Special Issue on Chemistry

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Issue Editor
Dr. A. Manikandan

Research Journal of Agricultural Sciences
An International Journal

P- ISSN: 0976-1675
E- ISSN: 2249-4538

Volume: 13
Issue: Special

Res. Jr. of Agril. Sci. (2022) 13(S): 103–105

CARAS

Res. Jr. of Agril. Sci. (2022) 13(Special): 103–105

www.rjas.org

ISSN: 0976-1675 (P)
ISSN: 2249-4538 (E)

Full Length Research Article

Murraya koenigii (Curry leaf) Leaf Extract Assisted Green Synthesis of Zinc Oxide Nanoparticles

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Received: 10 Dec 2021 | Revised accepted: 18 Feb 2022 | Published online: 25 Feb 2022

ABSTRACT

In this study focus on green synthesis of Zinc Oxide (ZnO) nanoparticles by Zinc nitrate and utilizing the bio components of leaves extract of *Murraya koenigii* (Curry leaf). ZnO NPs are known to be one of the multifunctional inorganic nanoparticles. There is a growing attention to biosynthesis the metal nanoparticles using organisms. Among these organisms, plants seem to be the best candidate and they are suitable for large scale biosynthesis of nanoparticles. ZnO NPs produced by plants are more stable and the rate of synthesis is faster than that in the case of other organisms. The particle size and morphology of the synthesized nanoparticles is characterized by using SEM and XRD. Functional groups of the sample were identified by using FT-IR spectroscopy.

***Key words*:** Zinc Oxide nanoparticles, *Murraya koenigii* (Curry leaf), Green synthesis

Nanotechnology is emerging as a rapidly growing discipline with applications in science and technology for the purpose of producing new nanoscale materials [1-3]. New biocidal agents have been developed as a result of recent advances in nanotechnology, specifically the ability to manufacture highly ordered nanoparticles of any size and form. Nanomaterials have been dubbed a "miracle of modern medicine [4-6] Nanotechnology is a multidisciplinary branch of science that is exploding in popularity. Individual molecules or bulk materials cannot match the structural, optical, or electrical features of nanometer-sized particles [7-10].

Zinc oxide (ZnO) is a technologically remarkable material with a diverse range of applications, including semiconductor (Eg = 3.37 eV), magnetic material, electroluminescent material, piezoelectric sensor and actuator, nanostructure varistor, field emission displaying material, thermoelectric material, gas sensor, cosmetic constituent, and so on [11-15]. Green nanotechnology aims to create nanomaterials and products that are neither harmful to the environment nor human health, as well as nano-products that solve environmental issues. It employs existing green chemistry and engineering ideas to create non-toxic nanomaterials and nano-products at low temperatures with minimal energy and renewable inputs [16, 17]. Green nanoparticle synthesis is a cutting-edge field of nanotechnology. The green concept focuses on selecting reagents that pose the least danger and produce only beneficial by-products. Green nanoparticle synthesis strives to protect the environment by discovering new chemical processes that do not pollute it.

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MATERIALS AND METHODS

Zinc (II) nitrate ($Zn(NO_3)_2$) (Merck Chemical) India. All glassware was washed with distilled (DI) water and dried in an hot air oven before use. *Murraya koenigii* leaves were collected in the Chennai and the leaves were washed several times and were cutted and grinded for powder. The extract was prepared by placing 20g of washed dried fine powdered leaves in 500 ml glass beaker along with 200ml of double DI water. The extract was cooled to room temperature and filtered using filter paper. The extract was stored in a refrigerator in order to be used for further experiments. 50 mL of *Murraya koenigii* leaf extract was taken and 2g of zinc nitrate ($Zn(NO_3)_2.6H_2O$) was added. The precursors was transferred into a ceramic crucible cup and heated in microwave oven 15 minutes and obtained white colored powder and were used for further studies.

Characterization techniques

The UV-Vis spectrum of ZnO nanoparticles synthesized by green method was recorded using JASCO Corp., V-570 spectrophotometer within the range of 200-800 nm. The presence and interaction of chemical functional groups was analyzed using FT-IR spectrophotometer (Perkin Elmer) at the range of 4000-400 cm-1. The X-ray diffraction (XRD) patterns were obtained for the centrifuged and dried samples using X–ray Rigaku diffractometer with Cu K_α source (30 kV, 100 mA), at a scan speed of 3.0000 deg/min, a step width of 0.1000 deg, in a 2θ range of 20-80°. The energy dispersive X-ray spectra (EDS) were obtained with a JEOL JSM-5610 scanning electron microscope equipped with back electron (BE) detector and EDS.

