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Research Article
Antifungal Activity of *Parkia biglobosa* Extract on Pathogenic Strain of *Candida albicans*

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Abstract

Background and Objective: Medicinal plants play an important role in the development of potent therapeutic agents. *Parkia biglobosa* is a plant used in traditional medicine for the treatment of certain diseases. In order to scientifically apprise some of the medical uses of *parkia biglobosa,* this study aimed at making phytochemical screening and evaluating some anti-fungal activities of *P. biglobosa* leaves and bark extracts. **Materials and Methods:** Two different extracts (ethanol and aqueous) of dried leaf of *Parkia biglobosa* were tested against pathogenic strain of *Candida albicans*. Phytochemical screening, minimum inhibitory concentration (MIC) values and minimum fungicidal concentration (MFC) values of the plant extracts were determined. **Results:** The major phytochemical constituent of interests such as alkaloids, glycosides and saponins are found to be present in the both aqueous and ethanolic extracts of bark and leaves of *Parkia biglobosa.* Aqueous bark extract of *Parkia biglobosa* produced the highest zone of inhibition of 11.60±0.58 at concentration of 50 mg mL^{-1} which surpassed nystatin (500 IU mL^{-1}) with zone of inhibition of 9.33±0.58. The lowest zone of inhibition of 1.03±0.08 was obtained by ethanolic leaves extract at concentration of 2.5 mg mL^{-1}. **Conclusion:** The fungi toxicity tests have shown that extracts from leaves and bark of *Parkia biglobosa* at concentration of 50 mg mL^{-1} can replace synthetic drugs in the management of intertrigo infection.

Key words: Extracts, fungi toxicity, intertrigo, *Parkia biglobosa*, medicinal plants, phytochemical

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

This study discovered the use of bark and leaves extracts of *Parkia biglobosa* that can be beneficial for replacement of synthetic drugs in the management of intertrigo infection caused by pathogenic stain of *Candida albicans.* This study will help the researcher to uncover the critical areas of zone of inhibition of plant extracts that many researchers were not able to explore. Thus a new theory of dosage of bark and leaves extracts of *Parkia biglobosa* may be arrived at.

In Africa, many species of trees serve as sources of food and for medicinal purposes to indigenous people. *Parkia biglobosa* tree have been known to be a native of Africa and is an important multipurpose tree of West African Savannah land[1]. Various part of *Parkia biglobosa* tree are used for medicinal purposes and have high value commercially. Plants have the ability to synthesize a wide variety of chemical compounds that are used to perform important biological functions and to defend against attack from predators such as insects, fungi and herbivorous mammals[2]. Chemical compounds in plants mediate their effects on the human body through processes identical to those already well understood for the chemical compounds in conventional drugs, thus herbal medicines do not differ greatly from conventional drugs in terms of how they study. This enables herbal medicines to be as effective as conventional medicines but also gives them the same potential to cause harmful side effects[3]. The use of plants as medicine is recognized as an effective way to discover future medicines.

Fungal diseases represent a critical problem to health and they are one of the main causes of morbidity and mortality worldwide[4]. Fungal infections have increased worldwide largely because of the increasing size of people at risk, including immune compromised patients receiving parenteral hyper alimentation and/or broad spectrum antibiotics[5]. Other reasons are increase in immunosuppressive conditions like AIDS and other factors such as organ transplantation, leukemia, diabetes and intravenous drug misuse among others[6]. An important group of the skin pathogens are the fungi, among which dermatophytes and *candida* spp. are prominent[7,8]. Under certain circumstances usually associated with a compromised host immune system, *Candida albicans* and related species can become pathogenic, causing oral, viginal and/or systemic candidiasis[9]. *Candida albicans* is notorious for causing candidiasis, it can affect esophagus with the potential of becoming systemic, causing a more serious condition called Candidemia[10]. It can also causes a variety of infections that range from non-life threatening mucosal candidiasis like vaginal yeast infections, thrust, skin and diaper rash to lethal disseminated candidiasis in those with compromised immune system who have an implant able medical device such as peace maker or artificial joint or who use broad spectrum antibiotcs[11].

