RESEARCH ARTICLE

INTERNATIONAL RESEARCH JOURNAL OF PHARMACY

www.irjponline.com

ISSN 2230 – 8407

GREEN SYNTHESIS OFZINC OXIDE NANOPARTICLES ANDITS CHARACTERIZATION STUDIES

Jayshree Parikh[1], Haribhau Ramrao Aher[2] and Sandeep Ramesh Gadhave[3*]

[1]Associate Professor, Department of Chemistry, Shri JJT University, Rajasthan, India.
[2]Principle, Arts, Commerce and Science College, Kolhar, Tal- Rahata, Dist- Ahmednager, Maharashatra, India.
[3]Research scholar,Shri JJT University, Rajasthan, India; Asistant Professor, Department of Chemistry, Padmashri Dr. VitthalraoVikhePatil College of Arts, Science and Commerce, Pravaranager, Tal- Rahata, Dist- Ahmednager, Maharashatra, India.

*Corresponding Author E-mail: srgdrug95@gmail.com

Article Received on: 10/08/2022, Accepted on: 10/09/2022, Published on: 15/09/2022

DOI: 10.7897/2230-8407.1303184

ABSTRACT

Michelia Champaka L.leaf extract mediated synthesis of nanoparticles by cost efficient method, as implementation of zinc nitrate as precursor material. Characterization includes FTIR, UV Visible Spectroscopy, SEM, HR-TEM. The nanomaterial synthesized possessed nano size of 40-80 nm with spherical and crystalline nature as characterized through Scanning electron microscopy (FE-SEM), High Resolution Transmission electron microscopyrevels nature of nanoparticles as spherical, dark shaded flowers, spindle shaped and extremely crystalline with an average size of 40 nm. Elemental diffraction spectroscopy (EDAX) shows Zn =16.48 % and O = 46.10 %. UV Vis spectroscopy gives ?max = 325nm of zinc oxide nanoparticles and 328 nm of leaf extract. Fourier transforms infrared spectroscopy (FTIR) show functional groups of ZnOnanoparticles and M. Champaka leaf extract. This technique of nano fusion is green and effective as the high quantity of nanomaterial obtained at low cost.

KEYWORDS: *Greensynthesis, Nanoparticles, Characterization, spectroscopy, Reducing agent, Bio reductant.*

INTRODUCTION

Today nanoscience is signal of the furthermost energetic grounds of investigation, that agreements through biological, physio-chemical and sciences of engineered production of nano material at nanoscale path. Nanoforms due to its small and finite size have attended special focus in variety of applications applicable to environment and mankind[1]. The size of nano varieties forms ranging in the 1 to 100 nanometers gaining significantly in chemical and physical variations in variety of properties as optical activity, conductivity of electric strength, thermal conduction, properties of satirical, properties in biology, optical absorptivity, properties of catalytic activity etc[2].

The objects of biology have come to a great interest by employment of its features in nanoparticles synthesis, as production of nanoparticles are from various biological matters. The large properties as photoelectrical, optical, electronic and chemical are due to the nanoforms which are synthesized biomimetically. Particles of nanosized is revealed by nature in the form of nanoparticles by utilization of green aspects as plant materials, bacterial resources and easily available entities from nature for the production of facile and green pathways of nanoparticles synthesis[6]. Nanoforms are synthesized by both biological and chemical pathways which involves distinct features as toxicity and environmental hazardous[7].Biological processes are innovation of biogenic and green synthesis of nanoparticles with the help of natural motilities and composition of metal salts, as the process involves use of low-cost procedures and equipment's[3].

Green synthesis of plant mediated fusion of nanoparticles with the combination of metal salts leading a great extent for the large-scale, low-cost method, easily available, cheap methodology makes this process reliable to green synthesis of nanoparticles. Plant material employed in the synthesis acts as a good reducing agent, capping agent and stabilization agent and having numerous applications in the fields of chemistry and medicine which a large breakthrough in current era[4].

Green and biologically facilized nano streams are largely employed in catalysis for efficient environment of reaction conditions. Nanoparticles synthesized by biogenic green synthesis have made a wide grip on numerous fields as photocatalytic degradation, waste water treatment, effluent treatment, environmental rehabilitation, sedimentation sewage treatment, pathological activities as bacterial and fungal inhibition, cytotoxicity assay, in treatment of severe diagnosed diseases, skin infections, cell reparation and fibrillation, agricultural purposes as useful pesticides, antioxidation activity[5].

