

## REVIEW ARTICLE

# Exploring Antifungal Action of Medicinal Plants: A Comprehensive Review

Achal Chhangani, Sonia Singh, Nikhil Sutar, Pallavi R. Kaple, Savitri Mali

Alard College of Pharmacy, Marunje, Pune

Corresponding Author: Achal Chhangani

### ABSTRACT

The need for the development of novel antifungal therapies arises from the rise in the prevalence of fungal infections in humans, and the limits of existing antimycotic medications, including the creation of resistance strains. There is no end to the possibilities for creating novel antifungals when it comes to plants, particularly those utilized in traditional medicine, which are associated with an unparalleled chemical diversity in both pure chemicals and plant extracts. Compounds from several phytochemical families, such as peptides, polyphenols, saponins, and essential oils and their components, have been shown to have antifungal action in recent years. ethnopharmacologically chosen plants have been studied and reviewed, primarily our research has reported the antifungal activity of several plant elements with some of their efficacy and action against fungal infection.

**Keywords:** Herbal, Antifungal, Medicine, Herbal extract, Toxicity, Herbs.

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## INTRODUCTION

Resistance to antibiotics has been on the rise in recent years, posing significant challenges to social well-being, mortality rates, and treatment effectiveness. It is important to note that humans and fungi share certain molecular mechanisms, which means that drugs used to combat fungal infections might also be toxic to bacteria. This issue is particularly concerning for individuals dealing with medical conditions like AIDS, organ transplants, chemotherapy, and diabetes. Existing medications for fungal infections have their limitations, including the development of further infections and adverse side effects. For almost three decades, broad-spectrum amphotericin B has been the primary drug available, despite its potential for severe nephrotoxicity in humans. In the 1980s and early 1990s, imidazole and triazoles showed promise in inhibiting fungal cell processes, but they have also been associated with reinfection and limited effectiveness. To address these challenges, there is a pressing need to discover new drugs that are safer and more efficient in combating significant fungal infections. Folk medicine has a long research history, with medicinal plants being a key source of bioactive compounds for treating diseases. Although there are hundreds of thousands of plant species, only a small percentage is utilized by humans. Some compounds derived from plants, like dimethyl pyrrole and indole derivatives, have shown antibacterial properties, but effective antibiotic production is still lacking. This review focuses on important antimicrobial agents found in higher plants, including flavonoids, phenols, and sulfur compounds. These secondary metabolites have demonstrated antifungal activity. In this study, we will discuss various plants from day-to-day life as well as some medicinal plants that are useful to cure fungal infection or can be used as an antifungal agent to prevent fungal infection. [1,2]

## PLANTS WITH ANTIFUNGAL EFFECT

- 1. Garlic (*Allium sativum*):** Garlic has allicin in it, which is effective against many fungi. Garlic extract may be more effective than standard antibiotics for fungal infections and less likely to cause cryptococcal meningitis. A study showed that consuming garlic improved *Candida albicans* infections in chickens after ten days. Another study shows that the ethanolic extract of garlic had an inhibitory

effect against the fungi tested, *Rhizopus* was sensitive to the aqueous extract, while *Fusarium* was sensitive to the ethanolic garlic extract. [3,4]

