



## SYNTHESIS, SPECTROSCOPIC INVESTIGATION AND BIOLOGICAL ACTIVITY OF Ni (II), Zn (II) COMPLEXES DERIVED FROM TETRADENTATE SCHIFF BASE LIGAND

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### ABSTRACT

Two different unsymmetrical chloro substituted nickel (II), zinc (II) complexes were synthesized by the reaction of corresponding precursor with Tetradentate Schiff base ligand. The ligand was characterised by UV-Visible, FT-IR, <sup>1</sup>H NMR Spectral studies. The synthesized complexes were characterised by molar conductance, UV-Visible, FT-IR spectral studies. The ligand and its complexes screened for antibacterial activity.

### KEY WORDS

Tetra-dentate Schiff base ligand, Nickel (II) complexes, Zinc (II) complexes antibacterial activity.

### INTRODUCTION:

Schiff base ligands which are able to form binuclear transition metal (II) complexes have been interest for several years<sup>1-7</sup>. There are only a few reports regarding the synthesis of unsymmetrical Schiff bases deived from equimolar condensation of a diamine and different aldehydes/ketones which is more difficult to obtain. This paper reports on the synthesis and characterization of Nickel (II) complexes using tetradentate Schiff base ligand obtained from 5-chloro-2-hydroxyacetophenone, 5-nitro-o-Phenylenediamine and Salicylaldehyde.

### EXPERIMENTAL:

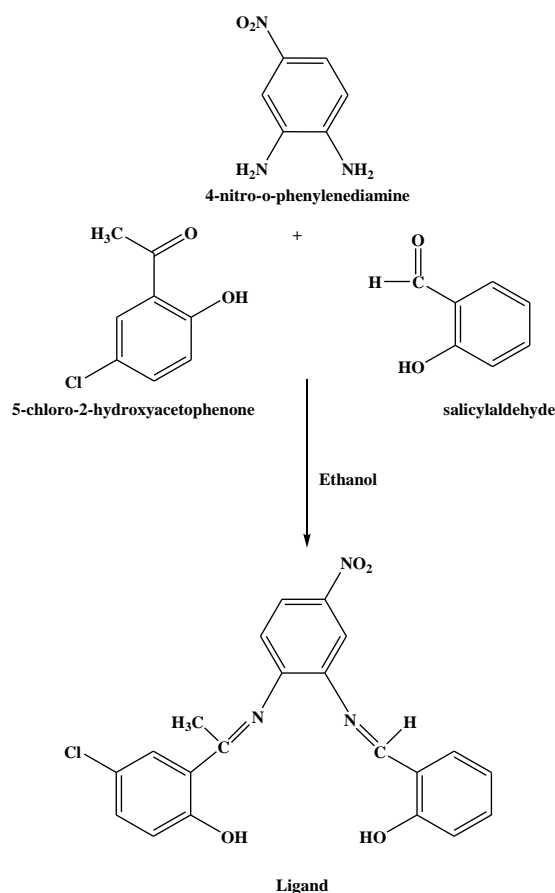
#### Materials and methods:

All chemicals and solvents used were of AR grade. IR spectra were recorded on a IR- Affinity-I Spectrometer

using KBr pellets in the range 4000-400 cm<sup>-1</sup>. Molar conductance of the ligand and complexes were measured in ethanol (10<sup>-3</sup>M) solutions using a digital conductivity meter. UV-Visible spectra were recorded using Systronics spectrophotometer operating in the range of 200-800 nm with quartz. Antibacterial activities were done at Micro Labs, Vellore, Tamilnadu, India.

