SYNTHESIS, BIOLOGICAL ACTIVITY AND STRUCTURAL INVESTIGATION OF SOME NEW 2 – AMINO - 4 - (P- ETHOXY PHENYL) THIAZOLE DERIVATIVES

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ABSTRACT

The complexes of the type ML_2X_2 (where M = Cu (II), Co (II) and Ni (II), L= 2-amino-4-(p-ethoxy phenyl) thiazole and X= Ci^-,NO_3^- were prepared and characterized on the basis of IR, elemental analysis, electronic and magnetic susceptibility studies. The complexes were ionic and octahedral which show significant covalency in metal-ligand bond. IR studies have shown that nitrogen of the amino group and sulphur of the thiazole ring took part in co-ordination. All the synthesized complexes were screened for their antifungal activity against different fungi at different concentrations. The activity decreases with decrease of concentration and the metal complexes are less toxic than the parent ligand.

Key Words: Octahedral Complexes, Elemental Analysis, Thiazole ligand, Toxicity.

INTRODUCTION

Complexes of heterocyclic compounds with paramagnetic transition metals have attracted close attention. A number of thiazole complexes have gained wide interest because they show a broad spectrum of biological and pharmaceutical activities such as anti-microbial, anti-corrosive, anti-tumor and anti-cancer action. Complexes of the ligand 2-amino-4-(p-ethoxy phenyl) thiazole with transition metals were prepared and characterized on the basis of IR, elemental analysis, electronic and magnetic susceptibility studies. A critical review of literature revealed that no systematic work on transition metal complexes of 2- amino-4-(p-ethoxy phenyl) thiazole has been carried out. Khamamkar et. al. 2012 studied the synthesis, spectral characterization and biological activity of Schiff's base derived metal complexes. Schiff's base derived complexes of derivatives of DHA were also studied by Mane et.al.2001. Malik et. al. 2013, 2014, 2015 studied the structural and biological aspects of transition metal complexes of the ligands oxazole and thiazole. The present paper deals with the preparation and characterization of Cu(II), Co(II) and Ni(II) complexes with 2-amino-4-(p-ethoxy phenyl)thiazole. Metal complexes play an important role in biological activity. In many cases metal complexes are more potent than free ligands. The newly prepared complexes were also screened for their antifungal activity against different fungi at different concentrations (Bharti et al. 2010).

EXPERIMENTAL

Materials and methods:

All the chemicals and reagents used were of analytical grade: otherwise they were purified before use. Organic solvent used was absolute alcohol. IR spectra of the ligand and complexes are recorded in nujolmull. The electronic spectra were recorded in MgO at room temperature on VSU-22 spectrophotometer. The measurements were carried out Guru Nanak Dev University, Amristar. Metal and sulphur contents of these complexes were estimated using the standard procedures

reported in literature (Vogal 1961 and Vogal 1958). The estimation of carbon, hydrogen and nitrogen were carried out at BHU, Varanasi and CDRI, Lucknow and results are given in Table 1. Magnetic measurements were carried out at IIT Roorkee at room temperature using Co $[Hg(CNS)_4]$ as a calibrant.

Table 1

Elemental Analysis Data

Complexes	%Calc./ Obs.					
	C	H	S	N	O	M
$C_{11}H_{12}N_2OS$	60.00 59.91	5.45 5.38	14.54 14.46	12.72 12.61	7.27 7.19	-----
$[Cu(C_{11}H_{12}N_2OS)_2Cl_2]$	45.95 45.86	4.17 4.09	11.14 11.12	9.74 9.68	5.57 5.50	11.05 11.01
$[Ni(C_{11}H_{12}N_2OS)_2Cl_2]$	46.31 46.28	4.21 4.17	11.22 11.19	9.82 9.77	5.61 5.52	10.35 10.29
$[Co(C_{11}H_{12}N_2OS)_2Cl_2]$	46.32 46.29	4.20 4.19	11.24 11.21	9.81 9.80	5.63 5.59	10.32 10.31
$[Cu(C_{11}H_{12}N_2OS)_2(NO_3)_2]$	42.07 42.02	3.82 3.79	10.19 10.14	13.38 13.36	20.39 20.34	10.11 10.08
$[Ni(C_{11}H_{12}N_2OS)_2(NO_3)_2]$	42.37 42.31	3.85 3.81	10.27 10.23	13.50 13.43	20.54 20.51	9.47 9.44
$[Co(C_{11}H_{12}N_2OS)_2(NO_3)_2]$	42.38 42.31	3.84 3.81	10.29 10.26	13.48 13.45	20.56 20.53	9.46 9.41

The ligand 2-amino-4-(p-ethoxy phenyl) thiazole was prepared using the procedure reported in the literature (Dodson et al. 1945).

