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Synthesis and antimicrobial activity of a new mannich bases N-[1-(substituted piperidylbenzyl)] benzamide ans its transition metal (II) complexes

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ABSTRACT

The present study was carried out the synthesis of a new mannich base, N-[1-(2-methyl piperidine benzyl)] benzamide (MPBB) and its complexation behaviour with Cu (II), Co (II), Ni (II) and Zn (II) ions. The structural features of the complexes are analysed by elemental analysis, IR, ^{1}H, ^{13}C NMR Spectra. The antimicrobial activity of the ligand and its complexes has been extensively studied in microorganisms such as Staphylococcus aureus, Bacillus substilis, Escherchia coli, Pseudomonas aeroginosa and Fungi Aspergillus niger, Aspergillus fumigatus, Mucor and Candida albicans by disc diffusion method using DMF as solvent. The values of zone of inhibition were found out at 37^{0} for a period of 24 hrs. The complexes have higher antimicrobial effect than the free ligand and the standard.

Key words: Mannich base N-[1 substituted piperidino benzyl] benzamide, Spectroscopic studies, Antimicrobial activity.

INTRODUCTION

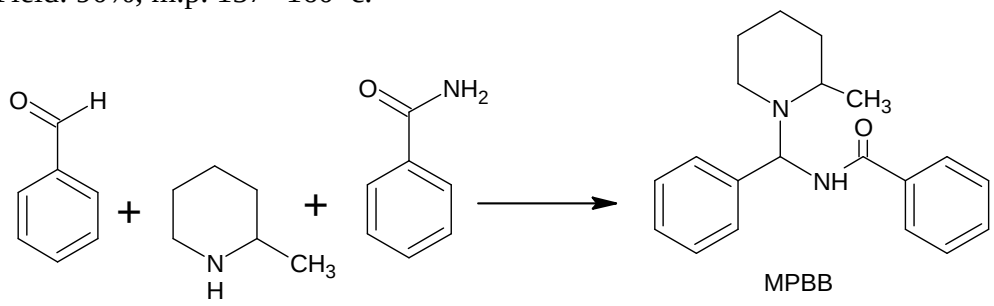
Organic chelating agents containing amide moiety as a functional group have a strong ability to form metal complexes and exhibit a variety of biological activities. Their analytical utility in the determination of both transition and non transition metal ions is well established. A number of studies have been done in the Mannich base complexes formed by the condensation of morpholine with different aldehydes. Studies on metal complexes of the benzaldehyde based Mannich bases have been reported in literature.[1-5]

In the present investigation four transition metal (II) Complexes using Mannich bases have been synthesised and screened for their antimicrobial activity by Disc diffusion method.

MATERIALS AND METHODS

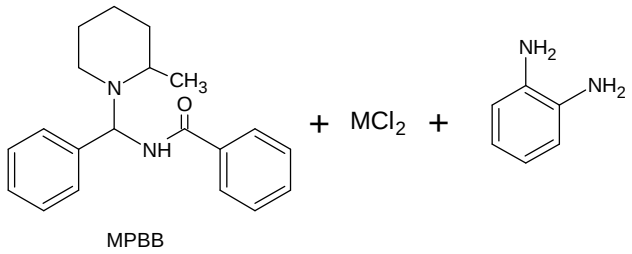
General procedure for the preparation of ligand [6-11]

The ligand was synthesised by addition of benzamide (12 g, 0.1 mol), 2- methyl piperidine (10 mL, 0.1 mol) and benzaldehyde (10 mL, 0.1 mol) in ice cold condition. The resulting solutions were stirred and kept at room temperature. The crude product was then dried and recrystallised in methanol. Yield: 90%; m.p. 157^0-160^0 c.

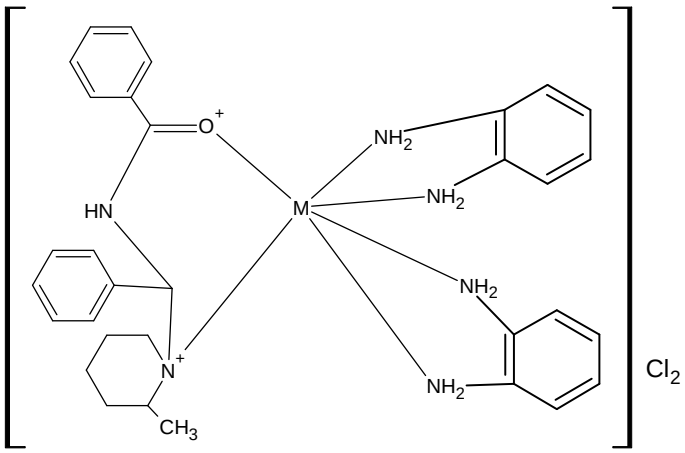


MPBB

SCHEME



MPBB



M=Cu (II), Co (II), Ni (II) and Zn (II)