#### SYNTHESIS OF SCHIFF BASE LIGAND:

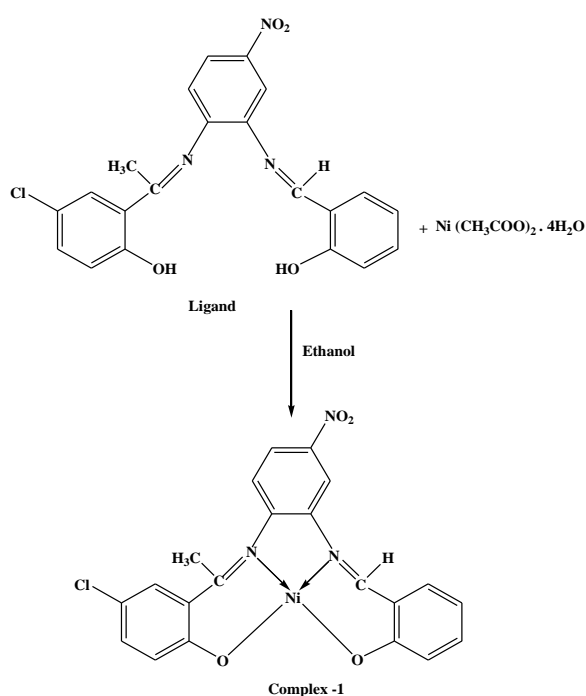
The Schiff base ligand were prepared by initially 5-chloro-2-hydroxyacetophenone (7 mmol) in ethanol was kept under magnetic stirring. To this ethanolic solution of 4-nitro-o-Phenylenediamine (7 mmol) and Salicylaldehyde (7 mmol) was added in the reaction mixture. The mixture was refluxed for 8 hours. The precipitate was filtered and washed with hot water and ethanol. The purified product was kept under oven at 60°C for 2 hours.



#### SYNTHESIS OF NICKEL (II) COMPLEX:

The schiff base ligand (0.5 mmol) dissolved in ethanol was kept under magnetic stirring. To this ethanolic solution of Ni (II) acetate tetrahydrate (0.5 mmol) was

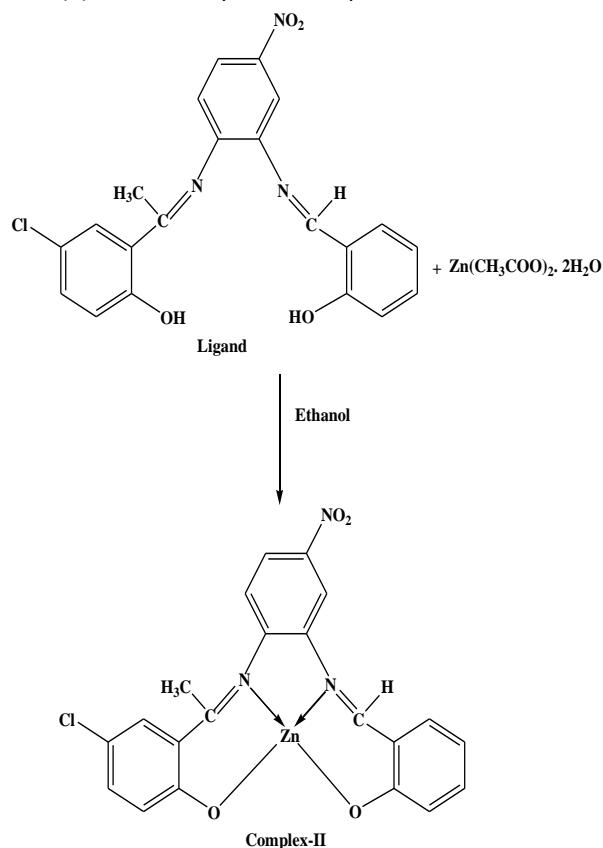
added in the reaction mixture. The mixture was refluxed for 8 hours. The precipitate was filtered and washed with hot water and ethanol. The purified product was kept under oven at 60°C for 2 hours.



### SYNTHESIS OF ZINC (II) COMPLEX:

The synthesis of Schiff base ligand (0.5 mmol) dissolved in ethanol was kept under magnetic stirring. Then added to ethanolic solution of Zn (II) acetate dihydrate

(0.5 mmol) in the reaction mixture. The mixture was refluxed for 8 hours. The precipitate was filtered and washed with hot water and ethanol. The product was kept under oven at 60°C for 2 hours.



