

# Rapid Green Synthesis of Zinc Oxide Nanoparticles Using Kedrostis Foetidissima (Jacq.) Cogn Leaf

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**ABSTRACT:** The synthesis, characterization and application of nanomaterials have become an important branch of nanotechnology. In the present work, we mainly focus on green chemistry in the synthesis of Zinc Oxide nanoparticles by using a dried leaves of Kedrostisfoetidissima (Jacq.)Cognleaf extract as the reducing agent. The synthesized nanoparticles were characterized by FTIR, Scanning Electron Microscope(SEM) and X-ray Diffraction (XRD). The ecofriendly green synthesis method provides simple, easy and cost effective faster synthesis of nanoparticles than chemical methods.

**KEY WORDS:**Green synthesis, Kedrostisfoetidissima leaf, Zinc Oxide nanoparticles, X-ray Diffraction(XRD), SEM.

## I.INTRODUCTION

Green synthesis techniques make use of moderately pollutant free chemicals to synthesis nanomaterials and embrace the use of benign solvents such as water, natural extracts. Green chemistry seeks to reduce pollution at source [1,2]. Nanoparticles are clusters of atoms in the size range of 1-100 nm. 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 [3]. Furthermore, ZnO is an environmentally friendly material, which is desirable especially for bio-applications, such as bio-imaging and cancer detection[4]. The green synthesis of metallic nanoparticles involves biocompatible ingredients under physiological conditions of temperature and pressure. Moreover, the biologically active molecules involved in the green synthesis of NPs act as functionalizing ligands, making these NPs more suitable for biomedical applications [5]. Nanoparticles present a higher surface area to volume ratio with decrease in size, distribution and morphology of the particles [6].

In the synthesis of nanoparticle toxic chemicals are used and lead to non-ecofriendly by products[3]. Use of biological organisms such as microorganisms, plant extract or plant biomass could be an alternative to chemical and physical methods for the production an eco-friendly manner on of nanoparticles [7]. Several biological systems including bacteria, fungi and yeast have been used in synthesis of nanoparticles [8]. Synthesis of nanoparticles using microorganism involves elaborate process of maintaining cell cultures, intracellular synthesis and multiple purification steps. In this regard using "green" methods in the synthesis of Zinc oxide nanoparticles has increasingly become a topic of interests as conventional chemical compounds/organic solvents as reducing agents[9] . Most of the synthetic physicochemical methods reported till date are heavily on the use of organic solvents and toxic reducing agents like thio phenol, mercapto acetate, sodium borohydride etc. Most of these chemicals are highly active and pose potential environmental and biological risks. With the increasing interest, in minimization or elimination of such kinds of hazardous chemicals ,the development of biological , biomimetic and biochemical approaches is desirable. Therefore, biological approach has advantages over physicochemical methods because of its clean, non-toxic chemicals, environmentally benign solvents, and user –friendly nature [10]. Zinc oxide nanomaterials are used in the preparation of substances processing medicinally as well as in cosmetics . Due to its antibacterial properties , zinc oxide is applied on the skin in the form of powders, antiseptic creams, surgical tapes and shampoos, to releve skin irritation, diaper rash,dry skin and blisters. Zinc oxide is used along with iron oxide to prepare calamine lotion and with eugenol to

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prepare zinc oxide eugenol which is used for dental applications [11,12]. Plant extracts mediated zinc oxide nanoparticle synthesis have been reported in Coriander sativum [13], Acalypha indica [14].

Kedrostisfoetidissima (Jacq.) Cogn is a traditional herb belonging to Cucurbitaceae family. The edible portions of the plant such as tubers, rhizome, and stem are consumed by tribal people. As an ethnomedical plant, it can be used for treating ailments, common cold, diarrhea, and measles. The phytochemical analysis of petroleum ether extract of leaf and chloroform extract of stem are revealed the presence of flavonoids, triterpenoids, phenols, steroids, and glycosides as reported in the literature [15,16].

In our present study, we have reported green synthesis of zinc oxide nanoparticles using Kedrostisfoetidissima leaf extract without using any toxic chemicals. To the best of our knowledge, biogenic green approach using Kedrostisfoetidissima leaf extract has been used for the first time as a reducing material as well as surface stabilizing agent for the synthesis of ZnO nanoparticles. The structure, phase and morphology of synthesized product were investigated by the standard characterization techniques.

