



Synthesis and antibacterial activity of a Mannich base, N₁[1-(4-hydroxyphenyl)-1-morpholinopropyl] semicarbazide and its Cu(II) complex

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ABSTRACT

The synthesis of Cu(II) complex derived from Mannich base N₁[1-(4-hydroxyphenyl)-1-morpholinopropyl] semicarbazide (HPMPS) derived by the condensation of 4-hydroxy propiophenone, morpholine and semicarbazide. Its structure has been confirmed on the basis of analytical, magnetic and spectral studies. The Cu(II) complex exhibit square-planar geometry. The antibacterial activity of synthesized ligand (HPMPS) and its Cu(II) complex was studied by the usual cup-plate-agar-diffusion method against Gram-positive (*Staphylococcus aureus*) and Gram-negative (*Escherichia coli*) bacteria. The qualitative and quantitative antimicrobial activity test results proved that the Cu(II) complex is very active than the free ligand. The increase in antibacterial activity is due to faster diffusion of metal complex as a whole through the cell membrane or due to the combined activity effect of the metal and ligand. © 2009 Trade Science Inc. - INDIA

KEYWORDS

Mannich-base;
Copper(II) complex;
Anti-bacterial activity.

INTRODUCTION

Metal complexes of Mannich bases have been studied extensively in recent years due to the selectivity and sensitivity of the ligands towards various metal ions^[1,2].

Much work has been done so far on isolation of solid complexes of different aromatic aldehydes or ketones, semicarbazides with transition metals^[3]. The ready accessibility, diverse chemical activity, and pharmacological properties^[4]. Azomethines constitute one of the most important classes of biologically active ligands providing potential binding sites through nitrogen and oxygen donor atoms.

The present poster reports the synthesis of N₁[1-(4-hydroxyphenyl)-1-morpholinopropyl] semicarbazide

and its Cu(II) complex. The bidentate ligand coordinates with the metal ion through the oxygen atom of the carbonyl group and nitrogen atom of semicarbazide group.

EXPERIMENTAL

The synthesized HPMPS have been characterized by infrared and ¹H-NMR spectral studies. The complexes characterized by infrared, electronic spectral studies and magnetic moment and conductivity measurement. The antibacterial activity of the investigated compounds was tested by the well diffusion method, using Muller-Hinton agar as the nutrient medium and ampicillin was used as the standard.

SYNTHESIS OF MANNICH BASE

Mannich base was synthesized by reported procedure^[5]. morpholine (10 mmol) was added drop wise to the Semicarbazide hydrochloride (10 mmol) in 20 mL of ethanol with constant stirring under ice-cold condition. Then, 4-hydroxy propiophenone (10 mmol) was added drop wise under the same condition. After 24 hours, brown solid obtained, was filtered and recrystallised from ethanol.

Yield: 67 %, M.P.162°C. C-57.13% (57.12), H-7.53% (7.52), N-19.03% (19.01)

SYNTHESIS OF METAL COMPLEXES

A solution of 5 mmol of CuCl_2 and the Mannich base (10 mmol) in ethanol was boiled under reflux for about 3h. The pH of the resulting solution was adjusted to optimum pH 7.0 by drop wise addition of NH_3 solution. The precipitated complexes were filtered, washed with water and dried it.

Yield: 58%. M.P.: 179 °C, Composition: C-51.72% (51.73), H-6.51% (6.50), N-17.23% (17.21), Cu-9.77% (9.76), IR (KBr, cm^{-1}): 3420–3380 (NH_2 , d), 1708($\text{C}=\text{O}$), 1599($\text{C}=\text{N}$), 762, 745 (para substituted benzene)

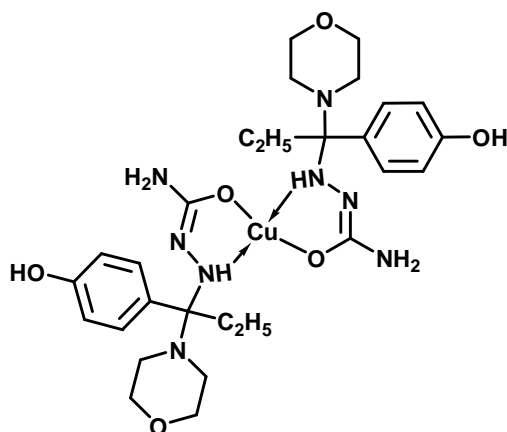


Figure 1 : $\text{Cu}[\text{HPMPS}]_2$ complex

RESULTS AND DISCUSSION

The $\text{Cu}(\text{II})$ complex is green colored and stable at room temperature. The elemental data show 1:2 (metal: ligand) stoichiometry. The absence of chloride is evident from Volhard's test. The low conductance value (1.8) of

the complex supports their non-electrolytic nature^[6].

The IR spectrum of the ligand shows bands in the regions $3420\text{--}3380\text{ cm}^{-1}$ and 1703 cm^{-1} , which are assigned to $\nu(\text{N-H})$ and $\nu(\text{C}=\text{O})$ of semicarbazone, respectively^[7]. In the spectra of complexes, the $\nu(\text{C-O})$ mode of the free ligand is not observed indicating the enolisation of $\text{C}=\text{O}$ followed by deprotonation and complexation with metal ions.

The stretching at 1599 cm^{-1} of $\nu(\text{C}=\text{N})$ of ligand is found to shift to lower wave number suggesting coordination of azomethine nitrogen^[7].

The band at 3380 cm^{-1} observed in the ligand, is absent in the complexes, suggesting deprotonation of NH of the ligand prior to the coordination to the metal.

ANTIBACTERIALACTIVITY

The UV-Vis spectrum of copper complex in DMSO solution displays a broad band at 14440 cm^{-1} attributable to ${}^2\text{B}_1\text{g} \rightarrow {}^2\text{A}_1\text{g}$ transition which strongly favours the square-planar geometry^[8].

This is further supported by the magnetic susceptibility value (1.77 B.M.).

The ligand HPMPS and its $\text{Cu}(\text{II})$ complex were tested for antibacterial activity. Mueller-Hinton agar was used for testing the susceptibility of microorganism by well diffusion method^[9] using DMSO as solvent, at a concentration of 0.1 M against Gram-positive (*Staphylococcus aureus*) and Gram-negative (*Escherichia coli*) bacteria. The zones of inhibition against the growth of microorganisms were determined at the end of an incubation period of 24 h at 37°C and the results are presented in TABLE 1. It was found that the metal complexes are more active than the free ligand. The increase in antibacterial activity is due to faster diffusion of metal complexes as a whole through the cell membrane or due to the combined activity effect of the metal and ligand^[10].

TABLE 1 : Antibacterial activity of ligand and its $\text{Cu}(\text{II})$ complex

Compound	Zone of inhibition	
	<i>Staphylococcus aureus</i>	<i>Escherichia coli</i>
HPMPS	7.0	6.0
$[\text{Cu}(\text{HPMPS})_2]$	13	11
Std. Drug	26	30

Short Communication

CONCLUSIONS

Copper(II) complex have been synthesized from the Mannich base N₁[1-(4-hydroxyphenyl)-1-morpholinopropyl] semicarbazide and characterized by elemental data, magnetic and spectral analyses. The metal complexes exhibit higher activity than the free ligand.

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