

Schiff Bases and Their Metal Complexes Derived from Ortho-phthalaldehyde: A review

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Abstract

Ortho phthalaldehyde (benzene-1,2-dicarbaldehyde) was synthesized for the first time in 1887. The molecule structure of OPA is a ring of benzene with two groups of (C=O). This aldehyde plays a significant role in the synthesis of Schiff bases through the reaction with primary amino acid, producing colored compounds. It is used as a reagent in the analysis of amino acids. This compound is utilized to prepare many metal complexes because it is a bidentate ligand. This review surveys the summarizes and literatures of the synthesis of Schiff bases and their complexes derived from ortho phthalaldehyde.

Keywords: ortho-phthalaldehyde, Schiff bases, metal complexes.

INTRODUCTION

Schiff bases are formed through the reaction between any primary amine with an aldehyde or a ketone under specific conditions, which is named by (Hugo Schiff) who synthesized it ⁽¹⁾. Structurally, a Schiff base, also known as imine or azomethine, is a nitrogen analog of an aldehyde or ketone in which the carbonyl group (C=O) has been replaced by an imine or azomethine group ⁽²⁻⁴⁾. Over the years, Schiff bases take off attention because of their application in biology, including; antibacterial, antifungal, anticancer, antioxidant, antiviral activity, and their great sensitivity, selectivity, and stability toward some metal ions such as; Co(II), Ni(II), Cu(II), Hg(II), Cd(II) and Ag(II) ^(5,6). The donor nature of the azomethine group's nitrogen atom is attributed to the ligation behavior of Schiff base in their metal complexes ⁽⁷⁻⁹⁾. Schiff base have colored crystals feature and form amines and carbonyl compounds when they are dissociated in water and hard acids ⁽¹⁰⁾.

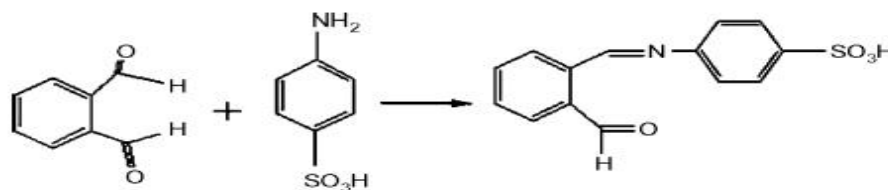
The complexes of Schiff bases could be prepared by replacing the double bond (C=O) with a metal transition ⁽⁹⁾. These compounds are used as electronic resources and photonic components because of the optical nonlinearity of the Schiff bases ⁽¹⁰⁾. Ortho - phthalaldehyde as an important source substance has widely applied in the synthesis and research of Schiff bases ⁽¹¹⁾. The reaction of o-phthalaldehyde consists of

the two carbonyl groups react with nucleophiles ⁽¹²⁾. o-phthalaldehyde is used as a high level disinfectant for medical tools in this field ⁽¹³⁾. O-pa have a hyper-sensitivity fluorescent in the implementations of amines or sulfhydryl ls in solution such as that found in proteins, amino acids, and peptides by capillary electrophoresis and chromatography ⁽¹⁴⁾.

LITERATURE REVIEW

Schiff bases and their complexes from ortho-phthalaldehyde

In 2008, Yuan F. and co-workers ¹⁷ presented a fast and sensitive method, which was proposed by measuring light dispersion signals (LS) with the frequent spectrometer, to determine the proteins with o- PA and sulfanilic acid. The study shows the formation of new dye- Schiff base by the reaction between the two carbonyl groups of o-phthalaldehyde with sulfanilic acid, followed immediately by the reaction with an acidic protein. This forms a clear signal of a base high level at 344 nm ⁽¹⁵⁾. Depending on the correlation between the density of the Lg and protein concentrations, a new analysis of HSA and PSA was recognized in the variety of 0.1-25.0 gm/ml with a determination limit (3σ) of 13 mg/ ml appropriation on the concentration determiner. Outcomes of the compound synthesis by this processed on the spectroscopy standard. Equation (1).



