

Antifungal Activity of Aloe Barbadensis and Nigella Sativa: A Review

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ABSTRACT

Aloe vera (*Aloe barbadense*) is a significant medicinal plant that has been in use throughout the world since ancient times. It is an herb, widely used in Ayurvedic, Unani, Homeopathic and Allopathic medicines for its essential medicinal properties. Aloe vera contains a wide range of vitamins, enzymes, amino acids, proteins, lipids, polysaccharides, lignin, saponin, minerals, sugars, and salicylic acids etc. It is a potent antimicrobial, antifungal, antibacterial and antiviral, etc. Aloe vera has essential antifungal properties against various fungal pathogens such as *Candida albicans*, *Trichophyton mentagrophytes*, *Alternaria alternata*, *Aspergillus fumigatus*, *Aspergillus niger*, *Aspergillus glaucus*, *Penicillium notatum*, *Penicillium digitatum*, *Rhizoctonia solani*, *Fusarium oxysporum*, *Trichophyton violaceum*, *Colletotrichum coccodes*, and *Drechslera hawaiiensis*, etc. Black cumin (*Nigella sativa*) is another significant medicinal plant. It belongs to Ranunculaceae family and acts as a potent antifungal. Black cumin seeds are rich in alkaloids, carbohydrates, proteins, ash, saponins, vitamins, minerals, linoleic acid, palmitic acid, trans-anetole, etc. The main constituents of the essential oils are trans-anethole, γ -terpinene, thymoquinone, thymohydroquinone, di-thymoquinone, thymol, 4-terpineol, carvacrol, tanethol, α -pinene, and sesquiterpene longifolene, etc. Black cumin is effective against several fungal pathogens such as *Trichophyton mentagrophytes*, *Epidermophyton floccosum*, *Aspergillus niger*, *Aspergillus flavus*, *Chaetomium globosum*, *Microsporum canis*, *Candida albicans*, and *Candida tropicalis*, etc.

1. Introduction

Medicinal plants are used to treat people because they are easily available at low cost and have less side effects. They have bioactive compounds and functional chemical groups. These are used in Ayurvedic, Unani and Siddha systems of medicines (Sen and Chakraborty, 2017). Eighty per cent population of world's population living in rural areas depend on herbal medicines (Sakarkar and Deshmukh, 2011). Medicinal plants have a lot of bioactive compounds with antimicrobial activity like flavonoids, coumarins, alkaloids, tannins, saponins, terpenes, lectins, and quinones etc. (Alamgir, 2017; O'Connor, 2015; Katz and Baltz, 2016). Plants like *Aegle marmelos*, *Capsicum frutescens*, *Thymus vulgaris*, *Alpinia galangal*, *Ananas comosus*, *Trigonella gracaecum*, *Euonymus europaeus*, *Blumea balsamifera*, *Cassia tora* and *Zingiber officinalis*, etc have antifungal properties (Meena and Sethi, 1994). Fungi are eukaryotes that are unicellular or multicellular. The most common fungal species are *Candida* and *Aspergillus*. Fungi are larger than bacteria (Pauw, 2011). Plant fungi cause a lot of economic losses in yield of field crops, vegetables, fruits, edible plant materials (Pauw, 2011; Knogge, 1996; Yang *et al.*, 2017). *Pyricularia oryzae*, *Fusarium oxysporum*, *Fusarium udum*, *Phytophthora infestans*, *Puccinia recondiata*, *Alternaria brassicaceae*, *Helminthosporium maydis*, *Sphacelotheca reiliana*, and *Phakospora packyrhizi* etc. cause yield loss in some major crops in India (Patel *et al.*, 2014). Fungal pathogens are categorized into two groups primary pathogens and opportunistic pathogens. Opportunistic pathogens are affected immunocompromised people (van Burik and Magee, 2001). Fungal diseases are causing morbidity and mortality and 15% population infected by superficial dermatophytes in the whole world (Pauw, 2011).

Dermatophytes are capable of occupying keratinized tissue of humans and animals (Moriarty and Morris-Jones, 2012; Behzadi and Behzadi, 2003).