Source of nanoparticles synthesis activated in this research is the medicinal plant i.e., *Michelia Champaka*, a big shrub as all plant parts is used as medicinal entities with very potential applications. The presence of numerous phytoconstituents in *Michelachampaka* plant increases its properties towards many activities and hence forth valuable various phytoconstituents as essential oils, aldehydes, phenols, terpenes, liriodenine, alkaloids, saponins, sterols, triterpenoids, aromatic volatile oil, carbohydrates, tannins, flavonoids, terpenoids, anthraquinone, polyphenol, glycosides, sesquiterpenes, parthenolide, guaianolides, volatile oil compounds like benzyl acetate, linalool, isoeugenol are present. So, this source is embedded in synthesis of biogenic implementation of nanoforms.

EXPERIMENTAL

Green nanoparticles synthesis of metallic fusion was carried in research laboratory of Department of chemistry and Department of biotechnology, Padmashri Dr. VitthalraoVikhePatil College of Arts, Science and Commerce, Pravaranagar, Maharashtra [India]. The high analytical grade chemicals as Sigma- Aldrich and Merck were purchased. Double distilled water was utilized throughout the experiment.

Collection of Plant Material

Michelia Champaka plant leaves was collected from botanical garden of Padmashri Dr. VitthalraoVikhePatil College of Arts, Science and Commerce, Pravaranagar, Maharashtra [India]. The collected leaves were subjected to flowing water for removal of impurities as dust and mud, which is repeatedly washed two three times with flowing water and then washed leaves is subjected to sun drying as it takes very less hours for drying and then converted into powder form with the help of grinder and meshed for the collection of fine powder, which is stored in container for further utilization.

Sample and Extract Preparation

Michelia Champaka leaves abstract was prepared in double distilled water by applying 100 gm of dried leaf powder in 500 ml of distilled water in a glass beaker and heated in heating mental at 80^0c for the duration of about 90 min. Change in Colour is observed from colorless to pale brown, abstract is filtered and stored in container bottle at 4^0c.Sample solution of zinc nitrate was conducted in aqueous medium as exactly 0.03397gm of zinc salt was weighted and transferred to glass beaker containing 200 ml of distilled water and stirred till dissolution of zinc salt is completed. Further zinc salt solution is diluted up to the 1Liter for 1mM concentration is obtained.

Synthesis of Nanoparticle

Michelia Champaka leaves abstract broth and zinc nitrate solution of 1mM attempted in a ratio of 1:1, as 20 ml of leaf broth abstract introduced in beaker and simultaneously drop by drop addition of 1mM zinc nitrate solution by a burette, Colour of leaf extract changes from pale brown to light white and as the addition increases with time, Colour of plant extract changes to milky in Colour, as the whole reaction is carried out on magnetic stirrer with continuous stirring. As obtained white milky suspension is heated at 80^0c for duration of 60 min with continuous stirring, forming into a viscous pale white Colour suspension. This obtained suspension is subjected to oven for drying at 90^0c for 3hrs and then concentrated in furnace for about 4 hours at 400^0c, obtained product is the pale white powder which is further stored and subjected in further characterization.

RESULT AND DISCUSSION

Synthesis of Biogenic Nanoparticles

Utilization of plants as bio-reductant in the biological synthesis of nanoparticles have a greater advantage over the several chemical processes and desired biological process of cell culture has been superficial for the scale up production of Nanoparticles on a large-scale fusion[6]. The involvement of *Michelia Champaka*aqueous leaf extract in the nucleation of Nanoparticles in the solutions is used as a reactant in the whole pursuit. Colour change of in the mixture of reactions is the primary basis of formation of zinc oxide Nanoparticles as Colour change occurs from pale brown to pale white Colour and the resultant pale white Colour indicates formation of zinc oxide Nanoparticles, hence as this change in Colour occurs due to surface plasma resonance (SPR) phenomenon. Resulting investigation claims that the medicinal plants have the potential in the synthesis of metallic Nanoparticles[7,8].

