Sub-Sahara African Academic
Research Publications
September, 2021, Editions

JPAS
Journal of Pure and Applied Science
Vol..21, No.9, ISSN 2318-9315

SYNTHESIS AND CHARACTERIZATION OF *EUPHORBIA MACULATA* ZINC NANOPARTICLE

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Abstract
Modern research dealing with synthesis, strategy and manipulation of particle's structure which result to changes in all properties i.e. chemical, physical and biological. This study investigated change in the optical properties and surface morphology of synthesized zinc nanoparticles of Euphorbia maculata and its crude extract. The plants extracts were prepared using hot percolation and Zn-NPs were synthesized by appropriate mixture of the extract with zinc sulphate solution in ratio of 1 to 2 following an established method. The optical properties of synthesized nanoparticles was obtained using UV/Vis spectrophotometer with peak absorbance at 380nm while the functional groups were determined using Fourier Transmission Infra-red Spectrophotometer (FTIR). The functional groups obtained were OH at 3295cm^{-1}; CH_2 at 2098cm^{-1} and C=O at 1636cm^{-1} while the average diameter of the surface morphology of the synthesized nanoparticle of E. maculata Zn-NP was 3.766 nm using Q250 Scanning Electron Microscope. Synthesized nanoparticle has wide application in electronics, medicines, material science which is aligning with sustainable development goal of Industry, Innovation and Infrastructure.

Keywords: *Nanoparticles; Zinc solution; Synthesis; Characterisation;*

Introduction
Metallic nanoparticles has been widely accepted in every aspect of science, engineering and medical fields, though scientists are still trying to explore new

dimensions for their respective value and this is generally attributed to their corresponding small sizes (Saiqa *et al.* 2015). According to Thuesombat *et al.*, (2014), the 'green' environment friendly processes in chemical synthesis are becoming more common as a result of world general problem associated with environmental concerns with modification in the area of the substrate used as demonstrated by Poinern *et al.*, (2015).

Zinc Nanoparticles are mostly synthesized through chemical methods but recent studies on green synthesis of Zinc nanoparticles has been achieved using living materials (microorganisms, enzymes and plant extract) (Akl *et al.,* 2014 and Das *et al.,* 2015). The study carried out by Vigneshwaran *et al.,* (2007) and Ravindra *et al.,* (2011) revealed that zinc nanoparticles possesses potential antimicrobial effects against infectious organisms such as *Escherichia coli, Bacillus subtilis, Vibrio cholerae, Pseudomonas aeruginosa, Syphilis typhus,* and *Staphylococcus aureus*. Medicinal plants are of great importance to the health of individuals and communities and the medicinal value of these plants lies in some chemical substances (phytochemicals) that produce a definite physiological action on the human body (Edeoga *et al*., 2005). This study will help to provide will help to provide information of active functional groups in the crude extract and synthesized Zn-nanoparticles in this plant *Euphorbia maculata*.

Nanotechnology has tremendous applications in diagnostic devices, drug delivery, tissue engineering, environmental chemistry, water filtration, producing ecofriendly energy production systems and quantum computers. Nano-sized metal particles have got much attention due to its unique optical, electrical and magnetic properties (Yong, 2013). Use of zinc oxide (ZnO) as a photocatalytic degradation material has been extensively studied by Goh, (2011) while preparation of ZnO nano-size has been carried out by different methods such as hydrothermal method, aerosol, micro-emulsion, ultrasonic, sol–gel method, evaporation of solution and suspensions, evaporative decomposition of solution (EDS), solid state reaction, conventional ceramic fabrication, wet chemical synthesis, spray pyrolysis method (Xu, 2004; Yong, 2013).

E. maculata is a summer annual plant that branches frequently at the base, forming a spreading mat against barren ground that is about 6-18 inches across, but usually less than 1 inches tall and its habitat include glades, dry sand prairies, cropland, gravelly areas along railroads and roadsides, lawns and gardens, cracks in sidewalks and pavement, borders along buildings, and sterile waste areas containing sand, gravel, or compacted soil. This plant prefers disturbed areas, and it is quite common in urban areas where there is a decaying infrastructure (Kay 2000).

Materials and Methodology

Collection of Plants Materials and Processing

Euphorbia maculata herb was collected from the botanical garden of Ogun State Institute of Technology Igbesa, Ogun State, identified by a botanist in the Department of Biological science.

