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PHYTOTHERAPY IN FUNGI AND FUNGAL DISEASE: A REVIEW OF EFFECTIVE MEDICINAL PLANTS ON IMPORTANT FUNGAL STRAINS AND DISEASES

Asghar Sepahvand [1], Behrouz Ezatpour [1], Fazel Tarkhan [2], Mahmoud Bahmani [3], Azadeh Khonsari [1] and Mahmoud Rafieian-Kopaei[*4]

Razi Herbal Medicines Research Center [1], Student Research Committee [2], Lorestan University of Medical Sciences, Khorramabad, Iran.
Leishmaniasis Research Center [3], Ilam University of Medical Sciences, Ilam, Iran.
Medical Plants Research Center [4], Basic Health Sciences Institute, Shahrekord University of Medical Sciences, Shahrekord, Iran.

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Correspondence to Author:
Prof. Mahmoud Rafieian-Kopaei

Medical Plants Research Center,
Basic Health Sciences Institute,
Shahrekord University of Medical Sciences, Shahrekord, Iran.

E-mail: rafieian@yahoo.com

ABSTRACT: Infectious diseases are among the most important common diseases worldwide that bring stupendous costs for human community. Medicinal plants are considered a rich source of antimicrobial agents and therefore can be used as antimicrobial remedies because of producing secondary metabolites. This article was designed to review the effective medicinal plants on fungi and fungal disease. In this study, the relevant articles published in Persian and English languages were searched for in the databases Magiran, Iranmedex, Irandoc, PubMed, Scopus, SID, Web of Science, and Science Direct using the search engine Google Scholar. To maximize the comprehensiveness of the search, the general terms antimicrobial, dermatophyte, mycotic, Iran, and anti-Candida as well as their Persian equivalents were used. AND and OR were used for combining searches. Medicinal herbs such as *Zataria multiflora*, *Thymus vulgaris*, *Thymus kotschyanus*, *Punicagranatum* L., *Rosmarinus officinalis* L., *Matricaria chamomilla* L., *Urtica dioica* L., *Mentha piperita* L. and *Salvia officinalis* L., *Thymus vulgaris, Salvia officinalis, Eucalyptus globulus, Mentha piperita, Oliveria decumbens, Echinophora Platyloba*, *Thymus eriocalyx* and *Thymus X-porlock*, *Achillea millefolium, Artemisia sieberi, Cuminum cyminum, Nigella sativa, Heracleum persicum, Hyssopus officinalis, Matricaria recutital, Menta spicata, Foeniculum vulgare, Pimpinella anisum, Plargonium graveolens, Rosmarinus officinalis, Saturia hortensis, Zataria multiflora, Thymus kotschyanus, Zataria multiflora, Ziziphora clinopodioides, Mentha piperita* L., *Physalis alkekengi* L., *Hymenocrater longiflorus* Benth and are the most important Medicinal herbs effective on fungal diseases. Medicinal herbs mentioned in this study due to phenolic compounds and antioxidant activities have antifungal effects.

INTRODUCTION: Infectious diseases are among the most important common diseases worldwide that bring stupendous costs for human community[1]. To date, around 200000 fungal species have been identified of which 100 species are pathogenic.

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Fungal infections are widely various and can cause mucosal, submucosal, superficial, cutaneous and visceral diseases depending on the involved part of the body [2].

Studies have demonstrated increased prevalence of opportunistic fungal infections for certain reasons such as AIDS, organ transplant, chemotherapy, and increased rate of cancer incidence that are associated with weak immune system, as well as expansion of resistance to the currently used antifungal drugs, which intensifies the necessity of

conducting pharmacological investigations to develop new antifungal drugs and compounds.

In addition, most available drugs have limited antifungal activity or have no potential safety for systemic administration [3]. Medicinal plants are considered a rich source of antimicrobial agents and therefore can be used as antimicrobial remedies because of producing secondary metabolites [4 - 6]. This article was designed to review the effective medicinal plants on fungi and fungal disease.

Search Strategy and Study Design: In this study, the relevant articles published in Persian and English languages were searched in the databases including Magiran, Iranmedex, Irandoc, PubMed, Scopus, SID, Web of Science, and Science Direct using the search engine Google Scholar. Manual search was also conducted on the references of the relevant articles. The main search terms used were essential oil, extract, fungi, plant, antifungal and their Persian equivalents. To maximize the comprehensiveness of the search, the general terms antimicrobial, dermatophyte, mycotic, Iran, and anti-Candida as well as their Persian equivalents were used. AND and OR were used for combining searches.

RESULTS: Based on the results in this review some plants with antifungal activity were obtained. The full lists of antifungal herbs are specified in **Table 1**.

DISCUSSION: Fungi are mostly plant like organisms. These organisms usually grow in warm and damp areas. Fungi mostly grow between the toes or on the scalp but may grow anywhere on or in the body. The symptoms of fungus infection include moist and red patches, scaling, and irritable, thickened or peeling skin. Sometimes infections are alongside with blisters and unpleasant odor. As showed, a lot of plants have antifungal activities, but the essential oils of Tea tree are good remedies to fight fungal infections. The essential oil of Tea tree should be applied directly to infected areas once, two or three times a day. Frequent applications for a period of time are important to complete the treatment period and diminish the signs infections [7].

Garlic also has anti-fungal activity, if it is applies to the infected regions three or four times per day. Garlic caps might be a good choice; however, its smell is a concern. Garlic is usually taken as a supplement but provides tremendous health benefits. Sometimes combination of medicinal plants extract such as mixture of essential oils or extracts of tea tree and black walnut are used to treat fungal infections. Vinegar is also frequently used alone or in addition to other remedies [7]. Phenolic compounds are the predominant content of most of these plants. These chemicals have antioxidant and anti-microbial activities. Some of these compounds have synergistic effects. They also might have synergistic impact with conventional ant-fungal drugs. This is an important subject in complementary medicine [8]. It should be noted that more plants have anti-bacterial activities than anti-fungal properties [9]. This maters further support that anti-microbial activities of some of these plants might be due to the presence of phenolic compounds. Especially the present of high flavonoid contents [9].

TABLE 1: NATIVE MEDICINAL PLANTS NATIVE TO IRAN EFFECTIVE ON IMPORTANT FUNGAL STRAINS AND DISEASES

Authors	Fungi	Plant	Family	Compounds	Main findings
(Amini *et al.*, 2012) [10]	*Pythium aphanidermatum, Rhizoctonia solani, Fusarium graminearum, Sclerotinia sclerotiorum.*	*Zataria multiflora, Thymus vulgaris, Thymus kotschyanus*	Labiatae	methanol	The results showed that the essential oils were highly effective on the four studied plant pathogenic fungi with mean growth inhibition of 100% at 200 µl/l concentration
(Sahraie-Rad *et al.*, 2015) [11]	*Malassezia fungus*	*Punica granatum, Rosmarinus officinalis, Matricariachamomilla, Urtica dioica, Mentha piperita Salvia officinalis* L.	Punicaceae Labiatae Compositae Urticaceae Labiatae Labiatae	methanol	Based on evidence, medicinal plant-based extracts have remarkable effects on dandruff removal with less side effects, though it takes a long time to treat this concern. The results showed that applying the combination of medicinal plant-based extracts and natural ingredients with chemical compounds in pharmaceutical industry could optimize treatment

