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Research Article

MONO-NUCLEATED TRANSITION METAL (M^{2+}) COMPLEXES OF A NEW SCHIFF-BASE AS LIGAND: SYNTHESIS, STRUCTURAL CHARACTERIZATION AND ANTI-MICROBIAL ACTIVITY

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ABSTRACT

We have synthesized a new class of Schiff-base Ligands with m-pthaladehyde and 3-amino benzoic acid. This adduct act as bi-dentate (N&O) ligand in the formation of mononuclear transition metal complexes of nickel (II), zinc (II), copper (II), cobalt (II), and cadmium (II). Ligand and complexes are characterized and their formation was confirmed by spectroscopic techniques *i.e.* ^{1}HNMR, FTIR, and UV-Vis spectroscopy. We have synthesized Ligand-metal coordination sphere $[M^{2+}(L)_2]$ (where M = Cu(II), Co(II), Cd(II),Ni(II)and Zn(II)) and L=3,3'-((1E,1'E)-(1,3 phenylenebis (methanylylidene)) bis (azanylylidene)) dibenzoic acid and (E)-N-((1H-indol-3-yl) methylene)-4H-1,2,4-triazole-4-amine. Both Ligand and their metal complexes showed magnificent antimicrobial property against *Pseudomonas aeruginosa* (MTCC 741) which causes nosocomial infections and *E. coli* (MTCC 1610) which causes intestinal infection.

Keywords: Schiff-base, Transition metal complex, m-pthaladehyde, 3-amino benzoic acid, Spectral study, Antimicrobial study.

1. INTRODUCTION

Schiff bases (SB's), firstly introduced by Hugo Schiff is an imine (-CH=N, a condensation product of an amine and an aldehyde or a ketone) under acid catalyzed condition with the loss of water molecule [1, 2]. SB's are having significant properties. SB is used for the synthesis of synthetic intermediates (like Penicillin synthesis) [3], heterocyclic compounds. SB' transition organometallic complexes have significant biological applications [4-5]. SB's are having a key role in coordination chemistry and form multiple bonded (-bi, -tri or –tetra dentate) metal complexes. These complexes are widely used as redox catalysts [6-9], and analytical reagents [10, 11]. These Schiff bases and metal complexes also exhibited an antibacterial [12], antifungal, antitumor [13], anticancer and anti-inflammatory property [14]. In this work, new SB's have been synthesized by using o-phthalaldehyde and derivatives of amines [15, 16]. These SB's and their transition metal complexes [17, 18] also showed strong catalytic and antimicrobial activity. The synthesis of SB's ligands which contains three macro cyclic rings was done with p-pthalaldehyde and di-anilines via reflux methods, and the formation of complex with nickel (II) showed antibacterial activity against gram-positive and gram-negativebacteria [19].

Some SB's show fluorescent activity, such as ((E)-2-((4-(diethylamino)benzylidene) amino)benzoic acid, DBAB) shows magnificent fluorescent activity when interacting with a metal ion. The sensibility is more selective for Fe^{3+}, Fe^{2+} and Cu^{2+} ions compared with other metal ions in DMF solution [20].

Schiff base (SB's) were synthesized by reaction between p-hydroxy benzaldehyde and derivatives of aminobenzoic acid, and their metal complexes were prepared with Ni (II), Cu (II), Co (II), Cd (II), Zn (II) and Cr (III) metal salts. SB's ligands act as multi-dentate macro cyclic structure which contains two or more donor site (atoms). These structures form the cage like cavities and act as host for metal ions [21]. Herein we report synthesis of p-pthalaldehyde and 3-aminobenzoic acid SBs and their transition metal complexes. These ligand and metal complexes are successfully synthesized and characterized by spectroscopic and other analytical methods and found to exhibit excellent antimicrobial activity against *Pseudomonas aeruginosa* and *E. coli* bacteria.

2. EXPERIMENTAL

2.1. Material

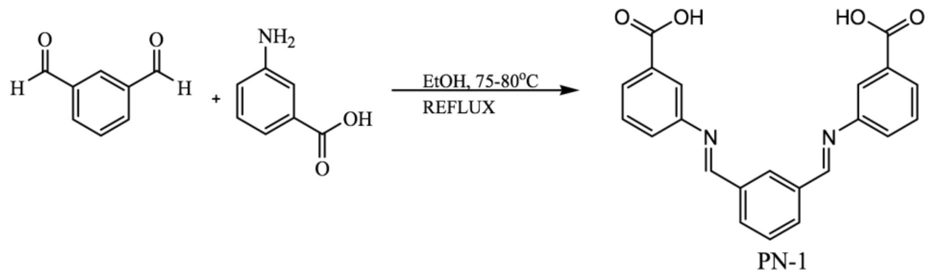
All reactants and reagents used in this work were purchased from Sigma Aldrich. Metal salts used were nitrate salt $Zn(NO_3)_2$, $Co(NO_3)_2$, $Cu(NO_3)_2$, $Cd(NO_3)_2$, $Ni(NO_3)_2$: Solvents used were of analytical grade, and purified and dried as per standard procedure before use. The melting point of synthesized compounds and complexes were measured by electro thermal melting point apparatus. Infrared spectroscopic analysis was done by IR-spectroscopy Brucker alpha-T, UV absorption study by Rigol ultra-3660-UV spectroscopy instrument, NMR spectra were obtained by Jeol Delta-550 model instrument.

