Assessment of Green Synthesized Cerium Oxide Nanoparticles from Peel Extract

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ABSTRACT

A subset of nanobiotechnology is the development of nanotechnology-based instruments for the study of biological processes. Microbial infection is a public health problem. This problem will be carried out with the help of many medicinal plants. In this present investigation the Cerium oxide Nanoparticles were synthesized from the medicinal plant; *Punica granatum* L peel extract using green synthesis methods, The Prepared Cerium oxide nanoparticles were characterized using Raman spectroscopy analysis. The cubic crystal structure of cerium oxide nanoparticles shows a very strong active base state in the Raman spectrum at 452cm^{-1}. The antifungal activity of *Candida albicans* and *Aspergillus niger* was conducted using the prepared Nanoparticles. As per the results obtained, the prepared nanoparticles have high anti-fungal activity which was found to be 14mm and 13mm.

Keywords: Cerium oxide nanoparticles, Antifungal activity, Raman Spectroscopy, CeO_2 Nps.

INTRODUCTION

Pomegranate (*Punica granatum* L) Peel is one of the most ancient and also endemic to the Mediterranean and has widely been employed in the folk medications of many nations. In India, arils are utilized or made into juice as such. Instead, the arils are utilized to make different added value goods such as concentrates, canned drinks, wine, jam, and jelly. The latest fresh juice preparation has a little amount of cellulose, ascorbic acid, and polyphenolic flavonoids. In addition, it belongs to the fruit cluster which has the most beneficial pharmacological effects, largely because of the extremely high concentration of several bioactive substances [1,2]. In yogurt samples, the addition of

pomegranate peel extracts has effectively been tested to boost the level of its immunity activity. Accordingly, today small particles of nanomaterials have become a major area of scientific research.

The bioactive of nanoparticles has increased greatly in the latest research. As a report of its exceptional stability and biocompatibility, Nanoceria has the most importance in all areas of research and its most importance. Nanoparticles of cerium the atomic number is 58 and it's oneof the most antimicrobial activities by using microbes by disk diffusion method. These materialshave a high redox activity. Some of the CeO_2 NPs can be used to form the +1 and +4 states. And also, nanoparticles of cerium are gaining in popularity because of their potential use in biomedicine. Toxins and disease arenot the only things they protect against, but so are radiation and toxicants.

Nano ceria having a large surface area provides high catalytic activity and this feature provides bioactivity to ceria NPs significantly. Also, the nano-ceria compound is used in removing oxidative stress from living organisms and it has been reported to be very effective [3,4]. Furthermore, the ceria NPs reduces the concentration of reactive oxygen species in livingcompounds and they have an impact on the hydroxyl radicals [5-7]. Cerium Oxide nanoparticleshave increased the zone of inhibition and they have been reported to electrostatic induction nature between nanoparticles and fungi cell wall membrane and produced more microbial activity.

Fungal-related infections represent a public health problem. However, most of the species are involved in the killing of fungi-related hospital infections. Mainly fungi-related disorders need some treatment or prophylaxis. Antifungal drugs are limited to four classes: azoles, echinocandins, polyenes, and flucytosine. Recently, antifungal administration may be oral or intravenous. As per the available literature, Cerium oxide nanoparticles prepared from the peel has an antifungal activity against *Candida albicans.*

Therefore, in this present investigation, the Cerium oxide nanoparticles synthesized from the Medicinal plant; *Punica granatum* L. The peel extract using the green synthesis method. Theprepared cerium oxide Nanoparticles were characterized by using Raman spectrometry analysis. The antifungal activity of *Candida albicans* and *Aspergillus niger* was conducted using the prepared Nanoparticles. As per the results obtained, the prepared Nanoparticles had more antifungal activity against *Candida albicans* than *Aspergillus niger* which was found to be 14mm and 13mm.

2. MATERIALS AND METHODS:

The chemicals that were utilized in the production of CeO_2 NPs were of an analytical grade and did not require any additional purification before use. In each of the many studies,cerium (III) nitrate hexahydrate from the American Sigma–Aldrich Chemical Company was usedefor this research work.

2.1 Preparation of *Punica granatum L* peel extract

Pomegranate was procured from organic garden, Tirupattur. The Peel was removed and a dried. Grind the same using mixer converted powder form. This is denoted as PGE.

