

REVIEW ARTICLE

Herbs Used in Fungal Infection: A Brief Review

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ABSTRACT

Fungal skin infections are among the most prevalent dermatological conditions today. An estimated 40 million people have fungal infections, according to research. Mucous membranes, keratinous tissues, and the skin are all impacted by superficial and subcutaneous fungal infections. The field of herbal medicine has grown exponentially in the last several decades. Because of its natural origin and few negative effects, it has become increasingly popular in developed and developing nations. Plant-based natural medicines are still utilized as therapeutic agents, particularly for treating illnesses caused by bacteria, fungi, viruses, protozoa, helminths, etc. The application of plant components to stop fungal infections brought on by different pathogens is the main topic of this review. It will therefore prove advantageous for the pharmaceutical industries.

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INTRODUCTION

These days, fungus-induced skin infections are among the most prevalent dermatological issues. Physicians can choose from a variety of therapy options, including liquid dosage formulation, semisolid dosage form, and solid dose form. Clear, transparent gels are a popular topical formulation in the cosmetics and pharmaceutical industries. Clinicians and patients have access to a wide range of vehicle preparations, from solids to semisolids and liquids, for the topical treatment of dermatological diseases as well as skincare. The use of herbal treatments as a natural substitute for conventional medications has gained popularity in recent years.[1] The majority of the population is at significant risk for contracting diseases that are commonly caused by microorganisms in developing countries, as evidenced by the findings of state or private health care systems. The financial crisis, the astronomical cost of manufactured drugs, and the inefficient public health and pharmaceutical care systems. Antifungal medications can be used to treat more serious systemic infections such as cryptococcal meningitis as well as fungal diseases including athlete's foot, ringworm, and candidiasis (thrush). These medications are typically purchased over the counter or with a prescription from a physician. However, the common usage of these medications renders them worthless because of antibiotic resistance and toxicity from continuous use.[2] Among the various health concerns, fungal infections pose a significant challenge, affecting millions of individuals worldwide. Antifungal herbal formulations have emerged as a promising solution, offering a holistic approach to combat these infections while minimizing the side effects associated with synthetic drugs.[3] Because antifungal classes are becoming limited and human pathogenic fungi are acquiring diversified drug resistance, research is currently being done to find novel antifungal drugs from other sources, like medicinal plants.[4]

SEVERAL THERAPEUTIC HERBS WITH ANTIFUNGAL QUALITIES

CURCUMIN LONGA

Indian golden spice is the name given to turmeric. Tall and perennial, *Curcuma longa* is known for its underground rhizomes, which are primarily oval, oblong, pyriform, and short-branched plants. It functions as a scavenger of oxygen free radicals and aids in preventing haemoglobin oxidation. Turmeric can help treat breast and prostate cancer by inhibiting the proliferation of cancer cells.[5]

Curcuma longa, sometimes referred to as ambī Haldar, has demonstrated fungicidal effectiveness with a minimum inhibitory concentration (MIC) of 32–128 µg/mL against 200 clinical specimens of different *Candida species*, including *C. tropicalis*, *C. glabrata*, and *C. albicans*. For the tested *Candida species*, curcumin, and amphotericin B have also shown synergistic action; however, in certain instances, the combination of fluconazole and curcumin produced beneficial effects instead of dynamic effects.[6] These findings imply that curcumin may be more effective against systemic fungal infections such as candidemia and candidiasis when combined with fungicide drugs that are presently on the market.[7]

OCIMUM SANCTUM

Ocimum sanctum, also known as Tulsi, is an aromatic plant in the Lamiaceae family that is used extensively in medicine and cooking. It comes from the Indian subcontinent and has been utilized for more than three millennia in Ayurvedic medicine. The medicinal herb *ocimum sanctum* possesses pharmacological qualities such as anabolic, hypotensive, cardiac depressive, smooth muscle relaxant, antifertility, and antistress activity. Its extract demonstrates antifungal properties. [8-9]

The findings of this investigation indicated that the antifungal activity might be attributed to the phytochemical ingredients. The secondary metabolites found in the leaves and stems of *Ocimum sanctum*'s methanolic and ethanolic extracts, such as flavonoids, are what give these extracts their effectiveness and could have a significant role in the advancement of the pharmaceutical industry as a therapeutic agent for a range of illnesses. Plant extracts containing ethanol and methanol have been shown to have relevant inhibitory effects on pathogens under test.[10-12]

