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Antibacterial and Anticancer Activities of Biogenic Synthesized Ag and ZNO NPS

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Abstract: ***Biogenic synthesis of Ag and ZnO nanoparticles has been proposed as an environmental friendly and cost effective method. Curcuma longa tuber extract was used to reduce silver nitrate and zinc acetate to Ag NPs and ZnO NPs. The extract acts as each reducing capping agent. Synthesis process be standardized by modifying various parameters like salt concentrations, C. longa tuber extract concentration, and temperature and incubation period. The formation of Silver and ZnO NPs was observed among color transition. The morphology of the amalgamate Ag and ZnO NPs be characterized with various experimental techniques (FESEM, TEM). The face-centered cuboidal structure of Ag and ZnO NPs be studied using X-ray optical phenomenon. Further Ag in addition to ZnO NPs were tested for antibacterial and anticancer activities.***

Keywords: ***Curcuma longa tuber extract, Ag and ZnO NPs, antibacterial, anticancer activities.***

I. INTRODUCTION

In up-to-the-minute decades, present has be an increased interest within the synthesis of inorganic nanomaterials due to their significant applications in biology, chemistry and biotechnology fields. Nanoparticles are generally synthesized using various chemical, physical and green methods. The inorganic nanomaterials such as Ag and ZnO nanoparticles are widely used in different scientific areas due to the simple, eco-friendly, facile, rapid and bio-synthesis methods (1-4). Chemical methods used earlier were harmful as they comprised chemicals harmful for atmosphere and human healthiness. There be a need for developing and implementing green methods for the synthesis of metal and metal compound nanoparticles (5-7). Such methods have been reported using bio compounds and agents such as biodegradable polymers, bacteria, enzymes, plants, fruits peel algae and fungi (8-12). They have many benefits including the solitary pot incorporation perennial plant process to remove excess amount of reduction compound, capping or stabilizing in the reaction process. *C. longa* is a rhizomatous herbaceous of the Zingiberaceae family. It is of therapeutic interest and is nontoxic. It is widely used in India, China and especially in other Asian countries because of its health benefits. *C. longa* tuber extract has significant properties including antioxidant, anti-diabetic, antibacterial, antifungal, anti-inflammatory and anticancer (13).

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The aim of the current study is just before carry out plain bio-synthesis of Ag and ZnO NPs by reduction of silver nitrate and zinc acetate solution with aqueous extract from the *C. longa*. The synthesis parameters were optimized to attain maximum yield of significant nano sized particles. The effects of assorted reaction parameters like temperature, incubation period, pH, precursor concentration of C. *longa* extract on NPs synthesis were studied. The synthesized NPs were characterized by Fourier remodel infrared spectroscopic analysis (FT-IR), Dynamic light-weight scattering (DLS), Field–emission scanning microscopy (FESEM) and Transmission microscopy (TEM). The structure of NPs was studied victimization X-ray diffraction. Medicament activity and antitumor effects of the C. longa tuber extract coated NPs were studied.

II. EXPERIMENTAL COLLECTION OF C.LONGA TUBERS APPARATUS

The fresh *C.longa* tubers be collected opening formers of Srikakulam.

2.1 Groundwork of C. longa tubers extract:

The tubers of C. *longa* be swab in running tap hose, followed by removal in deionized water and dried in oven for 3-4h. The dried *C. longa* tubers were powdered with a motor and pistil. The powdered min and hygienic samples were stored in an airtight container and away from the sunlight for further use. Four grams of C. *longa* tubers was assorted with 100ml of distilled water. This is heated up to 90°C for 60 using Whatman No.1 variety out paper. The final remnants were accumulating in cool dry place for further use. *C. longa* tuber contains various phyto constituents like carbohydrate, alkaloids, glycosides, phenolic, flavaniods, eugenol cirsilineol etc. which may act as dipping and capping mediator for creation of Ag and ZnO NPs.

2.2 Biosynthesis of Ag and ZnO Nanoparticles

The nitrate (AgNO3) stock answer was ready by dissolving one .58gm of $AgNO_3$ during 100ml of distilled rivulet. 10 ml of *C. longa* tuber powder extract was additional to 50ml of noble metalNO3 answer and unbroken at temperature for 24h beneath dark condition to induce the Ag nanoparticles. Zn acetate answer was ready by adding 1gm of Zn acetate to 100ml of deionized water. Later 20ml of C. longa tuber powder extract was additional into the dissolved precursor answer call in drop and stirred smartly for 2h. the ultimate precipitate was washed many times with deionized water. this is often to make sure the removal of excess capping agent and unreacted metal ions within the answer.

