



Physico-Chemical And Antimicrobial Study Of Metal Complexes Of Cu(I) And Schiff Bases Derived From Heterocyclic Amines

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Abstract: The Schiff bases like Benzaldimine Pyrrole was synthesized by benzaldehyde and pyrrole. Benzaldimine Thiophene was synthesized by benzaldehyde and thiophene. Benzaldimine Furan was synthesized by benzaldehyde and furan. Benzaldimine Pyridine was synthesized by benzaldehyde and pyridine. Naphthaldimine Pyrrole was synthesized by naphthaldehyde and pyrrole. Naphthaldimine Thiophene was synthesized by naphthaldehyde and thiophene. Naphthaldimine Furan was synthesized by naphthaldehyde and furan and Naphthaldimine Pyridine was synthesized by Naphthaldehyde with pyridine. Copper complexes of all bases were made and antimicrobial activity screening have been studied.

I. INTRODUCTION

Co-ordination compounds play a very significant role in our lives. The quest for deeper understanding of the nature of chemical bond has provided a major and contributing incentive in chemical sciences particularly in the study of co ordination compounds.

The chemistry of metal complexes with multidentate ligands having delocalized d orbitals, such as Schiff bases has recently gained more attention because of their numerous uses¹⁻².

Transitional metals play a vital role in different biological processes. Some of these processes are very specific in requirements of metal ions. Only certain metal ions in specific oxidation states can accomplish the necessary catalytic structure requirement. The activity of various metal ions in biological system has been explained in term of complex species formed in the living organisms. Many metal ions are found in several enzymes and reported to play a major role in various enzymatic reactions³. The metal complexes formed by ligand containing sulphur, nitrogen and oxygen are of immense importance due to exhibiting anticancer⁴, antiviral⁵, antibacterial⁶ and antifungal properties⁷.

The Schiff bases derived from some sulpha drugs have been successfully used as chelating, bacterial and fungicidal agents⁸. Dash et al⁹ reported the antifungal activity of heterocyclic Schiff bases derived from 4,5 diaryl-2-amino-thiozole and substituted aldehyde. Agarwal and coworker¹⁰ synthesized some coumarines and hydrazones as antibacterial and antifungal agents against *B.subtilis* and *I.montagrophytes*. Fungicidal¹¹ activity of N-aryl or hetero-2,2-disubstituted azomethine was tested against *A.niger* and *A.flavus*. Ibrahim et al¹² investigated the antimicrobial and antifungal activities.

II. MATERIAL AND METHOD

MATERIALS

1.Synthesis of Schiff Bases

a.Synthesis of Benzaldimine Thiophene

Benzaldehyde A.R.grade (0.01 mol) and ortho amino thiophene A.R.grade (0.01 mol) were mixed in 50 ml of ethanol. The mixture was refluxed for 3-7 hours on water bath. The resulting Benzaldehyde A.R.grade (0.01 mol) and ortho amino thiophene A.R.grade (0.01 mol) were mixed in 50 ml of ethanol. The mixture was refluxed for 3-7 hours on water bath. The resulting content was filtered to get white coloured crystal which were washed with ether and recrystallized from ethanol. The crystal were then dried under reduced pressure over fused calcium chloride.

b. Synthesis of Benzaldimine furan

Benzaldehyde A.R.grade (0.01 mol) and ortho amino A.R. grade (0.01 mol) were mixed in 50 ml of ethanol. The mixture was refluxed for 3-7 hours on water bath. The resulting content was filtered to get white coloured crystal which were washed with ether and then recrystallized from ethanol. The crystals were then dried under reduced pressure over fused calcium chloride.

c.Synthesis of Benzaldimine Pyrrole

Benzaldehyde A.R. grade (0.01 mol) ortho amino pyrrole A.R. grade (0.01 mol) were mixed in 50 ml ethanol. The mixture were refluxed for 3-7 hours on a water bath. The resulting content was filtered to get white coloured crystals which were washed with ether and then recrystallized from ethanol. The crystals were then dried under reduced pressure over fused calcium chloride.

d. Synthesis of Benzaldimine Pyridine

Benzaldehyde A.R. grade (0.01 mol) ortho amino pyridine A.R. grade (0.01 mol) were mixed in 50 ml ethanol. The mixture were refluxed for 3-7 hours on a water bath. The resulting content was filtered to get white coloured crystals which were washed with ether and then recrystallized from ethanol. The crystals were then dried under reduced pressure over fused calcium chloride.

