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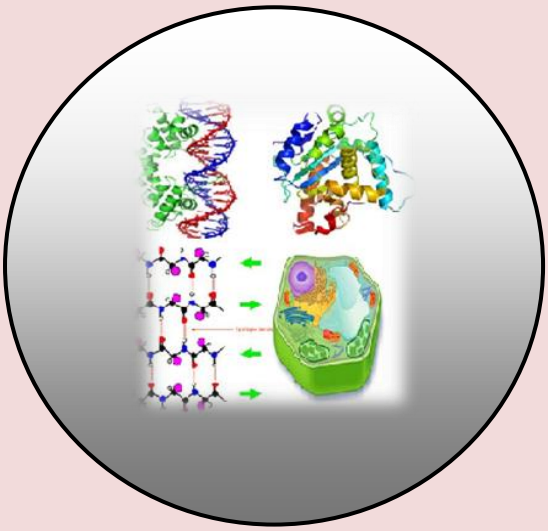

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RESEARCH PAPER

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Synthesis, Optical and Spectral Characterization of ZnO Nanoparticles by using *Moringa Oleifera, Murraya koenigii and Azadirachta indica* leaf Extract

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ABSTRACT

Green synthesis: The most preferred scheme of preparation as it makes utilize of pollution free chemicals and encourages the utilize of non-toxic solvent as water and plants extracts. The current research zinc oxide nanoparticles by eco-friendly green synthesis, environmentally benign leaf extracts of Moringa Oleifera, Murraya koenigii and Azadirachta indica and $Zn(NO_3)_26H_2O$ as precursor ZnO nanoparticles were characterised by XRD, TEM, FE-SEM and EDS. The optical properties were also agreed by ZnO nanoparticles.

Keywords: Leaf extracts; ZnO; XRD; TEM; SEM; EDS and Optical properties.

INTRODUCTION

ZnO NPs are active as very good remover for sulphur and arsenic present in water. Nanoparticles are extracted from the *Moringa oleifea* leaf and characterized [Elumalai et al., 2015]. On the origin of mass and geometrical form of ZnO NPs the band gap energy and emission strength in noticeable region were found as 3.51 eV and 402 nm [Elumalai and Velmurugan, 2015, Anbuvannan et al., 2015, Ramesh et al., 2015, Suresh et al., 2015, Santhoshkumar et al., 2014]. The absorption peak obtained at 326 nm in UV-Visible spectrum.

Sagar *et al*. (2015) conformed ZnO nanoparticle has physical properties, antibacterial possess high piezo electric and binding energy. ZnO NPs broadly used in pharmaceutical, rubber, textile and in paint industries [Sagar Raut and Thorat, 2015]. In synthesized ZnO nanoparticle, utilized plants used as dropping agent. The XRD outcome shows the ordinary particle size is 13.86 nm [Sagar Raut and Thakre, 2015]. Polyphenols (11%) and Flavonoids (12%) are used as dropping agent in synthesized ZnO NPs from cazziafstula plant extract and leaf extract [Suresh et al., 2015, Ramesh et al., 2014].

Even at space temperature ZnO NPs show higher luminescences. In literature to prepare ZnO NP, lot of method is available and application also more the methods are CVD, molecular beam epitaxy, sputtering and oxidation of metallic zinc from its ore. Nano particulate has great catalytic action because of large surface area; the no. of vacancies presence, extra presence of atoms in corners and edge.

ZnO prepared at area temperature has catalytic uses in water action and other ecological application. Plant crudes enriched with phenolic acid, flavonoids, alkaloids and terpenoids were greatly responsible for decreasing ionic into bulk metallic nano particles formation. Nanoparticles which are synthesized from green method exhibit very excellent antioxidant and antimicrobial activity.

EXPERIMENTAL

Preparation of leaf extract from *Moringa Oleifera, Murraya koenigii and Azadirachta indica*

$Zn(NO_3)_2$. $6H_2O$ in distilled water and leaf extracts from *Moringa Oleifera*, *Murraya koenigii* and *Azadirachta indica* are used in the ZnO NPs. *Moringa Oleifera*, *Murraya koenigii* and *Azadirachta indica* leaf was collected from the campus of Thanthai Hans Roever College (Autonomous), Perambalur, Tamil Nadu, India. The leaves were recognized and authenticated by the Thanthai Hans Roever Agriculture College, Perambalur, Tamil Nadu, India. The collected *Azadirachta indica*, *Moringa Oleifera* and *Murraya koenigii* leaf samples (figure 1) washed with doubly distilled water to eliminate impurities.

