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Review Article

A COMPREHENSIVE REVIEW ON SYNTHESIS AND BIOLOGICAL ACTIVITY OF SCHIFF BASES

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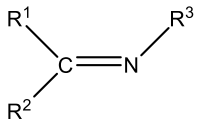
ABSTRACT

The chemistry of Schiff base containing compounds has been an interesting field of study from ancient years. Subsequently, Schiff base constitutes a significant class of compounds for new drug development. Schiff bases are the most widely used organic compounds. They are broadly utilized for industrial purposes and also exhibit a broad range of biological activities. The basic mechanism involved is a two step addition elimination mechanism. In the first step, the nitrogen base adds to the carbonyl compound to give a carbinolamine intermediate, followed by elimination of water to form the carbon-nitrogen double bond. Schiff bases are synthetically accessible and structurally diverse compounds, typically obtained by facile condensation between an aldehyde or a ketone with primary amines. These compounds along with their metal complexes are considered to be an important as catalysts in various biological processes. The search for Schiff base containing compounds with more selective activity and lower side effects continues to be an active area of argument examination in medicinal chemistry. This review summarizes the synthesis and biological activities of Schiff bases and their complexes.

Keywords: Antimicrobial, Anti-inflammatory, Anticancer, Schiff base, Synthesis

INTRODUCTION

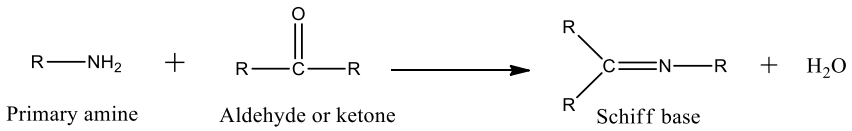
Schiff base (have been reported by Hugo Schiff) is a compound with the common structure $R_2C=NR'$ ($R' \neq H$). Schiff base can be considered a sub-class of imines, being either secondary ketimines or secondary aldimines depending on their structure. The word is often synonymous with azomethine which refers purposely to secondary aldimines (i.e. R-CH=NR' where $R' \neq H$).[1] The significance of Schiff bases and their metal complexes are significant as analgesic[2-3], anti-inflammatory[4-8], anticancer[9-13], anticonvulsant[14] and antimicrobial activities[15-24].



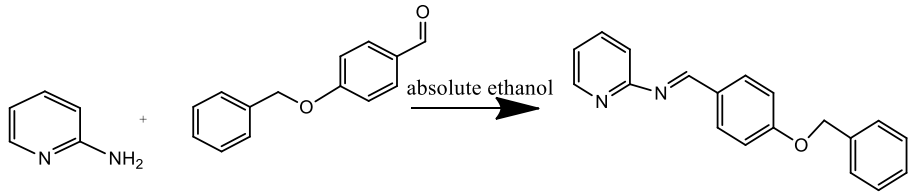
R^1, R^2, and/or R^3=alkyl or aryl

General structure of a Schiff base

It is generally formed by condensation of an aldehyde or ketone with a primary amine according to the following scheme[25].

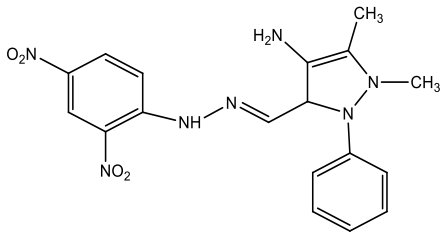


Aysen *et al* have reported the synthesis, characterization and investigation of antibacterial activities on five bacteria of Schiff base ligands. By the elemental analysis, FT-IR, ^1H NMR was used to characterize Schiff base ligands. From 4-benzyloxy-benzaldehyde and 2-aminopyridine (4-benzyloxy-benzylidene) pyridine-2-yl-amine was derived[26].



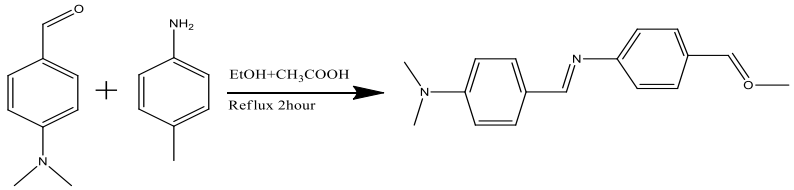
Scheme-1

Ak Kaura *et al* reported the synthesis of some novel Schiff bases of biological importance. With the help of agarwell diffusion method all the compounds have been screened for their *in vitro* antibacterial activity against two Gram +ve and two Gram –ve bacterial strains. It has been found that amongst all the test compounds taken for antibacterial evaluation, Compound 1 has shown maximum activity against *Bacillis subtilies*[27].



