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SILVER NANOPARTICLES ECO-FRIENDLY SYNTHESIS BY ORNAMENTAL FLOWER EXTRACTS AND EVALUATION OF THEIR ANTIMICROBIAL ACTIVITY

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ABSTRACT

The present work reports a simple, cost effective and eco-friendly method for the synthesis of silver Nanoparticles using different ornamental flowers like *Polianthes tuberosa, Tabernaemontana divaricata, Catharanthus roseus*, and *Chrysanthemum indicum*. The extracts of each flower were prepared. The formations of silver Nanoparticles from the extracts were identified by the colour changes. The extract color changes during the formation of silver Nanoparticles from pale yellow to dark red for *polianthes tuberosa*, light yellow to yellowish brown for *Tabernaemontana divaricata*, pale yellow to reddish brown for *Catharanthus roseus* and colorless solution to reddish brown for *Chrysanthemum indicum*. Silver Nanoparticles formation was confirmed by XRD, UV, FTIR, SEM, EDX and the antimicrobial activity.

KEY WORDS

Ornamental flowers, Silver Nanoparticles, XRD, UV, FTIR, SEM, EDX and Antimicrobial activity.

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INTRODUCTION

The word “nano” is used to indicate one billion of a meter or 10^{-9}. It size ranges from 1-100nm. “Nano” is agreek word meaning extremely small. Nanoparticles of metals have been extensively studied for their potential applications in catalysis, biological labeling, biosensing, drug delivery, etc. Silver nanoparticles can be prepared in many methods such as sol-gel process, chemical reduction method, chemical vapour deposition, Wet chemical method and biological methods. But these methods are more tedious and hazardous to both health and

environment. Biological methods are preferred as they are eco-friendly and cost-effective.

In the present study, AgNPs are synthesized by using the flower extract of the *Tabernaemontana divaricata, Polianthes tuberosa and catharanthus roseus*. *T.divaricata* is a glabrous, evergreen branched shrub belonging to the family Apocynaceae. The most common use of crude extract is its antibacterial action against infectious diseases such as syphilis, leprosy, etc. *polianthes tuberosa* belongs to the family Agavaceae is aperrineal plant. It is better known as the ornamental flowers, smelled fragrance of jasmine have some health benefits, ranging from the treatment of insomnia complaints, influenza, and rheumatism. *Catharanthus roseus* belongs to the family Apocynaceae, it grows a shrub in subtropical areas. The rose purple flower is commonly found and it is taken for study due to its unique properties. The extract of this flower is used in the treatment of diseases like lymphoma and leukemia. *Chrysanthemum indicum* is an herb with single, small-head, yellow daisies belongs to the family of sapotaceae. These flowers are an area of interest in the synthesis of AgNPs due to their attractive carotenoid pigments. This plant is highly beneficial and it is used in the traditional treatment of several diseases such as pneumonia, colitis, cancer, fever and sores. In our present study, a suitable green method for the synthesis of Silver nanoparticle was carried out using these flower extract as reducing agent.

MATERIALS AND METHOD

Materials

Fresh flowers of *Tabernaemontana divaricata, polianthes tuberosa*, *catharanthus roesus* and *Chrysanthemum indicum* were collected. Silver nitrate of nice chemicals was used.

Methods of preparation

The fresh flowers of *Tabernaemonatana divaricata* and *polianthes tuberosa* were washed several times with distilled water. The washed flowers were aerial dried to remove its residual moisture. The 50g of washed dried fine cut flowers taken in 250ml round bottom flask along with 200ml of distilled water. The mixture was then boiled for 2 hours until the color of the aqueous solution changes to light yellow and pale yellow. Then the extract was cooled to room temperature and filtered with whatmann No.1 filter paper.

The 5g of *catharanthus roseus* flowers were washed with distilled ware and cut into fine pieces. The flowers were taken in 250 ml Erlenmeyer flak, 50ml of distilled water was added and kept on a water bath for 10 minutes at 80^0 C. Then the extract was filtered using whatman No.1 filter paper.

A 20g of *chrysanthemum indicum* were cut into fine pieces and 500ml of deionized water was added and then boiled for 5 minutes. The crude extract was obtained and it was filtered using whatmannNo.1 filter paper.

Synthesis of silver nanoparticles

5mM aqueous solution of silver nitrate was prepared and to 10 ml of *Tabernaemontana divaricata* and *polianthes tuberosa* flower extract, 90ml of 1mM silver nitrate was added. As a result, a dark red solution was formed confirmed the formation of silver nanoparticles.

1mM aqueous solution of silver nitrate was prepared and to 10ml of the *Catharanthus roseus* flower extract, 90ml of 1mM silver nitrate solution was added. The color change from pale yellow to reddish brown occurs. 1mM aqueous solution of silver nitrate was prepared and to 5ml of the *chrysanthemum indicum* flower extract, 500ml of 1mM silver nitrate solution was added. The reaction mixture was kept undisturbed until the colorless solution changes to reddish brown color.

Characterization of silver nanoparticles

Characterization of nanoparticles is important task to understand and control over nanoparticles synthesis and applications and can be done using techniques such as scanning electron microscopy (SEM), X-ray diffractometry (XRD), Fourier transform infrared spectroscopy (FTIR), UV-vis spectroscopy and Energy dispersive x-ray spectroscopy (EDX).