2.2 Preparation of Cerium Oxide Nanoparticles

A 0.1M Solution of Cerium (III) nitrate hexahydrate ($CeN_3O_9.6H_2O$) was poured into the Beaker containing 1% PGE solutions. This blend was stimulated continually at a temperature of 80°C for 4–6 hrs. A white quickens confined. The procured extraction was sieved with the help of Whatman No. 1 Filter paper, the cerium oxide nanoparticles were obtained. The dried material was denoted as CeO_2 NPs.

Fig 1: Synthesis of Cerium oxide Nanoparticles

2.3 Raman Spectrometry analysis

The Prepared Nanoparticles were confirmed using Raman Spectrum (Takram P50C0R10, laser wavelength = 452cm^{-1}).

2.4 Antimicrobial activity

The obtained Pure form of cerium oxide nanoparticles from the water extraction of Peel. The Cerium oxide nanoparticles were tested against *Aspergillus niger* and *Candida albicans,* using the Agar Well diffusion method. The antimicrobial activity was accomplished by measuring the zone of inhibition by Kirby-Bauer Test.

3. RESULTS & DISCUSSION

Nanobiotechnology has been the focus of the most significant research in recent years. In the current studies, CeO_2 NPs were synthesized from cerium hexahydrate reagent and *Punica granatum* L peel extract was found to be an effective capping and reducing agent.

Raman Spectrum of Cerium Oxide Nanoparticles:

Raman Spectrum of CeO_2 NPs shown in Figure 1, that the sample's crystal structurewas documented by the absorption of peaks.

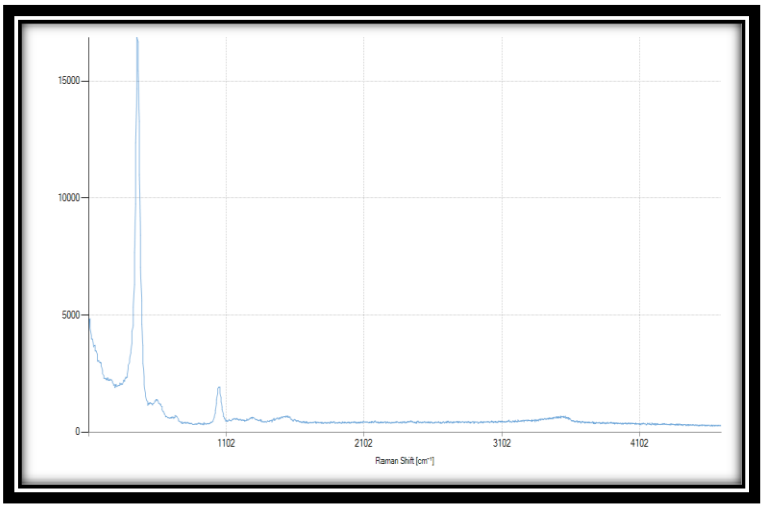


Fig .1. Raman Spectrum of synthesized CeO_2 Nanoparticles at 400 °C.

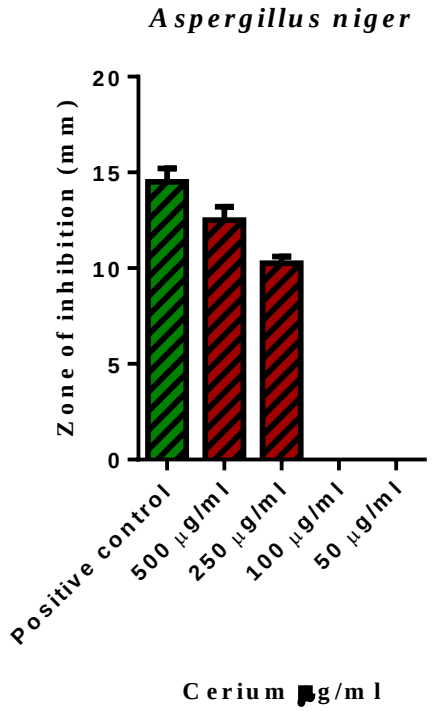
The Microscopic nature of the sample of CeO_2 NPs was documented. Raman spectrophotometry works as far as the idea of the Raman impact. This technique is a Powerful detection tool for extremely reactivity detection topology and chemical compounds of Nanoparticles and biotic systems. The cubic crystal structure of cerium oxide nanoparticles shows a very strong active base state in the Raman spectrum at 452cm^{-1}.