(Mousavi and Raftos, 2012) [12]	*Metrhizium sp.* *Ophiostoma sp.* *Trichoderma sp.* *Penicillium expansum*	*Thymus vulgaris* *Salvia officinalis* *Eucalyptus globulus* *Mentha piperita*	Labiatae Labiatae Myrtaceae Labiatae	hydro distillation	The MIC and MFC were, respectively, 0.022 and 0.064 mg/ml for Metrhizium sp., 0.02 and 0.064 mg/ml for Ophiostoma sp., 0.018 and 0.048 mg/ml for Trichoderma sp. and 0.03 and 0.085 mg/ml for Penicillium expansum. Penicillium expansum showed the lowest inhibitory activity yet the difference was *in*significant ($p>0.05$). Also, Trichoderma sp. was the most sensitive species to this combination. According to this experiment, this combination was found to have a wide spectrum of activities against all filamentous fungi examined in this study and may be recommended to control fungal diseases
(Amin *et al.*, 2005) [13]	*Aspergillus niger* *Candidia albicans*	*Oliveria decumbens*	Umbellifera	oil	The oil displayed high antimicrobial activity against all tested gram positive and gram negative bacteria and fungal strains
(Entezari *et al.*, 2009) [14]	*Candidia albicans, Aspergillus flavus and Aspergilus niger*	Echinophora Platyloba	Umbellifera	methanol	The growth of the three studied fungi, *C. albicans*, *A. flavus*, and *A. niger*, was not inhibited
(Rasooli and Owlia 2005) [15]	*Aspergillus parasiticus*	Thymus eriocalyx and Thymus X-porlock	Labiatae	Ethanol	Static effects of these oils against *A. parasiticus* were at 250 ppm and lethal effects of *T. eriocalyx* and *T. X-porlock* were 500 and 1000 ppm of the oils, respectively. Aflatoxin production was inhibited at 250 ppm of both oils with *T. eriocalyx* being a stronger inhibitor. Transmission electron microscopy of *A. parasiticus* exposed to MIC level (250 ppm) of the oils showed irreversible damage to cell wall, cell membrane, and cellular organelles
(Gharachorlou and Shamami, 2013) [16]	*Dermatophytes*	Artemisia L.	Asteraceae	Ethanol	Measurement of colonies diameter showed that there was significant difference in the groups administered with different doses of amino acid and herbal extract ($P<0.05$). Furthermore, it was shown that the efficacy of high doses of amino acid was higher than low doses; therefore, it can be argued that it acts dose-dependently. But compared with group 4, herbal extract showed better antifungal activity against *trichophyton mentagrophytes*. The strong effects of the essential oils of Artemisia are probably due to the high amount of terpenoids and flavonoids especially α-thujone content
(Naeini, *et al.*, 2009) [17]	*Candida albicans*	*Achillea millefolium* *Artemisia sieberi* *Cuminum cyminum* *Nigella sativa* *Heracleum persicum* *Hyssopus officinalis* *Matricaria recutital* *Menta spicata* *Foeniculum vulgare* *Pimpinella anisum* *Plargonium graveolens* *Rosmarinus officinalis* *Saturia hortensis* *Zataria multiflora* *Thymus kotschyanus* *Zataria multiflora* *Ziziphora clinopodioides*	Asteraceae Compositae Apiaceae Apiaceae Apiaceae Labiatae Asteraceae Labitae Ranuculaceae Apiaceae Geraniaceae Labiatae Labiatae Labiatae Labiatae Labiatae	Ethanol	Fourteen (87%) out of the 16 plants were found to be active. These oils confirmed the existence of a significant activity against *C. albicans* tested with MICs of 150-2300 mg/ml using broth macrodilution method and the growth inhibition zone of 16-55 mm using disc diffusion method. The essential oils of *Zatariamultiflora*, *Thymuskotschyanus*, *Cuminumcyminum*, and *Plargoniumgraveolens* showed significant activity against *C. albicans* ($P < 0.05$)

(Rasooli, Fakoor *et al.*, 2008) [18]	*Aflatoxin B1 (AFB1) of Aspergillus parasiticus*	*Rosmarinus officinalis* *Trachyspermum copticum*	Labiatae Umbelliferae	Ethanol	Aflatoxin production was inhibited at 450 ppm of both oils with *R. officinalis* being a stronger inhibitor
(Razzaghi-Abyaneh, Shams-Ghahfarokhi *et al.*, 2008) [19]	*Aflatoxin B1 (AFB1) of Aspergillus parasiticus*	*Satureja hortensis* L.	Labiatae	Ethanol	Clearly show a new biological activity for S. hortensis L. as strong inhibition of aflatoxin production by A. parasiticus. Carvacrol and thymol, the effective constituents of S. hortensis L., may be useful to control aflatoxin contamination of susceptible crops in the field
(Hadi, Sorkhi *et al.*, 2013) [20]	*Penicilium digitatum Sacc*	*Urtica dioica* , *Cinnamomum zeylanicum Blume,* *Matricaria chamomilla,* *Mentha piperita* L.	Urticaceae Lauraceae Compositae Labiatae	ethanol	The results demonstrated the plant extracts and their components had inhibitory activities on the growth rate and mycelial weight of this fungus
(Torabzadeh and Panahi 2011) [21]	*Microsporum canis,* *Candida albicans,* *Trichophyton mentagrophytes,* *Nocardia asteroids*	*Physalis alkekengi* L.	Solanaceae	Ethanol	Ethanol extracts had the strongest effect with MIC=15.62 for all the studied fungi. Although acetone extracts have a broad spectrum of activities as with ethanol extracts, they should be used at higher concentration to fully inhibit *C. albicans*. Isolated N. asteroids were the most sensitive fungi in this study. *C. albicans* was the most resistant fungus compared to the three other fungal species
(Tolouee, *et al.*, 2010) [22]	*Aspergillus niger*	*Matricaria chamomilla* L.	Compositae	Ethanol	These findings indicate the potential of *M. chamomilla* L. essential oil in preventing fungal contamination and subsequent deterioration of stored food and other susceptible materials
(Gandomi, *et al.*, 2009) [23]	*aflatoxin formation by Aspergillus flavus*	*Zataria multiflora* Boiss.	Labiatae	Ethanol	The results suggested the potential substitution of the antifungal chemicals by this essential oil as a natural inhibitor to control the growth of molds in foods such as cheese
(Ahmadi *et al.*, 2010)[24]	*Aspergillus niger* *Candida albicans.*	*Hymenocrater longiflorus* Benth.	Labiatae	methanol	The results revealed that the essential oil and polar sub-fraction were effective mostly on *Aspergillus niger* and *Candida albicans*.
(Ebrahimabadi, *et al.*, 2010) [25]	*Candida albicans* *Aspergillus niger*	*Salvia eremophila* Boiss	Labiatae	methanol	Among the fungal strains tested, *C. albicans* showed moderate sensitivity to both essential oil and extract while *A. niger* was only weakly sensitive to the oil. The maximum inhibition zones and MICs for microbial strains sensitive to the plant products were 8–32 mm and 7.8 to >500 lg/ml, respectively
(Ebrahimabadi *et al.*, 2010) [26]	*Candida albicans* *Aspergillus niger*	*Stachys inflata* Benth	Labiatae	methanol	The plant showed a week antimicrobial activity against the tested microorganisms
(Bamoniri *et al.*, 2010) [27]	*Candida albicans* *Aspergillus niger*	*Semenovia tragioides Boiss*	Umbelliferae	methanol	No effect
(Mahboubi and Bidgoli 2010) [28]	*Candida albicans*	*Myrtus communis*	Myrtaceae	methanol	The antifungal examinations showed that myrtle oil exhibited good antifungal activity against fungi. Myrtle oil showed significant antifungal activity when combined with amphotericin B
(Rasooli *et al.*, 2006) [29]	*Aspergillus niger*	*Thymus eriocalyx* *Thymus x-porlock*	Labiatae	methanol	It was concluded that the essential oils could be safely used as preservatives
(Omidbeygi *et al.*, 2007) [30]	*Aspergillus Xavus*	*Thymus vulgaris* *Satureja hortensis* *Syzygium aromaticum*	Labiatae Labiatae	methanol	The results showed that all essential oils could inhibit the growth of *A. Xavus*, and the thyme oil and summer savory showed the strongest inhibition at 350 ppm and 500 ppm, respectively
(Khosravi *et al.* 2009) [31]	*Pityriasis versicolor*	*Artemisia sieberi*	Compositae	methanol	The results showed 71% improvement in clotrimazole group and 91.9% in Mycoderm group after two weeks of the treatment with a significant statistical

