Synthesis, characterization of 2-amino thiazol schiff base and its metal (II) complexes

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ABSTRACT

Metal(II) complexes of a Schiff base derived from 2-hydroxy-1-naphthaldehyde and 2-aminothiazole were synthesized through reactions with acetate salts of Zn(II), Co(II), and Ni(II). The resulting metal complexes were characterized using various analytical methods, including elemental analysis, molar magnetic susceptibility, and spectral techniques. Fourier-transform infrared (FTIR) spectroscopy of the free Schiff base (HL) revealed a characteristic band at 1620 cm^{-1}, attributed to the azomethine (C=N) functional group. In the metal complexes, this band shifted to the range of 1640–1642 cm^{-1}, indicating coordination through the azomethine nitrogen atom. UV-Visible (electronic) spectral analysis suggested that the complexes exhibit either octahedral or tetrahedral geometries, based on their electronic transition patterns. The ligand and its metal(II) complexes displayed solubility in common organic solvents such as ethanol, methanol, dimethyl sulfoxide (DMSO), and dimethylformamide (DMF), but showed limited solubility in chloroform and were insoluble in water. The synthesized complexes also exhibited high thermal stability, with melting points ranging from 225°C to 300°C. Visually, the metal complexes appeared in various shades of black, while the free Schiff base ligand was yellow in color. The values obtained for the Co(II), Ni(II), and Zn(II) complexes for molar conductance studies were 18.8, 11.9, and 29.6 $\Omega^{-1}\cdot cm^2\cdot mol^{-1}$, respectively are markedly lower, indicating non-electrolytic behavior in solution. Magnetic susceptibility data supported the proposed geometries and electronic configurations, confirming high-spin octahedral and tetrahedral arrangements for Co(II) and Ni(II), respectively, and diamagnetism for the Zn(II) complex.

Keywords: *2-aminothiazoles, 2-hydroxy-1-naphthaldehyde, HL (Ligand), Metal (II), Schiff base.*

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Highlights of this paper

- 2-hydroxy-1-naphthaldehyde was reacted with 2-aminothiazole to give the Schiff base ligand.
- The Schiff base ligand was reacted with some selected metal salts which gave the metalcomplexes.
- The metal complexes were characterized using analytical techniques like Uv-Vis spectroscopy, FTIR.

1. INTRODUCTION

Metal ions have long been recognized as key players in the evolution of organometallic, coordination, inorganic, and medicinal chemistry due to their capacity to form stable, geometrically diverse, and biologically active complexes with a wide variety of ligands (George & Jack, 2013). From the early discovery of cisplatin as a groundbreaking anticancer agent to the ongoing development of ruthenium- and gold-based drugs, metal-ligand coordination continues to drive innovation in both therapeutic and industrial applications. In coordination chemistry, metal ions function as Lewis acids, accepting electron pairs from donor atoms within ligands to form coordination bonds. These interactions are foundational in designing metal complexes with unique electronic, magnetic, and catalytic properties (Tundejurca, 2017). Importantly, the geometry and oxidation state of the metal center influence the complex's reactivity and biological interactions, enabling fine-tuned activity against specific molecular targets.

According to Lewis acid-base theory, positively charged metal ions readily coordinate with electron-rich ligands to form chelates ring-like structures that often confer enhanced stability and bioavailability (Cotton, Wilkinson, Murillo, & Bochmann, 1999). Transition metals such as copper(II) and ruthenium(III) exhibit strong tendencies to form biologically relevant complexes with diverse therapeutic applications (Akinpelu & Adebayo, 2020). These metal-based compounds are particularly promising in combating infectious diseases and cancers due to their ability to generate reactive oxygen species (ROS), bind nucleic acids, inhibit enzymatic activity, and modulate signal transduction pathways. Chelating ligands further augment the pharmacokinetic profiles of metal complexes by increasing solubility, reducing systemic toxicity, and improving selectivity for pathogenic cells over healthy ones (Yadav, Kumar, & Prasad, 2021). Consequently, research into metal-based therapeutics is expanding into areas such as nanomedicine, photodynamic therapy, and enzyme inhibition, with notable success in treating resistant microbial strains and viral infections including HIV (Dhar & Lippard, 2009).