Effect of Temperature

The effect plays a very crucial role in the synthesis of zinc oxide Nanoparticles and hence it is important to study the conversion rate of Nanoparticles visually. At 40⁰c the Zn^{2+} ions reduction is not fully completed, which is due to the insufficient reaction condition, hence to increase the rate of conversion of Zn^{2+}ions, there should be a significant increase in the temperature which can be increased from 40⁰c to 80⁰c, this high temperature causes the rate of synthesis of zinc oxide Nanoparticles. In this process the nucleation rate of Nanoparticles in the suspension is maximum than that of rate of growth as the increase in temperature is also maximum, as the growth rate is lower because the nucleation rate by temperature is greater[9,10].

UV-Vis Spectrometry

UV-Vis absorption spectra of the *Michelia Champaka* leaf extract and zinc oxide Nanoparticles were absorbed in the range of ëmax of 325 nm[11]. The ëmax of pure zinc nitrate solution is in range of 315- 375 nm and hence absorption is usually detected in the range of 320- 370 nm for zinc oxide nanoparticles shown in Figure 1A. Absorption of *Michelia Champaka* aqueous leaf extract observed at 328 nm shown in Figure 1B.

FOURIER TRANSFORM INFRARED SPECTROPHOTOMETRY

Zinc Oxide Nanoparticles

The frequencies at 3920.87 and 3762.63 cm^{-1} shows the presence of -OH group of phenols of plant constituents, 3549 cm^{-1} indicates the -OH of phenols, 3473.00 cm^{-1} is due to the presence of hydroxyl group of alcohol and phenols. 3415 cm^{-1} determines the presence of bounded N-H stretching of amine and amides, 3239.59 cm^{-1} is frequency due to presence of -OH group of water, 2923.78 cm^{-1} stretching shows -OH group of plant phenolics and 2290.10 cm^{-1} gives -CN stretch. 2036.73 stretching determines the presence of silicon compounds due to plant constituents, 1766.35 cm^{-1} and 1636.00 cm^{-1} indicates the presence of -C=O stretching of esters and -C=C- of alkenes, 1616.78 cm^{-1} peak indicates presence of diketones, 1385.21 and 1250.41 cm^{-1} peaks are due to aromatic amines -C-N- and -C=O of carboxylic acid, 1110.10 cm $^{-1}$ peak show stretching of secondary alcohol -C-OH. Peak at 870 cm^{-1} determines phosphate group in plant constituents, peak at 587.00 and 534.00 cm^{-1} determines the -CH stretching frequency, 485.47 cm^{-1}sharp peak shows the Zn-O stretching[12]. FTIR stretching's illustrated in Figure 2A.

Michelia Champaka Plant Extract

Sharp peak at 3496.94 cm^{-1} shows a strong -OH stitching of phenols or water which relates to the zinc oxide Nanoparticles spectrum at 3473.00 cm^{-1}. Peak at 1788.01 cm^{-1} is due to -C=O ester stretching, 1614.42 and 1508.33 cm^{-1} peaks are due to -C=O of amide and -C=C- of alkenes, 1361.74 and 1315.45 cm^{-1} frequencies are of $-CH_3$, 1070.49 and 1047.35 cm^{-1} peak is of -C-O bond stretching, 690.52 cm^{-1}peak determines presence of chlorides. FTIR stretching's illustrated in Figure 2B.

Energy Dispersive X-ray Spectroscopic Analysis

Determination of composition of elements, the chemical purity and the stoichiometry of the processed zinc oxide Nanoparticles determined by EDAX. Zinc oxide Nanoparticles shoes a strong sharp peak which is determined by EDS along with several different peaks' signals of plant constituents' residues and plant chemicals present in the form of bioactive molecules in the *M. Champaka* leaf extracts. EDAX is analyzed in Figure 3.

