RESEARCH ARTICLE

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Synthesis of Bio Nanocatalyst of ZnO Nanoparticles using *Ocimum Basilicum* Leaves

Mahmood N. Jasim and Zainab T. Y. Alabdullah

ABSTRACT

The aqueous extract of *Ocimum basilicum* leaves and zinc salts (zinc sulphate) was used as precursors in this investigation to create zinc oxide nanoparticles. ultraviolet-visible spectroscopy, scanning electron microscopy, Dynamic light scattering (DLS) were used to characterize the produced nanoparticles. (SEM), Energy-dispersive X-ray analysis (EDX), Because UV-Vis spectra exhibit absorption peaks in the 350 nm range. DLS analysis prove the nano size for the prepared colloidal of zinc oxide nanoparticles. SEM investigations showed a spherical shape with an average size of (30-80) nm. Analysis of (EDX) showed that elementary analysis was which are 31.8% and oxygen is 21.3%.

Keywords: DLS, *Ocimum Basilicum* Leaves, SEM, Zinc Oxide Nanoparticles.

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I. Introduction

Recent years have seen a lot of interest in nanomaterials because of their distinctive qualities. Less than 100 nanometers in size, the nano scale is where materials exhibit novel physical and chemical properties that are considerably different from those that would be present if the substance were in its big natural size. This kind exhibits great corrosion resistance, biocompatibility, and high photocatalytic capacity in addition to being chemically and mechanically stable [1], [2].

Colored organic dyes and heavy metals are used in many industrial products, including those in the textile, pharmaceutical, culinary and cosmetic. These organic pollutants are harmful. Even in relatively small numbers, they can cause major health dangers when released into rivers, endangering aquatic life and wildlife in addition to humans [3]-[6].

Due to metals nanoparticles' unique physical, chemical, and biological properties, such as their high thermal and electrical conductivity, chemical stability, and high catalytic activity as well as their biometrically relevant antibacterial and anticancer actions [6],[7], Their applications are noteworthy and unique. The majority of metal nanoparticles are created utilizing a range of chemical and physical processes, many of which use potentially poisonous and damaging reactive chemicals [8]. Therefore, it is imperative that they be produced using more eco-friendly, ecologically sound, and greener ways [9]. Plants utilized as reactive components to create metals nanoparticles seem to be inexpensive and naturally beneficial, and the processes employed to utilize these materials are chemically and energy-safe [10]. The use of green synthesis techniques to create metal oxide nanoparticles is extremely relevant, according to recent research [11]-[13]. The synthesis of metallic nanoparticles uses metal and metal oxide-based which used in the dye degradation process, which results in the decolonization of the solution. Due to their extensive surface area and use as electron carriers in various industries like agriculture, medicine, and electronics, metal nanoparticles have a wide spectrum of features including electrical and optical properties [14]. As a result, the reactants will gain an electron before being reduced. ZnO nanoparticles will therefore function as an effective catalyst through the electron transfer mechanism [15]. There have been many documented techniques for treating wastewater, including adsorption, coagulation, membrane proficiency, etc., but the majority of these techniques are expensive and have drawbacks about separation, adsorption performance and slow kinetics [16], [17]. Although ZnO may be produced successfully using chemical processes, we have used a more environmentally friendly way in this study by using a plant leaves powder as a potential bionanocatalyst for producing ZnO nanoparticles [18], [19].

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II. Methods

Plant material conditions firstly, the purchased leaves of *Ocimum basilicum* from the market. It was washed with water and left to dry at air then it's crushed by mechanical molter and then filtered by mesh 60 micrometers at size. Finally, 0.1 g from the plant leaves was added to 0.1 gram zinc sulphate ($ZnSO_4.7H_2O$) and 100 milliliters of deionized water was added. The mixture put on the hot plate stirrer at (80 °C) until the gold yellow color appears Fig. 1 shows these results.

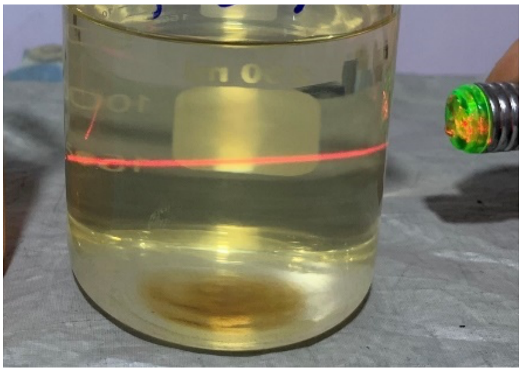


Fig. 1. Zinc oxide nanoparticles and leaser pointer for tyndle scattering.

