WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 5.990
Volume 4, Issue 8, 1618-1625. Research Article ISSN 2277– 7105

SYNTHESIS AND CHARACTERIZATION (IR, ELEMENTAL ANALYSIS, ELECTRONIC AND MAGNETIC SUSCEPTIBILITY STUDIES) OF 2- N-PHENYL IMINO-3-PHENYL -4- (P- HYDROXY PHENYL)-Δ^4- THIAZOLINE DERIVATIVES

Dinkar Malik*

Department of Chemistry, M. S. College, Saharanpur U.P.

Article Received on
25 May 2015,

Revised on 17 June 2015,
Accepted on 08 July 2015

***Correspondence for Author**
Dinkar Malik
Department of Chemistry, M. S. College, Saharanpur U.P.

ABSTRACT

The synthesis and characterization (IR, elemental analysis, electronic and magnetic susceptibility studies) of the transition metal complex of 2- N-Phenyl imino-3-Phenyl -4- (p- Hydroxy Phenyl)-Δ^4- Thiazoline is described; complexes are obtained in 71% yield from the treatment of bromine, acetophenone and diphenyl urea in ethanolic solution. The complexes were of the type ML_2X_2 (where M = Cu (II), Co (II) and Ni (II), L= 2- N-Phenyl imino-3-Phenyl -4- (p- Hydroxy Phenyl)-Δ^4- Thiazoline and X= Ci^-, $CH3COO^-$. The complexes were ionic which show significant covalency in metal-ligand bond. 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.

KEYWORDS: 2- N-Phenyl imino-3-Phenyl -4- (p- Hydroxy Phenyl)-Δ^4- Thiazoline ligand, Complexes, Toxicity, IR, Elemental analysis.

INTRODUCTION

Complexes of transition metals ions containing ligands with N, S and N, S, O donors are known to exibit interesting stereo chemical, electrochemical and electronic properties. Semicarbazones and thio semicarbazones are amongst the most widely studied nitrogen and oxygen/sulphur donor ligands. Besides, thio semicarbazones, in the last two decades, have emerged as an important class of sulphur ligands particularly for transition metal ions. The real impetus towards developing their coordination chemistry i.e. their physiochemical

properties and significant biological activities. Thiazolines and their derivativatives have created an interest due to their wide range of activity. Thiazoline and their derivatives possess antimalarial, antheminitic, antifungal, antibacterial and antitubercular activities. Such compounds can also be used as local anaesthetic, antiradiation drugs, antiviral and anti protozoan agent and also in the rubber industry as vulcanization accelerators. Complexes of the ligand 2- N-Phenyl imino-3-Phenyl -4- (p- Hydroxy Phenyl)-Δ^4- Thiazoline 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- N-Phenyl imino-3-Phenyl -4- (p-Hydroxy Phenyl)-Δ^4- Thiazoline 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- N-Phenyl imino-3-Phenyl -4- (p- Hydroxy Phenyl)-Δ^4- Thiazoline. 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
$C_{21}H_{16}N_2OS$	73.25 73.21	4.65 4.58	9.30 9.16	8.13 8.01	4.65 4.59	-----
$[Cu(C_{21}H_{16}N_2OS)_2Cl_2]$	61.27 61.16	3.80 3.74	7.70 7.62	6.81 6.68	3.80 3.76	7.70 7.51
$[Ni(C_{21}H_{16}N_2OS)_2Cl_2]$	61.61 61.46	3.90 3.79	7.82 7.72	6.82 6.68	3.90 3.80	7.20 7.11
$[Co(C_{21}H_{16}N_2OS)_2Cl_2]$	61.64 61.53	3.89 3.82	7.85 7.76	6.84 6.71	3.91 3.84	7.23 7.16
$[Cu(C_{21}H_{16}N_2OS)_2(CH_3COO)_2]$	63.40 63.32	4.31 4.29	7.30 7.34	6.40 6.36	11.04 11.01	7.30 7.28
$[Ni(C_{21}H_{16}N_2OS)_2(CH_3COO)_2]$	63.81 63.72	4.30 4.25	7.31 7.24	6.42 6.36	11.09 11.03	6.80 6.68
$[Co(C_{21}H_{16}N_2OS)_2(CH_3COO)_2]$	63.82 63.62	4.33 4.28	7.30 7.34	6.42 6.37	11.02 11.01	6.29 6.28

