

**ANTIFUNGAL PROPERTIES OF INDIAN HERBS**

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ABSTRACT

A disease brought on by a fungus that attacks tissue may not only affect the skin, but may also spread to the bones, tissues, and organs. An antifungal substance kills or stops the growth of fungus. Antifungal medication is usually used in the treatment of these diseases. In India, generous use of herbs is a common practice that offers therapies effectively to treat a variety of fungal infections. Different body parts may be affected by fungi, which can result in a variety of diseases and symptoms. Each type of infection is suggested, a specific treatment and herb, indirectly killing fungi or hindering their growth. The most commonly used herbs known in households are dhaniya, Tulasi, haldi etc. All are discussed in details in the paper along with the fungi on which they have the effect.

Keywords: Fungi, Fungal diseases, Antifungal, Traditional medicines, Alternative medicines, Medicinal plants, Mycosis, Herbs

Introduction

Early in the 1840s, the Hungarian microscopist David Grubby, based in Paris, made the first assertion that fungi might be responsible for human illness. ¹ Although, all fungi do not cause disease, moulds and yeasts are the fungi that can infect humans. Fungi can infect the body when they are breathed in, come into contact with the skin, cut, wound, or injected. People with



a compromised immune system, organ transplant recipients, tuberculosis patients, cancer patients, and those with Corona are more susceptible to fungal infections. Also, diabetes and HIV/AIDS patients frequently develop fungal infections.² More than one billion people worldwide are impacted by fungus infections each year. In 2020, it was predicted that 1.7 million people would die from a fungus.³

There are many different fungal infections (Mycosis) that can affect animals, and some of them can spread from animals to humans. Mycosis can be superficial, subcutaneous, or systemic, which refers to an infection that affects internal organs and is deep-seated and widely disseminated. Nails, vagina, skin, and the mouth are all susceptible to it. People who live or travel to particular regions of the world are susceptible to some types, including blast mycosis, Cryptococcus, coccidioidomycosis, and histoplasmosis. Additionally, those with lower immune systems are more susceptible to aspergillosis, pneumocystis pneumonia, candidiasis, mucormycosis, and talaromycosis.

Generally speaking, cultures, microscopy, and check on signs and symptoms are the foundation of prevention of fungal diseases, depending on the specific infection, antifungal medications are used as a form of treatment.

Also, by maintaining good hygiene and keeping skin dry and clean, fungal infections can be prevented.⁴ It's crucial to wash hands after communicating with others or animals. In India, it is often treated using medicinal plants and herbs that are considered to be antifungal. The type of fungal infection determines the course of treatment. Infected tissue occasionally needs to be surgically removed.⁵ The most common Antifungal herbs in India are as given below-

- 1. Tulasi or Holy basil (*Ocimum tenuiflorum*)** It is a seed-propagated herbaceous plant. According to Hinduism, it is a sacred plant. It is highly branched and about 30 cm tall. The oblong, green leaves are pubescent on both sides and have a serrated, serrated margin. The smell is pleasant. *Ocimum Sanctum* leaves possess a purplish floral appearance, and the dress is a reddish black hue.⁶

As one of its main chemical components, 0.1 to 0.9% of it is volatile oil. It also includes 20% eugenolmethyl ether, 70% eugenol, and 3% carvacrol. There are also other ingredients like



caryophylline, fixed oil, traces of alkaloids, saponin, tannin, vitamin C, maleic acid, citric acid, and tartaric acid.⁷

At a concentration of 200 g/mL, its leaves have antifungal activity against clinically isolated dermatophytes and *C. albicans*. Additionally, it has antiviral, antibacterial, and insecticidal properties.⁸

2. Neem (*Azadirachta indica*) or margosa. Its biological source is *Azadirachta indica* of the family Meliaceae, which provides the leaves and other aerial parts. The leaves are lanceolate and serrated in shape, and they range in length from 20 to 37 cm. It has bitter tasting leaves that range in colour from green to yellow. Flowers are 5 mm long, white, and fragrant. The fruits are oblong, 1.2 to 1.8 cm long, greenish yellow in colour, and have an extremely bitter taste. Neem's bark is 10 mm thick, rough, and greyish brown in colour.

All these parts of Neem have medicinal properties. Azadirachtin, salannin, and meliantriol are the active ingredients in neem. Nimbosterol and quercetin are found in the leaves, and azadirachtin, salannin, meliantriol, and mellacin are found in the seeds. The bitter-tasting compounds margosine, nimbin, nimbinine, nimbidine, and nimbosterol are found in the trunk bark. 20% stearic acid and 50% oleic acid are present.