					difference between the two groups ($p < 0.05$). The rate of improvement was derived 67.7% and 100% in clotrimazole and Mycoderm groups after four weeks of the treatment, respectively ($p < 0.001$)
(Khosravi *et al.*, 2013) [32]	*dermatophytosis*	*Artemisia sieberi*, *Cuminum cyminum*, *Foeniculum vulgare*, *Heracleum persicum*, *Menta spicata*, *Nigella sativa*, *Rosmarinus officinalis*, *Zataria multiflora* *Ziziphora clinopodioides*	Asteraceae Apiaceae Apiaceae Apiaceae Labiatae Ranunculaceae Labiatae Labiatae Labiatae	methanol	The most significant activity was observed with *A. sieberi*, exhibiting a lower MIC against dermatophytes than other plant oils ($P < 0.05$)
(Gavanji, Zaker *et al.*, 2015) [33]	*Candida albicans*	*Foeniculum vulgare* Mill, *Satureja hortensis* L, *Cuminum cyminum*, *Zataria multiflora*	Umbellifera Labiatae Umbellifera Labiatae	methanol	*Z. multiflora* Boiss essential oil at MIC of 34 g/mL and minimal lethal concentration [i.e., minimal fungicidal concentration (MFC)] of 64 g/mL had more powerful anti-*Candida* activity than the other essential oils. *C. cyminum* essential oil showed the least effect on the tested fungus
(Karbin, Rad *et al.*, 2009) [34]	*Aspergilus flavus*	*Hyssopus officinalis*, *Cuminum cyminum*, *Thymusvulgaris* *cupressus arizonica*	Labiatae Labiatae Labiatae Cupressaceae	methanol	The results showed that the essential oil of all plants affected the growth of *Aspergillus flavus in vitro*
(Sadeghi-Nejad, *et al.*, 2010) [35]	*Aspergillus flavus*, *A. niger*, *Penicillium sp.*, *Fusarium sp.*, *Alternaria sp.*, *Rhizopus sp.*, *Mucor sp.*	*Satureja khuzestanica* Jamzad	Labiatae	ethanolic	The findings showed that the ethanolic extract of *S. khuzestanica* leaves exhibited antifungal activity against all tested saprophytic fungi with MICs (625-5000 microg/ml)
(Falahati *et al.*, 2005) [36]	*Microsporum canis*, *Microsporum gypseum*, *Tricophyton rubrum*, *Tricophyton schoenleinii*, *Tricophyton mentagrophytes* *Epedermophyton floccosum*	*Eucalyptus camaldulensis*	*Myrtaceae*	Methanolic	*Eucalyptus camaldulensis* showed antifungal activity against all tested dermatophytes with MICs of 0.4-1.6 mg/mL according to inhibitory zones, 0.4-1.6 mg/mL according to agar dilution, and 0.2 to 1.6 mg/mL according to broth dilution
(Alizadeh and Shaabani, 2012) [37]	*Candida albicans*	*Salvia officinalis* L.	Lamiaceae	hydro-distillation	The oil showed high antimicrobial activity against *C. albicans*, two medically important pathogens compared with standard antibiotics
(Badiee *et al.*, 2012) [38]	*candida species*	*Salvia officinalis* L	Lamiaceae		The MICs of essential oil extracts against *C. albicans, C. parapsilosis*, and *C. krusei* (standard species), as well as *C. albicans* and *C. glabrata* (isolated from patients) were 15.6, 3.9, 31.3, 31.3 and 1.9 µg/ml, respectively
(Rasouli-Sadaghiani *et al.*, 2010) [39]	*Glomus fasciculatum* *Glomus etuonicatumi* *Glomus intraradices*	*Ocimum basilicum*	Labiatae		The results showed that mycorrhizal plants significantly had higher shoot and root dry weight, more leaf area, plant height, and lateral branches, as well as N, P, K, Ca, Fe, Cu and Mn concentration compared to non-inoculated plants
(Nejat *et al.*, 2015) [40]	*Trichophyton mentagrophytes* *Trichophyton verrucosum* *Microsporum gypseum*	*Thymus daenesis*, *Satureja bachtiarica*, *Althaea officinalis*	Labiatae Labiatae Malvaceae	ethanolic	The results showed that propolis extract suppressed the growth of all tested fungi with different degrees
(Avijgan *et al.*, 2012) [41]	*Candida vaginitis*	*Echinophora platyloba*	Umbellifera	hydroalcoholic	Fourteen days after treatment, the positive culture of vaginal discharge was observed in 13 cases (43.3%) of the group treated with fluconazole, and 6 cases (20%) treated with fluconazole and

					Echino cream ($p < 0.5$). The rate of recurrent candida vaginitis was 17 cases (56.7%) in the group treated with fluconazole and 8 cases (26.7%) in the other group ($p < 0.5$)
(Mousavi *et al.*, 2014) [42]	*Oncorhynchus mykiss*	*Thymus vulgaris* *Salvia officinalis* *Eucalyptus globulus* *Mentha piperita*	Labiatae Labiatae Myrtaceae Labiatae	hydroalcoholic	According to these findings, the combination use of essential oils can be proposed as a suitable antifungal therapeutic strategy in hatcheries
(Nabigol and Morshedi 2013) [43]	*Rhizopus stolonifer,* *Penicillium digitatum,* *Aspergillus niger* *Botrytis cinerea*	*Thymus danensis* *Thymus carmanicus*	Labiatae		Thymus sp. oils showed inhibitory effect even at low concentration (300µl/L) against *B. cinerea* and *R. stolonifer* as well as against *A. niger* and *P. digitatum* at 600µl/L. The primary concentration of both essential oils tested *in vivo* exhibited inhibitory activity against the four pathogens
(Mikaeili *et al.*, 2014) [44]	*Microsporum canis*	*Urtica dioica* L	Urticaceae	hydroalcoholic	The extracts did not display considerable antifungal activity against *M. canis* compared with terbinafine. The MICs of aqueous and hydroalcoholic extracts were 30 and 20 $mg.ml^{-1}$, respectively
(Mahmoudvand *et al.*, 2014) [45]	*Trichophyton mentagrophytes* *Trichophyton rubrum,* *Microsporum canis,* *Microsporum gypseum*	*Berberis vulgaris*	Berberidaceae	Methanolic and Chloroform	In evaluating antidermatophytic effects of various extracts of *B. vulgaris* and berberine by disk diffusion MLB, it could be observed that all the aforementioned extracts and berberine had potent antidermatophytic effects
(Saharkhiz *et al.*, 2012) [46]	*C. albicans* *C. glabrata* *C.tropicalis* *C. krusei* *C.dubliniensis* *C.parapsilosis* *C. neoformance* *C. albicans* *C.dubliniensis* *C. tropicalis* *C.parapsilosis* *C. glabrata* *A. flavus* *A. fumigatus* *A. fumigates* *A. oryzae* *A. clavatus*	*Mentha piperita*	Labiatae	hydrodistillation	The essential oil exhibited strong antifungal activities against the studied fungi at concentrations of 0.12 to 8.0 µL/mL
(Mahboubi and Bidgoli 2009) [47]	*Candida albicans*	*Artemisia aucheri Boiss*	*Compositae*	methanolic	The results showed that *Pseudomonas aeruginosa* was resistant to the oil and *Staphylococcus aureus* and *Candida albicans* showed the best sensitivity to the oil
(Verdian, *et al.*, 2008) [48]	*Candida albicans*	Artemisia annua L.	*Compositae*	methanolic	The activity was found to be more pronounced against fungal organisms than against gram-positive and gram negative bacteria
(TO and AA) [49]	*Microsporum canis,* *Trichophyton rubrum* *Epidermophyton floccosum*	*Artemisia siebri*	*Compositae*	methanolic	Among the tested species, *Epidermophyton floccosum* was the most sensitive species fungal than the three combined. Trichophyton rubrum the most resistant species to the antifungal effects of alcoholic and aquatic extracts and *Trichophyton rubrum* and *Microsporum canis* is the most resistant to the effects of antifungal miconazole were found. Among the species tested, *E. floccosum* most sensitive species fungal than the three combined. *T. rubrum* and *M. canis* is the most resistant to the effects of

					Antifungal miconazole and *Artemisia siebri* were found. Our results demonstrate that *A. sieberi* extract have good effect on saprophyte
(Larypoor, Akhavansepahy *et al*., 2009) [50]	*Epidermophyton floccosum Microsporum canis Microsporum gypseum, T. mentagrophytes T. mentagrophytes T. rubrum Trichophyton tonsurans*	*Hypercom perforatum*	Hypericaceae	hydro distillation	The essential oil of *H. perforatum* sufficiently inhibited and killed all tested dermatophytes at all different dilutions
(Abdollahi *et al*., 2011) [51]	*Aspergillus niger*	*Zataria multiflora* Boiss	Labiatae	Hydrodistillated	The essential oil inhibited sporulation of *A. niger* with no sporulation at 1,500 ppm
(Fateh *et al*., 2010) [52]	*Aspergillus fumigatus, Aspergillus flavus Aspergillus niger, Penicillium gryseogenum, Alternaria, Microsporum canis Trichophyton mentagrophytes*	*Allium hirtifolium*	Liliaceae	Alcoholic and aqueous extracts	Antifungal activity against all the tested fungal species with MICs of 0.058-0.8 mg/ml for alcoholic extract and 0.26-3.84 mg/ml for aqueous extract. The minimum fungicidal concentration of alcoholic and aqueous extracts ranged from 0.1 to 12.8 mg/ml and 0.6 to 68.26mg/ml, respectively.
(Khanahmadi *et al*., 2009) [53]	*Candida albicans*	*Artemisia haussknechtii*	Compositae	ethanolic extract	MIC of the extract against yeast was the lowest (2.5 µg/ml).
(Aghel *et al*., 2011) [54]	*Candida albicans*	*Dittrichia gravolence*	Compositae	Hydro distilled	Numerous essential oils have been tested for *in vivo* and *in vitro* antimycotic activity and some of them were found to be potential antifungal agents.
(Ahanjan *et al*., 2009) [55]	*Fusarium oxysporum Candida albicans*	*Parrotia persica*	Hammamelidaceae	methanol	These results revealed that the compound was 6-(ethoxymethyl)-tetrahydro-2H-pyran-2, 3, 4, 5-tetraol compound with 1-isopropyl-4- methoxybenzene, the compound was found responsible for antifungal activity against both *F. oxysporum* and *C. albicans*
(Arabi and Sardari 2010) [56]	*Candida albicans Aspergillus fumigatus Asperigillus niger*	*Dalbergia sissoo, Lathyrus pratensis, Oreophysa microphyalla, Astragalus stepporum, Ebenus stellata, Sophora alopecuroides, Ammodendron persicum* and *Taverniera cuneifolia*	Fabaceae	ethanol	The results showed activity against at least one of the microorganisms investigated in this study
(Naeini *et al*., 2014) [57]	*Candida albicans*	*Cuminum cyminum Salvadora persica*	Apiaceae Salvadoraceae	Alcoholic	The results suggested the possibility of substitution of the antifungal chemicals by *C. cyminum* essential oil and *S. persica* alcoholic extract as nature-based inhibitors to control the growth of the most important pathogenic Candida species and alternative therapies for candidiasis
(Pirbalouti *et al*., 2009) [58]	*Candida albicans*	*Satureja bachtiarica, Thymus daenensis, Scrophularia striata, Thymbra spicata, Tanacetum polycephalum, Artemisia kermanensis, Ziziphus spina-christi, Trachyspermum ammi Carum copticum* L. *Quercus brantii* Lindl.	Labiatae Labiatae Scrophulariaceae Labiatae Compositae Asteraceae Rhamnaceae Umbelliferae Umbelliferae Fagaceae	hydro-distillation	The herbs showed anti-Candida activity, including *Saturejab achtiarica*, *Thymus daenensis*, *Thymbra spicata*, *Tanacetum polycephalum*, and *Trachyspermum ammi*. Moreover, the extracts of *Scrophularia striata* and *Ziziphus spinachristi* were the most active at any of the tested concentrations.
(Hajieghrari *et al*., 2005) [59]	*Rhizoctonia solani, Pyricularia orizea Fusarium oxysporum*	*Cymbopogon parkeri* stapf	Gramineae	Hydro distillation	The results showed that concentrations of 600 microl/L of the essential oil completely inhibited the growth of all studied fungi. EC50 for *Rhizoctonia*