The ligand 2- N-Phenyl imino-3-Phenyl -4- (p- Hydroxy Phenyl)-Δ^4- Thiazoline 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})					
	ν C=N-C	νC-S	νC-H	ν C=C-N-C	νC=N	νM-S
$C_{21}H_{16}N_2OS$	1640-1575	745-685	3105-3074	1770-1605	1644-1591	--
$[Cu(C_{21}H_{16}N_2OS)_2Cl_2]$	1612-1550	724-660	3098-3078	1772-1610	1646-1588	317-290
$[Ni(C_{21}H_{16}N_2OS)_2Cl_2]$	1615-1552	728-661	3099-3080	1769-1603	1649-1587	326-282
$[Co(C_{21}H_{16}N_2OS)_2Cl_2]$	1614-1551	726-662	3102-3079	1771-1605	1639-1588	335-290
$[Cu(C_{21}H_{16}N_2OS)_2(CH_3COO)_2]$	1610-1555	725-667	3099-3078	1769-1605	1641-1588	317-290
$[Ni(C_{21}H_{16}N_2OS)_2(CH_3COO)_2]$	1616-1557	723-670	3098-3073	1772-1607	1638-1586	326-282
$[Co(C_{21}H_{16}N_2OS)_2(CH_3COO)_2]$	1611-1551	722-668	3090-3075	1778-1606	1641-1589	335-290

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

Table 3Electronic spectral bands and their assignments

Complexes	Bands (cm^{-1})	Assignment
$[Cu(C_{21}H_{16}N_2OS)_2(CH_3COO)_2]$	15320-15550 19118-20198	$^2B_{1g} \rightarrow {}^2A_{1g}$ $^2B_{1g} \rightarrow {}^2E_g$
$[Ni(C_{21}H_{16}N_2OS)_2(CH_3COO)_2]$	8500-9010 14034-15763 24046-24534	$^3A_{2g}(F) \rightarrow {}^3T_{2g}(F)\ (\nu_1)$ $^3A_{2g}(F) \rightarrow {}^3T_{1g}(F)\ (\nu_2)$ $^3A_{2g}(F) \rightarrow {}^3T_{1g}(P)\ (\nu_3)$
$[Co(C_{21}H_{16}N_2OS)_2(CH_3COO)_2]$	8832-9020 16060-17205 20007-20240	$^4T_{1g}(F) \rightarrow {}^4T_{2g}(F)\ (\nu_1)$ $^4T_{1g}(F) \rightarrow {}^4A_{2g}(F)\ (\nu_2)$ $^4T_{1g}(F) \rightarrow {}^4T_{1g}(P)\ (\nu_3)$

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

2- N-Phenyl imino-3-Phenyl -4- (p- Hydroxy Phenyl)-Δ^4- Thiazoline Dichloride/Diacetate 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 thiazolidinones derivatives were also synthesized by many workers (Maurya et. al. 2007, Issa et. al. 2008, 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

Elemental Analysis shows that the C, H and N of 2- N-Phenyl imino-3-Phenyl -4- (p-Hydroxy Phenyl)-Δ^4- Thiazoline ligand were (73.21, 4.58 and 8.01 respectively) which is compatible with that required (73.25, 4.65 and 8.13 respectively).The ligand has three donor sites viz. two nitrogen (one on thiazole ring and other on the imino group) and one ring sulphur. Thiazolines 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. (Earnshaw 1968).

IR Spectra

Formation of the ligand 2- N-Phenyl imino-3-Phenyl -4- (p- Hydroxy Phenyl)-Δ^4- Thiazoline was confirmed by the presence of IR absorption bands. The ring nitrogen does not take any part in the coordination because strong band obtained near about 1644-1591 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 imino group is taking part in complex formation because ν C=N-C asymmetric and symmetric stretching frequencies appeared in the region 1640 and 1575 cm^{-1} respectively, decreases after complex formation. The ring sulphur of thiazole ring is taking part in complex formation because the band observed at 745-685 cm^{-1} in the free ligand assigned to asymmetric ν (C-S) is shifted to lower frequency after complexation. From the above observations it is clear that the nitrogen of the imino group and ring sulphur take part in coordination.

Elemental Analysis

The element analysis show that the percent of N= 6.88 % and Cu= 7.51% which were compatible with required (N= 6.81 % and Cu =7.70% in complex $[Cu(C_{21}H_{16}N_2OS)_2Cl_2]$ and the percent of N= 6.36 % and Cu= 7.28% which were compatible with required (N= 6.40 % and Cu =7.30% in complex$[Cu(C_{21}H_{16}N_2OS)_2(CH_3COO)_2]$.

