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SYNTHESIS, CHARACTERIZATION AND ANTIMICROBIAL STUDIES OF Mn(II), Co(II) AND Zn(II) SCHIFF BASE COMPLEXES DERIVED FROM GLYCINE AND 2-HYDROXY-1-NAPHTHALDEHYDE

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ABSTRACT: The ligand glycine-2-hydroxy-1-naphthaldehyde (GNH) was synthesized by stirring at room temperature and used for the preparation of Mn(II), Co(II) and Zn(II) complexes. These were characterized using infrared, electronic absorption data, molar conductivity melting points and solubility. The melting points of the synthesized compounds were in the range of 235.6- 253.7 ^{0}C while the conductivities measured in DMSO were in the range of 2.09 - 6.65 µs. The infrared spectra data of these ligands and their metal complexes showed that the ligands are neutral bidentate molecules which coordinated to the metal ions through the azomethine nitrogen atom of the Schiff bases and the carboxylate oxygen atom of the schiff bases. From the UV visible data available, tetrahedral geometry have been assigned to the prepared complexes. The antimicrobial studies of the synthesized compounds on micro-organisms such as: *Escherichia coli*, *Staphylococus aureus*, *Salmonella typhi* and *Candida albicans* at different concentrations revealed that all the ligands and complexes have good antimicrobial activities. The complexes showed enhanced activities and their activities against the micro organisms increased with increasing concentrations.

KEYWORDS: Synthesis, Schiff bases, Ligand, Antimicrobial activitiy, Tetrahedral.

1 INTRODUCTION

Schiff bases also called imines are characterized by the azomethine (-C=N-) group and are usually formed by condensation of an aldehyde or ketone with a primary amine (Graham and Fryhle, 2004). This condensation reaction between a carbonyl compound and an amine leading to the formation of Schiff base is a facile reaction due to the good electrophylic characteristic properties of the carbonyl and the amine group (Petil, Jadhav and Petil, 2012). Works on Schiff bases are rapidly developing because Schiff base ligands are potentially capable of forming stable complexes (Xavier *et al., 2012*). In the past three decades, the synthesis, structure and characterization of Schiff bases and their complexes have aroused much interest because of their noteworthy contributions in material science, catalysis of many reactions such as carbonylation, hydroformylation, reduction, oxidation and hydrolysis (Xavier *et at*, 2012). Schiff bases show pharmaceutical and clinical properties such as analgesics, anti inflammatory, ulcerogenic, antimicrobial and anticancer activities (Osowole, Ott and Ogunlana, 2012). Also catalytic, analytical and industrial activities of Schiff bases have been extensively studied (Nirmal, *et al.,* 2010). In the area of bioinorganic chemistry, the interest on Schiff bases lies in the fact that they provide synthetic docking models for development of new chemotherapy to fit well into a binding site of a macromolecular target (Kumar, Nath and Kumar, 2013). This is usually achieved through molecular ducking by providing a large probe for deoxyribonucleic acid (DNA) structure and conformation (Zhang, Wang and Ding, 2010). Schiff bases are known for enhancement of life span, reduced coverage tumour weight and inhibition of growth of tumuor cell in Ehrlich Ascites Carcinomes (EAC) cell bearing in mice and also restore worn-out hematological parameters like hemoglobin content, Red Blood Cell (RBC) and White Blood Cell (WBC) to normal (Jesmin, Ali and Khanem, 2010). Many Schiff bases and their complexes are known to show promising antifungal, antibacterial, and anticancer activities (Raj, Vinnarasi and Rose, 2013). In addition some Schiff base complexes containing nitrogen and oxygen donor atoms are very effective in biocidal activities and other transformations in organic and inorganic chemistry (Mishra, Sharma and Jain, 2012; Kotkar and Juneja, 2013). This research work is focused on the synthesis and characterization of Mn^{2+}, Co^{2+}, and Zn^{2+} complexes of the ligand glycine-2-hydroxy-1-naphthaldehyde and their anti microbial activities.

2 EXPERIMENTAL

SYNTHESIS OF GLYCINE-2-HYDROXY-1-NAPHTHALDEHYDE (GHN)

Few drops of sodium hydroxide were added to (0.751 g, 0.01 mol) of glycine in 50 cm^3 of ethanol and the mixture was stirred magnetically at room temperature until a homogenous solution was obtained. 2-hydroxy-1-naphthaldehyde (1.722 g, 0.01 mol) in 50 cm^3 ethanol was added and stirred for three hours. The yellowish-brown precipitate obtained was filtered and washed with ethanol and dried over calcium chloride in a dessicator.

SYNTHESIS OF METAL(II) GLYCINE-2-HYDROXY-1-NAPHTHALDEHYDE

The schiff base glycine-2-hydroxy-1-naphthaldehyde (0.03 mol) was dissolved in 30cm^3 of ethanol, to this solution warm 30 cm^3 solution of the metal(II**)** chloride hydrate (0.03 mole) followed by few drops of sodium hydroxide. The mixture was magnetically stirred for three hours and the precipitate obtained was filtered and washed several times with ethanol then dried in a desiccator over anhydrous calcium chloride (Islam *et al.,* 2013).