Synthesis of metal complexes

Cu (II), Co (II), Ni (II) and Zn (II) complexes have been synthesised using ligand. The liquid being insoluble in water; all the complexes were prepared in chloroform and 1,2-diaminobenzene are mixed with an ethanolic solution of the metal salt, MCl_2 [where M= Cu (II), Co (II), Ni (II) and Zn (II)] in 1:1:1 mole ratio. The reaction mixture was warmed gently on a water bath for 1 h. The resulting complexes formed are filtered, washed and dried in vacumm.

Antimicrobial activity

The complexes are screened for their antibacterial and antifungal activity. The method used for the present study is disc diffusion method suggested by Maruzella and Percival [12]. The bacterial strains used as *Staphylococcus aureus, Bacillus substilis, Escherichia coli, Pseudomonas aeruginosa.* The Fungal strains used in the study viz., *Aspergillus niger, Aspergillus fumigatus, Mucor* and *Candida albicans.* The zone of inhibition values were found out at the end of and incubation period of 24 h at 37 ^{0}c. The results are given in the Table III and Table IV.

A comparative study of the ligand and its complexes indicates that the metal complexes are more active than the free ligand and the standard.

RESULTS AND DISCUSSION

The mannich base ligand and complex were characterised by elemental analysis, IR, ^{1}H and ^{13}C NMR Spectra. The complex is very stable at room temperature in air.

The IR Spectra provide valuable information regarding the nature of the functional group attached to the metal ion, the IR spectrum of the free ligand was compared with the spectra of the complexes. The complex shows its characteristic bands at 3370, 1638 and 1120 cm^{-1} which have been assigned to (NH), (CO) and (C-N-C) of piperidine group respectively. The spectra of the complex compared with those of the ligand, indicate that the Ligand is co-ordinated to the metal ion through the nitrogen atom of the piperidine group.

The ^{1}H NMR Spectra of the complex displayed the expected signals at 7.2-7.6 δ (m, Ar-H), 7.8 δ (CH), 5.6-5.9 δ (d,-NH Sec.amide), 2.2-2.6 δ (piperidine N-CH_2) and 1.40-1.82 δ (piperidine CH_2). The signal due to piperidine N-CH_2 protons is also shifted slightly downfield and appeared at 2.5-2.8 δ in those complexes.

Table I Physical data of Synthesised Compounds

S. No.	Complex	Mol. Formula	Mol. Weight	
1.	MPBB	$C_{20}H_{24}N_2O$	308.4234	70.8
2.	Cu (II)	$C_{32}H_{39}N_6O$ $CuCl_2$	658.1529	75.0
3.	Co (II)	$C_{32}H_{39}N_6O$ $CoCl_2$	653.5401	78.2
4.	Ni (II)	$C_{32}H_{39}N_6O$ $NiCl_2$	653.2969	76.4
5.	Zn (II)	$C_{32}H_{39}N_6O$ $ZnCl_2$	659.9969	72.5

Table III Antibacterial activity Metal (II) Complexes

S.No.	Complex	Inhibition zone (mm)			
		S. aureus	*B. substilis*	*E.coli*	*P. aeruginosa*
1.	Ligand	22	26	18	26
2.	Cu (II)	20	22	16	24
3.	Co(II)	24	25	18	26
4.	Ni(II)	22	26	14	25
5.	Zn(II)	21	22	16	25
6.	*Standard	25	28	22	28