2.2. Synthesis of Schiff base

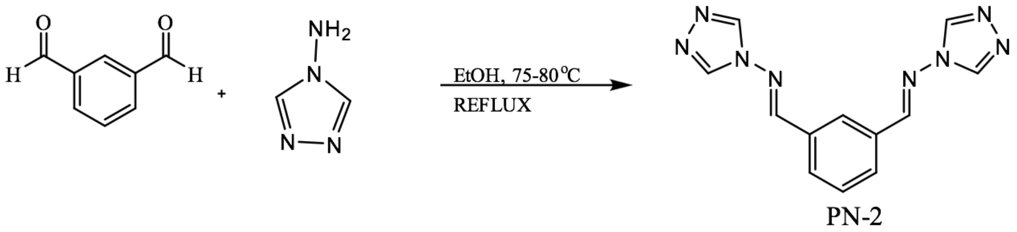
Compounds PN-1& PN-2 were synthesized by treatment of ethanolic solution of m-pthalaldehyde (1 m mol) 0.134 g with two different amines (2mmol) (Fig. 1). Compounds PN-1 was synthesized by treatment of ethanolic solution of m-pthalaldehyde (1mmol) 0.134 g with 3-aminobenzoic acid (2 m mol) 0.227 g. Compounds PN-2 was synthesized by treatment of ethanolic solution of m-pthalaldehyde (1mmol) 0.134 g with 4H-1,2,4-triazol-4-amine(2 m mol) 0.186 g in a round bottom flask and fixed on a heating magnetic stirrer and added with aldehyde solution drop wise at fixed temperature (75-80°C) and refluxed for 6-7 hours. White/pale yellow coloured precipitate was obtained, cooled the solution, filtered and dried. After drying, precipitate was washed with 1:2 ratios of hot water and ethanol solution. The progress of the reaction was monitored by TLC under UV-VIS chamber found a loss of reactant spot and the appearance of new reactant spot (Fig. 1).

2.3. Synthesis of Complexes

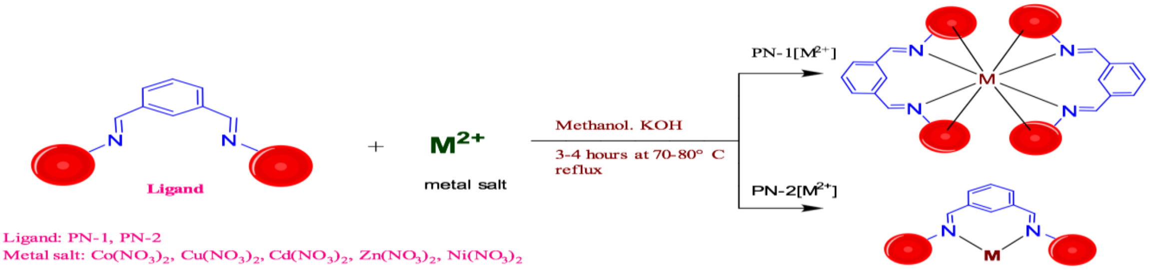
Metal complexes were synthesized by adding 2 equivalent of ligand PN-1 &PN-2 in methanolic solution. The solutions were taken in RB and placed on magnetic stirrer with heating mantle and added 2 equivalents of base solution in methanol drop wise and allowed the solution to stand for 15 min followed by addition of metal salt solution in methanol and addition of drop wise in ligand base solution, refluxed afterwards for 3-4 hours at 70-80°C. Precipitate of complex found was cooled, dried and washed with 1:2 ratios of hot water and methanol solution (Fig. 2).