## II. MATERIALS AND METHODS

### A. MATERIALS

Zinc nitrate ( $ZnNO_3$ ) and glassware was purchased from Merck Chemical Reagent Co. Ltd. India. All glassware was washed with sterile distilled water and dried in hot air oven before use

### B. PREPARATION OF THE LEAF EXTRACT

Kedrostisfoetidissima (Jacq.) Cogn leaves were collected from the surroundings of Namakkal. The leaves were thoroughly washed with water to remove the dust particles and then dried light. The dried leaves were cut in to fine pieces and grinded for powder. The extract used for the reduction of zinc ions ( $Zn^{2+}$ ) to zinc nanoparticles (ZnO) was prepared by placing 5g of washed, dried, fine powdered leaves in 250 ml glass beaker along with 100ml of double distilled water. The mixture was then boiled for 60 minutes by using magnetic stirrer until the colour of the aqueous solution changes from watery to light yellow. The leaf extract was cooled to room temperature and filtered using filter paper. The extract was stored in a refrigerator in order to be used for further experiments.

### C. PREPARATION OF ZINC OXIDE NANOPARTICLES

For the synthesis of nanoparticles, 50ml of Kedrostisfoetidissima (Jacq.) Cogn leaves extract was taken and boiled to 60-80 degree Celsius using a stirrer-heater. 5 grams of Zinc Nitrate was added to the solution as the temperatures reached 60 degree Celsius. This mixture is then boiled until it reduced to a deep yellow coloured paste. This paste was then collected in a ceramic crucible and heated in an air heated furnace at 400 degree Celsius for 2 hours. A light yellow coloured powder was obtained and this was carefully collected and packed for characterization purposes. The material was mashed in a mortar-pestle so as to get a finer nature for characterization.

### D. CHARACTERISATION OF ZINC OXIDE NANOPARTICLES

FTIR pattern of synthesized zinc oxide nanoparticles was studied in the scanning range from 400-4000 $cm^{-1}$  using a Shimadzu FTIR spectrophotometer. The purity and crystalline size were characterized by using X-ray diffractometer. The SEM analysis is used to identify the size and shape of the zinc oxide nanoparticles.

## III. RESULTS AND DISCUSSIONS

### A. FOURIER TRANSFORM INFRARED SPECTROSCOPY (FTIR) ANALYSIS

Fourier Transform Infrared Spectroscopy is used to identify the presence of biomolecules which plays an important role in the synthesis of nanoparticles and shown in the (Figure 1). The purity and crystalline size were characterized by using X-ray diffractometer. The SEM analysis is used to identify the size and shape of the zinc oxide nanoparticles. The possible biomolecules responsible for capping and reduction of zinc oxide nanoparticle of particular bonds vibrational peaks were noticed.

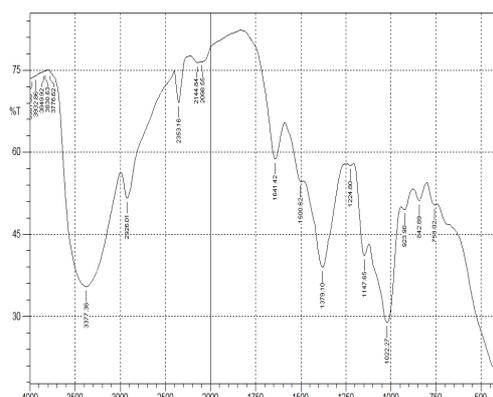


Fig.1: FTIR Analysis of Zinc Oxide nanoparticles prepared from Kedrostisfoetidissima leaf

The absorption peaks were identified around 3377.36, 2926.01, 2353.16, 1641.42, 1379.10, 1022.27 cm<sup>-1</sup> in Kedrostisfoetidissima leaves extract and the synthesized zinc oxide nanoparticles peaks were found. Therefore the synthesized nanoparticles were surrounded by (1641.42, 1379.10, 1022.27 cm<sup>-1</sup>) C=C aromatic ring, C-O stretching (3377.36, 2926.01, 2353.16 cm<sup>-1</sup>) were identified.