Metals like Fe, Pt, Ru, Au, and Cu have demonstrated potent activity against a wide array of pathogens and cancer cells by targeting cellular redox balance, DNA replication, and membrane integrity (Gupta & Sharma, 2015). In an era marked by increasing antimicrobial resistance and the limited efficacy of traditional small-molecule antibiotics, novel metal-based complexes offer a promising alternative approach. The World Health Organization has emphasized the urgent need for new antimicrobial agents, especially those with novel mechanisms of action. As such, the rational design and synthesis of Schiff base ligands and their metal(II) complexes are gaining traction as a strategic route to develop multifunctional drugs with broad-spectrum bioactivity. Schiff bases, owing to their structural flexibility, ease of synthesis, and ability to stabilize metal ions, serve as versatile platforms for constructing biologically potent metal complexes. These compounds not only expand the current drug repertoire but also provide insight into mechanisms of action and resistance, paving the way for next-generation therapeutics.

Therefore, this study explores the synthesis, characterization, and biological evaluation of Schiff base metal complexes with the goal of developing effective antimicrobial and antifungal agents that can address current therapeutic challenges.

2. MATERIALS AND METHODS

Copper (II) acetate , Iron (II) acetate Manganese (II) acetate, Zinc (II) acetate, Cobailt acetate, 2-amino-thioziol, 2,2 bypyridine, 2-hydroxy-1-napthaldehyde acetic acid, Ethanol, triethylamine, chloroformm dimethylformamide, dimethylsulfoxide, water were used as received from the supplier (Bristol scientific).

2.1. Synthesis of the Ligand (2ATS)

The 2-amino-thiazole Schiff base ligand was synthesized via a condensation reaction in an alcoholic medium under reflux conditions. Equimolar quantities of the respective reagents were refluxed for six hours. Upon completion, the reaction mixture was allowed to cool to room temperature on the laboratory bench. The resulting solid was filtered, washed, and recrystallized to afford the pure ligand.

2.2. Synthesis of Metal (II) Complexes

The synthesized Schiff base ligand (2ATS) was reacted with equimolar amounts of metal(II) acetate salts of Mg, Fe, Ni, Co, Zn, and Cu in ethanol. The reaction mixture was buffered with triethylamine and refluxed for six hours. After cooling to room temperature, the resulting precipitates were filtered, recrystallized, and stored in desiccators for further characterization.

2.3. Characterization of Synthesized Compounds

The melting or decomposition points of the Schiff base ligand(2ATS) and its metal(II) complexes were determined using a transparent cut-glass capillary tube and an electro thermal melting point apparatus. Infrared (IR) spectra were recorded in the range of 4000–400 cm^{-1} using a PerkinElmer IR spectrophotometer. Electronic reflectance spectra were obtained at room temperature using a PerkinElmer UV–Vis spectrometer, within the ranges of 190–400 nm (UV) and 400–900 nm (visible region).

3. RESULTS AND DISCUSSION

3.1. Physiochemical Data

The physicochemical data of the synthesized Schiff base and its Metal(II) complexes are summarized in Table 1. The analytical data of the complexes were consistence with the general formula LM, where L= (2ATS = $C_{14}H_{10}ON_2S$), and M=Mn(II), Fe(II), Co(II), Ni(II), Cu(II) and Zn(II). The Schiff base and its metal complexes are soluble in some common organic solvents such as ethanol, methanol, dimethylsulfoxide and dimethylformamide , and slightly soluble in chloroform and insoluble in water. The elemental analysis data confirmed the formation of 1:2 [metal: ligand] molar ratio. The Schiff base exhibits lower melting point compared to its complexes. The high melting points of the complexes indicated a better stability than the Schiff base (Jane & Chioma, 2024).

Table 1. Analytical data of synthesized compounds.

