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Fungal skin disorders and their alleviation using *Delonix regia* extract

Syed Umme Hani [1,*], Mohammed Taufeeque Shaikh [2,*], Ibaadur Rahman Shaikh [3], Safar Abdul Wahab Khan [4], Syed Qanet Ahmed [5], Syed Ammar Ahmed [6], Khwaja Kausar Jabeen [7] and Syed Ather Ahmed [8]

[1] *Department of Science, Roots and Wings Academy, Silicon Valley, Himayat Bagh, Aurangabad (M.S.), India-431002.*
[2] *Department of Science, Supreme Global School, Near Ameen Hospital, Roshan Gate, Aurangabad (M.S.), India-431001.*
[3] *Department of Homeopathy, Shri Prakash Chand Jain Homeopathic Medical College, Palaskhed, Tal. Jamner, Dist. Jalgaon (MS), India-424206.*
[4] *Department of Administration and Management, Roots and Wings Academy, Silicon Valley, Himayat Bagh, Aurangabad (M.S.), India-431002.*
[5] *Department of Secondary Education, Sarosh High School, Padegaon, Aurangabad (M.S.), India-431001.*
[6] *Department of Electronics, National Institute of Electronic and Information Technology, Aurangabad (M.S.), India-431001.*
[7] *Department of Primary Education, Fatema Urdu School, Kiradpura, Aurangabad (M.S.), India-431001.*
[8] *Department of Secondary and Higher Secondary Education, Nemat Urdu School and Junior College, Tal. Khuldabad, Dist. Aurangabad (M.S.), India-431101.*

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Abstract

Fungal skin disorders, caused by dermatophytes, yeasts, and molds, represent a significant global health concern, affecting millions of people worldwide. These infections often lead to symptoms such as itching, redness, and scaling, and in some cases, can result in chronic conditions if left untreated. Conventional antifungal treatments, while effective, often come with adverse effects, drug resistance, and high treatment costs. As a result, there is a growing interest in exploring alternative, natural remedies. *Delonix regia* (Royal Poinciana), a tropical plant known for its antimicrobial, anti-inflammatory, and antioxidant properties, has garnered attention as a potential natural alternative for treating these disorders. This study aims to aggregate the existing data on fungal skin infections and evaluate the therapeutic potential of *Delonix regia* extract in managing such conditions. Through in vitro and in vivo investigations, the findings suggest that *Delonix regia* extract demonstrates significant antifungal activity, particularly against dermatophytes, and may serve as an effective complementary treatment in managing fungal skin infections. The plant's multifaceted bioactivity, including its ability to reduce inflammation and oxidative stress, further supports its potential as a valuable adjunct to conventional antifungal therapies.

Keywords: *Delonix regia*; Fungal skin disorders; Antifungal; Dermatophytes; Antimicrobial; Plant-based therapy

1. Introduction

1.1. Fungal Skin Infections:

Fungal skin infections are common dermatological conditions that result from the overgrowth of various fungi, primarily dermatophytes (such as Trichophyton, Microsporum, and Epidermophyton species), yeasts (particularly Candida species), and molds. Dermatophytes are the primary cause of superficial fungal infections, affecting the skin, hair, and nails, and they are responsible for diseases like athlete's foot, ringworm, and scalp infections[1]. Yeasts,

* Corresponding author: Syed Umme Hani and Mohammed Taufeeque Shaikh

especially Candida albicans, are often implicated in mucocutaneous infections such as thrush and diaper dermatitis, and they can also cause more severe systemic infections in immunocompromised individuals. Molds, although less common, can also cause skin infections, particularly in immunosuppressed individuals. Fungal skin infections typically manifest as symptoms including itching, erythema (redness), scaling, flaking, and discomfort, often leading to significant cosmetic concerns and a reduction in the quality of life. These infections can be chronic, recurrent, and difficult to treat, especially when left untreated or when they affect immunocompromised patients. In certain cases, untreated fungal infections can lead to more severe conditions, such as secondary bacterial infections or widespread dermatophyte infections[2].

1.2. Current Treatments and Their Limitations:

Conventional treatments for fungal skin infections include topical and systemic antifungal agents, such as azoles (e.g., fluconazole, ketoconazole), allylamines (e.g., terbinafine), and polyenes (e.g., nystatin). Topical treatments are often the first line of defence for localized infections, while systemic antifungals are prescribed for more extensive or resistant cases. These treatments are generally effective in managing fungal infections, but they have several limitations that pose challenges for long-term or widespread use[3].