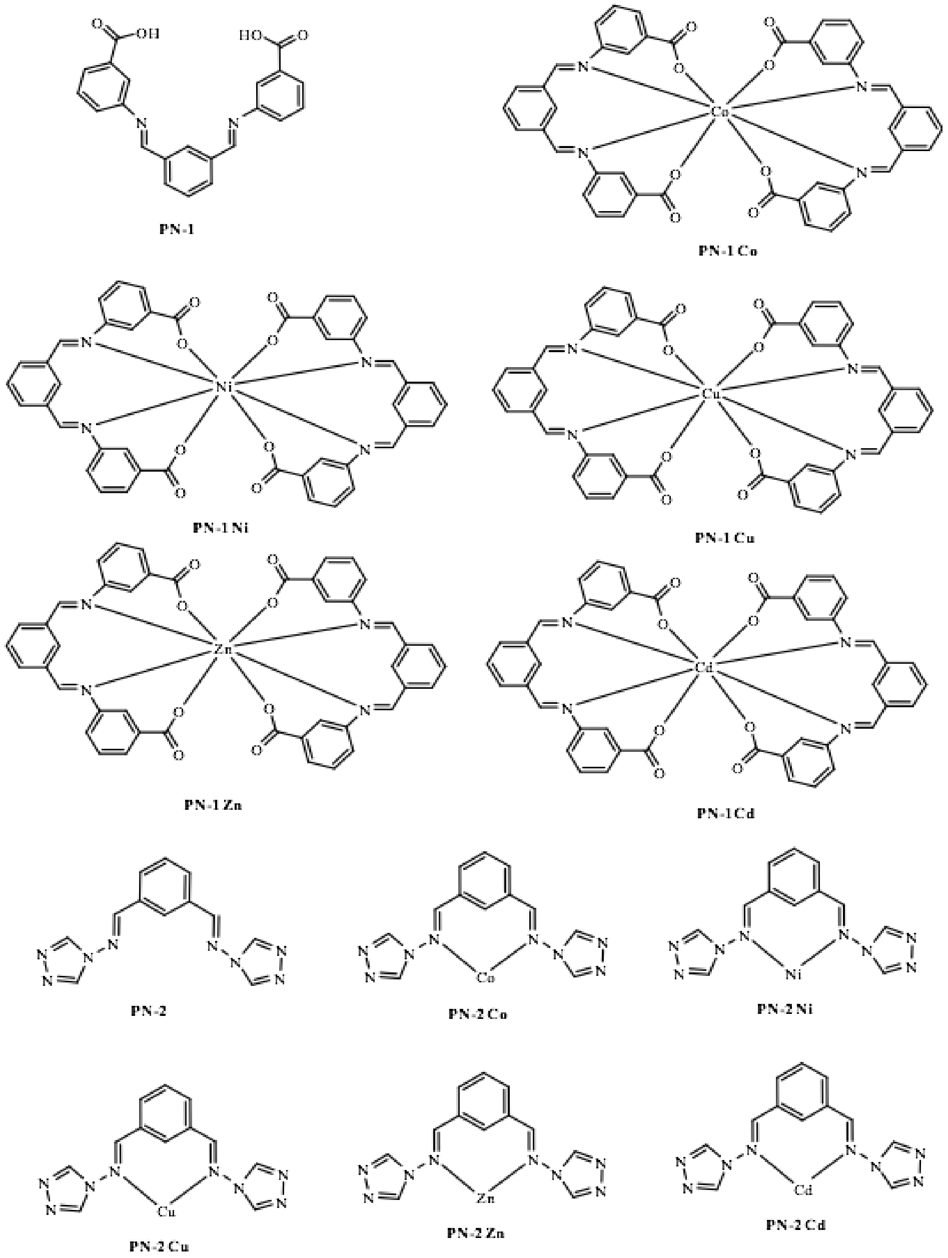
Scheme 1: General synthesis of PN-1



Scheme 2: General synthesis of PN-2



Scheme 3: General synthesis of PN-1 and PN-2 Complexes with transition metals



PN-1 PN-1 Co PN-1 Ni PN-1 Cu PN-1 Zn PN-1 Cd PN-2 PN-2 Co PN-2 Ni PN-2 Cu PN-2 Zn PN-2 Cd