Figure 1B: λmax. ZnO Nanoparticles

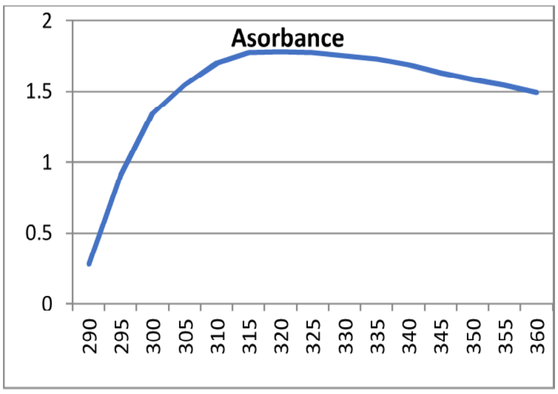


Figure 1B: λmax *M. Champaka* Leaf Extract

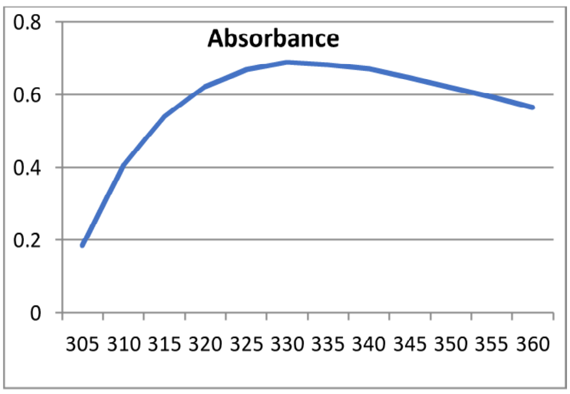


Figure 2B: ZnO Nanoparticles

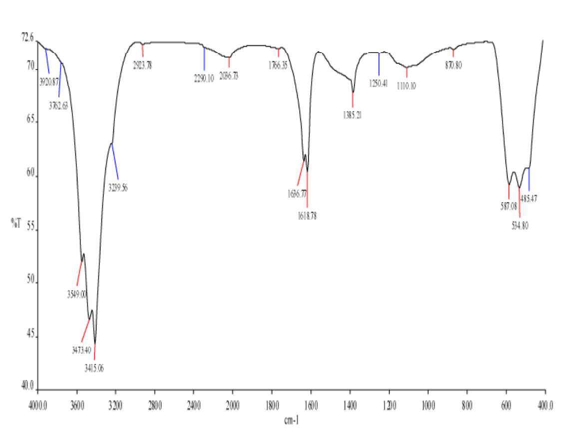


Figure 2B: *M. Champaka* Leaf Extract

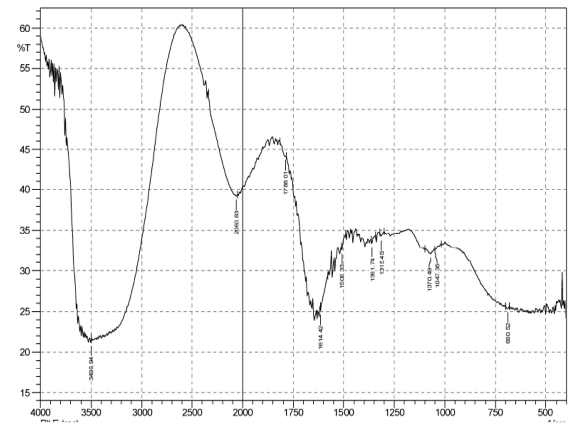
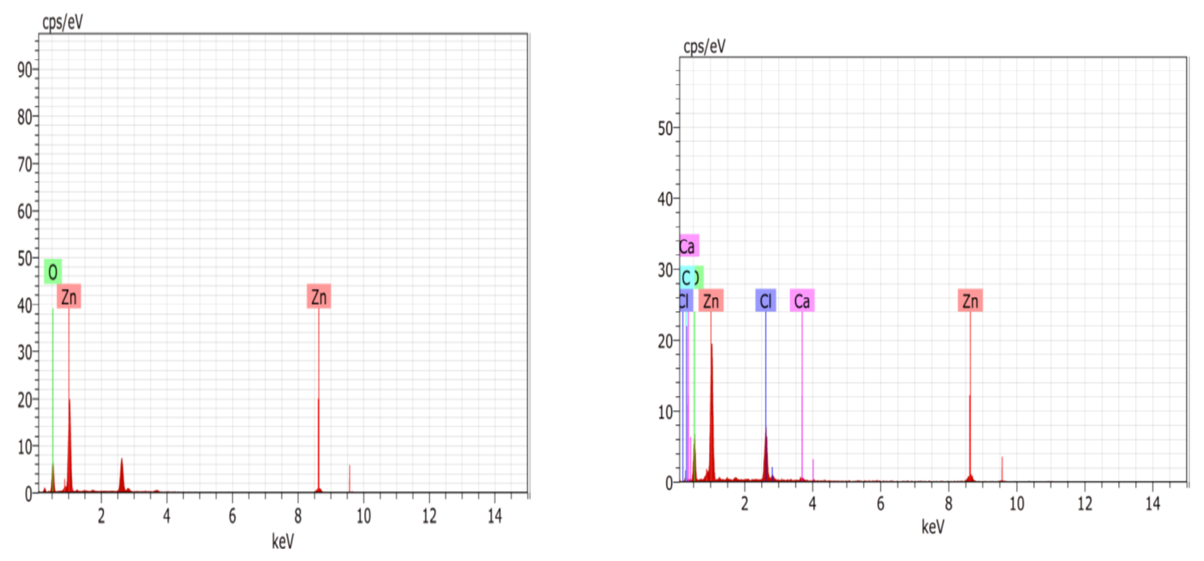


