



Synthesis and Spectral Characterization of Co (II), Ni (II) and Cu (II) Complexes of Quinoline Based Schiff Bases (QBSB)

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Abstract:

This abstract emphasizes the synthesis of Complexes of Co (II), Ni (II), and Cu (II) with Quinoline base. The structural elucidation of the isolated complexes have been done on the basis of Infrared spectra, Electronic spectra, Molar conductance, Magnetic moment. The ligand acts as neutral tridentate chelating agent and coordinating to the metal ion through amine and imine nitrogen and chlorine atom. The octahedral geometry and 1:2 nature of the complexes have been proposed.

Keywords: synthesis, spectral characterization, conductivity measurements, magnetic moment

Introduction

The derivatives of Hydrazone have been confirmed to act as antimicrobial¹⁻², anticonvulsant, analgesic, anti-inflammatory, antiplatelet, antitumoral, inhibitors of enzyme³, catalyst⁴ antitubercular⁵, anticancer⁵. Hydrazone is known to possess azomethine NHN=CH-proton. The polar and non polar nature of Quinoline hydrazones makes them feasible for permeation to the bacterial cell and thus inculcates amphiphilic properties along with the increase in solubility. The permeability of hydrazones into the cell wall of M. Tuberculosis



resulted in the better activity as Quinoline hydrazones⁵ might be interacting with the DNA gyrase enzyme which is important for DNA multiplication. The DNA gyrase inhibited by metal complexes alters the multiplication of bacterial cells eventually resulting in death of the bacteria. Schiff's base copper complexes of quinolone 2- carbaxaldehyde shows dose dependent, ant proliferative and propoptotic in the prostate cancer cell.⁶ Quinoline derivatives are used as antifoaming agent in refineries⁷. The synthesis of substituted quinoline Schiff's base has been a subject of great interest in research field or in organic chemistry.

Experimental/ Methodology

A-R grade chemicals were directly used in the same way as it was received. The ligands, metal complexes and solvents were analyzed by standard methods^{8(a,b)}. The IR spectra were recorded on Beckmann IR 20A spectrophotometer using KBr -pellets . Electronic spectra (DMF) were recorded on Perkin Elmer 400 spectrophotometer at CDRI, Lucknow. Magnetic susceptibility was measured on a Guoy balance using mercury tetrathiothiocyanato cobaltate as a calibrant. Conductivity measurements were made on Systronics conductometer model -303 using DMF.

Preparation of the Ligand QBSB:

The ligand QBSB was prepared by condensing 2- chloro-3 formyl quinoline with hydrazine hydrate in ethanol and synthesized by refluxing ethanolic solution of hydrazine hydrate with ethanolic solution of 2-chloro-3 formyl quinoline in the molar ratio 1:2 for 6 hrs in an oil bath at 120 -140 °C and then allowed to cool at room temperature. After sometime, the reaction mixtures were poured into crushed ice and the product was separated as a yellow solid following which it was filtered, washed with water, dried and recrystallized from Tetra hydro furan(THF) yielding 60-70 % . M.P = 248 °C ± 1° C

Preparation of the Complexes:



The metal complexes of Co(II), Ni(II), and Cu(II) were prepared by refluxing ethanolic solution of metal salts with the ethanolic solutions of the ligand QBSB in the molar ratio 1:3 under reflux for 5- 7 hrs on water bath and during overall process a pH 7-8 was maintained. The solid coloured complexes that separated on cooling were filtered, washed with cold water followed by ethanol, dried and recrystallized with tetra hydro furan yielding 60-65%.