2. *Aloe barbadensis*

Aloe vera belongs to the family of *Asphodelaceae (Liliaceae)* and is a xerophytic, succulent, shrubby plant. It is found generally in Africa, America and Europe. In India it is grown in Rajasthan, Gujrat, Tamil Nadu, Maharashtra and Andhra Pradesh (Surjushe *et al.*, 2008). *Aloe vera* contains enzymes, sugars, vitamins, salicylic acids, minerals, amino acids saponins and lignin, etc. (Shelton, 1991). *Aloe vera* has been used in herbal medicine all over the world since ancient times and helps in skin irritation, cuts, skin burning, skin swellings, facial wrinkles, damaged skin cell repairing and antimicrobial (Rajeswari *et al.*, 2012). *Aloe vera* inhibits the growth and development of fungal pathogen such as *Candida*. (Pathak and Sharma, 2017; Christaki and Florou-Paneri, 2010). *Aloe vera* was evaluated on *Rhizoctonia solani*, *Colletotrichum coccodes* and *Fusarium oxysporum* fungi. It was seen to successfully inhibit the growth of these fungal species (Sahu *et al.*, 2013). The leaves contain acids which have an inhibitory effect with highly susceptibility against *Candida albicans*. The leaf acid represents low inhibitory effect against *Aspergillus niger*. The methanolic extract of sap showed a higher inhibitory effect *Aspergillus niger* and *Candia albicans*. The water extract of sap exhibit intermediate susceptibility as *Aspergillus niger* and *Candida albicans*. The water extract of leaves has intermediate inhibitory effects against *Candida albicans* but *Aspergillus niger* resisted to its action. The acetone extract of sap showed an intermediate inhibitory effect against *Candida albicans* and *Aspergillus niger*. The acetone extract of leaves performed low inhibitory effect on *Aspergillus niger* and *Candida albicans* exhibited no susceptibility to it (Abakar *et al.*, 2017). *Aloe vera* performed zone of inhibition against *Candida albicans* and zone of inhibition depend on the concentration (Shireen *et al.*, 2015). The DMSO and ethanol extracts of *Aloe vera* gel showed inhibitory effect against *Aspergillus fumigatus* and *Penicillium notatum* (Gautam *et al.*, 2017). *Aloe vera* showed inhibitory effect against *Aspergillus fumigatus*, *Aspergillus glaucus*, *Aspergillus tereus*, *Candida albicans*, *Candida glabrata*, *Candida tropicalis*, *Trichophyton rubrum*, *Trichophyton verrucosum*, *Trichophyton mentagrophytes*, *Trichophyton tonsurans* and *Trichophyton violaceum* (Shamim *et al.*, 2004). *Aloe vera* gel have inhibit the growth of plant pathogenic fungi including *Alternaria alternata*, *Penicillium digitatum*, *Aspergillus niger*, *Aspergillus flavus* and *Drechslera hawaiiensis*. The Agar diffusion plate method used with different concentration of *Aloe vera* gel as 0.15%, 0.25% and 0.35% performed effective reduction against above mentioned fungi (Sitara *et al.*, 2011). The antifungal activity of crude extract of *Aloe vera* inhibited *Candida albicans* and *Fusarium oxysporum* (Waithaka *et al.*, 2018). The antifungal activity of *Aloe vera* gel extracts evaluated in-vitro against *Candida albicans* and using three solvents ethanol, methanol and aqueous also showed inhibition. The ethanol and aqueous extracts showed zone of inhibition on *Candida albicans* and ethanol extract showed the highest zone of inhibition on *Candida albicans* (Stanley *et al.*, 2014). An in vitro study of *Aloe vera* gel performed antifungal activity at higher concentration also showed that it can be used as an antifungal agent (Jain *et al.*, 2017).

3. *Nigella sativa*

Black cumin belongs to Ranunculaceae family and is cultivated for its pungent seeds which are used in herbal medicine and as a spice. The black seed plants are cultivated in India, Syria, Pakistan, Turkey and Saudi Arabia, etc. (Rajsekhar and Kuldeep, 2011). The black cumin seeds are dicotyledons, angular, trigonus, enormously black colour from external side, internally white, bitter taste and odour slightly aromatic (Duthie, 1960). The black cumin seeds have been used in several diseases like hypertension, liver problem, immune system, kidney problem, asthma and gastrointestinal disorders, etc. (Nasir *et al.*, 2014). Black cumin contains thymoquinone, thymohydroquinone, di-thymoquinone, 4-terpineol, p-cymene, carvacrol, tanethol, α -pinene, sesquiterpene longifolene and thymol, etc. (Sultana *et al.*, 2015). The ether extract of black cumin and thymoquinone was examined to have anti-dermatophyte activity against *Trichophyton species* and *Microsporum canis* by using the agar diffusion method which showed antifungal activity against these species (Aljabre *et al.*, 2005). The antifungal activity of the plant material has been tested against *Aspergillus niger*, *Aspergillus flavus* and *Alternaria* which showed essential activity against these fungi (Feroz and Uddin, 2016). The methanolic extract of black cumin oil has more antifungal activity than ether extract and more effective than Clomatrizol (Haloci *et al.*, 2012). In another study, the ethanolic extract showed considerable zone of inhibition against *Aspergillus niger* and it effectively depends on the concentration. Among the crude extracted phytochemicals of black cumin such as flavonoids, tannic acid and glycosides have also shown antifungal activity. The zone of inhibition of tannic acid is shown considerable (Zahra *et al.*, 2011). The antifungal activity of the oil extract of black cumin has been evaluated on *Aspergillus flavus* in the region of Algeria but shows less inhibition (Amrouche *et al.*, 2011). The antifungal activity of the black cumin volatile oil has shown an inhibitory effect against *Candida albicans*, *Aspergillus flavus*, *Aspergillus niger* and *Chaetomium globosum* (Gerige *et al.*, 2009). The antifungal activity of black cumin extract was tested against *Candida albicans* which has reported lowest antifungal effect on *Candida albicans* (Moghim *et al.*, 2015). The black cumin seed oil showed a potentially strong antifungal activity against *Candida species* (Asdadi *et al.*, 2014). The in vitro evaluation of

methanolic extract of black cumin seed have shown an inhibitory effect against *Candida tropicalis*, *Trichophyton mentagrophytes*, *Epidermophyton floccosum* and *Penicillium* (Sheik Noor Mohamed et al., 2015). In other study, essential oil showed antifungal activity against *Candida albicans* (Benlafya et al., 2014).

4.Conclusion

Aloe vera and Black cumin both have effective antifungal properties. These plants can be used as a natural antifungal agent as an alternative to synthetic fungicides. The oil extracts of black cumin performed moderate inhibitory effect against pathogenic filamentous fungi, aflatoxin-producing fungi, pathogenic yeasts and dermatophytes, etc. Aloe vera also showed sufficient inhibitory effect against various pathogenic moulds and *Candida albicans*. These plants can be applied as natural antifungal agents and can be assist dermatological diseases. Further research should be followed to isolate the bioactive compounds and establish best natural antifungal products against specific antifungal effect.

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