e. Synthesis of Naphthaldimine Thiophene

Naphthaldehyde A.R. grade (0.01 mol) and ortho aminothiophene A.R. grade (0.01 mol) were mixed in 50 ml of ethanol. The mixture was refluxed for 6-7 hours on a water bath. The resulting content was filtered to get yellow coloured crystals which were washed with ether and then recrystallized from ethanol. The crystals were then dried under reduced pressure over fused calcium chloride.

f. Synthesis of Naphthaldimine Furan

Naphthaldehyde A.R. grade (0.01 mol) and ortho aminofuran A.R. grade (0.01 mol) were mixed in 50 ml of ethanol. The mixture was refluxed for 6-7 hours on a water bath. The resulting content was filtered to get yellow coloured crystals which were washed with ether and then recrystallized from ethanol. The crystals were then dried under reduced pressure over fused calcium chloride.

g. Synthesis of Naphthaldimine Pyrrole

Naphthaldehyde A.R. grade (0.01 mol) and ortho aminopyrrole A.R. grade (0.01 mol) were mixed in 50 ml of ethanol. The mixture was refluxed for 6-7 hours on a water bath. The resulting content was filtered to get yellow coloured crystals which were washed with ether and then recrystallized from ethanol. The crystals were then dried under reduced pressure over fused calcium chloride.

h. Synthesis of Naphthaldimine Pyridine

Naphthaldehyde A.R. grade (0.01 mol) and ortho aminopyridine A.R. grade (0.01 mol) were mixed in 50 ml of ethanol. The mixture was refluxed for 6-7 hours on a water bath. The resulting content was filtered to get yellow coloured crystals which were washed with ether and then recrystallized from ethanol. The crystals were then dried under reduced pressure over fused calcium chloride.

2. Synthesis of Cu(II) Complexes

a. Synthesis of Benzaldimine thiophene Cu (II) Complexes

Benzaldehyde (0.01 mol) dissolved in 20 ml of ethanol, Benzaldimine thiophene (0.01 mol) in 20 ml of ethanol and copper chloride (0.01 mol) in 10 ml of water and ethanol were taken together in flask. The content was refluxed for 8-10 hours on a water bath and solution was reduced to 1/3 volume. Brown coloured crystalline solid so obtained was filtered, washed with ether and recrystallized with ethanol and dried in desicator over fused calcium chloride.

b. Synthesis of Benzaldimine Pyrrole Cu(II) Complexes

Benzaldehyde (0.01 mol) dissolved in 20 ml of ethanol, Benzaldimine pyrrole (0.01 mol) in 20 ml of ethanol and copper chloride (0.01 mol) in 10 ml of water and ethanol were taken together in flask. The content was refluxed for 8-10 hours on a water bath and solution was reduced to 1/3 volume. Brown coloured crystalline solid so obtained was filtered, washed with ether and recrystallized with ethanol and dried in desicator over fused calcium chloride.

c. Synthesis of Benzaldimine furan Cu (II) Complexes

Benzaldehyde (0.01 mol) dissolved in 20 ml of ethanol, Benzaldimine furan (0.01 mol) in 20 ml of ethanol and copper chloride (0.01 mol) in 10 ml of water and ethanol were taken together in flask. The content was refluxed for 8-10 hours on a water bath and solution was reduced to 1/3 volume. Brown coloured crystalline solid so obtained was filtered, washed with ether and recrystallized with ethanol and dried in desicator over fused calcium chloride.

d. Synthesis of Benzaldimine Pyridine Cu (II) Complexes

Benzaldehyde (0.01 mol) dissolved in 20 ml of ethanol, Benzaldimine pyridine (0.01 mol) in 20 ml of ethanol and copper chloride (0.01 mol) in 10 ml of water and ethanol were taken together in flask. The content was refluxed for 8-10 hours on a water bath and solution was reduced to 1/3 volume. Brown coloured crystalline solid so obtained was filtered, washed with ether and recrystallized with ethanol and dried in desicator over fused calcium chloride.

