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Eco-friendly green synthesis and characterization of stable ZnO Nanoparticle using small Gooseberry fruits extracts

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Abstract : Nano-sized ZnO were synthesized by a simplistic and green method of treating Zinc ions with aqueous *gooseberry* extract, used as a reducing along with a capping agent has been presently investigated. ZnO nanoparticles are characterized by UV-vis absorption spectroscopy analysis, Fourier transform infrared spectroscopy (FT-IR) analysis, X-ray diffraction (XRD) technique, scanning electron microscopy (SEM), and Energy Dispersive X-ray (EDX) spectrometer analysis. The results of UV-Vis absorption spectrum confirmed ZnO absorption band at 390 nm. FT-IR analysis was used to confirm the presence of alcohols, ethers, carboxylic acids, alkenes; aromatic groups are involved in these nanoparticles. XRD study exposed the face-centered cubic structure and size of the nanoparticles found at size 15. SEM result was shows spherical like structure. EDAX analysis indicated spectrum of Zn and oxide elements are presented in the nanoparticles. The nanoparticles are low cost and renewable materials similar to *gooseberry* extracts offer abundant benefits biomedical applications.
Keywords : Nanoparticles, Gooseberry, Green synthesis, XRD, FTIR.

Introduction

Nanoparticles are having dissimilar properties as compared with bulk materials. Zinc oxide (ZnO) had been attracted a good deal interest for its broadly programs maximum of the researchers are operating with zinc oxide nanoparticles because of their unique residences inclusive of hydrophobic, photo catalytic, absorption and etc..[1,2] Wet chemical synthesis of Zinc oxide nanoparticles is a costly compared to conventional process[3].The nanoparticles shaped the use of each approach display with precise properties. Now-a-days green nanotechnology has attracted a number of interests and includes an extensive variety of procedures that lessen or take away toxic materials to restore the surroundings.In this green synthesis of nanoparticles by means of plant life is currently under improvement[4] which is very much cost effective.

Researchers have done a lot of work in the green synthesis due to its immense advantages, for the research the work in the above mentioned synthesis we can utilize all parts of the suggested plant (leaves, stem, vegetation, seeds and roots.) to prepare nanoparticles such as ZnO,CuO,MgO[5] etc., which is harmless. Gooseberry was very much effective in weight when supplemented by good diet, dietetic supplements and a healthy lifestyle.The skin of gooseberry was very much effective and it is having many medicinal advantages and also the juicy part of the frut act as a toxic reducing agent[6].Goose berries have been shown to provide significant health benefits because of their high antioxidants, vitamins, minerals and fiber[7]. The fruit are versatile and nutritious which is having abundant source of vitamin C[8].

So the present work shows that small goose berries extract on the applicability of ZnO NPs more beneficial to the medicinal purpose. Only some papers reported the green synthesis of zinc oxide nanoparticles using "fruit" extracts and leaf extract but this is the first time to report and reveal the small gooseberry extract[9] and their characterzation techniques.

Materials and methods

Fruit material

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

Preparation of gooseberry fruit extract

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

Synthesis of Oxide nanoparticles

In a Typical effect, exact amount (1Mm) of Zinc Acetate Zn $(O_2CCH_3)_2$was dissolved in 100 ml de-ionized water under magnetic stirring at room temperature (1200 rpm). After obtaining a homogenous solution, 1-20 ml of an aqueous solution of *gooseberry* extracts was added drop by drop in zinc acetate solution turned in white color to brown color[10] (ZnO) in (Fig.1). Leave-taking the mixture under stirring for 2 minute vigorous stirring. The suspended particles were purified by dispersing in sterilized distilled water and centrifuged 4 times. Afterwards, the nanoparticles were washed with (DDW) and dried at 100° C.

Fig. 1.Goosseberry extract and reduction mixture

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.

Results and Discussions

UV–Vis absorption spectroscopy analysis

The formation of ZnO Nps was determined using the UV–visible spectroscopy. An absorption peak was observed in a spectrum at 390 nm which is the characteristic band for the pure zinc oxide. As an outcome of the surface Plasmon resonance phenomenon (SPR). The absorption spectrums of the metal oxide nanoparticles with 7 min time interval are shown in Fig. 2. Representative the high purity of the synthesized ZnO, MgO nanoparticles by this green technique.

