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SYSTEMATIC REVIEW ON ANTICANDIDAL ACTIVITY OF SOME SELECTED INDIAN MEDICINAL PLANTS

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ABSTRACT:

Medicinal plant extracts will become more significant in the field of medicine over the coming years. Garlic (Allium sativum), Aloe vera, neem (Azadirachta indica), tulsi (Ocimum sanctum), and turmeric (Curcuma longa) are a few of the common medicinal herbs used in India. Up to 70% of the world's population relies on traditional medicine for their primary healthcare, according to the World Health Organization. It is attracting a lot of attention for a variety of reasons, including cultural and economic barriers to accessing synthetic medications. Because they think traditional medicine has healing abilities, people are very interested in it. As a result, the WHO promotes integrating traditional medicine into regional healthcare systems. If plant preparations are safe and their effectiveness can be verified scientifically, then their usage can be justified. In this article, systematic review on anticandidal activity of some selected Indian medicinal plants has been selected.

Keywords: Anticandidal, Indian, Medicinal, Plants

INTRODUCTION:

One of the most common and significant opportunistic fungal infections caused by a species of Candida is candidiasis. The oral and vaginal mucosa, skin, gastrointestinal tract, lungs, and other bodily regions can all be affected by different types of candidiasis (Marzieh et al., 2016). The fact that a Candida infection can result in severe, perhaps fatal, bloodstream infections as well as the colonization of internal organs with Candida (disseminated candidemia) and subsequent serious health issues in people is a huge problem. Candida glabrata, Candida tropicalis, Candida parapsilosis, and Candida krusei are examples of non-albicans Candida (NAC), which are the next most prevalent Candida species after Candida albicans (Anaul and Zulfiqar, 2013).

SYSTEMATIC REVIEW OF LITERATURE:

Taxonomy of Candida Sp.:

The yeasts belonging to the genus Candida were first discovered by Langenbeck in 1839 (Yuthika and Samaranayake, 1994).

Taxonomically Candida is classified underKingdom: Fungi
Phylum: Ascomycota Subphylum: Saccharomycotina
Class: Saccharomycetes
Order: Saccharomycetales
Family: Saccharomycetaceae
Genus: Candida (David et al., 2011).

Morphology and Culture of Candida Sp.:

Candida is a yeast with an oval form and a diameter of 3–30 m. It creates offspring asexually through a process known as budding, in which protoplasmic protrusions or buds appear from the mother cell and develop until they finally separate to establish a new cell. Sometimes the daughter cells may not separate, forming chains of cells known as pseudo hyphae that resemble hyphae. Each hypha is made up of a row of lengthy cells. After 24–48 hours of incubation in solid culture media, the yeast begins to develop (Laura and Yolanda, 2013).

Virulence Factors of Candida Sp.:

Numerous investigations into the virulence traits of Candida sp. The ability of Candida spp. to elude host defenses, adhere, form biofilms on host tissue and on medical devices, and produce tissue-damaging hydrolytic enzymes such as hemolysin, proteases, and phospholipases are some of its virulence factors.
The adhesion to host surfaces, which is regulated by many cell-signaling cascades in both the fungus and the environment, is a key component in the fungal colonization of human tissues. Recent studies have demonstrated that Candida sp. can build biofilms on the surfaces of medical devices. It has been suggested (Sardi et al., 2013) that the first attachment of Candida cells is caused by adhesions, which are found on the surface of fungal cells and bind to amino acids and sugars on the surface of other cells or make them stick better to other surfaces. Catheters, dentures, and mucosal cell surfaces are frequently used in the literature as examples of adhesion substrates (François et al., 2013).

Since they are the most typical type of bacterial growth in the natural world and are associated with high levels of antibiotic resistance, biofilms are also significant in clinical infections (Jyotsna et al., 2001; Mary et al., 2004). A colony of microorganisms from the same or distinct species form structures known as biofilms. Biofilms are created by bacteria, yeasts, and filamentous fungi on both biotic and abiotic surfaces. On mucosal surfaces and medical devices, C. albicans creates a diverse biofilm that leads to illness and the spread of infection (Anna et al., 2015; Clarissa and Alexander, 2015).

