International Journal of Pharmaceutical Research and Development (IJPRD)
Platform for Pharmaceutical Researches & Ideas
www.ijprd.com

SYNTHESIS, SPECTRAL CHARACTERIZATION AND BIOLOGICAL ACTIVITY OF SCHIFF – BASE METAL COMPLEX

Birendra Pratap Singh*

[1]*Department of Chemistry, University Institute of Engineering & Technology. C.S.J.M. University, Kanpur, India*

ABSTRACT

The synthesis, spectral characterization and biological activity studies of Cd(II) complex of Schiff base ligand is reported. The complex was derived from 2, 3, butadiene, thiosemicarbazide and cadmium(II) acetate with continuous stirring and refluxing at 80^0C for several hours. The complex was characterized by IR and NMR spectral techniques. The above data suggest a square pyramidal structure of Schiff base metal complex. The biological activity of Schiff metal complex has been tested in vitro against bacteria's showed good antimicrobial activity.

Key words: *Schiff base, antibacterial activity, 2, 3-butadiene, IR spectra.*

Correspondence to Author

Birendra Pratap Singh

Department of Chemistry, University Institute of Engineering & Technology. C.S.J.M. University, Kanpur, India

Email: bpsinghcsjm@gmail.com

INTRODUCTION

Schiff bases are generally bi or tridentate ligands capable of forming vary stable complexes with transition metals. The uses of Schiff base in dyes, where as some are used as liquid crystals. The biological importance of Schiff base appears to be important intermediates in a number of an enzyme with an amino or a carbonyl group of the substrate. The metallo- elements which are present in trace and ultra quantities play vital roles at the molecular level in a living system. In a healthy body of an adult, the trace and ultra trace elements weigh less than 10 grams in total but life depends upon these elements far more than this figure. The transition metal ions are responsible for the proper functioning of different enzyme. If their concentration exceeds a certain level, then their toxic effects are evident. Many of the well known antibiotics, penicillin, streptomycin, bacitracin and tetracylin are chelating agent, their action is improved by the presence of small amounts of metal ions binding of metallo – elements with polydentate ligands to form ring structure. Schiff base possess antibacterial[1-22], anti-HIV activity[23-24], antifungal[25], antiviral[26-27] and antitumor activity[28-31]. Schiff bases are important compound for their wide range of biological activity. A new kind of chemotherapeutic Schiff bases are now attracting the attention of biochemists. In the virus replication process the roll of metal ion is

extremely important. A virus can penetrate into the host's cell only when it is mediated by the same suitable metal ions. Zn present in the cell wall of the bacterium E. coli can coordinate with the sulphur sit present in the virus coating. By using any suitable metal complex like Cd which can preferably bind with the 'S' sit as virus the penetration of the viral DNA into the host cell can be arrested.

In view of the above facts I synthesized the new Schiff base of thiosemicarbazide by condensing 2, 3, butadiene and cadmium(II) acetate with continuous stirring and refluxing at 80^0C for several hours.

MATERIALS AND METHODS

(a) Materials and measurements

The chemicals and reagents, such as 2.3-butadiene, thiosemicarbazide, cadmium(II) acetate and organic solvents are used as obtained. All reagents are analytical grade and were used without further purifications. The infra red spectra were recorded on FT-IR spectrophotometer, brucker (vertex 70) using KBr pallets in a range of 4000-400cm^{-1}. Zeol 400 MHz spectrophotometer was used for recording the ^{1}H NMR spectra using CD_3OD as solvent and TMS as internal standard.

Synthesis of Schiff base lignad

15 ml of ethanolic solution of 2,3, butadiene (5 mmol) was added drop wise to the ethanolic solution (15 ml) of thiosemicarbazide (10 mmol) with continuous stirring and refluxing at 80^0C for 20 hours. A light yellow colored precipitate was obtained by filtration and recrystallized from MeOH/EtOH in 1:1 molar ratio. The product was dried under reduced pressure.

