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Anti- Bacterial Activity of Tridentate Schiff Base and its Metal Complexes

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Abstract:

Schiff bases are aldehyde or ketone like compounds in which imine or azomethine group (–HC=N–) replaces carbonyl group. Schiff bases and its metal complexes have also been shown to exhibit a broad range of biological activities

Keywords: Biology activity, Schiff base & its metal complexes,

Introduction

Schiff base and its metal complexes have been synthesized by both Conventional Technique (CT) as well as solvent free Micro Wave Technique (MWTIT).Schiff bases ; first reported by Hugo Schiff (1) have also been shown to exhibit a wide range of biological activities, including antifungal, antibacterial, antimalarial, antiproliferative, anti-inflammatory, antiviral, and antipyretic properties [2], [3]. Imine or azomethine groups are present in various natural, natural-derived, and non-natural compounds. The imine group present in such compounds has been shown to be critical to their biological activities [4], [5], [6].

In this paper the biological activity of Schiff base and its metal complexes have been reported. Schiff base ligand and its metal complexes have been synthesized and characterized using various physicochemical techniques viz; elemental analysis, molecular weight determination, IR,^{1}HNMR, magnetic susceptibility measurement, molar conductance and ESR analysis as reported earlier. In this paper the biological activity of Schiff base and its metal complexes have been reported. Findings on Schiff base ligand (derived from the condensation of Anthranilic acid and Salicylaldehyde) and its metal(II) complexes with transition metal chloride are presented with the object of gaining more information about their antimicrobial properties.

Experimental

Materials and Methodology

All chemicals and reagents used for the preparation of ligand and complexes were commercial products (Sigma-Aldrich or Fluka) and were used without further purification. Solvents used for reactions were purified and dried by standard procedures (7).

Result and discussion

The preparation of a novel Schiff base ligand and its complexes with the appropriate transition metal(II)chloride, such as Mn,Fe,Co,Ni,Cu,Zn,Cd and Hg by both routes (conventional and microwave) were reported earlier(8). The Schiff base ligand and its metal (II) complexes were displayed good stability in solid state at room temperature and which were not shown by metal (III) complexes thus not reported. These compounds were characterized by the usual methods: elemental analysis, molar conductance, magnetic moment FTIR, ^{1}H-NMR, and ESR spectral analysis(8). On the basis of micro analytical data, metal complexes under investigation may be represented by formula MLX_n (Figure2), where M stands for metal ion, L for ligand- Schiff base ,X for the water molecule and n is number of water molecule. The

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Schiff base ligand was expected to act as a tridentate ligand, the possible coordination sites being imine nitrogen, the oxygen atom of the deprotonated salicylaldehydic group and the oxygen atom of the deprotonated carbonylic group (Figure 1).

In Vitro Antibacterial Activity

The Schiff base ligand and its metal (II) complexes (Mn, Fe, Co, Ni, Cu, Zn, Cd and Hg) were evaluated for their antibacterial activity against the two strains *Staphylococi coagulase* Gram (+) and Escherichia coli Gram (-) by inhibition zone method using agar diffusion method. The compounds were also shown to inhibit the growth of bacteria to a greater extent as the concentration was increased. The Schiff base ligand and metal complexes were failed to display antifungal activity against *Aspergillus niger* except SB_1–Cu, hence not reported in the paper. The plates were incubated for 24 hours at 37^0C.Sample of 10μg/l was placed on plate containing solid bacterial medium which was heavily seeded with spore suspension of the test organism. The compounds were tested at a concentration of 200, 100 and 50 μg/ml using as suitable solvent. After inoculation, the diameter of the clear zone of inhibition surrounding the sample was taken as a measure of inhibitory power of the sample against the particular test organism. The Vancamycin and Ceflaxomycin were used as the standard control. The susceptibility zones were measured in diameter (mm) and the results are reproduced in Table 5. The susceptibility zones measured were the clear zones around the discs killing the bacteria. All of the tested compounds showed a remarkable biological activity against Gram-positive and Gram-negative bacteria. Schiff base and its complexes individually exhibited varying degrees of inhibitory effects on the growth of the tested bacterial species. The antibacterial results evidently revealed that the activity of the Schiff base compounds became more pronounced when coordinated (9) to the metal ions. All metal ions were reported varying antibacterial influence on bacterial species. The Cd (II) and Mn (II) complexes of H_2SB_1 showed enhanced antibacterial activity than parent ligand for Gram- negative bacteria. Antibacterial activities of complexes were comparable with standard drug and showed slightly higher activity .It is definitive that metal ions do play a considerable role in enhancing the antibacterial activity of antibacterial agents on chelation. It was suggested that in the chelated complex, the positive charge of the metal ion was partially shared with the donor atoms and there was g-electron delocalization over the whole chelate ring. This increases the lipophilic character of the metal chelate and favors its permeation through lipoid layers of the bacterial membranes. It was also suspected that factors such as solubility, dipole moment and cell permeability mechanisms were also influenced by the presence of the metal ions, which were responsible in enhancing this role of metals as bactericidal. The antibacterial activity order is as follows-

Metal complexes of Schiff base >Standard drug >Parent Schiff base ligand

Conclusion

The antibacterial results explored that the parent ligand exhibited negligible activity which became more prominent when coordinated to the metal ions.