Compounds	**Molecular formula**	**Molecular weight**	**Colour**	**Melting point(ºC)**
2ATS	$C_{28}H_{24}N_4O_2S_2$	254.298	Yellow	225-227
[Co(2ATS)$_2$(H$_2$O)$_2$]	[Co($C_{28}H_{28}N_4O_4S_2$)]	639.526	Emerald black	290-300
[Zn(2ATS)$_2$(H$_2$O)$_2$]	[Zn($C_{28}H_{28}N_4O_4S_2$)]	644.146	Charcoal black	245-250
[Ni(2ATS)$_2$(H$_2$O)$_2$]	[Ni($C_{28}H_{28}N_4O_4S_2$)]	646.006	Black	250-255

Note: 2ATS = $C_{28}H_{24}N_4O_2S_2$)

3.2. Infrared Studies

Infrared spectroscopy is a vital tool for elucidating the coordination behavior of Schiff base ligands with metal ions. The FTIR spectra of the free ligand (2ATS) and its Co(II), Ni(II), and Zn(II) complexes exhibit characteristic vibrational bands that confirm both the successful formation of the Schiff base and its subsequent coordination to metal centers. In the spectrum of 2ATS, a broad band observed around 3442 cm^{-1} is attributed to the intramolecularly hydrogen-bonded phenolic –OH group. Upon coordination, this band undergoes a slight shift to the range of 3300–3429 cm^{-1}, suggesting the involvement of the phenolic oxygen in metal binding (Festus, Don-Lawson, & Ima-Bright, 2019; Silverstein, Webster, Kiemle, & Bryce, 2014). The sharp band at 1620 cm^{-1} in the free ligand corresponds to the azomethine (C=N) stretching vibration. This band shifts to 1586–1642 cm^{-1} in the metal complexes, indicating coordination through the imine nitrogen. The upward shift, particularly to 1642 cm^{-1} in the Ni(II) complex, implies an increase in bond order resulting from metal-ligand coordination (Nakamoto, 2009). The aromatic C=C stretching vibrations, appearing near 1552 cm^{-1} in the free ligand, are slightly shifted to 1458–1540 cm^{-1} in the metal complexes. These shifts reflect changes in electron density within the aromatic ring system due to metal coordination. Similarly, aromatic C–N stretching bands observed at 1458–1475 cm^{-1} further support the presence of conjugated systems and delocalization in both the ligand and its complexes (Festus & Okocha, 2017). A prominent band at 1139 cm^{-1} in the free ligand, assigned to C–O stretching of the phenolic group, shifts to 1162–1167 cm^{-1} upon complexation, confirming phenolic oxygen involvement in metal coordination (Silverstein et al., 2014).

Aliphatic C–H stretching bands are observed at 3114 cm^{-1} in the free ligand and 2924–3179 cm^{-1} in the complexes, consistent with aliphatic groups present in the structure. The aliphatic C–C stretching vibrations in the 1045–1096 cm^{-1} region remain relatively unchanged, suggesting minimal participation in coordination (Coates, 2000).The C–S stretching vibration, found at 820 cm^{-1} in the free ligand, shifts to 836–869 cm^{-1} in the complexes. This shift may indicate either direct coordination via the sulfur atom or conformational adjustments upon metal binding (Nakamoto, 2009).Notably, new absorption bands appear in the 500–519 cm^{-1} and 456–466 cm^{-1} regions in all metal complexes. These bands, absent in the free ligand, are assigned to M–N and M–O stretching vibrations, respectively. Their appearance provides strong evidence for bidentate coordination of the Schiff base ligand through the azomethine nitrogen and phenolic oxygen atoms (Nakamoto, 2009). Collectively, the spectral data confirm the successful formation of bidentate Schiff base metal(II) complexes, with coordination occurring via both the azomethine nitrogen and phenolic oxygen donor atoms, as evidenced by shifts in characteristic IR bands and the emergence of metal-ligand vibrational modes.

Table 2 presents an infrared data of the synthesized ligand and complexes.

Table 2. FTIR of the Schiff Base (2ATS) and its metal(II) complexes.

Compound	**$C_{14}H_{12}N_2OS$**	**$[Co(C_{28}H_2N_4O_4S_2)]$**	**$[Zn(C_{28}H_{28}N_4O_4S_2)]$**	**$[Ni(C_{28}H_{28}N_4O_4S_2)]$**
OH/H_2O	3442	3300	3388	3429
-C=N	1620	1640	1586	1642
-C=C	1552	1539	1458	1540
Aromatic C-N	1475	1458	1458	1460
Stretch C-O	1139	1162	1167	1162
C-H Stretch	3114	3179	--	2924
Aliphatic C-C	1082	1095	1045	1096
C-S	820	836	869	837
C-C Stretch (n ring)	1475	1458	1458	1460
=C-H Aromatic	3087	2922	-	2924
CH rocking in Plane	750	743	762	742
OH bending	971	976	994	978
CH_2 in plane Bending	1440	1424	1425	1435
CH_3 bend	1397	1393	1383	1395
M-N	-	513	500	519
M-O	-	456	466	**457**

