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GREEN SYNTHESIS OF ZINC OXIDE NANOPARTICLES WITH ALCOHOLIC EXTRACT *OF* CINCHONA STEM BARK AND CHARACTERIZATION THROUGH DIFFERENT ANALYTICAL TOOLS

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Abstract:

Nanotechnology is an important field of modern research dealing with design, synthesis, and manipulation of particle structures ranging from approximately 1-100 nm. Nanoparticles (NPs) have wide range of applications in areas such as health care, cosmetics, food and feed, environmental health, biomedical sciences, chemical industries, drug-gene delivery etc. Cinchona officinalis, commonly known as the cinchona tree, is a flowering plant species in the Rubiaceae family. It is a medicinal plant, one of several Cinchona species that produce quinine and other compounds. Quinine and other compounds are effective anti-fever agents and are particularly useful in preventing and treating malaria. In the present study, the use of natural herb i.e, Cinchona officinalis has various medicinal applications including treatment of diarrhea, dysentery, flatulence, and loss of appetite etc., Zinc oxide nanoparticles were loaded with Cinchona officinalis extract and were synthesized successfully by the chemical reduction method. Nanotechnology deals with the processing of separation, consolidation, and deformation of materials by one atom or by one molecule. The foremost conditions for the synthesis of nanoparticles are the selection of green or environment-friendly solvent, a good reducing agent, and a harmless material for stabilization. Zinc oxide nanoparticles, loaded with Cinchona officinalis extract. A detailed characterization of synthesized nanoparticles was carried out using different techniques such as X-Ray diffraction (XRD), Differential scanning calorimetry (DSC), Thermogravimetry analysis (TGA), Scanning electron microscopy (SEM).

Key Words: *Synthesis, Nanoparticles , Cinchona officinalis, Characterization.*

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INTRODUCTION:

Nanoparticles are tiny materials having size ranges from 1 to 100 nm. They can be classified into different classes based on their properties, shapes or sizes. The nanoparticles show enhanced properties such as high reactivity, strength, surface area, sensitivity, stability, etc. because of their small size. The nanoparticles are synthesized by various methods for research and commercial uses that are classified into three main types namely physical, chemical and mechanical processes that has seen a vast improvement over time [1]. Nanoparticles are the hollow structures of size ranging 1-100nm. They form different structures. It has applications in medicine, physics, optics and electronics. Nanoparticles are being investigated as potential drug delivery systems to achieve the most desirable biological outcomes. For analytical applications, the cavities are exploited for the entrapment of signalling molecules for specific targeting [2]. Zinc oxide (ZnO) shows antimicrobial action against wide range of bacterial species including gram negative and gram-positive bacteria. The synthesis of ZnO nanocomposites can be carried out by using various methods such as evaporation, pulse laser deposition, sol-gel method, etc. The ZnO nanoparticles manufactured in the absence of GA showed less antibacterial activity when compared to GA–ZnO nanoparticles [3]. The herb *Cinchona officinalis stem bark* contains compounds such as quinine, quinidine, cinchonine, cinchonidine, quinic acid, keno-tannic acid, qinovin, and kinova-tannic acid [4]. Cinchona is a highly potent remedy for the treatment of stomach disorders including nausea and vomiting. Relieves pain in the lower abdomen and treats conditions associated with flatulence. Beneficial remedy to treat inflammation of liver and can be used to cure jaundice. Cinchona is a powerful remedy to relieve pain in liver associated with gallstones. Corrects digestive disorders including conditions of diarrhoea with bodily weakness. It can be used to correct disorders of the menses such as premature menses. Provides relief from pain in the pelvis during menses and increases sexual desire. Excellent remedy for curing symptoms of hay fever with profuse sweating. Widely used as antimalarial drug [5]. Zinc oxide nanoparticles, loaded with *Cinchona officinalis stem bark* extract were synthesized successfully by the chemical reduction method[6]. A detailed characterization of synthesized nanoparticles was carried out using different techniques such as X-Ray diffraction (XRD), Differential scanning calorimetry (DSC), Thermogravimetry analysis (TGA), Scanning electron microscopy(SEM) [7]. The XRD studies are used to analyze the structure and nature of the synthesized nanoparticles. Scanning electron microscopy (SEM) is used to analyze to obtain a high- resolution image of the size and morphological of synthesized nanoparticles. Thermal analytical techniques such as TGA &DSC are used for the determination of thermal properties at different conditions as mass, heat, temperature, and time [8].

MATERIALS AND METHODS:

procurement of plant material:

The crude drug *Cinchona officinalis stem bark was* procured from Yucca enterprises Mumbai, Maharashtra, India.