Preparation of Plant Crude Extracts

Roy and Barik (2010) method was used with slight modification. The plants were washed, dried and pulverized while the plant broth preparation was obtained by boiling 10g of both dried powder in 100 mL of distilled water (hot percolation method) for 10min. The extract was cooled and filtered with Whatman filter paper no.1 while the filtrate was stored at 4^{o}C for further use.

Phytochemical Screening of *E. Maculata* and *W. Indica* Crude Extract

Phytochemical screening and identification of bioactive chemical constituents in the plant under study was carried out on the extract using the standard procedures as described by Sofowora (1993) and Elujoba *et al.,* (1989).

Zinc Nanoparticle Synthesis

Solution (250mL) of 0.004M (4mM) zinc sulphate heptahydrate $ZnSO_4.7H_2O$ (MW of 287.56g/mol) was prepared by dissolving 0.288g of $ZnSO_4.7H_2O$ salt in 250mL of distilled water; 5mL of the plant extracts were heated at 50^{o}C for 10 min while 10mL of 4mM of the Zinc solution was added to the plant extract in sample bottles labeled A according to Das *et al.,* (2015) but with slight modification. Visible colour change from dark brown to light brown marks the synthesis of zinc nanoparticle (Devasenan *et al.,* 2016). The samples were spun for 3 minute on vortex shaker at continuous high speed.

Instrumental Characterization of Plants Crude Extracts and Synthesized Zn-NPs

Zinc nanoparticles synthesized was monitored; its optical properties and surface area (nanoparticle) size determined respectively through the use of Jenway 6405 UV–Vis spectrophotometer (200-800nm) as described by Akl *et al.*, (2014); Devasenan *et al.*, (2016), Cary 630 Agilent Technologies FTIR. Cary 630 was used to characterize *E. maculata* as well as its Zn-NPs in order to determine the functional groups associated with the extract and Zn-NPs respectively. The bands and frequency were interpreted using IRPal 2.0 software and Infra-red spectroscopy interpretation manual (functional groups of the crude extracts and their Zn-NP respectively) while Q250 Scanning Electron Microscope (SEM) Eindhoven Netherlands was used to characterize their (crude extracts and synthesized Zn-NPs) morphological structure. ImageJ software was used to analyze the size (surface morphology) of synthesized Zn-NPs.

Result

Zinc Nanoparticles Synthesis

E. maculata crude extract colour was observed to change from dark brown to light brown indicating synthesis of Zn-NPs of plant crude extract as shown in plate 1.

Instrumental Characterization of Plants Crude Extracts and Synthesized Zn-NPs

The optical properties of *E. maculata* crude extract peak absorbance at 0.279 at 385nm, 0.321 at 480nm and 0.326 at 505nm (figure 1) while Zn-NP of *E. maculata* showed peak absorbance value of 0.806 at 380nm after 3hrs and 0.829 at 380nm after 24hrs respectively (figures 1 and 2).

The drift in both absorbance peak and wavelength (0.326 at 505nm to 0.806 – 0.829 at 380nm) indicated the synthesis of Zn-NP from *E. maculata* crude extracts (figures 1 to 2).

E. maculata (E1) extract possess a strong band at 3265cm^{-1} (42.6% transmittance) an indication of N-H stretch of primary amine or hydrogen bonded O-H stretch of alcohol; 1636cm^{-1} (64.414% transmittance) represent an N-H bend of primary amine or an indication of C=C stretch of alkenes or strong band of C=O stretch of amides. *E. maculata* Zn-NP possess a strong broadband at 3295cm^{-1} (75.6% transmittance) an indication of dimer OH of carboxylic acids or N-H stretch of primary amine or O-H stretch of hydrogen bonded alcohol while 1636cm^{-1} (88.309 % transmittance) represent an N-H bend of primary amine or an indication of C=C stretch of alkenes or strong band of C=O stretch of amides as presented in figures 3 and 4.

The crude extract and its nanoparticle had similar compounds but differ in their percentage composition (transmittance) which could be attributed to the presence of the Zinc nanoparticles (figures 3 and 4).