It is also used as an insecticide and antiseptic. Neem oil, nimbin, and nimbidine and Neem leaves have potent antifungal properties and can eradicate fungi such as *Aspergillus* and *Candida albicans*.⁹

3. Akhrot (*Juglans regia*) is indigenous to the area that are grown in Arunachal Pradesh, Himachal Pradesh, Uttarakhand and Jammu and Kashmir. It belongs to the Juglandaceae family. It is a broadleaf deciduous tree with leaves that are alternate, pinnately compound, with an odd number of leaflets—typically 5, 7, or 9—each measuring 5 to 15 cm long. It is 12–18 meters tall, has rounded fruits and greyish bark.

Chemical components included sugars, starches, fibre, fat (saturated, monounsaturated, and polyunsaturated), protein, vitamins (folates, niacin, pantothenic acid, pyridoxine, riboflavin, thiamin, vitamins A, C, E, and K), and minerals.



All *Candida* strains and *malassezia furfur* fungus were effectively inhibited by the extract of *Juglans regia*. Additionally, it's used to treat helminthiasis, diarrhoea, sinusitis, stomach aches, arthritis, asthma, eczema, scrofula, skin conditions, and a number of endocrine disorders like diabetes, anorexia, and thyroid.¹⁰

4. **Lahsun or Garlic (*Allium sativum*)**¹⁴ is from Amaryllidaceae family and is a bulbous flowering plant. It has 33.06% carbohydrates, 0.5% fat, 6.36% protein, vitamins, and minerals. Selenium and water are additional components.

Ajoene, a compound found in garlic, has effects that are antithrombotic, antitumoral, antifungal, and antiparasitic. The recently discovered antifungal property of ajoene makes it potentially applicable for the treatment of various fungal infections i.e. *Fusarium* spp and *Rhizopus* spp.¹¹

5. **Adrak or Ginger (*Zingiber officinale*)** is perennial herbaceous plant produces annual pseudostems that are about one metre tall and have narrow leaf blades. It is made up of dried rhizomes of *Zingiber Officinale*, a member of the Zingiberaceae family. It is buff-colored, short, flat, ovate, and oblique, with a pleasant aroma and flavour. Chemical components include zingiberene, shoganol, and gingerol, which has a pungent principal. It also contains 1–2% volatile oil.

The current study found that ginger extract effectively fights off the growth of fungi and prevents the formation of biofilms on *C. albicans* and *C. krusei*. The greatest effects on biofilm and antifungal activity were seen at concentrations between 0.625 mg/mL and 5 mg/mL.¹²

6. **Peppermint** is a hybrid mint, peppermint is a cross between spearmint and watermint. It is grown in Uttar Pradesh, Punjab, Haryana, and Bihar. It is a volatile oil derived from the flowering tops of *Mentha Piperita*, a plant in the Labiatae family. Colourless or yellow, with a distinctively pleasant odour and pungent taste it gives the tongue a cooling sensation. The majority of the chemical components in it are l-menthol, which makes up 70%. Terpene and methyl acetate are two additional components mentioned. About 80% of the remaining terpenes include camphene, l-limonene, isopulegone, pinene, and menthol.



The majority of bacterial and fungal infections are killed by peppermint essential oil.¹³ Menthol is the primary chemical component with antifungal properties inhibiting *Candida albicans* and *C. dubliniensis*.¹⁴

7. Gwar Patha or Aloe Vera (*Aloe barbadensis miller*) is a perennial evergreen in nature. It is a species of succulent plant from the genus *Aloe* containing about 500 species. It is grown in Alwar in Rajasthan, Satanapalli in Andhra Pradesh, Rajpipla in Gujarat and some parts of Tamil Nadu. It has a distinctive odour, is dark brown in colour, and comes in masses of various sizes. It also has an intensely bitter taste. Aloe contains a mixture glucosides collectively called 'aloin', which is the active constituent of the drug. Its chemical components include barbaloin, aloe emodin, isobarbaloin, aloinosides A and B, and p-caumaric acid.

It has potent anti-*Candida* and immune-boosting properties.¹⁵ It has antifungal, antiviral, and anti-inflammatory properties against pathogenic fungal strains.¹⁶

8. Mehendi or Henna (*Lawsonia Inermis*) is a flowering plant in the Lythraceae family grown in Punjab, Haryana, west Rajasthan, Madhya Pradesh and Gujarat. It is a 2–6 m tall, heavily branched small tree. When young, the bark is unarmed; as the plant ages, the branches develop spine tips. Young, quadrangular, green branches eventually turn red. The leaves contain Phenolic carbohydrates, flavonoids, saponins, proteins, alkaloids, terpenoids, quinones, coumarins, xanthonenes, fat, resin, and tannins are among its chemical components. Also present is 2-hydroxy-1,4-naphthoquinone.

