



Synthesis, Characterization and Biocidal Activity of Some Some Schiff Base and Its Metal Complexes of Co(II), Cu(II) and Ni(II)

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ABSTRACT

A series of metal complexes derivatives of 1-propyl-2-6-diphenyl piperidone semicarbazone(PDPS) with metal ions Cu(II), Co(II) and Ni(II) have been synthesized. The ligand and metal complexes obtained are characterized quantitatively and qualitatively by using, molar mass, elemental analyses, Infrared spectra, electronic spectra, magnetic susceptibility and conductivity measurements. On the basis of above physiochemical analysis, it has been observed that the ligand PDPS coordinate to the metal ion in a bidentate manner through azomethine nitrogen and oxygen atom of semicarbozone moiety. The remaining coordination centers are satisfied by anions such as X = Cl⁻, Br⁻ and I⁻. Electronic spectral and magnetic susceptibility measurement proposed the general composition of the complex is [M(PDPS)₂X₂] where M = Cu(II), X = Cl⁻ and Br⁻; M = Co(II) and Ni(II), X = Cl⁻, Br⁻ and I⁻. The complexes of Co(II) and Ni(II) were proposed octahedral geometries whereas distorted octahedral geometry reported for Cu(II) complexes. The preliminary *in vitro* antibacterial Screening activity revealed that complexes showed better inhibition against tested bacterial strains and higher compared to parent ligand.

Key word: PDPS/Semicarbazone/ Cu(II), Co(II) and Ni(II)/complexes/antibacterial activity.

INTRODUCTION

Wide varieties of geometries and reactivity of semicarbozone metal complexes have been reported¹⁻⁷ to possess several biocidal activities. The chemical and biocidal activity of semicarbozone have been subject of investigation in recent years. The biological activity is related to their interaction with several metal ions. Schiff bases ligand and their metal complexes play an important application in the area of analytical chemistry, polymer

sciences, Food and dyes industry, agriculture, biological sciences as antimicrobial agents, medical sciences as anticancer and metal corrosion inhibition agents. In view of the growing interest in the biocidal importance of Schiff and their metal complexes and in continuation⁸⁻¹² of our earlier recent work in this field we now report, the synthesis, characterization and antibacterial activity of Cu(II), Co(II) and Ni(II) complexes with bidentate Schiff base, 1- propyl 2- 6- diphenyl piperidone semicarbazone (PDPS).

EXPERIMENTAL

All the chemicals and reagents used were analytical grade. The solvents were used without any purification. The metal contents were determined using standard procedure¹³. Physical and analytical data of the Schiff base and their complexes is given in Table-1 and agreed with proposed formulae. The complexes are coloured and insoluble in water and common solvents but sparingly soluble in DMF.

Preparation of the ligand

The ligand PDPS was synthesized by the condensation of 1-propyl 2,6-diphenyl piperidone with semicarbazide hydrochloride in 1:1 molar ratio using absolute alcohol as the reaction medium. The mixture was refluxed on a water bath for 2 and a half hour and then allowed to stand overnight at room temperature. The product were crystallized from the same solvent and dried in vacuum. M.P.-163+1°C. Yield=65%.

Preparation of the complexes

The complexes of Cu(II), Co(II) and Ni(II) have been prepared by reacting ethanolic solution of metal halides with ethanolic solutions of the ligand in the molar ratio 1:2. The solid coloured complexes which is separated on cooling were filtered, washed with ethanol, dried in oven. Yield in all cases 60%-65%.

RESULTS AND DISCUSSION

I.R. spectra

IR spectra of the ligand and complexes were recorded on Perkin Elmer Spectrophotometer Model 577 using KBr disc.

The IR spectra of the ligand exhibit strong and broad band at 1660 cm^{-1} assignable to $\nu_{\text{C=N}}$. The band is shifted to lower wave numbers after complex formation proposes involvement of azomithine N in the banding with metal ions. The linkage with N atom is further supported by the appearance of a band in far IR region at $425\text{-}395\text{ cm}^{-1}$ in the complexes assignable¹⁵ to $\nu_{\text{M-N}}$. The IR spectra of the ligand exhibits strong and broad band at 1760 cm^{-1} assignable to $\nu_{\text{C=O}}$. This band undergoes to shift after complex formation propose coordination of metal ion through carbonyl oxygen. It is further supported by the appearance of a new far IR band at $525\text{-}505\text{ cm}^{-1}$ in the complexes which is assignable¹⁷ to $\nu_{\text{M-O}}$. The linkage with halogen is indicated by the appearance of another band in the far IR region $320\text{-}280\text{ cm}^{-1}$ assigned¹⁸ to $\nu_{\text{M-X}}$ (X = Cl⁻, Br⁻ or I⁻). The coordination with halogen is supported by the low molar conductivity of the complex in the range $11.2\text{-}13.7\text{ ohm}^{-1}\text{cm}^2\text{mol}^{-1}$. The electronic spectral and magnetic measurements data proposes octahedral geometry for the complexes which is justified by other physiochemical as well as Infrared spectral data.