**B. X-RAY DIFFRACTION (XRD) ANALYSIS**

The powdered sample was used by a Cu K $\alpha$  - X Ray Diffractometer for confirming the presence of ZnO and to analyze the structure were shown in (Figure2).

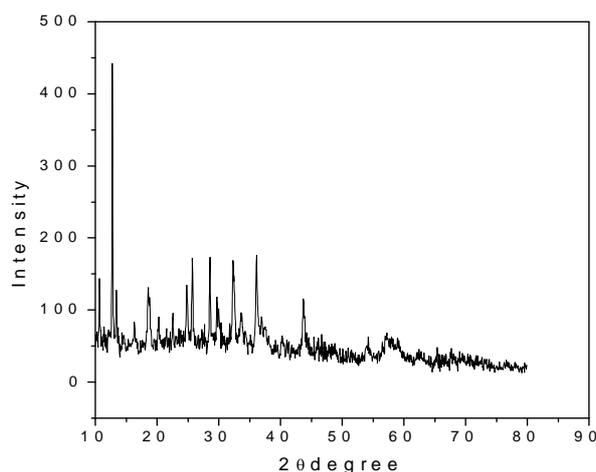


Fig.2 : X-ray diffraction pattern of Zinc Oxide nanoparticles using Kedrostisfoetidissima

XRD pattern of nanoparticles shows the intense peaks in the whole spectrum of 2θ value ranging from 10 to 80. The XRD spectrum showed different peaks  $\theta=32.3^\circ, 33.6^\circ, 36.1^\circ, 40.2^\circ, 43.7^\circ$  values corresponds to ZnO. The crystalline size was calculated from the width of the XRD peaks using Debye-Scherrer's formula.

$$D = 0.94\lambda / \beta \cos \theta$$

Where D is the average crystalline size perpendicular to the reflecting planes,  $\lambda$  is the X-ray wavelength,  $\beta$  is the full width at half maximum (FWHM), and  $\theta$  is the diffraction angle.

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### C. SCANNING ELECTRON MICROSCOPE (SEM) ANALYSIS

The SEM analysis was used to determine the structure of the reaction products that were formed. Thin films of the sample were prepared on a carbon coated copper grid by just dropping a very small amount of the

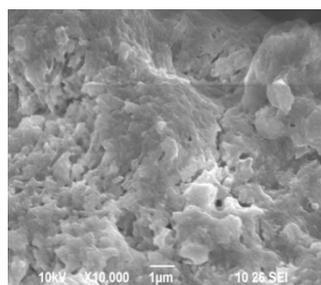
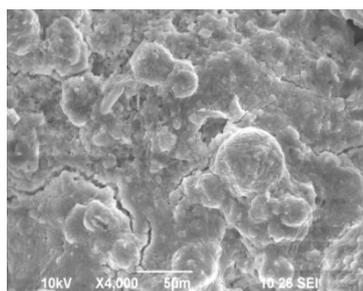


Figure 3 (a)

Figure 3 (b)

Fig.3 (a) and (b):SEM images of Zinc Oxide Nanoparticle

sample on the grid, extra solution was removed using a blotting paper and then the film on the SEM grid were allowed to dry by putting it under a mercury lamp for 5 min . SEM image has showed individual zinc particles as well as a number of aggregates and shown in Figure 3 (a) & (b).

### IV. CONCLUSION

The rapid green synthesis of zinc nanoparticles using leaf extract of *Kedrostisfoetidissima*(Jacq.) Cogn leaf provides an environmental friendly, simple and efficient route for synthesis of nanoparticles. The biological production of metal nanoparticles is becoming a very important field in chemistry, biology and materials science. Metal nanoparticles have been produced chemically and physically for a long time; however, their biological production has only been investigated very recently. The biological reduction of metals by plant extracts has been known since the early 1900s; however, the reduction products were not studied. The harmful and toxic reducing and stabilizing agents can be avoided by using the plant extracts. In the presence of strong oxidizing substances only Zinc nanoparticles can exist as ions. ZnO is non toxic it can be used as photocatalytic degradation materials of environmental pollutants. ZnO nanoparticles prepared from *Kedrostisfoetidissima*(Jacq.) Cogn leaf extract are expected to have more extensive application in biotechnology, sensors, medical, DNA labeling, drug delivery and water remediation.

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