3 RESULTS

Table 1: solubility data of the compounds

Solvents / Samples	Distilled water	Methanol	Ethanol	Acetone	DMSO	DMF
GHN	SS	S	S	S	S	S
$[Mn(GHN)_2]Cl_2$	INS	S	S	S	S	S
$[Co(GHN)_2]Cl_2$	INS	S	S	S	S	S
$[Zn(GHN)_2]Cl_2$	SS	S	S	S	S	S

S= soluble, SS= slightly soluble, INS= insoluble

Table 2: Physical data of the compounds

Ligands/Complexes	Colour	Nature	Melting point(^{0}C)	Conductivity (µs)
GHN	Yellowish brown	powdery	235.6	4.45
$[Mn(GHN)_2]Cl_2$	Brown	powdery	253.7	6.65
$[Co(GHN)_2]Cl_2$	Brown	powdery	241.2	3.05
$[Zn(GHN)_2]Cl_2$	Brown	powdery	238.0	2.09

Table 3: Antimicrobial results

Ligands/complexes	Zone of inhibition in (mm)				
	Concentrations (mg/ml)	*S. typhi*	*E.coli*	*S. aureus*	*C. albicans*
GHN	100 10 1	9 8 9	8 7 6	9 7 7	9 8 8
$[Mn(GHN)_2]Cl_2$	100 10 1	10 8 9	11 8 7	9 8 8	11 9 9
$[Co(GHN)_2]Cl_2$	100 10 1	8 8 7	8 8 8	9 8 8	9 8 8
$[Zn(GHN)_2]Cl_2$	100 10 1	12 9 8	11 8 7	9 8 8	12 9 8
Streptomycin	100 10 1	32 29 25	28 20 11	32 27 23	-
Ketoconazole		-	-	-	14 12 11

4 DISCUSSIONS

PHYSICAL PROPERTIES OF THE LIGANDS AND COMPLEXES

All the synthesized ligands and complexes were variedly coloured and exist in powdery form indicating their polymeric nature. The melting points obtained were in the range of 235.6- 253.7 ^{0}C. The molar conductance values are very low in the range of 2.09 - 6.65 µs suggesting their non electrolytic nature and some degree of polarity (Ogunniran, *et al.,* 2008). All melting points were measured using open capillary tubes on an electro thermal Gallenkamp melting point apparatus and the results showed that the complexes exhibit high melting points, indicating a strong bonding between the ligands and metal ion (Didarul *et al.*, 2010)

INFRARED DATA OF GHN AND ITS COMPLEXES

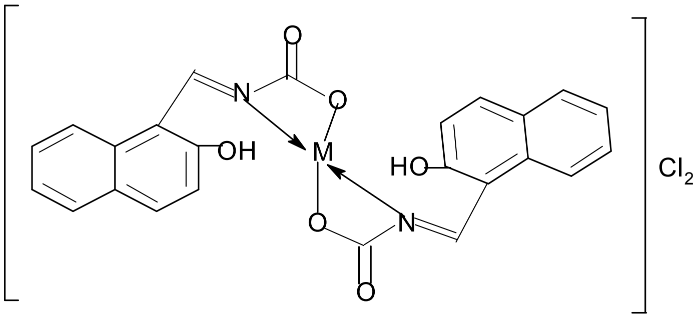
The strong band at 1626 cm^{-1} in the spectrum of the ligand is assigned to the vibration of the azomethine (C=N) group. This band was lowered to 1605 cm^{-1} for Mn(II) and Co(II) complexes and 1613 cm^{-1} for the Zn(II) complexes indicating the involvement of the azomethine nitrogen atom in coordination to the central metal atoms. The band at 1383 cm^{-1} in the spectrum of the ligand is a characteristic of the COO^- . This band was shifted to 1367, 1367 and 1392 cm^{-1} in the spectra of Mn(II), Co(II) and Zn(II) complexes, showing the participation of the carboxylate ion in coordination. The bands at 520 cm^{-1}, 549 cm^{-1} and 580 cm^{-1} in the spectra of Mn(II), Co(II) and Zn(II) complexes respectively have been attributed to the v(M-N) stretching while the bands shown by the spectra of the complexes at 430 cm^{-1}, 460 cm^{-1} and 499 cm^{-1} are due to v(M-O) stretching vibration for the respective metals. The IR spectra of the ligand and complexes revealed that the ligand coordinated to the metal ions through the carboxylate oxygen and the azomethine nitrogen atom, suggesting its bidentate nature.

ELECTRONIC SPECTRA DATA OF GHN AND ITS COMPLEXES

The ligand have band at 39,682, 29,940, 26,455 and 23,866 cm^{-1} assignable to n - σ*, n- σ*, π- π* and n- π* respectively. These transitions have been attributed to intra ligand transfer. These bands were hypsochromically shifted in the spectra of the complexes suggesting the co-ordination of the ligand to the metal ions. The electronic spectra of $[Mn(GHN)_2]Cl_2$ has d-d transitions at 26,595 and 23,640 cm^{-1} which can be assigned to $^6A_1 \rightarrow ^4A_1$ transitions typical of tetrahedral Mn(II) complex. The spectra of $[Co(GHN)_2]Cl_2$ a single d-d transition was observed at 13,642 cm^{-1} which is assignable to $^4A_2 \rightarrow ^4T_1$ transition which is typical of a tetrahedral structure of Co(II) complex (Osowole *et al*., 2012). The Zn(II) complex showed an absorption band at 23,866 cm^{-1} attributed to the Ligand to Metal (L→M) charge transfer which is compactable with tetrahedral structure for Zn(II) complex (Mishra and Gupta, 2011).

ANTIMICROBIAL STUDIES OF GHN AND ITS COMPLEXES

The metal complexes showed enhanced activities compared to the free ligands, The zinc complexes in all the cases studied proved to be a better antimicrobial agent compared to the ligands and other metal complexes. This is in agreement with the result obtained by Iniama, (2007).



Where M= Mn(II), Co(II) or Zn

5 CONCLUSION

The reaction proceeded through deprotonation of the carboxylic acid hydrogen leading to the formation of the carboxylate ion and subsequent coordination or the carboxylate ion the the metal ions. The ligand and its metal(II) complexes have good antimicrobial properties against : *Escherichia coli*, *Staphylococus aureus*, *Salmonella typhi* and *Candida albicans***.**

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