### RESULTS AND DISCUSSION:

#### CONDUCTANCE MEASUREMENTS

The molar conductance of Ligand and metal (II) complexes are listed in the Table-1. The molar

conductance values show that the complexes are non-electrolyte in nature<sup>8</sup>. The solvent used in molar conductance is ethanol.

**Table 1: Physical properties of metal (II) complexes:**

S.NO	Compound	Molecular formula	Molecular weight	Molar conductance (cm <sup>2</sup> ohm <sup>-1</sup> mol)
1	Ligand	C <sub>21</sub> H <sub>16</sub> N <sub>3</sub> O <sub>4</sub> Cl	409.69	-
2	Complex-I	C <sub>21</sub> H <sub>14</sub> N <sub>3</sub> O <sub>4</sub> ClNi	466.37	48
3	Complex-II	C <sub>21</sub> H <sub>14</sub> N <sub>3</sub> O <sub>4</sub> ClZn	473.08	50

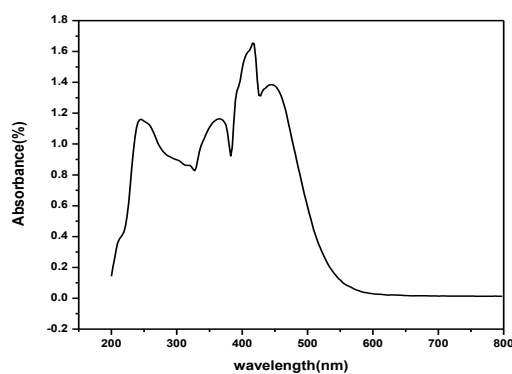
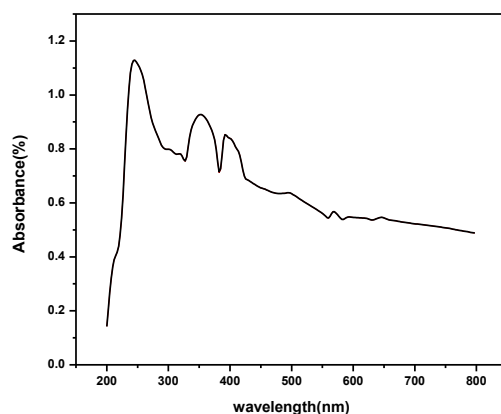
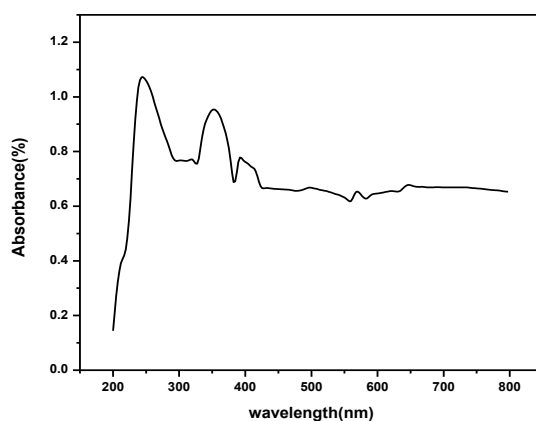
#### UV-VISIBLE SPECTROSCOPIC ANALYSIS

UV-Visible spectra of Ligand and all the complexes were recorded using ethanol is illustrated in Figure: 1-3 and the spectral data are listed in Table-2. The absorption band observed in the region of 248 nm was due to π-π\* transition of the benzene ring present in the ligand. The band at 364 nm was due to π-π\* transition of the azomethine group (-HC=N) present in the ligand. The band at 420 nm was due to n-π\* transition. The band

observed in the region of 243-245 nm was due to π-π\* transition of the benzene ring present in the complexes. The band at 352-358 nm was due to π-π\* transition of the azomethine group (-HC=N) present in the complexes<sup>9</sup>. The band at 417-418 nm was due to n-π\* transition. A new characteristic band observed in the region of 566- 568 nm was assigned to d-d transition of the complexes.