RESULTS AND DISCUSSION

The formation of silver nanoparticles can be observed by the color changes from light yellow and pale yellow to dark red solution for *tabernaemontana divaricata* and *polianthes tuberosa*, from pale yellow to reddish brown for *catharanthus roseus* and from colorless solution to reddish brown for *chrysanthemum indicum*.

The crysatalline nature of the AgNPs that were synthesized using *T.divaricata*, *P.tuberosa*, *C.roseus* and *C.indicum*. The mean particle diameter of the synthesized AgNPs was calculated from the scherrer's equation.

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

From the equation, the average crystalline size of the synthesized AgNPs was found to be 0.16nm for *T.divaricata*, 9.34nm for *P.tuberosa*, 0.21nm for *C.roseus* and 1.57nm for *C.indicum*.

Scanning electron microscopy analysis of the silver nanoparticles provided information about the morphology and size of the biosynthesized silver nanoparticle. The below are the SEM images obtained for the synthesized AgNPs of flower extracts.

Results obtained in the antimicrobial study revealed that the synthesized silver nanoparticles possess potential antibacterial activity against *staphylococcus, salmonella, Aspergillus, candida, serritia*.

The presence of the elemental silver can be seen in the graph presented by the EDX analysis, which indicate the reduction of silver ions. It has been reported that Nanoparticles synthesized using flower extracts are surrounded by a thin layer of some capping organic materials from the plant flower both that remains stable in the solution even after synthesis.

Table No.1: Antimicrobial activity for synthesized silver Nanoparticles

S.No	Sample	*Staphylococcus*	*Salmonella*	*Aspergillus*	*Candida*	*Serritia*
1	*T.divaricata*	16	18	10	R	R
2	*P.tuberosa*	16	20	10	10	R
3	*C.roseus*	14	19	10	R	R
4	*C.indicum*	14	18	10	10	R
5	C	R	R	R	R	R
6	S	17	18	16	17	20

Figure No.1: A. Photograph showing both Flower extract and color change after adding $AgNO_3$ of *T.divaricata*

Figure No.1: B. Photograph showing both Flower extract and color change after adding $AgNO_3$ of *P.tuberosa*

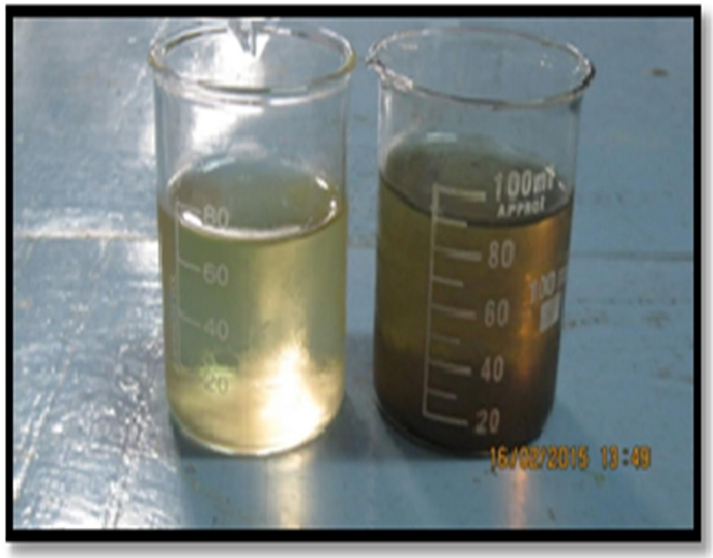

Figure No.1: C. Photograph showing both Flower extract and color change after adding $AgNO_3$ of *C.roseus*

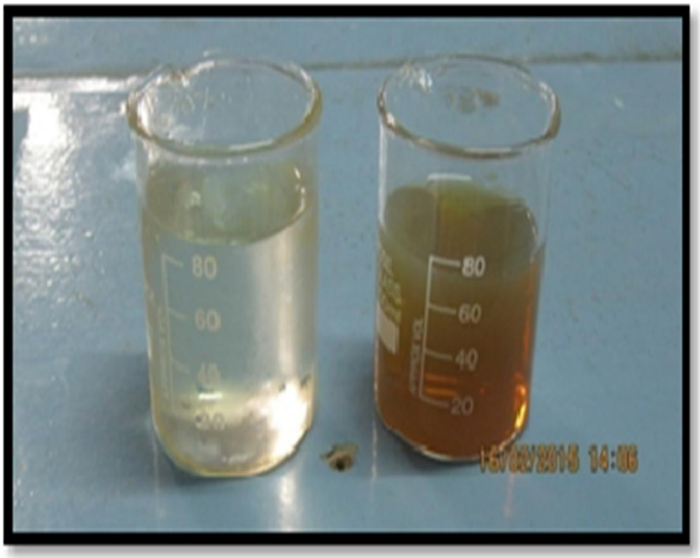

Figure No.1: D. Photograph showing both Flower extract and color change after adding $AgNO_3$ of *C.indicum*