The color change of the solution during experiment indicates for the reduction of zinc ions. The color of fresh extract of *Ocimum basilicum* was yellow. However, after addition of zinc acetate and constant shaking at 80°C the solution color changed gradually into gold yellow after 10 min which indicated the formation of ZnO nanoparticles. Biosynthesized by O. basilicum were visualized using SEM type (FESEM, HITACHI, S-4160).

For the degradation study, a constant volume of 15 ml of zinc nanoparticles was used, a light source of different power(tungsten lamb), (15 W and 30 W) and methylene blue dye prepared in a volume of (25 ml) and a concentration of (2.5 ppm).

III. Results and Discussion

There are many bioactive molecules from the plant such primary metabolites and secondary metabolites including phenolic content, glycosides, terpenoids, tannins and flavonoids as chemical constituents are well-known reducer agents of zinc ions which are responsible for the formation of ZnO nanoparticles. Moreover, the chemical element's presence in the extract has high tendency to bind with nanoparticles that it is resulted in the low affinity of nanoparticles to aggregate and their stabilization in the aqueous solution.

The synthesized ZnO nanoparticles were characterized by many techniques such UV-visible, DLS, SEM, EDX as following:

A. UV-Visible Spectroscopy

UV-visible Spectroscopy used for plasmon resonance examination. The plasmon resonance appears at 365 nm indicate for formation of zinc oxide and this is agreement with other researchers [21]. Fig. 2 shows these results.

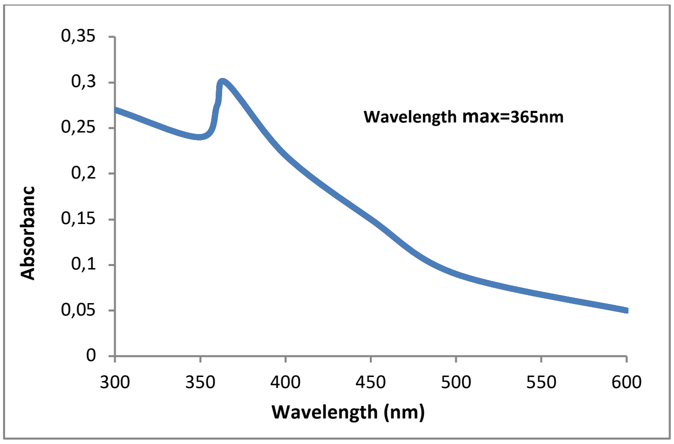


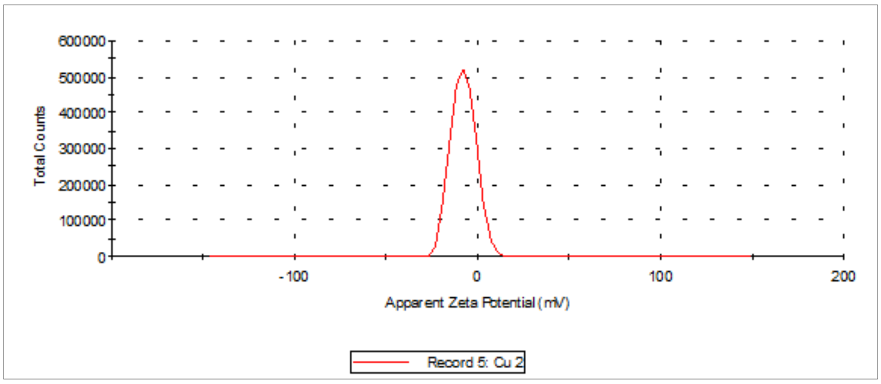
Fig. 2. Plasmon resonance for synthesized ZnO nanoparticles.