The sample was unbroken in kitchen appliance at 120oC for six h. Finally the synthesized material was hardened at 200oC in air atmosphere for 2h

2.3 Characterization of Ag and ZnO NPs

FE-SEM (Hitachi S-4500 FE-SEM) TEM analysis was performed to see the form and morphological structure of the as synthesized nanoparticles.

The ready ZnO and noble metal NPs were positioned on a carbon grid and dried at temperature. The pictures were captured at 120kV. Bruker D8 X-ray diffractometer was wont to study the crystalline structure of the synthesized NPs. metal Kœ is employed because the x-ray supply (λ =1.540A^{O}) at 30mA and 40V.DLS (Horiba SZ100) was wont to verify the particle size and Zeta potential. The photochemical involvement in Ag and ZnO NPs synthesis exploitation determined the FT-IR. The analysis was performed individually on the synthesized conductor and ZnO NPs, C. longa extract, and also the powdery sort of C. longa extract. FT-IR spectra (Perkin-Elmer spectrum) for confirm the practical teams of the samples within the vary 500-4000 cm-1 by getting ready a skinny of samples exploitation KBr.

2.4 Anticancer activity

Anticancer activity of Ag and ZnO NPs were performed by MTT assay. *In vitro* anticancer activity was done majorly against three cancer cell lines i.e., MCF7 (hormone dependent carcinoma cells), Norse deity (Cervical cancer cells) and benign cell line HEK 293, as indicated within the previous report [11]. Cicplatin drug was used as a positive management within the assay.

2.5. Evaluation of bacterial activity

Antimicrobial activities of the synthesized NPs were tested on Mueller-Hinton agar (MHA) using well diffusion method. The medicine activity was tested against E. coli and S. aureus. The microorganism strain was inoculated in MHA agar plate underneath antiseptic conditions. Completely different concentrations of the take a look at sample were other to the wells (4mm diameter) and incubated at 37o C for twenty-four h. The diameter of zone of inhibition was measured (in mm) once incubation.

III. OUTCOME AND DISCUSSION

This journal uses double-blind review process, which means that both the reviewer (s) and author (s) identities concealed from the reviewers, and vice versa, throughout the review process. All submitted manuscripts are reviewed by three reviewer one from India and rest two from overseas. There should be proper comments of the reviewers for the purpose of acceptance/ rejection. There should be minimum 01 to 02 week time window for it.

3.1 X-Ray diffraction (XRD):

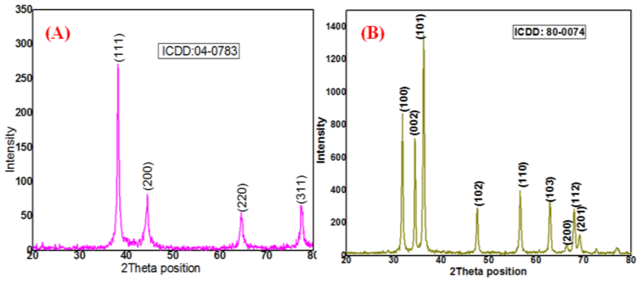

Fig. 1 XRD spectrum of synthesized (A) Ag and (B) ZnO NPs using *C. longa* extract

Ag and ZnO NPs were further studied using XRD analysis (Fig 1). The peaks at 2theta values thirty eight.64o, 44.11o, 64.14o and 77.04o may be indexed to (111), (200), (220) and (311) crystalline planes of the face focused cubical (fcc). Crystalline structure of bimetal silver that was matched with the information of the ICDD file no: 04-0783. The XRD pattern of the ZnO NPs shows 2theta values at 31.78^{o}, 34.45^{o}, 36.24^{o}, 47.61^{o}, 56.57^{o}, 62.82^{o}, 66.42^{o} and 67.96^{o} corresponding to the (100), (002), (101), (110), (103), (200), (112), (201) planes which confirmed the occurrence of pure ZnO Nanoparticles. Every one of the peaks was matched with ICDD file no: 80-0074. The strong and narrow peaks indicate the good crystalline structure of *C. longa* coated Ag and ZnO NPs. However no additional diffraction peaks were known within the XRD pattern of these NPs indicating that the precursors synthesized by *C. longa* were completely decomposed and no other crystalline impurities were found. The average crystalline size was analyzed using Debye- Scherer's formula and also the diameter of conductor and ZnO NPs was twenty nm and twenty six nm respectively (14-16).