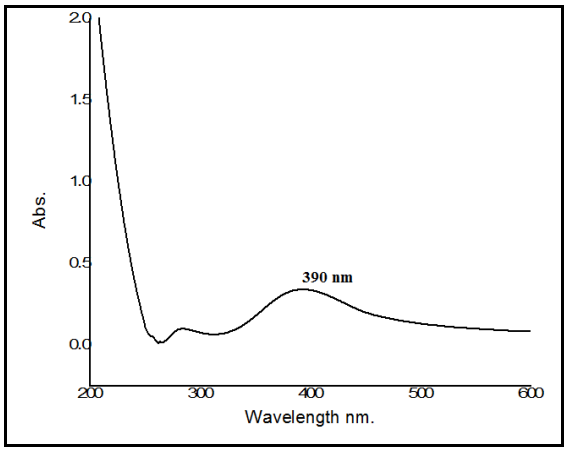

Fig. 2 UV-Vis abortion spectra for ZnO nanoparticles using gooseberry extract

X-ray diffraction (XRD) analysis:

Fig (3) shows the X-ray diffraction (XRD) pattern of ZnO nanopaticles synthesized from zinc acetate in the presence of *gooseberry* 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 (JCPDS-77-0191) confirming the formation of a cubic structure. Representative the phase transparency of ZnO nanopowder. The average crystallite size of the synthesized zinc oxide nano spherical was calculated to be 15 nm using Debye-Scherrer equation:

$$D=K\lambda/\beta\cos\theta$$

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.

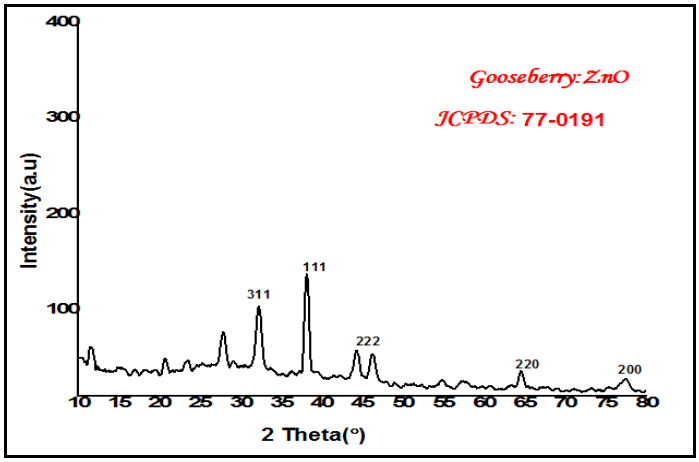

Fig. 3. XRD pattern of the synthesized zinc oxide nanoparticles.

FTIR spectrum analysis

To examine the bio-synthesis 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.4 shows identify the ZnO NPs synthesized by gooseberry extracts related the functional groups are 3764cm^{-1} (O-H) stretch, free hydroxyl alcohols, phenols compounds, 3448 (O-H) cm^{-1} alcohols, 2881 cm^{-1} (O-H) stretch, carboxylic acids. 2350 cm^{-1} (C=H) stretch indicates the alkynes group compounds and this wave number shifted to 1611cm^{-1}(2350 -1611 cm^{-1}) 1611 cm^{-1} (C=O) amides groups, 1398 cm^{-1} (C-H) bent indicating by an alkynes compounds 1216 cm^{-1} (C-O)alcohols, ethers, carboxylic acids, 712cm^{-1} alkynes(-C=C-H) bent 516cm^{-1} and 432 cm^{-1} (C-Br)stretch (C-I) stretch which very strong bond and groups contain an alkyl halide. 516 cm^{-1} and 432 cm^{-1} the absorption band was indicating Zn-O stretching vibration. The structural changes in FT-IR spectra indicated that the reducing and stabilization of zinc oxide nanoparticles by the coordination with OH, C=O, C-I, C-Br