The percent of N= 6.71 % and Co = 7.16% which were compatible with required (N= 6.84 % and Co =7.23% in complex $[Co(C_{21}H_{16}N_2OS)_2Cl_2]$ and the percent of N= 6.37 % and Co= 6.28% which were compatible with required (N= 6.42 % and Co =6.29% in complex$[Co(C_{21}H_{16}N_2OS)_2(CH_3COO)_2]$.

The percent of N= 6.68 % and Ni= 7.11% which were compatible with required (N= 6.82 % and Ni =7.30% in complex $[Ni(C_{21}H_{16}N_2OS)_2Cl_2]$ and the percent of N= 6.37 % and Ni= 6.68% which were compatible with required (N= 6.42 % and Ni =6.80% in complex$[Ni(C_{21}H_{16}N_2OS)_2(CH_3COO)_2]$.

Electronic Spectra

In the electronic spectra of Ni (II) complexes three bands at 8500-9010, 14034-15763 and 24046-24534 cm^{-1} were observed which may be assigned for $^3A_{2g}$ (F) → $^3T_{2g}$ (F) (ν_1), $^3A_{2g}$ (F) → $^3T_{1g}$ (F) (ν_2) and $^3A_{2g}$ (F) → $^3T_{1g}$ (P) (ν_3) which are characteristic of octahedral Ni(II) ion. The magnetic moment values are found in the range 2.90-3.20 B.M. This is in support of high spin octahedral complex.

The observed value of magnetic moment is found in the range 4.52-4.55 B.M. which is expected for tetrahedral Co(II) complex. Three bands were observed at 8832-9020, 16060-17205 and 20007-20240 cm^{-1} which may be assigned to $^4T_{1g}(F) \rightarrow {}^4T_{2g}$ (F) (ν_1), $^4T_{1g}(F) \rightarrow {}^4A_{2g}$ (F) (ν_2) and $^4T_{1g}(F) \rightarrow {}^4T_{1g}$ (P) (ν_3) respectively for tetrahedral complexes.

Two bands were observed in the electronic spectra of Cu (II) complexes in the region 15320-15550 and 19118-20198 cm^{-1} which may be assigned to $^2B_{1g} \rightarrow {}^2A_{1g}$ and $^2B_{1g} \rightarrow {}^2E_g$ respectively in a planar field. The magnetic moment value foe the Cu(II) complexes lie in the range 1.54-1.58 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 thiazolinee and their complexes were screened for the fungicidal activity against Drechslera-tetramera, Fusarium-oxysporum and Macrophomera-phaseoli. The presence of N-C-S group and the phenyl group increases the fungicidal activity. The presence of phenyl nucleus at position 3 exhibits the greater effect. 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.

ACKNOWLEDGEMENT

We gratefully acknowledge to Dr. K.K. Sharma, Principal M. S. College, Saharanpur (U.P.) for providing necessary facilities.

REFERENCES

1. Adibpour N, Khalaj A, Rajabalian S. Synthesis and antibacterial activity of isothiazolyloxazolidinones and analogous 3(2H)-isothiazolones. *Eur J Med Chem.,* 2010; 45: 19-24.
2. Aridoss G, Amirthaganesan S, Kim MS, Kim JT, Jeong YT. Synthesis, spectral and biological evaluation of some new thiazolidinones and thiazoles based on t-3-alkyl-r-2, c-6-diarylpiperidin- 4-ones. *Eur J Med Chem.,* 2009; 44: 4199-4210.
3. Arshad A, Osman H, Bagiey MC, Lan CK, Mohamad S, Safirah A, Zahariluddin M. Synthesis and antimicrobial properties of some new thiazolyl coumarin derivatives. *Eur J Med Chem.,* 2011, 1-7.

