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# Antibacterial and anticancer activity of trimetal nanoparticles

**P. Gurulakshmi**
Research Scholar (Reg.No: 19122232032011), PG and Research Department of Chemistry, V.O.Chidambaram College, Thoothukudi,ManonmaniamSundaranar University, Abishekapatti, Tirunelveli - 627 012, Tamil Nadu, India & Assistant Professor, A. P. C. Mahalaxmi College for Women, Thoothukudi
Corresponding author email: guru199127@gmail.com

**Jessica Fernando**
Assistant Professor,V.O.Chidambaram College, Thoothukudi, Manonmaniam Sundaranar University, Abishekapatti, Tirunelveli - 627 012, Tamil Nadu, India
Email: jessivoc@yahoo.com

***Abstract*---**Medical field is faced with the major threat of antibiotic resisting bacteria and has turned to nanotechnology for both the drugs and their delivery. In the current study, the antibacterial and anti-cancer activities of La/Bi/Cu trimetalnanoparticles have been evaluated. They were found to decrease the cell viability of HOS cell lines in in-vitro analysis. La/Bi/Cu trimetalnanoparticles were also found to control growth of two Gram negative bacteria (Enterobacterclocae, Pseudomonas Vs1)and two Gram positive bacteria(Bacillus 1.3,Bacillus8.3)at different concentration (50-150μg/L).Based on the results, the nanoparticles can be used against human cancer and other infectious diseases.

***Keywords*---**trimetal, antibacterial, anticancer, HOS cel.

## Introduction

Nanomaterials and Nanoparticles (NPs) (particularly metallicNPs) have novel and exceptional physical and biological properties [1-5].For decades, they have shown wide applications in diverse fields ranging from catalysis and electronics, Optoelectronics, bioengineering, sensing, tunable resonances, fuel cells, information/energy storage, and nanomedicine [6-12]. According to the number of metals/metal oxides involved, metal NPs can be divided into single metals (mono-metallic) and bi- or tri-metallic NPs. Among these materials, bi- and tri-metallic NPs have recently gained attention due to their unusual enhanced properties andnovel applications [13-15]. Compared with mono-metallic NPs and bi- metallic


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NPs, tri-metallic NPshave higher catalytic selectivity/activity and excellent efficiency in many applications.They canbe applied as heterogeneous nanocatalysts in different organic transformations [16,17]. Trimetallic NPs have recently acquired extra focus due to the progressive physicochemical characteristics(e.g., digital, optical, catalytic, and magnetic) generated from the synergistic results of their monometallic counterparts, in particular in catalytic structures [18].Trimetallic NPs are reported to exhibit efficient and promising antimicrobial potentials than the mono andbimetal Nanoparticles. For example, CuO,NiO,ZnO combined steel oxide NPs (~7 ± 2 nm)displayed high antibacterial activity towards E. coli and S. aureus bacterial cell, the NPs adhere to the bacterial cell wall and completely annihilate the cells [19]. In some reported examples, trimetallic Au,Pt,Ag NPs (~35–40 nm) exhibited capacity for anti biofilm and antimicrobial activity towards S. aureus, E. coli, Enterococcus faecium, Enterococcus faecalis, and Candida albicans [20]. The inhibition responses of trimetallic nanomaterials were reported to be better than monometallic and bimetallic ones, as within the case of Au/Pt/Ag trimetallic nanomaterials synthesized via MW assisted approach .The treatment and analysis of cancers in early stages areimportant, and in this regard, trimetallic NPs show promising potentials and researchers can explore such studies.We have reported the synthesis,characterization and dye degradation ability of La/Bi/Cu trimetal Nanoparticles earlier[21]. In this study, we have analysed and reported their antibacterial and anti-cancer activities.

## Material and Methods

### Materials

Double distilled water was utilized for all processes. Filtration was done using Whatman no.1 filter papers. Glasswares used for the reactions were washed well, rinsed with double distilled water and dried in hot air oven.

### Methods

### Synthesis of La/Bi/Cu Trimetal nanoparticles

La/Bi/Cu Trimetal nanoparticles were synthesized from precursors, lanthanum nitrate, bismuth nitrate and copper nitrate, their morphology was also characterized and reported [21].

### Evaluation of Antibacterial activity

Antibacterial activity of the trimetal nanoparticles were examined using water as solvent and tested against four different human pathogens such as *Bacillus* sp. 1.3, *Bacillus* sp. 8.5, *Pseudomonas aeruginosa, Enterobacterclocae* using agar well diffusion method[22]. The sterilized media are cooled to around 50˚C and poured into petriplates which are covered immediately. Nutrient agar plates were swabbed (sterile cotton swabs) with 12 hour old - broth culture of respective bacteria. Wellswere made in each of these plates using sterile cork borer (8mm diameter). Trimetal nanoparticles of different concentrations from 100mg/ml to 300mg/ml were prepared. About 30µl of different concentrations of trimetal nanoparticles were added using sterile pipettes into the wells and allowed to diffuse at room temperature for 2 hrs. The plates were incubated at 37°C for 18-24 h. The diameter of the inhibition zone (mm) was measured.