					solani, *Pyricularia orizea*, and *Fusariumoxy sporum* were 39.82, 72.00 and 43.63microl/L, respectively. The results indicated that the essential oil had strong fungi static activity
(Zihayat *et al*., 2013) [60]	*Microsporum canis, Microsporum gypseum, Trichophyton mentagrophytes*	*Myrtus communis*	Myrtaceae	Ethanolic	According to the disk diffusion, the ethyl acetate extract had the most optimal anti-fungal effect while according to autobiography, both ethyl acetate and methanol extracts in Rf=0.03 had anti-fungal effects and inhibition zone on the three examined fungi
(Naeini *et al*., 2011) [61]	*pityriasis versicolor*	*Zataria multiflora, Pelargoniumgraveolens Cuminum cyminum*	Labiatae Geraniaceae Apiaceae	water-distillation	This study indicated that *Z. multiflora*, *P. graveolens*, and *C. cyminum* essential oils had considerable anti-Malassezia activities, deserving further investigation to be clinically used for the treatment of *P. versicolor*
(Noori and Taghavi, 2013) [62]	*Aspergillus flavus Rhizopus stolonifer*	*Fistulina hepatica*		Methanolic	*F. hepatica* methanolic extract showed antibacterial effects on a gram-positive bacterium (*S. aureus*) and also antifungal effects on *A. flavus* while it was not effective on a gram-negative bacterium (*E. coli*) and *R. stolonifer*
(Hardani and Sadeghi-Nejad, 2013) [63]	*10 Candida isolates*	*Ixora brachiata*			The anticandidal effects of the plant caused the growth inhibition zones of 12-14 mm and MICs of 5. 0-10 mg ml⁻¹ for both root and leaf extracts of *I. brachiata* at 24-hour incubation period
(Mikaeili *et al*. 2012) [64]	*C. albicans*	*Astragalus verus*	Fabaceae	methanol and acetone	The aqueous extract (40%) prevented heavy burden of *C. albicans* in the tissues and the skin in oral and topical application, respectively. The results indicated that *A. verus* could serve as a potential source of anti-candidal drugs
(Torbati *et al.*, 2014) [65]	*Alternaria alternate Fusarium nygamai Aspergillus ochraceus Arthrinium phaeospermum Cladosporium cladosporioides Aureobasidium pullulans Epicoccum nigrus Penicillium expansum Truncatella angustata Trichothecium roseum Trichoderma harzianum*	*Olive fruit rot Olea* L.	Oleaceae	ethanol	Fungal infection caused significant increase in the extracted oil's acidity and peroxide values. However, there was no significant difference in the acidity and peroxide values among different treatments (fungal isolates)
(Ghasemi *et al*., 2005) [66]	*Candida albicans C. kefyr*	*Ferula gummosa* Boiss	Apiaceae	Hydro-distilation	The essential oil remarkably inhibited the growth of the tested microorganisms. The results indicated that the fruits could be used as an aromatic antimicrobial agent
(Faridi *et al.*, 2008) [67]	*Candida albicans Candida kefyr*	*Smyrniopsis aucheri*	Apiaceae		The studied oil showed strong candidacidal activity. The antibacterial and antifungal effects may be due to the high level of bisabolol and pinene in the essential oil
(Faramarzi *et al.*, 2008) [68]	*Aspergillus niger Aspergillus flavus Aspergillus fumigatus Candida albicans Cryptococcus neoformans*	*Geum kokanicum*	Rosaseae	Hydro-distillate	Inhibition zones for all fungal strains appeared in 1 mg per disc of the essential oil. *A. flavus* showed the zone even at 0.25 mg per disc and was the most susceptible fungal strain
(Yahyazadeh *et al.*, 2008) [69]	*Penicillium digitatum*	*Foeniculum vulgare, Thymus vulgaris, Eugenia caryophyllat*	Umbelliferae Labiatae Myrtaceae		Thyme and clove essential oils completely inhibited *P. digitatum* growth either when added into the medium 600 ll

		Salvia officinalis	Labiatae		l-1 or by their volatiles with 24 ll per 8 cm diameter Petri dish. Sage and fennel oils did not show any inhibitory activity on this fungus. Scanning electron microscopy was done to study the mode of action of clove oil in *P. digitatum* and it was observed that treatment with the oil led to large alteration in hyphal morphology
(Razzaghi-Abyaneh, *et al.*, 2013) [70]	*Aspergillus parasiticus*	*Heracleum persicum*	Apiaceae	ethyl acetate	*H. persicum* extract exerts antifungal and anti-AF activities by disrupting plasma membrane integrity and permeability mainly through interfering with ergosterol biosynthesis
(Iranshahi *et al.*, 2008) [71]	*dermatophytes*	*Ferula latisecta*	Umbelliferae		*Ferulalatisecta* fruits exerted activity against a range of human pathogenic dermatophytes
(Zarrin *et al.*, 2010) [72]	*Cryptococcus neoformans*	*Satureja Khuzestanica jamzad*	Labiatae	ethanol	This study demonstrated that *Satureja khuzestanica* extract had anticrptococcal activity
(Farjam, 2012) [73]	*Candida albicans*	*Salvia urmiensis*	Labiatae	ethyl acetate	The greatest antimicrobial activity was seen against *Bacillus subtilis* (106.7µg/ml) and *Candida albicans* (5.3µg/ml)
(Naeini *et al.*, 2010) [74]	*Fusarium verticillioides* *Fusarium poae* *Fusarium equiseti*	*Zataria multiflora* *Cuminum cyminum* *Foeniculum vulgare* *Heracleum persicum*	Labiatae Apiaceae Ranuculaceae Apiaceae		*Z. multiflora* and *H. persicum* showed the highest and lowest activity against toxigenic *Fusarium* isolates, whereas *C. cyminum* and *H. persicum* had the highest and lowest effect on non-toxigenic isolates, respectively. However, *F. vulgare* and *Pinaceae* had moderate effects on the tested fungi
(Ghaderi and Maleknezhad 2006) [75]	*Candida albicans*	*Berberis vulgaris*	Berberidaceae	ethanolic	*Berberisvulgaris* root extracts had anticandidal effects that were more prominent for ethanolic extract
(Behravan *et al.*, 2004)[76]	*Aspergillus niger,* *Trichophyton rubrum,* *Trichoderma reesei* *Microsporum gypseum* *Candida albicans* *Saccharomyces cerevisiae*	*Satureja mutica*	Labiatae	hydrodistillation	The essential oil was found to be fungicidal at ≥0.25 µl/ml against the filamentous fungi. The MIC of the oil against the two yeast strains was found to be 1333 ppm (1/750 v/v)
(Abolfazl, *et al.*, 2014) [77]	*Fusarium Oxysporum* *Aspergillus flavus* *Alternaria alternate*	*Stachys pubescens* *Coriandrum sativum,* *Cinnamomum zelanicum* *Bupleurum falcatum*	Labiatae Umbelliferae Lauraceae Umbelliferae	hydro-distillation	These oils exhibited a remarkable potency against the fungi
(Farzaneh, Ahmadzadeh *et al.*, 2005) [78]	*Tiarosporella phaseolin* *Fusarium moniliforme*	*Artemisia scoparia,* *A. sieberi* *A. aucheri*	Asteraceae	hydro-distillation	According to the bioassay results, the oils of *A. aucheri* and *A. sieberi* exhibited stronger antifungal activity. Minimum EC50 (41.406 microL/L) was resulted from *A. aucheri* on *Rhizoctonia solani*
(Kazemi Oskuee, Behravan *et al.*, 2011) [79]	*Candida albicans*	*Carum copticum*	Umbelliferae		*C. albicans* appeared to display significant resistance
(Behnam *et al.*, 2005) [80]	*Rhizopus stolonifer,* *Botrytis cinerea* *Aspergillus niger*	*Mentha piperita* *Lavendula angustifolia*	Labiatae Labiatae	hydrodistillation	Plate assays showed that the different concentrations of essential oils had antifungal activity against these fungi, and the essential oil of *L. angustifolia* showed stronger fungistatic activity
(Yousefzadi *et al.*, 2009) [81]	*C. albicans,* *Saccharomyces cerevisiae, Aspergillus niger*	*Tanacetum balsamita*	Compositae	hydrodistillation	According to the disc diffusion method and MICs, the antimicrobial activity of the essential oil was moderate to high
(Dehghan *et al.*, 2007) [82]	*Aspergillus niger* *Candida albicans*	*Ferula szovitsiana*	Umbelliferae	hydrodistillation	It was found that *F. szovitsiana* oil could be the most potent antimicrobial candidate with MIC of 1.25 mg

