

Candidiasis phytotherapy: An overview of the most important medicinal plants affecting the *Candida albicans*

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ABSTRACT

Fungal infections have been responsible for a dramatic increase of diseases in recent decades. *Candida albicans* is known as the most common human pathogen due to most virulence. There is wide variety of medicinal plants in Iran which many doctors and scientists believe that these plants could be used in diseases treatment cycle. Due to high incidence of candidiasis the aim of this study was to identify and report anti-*Candida albicans* medicinal plants in Iran. All required information was obtained by searching key words such as *Candida albicans*, candidiasis, medicinal plant and Iran in published articles in authentic Iranian and world scientific databases such as Blackwell wiley, Sciedencedirect, Springer, Scopus, Pubmed, Google scholar and Scientific information database (SID) and Magiran. Obtained results showed that *Peganum harmala*, *Aloe vera*, *Punica granatum L*, *Ananas comosus*, *ferula assa foetida*, *Nectaroscordum Tripedale*, *Allium cepa*, *lawsonia inermis*, *Crocus sativum*, *Allium sativum*, *Juglans regia*, *Teucrium polium*, *Zingiber officinale*, *Eucalyptus spp*, *Artemisia absinthium*, *Cinnamomum verum*, *Dianthus caryophyllus*, *Thymus vulgaris*, *Allium jesdianum*, *Plumbago Europaea* and *Origanum vulgare L.* are the main medicinal plants can affect *Candida albicans*.

KEY WORDS: Yeast, Candidiasis, *Candida albicans*, Medicinal plants, Iran.

1. INTRODUCTION

Nowadays Infectious diseases are day by day increasing in prevalence (Soroush, 2010; Taherikalani, 2008; Haggi-Ashtiani, 2007; Nakhjavani, 2013; Jabalameli, 2012; Khoramrooz, 2012; Shahsavhan, 2012; Asadollahi, 2011; Shahsavhan, 2011; Mahdi, 2010; Kalantari, 2007). Fungal infections were less common than bacterial and viral infections in the past but have been responsible for a dramatic increase of diseases in recent decades (Maryin and Mannino, 2003). Yeasts especially candida species are the most common fungi that have been isolated from human infections, in recent years (Neppelenbroek, 2006).

Candida albicans is known as the most common human pathogen between 150 species of candida yeast and cause of 60 percent of candidiasis infection due to most virulence. However, incidence of infection by other species such as *C. tropicalis*, *C. glabrata* and *C. krusei* has grown increasingly (Olson, 2005).

Candida is an opportunistic fungus that is capable of inducing acute and chronic infections of the mouth, vagina, lung and gastrointestinal tract with different body reactions such as severe infection, purulent and granulomatous inflammation (Rashidi and Arash, 2008).

It can be found in the mouth, vagina and intestine microflora and cause fatal infections and mortality in people with weakened immune systems such as AIDS, cancer, bone marrow or other organs transplant. Pregnancy, oral contraceptive drugs, antibiotics, diabetes, long-term skin contact with water, treatment with topical corticosteroids, some diseases of the endocrine system involved in causing illness by yeasts (Motaleb-nejad, 2005). Studies in the last decades have clearly indicated the unpleasant side effect of synthetic drugs. Recent studies considered to the use of medicinal plants due to increasing drug resistance to chemical drugs (Gurgan, 2006).

Using detergents, frequent shower or internal disorders can disrupt vaginal normal flora, consisting of lactic acid bacteria such as lactobacilli and resulting an overgrowth of candida cells and vaginal candidiasis (Mardh, 2003; Ogunshe, 2012).

Medical benefits of medicinal plants in various drugs and as pharmaceutical products are important (Bahmani, 2012; 2013; 2014; 2015; Baharvand-Ahmadi, 2015; Delfan, 2015). Medicinal plants are applied in various fields of medicine, industry, agriculture, food and numerous applications (Sarrafchi, 2015; Ebrahimie, 2015; Baharvand-Ahmadi, 2016).

There is wide variety of medicinal plants in Iran which many doctors and scientists believe that these plants could be used in diseases treatment cycle (Bahmani, 2015; 2016). General trend in use of medicinal plants and natural products in the world increased in recent years (Azadpour, 2016; Nasri, 2015). The main causes of this trend are low side effects of natural products and high side effects of synthetic drugs and environmental pollution (Delfan, 2015).

