SYNTHESIS AND CHARACTERIZATION OF ZINC DOPED WITH ANDROGRAPHIS PANICULATA NANOPARTICLES

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ABSTRACT

Zinc nanoparticles have been widely employed for various pharmacological applications. The leafs of Andrographis paniculata is high immune boost And used widely in Ayurveda medications, The Bio-mediated synthesis of zinc nanoparticles was carried out by utilizing the reducing and capping potential of Andrographis paniculata leaf extract. The capped Zinc Nanoparticles were characterized using XRD, FTIR, SEM and EDAX analyses, XRD pattern compared with the standard confirmed spectrum of zinc particles formed in the present experiments were in the form of Nano-crystals , as evidenced by the peaks at 2θ values. SEM conforms that particles are flakes and clumps in nature so as to reduce the total surface free energy. The EDAX results shows that The presence of Andrographis paniculata is confirmed along with O, Ca , Mg and Zn. The FTIR analysis conforms that the Zinc nanoparticles suggested that they might surround by the any of these organic molecules and hence Zn-O stretching is absence in the spectrum. The synthesized nanoparticles possess strong biological activities regarding anti-oxidant, anti-diabetic, and anti-inflammatory potentials which could be utilized in various biological applications by the cosmetic, food and biomedical industries.

INTRODUCTION

Nano science deals with a science of materials and technologies in the range of 1-100nm, they are generally called "Nanoparticles or Nano-materials". Nanoparticles are larger than individual atom and molecules, but smaller than the bulk solids; hence they obey neither quantum chemistry nor the laws of classical physics and have properties that are different from those expected. The materials can have different properties at the Nano scale. Some are better at conducting electricity or heat and some are stronger, some have different magnetic properties, some reflect light better or change colors as their size is changed. For example, nanomaterial's, have large surface area than similar volumes of large scale materials, i.e., large surface is available for interactions with other materials around them.

Nanoparticles are particles between 1 and 100 nanometers in size with a surrounding interfacial layer. The interfacial layer is an integral part of Nano scale matte, fundamentally affecting all of its properties. The interfacial layer typically 5 consists of ions, inorganic and organic molecules. In nanotechnology, a particle is defined as a small object that behaves as a whole unit with respect to its transport and properties. Particles are further classified according to diameter. The term nanoparticle is not usually applied to invidual molecules; it usually refers to inorganic materials Being much smaller than the wavelengths of visible light (400- 700 nm), nanoparticles cannot be seen with ordinary optical microscopes, requiring the use of electron microscopes. For the same reason, dispersions of nanoparticles in transparent media can be transparent, whereas suspensions of larger particles usually scatter some or all visible light incident on them. Nanoparticles also easily pass through common filters, such as common ceramic candles. so that separation from liquids requires special Nano filtration techniques.

Zinc Nanoparticles are being widely under use in a variety of fields due to its uniqueness and attractiveness in their properties like electrical, optical, dermatological and antibacterial. This makes them to be a promising element the widely distributed fields like automobiles, electronics, optoelectronics, textiles, medicine, drug delivery and cosmetics.

Most commonly, Zinc Nanoparticles are produced through chemical methods, like sol-gel processing, precipitation and electro deposition method . Zinc has been found highly attractive because of its remarkable application potential in solar cells, piezoelectric devices, U-V absorbers, pharmaceutical and cosmetic industries. Potentially, Zinc removed all the dyes and water pollutants from textile effluent under UV light have been proved. Nanoparticles exhibit completely new or improved properties with larger particles of the bulk materials and these novel properties are derived due to the variation in specific characteristics such as size, distribution and morphology of the particles. The properties of materials change as their size approaches the nanoscale and as the percentage of atoms at the surface of a material becomes significant . The growing need of environmental friendly nanoparticles, researchers are using green methods for the synthesis of various metal nanoparticles for pharmaceutical applications. Although different biological based synthetic methods are known for Zn are sought by researchers. Biological process has led to the development of an eco-friendly approach for the synthesis of nanoparticles. The use of non-toxic materials like plant extract & bacteria for synthesis of zinc nanoparticles offers numerous benefits of pharmaceutical application. Biological methods of nanoparticles synthesis using microorganisms, enzymes, fungus and plants or plant extracts have already shown to be possible. In recent, green synthesis of Zinc nanoparticles was achieved by using microorganisms, plant extract. Zinc nanoparticles show potential antimicrobial effects against infectious organisms such as Escherichia coli, Bacillus subtilis, Vibriocholerae, Pseudomonas aeruginosa, Syphilis typhus, and Staphylococcus aureus. In the present work was carried out to synthesize and characterize the Zinc Nanoparticles using Andrographis paniculata leaf extracts. Further Zinc nanoparticles were optical characterization using FT-IR spectrometer, structural characterization using scanning electron microscopy (SEM), EDAX, And XRD studies in various temperature.

