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Synthesis, Characterization and Antibacterial Activities of Co (II), Cu (II), Zn (II) Complexes Derived From Two Different Schiff Base

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Abstract- **Two new Schiff bases were synthesized by condensation of benzaldehyde and anthranilic acid in one combination(1), salicylaldehyde and urea in another combination(2). Both bases were used to form distinctly colored complexes with the metal ions Co(II), Cu(II), Zn(II).Two Schiff bases and their metal complexes were characterized using Fourier Transform Infrared Spectroscopy. The FT-IR Spectral results indicate the formation of the metal complexes. All the metal complexes and ligands were screened for their antibacterial activity. Among them Zn-2 complex, Co-2 complex and Schiff base-2 showed good activity against certain three bacterial species.**

Keywords: Schiff base, Metal complexes, Colour, Solubility, FT-IR, Antibacterial activity.

1. INTRODUCTION

Schiff bases are condensation products of primary amines with carbonyl compounds and they were first reported by Hugo Schiff in 1864. The common structural feature of these compounds is the azomethine group with a general formula RHC=N-R', where R and R' are alkyl, aryl, cyclo alkyl or heterocyclic groups which may be variously substituted1.Schiff bases are considered as a very important class of organic compounds which have wide applications in many biological aspects. These wide applications of Schiff bases have generated a great deal of interest in metal complexes. Schiff base–transition metal complexes are one of the most adaptable and thoroughly studied systems2-3.

Schiff bases also offer opportunities for inducing substrate chirality, tuning metal-centered electronic factors and enhancing the solubility and stability of homogenous or heterogeneous catalysts. Transition metals are involved in many biological processes which are essential to life process. The metals can coordinate with O- or N-terminals from proteins in a variety of models and play a crucial role in the conformation and function of biological macromolecules4.

Macrocyclic species based on transition metal compounds and multidentate ligands is an interesting field in chemistry and has been the subject of extensive research due to their potential applications in building block macrocyclic-based chemistry and environmental chemistry and biomedical5,6. The chemistry of Schiff-base is an important field in coordination chemistry. This is due to their ability to react with a range of metal ions forming stable complexes which have applications in different fields 7-8.

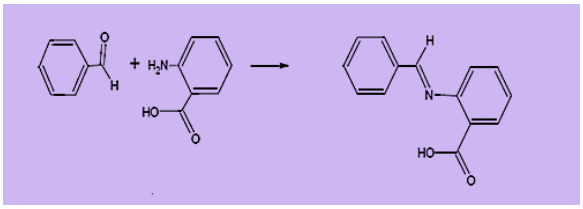
2. EXPERIMENTAL

The materials used in this investigation are A.R. benzaldehyde, anthranilic acid, salicylaldehyde, urea, copper chloride, cobalt chloride, zinc oxide, ethanol with 99% purity.

2.1 Preparation of Schiff base-1:

The Schiff base-1 was prepared by adding (25ml) of 2-amino benzoic acid ethanolic solution (0.01mol) to the same volume of ethanolic solution of benzaldehyde (0.01mol). The mixture was refluxed with stirring for 3hrs. The resulting solution was evaporated to half volume and the precipitated product was collected by filtration, washed twice with (5ml) hot ethanol and dried over anhydrous CaCl2.

The reaction for the formation of Schiff base-1 is as follows,

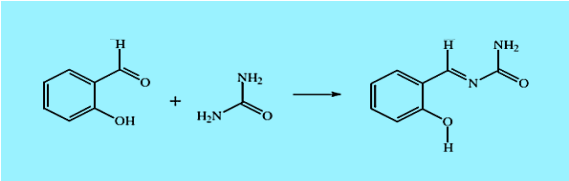


2.2 Preparation of the Schiff base-1 metal complexes:

A general method has been used for the preparation of all Chelate complexes. A solution (0.005 mol) of ligand-1 dissolved in 25 ml of hot ethanol was added with stirring to a stoichiometric amount (2:1) (0.005 mol) of Cu(II), Co(II) and Zn(II) chloride salts and the mixture were refluxed for 30 min. On cooling at room temperature, the colored complexes precipitated out in each case. They were filtered, washed with (5ml) ethanol and dried over anhydrous CaCl2.

