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Preparation and characterization of CeONPs from *T. cordifolia* plants extract by FTIR, Zeta and UV Spectroscopy

***[1]Ankit and [2] Dr Sandeep Singh**

Department of Biochemistry, MDU Rohtak

E-mail: langyanankit1995@gmail.com

Abstract

The use of plant extracts and microbes for preparation of nanoparticles is the key of green synthesis approach for nanoparticles preparation. Fresh CeNPs were prepared from the T. cordifolia plant extracts characterized by zeta sizer, FTIR and XRD. Cerium oxide was used for nanoparticles preparation in plant extract. These are rare earth metals (Ce, Sm, Y, La, Tb, Sc) which are multipurpose in action. In this research work, we prepared the CeNPs in lab with green approach methods. After heating the extract and cerium oxide at fixed temperature and continuous magnetic stirring of paste, the CeONPs as final outcome exposed to warm air oven at 300^{0}C for 3 hours. The CeONPs were subjected to various techniques for determination of crystal size and shape. The average size obtained was 6 nm which is good series of sizes of nanoparticles. The present work will signify the importance of hazarads chemicals free green biosynthetic methods for nanoparticles preparation as safest effort in this field.

Keywords: CeONPs, *T.cordifolia green approach etc.*

Introduction

The catalytic properties of cerium oxide nanoparticles are well reported from earlier various plant extract. Nanoscience research is expected today not because of only application and also by the way of synthesis (Gopinath *et al*., 2012). The green synthesis approach is modern trend in

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this field. The amalgamation of noble metal nanoparticles entices an growing curiosity due to their original and changed features as associated with those of macroscopical stage, that permit gorgeous submissions in numerous pitches such as antimicrobials (Priyadarshini *et al*, 2013), medicine, bioengineering, optics, microelectronics, catalysis, data stowage and energy alteration (Yeo *et al*., 2003). Additionally, the CeONPs shows magnetic and electric characters (Can xu Xlaogang Qu, 2014). The fresh plant samples were taken and crushed into fine powdered form. A nanometer is one-billionth of a meter. Dimensions between approximately 1 and 100 nanometers are known as the nanoscale. Currently, the use of plant extracts in this field is emerging very effectively. Green chemistry is an economical and environment responsive advance for plant extract aided biogenesis of the metal NPs (G. Sharmila, 2019). The preparation of CeONPs with *T. cordifolia* extract has been done. The prepared CeONPs were identified for size and shape using various analytical techniques like zeta potential, FTIR, UV spectroscopy.

Experimental work

Collection of *T. cordifolia*: Fresh *Guḍūci* (*Tinospora cordifolia)* (Wild. Miers) were procured from xerophytic area of Rohtak. The collected samples were washed with tap water and then subject to cutting into small segments in lab for experimental purpose.

Preparation of extracts: The biosynthetic process is eco-friendly, nonviolent, green tactic to prepare NPs employing various plants and their extract for biomedicine. (Razavi et al. 2015). T The physical impurities and outer loose bark were removed and the stems were washed thoroughly with deionized water. *T. cordifolia* (5 kg) stem of 1.6-2.0 cm thick were taken and chopped into pieces of 1.5-2.0 inches length. These pieces were pulverized thoroughly and converted into a slimy paste. The mass so obtained was kept for soaking overnight (12 h) and extracted 3 times in de-ionized water (1:5; w/v) in a glass beaker.

Preparation of cerium oxide nanoparticles: 10gm of fresh stem of T. cordifolia were taken in 250ml flask by warming it to 70^0 C in 100 ml milique water for 20 minutes. The fresh plant extracts were used as reducing agent (green synthesis approach) in preparation of CeNPs. Finally, the 20ml of stem extract added drop wise in the flask containing 0.1M (80ml) solution of cerium nitrate that is placed at 100^0C at constant and high-speed magnetic stirring

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for 5 hour. The yellow color was changed from white to yellow in mean time. The remaining of CeNPs was washed followed by centrifugation at 12000rpm for 15 minutes. The final product subjected to hot air oven at 300^0C for 3 hours.