Fig. 1: General representation of PN-1 and PN-2 and metal Complexes

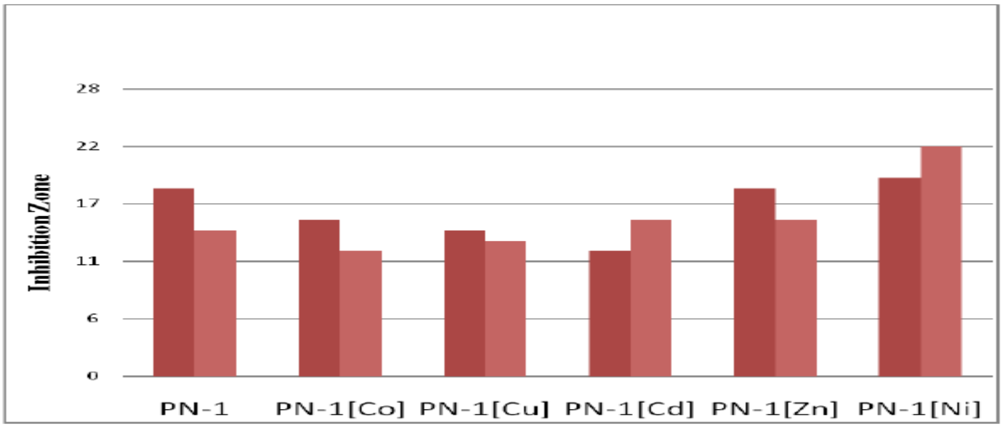


Fig. 2: Antimicrobial Activity of PN-1 and Metal Complexes

Fig. 3: antimicrobial activity of PN-2 and Metal Complexes

2.4. Biological study of compound

Stored bacterial cultures were seen by inoculating into luriya-burtani broth over night at 37o C. Inoculums were made from this freshly prepared culture of 1 ml Luria-Burtoni broth and incubated by the time the turbidity reached up to 0.5 McFarland solution at 595 nm. In at start, newly created ruler hinton agar plates were kept, ready to the media plate by created 8 MM wells from cork borer at equal distance. Every broth suspension of bacterial culture was inoculated on to and newly created 100 ml of synthesized material (200 pmm /ml dissolved in DMSO) poured on to every well. These culture plates were incubated at 37°C for 24 hours through well diffusion method. The area of inhibition shown was measured in mm after the incubation period.

3. RESULTS AND DISCUSSION

Synthesized Schiff base(ligands) and their metal complexes are solid and amorphous in state. Ligands are soluble in methanol and other solvent. Metal complexes are insoluble in methanol and ethanol but soluble in DMSO and their melting point is measured by melting point apparatus.

3.1. Characterization of Ligands

3.1.1. 3,3'((1E,1'E)(1,3phenylenebis(methanylylidene))bis(azanylylidene))dibenzoicacid;PN-1

Pale yellow colour powder; melting point 224°C; yield 0.352g (87%); IR adsorption are 3852.58(O-H medium, broad), 3739.95(O-H medium, broad), 3615. 69(O-H medium, broad), 3349.96(O-H medium, broad), 2970.35(O-C=O strong), 2875.07(O-C=O strong), 2551.63(O-C=O strong), 2358.68(O-C=O strong), 1680.21(-C=N-), 1633.76(-C=N-), 1569.42 (=C-H), 1444.90(=C-H), 1383.29(=C-H), 1288.26 (=C-H), 1148.51(C-H), 1083.91(C-H), 1040.73(C-H), 918.41 (C-H), 880.28(C-H), 785.49(C-H), 746.23 (C-H), 674.18(C-H); ^{1}HNMR of compound having 7.1δ ppm(m), 7.5δ ppm(s), 7.8δ ppm (d), 8.1 δ ppm (d), 10.0δ ppm(s), 8.4(s) 8.8δ ppm; UV-Vis absorption at 205nm- 275nm λ max.; Chemical Formula: $C_{22}H_{16}N_2O_4$; Molecular Weight: 372.111; Elemental Analysis: C,70.96; H, 4.33; N, 7.52; O, 17.19;

3.1.2. (N,N'E,N,N'E)-N,N'-(1,3-phenylenebis (methanylylidene))bis(4H-1,2,4-triazol-4 amine); PN-2

Bright white colour powder; melting point 238°C; yield 0.238g (78%); IR adsorption 3853.31(O-H medium, broad), 3739.78 (O-H medium ,broad), 3679.77 (O-H medium, broad), 3616.31(O-H medium, broad), 2923.32 (O-C=O strong), 2358.64(O-C=O strong), 1687.47(-C=N-), 1551.00(=C-H), 1421.02h(=C-H), 1366.79(=C-H), 1203.81(C-H), 1117(C-H), 1010.26 (C-H), 729.79(C-H), 658.63(C-H); ^{1}HNMR of compound having triazole ring which contain 9.1 δ ppm(s), 9.2 δ ppm(s), 8.3 δ ppm(s), 8.4 δ ppm(s), 7.9 δ ppm(s), 7.5 δ ppm(s), 5.1 δ ppm(s); UV-Vis absorption at 205nm- 300nm λ max; Chemical Formula: $C_{12}H_{10}N_8$; Molecular Weight:266.103; Elemental Analysis: C, 63.94; H, 4.10; N, 21.93; O, 10.02

3.2. Characterization of complexes

3.2.1. *bis((3((E)(3((E)((3carboxyphenyl)imino)methyl)benzylidene)amino)benzoyl))cadmium(II)*;**(PN1,Cd)**