**Anticancer activity in (ATCC CRL-1543) cell line (Human Osteosarcoma cells – HOS cells)**

The HOS cells cultured in Eagle's Minimum Essential Medium with 10% fetal bovine serum were subcultured in flat bottomed plates at $5 \times 10^4$ cells/well in 100µl culture medium. Different concentration of given samples (10, 20, 40, 60, 80 and 100 µl/ml) was added to the cells and incubated overnight at 37°C in the $CO_2$ incubator. The HOS cells were observed under microscope and photographed. After incubation, 50µl of MTT solution was added and further incubated for 3 hours. Then, 150 µl of the solubilization solution was added into each well, wrapped with aluminum foil and incubated 15 mins. The absorbance of the resultant formazan product was measured at 570 nm in the spectrophotometer.

**Results and Discussion**

The La/Bi/Cu trimetal nanoparticles have absorbance band at 308 nm due to the trimetal cluster. XRD analysis of La/Bi/Cu trimetal nanoparticles revealed the crystalline nature and size of the nanoparticles were in the range of 10.86nm-61.46nm. SEM image showed grain like shape of the nanoparticles. EDAX analysis proved that all three metals La,Bi,Cu were present in trimetal nanoparticles.[21]

**Antibacterial Activity**

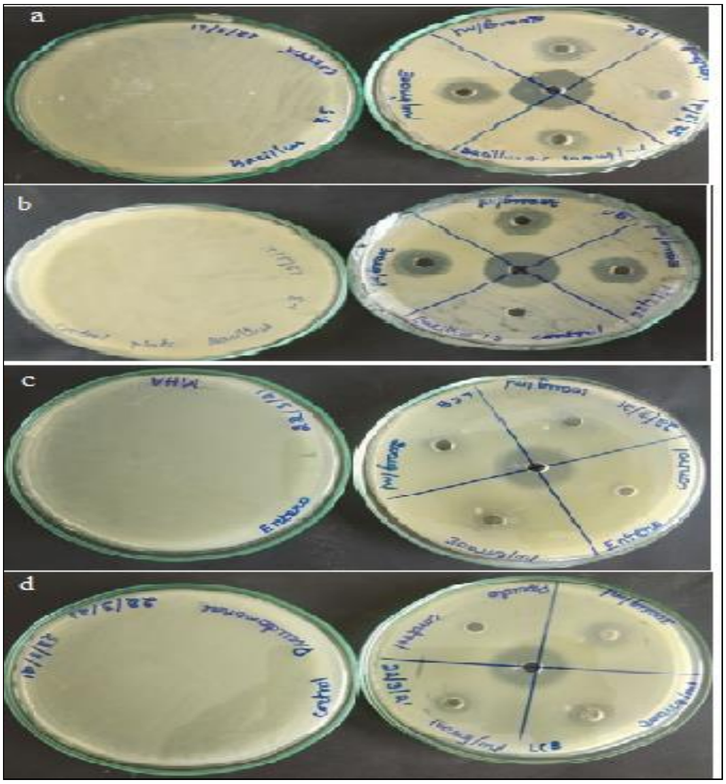


Fig. 3.1.(a-d) Antibacterial activity of La/Bi/Cu trimetal Nanoparticles

Table. 3.1.Inhibition Zone of Bacterial Species
Zone of inhibition in mm

| | Concentration (µg/L) | *Enterobacterclocae* | *Psemudomonas*VS1 | *Bacillus* 1.3 | *Bacillus* 8.3 |
|---|---|---|---|---|---|
| chloramphenicol | 1 | 2.6 | 3.5 | 3.7 | 3.7 |
| LBC | 50 | 0.9 | 1.5 | 2.4 | 2 |
| | 100 | 1 | 1.7 | 2.6 | 2.1 |
| | 150 | 1.1 | 1.9 | 2.7 | 2.3 |

The La/Bi/Cu trimetal nanoparticles was found to exert inhibitory effects on the two Gram negative bacteria (*Enterobacterclocae, Pseudomonas Vs1)and* two Gram positive bacteria(*Bacillus 1.3,Bacillus8.3)at different concentration (50-150*µg/L) shown in fig.3.1.The Zone of Inhibition of Gram negative and Gram positive bacteria is shown in Table 3.1. The antibacterial activity of La/Bi/Cu trimetal nanoparticles was compared to that of chloramphenicol as standard. The antibacterial activity increases with increase in the concentration of nanoparticles. The activity is obviously less than that of standard. The concentration of nanoparticles displayed adverse effect in antibacterial activity. The results show that La/Bi/Cu trimetal nanoparticles have better antibacterial activity against Gram positive bacteria when compared to Gram negative bacteria.

