# PLANT – BASED GREEN SYNTHESIS, CHARACTERISATION AND ANTIMICROBIAL EFFECT OF HEMIDESMUS INDICUS BIOFUNCTIONALIZED METAL DOPED MGO-CO3O4 NANOCOMPOSITES

**Abstract**: Synthesis and characterisation of Ag- MgO – CO3O4 - Au nanocomposites using leaf extract of Hemidesmus indicus and calculation of antimicrobial activity. Green innovative has been employed for the creation of Ag- MgO – CO3O4 - Au nanocomposites herbal extract has been arranged which was the developed for the creation of Ag- MgO – CO3O4 - Au nanocomposites. Valuation for the separation of nanocomposites were organised using UV-Visible spectroscopy, Energy Dispersive X ray Analysis (EDAX) ,scanning electronic microscopy (SEM). Antimicrobial and antifungal activity of Ag- MgO – CO3O4 - Au nanocomposites prepared by using aqueous extracted was studied using disc distribution method. Antimicrobial activity of Ag- MgO – CO3O4 - Au nanocomposites exposed that the nanoparticles have superior and antimicrobial activity when experiments were achieved under comparable conditions.

Keywords: Ag- MgO – CO3O4 - Au nanocomposites SEM, UV-Vis, EDAX, antimicrobial activity.

## *INTRODUCTION*

The area of nanotechnology is one of the greatest active researches in current material science. Synthesis of metal nanocomposites used for plant materials corresponding leaf, stem, root, seeds etc. The green synthesis of nanocomosites less harmful before to physical and chemical method. Gold nanoparticles are broadly used in biomedical ground because of their huge surface area, and high electron conductivity. The gold nanoparticles attested to be the harmless and much less toxic agents for drug delivery. Nanoparticles such as dendrimers, quantum dots, nanocomposites, and gold nanoparticles have more goods and widely used in some application such as drug delivery systems and imaging. The silver nanoparticle has various applications due to the huge degree of commercialization. Silver (Ag) is an attractive material for its typical properties, such as good conductivity, biosensing, catalytic activity, and antimicrobial activity. Ag nanoparticles are used in antimicrobial applications since the antimicrobial effect of Ag ions is well known [1]. Still, Ag nanoparticles have discrete plasmon optical spectra properties. Cobalt oxide ($Co_3O_4$) is an anti-ferromagnetic p-type semiconductor (with direct optical band gaps at 1.48 and 2.19 eV), which is measured to remain among the maximum path- functional materials as it has gas-sensing, catalytic and electrochemical properties [2-5]. In recent years, researchers need more on the synthesis of MgO (band gap of pure MgO is 3.3 eV) [6] nanoparticles due to its novel in progressive technologies Metal oxides are very important technological materials to be used in electronic and photonic devices. The magnesium oxide (MgO) is a very appropriate applicant for protection submissions due to its low heat capacity and high melting point. Recently, it was reported that MgO has a good bactericidal show in aqueous environments due to the formation of super-oxide. Various properties of MgO, such as catalytic behaviour, can be further enhanced if it is used as nanosized particles compared to micron-sized particles [7].

***Materials and methods***

***Materials***

Silver nitrate ($AgNO_3$),Mgnesiumsulphate ($MgSO_4.7H_2O$),Cobalt nitrate, tetra chloroaurate. All the solutions were prepared with Millipore water.

***COLLECTION OF PLANT***

Hemidesmus indicus leaf was collected from Salem District. The collected leaf was filled with appropriate bag and then transfer to the research laboratory. The Hemidesmus indicus leaf extract was washed several times with Millipore water and kept under room temperature for one day only.

***PREPARATION OF HEMIDESMUS INDICUS EXTRACTS***

10g of the fine cut leaves were taken in a 250 ml of glass beaker with 100ml of the millipore water under gentle stirring and 60 min the colour of the solution turned from brown to grey colour. Then extract was filtered thourgh 0.45 µm membrane filter. The filtrate was used as reducing agent and stabilizer.

**Biosynthesis of Ag- MgO – $CO_3O_4$ - Au nanocomposites.**

5ml of magnesium sulphate and 3ml of cobalt nitrate was added to the leaf extract under vigorous stirring . After 5 hours stirring the solution was added to the silver nitrate and tetra chloroaurate at room temperature under static conditions. The solutions was allowed to incubate for 3hours with gentle stirring After 3 hours the colour change of the reactions was witnessed and the time taken for the changes was noted. The brown precipitate product was separated from solution through centrifugation at 8000 rpm for 30 min at room temperature. The final sample was washed with autoclaved Millipore water twice and allowed air dry. The *Ag- Mg- CO- Au* nanocomposite (Fig.1) thus achieved was used for further characterisation.

