SEMIORGANIC SYNTHESIS OF ZINC OXIDE NANOPARTICLES USING ADHATODA VASICA LEAF EXTRACT AND ITS OPTICAL & STRUCTURAL CHARACTERIZATION

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Abstract: In this research work, the synthesis of zinc nanoparticles was carried out using adhatoda vasica's leaf extract. Adhatoda vasica is a highly effective medicinal plant possessing values in curing number of health issues. It's a very good ayurvedic therapeutic plant which is very well popular in India because of its efficiency in treating many diseases such as arthritis, bleeding disorders, allergic conditions, respiratory issues, dyspnea, bronchitis, tuberculosis etc.,. We have used its leaf as a reducing agent in the preparation of zinc nanoparticles. The care was given such that synthesis was performed under control conditions and optimized. Thus produced zinc nanoparticles from zinc nitrate were characterized using the optical spectroscopic techniques UV-Visible and Fourier Transform Infrared Spectroscopic methods. The structure of nanoparticle was observed with Scanning Electron Microscopy (SEM).

Keywords: **Adhatoda vasica, Zinc oxide nanoparticles, Zinc nitrate, UV-Visible, FTIR spectroscopy, SEM.**

I. INTRODUCTION

At present the synthesis of metal oxide nanoparticles involves majorly the toxic chemical methods which are time consuming and expensive. On the other hand, the semi organic synthesis technique with plant extract provides safety, less cost, trouble-free and less time. So this technique had drawn attention towards it and found to be alternate for conventional chemical techniques. Here in this work, zinc oxide nanoparticle was synthesized by maintain pH using sodium hydroxide (NaOH) as a stabilizing agent.

In India adhatoda vasica is so familiar as a medicinal herb finding its major place in various medical practice types such as siddha, ayurvedha, unani, homeopathy and also other ancient medicine. Adhatoda parts such as leaf, root, stem and flower were used in many medicinal drug preparations. Majorly the leaves were used in the herbal remedy for diseases like chronic bronchitis, whooping cough, fever, cold, cough, jaundice, asthma as sedative expectorant, diaschoea, dysentery and rheumatic painful inflammatory swellings. The leaves of adhatoda vasica contains secondary metabolites & Phytochemicals, such as vasicinone, vasicine, vasicol, vasicine acetate, vasicline, vasicinolone , 2-acctyle benzyl amine, vasicolineone and aadathodaine accountable for its biological properties. Hence, in this study using adhatoda's leaf extract the zinc oxide nanoparticle was synthesized in an effective way and optical & structural characterization was carried out using UV-Vis spectroscopy, FTIR & SEM analysis.

II. MATERIALS AND METHODS

`2.1 Materials

Zinc nitrate (Merck), Sodium hydroxide pellets (Merck), double distilled water and other chemicals were used in the nanoparticles synthesis. Leaves of adhatoda vasica were collected from the Botanical Garden, Adhiyaman Arts and Science College for Women, Uthangarai.

2.2 Preparation of adhatoda vasica leaf extract

Adhatoda vasica leaf (10 g) were washed, grinded and boiled in 50 ml of double distilled water for 15 minutes. Then aqueous leaf extract was cooled followed by filtering procedure using Whatman No. 1 filter paper. The final leaf extract was stored in sterile container at 4ºC for further usage.

2.3 Synthesis of Zinc Oxide Nanoparticles

In this synthesis technique, 11.9 g of zinc nitrate was dissolved in 40 ml of water and made to stir in the magnetic stirrer. To this mixture, 10 ml of adhatoda vasica leaf extract was added drop by drop using sterile injection. The resulting mixture was stirred continuously for atleast 10 minutes. Sodium hydroxide solution (2M) was added dropwise to above semiorganic solution. The pH of this solution was maintained at 12. The solution which appeared as green in colour now turned to form white crystalline precipitate. Finally, the mixture was centrifuged at 3000 rpm for 15 minutes and washed repeatedly with distilled water, followed by drying process. In drying process, the mixture was dried at 60ºC in hot air oven, the care was given such that to acquire very well dried zinc oxide nano powder. The powder was grinded into a fine powder with mortar and pestle to obtain the expected zinc oxide nanoparticles. The zinc oxide nanoparticles shifted in to a sterile vial and stored for further characterization.