2.3 Preparation of Schiff base-2:

The Schiff base was prepared by mixing an ethanolic solution (30 ml of 0.01mol) of salicylaldehyde and (0.01 mol) urea in the same volume of ethanol. Few drops of dil. HCl were added to adjust pH = 4 and the obtained mixture then refluxes with stirring for 2hrs.The precipitate was collected by filtration, recrystallized from ethanol and dried at ambient temperature. The reaction for the formation of Schiff base-2 is as follows,



2.4 Preparation of the Schiff base-2 metal complexes:

The chelates under investigations were prepared by mixing of 30 ml of ethanolic solution of the Schiff base-2 (0.01 mol) with the same amount of ethanolic solution of metal salts (0.01 mol), CuCl2, CoCl2, ZnO. Few drops of ammonium hydroxide were added to adjust the pH= 8.The reaction mixture was refluxed for 3hrs and then filtered, collected and then washed with ethanol. The chelates were dried desiccators over anhydrous CaCl2 under vaccum.

3. RESULTS AND DISCUSSION

3.1 Colour and Solubility of Schiff base and their metal complexes:

S. No	COMPLEX	COLOUR	ETHANOL	DMSO	DMF	ACETONE
1.	**BASE-1**	BLACK	S	S	S	IS
2.	**Co-1**	BLACK	S	S	S	IS
3.	**Cu-1**	BLACK	S	S	S	IS
4.	**Zn-1**	FLESH	S	S	S	IS
5.	**BASE-2**	YELLOW	S	S	S	IS
6.	**Co-2**	BLUE	S	S	S	IS
7.	**Cu-2**	GREEN	S	S	S	IS
8.	**Zn-2**	FLESH	S	S	S	IS

[S-Soluble, IS-Insoluble]

Table: 1. Colour and Solubility of Schiff base and their metal complexes in different solvents

3.2 Characterization of Schiff base and their metal complexes:

The FT-IR spectra of the prepared Schiff base and their metal complexes were taken in KBr pellets from 4000-400 cm-1 using Thermo scientific Nicolete iS5 ID5-Transmission Fourier Transform Infrared (FT-IR) instrument at V.O.C College, Tuticorin, Tamilnadu.

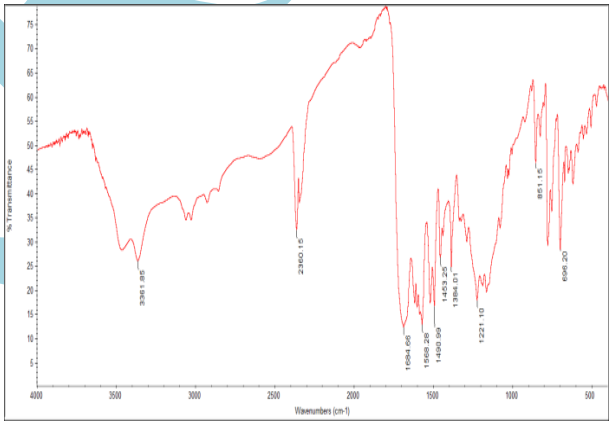


Fig.1. FT-IR Spectra of Schiff Base-1

FT-IR Spectroscopy can give useful information about the structural features of the complexes. The FT-IR Spectra of Schiff base-1given in Fig.1.The band at 3058 cm-1& 2924 cm-1 is due to υ(C-H) aromatic and aliphatic respectively. The band at 1684cm-1 is due to υ(C=O) stretching. The band at 1568cm-1 is due to υ(C=N) stretching. The band at 1384cm-1 is due to υ(COO-) stretching. All these stretching frequencies give clear evidence for the formation of Schiff base-19-11.

