# GREEN SYNTHESIS OF ALUMINIUM NANOPARTICLE FROM *Ixora macrothysra* EXTRACTS AND ITS ANTIBACTERIAL ACTIVITY

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**Abstract**

Aluminium nanoparticles ($Al_2O_3$NPs) have been synthesized in the presence of *Ixora macrothysra* flower extract at room temperature. The synthesized $Al_2O_3$NPs was characterized by UV-vis spectroscopy, SEM, EDS, XRD, SEM and FTIR. The UV-vis spectra of the $Al_2O_3$NPs show SPR band 278 nm for fresh sample and 270 nm for dried sample. SEM results indicate that $Al_2O_3$NPs are accumulated and cluster like in structure and the particle size of the Aluminium nanoparticles for fresh and dried sample synthesized were 20.73 nm and 27 nm respectively. Antibacterial activity of the synthesized $Al_2O_3$NPs has been assessed against *P.aeruginosa* and *S. pyogenes*. The results show that $Al_2O_3$NPs exhibit inhibitory effect and effect is a function of $Al_2O_3$NPs concentration. The antibacterial activity of the prepared $Al_2O_3$NPs has been compared with the extracts of the flower samples. It is found that the $Al_2O_3$ perform better than the flower extracts.

**Keywords:** *Ixora macrothysra*; Aluminium nanoparticles; green synthesis; characterization; antibacterial activity.

## Introduction

Metal nanoparticles have attracted considerable attention in recent times because of their attractive properties related with the quantum size effect and their limitless applications in areas such as optics, catalysis, optoelectronics, chemical/biochemical sensing, biomedical, and nanostructure Fabrication. The use of plant extract in the synthesis of metal nanoparticles is of remarkable interest because they can act as reducing agents as well as capping agents in addition to their environmental friendliness, sustainability and cost-effectiveness.

*Ixora* is a genus of shrubs and short trees which comprises about 400 taxa. It belongs to the family of Rubiaceae and subfamily Ixoroideae. *Ixora* are grown in Indian garden which comprises of colored, beautiful flowers, and leaves. The roots and flowers of the plant are involved in the treatment of dysentery, loss of appetite, nausea and chronic ulcers. Furthermore, the leaf of *Ixora macrothysra* has a potent antidiabetic property by lowering the blood glucose level and the flowers of the plant are the rich source of the phytochemicals.

Infectious diseases are a leading cause of death worldwide and antibiotic resistance has become a global concern. A way to prevent antibiotic resistance of pathogens is by using new compounds based on their antimicrobial, antioxidant, hemolytic and cell line studies. Phytomedicines derived from plants have showed better results in acting against the pathogens. Recent studies have also proven the activity of the nanoparticles derived from the plant sources also have high level of resistance against the pathogens. Most of the diseases are also linked to oxidative stress due to free radicals, biological process in metabolism etc., Compounds possessing these different activities are studied and in used in application. Several studies have now been done in this aspect.Herein, we report the green synthesis of Aluminium nanoparticles using extract of *Ixora macrothysra* flower and the potency of the nanoparticles against *P.aeruginosa* and *S.pyogenes*. The prepared nanoparticles were characterized by UV–vis, XRD, FTIR, SEM and EDS.

**Methodology**

**Synthesis and Characterization Of Aluminium Nanoparticles**

For synthesis of Aluminium nanoparticles, 50 mL of *Ixora macrothysra* flower extract (fresh and dried) was taken and boiled to 60-80 degree celsius using a stirrer heater. 10 mL of aluminium chloride (0.1M) aqueous solution was added to the stirring extract solution. Formation of precipitation is noted and was then hot air dried to obtain the nanoparticles. The synthesized powder was then collected in a ceramic crucible and heated in a furnace at 500° C for 2 hrs. A silver grey powder was obtained and this was carefully collected and packed for characterization using UV–vis, XRD, FTIR, SEM and EDS.

**Antibacterial activity**

The synthesized Al NPs were significantly screened for the antimicrobial potential against two bacterial cultures viz., *S. pyogenes* and *P. aeruginosa*. The anti-microbial potential was assessed by determining the inhibition zone diameter. The sensitivity of bacterial strains towards antibiotics with a clear zone around the well is tested using well diffusion method.

Inoculum containing the bacterial culture to be tested was spread on nutrient agar plates with a sterile swab moistened with the bacterial suspension. The wells of about 8 mm were cut in agar medium and filled with 100 µL of plant extract, synthesized Aluminium particles solution, negative control (distilled water) and positive control (Amoxillin) and allowed to diffuse at room temperature for 2 hrs. The plates were then incubated in the upright position at 37° C for 24 hrs.

**Result**

**Characterization of Aluminium Nanoparticles**

The synthesized Aluminium nanoparticles were characterized for their basic studies and were observed to have the properties such as the UV Vis spectrophotometer of the Aluminium nanoparticles were analysed and absorbance was read at 278 nm for fresh sample and 270 nm for dried sample. The particle size of the Aluminium nanoparticles for fresh and dried sample synthesized were 20.73 nm and 27 nm respectively. The basic studies showed that the Aluminium nanoparticles synthesized from the fresh sample produced better results than the dried sample and is used for the further studies. The

SEM analysis of the Aluminium nanoparticles from fresh sample showed that they are accumulated and cluster like in structure. The EDX were analysed along with SEM for their elemental composition, Al and O. The FTIR results showed the presence of the functional groups present. The XRD patterns showed the crystalline peaks observed from the Aluminium Nanoparticles.