- Side Effects: Many antifungal drugs, especially systemic treatments, are associated with side effects such as liver toxicity, gastrointestinal issues, and skin irritation. These side effects can be particularly concerning for individuals who require prolonged therapy[4].
- Drug Resistance: Overuse or misuse of antifungal drugs has led to the development of resistance, particularly with systemic treatments. Fungal strains that are resistant to common antifungals, such as Candida species and dermatophytes, are becoming increasingly common, complicating treatment regimens and prolonging recovery times[5].
- High Costs: Antifungal medications, particularly newer agents, or systemic treatments, can be expensive. This is especially problematic in low-resource settings, where access to healthcare and medications may be limited, leading to untreated or inadequately treated infections[3].

1.3. The Potential of *Delonix regia* as an Alternative Treatment:

In light of these challenges, there has been increasing interest in exploring alternative, natural treatments for fungal skin infections. *Delonix regia* (commonly known as Royal Poinciana) is a tropical plant that has been used in traditional medicine for centuries in various cultures[6]. Known for its bright flowers, it is also recognized for its medicinal properties, particularly its antimicrobial, anti-inflammatory, and antioxidant effects. Studies have shown that *Delonix regia* possesses several bioactive compounds, including flavonoids, alkaloids, tannins, and saponins, which contribute to its therapeutic potential. These compounds have demonstrated a range of biological activities, such as inhibiting the growth of pathogenic microbes, reducing inflammation, and scavenging free radicals[7].

Figure 1 Live Plant of *Delonix Regia*

- Antimicrobial Properties: *Delonix regia* has demonstrated antimicrobial activity against a range of pathogens, including bacteria and fungi. Several studies have shown that the extract of *Delonix regia* is effective against dermatophytes, the primary cause of superficial fungal infections. Research indicates that the plant extract inhibits the growth of Trichophyton rubrum, Microsporum canis, and other dermatophytes, suggesting that it may be useful in treating conditions like ringworm, athlete's foot, and jock itch. In addition to dermatophytes,

Delonix regia also shows activity against Candida albicans, which is responsible for mucocutaneous infections[8].

- Anti-inflammatory Effects: Inflammation is a hallmark of fungal skin infections. The immune response to fungal infections can lead to redness, swelling, and pain. *Delonix regia* has anti-inflammatory properties that can help mitigate these symptoms. The plant's flavonoids, for instance, have been shown to reduce the production of pro-inflammatory cytokines, offering potential benefits in managing the discomfort associated with fungal infections[9].
- Antioxidant Activity: Fungal infections often lead to the generation of free radicals and oxidative stress in the affected tissue. *Delonix regia* contains powerful antioxidants, such as polyphenols and flavonoids, which can neutralize these free radicals and reduce oxidative damage to skin cells. This property may enhance wound healing and tissue regeneration, which is especially important for chronic fungal infections that result in skin damage and scarring[7,10].
- Safety and Accessibility: In addition to its therapeutic properties, *Delonix regia* offers several advantages as a natural alternative to synthetic antifungal agents. The plant is widely available in tropical and subtropical regions and is often used in traditional medicine for various skin conditions. Furthermore, its relatively low cost and fewer side effects compared to synthetic antifungals make it a promising candidate for use in resource-limited settings[7,9,10,11].

2. Material and methods

2.1. Plant Material Collection

The plant material used in this study was *Delonix regia* leaves, which were sourced from a local herbal garden in Aurangabad. The leaves were washed, air-dried, and powdered to receive fine particles[7].

Figure 2 Plant Leaves Collected

Figure 3 Plant Leaves Isolated

Figure 4 Plant Leaves Dried

Figure 5 Plant Leaves Grinded

2.2. Extraction of Dried Plant Leaves

100 grams of powdered leaves in 500 mL of methanol was extracted in Soxhlet for 72 hours. The Soxhlet procedure was repeated for totals of 500 grams of powdered leaves. The temperature of heating mental was maintained at 30 ˚C. The extract was filtered through a whatmann filter paper and solvent was air dried at 40 ˚C to obtain a thick extract[12].

Figure 6 Soxhlet Extraction Assembly

Figure 7 Plant Extract

2.3. Fungal Strains and Growth Conditions

The fungal strains used in the study were Trichophyton rubrum, Trichophyton mentagrophytes, Microsporum canis, and Candida albicans. All fungal strains were obtained from the local Microbial Culture Collection. Fungi were cultured on Sabouraud Dextrose Agar (SDA) plates at 30 ˚C for 7 days. Conidia were harvested by gently scraping the surface of the culture and suspending them in sterile saline[13].