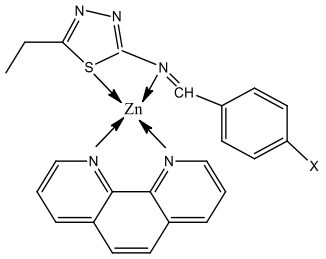
1

Ibrahim Razzaq *et al* reported transition metal complexes of Mn(II), Co(II) and Ni(II) which is derived from 4-aminoantipyrine, p-dimethyl amino benzaldehyde, p-amino benzaldehyde to give the following ligand 4-(4-(4-dimethyl aminobenzylideneamino) benzylideneamino)-1,5-dimethyl-2-phenyl-pyrazol-3 one[28].



Scheme-2

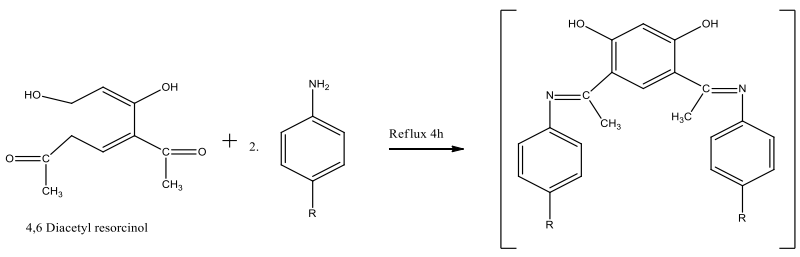
The synthesis of three zinc (II) complexes of thiadiazole derived Schiff base ligand describes by the KRM Naveen *et al*. The antibacterial investigations disclosed that the tested zinc (II) complexes illustrated potent microbial growth inhibition than their relevant thiadiazole Schiff base ligands[29].



X=Br,Cl,

2

Pandya H. Jignesh *et al* prepared two new series of Copper (II), Nickel (II) and Cobalt (II) complexes with two newly synthesized Schiff base ligands H2L1, H2L2. Through the condensation of 4, 6-diacetyl resorcinol with 4-bromo aniline and 4-methoxy aniline, H2L1 and H2L2 ligands of Schiff bases were synthesized. The outcomes of the biological screening disclose that the antimicrobial activities of the chelated ligands are superior as evaluated to the free ligands[30].

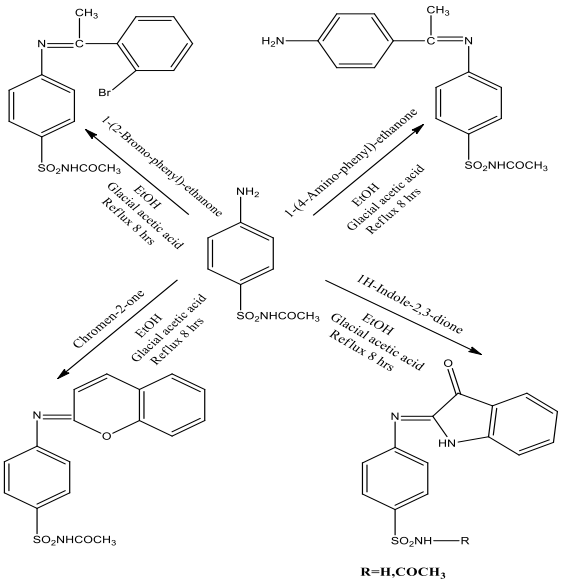


4,6 Diacetyl resorcinol

where R= C-Br for H_2L^1,-OCH_3 for H_2L^2
4,6-bis(1-(4-substituted-phenylimino) ethyl)benzene-1,3-diols

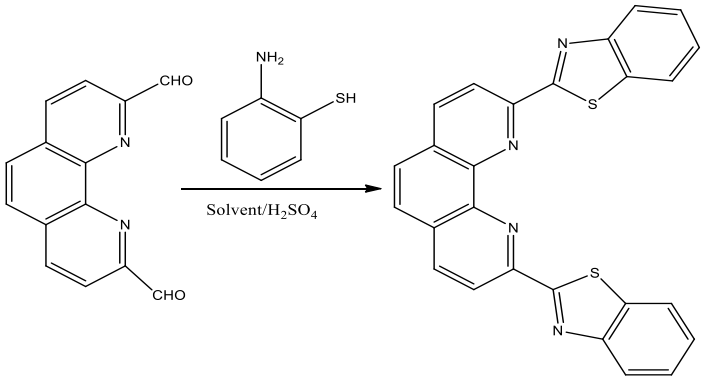
Scheme-3

Sonu *et al* have synthesize the superior antimicrobial compounds with Different substituted aromatic aldehydes / acetophenone are selected as the starting material for the synthesis of Schiff Bases by means of sulphonamide assists to formation of Schiff bases in presences of alcohol and acidic reagent. All the synthesized Schiff bases of sulphacetamide have revealed excellent antimicrobial activity[31].