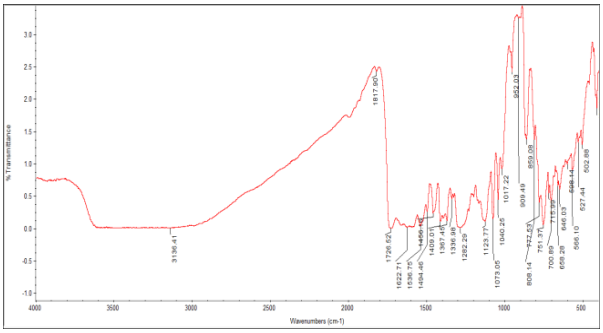


Fig.2 FT-IR Spectra of Co(II) complex-1

The FT-IR Spectra of Co(II) complex-1 given in Fig.2.The band at 1726cm-1 is due to υ(C=O) stretching. The band at 1622cm-1 is due to CH-stretching. The band at 1590cm-1 is due to υ(C=C) stretching. The band at 1494cm-1 is due to υ(C=N) stretching. The band at 1456cm-1 is due to stretching mode of CH, CH3 groups. The band at 1325cm-1 is due to υ(COO-) stretching. The band at 1227cm-1 is due to υ(C-H) plane bending. The band at 751cm-1 is due to υ(M-O) stretching. The band at456 cm-1 is due to υ(M-N) stretching. All these stretching frequencies give clear evidence for the formation of Co(II) complex-1.

3.3 Antibacterial Studies of Schiff bases and their metal complexes:

The Antibacterial activity of the two Schiff bases and their metal complexes were tested in vitro against representative Gram-positive bacteria species like Staphylococcus aureus and Gram-negative bacteria species such as Escherichiacoli and Pseudomonas aeruginosa by Muller-Hinton Agar method from Vivek Laboratories at Nagerkovil, Tamilnadu. Compounds inhibiting growth of one or both microorganism were further tested for their Minimum Inhibitory Concentration (MIC) of the compound. Among the Schiff base metal complexes, Zn-2 metal complex, Co-2 metal complex and Schiff base-2, showed good activity against all organisms. All other complexes and Schiff base-1 showed moderate activity. The antibacterial activity of the Schiff base metal complexes are given in Fig.3. From which it can be seen that the complexes had variable antibacterial activities.

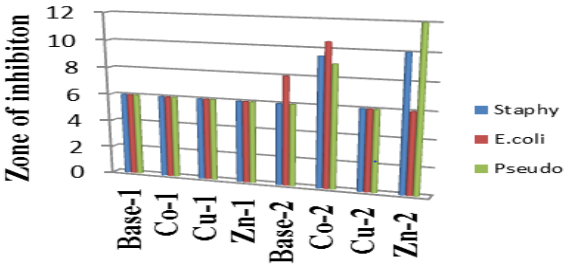


Fig.3. Graphical representation of the antibacterial activity

Fig.4. Inhibition zone of complexes against Escherichia coli, Staphylococcus aureus, Pseudomonas aeroginosa in Schiff base-1.

4. CONCLUSION

Benzaldehyde and anthranilic acid in one combination (Base-1) and salicylaldehyde and Urea in other combination (Base-2) undergo a condensation reaction to give a Schiff base 1 and 2, which forms distinctly colored complexes with the metal ions Co(II), Cu(II) and Zn(II).The prepared Schiff bases and their metal complexes were characterized using Fourier transform Infrared spectroscopy. Among the Schiff base metal complexes, Zn-2 metal complex, Co-2 metal complex and Schiff base-2, showed good activity against all organisms. All other complexes and Schiff base-1 showed moderate activity. The antibacterial activity of Zn-2 metal complexes against bacterial species is in the order of Pseudo> Staphy> E.coli. The order of Co-2 is E.coli> Staphy> Pseudo. The order of Schiff base-2 is E.coli> Staphy, Pseudo.

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