B. Dynamic Light Scattering (DLS)

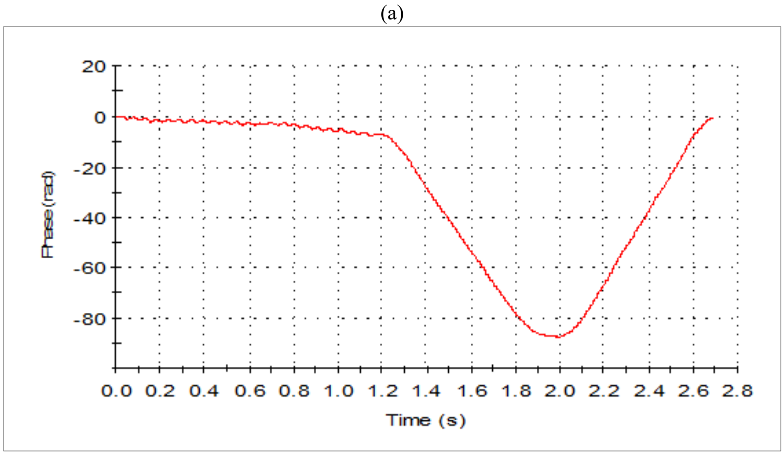
The average size of ZnO NPs was found using, Dynamic Light Scattering (DLS) type Malvern-Zetasizer (Nno-z 590). The size distribution of the small particles suspended in the solution is determined in the dynamic light scattering. The surface charge of nanoparticles is measured by zeta potential and is measured within the range (0.3 nm-10 µm). DLS measurements revealed that the average particle size and zeta potential value were in table l, hence prove of nanoparticles formation.

TABLE I: ZETA SIZER AND ZETA POTENTIAL OF SYNTHESIZED ZNO NANOPARTICLES

Polydispersity Pd (I)	Zeta Potential (mV)	Zeta Sizer (d.nm)	Sample
0.553	-7.56	130	ZnNPs (1000 ppm)



(a)



(b)

Fig. 3. Zeta potential for synthesized ZnO nanoparticles: a) Zeta Potential Distribution; b) Phase Plot.

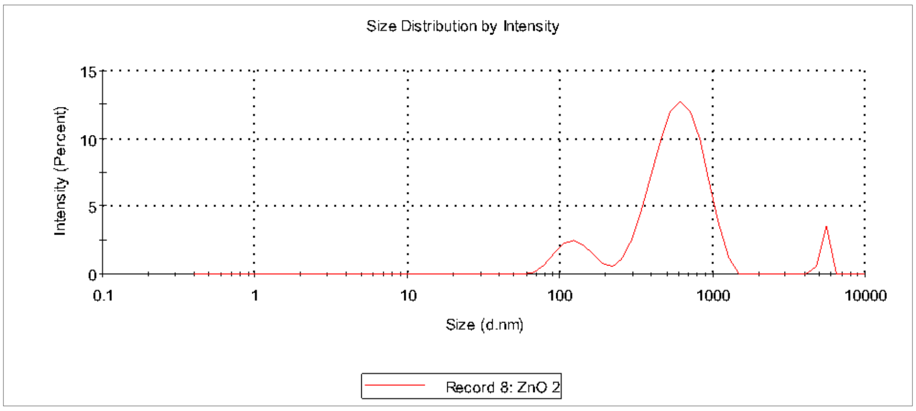


Fig. 4. Zeta sizer for synthesized ZnO nanoparticles.

C. Field Emission Scanning Electron Microscopy (SEM)

From this examination the particle morphology and structural surfaces of the prepared nanoparticles and imaging of the nanoparticles using a scanning electron as can be seen in (Fig. 5). SEM images demonstrated their uniform distribution, spherical shape, and nano-sized size range. FESEM photographs specified monodisperse nanoparticles that were sphere-shaped in nature and they uncommonly combined each other to form cluster of particles.

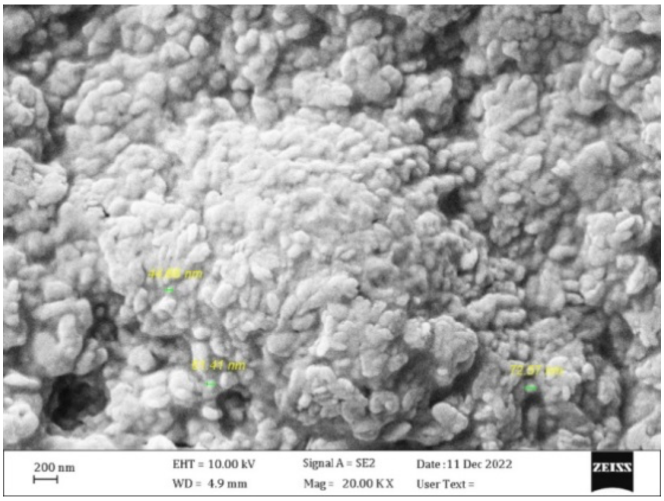


Figure 5: SEM image shows the morphology of the surface.