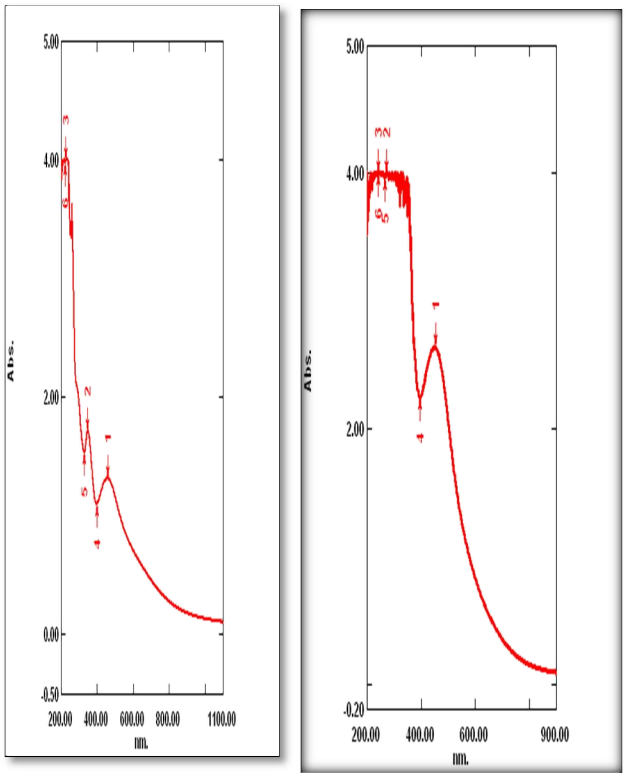

Figure No.2: A.UV-Vis spectra for *T. divaricata*, Figure No.2: B.UV-Vis spectra for *P. tuberosa*

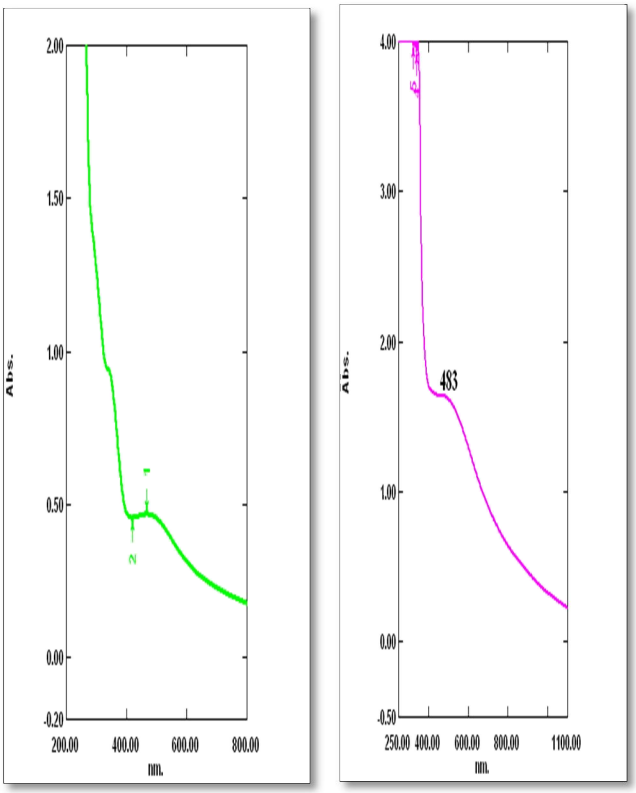

Figure No.2: C.UV-Vis spectra for *C.roseus*, Figure No.2: D.UV-Vis spectra for *C.indicum*