Figure 1. The photograph shows the *Moringa Oleifera* (Drumstick), *Azadirachta indica* (Neem) and *Murraya koenigii* (Curry leaf).

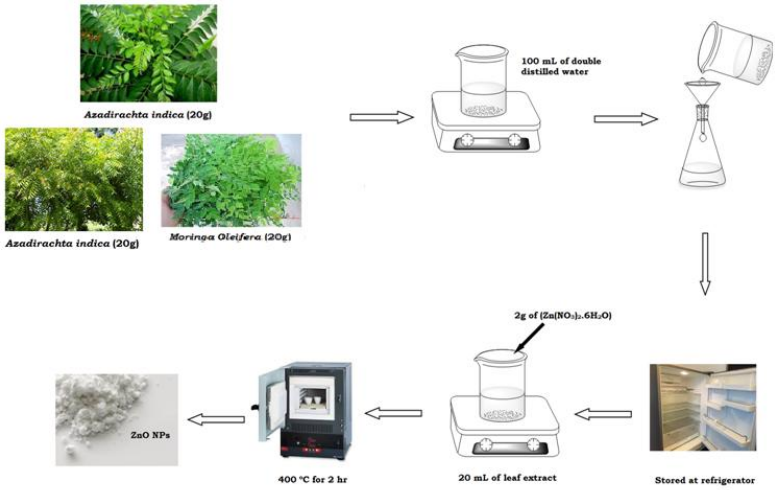


Figure 2. Synthetic route of ZnO nanoparticles.

ZnO NPs Synthesised by using *Moringa Oleifera*, *Murraya koenigii* and *Azadirachta indica* Leaf Extracts

Collected leaves washed carefully and stirred with doubly distilled water and allowed to dry. 20g of leaves were boiled in 100 ml of water 45 minutes at 80 ^{o}C. A yellow coloured solution formation indicates the completion of extraction and allows it cool. Then it is filtered in Whatmann 40 filter paper and stored in refridgerator. Further, 20 mL of leaf extracts was taken separately from the stock solution and boiled at 60–80 ^{o}C. When the temperature reached at 60 ^{o}C in solution, 2g of ($Zn(NO_3)_2.6H_2O$) was added. The mixture was boiled awaiting the development of yellowish brown colored glue. The paste was heated in muffle furnace which was maintained at 400 ^{o}C for 2 hrs by using silica crucible. The obtained ZnO NPs powder was used for structural and optical studies. The synthetic route of ZnO NPs is shown in Figure 2.

Characterization techniques

The synthesized nanoparticles were analyzed by TEM, XRD, EDS, UV-Vis and PL, respectively.

RESULTS AND DISCUSSION

XRD characterisation of ZnO NPs

XRD pattern of ZnO NPs are shown in Figure 3. All diffraction peaks attributed to crystalline of ZnO with the hexagonal primitive structure (space group: P63mc (186); a=3.249 nm, c=5.206 nm). The obtained data are in excellent accord with the JCPDS card for ZnO, 89-7102. The peak recorded at 2θ values are 31.72, 36.12, 47.37, 34.32, 56.47, 65.73, 67.67, 68.87, 62.62, 73.57 and 76.32 is corresponding to known plane of 100, 002, 110, 103, 112, 101, 102, 201 and 202 reflections respectively. The usual crystallite sizes (L) of ZnO NPs as 20, 19 and 19.53 nm. The most intense peaks of the individual crystals (using the Scherrer equation, $L = 0.9\lambda/\beta\cos\theta$, where λ is the wavelength of the X-rays used, θ is the diffraction approach and β is the FWHM of the peak,) the calculated surface area obtained for ZnO (*Moringa Oleifera*, *Murraya koenigii and Azadirachta indica*) are 28.73, 25.66 and 26.47 m^2/g.

