Zinc oxide Nanoparticles using *hibiscus* Leaf Extract

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Abstract: Research in nanotechnology highlights the possibility of green chemistry pathways to produce technologically important nanomaterials by eco-friendly methods. Nanoparticles synthesized using Green method has been broadly used in the field of medicine, cosmetics, textiles and others fields. It is known that the green synthesis of nanoparticles is gaining importance due to its simplicity, eco-friendliness and extensive antimicrobial activity.

In the present synthesis, the objective was to study the synthesis and analyses the Zinc Oxide Nanoparticles (ZnONPs) from *hibiscus* leaves extract and Zinc Nitrate (0.1M) by keeping overnight solution to get ZnONPs. It was then dried to get solid powder in oven for 4hrs at 600ºC.The samples were characterized by Ultra-Violet Spectroscopy (UV), CPS (Particle size analyzer), X-ray diffraction (XRD).The synthesized ZnONPs were applied for antibacterial activity against *S. aureus* and *E. coli* bacteria using agar disc diffusion method. The nanoparticles obtained by using green method having particle size 55-80nm.

Keywords: - Zinc oxide nanoparticles, Green method, *hibiscus* leaf extract, antimicrobial activity, Particle size analyzer

1. INTRODUCTION

Green synthesis nanoparticles production through plants, bacteria, fungi, and algae allows for the large scale production of metal oxide particles free of impurities. Different physical and chemical processes are now widely used to synthesize metal oxide nanoparticles, allowing one to obtain particles with desired characteristics.[1] Such manufacturing methods are typically costly and labor-intensive and can be hazardous to the environment and to living organisms. [2] Thus, there is a need for an alternative, cost-effective, safe and environmentally sound means of nanoparticles creation. [3]

Nanotechnology is a multidisciplinary scientific field undergoing explosive development. Nanometer-sized particles offer novel structural, optical and electronic properties that are not attainable with individual molecules or bulk solids. [4] The characters of metal and metal oxide nanoparticles have been of great interest due to their distinctive feature such as catalytic activity, optical, magnetic and electrical properties. [5] Nanoparticles interaction with biological materials and established a series of nanoparticles / biological interfaces that depend on colloidal forces as well as dynamic biophysicochemical interactions. [6] These interactions lead to the formation of new nanomaterial with control size shape, surface chemistry, roughness and surface coatings. The use of plants for the synthesis of nanoparticles novel and provides a cost-effective and environmentally friendly alternative to chemical and physical synthesis. [7] In addition, the use of plants can be easily scaled up for large-scale synthesis without the use of toxic chemicals or the need for high pressures, energy and temperatures. Nanoparticles present a higher surface area to volume ratio with decrease in size, distribution and morphology of the particles. [8] Noble metal oxide nanoparticles have been the subject of focused research due to their electronic, optical, mechanical, magnetic and chemical properties. Application of metal oxide nanoparticles within size range of 1-100 nm has novel and various properties. Nanotechnology is the production and use of particles at the smallest scale. Textile industry is also experiencing the benefits of nanotechnology in its diverse field of applications. Nanoparticles are very interesting because of their surface properties, different from bulk materials. Such properties make possible ordinary products with new functionalities[9]

The major response concerned in the biosynthesis of ZnONPs mediated by the leaf extract of *hibiscus* is reduction/oxidation reaction where the biological resources take part for the translation of metal compounds in to specific nanoparticles. In this work ZnONPs were synthesized by Green method. Zinc Nitrate (0.1M) and Plant extract are mixed together in presence of Distilled water at room temperature give precipitates and filtered. After the dry on oven heating we will characterized the sample. As obtained ZnONPs are characterized Using Ultraviolet visible spectroscopies (UV-Vis), Particles size analyzer (CPS), X-ray Diffraction (XRD). The antimicrobial activities of ZnONPs are done by Disk well diffusion method. And it can be further used in application for the textile. [10]

2. MATERIAL AND METHODS

2.1 Synthesis of ZnONPs

0.1 M Zinc Nitrate [Zn $(NO_3)_2.6H_2O$] is obtained in distilled water and stirred well to get homogeneous solution. Plant Extract of *Hibiscus* leaf is obtained in distilled water. The Zinc Nitrate (0.1M) and plant extract (Ratio 1:1) was added drop by drop with constant stirring the mixture at room temperature for 2-3 hrs. After the complete reaction the solutions is kept for 24hrs to ZnNPs. It is then dried in oven and calcinated at 600^0C in muffle furnace for 4hrs to get ZnONPs.

