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Research Article

Exploring The Antimicrobial Potential of Herbal Formulation of *Clerodendrum Infortunatum*

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ABSTRACT

Antimicrobial resistance is a pressing global challenge, necessitating the exploration of novel bioactive compounds from natural sources. Among these, *Clerodendrum infortunatum*, a species widely distributed in tropical and subtropical regions has its significant antimicrobial properties. Its leaves have properties including antibacterial, wound healing, treatment of different skin diseases and snake bites. Recent studies have revealed the leaves are rich in bioactive compounds such as terpenoids, phenolic acids and glycosides, which contribute to its antimicrobial properties. In this study, the herb used in the formulation and antimicrobial activity of those prepared formulations are determined by the pour plate method. Nutrition broth was used as medium for bacterial strain. Control experiment was carried out under the similar condition by using standard tetracycline (100ug/ml). The Petri dishes with bacterial cultures are incubated at $37\pm 2^{\circ}\text{C}$ for 24 hrs. The assessment of antimicrobial activity is based on the measurement of diameter of inhibition zone formed by dissolving the plant material extract in dimethyl sulfoxide and standard drug also. The extract showed more inhibitory zone than the standard drug Tetracycline and exhibited significant antimicrobial activity. F3 formulation has shown good stability and antibacterial properties. We can conclude formulations containing leave extract of *Clerodendrum infortunatum* exhibit good antibacterial potency against bacteria.

INTRODUCTION

Antimicrobial resistance (AMR) occurs when microorganisms like bacteria, viruses, fungi, and parasites evolve to resist the effects of

antimicrobial drugs, making infections harder to treat. This resistance develops due to the overuse or misuse of antibiotics, poor infection control, and environmental factors. AMR leads to

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prolonged illnesses, increased medical costs, and a higher risk of disease spread. Combating AMR requires proper antibiotic use, improved hygiene, and the development of new antimicrobial agents. *Clerodendrum infortunatum* extracts can enhance the effectiveness of antibiotics, reducing bacterial resistance. When combined with antibiotics like tetracycline and ampicillin, it improves susceptibility in resistant strains. Introduction to *Clerodendrum infortunatum* Linn. (Verbenaceae) and Its Antimicrobial Potential in Herbal Formulations-

Overview of *Clerodendrum infortunatum* Linn:

Clerodendrum infortunatum Linn., commonly known as Hill Glory Bower, is a significant medicinal shrub belonging to the Verbenaceae family. It is widely distributed in tropical and subtropical regions, including India, Bangladesh, Sri Lanka, and Southeast Asia [1]. The plant is well known in traditional Ayurvedic, Unani, and folk medicine due to its diverse pharmacological properties.

Botanical Description: -

This perennial shrub grows up to 1.5–3 meters in height and is characterized by its large, opposite, ovate leaves with serrated margins. It bears attractive, tubular, white or pinkish flowers with reddish stamens, forming terminal inflorescences. The fruit is a four-lobed, drupe-like structure, initially green and turning black upon ripening. The plant thrives in moist, well-drained soils and is commonly found in forests, roadsides, and wastelands.

Ethnomedicinal Uses: -

Traditionally, various parts of *C. infortunatum* have been used to treat ailments such

as fever, diarrhea, dysentery, wounds, inflammation, liver disorders, and respiratory problems. Different communities have used its leaves, roots, and flowers for their medicinal properties:

Leaves: Used as an anthelmintic, antipyretic, and anti-inflammatory agent.

Roots: Employed in treating snake bites, jaundice, and digestive disorders.

Flowers & Bark: Used for skin ailments and wound healing.

Phytochemical Constituents: - Phytochemical analysis of *C. infortunatum* reveals the presence of bioactive compounds such as:

Flavonoids (quercetin, kaempferol, luteolin):[10] Known for antioxidant and antimicrobial properties.

Terpenoids and Saponins: Exhibit anti-inflammatory and antimicrobial activities. Alkaloids (clerodin, colessterol): Contribute to anthelmintic and antibacterial effects.

Tannins and Phenolics: Act as potent antimicrobial and antioxidant agents [2].

Antimicrobial Potential and Herbal Formulations: -

Recent studies highlight the antimicrobial efficacy of *C. infortunatum*, making it a promising candidate for herbal formulations [11]. The plant exhibits broad-spectrum antimicrobial activity against Gram-positive and Gram-negative bacteria, fungi, and certain protozoa.