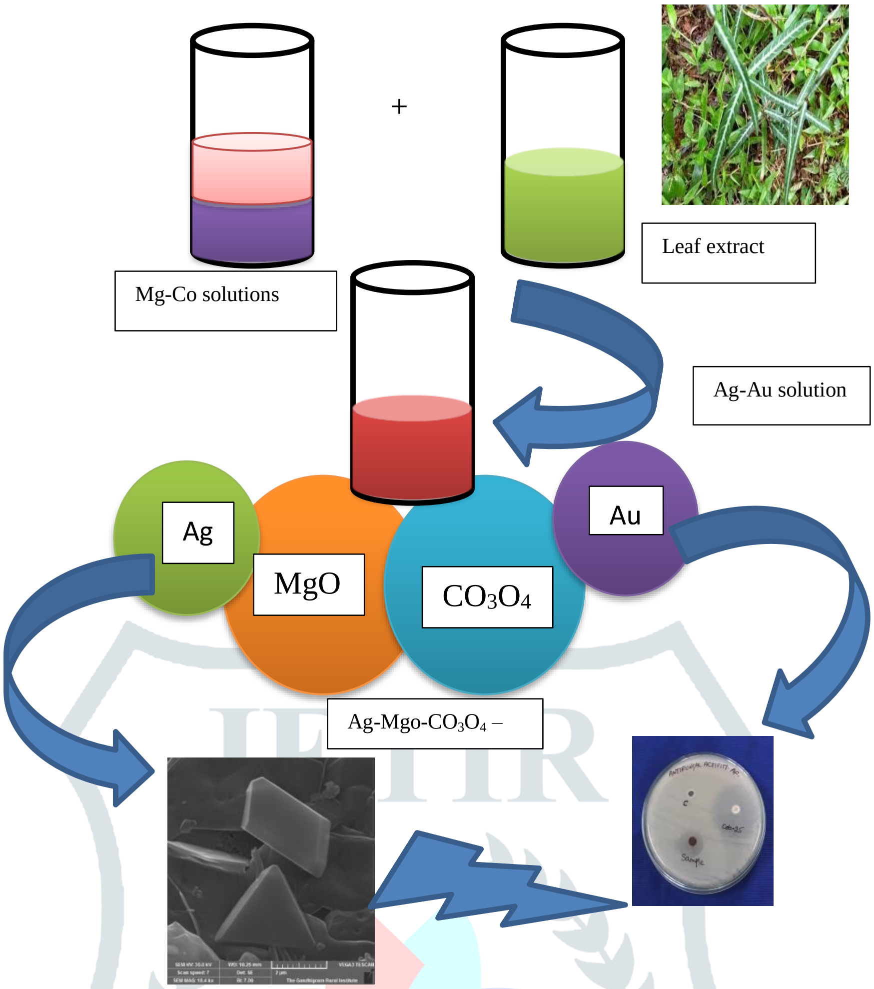



**Fig 1. Schematic diagram of Ag-Mgo-$CO_3O_4$ –Au nanocomposites**

### *MICRO-ORGANISM AND GROWTH CONDITIONS*

The bacterial strains E.coli, Bacillus sp, Staphylococcus aureus and Shigella flexneri was provided by the venture lab, Madurai.

## CHARACTERIZATION OF NANOPARTICLES

### *UV-SPECTROPHOTOMETER ANALYSIS*

The synthesized *Ag- Mg- CO- Au* nanocomposites nanoparticles were characterized through UV-Vis Spectrophotometer (ELICO –SL 159). The *Ag- Mg- CO- Au* nanocomposites range from 200-1200 nm was monitored by UV-Spectrophotometer.

