FRUIT MEDIATED SYNTHESIS AND CHARACTERISATION OF ZnO NANOPARTICLES USING STRAWBERRY EXTRACT

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Abstract

Fruit extracts are a cost effective, eco- friendly and efficient alternative for the bulky scale synthesis of nanoparticles. In the present study, strawberry fruit extract was used for metal oxide nanoparticles synthesis by the reduction of metal ions. A change in red colour in to dark brown indicated the formation of metal nanoparticles. The formed nanoparticles were further characterized by UV spectral analysis, FTIR and scanning electron Microscopy (SEM). UV analysis gave a well-known peak at which is characteristic to the metal nanoparticles. FTIR investigation exposed the bio-compounds answerable for the formation of nanoparticles. SEM studies indicated that the formed particles were spherical in shape and most of the particles were within the range 5 nm.

Keywords: *Strawberry, XRD, FTIR. SEM*

1. Introduction

Zinc Oxide (ZnO) Nanoparticles are the most important research due to special properties and wide application [1].Zinc oxide is a semiconductor with wide band gap (3.37), high excitation binding energy (60 eV) at room temperature [2] and unique optical as well as thermal and chemical stability [3] Strawberry cultivars vary widely in size, color, flavor, shape, degree of fertility, season of ripening, liability to disease and constitution of plant [4]. Garden strawberries contain the dimeric ellagitannin agrimoniin which is an isomer of sanguiin H-6. Other polyphenols present include flavonoids, such as anthocyanins, flavanols, flavonols and phenolic acids, such as hydroxybenzoic acid and hydroxycinnamic acid. [5] In this present work, we have used environmentally benign fruit extract which has therapeutic properties[6], as reducing agent which act as a bio reducible for synthesis of ZnO nanoparticles NPs.

2. Materials and methods

2.1. Fruit material

Fresh *strawberry* fruits were collected from the local market Theni Tamil Nadu, India.

2.2. Instruments Required for Synthesis

Magnetic stirrer with hot plate, Magnetic bead, Centrifuge (REMI)

2.3. Preparation of gooseberry fruit extract

A 50 g of *straw berry* fruits was thoroughly washed two more times with distilled water to remove dust particles then chopped finely and crushed using a mortar and pestle then 100 ml of double distilled water added. The straw berry extract was filtered through a Whatmann filter paper No. 1. The plain filtrate becomes used for the synthesis of ZnO nanoparticles.

NAME	:	Strawberries
FAMILY	:	Rosaceae
KINGDOM	:	Plantae
SPECISES	:	Ananassa
GENUS	:	Fragaria

2.4. Synthesis of zinc oxide nanoparticles

In a Typical effect, exact amount (1 Mm) of Zinc Acetate ($Zn(O_2CCH_3)_2$ was dissolved in 100 ml de-ionized water under magnetic stirring at room temperature (1500 rpm). After obtaining a homogenous solution, 1-10 ml of an aqueous solution of *strawberry* extracts was added drop by drop, the red color turned to light brown color, leave-taking the mixture under stirring for 15 minute vigorous stirring. Afterwards, the brown particles were washed with (DDW) and dried at temperature 80 degree for FT-IR, XRD and SEM analysis.

2.5. Characterization techniques

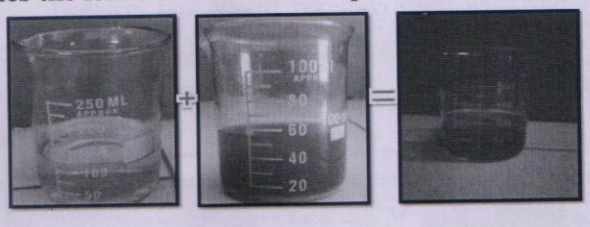
Characterization of nanoparticles is a significant task to understand and control over nanoparticles synthesis and applications and can be done using method such as scanning electron microscopy (SEM), powder X-ray diffractometry (XPERT-PRO) with

CuKα radiation λ = 1.5405 Å more a wide variety of Bragg angles ($20^{\circ} \leq 2\theta \leq 80^{\circ}$), Fourier transform infrared spectroscopy (FTIR- Shimadzu).) KBr pellet technique, and UV–Vis spectroscopy (Shimadzu -1800.

3. RESULTS AND DISCUSSION

3.1. Visual Examination

Initial color of Strawberry extract was red and turns to dark brown color after the addition of zinc acetate solution. Beyond 10 min there is no significant change in color indicating the completion of the reduction reaction. The color change in reaction after 10 min indicates the formation of ZnO nanoparticles.



3.2 UV–Vis absorption spectroscopy analysis

UV-Vis of the synthesized zinc oxide nanoparticles using raw and fresh strawberry extract is exposed in **Fig. 1**. An absorption peak was observed in spectrum at 290 nm which is the characteristic band for the pure zinc oxide. Representative the high purity of the synthesized zinc oxide nanoparticles by this green method.

