Impatiens Balsamina Leaf Extracts Mediated Synthesis and Characterization of Zinc Oxide Nanoparticles

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Abstract - Nanoparticles occur widely in nature and are a subject of great interest in various fields of sciences. They are of great importance and value, hence synthesis and its practical application is been a major area of researches. In the present study, plant mediated synthesis of zinc oxide nanoparticles is carried out using aqueous extracts of *Impatiens balsamina* leaf. The synthesized nanoparticles is characterized using Ultra violet- Visible spectroscopy (UV-Visible spectroscopy) and X-ray diffraction techniques (XRD techniques). The absorption maximum obtained from UV-Visible spectroscopy was 375nm and the XRD techniques showed a crystalline size of 37.4nm.

***Key Words*:** zinc oxide nanoparticles, impatiens balsamina, XRD, UV-Visible spectroscopy

1. INTRODUCTION

Nanotechnology is a field that is making a mark in research day by day and making an impact in all sphere of human life. [1] The field of nanotechnology has become more important in human life now a days as there are modern techniques to characterize its properties and evaluate its applications made them an important subject among the researchers. In material science, green synthesis has gained extensive attention as a reliable, sustainable and eco-friendly protocol for synthesizing a wide range of materials including nanomaterials. [2] The environmental friendly synthesis of nanoparticles process is a revolutionary step in the field of nanotechnology. [3]

Green synthesis of metallic nanoparticles using various biological materials like bacteria, fungi, algae and plant extracts exists. Among the available green methods of synthesis for metal metal oxide nanoparticles, utilization of plant extracts is rather simple and easy process to produce nanoparticles at large scale. Basically, green synthesis of materials or nanomaterials produced through regulation, control, clean up remediation process will directly help uplift their environmental friendliness. [4] Plants are nature's "chemical factories". They are cost efficient and require low maintenance. [5] Advantages of the method like minimization of waste, reduction of derivatives and pollution and use of safer solvents and renewable feedstock inspires the researchers to follow it. The nanoparticles produced through such methods are found to have many applications in various fields.

in the present study we used the plant *Impatiens balsamina* also known as balsam weed, garden balsam, garden touch-me-not, jewel weed and spotted snap weed, an annual herb belonging to the family *Balsaminaceae* commonly called as Balsam which grows from 60 to 100 cm high. In the plant mediated synthesis of nanoparticles, the plant extracts function as reducing, stabilizing and capping agents. [6] The zinc oxide (ZnO) nanoparticles is one of the most studied inorganic metal oxide nanoparticle [7] due to its wide range of applications. ZnO nanostructures have a great advantage to apply to a catalytic reaction process due to their large surface area and high catalytic activity. [8] US FDA has enlisted zinc oxide as GRAS (generally regarded as safe) metal oxide. [9] Of all the metal oxides nanoparticles zinc oxide nanoparticles are inexpensive to produce easily and safe. [10]

2. MATERIALS AND METHODS

2.1 Plant collection

The fresh leaves of *Impatiens balsamina* were collected from Palakkad district, Kerala state. Leaves was washed thoroughly with distilled water, dried under shade and powdered.

2.2 Aqueous extract preparation

The powdered leaves of *Impatiens balsamina* was added to 100ml distilled water taken in a 250ml conical flask. The solution was shaken well with an orbital shaker and boiled at 70°C for eight minutes. The hot solution was allowed to cool to room temperature. The extract was then filtered through a Whatman No. 1 filter paper.

2.3 Synthesis of zinc oxide nanoparticles

1M Zinc acetate was dissolved in 50ml distilled water and shaken for 1hour. Then sodium hydroxide solution (for regulating pH) and 25ml aqueous extracts of *impatiens balsamina* was added to the same. The solution was then kept for incubation period of 1 hour. The colour of the reaction mixture changed and a dirty colour appeared after incubation. The solution was left for 3 hours shaking. The precipitate formed was separated from the solution by centrifugation for 15 minutes and the pellets were collected, dried in an air oven operating at 70○C for 2 hours and stored in an air tight container for characterization studies.

2.4 Characterization of synthesized zinc oxide nanoparticles

The synthesized nanoparticles were analysed using X- ray diffractometer (XRD) operated at 45Kv and 30MA for determination of crystallinity and size of nano particles. The zinc oxide nanoparticles synthesized from *impatiens balsamina* leaf extract was subjected to UV-Vis spectroscopy and the spectrum was recorded between 800-200nm.