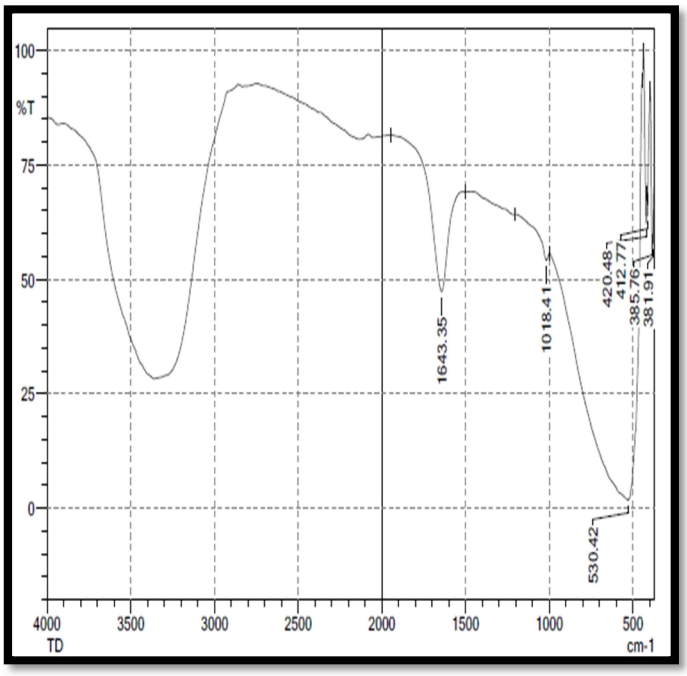

Figure No.3: A. FTIR spectra for the *T.divaricata*

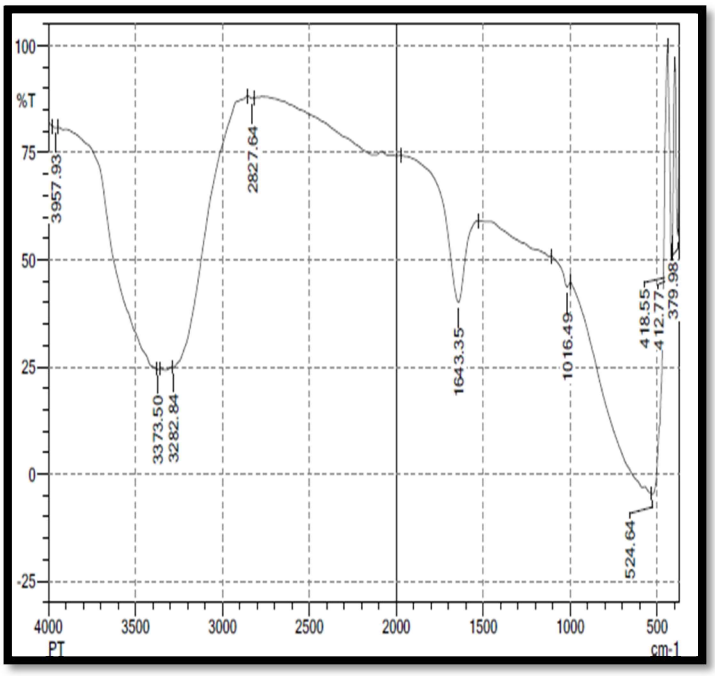

Figure No.3: B. FTIR spectra for the *P.tuberosa*

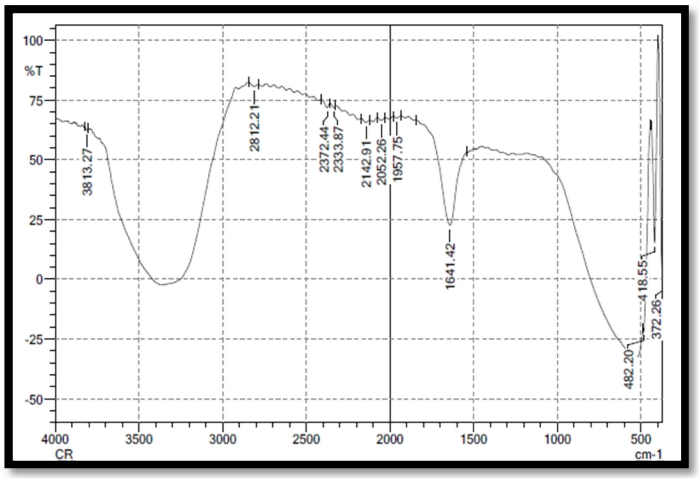

Figure No.3: C. FTIR spectra for the *C.roseus*

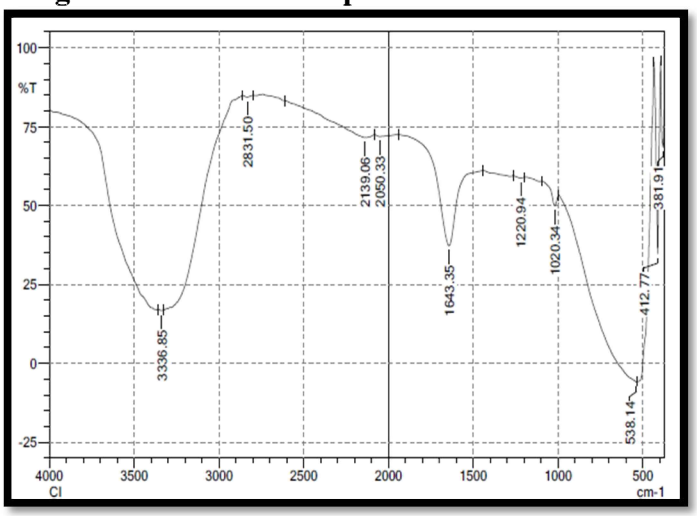

Figure No.3: D. FTIR spectra for the *C.indicum*

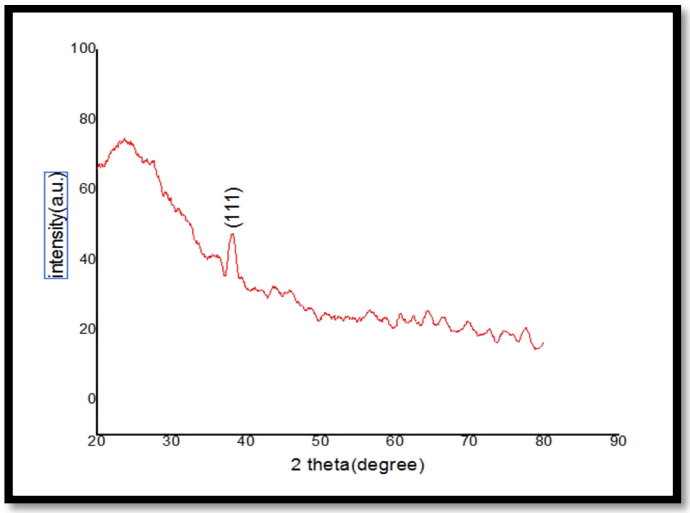

Figure No.4: A. XRD pattern for the *T.divaricata*

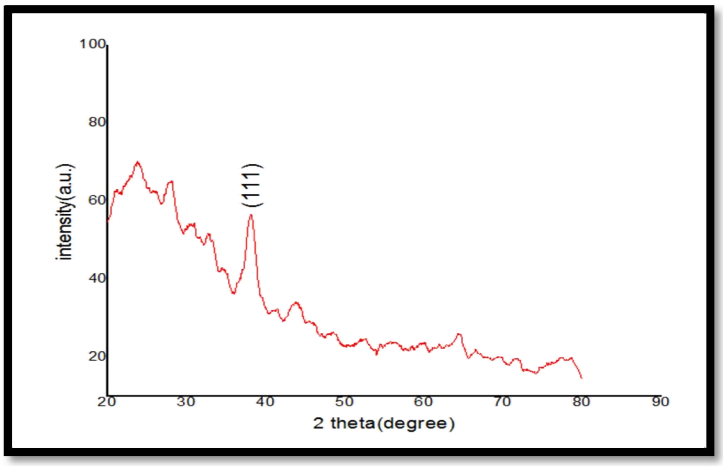

Figure No.4: B. XRD pattern for the *P.tuberosa*

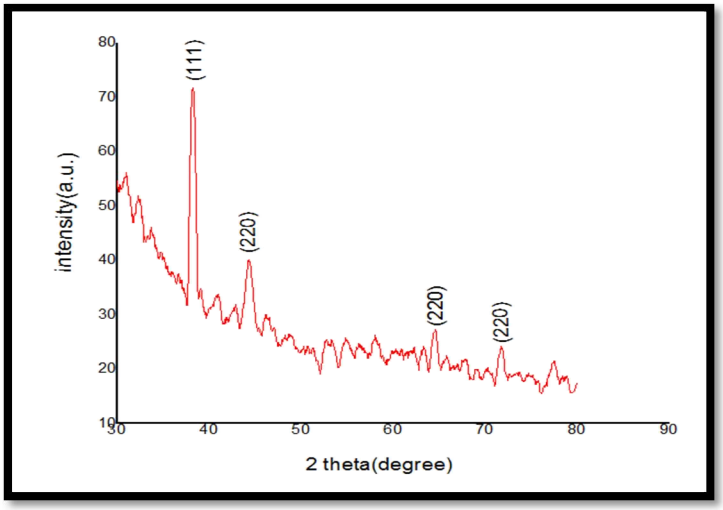

