



## Zinc Oxide Nanoparticles Synthesized From Curcuma Longa Extract for Seed Germination

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### Abstract

In the present work zinc oxide nanoparticles were synthesized using simple green method. The prepared nano particles of zinc oxide was characterized by using XRD, FTIR, TG/TDA and SEM. The particles size was estimated using XRD pattern. This study shows that the exploit of aqueous extraction of the curcuma longa tubers powder act as reducing and stabilizing agent. The preparation of nanoparticle by green synthesis causes significant effect on bioavailability of seed germination and seed growth parameters of the mung bean. The seed germination experiment was carried out under greenhouse conditions to ensure uniform conditions. Biological method highlights the necessity for sustainable study on the impacts of nanoparticles on agricultural and environmental sectors.

**Keywords:** Green method, Curcuma longa tubers, Mung bean, Seed germination.

## 1. Introduction

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## 1. Introduction

The development of nanotechnology will inevitably release nanoparticles into the environment with unidentified consequences. Nanoparticles are atomic or molecular aggregates with at least one dimension between 1 and 100 nm, which can drastically modify their physicochemical properties when compared to the bulk material. Owing to its high surface area to volume size ratio, exhibit significantly novel and improved physical, chemical, and biological properties, phenomena, and functions [1]. In biological systems, zinc oxide plays significant roles in a wide variety of metabolic processes such as carbohydrate, lipid, nucleic acid, and protein synthesis as well as their degradation. Green synthesized zinc oxide nanoparticles appear in different shapes such as nano-powder or nano-cluster or nano-crystal the plant extract phenol compounds it may be effect on size and shapes [2]. The use of zinc oxide nanoparticles (ZnO NPs) is increasing in agricultural products and consumer goods, such as cosmetics, clothing and bottle coatings. Green synthesized ZnO is an environmentally eco-friendly material, which is desirable especially for bio-applications, such as seed germination, bio-imaging and cancer detection. Zinc oxide nanoparticle is a commonly used metal oxide ENPs. Zinc oxide is used in a range of applications such as sunscreens and other personal care products, electrodes and biosensors [3] photo catalysis and solar cells. Owing to increasing use in consumer products, it is likely that through both deliberate application and accidental release, ENPs will find their way into aquatic, terrestrial and atmospheric environments [4-6]. There is considerable concern about the potentially harmful effects of those ENPs due to their unique properties, they may have significant effects on many organisms [2, 7] especially plants which are essential base component of all ecosystem.

## 2. Experimental Details

### 2.1. Materials

Curcuma longa tubers (from local super market), zinc nitrate (Sigma Rich), cerium nitrate (Sigma Rich), acetone, ethanol, and distilled water were used in the synthesis process in their pure form without any further modification.

### 2.2. Extraction of Curcuma Longa Tubers Powder

The *C. longa* tubers were purchased from a local market; The *C. longa* tubers were washed to remove the adhering mud particles and possible impurities. Later they were dried under sunlight for a week to completely remove the moisture. The tubers were cut into small pieces, powdered in a mixer, and then sieved using a 20-mesh sieve to get uniform size range. The final sieved powder was used for all further studies. For the production of extract, 0.3 g of *C. longa* tubers powder was added to a 200 mL flask with 100 mL ethanol and then mixed for 4 hours at 70°C temperature.

### 2.3. Green Synthesis of ZnO Nanoparticles

0.5M of zinc nitrate was added to 100ml distilled water under constant stirring. The curcuma longa tubers powder extraction was introduced to above solution. This was then placed in a magnetic stirrer for 2 hrs at 70°C temperature. After terminating the reaction, the pale white precipitate was then taken out and washed over and over again with distilled water followed by ethanol to get free of the impurities and then a pale yellow powder of ZnO nanoparticles was obtained. The resulting powder was annealed at 400°C for 2 h [8, 9].

### 2.4. Seeds

The mung bean seeds were purchased from market these seeds were kept in a dry place in the dark under the room temperature before using.

### 2.5. Seedling exposure

The seeds were checked for their viability by suspending them in double distilled water. The seeds which are settled to the bottom were selected for further study. The seeds were rinsed in double distilled water thrice and then surface sterilization of seeds was done. The biological synthesized ZnO nanoparticles were sonicated for 3 hrs. Then add the sterilized seeds in prepared nanoparticle suspensions (100mg) using a sonicator instrument. The soaked seeds were put in prepared pots and observe of the growth.

