

Comparative Anti-Fungal Potential of Novel Niosomal Gel and Plain Gel Formulation of Plant Extract

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ABSTRACT

Fungal infections pose a significant global health concern due to the emergence of resistant strains and the limited efficacy of conventional antifungal agents. The use of plant-based bioactives in novel drug delivery systems offers a promising alternative for enhanced therapeutic performance and reduced side effects. The present study focuses on the development and evaluation of a niosomal gel formulation containing the hydroalcoholic leaf extract of *Blumea lacera* (Burm.f.) DC., a medicinal plant traditionally known for its antimicrobial and wound-healing properties. The extract was prepared using hydroalcoholic solvent (70% ethanol:water) and evaluated for phytochemical constituents. Niosomes were formulated by the thin-film hydration method using non-ionic surfactant (Tween 40) and cholesterol in optimized ratios, and characterized for vesicle size, zeta potential, entrapment efficiency, and morphology. The optimized niosomal dispersion was incorporated into a carbopol-based gel to achieve sustained release and enhanced skin permeability. The antifungal activity of the developed niosomal gel was assessed against *Candida albicans* using the disc diffusion method, and compared with conventional gel and standard antifungal drug. Results demonstrated that the niosomal gel exhibited superior antifungal efficacy, prolonged drug release, and improved stability compared to the plain extract gel. Thus, the formulated niosomal gel of *Blumea lacera* extract could serve as a potential topical antifungal therapy with enhanced bioavailability and therapeutic performance.

KEYWORDS: *Blumea lacera*, niosomal gel, antifungal activity, hydroalcoholic extract, phytoconstituents, topical delivery.

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INTRODUCTION

Fungal infections of the skin and mucous membranes remain a major therapeutic challenge, particularly with the increasing prevalence of antifungal resistance and the limitations associated with existing synthetic agents (Reddy et al., 2022). Topical antifungal therapy often suffers from poor skin penetration, limited residence time, and adverse effects such as irritation and toxicity. These drawbacks have motivated researchers to explore natural plant-based bioactives integrated with advanced drug delivery systems to achieve improved efficacy and patient compliance (El-Baky et al., 2021).

Blumea lacera (Burm.f.) DC., a member of the family Asteraceae, is an aromatic herb widely distributed in tropical regions of Asia. Traditionally, it has been employed in folk medicine for the treatment of wounds, inflammation, microbial infections, and skin ailments. Phytochemical investigations have revealed the presence of flavonoids, terpenoids, alkaloids, phenolic compounds, and essential oils that contribute to its antimicrobial and antioxidant properties (Khair et al., 2014). However, the therapeutic potential of *B. lacera* remains underutilized due to poor solubility, instability, and limited skin penetration of its bioactive constituents (Ahmed et al., 2014; Ali et al., 2022).

Niosomes, non-ionic surfactant-based vesicular carriers, have emerged as a promising approach to enhance the delivery of plant-derived bioactives. They offer advantages such as improved encapsulation efficiency, controlled release, enhanced permeability, and biocompatibility. Incorporating niosomal dispersions into topical gels further improves patient acceptability and facilitates localized drug action at the infection site (Anonymous, 2023)

The present research aims to develop and evaluate a **novel niosomal gel formulation** containing the **hydroalcoholic leaf extract** of *Blumea lacera* for antifungal activity. The study involves extraction, formulation optimization, characterization, and biological evaluation of the developed niosomal gel against common pathogenic fungi. This work seeks to establish *Blumea lacera* as a potential natural antifungal agent and to demonstrate the effectiveness of niosomal gel systems in improving topical drug delivery

MATERIAL AND METHODS

Material: 2.5 % Niosomal Gel of **hydroalcoholic leaf extract** of *Blumea lacera*

Anti-fungal Activity

Fungal strain: Fungal strain i.e., *Candida albicans* was used for the present investigation.

Screening of Anti-fungal activity (Disc diffusion method)

Preparation of Disc: Disc of whatsmann filter paper of one quarter inch in diameter was prepared and the same was sterilized

using autoclave (Dwivedi, 2022).