3.3. Electronic Spectral

The Schiff base ligand (2ATS) exhibits multiple strong absorption bands in the ultraviolet region at 34,013, 29,411, 27,411, 27,027, 25,000, 23,255, 21,551, 21,367, 21,186, and 20,491 cm^{-1}. These bands are attributed to $\pi \rightarrow \pi^*$ and $n \rightarrow \pi^*$ transitions, originating from the aromatic rings and azomethine groups, and are characteristic of conjugated systems and non-bonding electron interactions on nitrogen and oxygen atoms (Silverstein et al., 2014). Additional lower-energy bands observed at 15,337 and 14,749 cm^{-1} may result from extended conjugation within the ligand or weak intraligand charge transfer transitions. The electronic spectrum of the cobalt(II) complex displays intense absorptions at 38,759 and 33,898 cm^{-1}, which correspond to retained ligand-centered $\pi \rightarrow \pi^*$ and $n \rightarrow \pi^*$ transitions, confirming the preservation of the chromophoric system upon coordination (Ali, Ahmed, & Khan, 2020). Notably, lower-energy absorptions at 15,455 and 11,261 cm^{-1} are assignable to d–d transitions, specifically $^4T_1g(F) \rightarrow {}^4A_2g(F)$ and $^4T_1g(F) \rightarrow {}^4T_2g(F)$, respectively. These transitions are indicative of a high-spin Co(II) ion in an octahedral ligand field, consistent with a d^7 electronic configuration (Kovala-Demertzi, Vlachou, & Demertzis, 2009). The relatively weak intensity of these bands aligns with their Laporte-forbidden nature. The nickel(II) complex shows high-energy absorptions at 38,759 and 33,787 cm^{-1}, corresponding to $\pi \rightarrow \pi^*$ transitions, and a medium-intensity band at 29,673 cm^{-1}, attributed to $n \rightarrow \pi^*$ transitions, indicating the dominance of ligand-centered transitions (Coates, 2000). In the lower-energy region, absorptions at 19,047, 16,393, 14,771, and 14,347 cm^{-1} are assigned to d–d transitions. These may be tentatively assigned as $^3A_2g(F) \rightarrow {}^3T_1g(F)$, $^1A_1g \rightarrow {}^1A_2g(P)$ (spin-forbidden), and $^2A_1g \rightarrow {}^3T_1g(F)$, with the latter likely influenced by spin-state mixing. The observed transition pattern and energies suggest a distorted tetrahedral coordination environment around the Ni(II) ion, typical of d^8 metal ions under such geometry (Singh, Kumar, & Lamba, 2021). Although square planar geometries are more prevalent for Ni(II), the spectral features observed here support a tetrahedral structure in this case. As expected for a d^{10} metal ion, the Zn(II) complex does not exhibit d–d transitions. However, strong absorptions are observed at 40,160, 33,783, 29,761, and 28,571 cm^{-1}, consistent with ligand-centered $\pi \rightarrow \pi^*$ and $n \rightarrow \pi^*$ transitions. Additional lower-energy bands at 15,337 and 14,662 cm^{-1} are likely attributable to metal-to-ligand (MLCT) or ligand-to-metal charge transfer (LMCT) transitions. LMCT transitions are more commonly reported for Zn(II) complexes when coordinated with strong donor ligands (Hosseinzadeh, Shakerian, & Tohidi, 2023). The overall spectral profile supports an octahedral coordination geometry around the Zn(II) center, in agreement with prior literature (Varghese, Joseph, & Raveendran, 2022). Table 3 presents electronic spectra data.

Table 3. Electronic Absorption Spectra data of the Compound.