III. RESULTS AND DISCUSSION

Zinc oxide nanoparticles found its most significant role in paint industry to obtain the efficient coatings of the surface due to its antimicrobial activity. Also in food packaging zinc oxide nanoparticles do not interrelate with food. Hence, this work concentrated to produce such an effectual zinc oxide nanoparticle and to observe its optical characterization with UV-Vis spectroscopy, FTIR spectroscopy and structural characterization with SEM analysis.

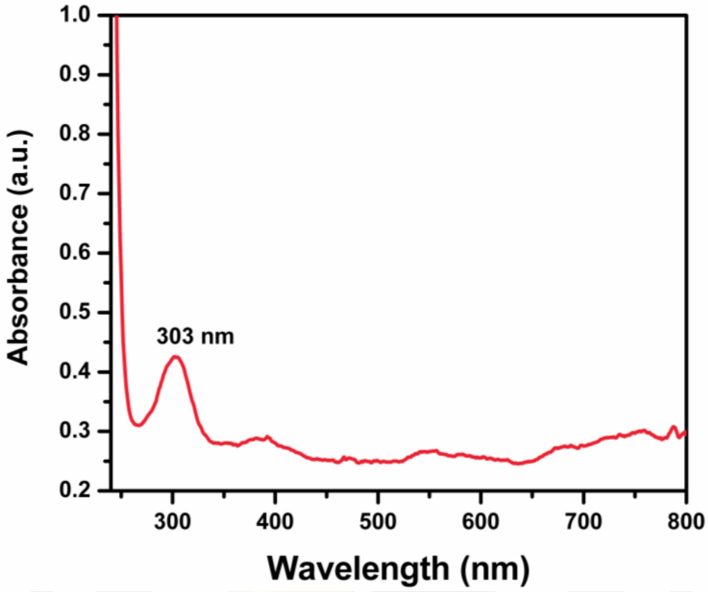

Figure 1: UV-Visible absorption spectrum of Zinc nanoparticles

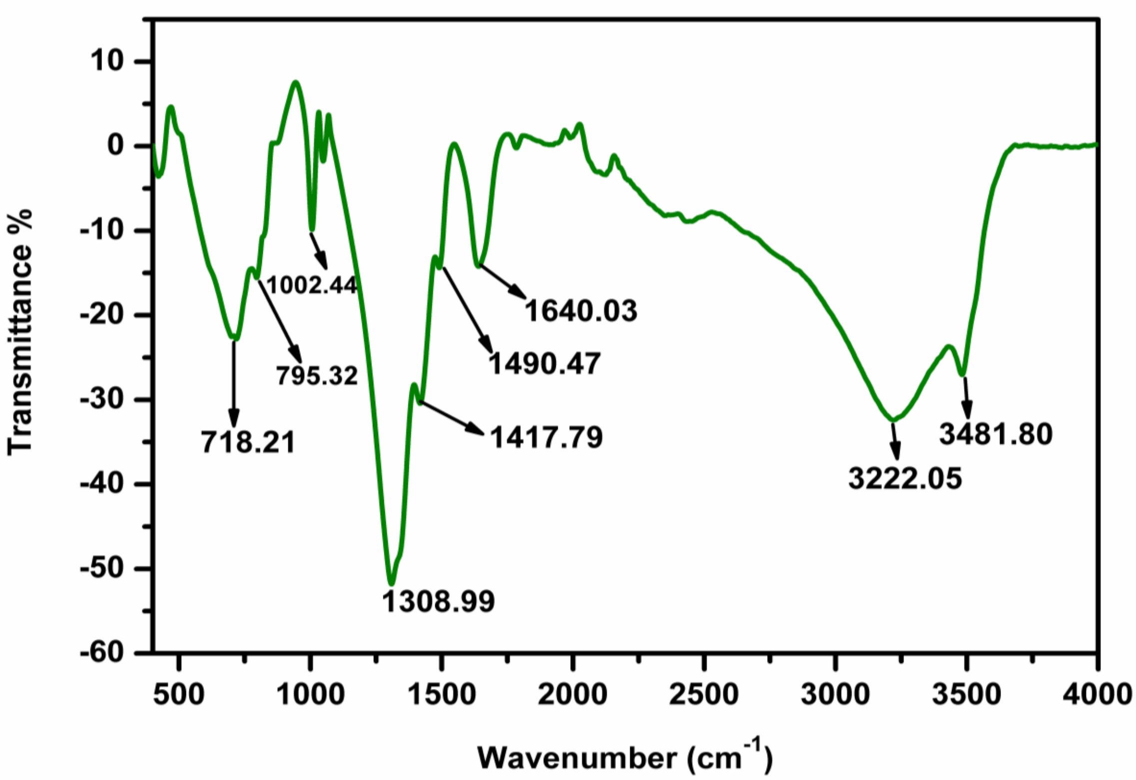

Figure 2: FTIR spectrum of Zinc nanoparticles

The fine powder of ZnO naoparticle was resuspended in double distilled water and placed in a double side cuvette in the sample compartment of UV-Visible spectrometer such that to acquire UV-Visible spectra. Figure 1 shows the UV-Visible spectrum of zinc nanoparticles prepared using solgel technique. The UV-Visible spectrum of zinc nanoparticle synthesized from leaf extract of adhatoda vasica has shown the characteristic absorbance band at 303 nm at pH 12. This prominent and sharp peak of zinc oxide nanoparticles confirms the major role of maintaining pH of nanoparticles solution mixture and drying temperature (fixed depending upon the decomposition temperature of the particles) to obtain the excellent absorbance peak.

Figure 2 shows the FTIR spectrum of the zinc nanoparticles synthesized from adhatoda vasica. From the FTIR spectrum the major peaks observed at 718.21, 795.32, 1002.44, 1308.99, 1417.79, 1490.47, 1640.03, 3222.05 and 3481.80 cm^{-1}. The FTIR bands appearing 