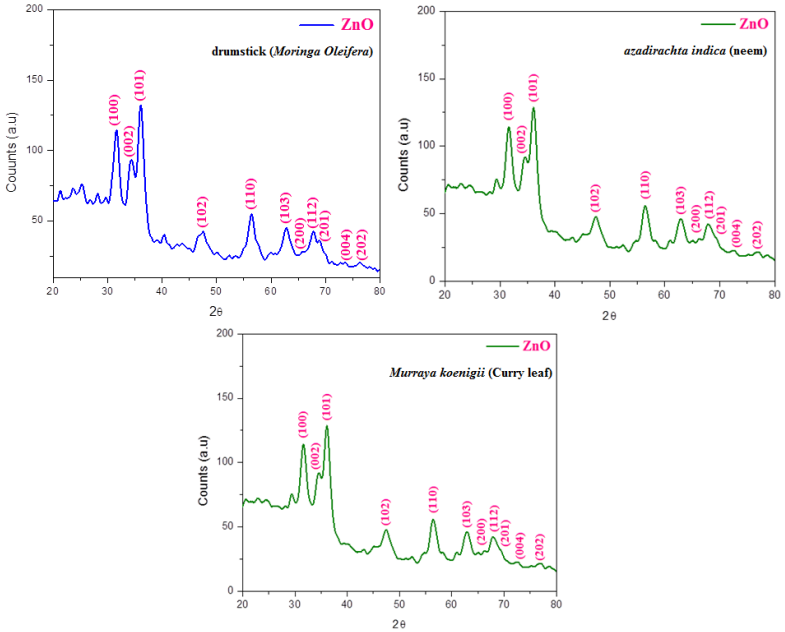


Figure 3. X-ray diffraction spectrum of ZnO NPs.

TEM - Transmission electron microscopy analysis

Figure 4 and 5 shows TEM images and dimension of the particles of synthesized ZnO NPs. The representation reveals sphere-shaped of ZnO NPs which are in accord with XRD. The agglomeration of ZnO NPs results in having elevated surface energy and densification.

These two results were obtained because synthesis carried out in aqueous medium and fine breathing between space particles [Salam et al., 2014]. The regular particle size is observed as 20, 18 and 20 nm which is good accord with XRD values. The representation evidently shows the existence of secondary material capping which be assigned to bioorganic compounds present in the leaf extract that verify by the observing sharp Bragg's reflection in the XRD spectrum [Sangeetha et al., 2011].

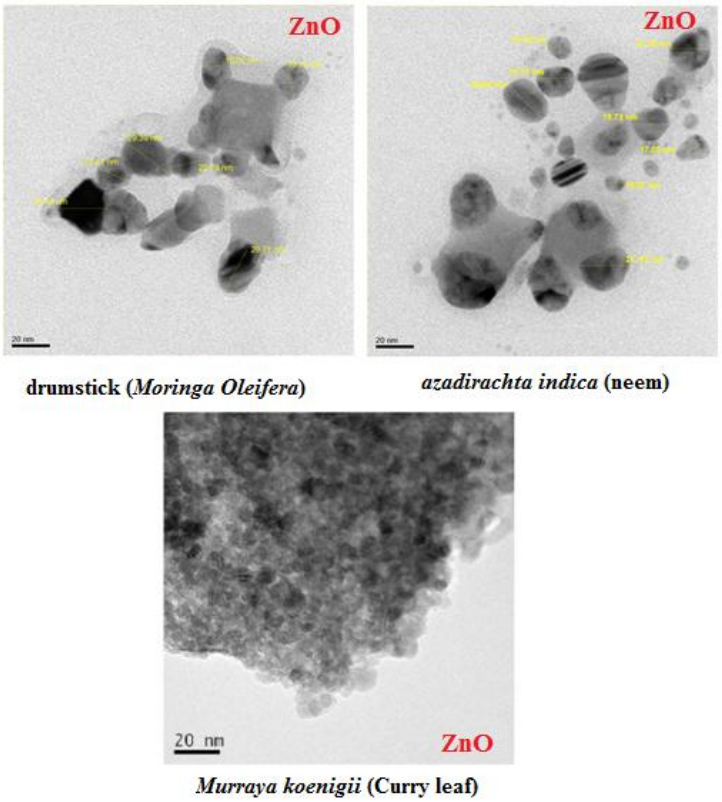


Figure 4. TEM image of synthesised ZnO NPs.

