

# Synthesis, Characterization and Applications of cobalt Schiff base complex

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## Abstract

Schiff Bases play an important role in Inorganic chemistry due to formation of very stable complexes with various transition Metals. It has been extensively studied over past decades as Schiff bases provide potential sites for bio-chemically active compounds. This review is to summarize various Biological activities of Schiff Bases complexes as it has been recognized widely and Complexes may serve as biologically important species. Most of them show Biological activities such as antifungal, antibacterial, and antimicrobial activities.

**Keywords:** Antibacterial, Antifungal, cobalt, Schiff Bases.

## 1. Introduction

Schiff Bases have been known since 1864 when Hugo Schiff reported the condensation of primary amines with carbonyls compounds [1]. Schiff Bases of aliphatic aldehyde are unstable in nature and readily get polymerized where as Schiff Bases with aromatic aldehyde are more stable due to conjugation system. Schiff Bases derived from amino acids are an important class of ligands that coordinate to metal ion by azomethine nitrogen. Ligands with heterocyclic molecules containing heteroatoms such as N, O, and in azomethine derivatives, C=N linkage is essential for biological activities. The presence of lone pair of electron in sp<sup>2</sup> hybridized orbital of nitrogen atom of the azomethine is of considerable chemical and biological importance. Schiff Bases are good chelating agents; generally bi- or tri- or tetra dentate ligands are more capable of forming very stable complexes with transition metals. Therefore Schiff bases metal complexes were widely investigated for their antifungal, antibacterial, antimicrobial, diuretic and antitumor, Antifertility and enzymatic activities [2-3]. Cobalt complex with corrinoid ligands is also important biologically as cobalmins which is an essential part of vitamin B<sub>12</sub>[4].

## 3.1. Experimental

### 3.1.1. Reagents

Chemicals are secured from prominent companies like sigma Aldrich, moly hemand used without further purification. Ethanol, methanol used for synthesis of metal complexes are A.R. grade and used as received for synthetic work. Co(NO<sub>3</sub>)<sub>2</sub>.6H<sub>2</sub>O is procured from Alfa easer.

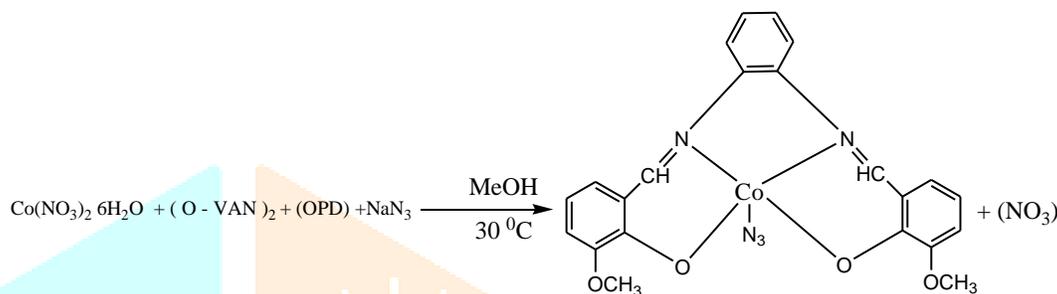
Caution: Azides are explosive, handle with care.

### 3.1.3. Synthesis of [(Co)(O-VAN)<sub>2</sub>(OPD)(N<sub>3</sub>)]·(NO<sub>3</sub>)

A Schiff's base solution (0.5mmol, 0.188gms) is dissolved in 10ml of hot methanol is added to a solution of cobalt nitrate (0.5mmol, 0.145gms) is dissolved in 10ml of water, immediately A brick red colored solution is appears. To this, a solution of sodium azide (0.5mmol, 0.032gms) is liquefied in 10ml of water is added, a crystalline brick red colored precipitate is obtained after one hour on constant stirring at room temperature Anal. exptal. C<sub>22</sub>H<sub>18</sub>N<sub>5</sub>CoO<sub>4</sub> (M.Wt.475.34) C, 55.59; H, 3.52; N, 14.71. Found: C, 55.63; H, 3.92; N, 14.76. Important IR absorptions (KBr disk, cm<sup>-1</sup>): 3431, 3361, 1600, 1197, 1176, 1384, 2154, 543, 424. Mass peaks (m/z): 540, 432, 234, 149.