Plate 1: Synthesized Zn-NP of *E. maculata*

Phytochemical Screening

Table 1: Qualitative Phytochemical Screening of *E. maculata*

Parameters	*E. maculata* Herb extract
Tannin	+
Saponin	+
Glycosides	+
Alkaloids	+

Key: + = Phytochemical present

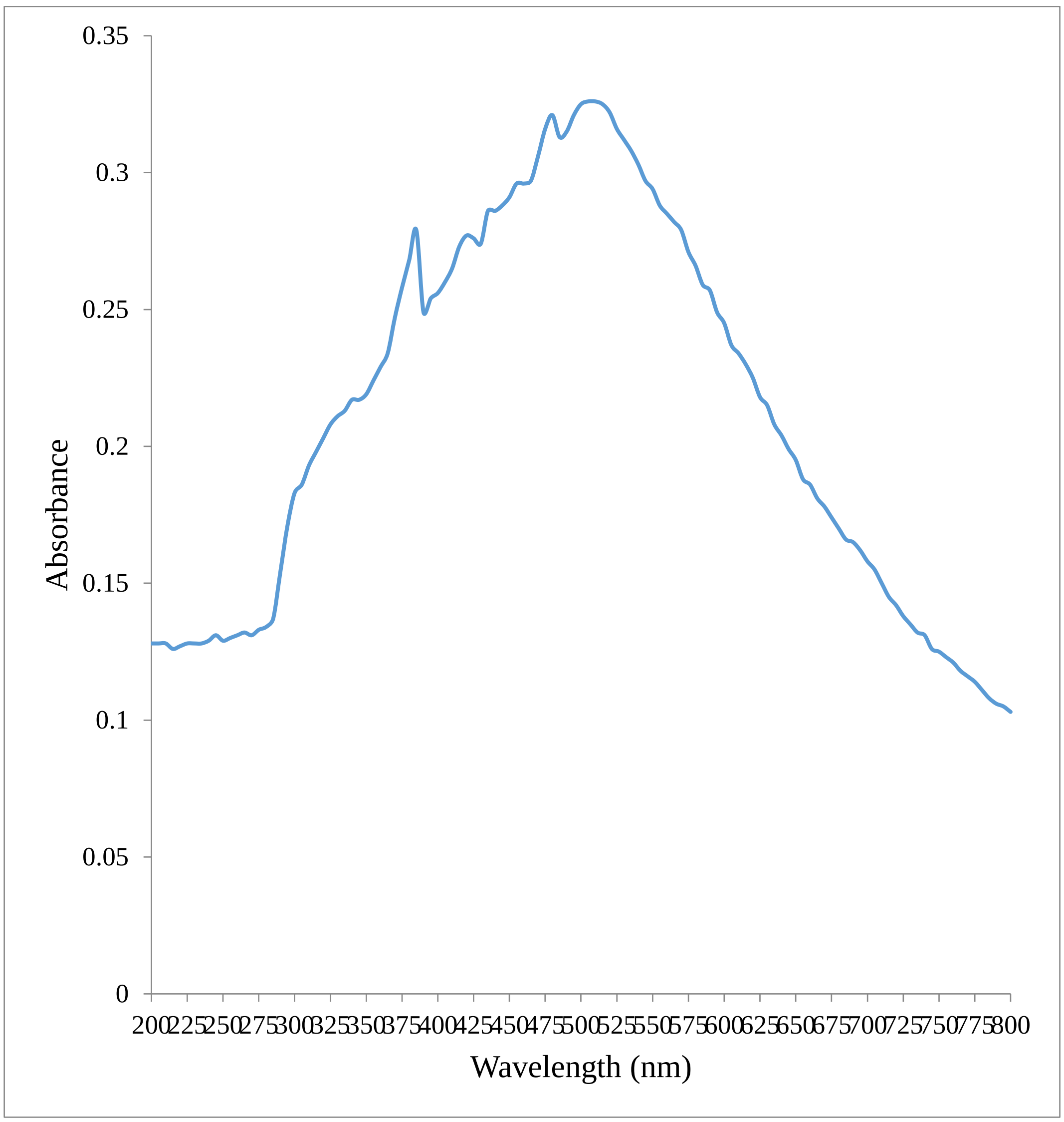

Figure 1: UV/Vis Spectrum of *E. indica* crude extract

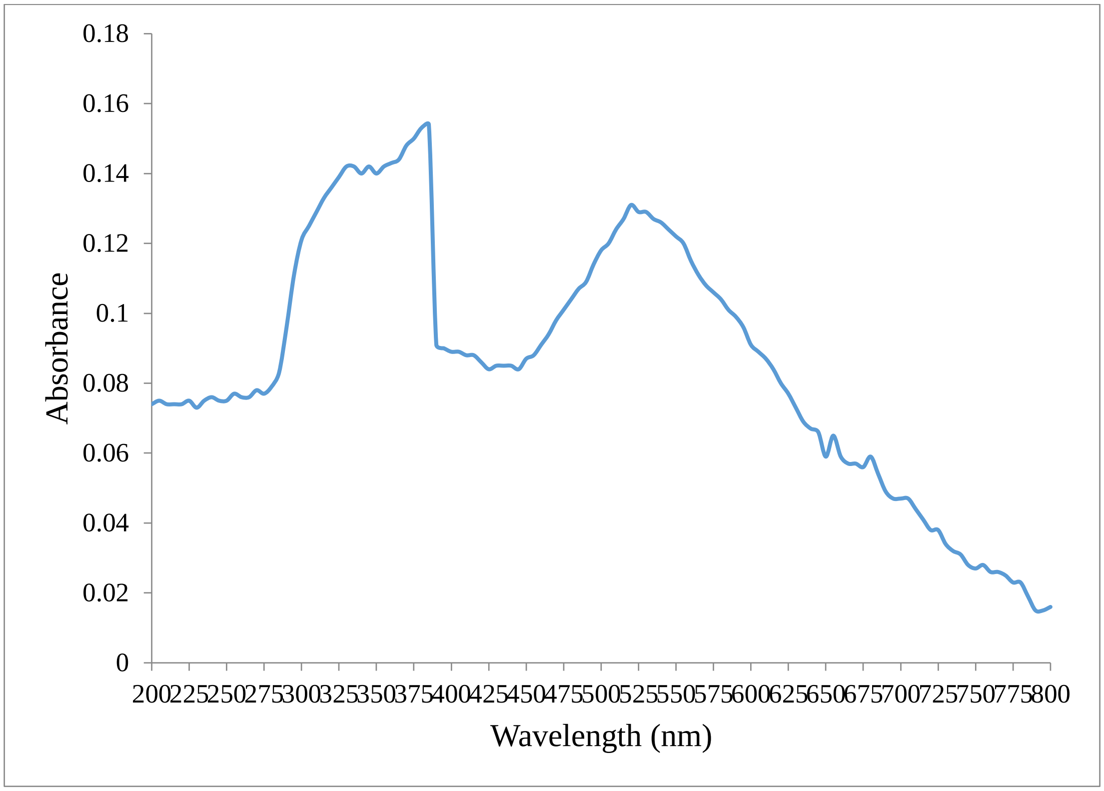

Figure 2: UV/Vis Spectra of *E. maculata* Zn-NP

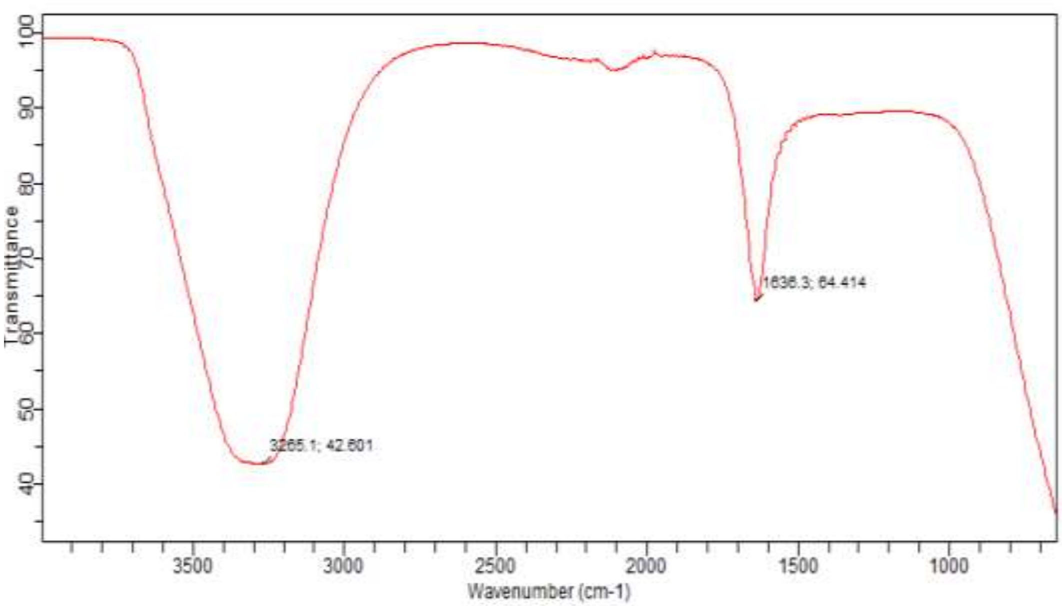

Figure 3: FTIR analysis of *E. maculata* crude extract

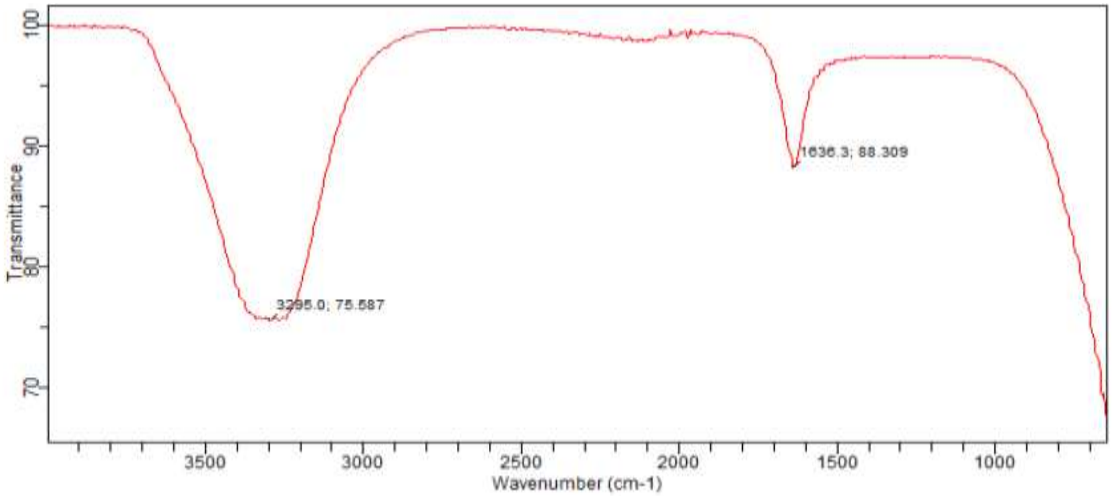

Figure 4: FTIR analyses of *E maculata* Zn-NP

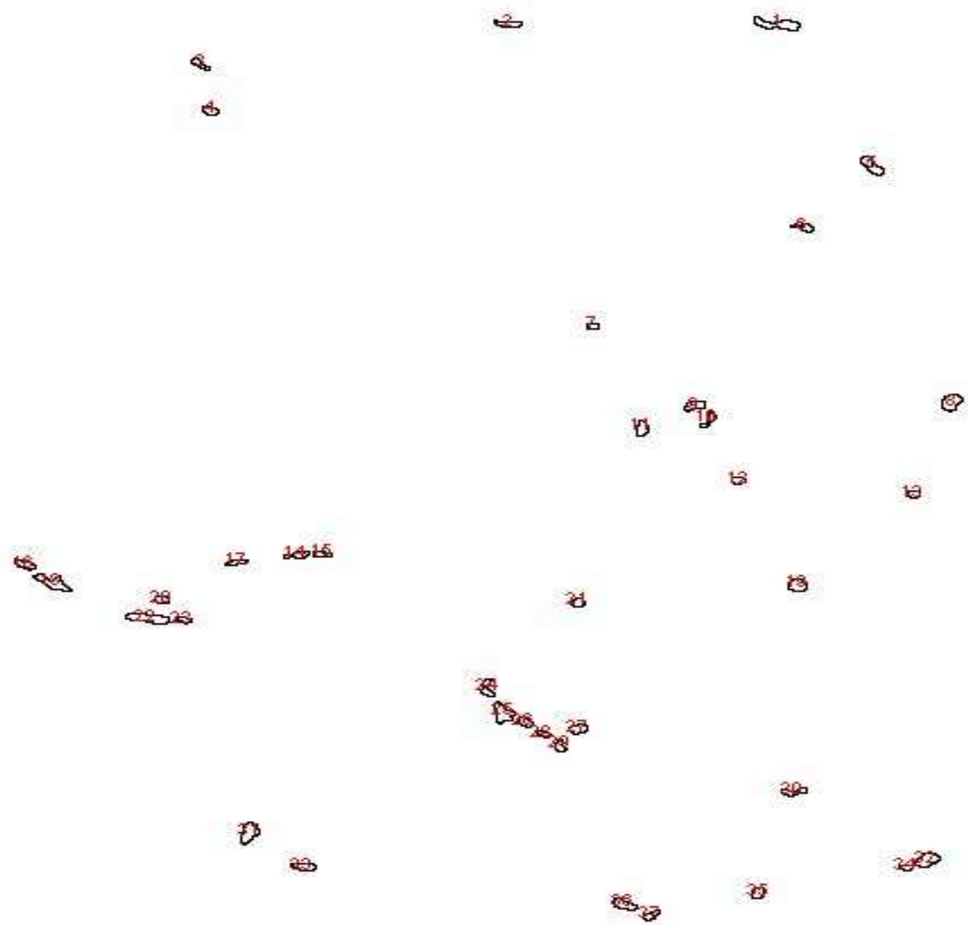

Figure 5: ImageJ cropped SEM Result of *E. maculata* Zn NP

Discussion

UV/Vis Spectrophotometry Analysis of Plant Extracts and Zn-NPs

UV/Visible peak absorbance (optical properties) of the synthesized Zn nanoparticles in this study using *E. maculata* extract (figure 1 above) agrees with previous studies of Satyanarayana *et al.