ALOE VERA

The pulp of *A. vera* inhibited *F. oxysporum* at 104 µl-1 and for a longer duration of time when applied to aloe vera. Both of the Aloe fraction kinds showed comparable activity. Moreover, the liquid fraction slowed the rate of colony development in *R. solani*, *F.oxysporum*, and *C. coccodes* at an amount of 105 µl 1-1. When applied to the *Aspergillus Niger* and *F. oxysporum* 18.5 mm and 18 mm zones of inhibition, leaf extract exhibits good effects.[13]

Experiments were done on the materials to find out how well-dried latex (*Aloe medicine*) and extractives of *Aloe vera* made from hexane, ethyl acetate, and methanol worked against different phytopathogenic fungi and what the active components' chemical makeup was. Thin-layer chromatographic bioautography was used to assess the extractives efficacy against *Cladosporium cucumerinum*, while the poisoned food technique was utilized to assess the extractive's efficiency against *Fusarium solani*, *Colletotrichum gloeosporioides*, and *Colletotrichum capsici*. Non-polar extractives made from hexane had lower activity than polar extractives made from methanol and ethyl acetate. When compared to *F. solani*, the extractives showed increased efficacy against species of *Colletotrichum*. [14-15]

Owing to their potency against both *Colletotrichum gloeosporioides* and *Cladosporium cucumerinum*, two components, aloin, and aloe-emodin, were identified as active principles.[16]

SOLANUM XANTHOCARPUM

The Indian nightshade, which is widely distributed throughout the country's dry regions, is well renowned for its ability to keep pests away. The study demonstrated the methanolic extract's strong antifungal effects. The methods of micro broth dilution, percent spore germination suppression, and disc diffusion are used to carry out the antifungal activities.[17-18]

Upon desiccation and methanol dissolution, the sample's final concentration was determined to be 0.1 mg/1000µl. After preparing and autoclaving the SDA medium, *Aspergillus Niger* fungal inoculum was added to the media plate. *Aspergillus Niger* was reported to exhibit a larger zone of inhibition than *Aspergillus flavus*, so this species required a minimal fungicidal dosage to be effective.[19]

PIPER BETLE

Phenolic characteristics of *P. betle* include antiproliferation, neuropharmacological, analgesic, antioxidant, hepatoprotective, antibacterial, antifungal, and anti-fertility effects.

All test pathogens, except *M. phaseolina*, showed greater than 50% inhibition against *P. betle* other sources of antifungal compounds for crop or plant protection against fungal infection could include the ethanolic extract of several higher plants. The extract demonstrated anticandidal action on *C. albicans* subcultures. The mature betel leaf's maximal zone of inhibition was seen in the ethyl acetate extract (26 mm). The MIC values of betel leaf extract were higher, at 125 µg/ml. Comparing these findings to those of fluconazole (62.5 µg/ml), they were, nevertheless, high. Compared to fluconazole, the ethyl acetate extract of mature betel leaf had better anticandidal action.[20]

ADHATODA VASICA

India is home to the well-known Vasaka or Malabar nut tree. The vasaka plant is a perennial that is evergreen, has many branches, a bitter taste, and an unpleasant Odor. It may survive for several seasons and keep its leaves all year round.[21] Various diseases and disorders, especially those affecting the

respiratory tract, have been claimed to be treated using leaves. For several illnesses, including ringworm and athlete's foot, it is a strong antifungal agent.[22]

ACORUS CALAMUS

The β -asarone compound fraction, which is derived from the crude methanolic extract of *Acorus Calamus* rhizomes, has been found to exhibit antifungal activity against *Aspergillus Niger*, *Saccharomyces Cerevisiae*, *Cryptococcus neoformans*, and *Candida albicans* yeast strains. Against all four test pathogens, the rhizome extract of *A. calamus* showed the strongest antifungal efficacy, fully (100%) suppressing mycelial development.[23-24]

