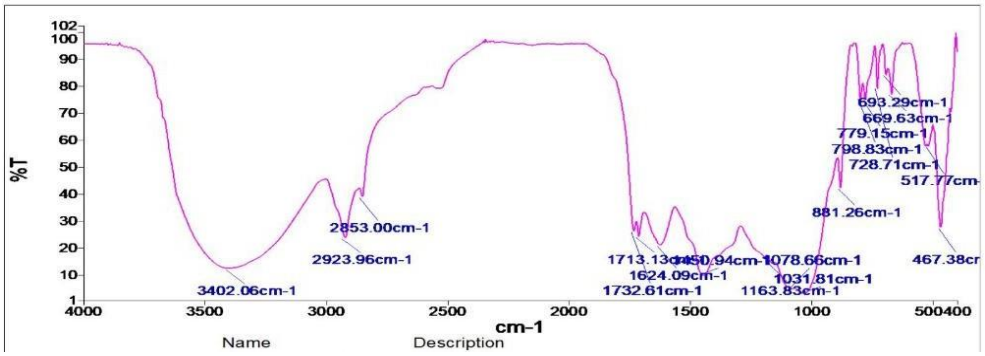


Fig. 8: FTIR Spectrum of Extract.

3. PHYSICAL EVALUATION

Tab. 6: Evaluation parameters of gel.

PARAMETERS	RESULT
Color	Greenish
Odor	Characteristics
Appearance	Smooth
Texture	Soft
Homogeneity	Uniform
pH	6.08
Viscosity	37790
Spread ability	6.05 sec
Washability	Easily washable
Stability studies	Stable at 2℃, 25℃ and 30℃

4. ANTIMICROBIAL ACTIVITY (ZONE OF INHIBITION)

- No microbial contamination was detected → confirms formulation sterility and safety
- Zone of inhibition:

› 20 mm against Staphylococcus aureus → strong activity (Gram-positive)

› 12 mm against Pseudomonas aeruginosa → moderate activity (Gram-negative)

Sr. No	Test	Result	
1	Test of microbial activity (Present or Absent test)	No microorganisms were detected in the analysed sample. Specifically, Gram-positive bacteria (e.g., *Staphylococcus aureus, Bacillus* spp.) and Gram-negative bacteria (e.g., *Escherichia coli, Pseudomonas* spp.) were found to be absent.	

2. Test of antimicrobial activity

A zone of inhibition measuring 12 mm was observed against the Gram-negative bacterium *Pseudomonas aeruginosa* 	A zone of inhibition measuring 20 mm was observed against the Gram-positive bacterium *S.aureus* 

The formulated product (Plant based phyto-therapeutic anti-bacterial gel) demonstrated antimicrobial activity against Gram-positive bacteria, namely *Staphylococcus aureus*, and Gram-negative bacteria, namely *Pseudomonas aeruginosa.*

Fig. 9: Antimicrobial Activity.

5. FTIR SPECTRUM INTERPRETATION OF GEL

Tab. 6: FTIR Spectrum Interpretation of Gel.

Peak (cm^{-1})	Interpretation	Functional Group
3435.14	Broad absorption band	O–H stretching (alcohols/phenols)
2956.60	Medium intensity peak	C–H stretching (alkanes)
2078.92	Weak peak	C≡C stretching (alkynes) / possible overtone
1638.89	Strong peak	C=O stretching / C=C (aromatic or alkene)
1413.71	Medium peak	C–H bending / O–H bending
1110.97	Strong peak	C–O stretching (alcohols, ethers)
1042.54	Strong peak	C–O stretching (primary alcohols)
991.82	Medium peak	=C–H bending (alkenes)
923.24	Medium peak	Out-of-plane C–H bending
674.97	Low frequency peak	C–H bending (aromatic compounds)

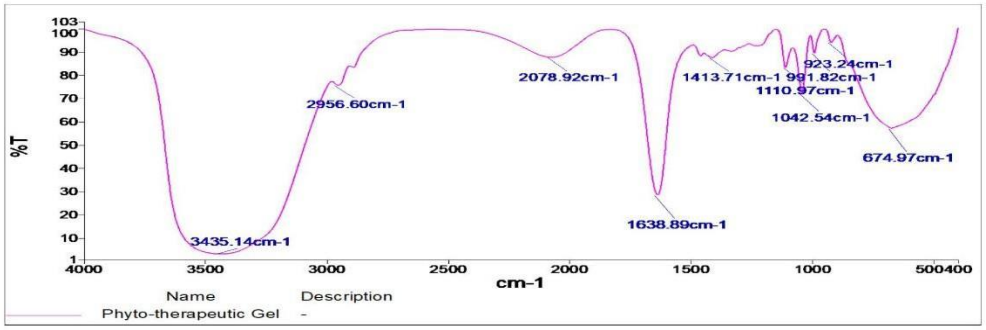


Fig. 10: FTIR Spectrum of Gel.

