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A Review on Bioactivity and Catalytic Activity of Transition Metal Complexes

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ABSTRACT
Complexes exhibit a wide range and much attention in recent year due to unique biological activities including antifungal, antibacterial, antiviral, antitumor, and anticancer properties. Which have led to several reports being published on them? Numerous Schiff base complexes composed of metal ions exhibit high catalytic activity of some metals and were also utilised as catalysts in the polymerization and exhibit greater selectivity in various reactions, including oxidation, hydroxylation, aldol condensation and epoxidation. A number of Schiff base complexes have excellent heat and moisture stabilities, which made them valuable catalysts for high-temperature processes. Complexes are analysed with the help of conductivity measurements, magnetic susceptibility, UV-Vis, IR, thermal analysis, 1H- and 13C-NMR etc. In this review we are evaluate transition metals complexes of bioactivity, catalytic properties.
Keywords: Transition Metal Complexes, Bioactivity, catalytic activity etc.

I. INTRODUCTION

From the few years ago Schiff base complexes determine their use in both homogeneous and heterogeneous catalysis. The number of transition metal complexes is fascinating due to it discusses a grate luminosity of structural, Bio-physico chemical and catalytic properties[1]. Some of the transition metal complexes bioactivity has been investigate by molecular docking with DNA and various proteins, also to be involved in proliferation of viral diseases or progression of cancer[2]. A large variety of transition metal complexes and ligands possessing O, N and S atoms as a donor have been reported as structural and functional mimics of biological systems[3].We are reveals the on- going features of biological activities of metal complex such as anticancer, antifungal, antimalarial, antibacterial, antiproliferative, anti-inflammatory, and antipyretic. Apart from the biological activities of the metal complex it also shows excellent catalytic activity due to the thermal and moisture stabilities[4]. Our study focuses on the biological activities of protein binding, DNA binding, cytotoxicity, and antibacterial properties, and also examines molecular dynamics. The research field for these types of metal complexes is extensive and encompasses many interdisciplinary fields, including biology[5]. The interaction of DNA with metal complexes has been well studied and has led to development of new metal–based drugs and as

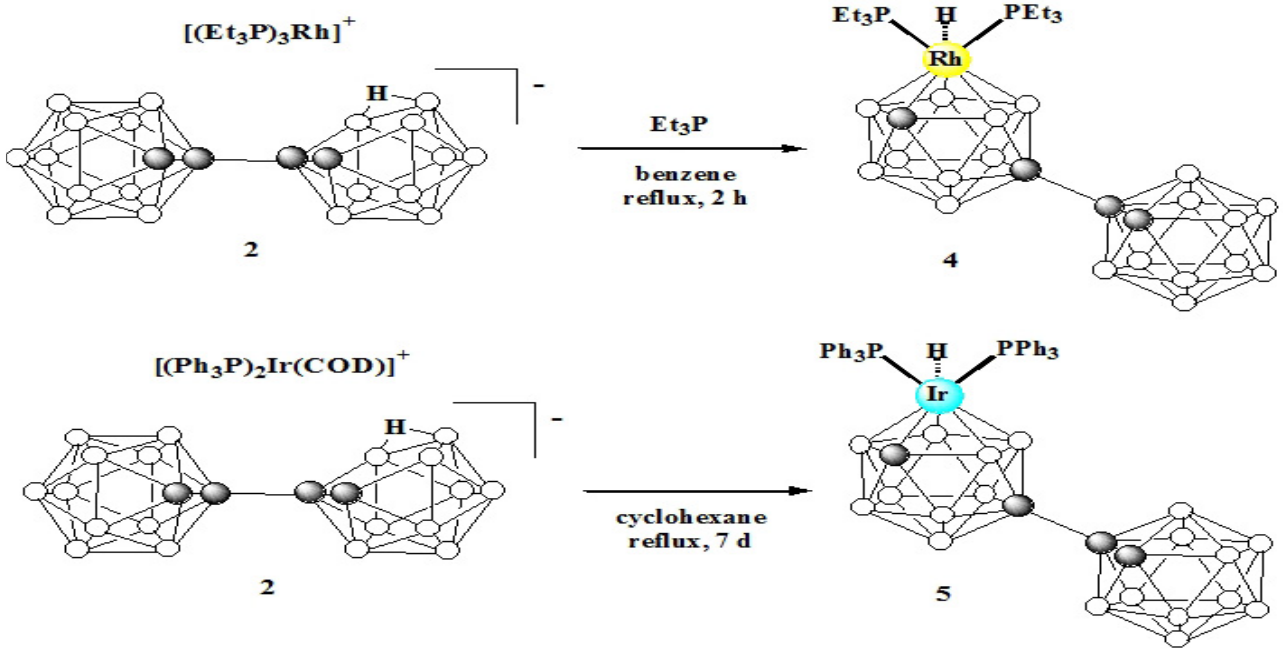
a DNA cleavage agents[6]. The heterocyclic Schiff base ligands and their metal complexes have been the subject of extensive investigation because of their wide use in biological field [7]. Schiff base complexes showed significant applications in reduction of ketones to alcohols[8]. Heterocyclic compounds possess impressive biological activity due to the strong aromaticity of the ring containing heteroatoms such as O, S, and N. Transition-metal complexes are widely used in the physical and biological sciences. They have essential roles in catalysis, synthesis, materials science, photo physics and bioinorganic chemistry. we thought it appropriate to devote one of the parts of this review to organic derivatives of 1, 10-bis (ortho-carborane) and this is various types of transition metal complexes with based ligands will be considered including those in which it acts as a deprotonated 6-ligand, or as a p-ligand formed by decapitation or reduction of the carborane cage as well as complexes based on phosphine derivatives of 1, 10-bis (ortho-carborane). There are two main types of metallacarborane based on icosahedral carboranes[9].