❖ Antibacterial Activity

Extracts from leaves and roots have demonstrated significant antibacterial effects against pathogens



like *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, and *Bacillus subtilis* [12]. The presence of flavonoids, alkaloids, and tannins disrupts bacterial cell membranes, inhibits enzyme activity, and prevents biofilm formation.

❖ Antifungal Activity

Studies indicate that ethanol and methanol extracts of *C. infortunatum* inhibit the growth of fungi such as *Candida albicans*, *Aspergillus niger*, and *Trichophyton rubrum*, making it useful in treating skin infections and fungal disorders.

❖ Herbal Formulations and Applications

Several herbal formulations incorporating

C. infortunatum have been developed to enhance its antimicrobial properties:

Herbal Ointments: Used for wound healing, skin infections, and burns.

Antimicrobial Herbal Gels: Effective against bacterial and fungal skin diseases. Mouthwash and Gargles: Useful in treating oral infections and gingivitis [13].

Herbal Teas and Decoctions: Used in gastrointestinal and respiratory infections. Hand Sanitizers and

Soaps: Natural disinfectants enriched with *C. infortunatum* extracts.

Mechanism of Action: -

The antimicrobial activity of *C. infortunatum* is attributed to its ability to [3]:

- Disrupt microbial cell walls and membranes, leading to cell lysis.

- Interfere with protein and DNA synthesis, inhibiting bacterial and fungal growth.
- Enhance immune response, providing additional protection against infections.

Clerodendrum infortunatum Linn. is a valuable medicinal plant with immense potential in antimicrobial applications [14]. Its rich phytochemical profile supports its traditional uses and validates its efficacy in modern herbal formulations. Future research should focus on clinical trials, formulation standardization, and sustainable cultivation to harness its full therapeutic potential.

1. Collection Of Plant Material & Extract: -

- The plant *Clerodendrum infortunatum* was selected for study. Its leaves were collected from Jagadishpur in Howrah District, West Bengal. The collected leaves were identified and authenticated from Botanical Garden, Central national herbarium. Specimen No. JIS/AS-01
- Fully dried and crushed for better extraction
- Grind the dry leaves into a coarse powder to increase surface area.
- Soak the leaves in a container with our chosen solvent water. Ratio about 3:10 leaf to solvent.
- Seal the container and let it sit for 1-2 weeks, shaking it daily.
- Filter the mixture using a cheesecloth or fine mesh [4].
- Concentrate the extract on hot water bath for about 1 hour to evaporate some solvent.



Fig1: Dried Leaves

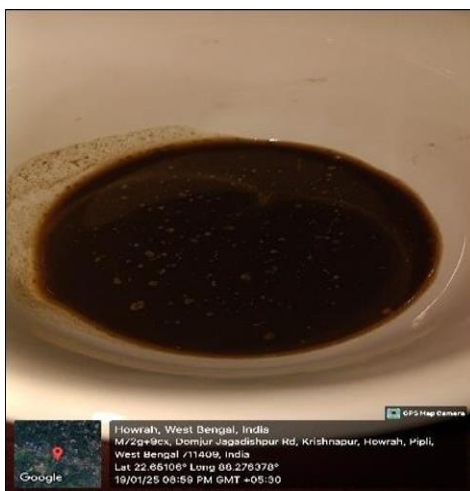


Fig2: Liquid Extract

MATERIALS AND METHODS:

The liquid plant extract was obtained from Jagadishpur, Howrah, India. Antibiotic assay medium A (Guru Nanak Institute of Pharmaceutical Science & Technology, Kolkata); Stearic acid, acetyl alcohol, KOH, Glycerine, Water, Preservative, Carbopol 940, Propyl paraben, Ethanol, Triethanolamine were also used in the study [5].

Cream Formulation: A simple oil-in-water (O/W) cream formulation with ingredient weights for 100 g and 2ml liquid extract of the plant's leaves as the active ingredient.

