# A REVIEW ON HERBAL DRUGS USED FOR FUNGAL INFECTION

Saroj Kumari *, Priya Sharma

* Assistant Professor, School of Pharmacy and Emerging Sciences, Baddi University of Emerging Sciences and Technology, Baddi, Solan - 173205, Himachal Pradesh, India.

## Abstract

Fungal infections pose a significant global health challenge, affecting millions of people annually. Conventional antifungal therapies, such as azoles, polyenes, and echinocandins, often face limitations like drug resistance, high toxicity, and elevated treatment costs. As a result, there is growing interest in exploring herbal drugs as alternative or complementary treatments due to their natural origin, lower side effects, and broad-spectrum antimicrobial properties. This review compiles and analyzes the efficacy, mechanisms, and therapeutic potential of various medicinal plants and herbal formulations used in the treatment of fungal infections.

Numerous studies have demonstrated the antifungal activity of herbs such as Allium sativum (garlic), *Azadirachta indica* (neem), *Ocimum sanctum* (holy basil), *Curcuma longa* (turmeric), and *Aloe vera*, which contain bioactive compounds like allicin, azadirachtin, eugenol, curcumin, and acemannan, respectively. These compounds exhibit antifungal effects by disrupting fungal cell membranes, inhibiting spore germination, and interfering with essential metabolic pathways. Additionally, essential oils from plants like *Cinnamomum zeylanicum* (cinnamon), *Melaleuca alternifolia* (tea tree), and *Thymus vulgaris* (thyme) have shown potent fungicidal activity against dermatophytes, Candida species, and Aspergillus strains.

Traditional medicine systems, including Ayurveda, Traditional Chinese Medicine (TCM), and African herbal medicine, have long utilized plant-based remedies for fungal diseases. Modern scientific validation supports many of these traditional claims, highlighting the potential of herbal drugs as effective antifungal agents. However, challenges such as standardization of extracts, bioavailability, and clinical efficacy remain areas requiring further research.

This review emphasizes the need for more in vitro, in vivo, and clinical studies to establish the safety, dosage, and synergistic effects of herbal antifungals. Integrating phytomedicine with conventional treatments could offer a sustainable approach to combating drug-resistant fungal infections while minimizing adverse effects. The findings underscore the importance of preserving ethnobotanical knowledge and advancing research on plant-derived antifungals to develop novel therapeutic options.

**Keywords:** Herbal drugs, antifungal activity, medicinal plants, fungal infections, bioactive compounds, traditional medicine, phytotherapy.

## Introduction

Fungal infections are a major public health concern, affecting millions of individuals worldwide, particularly those with weakened immune systems, such as HIV/AIDS patients, diabetics, and individuals undergoing chemotherapy or prolonged antibiotic therapy. Common fungal pathogens include *Candida albicans*, *Aspergillus fumigatus*, and dermatophytes such as *Trichophyton* species, which cause superficial infections like athlete's foot, ringworm, and life-threatening systemic infections such as candidiasis and aspergillosis. Conventional antifungal drugs, including azoles (fluconazole), polyenes (amphotericin B), and echinocandins (caspofungin), are widely used but are often associated with drawbacks such as drug resistance, toxicity, and high treatment costs. The increasing prevalence of multidrug-resistant fungal strains has further complicated treatment strategies, necessitating the exploration of alternative therapeutic approaches.

Herbal medicines have gained significant attention as potential antifungal agents due to their natural origin, minimal side effects, and broad-spectrum antimicrobial properties. Plants produce a variety of secondary metabolites, such as alkaloids, flavonoids, terpenoids, and phenolic compounds, which exhibit potent antifungal activity by disrupting fungal cell membranes, inhibiting enzyme function, or interfering with DNA replication. Traditional medicine systems, including Ayurveda, Traditional Chinese Medicine (TCM), and African herbal medicine, have long utilized plant extracts to treat fungal infections, providing a rich repository of knowledge for modern drug discovery.

Despite the promising potential of herbal antifungals, challenges such as lack of standardization, variability in bioactive compound concentrations, and limited clinical trials hinder their widespread adoption. This review aims to compile and evaluate scientific evidence on medicinal plants with antifungal properties, their mechanisms of action, and their therapeutic applications. By bridging traditional knowledge with modern research, this study highlights the potential of herbal drugs as effective, safe, and sustainable alternatives or adjuncts to conventional antifungal therapies. Herbs have been used for centuries to treat a variety of ailments, including fungal infections. There is a growing body of scientific evidence to support the use of herbs for antifungal purposes.

The commonly used herbs for antifungal purposes include: Garlic, Oregano oil, Neem, Tea tree oil, Pau d'arco, Calendula, Coconut oil, Clove oil, Cinnamon oilm Ginger.

These herbs work in a variety of ways to kill or inhibit the growth of fungi. Some herbs, such as garlic and oregano oil, contain compounds that can damage the cell membranes of fungi. Other herbs, such as tea tree oil and pau d'arco, contain compounds that can interfere with the fungi's ability to produce energy.

Herbs can be used to treat a variety of fungal infections, including: Athlete's foot, Ringworm, Jock itch, Yeast infections, Vaginal infections, Nail fungus.

Herbs can also be used to prevent fungal infections. For example, people who are at risk for developing athlete's foot can take garlic supplements or apply tea tree oil to their feet.

It is important to note that herbs are not always effective in treating fungal infections. In some cases, herbs may need to be used in conjunction with conventional antifungal medications. It is also important to talk to a doctor before taking herbs, especially if you are pregnant, breastfeeding, or have any other health conditions.