Preparation of samples entrapped disc: The accurately weighed samples of niosomal gel was prepared. All the dilution prepared was applied to whatsmann filter paper disc using a micropipette. The disc was then dried and sterilized (Shrivastava & Dwivedi, 2021)

Preparation of culture plate: The sabouraud's agar and mueller Hinton agar media was prepared by dissolving media in 1000 ml of distilled water and sterilized by autoclave at 121°C for 1 hour. The media was cooled and poured in sterilized petri plate to solidified at room temperature (Shrivastava & Dwivedi, 2021).

Evaluation of Zone of inhibition: The re-cultured fungal strain was used for antifungal evaluation. The zone of inhibition diameter was recorded with the help of zone reader scale. The zone of inhibition was calculated by subtracting diameter of sample or standard or control by diameter of disc (Shrivastava & Dwivedi, 2021).

Statistical analysis: All the reading obtained were analyzed using one way analysis of variance i.e., ANOVA. Student t-test was used. The values are found to be statistically significant (*P<0.00, **P<0.01). All the values obtained are expressed as mean± standard error means (SEM).

RESULTS AND DISCUSSION

Anti-fungal activity of niosomal gel formulation i.e., NBL-2.5% was determined against *Candida albicans* disc diffusion method. The zone of inhibition of NBL-2.5% was compared with standard drug (Clotrimazole) and the results obtained were presented in table 1 and shown in figure 1. The results indicate that niosomal gel containing plant activity showed better and significant antifungal activity.

Table 1: Anti-fungal Activity of Niosomal gel [NBL-2.5%] of Plant Extract

S/No.	Test	Zone of Inhibition (mm)
1.	Control	4.89±0.39
2.	Standard	24.22±0.27**
3.	NBL-2.5%	18.87±0.06**
4.	PGBL [2.5%]	16.39±0.21**

Note: Every value is presented as Mean (X) ± SEM, n = 3. Values are statistically significant *P<0.01, **P<0.001 when compared to control and standard, following a one-way ANOVA and student test.

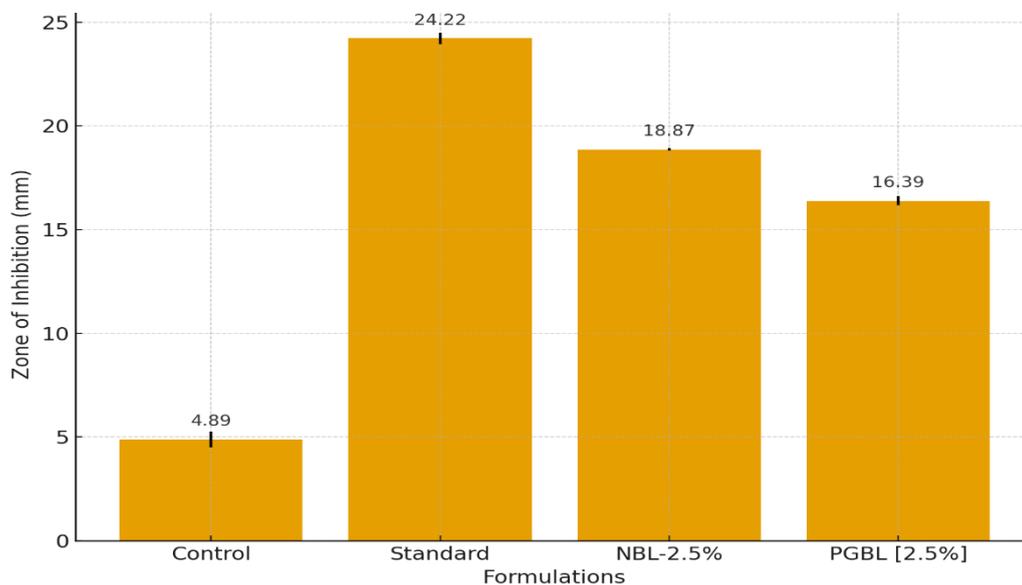


Fig. 1: Comparative Anti-fungal Activity of different formulation

CONCLUSION

The developed **niosomal gel of *Blumea lacera* hydroalcoholic leaf extract** demonstrated potent antifungal activity against *C. albicans*. The study establishes the potential of combining herbal extracts with niosomal technology as an effective strategy for the treatment of fungal infections with enhanced therapeutic efficacy and reduced side effects.

(Ahmed et al., 2014; Ali et al., 2022)

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