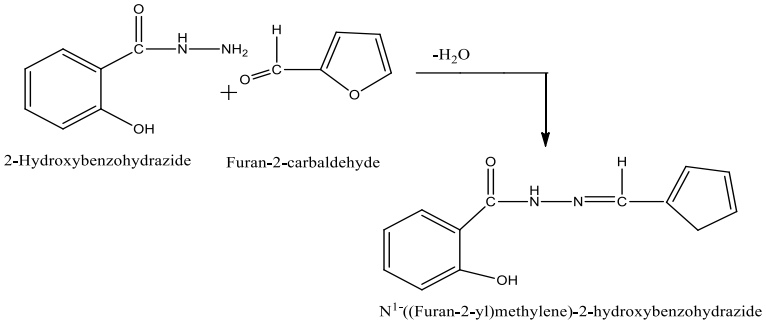
Scheme-4

Arifuzzaman Md. *et al* have synthesized four new Schiff bases with sulfur-containing amines such as 2-mercap- to aniline, S-alkyl/aryl dithiocarbazates and thiosemicarbazide of 1,10-phenanthroline-2,9-dicarboxaldehyde[32].



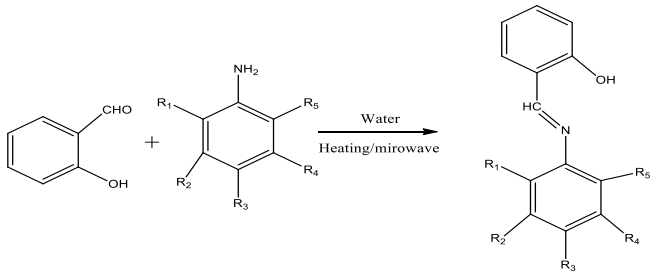
Scheme-5

Mangamamba T. *et al* have prepared Coordination complexes through metal ions Cu (II), Ni (II), Co (II), Fe (III), Mn (II), Cr (III), and VO (II) with six ligands formed through condensation products with azides and aldehydes or ketones are characterized. When compared to the activity of the commercial standard, the VO (II) complexes are found to be more potent[33].



Scheme-6

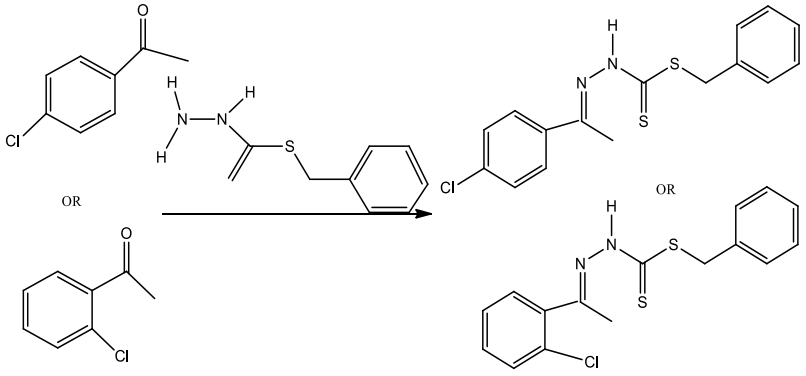
Bhagat Sunita *et al* have synthesized a series of Salicylaldehyde-based Schiff bases under microwave irradiation. It involves the condensation of Salicylaldehyde with various aromatic amines within water in microwave irradiation[34].



R_1=F,R_2=H,R_3=F,R_4=H,R_5=H
R_1=H,R_2=H,R_3=Cl,R_4=H,R_5=H
R_1=F,R_2=F,R_3=F,R_4=F,R_5=H
R_1=H,R_2=H,R_3Br,R_4=H,R_5=H
R_1=H,R_2=H,R_3=F,R_4=H,R_5=H

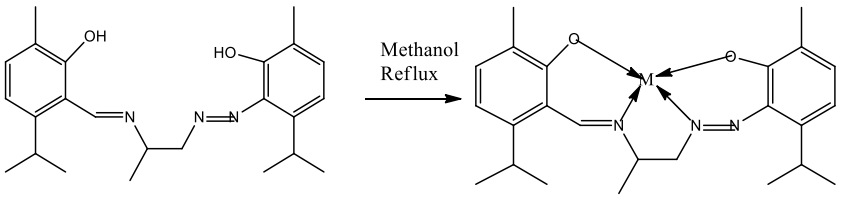
Scheme-7

From the condensation of S-benzyldithiocarbazate (SBDTC) with 2-chloroacetophenone and 4-chloroacetophenone to give S-benzyl-*β*-N-(2- chlorophenyl)methylenedithiocarbazate (NS2) and S-benzyl-*β*-N-(4 chlorophenyl)methylenedithiocarbazate (NS4) isomer, two bidentate Schiff base ligands having nitrogen sulphur donor sequence were reported by Khaled Mohammed *et al*. Anti microbial assay established the potential of NS2 and its complexes as well-built antimicrobial agents and the generally higher biological activity possessed by NS2 when compared to NS4[35].



