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Antibacterial and Antifungal Activities of Al-Zn-Cu Mixed Oxides

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***Abstract:*-- Al-Zn-Cu mixed oxide nanoparticles was synthesized via sol-gel method by maintaining the pH around 8. Antibacterial activity of mixed oxide and cerium oxide was evaluated against 3 bacterial strains by agar diffusion method. The results revealed that the mixed oxides was moderate activity against all the listed bacteria whereas, cerium oxide showed against Klebsiella only. Thus synthesized mixed oxide possesses improved antibacterial activity than cerium oxide. The zinc oxide possesses low activity against Pseudomonas aeruginosa (10 mm) and E.coli. The antifungal activity tests were carried out by diffusion method for the mixed oxide and cerium oxide . Both cerium and mixed oxides showed moderate activity against Candida albicans whereas, both showed least activity against Candida parapsolisis. Thus, the antimicrobial activity of the synthesized mixed oxide showed moderate activity against the three bacterial and two fungal strains. It possesses good antimicrobial activity. Hence, the mixed oxide could be used as a good redox catalyst and further suggest for medicinal applications.**

Key words: -Al-Zn-Cu mixed oxide, antibacterial activity, Klebsiella, Pseudomonas aeruginosa, E.coli, antifungal activity.

INTRODUCTION

Metal oxides play a very important role in many areas of chemistry, physics and materials science[1]. The metal elements are able to form a large number of oxide compounds[2]. Most oxides have significant degree of ionic bonding because of the most electronegative divalent oxygen atoms, which results in characteristics of ionic crystals, i.e., optical transparency, high electrical resistivity, low thermal conductivity, diamagnetism and chemical stability [3]. In technological applications, oxides are used in the fabrication of microelectronic circuits, sensors, piezoelectric devices, fuel cells, coatings for the passivation of surfaces against corrosion, and as catalysts. Oxide nanoparticles can exhibit unique physical and chemical properties due to their limited size and a high density of corner or edge surface sites. Particle size is expected to influence three important groups of basic properties in any material.

For a long time, scientist used antimicrobial drugs to inhibit and kill bacteria or other microbes but however they have been developed a specific microbial resistance over time. So one of the most promising strategy to get through this microbial resistance was to use nanoparticles [4]. Interestingly, ZnO-NPs are reported by several studies as non-toxic to human cells. This aspect necessitated their usage as antibacterial agents, noxious to microorganisms, and hold good biocompatibility to human cells. The various antibacterial mechanisms of nanomaterials are mostly attributed to their high specific surface area-to-volume ratios [5].

EXPERIMENTAL METHODS

Copper, Zinc, Aluminium mixed oxide were prepared by a Sol-gel method. An equimolar quantity of zinc Sulphate (1M), Copper Sulphate (1M), Aluminium Sulphate (1M) were taken in a round bottomed flask equipped with reflux condenser and refluxed for 1hour. This reaction mixture was then subjected to magnetic stirrer for 5 hours. After 5 hours, pH was maintained around 1.5 and a known volume of ammonia was added to it. The solution was allowed to stand for 2 hours for complete settlement of precipitate. Then the precipitate was filtered, and washed well with water and dried overnight in oven for 24 hours. Finally, a pale green color mixed oxide was obtained.

DISC DIFFUSION METHOD

The agar medium was inoculated with 50 µL fresh bacterial culture and sterilized discs were poured with synthesized nanocomposite and spread in petri plates with positive control in the center. Incubate the petri dishes at 37°C for 24 h. Zones were measured with zone reader. Experiment was performed with both bacterial strains.