Table 1 : IR , Electronic - Spectra Bands (cm^{-1}), Colour, Magnetic Moment, & Conductivity Measurement Data of Metal Complex with Ligand QBSB

Compounds (Colour)	$\sqrt{\text{N-H}}$	$\sqrt{\text{C=N}}$	$\sqrt{\text{M-N}}$	$\sqrt{\text{M-X}}$	μ_{eff} B.M	Ω_m Mhocm ² mol ⁻¹	λ_{max} electronic cm ⁻¹
QBSB (Y)	3255 (sb)	1630 (sb)	-	-			
[Co(QBSB) ₂] ₂ Cl ₂ (YR)	3220(mb)	1610(mb)	430(mb)	305(mb)	5.10	99.2	9700,16600,21600
[Co(QBSB) ₂] ₂ Br ₂ (YG)	3225(mb)	1615(mb)	435(mb)	265(mb)	4.79	96.9	9800,16300,21300
[Co(QBSB) ₂] ₂ (DB)	3220(mb)	1615(mb)	440(mb)	260(mb)	5.05	101.2	10000,16500,21800
[Ni(QBSB) ₂] ₂ Cl ₂ (R)	3230(mb)	1610(mb)	450(mb)	310(mb)	3.04	103.4	10300,17100,25300
[Ni(QBSB) ₂] ₂ Br ₂ (O)	3235(mb)	1605(mb)	445(mb)	280(mb)	3.11	105.2	10800,17300,25000
[Ni(QBSB) ₂] ₂ (RB)	3235(mb)	1610(mb)	455(mb)	270(mb)	3.18	107.6	10100,17800,25800
[Cu(QBSB) ₂] ₂ Cl ₂ (B)	3235(mb)	1615(mb)	465(mb)	310(mb)	1.72	109.5	13100,18500
[Cu(QBSB) ₂] ₂ Br ₂ (G)	3240(mb)	1610(mb)	475(mb)	285(mb)	1.84	112.1	13700,18800

Colour Abbreviations:- Y-yellow, YR-Yellowish Red, YG-Yellowish Green, DB-Dark Brown, R-Red, O-Orange, RB-Reddish brown, B-Brown, G-Grey

Results & Discussions:

IR Spectra of the ligand as well as complexes recorded in the frequency range 3500- 200 cm^{-1} have been furnished in **Table 1**. Vibrational bands for N-H stretching, C=N stretching provides unambiguous evidence that are structurally important for the complexes. The ligand displays a broad & strong band at 3255 cm^{-1} in the IR spectra which may be assigned to $\sqrt{\text{NH}}$ ⁹. The same band ranges 3240- 3220 cm^{-1} in the spectra of complexes indicating coordination with secondary amino group of quinoline. Due to the complexation, next IR spectra of the ligand exhibits strong and sharp band at 1630 cm^{-1} indicating coordination through azomethine,¹⁰⁻¹² N-



atom of hydrazine moiety that is further confirmed¹³ by the appearance of a band at 475-430 cm⁻¹ in the far infra red region and may be earmarked to ν_{M-N} . The band in the far IR region 310-260 cm⁻¹ may be earmarked to ν_{M-X} indicating¹³ the authenticity of linkage between metals and halogens.

From the above interpretation, the ligand may be co-ordinated in a tridentate manner through amine, N atom, imine N atom and chlorine atom of the ligand.

Electronic Spectra, Magnetic Moment, Conductivity Measurements of the Complexes:

Three bands in the region 10000- 9700, 16600- 16300 , 21800-21300 cm⁻¹ of electronic spectra of the Co (II) complexes may be due to ${}^4T_{1g}(F) \rightarrow {}^4T_{2g}(F)$, ${}^4A_{2g}(F)$ and ${}^4T_{1g}(P)$ transitions respectively indicating an octahedral¹⁴ geometry for Co(II) complexes which is further supported¹⁵ by high μ_{eff} value in the range 4.79- 5.10 B.M for all the Co(II) complexes. Three broad band in the regions 10800- 10100 ,17800-17100, 25800-25300 cm⁻¹ of Ni(II) complexes may be due to ${}^3A_{2g}(F) \rightarrow {}^3T_{2g}(F)$, ${}^3T_{1g}(F)$ and ${}^3T_{1g}(P)$ transitions respectively which indicates octahedral¹⁴ geometry for all the Ni(II) complexes and is further supported¹⁵ by the μ_{eff} value in the range 3.04- 3.18 B.M for all the Ni(II) complexes. The Cu (II) complexes exhibit two ligand field bands in the region 13700-13100 and 18800- 18500 cm⁻¹ which may be assigned to the transitions ${}^2E_g \rightarrow {}^2T_{2g}$ and charge transfer band respectively. The electronic spectra of all the Cu (II) complexes indicates an octahedral geometry¹⁴ around central metal ion which is further supported by the μ_{eff} value¹⁵ in the range 1.73 - 1.84 B.M. Molar conductance of the complexes were measured in the solvent dimethyl formamide and all the complexes were found to be electrolytic in nature of 1:2 type and conductivity are in the range 96.9-112.1 mho cm² mol⁻¹.