Knowing the compositions of medicinal plants provide useful information for their medical use and possible complications (Shayganni, 2015; Baharvand-Ahmadi, 2015). One of the most important tools for overcomes to diseases have been the use of medicinal plants for a long time (Bahmani, 2014). Due to high incidence of candidiasis, the aim of this study was to identify and report anti-*Candida albicans* medicinal plants in Iran.

2. MATERIALS AND METHODS

All required information was obtained by searching key words such as *Candida albicans*, candidiasis, medicinal plant and Iran in published articles in authentic Iranian and world scientific databases such as Blackwell wiley, Sciedencedirect, Springer, Scopus, Pubmed, Google scholar and Scientific information database (SID) and Magiran.

3. RESULTS

Peganum harmala, *Aloe vera*, *Punica granatum L*, *Ananas comosus*, *ferula assa foetida*, *Nectaroscordum Tripedale*, *Allium cepa*, *lawsonia inermis*, *Crocus sativum*, *Allium sativum*, *Juglans regia*, *Teucrium polium*, *Zingiber officinale*, *Eucalyptus spp*, *Artemisia absinthium*, *Cinnamomum verum*, *Dianthus caryophyllus*, *Thymus vulgaris*, *Allium jesdianum*, *Plumbago Europaea* and *Origanum vulgare L*, are the main medicinal plants can affect *Candida albicans*. Additional information about native medicinal plants against *Candida albicans* was shown in table 1.

Table 1. Important native medicinal plants of Iran against *Candida albicans*

Scientific name	Family name	Persian name	Description
<i>Peganum harmala</i>	<u>Nitrariaceae</u>	Espand	Results of a study showed that MIC and MBC of <i>Peganum harmala</i> extract for <i>C. albicans</i> were 1.8 and 1.4 (Diba, 2010).
<i>Aloe vera</i>	<u>Xanthorrhoeaceae</u>	Aloe vera	An experimental study showed that Aloe vera extract in doses 10, 100, 2050 mg/kg increased macrophage activity in the presence of mitogen in Balb/c mice that infected with <i>C. albicans</i> (Farahnejad, 2010).
<i>Punica granatum L</i>	Lythraceae	Anar	Obtained results of a study showed that treatment with hydromethanolic extract of <i>Punica granatum L</i> peel could improve <i>C. albicans</i> ' fungal infection in diabetic rats and its potency was same with itraconazole. Reducing the number of colonies was seen in second day of treatment (Sadeghpour, 2016).
<i>Ananas comosus</i>	<u>Bromeliaceae</u>	Ananas	An experimental study on various parts of <i>Ananas comosus</i> showed that growth inhibition zone for ethanolic extracts of Leaves, fruits and stem of this plant on <i>C. albicans</i> were 11 mm, 75. 5 mm and 5. 4 mm, respectively (Jafari, 2010).
<i>ferula assa foetida</i>	Apiaceae	Anghuzeh	Results of a study showed that aqueous extract of <i>ferula assa foetida</i> at a concentration of 8. 75 mg/ml killed all living cells of <i>C. albicans</i> . As well as MIC of this aqueous extract at 0. 273 and 4. 4 mg/ml concentrations were 50% and 90%, respectively (Jafari, 2008).
<i>Nectaroscordum Tripedale</i>	<u>Amaryllidaceae</u>	Pyaz tabestaneh	Results of an experimental study showed that growth inhibition zone of aqueous extract of <i>Nectaroscordum Tripedale</i> on <i>C. albicans</i> at a concentration 80mg/ml was 13 mm (Panahi, 2013).
<i>Allium cepa</i>	<u>Amaryllidaceae</u>	Pyaz	Results of a study showed that <i>C. albicans</i> were moderately susceptible, susceptible, resistant and resistant to crude extract, cold water extract, hot water extract and ethanolic extract of <i>Allium cepa</i> , respectively
<i>lawsonia inermis</i>	Lythraceae	Henna	Results of an experimental study showed that aqueous extracts of <i>lawsonia inermis</i> with a dose of

