International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

Synthesis of Schiff Base Metal Complexes of Sulfapyridine and Pyridine, Their Characterization and Biological Studies

Monika*, Arpna, Pallavi Bhardwaj

Department of Chemistry Baba Mastnath University, Asthal Bohar, Rohtak-124021, India
*Corresponding Author Email: dabasmonika9[at]gmail.com
pallavi198277[at]gmail.com

Abstract: ***Metal complexes of sulfapyridine are attracting the pharmaceuticals due to their enhanced biological activity. In recent study, on condensing sulfapridine and pyridine-2-aldehyde a Schiff base (N-pyridin-2-yl-4-[(pyridin-2-yl) methyl amino]benzene sulfonamide is synthesized. This ligand is complexed with metal ions and form stable complex. It can bind up with metal ions because it has two binding sites, one is pyridinyl nitrogen and the other is azomethine nitrogen atom. Characterization of ligand and metal complexes formed is done with IR, NMR, ^{1}H NMR and elemental analysis. Then their biological activity was observed against Pseudomonas aeruginosa, Staphylococcus aureus bacteria and against fungi Aspergillus niger, Candida. It was observed that the complexes have more pronounced biological activity than the Schiff base.***

Keywords: Pyridine, Sulfapyridine, Schiff base, antimicrobial, metal complexes

1. Introduction

Sulfa drugs act as anti-cancer agents and have a 4-amino benzene sulfonamide group. About half a centuary ago sulfa drug was introduced against bacterial infection. Sulfa drug Schiff bases can chelate with metal ions and form stable complexes which increases their biological activity. Metal ions cannot be directly used because as such they are toxic. Inorganic chemistry is developing very fast and the use of metal ions in the field of medicines is inceasing day by day. Efficiency of sulfa drugs get enhance on combination with suitable metal ion. Sulfa drug was the first drug used agsinst bacterial infection for the treatment of measles, urinary tract infections, bacterial infection, eye infections, meninitis and actinomycea [1-3]. Schiff base show antifungal, antibacterial, pharmacological and chelating properties [4-6]. Schiff base are obtained by condensing primary amines and aldehyde or ketone compounds in acidic medium. Hugo Schiff in 1864 first reported the Schiff base [7]. The formation of azomethine entity is an essential step because of its important biological properties such as antibacterial, antimicrobial [8], anti-inflammatory, insecticidal, anticancer [9], anticonvulsant [10], antitumor [11] and antituberculosis [12]. They has been also used in catalytic reactions, analytic chemistry, agrochemistry, food industry and in dyes [13]. This study involves the synthesis of Schiff base of sulfapyridine and pyridine. Schiff base is then complexed with various metal ions. Their characterization and antimicrobial activity is observed.

2. Experimental

The chemicals, metal salts and solvents of AR grade was used and were purchased from Merck. The melting point of the complexes was recorded with Elico melting point apparatus. Elemental analysis was recorded with elemental analyser.1H NMR was recorded with Brucker spectrometer. IR spectra was recorded with Perkin Elmer IR RXI spectrometer.

Synthesis of Schiff base ligand: 0.0125 mol of pyridine-2-aldehyde was dissolved to hot ethanol. Now add this solution to a hot solution of 0.0125 mol sulfapyridine. Then refluxed the solution for 4-5 h on hot plate. On cooling the solution precipitates separate out. Filter it out, washed it and dried it. This is our Schiff base. Its mp. was found 134^{0}C and yield 78%.

Schiff base metal complex synthesis 0.03 mol of Schiff base ligand was added to 25 ml hot magnetically stirred dioxane solution. This solution was added to an aqueous (0.0015 mol) metal chloride solution. Refluxed the solution for 5h. Cool the solution and collect the solid complex. Filter it, wash it and dried it thoroughly.

Biological activity: The complexed synthesized were screened against bacteria P. Aeruginosa, Staphylococcus aureus bacterias and A. niger, Candida albicans fungi. The data obtained was compared.

