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Review Article

A Review On The Design, Formulation, And Characterization Of Effective Anti-Fungal And Anti-Microbial Poly-Herbal Formulations

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ABSTRACT

Fungal skin infections are a prevalent dermatological issue globally, affecting around 40 million people. Recently, there's been a surge in interest in herbal medicine, particularly in Ayurveda, where treatments often come in powder or kesaya basma forms. Various ethnic groups utilize medicinal plants to address health concerns in both humans and animals, as these plants produce secondary metabolites with antimicrobial properties. Screening these plants could yield effective, non-toxic, and cost-efficient alternatives to chemical fungicides. The rise of antimicrobial resistance emphasizes the need for innovative solutions, especially for common topical skin infections that present therapeutic challenges despite available antimicrobial agents. This study explores a herbal gel formulation incorporating Momordica charantia* L., *Cassia fistula* L., *Calendula officinalis* L., and *Abelmoschus moschatus* Medik, highlighting their pharmacological potential.

INTRODUCTION

In developing countries, pathogenic fungi and bacterial strains are significant causes of life-threatening infections, particularly in immunocompromised patients. While numerous antibiotics and antimicrobial agents can effectively kill or inhibit these pathogens, resistance is increasingly becoming a major issue, with many microbes exhibiting multidrug resistance. This ongoing challenge represents a serious public health threat, as traditional treatments not only fail but may also cause adverse side effects. This highlights the urgent need for safer, natural, and cost-effective antifungal and antibacterial alternatives. As microbial infections continue to pose serious clinical challenges with considerable morbidity and mortality, the focus on antimicrobial susceptibility testing and the discovery of novel agents is growing. The specificity of these agents has enhanced our understanding of complex biochemical processes, and there has been increased awareness of antimicrobial treatments across various

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applications. In India, traditional medicine systems such as Ayurveda, Unani, Siddha, and various tribal practices have long incorporated herbal remedies, including those with antifungal properties. Ayurveda, in particular, is the most widely practiced and respected among these systems. Over the past few decades, there has been a notable shift in how herbal medicine is viewed in developed countries. Once seen as outdated and unreliable, herbs with antifungal benefits, such as neem and turmeric, are now recognized for their potential in treating fungal infections. This shift began in the 1960s with the 'hippie' movement, which emphasized natural living and alternative therapies [1,2]. The rise of the conservation movement and the establishment of companies that focus on eco-friendly, natural products also played a role in this change. Today, a variety of herbs with antifungal properties are available in different forms, including fresh, dried, and as ingredients in cosmetics, perfumes, and over-the-counter medications. While conventional medicine continues to advance, the resurgence of interest in herbal remedies highlights their historical importance and effectiveness. For most of human history, plants have been the primary treatment for a range of ailments, including fungal infections, and their relevance is growing once more as resistance to conventional antifungal treatments increases [2,3].

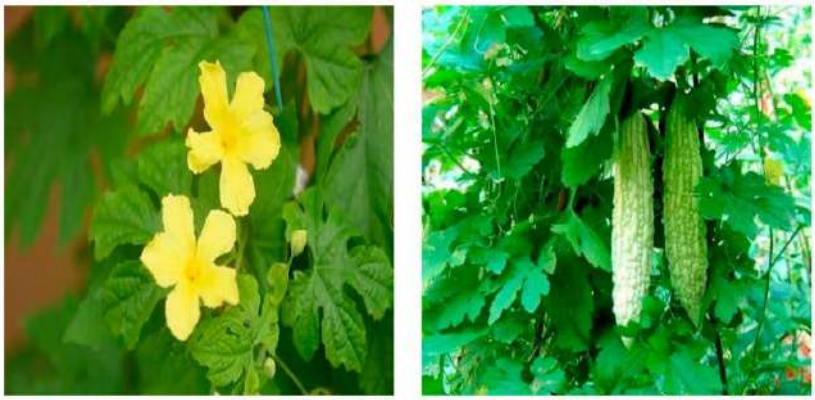

Figure 1: The above two pictures show the morphological characteristics of the M. charantia: (a) leaf and flowers (b) unripe fruits.