3. RESULT AND DISCUSSION

3.1 UV-Visible analysis

The UV-Visible spectrum of zinc oxide nanoparticles synthesized using *Impatiens balsamina* leaf extracts is shown in Fig 1. The synthesized zinc oxide nanoparticle had an absorption maximum at 375nm which is a characteristic wavelength of zinc oxide nanoparticles.

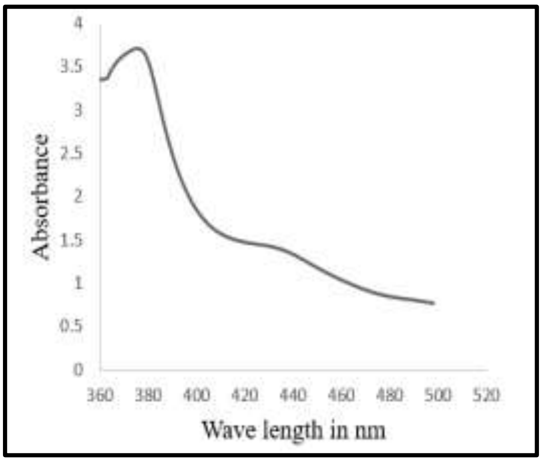

Fig 1 UV-Visible spectrum of zinc oxide nanoparticles

3.2 XRD analysis

On examining the XRD pattern shown in Fig 2 of zinc oxide nanoparticles synthesized using aqueous leaf extracts of impatiens balsamina, the crystalline size of the nanoparticles was calculated by Debye- Scherrer's formula and the percentage crystallinity was also calculated.

Table: 1 Crystallinity of zinc oxide nanoparticles

Nano material	Total intensity of stronger peaks(counts) (I_c)	Total intensity of broader peaks (counts) (I_a)	% Crystallinity, $\%\chi = (I_c / I_c + I_a) \times 100$
Zinc oxide nanoparticles	2996.61	804.1	78.84%

From the analysis, the percentage crystallinity of zinc oxide nanoparticles is 78.84%.

Particle size calculation by using **Debye Scherrer's formula,**

$$D = k\lambda/\beta \cos\theta$$

Where D- The particle size to be determined

k- Scherrer's constant =0.94

λ- The wavelength of the x-ray source = 0.15406nm

β- The Full Width for Half Maximum for the diffracted peak (FWHM) = 4.668×10-3 radians

θ- Bragg's angle for the peak = 24.54

D = (0.94 × 0.15406) ÷ (4.668×10-3 × cos 24.54) = 37.4nm

The size of the particle is 37.4nm which confirms that the synthesised particle is nano.

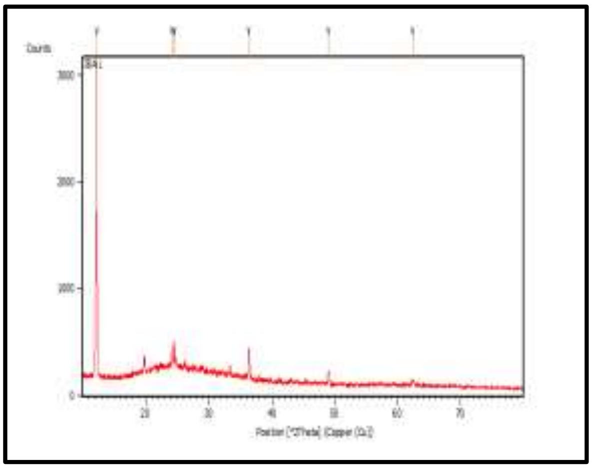

Fig 2 XRD graph of zinc oxide nanoparticles

4. CONCLUSIONS

The present study was an effort to find an eco-friendly method for the synthesis of zinc oxide nanoparticles.. The bio synthesis of zinc oxide nanoparticles was carried out using aqueous extracts of *Impatiens balsamina* and dirty white precipitation during the process indicated the formation of nanoparticles. Further the formation of zinc oxide nanoparticles was confirmed by UV-Vis spectroscopy, which showed an absorption maxima of 375nm indicating that the synthesized particles might be in nano scale. The XRD values were used to calculate the particle size of the synthesised nanoparticles using Debye Scherrer's formula and it was found to be 37.4nm.The percentange crystallinity of the nanoparticles was found to be 78.84% using the peak values of XRD. Thus it can be concluded that the plant mediated synthesis of zinc oxide nanoparticles can be successfully achieved by using aqueous extracts of *Impatiens balsamina* leaves.

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