These structurally varied metal complexes have broad applications in the field of optoelectronics [10.] The Optoelectronic devices rely on light–matter interactions and electronic properties of matter to convert light into electrical signal or vice versa. There has always been a drive to improve light–matter interactions in semiconductor materials to make better optoelectronic devices. Solar cells[11] organic field effect transistors (OFETs) [12] and electrochromic devices.[13] an electrochromic device (ECD) controls optical properties such as optical transmission, absorption, reflectance and/or emittance in a continual but reversible manner on application of voltage (electrochromism). This property enables an ECD to be used for applications like smart glass, electrochromic mirrors, and electrochromic display devices. On the information of various researches paper the complexes of chromium (III) gives imminent antimicrobial properties.

II. RESULT AND DISCUSSION

I. B. Sivaev and Vladimir I. Bregadze[14]: The 1, 10 –bis (ortho-carborane) has capacity to undergo similar reactions to single-cage carboranes but with two important differences, specifically 1) reactivity at a single cage is significantly influenced by the presence of a bulky electron withdrawing substituent and 2) the reactions could occur at both cages and such reactivity could be either isolated or cooperative. They play important roles in the chemistry of transition metal complexes with 1, 10 –bis (ortho-carborane)-based ligands. In particular, the large size and strong electron withdrawing effect of ortho-carborane cage as substituent has strong impact on the stability of certain isomers of metalla -carboranes based on decapitated 1,10 –bis (ortho-carborane). All this makes the chemistry of 1, 10 -bis (ortho-carborane) and their transition metal complexes extremely exciting and one which attracts the growing interest of researchers. Since some of the transition metal complexes described from derivatives of 1, 10-bis (ortho-carborane), At first of all, it should be noted that organic chemistry of 1, 10-bis (ortho-carborane) is much less explored then its organometallic chemistry. Despite the fact that the CH groups of 1, 10-bis (ortho-carborane) are easily metalized, to using this way very less number of its organic derivatives were obtained. It was found that the carboranyl group in the 2,1,8-metallacarboranes 1,10-bis(ortho-carborane) 1 produces a racemic mixture of closo-nido-bis(carborane) enantiomers, and the second cage results in a mixture of racemic and meso nido-nido-bis(carborane) diasteromers 3 ([8-(10,20-closo-C2B10H11-10-)-2-(p-cymene)-2,1,8-closo-RuC2B9H10] (7), [8-(10,20-closo-C2B10H11-10-)-2-Cp-2,1,8-closo-CoC2B9H10] (9) and [8-(10,20-closo-C2B10H11-10-)-2-Cp*-2,1,8-closo-CoC2B9H10]. It should be noted that the presence two polyhedral with a different arrangement of metal and carbon atoms makes it difficult or impossible to establish the exact11B-11B structure of Metalla-carboranes