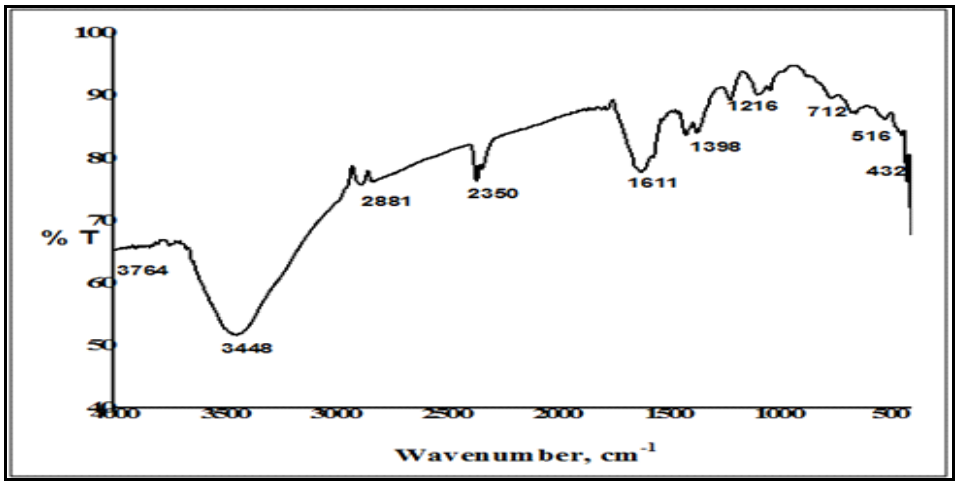

Fig. 4 FTIR spectra of ZnO NPs using gooseberry extract

Surface morphological analysis

Fig. 5 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 *Gooseberry* extract strongly manipulate the morphologies study of the resultant zinc oxide nanospherical are experiential with the help of SEM at 500X, 1000X magnification. The size and shape of the nanoparticles are depending upon the nature of reducing agent present in the gooseberry and the raw gooseberry extract act as a fast reaction of nanoparticles synthesization with 5 min (reaction time changes) This also indicated by the shift of FTIR analysis and the raw fruit extract mostly reducing by nanospherical range. The EDAX quantitative study presence that the Zn and oxide content has the maximum peak elementary composition. (**Fig. 6**).

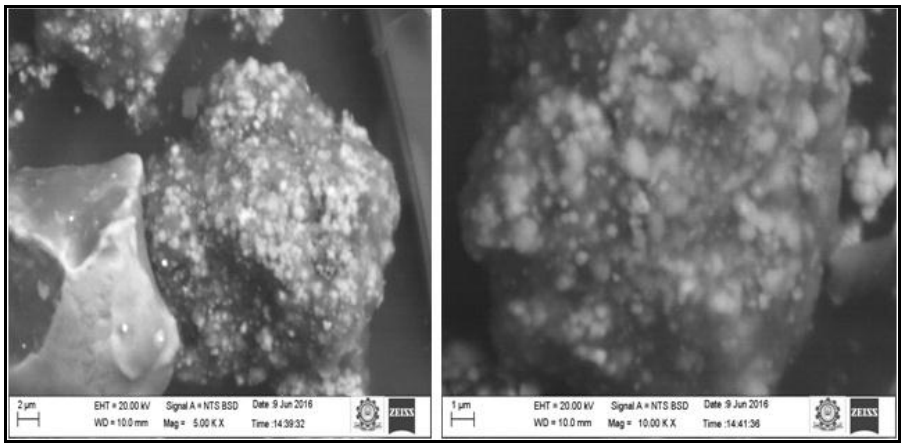

Fig. 5. SEM image of the synthesized ZnO nanospherical

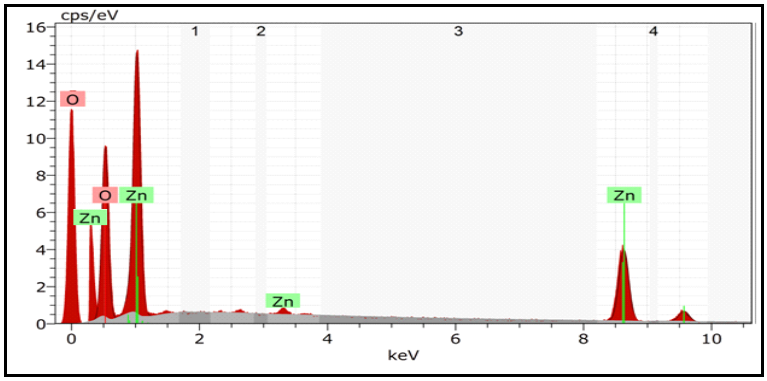

Fig.6. EDAX analysis for Zn and Oxide elements

Conclusion

In conclusion, our study can be considered as the first time report for synthesis of Zinc oxide nanoparticles using extracts of small *gooseberry*. ZnO nanoparticles were confirmed by color changes and were characterized by UV-visible analysis. The UV-visible spectra showed a broad peak located at 390 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.

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