RESULTS AND DISCUSSION

XRD analysis

Powder XRD pattern of ZnO NPs (Figure 1) recorded in the range of 20° to 80°, with a scanning step size 0.02°. All diffraction peaks attributed to crystalline of ZnO with the hexagonal structure. The peak at 2θ values 31.75, 34.34, 36.15, 47.38, 56.44, 62.63, 65.75, 67.68, 68.84, 73.51 and 76.35 is corresponding to the plane of (100), (002), (101), (102), (110), (103), (112), (201) and (202) reflections respectively. The average crystallite sizes (L) of ZnO NPs have been deduced as 12 nm.

SEM analysis

HR-SEM analysis was used to determine the surface morphology of ZnO nanoparticles that were formed. SEM images (Fig. 2) show spherical morphology with nanosized particle. The particle size and crystal structure of the ZnO NPs are in good agreement with powder XRD result with some deviation

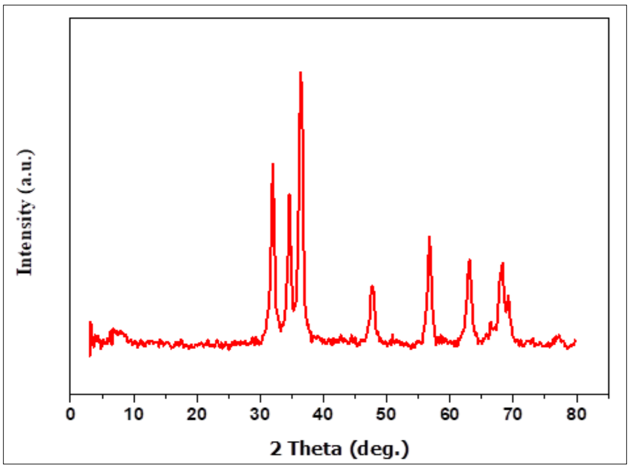

Fig 1 XRD spectrum of ZnO nanoparticles

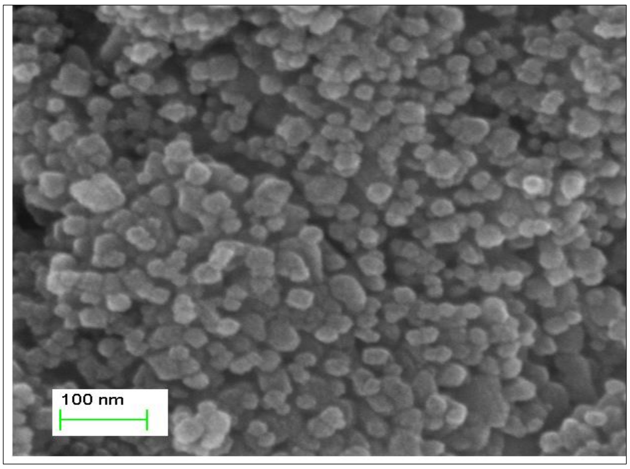

Fig 2 HR-SEM image of ZnO nanoparticles

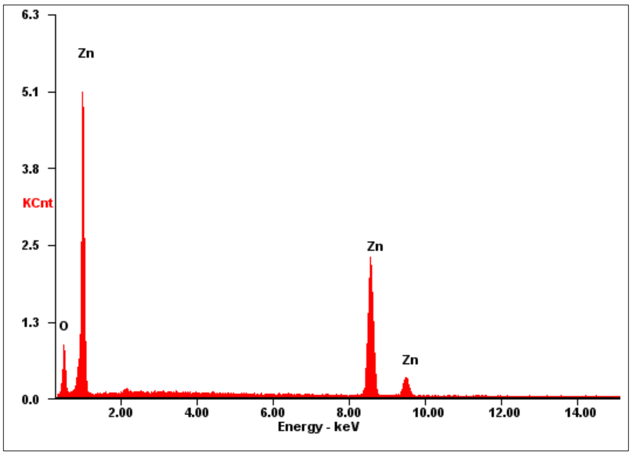

Fig 3 EDX spectra of ZnO nanoparticles

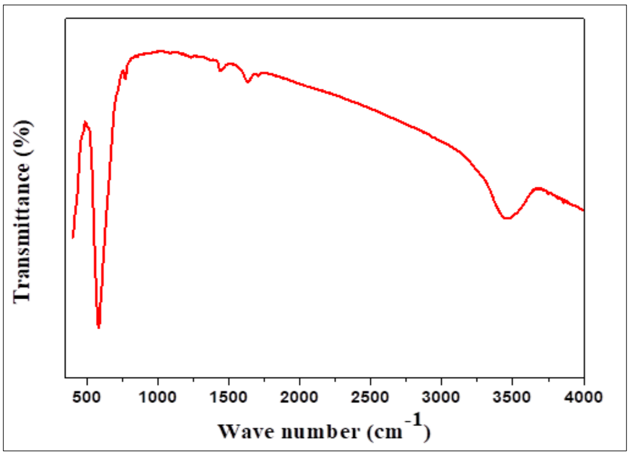

Fig 4 FT-IR Spectrum of ZnO nanoparticles

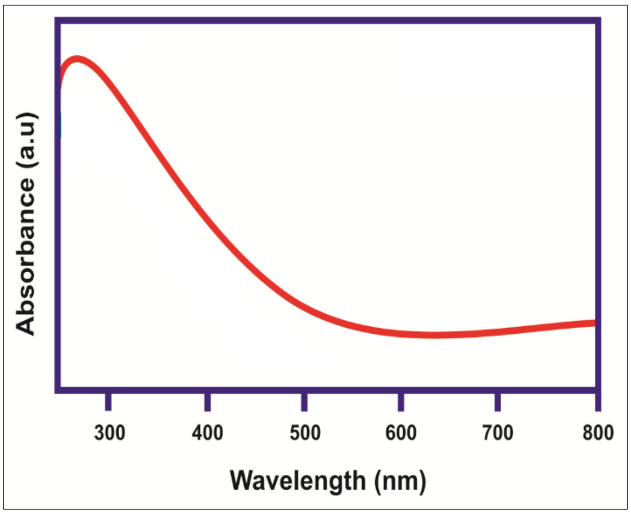

Fig 5 UV–visible absorption spectra of ZnO nanoparticles

EDX analysis

EDX spectrum (Fig. 3) shows phase purity and element composition of the green synthesized ZnO NPs. EDX spectrum showed strong signal is observed from Zn element and light signals from O element, which clearly indicates that the products are pure and there is no other impurity is formed.

FT-IR analysis