Light green colour powder; melting point 273°C; yield 0.564(81%); IR frequency; 3852(O-H medium ,broad), 3740.98(O-H medium, broad) 3616.55(O-H medium broad), 2361.64(O-C=O strong), 1744.40(-C=N-), 1687.64(-C=N-), 1642.70(C=O strong), 1525.81 (=C-H), 1462.13(=C-H), 1389.39(=C-H), 993.06(-C-H), 766.78(-C-H), 679.94(-C-H), 610.43(C-H), 574.20(N-Cd), 551.14(N-Cd), 540.25(O-Cd), 527.87 (O-Cd); UV-Vis absorption at 205nm-260nm λ max; Chemical Formula: $C_{44}H_{30}CdN_4O_8^{2+}$; Molecular Weight: 856.109; Elemental Analysis: C, 61.80; H, 3.54; Cd, 13.15; N, 6.55; O, 14.97

3.2.2. *bis((3((E)(3((E)((3carboxyphenyl)imino)methyl)benzylidene)amino)benzoyl)oxy)cobalt(II);***(PN1,Co)**

Brown colour powder; melting point 286°C; yield 0.556g (85%); IR frequency; 3852.93(O-H medium, broad), 3741.12(O-H medium, broad), 2360.71(O-C=O strong), 1687.53(-C=N-), 1548.33(-C-H), 1387. 51 (=C-H), 762.20(-C-H), 679.20(C-H), 609.23 (C-H), 552.65(Co-N), 528.30(Co-O); UV-Vis absorp-tion at 206nm-258nm λ max; Chemical Formula: $C_{44}H_{30}$ $CoN_4O_8^{2+}$; Molecular Weight: 801.138;b Elemental Analysis: C,65.92; H, 3.77; Co, 7.35;N, 6.99; O, 15.97

3.2.3. *bis((3((E)(3((E)((3carboxyphenyl)imino)methyl)benzylidene)amino)benzoyl)oxy)zinc(II);* **(PN1,Zn)**

Light brown colour powder; melting point 267°C; yield 0.599g (86%); IR frequency;3435(O-H medium, broad), 2357.39(O-C=O strong), 1620.47(-C=N-), 1558.68(-C-H), 1387.65(=C-H), 1153.86(-C-H), 914. 13 (C-H), 768.89(C-H), 687.04(C-H), 555.85(N-Zn); UV-Vis absorption at 205nm-300nm λ max; Chemical Formula: $C_{44}H_{30}N_4O_8Zn^{2+}$; Molecular Weight: 806.134; Elemental Analysis: C,65.40; H, 3.74; N, 6.93; O, 15.84; Zn, 8.09.

3.2.4. *bis((3-((E)-(3-((E)-((3carboxyphenyl) imino) methyl)benzylidene)amino)ben-zoyl) oxy) nickel (II);* **(PN-1,Ni)**

Light cream colour powder; melting point 278°C; yield 0.522(75%); IR frequency; 3835.04(O-H medium, broad), 3741.20(O-H medium, broad), 3616.79(O-H medium ,broad), 2361.55(O-C=O strong), 1687.77(-C=N-), 1620.51(-C=N-), 1553.39(-C-H), 1392.02 (=C-H), 1152.39(-C-H), 921.11(C-H), 770.95(C-H), 687.76(C-H), 609.78(C-H), 562.33(N-Ni), 528.51 (Ni-O); UV-Vis absorption at 205nm-265nm λ max; Chemical Formula: $C_{44}H_{30}N_4NiO_8^{2+}$; Molecular Weight: 800.141, Elemental Analysis: C, 65.94; H, 3.77; N, 6.99; Ni, 7.32; O, 15.97

3.2.5. *bis((3((E)(3((E)((3carboxyphenyl)imino)methyl)benzylidene)amino)benzoyl)oxy)copper(II) ;* **(PN1,Cu)**

Dark green colour powder; melting point 282°C; yield 0.529(76%); IR frequency; 3852.46(O-H medium, broad), 3740.74(O-H medium, broad), 3616.69(O-H medium, broad), 2361.34(O-C=O strong), 1687.55(-C=N-), 1525.05(-C=N-), 1389.79(=C-H), 755.86(-C-H), 563.77(N-Cu), 550.07 (N-Cu), 540.30(Cu-O), 528.32(Cu-O); UV-Vis absorption at 205nm-310nm λ max; Chemical Formula: $C_{44}H_{30}CuN_4O_8^{2+}$; Molecular Weight: 805.135; Elemental Analysis: C, 65.54; H, 3.75; Cu, 7.88; N, 6.95; O, 15.87

3.2.6. *(N,N'E,N,N'E)N,N'(1,3phenylenebis(methanylylidene))bis(4H1,2,4triazol4amine),cadmium(II);* **(PN-2,Cd)**