(Mohajeri *et al*., 2012) [83]	*Penicellium citrinum*	*Zataria multiflora*	Labiatae		It was found that the effect of different concentrations of essential oil on radial growth and sporulation was statistically significant ($p<0.05$)
(Darougheh *et al*., 2014) [84]		*Carum Carvi L*	Umbelliferae	distilled water	
(Ramezani, 2005) [85]	*Alternaria triticina*	*eucalyptus Citriodora*	Myrtaceae		A complete inhibition of radial growth, dry weight, and spore germination was observed at 1500, 1000 and 100 ppm, respectively
(Ghorbanian *et al*., 2008) [86]	*Aspergillus parasiticus*	*Azadirachta indica A. juss*			The inhibition of aflatoxin synthesis by plant extracts was found to be time- and dose-dependent. The maximum inhibitory effect was 80–90% in the presence of 50% concentration that was significant compared with control samples ($p< 0.05$)
(Mahboubi and Kazempour 2011) [87]	*Candida albicans* *Candida glabrata* *Aspergillus niger* *Aspergillus flavus* *Aspergillus parasiticus*	*Satureja hortensis*, *Trachyspermum copticum*	Labiatae Umbelliferae		Two essential oils exhibited strong antimicrobial activity but the antimicrobial activity of *T. copticum* oil was higher than that of *S. hortensis* oil
(Sadeghi-Nejad and Deokule 2010) [88]	Microsporum, Trichophyton Epidermophyton	*Pogostemon parviflorus*		ethanolic	It completely prevented the growth of the dermatophytic species with MICs of 2.5-10 mg/mL
(Sonboli *et al*., 2010) [89]	*Candida albicans* *Aspergillus niger* *Microsporium gypsium*	*Cymbopogon Olivieri*	Gramineae	hydrodistillation	The oil exhibited moderate to high activity towards the microorganisms among which *B. subtilis* and *C. albicans* with inhibition zones of 20 mm and MICs of 3.75 mg/ml and 2.5 mg/ml, respectively, being more sensitive than the others
(Avijgan *et al*., 2010) [90]	*Candida albicans*	*Echinophora Platyloba*	Umbelliferae	ethanol	The results showed that *Echinophora platyloba*, at 2mg/ml or higher concentrations, effectively inhibited the growth of *Candida albicans*. In other words, *C. albicans* could grow on media containing 1mg/ml of the extract
(Aghel *et al*., 2007) [91]	*Trichophytumrubrum* *Trichophytumverrucosum* *Microsporumcanis* *Microsporumgypseum*	*Zataria multiflora* Boiss	Labiatae	methanolic	
(Shokri *et al*., 2011) [92]	*Aspergillus flavus* *A. parasiticus* *A.ochraceus* *Fusarium verticillioides*	*Zataria multiflora* *Geranium pelargonium*	Labiatae Geraniaceae		The essential oils exhibited considerable inhibitory effects on these important toxigenic fungi with different concentrations demenstrating various degrees of growth inhibition.
(Mohaddese and Nastaran, 2009) [93]	*Aspergillus flavus* *Aspergillus niger*	*Zhumeria majdae*	Lamiaceae		The oil displayed inhibitory effect against *Bacillus subtilis*, *Proteus vulgaris*, *Aspergillus flavus* and *Aspergillus niger*.
(Ayatollahi and Kazemi, 2015) [94]	*Trichophyton mentagrophytes* *Trichophyton interdigitale* *Microsporum canis*, *Microsporum gypseum*	*Myrtus communis* L. *Cinnamomum zeylanicum*	Myrtaceae Lauraceae	macro dilution method	According to the findings, natural plants could be used in traditional medicine for the prevention and treatment of dermatophytic infections
(Bahadoran *et al*., 2010) [95]	*Candida albicans*	garlic and thyme	Liliaceae Labiatae		
(Shams Ghahfarokhi, *et al*., 2003) [96]	*Trichophyton mentagrophytes*	Onion and Garlic	Liliaceae		This inhibition reached a maximum of 100% for both extracts at 10% v/v concentrations
(Sadeghi, *et al*., 2013) [97]	*A. niger* *C. albicans* *S. cerevisiae*	*Satureja Intermedia*	Labiatae	hydrodistilled	The essential oil exhibited considerable antimicrobial activity against the studied bacteria and fungi

(Omran *et al.*, 2009) [98]	*C. albicans*	*Thymus vulgaris* L	Labiatae		Thyme and lemon essential oils had the highest (0.008-0.271%) and lowest (1-32%) anticandidal activities, respectively
(Hadizadeh *et al.*, 2009) [99]	*Alternaria alternate*	*Urtica dioica* L *Thymus vulgaris* L *Eucalyptus* spp *Ruta graveolens* L *Achillea millefolium* L	Urticaceae Labiatae Myrtaceae Rutaceae Compositae		Both the nettle and the thyme oils exhibited antifungal activity against *A. alternata*
(Gandomi *et al.*, 2014) [100]	*Penicillium citrinum* *Penicillium chrysogenum* *Aspergillus flavus* *Aspergillus niger* *Aspergillus parasiticus*	*Trachy spermum ammi*	Umbelliferae	hydrodistillation	The fungal species were inhibited at concentrations of 1000–2000 ppm
(Mohseni *et al.*, 2014) [101]	*Aspergillus parasiticus*	*Glycyrrhiza glabra*	Fabaceae		Study of the antifungal and antitoxin activity of licorice extract on *Aspergillus parasiticus* revealed its antifungal properties as well as its effective ability to decrease aflatoxin production
(Sharifi-Rad *et al.* 2015) [102]	*Candida albicans* *Aspergillus niger*	*Lallemantia royleana*	Labiatae	hydrodistilled	Antifungal screening of the essential oil of *L. royleana* showed that this oil significantly inhibited the growth of *Candidaalbicans* and *Aspergillus niger* (MIC=3.1 and 2.5 µg/mL, respectively).
(Nejad *et al.*, 2014) [103]	*Candida* *Aspergillus species*	*Myrtus communis*	Myrtaceae	ethanolic	The MICs of *Myrtus communis* leaf extract ranged 0.625-5.0 µg/µL and 5-40 µg/µL against *Candida* spp. and *Aspergillus* spp., respectively
(Mehrabani *et al.*, 2013) [104]	*M. canis.* *M.gypseum* *m.mentagrophytes*	*Myrtus communis*	Myrtaceae	hydroalcholic	Ethyl acetate followed by total methanolic extracts had the most optimal antifungal effects against the three tested genera of dermatophytes
(Bassiri-Jahromi *et al.*, 2015) [105]	*Candida albicans* *Candida parapsilosis* *Candida tropicalis* *Candida krusei* *Candida glabrata*	*Punica granatum* L.	Punicaceae	methanol	Pomegranate (*Punica granatum* L.) peel had potential antifungal activity against candidiasis, and was found to be an attractive option for the development of new management strategies for candidiasis
(Esfandiary *et al.*, 2015) [106]	*Candida glabrata* *Candida kefyer* *Candida krusei* *Candida parapsilosis*	*Zataria multiflora*	Labiatae		In this study, optimal antifungal activity against non-albicans Candida species was exhibited by *Z. multiflora* despite a wide range of MICs (34875-139500 µg/ml)
(Abdollahzadeh *et al*., 2011) [107]	*Candida albicans*	*Punica Granatum*	Punicaceae	methanolic	None of the concentrations of MEPGP inhibited *C. albicans*
(Mahmoudvand *et al.*, 2014) [108]	*Trichophyton mentagrophytes*, *Microsporum canis*, *Microsporum gypseum*	*Nigella sativa*	Apiaceae		The results showed that the essential oil and various extracts of *N. sativa* especially thymoquinone had potent antifungal effects on *T. mentagrophytes*, *M. canis*, and *M. gypseum* as pathogenic dermatophyte strains
(Jamalian, *et al.*, 2012) [109]	*Aspergillus flavus* *Aspergillus fumigatus* *Trichoderma harzianum* *Fusarium oxysporum*	*Matricaria recutita*	Compositae	hydrodistillation	According to this study, *M. recutita* could be considered a potential candidate for development of effective antifungal formulations suitable for treatment of dermatophytosis and other fungal infections
(Ali *et al.*, 2012) [110]	*Aspergillus flavus*	*Parsley* *Ginger Volatile*	Umbelliferae Zingiberaceae	hydrodistillation and ethanol	Parsley essential oil showed a stronger inhibitory effect than ginger on *A. flavus* growth. In contrast, ginger ethanolic extract exerted a superior inhibitory activity for aflatoxin production at 20000 ppm (92.93%)
(Mannani *et al.*, 2012) [111]	*Microsporum canis* *Microsporum gypseum* *Microsporum nanum*	*Propolis*		ethanolic	The MIC of propolis ethanolic extract was 0.2 µL/mL for *M. gypseum*, 0.05µL/mL for *M. nanum* and 0.025µL/mL for *M. canis*