Preparation of extract:

The procured plant material *Cinchona officinalis stem bark* were washed thrice with tap water and one time with distilled water finally allowed to dry under shade, and then coarsely powdered in a blender. The coarse powder (250 gm) was subjected to maceration for 72 hours, followed by exhaustive maceration for 48 hours by using pure ethanol for *Cinchona officinalis stem bark*. The solvents were decanted and filtered with filter paper and recovered by distillation at 60° C to 70° C. The extract was dried under desiccators [9].

Synthesis of zinc oxide nanoparticles using *Cinchona officinalis* extract:

Pure and analytical grade chemicals were used in the synthesis of ZnO nanoparticles such as zinc acetate, ethanol, methanol, distilled water, sodium hydroxide (NaOH). It was prepared by the chemical reduction method. Firstly take zinc acetate 5gm in 250ml of RBF dissolved in 100ml of deionized water and make up to the 250ml in RBF, then add *Cinchona officinalis stem bark* extract of 20ml into zinc acetate solution at 60 ^{0}c by continuous stirring for 45mins on a magnetic stirrer for complete dissolution. After that kept it under reflux for 24hours at 100 ^{0}c in a water bath. Then add 10ml of NaOH solution (0.1M) drop wise from the corner of the flask with continuously stirring and again the total mixture was kept under reflux for 5hours. centrifugation for 20 minutes then filter the solution by using whatman filter paper. Then dried in an oven at 80^{0}c overnight and yield the product accurately finally stored the product in air tight container [10].

Characterization:

1) X-ray diffraction studies:

The phase determination of the synthesized nanoparticles, crystalline dimensions, the bulk composition can be studied using X-ray diffraction techniques (BRUKER D8 ADVANCE) using Cu radiation. The synthesized Zinc oxide nanoparticle from zinc acetate samples loaded with *Cinchona*

officinalis stem bark extract was scanned along with 2θ ranges. The various phase dimensions present in the samples were identified with available data [11].

2) Scanning electron microscopy (SEM):
The morphological characteristics and particle size assessment of synthesized nanoparticles were studied using FFI Quanta 200 FEG with EDS scanning electron microscopy. The samples containing prepared Nanoparticles were diluted using distilled water and sonicated. A small drop of the sample was placed on round cover glass (1.2cm) and allowed to dry in a desiccator at room temperature mounted on an SEM stub and coated with a thin layer of platinum to make the samples conductive for SEM analysis. The compositional analysis was carried using energy-dispersive X-ray spectroscopy [EDS] which identifies the phases present in the samples.

3) Differential scanning calorimetry (DSC):
The thermal properties such as enthalpy, heat flow, decomposition rate profile, melting point, and phase transitions reactions of the sample can be determined by differential scanning calorimetry (DSC) [12].

4) Thermogravimetric analysis (TGA):
To study the thermal decomposition rate profile of a powered sample and to determine the thermal stability, mass transfer over time and temperature in a sample can be measured by thermal gravimetric analytical techniques. A thermogravimetric analyzer measures mass by varying the temperature over a while [13].

RESULTS AND DISCUSSION:

1) X-ray diffraction pattern for synthesized Nanoparticles:

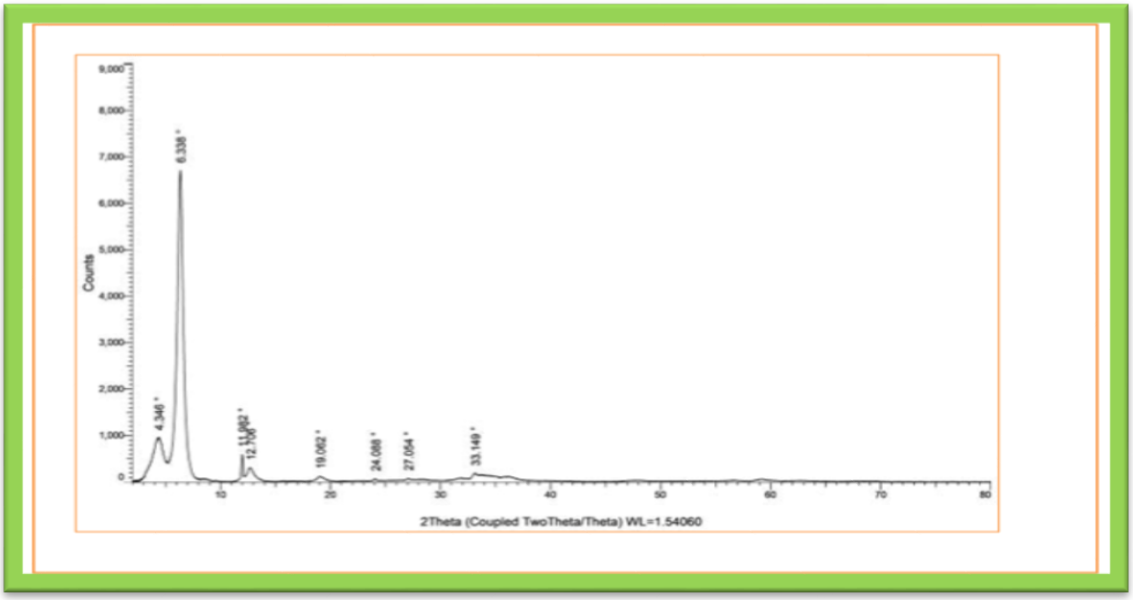

Figure 1 : XRD Graph of synthesized nanoparticles.