3.2 Particle size division and zeta potential measurements of Ag and ZnO Nanoparticles

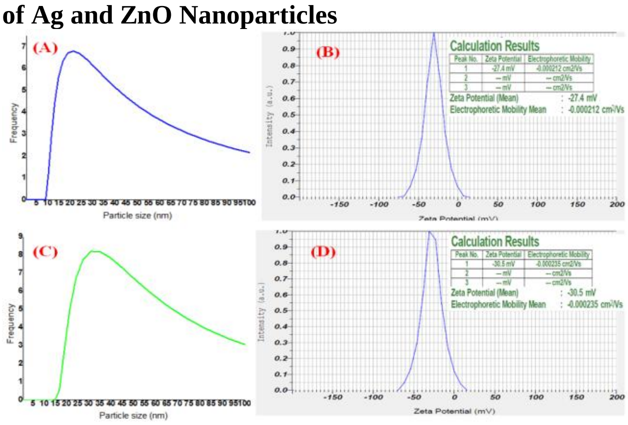

Fig. 2 (A) element size (B) zeta probable of Ag NPs (C) unit size (D) zeta prospective of ZnO NPs synthesized by *C. longa* extract.

To analyze the size distribution of the conductor and ZnO NPs, they were spread in ethyl alcohol, followed by radical sonication. the dimensions distribution of the NPs determined by dynamic lightweight scattering (DLS). The particles size distribution curve shows that the dimensions of conductor and ZnO is twenty nine nm and thirty six nm severally as shown in Fig a pair of. the soundness of conductor and ZnO NPs determined by exploitation alphabetic character potential measuring.

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The alphabetic character potential states the electrical potential of NPs boundary. The alphabetic character potential worth of synthesized conductor and ZnO NPs was -30.3 mV and -27.78 mV severally. The electric charge on the surface of the synthesized NPs cause the robust repulsion among the particles which can forestall agglomeration of nanoparticles. Hence, it had been terminated that the synthesized nanoparticles were fairly stable. The secondary metabolites like flavonoide and synthetic resin acid gift within the C. longa extract could also be liable for helpful the synthesized nanoparticles (17).

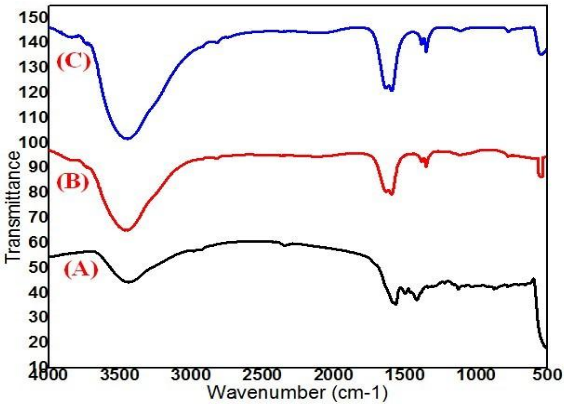

Fig. 3 FT-IR spectra of (A) *C. longa* extract and synthesized (A) Ag (B) ZnO NPs using *C. longa* extract

The different photo chemicals present in *C. longa* tuber extract (Fig3) were identified using FT-IR analysis. The photo chemicals may play a key role within the reduction of metal ions and stabilization of the nanoparticles. The FT-IR analysis reveals the interactions between the C. longa extract and also the synthesized NPs. It conjointly reveals the practical teams and bonding data of the bio molecules concerned within the synthesis of NPS. Fig .3 shows the shift in peak position of C. longa tuber powder extract and conjointly the conductor and ZnO NPs synthesized with C. longa tuber powder extract. The shifting of the peaks square measure important which offer data concerning the practical teams concerned within the NP formation. The flavonoid and phenol practical teams were liable for the peaks at 3000 cm-1 and 3500cm-1 thanks to O-H stretching. The involvement of C-H bond, C-H stretching and olefin practical teams within the NPs synthesis was known by peak disappearance of the C. longa tuber powder extract at 2954cm-1. the height at 1495 cm-1 indicates the N-H stretching. The C-N bond stretching and aromatic amines that were concerned within the NPs synthesis was confirmed by the height at 1388 cm-1 in C. longa tuber powder extract that was shifted within the synthesized NPs. The FT-IR spectra of the NPs displayed important peaks that shifted in similitude with those on the FT-IR spectra of C. longa tuber powder extract that specify that O-H, C-H and C-N teams were concerned in NPs synthesis. The coefficient bands at 505 cm-1 and 510 cm-1 stretching ensure the presence of the conductor and ZnO NPs.