3. RESULTS AND DISCUSSION

ZnONPs were successfully synthesized via Green method using equal volume of zinc Nitrate (0.1M) and plant extract**.**

3.1 UV-Vis spectroscopy Analysis

UV-Vis spectroscopy showed a increase in intensity of the characteristic surface Plasmon band in the spectrum for the range of 250-450 nm wavelength for ZnONPs. As mentioned earlier the range of the spectrum near to 365nm gives the confirmation for the ZnONP's shown in fig. 1

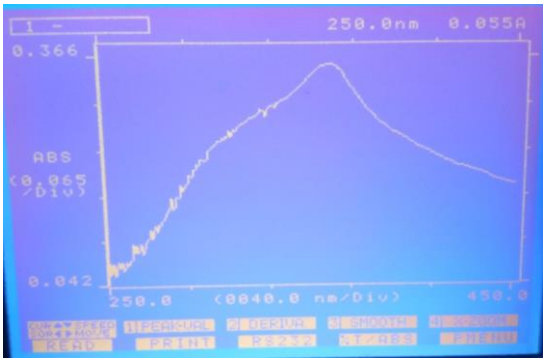

Fig.1 Uv-vis spectrum of ZnONps obtained by green method

3.2 X-ray diffraction (XRD) analysis

The pattern of X-ray diffraction (XRD) are prepared by ZnONP's prepared by Green method is shown in fig.2. According to the X- ray spectrogram of the crystal structure, the well defined peaks typical of ZnO crystal structure. The peaks are sharp which indicate the ZnONPs are crystalline which is confirmed by JCPDS data (D-2 Phaser Bruker).

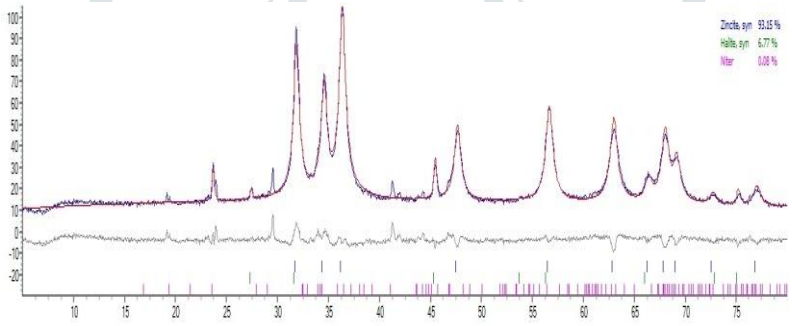

Fig 2. X-ray spectrum of ZnONPs obtained by green method

The XRD patterns of these samples give distinctive ZnONPs peaks in the Fig.2 at 100,102,101,102,110,110,103,200,112,201 and 004 respectively.

3.3) Particles size analysis

The CPS instrument have ability to measure the particle size of nanoparticles 1nm to 75µm. A homogenous solution obtained by probe sonication of ZnONPs in distilled water was used for particle size analysis. The aqueous ultra sonicated homogeneous solution ZnONPs (1 micro liter) solution is injected into the CPS instrument.