Here are some additional things to keep in mind when using herbs for antifungal purposes:

- It may take several weeks or even months to see results.
- Herbs can interact with other medications, so it is important to talk to your doctor before taking them.
- Herbs may not be effective for everyone.

## 1. Garlic

Garlic (*Allium sativum*) has long been recognized for its potential antifungal properties. It contains several bioactive compounds that contribute to its therapeutic effects, including allicin, ajoene, and sulphur compounds. While scientific research on garlic's antifungal properties is limited, preliminary studies suggest its effectiveness against certain fungal species. Here is a detailed note on garlic as an antifungal drug:

- **Mechanism of action:** Garlic exerts its antifungal effects through multiple mechanisms. Allicin, one of the primary bioactive compounds in garlic, is formed when garlic is crushed or chopped. Allicin exhibits broad-spectrum antimicrobial activity, including antifungal properties. It inhibits the growth of fungi by interfering with their cell membranes and enzymatic processes.
- **Antifungal activity:** Garlic has shown potential activity against various fungal species, including Candida albicans, Candida glabrata, Aspergillus fumigatus, and Trichophyton rubrum. Studies have demonstrated its ability to inhibit the growth and replication of these fungi, suggesting its potential as an antifungal agent.
- **Candida infections:** Garlic has received particular attention for its potential efficacy against Candida species, which are common fungal pathogens responsible for various infections, including oral thrush and vaginal yeast infections. In vitro studies have shown that garlic extracts and compounds can inhibit the growth of Candida and disrupt its biofilm formation, which enhances

its antifungal activity.

- **Combination therapy:** Garlic may also enhance the efficacy of conventional antifungal drugs. Some studies have shown that combining garlic extracts or compounds with existing antifungal medications can improve their effectiveness against resistant strains of fungi. The synergistic effects of garlic with conventional antifungal drugs may provide a more potent and comprehensive treatment approach.
- **Application methods:** Garlic can be used in different forms for antifungal purposes. Fresh garlic cloves can be consumed orally, but the high concentration of active compounds may cause gastrointestinal discomfort. Garlic supplements are available in the form of capsules or tablets, providing a standardized dosage of garlic extract. Additionally, crushed garlic can be applied topically to the affected area for localized fungal infections.

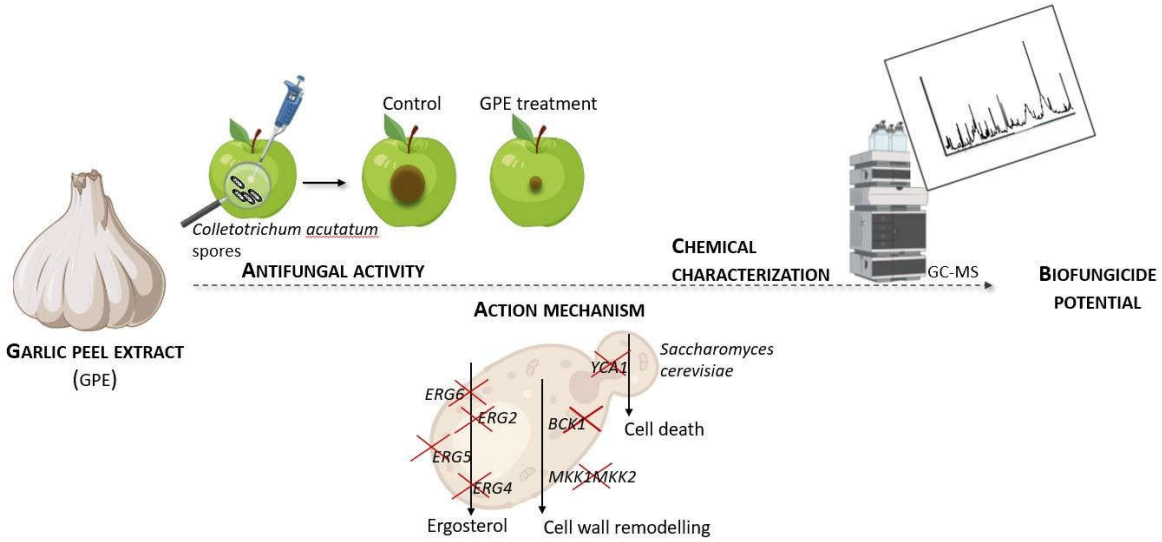


*Figure 1:* Garlic as an Antifungal Agent

- **Considerations and limitations:** While garlic shows promise as an antifungal agent, there are some considerations to keep in mind. The quality and potency of garlic products can vary, so using standardized preparations or consulting with a healthcare professional is advisable. It's worth noting that garlic may interact with certain medications, such as blood thinners, and individuals with bleeding disorders should exercise caution.

  Overall, while garlic has been traditionally used and shows promise as an antifungal agent, more research is needed to establish its efficacy, optimal

dosage, and safety for treating fungal infections. It's crucial to consult with a healthcare professional for appropriate diagnosis and guidance on using garlic as part of an antifungal treatment plan [1-5].