Figure 3: EDAX of Zinc Oxide Nanoparticles



Spectra of EDX are shown in image, presence of constituents of elements present i.e., Zn (16.48%), O (46.10%), C (26.44%)[13]. in the zinc oxide nanoparticles. Presence of zinc oxide in the synthesized sample is constituted and confirmed by EDX spectra of image indicates the clear representation of the perfect formation of the zinc oxide nanoparticles with the fusion of the leaf extract of *Michelia Champaka*.

Scanning Electron Microscopy

Surface morphology and size determination of zinc oxide Nanoparticles was attempted by the SEM shown in figure 4. Images of SEM of zinc oxide nanoparticles show white Colour spotted particles, which are mega- spherical in shape, having uniformity which range in the size of 40 nm in diameter[14,15]. The reduction has been performed by the plant extract and shows the formation of agglomerated aggregated particles as the zinc oxide Nanoparticles are stabilized by the plant extract as the capping agents.

HIGH RESOLUTION TRANSMISSION ELECTRON MICROSCOPY (HR-TEM)

Structural morphology and size of particle is revealed by HR-TEM. Particle size is confirmed of about 40-70 nm in diameter and show some irregular arrangement in the spherical shape[16,17]. HRTEM gives particles present with spindle shape, flower like apperence and confirms the presence of pores in synthesized zinc oxide nanoparticles is shown in figure 5.

