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RESEARCH ARTICLE

GREEN SYNTHESIS OF ZNO NANOPARTICALES FROM *EMBLICA OFFICINALIS* FRUIT EXTRACT

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ABSTRACT

In the present investigation the green synthesis of ZnO nanoparticles was carried out by using aqueous fruit extract of *Emblica officinalis* .Optimization for substrate (Zinc acetate) concentration was evaluated for 1mM, 50mM and 100mM. The biogenic ZnO nanoparticles were characterized by UV-Visible spectrophotometry and FTIR (Fourier-Transform Infrared Spectroscopy). It was found that only in 100mM concentration of zinc acetate ZnO nanoparticles were synthesized having peaks at 350nm,370nm,390nm and 410nm .FTIR analysis reveals that flavonoids were capping agent for biogenic ZnO nanoparticles and amines were found to be reducing agent. Antibacterial potential of ZnO nanoparticles was tested on *Salmonella typhi* confirming antibacterial activity for the same.

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INTRODUCTION

Nanotechnology involves the use of materials having nanoscale dimensions in the range of 1–100 nm (J. Santhoshkumar *et al* ., 2017). Nanotechnology has animatedly developed as a research for the synthesis of structure of particles with facet smaller than 100nm (Gnanasangeetha 2014). Nanoparticles are of great scientific interest as they are, in effect, a bridge between bulk materials and atomic or molecular structures. The properties of nanoparticles have large surface area of the material, which dominates the contributions made by the small bulk of the materia (Geetha M. Pinto 2016). Smaller the size of the particles greater will be the aspect ratio i.e., greater surface area compared to their volume. This increased surface area of the smaller nanoparticles enhances the reactivity of the nanoparticles with the surrounding molecules. Zinc oxide has application in micro- electronics, diagnostics, optoelectronic devices, biomolecular detection, surface acoustic wave devices like laser devices, electromagnetic coupled sensor. They can act as an alternative source for degradation of atmospheric pollutants. They also have potential application in the field of medicine like drug delivery, biological activities such as antimicrobial, antioxidant and diagnosis of diseases (Santhoshkumar 2016, Anbukkarasi 2015 and Sangeetha Gunalan 2014). Biosynthesis of nanoparticles is an approach of synthesizing nanoparticles using microorganisms and plants having biomedical applications.

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This approach is an environment-friendly, cost- effective, biocompatible, safe, green approach . Green synthesis includes synthesis through plants, bacteria, fungi, algae etc. They allow large scale production of ZnO NPs free of additional impurities. NPs synthesized from green approach show more catalytic activity and limit the use of expensive and toxic chemicals. These natural strains and plant extract secrete some phytochemicals that act as both reducing agent and capping or stabilization agent. ZnO NP synthesized from *Gloriosa superba, Epigallocatechin gallate, Manihot esculenta, Cinnamomum camphora, Emblica officinalis*,lemon grass, *Trifolium pratense* have been reported. Plants in production of nanoparticles have advantages such as easily available, safe to handle and broad range of biomolecules such as alkaloids, terpenoids, phenols, flavanoids, tannins, quinines etc. are known to mediate synthesis of nanoparticles (Sangeetha Gunalan 2014 and Kavitha K.S. 2013). *Emblica officinalis* (*E. officinalis*) is a deciduous tree, commonly known as 'Indian gooseberry' or 'amlal. It belongs to the family Phyllanthaceae (Kumaravel Palanisamy 2014). Amla is a small to medium sized deciduous tree, found inth roughout India, Pakistan, Uzbekistan, Sri Lanka, South East Asia, China and Malaysia. It grows about 8-18m height with thin light grey bark, leaves are simple, light green, sub-sessile, closely s*et al* ong the branchlets looks like pinnate leaves; flowers are greenish yellow; fruits are globose, fleshy, pale yellow with six obscure vertical furrows enclosing six trigonous seeds in two seeded three crustaceous cocci. *Emblica officinalis* s highly nutritious and is one of the richest sources of vitamin-C, amino acids and minerals.