**Table-2: UV-Visible Spectral data of Ligand and metal (II) complexes:**

Compounds	Wavelength (nm)			
	$\pi - \pi^*$ (nm) (benzene)	$\pi - \pi^*$ (nm) (-HC=N)	$n - \pi^*$ (nm)	d-d(nm)
Ligand	248	364	420	-
Complex-I	243	352	417	566
Complex-II	245	358	418	568


**Figure 1: UV-Visible spectrum of Schiff base Ligand**

**Figure 2: UV-Visible spectrum of Complex -I**

**Figure 3: UV-Visible spectrum of Complex -II**

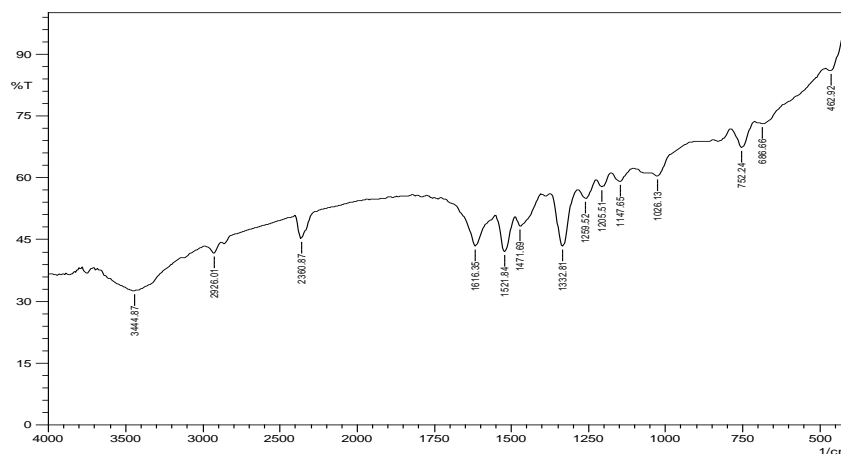
### FT-IR SPECTROSCOPIC ANALYSIS

The FT-IR spectrum of Ligand and metal (II) complexes have shown in Figure 4-5. The peak at  $1620\text{ cm}^{-1}$  was due to the stretching frequency of the azomethine group ( $-\text{HC}=\text{N}$ ) in the ligand. The peak appeared at  $1332\text{ cm}^{-1}$  were assigned to C-O stretching vibration of the ligand. The peak at  $3377\text{ cm}^{-1}$  have been assigned to the -OH stretching vibration of the ligand. The peak at  $1616\text{--}1618\text{ cm}^{-1}$  was observed due to the stretching frequency of the azomethine group ( $-\text{HC}=\text{N}$ ) in the complexes. The

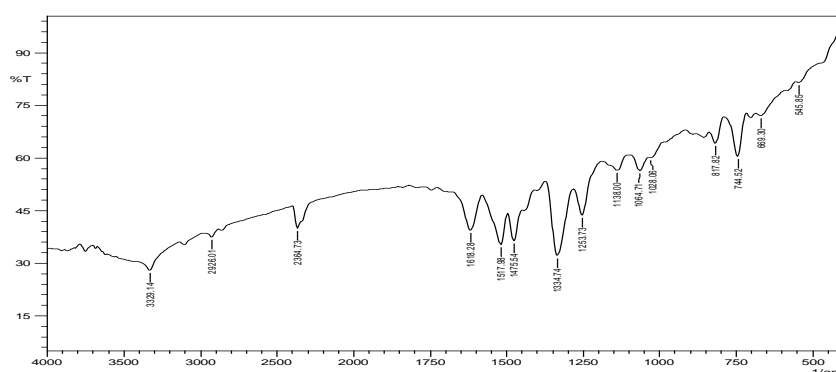
peak  $1620\text{ cm}^{-1}$  was due to azomethine group of the ligand and it was shifted to lower frequency after complexation<sup>10</sup>. The peak appeared at  $1253\text{--}1259\text{ cm}^{-1}$  were assigned to C-O stretching vibration. The bands presence at  $3329\text{--}3444\text{ cm}^{-1}$  have been assigned to the -OH stretching vibrations. The peak at  $455\text{--}462\text{ cm}^{-1}$  was observed due to M-O stretching vibrations. The peak at  $545\text{--}557\text{ cm}^{-1}$  was observed due to M-N stretching vibrations.