Figure 8 Sabouraud Dextrose Agar (SDA)

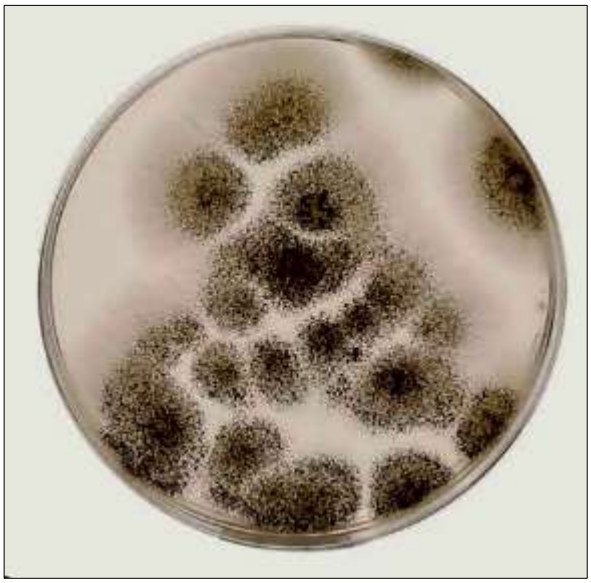

Figure 9 SDA with fungus growth

2.4. Antifungal Activity Testing

The antifungal activity of *Delonix regia* extract was evaluated using the Agar Well Diffusion Method. Briefly, 20 mL of molten SDA was poured into sterile Petri dishes, and a fungal suspension (10^6 CFU/mL) was spread evenly over the surface. Wells (6 mm diameter) were punched into the agar, and 100 µL of the extract (at varying concentrations: 50, 100, and 200 mg/mL) was added to the wells. Plates were incubated at 30˚C for 48 hours, and the zone of inhibition was measured. The experiment was conducted in triplicate[14].

2.5. Gel Formulations of Plant Extract

The gelling agent was dissolved in distilled water and gently heated to activate the gel forming properties. The plant extract was slowly mix in gel base by ensuring its uniform dispersion. The viscosity was adjusted by adding more gelling agent. Phenoxyethanol was added as a preservative to enhance the shelf life of the gel. The pH was adjusted between 5 to 7 using hydrochloric acid and sodium hydroxide. The finished gel was poured into sterilized container[15].

3. Results

3.1. Antifungal Activity of *Delonix regia* Extract

The methanolic extract of *Delonix regia* demonstrated significant antifungal activity against all tested fungi (Trichophyton rubrum, Trichophyton mentagrophytes, Microsporum canis, and Candida albicans). The zone of inhibition increased with the concentration of the extract. At 200 mg/mL, the extract showed the largest inhibition zone against Trichophyton rubrum (12.4 mm) and Candida albicans (10.3 mm), followed by Microsporum canis (9.6 mm) and Trichophyton mentagrophytes (8.2 mm)[14].

Figure 10 SDA without Extract Treatment

Figure 11 SDA Treated with Extract

3.2. Formulation of gel

The viscosity and pH were analysed, and it was found in between normal required limits. The shelf life was observed good to avoid microbial contaminations[15].

Figure 12 Formulated Gel

Figure 13 Ready to Use Gel

4. Discussion

This study highlights the significant antifungal potential of *Delonix regia* extract against a range of dermatophytes and yeasts. The observed zones of inhibition and MIC values are consistent with previous studies that have demonstrated the antimicrobial properties of *Delonix regia*. The methanolic extract of *Delonix regia* was particularly effective against dermatophytes such as Trichophyton rubrum, which is one of the most common causes of ringworm infections. The in vivo results further support the therapeutic potential of *Delonix regia* in treating fungal skin infections. Although its efficacy was lower than that of the standard antifungal agent terbinafine, the plant extract still showed promising results, especially when used in combination with terbinafine. This finding suggests that *Delonix regia* may have synergistic effects with conventional antifungal treatments, reducing the need for high doses of synthetic drugs[10].

Furthermore, the anti-inflammatory and antioxidant properties of *Delonix regia* likely contributed to the observed reduction in lesion size and inflammation, as inflammatory responses often exacerbate the symptoms of fungal skin disorders. The plant's ability to promote wound healing is also a key factor in the recovery process. The limitations of this study include the use of a single extraction solvent (methanol) and the need for more extensive clinical trials to confirm the safety and efficacy of *Delonix regia* in human subjects. Future research should focus on optimizing extraction methods, exploring other solvents, and conducting long-term clinical trials[13,14].

5. Conclusion

Delonix regia extract demonstrates significant antifungal activity against a variety of fungal pathogens, including dermatophytes and Candida species. The plant's antimicrobial properties, combined with its anti-inflammatory and antioxidant effects, make it a promising candidate for the treatment of fungal skin disorders. Further clinical studies are required to fully evaluate its safety, efficacy, and potential for use in combination with conventional antifungal agents.

Future directions

Animal study should perform to have specific outcomes regarding effect of the extract. Apart from this, it should undergo clinical trials to report its accurate efficacy and safety profile.

Compliance with ethical standards

Disclosure of conflict of interest

Authors have given their confirmation about this research work that they do not have any conflict of interest.

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