Scheme-8

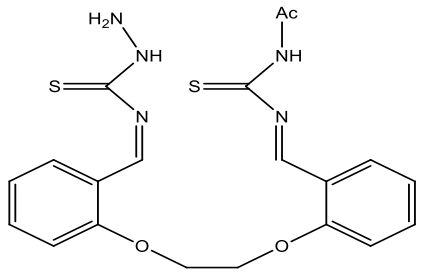
Tadavi K. Samina *et al* prepared [MnL], [CoL] and $[NiL]_2$ complexes from a novel schiff base H2L which derived from the simple condensation of 2-hydroxy-6-isopropyl-3-methyl benzaldehyde and 1,2-diaminopropane in 2:1 M ratio[36].



M= Mn, Co and Ni

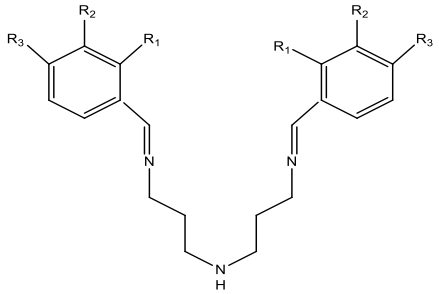
Scheme-9

Ehab M Zayed *et al* reported novel Schiff bases (Figure 8). Their biological activities have been checked *in vitro* against *Escherichia coli, Proteus vulgaris, Bacillis subtilies* and *Staphylococcus aurous* bacteria in order to evaluate their antimicrobial potential[37].



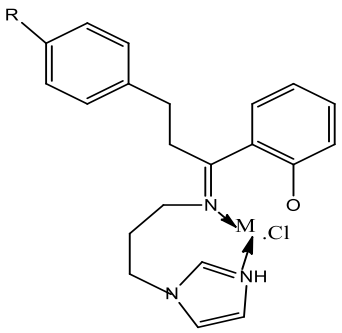
3

Six Schiff bases Synthesized by SA Matar *et al* through reacting 3, 3' -diaminodipropylamine with different benzaldehyde derivatives. The synthesized compounds were evaluated for *in vitro* antimicrobial activity against a number of Gram-positive and Gram-negative bacteria. These compounds confirmed bacteriostatic rather than bactericidal activities against Gram positive and Gram-negative bacteria[38].



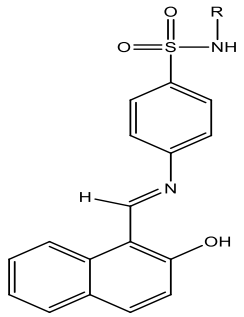
4

Kalanithi M *et al* reported tridentate Co (II), Ni (II), Cu (II) and Zn (II) complexes of chalcone based ligands of schiff bases 2-[1-(3-(1H-imidazol-1-yl) propylimino)-3-(phenylallyl)]phenol, 2-[1-(3-(1H-imidazol-1- yl)propylimino)-3-p-tolylallyl]phenol, and 2-[1-(3-(1H-imidazol- 1-yl)propylimino)-3-4-nitrophenylallyl]phenol (Figure 5)[39].



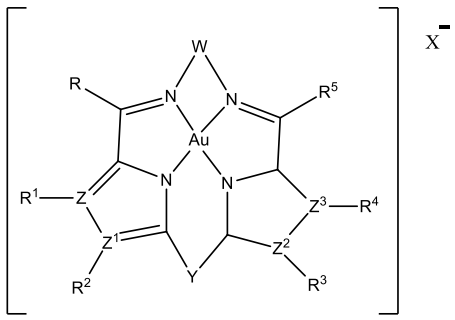
5

S Mondal *et al* synthesized schiff bases with the help of condensation of sulfonamides (sulfathiazole, sulfa pyridine, sulfadiazine, sulfamerazine and sulfa-guanidine) and 2-hydroxyl naphthaldehyde[40].



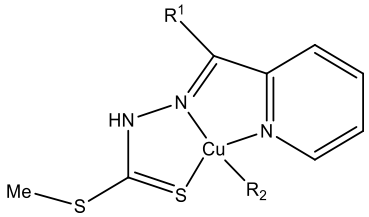
6

Munro *et al* synthesized gold (III) complexes, resultant from Schiff bases, as potent cytotoxic agents, by reacting two equal amount of 1 H-pyrrole-2-carbaldehyde or 5-methyl-1 H imidazole- 4-carbaldehyde with diamines (1,2 or 1,3-diaminoalkanes). *In vitro* evaluation of these complexes showing cytotoxicity against the cancer cell[41].



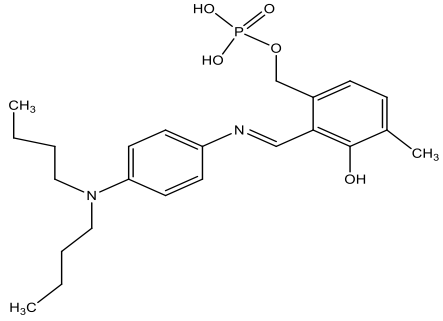
7

Djaballah H *et al* reported Schiff base copper complexes as reversible allosteric inhibitors of the enzyme caspase (typically caspase 9 and caspase 3) that are also capable of disrupting tumor necrosis factor-α (TNAFα)[42].



