Abstract--- In this paper, the synthesis of monodisperse nanoparticles of zinc and copper oxide has been reported by biological method. A facile and efficient eco-friendly synthesis of copper oxide nanoparticles was carried out based on green chemistry approach with controlled surface properties. Both synthesized ZnO and CuO nanoparticles were characterized by using FT-IR, XRD, SEM, and DLS techniques. The particles are crystalline in nature and average sizes were under 50 nm. This new green approach of synthesis is a novel, cheap, and convenient technique that could be applied via heating by heater or microwave apparatus. It is suitable for large scale generation and health related applications of both ZnO and CuO nanoparticles.

Keywords--- Biological synthesis, Copper oxide, Nanostructuer, Zinc oxide.

I. INTRODUCTION

Synthesis of metallic and/or oxide nanoparticles taking assistance of green methods has attained enormous attention in the recent years [1]-[3]. Although a lot of works have been done with the name of green synthesis and production of metal and oxide nanoparticles in the recently, however the problem has not been solved properly. Indeed, such methods are not really green in their nature. However, phytosynthesis is one of the most promised pathways of green synthesis. Plant systems widely distributed along the ecological boundaries, are easily available and safe to handle. Such studies could prove to have an huge effect in the immediate future if plant tissue culture and downstream processing procedures are applied in order to synthesize metallic as well as oxide nanoparticles on industrial scale.

The present investigation is an effort in this direction. So, the synthesis of Zinc and Copper oxide nanoparticles (abbreviated ZnO and CuO NPs) has been reported so that Rosa Sahandina could also be taken as potential candidate plant specimens for the synthesis of metal as well as oxide nanoparticles.

II. MATERIALS AND METHODS

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A. Classic synthesis of ZnO and CuO NPs using Rosa sahandina fruit broth

A typical procedure was employed for ZnO NPs, where Rosa Sahandina broth extracts were prepared with distilled water. Later, zinc nitrate was dissolved in the Rosa Sahandina solution under constant stirring using magnetic stirrer. After complete dissolution of the mixture, the solution was kept under vigorous stirring at 140°C for 5 h, allowed to cool at room temperature and the supernatant was discarded. The pale white solid product obtained was centrifuged twice at 4000 rpm for 4-5 h.

B. Microwave assessed synthesis of ZnO and CuO NPs using Rosa Sahandina fruit broth

Zinc and Copper nitrate and Rosa Sahandina powder extract taken in 1:2 weight ratio was subjected to microwave heating at 180 W which produced a white and black precipitate at the end. The precipitates were centrifuged, and dried in hot air oven for 4-5 h.

III. RESULTS AND DISCUSSION

The study reports the formation of nanoparticles when exposed to Rosa Sahandina extract by monitoring changes in colour as particle size increased. White precipitate formed was the end product in synthesis ZnO whereas in synthesis CuO, black precipitate appeared.

Fig. 1 shows the FTIR spectra of ZnO and CuO NPs which synthesized by classic method. As a typical example, the peaks in the region between 600 and 400 cm$^{-1}$ are assigned to Zn-O are clearly represented in the Fig. 1 a. The peaks at 3451, 1552 and 1393 cm$^{-1}$ indicate the presence of -OH stretching of intramolecular hydrogen bond, C=O stretching and C-C stretching of alkanes. Similar spectra are obtained for the nanomaterials produced via synthesis using microwave.
The bands at 3450, 3266 and 2932 cm\(^{-1}\) have been assigned to stretching vibrations of the primary and secondary amines, O-H stretching of alcohols and C-H stretching of alkanes. The corresponding bending vibration for primary and secondary amines is also observed. The intense bands observed at 924, 1020, 1150 and 1380 cm\(^{-1}\) have been assigned to alcohols and phenolic groups, C-N stretching vibrations of aliphatic and aromatic amines, respectively.

The mechanism by which nanoparticles are formed in the biosynthesis procedures is still not clear. However, it appears that the existence of some phenolic compounds, terpenoids or proteins and especially carboxylic acids in Rosa Sahandina that are bound to the surface of ZnO and CuO NPs that remained despite repeated washing. The stability of NPs may be due to the free amino and carboxylic groups that have interacted with the zinc surface. Such groups in the extract could play a role as capping agents of the nanoparticle. These groups prevent agglomeration and aids in the stabilization by coating the metal nanoparticles.

**XRD analysis**

The crystallinity of the synthesized ZnO and CuO NPs could be evaluated using XRD pattern. For example, CuO NPs showed sharp peaks based on Bragg’s reflection corresponding to (110), (111), (200), (202), (020), (202), (113), (311), (220) and (400) (Fig. 2b). All diffraction peaks can be indexed as the typical monoclinic structure and no extra diffraction peaks of other phases are observed.

**SEM studies**

The SEM micrographs in Figs3(a) clearly show well dispersed, versatile and spherical shape distribution of ZnO and CuO NPs prepared with Rosa Sahandina extract with particle sizes ranging under 50 nm.
Fig. 3 SEM photo micrographs showing of the synthesized (a) ZnONPs and (b) CuONPs

**DLS and Zeta potential measurement**

The diagram of DLS analysis demonstrated that the NPs formed with fairly well-defined dimensions and good monodispersity (Fig. 4a and b). The zeta potential of the synthesized NPs was determined in water as dispersant. The zeta potential was found to be -20 to -30 and -25 to -35 mv for ZnO and CuO, respectively. The high negative value approves the repulsion among the particles and thereby increases in stability of the structure of NPs.

**IV. CONCLUSION**

In this paper, we have reported for the first time, the use of Rosa Sahanidina extracts for the synthesis of ZnO and CuO nanoparticles using water as solvent under classical and microwave irradiations. The ZnO and CuO nanoparticles were found to be spherical in shape with a size under 50 nm. The use of environmentally benign materials like plant extracts, for the synthesis of nanoparticles offers numerous benefits of eco-friendliness and compatibility. Besides, the applications of such nanoparticles in pharmaceutical and other biomedical applications make this method potentially use for the large-scale synthesis of other inorganic nanomaterials.

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