(Asili *et al.*, 2009) [112]	*Candida albicans*	*Ferula badrakema*	Apiaceae	hydrodistillation	The essential oil of the fruits was moderately active against *C. albicans* as a fungal strain with MICs of 3.125 mg/ml, 12.5 mg/ml, and 6.25 mg/ml, respectively
(Morteza-Semnani *et al.*, 2011) [113]	*Aspergilus niger* *Candida albicans*	*Mentha pulegium L.*	Lamiaceae		*M. pulegium* oil's antimicrobial activity against *Aspergilus niger* and *Candida albicans* was concentration-dependent
(Alizadeh 2013) [114]	*Candida albicans*	*Salvia virgata*	Labiatae	hydrodistillation	The oils of various ontogenetic conditions exerted moderate antimicrobial activity against *Candida albicans*
(Alizadeh *et al.*, 2013) [115]	*Alternaria solani, Fusarium solani Rhizoctonia solani*	*Thymus daenensis*	Labiatae	hydro distillation	*T. daenensis* oil exhibited great antifungal activities against three phathogenic fungi
(Hadian *et al.*, 2007) [116]	*Tiarosporella phaseolina, Fusarium moniliforme*	*Artemisia khorasanica*	Compositae	hydro-distillation	The oil was effective and showed fungi static activity
(Jahansooz *et al.*, 2008) [117]	*Fusarium solani Colletotrichum gleosporoides, Botrytis cinerea Fusarium verticillioides Aspergillus niger*	*Ferula gummosa*	Apiaceae		The antifungal activities of oils against four plant phytopathogenic fungi showed that the oil of all samples were effective on growth of *B. cinerea* with increasing the concentrations, and the effect was less pronounced for 1200 ppm. However, the various concentrations of *F. gummosa* oil in each sample coud not affect *F. verticillioides* growth. The growth of *C. gleosporoides* and *A. niger* was inhibited only in Semnan and Kashan, respectively. The results showed that *F. gummosa* essential oils could be used as antifungal agents to manage some diseases due to plant fungi
(Morteza-Semnani and Saeedi 2009) [118]	*Aspergilus niger* *Candida albicans*	*Stachys persica*	Labiatae	Hydro distillation	The *S. persica* oil exhibited concentration-dependent antimicrobial effect on *Bacillus subtilis*, *Aspergilus niger*, and *Candida albicans*
(Iranshahi *et al.*, 2008)[119]	*Candida albicans*	*Ferula latisecta*	Apiaceae		The MIC of the oil was determined using broth dilution method against four bacterial and one fungal strains. The MIC of the oil was found to be 0.195 mg/ml against *Candida albicans*
(Yousefzadi *et al*., 2013) [120]		*khuzistanica Jamzad*	Lamiaceae	hydro-distillation	Based on the findings, it was concluded that the essential oil of *S. khuzistanica* and its major components could have potentially further anti-bacterial and anti-cancer uses; however, far more extensive testing of toxicities of normal (*i.e.* primary) cells is needed
(Razavi and Nejad-Ebrahimi 2010) [121]		*Zosima absinthifolia*	Umbelliferae	hydro-distillation	The major components of the oil were octyl acetate (87.48%), octyl octanoate (5.03%), and 1-octanol (2.37%). The oil showed modest to weak allelopatic effects and high antibacterial effects against *Bacillus subtilis*, *Bacillus pumilus*, and modest to strong effects on different bacteria and fungi
(Khosravi *et al*., 2011) [122]	*Candida glabrata*	*Artemisia sieberi Origanum vulgare*	Compositae Labiatae	hydro-distillation	According to broth macrodilution method, all the tested *C. glabrata* isolates were sensitive to the essential oils in a concentration-dependent manner. MICs varied from 37.4 to 4781.3 µg/ml for *A. sieberi* (mean: 1496.4 µg/ml) and 0.5 to 1100 µg/ml for *O. vulgare* (mean: 340.2 µg/ml) essential oils
(Mikaeili *et al.*, 2012) [123]	*Trichophyton verrucosum*	*Astragalus verus*	Fabaceae		Aqueous extract displayed promising antidermatophytic activity
(Avijgan *et al*.,	*Candida albicans*	*Echinophora platyloba*	Umbellifera	ethanolic	The results of this study showed a potent

2014) [124]					synergistic effect of *E. platyloba* ethanolic 34 extract
(Safaei-Ghomi and Ahd 2010) [125]		*Eucalyptus largiflorens* *Eucalyptus intertexta*	Myrtaceae	methanol	The results of MIC study revealed that the essential oil had a stronger activity and broader spectrum than those of the methanol extract
(Safaei-Ghomi and Batooli 2010) [126]	*Aspergillus niger* *Candida albicans*	*Eucalyptus sargentii*	Myrtaceae		According to the bioassay results, the oil exhibited moderate to high antimicrobial activity
(Khakshoor and Pazooki 2014) [127]	*Candida albicans* *Aspergillus niger* *Saprolegnia parasitica* *Fusarium solani* *Saprolegnia sp.*	*Gelliodes carnosa*		Ethanol ethyl acetate methanol	Strong antifungal activities were exerted by E4 against *Fusarium* sp.2, *Fusarium* sp.1, *F. solani*, and *Saprolegnia parasitica* (MIC: 500 µg/ml)
(Ramezani *et al.*, 2006) [128]	*Aspergillus niger* *Candida albicans*	*Artemisia kopetdaghensis*	Asteraceae	Hydro-distillation	The essential oil showed a moderate antimicrobial activity
(Kazemi *et al.*, 2009) [129]	*Candida albicans*	*Artemisia tschernieviana*	Asteraceae	Hydro-distillation	The results showed that this oil was active against all the tested strains
(Kordali *et al.*, 2005) [130]		*Artemisia absinthium* *Artemisia santonicum* *Artemisia spicigera*	Asteraceae	Hydro-distillation	The results showed that all of the oils had potent inhibitory effects at a very broad spectrum against all of the tested fungi
(Sonboli *et al.*, 2007) [131]	*Candida albicans, Saccharomyces cerevisiae and Aspergillus niger*	*Tetrataenium lasiopetalum*	Apiaceae	Hydro-distillation	According to the bioassay results, the oil exhibited moderate to high antimicrobial activity
(Mahboubi and Kazempour, 2015) [132]	*Trichophyton rubrum* *Trichophyton mentagrophytes,* *Microsporum canis* *M. gypseum,* *Trichophyton schoenleinii* *Trichophyton verrucosum*	*Allium hirtifolium*	Liliaceae	aqueous extract	The anti-fungal activity of *A. hirtifolium* was great compared with ketoconazole
(Atai *et al*., 2009) [133]	*Candida albicans*	*Zingiber officinale*	Zingiberaceae	Ethanolic	The results showed that the ethanolic extract was effective on *Candida albicans* (2 mg/ml) at the concentration of 1:5. The study indicated that ginger extract could be used in treatment of oral candidiasis
(Zia *et al.*, 2009) [134]	*Trichophyton mentagrophytis* *Trichophyton rubrum* *Trichophyton verrucosum*	*Propolis*		alcoholic	Alcoholic extract of propolis showed antifungal activity against these three species. MIC of alcoholic extract of the propolis per 1 mm of the medium was 0.00625 for *T. verrucosum*, 0.0125 for *T. mentagrophytis*, and 0.05 for *T. rubrum*
(Soltani *et al.*, 2009) [135]	*Candida albicans*	*Garlic*	Liliaceae	chloroformic	The results showed that allicin activated the immune system against this fungus. Macrophages with allicin produced more nitric oxide compared to the group without allicin
(Modaressi *et al*., 2013) [136]	*Aspergillus niger* *Aspergillus candidus* *Candida albicans*	*Mindium laevigatum*	Campanulaceae	Methanolic	The antifungal activity of the extracts against different fungi varied from 14.0 to 3 mm and the MICs from 50 to 400 µg.mL
(Khosravi *et al*., 2009) [137]	*Candida albicans*	*Zataria multiflora*	Labiatae	steam distillation	These data may explain the increased rate of yeast clearance and reduced dissemination to the viscera in *Z. multiflora*-treated mice.
(Khosravi *et al.*, 2011) [138]	*Aspergillus Fumigatus* and *Aspergillus Flavus*	*Cuminum cyminum,* *Ziziphora clinopodioides* *Nigella sativa*	Apiaceae Labiatae Apiaceae	water distillation	The results demonstrated the anti-*Aspergillus* activities of *C. cyminum*, *Z. clinopodioides* and *N. sativa* essential oils, which strengthens the potential use of these substances as anti-mould in the future
(Mousavi and Kazemi, 2015) [139]	*Trichophyton mentagrophytes*	*Myrtus communis* *Cinnamomum*			