Utilization of bioactive compounds to form CeNPs (modified method of Arumugam *et al.*, 2015): First, 3.26g Ce $(NO_3).6H_2O$ was added to 20% 100ml stem extract (pre-heated to 80^0C) then stirring for 4 hrs to precipitate. UV-Visible spectrum will be noted after every 30 minutes till 3 hrs. The *pH* of solution will also be optimized by repeating procedures at different *pH* values i.e. 5, 5.5, 6, 6.5, 7.5, 8, 8.5, 9, 9.5 and 10.

Zeta Seizer

Zeta potential is a physical property which is given the net surface charge of the nanoparticles, when these particles inside the solution repelling each other's since produced Coulomb explosion between the charges of the nano particles giving rise to no tendency for the particles to agglomerate (Zhang *et al.,* 2008). It was done at Aryabhatt Instrumentation Institute (AIIG) GJU Hissar. Zeta potential and size was measured with Malvern Instrument**.**

FTIR

Different functional and chemical groups were measured with the help of the FTIR at GJU Hissar. The FTIR employed for reorganization of variation when the CeNPs were incorporated. For getting better noise to signal ration 125 scans of the film were used in basic range between 400-4000 cm^{-1}, a greater technique for characterization as direct chemo absorption of environmental moisture & CO_2on the surface of CeO_2NPs (Nuromohammadi et al 2018). The cerium oxide stretch has been proven already for absorption band at wave length no 550.84 per centimeter (Ansari et al.2009)

UV spectroscopic analysis

It has become a common analytical instrument in laboratories. In many applications other techniques could be employed but it is most preferred due to its effortlessness, flexibility, rage, correctness and low cost. UV–Visible analysis is an important way to confirm the formation of metal nano particles in colloidal solutions.

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Result and Discussion

The prepared CeNPs were analyzed under the several instrumentations for size and shape confirmation. Various techniques have been performed for accuracy of particles size and shapes. The size range of CeONPs was 6nm which is the average size was 6 nm. In a study, the ROS lead significantly reduced in H9C2 cells exposed to CeONPs with sizes of ranging between 1 to 100nm for one day (N. J., et al 2011).

Zeta Seizer

Zeta potential was performed at Malvern Instrument in ACIL MDU, Rohtak. The size of the NPs was observed at the peak 6.874 with having 100% intensity.

Various sizes of CeONPs by Zeta Sizer					
			Size (d.nm)	**% Intensity**	**SD (d.nm)**
Z-Average (d. nm)	6251	Peak 1	6.874	100	0.4939
PdI	1.000	Peak 2	0.000	0.0	0.000
Intercept	1.20	Peak 3	0.000	0.0	0.000

Table No.1 Different sizes of CeONPs calculated by Zeta siezer

Zeta Size Peaks:

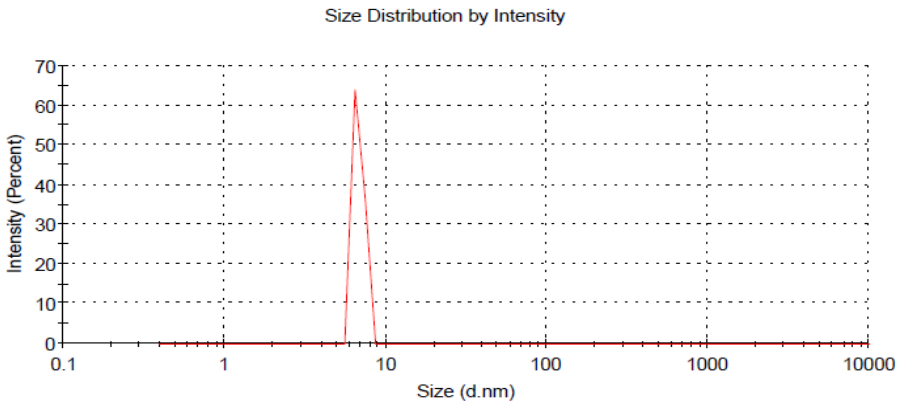

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Figure No. 1 Zeta sizer peak of CeONPs

Fourier transform infrared spectroscopy

The FTIR spectrum of CeNPs was recorded in the wave number range of 400-4000 per cm. The peak at 450- 550 is attributed to the O-Ce-O stretching mode of vibration and peak at 539cm here shows the O-Ce-O stretch. The two sharp peak 1587 cm and 3414 cm shows that banding pattern of N-O stretching and N-H stretching respectively.