Although a large number of antimicrobial agents have been discovered, pathogenic micro-organisms are constantly developing resistance to those agents[12]. However, since many of the available antifungal drugs have undesirable side effect or are very toxic, produce recurrence, show drug-drug interactions or lead to the development of resistance, some shows ineffectiveness and have become therefore less successful in therapeutic strategies[13]. Therefore, it is necessary to search for more effective and less toxic novel anti-fungal agents that would overcome these disadvantages. The present investigation is focused on the screening of *Parkia biglobosa* against human fungal pathogen *Candida albicans*.

MATERIALS AND METHODS

Tested micro-organism: One standard strain of *Candida albicans* was obtained from Microbiology Laboratory of Nigerian Institute for *Trypanosomiasis* Research (Federal Ministry of Science and Technology) Kaduna, Nigeria. These isolates were maintained on Sabouraud dextrose agar SDA (BIOMARK Laboratories, India) at 4°C. Colonies from the SDA plates were stained by Gram-staining techniques following the procedure[14].

Plant material collection: Fresh bark and leaves of *Parkia biglobosa* were collected at Trial Afforestation Research Station, Forestry Research Institute of Nigeria, Afaka Kaduna. The plant parts were chopped and shade-dried at room temperature for 2 weeks then grounded using mortar and pestle to a fine powder in accordance to method described by Al-Hussaini and Al-Mohana[15]. The grounded samples were then transported for extraction process.

Preparation of aqueous and ethanolic extracts: The grounded powder was weighed on Sartorius balance type (BA 610) 100 g each of the dried samples (bark and leaves) were dissolved in 500 mL of 95% ethanol and also 100 g of each of the dried samples were dissolved in 1000 mL of distilled water separately. After the plant materials were successively extracted with ethanol and distilled water separately, the extract was filtered through (Whatman® No. 1, England) in Buchner funnel. This was followed by concentration of the ethanol filtrate on Rotary evaporator type Buchi-R-Switzerland at 50°C to recover the solvent used

and the aqueous filtrate was concentrated using water bath. The filtrate stock solution was kept air dried for further analysis[15].

Phytochemical screening: Chemical constituents of the extracts were analyzed to detect the presence of particular compounds using standard procedures[16,17].

Fungi toxicity test: Different concentration of each plant extract was prepared for studying their anti-fungal activity following the standard method.

Determination of minimum inhibitory concentration (MIC): The least concentration of the plant extracts that does permit any visible growth of the inoculated test organism in the broth medium was regarded as the MIC in each case. Control experiments were performed without the plant extracts according to the standard method[18].

Determination of minimum fungicidal concentration (MFC) of the extracts: The contents of the tubes that showed no visible fungal growth or turbidity in the minimum inhibitory concentration experiment were cultured into prepared Sabouraud dextrose agar plate to assay for the fungicidal effect of the extracts. The plates containing the test organisms were incubated at 37°C for 48 h. The minimum fungicidal concentration was regarded as the lowest concentration that did not yield any fungal growth on the solid medium used[18].

RESULTS

Qualitative analysis of the phytochemicals of ethanolic and aqueous extracts: Phytochemical screening of the plant extracts showed presence of some phytocompounds (Table 1).

Susceptibility testing of aqueous and ethanolic plant extracts and anti-fungal drugs in culture media on *candida albicans*: Figure 1 shows inhibition zones (mm) of *C. albicans* growth produced by aqueous and ethanolic plant extracts in culture media. Almost all the plant extracts exhibit anti-fungal effects against *C. albicans* (Fig. 1). In particular, aqueous extracts offer effective bioactive compounds for growth inhibition of *C. albicans* especially at concentration of 50 mg mL^{-1} (Fig. 1). Even at low concentrations, these plant extracts showed anti-fungal activity. Figure 2 shows the inhibition zones (mm) of *C. albicans* growth produced by nystatin and ketoconazole.