Plants like *Momordica charantia* L., *Cassia fistula* L., *Calendula officinalis* L., and *Abelmoschus moschatus* Medik. have been utilized for their medicinal properties across various traditional systems. - Momordica charantiaL. (Bitter melon) is known for its potential in managing diabetes and its anti-inflammatory properties. -Cassia fistula L. (Golden shower tree) is celebrated for its laxative effects and its role in treating digestive disorders.

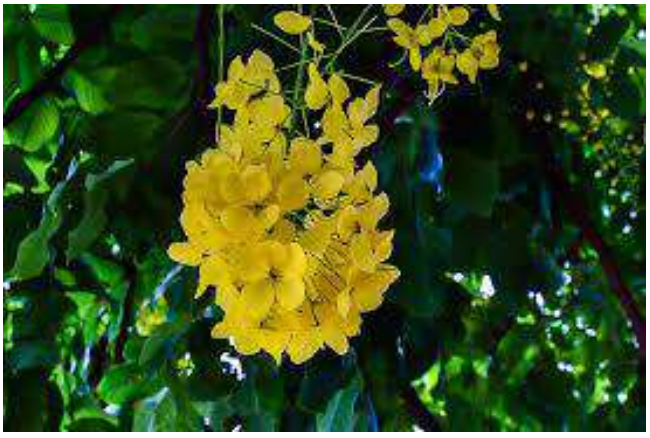

Figure 2: The above two pictures show the morphological characteristics Cassia fistula* L

- Calendula officinalisL. (Marigold) is widely used for its anti-inflammatory and wound-healing properties.

- Abelmoschus moschatus Medik. (Musk mallow) is recognized for its antimicrobial and anti-inflammatory benefits [4,5,6]. These plantsare rich in various phytochemicals such as flavonoids, saponins, and alkaloids, which contribute to their therapeutic effects. The study of these plants aims to explore their antifungal activities and their potential use in combined formulations to enhance efficacy. Gel formulations are particularly suitable for these applications due to their ease of application, prolonged contact time, and minimal side effects compared to other topical or oral treatments. Antifungal medications, including azoles, polyenes, echinocandins, and pyrimidine analogs, are commonly used to treat denture stomatitis. However, the effectiveness of these treatments is diminishing, largely due to the development of antifungal resistance, varying resistance profiles among Candida species, and issues with patient adherence to treatment regimens [7,8]. There has been a growing shift towards using natural substances, such as phytochemicals, to address fungal infections. Advances in science have led to the identification of more pharmacologically active Ayurvedic medicines that offer effective treatment options. The beneficial effects of these herbal medicines are attributed to their bioactive compounds, including saponins, tannins, alkaloids, and flavonoids [9]. Terpenoids and sesquiterpenes are examples of compounds that work together to produce beneficial effects. Herbal treatments are increasingly favored for their compatibility with biological systems and their reduced side effects compared to synthetic medications. For many years, essential oils and herbal extracts have been used in pharmaceuticals, alternative medicine, and natural therapies. These oils and extracts are well-known for their antimicrobial properties and other uses, such as in perfumes (cedarwood and rosewood), flavoring agents (lime and juniper oil), and preservatives (lemongrass oil). Herbal preparations consist of active substances derived from one or more herbs, including various plant parts such as leaves, flowers, fruits, seeds, stems, bark, or roots, either fragmented or powdered. When multiple herbs are combined, the result is a mixed herbal product or polyherbal formulation [10,11]. These polyherbal formulations benefit from the synergistic effects of their active constituents, often providing enhanced therapeutic outcomes and better patient compliance compared to single-herb formulations. Additionally, they are generally more affordable, eco-friendly, and safe. Topical biphasic dosage forms offer properties between solid and liquid dosage forms and possess distinctive rheological properties. They are advantageous for their ease of application and prolonged presence at the site of application. Gels, in particular, are valued for their compatibility with various excipients, thixotropic nature, easy spreadability, and non-staining, greaseless characteristics.

