



Study On Metal Complexes Of Benzimidazole Novel And There In Vitro Antimicrobial Activity

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Abstract

In present paper, we reported about the metal complexes of novel Ligand containing thiosemicarbazide namely, 2-(1-(6-Chloro-1H-benzimidazol-1-yl) propan-2-ylidene) hydrazine carbothioamide (CBITS). All the synthesised ligand and all metal complexes were characterized by analytical and spectroscopic data. They are also screened for Antimicrobial Activity.

Keywords: Metal complexes, Thiosemicarbazone, 6-Chloro-1H-benzimidazole, Spectral analysis and Antimicrobial activities.

Introduction

Thiosemicarbazones shows potential pharmaceutical activities like anticancer, antitumor and biological activities¹⁻³. Due to various pharmaceutical as well as biological activity number of research work carried out to synthesizing novel heterocyclic compounds⁴⁻⁶. Thiosemicarbazones generally act as chelating ligands⁷⁻⁹. Benzimidazoles are associated with diverse pharmaceutical activities such as antibacterial, insecticidal, antagonist, fungicidal, antimicrobial, asvitronectial receptes, anthelmintic, anti-inflamatory, etc¹⁰⁻¹³. Looking to systematic literature study of Thiosemicarbazone and benzimidazole derivatives, it was found that number of benzimidazole derivatives were synthesis by different researchers. In continuous of our previous work^{14,15} the present paper comprise the metal complexation study of

benzimidazole-thiosemicarbazone clubbed compound. The whole reaction work is summarized in following scheme-1.

<<Figure-1 Reaction work>>

Experimental

Material and Methods:

All the chemicals were used laboratory grade. Metals and elemental contents were determined by standard method¹⁶. Infrared and NMR spectrum of the synthesized Ligand and its metal complexes were recorded on Nicolet 760 FT-IR spectrometer and 60 MHz NMR spectrophotometer. LC-MS of selected samples taken on LC-MSD- Trap-SL_01046. The evaluation of antimicrobial activity has been carried out using Broth Dilution method for antimicrobial study⁵⁻⁸.

Synthesis of 6-Chloro-1-(1H-Benzimidazol-1-yl) propan-2-one(CBIP)⁸⁻¹¹ :

Reflux 6-Chloro-1H-benzimidazole (0.01 mole), chloro acetone (0.01 mole) and 150 mL of dry acetone add 30 g of anhy,Na₂CO₃ for 6 h at 80°C. After completion of reaction product was separated out. Filter the product and recrystallized from ethanol. The purity of the compound was checked by TLC and melting point. Yield:77%;M.P.: 132-33°C, Elemental Analysis C₁₀H₉N₂OCl (208.5gm/mole);: Calc.(Found)% C 57.57 (57.5); %H4.35 (4.3); %N 13.43 (13.4); and %Cl 16.99(16.9). IR Spectral (cm⁻¹) shows at 2910,2818,1503, 1370(C-H Str.),1671(C=O), 3063 (Aromatic C-H Str.),1593 (-C=N) 1593,1463(Aromatic C-C Str.) and 776(Aromatic C-Cl). NMR (δ ppm) at 2.10 (s, 3H, -CH₃), 7.40-8.40 (m, 4H, benzimidazole C-H) and 4.90 (s, 2H, -CH₂-).

Synthesis of 2-(1-(6-Chloro-1H-benzimidazol-1-yl)propan-2-ylidene)hydrazine carbothioamide (CBITS) ⁸⁻¹¹:

Reflux thiosemicarbazide (0.03mol) in ethanol and the alcoholic solution of 6-Chloro-1-(1H-Benzimidazol-1-yl) propan-2-one (0.03mol) at 80°C for 7 hrs with continuous stirring. After cooling the compounds were filtered and recrystallized from methanol. Yield: 75 % ;M.P.:157-58°C;Elemental Analysis of C₁₁H₁₂N₅SCl (281.5 gm/mole):Calc.(Found)%C46.89(46.8);%H4.29(4.2);%N 24.86 (24.8); %S11.38(11.3)and %Cl,12.58 (12.5). IR Spectral (cm⁻¹) shows at 3402 (N-H Str.),2930,2817,1463,1412 (C-H Str.),1631(C=N)3050(Aromatic C-H Str.) 748 (C=S) and 778(Aromatic C-Cl). NMR (δ ppm) at 1.91(s,3H,-CH₃),7.36-8.37(m,4H,Ar C-H), 4.92 - 4.93(s, 2H,-CH₂-), 8.64 (s, 1H,-NH-) and 3.75-3.72(s,

2H,-NH₂).. LC-MS: M/z at 282.6 (M⁺).

