



Evaluation of the Anti-Candida Activities of Some Plant Extracts on *Candida tropicalis* and *Candida* Spp Isolated from Prison Inmates in Owerri, Imo State, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JAMMR/2021/v33i2131149

Editor(s):

(1) Dr. Elvira Bormusov, The Lloyd Rigler Sleep Apnea Research Laboratory, Israel.

Reviewers:

(1) Amit Kumar Dutta, Amity University, India.

(2) P. Sampath Kumar, SASTRA Deemed University, India.

Complete Peer review History: <http://www.sdiarticle4.com/review-history/76108>

Original Research Article

**Received 13 August 2021
Accepted 27 October 2021
Published 05 November 2021**

ABSTRACT

Aim: This study aimed at determining the anti-candida activities of *Alternanthera brasiliana* and *Curcuma longa* on *Candida tropicalis* and *Candida* spp isolated from prison inmates in Owerri, Southeast, Nigeria.

Study Design: Cross-sectional descriptive study.

Place and Duration of Study: Owerri federal prison between March 2020 - June 2021.

Methodology: The anti-candida activities of methanolic extracts of *Alternanthera brasiliana* and *Curcuma longa* on *Candida tropicalis* and *Candida* spp were evaluated by the disc diffusion method. The plant extracts were obtained by soxhlet extraction using methanol as solvent. The results were obtained by measuring the inhibition zone diameter in millimeters.

Results: In order to ascertain the anti-candida activities of *Alternanthera brasiliana* and *Curcuma longa* in Owerri, Imo State, Nigeria, the antimicrobial properties of their extracts were tested by disc diffusion. Of the two plant extracts used methanolic extracts of *Curcuma longa* had better anti-candida properties than *Alternanthera brasiliana* inhibiting the growth of *Candida spp* at the concentrations of 200 mg/ml, 100 mg/ml and 50 mg/ml with inhibition zones ranging from 11 mm, 10 mm and 9 mm respectively. Methanolic extracts of *Alternanthera brasiliana* exhibited no anti-candida activity at different concentrations.

Conclusion:The results show that *Curcuma longa* had better anti-candida activity against *Candida spp.* and might be promising, at least, in the treatment of *Candida spp* infections.

Keywords: *Candida tropicalis*; *Candida spp*; *Alternanthera brasiliana*; *Curcuma longa*; anti-candida activities; prison; inmates.

1. INTRODUCTION

Several decades ago plants have been used in treating human diseases and infections of public health importance. The growth of traditional medicine has long been attributed to ever-increasing medicinal plants rich in pharmacologically active components with proven efficacy against some well-known diseases and medical conditions [1]. The emergence of pathogenic microorganisms that are resistant or multi-resistant to a major class of antibiotics has increased in recent years due to the indiscriminate use of synthetic antimicrobial drugs. In addition, high cost and adverse side effects commonly associated with popular synthetic antibiotics, such as hypersensitivity, allergic reactions, immunosuppression etc. are the major burning global issues in treating infectious diseases [2,3].

The Use of traditional medicines in treatment and management of the various disease is now encouraged by World Health Organization (WHO) due to their readily availability, cost-effective and high potency against some diseases [4]. Many traditionally known medicinal plants studied in the last few decades have been reported to possess various medicinal properties such as anticancer activity, antioxidant activity, anti-inflammatory, anti-diabetic, antibacterial, antifungal and hepato-protective activities [5]. Medicinal plants are key sources of bioactive compounds for herbal medicine, antibiotics, antioxidants, and pharmaceutical drugs [6]. There is virtually no plant on earth without any health benefit; however, there are many plants with yet to be discovered health benefits. Their bioactive constituents can be used in whole or as extracted forms for the management of ailments due to the available findings that they possess little or no side effects, are readily available and can protect humans against many diseases [7].

Alternanthera brasiliana (L) O. Kuntze belongs to the family Amaranthaceae commonly known in Brazil as joy weed or Josephs coat is widely used as a medicinal agent to cure different diseases, such as inflammation, wound healing, analgesic, antitumor activity, immune modulator and lymphocyte proliferation [8,9]. The whole plant of *Alternanthera brasiliana* (L) Kuntze shows antibacterial activity, and the plant is used in bronchitis and asthma treatment. The crude methanolic extract of *Alternanthera brasiliana* (L) Kuntze has antimicrobial activities against *Staphylococcus aureus*, *S epidermidis*, *Escherichia coli*, *Bacillus subtilis*, *Micrococcus luteus*, *Candida albicans*, *Saccharomyces cerevisiae*. These microbes produced resistance against methanolic extract of *Alternanthera brasiliana* [10].