Synthesis of complex

A solution (40 ml) of Schiff base ligand (5 mmol) in ethanol was slowly added to the solution (40 ml) of cadmium(II) acetate (5 mmol) in the same solvent. The reaction mixture was refluxed for seven hours at 80^0C. The resulting desired product as a dark yellow solid was filtered, washed with ethanol and dried under reduced pressure.

(b) *Test Organisms*

The test microorganism used for the antibacterial activity was performed on broth and nutrient agar media which contains 0.5g peptone, 0.25g NaCl, 0.5g beef powder extract and 2.0g peptone, 1.0g NaCl, 2.0g beef powder extract, 4.0g agar, respectively. A bacterium was cultured over night at 28^0C for 24 hour in Muller Hington broth inoculums. Sterile Petri disc with a diameter of 6mm plates were prepared by pipetting 25µL volume of stock solution of extract (2mg/ml) on to sterile blank plates. The plates were air dried and stocked solution at 4^0C, used within two to three days, a plate containing metal complex was applied to incubated plates by using flamed forcipes.

Antibacterial activity of Schiff base ligand and their metal complex were evaluated by plate method using 1000µL of suspension containing 10^8 CFU/ml of bacteria spread on Mullar Hington Agar medium. The metal complex was dissolved in CH_3OH at a concentration of 100mg/ml. The disc (6 mm diameter) impregnated with 25, 50, 75 and 100µL of 1000 µL of complex solution placed on seeded agar and the disc plates were incubated at 28^0C for 24 hours depending on the diameter of zone inhibition formed around the plates.

RESULTS & DISCUSSION

Infra-red spectroscopy

The infrared spectrum (Fig. 1) of ligand indicated the presence of secondary amine N-H) and primary amine $\upsilon(NH_2)$ groups due to appearance of absorption of frequencies at 3414 $cm^{-1}$and 3234 cm^{-1}, respectively. The appearance of υ(C=N) group was confirmed by the absorption of frequency at 1600 cm^{-1}. The confirmation of υ(C=S) and υ(N-N) groups were observed due the appearance of peaks at 1492 cm^{-1} and 1456 cm^{-1}, respectively.