The four stages of biofilm growth are as follows: In the first stage, yeasts stick to the substrate; next, cells colonize. At a later stage, the cells multiply and expand to produce the basal layer that anchors the cells. The shift from yeast to hyphae and the generation of pseudo hyphae are then stimulated by the adhesion to the surface, and at the mature stage, the structure enlarges and yeast cells on the top of the biofilm diffuse to distant areas to begin the cycle (Anna et al., 2015).

Carbohydrates, proteins, phosphate, and hexosamines make up the biofilm matrix. Fungal strain and species, medium composition, pH, and oxygen levels are just a few examples of the environmental factors that affect biofilm development and matrix composition. Fungi may benefit from biofilms because they can avoid host immune systems, fend off antifungal medications, and withstand pressure from rival species. Because of this, illnesses brought on by biofilms are challenging to cure (François et al., 2013; Sardi et al., 2013).

Proteases and phospholipases are extracellular hydrolytic enzymes that are crucial for host tissue adhesion, penetration, invasion, and destruction. Hemolysin is necessary for iron absorption and survival as well. Microbes produce proteins called hemolysin to obliterate red blood cells. Iron is necessary for the growth of yeasts, and having access to it is necessary for the spread of infection (Sardi et al., 2013).

Importance of Medicinal Plants:

One question that can be raised is whether medicinal plant extracts could be an alternative in the treatment of candidiasis. Hippocrates in the late fifth century B.C. itself had mentioned 300 to 400 medicinal plants (Marjorie, 1999). In a study done by Arjuna et al. (2011) in Kuwait, the herbal toothpaste presented significant anticandidal activity against two important Candida sp. associated with oral candidiasis compared to other conventional formulations.

It has been suggested that it may be most probably due to a synergistic effect of the herbal constituents included in this formulation and this seems to be a reliable and innovative approach. In addition, this study suggests that the anticandidal properties of ingredients in toothpastes may have a wider applicability and could be considered for the future development of anticandidal drugs principally for topical application.

Indian medicinal plants have been used in successful management of various disease conditions (Ekta et al**.,** 2012). From time immemorial, medicinal plants have many applications in the traditional herbal medicine and this approach has led to the discovery of

numerous pharmacologically active molecules and drugs for humans. Evidence of the biomedical potential of herbal drugs used worldwide in traditional medicine has been reported. It is well known that medicinal plants or their secondary metabolites possess activity against infectious agents such as viruses, bacteria and fungi (Armando et al., 2013).

Natural products of animals, plants and microbial sources have been used by man for thousands of years either in the pure forms or crude extracts to treat many diseases (Gebreselema and Mebrahtu, 2013). Preparations of plants or parts of them were widely used in medicine since ancient times. Herbal treatment is very popular because it is easily available, cheap and less toxic (Mohammad, 2013). Use of plant products for the control of fungal diseases is considered as an alternative to antifungal agents due to their reduced cost and adverse reactions.

Screening of medicinal plants for antimicrobial agents has gained much importance. Hence, there is an urgent need to promote the traditional therapeutic measures which are acceptable, easily available and cost effective (Sunitha et al., 2013). Plant extracts are continuously used to find new compound against pathogens. About 20% of the plants in the world have been used to pharmacological test and a number of new antibiotics introduced on the market are obtained from natural resources (Pankaj et al., 2013)

There are evidences to show potential of medicinal plants used in various traditional systems and in future more co-ordinated researches aimed at correlating phytochemical properties to pharmacological activities is expected (Bhuvana et al., 2014). But it is found that, there is still considerable uncertainty regarding which medicinal plant is most effective against candidiaisis.

Allium sativum:

Garlic (Allium sativum L.) has been gaining much attention because, it is one of those plants that was seriously investigated over several years and used for centuries to fight infectious diseases. The taxonomic position of garlic was under family Alliaceae, mainly based on the sequences of nuclear ribosomal DNA by Nikolai et al. (2006). It has widespread use as a topical and systemic antimicrobial agent. In the traditional approach, it is used to inhibit and kill bacteria, fungi, lower blood pressure, blood cholesterol and blood sugar, prevents blood clotting and contains antitumor properties. It can also boost the immune system to fight diseases and maintain health. In recent years there has been considerable interest in the effect of garlic on Candida. Garlic has been shown to inhibit growth of C. albicans and other Candida sp. (Gafar et al., 2012; Gebreselema and Mebrahtu, 2013; Aala et al., 2014).