Off white melting point; 305°C; yield; 0.52g (92%); IR frequency;3852.13(O-H medium, broad), 3740.36(O-H medium, broad), 3680.67(O-H medium, broad, 2358.73(C-N=N strong), 1687.32(-C=N-), 1457.30 (=C-H), 1170.88(=C-H), 1048.87(=C-H), 973.93(C-H), 855.56(C-H), 800.33(C-H), 680.40(C-H)568.18 (Cd-N), 527.03 (Cd-O); UV-Vis absorption at 206nm-300nm λ max; Chemical Formula: $C_{12}H_{10}$ N_8Cd^{2+}; Molecular Weight: 378.671; Elemental Analysis: C, 38.06; H, 2.66; Cd, 29.69; N, 29.59.

3.2.7. *(N,N'E,N,N'E)-N,N'-(1,3phenylenebis (methanylylidene))bis(4H1,2,4triazol4amine),cobalt (II);* **(PN-2,Co)**

Light grey; melting point 259°C; yield; 0.44g (80%); IR frequency;3835.33(O-H medium, broad), 3740.04 (O-H medium, broad), 2358.09(C-N=N strong), 1686.64 (-C=N-), 1503.75(=C-H), 1386.90(=C-H), 1169.28 (=C-H), 973.82(C-H), 848.87(C-H), 794.33 (C-H), 682.24(C-H), 585.04(Co-N),528.50(Co-O); UV-Vis absorption at 205nm-315nm λ max; Chemical Formula: $C_{12}H_{10}$ N_8Co^{2+}; Molecular Weight: 325.193; Elemental Analysis: C, 44.32; H, 3.10; Co, 18.12; N, 34.46 .

3.2.8. (N,N'E,N,N'E)-N,N'-(1,3-phenylenebis (methanylylidene))bis(4H-1,2,4-triazol-4amine), zinc(II); **(PN-2,Zn)**

Pale yellow colour; melting point 287°C; yield; 0.49g (88%).; IR frequency;3852.36(O-H medium ,broad), 3740.05(O-H medium, broad), 3680.21(O-H medium, broad), 3615.95(O-H medium, broad), 2358.56(C-N═N strong), 1744.46(-C=N-), 1687.40(-C═N-), 1652.66(-C═N-), 1507.89(-C-H), 1383.93(═C-H), 1169.50(-C-H), 1048.11(-C-H), 973.26(-C-H), 848. 96 (-C-H), 677.73(-C-H)554.89(Zn-N), 527.72 (Zn-O); UV-Vis absorption at 206nm-306nm λ max; Chemical Formula: $C_{12}H_{10}N_8Zn^{2+}$, Molecular Weight: 331.640; Elemental Analysis: C, 43.46; H, 3.04; N, 33.79; Zn, 19.72

3.2.9. (N,N'E,N,N'E)-N,N'-(1,3phenylenebis (methanylylidene))bis(4H1,2,4triazol4amine), nickel (II); **(PN-2,Ni)**

Whitish blue colour; melting point 301°C; yield; 0.43g (78%); IR frequency;3852.24(O-H medium ,broad), 3740.33(O-H medium, broad), 3680.97(O-H medium, broad), 3616.74(O-H medium, broad), 2358.95(C-N═N strong), 1744.20(-C═N-), 1687.23(-C═N-), 1653.00(-C═N-), 1507.19(-C-H), 1389.23(═C-H), 1170.56(═C-H), 1048.91(═C-H), 973.58(-C-H), 847. 53 (-C-H), 797.61(-C-H), 677.44(-C-H), 577.97 (Ni-N), 526.65(Ni-O); UV-Vis absorption at 205nm-305nm λ max.; Chemical Formula: $C_{12}H_{10}N_8Ni^{2+}$; Molecular Weight: 324.954; Elemental Analysis: C, 44.35; H, 3.10; N, 34.48; Ni, 18.06

3.2.10. (N,N'E,N,N'E)-N,N'-(1,3-phenylenebis (methanylylidene))bis(4H-1,2,4-triazol4-amine), copper(II); **(PN-2,Cu)**

Sky blue; melting point 310°C; yield; 0.41g (89%); IR frequency;3835.94(O-H medium ,broad),3739.61(O-H medium, broad), 3680.57(O-H medium, broad), 2358.50 (C-N═N strong), 1686.77(-C═N-), 1506.07 (-C═N-), 2170.56(═C-H), 71170.56(═C-H), 1046.86 (-C-H), 972.49(-C-H), 848.46(-C-H), 794.04 (-C-H), 679.70(-C-H), 614.21(-C-H), 566.72(Cu-N), 523.64 (Cu-O); UV-Vis absorption at 206nm-325nm λ max; Chemical Formula: $C_{12}H_{10}N_8Cu^{2+}$; Molecular Weight: 329.806; Elemental Analysis: C, 43.70; H, 3.06; Cu, 19.27; N, 33.98.