Table 1: Qualitative analysis of phytochemicals from plant extracts

	Ethanolic extracts		Aqueous extracts	
Phytochemicals	PBL	PBB	PBL	PBB
Alkaloids	+	+	+	+
Glycosides	+	+	+	+
Flavonoids	+	-	+	-
Saponins	+	+	+	+
Tannins	+	+	+	+
Steroids	-	+	+	+
Phenols	-	+	+	+
Proteins	-	-	+	+

Presence of constituent = +ve, Absence of constituent: -ve, PBL: *Parkia biglobosa* leave, PBB: *Parkia biglobosa* bark

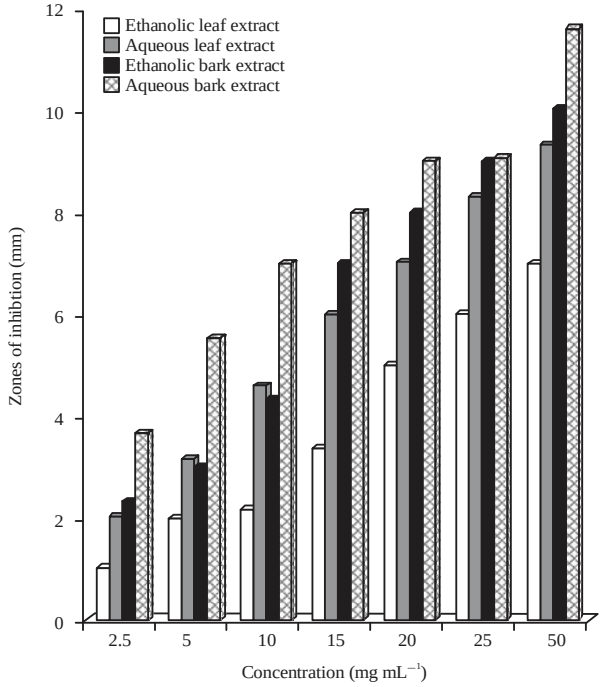

Fig. 1: Zones of inhibition (mm) of *C. albicans* growth produced by aqueous and ethanolic leaves and bark extracts of *Parkia biglibosa* in culture media

Minimum inhibitory concentration (MIC) and minimum fungicidal concentration (MFC) of plant extracts against *C. albicans*: The minimum inhibitory concentrations of the plant extracts were presented in Fig. 3 and 4. The minimum fungicidal concentration of the extracts proved to possess more fungicidal action against *C. albicans* when they are assayed (Fig. 4).

DISCUSSION

Among the phytochemicals determine in this study, phenolic compounds are one of the largest and most

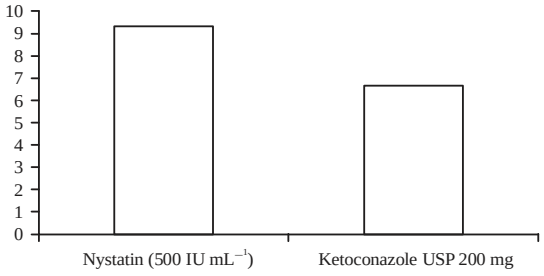

Fig. 2: Zones of inhibition (mm) of *C. albicans* growth produced by anti-fungal drugs in culture media

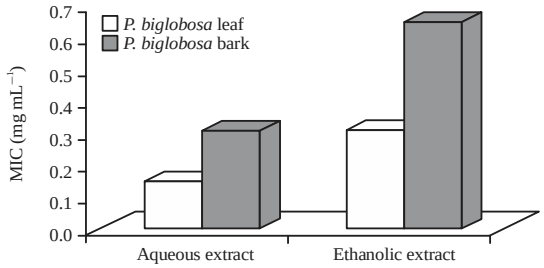

Fig. 3: Minimum inhibitory concentration (MIC) of plant extracts against *C. albicans*