Table 2

Characteristic IR bands of ligands and complexes

Complexes	IR Bands (cm^{-1})					
	νN-H	νN=C-S	νC-H	ν C=C-N-C	νC=N	νM-S
$C_{11}H_{12}N_2OS$	3340-3300	1550-1400	3100-3080	1680-1460	1636-1585	--
$[Cu(C_{11}H_{12}N_2OS)_2Cl_2]$	3282-3120	1532-1378	3098-3078	1680-1461	1626-1580	270-250
$[Ni(C_{11}H_{12}N_2OS)_2Cl_2]$	3275-3138	1528-1371	3096-3082	1679-1459	1629-1587	268-248
$[Co(C_{11}H_{12}N_2OS)_2Cl_2]$	3278-3119	1526-1372	3103-3081	1677-1457	1631-1585	266-251
$[Cu(C_{11}H_{12}N_2OS)_2(NO_3)_2]$	3274-3118	1525-1367	3099-3077	1769-1458	1631-1578	267-242
$[Ni(C_{11}H_{12}N_2OS)_2(NO_3)_2]$	3751-3119	1523-1374	3096-3076	1677-1459	1635-1586	264- 246
$[Co(C_{11}H_{12}N_2OS)_2(NO_3)_2]$	3291-3131	1522-1368	3095-3076	1678-1456	1639-1582	270-246

A shift in the νN=C-S and νN-H band frequencies is observed in all the complexes. This shows that the lone pair of electron presents on the sulphur atom of thiazole ring and nitrogen atom of free amino group is taking part in co-ordination (Table 2).

Table 3

Electronic spectral bands and their assignments

Complexes	Bands (cm^{-1})	Assignment
$[Cu(C_{11}H_{12}N_2O\,S)_2Cl_2/(NO_3)_2]$	15028-15618 18118-19098	$^2B_{1g} \rightarrow {}^2A_{1g}$ $^2B_{1g} \rightarrow {}^2E_g$
$[Ni(C_{11}H_{12}N_2O\,S)_2Cl_2/(NO_3)_2]$	9005-9987 14134-15759 24020-26500	$^3A_{2g}(F) \rightarrow {}^3T_{2g}(F)\ (\nu_1)$ $^3A_{2g}(F) \rightarrow {}^3T_{1g}(F)\ (\nu_2)$ $^3A_{2g}(F) \rightarrow {}^3T_{1g}(P)\ (\nu_3)$
$[Co(C_{11}H_{12}N_2O\,S)_2Cl_2/(NO_3)_2]$	8840-9120 16050-17245 20587-21248	$^4T_{1g}(F) \rightarrow {}^4T_{2g}(F)\ (\nu_1)$ $^4T_{1g}(F) \rightarrow {}^4A_{2g}(F)\ (\nu_2)$ $^4T_{1g}(F) \rightarrow {}^4T_{1g}(P)\ (\nu_3)$

CZ-record UV-Viz. spectrometer provided with an automatic recorder was used to record the electronic spectra of the complexes in ethanol at room temperature (Table 3).

Preparation of metal complexes

Preparation of metal complexes

Bis [2-amino-4-(p-ethoxy phenyl) thiazole] Dichloride/Dinitrate ligands and M(II) salts where M= Ni(II), Cu(II) and Co(II) are taken to synthesize the complex. The respective metal salts in dry alcohol were taken into a round bottom flask and mixed with required amount of ligand (1:2ratio). A little amount of alcohol was also added. The reaction mixture was refluxed on water bath for at least two hours and then the reaction mixture was concentrated to half of its volume. On keeping for overnight, crystals of metal complexes separate out which were filtered, washed with alcohol and finally with ether and then dried in vacuum. Similarly some complexes of thiazole were also synthesized by many workers (Khalil et al. 2009; Aridoss et al. 2009; Kaergoudar et al. 2008; Dawane et al. 2010; Adibpour et al. 2010; Arshad et al. 2011 and Giri et al. 2009).