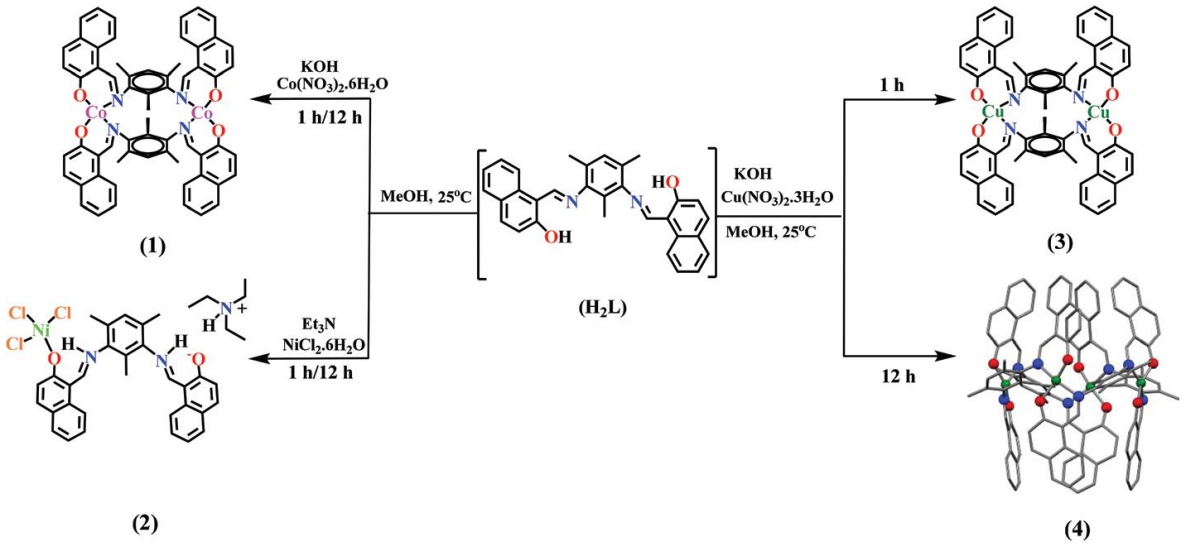
using COSY, NMR spectroscopy due to signal overlapping. Therefore, X-ray diffraction is critical for determination of molecular structures.



Enas S. Dafallah, et al[15]:

The complexes C_1, [VO_2(Sal-DAP)] and C_2, [VO_2(Sal-PA)] are characterized by conductivity measurements, magnetic susceptibility, UV-Vis, IR, thermal analysis, ^{1}H- and ^{13}C-NMR.The molecular structure of these complexes were confirmed using the DFT calculation to obtain the optimized geometries using the Gaussian09 program at the B3LYP/LANL2DZ level of theory. Synthesis, Characterization and DFT Calculations of Schiff base Vanadium (V) Complexes Derived from Salicyldehyde with 1, 2-Diaminopropane or 2-Picolylamine A Various vanadium complexes with ligands bearing oxygen and nitrogen donors have been reported as structural and functional mimics of biological systems. Vanadium complexes play an important role in biological as well as in catalytic processes[10]. In general, this leads to the presence of diasteromers generated by the additional chiral center at the vanadium site[16].

Anoop Kumar Saini et al[12]: they have designed and synthesized four new complexes with varying reaction conditions for their biological activity. The expressed various structure design that from monomeric to dimeric to tetrameric complexes by slightly neutering the reaction conditions. These complexes determine a strong interaction between complex 1 and 4 with BAS protein and DNA through Molecular docking and emission titration results are in agreement. The bioactivity of **1**–**3** have been investigated through molecular docking with DNA and various proteins, known to be involved in proliferation of viral diseases or progression of cancer. Complex **1** shows the best results, through strong binding affinity with NS2B/NS3 Protease (Dengue Virus) in terms of binding energy (11.21Kcal/mol.) and inhibition constant (6.02 nM). The experiment evidence for effective binding of **1**–**4** with Bovine Serum Albumin (BSA) protein and calf thymus DNA (CT–DNA) is in agreement with our molecular docking results. In addition, the cytotoxicity and antibacterial activity of **1**–**4** were examined and found to be compatible in biological system, with **4** showing highest antibacterial activity. The order of antibacterial activity towards Gram negative bacteria was found to be: 4 >1 > 3 > 2 determined. All four complexes were analysed by elemental analysis and UV/vis analysis, and their molecular structures were authenticated by single crystal X-ray studies.