Equation 1. Preparation of (*E*)-4-((2-formylbenzylidene) amino) benzenesulfonic acid

In 2009, the physicochemical and biological activities of some of [MnII] complexes structure was synthesized by Shanker K. and co-workers⁽¹⁸⁾. The Schiff bases were diagnosed as a macro superiority base. The reaction was observed from the condensation of o-PA with a group of diamines in methanol. All the complexes that synthesized from Mn⁺² was solid. The samples were distinguished by using spectrometer methods; FT-Infrared, mass, Visible. Spectrum. The structure of the compounds was five square-shaped hierarchical. The biological activities of the complexes were experimented against some types of bacteria. Their inhibitory was probable and the activities established by these complexes were contrasted with standard drugs. In a previous study done by Khalifa K. M. *et al.* (2009), three new complexes from ortho-phthalaldehyde with metal ions (Co-Ni - and Cu) were synthesized and distinguished⁽¹⁹⁾. These compounds were tested by physiochemical and spectral methods such as; FT-IR, conductivity, ¹HNMR. The primary analysis information showed a molar conductivity [1:1] and [1:2] of metal-ligand. All the peaks of the IR spectra revealed that metal ions were coordinated with a ligand. The ¹HNMR suggests the geometrical structures of the complexes.

In 2010, Geeta B. and co-laborers studied that a bi nucleating new Schiff base was the result of the reaction between glycel-glycine and o-PA with a phenylene as a separator. The structure of the complexes was octahedral shape, such as; CoII, NiII, CuII, and PdII. Coordination of ligand to metal was examined by elemental analysis, molar conductivity, magnetic features, FT-IR, ¹H Nuclear magnetic resonance, C¹³, ESR, Thermo gravimetric analysis and electronic spectrometer. There are two variant coordination positions of each nuclear complex central metal. An instance of CuII compounds, erythrocyte sedimentation rate test provided further data to identify the binuclear form of the occurrence of magnetic behavior. Compounds were examined against Gram-positive and Gram-negative bacteria, showing suitable biological activities⁽²⁰⁾.

In 2012, Sand hanamalar D.*et al.* prepared Schiff bases

and their complexes of (VO, Ni, and Cu)⁺² by using easy methods. The reaction between diaminobenzidine and o-phthalaldehyde produced complexes, having metal chloride ratio of 1:4:2:2. All compounds that synthesized were calculated through spectral and analytical data and the bonding location from the azomethine group. The square planner and square pyramidal were the geometrical shapes of these complexes. The estimation of these complexes was tested by antimicrobial activities⁽²¹⁾. In 2013, Ekamparam A. and co-workers synthesized and characterized a Schiff base and its metal complexes, which were derived from the condensation of o-phthalaldehyde, dihydroxybenzidine and m-aminophenol with Cu (II), Ni (II), and VO(II) complexes⁽²²⁾. Spectral methods such as; FT-IR, ¹HNMR, UV-Vis, were used to examine the compounds. Also, EPR studies, conductivity measurements, and magnetic moments. The evaluation of the Schiff base ligand complexes was done by antimicrobial activities and DNA split.

In a previous research conducted by Sreenivas V. *et al.* (2014), tetradentate ligand of Schiff base was synthesized via condensation of o-PA with m-aminobenzyle alcohol, m-amino benzohydrazine, and 2-amino-2-methyl-1-propanol (L₁, L₂, and L₃) correspondingly⁽²³⁾. Following that, the three synthesized ligands were reacted with [RCl₂(DMSO)₄] with Ru (II) in the methanol to reduce the related Ru(II) complexes. All samples were studied by ¹HNMR, FT-IR, elemental analysis, and GC-Mass spectral. In 2017, Voguri H. Babu *et al.* synthesized a bidentate Schiff base ligand by the condensation of o-PA and glycel-glycin, which was followed by the reaction between Schiff base with nuclear metal complexes [M₂(L)(H₂O)₄]⁺²⁽²⁴⁾. The shape of the ligand was octahedral N₄O₄ that assisted its binding with the central atom Fe(II). All the materials were characterized by elemental analysis and spectral methods such as; ESR spectra, C¹³, infrared spectrum, ¹HNMR, magnetic measurements, and electronic spectroscopy. The prepared compounds 'biological activities were examined against gram + and gram- and all were good. Figure (1).