			5 mg/ml can reduce more than 80% population of created biofilms of <i>C. albicans</i> on acrylic surfaces (Momeni, 2010).
<i>Crocus sativum</i>	<u>Iridaceae</u>	Zafaran	Results of a study showed that MIC of <i>Crocus sativum</i> on <i>C. albicans</i> was 12. 5 mg/ml and its MFC was 25 µg/ml (Jafari, 2014).
<i>Allium sativum</i>	<u>Amaryllidaceae</u>	Sir	Results of an experimental study showed that growth inhibition ability of aqueous extract of <i>Allium sativum</i> on <i>C. albicans</i> at a concentration 0. 625 mg/ml was 17% and MIC of this extract was 10 mg/ml on <i>C. Albicans</i> (Ayatollahi Mousavi, 2008).
<i>Juglans regia</i>	<u>Juglandaceae</u>	Gerdo	Results of a study on methanolic extract of fruit peel and leaves of <i>Juglans regia</i> showed MIC and MBC on <i>C. albicans</i> were 6.25-50 mg/ml and 6.25-25 mg/ml.
<i>Teucrium polium</i>	<u>Lamiaceae</u>	Maryam nokhodi	Results of an experimental study showed that MIC of <i>Teucrium polium</i> on <i>C. albicans</i> was 1000 µg/ml (Shoaei, 2012).
<i>Zingiber officinale</i>	Zingiberaceae	Zanjabil	Results of an experimental study showed that MIC of <i>Zingiber officinale</i> on <i>C. albicans</i> was 62.25 µg/ml (Ataei, 2007).
<i>Eucalyptus</i> spp	Myrtaceae	Ocalyptus	Results of an experimental study showed that <i>Eucalyptus</i> extract at a concentration 1/40 had strong inhibitory effect on <i>C. albicans</i> growth equal to (+++) (Ataei, 2007).
<i>Artemisia absinthium</i>	Asteraceae	Afsantin	Results of an experimental study showed that <i>Artemisia absinthium</i> extract at a concentration 1/40 had strong inhibitory effect on <i>C. albicans</i> growth equal to (+++) (Ataei, 2007).
<i>Cinnamomum verum</i>	Lauraceae	Darchin	Results of an experimental study showed that <i>Cinnamomum verum</i> extract at a concentration 1/40 had strong inhibitory effect on <i>C. albicans</i> growth equal to (+++) (Ataei, 2007).
<i>Dianthus caryophyllus</i>	Caryophyllaceae	Mikhak	Results of a study showed that growth inhibitory zone of <i>Dianthus caryophyllus</i> for <i>C. albicans</i> was 31.3 ± 0.82 mm (Arbabi klati, 2012).
<i>Thymus vulgaris</i>	Lamiaceae	Avishan	Results of a study showed that growth inhibitory zone of <i>Thymus vulgaris</i> for <i>C. albicans</i> was 27.4 ± 0.82 mm (Arbabi klati, 2012).
<i>Allium jesdianum</i>	Liliaceae	Allium	Results of a study showed that growth inhibition zone of condensed extracts of stems, leaves and onions of <i>Allium jesdianum</i> on <i>C. albicans</i> were 10, 11 and 10 mm respectively, MIC of them were 300, 200 and 300 µg/ml and MFC of these extracts were 400, 300 and 400 µg/ml (Madani, 2009).
<i>Plumbago Europaea</i>	Plumbaginaceae	Alaf dandan	Results of a study showed that 2% concentration of <i>Plumbago Europaea</i> was stopped growth of <i>C. albicans</i> (Sadeghian, 2006).
<i>Origanum vulgare L.</i>	Lamiaceae	Marzanoosh	Results of a study showed that MIC50, MIC90 and MFC of aqueous extract of <i>Origanum vulgare L.</i> on sensitive strains of <i>C. albicans</i> were 125-250, 250-500 and 500-1000 microliter. MIC50, MIC90 and MFC of methanolic extract of this plant were 15. 62-62. 5, 31. 25-125 and 125-250 mg/ml (Akbari, 2007).