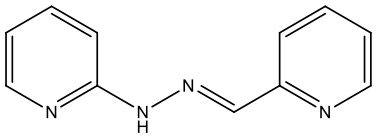
8

Tan Y *et al* synthesized schiff bases by reacting pyridoxal-5′-phosphate with N, N- dibutyl-p-phenyldiamine for purpose of homocysteine[43].



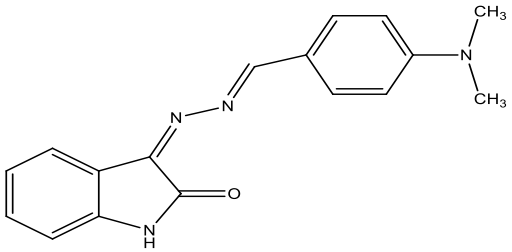
9

Al-Nuri MA *et al* synthesized six heterocyclic Schiff bases as novel anti glycation agents Schiff base was established as the most potent anti glycating agent surrounded by all the compounds[44].



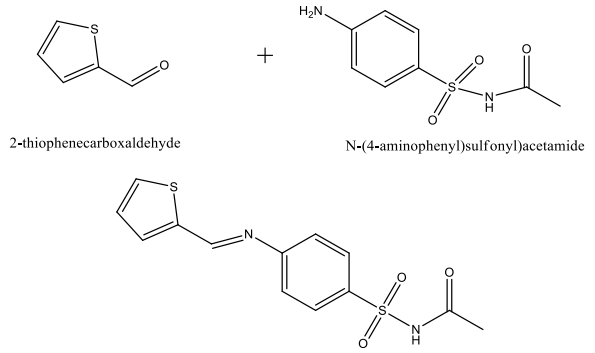
10

Sangamesh A. Patil *et al* reported the preparation of Co (II), Ni (II) and Mn (II) metal complexes of new is a tin schiff base ligand and the complexes show activity against *Mycobacterium tuberculosis* strain (H37Rv)[45] .



11

Ahmad S. Abu-Khadra *et al s*ynthesized the Metal complexes of (*E*)-*N*-(4-(thiophen-2-ylmethyleneamino) phenylsulfonyl) acetamide (S.TH) Schiff bases resulting from sulfacetamide (*N*-[4-(amino-phenyl) sulfonil] acetamide) and 2-thiophenecarboxaldehyde. Complexes have shows potential activity upon screening for the antifungal and antibacterial characteristics[46].



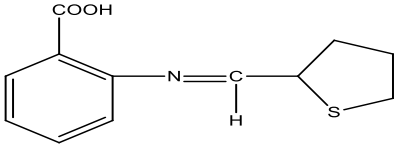
2-thiophenecarboxaldehyde

N-(4-aminophenyl)sulfonyl)acetamide

(E)-N-(4-(thiophen -2-ylmethyleneamino)phenylsulfonyl)acetamide

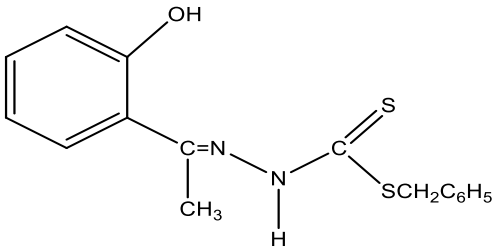
Scheme-10

A.V.G.S. Prasad *et al* reported the Schiff base from 2-thiophene-carboxy- aldehyde and 2- nitro benzoic acid. By various spectroscopic studies, the chemical structures of the Schiff-base ligand and its metal complexes were confirmed. The experimental results recommended that Schiff base derivatives are much potent in antibacterial and antifungal activities[47].



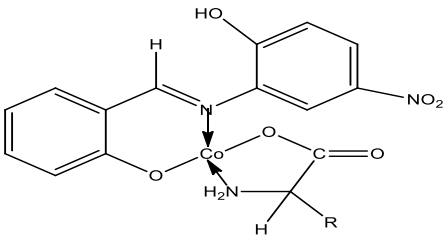
12

D. Nasrin *et al* synthesized the Schiff base ligand through the condensation reaction of S-benzyldithiocarbazate with 2-hydroxyacetophenone. The produced compounds have been checked for their antibacterial and antifungal studies[48].



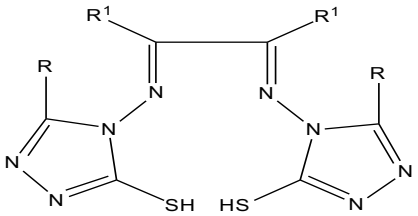
13

Ajay R. Patil *et al* prepared Co (II) complexes of Schiff base 2-amino-4-nitrophenol-N-salicylidene with amino acids[49].