3.3. Infrared (IR) Spectral Studies

Synthesized compounds show characteristic transitional band; stretching frequency of highly electronegative atom bond with electron withdrawing group show maximum transition Band at3852-3600cm^{-1} (O-H medium broad) due to presence of acidic group, the multiple bonded electron withdrawing group show transitional bending frequency at 2358.73 cm^{-1}due to presence of C-N═N strong group. Schiff base formation between aldehyde and amine group is due to imine bond which show stretching frequency at 1687-1655 cm^{-1} because of -C═N- bond and this is significantly shown by the formation of actual product, 1457.30 (═C-H), 1170.88 (═C-H), 1048.87 (═C-H), 973.93 (C-H), 855.56 (C-H), 800.33 (C-H), 680.40 (C-H), 568.18 (M-N), 527.03 (M-O). (S 15-26)

3.4. UV-Vis Spectral Studies

Synthesized ligand (PN-1) phenylenebis-(methanylylidene)) bis-(azanylylidene)) di-benzoic acid show absorption at 205nm- 275nm λ max found π-π* transition of electron in C═N bond and conjugated double in aromatic system similarly in ligand (PN-2) 3,3'-((1E,1'E)-(1,3 and (E)-N-((1H-indol-3-yl) methylene)-4H-1,2,4-triazol-4-amine show absorption on 205nm-260nm λ max (Fig. 4).

Complexes in these ligands coordinate with empty d orbital of metal ions form different coordination sphere, complex of Cd having d^9 configuration and show 260-300nm λ max, complex of Co having d^7 configuration and show 258-315nm λ max, complex of Zn having d^9 configuration and show 300-306nm λ max, complex of Ni having d^8 configuration and show 265-305nm λ max, complex of Cu having d^9 configuration and show 310-325nm λ max.

3.5. Nuclear Magnetic Resonance spectral studies

^{1}HNMR spectra of compound are found as expected and predicted for structure of compound. compound having aromatic proton which is shown by the chemical shift on 7.5-7.8 δppm (doublet and multiplet) to determine the ring structure of pthalaldehyde core of synthesized compound and in benzyl amine ring show chemical shift at 8.10δ ppm due to the presence of electron withdrawing group, triazole ring containing proton show chemical shift at 9.1 δ ppm(s), 9.1 δ ppm(s) and this COOH (acidic proton) show chemical shift at 10.0δ ppm(s) evidence for presence of acidic group. Schiff base (-CH=N-) proton show chemical shift at 8.5-8.8δ ppm which determine the formation of bond between aldehyde and amine group (S 1-2).

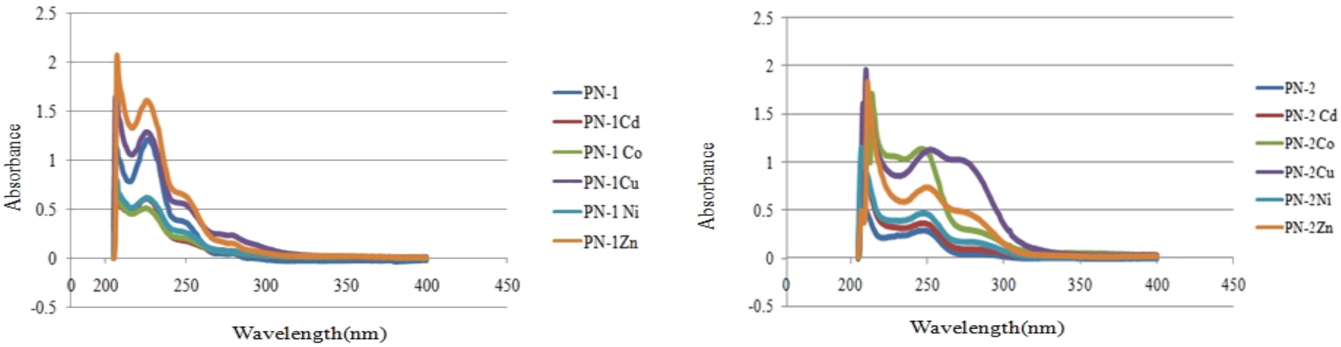


Fig. 4: UV/Vis spectra of PN-1, PN-2 and metal complexes

Table 1: Mass spectra of the Sb's and their metal complexes Comparative study of synthesized compounds with reported article is found as