2. **Tea Tree (*Melaleuca alternifolia*):** Tea tree oil (TTO) is a natural oil with antifungal properties. It contains over a hundred different compounds, with terpinen-4-ol being the main compound responsible for its antifungal effects. The researchers discovered that 22 distinct strains of *Malassezia furfur* were more susceptible to tea tree oil. [5,6]
3. **Oregano (*Origanum vulgare*):** *Origanum* species is a diverse perennial herb that is found in various regions across the globe. Its extracts and derivatives are extensively used in traditional medicine because of their antifungal. Common compounds found in *Origanum* species include phenols, terpenes, and derivatives like thymol, carvacrol, linalool, limonene, and  $\beta$ -caryophyllene. Previous studies show that *Origanum* species exhibit antimicrobial activity against many phytopathogenic fungi and bacteria. According to another study, extract works best against black and yellow yeast. [7,8]
4. **Neem (*Azadirachta indica*):** Neem leaf oil is effective against a variety of bacterial and fungal infections. It has been found to inhibit the growth of fungal strains including *Fusarium oxysporum* and *Penicillium*. According to the study, neem extract had efficacy against *Candida albicans* that was superior to 2% CHX and on par with 3% NaOCl. Chlorhexidine, sodium hypochlorite, and *Candida albicans*. [9,10]
5. **Turmeric (*Curcuma longa*):** Ether and chloroform extracts and turmeric oil have anti-inflammatory properties. Crude ethanol extract also has anti-inflammatory properties. Turmeric oil is also effective against *Aspergillus flavus*, *Aspergillus parasiticus*, *Fusarium moniliforme*, and *Penicillium digitatum*. According to the study at dilutions of 1:40–1:320, turmeric oil inhibited 15 types of dermatophytes and at dilutions of 1:40–1:80, four distinct fungal isolates were suppressed by turmeric oil. [11,12]
6. **Clove (*Syzygium aromaticum*):** Clove oil, derived from aromatic cloves is described as an effective antifungal and is widely used in medicine. Previous studies have reported the antifungal activity of clove oil against yeasts and filamentous fungi such as many bacterial fungi and human pathogenic fungi. Clove basic oil has appeared the capacity to repress the development of *Venturia inaequalis*, *Candida albicans*, *Candida glabrata*, and *Candida tropicalis*. [13,14]
7. **Ginger (*Zingiber officinale*):** Studies have shown that ginger compounds have high antifungal activity, with fungi being more sensitive to them than bacteria. The essential oil has a higher effect on *Candida albicans* and *Aspergillus niger*, with 1  $\mu$ L/mL being the inhibitory concentration. The action mechanism of essential oil is not clear, but it contains substances like zingiberene, zingerone, and trans-[6]-shogaol that have high antifungal action. Ginger essential oil shows an inhibitory effect on mycotoxins *fumonisin B1* and *fumonisin B2* produced by *Fusarium verticillioides*. [15]
8. **Thyme (*Thymus vulgaris*):** Thyme essential oil has a wide range of antifungal properties. The vapor phase of the oil exhibits long-term inhibitory activity against mold in wet environments. Thyme and thymol essential oils can be used in low concentrations to kill fungi on the topical part of the body. [16]
9. **Rosemary (*Rosmarinus officinalis*):** The chemical composition, genetic diversity, and antifungal properties of rosemary plants were examined. It is used in folk medicine as an antispasmodic to treat renal colic. Rosemary relaxes and shifts the smooth muscles in the trachea and has choleric, hepatoprotective, and anti-tumor functions. Studies on the activity of rosemary oil were found against *Alternaria alternata*, *Botrytis cinerea*, and *Fusarium oxysporum*. [17,18]
10. **Chamomile (*Matricaria chamomilla*):** Chamomile has been one of the most used and prescribed medicinal herbs for centuries. Chamomile components are often used for their antifungal properties. Chamomile treatment belongs to many active substances, such as phenolic and flavonoids apigenin, quercetin, flavonoids, luteolin, and their glycosides which can act as an antifungal agent. A previous study concluded that chamomile is effective against *Aspergillus flavus*, *Aspergillus niger*, *Aspergillus terreus*, and *Fusarium culmorum*. [19,20]
11. **Black Walnut (*Juglans nigra*):** Walnut green shell works as a readily available source of natural bioactive compounds with potent antioxidant activity. Additionally, fruit extracted with chloroform can inhibit the growth of different fungi. Phenolic compounds in it especially flavonoids, participate in the plant's defense mechanisms against fungal diseases. The protection of the extract and one of its products was investigated against four fungi and three dermatophytes *Microsporum canis*, *Trichophyton mentagrophytes*, and *Trichophyton rubrum*. [21,22]
12. **Grapefruit Seed Extract (*Citrus paradisi*):** Grapefruit seed extract (GSE) is a natural plant product and contains many polyphenolic compounds. Flavonoids account for approximately 80% of the polyphenolic compounds in GSE, indicating that GSE has a stronger inhibitory effect on *Candida*

*albicans* and NACS than flavonoid-containing plant extracts. Indeed, we have previously reported that GSE has an inhibitory effect on *Candida albicans* biofilms on tooth root resin. GSE has bactericidal activity against *Candida albicans*. *Candida albicans* and NACS have no side effects when applied to the oral mucosa. Therefore, GSE may be an alternative to conventional medicine for immunocompromised patients.[23]

13. **Licorice (*Glycyrrhiza glabra*):** Sato *et al.*(2000) reported that the methanol extract of licorice has bactericidal activity against licorice and *Chaetomium*, while glabridin was found to be responsible for these effects (Sato et al. People) *Ib.*, 2000). Isoflavones such as glabridin, glycyrrhizin, and their derivatives are responsible for inhibiting *Mycobacterium smegmatis*, *Shigella*, *Salmonella*, and *Escherichia coli* in the body. *Escherichia coli*, *Streptococcus mutans*, and *Lactobacillus acidophilus* (Ajagannavar et al., 2014). Recently, Chandra and Gunasekaran (2017) also reported the antibacterial activity of crude methanolic extract of Aphrodisiac against *Alternaria koji*. [24]
14. **Basil (*Ocimum basilicum*):** The fungicidal properties of two chemotypes of basil (*Ocimum basilicum*) oil and its main components were examined by in vitro and in vivo experiments. Both methylpiperol chemical type oil and linalool chemical type oil reduces the mycelial growth of the plant pathogenic fungus *Bacillus leguminosarum* and the main effect of this oil is to reduce fungal diseases where methylpiperol, Linalool, Eugenol, and eucalyptus oil reduce the growth. Mixing pure oil components in the same proportion as the entire oil led to a reduction in the growth of fungal infections; This shows that the antifungal effect of the whole oil is the main factor of the important ingredient. [25]
15. **Gotu Kola (*Centella Asiatica*):** It is a rich source of amino acids, phenols, terpenoids, carbohydrates, and *Candida* in the source. Many scientific studies on *Centella Asiatica* prove its antifungal agent and different medicinal and therapeutic properties for the skin. It is protective, cardioprotective, radioprotective, and can heal wounds. Studies have shown that *Centella Asiatica* is potent against many fungi such as *Aspergillus niger* and *Candida albicans* also against *Aspergillus flavus* and *Penicillium citrinum*. [26,27]

## CONCLUSION

Despite significant medical advances in recent years, fungal infections are still a major health problem due to the ineffectiveness of current antibiotics. The plant kingdom is the source of traditional medicine and has many biological properties, providing great potential for the development of new drugs. Over the past few years, studies by various groups have shown that many types of drugs have excellent immune responses. Unsaturated fatty acids, polyphenols, triterpene derivatives, and especially essential oils have proven to be beneficial species. Some of these are related to commercial antibiotics used in medicine. Synergistic effects of certain ingredients have also been reported for combinations such as essential oils. As per the study, these fifteen plants are grown globally which has promising antifungal effects.

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