Curcuma longa (turmeric) belongs to the family Zingiberaceae. It includes more than 80 species of rhizomatous perennial herbs and has widespread existence in the tropics of Asia, Africa, and Australia. *Curcuma longa* is the rhizome or underground stem of a ginger like plant. The plant is a herbaceous perennial, 60-90 cm high with a short stem tufted leaf. Its flowers are yellow, between 10-15 cm in length and they group together in dense spikes, which appear from the end of spring until the middle session. No fruits are known for this plant. They are highly branched, yellow-to-orange, cylindrical, aromatic rhizomes. *C. longa*, commonly known as turmeric (Haldi), is a well-known plant that is used as a drug in the Ayurvedic and Unani systems of medicine. Other various common names includes *Curcuma*, acafrao da India (port.), geelwortel (Dutch), kurkum (Arab), Manjano (East Africa (KiSwahili), manjal (Tamil), kunyit (Indonesia), temukunyit (Malaysian), and iyu-chin (Chin.). The most important chemical components of turmeric are a group of compounds called curcuminoids, which include

curcumin (diferuloylmethane), demethoxycurcumin, and bisdemethoxycurcumin [11-13].

Yeasts of the genus *Candida* and other species are the fungal agents most frequently involved in the etiology of cutaneous infections. Many studies investing the antifungal susceptibility of clinical strains of *Candida* spp. have been performed with a variety of results and these studies point to the emergence of new resistant strains [14]. Candidiasis is an acute or chronic infection produced by *Candida* species, often, limited to the skin and mucous membranes but can produce severe systemic disease in immunocompromised patients and immunocompetent persons. Cutaneous candidiasis and other forms of candidosis or moniliasis are infections caused by the yeast *Candida albicans* and other *Candida* species. This dimorphic yeast is a commensal that colonizes the skin, gastrointestinal and reproductive tracts. It is usually a secondary infection of skin and nail (body folds) in predisposed patients. It is a common opportunistic disease and usually leads to maceration and trauma in the skin and is commonly found in obese people, diabetics and people on oral contraceptives and antibiotics. Disease involvement may be localized or generalized to the skin and nails. The spectrum of cutaneous candidiasis includes diaper rash, intertrigo candidiasis, *Candida* folliculitis, otomycosis, onychia and paraonychia [15].

Candidiasis is an acute or chronic infection produced by *Candida*, generally limited to the skin and mucous membranes, but it could produce a serious systemic disease. Cutaneous candidiasis usually occurs in warm, moist and creased areas such as axillary folds inguinal or intergluteal areas. Candidal balanitis affects the glans penis and the inner aspect of the foreskin. Cutaneous candidiasis is arguably the most common form of candidiasis. The infection involves the very outer-most layers of the skin. Usually, *Candida* is kept under control by the native bacteria and by the body's immune defenses. If the mix of native bacteria is changed by antibiotics or the body moisture, the native bacteria undergo changes in its acidity or chemistry, it can allow the yeast to thrive and cause the symptom. Symptomatically, pruritus (itching) and irritation of the affected areas are the usual complaints. More severe lesions can also be quite painful, especially if located in regions where clothing binds tightly [16]. There is limited literature relating to the anticandida activities of *Alternanthera brasiliana*

and *Curcuma longa*. The present study therefore investigated the anti-*Candida* activities of the methanolic extracts of *Alternanthera brasiliana* and *Curcuma longa* on *Candida tropicalis* and *Candida* spp. isolated from prison inmates in Owerri, Imo State, Nigeria.

2. MATERIALS AND METHODS

2.1 Plant Collection and Identification

The plant material- *Alternanthera brasiliana* leaves and *Curcuma longa* rhizome were harvested from different locations in Imo State and identified at the department of biology/Microbiology of the Imo State Polytechnic, Umuagwo- Ohaji. The plant materials were washed with sterile water, air dried at room temperature, ground and stored in an air tight container for future use.

2.2 Extraction of Medicinal Plants

Dried, ground plant materials were subjected to soxhlet extraction using methanol as solvent. After extraction, the traces of solvent were evaporated to get the crude extract using a rotary evaporator. The crude plant extracts were stored in a refrigerator at 4°C for subsequent use [17].

2.3 Inoculum Preparation

Inoculum preparation was done using the method of [18] with little modification. A five-day old fungal isolate grown on SDA was aseptically scraped and transferred into 10ml of sterile water in a sterile bottle and agitated vigorously. The suspension was diluted serially ten-fold and used for antifungal screening.

2.4 Reconstitution of Plant Extracts

The extracts were reconstituted using the method described by [19] with slight modification. The dried extracts were reconstituted by dissolving two grams (2g) of extract in 10ml of 2% of DimethylSulphoxide (DMSO) to give 200mg/ml stock. Two-fold serial dilutions was done to obtain the concentrations of 6.25mg/ml, 12.5 mg/ml, 25mg/ml 50mg/ml and 100mg/ml which were applied on prepared discs.