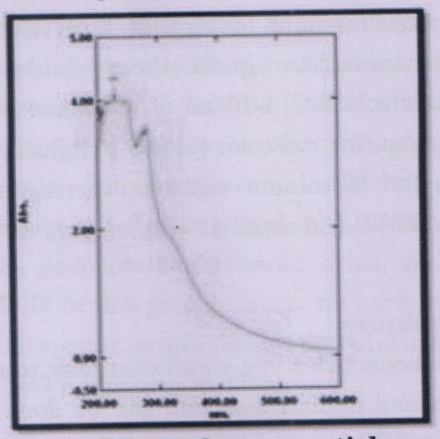


Fig. 1 UV-Vis abortion spectra for ZnO nanoparticles using strawberry extract

3.3. X-ray diffraction (XRD) analysis

Fig (2) shows the X-ray diffraction (XRD) pattern of ZnO nanopaticles synthesized from zinc acetate in the presence of *strawberry* fruit extract at room temperature. The XRD pattern revealed the orientation and face centered cubic nature of zinc oxide nanoparticles. The peak position is indexed as (111), (222), (311), (220) and (200) planes, which are in good agreement with those of particles ZnO obtained from the International Center of Diffraction Data card (JCPDS-77-0191) confirming the formation of a cubic structure. Indicating the phase purity of ZnO nanopowder. The average crystallite size of the synthesized zinc oxide nano spherical was calculated to be 5 nm using Debye-Scherrer equation **[7]**:

$$D = \frac{K}{\lambda} \beta \cos \theta$$

Where D is the crystalline size of zinc oxide nano spherical,

λ represents the wavelength of x-ray source 0.1541 nm used in XRD,

β is the full width at half maximum of the diffraction peak,

K is the Scherrer constant with a value from 0.9 to 1 and θ is the Bragg angle.

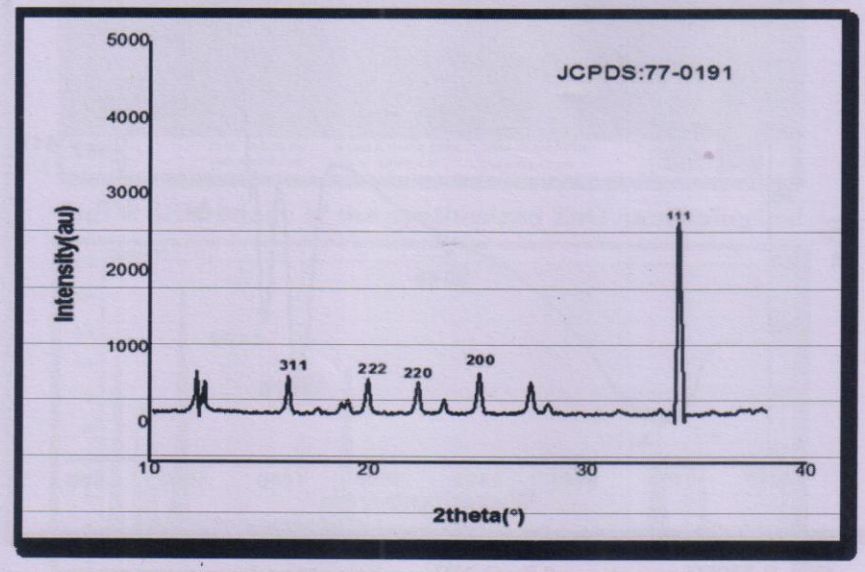


Fig. 2. XRD pattern of the synthesized zinc oxide nano spherical

3.4. FTIR spectrum analysis

To examine the bio-template effect on the synthesis of ZnO nanoparticles prepared by hydrothermal method, FTIR spectra were measured at room temperature using the KBr pellet technique in the range of 4000–400 cm^{-1}. Samples were gently mixed KBr powder and compressed into discs.

Fig. 3 shows identify the ZnO NPs synthesized by gooseberry extracts related the functional groups are 3470 cm^{-1} (O-H) stretch, free hydroxyl alcohols, phenols compounds carboxylic acids. 2340 cm^{-1} (C=H) stretch indicates the alkynes group compounds and this wave number shifted to 1675cm^{-1} (2340-1675 cm^{-1}) 1675 cm^{-1} (C=O) amides groups, 1312 cm^{-1} (C-H) bent indicating by an alkynes compounds 1026 cm^{-1} (C-O)alcohols, ethers, carboxylic acids, 672cm^{-1} alkynes (-C=C-H) bent 697cm^{-1} and 417 cm^{-1} (C-Br) stretch (C-I) stretch which very strong bond and groups contain an alkyl halide. At 697 cm^{-1} and 417 cm^{-1}, the absorption bands indicate Zn-O stretching vibration. The structural changes in FT-IR spectra indicated that the reducing and stabilization of zinc oxide nanoparticles.