## 3. Results and Discussions

### 3.1. XRD Analysis

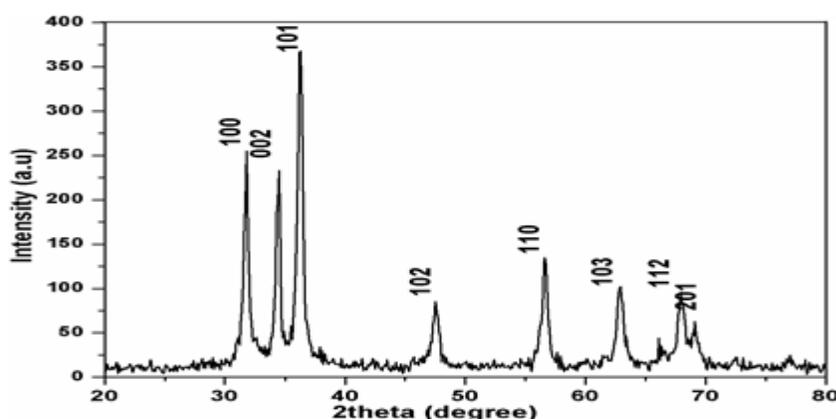


Fig-1. XRD pattern of ZnO nanoparticles

The strong diffraction peaks of ZnO detected in the sample, which demonstrate that the synthesized product have well-crystalline wurtzite hexagonal phase ZnO. Figure.1 shows the distinctive peaks at (100), (002), (101), (102), (110), (103), (112) and (201) which demonstrate that the synthesized product have well-crystalline wurtzite hexagonal Phase ZnO. Chenguo, et al. [10] And above peak values are compared with JCPDS card numbers 76-0704, 34-0394 concluded that all the characteristic peaks observed are well-matched with those of wurtzite hexagonal well-crystalline ZnO. The crystalline size of as prepared sample was found using scherrer formula  $D = 0.9\lambda/\beta\cos\theta$  where D= average particle size,  $\beta$  is full width at half maxima,  $\theta$  is the bragg angle,  $\lambda$  is the wavelength in angstrom. The crystalline size of biological method ZnO is about 24 nm.

### 3.2. TG/DTA Analysis

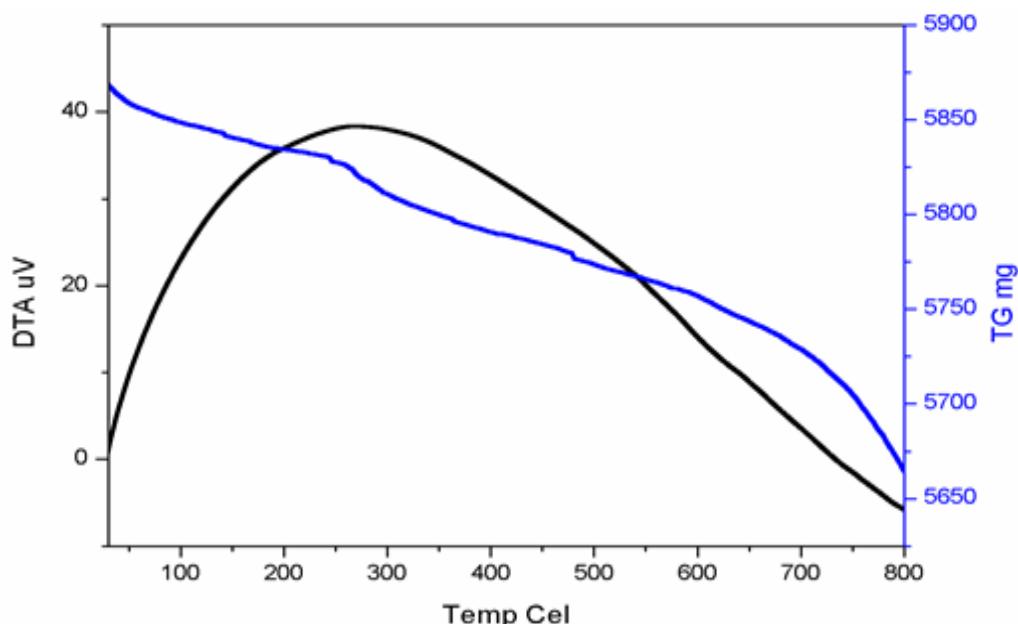


Fig-2. TG/DTA curve of ZnO nanoparticles

The TGA curves of the prepared sample are shown in Figure 2 and the variation of thermal stability in ZnO nanoparticles in biological method are visualized. The temperature below 100°C is attributed to the loss of adsorbed water on the surface. The second stage around 120 to 350°C may be due to the release of residual chemisorbed water and the release of organic residues. The third part appeared after 350°C ascribed to the removal of hydroxyl group on the materials. The DTA curve in Figure 2 further confirms the loss of water and organic residues. The endothermic peak at around 40°C is attributed to desorption of water. The exothermic peak at 280°C confirms the release of residual chemisorbed water and the release of organic residues [11].