DISCUSSION

Obtained results showed that *Peganum harmala*, *Aloe vera*, *Punica granatum L*, *Ananas comosus*, *ferula assa foetida*, *Nectaroscordum Tripedale*, *Allium cepa*, *lawsonia inermis*, *Crocus sativum*, *Allium sativum*, *Juglans regia*, *Teucrium polium*, *Zingiber officinale*, *Eucalyptus spp*, *Artemisia absinthium*, *Cinnamomum verum*, *Dianthus caryophyllus*, *Thymus vulgaris*, *Allium jesdianum*, *Plumbago Europaea* and *Origanum vulgare L*, are used against *Candida albicans* infections. Phytochemical studies of these medicinal plants showed that main compounds of *Plumbagoeuropaea* are tannin, amidon, gallic acid and an unknown chemical composition as plumbagin (Emerson, 1993).

Beta sitosterol, Arashidonic acid, cryptogein, lanosterol, harmaline, harmine, harmalol and vasicine are the main constituents of *Peganum harmala* (Sharbatkori, 2007). The most important compound in *Aloe vera* is 1, 2 dihydro comarine (Zhang, 2006). The bioactive compounds of *Punica granatum L* include ellagic acid, gallic acid, Punicalagin, punicalin, Chlorogenic acid, Hydroxycinnamic acid, protocatchic acids, hydroxy benzoic acid, caffeoic acid, ferulic acid, phloridzin, quercetin, catechin, p-coumaric acid, and o-coumaric acid (Denning, 1997). Zingiberene, zingerone, Shogaol and gingerols, Zabulon, Oleoresin are extracted of *Zingiber officinale* as anti-*Candida albicans* (Chyun, 2007; Cruickshank, 1975). Manitol, tannic acid, mucilage and gallic acid are the chemical constituents of *lawsonia inermis* but 2-hydroxy naphthoquinone or Lawsone is the most important compound of this medicinal plant (Austin, 2003; Jeyathilakan, 2012). Allicin is main compound of *Allium sativum* (Jain, 1998; Ghannoum, 1990).

Main bioactive ingredients of *Juglans regia* are Juglone and Quercetin (Wichtl M, Bisset, 1994; 1986, 1986; Thakur, 2011). Diterpenoids, 5, 7 glycoside, 6-methoxy genguanine, thymol, carvacrol, beta caryophyllen, humulene andoxide caryophyllene are chemical compounds of *Teucrium polium* (Esmaili, 2004; Abdollahi, 2003). The most important chemical ingredients of *Eucalyptus* leaves is 1,8 cineol or Eucalyptol (Oyediji, 1999; Mulyaningsih, 2010). Cinnamaldehyde, coumarin, Caryophyllene, cinnamyl acetate and are the main compounds of *Cinnamomum verum* (Mohammad Beigi, 2008). Absinthin is bioactive compound of *Artemisia absinthium* (Ramezani, 2004). All of the mentioned chemical compounds have anti-candida effects. Although infections might be induced by various mechanisms through various pathogens (Bagheri, 2016; Shirzad, 2015; Salimzadeh, 2015; Razavi, 2015; Bagheri, 2015; Bagheri, 2015; Azadegan-Dehkordi, 2015; Azadegan-Dehkordi, 2015; Zandi, 2014; Rahimian, 2014; Bagheri, 2014; Zandi, 2013; Bagheri, 2013; Bagheri, 2013), however, phenolic compounds mostly have antimicrobial activity against these pathogens. Including antifungal effects. Hence, these compound might have been a part of the effects of these plants. There are a lot of other plants which have phenolic compounds and antioxidant activity (Shirani, 2011; Bahmani, 2015; Nasri, 2015; Rafieian-Kopaei, 2014; Nasri, 2016; Khodadadi, 2016; Rafieian-Kopaei and Baradaran, 2013; Nasri, 2016; Rafieian-Kopaei, 2013; Mardani, 2015; Nasri, 2016; Kafeshani, 2015; Dehghan Shahreza, 2016). Thesefore, these plants may also have antifungal properties.

4. CONCLUSION

Because of the infectious diseases have high outbreak and spread, therefore medicinal plants through their active ingredients have a good therapeutic effect. Medical plants listed in this article have antibacterial and antifungi effects, which can be described as a combination of proven anti-Candidiasis context.

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