Yield: 0.170gm (60%)

M.P; 325<sup>0</sup>C



**Fig: Proposed Structure of [(Co)(O-VAN)<sub>2</sub>(OPD)(N<sub>3</sub>)]·(NO<sub>3</sub>)**

### 3.2. Physical Measurements

An IR spectrum is obtained with a Bruker-alpha-T FT-IR spectrophotometer. UV spectrum is chronicled on systronics 2700R UV spectrophotometer. LC-MS Spectra is recorded on AGILANT-Triple Quad (LC-MS/MS) mass spectrometer. XRD in Andhra university.

#### 3.2.2. Electronic Spectrum of [(Co)(O-VAN)<sub>2</sub>(OPD)(N<sub>3</sub>)]·(NO<sub>3</sub>)

The uv-visible spectra of metal complexes are recorded in DMF in the range 200 – 800 nm. The electronic spectrum of free Schiff base showed three bands around 240, 350 and 450 nm characteristic of  $\pi$ - $\pi^*$  and  $n$ - $\pi^*$  transitions. In the metal complexes, this band is shifted to a longer wave length with increasing intensity. This shift may be attributed to the donation of lone pair of electrons of oxygen of Schiff base to metal ion. The cobalt complexes exhibits bands around 255-300 nm, 350- 355 nm and 475-495 nm. The broad penetrating and ailingdetermined bands around 350-355 nm may be assigned to LMCT or MLCT. The high intensity band around 250 nm is of ligand origin assignable to  $n$ - $\pi^*$  or  $\pi$ - $\pi^*$  transition.[5]the complexes showed shoulder broad bands in the range of 300-325 nm may be assigned to the d-d transition.

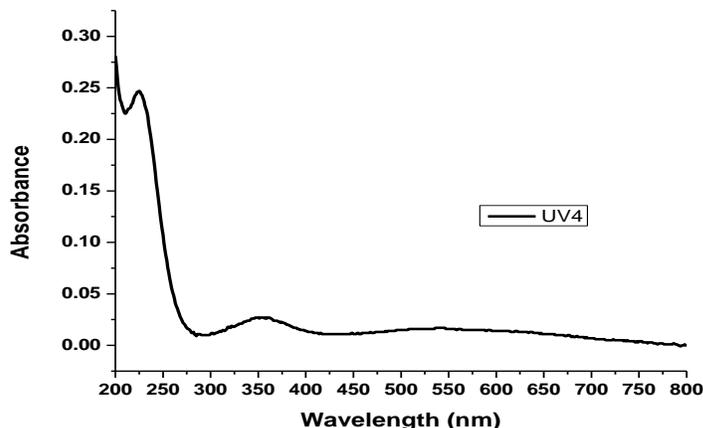
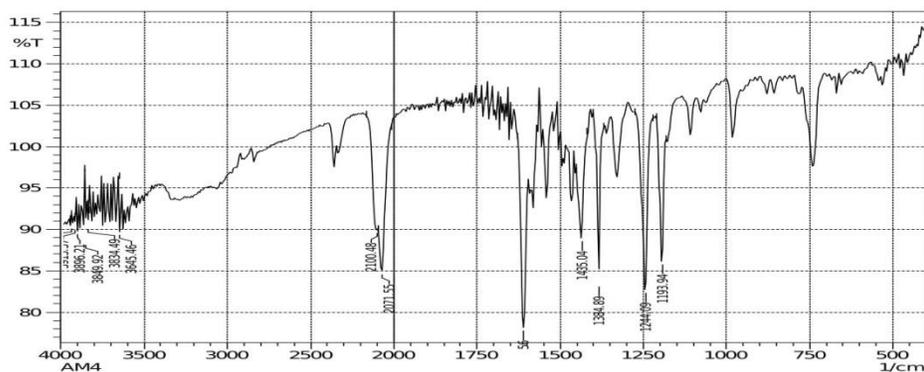


Fig:

### 3.2.5. IR Spectrum of $[(Co)(O-VAN)_2(OPD)(N_3)].(NO_3)$

The weak broad bands in the region  $3595-3545\text{cm}^{-1}$  due to hydrogen bonded OH group. This indicates that the phenolic oxygen atoms present in the Schiff bases are coordinated to the metal centers. The strong  $\nu(C=N)$  bands occurring in the range of  $1600\text{cm}^{-1}$  are shifted slightly toward lower frequencies compared to the free Schiff bases indicating the coordinated azomethine nitrogen atom to the metal center. The  $\nu(CN)$  absorption at  $2115\text{cm}^{-1}$  as a single peak suggests the presence of N-coordinated terminal bridged azide group (NNN) appears at  $2100\text{cm}^{-1}$  as a bridged peak indicating the presence of terminal bridged azide ion coordination to the metal center, A sharp band due to  $1384\text{cm}^{-1}$  confirm nitrate in outer sphere.[6]