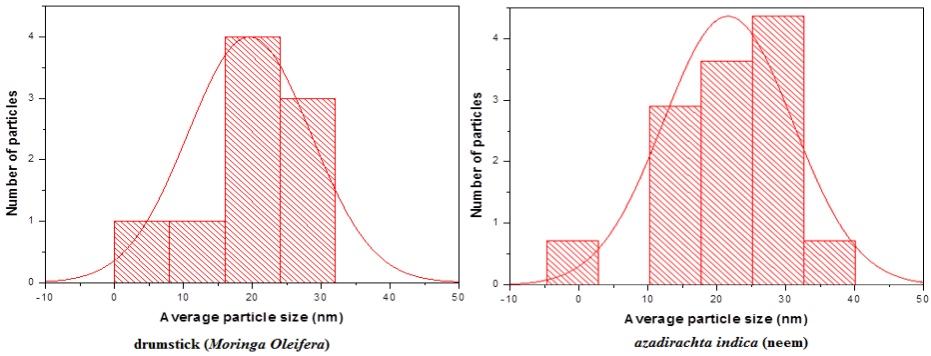
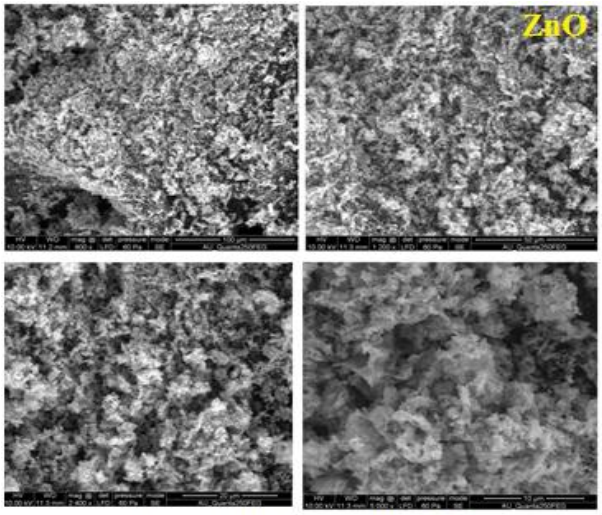


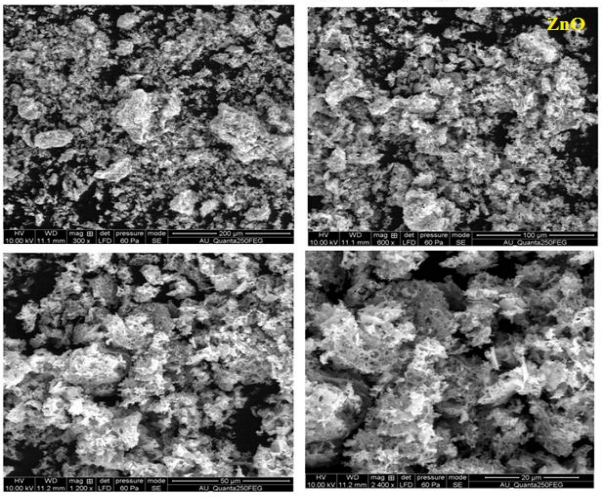
Figure 5. TEM image of ZnO particle size distribution.

FE-SEM with EDX analysis

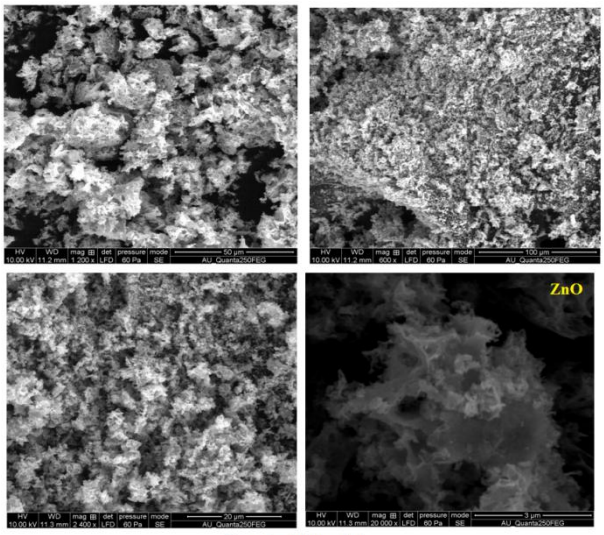
A FE-SEM image shows morphology, topography and size of synthesized particles [Azizi et al., 2014]. The FE-SEM images of *Moringa Oleifera*, *Murraya koenigii* and *Azadirachta indica* leaf extract ZnO NPs are in Figure 6. Size and construction of the ZnO NPs are in good agreement with XRD result with a little deviation. EDX spectrum (Figure 7) shows clarity and composition of ZnO NPs. A powerful signal is experimental from Zn element and slight signals are due to O, Mo, Br, Mg, Cl, K and Ca elements. The presence of weak signal shows the X-ray emission of macromolecules such as protein, enzymes, and carbohydrate present in cell wall.



drumstick (*Moringa Oleifera*)



azadirachta indica (neem)



Murraya koenigii (Curry leaf)

Figure 6. FE-SEM of ZnO nanoparticles at different magnifications.

