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Amla fruit mediated synthesis of zinc oxide nanoparticles and its antifungal activity

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ABSTRACT

To study the antifungal activity of ZnO nanoparticles synthesised from amla fruit. Nanotechnology has offered great possibilities in various fields of science and technology. It has been playing a crucial role in the development of modern materials in recent years. The antifungal activity of ZnO occurs by the deformation of fungal hyphae leading to the death of fungal hyphae, which may lead to cellular destruction. Preparation of plant extract, Synthesis of nanoparticles, Characteristics of nanoparticles, Preparation of nanoparticles powder, Antifungal activity of nanoparticles against *Candida albicans.* The peak found in the spectroscopy indicates the formation of ZnO nanoparticle. It is clearly seen from the graph that increase in concentration results in an increase in antifungal activity. The antifungal activity, in this case, was proved with *Aspergillus niger and Aspergillus terreus.* The results conclude that ZnO nanoparticle can be used to prevent any antifungal diseases.

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INTRODUCTION

Nanotechnology is considered as a developing field in science and technology. It has been playing a crucial role in the development of various nanomaterials in recent years (Agarwal *et al.*, 2017). Numerous advantages of pharmaceutical nanoparticles has grabbed the attention of many researchers for new innovations (Agarwal *et al.*, 2018). Application of nanoparticles in medicine has brought innovation in dosage forms with improvised therapeutic effects reducing the side effects of the drugs (Menon *et al.*, 2018; Rajeshkumar and Bharath, 2017). Metals have been used for decades to treat various infectious diseases (Malarkodi and Rajeshkumar, 2017).

The utilisation of metal and their oxides nanoparticles for antifungal activity is attracting more attention as these suggest superior activity towards resistant microorganisms (Happy *et al.*, 2019). When the human body is infected by any external pathogen, the immune system gets activated, and leukocytes comes into action. They eliminate the bacteria by cutting off all the basic requirements such as transitional metals for the survival of the bacteria (Shanmugam *et al.*, 2018; Rajeshkumar, 2018; Sujatha *et al.*, 2018). Thus transition metals could act as a substitute to an organic antifungal agent (Rajeshkumar *et al.*, 2018b).

Zn which is the second abundant transition metal present in the human body ,plays an important role in the maintaining of immune system (Rajeshkumar *et al.*, 2018a). zinc supplements reduces diarrhoea,pneumonia and malaria (Santhoshkumar *et al.*, 2017). Zinc oxide is stable compound and is capable of withstanding any harsh processes (Sunar *et al.*, 2019). ZnO is also considered as the safest

material for humans (Srinisha *et al.*, 2019). The anti-fungal activity of ZnO occurs by the deformation of fungal hyphae leading to the death of fungal hyphae which may lead to cellular destruction (Sharma *et al.*, 2013).

Zinc oxide is considered as a quite interesting material because of its application in areas such as optical, endodontics and gas sensing. In addition,Zinc oxide has been considered as the anti-fungal agent which has no toxicity and harmful environmental effects (Esteban-Tejeda *et al.*, 2015; Haq *et al.*, 2017; Saraf, 2013). Due to the safety of Zinc oxide nanoparticles and its compatibility with human skin it is accepted as a additive for textiles and surfaces that comes in contact with human skin (Liu *et al.*, 2014; Cioffi and Rai, 2012). ZnO nanoparticles express high photo catalytic properties which enhances their antifungal activity (Rasmussen *et al.*, 2010). ZnO nanoparticles produce ROS under the UV light.

MATERIALS AND METHODS

Preparation of plant extract

Amla fruit were collected from Chennai. The collected fruits were washed 3-4 times using distilled water. Then cut and dried in shade for 7-14 days. The well dried fruit pieces were made into powder. The collected powder was stored in air tight containers.1 gm of amla powder was dissolved in distilled water and boiled for 5-10 minutes at 60-70 degree celsius. The solution was then filtered by using filter paper. The filtered extract was collected in a beaker and stored in 4 °C for further use.