* (2012) with peak value at 355-395nm; Das *et al.*, (2015) with absorbance peak of 377nm; Akl *et al.*, (2015), and Bheemanagouda *et al.*, (2016) having peak absorbance of 374nm; Wong (2016) with peak value of 360nm depending on the method of fabrication.

Fourier Transmission Infra-Red (FTIR) Analysis

FTIR result obtained in this study agrees with reports of Wong (2016), Kokila *et al*., (2015) and Akl *et al.* (2014) whose work attributed bands ranged between 3500 cm^{-1} to 3200 cm^{-1} to O-H stretches from alcohol, phenol or maybe some water residues remaining on the nanoparticles, 2990 cm^{-1} to 2850 cm^{-1} correspond to the symmetric and asymmetric stretching vibrations of C-H in $–CH_3$ and $–CH_2$- of aliphatic chain, 2750 cm^{-1} to 2350 cm^{-1} to the N-H stretching vibrational mode in $–NH_3^+$ amine, 1580 cm^{-1} to 1640 cm^{-1} are NH_3^+ deformation of NH_3^+ in amino acids or carboxylic acid salt (COO-) anti-symmetric stretches and 1065 cm^{-1} to 1015 cm^{-1} is the C-O vibrational stretching from an alcohol (C-OH). These vibrational bands are mostly found in the structures of plant extracts as well as others compounds such as cellulose, pectin and hemicellulose. According to Kokila *et al*., (2015), the shift of bands to lower frequency (511cm^{-1}) indicates the participation of these compounds in the synthesis of ZnO NPs which is owned by Zn-O vibrational stretching that further confirmed the formation of ZnO NPs at 511cm^{-1}.

Scanning Electron Microscopy (SEM) Analysis

The size of ZnO particles synthesized in this study agrees with the report of Akl *et al.* (2014) with estimation range of 10 to 30nm; Gupta *et al.* (2006), Khoshhesab *et al.*, (2011) and Satyanarayana *et al.* (2012) whose work reported 10nm particle size. According to Akl *et al.* (2014), it is possible that the thicker sheets may consist of many thinner sheets aggregated to form a network of nanoparticles which justify the sizes of the nanoparticles synthesized (figure 5).

Conclusion

In line of this study, it showed that the addition of zinc solution altered the relative abundance of the functional group and by so doing altering the extracts properties. As such, the synthesized Zn-NP can be deployed in electronics, medicine for delivery purpose as well as potential drug source as well as a means of turning waste to wealth.

Reference

Akl, M. A., Borhan, A. and Ahmad, L. A. (2014). Green synthesis, characterization and optical properties of zinc oxide nanosheets using *Olea Europea* leaf extract. *Adv. Mat. Lett*. **5**(9), 520-524, DOI: 10.5185/Amlett.2014.5575.

Bheemanagouda, N., Patil, N. and Taranath, T. C. (2016). *Limonia acidissima* L. leaf mediated synthesis of zinc oxide nanoparticles: a potent tool against *Mycobacterium tuberculosis*. *International Journal of Mycobacteriology,* **5**, pp.197-204.