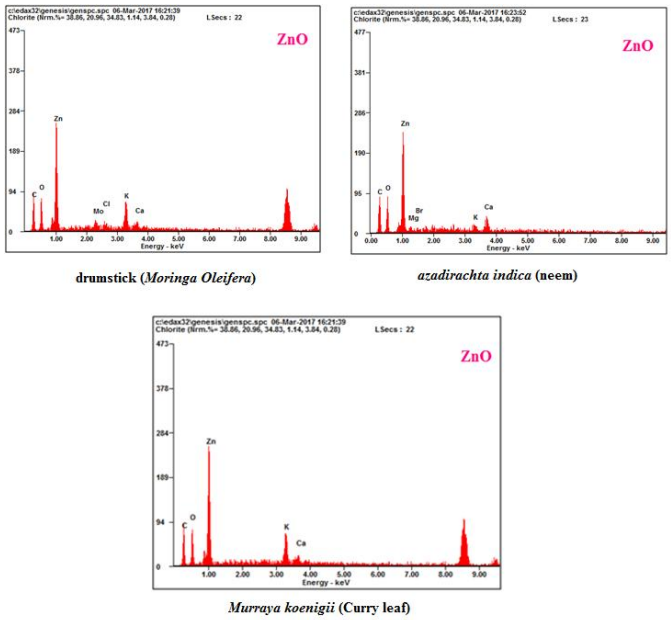


Figure 7. EDX spectrum of ZnO nanoparticles.

Optical properties of green synthesized ZnO NPs

ZnO nanoparticles absorption spectrum are present in Figure 8 and optical absorption edge, peaks observed at 240, 261, 300 and 375 nm wavelength confirms the existence of ZnO NPs and these results were reported by previous researchers [Rajiv et al., 2013, Jayaseelan et al., 2012]. The photoluminescence peak of ZnO NPs given in Figure 8. The defects related are observed at 311, 327, 337 and 403 nm. The fluorescence emission at 403 nm is experimental due to recombination of a photogenerated hole among independently ionized charged state. The source of the fluorescence emissions as the recombination of electrons, which are trapped at separately ionized oxygen vacancy centers, with holes that are created in the valence band [Watanabe and Fujihara, 2011].

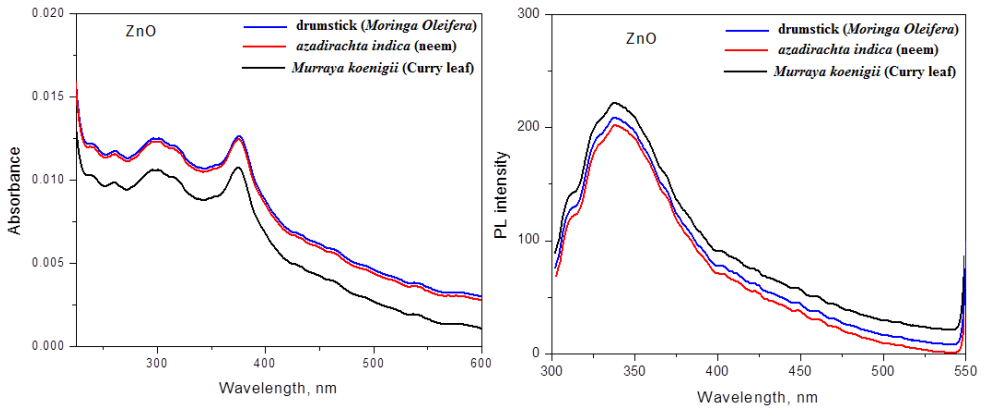


Figure 8. UV-Vis and Photoluminescence of ZnO nanoparticles.

CONCLUSION

XRD spectrum shows the hexagonal primitive crystalline phase of ZnO and peaks are good accord with standard JCPDS number 89-7102. TEM image of ZnO NPs reveals spherical shape which is in agreement with XRD. The FE-SEM shows sphere-shaped morphology with a self associated ZnO nanoparticles. EDX spectrum confirms the purity of the ZnO nanoparticles. Moreover current work on synthesized ZnO nanoparticles using the Eco-friendly method synthesis has an important advantage that it has lesser or almost zero contamination in the environment because they are derived from the natural plant leaf extract.

The optical properties of absorption are observed at 240, 261, 300 and 375 nm, emission spectrum are observed at 311, 327, 337 and 403 nm. There is green synthesised *Moringa Oleifera*, *Murraya koenigii* and *Azadirachta indica* leaf extract ZnO nanoparticles are exhibit the good optical properties.

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