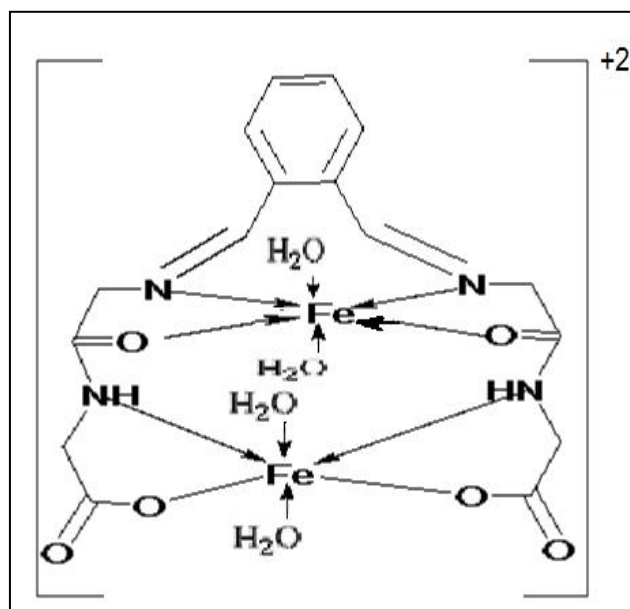
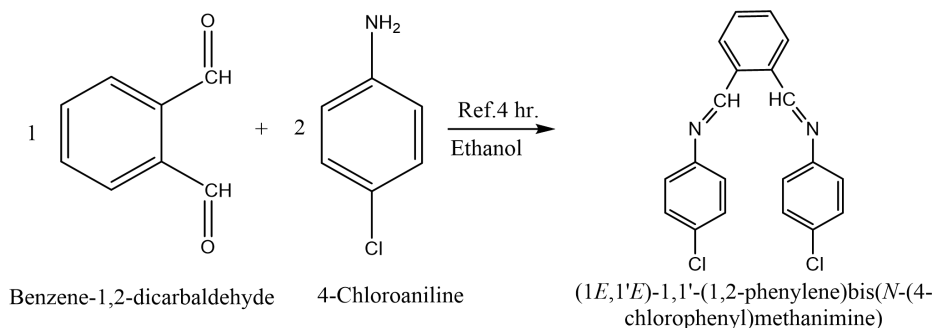


Figure 1. The Structure of Fe (II) complexes

In a previous study (2018), Venugopal p. and co-worker synthesized some metal complexes of (Cu, Pd, and Ru)⁺², N₄, and N₂O₂ based tetradentate Schiff base ligands through the reaction between 3,5-diaminobenzoic acid with o-salicylaldehyde (HL) and ortho-PA in that order. The prepared compounds were studied by various processes like; as elemental analysis, Infrared spectrum, vis spectrum, and conductivity measures. The metal complexes 'antibacterial activity was noticed in the decreasing of dabigatran, and morphine issued the synthesis as an intermediate. The complexes of the ligand might stimulate selectivity to raise yields⁽²⁵⁾. In 2018, Saba H. Mahdi and a co-worker⁽²⁶⁾ synthesized new mixed ligand Schiff bases and some metal complexes of (Mn, Co, Ni, Cu, Cd, and Hg)⁺² from the reaction between ortho-PA and para-nitroaniline as a major ligand and anthranilic acid as a minor ligand. The materials were differentiated by various processes such as; UV-Vis., FT-Infrared, MS-spectrometer, ¹HNMR, molar conductance, atomic absorption and magnetic measurement. Schiff

base ligand complexes have octahedral geometries. The study of antimicrobial activities showed different activities against two types of bacteria (G+) and two types of bacteria (G-).

In a recent study (2020),⁽²⁷⁾ Schiff base ligand and metal complexes of Cobalt⁺², Nickel⁺², Copper⁺², Cadmium⁺², and Mercury⁺² were prepared. The condensation of ortho-phthalaldehyde with para-chloroaniline formed the ligand (L), followed by the reaction between Schiff base ligand with metal ions to produce the metal complexes. The synthesized compounds (ligand and its complexes) were identified by elemental analysis and spectral processes such as; MS spectrometer, ¹HNMR, FTIR, UV-Visible, atomic absorption and magnetic susceptibility. The analytical data of the compounds revealed their octahedral geometries. The ligand and its complexes revealed different biological activities toward various types of bacteria; two grams positive and two grams negative. Scheme (2).

**Scheme 2.** The synthesis of ligand

CONCLUSION

Ortho-phthalaldehyde is an aldehyde that plays a significant role in synthesizing different Schiff base ligands by condensation with primary amines, to form many metal complexes. In this review, synthesis of the Schiff and its complexes and the biological activities have been summarized from 2008 to 2020.

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