Table 1:

Ingredient	Function	% (w/w)	Weight (g)
Purified water	Solvent	60%	60.0 g
Glycerine	Humectant	5.0%	5.0 g
Acetyl alcohol	Thickener	3.0%	3.0 g
Stearic acid	Thickener	2.0%	2.0 g
Mineral oil	Emollient	8.0%	8.0 g
Emulsifying wax	Emulsifier	5.0%	5.0 g
Preservative	Anti-microbial	0.5%	0.5 g
Ph adjuster (citric acid)	pH Balancing	0.2%	0.2 g

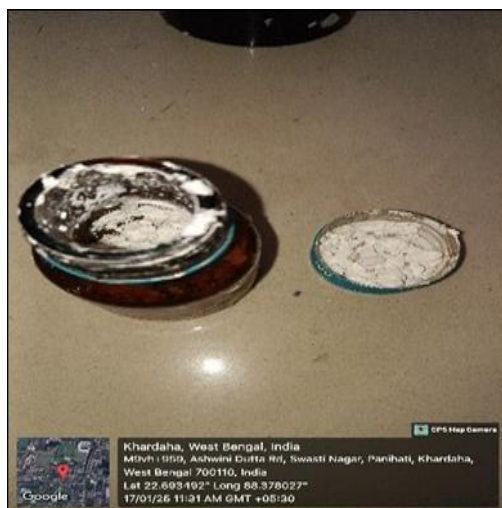


Fig3: Cream Formulation

Gel Formulation:

A basic gel formulation with ingredient weights for 100 g and 2ml liquid extract of the plant's leaves as the active ingredient [15].

Table 2:

Ingredient	Function	Weight (%)
Carbomer (e.g. Carbopol 940)	Gelling agent	2
Propylene Glycol	Solvent	80
Triethanolamine	Humectant	5
Preservative	PH adjuster	0.5



Fig4: Gel Formation

3.3.2. Procedure:

After preparing the media, spread the microbial culture on the agar surface using a sterile swab. For this zone of inhibition method, gram negative bacteria *E. coli* was used. Make wells in the agar (6-8 mm diameter) Fill the wells with the test formulation (cream/gel) Incubate at 37 degree for 24 hours. Measure the zone of inhibition around the wells [3].

Zone of inhibition = (A) = πr^2

[Where r is the radius]

4. Inhibition Zone Analysis of Gram-Negative Bacteria

***E. coli*:**

The antimicrobial activity of Cream, Gel, liquid extract and standard drug was evaluated using the agar well diffusion method, and the resulting zones of inhibition were measured in millimetres (mm). The results indicate a significant inhibitory effect against the bacteria, with varying efficacy across different concentration [8].

Table 4:

Samples	<i>E. Coli</i> Zone of Inhibition (MM)
Cream Formulation	25
GEL Formulation	24.3
Liquid Extract of the Leaves	26
Standard Drug	22





Fig5 & Fig6: Assay Result for Cream & Gel Formulation

5. Evaluation Of Cream and Gel Formulation:

The average inhibition zone diameter for cream formulation was 26 against *E. coli*. The inhibition zone was similar to that of other standard antifungal drugs. A clear zone was observed indicating the effectiveness of the formulation. The diameter of the inhibition zone (in mm) for gel formulation 24.3. A zone of inhibition was observed slightly.

6. DISCUSSION:

Overall, these findings highlight the therapeutic potential of *Clerodendrum infortunatum* as an antimicrobial agent and suggest that further development and clinical testing could establish it as a viable herbal remedy for bacterial infections. The antimicrobial potential of herbal formulation of *Clerodendrum infortunatum* was shown that is better than the standard drugs. Even the ingredients present in those formulations were not affecting the liquid extract's properties. It remains same as the liquid extract. The herbal formulation's antimicrobial activity is attributed to the presence of bioactive compounds, such as flavonoids, alkaloids, and phenolic compounds, which contribute to its ability to disrupt microbial cell membranes and interfere with microbial metabolic pathways. Although the formulation showed promising results, it exhibited variable efficacy against different

bacterial strains, particularly Gram-negative bacteria like *Pseudomonas aeruginosa*, highlighting the need for further optimization. Additionally, the synergistic effects observed when combined with certain conventional antibiotics suggest that *C. infortunatum* could be used as a complementary therapy to enhance the effectiveness of existing antibiotics, offering a potential strategy to combat antimicrobial resistance. This study underscores the potential of *Clerodendrum infortunatum* as a viable candidate for further development into antimicrobial agents, both as a standalone product and in combination with conventional drugs. However, additional studies, including in vivo testing, stability analysis, and standardization of the formulation, are essential to fully realize its therapeutic potential and to ensure safety and efficacy in clinical applications.

7. CONCLUSION:

The results of this study demonstrate that *Clerodendrum infortunatum* holds significant antimicrobial potential, with its herbal formulation exhibiting effective antibacterial and antifungal activity against a range of pathogens, as well as fungi such as *Candida albicans* and *Aspergillus niger*.

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