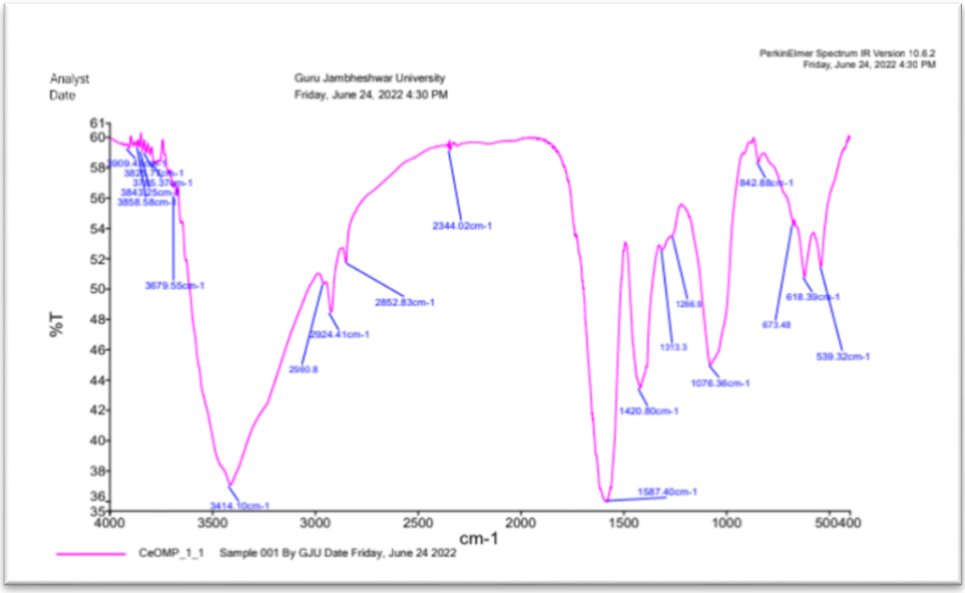

Figure No. 2 The graph for FTIR spectra at different wavelengths and several peaks observed.

Separate phases were not recognized as peaks are confirmative that intact cerium oxide is gained through no additional impurities. The extent of crystal can be resolute by expansion of crests which may additionally examined by methods of Debye–Scherrer and Williamson–Hall (Pujar et.al 2018).

UV spectroscopy

The UV absorption spectrum of CeNPs was measured at range of 200-600 nm. The samples were characterized against water as the reference sample. The UV-Visible spectrum was recorded for

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cerium oxide (III and IV). The peak was observed at 261 nm which is in agreement of UV absorbance results from earlier work, Akl M. Awwad et al., 2014 (377nm).

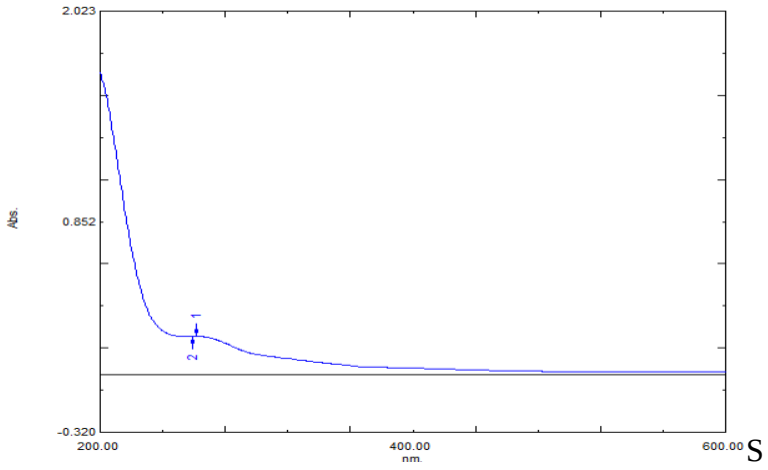

Figure No. 3 UV peak for CeNPs.