Compounds	Solvent	Absorption	Band assignment	Geometry
$(C_{28}H_{28}N_4O_4S_2)$	$(CH_3)_2NCHO$	34013		
		29411, 27411, 27027		
		25000, 23255, 21551		
		21367, 21186, 20491		
		15337, 14749		
$[Co(C_{28}H_{28}N_4O_4S_2)]$	$(CH_3)_2NCHO$	38759, 33898 26178, 25380	π→π* n→π*	Octahedral
		15455	$^4T_1g(f) \rightarrow {}^4A_2(f)$	
		14347, 14347 11261	$^4T_1g(f) \rightarrow {}^4T_2g(f)$ $^4T_{2g}(F) \rightarrow {}^4A_{2g}(F)$	
$[Ni(C_{28}H_{24}N_4O_2S_2)]$	$(CH_3)_2NCHO$	38759, 33787	π – π*	Tetrahedral
		29673 19047	n→π* $^1A_{1g} \rightarrow {}^1A_{2g}(P)$	
		16393	$^3A_{2g}(f) \rightarrow {}^3T_{1g}(f)$	
		14,771, 14347	$^2A_1g(f) \rightarrow {}^3T_1g(f)$	
$[Zn(C_{28}H_{28}N_4O_4S_2)]$	$(CH_3)_2NCHO$	40160	Charge transfer	Octahedral
		33783 29761, 28571	π →π* n→π*	
		15337, 14662	M→L CT	

3.4. Molar Conductance

The measured molar conductance values of the metal complexes in DMSO fall significantly below the typical range for electrolytic behavior. For 1:1 electrolytes, conductance values generally range from 70–90 $\Omega^{-1}\cdot cm^2\cdot mol^{-1}$, while 2:1 or 1:2 electrolytes exhibit values exceeding 120 $\Omega^{-1}\cdot cm^2\cdot mol^{-1}$. In contrast, the values obtained for the Co(II), Ni(II), and Zn(II) complexes-18.8, 11.9, and 29.6 $\Omega^{-1}\cdot cm^2\cdot mol^{-1}$, respectively are markedly lower, indicating non-electrolytic behavior in solution. This suggests that the complexes do not undergo dissociation into ions in DMSO and exist as electrically neutral species. The absence of ionic dissociation implies that all donor atoms from the Schiff base ligand are directly coordinated to the metal centers, with no free anionic counter ions (e.g., Cl^- or NO_3^-) present in the outer coordination sphere. Such characteristics are typical of inner-sphere complexes, where the ligand fully satisfies the coordination requirements of the metal ion, leading to charge-neutral coordination compounds (Festus & Wodi, 2021). Among the complexes, the Zn(II) complex exhibited a slightly higher molar conductance value (29.6 $\Omega^{-1}\cdot cm^2\cdot mol^{-1}$) relative to Co(II) and Ni(II). This variation may be attributed to subtle differences in solvation dynamics, ion–dipole interactions with the DMSO solvent, or minor degrees of partial dissociation. Nevertheless, the observed value remains within the non-electrolyte range, consistent with previously reported Zn(II) systems of similar coordination environments (Ali et al., 2020). Table 4 presents the data for the molar conductance studies.

Table 4. Molar conductance.

Complexes	Ohm^{-1} cm^{2}mol-1	Solvent	Weight taken	Inference
$[Co(C_{28}H_{28}N_4O_4S_2)]$	18.8	$(CH_3)_2SO$	1.0	Non electrolyte
$[Zn(C_{28}H_{28}N_4O_4S_2)]$	29.6	$(CH_3)_2SO$	1.0	Non electrolyte
$[Ni(C_{28}H_{28}N_4O_4S_2)$	11.9	$(CH_3)_2SO$	1.0	Non electrolyte

3.5. Magnetic Moment

The magnetic susceptibility measurements provide further insight into the electronic configurations and geometries of the metal complexes. The effective magnetic moment (μeff) of the Co(II) complex was found to be 4.4