Table 1 Antimicrobial activity of the Schiff Base (H_2SB_1) and its metal complexes as percentage (%) zone of inhibition with different dilution

S.No.	Schiff Base and its Complexes	*Staphylococicoagulase (Gram+)* Negative Control :Vancamycin (12mm)			*Escherichia coli(Gram-)* Positive Control :Ceflaxomycin; (13mm)		
		50ppm	**100ppm**	**200ppm**	**50ppm**	**100ppm**	**200ppm**
1	**H_2SB_1**	1mm	**2mm**	**3mm**	-	_	_

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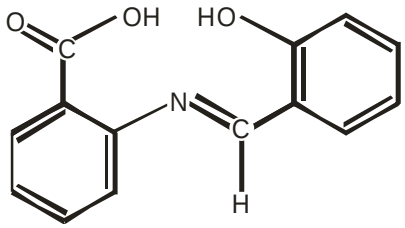
2	**SB_1 –Mn**	2mm	4mm	6mm	**15mm**	**22mm**	**25mm**
3	**SB_1-Fe**	6mm	6mm	6mm	5mm	7mm	10mm
4	**SB_1-Co**	8mm	10mm	13mm	7mm	10mm	15mm
5	**SB_1-Ni**	5mm	8mm	11mm	6mm	7mm	20mm
6	**SB_1-Cu**	4mm	7mm	10mm	15mm	17mm	20mm
7	**SB_1-Zn**	8mm	11mm	15mm	10mm	13mm	15mm
8	**SB_1-Cd**	30mm	35mm	40mm	18mm	20mm	23mm
9	**SB_1-Hg**	7mm	10mm	13mm	6mm	8mm	13mm

(**McFarland turbidity standard:** The McFarland standard is used to adjust the turbidity of the inoculum for the susceptibility test).



(H_2 SB_1)

Figure 1 Structure of Schiff Base (SB1)

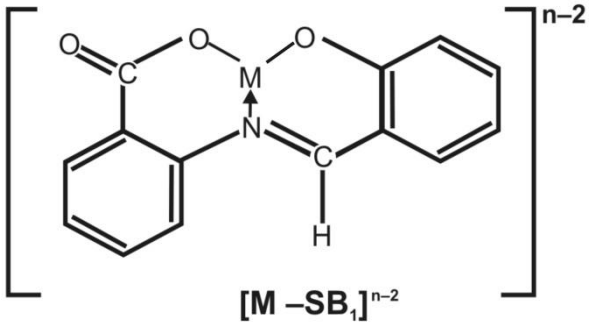


Figure 2 Structure of Schiff Base Metal complex (n=2)
Where, M = Mn (II), Fe (II), Co (II), Ni (II), Cu (II),Zn(II), Cd(II), Hg(II)

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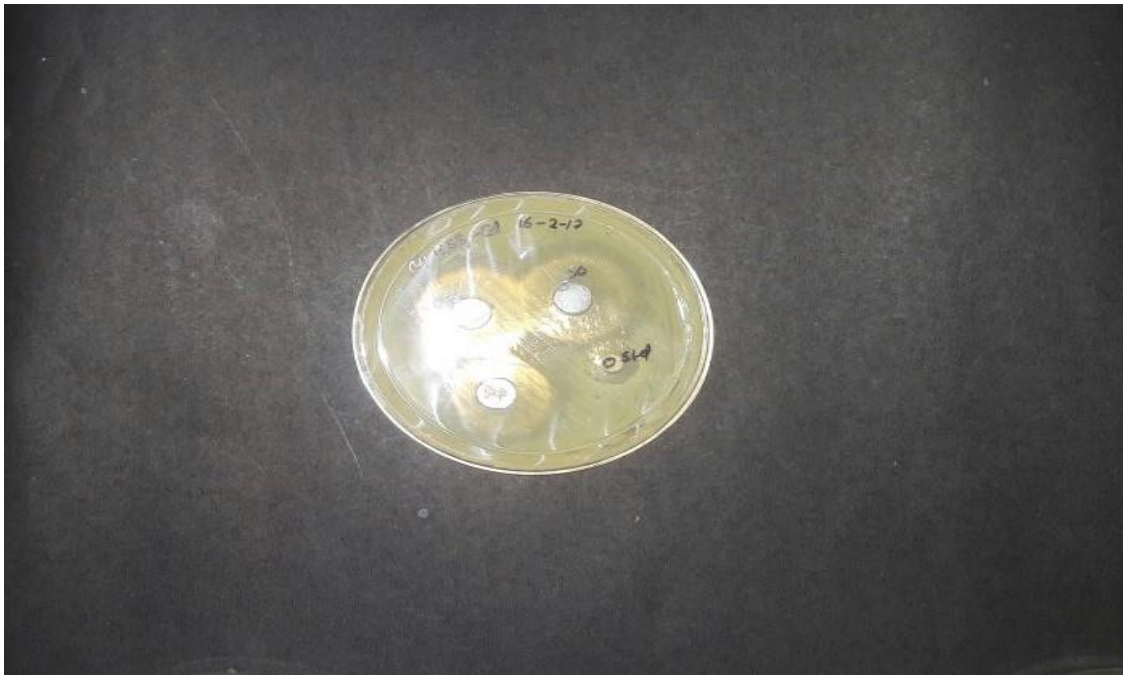

Figure 3 Antibacterial Activity of Cd (II)-SB_1 against *Staphylococi coagulase* Gram+ Bacteria

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