## 2. Tea tree oil

Tea tree oil (Melaleuca alternifolia) is a popular essential oil known for its potential antifungal properties. It has been used traditionally for various medicinal purposes, including treating fungal infections. Here is a detailed note on tea tree oil as an antifungal agent:

- **Active constituents:** Tea tree oil contains several bioactive compounds, with terpinen- 4-ol being the primary active ingredient. Terpinen-4-ol is known for its antimicrobial properties, including antifungal activity against various fungal species.
- **Antifungal activity:** Tea tree oil has shown efficacy against different types of fungi, including Candida species, dermatophytes (such as Trichophyton and Microsporum species), and Malassezia furfur. It has been studied for its potential use in treating fungal infections like athlete's foot, nail fungus (onychomycosis), and fungal skin conditions.
- **Mechanism of action:** The exact mechanism by which tea tree oil exerts its antifungal effects is not fully understood. However, it is believed to disrupt the fungal cell membrane, inhibit fungal enzyme activity, and interfere with the fungal cell's energy metabolism.
- ***In vitro* and *in vivo* studies:** Laboratory studies have demonstrated the antifungal activity of tea tree oil against various fungal strains. In vivo studies, including clinical trials, have also shown positive outcomes in the treatment of fungal infections. Tea tree oil has been found to be effective in reducing the growth and viability of fungal organisms.
- **Topical application:** Tea tree oil is primarily used topically for fungal infections. It should always be diluted with a carrier oil, such as coconut oil or olive oil, before application to avoid skin irritation. The recommended dilution ratio is typically 5-10% tea tree oil to carrier oil. It can be applied directly to the affected area using a cotton swab or a clean fingertip.
- **Safety considerations:** While tea tree oil is generally safe for topical use, it can cause skin irritation or allergic reactions in some individuals. It should not be

ingested, as it may be toxic if swallowed. It is important to perform a patch test on a small area of skin before applying tea tree oil to a larger area to check for any adverse reactions. Additionally, tea tree oil should be kept out of reach of children.

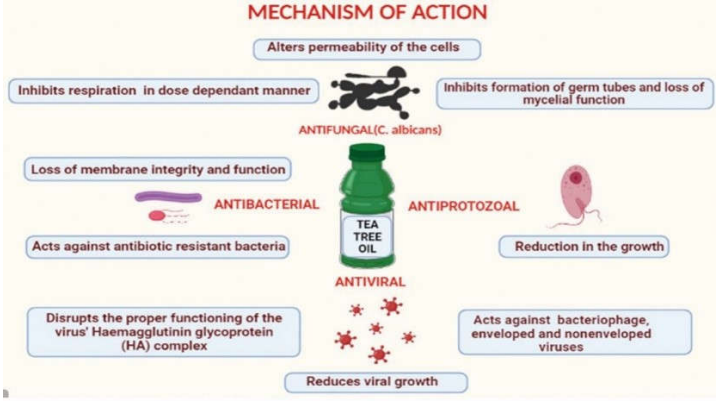


*Figure 2:* Tea Tree Oil as An Antifungal Agent

- **Consultation with healthcare professionals:** If you are considering using tea tree oil for a fungal infection, it is advisable to consult with a healthcare professional, especially if you have any underlying medical conditions or are taking other medications. They can provide appropriate guidance, recommend the best course of treatment, and ensure it is safe for your specific situation.

While tea tree oil shows promise as an antifungal agent, it should not replace medical advice or prescribed treatments. It is important to seek professional guidance for an accurate diagnosis and to determine the most suitable treatment plan for your fungal infection [6-11].

## 3. Oregano oil

Oregano oil, derived from the leaves of the oregano plant (*Origanum vulgare or Origanum heracleoticum*), has gained attention for its potential antifungal properties. It contains several bioactive compounds, including carvacrol and thymol, which are believed to contribute to its therapeutic effects. Here is a detailed note on oregano oil as an antifungal drug:

- **Antifungal activity:** Oregano oil has demonstrated potential antifungal activity against various fungal species, including Candida albicans, Aspergillus species, and dermatophytes like Trichophyton and Microsporum species. It has been investigated for its efficacy in treating fungal infections such as candidiasis

(yeast infections), toenail fungus, and skin fungal infections.

- **Mechanism of action:** The primary bioactive compounds in oregano oil, carvacrol, and thymol, are believed to be responsible for its antifungal effects. These compounds have been shown to disrupt fungal cell membranes, inhibit fungal growth, and interfere with cellular processes vital for fungal survival.
- **Research studies:** In vitro studies have demonstrated the effectiveness of oregano oil against various fungal strains. It has shown fungicidal and fungistatic effects, inhibiting the growth and replication of fungi. Some studies have also explored the synergistic effects of oregano oil when combined with conventional antifungal drugs, potentially enhancing their antifungal activity.
- **Topical and oral use:** Oregano oil can be used both topically and orally for fungal infections. For topical application, it is typically diluted with a carrier oil (e.g., olive oil or coconut oil) before being applied to the affected area. The recommended dilution ratio is usually around 1-3% oregano oil to carrier oil. When using orally, it is important to follow appropriate dosage guidelines and consult with a healthcare professional for guidance.
- **Safety considerations:** Oregano oil is generally safe when used appropriately, but it can cause skin irritation or allergic reactions in some individuals, especially when applied undiluted. It should be avoided by pregnant or breastfeeding women, young children, and individuals with known allergies to oregano or related plants. It is important to perform a patch test before using oregano oil topically and to start with lower concentrations to assess tolerance.
- **Consultation with healthcare professionals:** If you are considering using oregano oil as an antifungal treatment, it is advisable to consult with a healthcare professional, especially if you have underlying health conditions or are taking other medications. They can provide personalized guidance, recommend appropriate dosage and application methods, and monitor your progress.