e. Synthesis of Naphthaldimine thiophene Cu(II) Complexes

Naphthaldehyde (0.01 mol) dissolved in 20 ml of ethanol, Naphthaldimine thiophene (0.01 mol) in 20 ml of ethanol and copper chloride (0.01 mol) in 10 ml of water and ethanol were taken together in flask. The content was refluxed 8-10 hours on a water bath and the solution was reduced to 1/3 volume. Brown coloured crystalline

solid so obtained was filtered, washed with ether and recrystallized with ethanol and dried in desicator over fused calcium chloride.

f. Synthesis of Naphthaldimine furan Cu(II) Complexes

Benzaldehyde (0.01 mol) dissolved in 20 ml of ethanol, Benzaldimine furan (0.01 mol) in 20 ml of ethanol and copper chloride (0.01 mol) in 10 ml of water and ethanol were taken together in flask. The content was refluxed for 8-10 hours on a water bath and solution was reduced to 1/3 volume. Brown coloured crystalline solid so obtained was filtered, washed with ether and recrystallized with ethanol and dried in desicator over fused calcium chloride.

g. Synthesis of Naphthaldimine Pyrrole Cu(II) Complexes

Benzaldehyde (0.01 mol) dissolved in 20 ml of ethanol, Benzaldimine pyrrole (0.01 mol) in 20 ml of ethanol and copper chloride (0.01 mol) in 10 ml of water and ethanol were taken together in flask. The content was refluxed for 8-10 hours on a water bath and solution was reduced to 1/3 volume. Brown coloured crystalline solid so obtained was filtered, washed with ether and recrystallized with ethanol and dried in desicator over fused calcium chloride.

h. Synthesis of Naphthaldimine pyridine Cu(II) Complexes

Benzaldehyde (0.01 mol) dissolved in 20 ml of ethanol, Benzaldimine pyrrole (0.01 mol) in 20 ml of ethanol and copper chloride (0.01 mol) in 10 ml of water and ethanol were taken together in flask. The content was refluxed for 8-10 hours on a water bath and solution was reduced to 1/3 volume. Brown coloured crystalline solid so obtained was filtered, washed with ether and recrystallized with ethanol and dried in desicator over fused calcium chloride.

III. METHOD

The method includes addition of test compound in variable concentration in separate lots of sterilized nutrient medium and thereafter the medium containing chemical is plated with the test micro-organism. The results are taken after a period of growth at $28 \pm 1^\circ\text{C}$ temperature for the appearance of growth.

Medium

For the evaluation of antimicrobial activity potato dextrose agar (PDA) and nutrient agar (NA) were prepared. The prepared medium were sterilized at 15 lb, 121°C temperature for 30 minutes in autoclave.

Before pouring the medium in the sterilized petridishes 0.001 gm of of sterilized medium in each petridish. The medium solidified after 30 minutes.

Incubation

The prepared petridishes were incubated at $38 \pm 1^\circ\text{C}$ for fungi and $37 \pm 1^\circ\text{C}$ for bacteria in BOD incubator in separate lots.

Preparation of sample solution

Calculated amount of Schiff bases and their metal complexes were dissolved in suitable volume of methanol. So as to make two different concentrations from 500-1000 ppm.

RESULT AND DISCUSSION

All the results of antibacterial and antifungal screening have been summarized in Table 1 to 8. The selected pathogens are as

- | | |
|--------------|----------------|
| 1. A. niger | 4. E. coli |
| 2. A. flavus | 5. B. subtilis |
| 3. S. aureus | |

Table- 1

Antifungal and antibacterial activity screening of ligands and their complexes.

S.N.	Name of Ligands/complex	Conc. In ppm	antifungal		Antibacterial		
			A. flavus	A. Niger	E. coli	S. aureus	B subtilis
1	Benzaldimine thiophene	250	-	-	-	-	-
		500	+	-	-	-	++
		750	++	++	-	+++	++
		1000	+++	+++	-	++++	++++
2.	Copper complex of Benzaldimine thiophene	250	++	-	-	++	++
		500	+++	+++	-	+++	+++
		750	++++	++++	-	+++	++++
		1000	+++++	+++++	-	+++++	+++++

Table-2

Antifungal and antibacterial activity screening of ligands and their complexes.

S.N.	Name of Ligands/complex	Conc. In ppm	antifungal		Antibacterial		
			A. flavus	A. Niger	E. coli	S.aureus	B subtilis
1	Benzaldimine thiophene	250	-	-	-	-	-
		500	+	-	-	-	++
		750	++	++	-	+++	++
		1000	+++	+++	-	++++	++++
2.	Copper complex of Benzaldimine thiophene	250	++	-	-	++	++
		500	+++	+++	-	+++	+++
		750	++++	++++	-	+++	++++
		1000	+++++	+++++	-	+++++	+++++

Table-3

Antifungal and antibacterial activity screening of ligands and their complexes.

