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SYNTHESIS AND CHARACTERIZATION OF SOME TERNARY COMPLEXES OF Zn (II) & Cd (II) AND THEIR ANTIMICROBIAL ACTIVITY

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ABSTRACT

Some new ternary complexes of Zn (II) and Cd (II) with 8-hydroxyquinoline as primary and glycine, lysine & alanine as secondary ligands have been synthesised and their structural features have been arrived from their micro-analytical, IR and EPR spectral data. The electrolytic behavior of the chelates was assessed from their molar conductance data. Analytical data suggested 1 : 1 : 1 stochiometric composition for the isolated ternary complexes. IR spectra confirm that the primary and secondary ligands are coordinated through O/N donor atoms. The magnetic susceptibility and electronic absorption spectra of all the complexes indicate an octahedral geometry around the central metal ion. Antimicrobial activity of the complexes have also been studied. It has been found that all the complexes have higher antimicrobial activity than the free ligand and the standard.

Key words: Synthesis, Zn (II), Cd (II), Ternary complex, Antimicrobial activity, Oxine, Amino acids.

INTRODUCTION

From the survey of existing literature, it appears that metal complexes have played a vital role in the development of coordination chemistry[1-5]. Earlier work reported that some drugs showed increased activity, when administered as metal chelates rather than as organic compounds[6-8]. A broad spectrum of biologocal activity is reported to be associated with a large number of heterocyclic compounds[9-12]. A thorough survey of the literature reveals that the ternary complexes of Zn (II) and Cd (II) with 8-hydroxyquinoline as primary ligand and glycine, L-lysine & L-alanine as secondary ligands have not been studied so far. Herein, we report the synthesis and characterization of these compounds. The complexes have also been screened for their antimicrobial activity.

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The proposed structure of the complexes is –

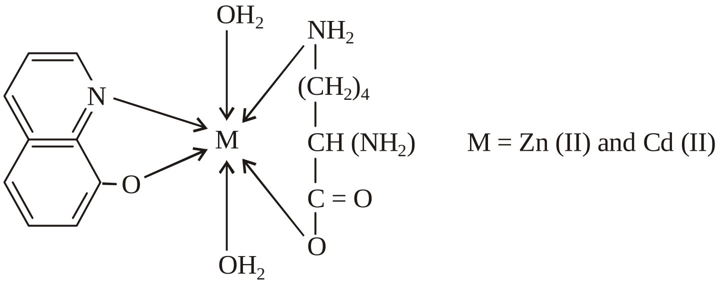

Fig. 1: Structure of complex

EXPERIMENTAL

All the reagents used were of AnalaR grade. Equimolar (0.1 M) solutions of respective metal salts and 8-hydroxyquinoline (oxine) were prepared in ethanol. Similarly, 0.2 M solution of different amino acids were obtained by dissolving their requisite amount in deionized water. All the three solutions were then mixed in 1 : 1 : 1 ratio and stirred on a magnetic stirrer constantly for 45 min. pH was adjusted between 3.0-4.5 by using 0.2 M NaOH solution. The crystalline complexes formed were separated and washed with ethanol, acetone, dry ether and dried of 60-70^{o}C. The infrared spectra were recorded on Shimadzu spectrophotometer to characterize the structure of the complexes. Conductivity water was used in the synthesis of these complexes.

RESULTS AND DISCUSSION

Analytical data (Table 1) suggested 1 : 1 : 1 stoichiometry for the ternery complexes. The complexes were soluble in common organic solvents like DMSO and DMF.

The magnetic moment values of Zn (II) complexes were found to be 3.06-3.23 BM[13,14]. The spectra of these complexes exhibit three bands at 11200, 16400 and 22800 cm^{-1} corresponding to transitions $3A_{2g}$ (F) → $3T_{2g}$ (F), $3A_{2g}$ (F) → $3T_{1g}$ (F) and $3A_{2g}$ (F) → $3T_{2g}$ (P), respectively, which corresponds to octahedral geometry[15]. Magnetic moment values of Cd (II) complexes (4.46 to 4.83 BM) indicated $6A_{1g}$ as ground state of d^5 configuration in high spin octahedral stereochemistry. The electronic spectra of the Cd (II) complexes exhibit bands at 15850-15600, 8740-18100 and 23850-23600 cm^{-1}, which can be assigned to the transitions $6A_{1g}$, → $4T_{1g}$, $6A_1$g, → $4T_{2g}$ and $6A_{1g}$, → $4E_g$, $4A_{1g}$ (G), respectively suggesting an octahedral stereochemistry. From a careful comparison of the infrated spectra of metal complexes with those of ligands, it was observed that a band at 1260 cm^{-1} due to OH bending in oxine disappears during chelate formation. This indicates complex formation between the metal cation and the ligand. In the chelate, a band was observed around 560 cm^{-1} corresponding to MO vibration, which suggests that phenolic groups are involved in bond formation with metal ions.