Synthesis of Metal complexes of 2-(1-(6-Chloro- 1H-benzimidazol -1-yl) propan -2- ylidene) hydrazine carbothioamide (M-CBITS)⁸⁻¹¹:

All metal complexes of CBITS (i.e. of Cu(II), Co(II), Ni(II), Mn(II) and Zn(II) ions) were synthesized by adding of the appropriate metal salts (1.0 mmol, in 20 ml ethyl alcohol/water (50:50) volume to a hot solution of CBITS (2.0 mmol, in 30 ml ethyl alcohol (95%). The resultant color solutions were stirred and refluxed on a hot plate at 80°C for 1 h. The volume of the resulted solution was reduced to half volume by evaporation. After 24hrs, the colored solid complexes formed, were filtered, the solids washed with ethanol and diethyl ether and finally dried under vacuum. All complexes were prepared and isolated in amorphous shape.

<<Table-1. Analysis of CBITS Ligand And Its Metal Complex>>

<<Table – 2 Spectral Features and Magnetic Moment of CBITS- Metal Chelates>>

Results and Discussion

The synthesis of 2-(1-(6-Chloro-1H-benzimidazol-1-yl)propan-2-ylidene) hydrazine carbothioamide (CBITS) was prepared by condensation of 6-Chloro-1- (1H- Benzimidazol-1-yl) propan-2-one with thiosemicarbazide. Table-1 present the elemental analysis, which are consistent with the structure predicted(Scheme-1). The IR spectrum of CBITS were observed at 3402 (N-H,NH₂ and NH), 1631(C=N), 748 (C=S) cm⁻¹ comprises the important bands of thiosemicarbazide. The NMR spectrum of CBITS indicates that the singlet of 2 H and 1H at 3.75-3.72 and 8.64 for NH of thiosemicarbazide. Thus the structure of CBITS is confirmed as shown in Scheme-I.

The metal and C, H, N contents of metal complexes of CBITS(Table-I) are also consistent with the predicted structure. The results show that the metal: ligand (M:L) ratio for all divalent metal complex is 1:2.

The presence of band characteristic of metal-nitrogen and metal-Sulphur group of parent CBITS in the infrared spectra of all the complexes suggest the formation of the entire metalocyclic compound. The other bands are almost at their respectable positions as appeared in the spectrum of parent-CBITS ligand.

The observed μ_{eff} values in the range 2.33-5.52 B.M are consistent with the above moiety. The value of magnetic moments and reflectance spectral data of each complexes co-relates with structure assigned as the octahedral geometry^{12,13}. The data of electronic transitions and magnetic moments of metal

complexes are summarized in Table-2.

<<Figure-2 Antibacterial Activity of CBITS Ligand and Its Metal Chelates>>

<<Figure-3 Antifungal activity of CBITS Ligand and Its Metal Chelates>>

The screening of antibacterial and antifungal activity of CBITS ligand and its all complexes (Table-3 and 4) reveals that the ligand is moderately toxic against bacteria and fungi, while all the complexes are more toxic than ligand. Among all the complexes the Cu(II) complex is more toxic against fungi(Figure-2 and 3).

Conclusions

Novel synthesis ligand, 2-(1-(6-Chloro-1H-benzimidazol-1-yl) propan-2-ylidene) hydrazine carbothioamide (CBITS) and their metal complexes structure are determined by analytical and spectroscopic data, which are consistent with structure. They are shows good Antimicrobial Activity.

Acknowledgements

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Table-1. Analysis of CBITS Ligand And Its Metal Complex

Ligand and Metal Complexes	Elemental analysis (%)							
	Mol. wt.	Yield %	C%	H%	N%	S%	Cl%	M%
			Cald. Found	Cald. Found	Cald. Found	Cald. Found	Cald. Found	
C ₁₁ H ₁₂ N ₅ SCl	281.5	75	46.89	4.29	24.86	11.38	12.58	-
			46.8	4.2	24.8	11.3	12.5	-
C ₂₂ H ₂₄ N ₁₀ S ₂ Cl ₂ Cu ^(II) ·2H ₂ O	663.54	72	39.85	4.26	21.12	9.67	10.69	9.58
			39.8	4.2	21.1	9.6	10.6	9.5
C ₂₂ H ₂₄ N ₁₀ S ₂ Cl ₂ Ni ^(II) ·2H ₂ O	658.71	70	40.14	4.29	21.28	9.74	10.77	8.92
			40.1	4.2	21.2	9.7	10.7	8.9
C ₂₂ H ₂₄ N ₁₀ S ₂ Cl ₂ Co ^(II) ·2H ₂ O	658.94	68	40.13	4.29	21.27	9.74	10.77	8.95
			40.1	4.2	21.2	9.7	10.7	8.9
C ₂₂ H ₂₄ N ₁₀ S ₂ Cl ₂ Zn ^(II) ·2H ₂ O	664.38	66	39.74	4.24	21.06	9.64	10.66	9.83
			39.7	4.2	21.0	9.6	10.6	9.8
C ₂₂ H ₂₄ N ₁₀ S ₂ Cl ₂ Mn ^(II) ·2H ₂ O	654.94	69	40.37	4.31	21.40	9.80	10.83	8.39
			40.3	4.3	21.3	9.7	10.8	8.3