It is employed as an astringent, purgative, and contraceptive. Lawsons and six *L. inermis* plant extracts, which were used by traditional healers in Algeria to treat the illnesses, were tested for their antifungal activity against filamentous fungi.¹⁷

9. Neebu Ghas or Lemon Grass (*Cymbopogon citratus*) is native to Maritime Southeast Asia but has been introduced to many tropical areas. It is known for essential oil, which belongs to the Poaceae family. It is a grass-like plant with long, slender foliage that can reach heights of two to three feet. The colour of the leaves is grayish-green. In India it is grown in Kerala, Karnataka, Tamil Nadu in the southern region, parts of Uttar Pradesh and Uttaranchal in the northern region and Assam in the north-eastern region. It frequently comes in stem form for



sale. Strong lemon flavour is delivered by the stems and leaves. Terpenes, alcohols, ketones, aldehydes, and esters are present in it. Essential oils such as Citral, Nerol Geraniol, Citronellal, Terpinolene, Geranyl acetate, Myrecene, and Terpinol Methylheptenone are some phytoconstituents.

Lemongrass oil is successful in preventing four different kinds of fungi. A particular kind is useful for jock itch, ringworm, and athlete's foot.¹⁸

- 10. Amrood (*Psidium Guajava*)** is a small evergreen tree in the Myrtaceae family, provided the leaves and fruits. A small, evergreen tree with numerous branches and a light to reddish brown, thin, smooth, continuously flaking bark, it is between 3 and 10 metres tall. Its stems are crooked, and its roots are typically superficial and very extensive. In India it is grown in Uttar Pradesh, Bihar, West Bengal, Maharashtra, Chhattisgarh, Tamil Nadu, Karnataka, Madhya Pradesh, Gujarat and Andhra Pradesh.

It is orange to yellowish orange in colour and has a distinctive odour and taste that is slightly bitter. The ovate, 2.5 cm long, and 1 to 2 cm thick round rhizome are round. The leaves contain gallic acid, rutin, naringenin, catechin, epicatechin, isoflavonoids, phenolic compounds, and kaempferol. Lycopene, -carotene, and -cryptoxanthin are just a few of the carotenoids and ascorbic acid that are abundant in the pulp. The fruit has flavonoids, oleanolic acid, guaijavarin, quercetin, lyxopyranoside, and arabopyranoside.

The secondary metabolites in *Psidium guajava* have been shown to have antifungal activity. *Candida* spp's fungus growth was impeded by the fractions. It is used to treat ulcers, rheumatism, diabetes, hypertension, caries, inflammation, fever, diarrhoea, and rheumatoid arthritis. It also has anti-amoebic, antibacterial, antidiarrheal, antifilarial, and anti-inflammatory properties.¹⁹

- 11. Haldi (*Curcuma longa*)** is a member of the ginger family, is used in both dried and fresh form. It is a spice of regular use in Indian households, eaten in raw or dried form. It is grown in Andhra Pradesh, Tamil Nadu, Orissa, Karnataka, West Bengal, Gujarat, Meghalaya, Maharashtra, and Assam.



5% volatile, resin, starch, and curcuminoids are some examples of the dried biological sources from which it is derived. Its constituents include curcumin, turmeric oil, termerone, zingiberene, and benzoic acid.

Curcuma longa is used for its potent antifungal properties. The antifungal effect included disruption of the fungal cell membrane as well as inhibition of the synthesis of ergosterol, respiration, succinate dehydrogenase (SDH), and NADH oxidase.²⁰

12. **Genda or Marigold (*Tagetes erecta*)** is a perennial plant with a long lifespan that can reach a height of 3 m. It belongs to the Asteraceae family. When young, the stems have a hollow interior, a faint ridge, and hairs. The petioles are where the alternately arranged leaves are carried. The main elements are -pinene (9.9%), Limonene (5.40%), (Z)--ocimene (4.02%), p-cymen-8-ol (3.0%), Piperitone (11.72%), (E)-nerolidol (3.78%), and spathulenol (10.8%).²¹

It is also sometimes used to treat malaria. It has antifungal properties²² and can be used as broad-spectrum fungicides.