Studies by Moses et al. (1986) had reported garlic extract blocks lipid synthesis in C.albicans. This research has tended to focus on C. albicans only rather than NAC. Mahmoud (1988) also showed that garlic treatment affected growth of the yeast cells of C. albicans.

Lemar et al. (2002) showed C. albicans as sensitive to garlic. In addition, Giles et al. (2003) reported garlic tablet formulation being good in anticandidal activity. The results of a study by Jennifer et al. (2005) appear promising and look for further investigation for determination of the antifungal activity of Fresh Garlic Extract against C. albicans. Similarly, Masoomeh et al. (2006) had reported effective in vitro activity of garlic extract against C. albicans. Again, aqueous extract of garlic has been demonstrated to inhibit the growth of C. albicans by Vinay and Dinesh (2008). Londhe et al. (2011) reported Allium sativum, had the best activity against C. albicans. Mikaili et al. (2013) indicated one study showing that allicin from garlic has antifungal activity particularly against C. albicans and another in vitro study showing antifungal activity of allicin and its synergy with the azoles in the treatment of candidiasis. Allicin was also found to enhance the effect of amphotericin B against C. albicans. Main limitation of these studies is the experiments are done with C. albicans only, whereas NAC also are pathogenic.

Adejare et al. (2013) found the aqueous extract of garlic as less active than the alcoholic extract. C. albicans and C. glabrata were inhibited at a concentration of 200 mg/ml of the alcoholic extract where as C. tropicalis was inhibited at 25 mg/ml. All the isolates tested with garlic aqueous extract was found to have a uniform minimum inhibitory concentration of 200 mg/ml.

A study by Watson et al. (2014) does not support that oral garlic was effective in reducing Candida colonisation in vaginal candidiasis. But this study provides a foundation for planning future studies investigating the effect of garlic on Candida colonisation as topical preparations. Bayan et al. (2014) had reported many fungi, including Candida as sensitive to garlic. In a study by Guoliang et al. (2015), the results indicated that Fresh Garlic Extract has inhibition properties against C. albicans. These observations are insufficient to explain the MIC against Candida sp.

Aloe vera:

Aloe (Aloe vera) is an important and traditional medicinal plant belonging to the family Liliaceae. Much work on the potential of Aloe vera has been carried out. Aloe vera extracts have antibacterial and antifungal activities (Rajeswari et al., 2012; Chandegara and Varshney, 2013; Bhuvana et al., 2014). Uzma et al. (2011) made a distinction between the antifungal effect of Aloe vera extract on both C. albicans and C. tropicalis. It was pointed out that the

antifungal activity was more pronounced on C. albicans. Paoulomi et al. (2013) had studied extensively on Aloe vera plant and had found significant pharmacological activities of the plant, including activity against human pathogen C. albicans. In addition, Agarry et al. (2005) had come to the conclusion that the leaf possesses inhibitory effects on C. albicans. The results of a study by Bernardes et al. (2012) demonstrated that Aloe vera fresh leaves extract can inhibit both the growth and the germ tube formation by C. albicans and suggest the possibility of Aloe vera extract used as a promising new antifungal treatment.

Kedarnath et al. (2013) also had revealed the importance Aloe vera leaves and described that methanol extract has shown high zone of inhibition in Candida sp. On the contrary, Tamilarasi et al. (2014) provided information that C. albicans was more sensitive to ethanol extract of Aloe vera followed by the aqueous extract. Mbajiuka et al. (2014) recommended Aloe vera as an alternative to chemicals used in medication to reduce the toxicity of them. They reported the MIC of both aqueous and ethanol extract of Aloe vera against C. albicans as 0.50 mg/ml.

Fazlia et al. (2015) supports that Aloe vera extract effectively inhibited the growth of C. albicans compared with amphotericin B as emerged from disk diffusion test and the inhibitory effect varied with concentration. Gopakumar et al. (2016) also had reported promising results of Aloe vera for management of oral diseases. One of the major drawbacks of these studies was the lack of quantitative determination of the MIC against different Candida sp.