**Antibacterial activity**

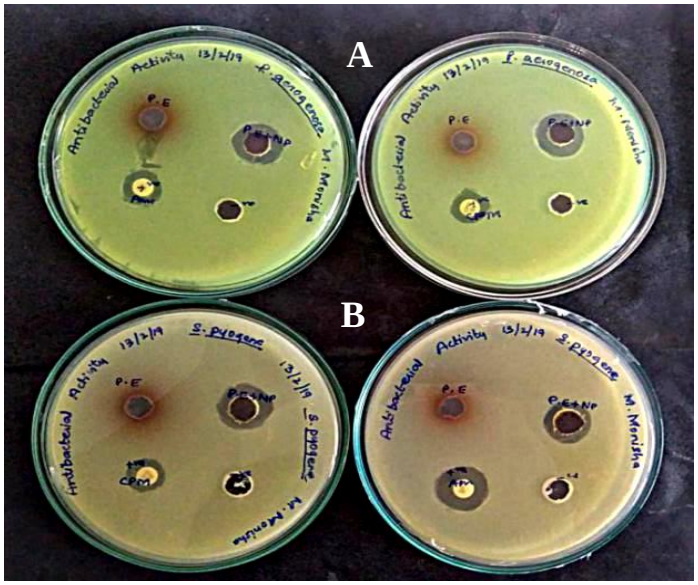
The antibacterial activity of the synthesized nanoparticles against the organisms *S. pyogenes* and *P. aeruginosa* were checked. The zone of inhibition of different extract against the organisms are given in the table.

The synthesized Aluminium nanoparticles showed higher activity against the bacterial cultures than the plant extract and the positive control. The organisms were observed to be highly susceptible to Aluminium nanoparticles.

The zone of inhibition of the different extracts were observed and measured. The zone of inhibition of the bacterial growth and a zone diameter of 6 mm and above was considered to be as susceptible and a zone diameter below 6 mm was considered to be as resistant. Similar to Aluminium nanoparticles, the plant based nanomaterials also show antimicrobial activity, but with lower toxicity.

Significant antibacterial activity of $Al_2O_3$-NPs against the MDR (ESBLs and MBLs positive) isolates of *P. aeruginosa* (Mohammad A. Ansari 2014).

| Sample | Zone Of Inhibition In Plant Extract | Zone Of Inhibition In Synthesized Aluminium Nanoparticles | Zone Of Inhibition Of Positive Control | Zone Of Inhibition Of Negative Control |
|---|---|---|---|---|
| ***P.aerogenosa*** | 16 mm | 22 mm | 19 mm | _ |
| ***S.pyogenes*** | 13 mm | 18 mm | 14 mm | _ |



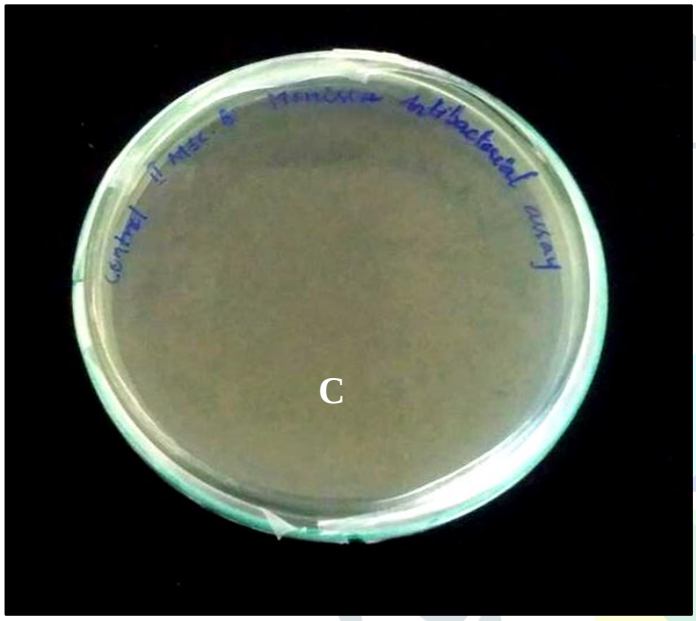




**Image showing results of Antibacterial Activity**

**A - *P.aeroginosa* ( gram negative )**

**B - *S.pyogenes* ( gram positive )**

**C - Control**

## Conclusion

The Aluminium nanoparticles were successfully synthesized by green synthesis method and characterized using various techniques. The average particle size of the synthesized Aluminium nanoparticles were found to be about 25 nm. These synthesized Aluminium nanoparticles were then assayed for their antimicrobial activity against the *P.aerogenosa* and *S.pyogenes*. They showed better inhibition against the organisms than the positive control cephalosporin and the pure flower extracts of the plant *Ixora macrothysra*.

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