6. UV–VISIBLE SPECTRUM INTERPRETATION OF GEL

- **OBSERVED DATA**

› Wavelength range: 200–400 nm

› Peak observed at: 256.60 nm

› Absorbance at peak: 0.698

The UV–Visible spectrum of the formulated phyto-therapeutic antibacterial gel was recorded in the wavelength range of 200–400 nm. The spectrum exhibited a prominent absorption peak at 256.60 nm with an absorbance of 0.698. This absorption is attributed to $\pi \rightarrow \pi^*$ electronic transitions of aromatic and conjugated systems present in phytoconstituents such as flavonoids and phenolic compounds.

The presence of this peak confirms the successful incorporation of plant-derived bioactive compounds into the gel formulation. Furthermore, the absence of additional unexpected peaks indicates that there are no significant interactions between the extract and excipients, suggesting good compatibility and stability of the formulation.

The UV spectral analysis supports the presence of active phytochemicals and confirms that the prepared gel formulation is stable and suitable for antibacterial applications.

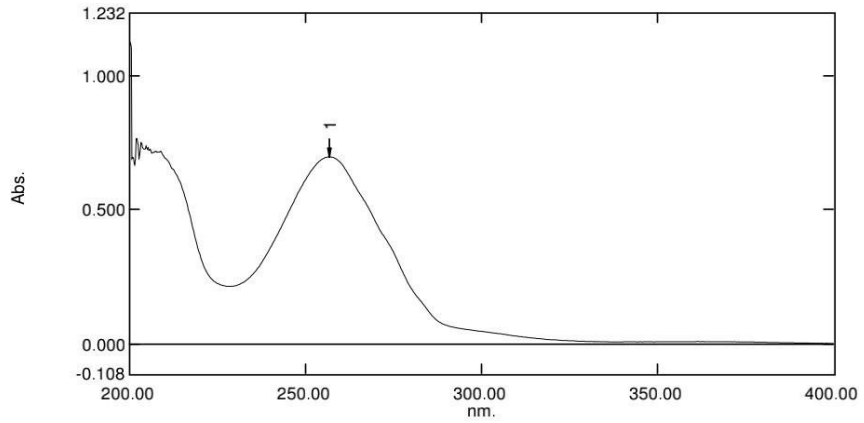


Fig. 11: UV–Visible Spectrum of Gel.

CONCLUSION

The present study successfully formulated and evaluated a plant-based phyto-therapeutic antibacterial gel using the ethanol extract of Calotropis gigantea flowers. The formulated gel demonstrated desirable physicochemical properties such as appropriate pH, good spreadability, suitable viscosity, homogeneity, and stability under different temperature conditions. These characteristics indicate that the prepared formulation is suitable for topical application and provides good patient acceptability.

Preliminary phytochemical screening confirmed the presence of important bioactive constituents such as alkaloids, flavonoids, tannins, terpenoids, glycosides, and phenolic compounds, which are responsible for antimicrobial activity. The antimicrobial evaluation showed a significant zone of inhibition against common pathogenic bacteria, with strong activity against Staphylococcus aureus and moderate activity against Pseudomonas aeruginosa, demonstrating the effectiveness of the herbal formulation in treating bacterial skin infections.

Furthermore, spectral analysis studies such as FTIR and UV–Visible spectroscopy confirmed the compatibility of the extract with excipients and the successful incorporation of active phytoconstituents into the gel formulation. The stability studies also indicated that the formulation remained physically stable under various storage conditions.

Therefore, the developed phyto-therapeutic antibacterial gel can be considered a safe, effective, and economical alternative to conventional synthetic topical agents for the management of

bacterial skin infections. Future studies may focus on clinical evaluation, large-scale production, and long-term stability testing to further establish its therapeutic potential.

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