2.5 Antifungal Screening

The antifungal activity of the plant extracts was carried out on the 14 isolates using the disc diffusion method as described by [20]. Sterilized discs (6mm) prepared from Whatman filter paper No 1, were impregnated with different

Table 1. Anti-Candida Activities of the Methanolic Extracts of *Alternanthera brasiliana* and *Curcuma longa* on *Candida tropicalis* and *Candida* spp. at different concentrations

Zones of inhibition (Mm) at different concentrations													
	<i>Alternanthera brasiliana</i>						<i>Curcuma longa</i>						
Isolates	200m g/ml	100mg/ ml	50mg/ ml	25mg/ ml	12.5mg/ ml	6.25mg/ ml	200mg/ ml	100mg/ ml	50mg/ ml	25mg/ ml	12.5mg/ ml	6.25mg/ ml	DMSO
<i>Candida tropicalis</i>	R	R	R	R	R	R	R	R	R	R	R	R	R
<i>Candida</i> spp	R	R	R	R	R	R	10	11	9	R	R	R	R

Key: R means resistant

concentrations of the methanolic extracts dissolved and in 2% Dimethylsulphoxide (DMSO) and placed on SDA plates spread inoculated with 0.1ml of 10^4 dilution of the inocula preparation. The plates were incubated at 27°C and the average diameter zone of inhibition was recorded after 48hours. Discs prepared with 2% DMSO served as a negative control.

3. RESULTS

The methanolic extracts of *Curcuma longa* inhibited *Candida* spp with zones of inhibition ranging from 9mm to 11mm (Table 1). The largest zones of inhibition occurred at the concentrations of 100mg/ml followed by 200mg/ml and 50mg/ml which indicated that *Candida* spp was sensitive to the *Curcuma longa* extract than *Alternanthera brasiliana*. *Alternanthera brasiliana* had no activity against *Candida tropicalis* and *Candida* spp. as shown in "Table" 1.

4. DISCUSSION

The occurrence of candidiasis infection is a public health problem. This is because of the development of antifungal drug resistance of the pathogens and side effects exhibited by the drugs used for fungal diseases. Hence, there is a great demand for a safer alternative and effective chemotherapeutic agent. Use of medicinal herbs in the treatment of skin diseases including mycotic infection is an age-old practice in many parts of the world [21,22]. A review of the literature indicates that *Curcuma longa* was used as a folk medicine all over the world from ancient times (Rudrappa, [23,24].

The anti-*Candida* activities of the methanolic extracts of *Alternanthera brasiliana* and *Curcuma longa* against *Candida tropicalis* and *Candida* spp. isolated from prison inmates in Owerri, Imo State, Nigeria were studied. The result of this study is partially in line with [25] who revealed that curcumin dramatically inhibited the adhesion of *Candida* species isolated such as *C. albicans*, *C. parasilosis*, *C. tropicalis*, *C. glabrata*, *C. dubliniensis*, *C. krusei*, *C. neoformans* and *Paracoccidioides brasiliensis* from AIDS patients to BEC, demonstrating that curcumin is a promising lead compound that warrants further investigation into its therapeutical use in immunocompromised patients while the growth of *Aspergillus* isolates was not affected [26]. also revealed that the methanolic extracts from fresh

and dry rhizomes of *C. longa* were moderately effective against some fungi at different concentrations. Our result agrees with this [27]. demonstrated anti-candida activity of *Curcuma longa* against *Candida albicans*, *C tropicalis*, *C. glabrata* and *C. dubliniensis*. This is not in line with our result since the *Curcuma longa* was not active against *C. tropicalis* in our findings. [28] reported antifungal activity of *Curcuma longa* against *Candida tropicalis*, *C. albicans*, *Aspergillus niger*, *Fusarium* spp and *Alternaria* spp. This is not also totally supported by our findings since *Curcuma longa* was not active against *C. tropicalis*. [29] also revealed that curcumin application can be an effective strategy to overcome the drug resistance in antifungal infection especially candidiasis. Our findings partially agree with this. [30] reported anticandida activity of curcumin against all clinical *Candida* strain tested. Our result is however not in total concordance with the above since only *Candida* species was sensitive to *C. longa*. The result of this present study substantiates the work by [31] who revealed that *Alternanthera brasiliana* did not present activity against *Candida* spp. It is also in concordance with [32] who reported that extracts of *A. brasiliana* was inactive against all microorganisms tested.

5. CONCLUSIONS

The findings of this study showed that the extracts of *Curcuma longa* had some significance in inhibiting *Candida* spp. As the findings of this study compared favorably with previous studies on anti-candida activity of *Curcuma longa*, the plant might be a promising source of drugs for treatment of *Candida* infections. Further work on this study may help to design a new drug against candidiasis.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the management of Owerri, federal prison for their assistance in collecting the samples for the study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
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