S.No.	Angle	d-value	Relative intensity
1.	4.36^0	20.31	14.2%
2.	6.34^0	13.93	100.0%
3.	11.98^0	7.38	8.8%
4.	12.70^0	6.96	4.6%
5.	19.06^0	4.65	1.9%
6.	24.05^0	3.69	1.1%
7.	27.05^0	3.29	1.2%

Table 1: XRD Values for synthesized Nanoparticles.

2) SEM Analysis for synthesized Nanoparticles:

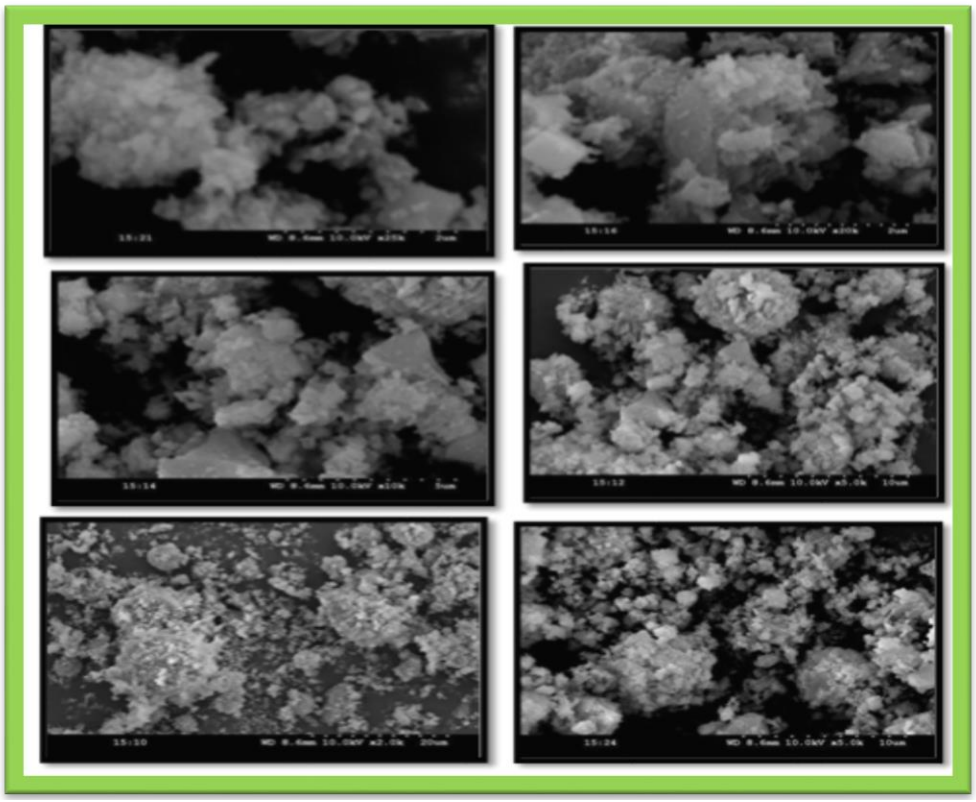

Figure 2: SEM Analysis of ZnO Np Loaded With *Cinchona officinalis* extract.

To acquire the size and to observe the morphology, the synthesized nanoparticle was subjected to scanning electron Microscopical examination (SEM). And the images are presented above. The *Cinchona officinalis* extract concentration will directly influence the size and morphology of nanoparticles. Increased concentration of zinc oxide (1% w/v) covers the thick layer to form a hollow spherical globular.

3) DSC study of nanoparticles:

