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Antimicrobial Activity of Mixed Schiff Base Ligand Complexes of Ni(II), Cu(Ii) and Zn(II)

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Abstract - The ability of Schiff bases to form complexes with transition metal ions makes them a particularly significant family of organic molecules.Complexes of nickel(II), copper(II), and zinc(II) with a variety of Schiff base ligands.. The Schiff bases coordinate via the deprotonated phenolic oxygen or azomethine nitrogen atoms, making them bidentate monobasic ligands. Reflux screening was used to examine ligands and mixed ligand complexes for antibacterial activity. Antimicrobial activity of metal complexes is shown to be greater than that of the free ligand.

Keywords - Schiff bases, Mixed ligand, Metal complexes, Antimicrobial activity.

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INTRODUCTION

Coordination chemistry has benefited greatly from the discoveries of Schiff bases & their metal complexes. Hugo Schiff published the first account of Schiff base in 1864. By condensing amines and carbonyl compounds under various circumstances and in various solvents while removing water molecules, schiff bases may be made. Schiff bases are more often formed when a dehydrating agent is present. The Schiff bases serve as a foundation for the synthesis of several heterocyclic compounds even though they are stable solids. Due to their significance in the fields of medicine, agriculture, analysis, biology, and industry, the Schiff bases & their metal complexes have been the focus of considerable study. These compounds contain unusual structural features, intriguing spectroscopic, and magnetic characteristics.[1]

Nickel (Ni):-

Nickel serves crucial functions in the biology of bacteria and plants, despite not being identified until the 1970s. The active areas of urease include nickel complexes, which are widely exploited in the development of novel magnetic materials. Numerous facets of chemistry rely heavily on the research of nickel compounds. [2]

Copper (Cu):-

When assessing copper's biological availability in the environment and in food, its chemical makeup is crucial. The capacity of copper to regulate organism development is one of its many applications. This happens when copper is present physiologically and at harmful doses. Copper is thus used in a variety of cidal agents. For instance, copper has shown to be an efficient antibacterial and antiplaque ingredient in toothpaste and mouthwash.[3]

Zinc (Zn):-

With the help of ligands comprising N, S, O, halides, and CN, zinc may form stable complexes. Zn II) ion-containing compounds are often diamagnetic and colorless. No crystal lattice stabilization is possible with the d10 Configuration. The size & polarizing ability of the zinc (II) cation, as well as the steric needs of the ligands, determine the stereochemistry of a certain molecule. Thus, four coordinated tetrahedral compounds are preferred by Zn (II). [4]

Increasing drug resistance has made Staphylococcus aureus a dangerous and more important pathogen . Despite sharing comparable phylogenetic origins with the CoNS, it is both different from and more virulent than the CoNS . Colonies of the aureus species (often) exhibit a golden color when grown on solid medium, whereas those of the CoNS variety are very light in color and transparent white .[5]

The term "microorganism" is used to refer to a broad category that includes many different kinds of creatures. Bacteria are prokaryotic bacteria that do not possess chlorophyll as they divide by cytokinesis. Staining, oxygen consumption, carbon source, and shape are used to categorize them further. Pharmaceuticals known as antibacterials are used to combat bacterial growth. Penicillin G, Cephalothin, ampicillin, Amoxicillin, Clavamox, Streptomycin etc are few antibacterial drugs. Modes of action include blocking protein synthesis, beta-

lactamase production, and cell wall and murein assembly. An antifungal medication is a treatment which is used to treat fungal infections. Various fungal illnesses are: athlete's foot, ring worm, candidiasis , dangerous systemic infections like cryptococcal meningitis. Antifungal medicines typically utilized include Amphotericin B, Clotrimazole, miconazole, flucanazole and flucytosine. They are used to suppress systemic and severe fungal infections. They have numerous ways of activities such as changing porosity of cell membrane, blocking sterol production or competing with uracil.[6]

Medications with antimicrobial properties are used to eliminate or slow the spread of microorganisms including bacteria, fungus, viruses, spirochaetes, protozoa, and so on. Almost every infectious illness in India can be traced back to bacteria, fungus, and viruses, from malaria to AIDS. With Fleming's 1929 discovery of the potent bactericidal substance pencillin and Domagk's 1935 discovery of synthetic compounds, sulfonamides with wide antimicrobial action, the current age of antimicrobial chemotherapy born. The development of novel antibiotics is now the primary method for combating bacterial resistance.[7]