3.1 Antifungal activity of CeO_2 NPs

As per Available literature, the cerium oxide nanoparticles have an enormous application, antifungal, antioxidant, anti-inflammatory, and anti-cancer activity. So, the prepared sample were analysed and confirmed its antifungal activity against *Aspergillus niger.* In addition, the fungicidal-related disease affects and leads to severe health disorders. So, antifungal activity wasalso tested against *Candida albicans*.

The zone of inhibition of the assay is to identify the evaluation of cerium oxide nanoparticles. As shown in the figure-3 standard curve was plotted using a different concentration of CeO_2 NPs on X-axis, the concentration of the test compound was 50,100,250 and 500 µg/ml, next followed by the Y-axis Zone of inhibition in the millimeter. The final results showed that to inhibit the growth of *Candida albicans, a* Maximum concentration of cerium oxide nanoparticles were needed. The Positive control of (Amphotericin B) could inhibit the growth of Particular *Candida albicans* with the inhibition of a diameter range of 15 mm. These results suggest that as-synthesized Cerium Oxide nanoparticles have a strong antifungal activity,as the inhibition zone value of 10-20 mm is classified as strong. So, the final results of inhibition are very strong. These results compared with existing literature [9].

Figure.2. Effect of CeO_2 NPs against *Aspergillus niger* and *Candida albicans*



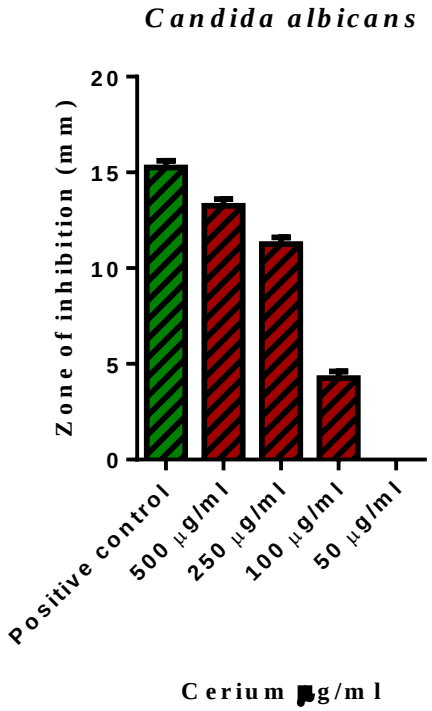


Fig-4a Zone of Inhibition of CeO_2 NPs against *Aspergillus niger*

Fig-4a Zone of Inhibition of CeO_2 NPs against *Aspergillus niger*

Based on the results obtained we proposed that the smaller particle size of cerium oxide

nanoparticles provides a larger area, here providing more active sites for fungi. So, with the help of small nanoparticles to prevent fungal infection and Fungi by using zone of inhibition methods. Finally, Utilising the disk diffusion approach, the effect of cerium oxide nanoparticles can act as an antifungal against through the zone of inhibition.

Table-1.
SD± Means of zone of inhibition obtained by CeO2 against Candida albicans and Aspergillus niger

S.NO	Name of the test organism	Name ofthe test sample	of inhibition (mm)SD ± Mean				
			500 µg/ml	250 µg/ml	100 µg/ml	50 µg/ml	PC
1.	*Candida albicans*	CeO_2 Nps.	13.25±0.35	11.25±0.35	4.25±0.35	-	15.25±0.35
2.	*Aspergillus niger*		12.5±0.7	10.25±0.35	-	-	14.5±0.7

Table-2.
Zone of Inhibition for *Candida albicans*

S.No	Sample	ncentration(mg/ml)	Zone of Inhibition for *Candida albicans*
1	Standard (Amphotericin B)		16mm
2	Control (DMSO)		NA
3	CeO_2 Nps.	1 mg	14mm

Table-3.
Zone of Inhibition for *Aspergillus niger*

S.No	Sample	ncentration(mg/ml)	Zone of Inhibition for *Aspergillus niger*
1	Standard (Amphotericin B)		15mm
2	Control (DMSO)		NA
3	CeO_2 Nps.	1 mg	13mm

4. Conclusion:

We concluded that the plant-mediated cerium oxide nanoparticles were successfully produced. Without the use of acids or bases, a significant amount of nanoceria was generated from the *Punica granatum* L peel water extraction process. The obtained CeO_2 NPs was confirmed with the Raman Spectrum in the form of a crystal

structure. Raman Spectrometry diffraction patterns showed that crystal structure. Therefore, results of nanoparticles synthesized from *Punica granatum* L peel found to exhibit antifungal property effectively against *Candida albicans*, showing good potential to be reliably applied in biomedical applications.

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