BIOLOGICAL APPLICATIONS

antibacterial activity and anti-fungal activity

Antibacterial activity of mixed oxide and, Aluminium oxide were evaluated against three bacterial strains by agar diffusion method. Both shows moderate activity against the listed bacteria and the results were given in table 1 . The

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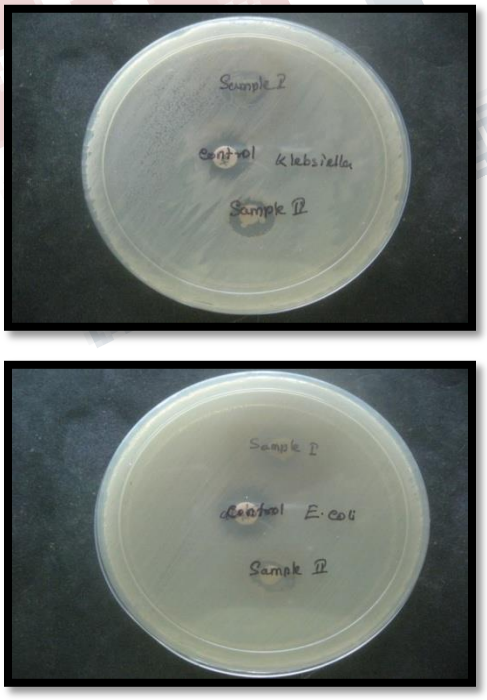
results showed that mixed oxide showed moderate activity against all the listed bacteria whereas Aluminium oxide showed against klebsiella only. Thus, synthesized mixed oxide possessed improved antibacterial activity than Aluminium oxide.

The anti-fungal tests were carried out by diffusion method for the mixed oxide and aluminium oxide and the zone of inhibition were shown in table 1. Both aluminium and mixed oxide shows moderate activity against Candida albicans whereas, both shows least activity against Candida parapsolisis.

Table: 1. Antimicrobial activity of metal oxide
Sample I-Aluminum oxide
Sample II-Mixed oxide

Sample	Anti-bacterial zone of inhibition(mm)			Anti-fungal zone of inhibition(mm)	
	E.coli	Klebsiella	Pseudo - monas aerugi -nosa	Candida albicans	Candida parap solisis
Sample I	-	10	-	10	-
Sample II	9	7	11	16	-
Control	15	13	15	28	28



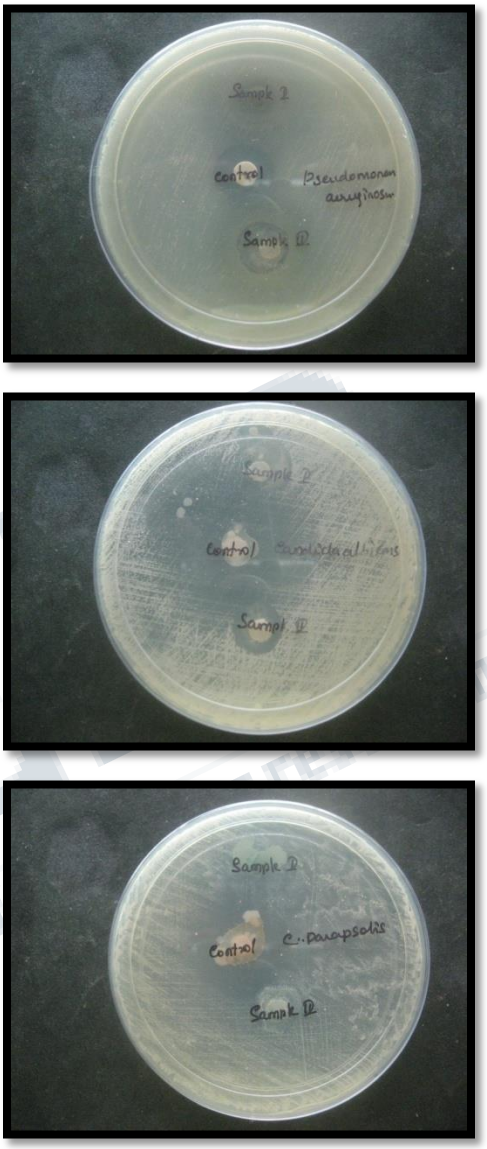


Fig 1- 5. Antibacterial & Antifungal activity of mixed oxide

CONCLUSION

The antimicrobial activity of the synthesized mixed oxide showed moderate activity against the 3 bacterial and 2 fungal strains. It possessed good antimicrobial activity. .Overall this study showed not only the antimicrobial efficiency of synthesized metal oxides but also the biocompatibility of this oxide. Hence, the mixed oxide can be used as antimicrobial agent and can be further investigated for medicinal applications.

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