**Ciprofloxacin (50µg/ml)*

Table II Characterisation Data of Synthesised Transition Metals (II) Complexes

S. No.	Compound	IR Spectra in cm-1	PMR Spectra in ppm	^{13}C NMR Spectra in ppm
1.	MPBB	3080,1655,1640,1600,1570, 1470, 600	8.2 (s, 1H, -NH CO), 7.95-6.18 (m,18H, Ar-H), 6.01(s,1H, -C-H<), 4.21(s,8H, -[NH2]$_4$), 2.44-2.42 (t,7.1 2H, 1H ; H_2-Piperidino), 2.33-2.30 (t,6.5 Hz, 2H; H_6-Piperidino) , 2.1-1.54 (m,6H; H_3,H_4,H_5-Piperidino),1.2 (s,3H, CH_3)	166.7,145.3,138.3,134.4,134.2,132.2, 130.5,129.9,128.9,128.5,128.2,127.5, 127.3,119.7,118.8,117.1,116.3,114.3, 68.2,51.7, 46.6,34.0,26.4,23.2,19.9
2.	Cu (II)	3370,3080,2875,1695,1640, 1638,1605,1495,1425,1340, 1120,1052,700	8.2 (s, 1H, -NH CO), 7.92-6.21(m,18H, Ar-H), 6.1 (s,1H,- C-H<),4.23 (s,8H, -[NH2]$_4$), 2.43-2.40 (t,7.5 Hz, 1H;H_2-Piperidino) 2.33-2.30 (t,6.8 Hz, 2H;H_6-Piperidino), 2.11-1.53 (m,6H; H_3,H_4,H_5-Piperidino),1.21 (s,3H, CH_3)	166.6,145.2,138.3,134.5,134.7,132.6, 130.1,129.7,128.6,127.9,127.6,127.3, 127.2,19.6,117.9, 117.3, 116.4, 114.4, 68.9, 51.2, 45.9, 34.2, 26.9, 23.3, 19.7
3.	Co(II)	3352,3220,3077,2965,1650, 1640,1605,1595,1340,1330, 1052	7.99 (s, 1H,- NH CO), 7.96-6.20(m,18H, Ar-H), 6.03 (s,1H, -C-H<),4.23 (s,8H, -[NH2]$_4$), 2.41-2.43 (t,7.5 Hz, 1H;H_2-Piperidino) 2.33-2.36 (t,7.8 Hz, 2H;H_6-Piperidino),1.50-2.12 (m,6H; H_3,H_4,H_5-Piperidino),1.20 (s,3H, CH_3)	166.0,145.2,138.3,134.9,134.6,132.0, 130.9,128.9,128.8,128.7,128.5,127.5, 127.3,119.8,118.1, 117.9, 116.2, 114.5, 68.3,51.6, 46.7, 34.2, 26.5, 23.6, 19.8
4.	Ni(II)	3370,3101,2940,1665,1640, 1605,1470,1425,1340,1120	8.19 (s, 1H,- NH CO), 7.92-6.25 (m,18H, Ar-H), 6.04 (s,1H, -C-H<), 4.20 (s,8H,- [NH2]$_4$), 2.42-2.40 (t,7.9 Hz, 1H;H_2-Piperidino), 2.30-2.28 (t,7.1 Hz, 2H;H_6-Piperidino),2.11-1.56 (m,6H; H_3,H_4,H_5-Piperidino),1.18 (s,3H, CH_3)	166.6,145.2,138.2,134.3,134.1,132.0, 130.3,129.8,128.8,128.0,128.0,127.4, 127.2,119.6,118.6,117.0,116.1,114.0, 68.1,51.6, 46.7,34.2,25.9,23.1,19.8
5.	Zn(II)	3368,3080,2918,1666,1630, 1605,1495,1424,1342,1120	7.85-6.28 (m, 18H, Ar-H),5.99 (s,1H, -C-H<), 4.19 (s,8H,-[NH2]$_4$),2.37-2.40 (t,6.8 Hz, 1H; H_2-Piperidino), 2.95-2.97 (t,7.6 Hz, 2H; H_6-Piperidino), 2.09-2.04 (m,6H; H_3,H_4,H_5-Piperidino),1.18 (s,3H, CH_3)	165.9,144.8,137.8,134.6,133.9,132.6, 129.8,129.6,128.5,128.2,128.0,127.9, 127.3,119.6,118.8,117.2,116.3,114.7, 68.6,51.6, 46.8,34.3,26.6,22.9,18.2

Table IV Antifungal activity of Metal (II) Complexes

S.No	Complex	Inhibition zone (mm)			
		A.niger	*A.fumigatus*	*Mucor*	*C.albicans*
1.	Ligand	22	20	18	26
2.	Cu (II)	24	22	16	25
3.	Co(II)	25	18	20	26
4.	Ni(II)	24	16	22	27
5.	Zn(II)	20	20	20	26
6.	*Standard	26	23	20	28

**Clotrimazole (10µg/ml)*

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