D. Energy Dispersive X-Ray (EDX)

The elemental analysis was examined using the EDX technique. Fig. 6 illustrations how the elemental analysis was carried out using EDX. According to the percentage of ZnO nanoparticles, which are 31.8%, oxygen is 21.3.

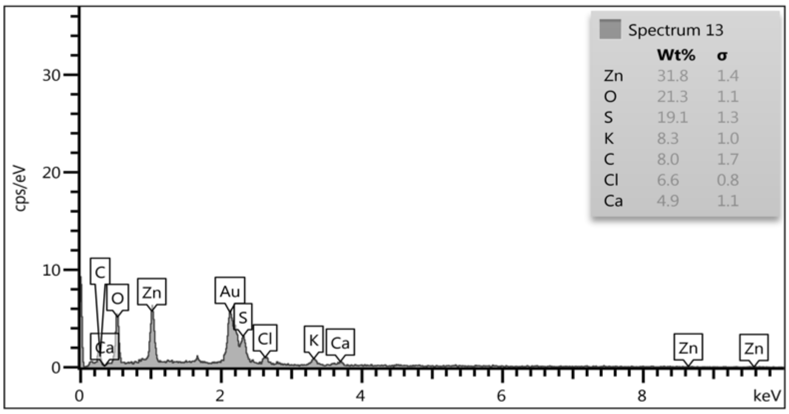


Fig. 6. Energy Dispersive X-ray for displays the qualitative and qualitative analysis of synthesized ZnO nanoparticles.

E. Degradation of Methylene Blue Dye Using ZnO Nanoparticles

The optimum wavelength of methylene blue was measure at 663 nm this finding was fixed for the standard curve, the concentrations were in the range (1-8) ppm was calculated for methylene blue with good applicability with lambert-beer law. Fig. 7 and Fig. 8 display these findings.

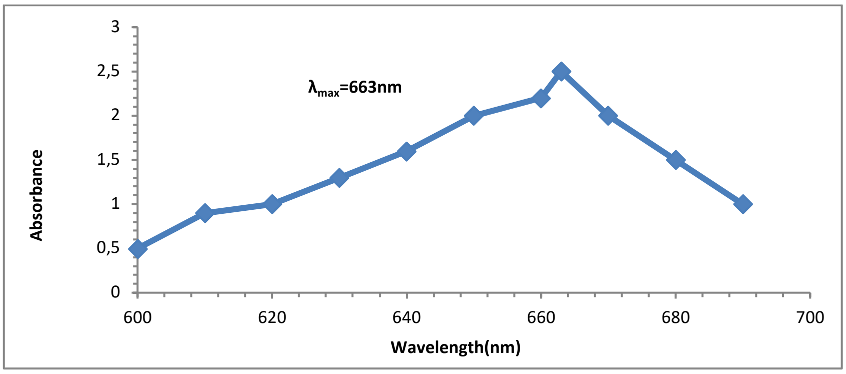


Fig. 7. The maximum wavelength of methylene blue dye.

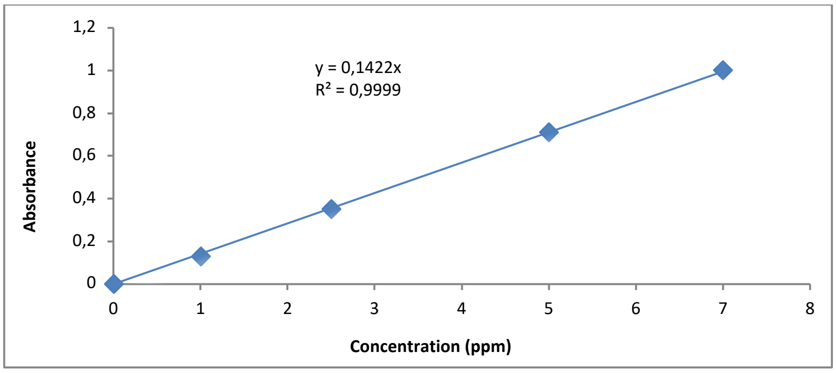


Fig. 8. Standard calibration curve of methylene blue dye.

The degradation was done by optimum conditions using different lights power (15,30) W and different dyes concentrations (2.5 and 5) ppm, as followings:

F. Degradation of Methylene Blue Dye at Different Lights

The degradation was done using different powers of lights (15 W and 30 W) the degradation of dye was bigger at 30 W at volume (15 ml) from ZnO nanoparticles. Fig. 9 shows these results.