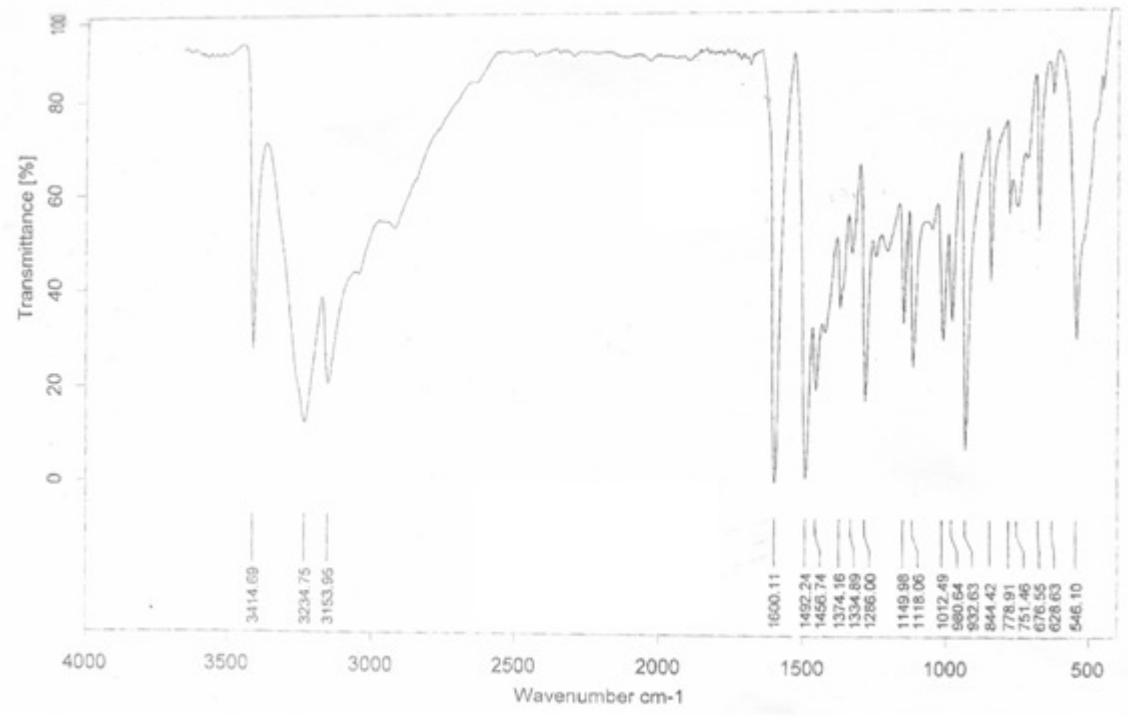

Fig. 1 IR spectrum of Schiff-base ligand

The IR spectrum (Fig. 2) of metal complex showed a bands at 3451 cm^{-1} and 1614 cm^{-1} corresponds to υ(NH_2) and υ(C=N), respectively. The bonds are shifted to lower frequencies in the spectrum of complex, 1492 cm^{-1} as compared to 1490 cm^{-1} and 1456 cm^{-1} as compared to 1443 cm^{-1} of ligand indicated the involvement of υ(N-N) nitrogen and υ(C=S) sulphur group, respectively, in coordination to the metal ion.