Fig: FTIR of  $[(Co)(O-VAN)_2(OPD)(N_3)].(NO_3)$ 

### 3.2.15. Powder x-ray diffractogram $[(Co)(O-VAN)_2(OPD)(N_3)].(NO_3)$

Crystallite size is obtained using Scherer's equation,  $D = K\lambda/(\beta \cos\theta)$ , where D is the particle size in nm of the crystal grain has been calculated using maximum intensity peak; K is the Scherer's constant;  $\lambda$  is the wavelength of target used;  $\beta$  is the full width at half maximum reflection height in terms of radian and  $\theta$  is the Bragg diffraction angle at peak position in degree

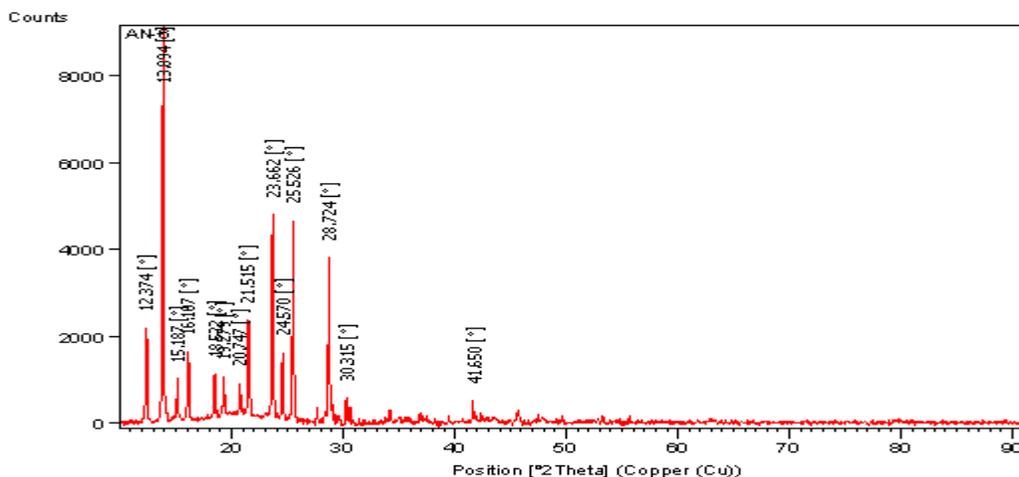


fig:X-ray diffraction pattern of  $[(Co)(O-VAN)_2(OPD)(N_3)].(NO_3)$

COMPLEX	2θ	Crystallite size
$[(Co)(O-VAN)_2(OPD)(N_3)].(NO_3)$	13.09352732	79.37nm

### 3.2.7.LC-MS Spectrum of $[(Co)(O-VAN)_2(OPD)(N_3)].(NO_3)$

The peak at 540(m/z) is complex destined to two ortho vanillin, one OPD, one cobalt, one azide, and one nitrate molecules  $[(Co)(O-VAN)_2(OPD)(N_3)].(NO_3)$ . The peak at 432 (m/z) refers to the complex bound to two ortho vanillin, one OPD, and one cobalt fragments  $[(O-VAN)_2(OPD)(Co)]$ . Besides, the peak at 234(m/z) is complex bound to one Ortho vanillin, and one OPD molecules designated that  $[(O-VAN)(OPD)]$ . The peak at 149(m/z) is ortho vanillin.