Figure No.4: C. XRD pattern for the *C.roseus*

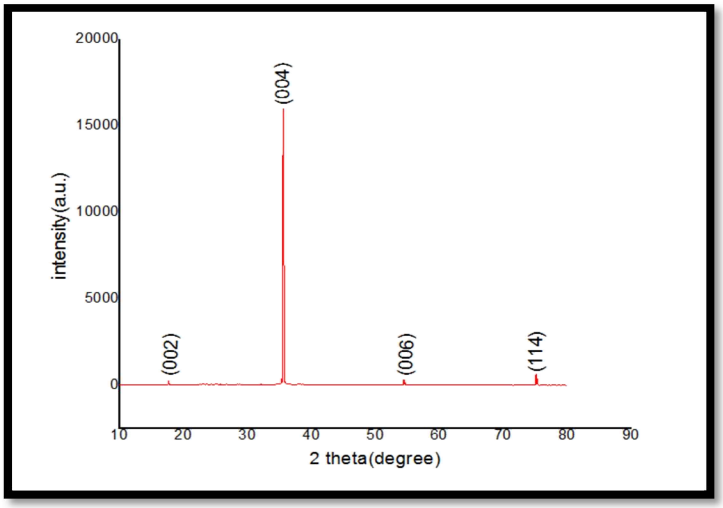

Figure No.4: D. XRD pattern for the *C.indicum*

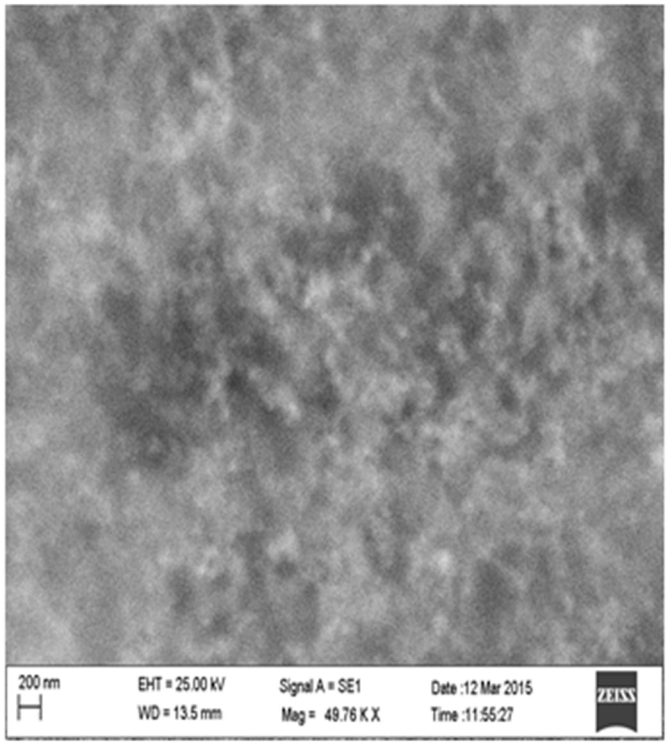

Figure No.5: A. SEM image for *T.divaricata*

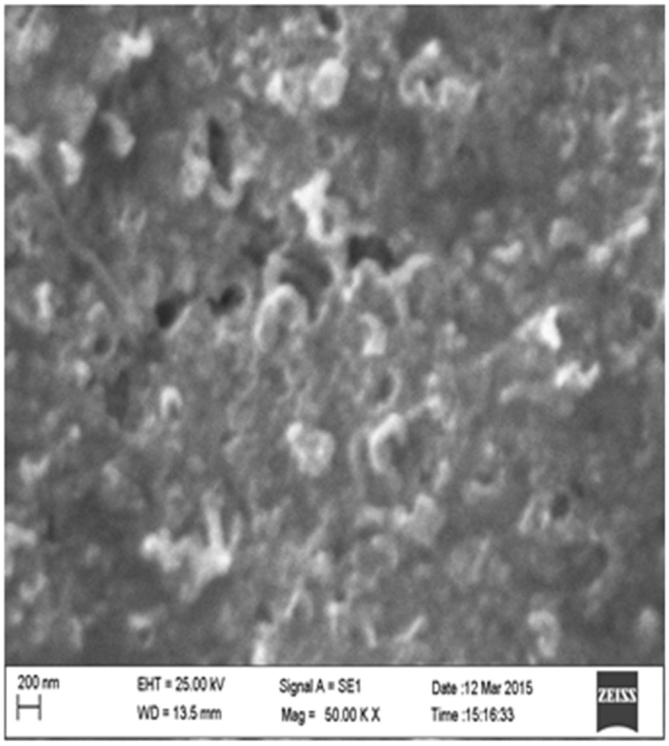

Figure No.5: C. SEM image for *C.roseus*

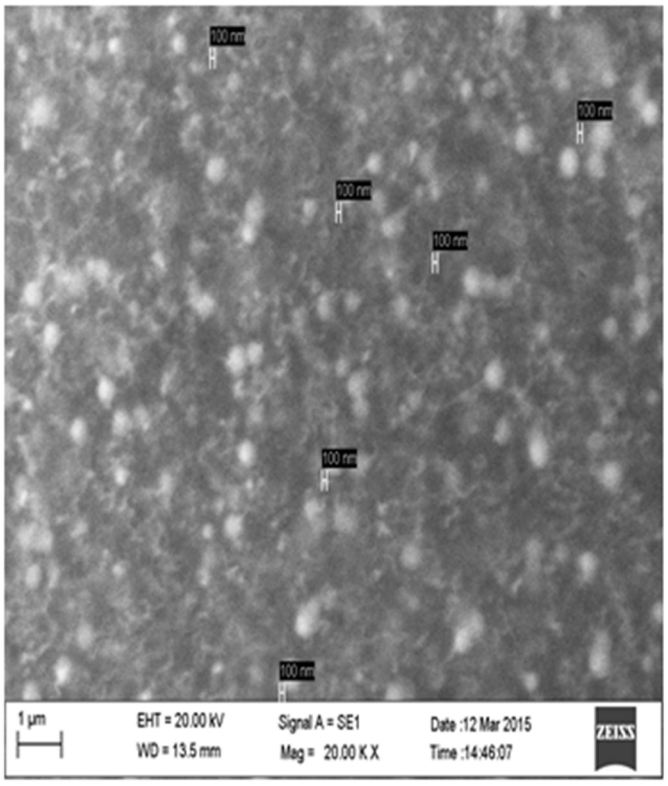

Figure No.5: B. SEM image for *P.tuberosa*

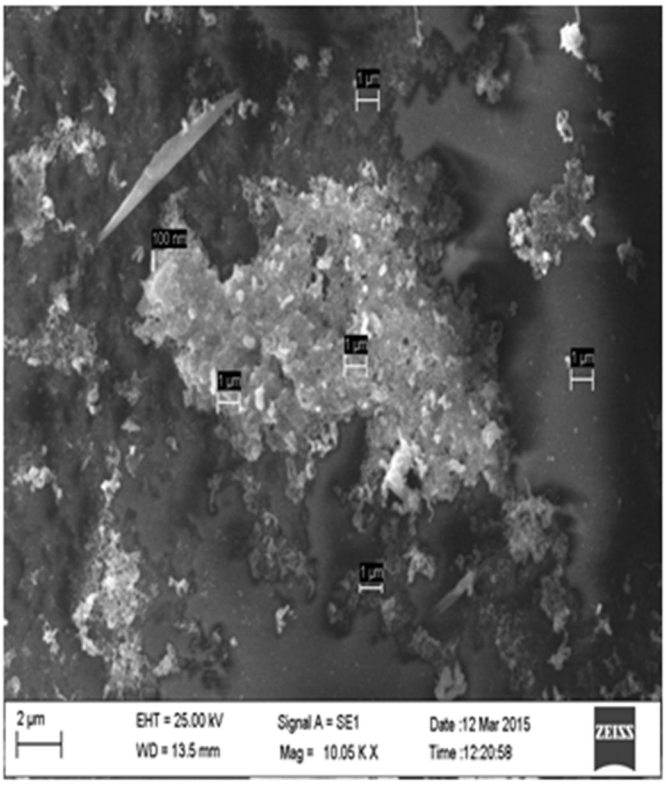

Figure No.5: D. SEM image for *C.indicum*

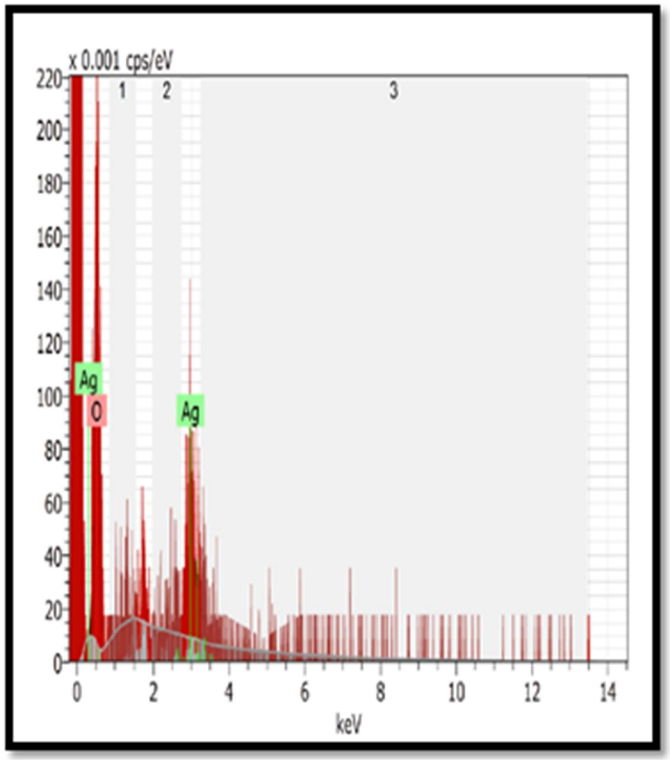

Figure No.6: A. EDX spectra for *T.divaricata*

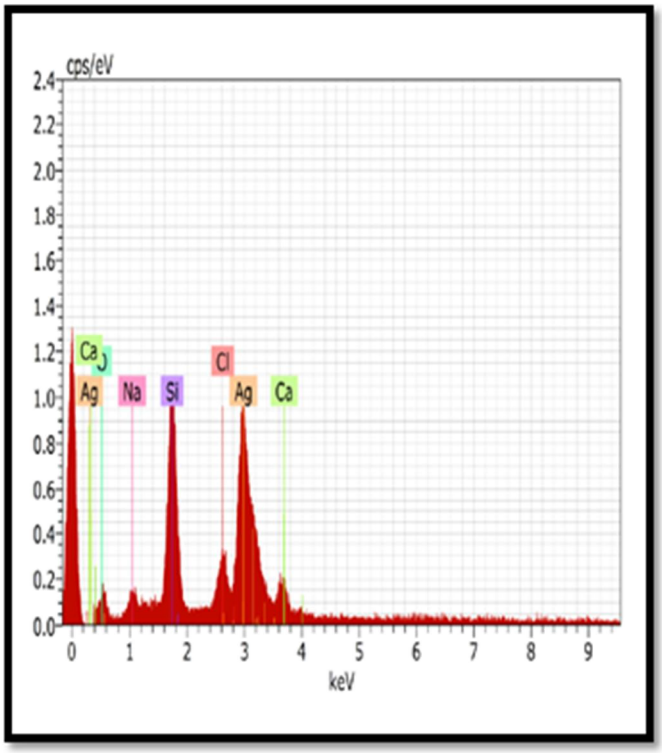

