# METAL COMPLEXES OF SCHIFF BASES AND THEIR POTENTIAL APPLICATIONS

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## Introduction

Metal complexes are crucial to industrial, medicinal, and agricultural chemistry. For the synthesis of complex chemicals known as Schiff bases, which are condensation products of primary amines and aldehydes or ketones, ligands—metals encircled by clusters of ions or molecules—are utilized. In addition to certain applications as antifertility and enzymatic agents, this study addresses usage of Schiff bases and their metal complexes as catalysts in diverse biological systems, polymers, and colors.

## Catalysts

Oxygenation, hydrolysis, electro-reduction, and decomposition6 are all processes that are catalyzed by aromatic Schiff bases or their metal complexes. In the oxygenation of alkene, four coordinated Co(II) Schiff base chelate complexes exhibit catalytic activity. Phenols (naphthol) are oxidized by metalloporphyrins. Some copper complexes made with amino acids increase hydrolysis rate by 10 to 50 times more than a single copper (II) ion. Oxygen electro-reduction by the synthetic iron (II) Schiff base complex is catalyzed. Some metal complexes of a polymer-bound Schiff base exhibit catalytic activity in the oxidation of ascorbic acid and the breakdown of hydrogen peroxide. Complexes of cyanohydrins and cobalt show catalytic activity.

biological processes

## Microbiological Activities

Escherichia coli, Staphylococcus aureus, Bacillus subtilis, and Proteus vulgaris are all susceptible to the antibacterial properties of schiff base, which is produced from furylglyoxal and p-toluidene. Pathogenic bacteria are resistant to thallium (I) and benzothiazoline complexes, which have antibacterial action. Different metal complexes in the IInd and IVth oxidation state that were produced with aniline interact differently with certain microorganisms. Mo (IV) and Mn (II) metal complexes with hydrazine carboxamide and hydrazine carbothiamide as ligands have antibacterial action against S. aureus and Xanthomonas compestris, respectively. E. coli, S. aureus, B. subtilis, and B. pumpilis are all susceptible to the antibacterial effects of tridentate Schiff bases and their metal complexes. A few aldimines, pyrazines, Schiff bases produced from amino acids, and Schiff bases formed from heterocylic ketone have antibacterial action. A few heterocyclic Schiff bases have antimicrobial properties. Schiff bases produced from isatin have anti-HIV and antimicrobial properties. Schiff bases show antibacterial activity. Schiff bases, which are ligands with cyclo-butane and thiazole rings, have antibacterial properties.

Antibacterial activity is shown by the Schiff bases of pyrolidione, pyridone with o-

phenylenediamine, and their metal complexes. Tauriene N-5 chloro-salicylidiene Colibacillus and Pseudomonas aeruginosa are resistant to the antibacterial effects of Schiff base and its Cu, Ni complexes. Mycobacterium smegmatis and M. lovis BCG are more resistant to the antimycobacterial effects of Schiff base conjugates of p-amino salicylic acid. Antibacterial action is shown by Schiff base in combination with thiophene carboxaldehyde and aminobenzoic acid. Bacteriostatic action against B. subtilis, E. coli, and S. aureus is shown using lysine-based Schiff bases and their complexes with La, Co, and Fe. Complexes of Zn (II), Cd (II), Ni (II), and Cu (II) with semicarbazide, furfural, and furfurylidene diamineSchiff bases with have antimicrobial properties. S. typhi, S. aureus, Kelbsiella pneumoniae, B. subtilis, and S. flexneri are all susceptible to the antibacterial effects of salicylidene derivatives64, neutral tetra-dentate ligand, and metal-complexes. Organo-silicon (IV) complexes with bi-dentate Schiff bases, as well as organo-silicon (IV) complexes with nitrogen donar ligands of sulpha medicines, are all capable of inhibiting the growth of bacteria. Schiff bases and their metal complexes' antibacterial activity against E. coli may be investigated using microcalorimetry.

Antifungal Procedures

Benzothiazole and thiazole Schiff bases have potent antifungal properties. Methoxy, halogen, and napthyl groups increase Curvularia-targeting fungicidal action. When used against A. niger, pyrandione Schiff bases have physiological action. Candida albicans, Trichophyton rubrum, T. mentagrophytes, A. niger, and Micosporum gypsum are all susceptible to certain Schiff bases of quinazolinones, which have antifungal properties. nictoinamide furfurglidene A. niger, Alternaria solani, and Collectotricum capsici are all susceptible to the antifungal effects of Schiff base.