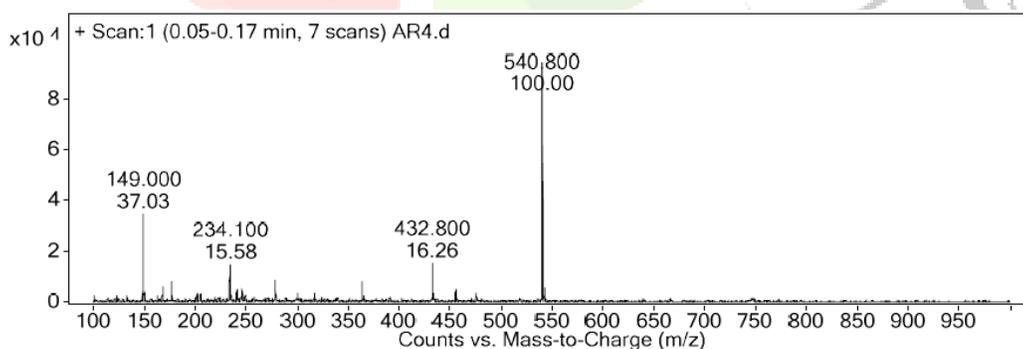


Fig: LC-MS Spectrum of  $[(Co)(O-VAN)_2(OPD)(N_3)].(NO_3)$

### 3.2.12.Antimicrobial Screening of $[(Co)(O-VAN)_2(OPD)(N_3)].(NO_3)$

The complex is screened *in vitro* for anti-bacterial activity against *E.coli*, *S.aureus* and antifungal activity against *C.albicans* by Agar-well diffusion method [7]. The anti-bacterial and antifungal activities of complex are listed in table



**Fig :Inhibition zones for Schiff's base complex against S.aureus E.coli**



**Fig:Inhibition zones for Schiff's base complex against C.albicans**

Bacteria	Inhibition zone (mm)
S.aureus	11
E.coli	7
Fungi	Inhibition zone (mm)
C.albicans	NIL

**Table: Antimicrobial activities of Schiff's base complex**

The complex showed good antibacterial activity against E.coli, S.aureus and anti-fungal activity against C.albicans.

### 3.2.13. Cytotoxic studies of $[(Co)_n(O-VAN)_2(OPD)(N_3)] \cdot (NO_3)$

The fused complex is screened for their cytotoxicity (MCF-7, cell lines). From the data, it is observed that the complex displayed their cytotoxic activities as  $IC_{50}$  ( $\mu g/mL$ ) against breast cancer MCF-7. The  $IC_{50}$  values of the complex are listed in table

Conc( $\mu g/ml$ )	% cell survival	% cell inhibition
0.1	98.83086	1.16914
1	88.34431	11.65569
10	82.90277	17.09723
100	22.61953	79.38047

**Table.3. Dose response of complex on MCF-7 cell line**

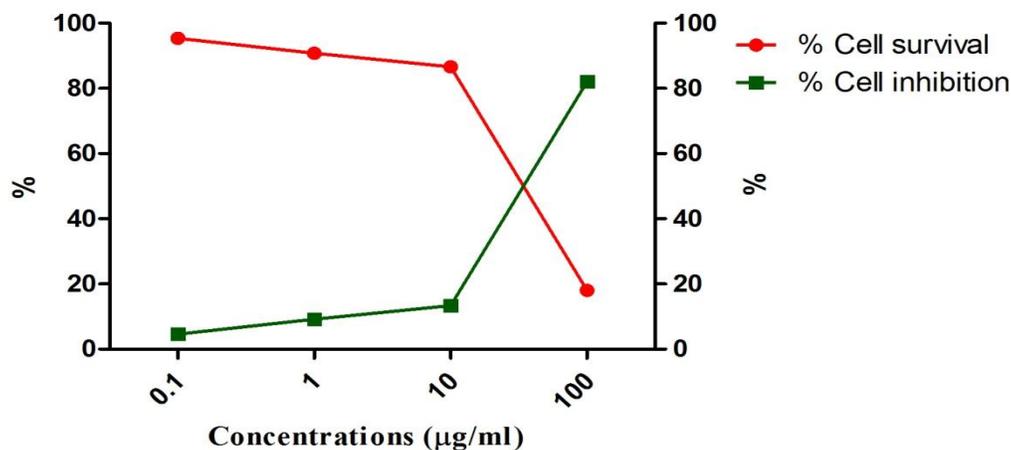


Fig:Effect of complex on MCF7 Cell viability for 24h Incubation time

IC<sub>50</sub>

50.45µg/mL

## 5. Conclusions

In the present research study, we synthesized new complexes of Co(II) these complexes are characterized by various physicochemical and spectral analyses. The results exhibit that the synthesized ligand binds with metal ions in tetradentate through N donor sites of ortho phenylene diamines as well as O atom of the ortho vanillin group. IR, LC-MSXRD studies of the complexes also helped to characterize the complexes. The antibacterial data show that the metal complexes have biological activity. The complex shows cytotoxic properties. ...

## 6. Acknowledgement

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