	Trichophyton interdigitale, Microsporum canis, and Microsporum gypseum	*zeylanicum Blume*			
(Massiha and Zolfaghar Muradov, 2015) [140]	*Microsporum canis, Microsporum gypseum, Trichophyton mentagrophytes, Trichophyton rubrum, Trichophyton schoenleinii, Epidermophyton flocosum*	*Calendula Officinalis* *Acacia arabica* *Altheae officinalis* *Ginkgo biloba* *Juglans regia,* *Osimum basilicum,* *Solanum nigrum* *Hypericum perforatum* *Urtica dioica* *Anagalis arvensis*	Compositae Mimosaceae Malvaceae Ginkgoaceae Juglandaceae Labiatae Solanaceae Hypericaceae Urticaceae Primulaceae	methanol	Plants under review showed antifungal activity against all the studied dermatophytes with MICs of 0.001- 0.016 mg/mL according to inhibitory zone, 0.3-12.8 mg/mL according to agar dilution, and 0.2-12.5 mg/mL according to broth dilution
(Khosravi-Darani *et al*., 2013) [141]	*Candida albicans*	*Honey* and *mint extract* *Honey* and *ginger extract* *Honey* and *Zataria Extract* *Honey* and *ginger starch*	Labiatae Zingiberaceae Labiatae Zingiberaceae	ethanolic	The results showed that ginger extract had a more significant impact on the microorganism growth compared to other extracts
(Khoshkholgh-Pahlaviani *et al*., 2013) [142]	*Candida Albicans*	*Anagalis Arvensis*	Myrsinaceae	methanol	Methanol extract of *A. arvensis* exerted inhibitory effect on the standard strain and clinical isolates of *C. albicans*. The MIC of the extract was lower than that of nystatin while the combination of the growth inhibitory concentration was greater than nystatin alone
(Sonboli *et al*., 2004) [143]	*Candida albicans* *Saccharomyces cerevisiae* *Aspergillus niger* *Microsporium gypsium*	*Nepeta crispa*	Labiatae	Hydro-distillation	The oil displayed a remarkable antifungal activity against all the studied fungi
(Sonboli *et al*., 2004) [144]	*Candida albicans* *Saccharomyces cerevisiae* *Aspergillus niger*	*Satureja laxiflora*	Labiatae	Hydro-distillation	It was clearly seen that the antifungal activity of *S. laxiflora* oil at high volume (2.4 µl) mainly is similar to that of the standard antibiotic, nystatine. In comparison, a higher volume of the oil indicated a potent inhibitory activity against the tested bacteria than the positive control, ampicillin
(Sonboli *et al*., 2006) [145]	*Aspergillus niger* *Candida albicans* *Saccharomyces cerevisiae*	*S. santolinifolia* *S. hydrangea* *S. mirzayanii*	Labiatae	Hydro-distillation	The most susceptible microbial strains were *Bacillus subtilis* and *Staphylococcus epidermidis* (MIC of 1.25 mg/ml) followed by *Aspergillus niger* and *Candida albicans* (MIC of 2.5 mg/ml)
(Sonboli *et al*., 2006) [146]	*Candida albicans,* *Saccharomyces cerevisiae* *Aspergillus niger*	*Gontscharovia popovii*	Labiatae	Hydro-distillation	According to bioassay results, the oil exhibited strong antimicrobial activity against all the tested fungi and bacteria
(Yousefzadi *et al*., 2007) [147]	*Candida Albicans* *Saccharomyces cerevisiae Aspergillus niger*	*Salvia multicaulis,* *S. sclarea* *S. verticillata*	Labiatae	Hydro-distillation	In contrast to antibacterial activity, the oils exhibited no or slight antifungal property, and only the *S. multicaulis* oilshowed weak activity against the two tested yeasts, *C. albicans* and *S. cerevisiae*
(Taran *et al*., 2011) [148]	*Candida Albicans* *Saccharomyces cerevisiae*	*Quercus brantii*	Fagaceae	Ether and hydroalcoholic	Hydroalcoholic and ether *Q. brantii* extracts inhibited inhibitory effects on fungi, gram-positive bacteria, and gram-negative bacteria
(Nasiri Kashani *et al*., 2009) [149]	*Aspergillus fumigatus* *Aspergillus Flavus* *Aspergillus niger* *Penicillium gryseogenum* *Alternaria* *Trichophyton mentagrophytes* *Microsporum canis*	*Allium Hirtifolium*	Liliaceae	Ethanolic and aqueous	The MFC of aqueous and alcoholic extracts was derived 0.6-26.68 mg/ml and 0.1-28.12 mg/ml, respectively