### *SCANNING ELECTRONIC MICROSCOPY (SEM)*

The nanoparticles morphology and size were determined by SEM. The SEM analysis were established by using (JSM-5600LV)

## RESULT AND DISCUSSION

### *UV-VIS SPECTRAL ANALYSIS*

UV-visible spectrum of Ag & Au nanoparticles green synthesized by using hemidusmus indicus. The silver nanoparticles and gives rise to an absorption band at 449nm (2.7ev). The gold at various time like 5,15,30min and 1hour nanoparticles absorption band at 500-600nm. This due do the transfer of electron s from the valence band to the conduction band. The band gab energy corresponds to the absorption limit and can be estimated by the given realation Tauc realation (Nagabhushana etal.2010)

$$Eg = hc/\lambda \text{ ev} \quad \text{-----------------------------------------------------------(1)}$$

Eg is the band gab energy eV h is the plank's constant, c light velocity and λ wavelength

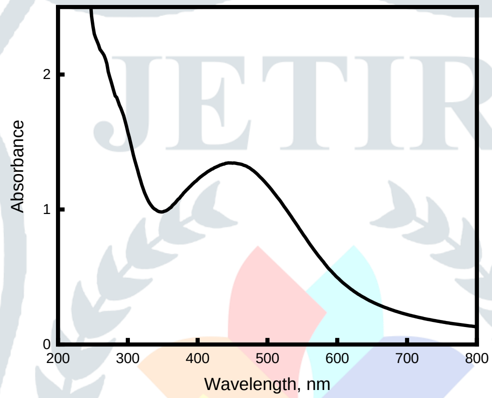



**Fig.2 UV-Vis spectrum of Ag nano**

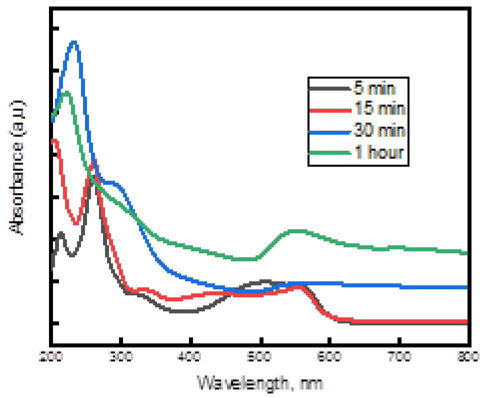



**Fig.3 UV-Vis spectrum of Au nano various mins**

***SCANNING ELECTRONIC MICROSCOPY (SEM)***

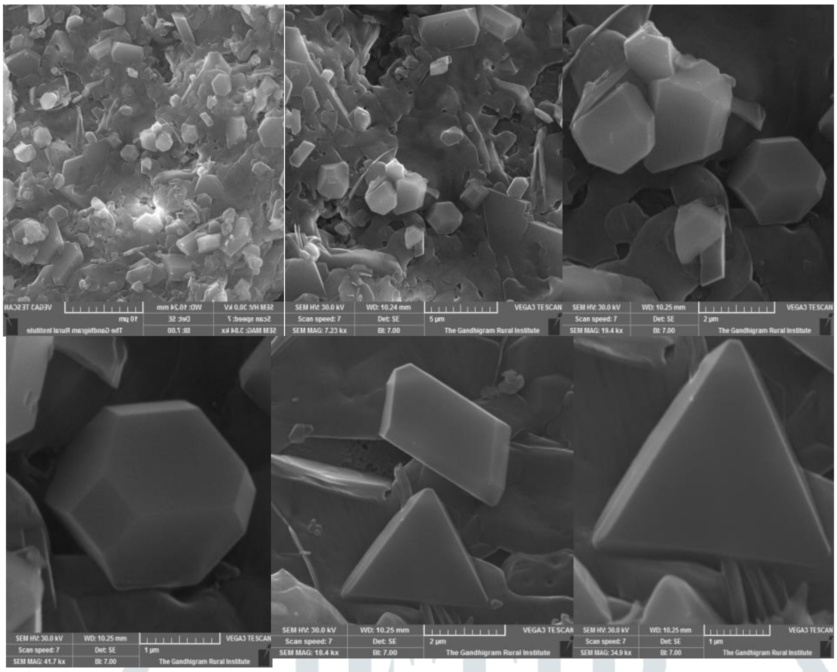


**Fig.4 SEM of Ag-Mgo-$CO_3O_4$ –Au nanocomposites**

The Fig 2. The figure shows surface morphology of pure Ag-Mgo-$CO_3O_4$ –Au nanocomposites. Scanning electron microscopy analysis was complete using ZESS EVO 50 SEM machine. It can be seen that the sample exhibit a cube like structure. This feature is favourable for biomedical application. The diameter of Ag-Mgo-$CO_3O_4$ –Au nanocomposites was approximately between 300 to800 nm.