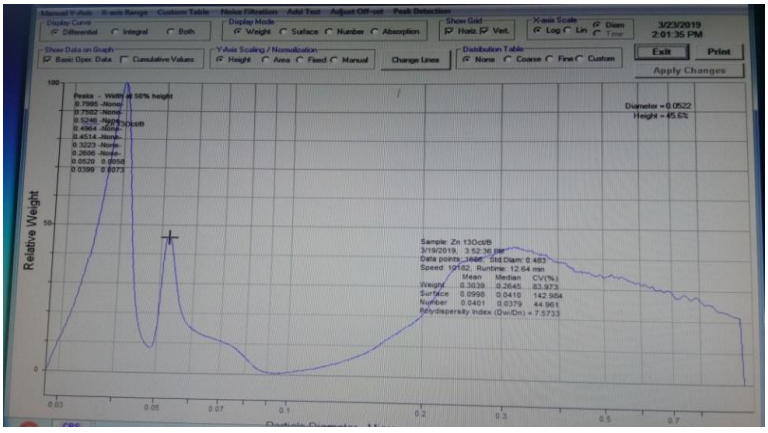

Fig 3. Particle size analysis of ZnONPs **obtained by green method**

3.4 Antimicrobial activity

Antibacterial tests were carried out by the disc diffusion method using the suspension of bacteria spread on nutrient agar11. Antimicrobial activity of ZnONPs obtained by wet chemical method against Gram positive and Gram negative bacteria shown in fig.4. The results show the excellent antibacterial activity of the samples which was found to be improving with increase in concentration of ZnONPs. The antibacterial activity of ZnONPs against *S. aureus* was found maximum compare to *E. coli* as shown in fig.(4),

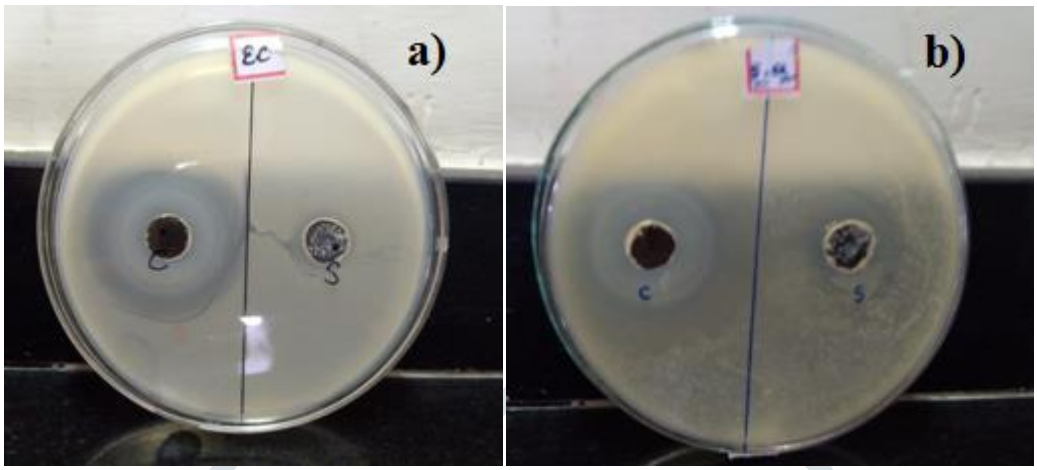

Fig.4 inhibition ZnONPs against the *E.coli* (a) and (b) for inhibition ZnONPs against the *s.aureus*

Table 1. The antibacterial activity of ZnONPs against *S. aureus and E.Coli*

Organisms	**Zone of Control** (in mm)	**Zone of Sample** (in mm)
E.Coli	12mm	04mm
S.aureus	10 mm	06 mm

The left side(a) shows the ZnONP's against the *E.coli* with zone of inhibition 12mm & 04mm with different two concentrations. Another right side (b) shows the ZnONP's against the *S.aureus* 10 mm & 06 mm with different two concentrations.

4. Conclusion

In this research study, ZnONPs were successfully synthesized via the green method using zinc nitrate solution**.** Several approaches have been employed to obtain a better synthesis of ZnONPs, such as chemical and biological methods. Development of easy, reliable an eco-friendly methods helps increase interest in the synthesis. In conclusion, a simple method has been developed to prepare nano size ZnO and coat the same on cotton fabrics to impart functional properties. The nano-ZnO coated cotton fabric is found to have the antimicrobial property. It also clearly demonstrated that the ZnO nanoparticles treated fabrics showed increased antibacterial effect than the ZnO bulk treated fabrics in comparison with the untreated fabric. The results also demonstrated that higher antibacterial activity was observed against *S.aureus* than *E.coli* both in qualitative and quantitative tests. Nanoparticles showed small amount of agglomeration.

A Biological method has been developed to prepare large quantity nano-ZnO. This nano-ZnO powder was found to have excellent antimicrobial property. It also clearly demonstrated that the ZnO nanoparticles increased antibacterial effect than the ZnO bulk. The results also demonstrated that higher antibacterial activity was observed against *S.aureus* than *E.coli* both in qualitative and quantitative tests. Green method gave the qualitative as well as the quantitative yield of 70-80% by using plant leaf extract and water as solvent for the synthesis.

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