It contains several chemical constituents like tannins, alkaloids and phenols. Among all hydrolysable tannins, Emblicanin A and B; gallic acid, ellagic acid are reported to possess biological activity. Almost all parts possess medicinal properties, particularly fruit, which has been used in Ayurveda as a powerful *rasayana* and in customary medicine in the treatment of diarrhoea, jaundice, inflammation and several other ailments. *Emblica officinalis* fruit is widely used in the Indian system of medicine as alone or in combination with other plants and is used to treat common cold and fever, as diuretic, laxative, liver tonic, refrigerant, stomachic, restorative, anti-pyretic, hair tonic; to prevent ulcer and dyspepsia (Swetha Dasaroju, 2014). *Emblica officinalis* used in various traditional medicinal system like, Ayurvedha, Tibetan and Siddha to treat various ailments (Zhang, 2000). *E. officinalis* exhibits several important biological activity such as, antimicrobial, antiinflammatory, antidiabetic activity (Sabu. 2002) antiproliferative activity (Lambertini), antidiarrheal (Anbukkarasi 2015 and Kumaravel Palanisamy 2014). In the present study aqueous fruit extract of *Emblica officinalis* was explored for green synthesis of ZnO nanoparticles and its antibacterial potential against human pathogen (*Salmonella typhi*)

MATERIALS AND METHODS

Collection of plant: Fresh fruit of plant *Emblica officinalis* were collected from Mahal pimpari, Aurangabad, Maharashtra, India.

Preparation of extract: Fruits were washed with the tap water then by the sterile distilled water to remove dust. The fruit initially chopped by sterile blade and deseeded. The proportion of fruit : water was taken as 1:10 in ratio. The mixture was boiled for 10 min. Then cooled it. The mixture was grind by grinder to prepare the juice. The fruit extract was filtered Whaltman filter paper no. 1. The plant extract were ready for the green synthesis of ZnO nanoparticles.

Synthesis of ZnO nanoparticles: The various concentrations of zinc acetate(1mM , 50mM, 100mM) were used for the green synthesis of nanoparticles. 3ml of zinc acetate and 7ml of fruit extract was taken in acid rinse screw cap tubes and incubated at 37° C for 24hrs at 37^0C. The synthesized ZnO nanoparticles were washed with sterile distilled water for 3 times by centrifuging at 10000 rpm for 20min. and suspended in 1ml sterile distilled water.

Characterization of ZnO Nanoparticles: The visual observation of white precipitate suggest synthesized ZnO nanoparticles. The synthesized Zno nanoparticles were analysed by UV-Visible spectrophotometer(Systronic) at wavelength ranging from 200 to 800 nm. The FTIR analysis was performed for plant extract and ZnO nanparticles (Brooker FTIR).

Antibacetrial Activity : The tube dilution method was used to study antibacterial activity. The antibacterial potential of synthesized ZnO nanoparticles was tested against *Salmonella typhi*. For antimicrobial lassay, microbial colonies of *Salmonella typhi* were inoculated into 5ml of nutrient broth medium and incubated for 24hr at 37^0C. In 2ml of nutrient broth 20µl of inoculums of O.D. 0.8–0.1 was inoculated. In the inoculated tubes 20µl ZnO nanoparticles synthesized by using 1mM, 50mm and 100mM substrate, 20µl of plant extract was added and one kept uinoculated. The tubes were incubated at 37^0C for 24hrs. Next day absorbance at 600nm was measured.

RESULTS

Characterization of ZnO Nanoparticles

Visual Observation: The addition of fruit extract to Zinc acetate resulted in formation of white precipitate at 37^0C for 24hr suggesting synthesis of ZnO nanoparticles.

UV-Visible Analysis: The UV-Visible absorbance from 200nm to 800nm of green synthesized nanoparticles by using concentration of zinc acetate 1mM, 50mM and 100mM was analyzed. The sample analysis for 1mM Zinc acetate as a substrate indicate a sharp peak at 720nm (Table no.1 and Fig. No.2). At 50mM substrate concentration no sharp peak observed which may be due uneven size distribution of ZnO nanoparticles (Fig. No.2). At 100mM substrate concentration four peaks were observed at wave length 350nm, 370nm, 390nm and 410nm indicating synthesis of ZnO nanoparticles (Fig. No.2).