**Anticancer Activity**

Table.3.2.MTT assay on cytotoxic activity of La/Bi/Cu trimetal Nanoparticles against HOS cell

| Sample Concentration (µg/mL) | OD value I | OD value II | OD value III | Average OD | Percentage Viability |
|---|---|---|---|---|---|
| Negative Control | 1.787 | 1.778 | 1.783 | 1.782 | 100.01±0.25 |
| Positive Control | 0.084 | 0.081 | 0.089 | 0.084 | 4.72±0.23 |
| La/Bi/Cu trimetal Nanoparticles | | | | | |
| 10µl | 1.611 | 1.624 | 1.604 | 1.613 | 90.49±0.57 |
| 20µl | 0.821 | 0.841 | 0.840 | 0.834 | 46.77±0.63 |
| 40µl | 0.156 | 0.151 | 0.166 | 0.157 | 8.82±0.43 |
| 60µl | 0.095 | 0.104 | 0.101 | 0.100 | 5.58±0.26 |
| 80µl | 0.090 | 0.088 | 0.081 | 0.086 | 4.82±0.27 |
| 100µl | 0.084 | 0.093 | 0.083 | 0.086 | 4.84±0.31 |

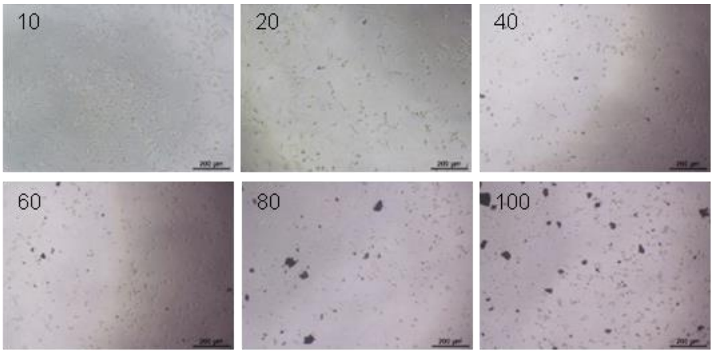


Fig.3.2.Microscopic image of Cytotoxic activity of La/Bi/Cu trimetal Nanoparticles against HOS cell line

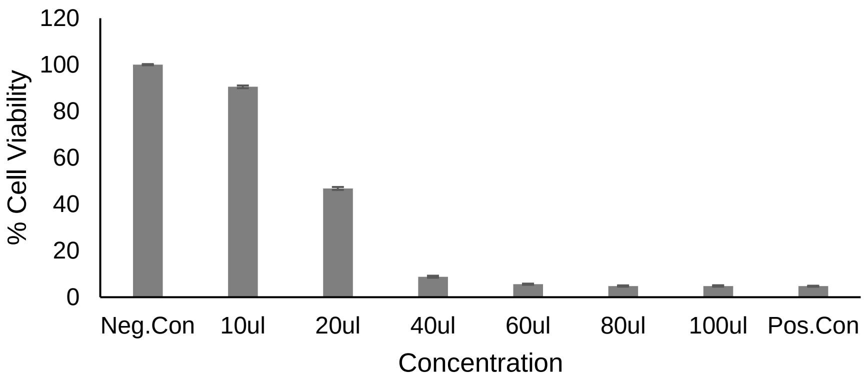


Fig. 3.3.Anticancer activity of La/Bi/Cu trimetal Nanoparticles against HOS cell line

In vitro cytotoxic activity against HOS cell line at different concentrations was investigated.The studies were performed with different concentrations such (10, 20, 40, 60, 80 and 100 µl/ml). The anticancer activity of nanoparticles against HOS cell line increased while in the concentration of La/Bi/Cu trimetal nanoparticles. The results show the good cytotoxic activity against the cancer cells (Fig.3.3). The concentration of nanoparticles plays an important role in the anticancer activity.The La/Bi/Cu trimetal nanoparticles are having the good results against HOS in that 100 µl show fine results followed by80 µl ,60 µl,40 µl,20 µl and 10µl.

**Conclusion**

In summary, La/Bi/Cu Trimetal Nanoparticles exhibit antibacterial activity againstGram negative bacteria (*Enterobacterclocae, Pseudomonas Vs1)and* two Gram positive bacteria(*Bacillus 1.3,Bacillus8.3).,*the maximum bactericidal effect was reached by 150(µg/L) also showed in vitro anticancer activity against Human Osteosarcoma celllines.Due to the potential anti-bacterial, anticancer and antihemolytic activity of La/Bi/Cu trimetal Nanoparticles , it can be effectively used in the field of medicine, besides pharmaceutical, cosmetic and food industries.

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