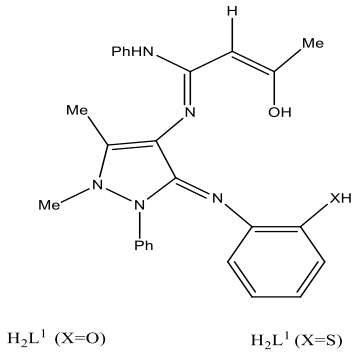
14

M. S. Yadawe *et al* synthesized Complexes of Co (II) and Ni (II) with new Schiff bases through the 4-amino-5-sulfanyl-1.2.4-triazoles and glyoxal, biacetyl or benzil. Various of the complexes were screened for their antibacterial and antifungal activity, and one of the Co (II) complex was evaluated for oxytocic Moreover, complex(c) (R; Me, R1; H) was establish to inhibit the oxytoxic activity of oxytocin on isolated rat uterus[50].



15

Natarajan *et al* synthesized neutral tetradentate chelate complexes of Cu (II), Ni (II), Co (II), Mn (II), Zn (II) and VO (II) in EtOH using Schiff bases resultant from acetoacetanilido-4-aminoantipyrine and 2-aminophenol/2-aminothiophenol. The *in vitro* antimicrobial activity of the investigated compounds was tested against the microorganisms, a large amount of the metal chelates have higher antimicrobial activity than the free ligands[51].



H_2L^1 (X=O) H_2L^1 (X=S)

16

CONCLUSION

The impact of Schiff bases in medicinal chemistry is deep rooted. Schiff base ligands are believed advantageous ligands because they are easily prepared by a simple one pot condensation of an aldehyde and primary amines. These compounds and their metal complexes had a diversity of applications including clinical, analytical, industrial they also play significant roles in catalysts. In this review, the biological activities of Schiff base and its complexes have been summarized. Thus Schiff bases derivative can be further explored for development of potent medicinal agents.

REFERENCES

1. https://en.wikipedia.org/wiki/Schiff base
2. Chinnasamy RP, Sundararajan R, Govindraj S. Synthesis characterization and analgesic activity of novel Schiff base of isatin derivatives. Journal of Advanced Pharmaceutical Technology and Research 2010; 3: 342-347.
3. Arora R, Kapoor A, Gill NS and Rana AC. Synthesis of novel Schiff bases of 5–aminosalicyclic acid by grinding technique and its evaluation for anti-inflammatory and analgesic activities. International Research Journal of Pharmacy 2012; 3(7).
4. Alam MS, Choi JH, Lee DU. Synthesis of novel Schiff base analogues of 4-amino-1,5-dimethyl-2-phenylpyrazol-3-one and their evaluation for antioxidant and anti-inflammatory activity. Bioorganic and Medicinal Chemistry 2012; 20(13): 4103-4108.
5. Bassyouni F, Abu-Bakr S, Hegab K, El-Eraky W, El Beih A and Rehim M. Synthesis of new transition metal complexes of 1 H-perimidine derivatives having antimicrobial and anti inflammatory activities. Research on Chemical Intermediates 2012; 38(7): 1527.
6. Bhosale PP, Chavan RS and Bhosale AV. Design Synthesis, Biological Evaluation of thiazoyl Schiff base derivatives as novel anti-inflammatory agents. Indian Journal of Chemistry 2012; 51B: 1649 – 1654.
7. Ghadage RV and Shirote PJ. Synthesis of some new Schiff bases of quinoxaline-2(1H)-one as potent anti-inflammatory agents. International Journal of Research and Development 2011; 3(7): 157-164.
8. Hussein MA, Omar RH and Farghaly HS. Design, synthesis, structure elucidation and biochemical evaluation of some novel anti inflammatory Schiff base derivatives bearing pyrazolo [3,4-D] pyrimidine-4-ones. International Journal of Academic Research 2011; 3: 454-462.
9. Kamel MM, Ali HI, Anwar MM, Mohamed NA, Soliman AM. Synthesis, antitumor activity and molecular docking study of novel Sulfonamide-Schiff's bases, thiazolidinones, benzothiazinones and their C-nucleoside derivatives. Eur J Med Chem 2010; 45(2): 572-580.
10. Gursoy E, Guzeldemirci Ulusoy N. Synthesis and primary cytotoxicity evaluation of new imidazo [2,1-b]thiazole derivatives. European Journal of Medicinal Chemistry 2007; 42(3): 320-326.
11. F Shabani, L A Saghatforoush, S Ghammamy. Synthesis, characterization and anti-tumor activity of iron (III) Schiff base complexes with un-symmetric tetradentate ligands. Bulletin of the Chemical Society of Ethiopia 2010; 24(2): 193-199.
12. R. Miri, N. Razzaghi-asl and M. K. Mohammadi. QM study and conformational analysis of an isatin Schiff base as a potential cytotoxic agent, Journal of Molecular Modeling 2013; 19(2): 727–735.
13. S. M. M. Ali, M. Abul Kalam Azad, M. Jesmin *et al*. *In vivo* anticancer activity of Vanillin semicarbazone, Asian Pacific Journal of Tropical Biomedicine 2012; 2(6): 438–442.