Bohr magnetons (B.M.), which is consistent with the presence of three unpaired electrons. This value aligns closely with the theoretical spin-only moment of 3.87 B.M. for a high-spin d^7 system in an octahedral geometry, though the observed enhancement is attributed to orbital contribution—an expected phenomenon in Co(II) complexes due to their incomplete orbital quenching. The measured molar susceptibility (7.63×10^{-3} erg·G^{-2}·mol^{-1}) supports a strongly paramagnetic behavior, further reinforcing the octahedral geometry deduced from UV–Vis and IR spectroscopic data. The Ni(II) complex exhibits an effective magnetic moment of 3.7 B.M., indicative of two unpaired electrons. This value exceeds the spin-only value of 2.83 B.M. for a d^8 system, a discrepancy attributable to the orbital contribution that is typically more pronounced in tetrahedral environments compared to square planar geometries (Cotton et al., 1999). The corresponding susceptibility value (5.38×10^{-3} erg·G^{-2}·mol^{-1}) is consistent with a high-spin paramagnetic species. These findings are in agreement with the proposed distorted tetrahedral geometry, as inferred from the electronic spectra and molar conductance data. In contrast, the Zn(II) complex displays a very low magnetic moment of 0.58 B.M., indicating diamagnetic behavior, as expected for a d^{10} configuration with no unpaired electrons. This observation aligns with the established diamagnetism of Zn(II) Schiff base complexes (Festus, Ima-Bright, & Osi, 2022). The slight deviation from the ideal zero value is likely due to minor experimental artifacts, such as residual solvent effects or instrumental limitations. The absence of d–d transitions in the UV–Vis spectrum and the non-electrolytic nature of the complex further confirm a fully coordinated, closed-shell Zn(II) species. Table 5 shows the effective magnetic moment of the complexes.

Table 5. Molar µ*eff*, gram µ*eff* and effective magnetic moments of the complexes.

Compound	Xg ($ergG^{-2}g^{-1}$)	Xm ($ergG^{-2}mol^{-1}$)	µeff (B.m)
[$Co(C_{28}H_{28}N_4O_4S_2)$]	$1.3781x10^{-5}$	$7.6275x10^{-3}$	4.4
[$Ni(C_{28}H_{28}N_4O_4S_2)$	$9.727x10^{-5}$	$5.38188x10^{-3}$	3.7
[$Zn(C_{28}H_{28}N_4O_4S_2)$]	$-2.4590x10^{-7}$	$-1.3522x10^{-4}$	0.58

Note: 2ATS, = $C_{28}H_{28}N_4O_4S_2$.

4. CONCLUSION

A novel Schiff base ligand (2ATS), derived from the condensation of 2-hydroxy-1-naphthaldehyde and 2-aminothiazole, was successfully synthesized and complexed with Co(II), Ni(II), and Zn(II) ions. The resulting metal(II) complexes were comprehensively characterized using melting point determination, infrared (IR) spectroscopy, ultraviolet-visible (UV–Vis) spectroscopy, magnetic susceptibility measurements, and molar conductance studies. The observed differences in melting points between the free ligand and its metal complexes confirm the formation of new coordination compounds with distinct physicochemical properties. Additionally, the metal complexes exhibited color variations relative to the free ligand and starting materials, further indicating successful complexation and changes in the electronic environment. Elemental analysis data closely matched the calculated theoretical values, validating the proposed stoichiometry and confirming the successful incorporation of metal ions into the ligand framework. Spectroscopic and magnetic data revealed that the Co(II) and Zn(II) complexes adopt octahedral geometries, while the Ni(II) complex assumes a distorted tetrahedral geometry. These structural assignments were corroborated by consistent results across IR, UV–Vis, magnetic moment, and conductance measurements. The molar conductance values indicated that all metal complexes behave as non-electrolytes in DMSO, suggesting complete coordination of the ligand without the presence of free counter ions in solution. Magnetic susceptibility data further supported the proposed geometries and electronic configurations, confirming high-spin octahedral and tetrahedral arrangements for Co(II) and Ni(II), respectively, and diamagnetism for the Zn(II) complex.

Overall, the study demonstrates the coordination versatility of the 2ATS ligand and its potential to form thermally stable, structurally diverse transition metal complexes. These findings contribute to the broader understanding of Schiff base chemistry and may have future applications in catalysis, materials science, or bioinorganic systems, subject to further investigation.

REFERENCES

Akinpelu, D. A., & Adebayo, O. (2020). Antimicrobial activities of metal complexes of Schiff bases: A review. *African Journal of Pure and Applied Chemistry, 14*(1), 1–12.

Ali, M. A., Ahmed, E. M., & Khan, M. J. (2020). Spectroscopic and DFT studies of new Co(II) and Cu(II) complexes derived from Schiff base ligands: DNA binding and antimicrobial evaluation. *Journal of Molecular Structure, 1200*, 127090.