Table – 2 Spectral Features and Magnetic Moment of CBITS- Metal Chelates

Metal Chelates	μ_{eff} (BM)	Electronic data(cm ⁻¹)	spectral Transition
CBITS-Cu(II)	2.33	23991 15764	CT ${}^2B_{1g} \rightarrow {}^2A_{1g}$
CBITS-Ni(II)	3.40	22242 15796	${}^3A_{2g} \rightarrow {}^3T_{1g}$ (P) ${}^3A_{2g} \rightarrow {}^3T_{1g}$ (F)
CBITS-Co(II)	4.48	23955 18119 8742	${}^4T_{1g}(F) \rightarrow {}^6T_{2g}(\square_1)$ ${}^4T_{1g}(F) \rightarrow {}^4A_{2g}(\square_2)$ ${}^4T_{1g}(F) \rightarrow {}^4T_{1g}(P)$
CBITS-Mn(II)	5.52	23888 18346 16850	${}^6A_{1g} \rightarrow {}^6A_{1g}({}^4E_g)$ ${}^6A_{1g} \rightarrow {}^4T_{2g}({}^4G)$ ${}^6A_{1g} \rightarrow {}^4T_{1g}({}^4G)$
CBITS-Zn(II)	D	-	-

D*=Diamagnetic

Figure Captions

Figure-1 Reaction work

Figure-2 Antibacterial Activity of CBITS Ligand and Its Metal Chelates

Figure-3 Antifungal activity of CBITS Ligand and Its Metal Chelates

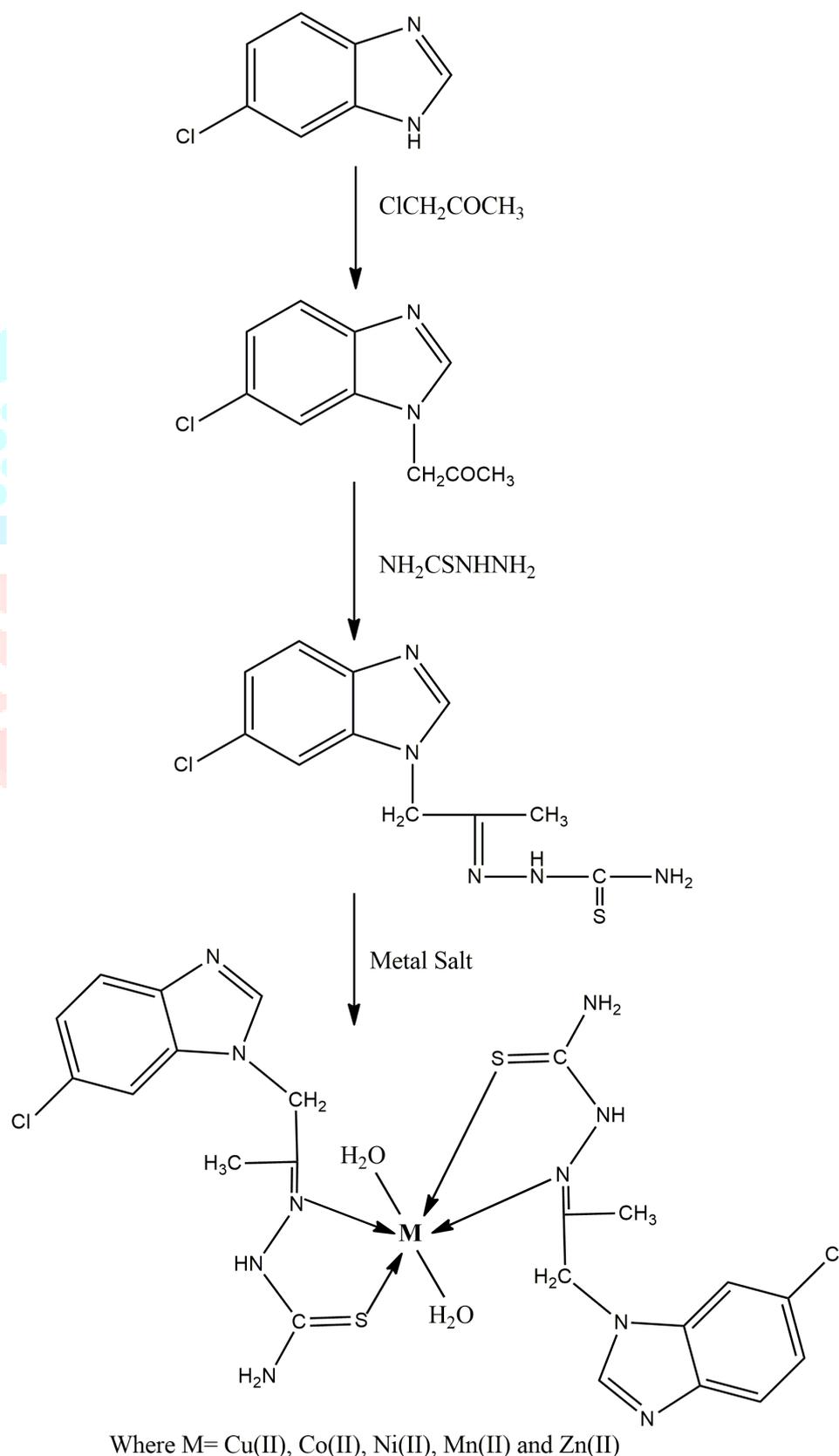


Figure-1 Reaction work

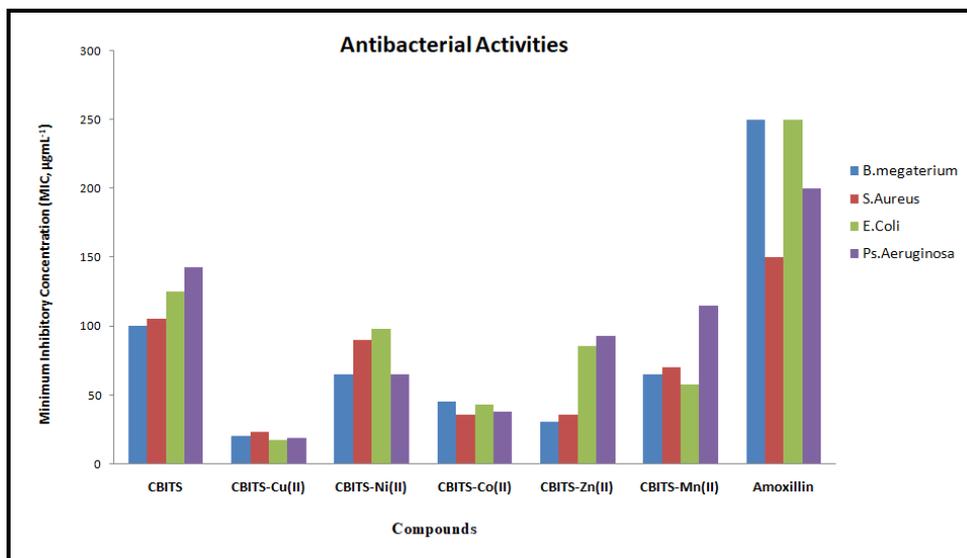


Figure-2 Antibacterial Activity of CBITS Ligand and Its Metal Chelates

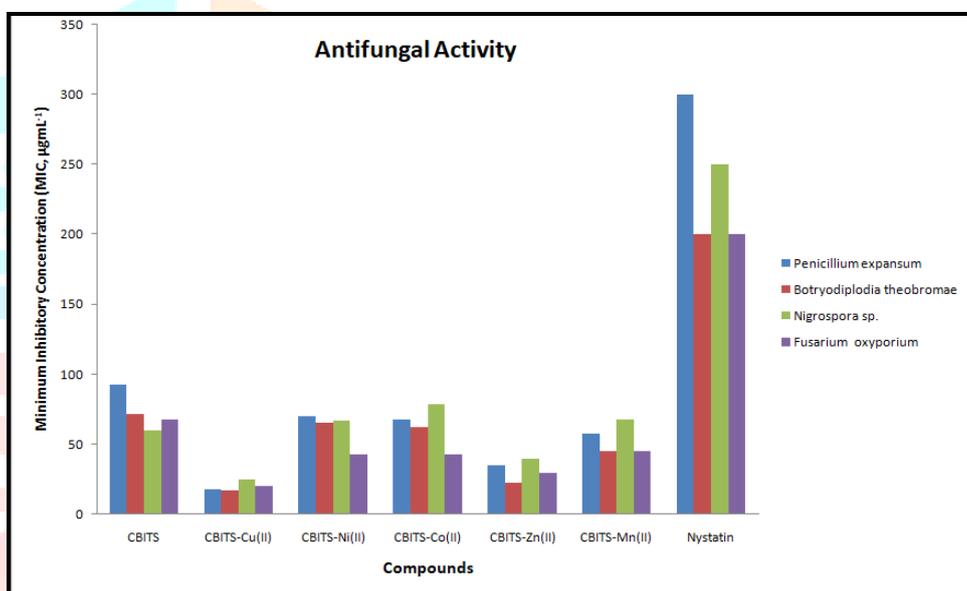


Figure-3 Antifungal activity of CBITS Ligand and Its Metal Chelates