A. K. Chaubey and S. N. Pandeya. Synthesis and anticonvulsant activity (Chemo Shock) of Schiff and Mannich bases of Isatin derivatives with 2-Amino pyridine (mechanism of action), International Journal of Pharmaceutical Technology and Research 2012; 4(4): 590–598.

14. http://dx.doi.org/10.1007/s11243-011-518-7
15. http://dx.doi.org/10.1007/s11243-011-485-z

A. K. Singh, O. P. Pandey and S. K. Sengupta. Synthesis, Spectral Characterization and Biological Activity of Zinc (II) Complexes with 3-Substituted Phenyl-4-Amino-5-Hydra- zino-1, 2, 4-Triazole Schiff Bases, Spectrochimica Acta Part A: Molecular and Bio molecular Spectroscopy 2012; 85(1): 1-6.

16. A .B. Gunduzalp and H. F. Ozbay. The Synthesis, Characterization and Antibacterial Activities of Dinuclear Ni (II), Cu (II) and Fe (III) Schiff Base Complexes1, Russian Journal of Inorganic Chemistry 2012; 57(2): 257-260.
17. M. Kalanithi, M. Rajarajan, P. Tharmaraj and C. D. Sheela, Redox and Antimicrobial Studies of Transition Metal (II) Tetradentate Schiff Base Complexes, Spectrochimica Acta Part A: Molecular and Bio molecular Spectroscopy 2012; 87: 155-162.
18. N. Mahalakshmi, R. Rajavel. Synthesis, spectroscopic, DNA cleavage and antibacterial activity of binuclear schiff base complex, Arabian Journal of Chemistry 2014; 7: 509-517.
19. Mohammed Fakruddin Ali Ahmed and V. Mahammad Yunus. Microwave Synthesis and Antimicrobial Activity of Some Cu (II), Co (II), Ni (II) and Cr (III) complexes with Schiff base 2,6-Pyridine dicarboxaldehyde Thiosemicabazone, Oriental Journal Of Chemistry (An International Open Free Access, Peer Reviewed Research Journal): 0970-020 X CODEN: OJCHEG, 2014; 30(1): 111-117.
20. Mohammed Fakruddin Ali Ahamed, Venkatesan Jayakumar. Microwave Synthesis and Antimicrobial Activity of Novel Metal-Complexes with Schiff Base 2, 5-Thiophene Dicarboxaldehyde-Thiosemicarbazone, Scholars Academic Journal of Pharmacy (SAJP), Sch. Acad. J. Pharm., 2014; 3(5): 406-410.