### 3.3. FTIR Analysis

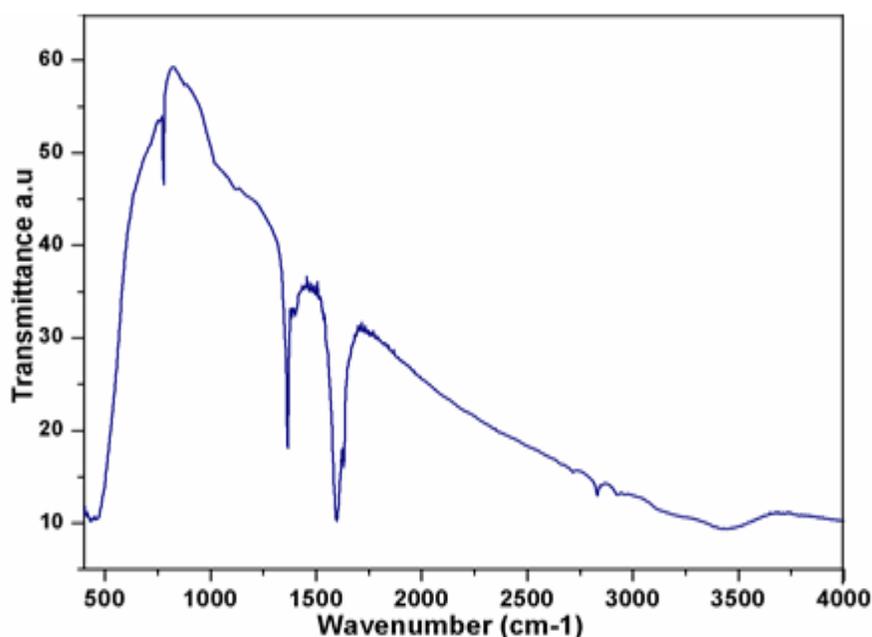


Fig-3. FTIR spectra of ZnO nanoparticles

Figure 3 shows synthesized zinc nanoparticles were subjected to FT-IR analysis to detect the various characteristic functional group associated with the synthesized nanoparticles. The peaks indicate the characteristics functional group present in the synthesized zinc oxide nanoparticles which is done in the range of 400 to 4000  $\text{cm}^{-1}$ . The bands centered at 3474 and 1610  $\text{cm}^{-1}$  are assigned to stretching and bending vibration of  $\text{H}_2\text{O}$  absorbed from the environment, respectively. The very intense bands between 1242 and 1407  $\text{cm}^{-1}$  are attributed to Zn-O bonds. The broad band centered at 468  $\text{cm}^{-1}$  is responsible for ZnO bonds [12].

### 3.4. Scanning Electron Microscope

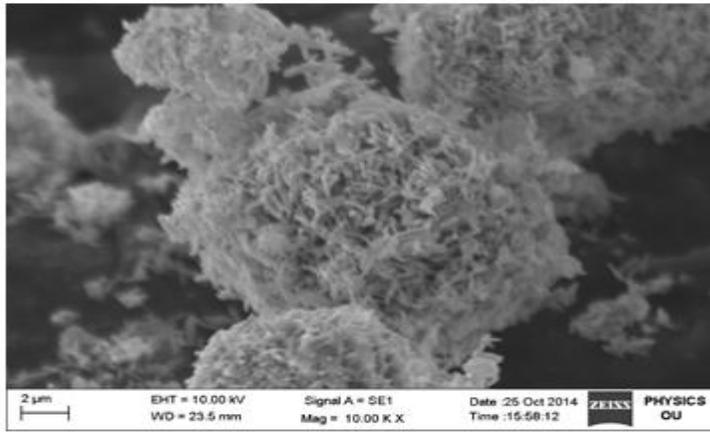


Fig-4. SEM image of ZnO nanoparticles

Morphology of synthesized ZnO nanoparticles were studied using scanning electron microscope (SEM) and is shown in Figure.4 at magnifications for biological methods of ZnO nanoparticles respectively [13, 14]. Biologically synthesized nanoparticles of ZnO were found to be spherical and thin plates in shape respectively. The biologically synthesized nanoparticles are of lower size than chemically synthesized with size uniformity. And some agglomeration was also observed in chemically synthesized nanoparticles