3.3 FE-SEM analysis

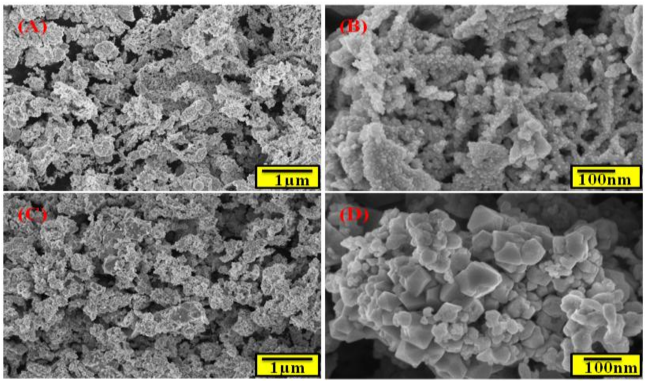

Fig. 4 FE-SEM images of synthesized (A) 1μm of Ag NPs and (B) 100nm of Ag NPs (C) 1μm of ZnO and (D) 100 nm of ZnO NPs using *C. longa* extract

FE-SEM images show the morphology of noble metal and ZnO NPs. Fig. four (A-D) shows the FE-SEM pictures of noble metal and ZnO NPs synthesized by C.longa tuber extract. The noble metal NPs were confirmed by the upper (1um) and lower (100nm) magnification of FE-SEM pictures as shown in fig. 4(A) and (B). The fig (C and D) shows completely different magnification of the surface morphology of the synthesized ZnO NPs. The FE-SEM pictures show the uniform distribution of ZnO NPs and their partially spherical and cubic shape. The bio-synthesized NPs were shown to have a smooth surface due to the presence of the biological compounds (18-20).

3.4 TEM analysis

The *C. longa* tuber extract was used for synthesizing and stabilizing the Ag and ZnO NPs as shown the TEM pictures in Fig .5. These NPs principally combined with the extract compounds have shaped sphere like structures. Because of the presence of the over one reducer within the C.longa tuber extract, NPs of various size were generated. the scale of the NPs was addicted to the character of extract used in the synthesis method. this could flow from to the various inhibitor capability of the extract used and conjointly because of the capping capability of the constituents gift within the extract.

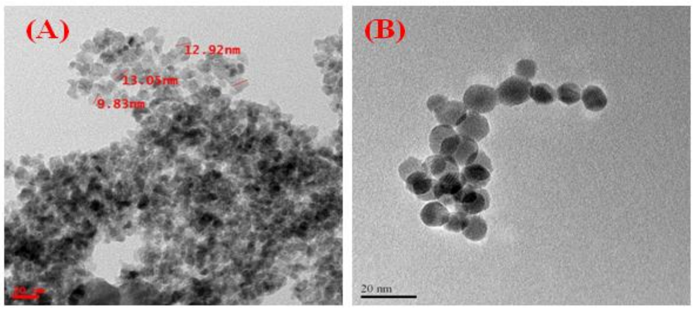

Fig. 5 TEM images of synthesized (A) Ag and (B) ZnO NPs using *C. longa* extract

3.5 Antibacterial and Anticancer Activity of Ag and ZnO NPs

Table 1: Antibacterial activity of synthesized Ag and ZnO NPs using *C. longa* extract

S. No.	Compounds	Zone of inhibition (Diameter in mm at conc. 3 mg/mL)							
		Escherichia coli (-ve)				*Staphylococcus aureus* (+ve)			
		50 µl	100 µl	150 µl	200 µl	50 µl	100 µl	150 µl	200 µl
1	**Silver (Ag) NPs**	12 ± 0.35	13 ± 0.25	15 ± 0.65	18 ± 0.86	13 ± 0.28	14 ± 0.55	16 ± 0.59	18 ± 0.86
2	**Zinc oxide (ZnO) NPs**	11 ± 0.22	12 ± 0.45	15 ± 0.65	19 ± 0.93	11 ± 0.26	13 ± 0.53	15 ± 0.67	19 ± 0.59