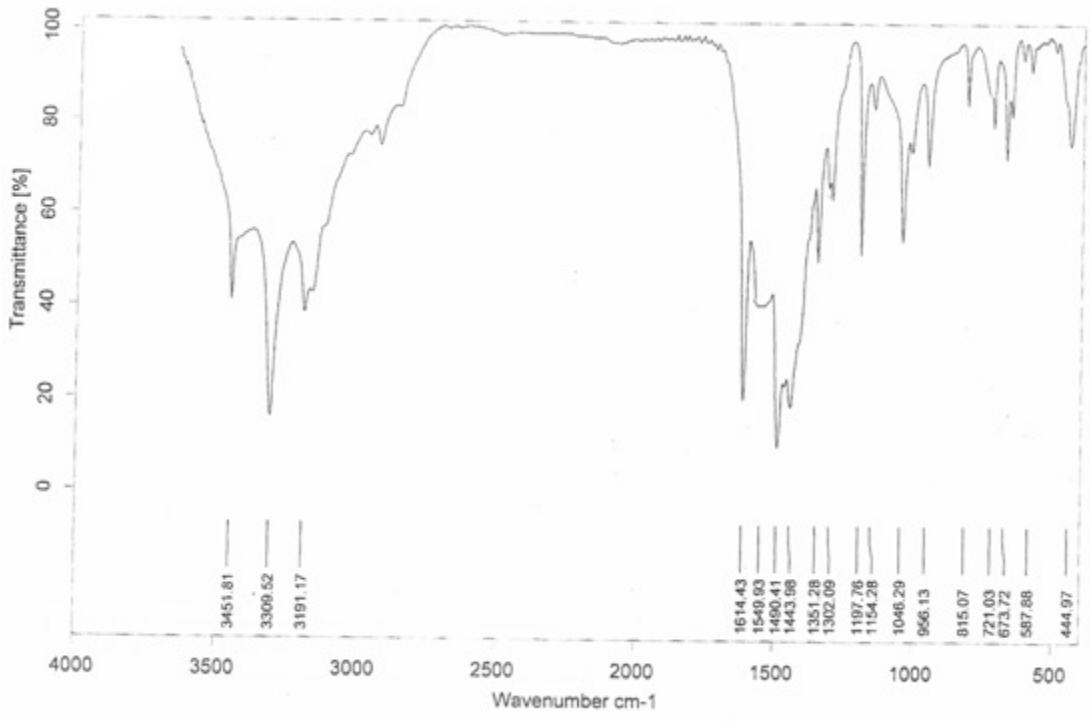

Fig: 2 IR Spectrum of Schiff-base metal complex

NMR Spectroscopy

The ^{1}H NMR spectrum (Fig. 3) of the ligand in CD_3OD showed a singlet peak at 2.54 ppm (6H, s) confirms the presence of methyl group. The appearance of the peak at 8.4 ppm (4H, s) was occurred due to the presence of -NH_2 group. The secondary amine was confirmed by the appearance of the peak at 10.7 ppm (2H, s).

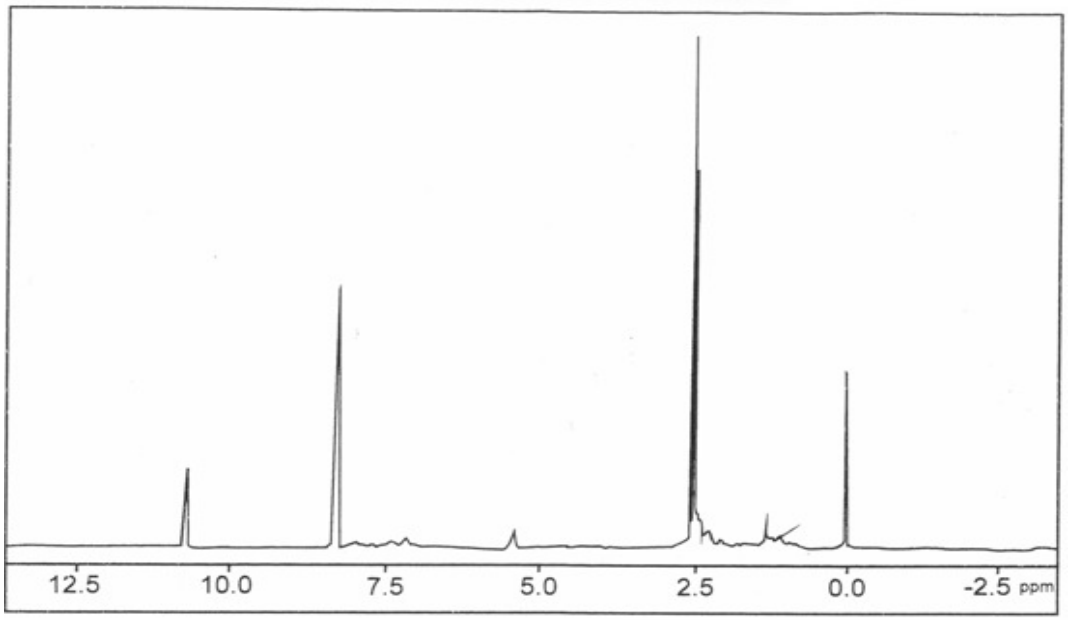

Fig: 3 ^{1}H NMR spectrum of Schiff-base ligand

The presence of methyl group was confirmed due to the appearance of peak at 2.08 ppm (6H, s) in the spectrum (Fig. 4) of metal complex. The confirmation of -NH_2 group was indicated by the appearance of peak at 8.46 ppm. The removal of N-H proton was observed by the absence of peak of proton in the spectrum of metal complex. The -NH_2 proton signal in the spectrum of complex was shifted downfield as compared to the free lignad, suggested deshielding of -NH_2 group due to coordination with metal ion.