The antifungal properties of Schiff bases and their metal complexes against Helminthosporium gramineum (which causes stripe disease in barely), Syncephalostrum racemosus (which causes fruit rot in tomato), and C. capsici (which causes die back disease in chillies) are demonstrated. Additionally, the metal complexes of the ligands hydrazine and carbothioamide have antifungal action against A. alternata and H. graminicum. Complexes of molybdenum and manganese prevent illness in the brinjal crop, which is brought on by A.alternata. A. niger and A. alternata are both susceptible to the microbiological activity of Schiff bases and metal complexes generated from benzothiazole or phenyl-azo-thiazole. Biocidal activities may be shown in the tridentate Schiff base and their metal complexes. Thallium (I) complexes with benzothiazolines, copper (II) complexes with benzoylpyridine, and ruthenium (II) complexes with Schiff base salicyladmine Schiff base has antifungal properties. Triazole-oxyvanadium (IV) complexes have antifungal action.

A. niger and A. alternata are resistant to A. (III), Sb (III), and Bi (III) complexes81 with o-tolylammonium di-thiocarbamate. A few new Schiff bases82 generated from cephalexin and their metal complexes have antifungal properties. Salicylaldehyde- and boronate-derived Schiff bases83 have antifungal properties against A. niger and A. flaves. Tetranychus bimaculatus may be killed by the Schiff base of salicylaldehyde and O,O-di-methyl thiophosphoramide and their complexes with Cu(II), Ni(II), and Zn(II).

**Virological Activities**

Gossypol Schiff bases have significant antiviral action. Cucumber mosaic virus was inhibited by silver complexes86 in oxidation state I; glycine salicylaldehyde Schiff base Ag (I) produced efficient results up to 74.7% against C. mosaic virus.

Synergistic Insecticide Action

The complexes of Schiff base, which is formed from salicylaldehyde or thiophene-2-aldehydes and sulfane thiadizole, are poisonous to insects.

An step in the manufacture of photostable pyrthriod insecticides is amino acid. On the aldehyde portion of the Schiff base, flourination89 increases insecticidal action. The insecticidal properties of schiff bases (thiadiazole derivatives with salicylaldehyde or o-vanillin) and their metal complexes with Mo (IV) against bollworms are shown, and they also increase the cell survival rate of mung bean sprouts.

With wheat, rye, and barley seedlings, Plant Growth Regulator N-acetylated compounds exhibit growth inhibitory action. Schiff bases demonstrate amazing actions of plant hormones like auxins on root development. As a plant growth hormone, Schiff base of ester and carboxylic acid has outstanding efficacy. Thiodiazole Schiff bases have strong auxin and cytokin95-regulatory action in plants.

**Additional Therapeutic Exercises**

Numerous Schiff bases have anti-inflammatory, allergy inhibitory, radical scavenging, analgesic, and anti-oxidative properties. Schiff bases99 generated from thiazoles have analgesic and anti-inflammatory properties. Chitosan and carboxymethyl-chitosan's Schiff bases have antioxidant properties including superoxide and hydroxyl scavenging. Significant anthelmintic and analgesic activities may be found in furan semicarbazone metal complexes.

**Cytotoxic and anti-tumor properties**

Salicylidiene anthranilic acid, , exhibits complexation behavior with copper complexes and antiulcer action that increases. Salicylaldehyde, dihydroxybenzaldehyde, glycine, and L-alanine were used to synthesis certain Schiff bases and their metal complexes including Cu, Ni, Zn, and Co. These compounds have anticancer activity, and their order of reactivity with metal complexes is Ni>Cu>Zn>Co. High action against human tumor cell lines is possessed by Schiff bases generated from aromatic and heterocylic amines. Aryl-azo Schiff bases 105 have anti-cancer properties. Indole-2-caboxaldehydes' Schiff bases have inhibitory effects on K B cell lines. In vitro anticancer effects are shown by diorgano- tin (IV) complexes and Schiff base, which also block interactions with K B HCT-8 and BEL-7402 tumor cell lines.

**Polymers**

When done in solution and with ethylene-diammine, photochemical breakdown of natural rubber produces amine108 terminated liquid natural rubber (ATNR). When ATNR is combined with glyoxal, ploy Schiff base108 is produced, improving age resistance. Tridentate-organocobalt complexes The co-polymerization of dienyl and vinyl monomers in an emulsion is initiated by the schiff base.