Fig. 1. ZnO nanoparticle Synthesis

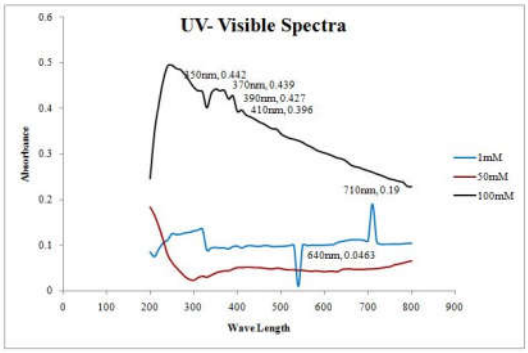

Fig. 2. Graph of UV-Visible spectra of ZnO nanoparticles

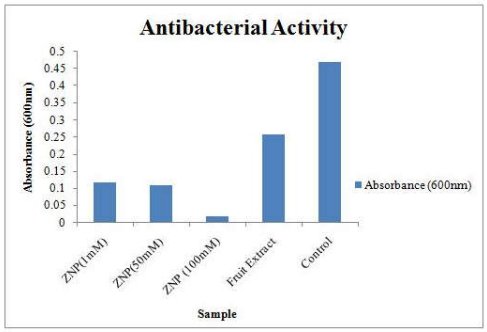

Fig. 3. Antibacterial Activity for Salmonella typhi

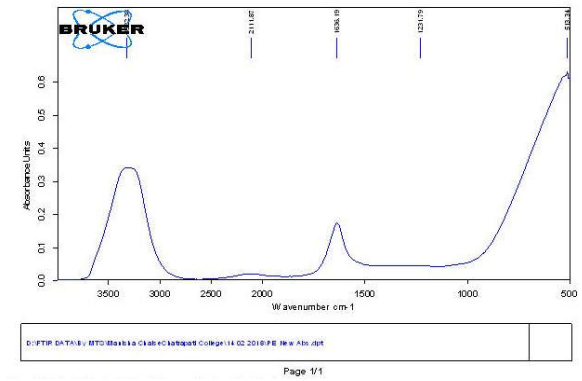

Fig. 3. FTIR of Emblica officinalis Fruit extract

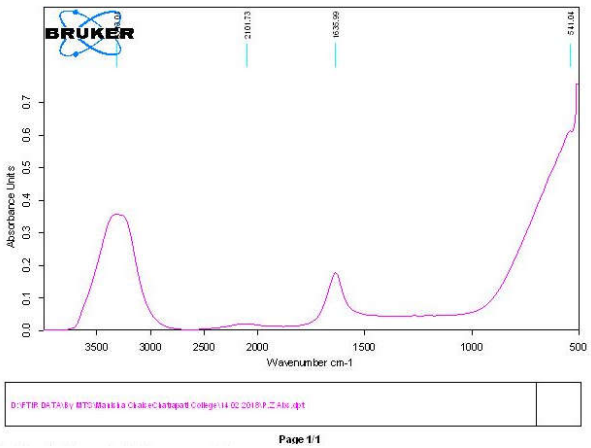

Fig. 4. Biogenic ZnO nanoparticles

FITR analysis: Interpretation of the IR spectrum involves the correlation of the absorption bands (vibrational bands) with the chemical compounds in the sample. In this way, the biomolecules present in plant extracts that are responsible for the reduction and stabilization processes of the green synthesis of nanoparticles can be identified. The FT-IR spectrum of the *Emblica officinalis* and that of the synthesized ZnO NPs are shown in Fig.no. 3 and 4 . The IR spectra of Fruit extract illustrated as broad peak at 3322.37 corresponded to -OH stretching vibrations and peak at 2111.87 corresponded to C triple bond C.