- **ESCHERICHIA COLI**

E. coli, or Escherichia coli, is a bacterium that is often found inside the lower intestine of mammals and other warm-blooded creatures. It is Gram-negative, facultatively anaerobic, and rod-shaped (endotherms). While the vast majority of E. coli strains pose no threat to human health, some serotypes may cause severe food poisoning and are sometimes to blame for product recalls as a result of contamination. [8]

- **PSEUDOMONAS AERUGINOSA**

Pseudomonas aeruginosa is a member of the Pseudomonadaceae family and is a Gram-negative, aerobic rod bacterium. There are 12 other members of the P. aeruginosa family. P. aeruginosa, like other species in the genus, is widespread in both the environment and the human body. Researchers think that Pseudomonas bacteria are one of the few genuine plant pathogens. P. aeruginosa has emerged as an important opportunistic pathogen in medical settings. Nosocomial pathogen status has been confirmed by recent epidemiological research, especially for antibiotic-resistant strains of this microorganism. [9]

- **STAPHYLOCOCCUS AUREUS**

Increasing drug resistance has made Staphylococcus aureus a dangerous and more important pathogen . Despite sharing comparable phylogenetic origins with the CoNS, it is both different from and more virulent than the CoNS . Colonies of the aureus species (often) exhibit a golden color when grown on solid medium, whereas those of the CoNS variety are very light in color and transparent white .Databases for the genomes of seven different strains of S. aureus are now complete The typical genomic size of S. aureus is 2.8Mb . S. aureus has a thick protective layer called a cell wall that is 20-40 nm thick and has a rather amorphous appearance.[10-11]

PROCEDURE OF ANTIMICROBIAL ACTIVITY

Bioassays are useful for determining microbial activity and are essential in the development of new methods for measuring substances bioactivity. In this study, the antibacterial efficacy of all derivatives was examined, including their effectiveness against various strains of bacteria.[12]

Rotate the soaked swab firmly against the top inner wall of the tube to express excess fluid, then dip it into the standard inoculums , being careful not to contaminate the inoculums. Spread the agar out evenly on the plate at a 60°C angle. Keep the cover on for 5-15 minutes to let the inoculums dry up.[13-14]

Use an aseptic method for applying the discs. Place the discs such that the farthest points from each other are at least 24 millimeters. Discs containing sensitive organisms, as well as those containing penicillin and cephalosporins, are best implanted with their centers 30 mm apart.[15]

Start incubating at 35 +_°C straight away and check results after 16-18 hours. It is important to incubate delicate organisms at the correct temperature and for the appropriate amount of time. Put the plates in an incubator at 35 °C right away, and check them after 20 to 24 hours to see how the fungi are doing. If the plate was streaked properly, the ensuing zones of inhibition will be perfectly round, and the resulting lawn will be roughly continuous. When no development has been seen after 24 hours of incubation, read the results after 48 hours.[16]

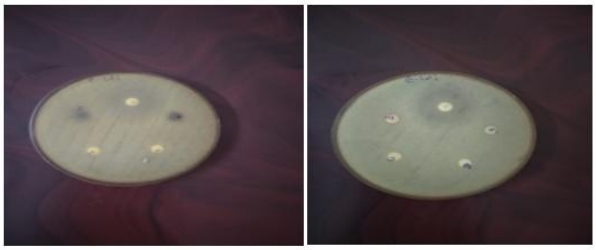
RESULT

The disc diffusion technique was used to test the antibacterial efficacy of synthesized Schiff bases & their associated mixed ligand metal complexes against Escherichia coli, Pseudomonas aeruginosa, and Staphylococcus aureus. Disk-centered inhibition zones were evaluated to determine optimal disc size for inhibition. Different microbial growth inhibition zones are mentioned. The metal complexes are shown to have more antibacterial action than that of the free ligand. hence, complexation enhances antibacterial action. Chelation theory also provides an explanation for why metal complexes have enhanced activity.[17-19]

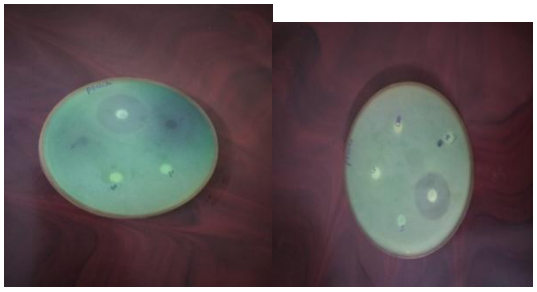
1. Antimicrobial AnalysisOfLigand[SL-1]AndItsMetalComplexes.