Synthesis of nanoparticles

20 milli molar of 80 mL zinc sulphate is prepared using double distilled water. The plant extract (amla fruit) is added to the metal solution and was made into 100 ml solution. The colour change was observed visually and photographs were taken. The solution is kept in magnetic stirrer for nanoparticles synthesis.

Characteristics of nanoparticles

The synthesis of nanoparticles solution preliminary characterised by using UV-vis- spectroscopy. The results were recorded for the graphical analysis.

Preparation of nanoparticles powder

The nanoparticles solution is centrifugal using lark refrigerated centrifuge at 8000 rpm for 10 minutes and the pellet is collected and washed with distilled water twice . The final purified pellet is collected and dried at 100-150 degree Celsius for zinc oxide nanoparticles for 24 hours. Finally, the nanopar-

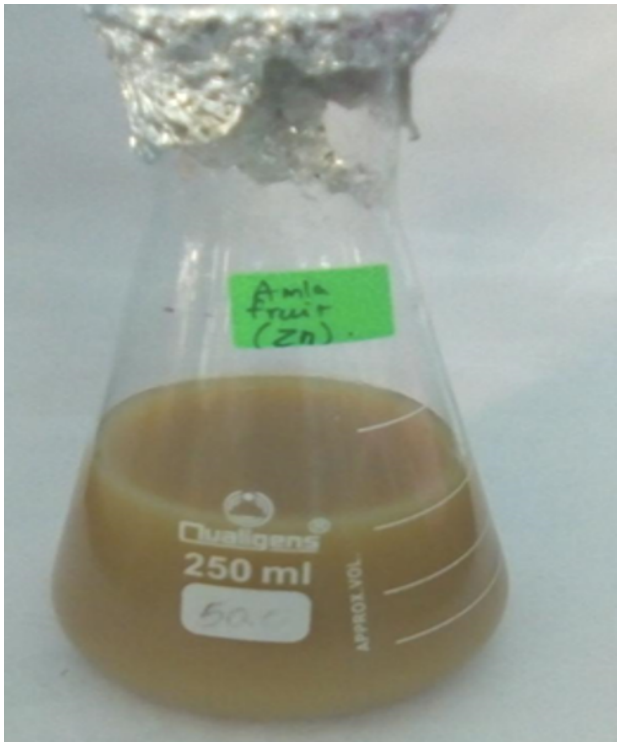

Figure 1: Visual observation

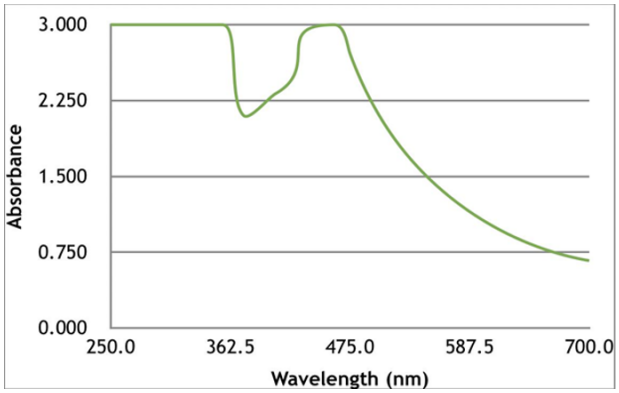

Figure 2: UV-vis spectroscopy

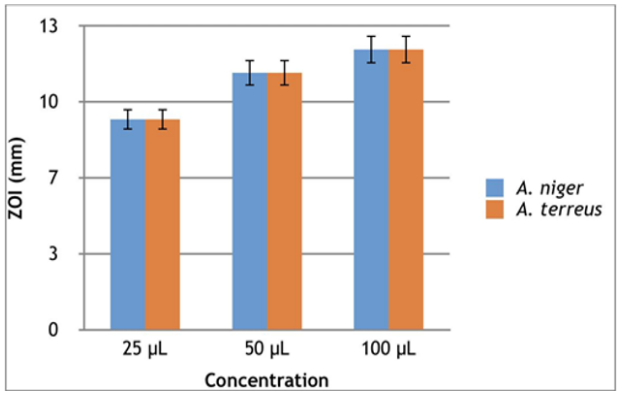

Figure 3: Zone of inhibition of ZnONPs against fungal pathogens

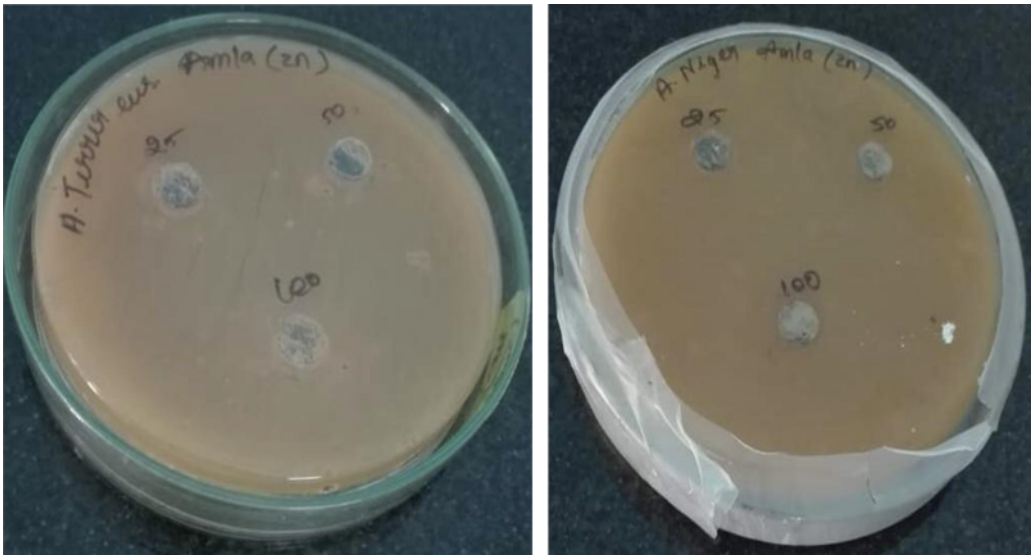

Figure 4: Antifungal activity of ZnONPs

ticles powder is collected and stored in air tight eppendorff tube.

Antifungal activity of nanoparticles against *Candida albicans*