3. Results

Analytic data: The analytical data is in accordance with molecular formulae of complexes. Schiff base ligand and Schiff base metal complexes are in 1: 2 (M: L) ratio [M=Ni^{2+}, Cu^{2+}, Co^{2+}, Zn^{2+}, $Mn^{2}]^{+}$ having formula [M (HNSP) $_2Cl_2$] (Table-1).

IR Spectra: [Table-2] Schiff base has donor sites ring nitrogen, the azomethine nitrogen, the sulphonamide oxygen and the sulphonamide nitrogen [14]. Azomethine (-CH=N-) group of the ligand shows a peak at 1630 cm^{-1}. A peak is observed at 1385 cm^{-1} which confirms (C-N) bond. The frequency for (HC=N) bond decreased by 20-45 cm^{-1} for all metal complexes. Presence of phenolic oxygen was confirmed with a broad band at 3430 cm^{-1}. Coordination through pyridinyl ring nitrogen confirmed by the frequency

shift of these complexes by 15-33 cm^{-1}. The frequency for the Schiff base because of νas (SO_2) and νs (SO_2) was observed at 1272-1230 cm^{-1} and 1140-1128 cm^{-1}, respectively. No change occurs in these bands in the complexes which show no involvement of-SO_2 group for coordination.

^{1}H NMR spectra DMSO-d_6 spectrophotometer was used to record 1H NMR spectra of complexes. Azomethine (-CH=N-) group was confirmed by the peak at 8.5 ppm. This peak on complexation with metals gets upfield. The peaks 6.53-8.49 ppm confirms the presence of phenolic hydrogens.

Table 1: Physical Data of Complexes

Schiff base and complexes	Colour	H (%)	C (%)	N (%)	Mpt (^{0}C)	YIELD ((%))
HNSP	Yellow	4.22 (3.83)	61.32 (60.30)	15.47 (15.42)	135	76
[Zn (HNSP) $_2Cl_2$]	dark brown	3.55 (3.10)	52.67 (52.15)	12.80 (12.63)	155	65
[Cu (HNSP) $_2Cl_2$]	Green	3.02 (3.41)	56.56 (56.26)	12.80 (12.45)	196	72
[Mn (HNSP) $_2Cl_2$]	grey	3.50 (3.22)	50.33 (50.18)	13.60 (13.03)	172	85
[Ni (HNSP) $_2Cl_2$]	greenish yellow	3.88 (3.43)	50.65 (50.55)	13.85 (13.10)	247	55
[Co (HNSP) $_2Cl_2$]	orange	3.51 (3.43)	50.55 (50.50)	13.96 (13.49)	242	55

Table 2: IR data of complexes

Ligand and complexes (cm-1)	ν (N-H)	ν (>C-N) Pyridynyl nitrogen	ν (-CH=N-) Azomethine	ν (M-N)	ν_a (SO_2), ν_{as} (SO_2)	ν (S-N)
HNSP	3415	1385	1633	-	1275, 1140	958
[Zn (HNSP) 2Cl2]	3405	1365	1605	462	1275, 1140	955
[Cu (HNSP) 2Cl2]	3415	1365	1593	563	1280, 1135	962
[Mn (HNSP) 2Cl2]	3415	1370	1590	465	1260, 1135	950
[Ni (HNSP) $_2Cl_2$]	3420	1375	1615	485	1275, 1130	960
[Co (HNSP) $_2$ Cl_2]	3417	1385	1630	495	1275, 1135	958

Table 3: Antimicrobial activity of complexes

Inhibition effects of complexes	Pseudomonas aeruginosa	Staphylococcus aureus	Aspergillus niger	Candida albicans
HNSP	15	13	13	15
[Zn (HNSP) 2Cl2]	19	15	15	16
[Cu (HNSP) 2Cl2]	20	13	15	16
[Mn (HNSP) 2Cl2]	10	-	14	13
[Ni (HNSP) $_2Cl_2$]	19	32	12	16
[Co (HNSP) $_2$ Cl_2]	19	16	14	-