While oregano oil shows promise as an antifungal agent, it should not replace medical advice or prescribed treatments. It is important to seek professional guidance for an accurate diagnosis and to determine the most suitable treatment plan for your fungal infection [12-15].

## 4. Neem

Neem (*Azadirachta indica*) is a tree native to the Indian subcontinent and has been widely used in traditional medicine for its potential antifungal, antibacterial, and antiviral properties. Various parts of the neem tree, including its leaves, bark, seeds, and oil, have been utilized for medicinal purposes. Here is a detailed note on neem as an antifungal drug:

- **Active constituents:** Neem contains numerous bioactive compounds, including nimbin, nimbidin, nimbidol, gedunin, azadirachtin, and quercetin. These compounds contribute to the antifungal activity of neem and provide a range of therapeutic benefits.
- **Antifungal activity:** Neem has demonstrated broad-spectrum antifungal activity against different fungal species, including Candida albicans, Aspergillus species, Trichophyton species, and Malassezia furfur. It inhibits fungal growth by disrupting the cell membrane, interfering with fungal enzymes, and altering cellular processes.
- **Mechanism of action:** The active compounds in neem oil, particularly azadirachtin, have been found to disrupt the cell membrane of fungi, leading to leakage of cellular contents and subsequent inhibition of fungal growth. Other components, such as nimbidin and gedunin, exhibit antifungal effects by interfering with fungal enzyme activity.
- **Application methods:** Neem oil can be used topically for the treatment of fungal infections. It can be applied directly to the affected area or diluted with a carrier oil before application. Neem extracts, such as creams or lotions, are also available for topical use. Neem capsules or oral solutions may be used for systemic fungal infections, but it's important to consult with a healthcare professional for proper dosage and administration.
- **Skin-related fungal infections:** Neem oil has been traditionally used for the treatment of various skin fungal infections, such as ringworm, athlete's foot, and nail fungus. It can help relieve symptoms like itching, inflammation, and redness associated with these conditions.
- **Safety considerations:** Neem oil is generally safe for topical use, but it may cause skin irritation or allergic reactions in some individuals. It is recommended to perform a patch test before using neem oil on larger areas of the skin. Neem should not be ingested in large quantities as it may have toxic effects. Pregnant

or breastfeeding women, as well as individuals with known allergies to neem or related plants, should exercise caution.

- **Consultation with healthcare professionals:** If you are considering using neem as an antifungal treatment, it is advisable to consult with a healthcare professional, particularly if you have underlying health conditions or are taking other medications. They can provide guidance on the appropriate use of neem, recommend specific formulations, and monitor your progress.

While neem has shown promise as an antifungal agent, more research is needed to establish its efficacy, optimal dosage, and safety for treating fungal infections. It is important to seek professional guidance for an accurate diagnosis and to determine the most suitable treatment plan for your specific fungal infection [16-20].

## 5. Pau d'arco

Pau d'arco, also known as Lapacho or Tabebuia impetiginosa, is a tree native to South America. It has a long history of traditional use for its potential medicinal properties, including as an antifungal agent. The inner bark of pau d'arco has been specifically recognized for its antifungal properties. Here is a detailed note on pau d'arco as an antifungal drug:

- **Active constituents:** Pau d'arco contains various bioactive compounds, including naphthoquinones (such as lapachol and beta-lapachone), quinoids, flavonoids, and phenolic acids. These compounds contribute to the antifungal activity of pau d'arco.
- **Antifungal activity:** Pau d'arco has been traditionally used for its potential antifungal properties against various fungal species, including Candida, Aspergillus, and dermatophytes like Trichophyton and Microsporum. It has been studied for its efficacy in treating fungal infections such as candidiasis, athlete's foot, and ringworm.
- **Mechanism of action:** The naphthoquinones, particularly lapachol, are believed to be responsible for the antifungal effects of pau d'arco. Lapachol interferes with the synthesis of fungal cell components and disrupts fungal enzymes, leading to inhibition of fungal growth. Other compounds in pau d'arco may also contribute to its antifungal activity.
- **Research studies:** In vitro studies have demonstrated the antifungal activity of pau d'arco against various fungal strains. It has shown inhibitory effects on the

growth and replication of fungi. However, more research is needed to understand its full spectrum of antifungal activity and its effectiveness against specific fungal infections.

- **Application methods:** Pau d'arco is typically available in the form of tea, capsules, or extracts. Pau d'arco tea is prepared by steeping the inner bark in hot water. It can be consumed orally or used topically for fungal infections. Pau d'arco extracts or capsules may also be used, but it is important to follow recommended dosage guidelines and consult with a healthcare professional for guidance.
- **Safety considerations:** Pau d'arco is generally considered safe for short-term use when taken as directed. However, long-term use or excessive consumption may have adverse effects. Some individuals may experience gastrointestinal upset or allergic reactions. Pau d'arco should be avoided by pregnant or breastfeeding women, individuals with low blood pressure, and those taking anticoagulant medications.
- **Consultation with healthcare professionals**: If you are considering using pau d'arco as an antifungal treatment, it is advisable to consult with a healthcare professional, especially if you have underlying health conditions or are taking other medications. They can provide personalized guidance, recommend appropriate forms and dosages, and monitor your progress.

While pau d'arco has been traditionally used and shows potential as an antifungal agent, further research is needed to establish its efficacy, optimal dosage, and safety for treating fungal infections. It is important to seek professional guidance for an accurate diagnosis and to determine the most suitable treatment plan for your specific fungal infection [21-24].