**Enzymatic Activity and Infertility**

Reproductive physiology may be affected by Schiff bases15 of hydrazine carboxoamide and hydrazine as well as metal complexes of dioxo Mo (IV) and Mn (II). Protein enzyme activity is abolished by Schiff base linkage with pyridoxal 5'phosphate from lysine to alanine or histidine. Dyes Cobalt complex, chromium azomethine complex a compound with an asymmetric Schiff base of Leather, food packaging, wool, and other materials may be dyed quickly using 1:2 chromium dyes. Textiles made of cellulose ployester are dyed using azo groups that include metal complexes. Polyfibers are mass-dyed using a few metal complexes. Salicylaldehyde with diamine, a Schiff base with cobalt complex 112, has high light resistance, great storage

properties, and does not deteriorate even in acidic gases (CO2). In order to determine the presence of Ni in various natural food samples, novel tetra dentate Schiff base is used as a chromogenic reagent118.

**Different Applications**

According to the chemistry of amine-induced head separation and pyridoxal action, Schiff base119, which is generated between proteins in the nuclear membrane, connects the head and tail of sperm. N-salicylaldehyde amino glucose (SG) Schiff base complex 120 with Cu (II) and Zn (II) significantly inhibited the production of oxygen. Cu (SG) had a greater inhibitory impact than Zn (SG). DNA from salman sperm is combined with the complexes Cu and Co. In the formation of amylose, the tetradentate Schiff base and its metal complexes with Mn (II), Ni (II), Cu (II), and Zn (II) have various effects on the membrane. While Ni (II) and Cu (II) complexes impeded it, Zn (II) and Mn (II) complexes enhanced amylose transit through membrane.

There is some simple harmonic generating activity in certain Schiff bases121. Amido-Schiff base functions as a thrombin inhibitor by forming chelates with Cu (II) and Fe (II). In the breakdown of Schiff bases produced from aldose, carnosine and anserine function as efficient trans-glycating agents.

**References**

*1. Dhar D N & Taploo C L, Schiff bases and their applications, J Sci Ind Res, **41** (1982) 501-506.*

*2. Nishinaga A, Yamada T, Fujisawa H & Ishizaki K, Catalysis by cobalt Schiff complexes in the oxygenation of alkenes on the mechanism of ketonization, J Mol Catal, **48** (1988) 249-64, (1276); Chem Abstr, **111** (1989) 22902.*

*3. Xi Z, Liu W, Cao G, Du W, Huang J, Cai K & Guo H, Catalytic oxidation of naphthol by metalloporphyrins, Cuihau Xuebao, **7** (1986) 357-63; Chem Abstr, **106** (1987) 140082.*

*4. Chakraborty H, Paul N & Rahman M L, Catalytic activities of Schiff bases aquo complexes of Cu(II) in the hydrolysis of aminoacid esters, Trans Met Chem (Lond), **19** (1994)524-526.*

*5. Zhao Y D, Pang D W, Zong Z, Cheng J K, Luo Z F, Feng C J, Shen H Y& Zhung X C, Electochemical studies of antitumor drugs, fundamental electrochemical characteristics of an iron(III)Schiff base complex and its interaction with DNA, Huaxe Xuebao, **56** (1988)178-183; Chem Abstr, **128** (1998) 252661.*

*6. Sreekala R, Yusuff K K & Mohammed, Catalytic activity of mixed ligand five coordinate Co (II) complexes of a polymer bound Schiff base, Catal (Pap Natl Symp), (1994) 507-510; Chem Abstr, **130** (1999) 115551.*

*7. Beokon Y N, Bulychev A G, Maleev V I, North M, Malfanov I L & Nikolai S, Asymmetric synthesis of cyanohydrins catalysed by a potassium bis [ N-salicylidene-(R) tryptophanato] cobaltate complex, Mendeleev Comm, (2004) 249-250; Chem Abstr, **143** (2005) 277534.*

*8. Saxena C G, & Shrivastava S V, Mn(II) ,Co(II) ,Ni(II) and Cu(II) complexes with p-toly-2-furylgloxalimine, J Ind Chem.Soc, **64** (1987) 685-686.*

*9. Bhardwaj C N & Singh V R,Synthesis and characterization of thallium(I) complexes of biologically active benzothiazolines, Indian J Chem, **33A** (1994) 423-425.*

*10. Bharamagouclar T D, Pujar M A & Alagawadi A R, Biological activity of Schiff base and their metal complexes, Curr Sci, **56** (1987) 889-890.*

*11. Grumus, F, Gurkah P, Gunduz. N, & Abbasoglu U, In vitro antibacterial activities of Schiff bases and Ni (II) complexes, (FABAD) Farm Bilmer Derg**, 19** (1994) 5-8; Chem Abstr, **121** (1994) 153127.*