KEYWORDS

Zinc Nanoparticles, Andrographis paniculata, characterization techniques, X-ray diffraction studies (XRD) – Structural analysis, Scanning Electron Microscope (SEM) - surface morphology, Energy Dispersive X-ray analysis (EDAX) - elemental composition, Fourier transform infrared spectroscopy (FTIR)- purity and composition.

EXPERIMENTAL,

From various synthesis method we chosen the Nitriding process Because its an Simplest and Easy technique. Therefore the process is adding by 60g of zinc nitrate was dissolved in a 75ml of distilled water which was mixed with 60g of citric acid (dissolved in 10ml of water)and 36.73g of urea(dissolved in 10ml of water)and kept in a magnetic stirrer for 10 minutes. After 10 minutes,15 g of Andrographis paniculata was taken and dissolved in 10ml of water. This event was kept in a magnetic stirrer for one hour of 60℃ .Then 10ml Poly Ethylene Glycol (PEG) was added and again kept in hot plate for 10 hours at a constant temperature. Later it was kept in muffle furnace for 500℃ of temperature up to 3 hours. For 700 degree Celsius the process is repeated.

RESULTS AND DISCUSSION,

Structural Characterization and Morphology

The structural characterization was carried out using powder X-RD analysis technique. The dry powders of the zinc Nanoparticles were used for X-RD analysis. The X-RD pattern indicates that the zinc Nanoparticles had a wurtzite hexagonal structure. The obtained results illustrate that zinc ions had indeed been reduced to Zn by andrographis paniculata plant extract under reaction conditions. To determine the average particles size of the Zinc Nanoparticles, the Debye Sherrer's equation is used.

$$D=K\lambda / B\cos\Theta$$

Where, D is the crystalline size of Nanoparticles, K is the sherrer's constant, λ is the wavelength of the X – Ray sources used in X – RD, B is the full width at half maximum of the diffraction peak, Θ is the Bragg's angle.

Table-1 The grain size and FWHM of the planes of XRD spectra at 500^0

S.No	Plane	2θ (°)	FWHM	Grain size(D) nm
1	100	31.63	0.2379	36.27
2	002	34.27	0.5058	17.17
3	102	47.45	0.7667	11.82
4	110	50.06	0.0691	13.26
5	103	56.44	0.5567	16.92

Table-2 The grain size and FWHM of the planes of XRD spectra at 700^0

S.No	Plane	2θ (°)	FWHM	Grain size(D) nm
1	100	31.68	0.251	34.38
2	002	34.35	0.2593	33.51
3	102	47.47	0.2795	26.35
4	103	56.51	0.3442	32.59
5	200	66.29	0.3478	28.51

The surface morphology of the Zinc Nanoparticles was characterized using SEM analysis-(Scanning Electron Microscopy) the figure-1 shows the Zinc Nanoparticles synthesized by the plant extract of andrographis paniculata. It represent the particles are flakes and clumps in nature so as to reduce the total surface free energy.

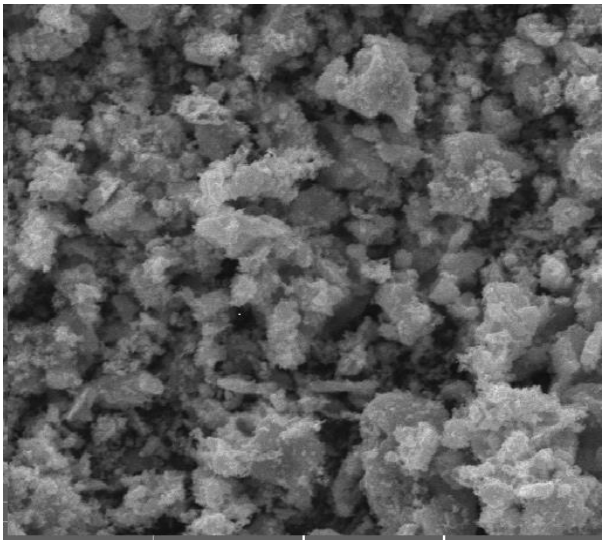

Fig-1 SEM pattern of synthesized Andrographis paniculata doped with ZnO

The energy dispersive x-ray (EDAX) study is carried out to know the elemental composition of synthesized samples and for confirmation of successful doping of Andrographis paniculata in Zinc site and is shown in fig-2 that The presence of Andrographis paniculata is confirmed along with O, Ca, Mg and Zn and shown in. But C, Al, Si, Cl, K, Fe was present inbthe sample and this may be considered as a impurity.