## 6. Calendula

Calendula, also known as Calendula officinalis or pot marigold, is a flowering plant that has been used for centuries for its medicinal properties. While it is primarily known for its anti- inflammatory and wound healing effects, it also possesses antifungal activity. Here is a detailed note on calendula as an antifungal drug:

- **Active constituents:** Calendula contains various bioactive compounds, including triterpenoids, flavonoids, carotenoids, and volatile oils. These constituents contribute to the medicinal properties of calendula, including its

antifungal activity.

- **Antifungal activity:** Calendula has been found to exhibit antifungal activity against several fungal species, including Candida albicans, Aspergillus species, and dermatophytes. It has been studied for its potential use in the treatment of fungal infections such as candidiasis, athlete's foot, and ringworm.
- **Mechanism of action:** The exact mechanisms by which calendula exerts its antifungal effects are not fully understood. However, it is believed that the active compounds in calendula interfere with fungal cell membranes, inhibit fungal enzyme activity, and disrupt fungal growth and replication.
- **Research studies:** While there is limited research specifically focused on calendula as an antifungal drug, some studies have shown its inhibitory effects on fungal growth. Calendula extracts or formulations have been evaluated for their potential use in combination with conventional antifungal medications, showing synergistic effects in inhibiting fungal pathogens.
- **Application methods:** Calendula can be used topically as a cream, ointment, or infused oil for fungal infections. It is typically applied directly to the affected area. Calendula- based products are also available in the form of soaps, lotions, and tinctures. It is important to follow the recommended instructions and consult with a healthcare professional for proper usage.
- **Safety considerations:** Calendula is generally considered safe for topical use. However, some individuals may experience skin irritation or allergic reactions. It is advisable to perform a patch test before applying calendula products to a larger area of the skin. Calendula should not be ingested unless specifically formulated and labeled for oral use. Pregnant or breastfeeding women should exercise caution and consult with a healthcare professional before using calendula products.
- **Consultation with healthcare professionals:** If you are considering using calendula as an antifungal treatment, it is advisable to consult with a healthcare professional, especially if you have underlying health conditions or are taking other medications. They can provide guidance on the appropriate use of calendula, recommend specific formulations, and monitor your progress.

While calendula has shown potential as an antifungal agent, more research is needed to establish its efficacy, optimal dosage, and safety for treating fungal infections. It is important to seek professional guidance for an accurate diagnosis and to determine the

most suitable treatment plan for your specific fungal infection [25-28].

## 7. Clove oil

Clove oil, derived from the cloves of the Syzygium aromaticum plant, has been used for centuries for its medicinal properties. Among its many applications, clove oil is recognized for its potent antifungal activity. Here is a detailed note on clove oil as an antifungal drug:

- **Antifungal Properties:** Clove oil contains several active compounds, including eugenol, eugenyl acetate, and β-caryophyllene, which contribute to its antifungal properties. These compounds possess significant antifungal activity against various fungal species, including Candida albicans, Aspergillus spp., Cryptococcus neoformans, and dermatophytes.
- **Mechanism of Action:** The antifungal mechanism of clove oil involves multiple actions. Eugenol, the primary active component of clove oil, disrupts fungal cell membranes by inhibiting the synthesis of ergosterol, an essential component of fungal cell walls. This disruption leads to increased permeability and leakage of cellular contents, ultimately causing cell death. Additionally, clove oil can interfere with fungal biofilm formation, which plays a crucial role in the pathogenesis of many fungal infections.
- **Candida Infections:** Candida species are common fungal pathogens responsible for various infections, including oral thrush, vaginal candidiasis, and systemic candidiasis. Clove oil has shown promising antifungal activity against Candida species, inhibiting their growth and reducing biofilm formation. It can be used topically or orally to combat Candida infections.
- **Dermatophyte Infections:** Dermatophytes are fungi that cause skin, hair, and nail infections, such as ringworm and athlete's foot. Clove oil has demonstrated antifungal efficacy against dermatophytes, making it a potential treatment option for these infections. It can be applied topically in the form of creams, lotions, or diluted solutions.
- **Safety and Precautions:** While clove oil is generally considered safe when used appropriately, a few precautions should be noted. Undiluted clove oil may cause skin irritation and should be diluted with a suitable carrier oil before topical application. It is important to perform a patch test before using clove oil to check for any adverse reactions. Additionally, clove oil should be used with caution in pregnant women,

children, and individuals with sensitive skin.

- **Availability and Formulations:** Clove oil is widely available in health food stores, pharmacies, and online retailers. It can be purchased as pure essential oil or as an ingredient in various antifungal products such as creams, ointments, mouthwashes, and soaps. When selecting a clove oil product, it is advisable to choose reputable brands and follow the instructions provided.
- **Consultation with Healthcare Professionals:** If you suspect a fungal infection or are considering using clove oil as an antifungal treatment, it is recommended to consult with a healthcare professional, such as a dermatologist or pharmacist. They can provide appropriate guidance, evaluate the condition, and suggest the most suitable treatment options based on individual circumstances.

In summary, clove oil possesses notable antifungal properties, particularly against Candida species and dermatophytes. Its active compounds disrupt fungal cell membranes and inhibit biofilm formation, contributing to its effectiveness as an antifungal drug. However, it is essential to exercise caution, follow proper dilution guidelines, and seek professional advice when using clove oil for antifungal purposes [29-32].