21. S.Chandraleka, G.Chandramohan, D. Dhanasekaran, P. Meenakumari and A. Panneerselvam. Antifungal activity of amino acid schiff base Copper (II) complexes with phenanthroline and Bipyridyl, International Journal of Chemical and Analytical Science,: 0976-1206, 2011; 2(10): 1235-1240.
22. Gajanan M. Dongare. Synthesis, Characterization and bacterial Screening transition metal Complexes tridentate Schiff bases of Benzene diamine, Journal of Medicinal Chemistry and Drug Discovery, Special Issue, Analytical Chemistry Teachers And Researchers, Association, National Convention/Seminar; 2015. p. 2347-9027.
23. http://shodhganga.inflibnet.ac.in/bitstream/10603/8812/6/06_chapter%201.pdf
24. Demir M A, Okalp B and Mercirmek B. Synthesis and antibacterial activity of schiff base derivatives. International Journal of Drug Development and Research 2010; 2: 0975-9344.
25. Kaura AK and Kaura M, Synthesis ,spectral and comparative antimicrobial study of schiff bases, International Journal of Pharmaceutical Chemistry 2012; 3 (4): 0976-9390.
26. Ibrahim R A. Preparation and characterization of some transition metal complexes of bis schiff base ligand. International Journal of Applied Research 2015; 3: 2320-5407.
27. Naveen KRM, Shiva PK, Nayak S and Prasad N. Novel Zinc (II) complexes with thiadiazole containing schiff bases: Synthesis and structural characterization. Journal of chemistry 2016; e-: 2319-9849,p-:2322-00.
28. Jignesh HP, Rajendra NJ and Kalpesh JG. Spectral characterization and biological evaluation of schiff bases and their mixed ligand metal complexes derived from 4,6-diacetylresorcinol. Journal of Saudi Chemical Society 2014; 18: 190-199 .
29. Sonu, Arvind K, Sabiya P and Himanshu P. Synthesis and antimicrobial study of some new schiff bases of sulphonamides derivatives. International Journal of Research in Science and Pharmacy 2017; 2231-2781.
30. Md. Arifuzzaman Md. R. Karim, Tasneem A S, Aminul H M, *et al* .Synthesis and characterization of new schiff bases formed by condensation of 2,9-phaenathroline-1,10-dialdehyde with sulfur-containing amines. International Journal of Organic Chemistry 2013; 3: 81-86.
31. T. Mangamamba, M.C. Ganorkar, and G. Swarnabala. Characterization of complexes synthesized using schiff base ligands and their screening for toxicity two fungal and one bacterial species on rice pathogens. International Journal of Industrial Chemistry 2014; article id 736538.
32. Sunita B, Nutan S,Tejpal S C. Synthesis of some salicylaldehyde-based schiff bases in aqueous media. Journal of Chemistry 2013; article id 909217.
33. Md. Khaled BB, M. Ibrahim, M. Tahir, Karen A.C and Teng- JK. Synthesis, characterization and bioactivity of schiff bases and their Cd^{2+} , Zn^{2+}, Cu^{2+} and Ni^{2+} complexes derived from chloroacetophenone isomers . Bioinorganic chemistry and applications ,vol .2013 ;article id 362513.
34. Samina KT, Abhijit AY and Ratnamala SB. Synthesis and characterization of a novel schiff base of 1,2-diaminopraopane with substituted salicylaldehyde and its transition metal complexes. Journal of Molecular Structure 2018; 1152: 223-231.
35. EM Zayed, ME Desawy. Preparation and structure investigation of novel Schiff bases using spectroscopic, thermal analyses and molecular orbital calculations and studying their biological activities 2015; 134: 155-164.
36. SA Matar, H Wamidh, B Talib, S Mohammad Mustafa, S Mohammad, *et al*. Synthesis, characterization, and antimicrobial activity of Schiff bases derived from benzaldehydes and 3, 30-diaminodipropylamine. Arabian Journal of Chemistry 2013; 8(6): 850-857.
37. M Kalanithi, M Rajarajan, P Tharmaraj, CD Sheela. Spectral, biological screening of metal chelates of chalcone based Schiff bases of N-(3-aminopropyl) imidazole. Mol Biomol Spectrosc 2012; 87: 155-162.
38. S Mondal, SM Mandal, TK Mondal, C Sinha. Spectroscopic characterization, antimicrobial activity, DFT computation and docking studies of sulfonamide Schiff bases. J Molecular Structure 2017; 11(27): 557- 567 .
39. Munro OQ, Akerman KJ, Akerman P. Gold complexes for use in the treatment of cancer; 2013. US20130090472.
40. Djaballah H, Feldman T, Jiang X, et al. Allosteric reversible pancaspase inhibitors 2012; WO2012134822.
41. Tan Y, Li S. Schiff-base conjugate of n, n-dibutyl-p-phenylenediaminewith pyridoxal 5′-phosphate for improved homocysteine assays using pyridoxal 5′-phosphate-dependent enzymes.2014;US20140193801.
42. Al-Resayes SI, Warad I, Al-Nuri MA, *et al*. Heterocyclic schiff's bases as novel and new anti glycation agents; 2014; US20140221429.
43. Sathe BS, Jagtap VA, Sreenivasa GM. Synthesis, characterization and *in-vitro* anti inflammatory evaluation of new fluorobenzothiazole Schiff bases. Int. J. Phar. Tech. Res 2011; 3(3): 164-169.
44. Ahmad S A-K, Ahmed SA, Amr Md. Rabie SF and Hassan Y A-E .Preparation ,characterization and antimicrobial activity of schiff base of (E) –N- (4-(Thiophen-2-ylmethyleneamino)phenylsulfonyl)acetamide metal complexes. The open bioactive compounds Journal 2018; 6: 1-10.
45. A.V.G.S. Prasad, P. Venkateswara Rao, P.S.S. Prasad. Spectral and Biological studies of Manganese (II) and Cobalt (II) Complexes with Schiff Base Derived from 2-Thiophenecarboxylaldehyde and 2-nitrobenzoic Acid, International Journal for Pharmaceutical Research Scholars (IJPRS), No: 2277 – 7873, 2014; V-3, I-1: 91-94
46. D. Nasrin,M. Ashraful Alam, M. Nazmul Hossain and M. Nazimuddin. Synthesis, Characterization and antimicrobial activity of Schiff Base metal complexes derived from S-benzyldithiocarbazate with 2-hydroxyacetophenone. Chemistry Journal 2049-954X 2013; 3(1): 13-19.
47. Ajay R. Patil, Kamini J. Donde, Sambhaji S. Raut, Vishwanath R. Patil and Rama S. Lokhande. Synthesis, characterization and biological activity of mixed ligand Co (II) complexes of schiff base 2-amino-4-nitrophenol-n-salicylidene with some amino acids Journal of Chemical and Pharmaceutical Research,: 0975-7384, CODEN(USA) : JCPRC5 2012; 4(2): 1413-1425.
48. http://dx.doi.org/10.1023/A:1018400121316
49. N. Ramam, A. Kulandaisamy, C. Thangaraja and K. Jeyasubramanian. Redox and Antimicrobial Studies of Transition Metal (II) Tetradentate Schiff Base Complexes, Transition Metal Chemistry 2003; 28(1): 2936.

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