S. No.	Sample code	Molecular Weight (Calculated) M+	Molecular peak (Observed) M+
1.	PN-1	372.37	372.11
2.	PN-2	266.26	266.10
3.	PN-1 Co	801.66	801.14
4.	PN-1Ni	801.42	800.14
5.	PN-1 Cu	806.28	805.14
6.	PN-1Zn	808.12	806.13
7.	PN-1Cd	855.14	856.11
8.	PN-2Co	325.19	325.03
9.	PN-2Ni	324.95	324.04
10.	PN-2Cu	329.81	329.04
11.	PN-2Zn	331.65	330.03
12.	PN-2Cd	378.67	380.01

Table 2: Comparative description of the Sb's and their metal complex

Compound and Complexes	*E. coli* (MTCC 1610)	*Pseudomonas aeruginosa* (MTCC 741)
PN-1	18	14
PN-1[Co]	15	12
PN-1[Ni]	14	13
PN-1[Cu]	12	15
PN-1[Zn]	18	15
PN-1[Cd]	19	22
PN-2	16	15
PN-2[Co]	12	12
PN-2[Ni]	17	14
PN-2[Cu]	14	15
PN-2[Zn]	16	17
PN-2[Cd]	20	19
$Ni_2C_{40}H_{28}N_4O_4S_2Cl_4$ ($Ni_2L_1C_{14}$)[22]	12.5	12.5
$Ni_2C_{42}H_{32}N_4Cl_4$ ($Ni_2L_3C_{14}$)[22]	12.5	12.5
$CoC_{12}H_{10}O_4N_{22}H_2O$[23]	11	16
$CuC_{14}H_{14}O_4N_2$[23]	20	15

3.6. Mass Spectral study

Mass study of synthesized compound and complex is studies by mass spectroscopy instrument (micro TOF-Q II 10348 MS-ESI on 3000 m/z). These spectral data show fundamental mass peak of (M^+) and some other isotopic peak. In ligand compound PN-1 and PN-2 show M+ at 372.11 and 266.1 and some other isotopic peaks also. By the complexation of these ligands with di-cationic transition metal ion they form coordination complexes in which PN-1 form tetra-dantate and PN-2 form bi- dantate complexes with 2:1 ratio of ligand and metal ion. Mass of these complexes is also analyzed and they give M+ peak and other isotopic peaks also. **(S 3-14).**

3.7. Biological study of compound and their complexes

The antimicrobial study of the compounds was done by well diffusion method by using Muller Hinton agar. The synthesized ligand and metal complexes were used as antimicrobial agents against bacterial cultures E.coli (MTCC 1610), Pseudomonas aeruginosa (MTCC 741). (S-27-28) First of all revive deep freeze bacterial culture on agar media of Luria burtani agar then incubate into broth media of Luria burtani and let them stand for 24H incubation and at the turbidity of bacterial culture by suspensions of microorganism (0.47 McFarland) solution at 582 nm. Prepare sterilized Muller Hinton agar medium. Pick out the bacterial suspension of broth culture 24 hours old turbidity 0.47 was set at 582 nm and incubated for 10 minutes. 8mm Wells were prepared aseptically then prepare the solution of compound and complexes (300 PPM/ml) 100/l was filled in each well and let it to incubate at 37°C for 48 hours. The inhibition of bacterial culture is found.

3.8. Antibacterial Activity of the Metal Complexes

These synthesized ligands and their complexes are having antimicrobial activity against *Pseudomonas aeruginosa* (MTCC 741) which is causing of nosocomial infections in animals and *E.Coli* (MTCC 1610) cause intestinal infection in human and other mammals. These micro-organisms are common infection causing agents. So these synthesized compounds show excellent activity against then especially Cd metal complex show the highest inhibition zone as compared with other metal complexes and ligands, May be due to toxic nature of Cd (S 27-28).

4. CONCLUSION

Here in we successfully reported the synthesis Schiff base and characterized them by IR-spectroscopy which gives the confirmation for formation of C═N bond with transition frequency between the bands 1682-1650 cm^{-1} and in metal complex they show very low peak at 580-540 cm^{-1} which shows the bond between metal and donor atoms as N or O and also confirm the presence of all kinds of bonding in given structure. UV-Vis spectra give significant information about the transition of an electron in different energy levels in the range of 205-330nm λ max absorption spectra. In^{1}HNMR-spectradue to the presence of Schiff base (-CH═N-) proton show the chemical shift at 8.5-8.8δ ppm which indicated the formation of bond between aldehyde and amine group, and two kinds of aromatic ring present which show their individual chemical shift, core ring show 7.5 to 7.8 δ ppm and terminal ring which contain acidic group they show higher chemical shift value at 8.1 δ ppm. All of these ^{1}HNMR of compound, which prove that similar molecule is formed. These all synthesized compounds having antibacterial properties against pathogenic bacteria which further used for the treatment against their infection

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