718.21 & 795.32 cm^{-1} might be due to C-H bending vibration of alkenes. The 1002.44 cm^{-1} corresponds to C-O stretching vibration of alkoxy group. The bands at 1308.99, 1417.79 & 1490.47 cm^{-1} arises due to presence of C-O stretching vibration of acyl and phenyl group & C-H bending vibration respectively. Another peak at 1640.03 cm^{-1} might be due to the presence of C=N stretching vibration. The band at 3222.05 cm^{-1} corresponds to C-H stretching vibration and another sharp peak at 3481.80 cm^{-1} might be assigned to O-H stretching mode of hydroxyl group (Jamdagni et al 2018).

SEM images of ZnO nanoparticles synthesized by semi organic method were shown in Figure. 3. Analysis of the images shows that formation of zinc oxide nanoparticles shows cluster morphology.

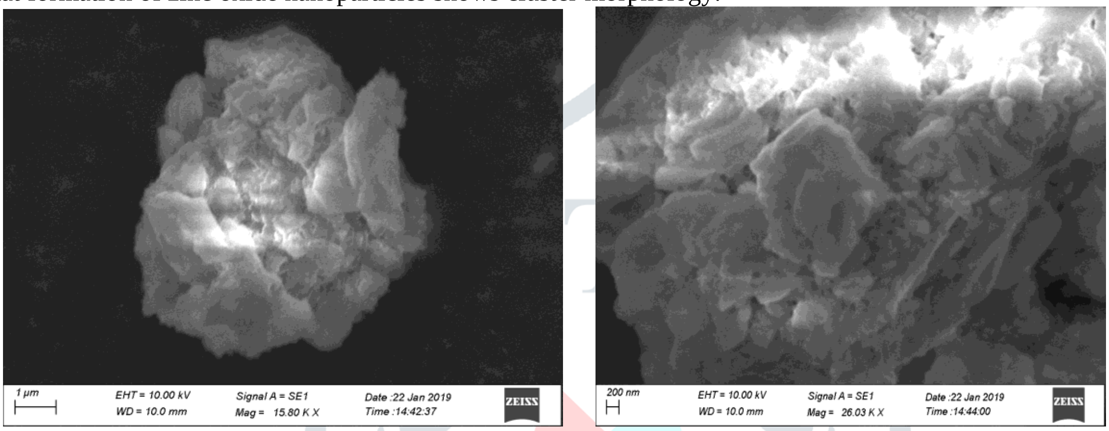

Figure 3: SEM images of zinc oxide nanoparticles

IV. CONCLUSION

In this research work, synthesis of zinc oxide nanoparticles was carried out using adhatoda vasica leaf extract using solgel method. The resultant fine ZnO nanoparticles powder was characterized using optical spectroscopic techniques- UV-Visible spectroscopy, FTIR and structure SEM analysis. From the UV-Visible absorbance band it was confirmed that the ZnO nanoparticle formation and several major bands of functional group of nanoparticles were very well seen through FTIR spectroscopy. SEM analysis confirms the formation of zinc oxide nanoparticles. Hence, it was concluded that this semi organic synthesis method could pave way for the preparation of zinc nanoparticles in an eco-friendly and cost effective manner.

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