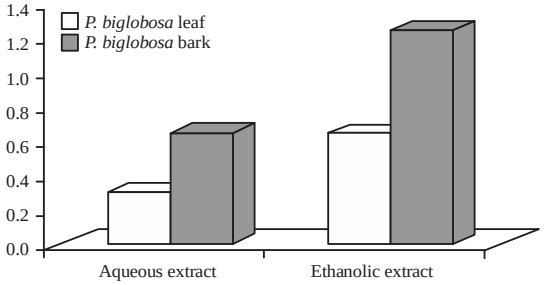

Fig. 4: Minimum fungicidal concentration (MFC) of plant extracts against *C. albicans*

ubiquitous groups of plant metabolites[19]. They possess biological properties such as anti-apoptosis, anti-aging, anti-carcinogen, anti-inflammation, anti-atherosclerosis, cardiovascular protection and improvement of endothelial function as well as inhibition of angiogenesis and cell proliferation activities[20]. Several studies have described the anti-oxidant properties of medicinal plants which are rich in phenolic compounds[21]. Natural anti-oxidant mainly comes from plants in the form of phenolic compounds such as flavonoid, phenolic acids, tocopherols etc[22]. Flavonoids are hydroxylated phenolic substances known to be synthesized by plants in response to microbial infection and they have been found to be anti-microbial substances against wide array of micro-organisms' *in vitro*. Their activity is probably due to their ability to complex with extracellular and soluble proteins and to complex with bacterial cell wall[23].

The plant extracts were also revealed to contain saponins which are known to produce inhibitory effect on inflammation[24]. Saponins have the property of precipitating and coagulating red blood cells. Some of the characteristics of saponins include formation of foams in aqueous solutions, hemolytic activity, cholesterol binding properties and bitterness[25]. Steroids have been reported to have anti-bacterial properties[23] and they are very important compounds especially due to their relationship with compounds such as sex hormones[26]. Alkaloids have been associated with medicinal uses for centuries and one of their common biological properties is their cytotoxicity[27].

Candida albicans remains the most common infection-causing fungus, about 45% of clinical infections are caused by this pathogen[28]. Despite serious environmental implications associated with the excessive use of chemical, fungicides still remains the first line of defense against fungal pathogens. Moreover, these fungicides when ingested by human beings and animals through food and water cause various ailments in the body. Search of natural fungicidal principle from the plant sources would definitely be a better alternative to these hazardous synthetic chemicals. Mishra *et al.*[29], Mahmoudabadi *et al.*[30], Al-Bayati and Al-Mola[31] and Banso *et al.*[32] demonstrated that ethanolic extracts of medicinal herbs inhibit growth of *C. albicans*. It was revealed in this study, that increase in the anti-fungal activity of the extracts was enhanced by increase in the concentration of the extracts which also agrees with the report of Prescott *et al.*[33] that higher concentration of anti-microbial substance showed appreciation in growth inhibition.

The minimum inhibitory concentration values of the plant extracts against the test organisms showed that fungi vary widely in the degree of their susceptibility to anti-fungal agents. This agrees with the report that antimicrobial agents with low activity against an organism have high minimum inhibitory concentration while a highly antimicrobial agent has a low minimum inhibitory concentration[32].

CONCLUSION

The present study demonstrates the anti-fungal potentialities of bark and leaves of *Parkia biglobosa* which would improve our understanding to the biological role of the plant and Future Avenue to develop new pharmacological studies and anti-fungal therapies. Bioactive compounds from plants in purified form can replace synthetic drugs and used efficiently against intertrigo infection. The results of this study

revealed the presence of medicinally important constituents in the leaf and stem bark of *Parkia biglobosa*. Therefore, this plant parts could be seen as a good source of bio-active chemical compounds which can be of great value in drug production. Further study should be carried out to isolate, purify and characterize the active constituents responsible for inhibiting the growth of *Candida albicans*.

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