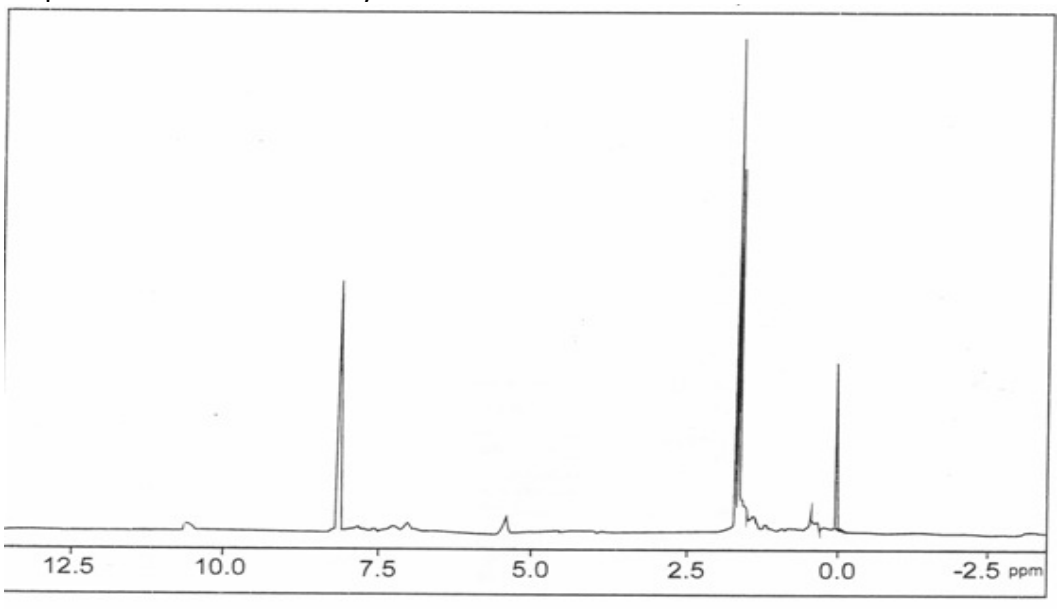

Fig: 4 ^{1}H NMR spectrum of Schiff-base metal complex

Antibacterial activity

The Schiff base ligand and its metal complexes are playing an important role in medicinal chemistry. To contribute in the field, the Schiff base metal complex was evaluated for antibacterial activity against Escherichia coli and Pseudomonas aeruginosa bacteria's. The minimum inhibitory concentrations values of the complex are summarized in table 1. The activity of the Schiff base metal complex increases as concentration increases because concentration plays an important role in the measurement of antimicrobial activity. 100 µL concentration of metal complex was observed inhibitorier as compared to 25µL, 50 µL and 75 µL concentrations against Escherichia Coli and Pseudomonas aeruginosa. The presence of Cd-metal ion is also increasing the biological activity of metal complex.

Table 1. Antibacterial activity of Schiff base metal complex

Concentrations of sample	**Escherichia Coli**	**Diameter of growth of inhibition zone (mm)**	**Pseudomonas Aeruginosa**	**Diameter of growth of inhibition zone (mm)**
25 µL	++	15	+	10
50 µL	+++	21	++	13
75 µL	++++	23	+++	14
100 µL	+++++	25	++++	15

CONCLUSION

The Schiff metal complex was synthesized from the reaction of 2, 3-butadiene, thiosemicarbazide and cadmium (II) acetate in ethanol with continuous stirring and refluxing at 80^0C for several hours. The investigated complex was characterized by various spectral techniques such as IR and NMR spectroscopy. The IR spectra of the complex showed the lower shifting in the frequencies after the coordination of metal ion to the ligand. The down field shifting in NMR spectra indicated the coordination of metal ion to sulphur and nitrogen after the removal of N-H proton. Based on these data a square pyramidal geometry (Fig. 5) has been assigned for the Schiff base metal complex. Antibacterial activities have been shown that the metal complex have a significant biological activity against the tested microorganisms.