WITHANIA SOMNIFERA

It has been determined how effective several extracts derived from various ashwagandha plant parts are against fungi. A range of test fungal species, including *Alternaria brassica*, *Aspergillus flavus*, *Aspergillus fumigatus*, *Aspergillus Niger*, *Aspergillus oryzae*, *Candida albicans*, *Candida kefy*, *Candida tropicalis*, *Cryptococcus neoforman*, *Dreschlera turcica*, *Fusarium oxysporum*, *Fusarium verticilloides*, *Penicillium chrysogenum*, *Penicillium citrinum*, and *Trichoderma viridae* were used to assess the antifungal activity of ashwagandha.[25]

Among the plant parts used to assess the antifungal activity were the calyx, flower, fruits, leaves, roots, and stem. The ashwagandha root was the part of the plant that was most frequently used. A variety of solvents were utilized during the extraction procedure to evaluate the antifungal activity of various ashwagandha components, including acetone, benzene, chloroform, ethanol, ethyl acetate, glacial acetic acid, hexane, isopropanol, methanol, petroleum ether, toluene, and hot and cold water. Nevertheless, methanol was the preferred solvent for removing phytochemicals from certain ashwagandha parts.[26]

This study investigated the antifungal activity of *W. somnifera* root extract (at 0.5, 1.0, 2.0, and 2.5g) against *Fusarium solani* using clotrimazole (1%), as a reference, and a filter disc without extract as a control. The extract had a more potent inhibitory impact on *F. solani* growth than clotrimazole.[27]

GLYCYRRHIZA GLABRA

Licorice has traditionally been used by Chinese medical practitioners to treat fungal infections, including ringworm. The reason behind this is that out of all the herbs, licorice has the highest concentration of antifungal chemicals. You can either make a direct application of dried licorice by boiling it, or you can incorporate it into your garlic footbath.[27]

MENTHA PIPERITA

The composition and antifungal characteristics of *Mentha piperita* oil were investigated using the agar dilution method on *Fusarium oxysporum f. sp. ciceri*, *Macrophomina phaseolina*, and *Dreschlera Oryza*. The test was conducted in duplicate factorial trials with a random complete block design. Based on GS/MS analysis, the main components of the essential oil are menthol (19.76%), menthan-3-one (19.31%), menthofuran+isomenthone (9.12%), 1, 8-cineole+beta phellandren (8.8%), and menthol acetate (5.63%).[28]

ALLIUM SATIVUM

Six fractions produced from garlic were tested for their antifungal efficacy using an in vitro system. Ajoene was the most active component in these fractions. Ajoene inhibited the development of *Aspergillus Niger* and *Candida albicans* at concentrations below 20 micrograms/ml. Scientific studies have demonstrated the effectiveness of garlic as a treatment for fungus infections, such as athlete's foot. Soaking the affected foot in a tub of warm water containing several cloves of garlic usually relieves itching and burning in the affected area. Garlic can also be applied directly to the affected area at least once a day by soaking it in olive oil.[29-30]

ZINGIBER OFFICINALIS

Some of the most common fungal infections can be inhibited in growth by ginger (*Zingiber officinale*). We'll talk about studies that show ginger can fight off the fungi that cause yeast infections and ringworm/tinea. As a result, it can be used to treat conditions like various types of yeast infections and athlete's foot (tinea pedis).[31]

At least twice a day, apply a mixture made from a single teaspoon of simmered ginger root along with a cup of hot water straight to the affected area of the foot. Caprylic acid, a component of ginger, has potent antifungal properties.[32-33]

CASSIA ALATA

Regarding *Candida albicans*, *Penicillium sp.*, *Aspergillus fumigatus*, *A. flavus*, *Mucor sp.*, and *Rhizopus sp.*, the leaf extract showed no notable effects. On the other hand, *Trichophyton mentagrophytes*, *T. rubrum*, and *Microsporum [Microsporum] gypsum* were completely inhibited from growing at a concentration of 2.5% w/v. The investigation's findings suggest that *Cassia alata* is more effective than some human pathogenic fungi at suppressing fungal growth. Further investigation into the effectiveness and safety of

this intriguing plant is therefore encouraged, to replace certain less successful herbs in clinical practice.[34]

CONCLUSION

The antifungal qualities of extracts of medicinal plants chosen for their repute in the Indian traditional medical system and Ayurveda were examined. Based on a review of the literature, it was found that many drugs become worthless because of antibiotic resistance and toxicity from continuous usage. As a result, herbal remedies that are safe to use alongside synthetic treatments are important medications for the future.

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