Azadirachta indica:

Azadirachta indica, commonly known as neem, belongs to Family Meliaceae, is one of the medicinal plants that has gained worldwide importance due to its medicinal properties (Sonal and Pankaj, 2014). Kausik et al. (2002) reviewed extracts of neem leaf, neem oil and seed kernels effective against human fungi including Candida. Several initial works in this field focused primarily on the anticandidal activity of Azadirachta indica. Some preliminary work was carried out by Charmaine et al. (2005) and they have reported alcoholic extracts of neem seed as a promising anticandidal agent. Again, neem extract has shown fungistatic and fungicidal activities against Candida sp. (Sunday and Joy, 2009; Sairam et al., 2000). The investigations on neem leaves by Aarti et al. (2010) found that neem leaf extract had significant effect against C. albicans by agar well diffusion method.

The systematic study on neem extracts carried out by Nayak et al. (2011) had shown the anticandidal activity of neem extracts in low concentrations. Aqueous extract of neem showed 7.5% and ethanol extract showed 3.75% as MIC, which was not a statistically significant difference. Similarly, Bishnu et al. (2011) and Milin et al. (2014) experimented on antibacterial and anticandidal screening of some of the traditionally used medicinal plants

in Nepal and India, including Azadirachta indica and Ocimum sanctum and the results showed a remarkable action of the ethanol and aqueous extract of them. In addition, alcohol was found to be a better solvent for extraction of medically active substances compared to water. In a study by Raja et al. (2013), aqueous extracts of neem leaf showed antifungal activity in 1mg/ml concentration.

Mohammad (2012) had stated that the future research in antimicrobial therapy may focus on finding how to overcome resistance to antimicrobials, or how to treat infections with alternative means. Similarly, Sarita et al. (2014) stressed on the importance of utilizing the medicinal properties of whole neem plant in various human disorders. As per Abhishek and Pratap (2015), different parts of this plant like leaf, bark and seeds exhibit antimicrobial effect against a wide variety of microorganisms. Sonalkar et al. (2014) clearly stated that neem leaves have antifungal properties. Similarly, Yogesh et al. (2015) also reported that neem leaf extracts prevented the growth of C. albicans but they also failed to provide the accurate concentration of the plant extract which may be effective against Candida sp.

Ocimum santum:

Ocimum sanctum has been used in India over five thousand years, as a medicine for body, mind and spirit and is known for its amazing health benefits (Ekta et al., 2012). The genus Ocimum comprises more than 150 species and is considered as one of the largest genera of the Lamiaceae family (Devesh et al., 2012). The study by Amber et al. (2010) observed fungicidal characteristics of O. sanctum in treatment for candidiasis. A major advance in the field was when Bhateja and Arora (2012) emphasised on the antifungal activity of Ocimum sanctum against C. albicans and C. tropicalis. In vitro studies performed by Gupta et al. (2014) using aqueous extract of Ocimum sanctum showed antifungal activity. However, in the opinion of Vitul (2015), the effect of tulsi extract should be explored on previously unexplored fungal species. But all these findings seem somewhat superficial.

Curcuma longa:

Curcuma longa is the popular Indian spice, turmeric, which is a member of the family Zingiberaceae. Curcumin has antioxidant, antiinflammatory, antiviral and antifungal actions (Jaggi, 2012). A study that used oral strains found out that curcumin inhibited the adhesion of Candida sp., indicating that it is a promising drug for immune compromised patients (Martins et al., 2009). In an animal study, topically applied turmeric oil inhibited pathogenic fungi (Akram et al., 2010). Lı´via et al. (2011) investigated the use of curcumin for the inactivation of C. albicans isolated from patients with oral candidiasis and the results showedthat there was a significant reduction in the viability of C. albicans. Even though, recent review of literature on the topic found that Neelofar et al. (2011), Subash et al. (2013) and Raja et al. (2014) reported curcumin as a promising anticandidal agent of clinical interest; curcumin was found

to be less effective than fluconazole. On the other hand, Candida sp. isolated from AIDS patients were markedly inhibited by curcumin and it was found to be more effective compared to fluconazole (Soheil et al., 2014).

An even greater concern should be on the concentration of the extract which has anticandidal activity. According to Mithra et al. (2012), the aqueous extract of Curcuma longa showed good inhibitory activity against C. albicans. The MIC of aqueous extract against C. albicans was determined as 190 mg/ml. Raja et al. (2014) obtained MIC of Curcuma longa methanol extract with C. tropicalis and C. glabrata as 1200 µg/ml.