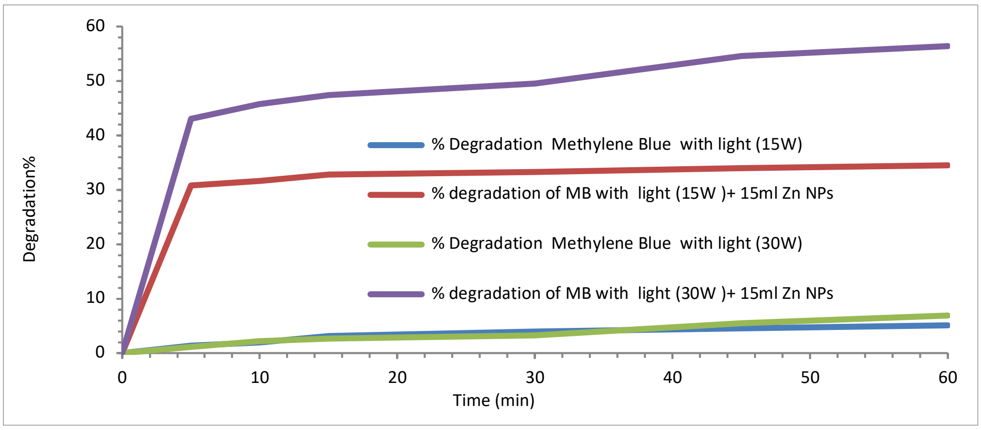


Fig. 9. Percentage of breakdown of methylene blue dye with zinc nanoparticles prepared at different light sources, and fixed size of zinc nanoparticles.

G. Degredation of Methylene Blue Dye at Different Concentration

Methylene blue dye was employed in this work at different concentrations (2.5 ppm and 5 ppm) in a volume of (25 ml), along with a constant volume of prepared zinc nanoparticles and a constant light source (30 W). The outcomes are displayed in Fig. 10. In comparison to methylene dye prepared at a concentration of (5 ppm) with zinc nanoparticles as a catalyst, which has a degredation rate of (48%), the methylene dye prepared at a concentration of (2.5 ppm) with zinc nanoparticles has a better percentage of degradation and a higher percentage of breakage (56.4%). Fig. 10 shows these results.

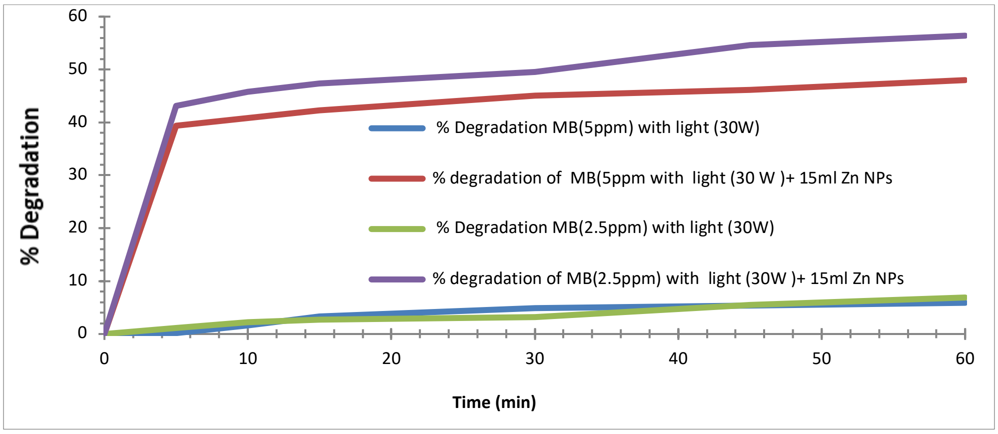


Fig. 10. Examination of the degradation of methylene blue dye utilizing produced zinc nanoparticles, varied dye concentrations, and a continuous light source (30 W).

IV. Conclusion

Studies amply demonstrated the synthesis of ZnO nanoparticles and revealed the presence of several phytochemicals in the plant extract, which serve as a capping and stabilizing agent for the generated ZnO nanoparticles. From the analyses of results, it is obvious that the precursors have played a vital role in surface shape and structure of ZnO nanoparticles. Our results confirm the potential of *Ocimum basilicum*. for the synthesis of ZnO nanoparticles in a simple, quick and ecofriendly approach. ZnO nanoparticles can be used for degradation of methylene blue dye in polluted water using visible light (tungsten lamb). With a degradation rate of 56.4% at a concentration of the dye of 2.5 ppm, the photodegradation experiments of these nanoparticles prove very excellent photocatalytic activity on methylene blue dye.

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