*12. Deshmukh M D & Doshi A G, Synthesis of Schiff bases and their applications, Orient J Chem, **11** (1995) 86-96; Chem Abstr,**123** (1995) 256269.*

*13. Tumer M, Koksal H, Serin S & Digrak M, Antimicrobial study of mononuclear and binuclear mixed ligand Cu(II) complexes, derived from 1,10-phenanthroline, Trans Met Chem (Dordrecht Neth.), **24** (1999) 13-17.*

*14. Dholakiya P P & Patel M N, Synthesis and antimicrobial activity of Mn(II),Co(II),Ni(II),Cu(I) and Cd(II)*

*complexes with bidentate Schiff base and 2,2'bipyridylamine, Synth react Inorg Met Org Chem,* ***32*** *(2002) 753-762; Chem Abstr,* ***137*** *(2002) 178002.*

*15. Singh R, Gupta N & Fahmi N, Biochemical aspects of dioxomolybdenum(VI) and manganese (II) complexes, IndianJ Chem,* ***38 A*** *(1999) 1150-1158.*

*16. Ranga S P, Sharma S, Chowdhary V, Parihar M, & Mehta R K,Spectral and antibacterial investigation on tridentate Schiff bases and their Co(II),Cu(II) and Ni(II) complexes, J Curr Bio Sci,* ***5*** *(1988) 98-100.*

*17. Chohan & Zahid H, Biologically active transition metal complexes of Ni(II),Cu(II) and Zn(II) with2-aminothiazole Schiff bases, Met-Based Drugs,* ***6*** *(1999)187-192; Chem Abstr,* ***131*** *(1999) 294750.*

*18. Chohan & Zahid H, Ni(II), Cu(II) and Zn(II) metal chelates with thiazole Schiff bases synthesis ,characterization and bactericidal properties, Met-Based Drugs,* ***6*** *(1999) 75-80; ChemAbstr,* ***131*** *(1999) 96444.*

*19. Cohan, Zahid H & Kausar S, Synthesis, characterization and biological effect of anions on Co(II) and Ni(II) chelates of tridentate Schiff base, J Chem Soc Pak,* ***23*** *(2001) 163-167; Chem Abstr,* ***136*** *(2002) 410591.*

*20. Nakamoto O & Hidaka A, Synthesis and resolution of some Schiff bases of biological interest, Delta J Sci,* ***15*** *(1991) 47- 56; Chem Abstr,* ***118*** *(1993) 16875.*

*21. Chohan, Hussain Z, Pervez & Humayun, Biologically active complexes of Ni(II) , Cu(II) and Zn(II) with tridentate NNO,NNS and NNN donor pyrazine derived ligands, Synth React Inorg Met Org Chem,* ***23*** *(1993) 1061-1071.*

*22. Malik Z A & Alam S, Antimicrobial screening and synthesis of aminoacid esters and their Schiff bases from indan-1,2,3,-trione,J Pure Appl Sci,* ***17*** *(1984) 69-76.*

*23. Cohan Z H, Praveen M & Ghaffar A, Strucural and biological behaviour of Co(II),Cu(II) and Ni(II) aminoacid derived Schiff bases, Met-Based Drugs,* ***4*** *(1997) 267-272; Chem Abstr,* ***128*** *(1998) 112790.*

*24. Sari N, Guerkan P & Arslan S, Synthesis, potentiometeric and antimicrobial activity studies on 2-pyridinylidene-DL-aminoacids and their complexes, rans Met Chem (Dordrecht, Neth),* ***28*** *(2003) 468-474.*

*25. Singh H L, Sharma M & Varshney A K, Synthesis, characterization and antimicrobial studies of tin(II) complexes with Schiff base of sulpha drugs, A C G C Chem Res Commun,* ***8*** *(1998) 35-40; Chem Abstr,* ***131*** *(1999) 110367.*

*26. Joshi K T & Pancholi A M, Synthesis, characterization and antibacterial activity of complexes of Schiff base derived from 2-amino-5-methyl-4-phenyl thiazole and heterocyclic ketone ²- diketone, Orient J Chem,* ***16*** *(2000) 287-290; Chem Abstr,* ***134*** *(2001) 80195.*

*27. Mishra V, Saksena D K & Jain M C, Synthesis and biocidal activity of iso thiocyanto chromium (III) complexes and some heterocyclic Schiff base, Synth React Inorg Met Org Chem* ***17*** *(1987) 987-1002.*