CONCLUSION:

Different species of Candida will become a prominent cause of candidiasis over the next few years. The fact that prior studies on candidiasis have mostly focused on C. albicans alone is a critical concern. NAC has received little attention from researchers despite being a significant pathogen in candidiasis.

REFERENCES:

Anaul K M and Zulfiqar A. (2013). Candida Infections and Their Prevention. ISRN Prevent Med. Article ID 763628. 13 pages.

Anna C B P C, Cristiane A P and Graziella N B B. (2015). Mini-review – Candida albicans biofilms: characteristics, clinical relevance, and drug susceptibility. The Battle against Microbial Pathogens: Basic Science, Technological Advances and Educational Programs (A.Mendez-Vilas, Ed.) FORMATEX. 413-421.

Arjuna N B E, Zia U K, Rachel C and Leeba P. (2011). A Comparison of the Antifungal Activity of Herbal Toothpastes against Other Brands of Toothpastes on Clinical Isolates of Candida albicans and Candida dubliniensis. Med Princ Pract. 20: 112-117.

Armando H, Edgar O L, Aida V R, Alejandro Z, Enrique J, Jaime T and Angeles M M. (2013). Use of antifungal saponin sc-2 of Solanum chrysotrichum for the treatment of vulvovaginal candidiasis: in vitro studies and clinical experiences. Afr J Tradit Complement Altern Med. 10(2): 410-417.

Bhuvana K B, Hema N G and Rajesh T P. (2014). Review on Aloe vera. Int J Adv Res. 2: Issue 3, 677-691.

Clarissa J N and Alexander D J. (2015). Candida albicans Biofilms and Human Disease. Annu Rev Microbiol. 69: 71-92.

Ekta S, Sheel S, Jaya D and Swapnil S. (2012). Diversified potentials of Ocimum sanctum Linn

(Tulsi): An exhaustive survey. J Nat Prod Plant Resour. 2(1): 39-48.

François L M, Duncan W and Bernhard H. (2013). Candida albicans pathogenicity mechanisms. Virulence. 4: 2, 119-128.

Gebreselema G and Mebrahtu G. (2013). Medicinal values of garlic: A review. Int J Med Sci. 5(9): 401-408.

Jyotsna C, Duncan M K, Pranab K M, Lois L H, Thomas M and Mahmoud A G. (2001). Biofilm Formation by the Fungal Pathogen Candida albicans: Development, Architecture, and Drug Resistance. J Bacteriol. 183: No. 18. 5385-5394.

Laura C and Yolanda J. (2013). Clinical and microbiological diagnosis of oral candidiasis. J Clin Exp Dent. 5(5): e279-286.

Marjorie M C. (1999). Plant Products as Antimicrobial Agents. Clin Microbiol Rev. 12: No. 4. 564-582.

Mary A J, William A F and Timothy F M. (2004). Fungal Biofilms and Drug Resistance. Emerg Infect Dis. 10: No. 1, 14-19.

Mohammad A. (2013). A Review on Spermicidal Activities of Azadirachta indica. J Pharmacog Phytochem. 1: No. 5: 61-79.

Pankaj K S, Deen D G, Ritu S, Priyanka P, Sharmistha G, Atul K S, Ajay K and Kapil D P. (2013). Therapeutic and Medicinal Uses of Aloe vera: A Review. Pharmacol Pharm. 4: 599-610.

Sardi J C O, Scorzoni L, Bernardi T, Fusco-Almeida A M and Mendes G M J S. (2013). Candida species: current epidemiology, pathogenicity, biofilm formation, natural antifungal products and new therapeutic options. J Med Microbiol. 62: 10-24.

Sunitha J D, Shilpa P, Madhusudan A S and Ravindra S V. (2013). Antimicrobial activity of plant extracts on Candida albicans: An in vitro study. Indian J Dent Res. 24(4): 401-405.

Yuthika H S and Samaranayake L P. (1994). Candida krusei: biology, epidemiology, pathogenicity and clinical manifestations of an emerging pathogen. J Med Microbiol. 41: 295-310.