Srong band at 1636.19 corresponds to C=C streach in aromatic compound and C=O streach in polyphenols. Weak band of 1231.79 attributes C-N streach in amine group and 513.19 characeristic of C-Br stretch in alkyl halide. The peaks 3313.04, 2101.73 and 1635.99 were constant in IR analysis of ZnO nanoparticles indicates that were involved as capping agent. The Peak at 541.04 is characteristic of ZnO nanoparticles confirming synthesis of ZnO nanoparticles with capping agents as flavonones. The bands from plant extract and ZnO nanoparticles sample was shifted demonstrates their interaction with ZnO nanoprticles as well as absence of band confirms group involved in reduction reaction.

Antibacterial Activity of ZnO nanoparticles: The antibacterial activity was studied for *Salmonella typhi.* The tube dilution assay was explored for it. The results demonstrates bacterial acs that ZnO nanoparticles have antibacterial activity. The nanoparticles synthesized by utilizing 100mM of substrate concentration (Zinc Acetate) was observed to be potent antibacterial agent than 1mM and 50mM substrate concentration (Fig no. 3).

DISCUSSION

The present work Is delt with the Green synthesis of ZnO nanoparticales using aqueous fruit extract o Emblica officinalis. Emblica officinalis is a medicinal plant with having phytochemical as (Sowmya, 2017) which are being having ability to synthesize ZnO nanoparticals (Nakarao and *et al* , 2014). In the present study aqueous fruit extract of Emblica officinals was used which was first time evaluated for its ability to synthesize ZnO nanoparticals. Previously methanolic fruit extract of Emblica officinals was explored for synthesis of ZnO nanoparticals. Leaves of Emblica officialis(V. Anbukkarasi, 2015) also have potential to synthesize ZnO nanoparticetal (Gnananasargeeth and etal, 2014),(Geetha Pinto, 2016). The visual observation that aqueous fruit extract was able to convert the zinc acetate to ZnO nanpartcales by forming white precipitate. The confirmation of synthesis of ZnO nanoparticales done by UV-visible spectroscopy. The increasing concentration of zinc acetate 1mM, 50mM and 100mM was taken to synthesis ZnO nanoparticles. The spectral study indicate the 1mM have sharp peak at 710mM and 100mM have peak at 350nm, 370nm, 390nm 410nm. 100mM peaks were characteristic peaks of ZnO nanoparticals . Sggesting 100mM zinc acetate as optimum substrate concentration for synthesis of ZnO nanoparticals. The ZnO nanoparticals peaks were found in same range 330nm - 450nm (Senthilkumar and Sivkumar, 2014, Sadhan Kumar Chaudhuri, 2017).

The comparision of IR spectra of ZnO nanoparticles and Fruit extract illustrates that, the peaks 3313.04, 2101.73 and 1635.99 were constant in IR analysis of ZnO nanoparticles indicates that were involved as capping agent. The Peak at 541.04 is characteristic of ZnO nanoparticles confirming synthesis of ZnO nanoparticles with capping agents as flavonones. The bands from plant extract and ZnO nanoparticles sample was shifted demonstrates their interaction with ZnO nanoprticles as well as absence of band confirms group involved in reduction reaction. The biogenic ZnO nanoparticles have peak in the range 408-550 (Gnanasangeetha, 2014). The capping agent flovonones awere abosered in another studies (Prasanta Sutradhar and Mitali Saha, 2016). In Macrodilution method which was performed for testing of antibacterial activity of ZnO nanoparticales first time demonstrate as per reference that ZnO nanopartcales syntisized from Emblica officinalis have antibacterial activity.

Conclusion

The fruit extract of Emblica officinalis was evaluated for synthesis of ZnO nanopartcales. The UV-visible spectra illustrates the ZnO nanoparticales were syntesised from zinc acetate concentration 100mM. The ZnO nanoparticales synthesised have antibacterial activity for Salmonella typhi.

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Conflicts of Interest: The authors declare no conflict of interest.

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