The functional group of green synthesized ZnO nanoparticle was measured by FT-IR spectra and as shown in Figure 4. The broad absorption band at 3380 and 3480 cm^{-1} can be assigned to O–H stretching group. The weak absorption peaks are observed at 2910 and 2620 cm^{-1} corresponding to C–H stretching in alkanes. The weak absorption band at 522 cm^{-1} is corresponding to the Zn–O. The region between 420 and 610 cm^{-1} is corresponding to M-O.

UV–visible absorption spectra

The optical properties of ZnO nanoparticles were investigated by UV–visible absorption spectra. The band gap of the samples can be evaluated from the E_g measurements using Kubelka-Munk model and the F(R) is estimated from the following Eq.

$$F(R) = (1-R)^2/2R$$

where F(R) is the remission or Kubelka–Munk function, and R is the reflectance. A graph is plotted between $[F(R)h\upsilon]^2$ and $h\upsilon$, and the intercept value is the band gap energy (Fig. 5). The estimated band gap of is 3.38 eV respectively.

CONCLUSION

The biological production of green synthesized ZnO nanoparticles is becoming a very important field in chemistry and materials science. ZnO nanoparticles have been produced chemically and physically for a long time. The rapid bio-synthesis of ZnO nanoparticles using leaf extract of *Murraya koenigii* (Curry leaf) provides simple and efficient route. The use of *Murraya koenigii* (Curry leaf) plant extracts avoids the usage of harmful and toxic chemicals. The synthesized ZnO nanoparticles sizes are in the range of 15-18 nm.

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