The *A.niger and A. terrus* fungal isolate was isolated using serial dilution method and confirmed using specific media. The agar well diffusion method used to prove the antifungal activity of Zinc Oxide Nanoparticles. Different dosages of NPs were tested against the oral pathogenic *candida albicans*. The fresh fungal suspensions were dispersed on the surface of agar plates. Different concentration of nanoparticles (30, 60 & 90 μL) was incorporated into the wells as well as the plates and discs were incubated at 37°C for 48 h. The antibiotics were used as positive control. Zone of inhibition was recorded in each plate and the results were recorded.

RESULTS AND DISCUSSION

The addition of zinc sulphate with amla fruit extract forms cloudy with brown in clour confirms the zinc oxide nanoparticles shwn in Figure 1. The Figure 2 shows the surface plasmon resonance of zinc oxide nanoparticles at 430 nm confirms the zinc oxide nanoparticles.

The peak found in the spectroscopy indicates the formation of ZnO nanoparticles.

Antifungal activity

The Figure 3 and Figure 4 is clearly seen from the above graph that increases in concentration results in increase in antifungal activity. The antifungal activity in this case was proved with *A.niger* and *A.terreus.*

CONCLUSION

The results conclude that ZnO nanoparticle can be used to prevent any antifungal diseases. Various antifungal diseases such as candidiasis, Athelete's foot, Mycosis, Ring worm can be controlled by using ZnO nanoparticles.

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