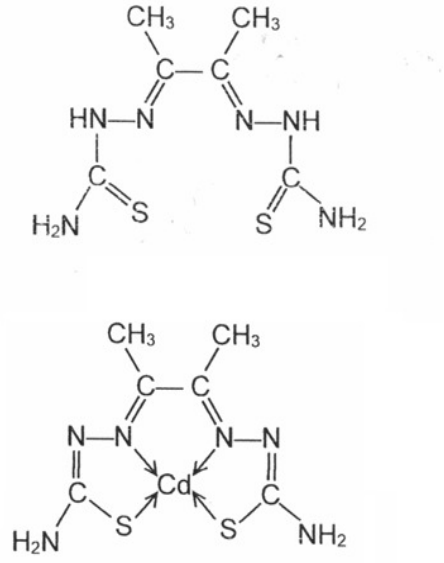

Fig: 5 Structures of Schiff-base ligand and metal complex

ACKNOWLEDGEMENTS

Author is thankful to the Director, University Institute of Engineering & Technology, C.S.J.M. University, Kanpur for providing laboratory facilities.

REFERENCES

1. Song L, Xie Y, Wang H, Synthesis and antibacterial activity of benzimidazole Schiff base, Zhonggu Yaowu, Huaxue Zaahi, 10**,** 2000, 92-94.
2. Patel V K, Jejurkar C R, Mixed Schiff base complexes and their applications as pigments and antibacterial agent, Orient J Chem, 10, 1994, 63-65.
3. Mishra P, Gupta N P, Shakya K A, Synthesis of Schiff bases of 3-amino-2-methylquinazolin-4(3H) ones and their antimicrobial activities, J Ind Chem Soc, 68, 1991 618-619.
4. Csaszar J, Morvay J, Herczey O, Antibacterial activities of 5-nitro-2-furaldehyde of Schiff bases with sulfonamides, Acta phys Chem, 31, 1985, 717-22.
5. Pop R D, Donea A, Chiorean V, Farcasan V, The biological activity of some Schiff bases of 4-aminobiphenyl and 2-phenyl-4-(p-aminophenyl) thiazole, Stud Univ Babes-Bolyan Chem, 32, 1987, 85-89.
6. More P G, Bhalvankar R B, Pattar S C, Schiff bases derived from substituted-2-aminothiazole and substituted salicylaldehyde and 2-hydroxy-1-napthaldehyde exhibits antibacterial and antifungal activity, J Indian Chem Soc*,* 78, 2001, 474-475.
7. Jeewoth T, Bhowon M G, Wah H, Li K, Synthesis and antibacterial properties of Schiff bases and metal complexes derived from 2,3 diaminopyridine, Trans Met Chem, 24, 1999, 445-448.
8. Hossain M E, Alam M A, Ali M A, Nazimuddin M, Smith F E, Hynes R, Bioactivities of Cu(II) complexes of the 2-acetyl pyridine Schiff bases of 5-methyl and 5-benzylidithicarbazate, Polyhedron, 15, 1996, 973-80.
9. Bi S, Li G, Synthesis, characterization and antifungal activity of metal complexes of the Schiff bases derived from 4-acetylbiphenyl and 5- benzyldithiocarbazate, Synth React Inorg Met-org Chem, 29, 1999, 1829-1841.
10. Huang Z, Qu S, Feng Y, The antibacterial activity of o-vanilline glucosamine Schiff base Zn complex, Huaxue Yanjiu Yu Yingyong, 10, 1998, 595-599.
11. Zhang S, Jia Y, Miao F, Synthesis, characterization and bacteriostatic activity of compound derived from PMTFP and salicylic hydrazide, Tianjin Shifan Daxue Xuebao*,* Ziran Kexueban, 23, 2003, 4-6.
12. Ding F, Jia Y, Wang J, Synthesis, characterization and antibacterial activities of Schiff base derived from PMBP and p-aminodimethylaniline and its transition metal complexes, Yingyong Huaxue, 21, 2004, 835-837.
13. Chohan, Zahid H, Farooq M A, Scoozzafava A, Supuran C T, Antibacterial Schiff bases of oxalyl-hydrazine diamide in corporating pyrrolyl and salicyl moieties and of their zinc(II) complexes, J Enzy Inhib Medi Chem, 17, 2002,1-7.
14. Bi X, Bi X, Li T, Synthesis, characterization and antibacterial activity of complexes of bis- Schiff bases from difurfural-1,2-phenylenediamine, Huayong shikan*,* 14, 2000, 22-24.
15. Baseer M A, Jadhav V D, Phule R M, Archana Y V, Vibhute Y B, Synthesis and antibacterial activity of new Schiff base, Orient J Chem, 16, 2000, 553-556.
16. Mulwad V V, Shriodkar J M, Synthesis and biological activity of Schiff bases, thiazolidinones and azetidinones of 4-hydroxy coumarin, Indian J Hetero Chem*,* 11, 2002, 199-202.
17. Shikkargol R K, Mallikarjuna N N, Angadi S D, Synthesis, characterization and biological activities of La(III) complexes with indole Schiff bases, Nat Acad Sci Lett, 24, 2001, 39-43.
18. Tian H, Wei J, Wang L and Zhu W, Synthesis, characterization and antibacterial activities of p-flurobenzaldehyde Schiff base, Huaxue Shiji, 25, 2003, 227-228.
19. Raman M, Muthuraj V, Ravichandran S, Kulandaisamy A, Synthesis, characterization