Figure No.6: C. EDX spectra for *C.roseus*

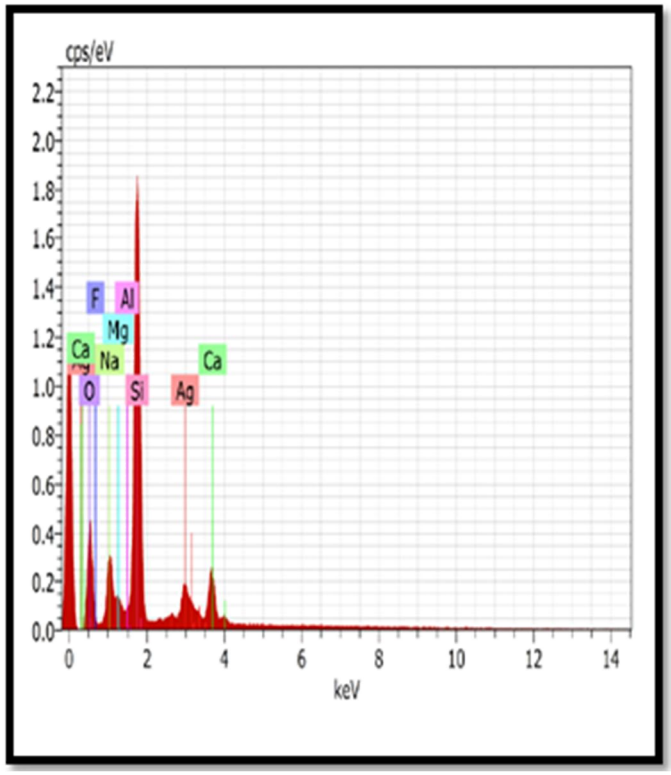

Figure No.6: B. EDX spectra for *P.tuberosa*

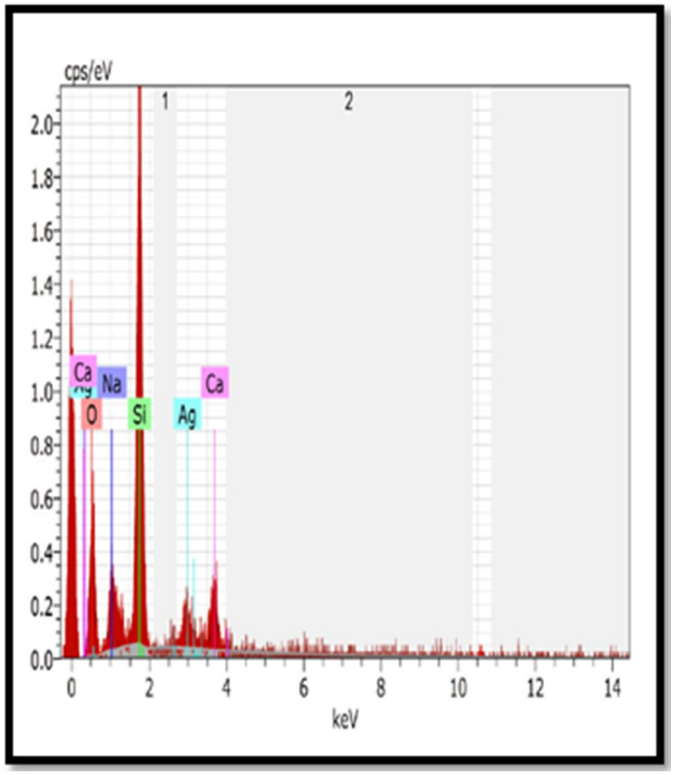

Figure No.6: D. EDX spectra for *C.indicum*

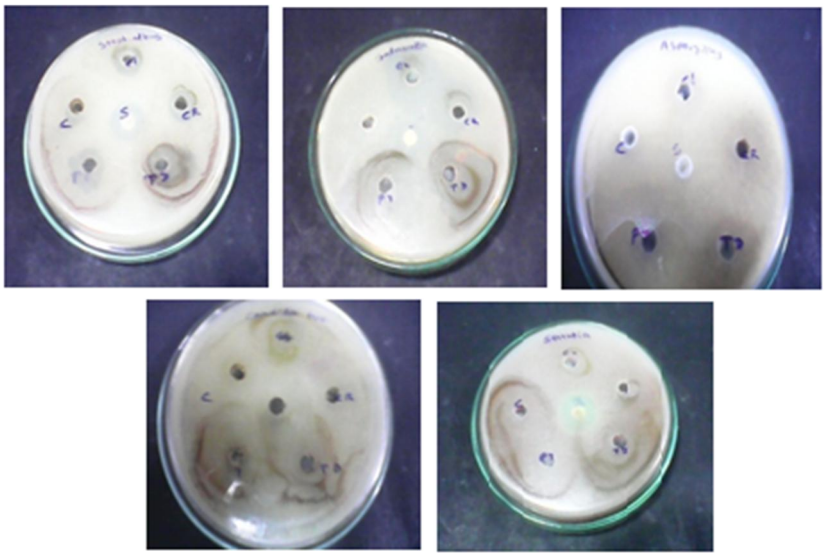

Figure No.7: Plate showing inhibition zone area of Bacteria and Fungi Impregnated of AgNPs of Flower extract

CONCLUSION

Biogenic synthesis of silver nanoparticles using *T.divaricata, p.tuberosa, C.roseus, C.indicum* flower extracts were performed by adopting standard procedure and it was characterized by UV, FTIR, XRD, SEM and EDX studies. The typical XRD pattern revealed that the average size of silver nanoparticles was found to be 0.16 nm, 9.34 nm, 0.21 nm, 1.57 nm corresponding to four flower extracts mediated AgNPs respectively and exist an cubic and hexagonal Ag crystals. The spectroscopic analysis using UV-Visible spectroscopy which gave a peak 453 nm, 458 nm, 468 nm and 483 nm proved the formation of AgNPs. The FTIR analysis of the flower extract mediated AgNPs was performed and indicate the presence of amides, alkyl halides, aldehydes and amines. The SEM analysis showed that the synthesized AgNPs in various morphologies and EDX indicated the presence of silver along with some impurities present in the extract. Results obtained in the Antimicrobial studies revealed that the synthesized AgNPs possess potential antimicrobial activity against *Staphylococcus, Salmonella, Aspergillus, Candida* and *Serritia*. Applications of such eco-friendly AgNPs in different fields of science like medicine, catalyses, Drug delivery systems etc., makes this bioreduction process a highly suitable way for large scale synthesis.

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CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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