***EDAX ANALYSIS***

EDAX spectra recorded from the Ag-MgO-$CO_3O_4$-Au nanocomposites were shown in fig 5. From EDAX spectra, it is clear that Ag-MgO-$CO_3O_4$-Au nanocomposites reduced by Hemidesmus indicus have the weight percentage of nano Ag, Mg, CO & Au nanoparticels. The shapes of the Ag-MgO-$CO_3O_4$-Au cube & porous in nature.

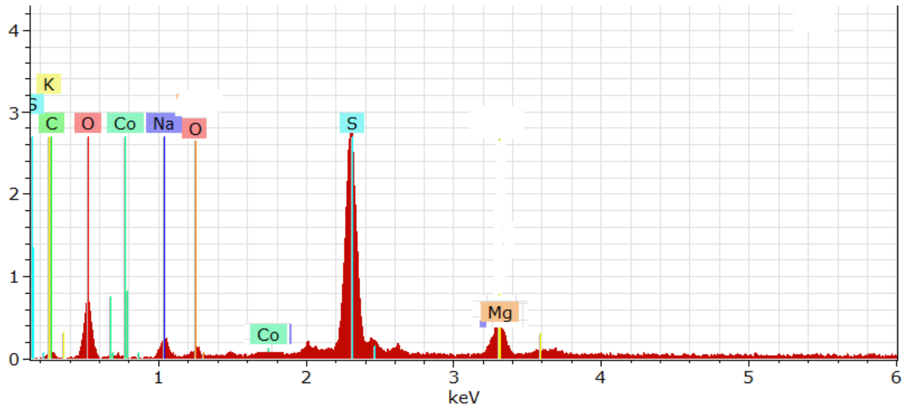



**Fig.5 EDAX of Ag-Mgo-$CO_3O_4$ –Au nanocomposites**

**Antimicrobial activity& Antifungal activity of compounds treated against bacterial pathogens using well diffusion method**

Antimicrobial activity of the compounds was determined using well diffusion method. It was performed by sterilizing Mueller Hinton agar media. After solidification, wells were cut on the Mueller Hinton agar using cork borer. The test bacterial pathogens were swabbed onto the surface of Mueller Hinton agar plates. The Nano-particle synthesized sample was placed on the well. The plates were incubated at 37$^{o}$C for 24 hours, and then the zone of inhibition was measured in millimeters. Each antibacterial assay was performed in triplicate and mean values were reported.

**Table: 1. Antimicrobial activity of the compounds treated against bacterial pathogens**

| **Test organisms** | **Zone of inhibition in millimeter (in diameter)** | | |
|---|---|---|---|
| | **Sample (Nano-Particle )** | **Control** | **Standard Amickacin 30µg** |
| ***E. coli*** | 19 | NZ | 21 |
| ***Staphylococcus aureus*** | 23 | NZ | 25 |
| ***Shigella flexneri*** | 29 | NZ | 27 |
| ***Bacillus sp*** | 26 | NZ | 24 |