## 8. Coconut oil

Coconut oil has gained popularity as a natural remedy for various health conditions, including its potential as an antifungal agent. Here is a detailed note on coconut oil as an antifungal drug:

- **Antifungal Properties:** Coconut oil contains several active components, including lauric acid, capric acid, and caprylic acid, which exhibit potent antifungal properties. These fatty acids have been shown to have activity against various fungal species, including Candida albicans, Malassezia furfur (causing dandruff and skin infections), and dermatophytes (causing fungal skin infections).
- **Mechanism of Action:** The antifungal activity of coconut oil is primarily attributed to its fatty acid content. Lauric acid, in particular, has been extensively studied and is known for its strong antimicrobial properties. It disrupts the cell membranes of fungi by disrupting their lipid structure, leading to cell death. Additionally, coconut oil can interfere with the formation of fungal biofilms, which are communities of microorganisms that protect the fungi and enhance their resistance to treatment.
- **Candida Infections:** Coconut oil has shown promising antifungal effects against

Candida species, including Candida albicans, a common cause of oral and genital yeast infections. Studies have demonstrated that coconut oil, when applied topically or ingested orally, can inhibit the growth of Candida cells, disrupt their cell membranes, and reduce their ability to form biofilms.

- **Dermatophyte Infections:** Dermatophytes are fungi responsible for various skin, hair, and nail infections. Coconut oil has been found to possess antifungal activity against dermatophytes, making it a potential treatment option. Topical application of coconut oil to the affected areas can help alleviate symptoms and inhibit the growth of these fungi.

*Figure 3:* Coconut Oil as An Antifungal Agent

- **Safety and Precautions:** Coconut oil is generally safe for external use. However, individuals with coconut allergies should avoid using coconut oil as it can cause allergic reactions. Ingesting coconut oil orally is generally considered safe, but it is advisable to consult a healthcare professional before using it as a dietary supplement, especially if you have any underlying health conditions or are taking medications.
- **Availability and Formulations:** Coconut oil is readily available in various forms, including refined and virgin coconut oil. When using coconut oil as an antifungal agent, it is generally recommended to opt for virgin or extra virgin coconut oil, as it retains more of its natural beneficial compounds. Coconut oil can be used topically by applying it directly to the affected area or as an ingredient in homemade or commercially available antifungal creams, lotions, or soaps.
- **Consultation with Healthcare Professionals:** If you suspect a fungal infection or are considering using coconut oil as an antifungal treatment, it is advisable to consult with a healthcare professional, such as a dermatologist or pharmacist. They can provide appropriate guidance, evaluate the condition, and suggest the most suitable treatment options based on individual circumstances.

In conclusion, coconut oil, particularly due to its lauric acid content, exhibits antifungal

properties that can be beneficial in the treatment of fungal infections, including Candida and dermatophyte infections. However, it is important to exercise caution, consider individual sensitivities or allergies, and seek professional advice when using coconut oil as an antifungal remedy [33-35].

## 9. Ginger

Ginger, scientifically known as Zingiber officinale, is a widely used spice and medicinal plant with numerous health benefits. While ginger is primarily known for its anti-inflammatory and digestive properties, it also possesses certain antifungal properties. Here is a detailed note on ginger as an antifungal drug:

- **Antifungal Properties:** Ginger contains several bioactive compounds, including gingerols, shogaols, and zingerone, which contribute to its antifungal activity. These compounds have been shown to exhibit varying degrees of antifungal efficacy against fungal pathogens such as Candida species, Aspergillus species, and Trichophyton species.
- **Mechanism of Action:** The antifungal mechanism of ginger involves multiple actions. Gingerols and related compounds interfere with the integrity of the fungal cell membrane, leading to increased permeability and leakage of cellular contents. This disruption ultimately impairs fungal growth and survival. Additionally, ginger compounds can inhibit the production of certain fungal enzymes and disrupt fungal biofilm formation, which plays a role in fungal pathogenicity.
- **Candida Infections:** Candida species, including Candida albicans, are common fungal pathogens responsible for various infections, such as oral thrush, vaginal candidiasis, and systemic candidiasis. Studies have demonstrated that ginger extracts and compounds derived from ginger exhibit antifungal activity against Candida species, inhibiting their growth and biofilm formation. Ginger can be consumed orally or applied topically in the form of creams or gels to combat Candida infections.
- **Dermatophyte Infections:** Dermatophytes are fungi that cause skin, hair, and nail infections, including ringworm and athlete's foot. Ginger has been investigated for its potential antifungal activity against dermatophytes. Studies have shown that ginger extracts and its active compounds can inhibit the growth of dermatophytes and reduce their ability to form biofilms. Topical application of ginger preparations may help alleviate symptoms and aid in the treatment of dermatophyte infections.
- **Safety and Precautions:** Ginger is generally safe for most individuals when

consumed in moderate amounts. However, it is important to note that ginger can interact with certain medications and may not be suitable for everyone. Additionally, ginger extracts or concentrated forms may cause skin irritation when applied topically. As with any herbal remedy, it is advisable to consult with a healthcare professional before using ginger as an antifungal treatment, especially if you have any underlying health conditions or are taking medications.

- **Availability and Administration:** Ginger is widely available in various forms, including fresh ginger root, powdered ginger, ginger extracts, and ginger supplements. It can be incorporated into meals, consumed as a tea, or used in the preparation of topical applications such as creams or poultices for antifungal purposes. When selecting ginger products, it is important to choose reputable sources and follow the recommended dosages.
- **Consultation with Healthcare Professionals:** If you suspect a fungal infection or are considering using ginger as an antifungal treatment, it is recommended to consult with a healthcare professional, such as a dermatologist or pharmacist. They can provide appropriate guidance, evaluate the condition, and suggest the most suitable treatment options based on individual circumstances.