### 3.5. Preparation of ZnO Nanoparticles Suspension and Mungbean Seed Treatment

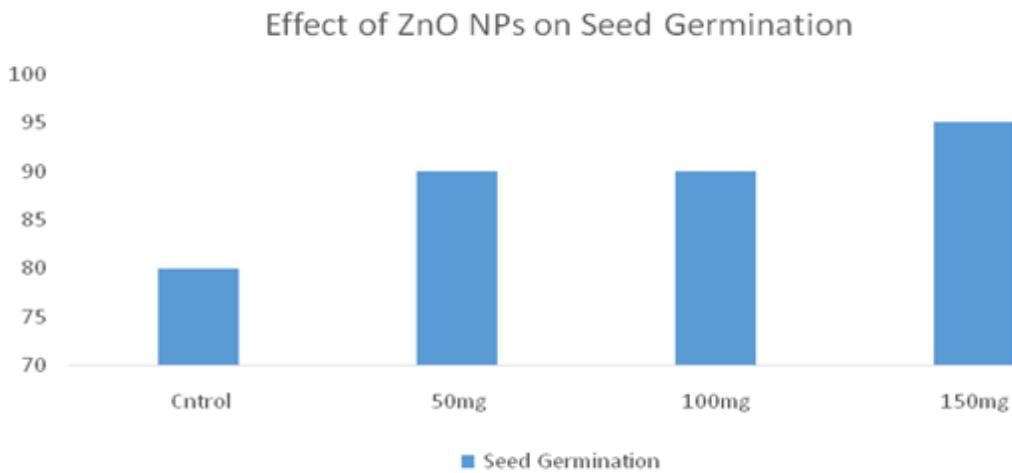


Fig-5. Effect of ZnO NPs on mungbean seed germination

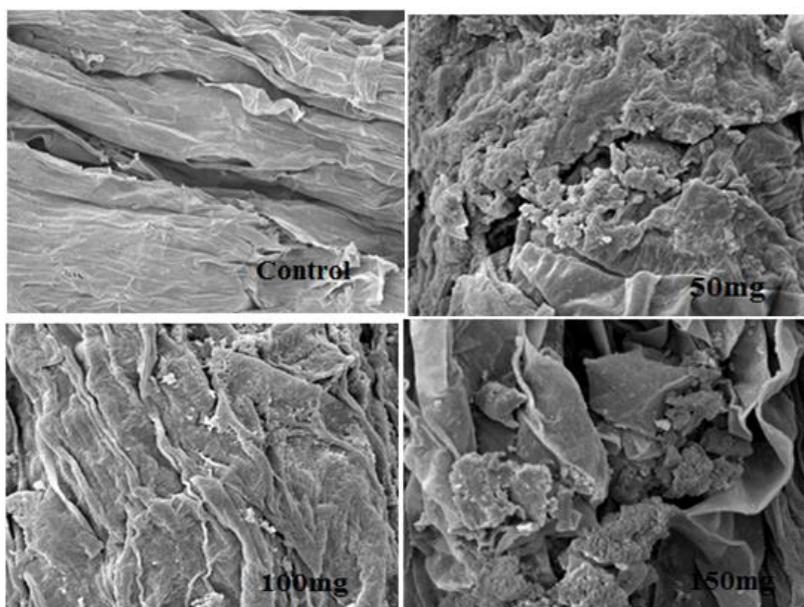


Fig-6. Mung bean root surface analysis with SEM

The green synthesized ZnO nanoparticles suspension were prepared with different concentration of (0.0, 50, 100, 150mg) mungbean seeds were sterilization with distilled water several times and soaked for 30 minutes. The different concentration of ZnO suspensions sonicator for dispersion of nanoparticles and then soaked of these seeds in suspensions. The sterilized soil was prepared filled in the pots the sowing seeds poured in this and observed germination and plant growth. Our results indicated that nano sized ZnO in lower concentration could promote the seed germination and seedling growth of mungbean in comparison to control. Nanoparticles can explain their actions depending on both the chemical composition and on the size and/or shape of the particles. Seed soaking with nano-ZnO could increase the germination capacity of *mung bean* [15-17]. The biological synthesized ZnO nanoparticles

are environmental eco-friendly and easily dissolved in water compared to the chemically synthesized nanoparticles. Percentage of seed germination was significantly affected by the interaction of different concentration of ZnO nanoparticles. Due to interaction of ZnO NPs the percentage of germination has been increased. From results the control has shown the 80% germination, nanoparticles treated seeds has shown variation in germination at graded concentration of nanoparticles viz., 50mg shown 90%, 100mg shown 90% and 150mg shown 95% germination in mungbean seeds. The ZnO nanoparticles can penetrate seed coat and stimulate the growth hormones especially IAA (indole acetic acid), the IAA started early seed germination and support the water uptake of the mungbean plant from ground [18-20].

#### 4. Conclusion

In current study the green synthesized ZnO NPs were characterized by different techniques for calculation of crystalline size, particles size, morphology, chemical compositions, thermal analysis etc. The ZnO nanoparticles effect on mung bean seed germination and the length of root and shoot were studied. Nanoparticles of metal oxide are quickly transported through the plant and included in the metabolic processes. We observed that in green gram seeds germination biologically synthesized nanoparticles suspension solution shown good shoot, root growth results. However, an observed positive effect of ZnO nanoparticles on the seed germination could have significant economic importance for agriculture.

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