4. Bharti SK, Nath G, Tilak R, Singh SK. Synthesis, anti-bacterial and anti-fungal activities of some novel Schiff bases containing 2,4-disubstituted thiazole ring. *Eur J Med Chem.*, 2010; 45: 651-660.
5. Dawane BS, Konda SG, Mandawad GG, Shaikh BM. Poly(ethylene glycol) (PEG-400) as an alternative reaction solvent for the synthesis of some new 1-(4- (4-chlorophenyl)-2-thiazolyl)-3-aryl-5-(2-butyl-4-chloro-1H-imidazol-5yl)-2-pyrazolines and their in vitro antimicrobial evaluation. *Eur J Med Chem.*, 2010; 45: 387-392.
6. Dodson RM, King LC. The reaction of ketones with halogens and thio urea *J. Am. Chem. Soc.*, 1945; 67: 2242.
7. Earnshaw A, *Magnetochemistry*. Academic Press. New York., 1968
8. Giri RS, Thaker HM, Giordano T, Williams J, Rogers D, Sudersanam V, Vasu KK. Design, Synthesis and characterization of novel 2-(2,4- disubstituted-thiazole-5-yl)-3-aryl-3H-quinazoline- 4-one derivatives as inhibitors of NF-IB and AP-1 mediated transcription activation and as potential anti-inflammatory agents. *Eur J Med Chem.*, 2009; 44: 2184-2189.
9. Issa RM, Khedr AM, Rizk H, 1H-NMR, IR and UV/VIS Spectroscopic Studies of Some Schiff Bases Derived From 2-Aminobenzothiazole and 2-Amino-3-hydroxypyr, *Journal of the Chinese Chemical Society.*, 2008; 55: 875-884.
10. Karegoudar P, Karthikeyan MS, Prasad DJ, Mahalinga M, Holla BS, Kumari NS. Synthesis of some novel 2,4-disubstituted thiazoles as possible antimicrobial agents. *Eur J Med Chem.*, 2008; 43: 261-267.
11. Khalil AM, Berghot MA, Gouda MA. Synthesis and antibacterial activity of some new thiazole and thiophene derivatives. *Eur J Med Chem.*, 2009; 44: 4434-4440.
12. Khamamkar Ashwini, Pallapothula Rao Venkateshwar. Synthesis, Spectral Characterization and Biological activity of Schiff's base derived metal complexes. J. Ind. Council Chem., 2012; 29(1&2): 71-76.
13. Malik Dinkar, Yadav Punam, Kumar Sandeep A new method of Synthesis of the ligand 2- amino -4- (p- dihydroxy phenyl) Thiazole and characterizatin of its Nickel (Ii), Cobalt (II) and Copper (II) complexes Int. J. Phys. & Appl. Sc., 2015; 2(2): 8-14.
14. Malik Dinkar, Yadav Punam, Kumar Sandeep Synthesis and Structural Investigation of Transition Metal Complexes of the Ligand 2- Amino -4- (P- Dihydroxy Phenyl) Oxazole. Int. J. Inst. Phar. & Life. Sc., 2015; 5(1): 101-109.

15. Malik Dinkar, Yadav Punam, Kumar Sandeep, Malik Vijai Studies on Structural and biological aspects of transition metal complexes of the ligand 2-amino-4-(p-hydroxy phenyl) thiazole. Discovery Pharmacy., 2013; 5(15): 15-17.
16. Malik Dinkar, Yadav Punam, Kumar Sandeep, Malik Vijai Studies on Structural and Biological Aspects of Transition Metal complexes of the Ligand 2- Amino -4-(P-Methoxy Phenyl) Thiazole. Int. J.Med. & Phrm. Chem., 2014: 1-3.
17. Malik Dinkar, Yadav Punam, Kumar Sandeep, Malik Vijai Synthesis, Characterization and Fungicidal Activity 2- Amino -4-(P-Ethoxy Phenyl) Oxazole Complexes of Transition Metal (II) ions. Res. J. of Chem. Sci., 2014; 4(4): 1-8.
18. Mane PS, Shirodkar SG, Arbad BR, Chondhekar TK I. JC, Sec A; Inorganic, Bio-inorganic, Physical & Analytical Chemistry., 2001; 40(6): 648.
19. Maurya RC, Chourasia J, Sharma P, Synthesis, characterization and 3D molecular modeling of some ternary complexes of Cu(II), Ni(II), Co(II), Zn(II), Sm(III), Th(IV) and UO2(VI) with Schiff base derived from sulfa drug sulfabenzamide and 1,10-phenanthroline, *Indian j. of chemistry*., 2007; 46: 1594-1604.
20. Vogal AI. *A Text Book of Quantitative Inorganic Analysis*. 3rd ed. (English Language Book Society and Longman)., 1961.
21. Vogal AI. *Quantitative Organic Analysis*., 1958.