13. **Dhatura (Datura Metel)**¹⁷ belongs to the Solanaceae family, and consists of dried leaves and flowering tops. The flower is 7 cm long

The plant is It is a light green colour. It smells distinctively bitter and tastes bitter. Microscopy reveals that it is composed of 6 to 8 layers of spongy parenchymatous cells. It contains chemicals like Hyoscine, l-hyoscyamine, and atropine make up 0.5%.

D. metel extracts have the potential to be used as fungicide. Using pathogenic species of *Aspergillus*, the antifungal properties²³ of *Datura metel* can be used to treat gastric duodenal ulcers, coughs, and asthma.

14. **Lavang or Clove bud (*Syzygium aromaticum*)** is the dried flower buds of the plant in Myrtaceae family. It is either dark brown or crimson red in colour, has an aromatic scent, a spicy, pungent flavour, and causes numbness after swallowing. Microscopically, it contains epidermal cells, phloem fibres, pollen grains, parenchyma, sclereid cells, and a fragment of the hypanthium revealing a portion of the oil gland. It contains volatile oils such as alpha- and beta-caryophylline, methyl furfural, eugenol, and isoeugenol.



Aspergillus fumigatus, *Candida albicans*, and *Cryptococcus neoformans* are just a few examples of opportunistic fungal pathogens that can be effectively treated with clove bud oil due to its potent antifungal properties. Eugenol is the component that gives it antifungal properties.²⁴ Additionally, it functions as a flavouring agent, stimulant, carminative, and dental analgesic.

15. Dhaniya (*Coriandrum Sativum*) is the dried, ripe fruits of *Coriandrum sativum*, a member of the Umbelliferae family. It has a brownish yellow hue. It tastes distinctively spicy and has an aromatic scent. A layer of several rows of thin-walled, more or less collapsed parenchyma is separated from a broad zone of strongly lignified, sclerenchymatous fibres that extend as a continuous ring in the mesocarp of each of the mericarps by microscopy. It contains proteins 17%, terpenes 20%, fixed oil 13–20%, and volatile oil 0.2–1%, or coriandrol (D- linalo about 60–70%).

Sativum has a strong antifungal effect against *Candida* species, according to research. Additionally, it functions as a stimulant, flavouring agent, and carminative.²⁵

16. Dalchini or Cinnamon (*Cinnamomum verum*) is made up of the dried bark of tree in the Lauraceae family. Its outer surface is a dull yellowish brown. It has a strong aroma and a warm, sweet, and aromatic flavour. Microscopy reveals that cork and cortex are absent, along with small groups of 6 to 15 pericyclic fibres, 3 to 4 layers of pitted sclerides, and large isolated oil cells. Phloem fibres that are single, isolated, circular, and lignified that are at least 12 to 22 to 35 microns wide and 200 to 500 to 600 microns long

It contains calcium oxalate, tannins, mucilage, starch, cinnamic aldehyde, about 0.5 to 1% volatile oil, and about 55 to 65% cinnamic aldehyde.

Cinnamon has strong antibacterial and antifungal properties. It has been discovered to aid in slowing down and halting the spread of *Candida albicans* while for *C. tropicalis* strain only an additive effect was observed.²⁶ It also functions as a flavouring and carminative.



17. Jaiphal or Nutmeg (*Myristica fragrans Houtt*) is made up of dried, ripe seeds from the Myristica Fragrant plant, which belongs to the Myristicaceae family. The kernels are brown or greenish brown. The length and width of the kernels are 20 to 30 mm, respectively. It has a potent aroma and a flavour that is both pungent and aromatic. It has a volatile oil, including iso-eugenol, myristicine, and elemicin. Protein and starch are also present. It serves as an antifungal agent²⁷ and used as a carminative.

18. Oregano (*Origanum vulgare*) is a flowering plant species belonging to the Lamiaceae mint family. It has opposite leaves that are 1-4 cm long and is a woody perennial plant that grows 20–80 cm tall.

Carvacrol, -fenchyl alcohol, thymol, and -terpinene are the main ingredients in oregano essential oil. The highest phenolic content and most potent antioxidant qualities are found in hot water extract.

Oregano essential oil may be a more potent antifungal and can prevent and treat fungal skin infections, such as athlete's foot and ringworm. Inflammation, bacterial and fungal infections, and other conditions are also treated with it.²⁸

To conclude, plants with antifungal properties are useful as medicinal herbs because they kill disease-causing microbes. They also prevent the spread of pathogenic microbes that are responsible for communicable diseases. Experts in herbal medicine advise using herbs that have a calming effect on the body, such as calming herbs. A traditional health care system that is well-organized is the traditional Indian medical system.

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