Debdulal Maity[19]. **:** The transition metal complexes of ligands containing some hetero atoms, like oxygen, nitrogen and Sulfur donors show the carcinostatic, antitumour, antiviral, antifungal and antibacterial activities. Therefore, the research field involving these types of metal complexes is very extensive and includes a number of interdisciplinary areas such as bioinorganic chemistry, catalysis, magneto chemistry and photochemistry. Furthermore, with the developments in inorganic chemistry research people are having new ideas regarding versatile uses of metal complexes as therapeutic agents and as drugs for the treatment of several human diseases. Due to their potential applications in pharmaceuticals, antibacterial, antifungal, anticancer and anti-inflammatory actions synthesis of Schiff base metal complexes, particularly those of transition metal ions, with different molecular topologies and sets of donor atoms is becoming an emerging area of research[17].

Copper (II) complexes shows different properties like antifungal, antitumor, and antibacterial, leukaemia also the ligand containing thiosemicarbazide or semicarbizide group gives antimalarial property[18]. The ruthenium hexagonal coordination complexes shows antifungal property but it is toxic due to ligands are chelated form compare to free ligand complexes. With increases metal chelate toxicity will increase.

Fe (III) or Co (II) or Ni (II) or UO_2 (II) showed an excellent antibacterial activity against *Escherichia coli, Pseudomonas aeruginosa and Staphylococcus pyogenes*. Fe (III), Cu (II), Zn (II) and UO_2 (II) complexes can inhibit the growth of *E. coli*. Thus, these complexes could be applied fairly to prevent some common diseases caused by *E. coli*. Again the growth of Gram-positive bacterial strains (*Staphylococcus pyogenes* and *P. aeruginosa*) could be inhibited by using Fe (III), Co (II), Cu (II), Zn (II) and UO_2 (II) Schiff base complexes. As well as the Platinum(II) complexes are more active antimicrobials than the precursor Schiff base ligands against one or more microorganisms as well as it shows antibacterial property against *E. coli*, *Bacillus subtilis*, *P. aeruginosa*, *Staphylococcus aureus* Containing with salicylaldehyde and o/p –furaldehyde Schiff base complexes. Co (III) complex of a new hybrid amine-imine-oxime ligand derived from the condensation reaction of diacetylmonoxime with benzidine was reported to have antibacterial activity against *Bacillius subtilis*. But it has no activity against *Staphylococcus aureus* or the Gram-negative bacteria *Escherichia coli* and *Enterobacter fecalis*[20].The cobalt (III) complexes of such ligands found to be important due to their antibacterial or antiviral activities. In 1998, Epstein and co-worker's reported a series of Co (III) complexes (**1d**) containing N, O donor ligands of the following type for their use in the treatment of blindness in industrial nations, known as epithelial herpetic keratitis[21].

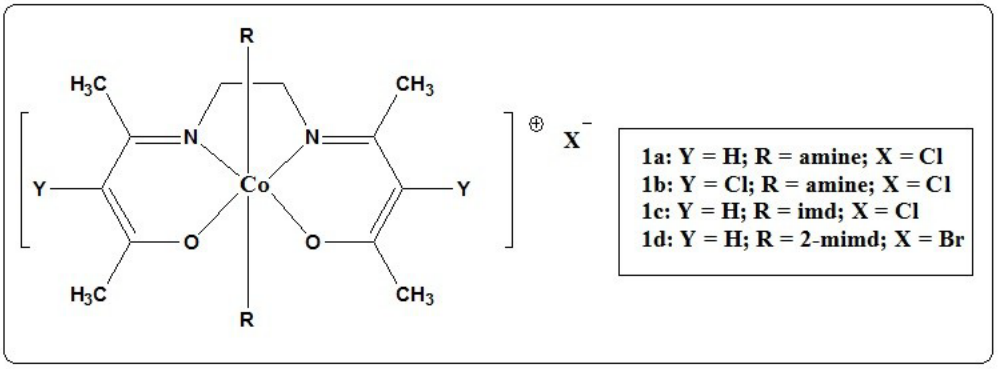
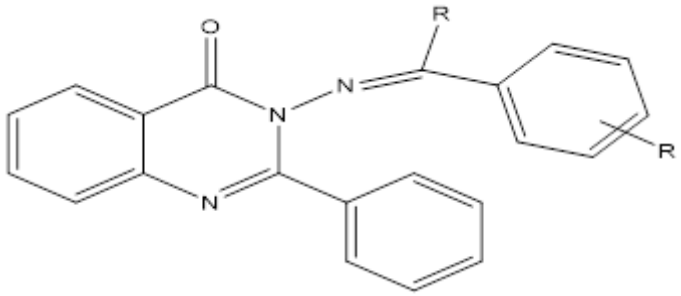