Conclusion:

Spectral studies implies that the ligand behaves as a neutral tridentate chelating agent being bonded to the metal ion through amine and imine nitrogen and chlorine atoms of ligand.

Scope of Further Work :

After perceiving the scope of the utility of quinoline derivatives in the present work, researches may be carried out in the medical as well as several other fields.



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References:

1. Sevim Rollas and S, Guniz Kucukguzel, *Molecules*, 2007, 12 (8)1910-1039.
2. S. Rollas ,N. GFuujitaulerman, H. Erdeniz, *Farmaco*, 2002,57,171-174.
3. J.C.Craliz, J. C. Rub , D.Willis and J . Edger, *Nature*, 1955, 34, 176.,
4. T. Mino,S. Yoshlaki, M. Sakamoto and T. Fujita, *The Journal of Organic Chemistry*,2005, 70,6,2191-2194.
5. C. Mustapha Mandewale and S. Ramesh Yamgar, *Beni-Suef university Journal of Basic and applied Sciences*, 2017,6 ,4,354-361.
6. S. Adsule, V. Barve et , D. Chen, F. Ahmad, S Pandave , *Journal Of Medicinal Chemistry*, 2006, 49, 24, 2006
7. S.Calus, E Gondek, A.Danel,,B. Jarosz, MPokladko, A V Kityk, *Mater. Lett.*, 2007, 61, 3292-3295.
8. (a)G. H. Jeffery, J. Bassett, J . Mendham, R.C. Denney, *Vogel Text Book of Quantitative Chemical Analysis* , 5th Edition, ELBS, 1996. (b) G.L Choudhry, S R Prasad and A.Rehman , *J. Indian Chem. Soc.*, 1997, 74, 683.
9. R.M. Silverstein, *Spectrometric Identification of Organic Compounds*, 5th Edition, John Wiley (1991), 123.
10. K. Nakanishi, *Infrared Absorption Spectroscopy*, Nankado Company, Tokyo, 1964, 45.
11. I.J. Bellamy, *The Infrared Spectra of Complex Molecules*, Chapman and Hall, London , 1975.
12. K. Nokamoto, *Infrared Spectra of Inorganic and Coordinated Compounds*, Wiley International, New York, 1970.
13. K. Nakamoto, *Spectroscopy and Structure of Metal Chelate Compounds* ,John Wiley, New York, 1968.
14. A.B.P .Lever, *Inorganic Electronic spectroscopy*, Elsevier, New York, 1968.
15. R.L Carlin, and A.J Van, *Magnetic Properties of Transition Metal Compounds*, Springer-Verlag, New York, 1997.
16. Najlas S.AlRadadi, Ehab M.Zayed et al, *Hindawi, Journal of Chemistry*, vol.2020, Article 2D-1548641,12, <https://doi.org/10.1155/2020/1548641>



17. Nesrine Amiri, Marwa Bourguiba ,et al, Inorganic Chemistry Communication –vol .118, Aug-2020, 107995
18. Ali M.A Al-Khazaji, Rehaib A.M.A l Hassani, Sys Rev.Pharm,m2020,1195), 535,555
19. J.Hermle, G.Mayer, Acta Cryst, E 67,m-1089, 2011
20. K. Nkamoto, Wiley Interscience, Newyork, 2009, 66-74
21. Y.R. Sharma, Elementary Organic Spectroscopy, 12th ed, S.Chand & Company. Ltd, New Delhi, 2000.
22. D.A.Odera and A.V. Doshi, J Institution of Chem (India),1993,65,158
23. D.H. Williams and I. Fleming, Spectroscopic Methods in Organic Chemistry, 5th ed, Tata Mc. Graw Hill Pub. Comp.Ltd, USA , 1996