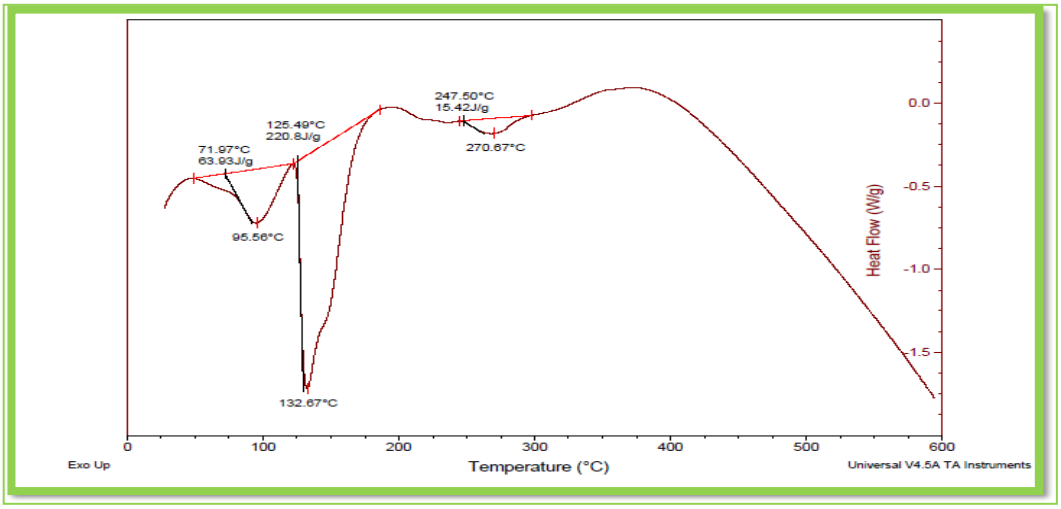

Figure 3: Differential Scanning Calorimetry (DSC).

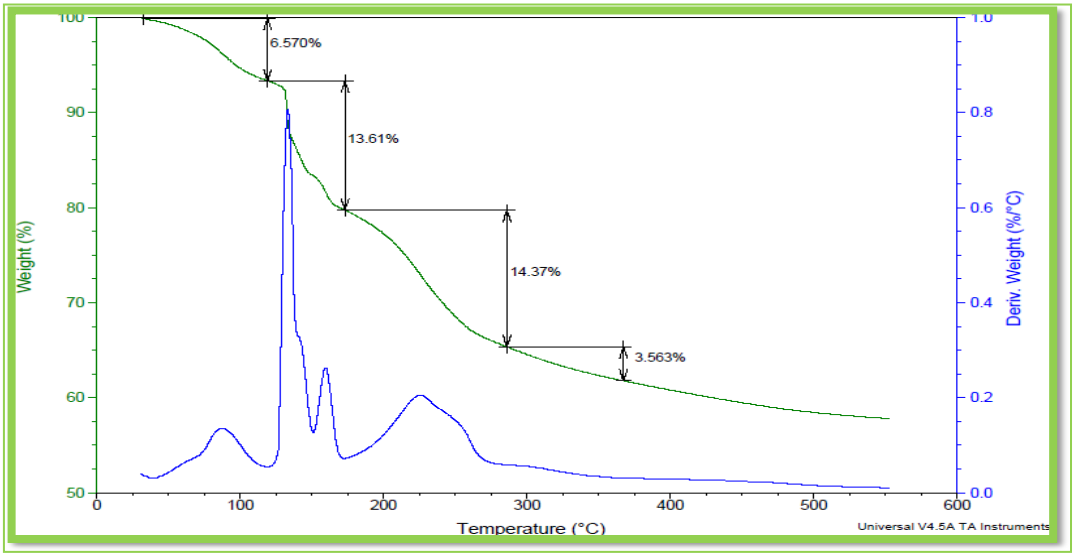

Figure 4: Graphic presentation of TGA.

It was observed that endothermic peak at a temperature ranging from 10 ^{0}c to 130^{0}c and the thermogram of zinc oxide shows a broad endothermic peak which may be due to loss of water of crystallization and exothermic reactions shows the decomposition of nanoparticles.

The thermogram of zinc oxide nanoparticles was characterized by a sharp endothermic peak appearing at a temperature range of 132.67 ^{0}c, which indicates the melting point [% weight loss] of the drug with a temperature onset at about 130 ^{0}c is recorded. The enthalpy is normalized at (247.50)15.42j/g.

4) Thermo gravimetry analysis (TGA):

The Thermogravimetric analytical representation, which is a simple and accurate technique to study the decomposition pattern and thermal stability of polymers Thermo gravimetric analysis of zinc oxide nanoparticles is carried out under nitrogen atmosphere and the analytical result of the thermogram shows the thermal stability and thermal behavior of *Cinchona officinalis* extracted the nanoparticle by Heating sample from 10 to 900^{0}c, at 10^{0}c per minute results in 6.570% mass loss due to polysaccharide.

CONCLUSION:

Zinc oxide nanoparticles were loaded with *Cinchona officinalis* extract and were synthesized successfully by the chemical reduction method. Generally, the chemical methods used are too expensive, and incorporate the use is too expensive. A detailed characterization of synthesized nanoparticles was carried out using different techniques such as X-Ray diffraction (XRD), Differential scanning calorimetry (DSC), Thermogravimetry analysis (TGA), Scanning electron microscopy (SEM). The future scope of this research work about *Cinchona officinalis* extract is wide because, it is a natural source with antioxidant activity and used to treat different types of diseases traditionally.

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