In summary, ginger exhibits certain antifungal properties that can be beneficial in the treatment of fungal infections, including those caused by Candida species and dermatophytes. However, further research is needed to establish the optimal dosages, formulations, and efficacy of ginger as an antifungal drug. It is essential to exercise caution, consult with healthcare professionals, and consider individual sensitivities when using ginger for antifungal purposes [36-39].

## 10. Cinnamon oil

Cinnamon oil, derived from the bark or leaves of the cinnamon tree (*Cinnamomum spp*.), has been recognized for its aromatic and medicinal properties for centuries. One of its notable applications is its potential as an antifungal agent. Here is a detailed note on cinnamon oil as an antifungal drug:

- **Antifungal Properties:** Cinnamon oil contains several active compounds, including cinnamaldehyde, eugenol, and linalool, which contribute to its antifungal properties. These components have been shown to exhibit significant antifungal activity against various fungal pathogens, including Candida species, Aspergillus species, dermatophytes, and other clinically relevant fungi.

- **Mechanism of Action:** The antifungal activity of cinnamon oil is attributed to its active components, primarily cinnamaldehyde. Cinnamaldehyde disrupts the integrity of fungal cell membranes, leading to increased permeability and leakage of cellular contents, ultimately resulting in fungal cell death. Additionally, cinnamon oil may inhibit the production of certain fungal enzymes and interfere with the formation of fungal biofilms, contributing to its antifungal effects.
- **Candida Infections:** Candida species are common fungal pathogens responsible for infections such as oral thrush, vaginal candidiasis, and systemic candidiasis. Cinnamon oil has demonstrated antifungal activity against Candida species, inhibiting their growth and reducing biofilm formation. It can be used topically or in mouthwashes as a potential treatment option for Candida infections.
- **Dermatophyte Infections:** Dermatophytes cause fungal skin, hair, and nail infections, including ringworm and athlete's foot. Cinnamon oil has shown promising antifungal efficacy against dermatophytes. Its application in the form of creams, lotions, or diluted solutions can help combat dermatophyte infections and alleviate associated symptoms.
- **Safety and Precautions:** Cinnamon oil is generally safe when used appropriately. However, it is a potent oil that can cause skin irritation and sensitization in some individuals, especially when used undiluted or in high concentrations. It is important to dilute cinnamon oil properly in a suitable carrier oil before topical application and perform a patch test before using it on larger areas. Individuals with known allergies to cinnamon or its components should avoid using cinnamon oil.
- **Availability and Formulations:** Cinnamon oil is available in health food stores, pharmacies, and online retailers. It can be purchased as pure essential oil or as an ingredient in various antifungal products such as creams, lotions, and mouthwashes. When selecting cinnamon oil products, it is advisable to choose reputable brands and follow the instructions provided.
- **Consultation with Healthcare Professionals:** If you suspect a fungal infection or are considering using cinnamon oil as an antifungal treatment, it is recommended to consult with a healthcare professional, such as a dermatologist or pharmacist. They can provide appropriate guidance, evaluate the condition, and suggest the most suitable treatment options based on individual circumstances.

In conclusion, cinnamon oil possesses notable antifungal properties, primarily due to its active component, cinnamaldehyde. It demonstrates efficacy against various fungal pathogens, including Candida species and dermatophytes. However, it is important to

exercise caution, properly dilute cinnamon oil, and consider individual sensitivities or allergies when using it as an antifungal remedy. Consulting with healthcare professionals is advisable for proper evaluation and guidance [40-44].

**CONCLUSION:** The comprehensive review on herbal drugs used for fungal infections provides valuable insights into the efficacy and safety of herbal remedies in combating fungal infections. The article highlights the extensive use of herbal drugs across various cultures and presents a wealth of scientific evidence supporting their antifungal properties. Furthermore, the review underscores the importance of considering herbal alternatives alongside conventional antifungal treatments, given their potential to offer new therapeutic options and minimize the risk of drug resistance. However, it is crucial to acknowledge that further research is needed to elucidate the mechanisms of action, standardize dosage regimens, and evaluate the long-term effects of herbal drugs. Despite these limitations, the findings of this review contribute to the growing body of knowledge on herbal medicine, paving the way for future investigations and potentially improving the management of fungal infections.

## REFERENCES

1. Ankri, S., & Mirelman, D. (1999). Antimicrobial properties of allicin from garlic. Microbes and Infection, 1(2), 125-129.
2. Sharma, V., Brar, A., Rana, C., & Sharma, A. (2010). Garlic: A boon for infectious diseases. Trends in Biotechnology, 4(2), 93-101.
3. Shuford, J. A., Steckelberg, J. M., Patel, R., & Zirakzadeh, A. (2001). In vitro activity of 'natural' antimicrobials against dermatophytes. Medical Mycology, 39(4), 321-324.
4. Arora, D. S., & Kaur, J. (2011). Antimicrobial activity of spices. International Journal of Antimicrobial Agents, 1(1), 86-89.
5. Bakhshi, M., Taheri, B., & Khodadadi, H. (2017). In vitro inhibitory effects of garlic extract on growth of Aspergillus fumigatus and Candida species. Journal of HerbMed Pharmacology, 6(4), 185-189.
6. Carson, C. F., Hammer, K. A., & Riley, T. V. (2006). Melaleuca alternifolia (Tea Tree) oil: a review of antimicrobial and other medicinal properties. Clinical Microbiology Reviews, 19(1), 50-62.
7. Hammer, K. A., Carson, C. F., & Riley, T. V. (2012). Antifungal activity of the

components of Melaleuca alternifolia (tea tree) oil. Journal of Applied Microbiology, 113(6), 1214- 1222.