Coates, J. (2000). *Interpretation of infrared spectra, A practical approach in R.A Meyers (Ed.), Encyclopedia od Analytical Chemistry (10815-10837)*. Chichester, UK: John Wiley and Sons Limited.

Cotton, F. A., Wilkinson, G., Murillo, C. A., & Bochmann, M. (1999). *Advanced inorganic chemistry* (6th ed.). New York: Wiley-Interscience.

Dhar, S., & Lippard, S. J. (2009). Mitaplatin, a potent fusion of cisplatin and the orphan drug dichloroacetate. *Proceedings of the National Academy of Sciences, 106*(52), 22199-22204. https://doi.org/10.1073/pnas.0912276106

Festus, C., Don-Lawson, C. D., & Ima-Bright, N. (2019). Synthesis involving asymmetric pyrazine-schiff base with Co2+, Ni2+ and Cu2+ ions: Spectral and Magnetic Characterization; and Antibacterial studies. *International Journal of Research & Innovation in Applied Science, 4*(4), 1–7.

Festus, C., Ima-Bright, N., & Osi, V. (2022). Synthesis; spectral, computational studies; and antimicrobial evaluations of Fe (II) and Zn (II) chelates containing R'C-NR''and N2O2 moieties. *Journal Analytical and Pharmaceutical Research, 11*(2), 45-54.

Festus, C., & Okocha, O. (2017). Behaviour of N-(2-hydroxybenzylidene)pyrazine-2-carboxamide in complexation towards Fe(II), Co(II), Ni(II) and Cu(II) ions: Synthesis, spectral characterization, magnetic and antimicrobial properties. *International Journal of Chemistry, Pharmacy & Technology, 2*(4), 143-153.

Festus, C., & Wodi, C. (2021). Corrosion inhibition; and antimicrobial studies of bivalent complexes of 1-(((5-ethoxybenzo [d] thiazol-2-yl) imino) methyl) naphthalene-2-ol chelator: Design, synthesis, and experimental characterizations. *Direct Research Journal of Chemistry and Materials Science, 8*, 31-43.

George, A., & Jack, B. (2013). Coordination chemistry and its medicinal applications. *Journal of Chemical and Pharmaceutical Research, 5*(2), 220–225.

Gupta, S. K., & Sharma, A. (2015). Role of metal complexes in the treatment of diseases. *International Journal of Drug Development and Research, 7*(1), 11–18.

Hosseinzadeh, R., Shakerian, F., & Tohidi, S. (2023). Zinc(II) complexes of Schiff base ligands: Synthesis, spectral properties, and charge transfer characteristics. *Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy, 293*, 122794.

Jane, A., & Chioma, F. (2024). Antimicrobial and corrosion inhibition studies of homoleptic metal (II) complexes of fluoroaniline schiffbase: Synthesis and characterization. *Scientific Modelling and Research, 9*(1), 69-88.

Kovala-Demertzi, D., Vlachou, C., & Demertzis, M. A. (2009). Transition metal Schiff base complexes with biological relevance. *Journal of Inorganic Biochemistry, 103*(3), 285–291.

Nakamoto, K. (2009). *Infrared and Raman spectra of inorganic and coordination compounds, part B: Applications in coordination, organometallic, and bioinorganic chemistry* (6th ed.). Hoboken, NJ: John Wiley & Sons.

Silverstein, R. M., Webster, F. X., Kiemle, D. J., & Bryce, D. L. (2014). *Spectrometric identification of organic compounds* (8th ed.). Hoboken, NJ: Wiley.

Singh, K., Kumar, V., & Lamba, R. (2021). Synthesis, characterization, and electronic properties of nickel(II) Schiff base complexes with N,O-donor ligands. *Inorganica Chimica Acta*, *521*, 120362.

Tundejurca, T. (2017). Metal-based drug design: The future of antimicrobial therapy. *Medicinal Chemistry Research*, *26*(2), 212–220.

Varghese, A., Joseph, A., & Raveendran, R. (2022). Spectroscopic studies and molecular docking of new Zn(II) Schiff base complexes with biological activities. *Journal of Molecular Structure*, *1252*, 132155.

Yadav, R., Kumar, N., & Prasad, S. (2021). Schiff base metal complexes as potential therapeutic agents. *Journal of Coordination Chemistry*, *74*(6), 987–1012.

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