**Standard: Amickacin 30 µg**

**C-Control**

**Solvent used**: DMSO (Dimethyl Sulphoxide)

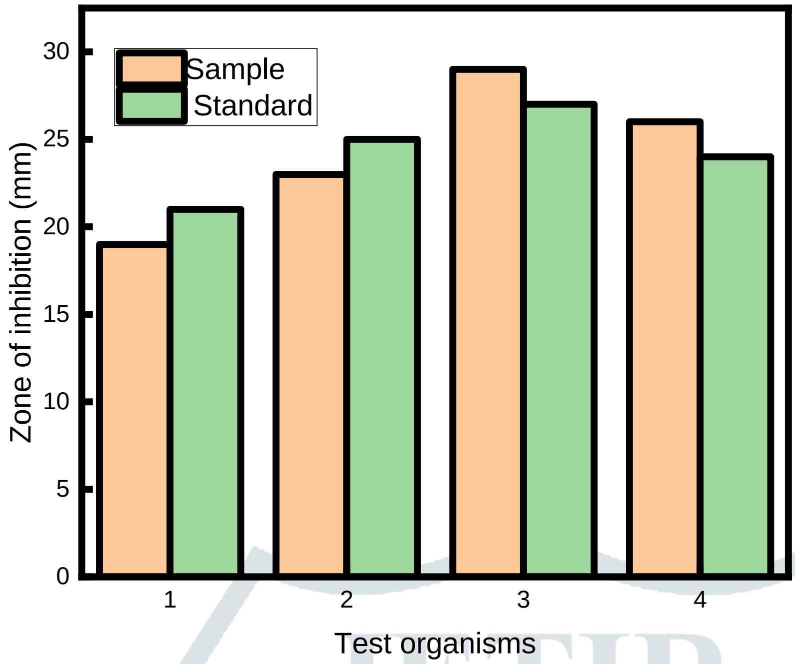



**Fig.6. Antimicrobial activity of the compounds treated against bacterial pathogens**

**Plate: 1. Antimicrobial activity of the Compound treated against *E .coli***


**Plate: 2. Antimicrobial activity of the Compound treated against *Staphylococcus aureus***

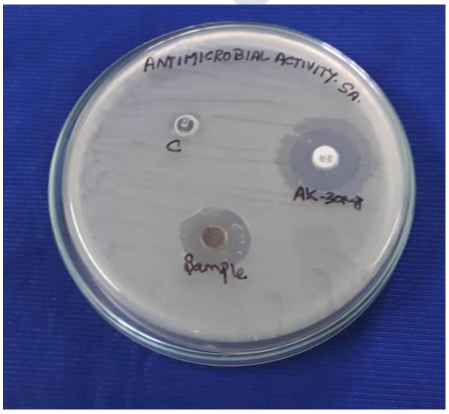



**Plate: 3. Antimicrobial activity of the Compound treated against *Shigella flexneri***

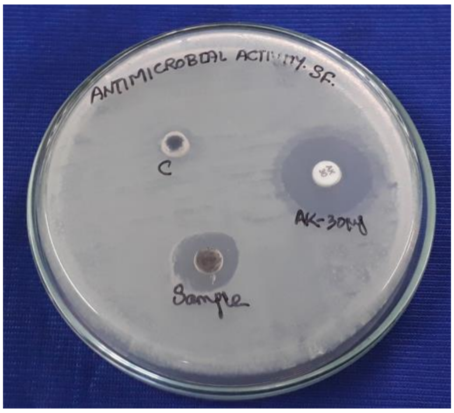



Plate: 4. Antimicrobial activity of the Compound treated against *Bacillus sp*

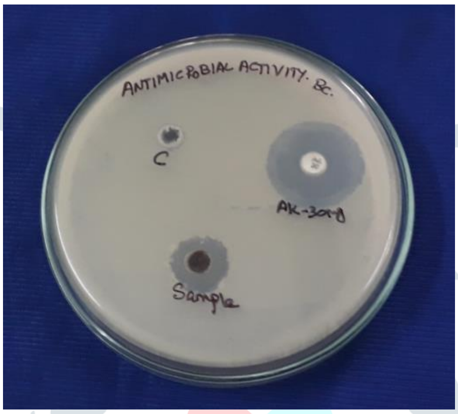



**Table. 2. Antifungal activity of the compounds treated against fungal pathogens**

| Test organisms | Zone of inhibition in millimeter (in diameter) | | |
|---|---|---|---|
| | Sample (Nano –Particles) | Solvent control | Standard Cotrimoxazole 25µg |
| ***Odium caricae*** | 19 | NZ | 21 |
| ***Aspergillus flavus*** | 17 | NZ | 17 |
| ***Aspergillus niger*** | 21 | NZ | 18 |