RESULTS AND DISCUSSION

The ligand has three donor sites viz. two nitrogen (one on thiazole ring and other on the amino group) and one ring sulphur. Thiazoles are formally derived from imidazole by replacement of -NH by sulphur in position one makes it better π acceptor due to the availability of empty d-orbital on sulphur atom. The infra-red and far infra-red spectra of the ligand and its complexes were recorded to detect the point of co-ordination.

IR Spectra:

Formation of the ligand 2-amino-4-(p-ethoxy phenyl) thiazole was confirmed by the presence of IR absorption band at 3340-3300 cm^{-1} for N-H stretching and N=C-S absorption band at 1550-1400 cm^{-1}.The ring nitrogen does not take any part in the coordination because strong band obtained near about 1636-1585 cm^{-1} which is due to ν (C=N) frequencies in the free ligand is completely unaffected after complex formation. The lone pair of electron available on nitrogen

atom of amino group is taking part in complex formation because ν(N-H) asymmetric and symmetric stretching frequencies appeared in the region 3400 and 3300 cm^{-1} respectively, decreases after complex formation due to interaction of lone pair of nitrogen. The ring sulphur of thiazole ring is taking part in complex formation because the band observed at 650 cm^{-1} in the free ligand assigned to asymmetric ν (C-S) is shifted to lower frequency after complexation and the symmetric ν (C-S) frequency obtained at 685 cm^{-1} completely disappears or intensity of this band is reduced after complexation. From the above observation it is clear that the nitrogen of the $-NH_2$ group and ring sulphur take part in coordination.

Electronic Spectra:

In the electronic spectra of Ni (II) complexes bands were observed in the region 14134-15759 cm^{-1} can be assigned to $^3A_{2g}$ (F) → $^3T_{1g}$ (F) ($\sqrt{_2}$), the highest energy transition ν_3 obtained in the region 24020-26500 cm^{-1} may probably be due to $^3A_{2g}$ (F) → $^3T_{1g}$ (P) while the spin allowed transition of the lowest energy ν_1 may be assigned to $^3A_{2g}$ (F) → $^3T_{2g}$ (F) which are characteristic of octahedral Ni(II) ion. The magnetic moment values found in the range 2.94-3.26 B.M. This is a support of high spin octahedral geometry (Earnshaw 1968). In present Co (II) complexes three bands at 8840-9120, 16050-17245 and 20587-21248 cm^{-1} were observed which may be assigned for $^4T_{1g}$ (F) → $^4T_{2g}$(F) (ν_1), $^4T_{1g}$ (F) → $^4A_{2g}$ (F)(ν_2) and $^4T_{1g}$ (F) → $^4T_{1g}$ (P) (ν_3) respectively. The observed splitting of these bands suggests the octahedral geometry. Two bands were observed in electronic spectra of Cu (II) complexes in the region 15028-15618 and 18118-19098cm^{-1} which may be assigned to $^2B_{1g}$ → $^2A_{1g}$ and $^2B_{1g}$ → $^2E_{1g}$ transitions respectively in a planar field. The magnetic moment values for the Cu(II) complexes lie in the range 1.61-1.66 B.M. which support square planar geometry.

Fungicidal Activity:

Sulphur and its various compounds are known which function as fungicides and pesticide. Colloidal sulphur was used as insecticide. The thiazole and their complexes were screened for the fungicidal activity against Drechlera-tetramera, Fusarium-oxysporum and Macroohomia-phaseoli. The metal complexes are less toxic than the free ligand. This might be due to the fact that free sulphur is present in the ligand, responsible for toxicity is co-ordinated to metal in the complex. It is also observed that the ligand as well as their metal complexes is more toxic at higher concentration and the activity decreases with decrease in concentration.

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