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Synthesis, Characterization Antimicrobial Investigations of Copper (II) Complexes with Some Benzylbenzimidazole Derivatives

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ABSTRACT

We report the synthesis of the Benzimidazole ligands, 2-[(1H Benzimidazole-2-yl)-methyl]-phenol, 2-[(1H-Bezimidazole-2yl)]-bromo-phenol, 2-[(1H-Benzimidazole-2yl)]-4-bromo-6-iodo-phenol, 2-[(1H-Benzimidzole-2yl)]-4,6-diiodo-phenol and their Cu(II) metal complexes, characterization and antimicrobial activity. The structure of the ligands and their complexes was investigated using, FT-IR, UV–Vis, TGA/DTA, X-ray Diffferaction. In the complexes, all the ligands behave as bidentate ligands, the oxygen in the ortho position and azomethine nitrogen atoms of the ligands coordinate to the metal ions. Antimicrobial activity of the ligands and metal complexes were tested Aspergillusniger, Aspergillusflavus, Escherichia coli and Bacillus subtilisusing by the disc diffusion method.

Keywords:-Benzimidazole, antimicrobial activity, Cu metals, spectral properties etc.

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INTRODUCTION

The development of modern medicinal inorganic chemistry, stimulated by the discovery of cis-dichlorodimineplatinum(II) cisplatin& its subsequent use as a rug in the treatment of several human tumers has been facilated buy inorganic chemistry extensive knowledge of the coordination and redox properties of metal ions. Metal centers, being positively charge & Lewis acid, reformed to bid to negatively charged Biomolecules and the constituents of halogens, organic molecules speciallyheterocyclic compounds, proteins and nucleic acid offer excellent ligands for building of metal ions. The pharmaceuticals use of metal complexes with Heterocyclic ligands. Therefore has excellent potentialBenzimidazole is a heterocyclic aromatic organic compound This bicyclic compound consists of the having imidazole ring fused with benzene containing nitrogen, oxygen and its derivatives are of wide interest because of their diverse biological activity and clinical applications, they are remarkably effective compounds both with respect to their inhibitory activity. Melting at 172 benzimidazole compound in nature is N-ribosyl-dimethyl benzimidazole, which serves as an axial ligand for cobalt in vitamin B12. , in an extension of the well-elaborated imidazole system, has been used as carbon skeletons for N-heterocyclic carbenes. Extensive biochemical and pharmacological studies have confirmed that benzimidazole molecules are effective against various strains of microorganisms[1,2].

Various biological activities reported on benzimidazole derivatives are antioxidant[3,4]anti-inflammatory[5,6]analgesic[7], anti-hepatitis- B-virus[8] antihypertensive[9], anthelmenthic[10-12] antiprotozoal[13,14] anticancer[15] and antimicrobial[16-17]. Benzimidazole and its derivatives are used in organic synthesis and vermicides or fungicides as they inhibit the action of certain microorganisms. Examples of benzimidazole class fungicides include benomyl, carbendazim, chlorfenazole, cypendazole, debacarb, fuberidazole, furophanate, mecarbinzid, rabenzazole, thiabendazole, thiophanate. Benzimidazole structure is the nucleus in some drugs such as proton pump inhibitors and anthelmintic agents.0C, boils at 360 0C, slightly soluble in water, soluble in ethanol. In the present investigation we report here thesynthesis, characterization and antimicrobial studies of derivatives of Benzimidazoletheir metal complexes.

EXPERIMENTAL

All the chemicals used to prepare the complexes of analytical reagent grade, commercially available from different sources.

2.1General procedure for synthesis of Benzimidazole Ligands

Here o-phenylenediamine (1 mM) &salisaldehyde(1mM) were mixed in a ethanol catalytic amount of phenyl bromide, boric acid (20 M) was added, this mixture was stirred magnetically at room temperature for 30 to 60 min. After completion of reaction, reaction mixture was poured into crushed ice. Obtained Precipitate was filtered & dried. In all the cases, the product obtained after the usual work up gave satisfactory spectral data.

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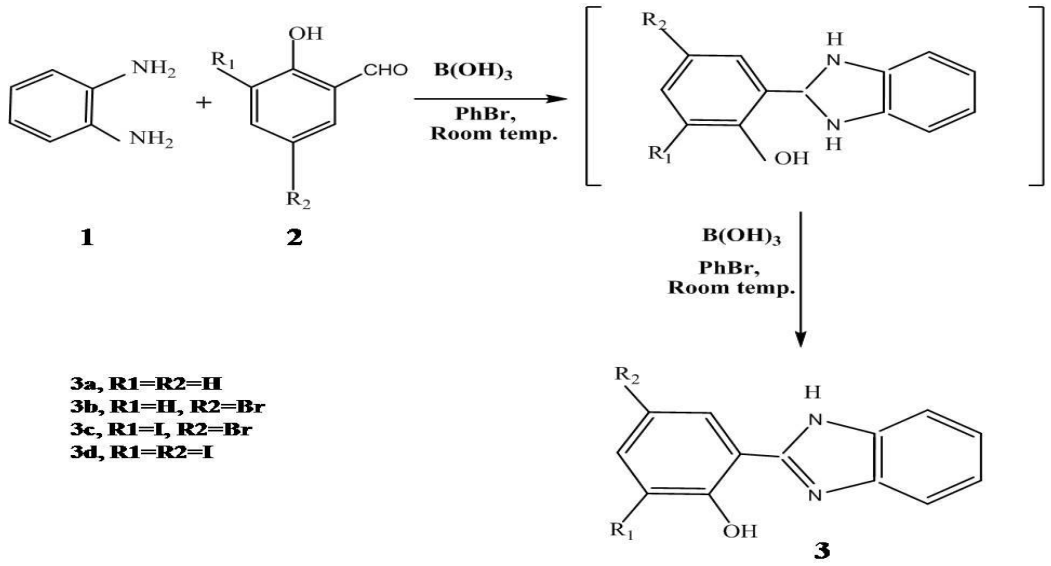
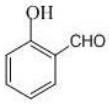
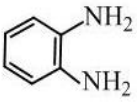
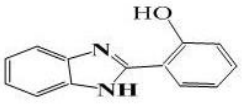
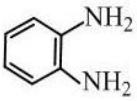
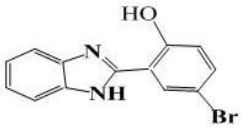
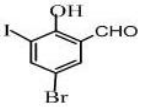
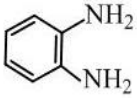
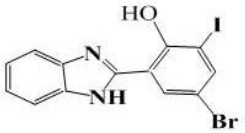
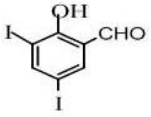
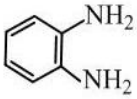
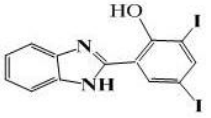