Fig. 1d.

These Co(III) Schiff base complexes have a capacity to inhibit Sp1, a DNA binding zinc finger protein and used in the treatment of human immunodeficiency virus type 1 (HIV-1)[22].

K.S. Kumar et al. synthesized a group of Schiff Base compound based on 3-(benzylideneamino)-2-phenylquinazoline-4(3H)-one and presented a detail report of anti-viral activity of these compounds against herpes simplex virus-1 (KOS), herpes simplex virus-2 (G), vaccinia virus, vesicular stomatitis virus, herpes simplex virus-1 TK- KOS ACVr, Para influenza-3 virus, reovirus-1, Sindbis virus, Coxsackie virus B4, Punta Toro virus, feline corona virus (FIPV), feline herpes virus, respiratory syncytial virus and influenza A H1N1 subtype, influenza A H3N2 subtype, influenza B[23].



Garcıa-Friaza et al.: Reported some Pd (II) and Pt (II) complexes with the following Schiff bases and studied anti-tumour activities, changing the substituents on the Pyridyl and toluene rings. In these two metals the Pd (II) complexes shows more activity than the Pt (II) complexes. All the complexes possess potential anti-cancer activities[24].

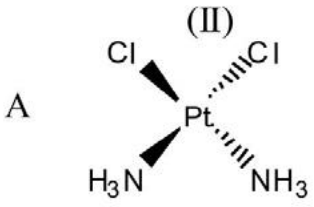
Mokhles M. Abd-Elzaher et al. The Schiff bases of Salicyldehyde with 2- amino-4- phenyl-5-methyl thiazole of some metal complexes were studied against different human tumour cell lines: breast cancer MCF-7, liver cancer HepG2, lung carcinoma A549 and colorectal cancer HCT116 in comparison with the activity of doxorubicin as a reference drug. The study showed that Zn (II) complex showed potent inhibition against human TRK in the four cell lines (HepG2, MCF7, A549 and HCT116) by the ratio 80, 70, 61 and 64% respectively as compared to the inhibition in the untreated cells[25].

Dongfang et al. 2008 Five ternary complexes of the rare earth ions with o-phenanthroline and Schiff base salicylaldehyde L-phenylalanine were used to test the anticancer effect of the complexes with K562 tumour cell. The complexes could inhibit K562 tumour cell's growth, generation, and induce apoptosis. This inhibition can be accelerated by increasing the dosage. They have reported that three metal complexes (Cu (II), Zn (II), and Cd (II)) of a ligand derived from 2-acetylpyridine and L-tryptophan have anticancer activities on MDA-MB-231 of breast cancer cells.

Zhang et al. 2012. (Where Ln (III) = La, Eu, Gd, Tb, Dy, Ho and Er) among the complexes of La and Eu are most potential in anti-tumor activity with percentage inhibition of 87.1 and 78.5%, respectively against leukaemia cells. Cu (II), Ni (II), Pd (II) and Pt (II) among the complexes Ni (II) have more efficient property against human breast cancer[26]. A series of Cu (II)-salicylidene-amino acid Schiff bases-Phen(Bipy.) ternary complexes of the following Schiff base ligand were reported by Wang et al. All the compounds showed fair anticancer activities[27]. reported some mononuclear complexes of Cu (II), Mn (II), Co (II), and Ni (II) with *bis*- Schiff base ligand derived from 2,3-butanedione and thiosemicarbazides about their synthesis and anti-cancer activities. The cytotoxicity assay was done against five different kinds of cells lines (HL-60, Spca-1, Tb, MGC, and K562). Among them, the Cu (II) complex was found to have highest anti-tumour activity[28]. Copper complexes of a tridentate ligand containing two pyridine and one imine nitrogen donor atom and the complexes possess anticancer activities[29]. Complexes of Cu and Zn showed potential activities against larynx cancer cells with IC50 values of 0.47 and 0.60 μg/mL, respectively[30-32].