A) Utilized Microorganisms
1. Escherichiacoli.
2. Pseudomonas aeruginosa
3. Staphylococcus

B) Photos of Zone of Inhibition
1. Escherichia coli



2) Pseudomonas aeruginosa



3) Staphylococcus

C) Labeling of the samples.

Cu, Ni and Zn metal complex 2{(E)-4(methylphenyl)iminomethyl}phenol) ligand

D) ObservationTable:-

Schiff base metal complexes with antimicrobial action

Sample No	Escherichia coli	Pseudomonas aeruginosa	Staphylococcus
Ligand 1 (2{(E)-4(methylphenyl) iminomethyl}phenol)	No Zone	No Zone	No Zone
1.SL1-Cu	No Zone	No Zone	18 mm
2. SL1-Ni	No Zone	No Zone	No Zone
3. SL1-Zn	No Zone	No Zone	No Zone

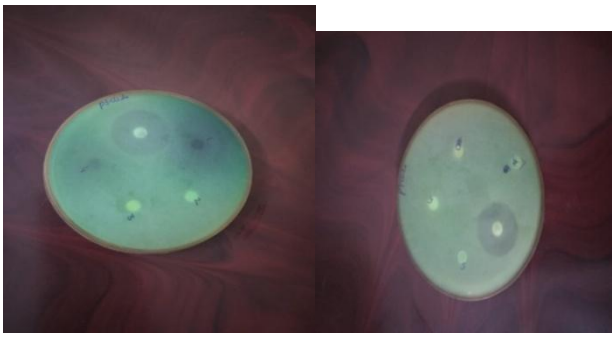
From above observation table Cu, Ni and Zn complexes of ligand only Cu shows antimicrobial activity against Staphylococcus.[20]

2. Antimicrobialanalysis of Ligand[SL-2] and its metal complexes.

A) Utilized Microorganisms
1. Escherichiacoli.
2. Pseudomonas aeruginosa
3. Staphylococcus

B) Photos of Zone of Inhibition
1. Escherichia coli

2. Pseudomonas aeruginosa



3. Staphylococcus

C) Labeling of the samples.

Cu,Ni& Zn metal complex 2{(E)-2(methylphenyl)iminomethyl}phenol)

D) ObservationTable:-

Schiff base metal complexes with antimicrobial action

Sample No	Escherichia coli	Pseudomonas aeruginosa	Staphylococcus
Ligand 2 2{(E)-2(methylphenyl) iminomethyl}phenol)	No Zone	No Zone	No Zone
1.SL2-Cu	No Zone	No Zone	16 mm
2. SL2-Ni	No Zone	No Zone	No Zone
3. SL2-Zn	No Zone	No Zone	No Zone

From above observation table Cu, Ni and Zn complexes of ligand only Cu shows antimicrobial activity against Staphylococcus**.** [21]

CONCLUSION

The rational methods for the synthesis of metal - organic polymeric networks has been an intensively researched issue due to the huge potential for generating innovative materials with fascinating useful functions. Cooperation between the metal's first-coordination sphere and also the second-sphere non-covalent active sites is essential for the logical development of metal-organic biomolecules frame works. Recently, enantioselective synthesis and the study of chiral ligands have become significant areas of study. This is because chiral coordination polymers have several potential uses, including enantioselective production, asymmetric catalysis, the building of chiral supermolecular structure, and state-of-the-art material production. For many years, Schiff bases have been one of the most important chelating systems in coordination compounds, and the use of these molecules in the expanding area of material science is a prime example of this trend.

Schiff bases and the transition metal complexes they form are essential to several biological processes, and this is well established. There has been a lot of study into how Schiff base ligands behave as donors when bound to metal ions. In light of recent research, it has become clear that Schiff base transition metal coordination complexes are an intriguing family of compounds that may be employed as effective antibacterial and antifungal treatments. The current study thus aims to synthesize and evaluate the physiochemical and antibacterial characteristics of certain potential organometallic complexes. In this research, we focus on Schiff base ligands bound to transition metals.

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