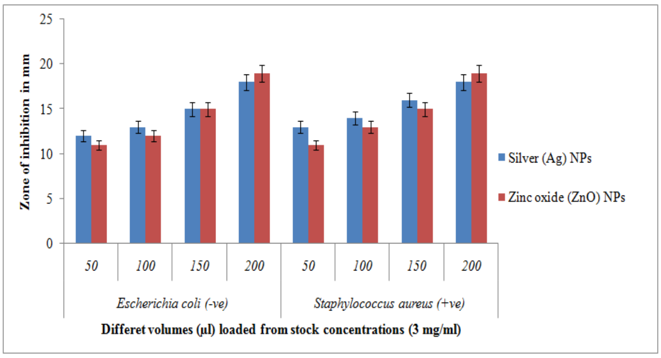

Fig.6 Antibacterial activity of synthesized Ag and ZnO NPs using *C. longa* extract

The anti pathogenic activity of noble metal NPs and ZnO NPs were calculable victimization well diffusion technique (fig 6). Results showed vital bactericide activity. The opposing morbific activity of the synthesized noble metal and ZnO NPs depends on size, form and concentration of the NPs The smaller sized NPs have highest pathogenic activity due to enlarged surface interaction with bacteria cell membrane interface. The enthalpy of the nanoparticles causes the disruption of cell and the internal energy gradient between cell and nanoparticle might be one of the parameters for increased bactericide activity. The inhibition is also because of the interaction of noble metal and ZnO NPs with enzymes, DNA and cell membrane or the generated reactive oxygen species (ROS) that might misguide the transportation channels (21,22).

3.6 Anticancer activity of Ag and ZnO NPs

Table 2: Anticancer activity of synthesized Ag and ZnO NPs using *C. longa* extract

S.NO	Compound Code	IC_{50} (µM) * (MCF-7)	IC_{50} (µM) * (HeLa)	IC_{50} (µM) * HEK 293
1	Ag	82.3±0.08	76.8±0.09	142.3±0.321
2	ZnO	28.1±0.08	17.2±0.09	107.3±0.093
3	Cisplatin	15.5±0.25	14.1±0.20	81.4±0.218

*Values are expressed as mean ± SD (n=4).

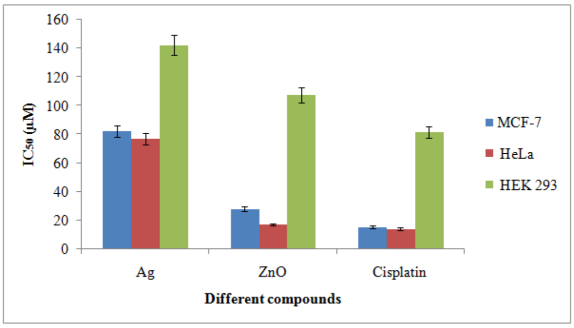

Fig. 7 Anticancer activity of synthesized Ag and ZnO NPs using *C.* longa extract

The metastatic tumor activity of inexperienced synthesized noble metal and ZnO NPs were determined against various human cancer cell lines by MTT bioassay (fig. 7). Standard drug used for this assay was cisplatin. The results were statistically significant. IC_{50} values were calculated (Table 2). The synthesized NPs showed good anticancer activity in all the three cell lines (MCF-7, HeLa and HEK 293) studied. The IC_{50} values of ZnO NPs were lower than the Ag NPs in all the cell lines tested (23).

IV. CONCLUSION

In this study we have a tendency to reportable bio-synthesis of noble metal and ZnO NPs victimization C. longa tuber powder extract. The crystalline nature, chemical composition, particle size, stability, morphology and form of the noble metal and ZnO NPs were analyzed by completely different characterization techniques like XRD, FT-IR, DLS, letter of the alphabet potential, FESEM and TEM analysis. The NPs showed potent antibacterial and anticancer activities. ZnO NPs showed more prominent anticancer activity.

ACKNOWLEDGEMENT

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IOSR Journal of Applied Physics Vol. No.7, Issue-2, March-April 2015. I have presented paper on Few Layered Graphene/ZnO Nanocomposites as Electrode of Supercapacitor at the 2nd International Conference on Inventive Material science applications ICIMA2019 Organized by PPG Institute of Technology during 25-26, September 25-26, 2019 at Coimabatore, Tamilnadu, India