S.N.	Name of Ligands/complex	Conc. In ppm	antifungal		Antibacterial		
			A. flavus	A. Niger	E. coli	S.aureus	B subtilis
1	Benzaldimine thiophene	250	-	-	-	-	-
		500	+	-	-	-	++
		750	++	++	-	+++	++
		1000	+++	+++	-	++++	++++
2.	Copper complex of Benzaldimine thiophene	250	++	-	-	++	++
		500	+++	+++	-	+++	+++
		750	++++	++++	-	+++	++++
		1000	+++++	+++++	-	+++++	+++++

Table-4

Antifungal and antibacterial activity screening of ligands and their complexes.

S.N.	Name of Ligands/complex	Conc. In ppm	antifungal		Antibacterial		
			A. flavus	A. Niger	E. coli	S.aureus	B subtilis
1	Benzaldimine thiophene	250	-	-	-	-	-
		500	+	-	-	-	++
		750	++	++	-	+++	++
		1000	+++	+++	-	++++	++++
2.	Copper complex of Benzaldimine thiophene	250	++	-	-	++	++
		500	+++	+++	-	+++	+++
		750	++++	++++	-	+++	++++
		1000	+++++	+++++	-	+++++	+++++

Table-5

Antifungal and antibacterial activity screening of ligands and their complexes.

S.N.	Name of Ligands/complex	Conc. In ppm	antifungal		Antibacterial		
			A. flavus	A. Niger	E. coli	S.aureus	B subtilis
1	Benzaldimine thiophene	250	-	-	-	-	-
		500	+	-	-	-	++
		750	++	++	-	+++	++
		1000	+++	+++	-	++++	++++
2.	Copper complex of Benzaldimine thiophene	250	++	-	-	++	++
		500	+++	+++	-	+++	+++
		750	++++	++++	-	+++	++++
		1000	+++++	+++++	-	+++++	+++++

Table-6

Antifungal and antibacterial activity screening of ligands and their complexes.

S.N.	Name of Ligands/complex	Conc. In ppm	antifungal		Antibacterial		
			A. flavus	A. Niger	E. coli	S.aureus	B subtilis
1	Benzaldimine thiophene	250	-	-	-	-	-
		500	+	-	-	-	++
		750	++	++	-	+++	++
		1000	+++	+++	-	++++	++++
2.	Copper complex of Benzaldimine thiophene	250	++	-	-	++	++
		500	+++	+++	-	+++	+++
		750	++++	++++	-	+++	++++
		1000	+++++	+++++	-	+++++	+++++

Table-7

Antifungal and antibacterial activity screening of ligands and their complexes.

S.N.	Name of Ligands/complex	Conc. In ppm	antifungal		Antibacterial		
			A. flavus	A. Niger	E. coli	S.aureus	B subtilis
1	Benzaldimine thiophene	250	-	-	-	-	-
		500	+	-	-	-	++
		750	++	++	-	+++	++
		1000	+++	+++	-	++++	++++
2.	Copper complex of Benzaldimine thiophene	250	++	-	-	++	++
		500	+++	+++	-	+++	+++
		750	++++	++++	-	+++	++++
		1000	+++++	+++++	-	+++++	+++++

Table-8

Antifungal and antibacterial activity screening of ligands and their complexes.

S.N.	Name of Ligands/complex	Conc. In ppm	antifungal		Antibacterial		
			A. flavus	A. Niger	E. coli	S.aureus	B subtilis
1	Benzaldimine thiophene	250	-	-	-	-	-
		500	+	-	-	-	++
		750	++	++	-	+++	++
		1000	+++	+++	-	++++	++++
2.	Copper complex of Benzaldimine thiophene	250	++	-	-	++	++
		500	+++	+++	-	+++	+++
		750	++++	++++	-	+++	++++
		1000	+++++	+++++	-	+++++	+++++

Among the synthesized Schiff bases and their metal complexes all of them exhibited better activity against the selected pathogenic organism. The detailed antimicrobial study of these synthesized Schiff bases revealed that all these are active against fungi and bacteria. Metal complexes of copper exhibited enhanced activity.

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