Figure 4: SEM Images of Zinc Oxide Nanoparticles

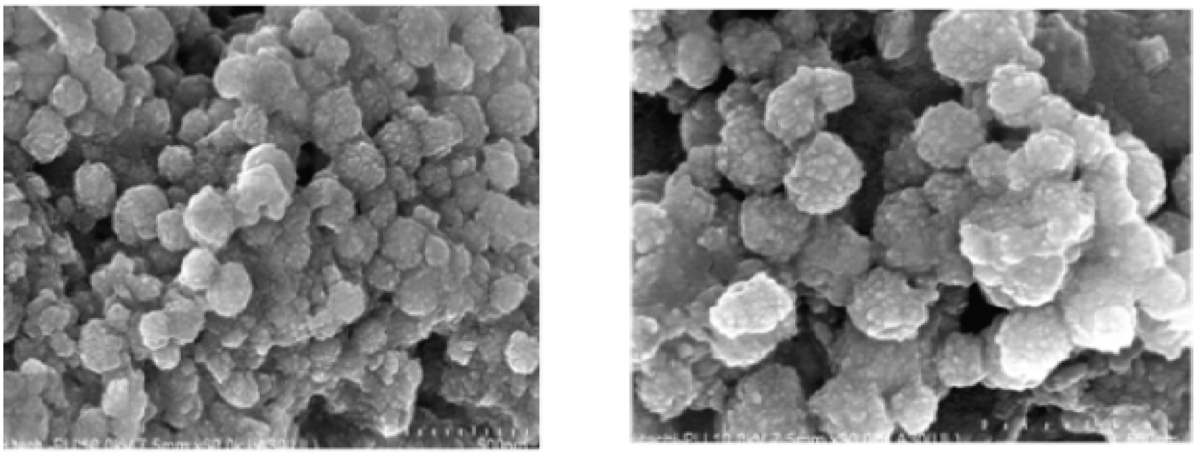
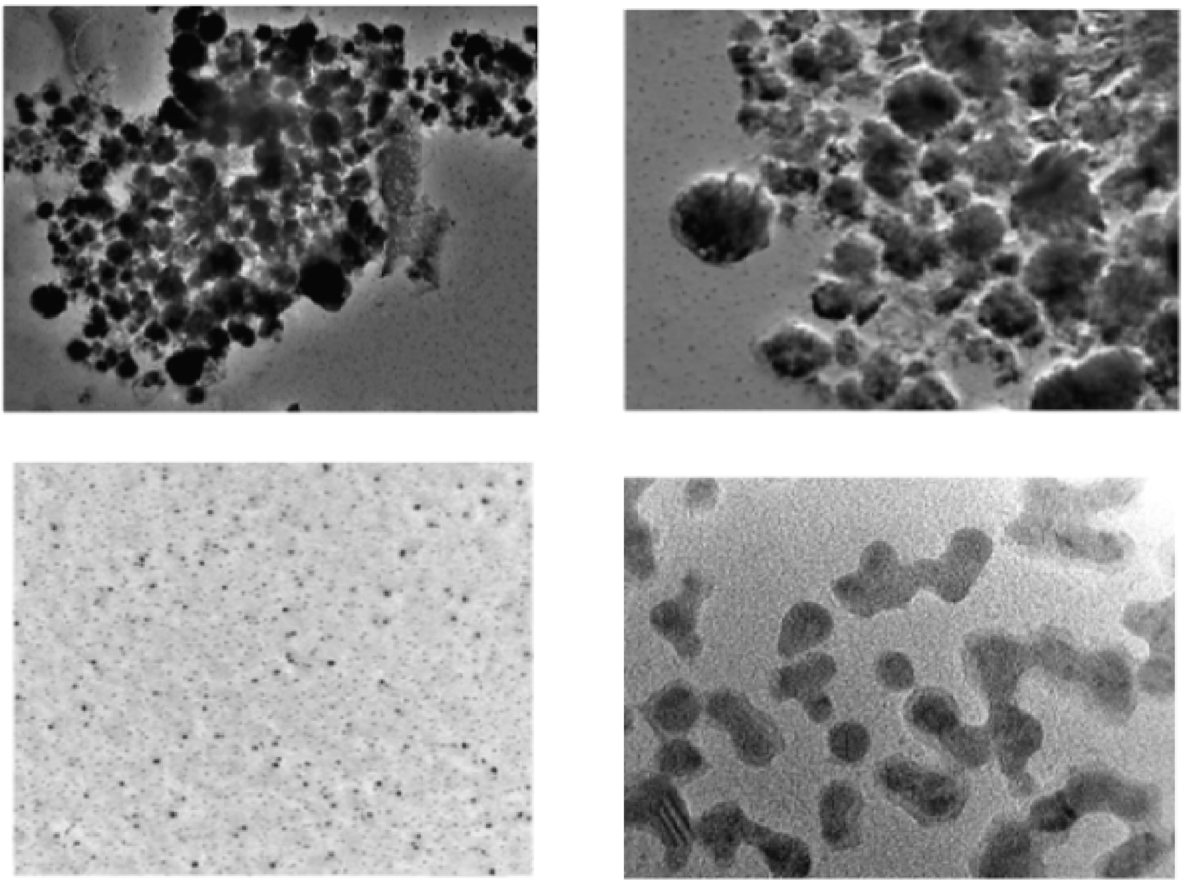


Figure 5: HR-Transmission Electron Microscopy



ACKNOWLEDGEMENT

The authors are very grateful to Department of Chemistry (Padmashri Dr. VitthalraoVikhePatil College of Arts, Science and Commerce, Pravaranagar, Maharashtra,India) for providing research facilities.

REFERENCES

1. Rehana, D., Mahendiran, D., Kumar, R.S., Raheman, A. K. *et al.*, *In vitro* Antioxidant and Antidiabetic Activities of Zinc Oxide Nanoparticles Synthesized Using Different Plant Extracts, *BioproBiocys*, 2017; 40(6): 943-957.