Das, S., Niranjan, B., Saha, S., Chakraborty, M., Maiti, M., Basu, R. and Nandy, P. (2015). Green synthesis of zinc oxide nanoparticles using *Hibiscus subdariffa* leaf extract: effect of temperature on synthesis, anti-bacterial activity and anti-diabetic activity. *The RSC journal*, **5**, 4993–5003.

Devasenan, S., Hajara, B. N. and Jayanthi, S. S. (2016). Green synthesis and characterization of zinc nanoparticle using *Andrographis paniculata* leaf extract. *Int. J. Pharm. Sci. Rev. Res.*, **39**(1), Article No. 48, Pages: 243-247

Edeoga, H. O., Okwu, D. E. and Mbaebie, B. O. (2005). Phytochemical. Constituents of some Nigerian medicinal plants. *African J Biotechnol*; **4**: 685-688.

Elujoba, A. A., Ajulo, O. O. and Iwabo, G. O. (1989). Chemical and biological analysis of Nigeria *Cassia* species for laxative activity. *J. Pharm. Biomed. Anal.* **12**: 1453-1457.

Goh H. S. (2011): ZnO nanoflake arrays prepared via anodization and their performance in the photodegradation of methyl orange. *Turkish J Chem*. **35**: 375-391.

Kay, Y. (2000). *Field Guide to Indiana Wildflowers*

Khoshhesab, Z. M. Sarfaraz, M. and Asadabad, M. A. (2011). “Preparation of ZnO nanostructures by chemical precipitation method,” Synthesis and Reactivity in Inorganic, *Metal-Organic and Nano-Metal Chemistry*. **41**, (7), pp. 814–819.

Kokila, T., Ramesh, P. S. and Geetha, D. (2015). Biosynthesis of silver nanoparticles from *Cavendish* banana peel extract and its antibacterial and free radical scavenging assay: a novel biological approach. *Applied Nanoscience,* **5**, pp.911-920.

Poinern, G. E. J., Tripathy, S. K., Sharma, S., Fawcett, D. and Shah, M. (2015). Green synthesis of metallic nanoparticles via biological entities. *Materials*, **8**, 7278-7308.

Ravindra, P. S., Vineet, K. S., Raghvendra, S. Y., Prashant, K. S., Prashant, K. S. and Avinash, C. P. (2011). Biological approach of zinc oxide nanoparticles formation and its characterization, *Adv. Mat. Lett*., **2**(4), 313-317.

Roy, N. and Barik, A. (2010). Green synthesis of silver nanoparticles from the unexploited weed resources. *Int J Nanotechnol Appl*. **4**(2):95–101.

Saiqa, I., Shakeel, A. S, Mudasir, A. and Babu, L. S. (2015). Green synthesis of silver nanoparticles using Azadirachta indica aqueous leaf extract, *Journal of Radiation Research and Applied Sciences.* **9.** 1-7

Satyanarayana, T., Srinivasa, R. K. and Nagarjuna, G. (2012). Synthesis, characterization, and spectroscopic properties of ZnO nanoparticles. *ISRN Nanotechnology.* **2012** Article ID 372505, 6 pages

Sofowora A (1993). Screening plants for bioactive agents. In: Medicinal plants and traditional medicinal in Africa. 2nd Ed. Ibadan, Nigeria: Spectrum Books Ltd, Sunshine House, Pp.128.

Thuesombat, P., Hannongbua, S., Akasit, S. and Chadchawan, S. (2014). Ecotoxicology and environmental safety effect of silver nanoparticles on rice (*Oryza sativa* L. cv. KDML 105) seed germination and seedling growth. *Ecotoxicology and Environmental Safety*, **104**, 302-309.

Vigneshwaran, N., Ashtaputre, N. M., Varadarajan, P. V., Nachane, R. P., Paraliker, K. M. and Balasubramanya, R. H. (2007): Biological Synthesis of Silver Nanoparticles Using the Fungus Aspergillus flavus, Mater. *Lett.,* **61**, 1413-1418.

Wong, H. L. (2016). Green Synthesis, Characterization of Zinc Oxide Nanoparticles and their Photocatalytic Activity*: A Bachelor of Science Research work in the Universiti Tunku Abdul Rahman.*

Xu, H. (2004). Hydrothermal synthesis of zinc oxide powders with controllable morphology. *Ceram Int.;* **30**: 93-97.

Yong, N. L. (2013). Synthesis and characterization of silver oxide nanoparticles by a novel method. *Int J Scient Eng Res*. **4**: 155-158