Conclusion

Presently, the demand of NPs synthesis by green approach is increasing day by day in research era because of eco-friendly nature. The NPs prepared by plant extracts and microbial contribution have easiness in various industries, engineering, biotechnology and other similar fields. The CeNPs prepared from the plant extract of *T. cordifolia* undergone various techniques proved that the effectiveness of CeNPs is of good quality by mapping the shape and size.The sound structure of NPs is mapped by popular techniques like XRD, SEM and Zeta sizer etc. which means the outline and its exterior countryside. The FTIR spectra gritty the occurrence of CeNPs while the XRD scrutiny determined the crystal building of the nanoparticles.

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References

Akl M. Awwad, Borhan Albiss, Ahmad L. Ahmad (2014). Green synthesis, characterization and optical properties of zinc oxide nanosheets using *Olea europea* leaf extract. *Adv. Mat. Lett.* 2014, 5(9), 520-524.

Ansari, A.A., P.R. Solanki and B.D. Malhotra, (**2009**). Hydrogen peroxide sensor based on horse radish peroxidase immobilized nanostructured cerium oxide film. J. Biotechnol., 142: 179-184.

C Xu, Z Liu, L Wu, J Ren, X Qu (2014). Nucleoside triphosphates as promoters to enhance nanoceria enzyme-like activity and for single-nucleotide polymorphism typing. *Advanced Functional Materials.* Vol.24, (11). PP 1624-1630. doi.org/10.1002/adfm.201301649.

G. Sharmila, M. Thirumarimurugan, C. Muthukumaran, **(2019)**. Green synthesis of ZnO nanoparticles using Tecoma castanifolia leaf extract: characterization and evaluation of its antioxidant, bactericidal and anticancer activities, Microchem. J. 145 578–587.

Gopinath V, MubarakAli D, Priyadarshini S, Priyadharsshini NM, Thajuddin N, Velusamy P (2012). Biosynthesis of silver nanoparticles from Tribulus terrestris and its antimicrobial activity: a novel biological approach. *Colloids and Surfaces B: Biointerfaces.* 96:69-74.

N. J., Wang K, Kolattukudy P., (2011). Cerium Oxide Nanoparticles Inhibits Oxidative Stress and Nuclear Factor- B Activation in H9c2 Cardiomyocytes Exposed to Cigarette Smoke Extract. *Journal of Pharmacology and Experimental Therapeutics* 338(1):53-61DOI:10.1124/jpet.111.179978.

Priyadarshini S, Gopinath V, Priyadharsshini NM, MubarakAli D, Velusamy P (2013). Synthesis of anisotropic silver nanoparticles using novel strain, *Bacillus flexus* and its biomedical application. *Colloids Surfaces B: Biointerfaces*, 102: 232-237.

Razavi M, Salahinejad E, Fahmy M et al (2015). Green chemical and biological synthesis of nanoparticles and their biomedical applications. In: Basiuk V, Basiuk E (eds) Green

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processes for nanotechnology. Springer, Cham. https://doi.org/10.1007/978- 3-319-15461-9_7

Sharmila G, Muthukumaran C, Saraswathi H, Sangeetha, E, Soundarya S, Narasimhan, Kumar M. (2019) Green synthesis, characterization and biological activities of nanoceria. *Ceramics Int.* Vol. 45, Issue 9, PP 12382-12386.

Yeo SY, Lee HJ, Jeong SH (2003). Preparation of nanocomposite fibers for permanent antibacterial effect. *Journal of Material Sciences*. 38: 2143-2147.

Zhan G, Huang J, Du M, Abdul-Rauf I, Ma Y and Li Q (2011). Green synthesis of Au–Pd bimetallic nanoparticles: Single-step bioreduction method with plant extract. *Material Letters*. 65: 2989-2991.

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