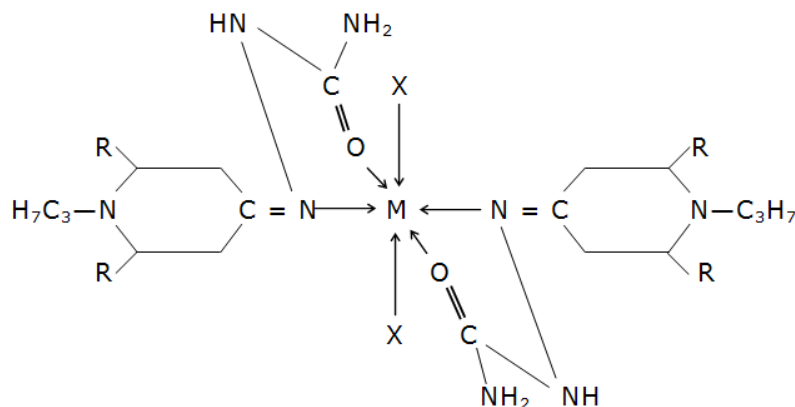


Fig.1 : $[\text{M}(\text{PDPS})\text{X}_2]$

M = Co(II) and Ni(II); X = Cl⁻, Br⁻ and I⁻ ; M = Cu(II); X = Cl⁻ and Br⁻ ; R = Phenyl

Table 1: Physical and Analytical data of ligand PDPS and its Cu(II), Co(II) and Ni(II) complexes

Compounds (Colour)	Molar mass	DT °C	% Analysis found (calculated)				Ω_m ohm ⁻¹ cm ² mol ⁻¹	λ_{max} electronic cm ⁻¹	μ_{eff} B.M
			M	C	N	H			
PDPS (Colourless)	336			71.28 (71.42)	16.53 (16.66)	7.07 (7.14)			
[Co(PDPS) ₂ Cl ₂] (Brown)	801.93	276	7.28 (7.34)	59.69 (59.85)	13.85 (13.96)	5.90 (5.98)	11.6	10300, 17200 22240	5.10
[Co(PDPS) ₂ Br ₂] (Brown)	890.738	293	6.53 (6.61)	53.70 (53.88)	12.40 (12.57)	5.31 (5.38)	11.4	10200, 17300 22300	5.14
[Co(PDPS) ₂ I ₂] (Dark Brown)	983.818	306	5.87 (5.98)	48.53 (48.78)	11.26 (11.38)	4.79 (4.87)	11.8	10100, 17340 122500	4.99
[Ni(PDPS) ₂ Cl ₂] (Green)	801.71	318	7.27 (7.32)	59.66 (59.87)	13.84 (13.97)	5.97 (5.98)	12.2	12100, 18000 25300	3.08
[Ni(PDPS) ₂ Br ₂] (Green)	890.51	311	6.50 (6.59)	53.73 (53.90)	12.30 (12.59)	5.30 (5.39)	12.5	12200, 18300 25800	3.02
[Ni(PDPS) ₂ I ₂] (Yellow)	983.60	324	5.85 (5.96)	48.50 (48.89)	11.27 (11.38)	4.77 (4.88)	12.7	12000, 18400 25300	3.04
[Cu(PDPS) ₂ Cl ₂] (Blue)	806.54	337	7.80 (7.87)	59.26 (59.51)	13.79 (13.88)	5.88 (5.94)	13.5	13300, 17100	1.89
[Cu(PDPS) ₂ Br ₂] (Blue)	895.348	331	6.92 (7.09)	53.48 (53.61)	12.39 (12.50)	5.30 (5.36)	13.7	13500, 17400	1.87

DT = Decomposition Temperature

Molar Conductance

Conductivity of the complexes were measured in the solvent DMF on Systronic conductivity meter model 303 at the concentration 10^{-3} M and all the complexes were found to be non electrolytic¹⁹ in nature. The molar conductance measurements of the complexes were found in the range 11.4-13.7 $\text{ohm}^{-1} \text{cm}^2 \text{mol}^{-1}$. The conductivity value also supported the structure assigned on the basis of physiochemical and spectroscopic measurements.

Antibacterial Study

Schiff bases and their metal complexes have been reported antibacterial activity against the *Escherichia coli* and *Staphylococcus aureus* by using paper disc diffusion method.²⁰ The result reveals that the metal chelates are more potent than the parent ligand. The increased potency of metal complexes may be attributed to their increased lipophilic nature arising due to chelation^{21,22} mode of action of antimicrobials due to involvement of various targets in microorganism.

Table 2: Salient features of IR spectral bands of ligand PDPS and its metal complexes

Compounds	$\nu_{\text{C}=\text{N}}$	$\nu_{\text{C}=\text{SO}}$	$\nu_{\text{M}-\text{O}}$	$\nu_{\text{M}-\text{N}}$	$\nu_{\text{M}-\text{X}}$
PDPS	1660 s,b	1760 s,b			
[Co(PDPS) ₂ Cl ₂]	1640 m,b	1735 m,b	515 m	405 m	315 m
[Co(PDPS) ₂ Br ₂]	1635 m,b	1740 m,b	510 m	410 m	315 m
[Co(PDPS) ₂ I ₂]	1630 m,b	1730 m,b	510 m	420 m	280 m
[Ni(PDPS) ₂ Cl ₂]	1630 m,b	1735 m,b	520 m	4420 m	320 m
[Ni(PDPS) ₂ Br ₂]	1635 m,b	1740 m,b	520 m	415 m	300 m
[Ni(PDPS) ₂ I ₂]	1640 m,b	1735 m,b	515 m	420 m	295 m
[Cu(PDPS) ₂ Cl ₂]	1635 m,b	1730 m,b	525 m	395 m	300 m
[Cu(PDPS) ₂ Br ₂]	1640 m,b	1735 m,b	515 m	400 m	305 m

CONCLUSION

Thus on the basis of elemental analyses, IR, electronic spectra, magnetic susceptibility, molar conductivity measurement studies it may be proposed that the ligand PDPS behaves as a neutral bidentate manner and coordination is proposed

through azomethine nitrogen atom and carbonyl oxygen of semicarbazone moiety. The remaining coordination centres are satisfied by negative ions such as Cl⁻, Br⁻ or I⁻. On the basis of available evidence octahedral geometry has been proposed for Cu(II), Co(II) and Ni(II) complexes as shown in Fig-1.

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