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Synthesis, Characterization, Spectral and Antimicrobial Studies on Some Mixed Complexes of Transition Metal

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Some new ternary complexes of Mn(II) and Ni(II) with 8-hydroxy quinoline as primary and glycine, lysine, alanine as secondary ligands have been synthesized and their structural features have been studied on the basis of analytical and spectral data. Analytical data suggest 1:1:1 stoichiometric composition for the isolated ternary complexes. IR spectra confirm the primary and secondary ligands are co-ordinated through O/N donor atoms. Antimicrobial activity of the complexes have also been studied.

Key Words: Synthesis, Mn(II), Ni(II), Ternary complex, Antimicrobial agents, Oxine, Amino acids.

INTRODUCTION

A broad spectrum of biological activity is reported to be associated with a large number of heterocyclic compounds[1-4]. A thorough survey of the literature reveals that the ternary complexes of Mn(II) and Ni(II) with 8-hydroxy quinoline as primary ligand and glycine, L-lysine, L-alanine as secondary ligands have not been studied so far. Here, we report the synthesis and characterization of these compounds. The complexes have been screened for their antimicrobial activity.

EXPERIMENTAL

All the reagents used were of AnalR grade. Equimolar (0.2 M) solutions of respective metal salts and 8-hydroxy quinoline (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 three solution 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 and dry ether and dried at 60-70 ºC. FT-IR were recorded on Shimadzu spectrophotometer to characterize the structure of the complexes.

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RESULTS AND DISCUSSION

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

TABLE-1
COLOUR, ANALYTICAL, CONDUCTANCE AND MAGNETIC MOMENT DATA OF METAL COMPLEXES

Complex	Colour of the complex	Elemental analysis: Found (Calcd.) %				Ω^{-1} (cm^2 mol^{-1})	μ_{eff} (BM)
		M	C	H	N		
Ni(8-HQ) Glycine	Green	19.54 (19.65)	44.05 (44.19)	6.10 (6.0)	14.23 (14.06)	61.4	3.27
Ni(8-HQ) L-Lysine	Green	15.21 (15.30)	46.87 (46.91)	5.78 (5.99)	10.88 (10.94)	59.2	3.33
Ni(8-HQ) L-Alanine	Green	17.70 (17.99)	44.24 (44.14)	4.77 (4.90)	8.52 (8.50)	62.3	3.36
Mn(8-HQ) Glycine	Yellow	18.72 (18.63)	45.02 (44.75)	6.20 (6.10)	14.13 (14.23)	58.2	5.80
Mn(8-HQ) L-Lysine	Yellow	14.34 (14.46)	47.22 (47.37)	6.09 (6.05)	11.01 (11.05)	57.3	5.81
Mn(8-HQ) L-Alanine	Yellow	17.13 (17.02)	44.50 (44.58)	4.88 (4.95)	8.53 (8.66)	62.4	5.83

The magnetic moment values of Ni(II) complexes are found to be 3.27-3.36 BM[5,6]. The spectra of these complexes exhibit three bands at 10900, 16100 and 22400 cm^{-1} corresponding to the transitions $^3A_{2g}(F) \rightarrow {}^3T_{2g}(F)$, $^3A_{2g}(F) \rightarrow {}^3T_{1g}(F)$ and $^3A_{2g}(F) \rightarrow {}^3T_{2g}(P)$, respectively, which corresponds to octahedral geometry[7].

Magnetic moment values of the present Mn(II) complexes (5.80 to 5.83 BM) indicates $^6A_{1g}$ as ground state for d^5 configuration in high spin octahedral stereochemistry. The electronic spectra of the Mn(II) complexes exhibits three bands at 15650-15500, 18630-18400 and 23650-23400 cm^{-1} which can be assigned to the transitions $^6A_{1g} \rightarrow {}^4T_{1g}$, $^6A_{1g} \rightarrow {}^4T_{2g}$ and $^6A_{1g} \rightarrow {}^4Eg$, $^4A_{1g}(G)$, respectively suggesting an octahedral stereochemistry.

From a careful comparison of the infrared spectra of metal complexes with those of ligands, it is inferred that a band at 1200 cm^{-1} due to OH bending in oxine disappears during chelate formation. This indicates complex formation between the matal cation and the ligand leading to generation of a new entity. In the chelate, the band observed around 500 cm^{-1} corresponds to MO vibration suggests that phenolic groups are involved in bond formation with metal ions.

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 π interaction. Nakamoto[7,8] has 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-hydroxy quinoline is being utilized with various species showing absence of phenolic -OH group and generation of new entities. Further, weight loss in the complexes at 140-180 ºC corresponds to a coordinated water molecule.

Bacterial screening

The antimicrobial activity of the ligands and synthesized ternary complexes were evaluated by the paper-disc plate methods[9]. The MTCC cultures of *E. coli., 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 is shown in Table-2 and control used as mentioned in Table-3. All the synthesized compounds along with the parent compound were screened for their antibacterial activities. DMSO and chloroform were taken as control standard. From the antibacterial screening it is observed that Ni(8HQ) with L-alanine was found more active against *B. subtilis*, *S. typhi* and *A. niger* as gram positive bacteria only 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 Mn(8HQ)-lysine and alanine show active against gram negative bacteria, whereas others found inactive.

TABLE-2
ZONE OF INHIBITION (mm)

Complex	Solvent	*E. coli* (614)	*S. aureus* (96)	*B. subtilis* (441)	*S. typhi* (531)	*A. niger* (281)
Ni+8HQ+Glycine	Chloroform	–	–	–	–	0.2
Ni+8HQ+Lysine	Chloroform	–	–	40	–	10.0
Ni+8HQ+Alanine	Chloroform	–	–	32	19	15.0
Mn+8HQ+Glycine	DMSO	–	–	–	–	37.0
Mn+8HQ+Lysine	DMSO	–	–	20	–	22.0
Mn+8HQ+Alanine	DMSO	13	–	–	–	25.0

TABLE-3
CONTROL (mm)

Solvent	*E. coli*	*S. aureus*	*B. subtilis*	*S. typhi*	*A. niger*
DMSO	–	14	–	–	11
Chloroform	–	10	–	–	–

From this it has been observed that amongst the synthesized complexes were found active against *S. aureus*. Thus, it can be concluded that it is worthwhile to persue further investigation by modifying the structure as well as the concentration ratio.

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