(Banaeian-Boroujeni, *et al.*, 2015) [150]	*Candida albicans*	*Salvia Officinalis*	Labiatae	Ethanolic	*S. officinalis* extract inhibited *C. albicans* growth and could be effective in treating vaginitis due to *C. albicans*
(Davoudi *et al.*, 2014) [151]	*Candida albicans, Saccharomyces cerevisiae*	*Helichrysum arenarium* L.	Compositae	Distillation	
(Ataei Azimi *et al.*, 2007) [152]	*Fusarium solani Fusarium poae*	*Sorghum Bicolor* (L.)	Gramineae	Aqueous, alcoholic, phenolic	Alcoholic extract at 20, 30, and 40 mg concentrations was studied and 30-mg concentration was found to exert an effect 2.5 times higher than those of the two other concentrations. Phenolic compounds at 0, 10, and 25 g/l were effective on both fungi
(Akbari 2007) [153]	*Fluconazol-Resistant Susceptible Candida albicans*	*Thymus valgaris Crigahum vulgare* L.	Labiatae Labiatae	Aqueous, methanolic	Methanolic *T. vulgaris* extractat 0.49-125 mg/ml followed by *C. vulgare* essential oil and the aqueous extracts of both plants displayed antifungal activity
(Avijgan *et al.*, 2006) [154]	*Microsporum canis, Microsporum gypseum, Tricophyton rubrum, Tricophyton schoenleinii, Tricophyton mentagrophytes Trichophyton verrucosum*	*Echinophora platyloba*	Umbellifera	Hydroalcoholic	*T. schoenleinii* and *T. verrucosum* were consistently sensitive, *T. rubrum* and *M. gypseum* were consistently resistant, and tricomython and *M. canis* at 250 mg were sensitive
(Mohammadi, *et al.*, 2010) [155]	*Aspergillus nidulance Aspergillus fumigatus Aspergillus Flavus Aspergillus niger*	*Cinnamomum Zeylanicum*	Lauraceae	Microdilution	Antifungal effect was exerted on all the strains
(Abdolmaleki, *et al.*, 2011) [156]	*Rhizoctonia solani Fusarium onysporam Bipolaris sorokiniana Phytophthora drechsleri*	*Mentna Pipertia*	Labiatae	Aqueous, methanolic, ethanolic, acetone, and chloroform	Ethanolic and chloroform extracts displayed no antifungal effects. Methanolic and acetone extracts exerted little effect on Fusarium. Aqueous extract at 500 ppm exerted antifungal effect on *P. drechsleri*and at 100 ppm on *B. sorokiniana*. For the other two fungi, the extract at 2000 ppm caused no effect on the fungus growth
(Najib – Zadeh *et al.*, 2011) [157]	*Candida albicans*	*Myrtus communis*	Myrtaceae	Distillation	Treatment with *M. communis* essential oil at a concentration two times higher than MIC did not suffice to eradicate candidiasis in immunosuppressed rats; hence, higher concentrations of this essential oil should be used
(Mohammadi *et al.*, 2007) [158]	*Fluconazol-Resistant Susceptible Candida albicans*	*Boswellia Serrata*	Burseraceae	Distillation	The inhibitory effect of the essential oil on all fungal strains of *C. albicans*
(Mohammadi, *et al.*, 2008) [159]	*Aspergillus nidulance Aspergillus fumigatus Aspergillus Flavus Aspergillus niger*	*Myrtus Communisl*	Myrtaceae	Distillation	The essential oil had optimal antifungal effects on all Aspergillus isolates 5 isolates up to 1.8; 8 isolates up to 1:16; 10 isolates up to 1:32
(Babaei *et al.*, 2014) [160]	*Aspergillus Flavus*	*Aloe vera*	Liliaceae	Acetone, methanolic, ethanolic, aqueous	The greatest antifungal activity was seen at 105 microl/l of the acetone extract
(Diba *et al.*, 2010) [161]	*Candida albicans Aspergillus fumigatus Aspergillus niger*	*Propolis*		Alcoholic	The inhibitory effect of the extract at 0.25 concentration was observed on half of the fungi (*C. albicans*), at 3.2% g/α affected Aspergillus, but at 0.125 was effective on *A. niger*
(Dehghan *et al.*, 2013) [162]	*Candida Cryptococcus neoformans*	*Ferula szowitsiana*	*Umbelliferae*	Chloroform	The greatest effect of the extract was exerted on *C. neoformans* with inhibition zone diameter of 23.1 mm and no effect on *M. canis* was seen
(Motaharinia *et al.*, 2011) [163]	*malassezia furfur*	*Althaea officinalis Glycyrrhiza glabra root*	*Malvaceae Fabaceae*	Alcoholic	This study demonstrated that *A. officinalis* flower extract exerted greater antifungal effects than *A. officinalis* root

					and *G. glabra* root extracts
(Shoaie, *et al.*, 2012) [164]	*Candida albicans* *Candida tropicalis* *Candida krusei* *Candida glabrata*	*Teucrium Polium* *Zingiber Officinale*	*Labiatae* *Zingiberaceae*	Hydroalcoholic	The extracts of the two plants exerted antifungal effects on each other and no effect on the fungi. *Z. officinale* exerted greater antifungal effect than *T. polium*
(Haghighi *et al.*, 2011) [165]	*Candida albicans*	*Petroselinum Crispum* *Cuminum cyminum* *Bunium persicum*	*Labiatae* *Umbelliferae* *Umbelliferae* *Umbelliferae*	Hydroalcoholic	The essential oils were found to exert inhibitory effects at 146, 620, 580, and 48 microg/ml
(Afshari, *et al.*, 2013) [166]	*Aspergillus Flavus*	*Thymus vulgaris* *Satureja Foeniculum* *Eucalyptus camadulensis* *Rosmarinus officinalis* *Ferula gummosa boiss*	Labiatae Labiatae Umbelliferae Myrtaceae Labiatae Umbelliferae	Distillation	The concentrations of 800 and 1000 PPM of Avishan and Razianeh had the most effects on inhibition of Aflatoxin B preparation
(Roudbary *et al.*, 2009) [167]	*Candida albicans* *Candida dubliniensis*	*Crocus satirum*	Iridaceae	Ethanolic	Alcoholic *C. satirum* extract had antifungal effects with greater effects on *C. dubliniensis* than on *C. albicans*
(Moslemi *et al.*, 2015) [168]	*Candida albicans* *Fusarium oxysporum* *Aspergillus fumigatus* *Aspergillus Flavus* *Aspergillus niger*	*Ephedra Pachyclada*	Ephedraceae	Methanolic Aqueous Chloroform	These extracts exerted optimal antifungal effects on *C. albicans* growth but no effect on other fung.
(Aali, *et al.*, 1998) [169]	*Candida albicans*	*Myrtus communis*	Myrtaceae	Methanolic	The methanol extract at 20 mg concentration exerted greater antifungal effect than clotrimazole at basin concentration
(Hoseini *et al.*, 2011) [170]	*Candida albicans*	*Carvacrol (Satureja)*	Labiatae	Essential oil	Carvacrol essential oil displayed suitable antifungal effects on sensitive and resistant strains to fluconazole in *C. albicans*
(Shams Ghahfarokhi, *et al.*, 2007) [171]	*Epidermophyton floccosum* *Microsporum canis,* *Microsporum gypseum,* *Tricophyton rubrum* *Tricophyton mentagrophytes*	*onion ,* *garlic*	Liliaceae	Aqueous	In this study, the effects of the plants were studied by trebniafine and the greatest antifungal effect was exerted by trebniafine on *M. canis* and *M. gypseum*. *M. canis* displayed the highest resistance to our extract. Overall, aqueous extract exerted the greatest inhibitory effect on dermatophytes at lower concentrations
(Mohammadpour *et al.*, 2011) [172]	*Candida albicans*	*Zataria multiflora* *Satureja Bachthiarica* *Thymus vulgaris*	Labiatae	Essential oil	The MIC of *S. bachtiarica* forfungal growth was lower than those of other extracts while *T. vulgaris* exhibited the greatest antifungal property
(Sepahvand *et al.*, 2005) [173]	*Trichophyton mentagrophytes,* *Fusarium sp* *Cryptococcus neoformans* *Epidermophyton floccosum* *Microsporum gypseum,* *Tricophyton rubrum* *Trichophyton verrucosum* *Aspergillus fumigatus* *Aspergillus Flavus*	*Satureja Khuzestanica jamzad*	Labiatae	Distillation	*S. khuzestanica* could exert 100% inhibitory effects on all fungi except for *T.* The inhibitory effects on *T.* ??? were various at different concentrations
(Falahati, *et al.*, 2011) [174]	*Aspergillus niger* *Microsporum gypseum* *Candida albicans* *Saccharomyces cerevisiae* *Aspergillus niger*	*Peganum Harmala*	Zygophyllaceae	Alkaloid	1-3.2 mg/ml of the extract exerted antifungal effects on all fungi
(Nodoushan, *et al.*, 2007) [175]	*Candida albicans* *Candida tropicalis* *Candida krusei* *Candida glabrata*	Garlic (*Allium sativum*)	Liliaceae	Aqueous	*C. tropicalis*, *C. glabrata*, and *C. albicans* were sensitive to *A. sativum* and displayed optimal antifungal effects but *C. krusei* was the most resistant species to

					the extract.
(janani, *et al*., 2011) [176]	*Candida albicans*	*Myrtus communis*	myrtacea	Cream	This study demonstrated that *M. communis* cream has similar therapeutic effects to clotrimazole cream and even more effective in improving certain symptoms than this cream
(Norooz-mirzaaghakhani, *et al*., 2015) [177]	*Candida albicans* *Candida parapsilosis* *Candida krusei* *Candida glabrata*	Anethum Graveolens	Umbelliferae	Aqueous	This study demonstrated that *A. graveolens* seed had no antifungal effect.
(Falahati *et al*., 2015) [178]	*Candida albicans, Candida glabrata* and *Saccharomyces cerevisiae*	*Pistacia atlantica*	Anacardiaceae		Based on GC/MS analysis, the main components of *P. atlantica* fruit extract were β-myrcene (41.4%), α- pinene (32.48%), and limonene (4.66%), whereas the major components of *P. atlantica* fruit extract were trans-caryophyllene (15.18%), α-amorphene (8.1%) and neo-allo-ocimene (6.21%). According to the finding, all the components exhibited both fungistatic and fungicidal activities with MICs of 6.66-26.66 mg/mL and MFCs of 13.3-37.3 mg/mL, respectively. Among the studied extracts, the methanolic *P. atlantica* fresh fruit extract was significantly more effective than other extracts (P<0.05)

CONCLUSION: More clinical Studies to determine the safety and effectiveness of medicinal plants and possible toxic ingredients and their active substances can lead to the production of safe and efficient drugs for fungal strains and diseases.

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