K. C. Gupta and A. K. Sutar.: The catalytic activity of metal complexes of binaphthyl, binaphthol and their combinations, The Pyridyl bis(imide) and pyridine bis(imine) complexes of cobalt(II), iron(II) ions have been used as catalysts in the polymerization of ethylene and propylene. The phenoxy-imine (FI) complexes of zirconium, titanium and vanadium and Schiff base complexes of nickel(II) and palladium(II) were also used as catalysts in the polymerization of ethylene[33]. The zirconium complexes combined with $MgCl_2$/RmAl (OR ^{n} displayed strikingly high activities. The titanium complexes also showed catalytic activity, the vanadium complexes showed activity at elevated temperatures and iron(III) and cobalt(II) complexes of pyridine bis (imine) ligands 43 showed significant activity in the polymerization[34-36]. Metal complexes with unsymmetrically-substituted tetradentate SBs are one of the most important classes of coordination compounds. They have been found in a lot of biologically active drugs[37-40].

Xiang Liua,* and Jean-René Hamonb. The study of multidentate Schiff base metal complexes is crucial to accurately and thoroughly comprehend structure–property relationships in order to optimise and improve their use in a wide range of applications, given the simplicity and accessibility of multidentate Schiff bases and their metal complexes with multiple properties[41]. The complex [NiLOAc] excelled in halting proliferation of the cervical and colon cancer cells with median inhibitory concentration (IC50) values of 28.33 and 34.4 μM, respectively. The complex, [PdLOAc] demonstrated selective cytotoxicity against breast cancer line MCF-7 with IC50= 47.5 μM, also showed inhibitory effect against colon cancer cell line (HCT-116) with IC50 = 55.66 μM. The complex, [PtLdmso] showed mild activity against breast cancer (MCF-7) and cervical cancer (Hela) cells. It displayed insignificant cytotoxicity against human endothelial cells (EA.hy926)[42.] Cisplatin was approved for treating humans against cancer in 1978. Cisplatin was synthesized by Pyrone in 1844.



Cisplatin

However, its biological effects on cancer were accidentally discovered by Rosenberg and co-workers in 1965. Na[NiLOAc], Na[PdLOAc] and Na[PtLdmso]. The synthesized compounds were fully characterized and evaluated for their antiproliferative effects. The compounds were tested against three human cancer cell lines

and one normal cell line to screen for their cytotoxic potential and as anticancer agents against colon, breast and cervical cancers[43].

III.CONCLUSION

A significant part of bioinorganic chemistry, as well as a wealth of structural, physico-chemical, and catalytic features are revealed by the synthesis and structure of multidentate Schiff bases and their metal complexes. This review focused on some background and recent progress in the synthesis of Schiff bases and their mono-nuclear transition metal complexes, structural and physico physico-chemical properties (like catalysis, spin crossover etc.). Aalso applications found in polymeric materials photovoltaic materials, energy materials, nuclear medicine and as components of pharmaceutically active co-crystals. However, transformation of metal complexes into human drugs is not an easy task, as accumulation of metal ions in the body fluids can be potentially hazardous to health. Hence, biocompatibility of the metal complexes, in addition to their bio efficacy, is an Imperative factor to be considered first. The Schiff base metal complexes are crucial to accurately and thoroughly comprehend structure–property relationships in order to optimise and improve their use in a wide range of applications. These complexes demonstrated cytotoxic and antitumor activity due to which they can be used for therapeutic purposes, while DNA protection activity was observed. The various metal complexes acting as drug medicine on various diseases such as antitumor, leukaemia, breast cancer, antimalarial, antifungal etc.

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