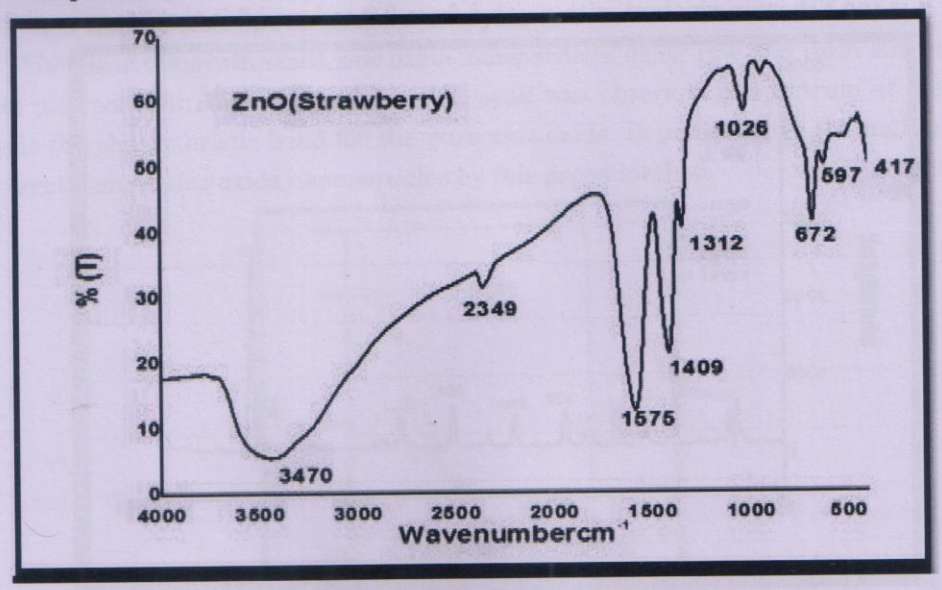


Fig. 3 FTIR spectra of ZnO NPs using strawberry extract

3.5. Surface morphological analysis

Fig. 4 shows the SEM study was used to establish the structure of the reaction products that were formed. Zinc oxide nanospherical via this green technique, to establish that the *strawberry* extract strongly manipulate the morphologies study of the resultant zinc oxide nanospherical are experiential with the help of SEM at 10.00KX magnification. The size and shape of the nanoparticles are depending upon the green extract as reducing agent present in the strawberry extract act as a fast reaction of nanoparticles synthesization with 10min (reaction time changes) This also indicated by the shift of FTIR analysis and the raw fruit extract mostly reducing by nanospherical range.

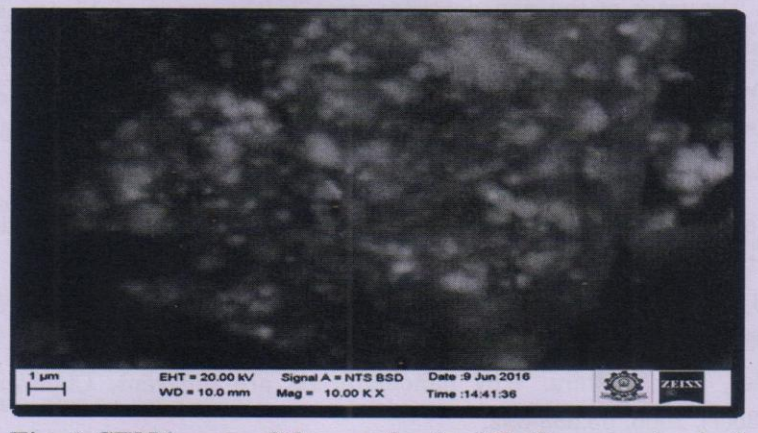


Fig. 4. SEM image of the synthesized ZnO nanospherical

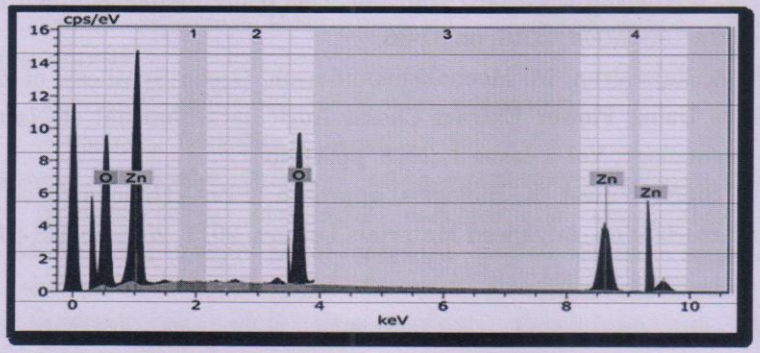


Fig. 5. EDAX analysis for Zn and Oxide elements

The EDAX quantitative study predicts that the Zn and oxide content has the peak elementary composition. (**Fig. 5**).

4. Conclusion

In conclusion, our study can be considered as the first time report for the synthesis of Zinc oxide nanoparticles using extracts of strawberry. This process is both energy eco friendly and cost effective and these particles are highly stable. ZnO nanoparticles were confirmed by color changes and were characterized by UV-visible analysis. The UV-visible spectra showed a broad peak located at 290 nm for ZnO nanoparticles. The SEM images shows formation of spherical shape zinc oxide nanoparticles. The sizes of the nanoparticles were in the range of 15 nm, showing a broad size distribution. FT-IR peaks were in the extract ranging from 4000-400cm^{-1} which confirmed the presence of alkynes, alcohols, carboxylic acids in the ZnO NPs. EDAX analysis was confirmed by elements of Zn and Oxide.

References

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