and electrochemical behaviour of Cu(II), Co(II), Ni(II) and Zn(II) complexes derived from acetylacetone and p- anisidine and their antimicrobial activity, Indian Acad Sci Chem Soc, 115, 2003, 161-167.
20. Desai J M, Desai K K, Synthesis and antibacterial activity of oximes semicarbazone and thiosemicarbazones, Asian J Chem, 11,1999, 1071-1073.
21. Brousse B N, Massa R, Monglioni A G, Alho M M, D' Accorso N, Gutkind G, Moltrasio G Y, Antibacterial and antifungal activity of some thiosemicarbazones and 1,3,4-thiadiazolines, J Chilean Chem Soc, 49, 2004, 45-49.
22. De B, Marbaniang E M, Kalita R, Debnath M, Das M C, Kalita U, Lalfukmawia S, Gupta J K, Antimicrobial activities of Schiff base of 1-aminoethyl 2, 4-substituted imidazolin-5-(4H)-ones, J Inst Chemists (India), 77**,** 2005, 20-22.
23. Pandeya S N, Sriram D, Nath G, De C E, Synthesis and antimicrobial activity of Schiff base and Mannich base of Istain and their derivatives with pyrimidine, Farmaco, 54, 1999, 624-628.
24. Kar D M, Sahu S K, Paradhan D, Dash G K, Mishra P K, Synthesis, antimicrobial and anti-inflammatory activities of some novel isatinoid compounds, J Teach Res Chem, 10, 2003, 20-24.
25. Dash B, Mahapatra P K, Panda D, Patnaik J M, Fungicidal activities of Schiff base derived from p-hydroxybenzaldehydes and their derivatives, J Indian Chem Soc, 61, 1984, 1061-1064.
26. Mirzabdullaev A B, Aslanova D Kh, Ershov F I, Prep. Induktory Interferona (Imst Biol Org Khim, Tashkent USSR) 1981, 129-344.
27. Meng F, Zhao Q, Li M, Xin Y, Yingyong Huaxue, 19, 2002, 1183-1185.
28. Parashar R K, Sharma R C, Mohan G, Biological activity of some Schiff bases and their metal complexes, Biol Trace Elem Res, 23, 1989, 145-50.
29. Gaowen Y, Xiaping X Huan T, Chenxue Z, Synthesis antitumor activity of Schiff base Coordination compounds, Yingyoung Huaxue, 12, 1995, 13-15.
30. Sharma K P, Jolly V S, Pathak P, Schiff base and their derivatives as potential anticancer agents, Ultra Sci Phys Sci, 10, 1998, 263-266.
31. Phatak P, Jolly V S, Sharma K P, Synthesis and biological activities of some new substituted aryl azo Schiff base, Orient J Chem, 16, 2000, 493-494.

*****