**Solvent used**: DMSO (Dimethyl Sulphoxide)

**Standard used**: Cotrimoxazole 25 µg.

**C- Control**

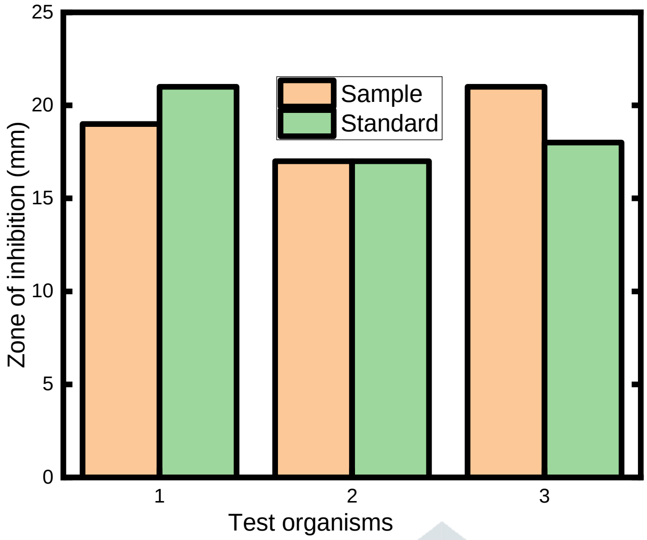



**Fig.7. Antimicrobial activity of the compounds treated against fungal pathogens**

**Plate: 1. Antifungal activity of Nano-compounds treated against *Odium caricae***

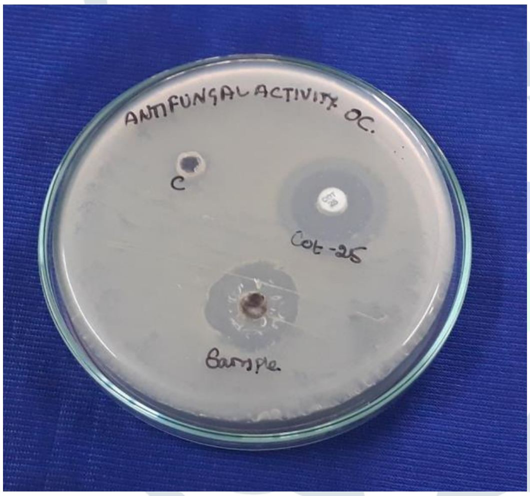



**Plate: 2. Antifungal activity of Nano-compounds treated against *Aspergillus niger***

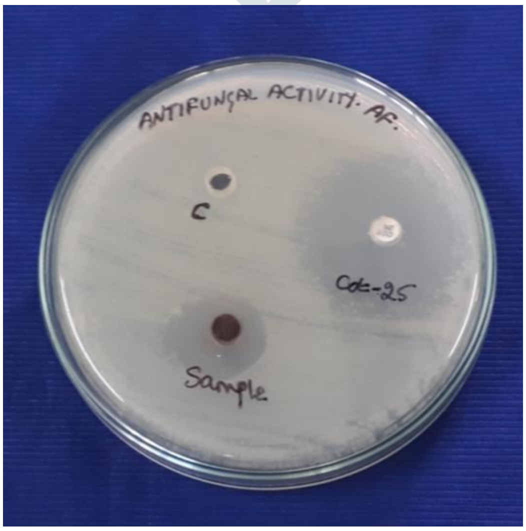
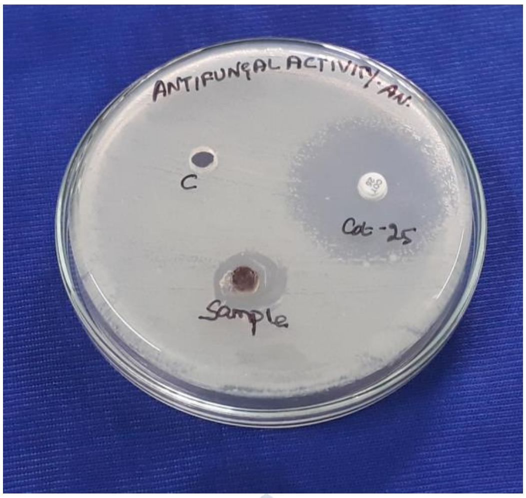


**Plate: 3. Antifungal activity of Nano-compounds treated against *Aspergillus flavus***




***CONCLUSION***

In this study, pure and Ag and Au nanoparticles doped Mgo-$CO_3O_4$ – nanocomposites were synthesised using Hydrothermal method and also, the effect of Ag - Mgo-$CO_3O_4$-Au nanocomposites structural, antibacterial, antifungal and morphological properties of this nanocomposites was investigated by UV, EDAX, and SEM. Ag - Mgo-$CO_3O_4$-Au nanocomposite was successfully synthesized via environment-friendly hydrothermal method and used to kill E. coli, Staphylococcus aureus, Shigella flexneri, Bacillus sp, Odium caricae, Aspergillus flavus and Aspergillus niger. Ag - Mgo-$CO_3O_4$-Au shows outstanding antibacterial and antifungal activity that increases with increasing nanocomposites with metal concentration content of the samples. Furthermore, the antibacterial and antifungal activity towards Shigella flexneri and Aspergillus niger was stronger than compare to than that towards E. coli, Staphylococcus aureus, Bacillus sp, Odium caricae, and Aspergillus flavus.Such nanocomposites structure composite could have favourable applications as antibacterial materials for microbiocides.

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