Table 1: Colour, analytical, conductance and magnetic moment data of metal complexes

Complex	Colour of the complex	Elecmental analysis Found (calcd.) %				W^{-1} (cm^2 mol^{-1})	M_{eff} (BM)
		M	C	H	N		
Zn (8-HQ) Glycine $2H_2O$	Lemon yellow	23.03 (23.18)	46.56 (46.76)	3.52 (3.65)	9.87 (9.92)	62.4	3.06
Zn (8-HQ) L-Lycine $2H_2O$	Lemon yellow	16.74 (16.82	46.09 (46.52)	5.89 (5.95)	10.75 (10.82)	59.7	3.10
Zn (8-HQ) L-Alanine $2H_2O$	Lemon yellow	16.69 (16.85)	43.18 (43.72)	4.79 (4.85)	8.39 (8.49)	61.3	3.23
Cd (8-HQ) Glycine $2H_2O$	Yellowish white	24.54 (24.72)	36.18 (36.42)	3.68 (3.86)	10.32 (10.53)	58.2	4.46
Cd (8-HQ) L-Lycine $2H_2O$	Yellowish white	18.73 (18.87)	38.29 (38.32)	4.18 (4.32)	9.28 (9.35)	57.3	4.81
Cd (8-HQ) L-Alanine $2H_2O$	Yellowish white	18.42 (18.65)	37.52 (37.72)	4.62 (4.72)	10.54 (10.74)	62.5	4.83

The M-N stretching frequency in the oxine complex is obtained at higher wave number because of the double bond character of M-N due to M-N interaction. Fujita et al.[16] have shown that M-N stretching frequency undergoes coupling with other stretching vibrations resulting in a number of bands. The bands around 730 and 610 cm^{-1} may correspond to the coupled ν (M-N).

From these results, it is concluded that the primary ligand 8-hydroxyquinoline is being utilized with various species showing absence of phenolic -OH group. Further, weight loss in the complexes at 170-210°C corresponds to a coordinated water molecule.

Bacterial screening

The antimicrobial activity of the ligands and synthesized ternery complexes were evaluated by the paper-disc plate methods[17]. The MTCC cultures of S. *Aureus, B. Subtilis, S. typhi and A. niger* were taken for the antimicrobial screening. The results of the antibacterial screening in terms of zone of inhibition are shown in Table 2 and control used (Table 3). All the synthesized compounds along with the parent compound were screened for there antibacterial activity. DMSO and chloroform were taken as control standard. From the antibacterial screening, it was observed that Zn-(8HQ)-L-lysine and Cd-(8HQ)-alanine complexes were found to be more active against *B. subtilis* and S. typhi where as with gram negative bacteria, no significant activity has been observed against *A. niger*. All Compounds were found active amongst the synthesized complexes. Only Cd-(8HQ)-lysine and Cd-(8HQ)-alanine complexes show activity against *B. subtilis* and *E. coli* bacteria, whereas others were found inactive. All the complexes of Zn and Cd were active against *A. niger*; however with different activity.

Table 2: Zone of inhibition (mm)

Complex solvent		***E. coli* (614)**	***S. aureus* (96)**	***B. Subtilis* (441)**	***S. typhi* (531)**	***A. niger* (281)**
Zn + 8HQ + Glycine	Chloroform	--	--	--	--	3.0
Zn + 8HQ + Lysine	Chloroform	--	--	36	21	17.0
Zn + 8HQ + Alanine	Chloroform	--	--	44	--	12.0
Cd + 8HQ + Glycine	DMSO	--	--	--	--	29.0
Cd + 8HQ + Lysine	DMSO	--	--	22	--	24.0
Cd + 8HQ + Alanine	DMSO	15	--	--	--	27.0

Table 3: Control (Zone of inhibition in mm)

Solvent	***E. coli***	***S. aureus***	***B. subtilis***	***S. typhi***	***A. niger***
DMSO	--	18	--	--	15
Chloroform	--	13	--	--	--

In these observations, it has been observed that the synthesized complexes were found active against some bacteria and fungi. Thus, it is worthwhile to persue further investigations by modifying the structure as well as the concentration ratio.

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