CHALLENGES

- Acceptance and Effectiveness: Herbal formulations are widely accepted for their therapeutic properties, including antifungal, anti-inflammatory, antimicrobial, and anti-aging effects. They often outperform synthetic alternatives in terms of therapeutic outcomes.
- Objective Evaluation: Assessing conflicting data on toxicity, epidemiology, and the authenticity of herbal materials is essential for ensuring safety and efficacy.
- Lower Toxicity: Herbal products tend to be less toxic and are less likely to cause skin irritation compared to synthetic options.
- Long History of Use: The longstanding use of herbal drugs fosters better patient compliance and trust.
- Cost-Effectiveness: Herbal formulations are generally more affordable than synthetic gels, making them accessible to a broader audience.

- Risk Management: Effective management of herbal products within acceptable risk levels is necessary to ensure safety.
- Documentation Requirements: Comprehensive pharmacological, toxicological, and clinical documentation is needed to validate the efficacy and safety of herbal formulations. This study aims to develop and evaluate a polyherbal gel containing extracts from *Momordica charantia* L., *Cassia fistula* L., *Calendula officinalis* L., and *Abelmoschus moschatus* Medik. The focus is on comparing the antifungal activity and clinical efficacy of this gel against commercially available options for treating antifungal antimicrobial action [14,15].

DISCUSSION

The use of plants as a source of medicine is a longstanding tradition in India, forming a crucial part of the healthcare system. Practitioners often create their own formulations, underscoring the need for thorough documentation and research. Herbal medicine has gained international significance, both medicinally and economically, with various plant parts—including leaves, roots, stems, fruits, flowers, and whole plants—being utilized for their therapeutic properties. Plants such as *Momordica charantia* L., *Cassia fistula* L., *Calendula officinalis* L., and *Abelmoschus moschatus* Medik are recognized for their antioxidant, anti-inflammatory, anti-diabetic, and antibacterial activities. These medicinal plants are rich in biologically active compounds, including carbohydrates, proteins, terpenoids, flavonoids, and phenolic compounds, which contribute to disease management and overall health. Despite the rising popularity of herbal remedies, concerns regarding their quality, safety, and efficacy persist, especially as antimicrobial resistance becomes more prevalent due to the increased use of conventional antifungal and antimicrobial agents. Many ethnic communities continue to rely on these plants for treating various ailments in both humans and animals. Their secondary metabolites exhibit antimicrobial properties, making them valuable for developing treatments against infections and managing chronic wounds. The challenge of antimicrobial resistance has spurred heightened interest in exploring these plants for new solutions. The growing prevalence of microbial infections necessitates the development of innovative materials with antimicrobial properties. Gels, in particular, have become crucial in medical applications, including drug delivery and wound management, by providing selective antimicrobial activity.

CONCLUSION

Essential oils and extracts from aromatic plants exhibit potent antimicrobial properties against various fungi and bacteria. Historically, herbs have served as the foundation of primary healthcare across cultures, playing a crucial role in the advancement of modern medicine. The frequent use of allopathic drugs often leads to adverse side effects, prompting a resurgence of interest in herbal remedies, which are now regarded as safe alternatives to synthetic options. The careful selection of plants at the right concentrations is vital for achieving the desired therapeutic effects. To prioritize consumer safety, researchers are working to introduce complementary antimicrobial agents, aiming to reduce reliance on chemical preservatives and antibiotics. Conventional chemicals can lead to numerous health issues, such as liver damage, kidney failure, skin allergies, and the rise of multidrug-resistant pathogens. Encouragingly, some bacteria resistant to traditional antibiotics are still vulnerable to essential oils and herbal extracts from spices and condiments. Given the alarming rise in new and reemerging infectious diseases, there is a pressing need to discover new antimicrobial compounds

with diverse chemical structures and innovative mechanisms of action.

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AUTHORS CONTRIBUTIONS

All the authors have contributed equally

CONFLICT OF INTERESTS

Declared none

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