8. Silva, F., Ferreira, S., Duarte, A., & Mendonça, D. I. (2012). Antifungal activity of tea tree oil from Melaleuca alternifolia against Trichophyton equinum: an in vivo assay. Fitoterapia, 83(5), 871-873.
9. Mondello, F., De Bernardis, F., Girolamo, A., Salvatore, G., & Cassone, A. (2003). In vivo activity of terpinen-4-ol, the main bioactive component of Melaleuca alternifolia Cheel (tea tree) oil against azole-susceptible and -resistant human pathogenic Candida species. BMC Infectious Diseases, 3(1), 1-9.
10. Hammer, K. A., & Carson, C. F. (2011). The safety of topical and aromatic tea tree oil and its clinical effectiveness. Australian Journal of Pharmacy, 92(4), 10-13.
11. Satchell, A. C., Saurajen, A., Bell, C., & Barnetson, R. S. (2002). Treatment of interdigital tinea pedis with 25% and 50% tea tree oil solution: a randomized, placebo-controlled, blinded study. Australasian Journal of Dermatology, 43(3), 175-178.
12. Pina-Vaz, C., Gonçalves Rodrigues, A., Pinto, E., et al. (2004). Antifungal activity of Thymus oils and their major compounds. Journal of the European Academy of Dermatology and Venereology, 18(1), 73-78.
13. Force, M., Sparks, W. S., & Ronzio, R. A. (2000). Inhibition of enteric parasites by emulsified oil of oregano in vivo. Phytotherapy Research, 14(3), 213-214.
14. Manohar, V., Ingram, C., Gray, J., & Talpur, N. A. (2001). Antifungal activities of origanum oil against Candida albicans. Molecular and Cellular Biochemistry, 228(1-2), 111-117.
15. Force, M., Sparks, W. S., & Ronzio, R. A. (2000). Inhibition of enteric parasites by emulsified oil of oregano in vivo. Phytotherapy Research, 14(3), 213-214.
16. Biswas, K., Chattopadhyay, I., Banerjee, R. K., & Bandyopadhyay, U. (2002). Biological activities and medicinal properties of neem (Azadirachta indica). Current Science, 82(11), 1336-1345.
17. Subapriya, R., & Nagini, S. (2005). Medicinal properties of neem leaves: a review. Current Medicinal Chemistry-Anti-Cancer Agents, 5(2), 149-156
18. Singh, N., Pandey, B. R., & Verma, P. (2018). An updated review on medicinal properties of Azadirachta indica. Journal of Intercultural Ethnopharmacology, 7(3), 318-328.
19. Prakash, B., & Gupta, C. (2011). Therapeutic uses of Azadirachta indica (Neem)

with their implications in dentistry: A review. Indian Journal of Dental Research, 22(5), 588.

20. Tiwari, R. P., Srivastava, P., & Singh, B. D. (2009). A review on commercial propagation of Azadirachta indica A. Juss. by the use of tissue culture technique. Journal of Plantation Crops, 37(3), 217-226.
21. Ríos, J. L., & Recio, M. C. (2005). Medicinal plants and antimicrobial activity. Journal of Ethnopharmacology, 100(1-2), 80-84.
22. Teixeira, M. L., Chaves, F. C., Costa, W. F., et al. (2012). In vitro and in vivo antifungal activity of Tabebuia avellanedae against dermatophytes. Brazilian Journal of Microbiology, 43(4), 1376-1383.
23. Yi, J. M., Kim, M. S., Ahn, H., et al. (2017). Potential antifungal effects of Tabebuia avellanedae extracts against Candida albicans yeast forms and biofilms. Mycobiology, 45(4), 261-267.
24. Yoshida, T., & Sakane, T. (2009). Anti-inflammatory and anti-fungal effects of Tabebuia avellanedae extracts. Yakugaku Zasshi, 129(4), 427-431.
25. Dawid-Pać, R. (2013). Medicinal plants used in treatment of inflammatory skin diseases. Advances in Dermatology and Allergology, 30(3), 170-177.
26. Jiménez-Medina, E., Garcia-Lora, A., Paco, L., et al. (2006). A new extract of the plant Calendula officinalis produces a dual in vitro effect: cytotoxic anti-tumor activity and lymphocyte activation. BMC Cancer, 6, 119.
27. Pommier, P., Gomez, F., Sunyach, M. P., et al. (2004). Phase III randomized trial of Calendula officinalis compared with trolamine for the prevention of acute dermatitis during irradiation for breast cancer. Journal of Clinical Oncology, 22(8), 1447-1453.
28. Preethi, K. C., Siveen, K. S., Kuttan, R., et al. (2013). Calendula officinalis extract inhibits benzo(a)pyrene-induced lung tumorigenesis in mice. Environmental Toxicology, 28(10), 551-559.
29. Khan, M. S. A., Ahmad, I., & Cameotra, S. S. (2014). Phenylpropanoids and terpenoids: the promising antifungal arsenal for Candida infections. Current Drug Targets, 15(10), 948- 965.
30. Prabuseenivasan, S., Jayakumar, M., & Ignacimuthu, S. (2006). In vitro antibacterial activity of some plant essential oils. BMC Complementary and Alternative Medicine, 6, 39.