Figure 1: Synthesis of ligand

Sr. No	Reactant		Product	Reaction Time	Yield
	Aldehides	Amines			
1				45 min	80
2				60 min	76
3				55 min	83
4				70 min	71

Synthesis of complexes

All the complexes were prepared following the same procedure. Hot methanolic solution of ligand (0.5mol) and hotmethanolic solution of corresponding Copper nitrate

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(0.55 mol)were mixed together with constant stirring. The mixture wasrefluxed for 2–3 h at 70–80 ◦C on water bath. On cooling, coloredsolid metal complex was precipitated out. The product wasfiltered, washed with cold methanol and dried under vacuumover P4O10. Purity of the complex was checked by TLC andmelting points

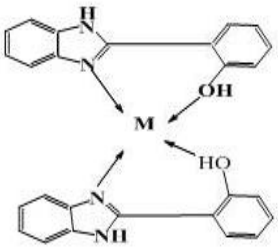

Figure 2: General structure of Metal Complex

Physical measurements

FTIR of complexes were carried in pune university temperature range of 0–1000 ◦C. Melting points of the ligands and decomposition temperature of complexes were determined in an open capillary tube. Magnetic susceptibilities of the complexes were determined on Gouybalance model 7550 using Hg[Co(NCS)4] as standard.

RESULT AND DISCUSSION

On the basis of physical analysis, the complexes were assigned to possess the composition shown in Table 1.

Table 1: Physical characteristics of copper metal complexes

Complex	Impherical Formula	Molecular wt.	Melting Pt.(°C)	Colour	Yield (%)
2a	$(C_{13}H_{10}N_2O)_2Cu$	649	188	Black	82
2b	$(C_{13}H_9N_2OBr)_2Cu$	605	205	Brown	85
2c	$(C_{13}H_8N_2OIBr)_2Cu$	857	223	Greenesh brown	81
2d	$(C_{13}H_8N_2OI_2)_2Cu$	949	247	Greenesh Black	89

Spectral analysis

FT-IR

The IR spectraof the ligands show a strong band in the 3200–3400 regionsassigned to the OH group. The disappearance of this band inthe spectra of the complexesindicates the deprotonation of the hydroxyl group and co-ordination through oxygen. The band observed at 1636–1620 cm−1 in the ligand is assigned to azomethine group. The shift of this band in the complexes towards lower region to the extent of 10–20 cm−1, indicates co-ordination through the azomethine nitrogen. In the free ligands, bands at 1249 cm−1 due to C–O (phenolic) shift to higher frequency by 30–50 cm−1 in the complexes, indicating co-ordination of the phenolic oxygen atom to the metal ion .These facts suggest that the shifts are due to co-ordination ofligand to the metal atom by the azomethine nitrogen and phenolicoxygen [19].This fact is also supported by the results of elementalanalyses, and TGA of complexes. Two new bands appearingin the low frequency ranges 515–581 cm−1 and 420–481 cm−1are assigned to (M–O) and (M–N), respectively.

Magnetic properties

The room temperature effective magnetic moments of the copper(II) complexes are in the range of 1.73-2.20µB, which corresponds to one unpaired electron typical for tetrahedral geometry.

Antimicrobial activity of complexes

The antimicrobial activity of test compounds was tested by disc diffusion method. Total four test microorganisms were included namely *Aspergillusniger* MTCC 4325, *Aspergillusflavus* MTCC 2813, *Escherichia coli* MTCC2939and *Bacillus subtilis* MTCC1789. The test compound was dissolved in dimethyl sulphoxide and loaded on a sterile filter paper disc of 6 mm diam. The petriplates containing nutrient agar medium (HiMedia) were spread with 100 µl of actively growing broth culture of the test bacteria using sterile cotton swab and allowed to dry for 10 min. For fungal species, 100 µl of active culture was spreaded on CzapekDox agar (HiMedia).Then the impregnated discs were placed on the surface of inoculated agar medium. Discs loaded with dimethyl sulphoxide (Sd Fine Chemicals) were served as control. Streptomycin and fluconazole (HiMedia) discs were used as positive control for bacterial and fungal species respectively. The nutrient agar plates were incubated at 37 °C for 24 h and CzapekDox agar plates at 30 °C for 7 days. The development of inhibition zone around the disc was recorded in terms of mm and compared with controls.

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