**Table-3: FT-IR Spectral data of metal (II) complexes:**

Compounds	$\nu(\text{-C=N})$ $\text{cm}^{-1}$	$\nu(\text{-C-O})$ $\text{cm}^{-1}$	$\nu(\text{-OH})$ $\text{cm}^{-1}$	$\nu(\text{M-O})$ $\text{cm}^{-1}$	$\nu(\text{M-N})$ $\text{cm}^{-1}$
Ligand	1620	1332	3377	—	—
Complex-I	1616	1259	3444	462	557
Complex-II	1618	1253	3329	455	545



**Figure 4: FT-IR Spectrum of Ni(II) Complex**



**Figure 5: FT-IR Spectrum of Zn(II) Complex**

### <sup>1</sup>H NMR SPECTROSCOPIC ANALYSIS OF LIGAND

The <sup>1</sup>H NMR spectra of Schiff base ligand are recorded using  $\text{CDCl}_3$  as solvent, tetramethylsilane (TMS) as internal standard. The <sup>1</sup>H-NMR spectral data of Schiff base ligand and its spectrum is shown in Figure 6. The signal appeared at  $8.00\text{--}8.72\text{ ppm}$  was due to the

protons of the azomethine group ( $-\text{HC}=\text{N}$ ). The multiplet signal observed at  $7.26\text{--}7.88\text{ ppm}$  was due to the aromatic protons. The signal observed at  $6.74\text{--}6.96\text{ ppm}$  was due to the aromatic hydrocarbon. The signal observed at  $5.40\text{--}5.68\text{ ppm}$  is due to protons of aromatic

alcohol. The signal observed at 2.63 ppm is due to methyl group.

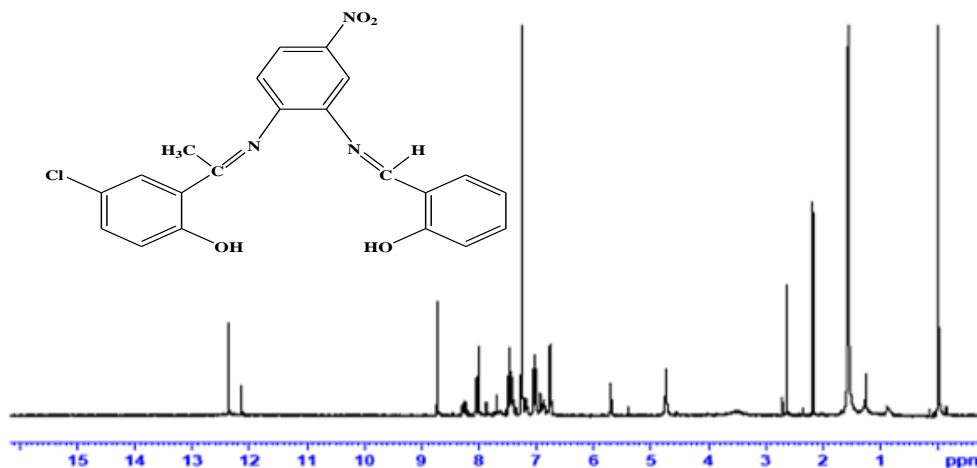


Figure 6:  $^1\text{H}$  NMR Spectrum of Schiff Base Ligand

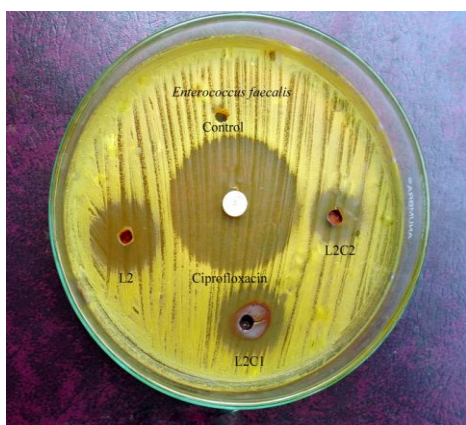
#### BIOLOGICAL ACTIVITY

The ligand and the complexes were screened for *in-vitro* antibacterial activity against *Enterococcus faecalis*,