4. Biological Activity

Disc diffusion method is used to screen the biological properties of complexes against bacteria (for Staphylococcus aureus, Pseudomonas aeruginosa). Complex of Cu, Ni (II), Mn (II), Zn (II) shows significant antibacterial effects against bacteria. For Mn^{2+} complex the inhibitory effect is less than ligand. Cu^{2+} and Ni^{2+} complexes shows highest antimicrobial activity. Data recorded shows that the metal complexes has more significant antimicrobial property than ligand (Table-3).

References

[1] Yun M. K., Wu Y., Li Z., Zhao Y., Waddell M. B., Ferreira A. M., Lee R. E., Bashford D., White S. W., Catalysis and Sulfa Drug Resistance in Dihydropteroate Synthase Science 335 (2012) 1110-1114.
[2] Nagpal P., Singh R. V., Toxicological effects, biological aspects and spectral characterization of organoboron (III) complexes of sulfonamide-imines Appl. Organometal. Chem.18 (2004) 221-226.
[3] Scozzafava A., Owa T., Mastrolorenzo A., Supuran C. T., Anticancer and Antiviral Sulfonamides Curr. Med. Chem.10 (2003) 925-953.
[4] Hu F. L., Yin X. H., Mi Y., Zhang S. S., Luo W. Q. Synthesis, characterization and luminescence properties of Eu (III) and Tb (III) complexes with novel pyrazole derivatives and 1, 10-phenanthroline Spectrochim. Acta A 75 (2010) 825-829.
[5] Sandip B., Samanta A., A New Strategy for Ratiometric Fluorescence Detection of Transition Metal IonsJ. Phys. Chem. B110 (2006) 6437-6440.
[6] McCarthy P. J., Hovey R. J., Ueno K. Inner Complex Chelates. I. Analogs of Bisacetyl acetone ethylenediimine and its Metal Chelates *J. Am. Chem. Soc.1*955, 77, 22, 5820-5824
[7] Böttcher A., Takeuchi T., Hardcastle K. I., Meade T. J., Gray H. B. Spectroscopy and Electrochemistry of Cobalt (III) Schiff Base Complexes. Inorg. Chem 1997; 36: 2498-2504.
[8] Wadher SJ, Karande NA, Yeole PG. Synthesis and biological evaluation of schiff base of dapsone and their derivative as antimicrobial agents. Int J Pharm Tech Res 2009; 1 (1): 12.
[9] Popp F. D., Kirsch W. Synthesis of potential anticancer agents V. schiff bases and related compounds 1-2. J Org Chem 1961; 26 (10): 3858-60.
[10] Cates L. A., Rashed M. S. Phosphorus GABA analogues as potential prodrugs. Pharm Res 1984; 1 (6): 271-4.

[11] Hadjipavlou-Litina D. J., Geronikaki A. A. Anti-inflammatory activity of some novel 1-[3-(aroylo)] and one 1-[3-(aryloxy)]-propyl aminothiazole in correlation with structure and lipophilicity. Arzneimittelforschung 1996; 46 (8): 805-8.
[12] Solak N., Rollas S. Synthesis and anti-tuberculosis activity of 2-(aryl/alkyl amino)-5-(4-aminophenyl)-1, 3, 4-thiadiazoles and their Schiff bases. ARKIVOC 2006; 12: 173-81.
[13] Tsuge O., Kanemasa S. Recent advances in azomethine ylide chemistry in Advances in heterocyclic chemistry Jan 1 Academic Press 1989; 45 (23): 231-349.
[14] Maurya R. C., Patel P. and Rajput S., Synth. React. Inorg. Met. -Org. Chem., 33, 801 (2003)