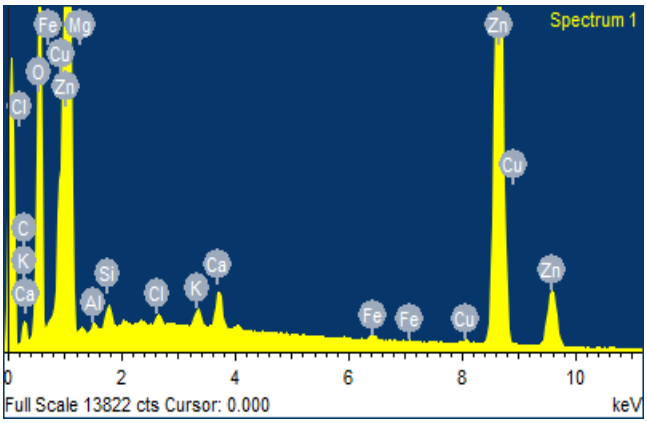

Fig-2 EDAX spectrum of synthesized Andrographis paniculata doped ZnO

Fourier transform infrared spectroscopy (FTIR) used to study the purity and composition of the synthesized products. It is used to determine the functional groups and type of bonds present in the system. The dried ZnO nanoparticles mixed with Andrographis paniculata where characterized

with FTIR. In the figure-3 the FTIR spectra explained by various peaks obtained by all the synthesized ZnO nanoparticles.

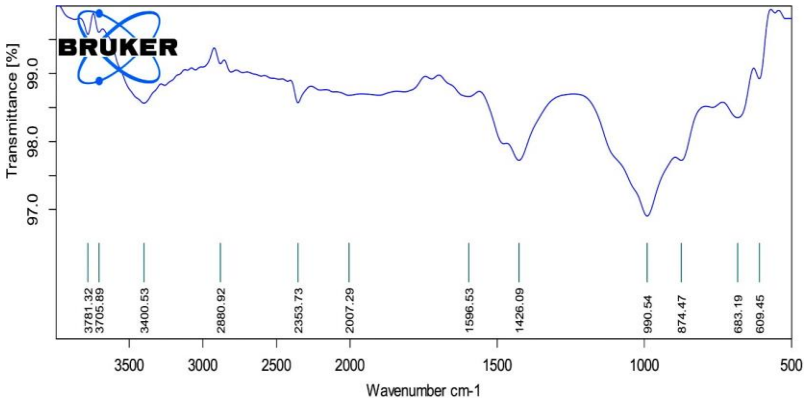

Fig-3 FTIR spectra of synthesized Andrographis paniculata doped with ZnO

In the zinc nanoparticles, peak values at 683.19, 990.54, 1426.09, 1596.53, 2007.29, 2880.92, 3400.53, 3781.2 cm^{-1} is observed. Peak at 683.19 cm^{-1} corresponds to C – H bending of aromatic, 990.54 cm^{-1} corresponds to C=C bending alkene (strong). The peak located at 1426.09 cm^{-1} corresponds to O-H alcohol bending. Peak at 1596.53 cm^{-1} corresponds to C=O stretching of amides 2007.29 cm^{-1} due to weak C-H stretching. The peaks at 2880.92, 3400.53, 3781.2 cm^{-1} due to C-H stretching alkene, Alcohol O-H stretching, Phenolic OH group.The FTIR analysis of Zinc nanoparticles suggested that they might surround by the any of these organic molecules and hence Zn-O stretching is absence in the spectrum. The physicochemical properties of andrographis paniculata leaf extract act as capping agent and prevents the nanoparticles formed from aggregation.

CONCLUSION

In conclusion, the field of nanoscience and nanotechnology is the development of eco-friendly processes for synthesis of zinc Nanoparticles. Here we have reported the zinc Nanoparticles is successfully synthesized by using andrographis paniculata leaf extract for the antimicrobial activity for the future studies. The structural characteristics and morphology of the obtained zinc Nanoparticles were studied using the X RD, EDAX and SEM techniques. The functional group present in the leaf extract was confirmed by FTIR analysis.The result is confirmed the Zinc Nanoparticles with high stability but with some impurities and might during the sample and characterization process.

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