2. Abomuti, M.A., Danish, E.V., Fizoz, A., Hasan, N. *et al.*, Using Salvia Efficinalis Leaf Extract and Their Photocatalytic and Antifungal Activities, *Biology*, 2021;10,1075.

3. Hosny, M., Ettaweil, A.S., Mosttafa, M., El-Badry, Y.A., Hussain, E.E. *et al.*, Facile Synthesis of Gold Nanoparticles For Anticancer, Antioxidant Applications and Photocatalytic Degradation of Toxic Organic Pollutants, *ACS Omega*, 2022; 7, 3121-3133.

4. Chauhan, A., Verma, R., Kumari, S., Sharma, A., Shandilya, P., *et al.*, *Photocatalytic Dye Degradation and Antimicrobial Activities*, 2020; 10: 788.

5. Mansour, S.S.M., W.I.M.El-Azab, Ali, H.R. *et al.*, Green Synthesis and Characterization of Znonano Particles For Photocatalytic Degradation of Anthracene, *Nanosci and Nanotech*, 2015; 6: 045012,11.

6. Xie, Y., He, Y., *et al.*, Antibacterial Activity and Mechanism of Action of Zinc Oxide Nanoparticles Against Campylobacter Jejuni, *App and Envi Microbiology*, 2011; 77: 7, 2325-2331.

7. Ginjupalli, K., Alla, R., Shaw, T., *et al.*, Comparative Evaluation Efficacy of Zinc Oxide and Copper Oxide Nanoparticles As Antimicrobial Additives In Alginate Impression, *M Today: Proceedings*, 2018; 16258- 16266.

8. Bala, N., Saha, S. *et al.*, Green Synthesis of Zinc Oxide Nanoparticles Using Hibiscus Subdariffa Leaf Extract: Effect of Temperature on Synthesis, *Antibacterial Activity and Anti-diabetic Activity, RCS adv*, 2015; 5: 4993.

9. Azizi, S., *et al.*, Green Biosynthesis and Characterization of Zinc Oxide Nanoparticles Using Brown Marine Macroalgasargassummuticum Aqueous Extract, *Mat Let*, 2014; 116, 275-277.

10. Agarwal, H., *et al.*, Mechanistic Study on Antibacterial Action Zinc Oxide Nanoparticles Synthesized Using Green Route, *Chem-bio I Actions*, 2018; 286, 60-70.

11. Alias, S.S., *et al.*, Effect of pH on ZnO Nanoparticle Properties Synthesized by Sol-gel Centrifugation, *Jou. of Alloy and Comp*, 2010; 499, 231-237.

12. Gandhi, P. R., *et al*, Accricidal, Pediculicidal and Larvicidal Activity of Synthesized Zno Nanoparticles Using Momordicacharantia Leaf Extract Against Blood Feeding Parasites, *Expparasit*, 2016; 1-32.

13. Hajinasari, R., *et al.*, Biosynthesis of Zno Nanoparticles Using Corn Silk of Zea Mays L. Extract, *Chem Letters*, 2016; 45, 1238-1240.

14. Karnar, T., *et al.*, Biosynthesis of ZnO Nanoparticles Using Rambutan (Nephuliumlappacellm. L) Peel Extract and Their Photolytic Activity of Methyl Orange, *Jou of Mol Sci.*, 2016; 8, 223-240.

15. Khan, M., Husain, A., *et al.*, Comparative Study of the Cytotoxic and Genotoxic Potentials of Zinc Oxide and Titanium Dioxide Nanoparticles, *Toxi Reports*, 2015.

16. Lingaraju, K., Naika, H.R., *et al.*, Biogenic Synthesis of Zinc Oxide Nanoparticles Using Rutagravealens L. and Their Antibacterial and Antioxidant Activities, *App Nano*, 2015.

17. Mohammadi, F.M., Ghasemi, N., et al, Influence of Temperature and Concentration on Biosynthesis and Characterization of Zinc Oxide Nanoparticles Using Cheery Extract, *Jou of Nanos In Chem*, 2018; 8, 93-103.