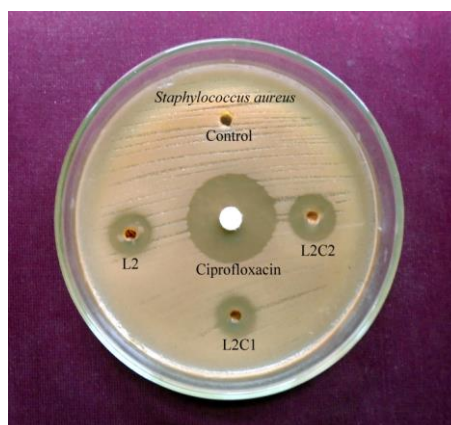
*Staphylococcus aureus*, *Salmonella typhi*, *Escherichia coli*. Ciprofloxacin was used as standard drug and DMSO as control. The antibacterial data summarized in table 4:

Table 4: Zone of inhibition of Ligand and Metal (II) complexes:

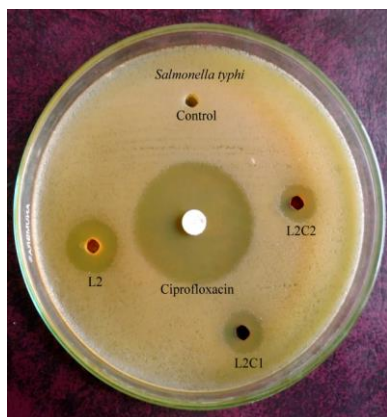
S.No	Microorganisms	L2	L2C1[Ni (II)]	L2C2[Zn (II)]	Ciprofloxacin
1	<i>Enterococcus faecalis</i>	15	16	12	30
2	<i>Staphylococcus aureus</i>	15	15	17	32
3	<i>Salmonella typhi</i>	15	11	10	33
4	<i>Escherichia coli</i>	7	5	9	20



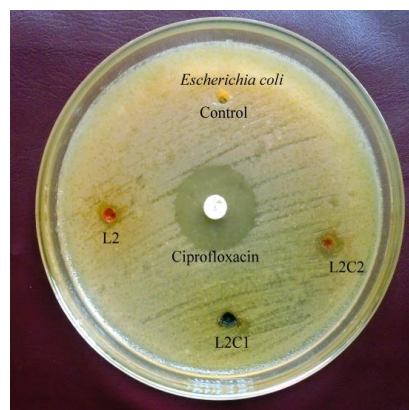
Zone inhibition of against *Enterococcus faecalis*



Zone inhibition of against *Staphylococcus aureus*



Zone inhibition of against *Salmonella typhi*



Zone inhibition of against *Escherichia coli*

The Schiff base complex L2C1 shows higher zone of inhibition value than other complex against *Enterococcus faecalis*. The complex L2C2 shows higher zone of inhibition value than other complex against *Staphylococcus aureus*.

#### CONCLUSION:

Tetradentate Schiff base ligand were synthesized using 4-nitro-o-phenylenediamine, 5-chloro-2-hydroxyacetophenone and salicylaldehyde. The synthesized transition metal [Ni(II), Zn(II)] complexes were characterized by using various analytical techniques such as UV-Visible, FT-IR, Conductivity measurement. The synthesized transition metal [Ni(II), Zn(II)] complexes were screened for their antibacterial activity against *Staphylococcus aureus*, *Enterococcus faecalis*, *Salmonella typhi*, *Escherichia coli*. The ligand and complexes were found to good inhibition to all selected micro organisms.

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