

Plant growth development and Environmental studies of Schiff base metal Complexes

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Abstract

Plant growth development and Environmental influences of metal complexes derived from ligand. Schiff base ligand has been prepared by the condensation of 2-hydroxy-5-chloro acetophenone and thiazole. The ligand was characterized by elemental analysis and spectral methods. The coordinating ability of the ligand is investigated by preparing its metal complexes with Cr(III), Mn(III), Fe(III), VO(IV), Zr(IV) and UO₂(VI) have been prepared and characterized by elemental analysis, molecular weight determinations, conductance measurements, spectral and thermal studies. Environmental and Plant growth development application of Schiff base metal complexes.

Keywords: Schiff base, Magnetic, Environmental and Plant development

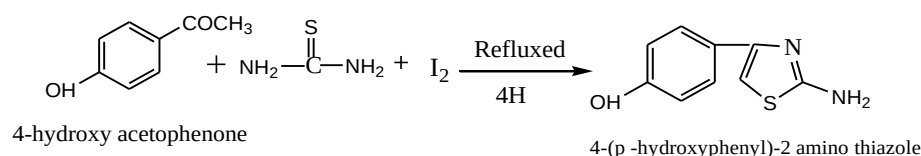
Introduction

Schiff bases and their transition metal complexes as cornerstones in applied chemistry¹ Synthesis, characterization and biological activity of metal complexes and their Schiff base ligands². A review on the history, synthesis, and applications of Schiff bases and their metal complexes³. Spectral, Structural, and Antibacterial Study of Cu(II) Complex with N₂O₂ Donor Schiff Base Ligand and Its Usage in Preparation of CuO Nanoparticle⁴. These compounds are majorly used in industries and also have significant biological activities, including antioxidant, antibacterial, antifungal, antiviral and antitumor. There is synthesis, characterization and biological activities of new Schiff Base Compound and its lanthanide complex⁵. Due to biological potency, pharmacological properties and synthetic flexibility of thiazole Schiff bases. The aim of present investigation is to synthesize various transition metal complexes of Schiff base derived from 2-hydroxy-5-chloro acetophenone and 4-(p-hydroxyphenyl)-2 amino thiazole and observing towards the environmental and plant growth.

Experimental

All the chemicals were of A.R. grade and used as received. 2-hydroxy-5-chloro acetophenone (HCA) and 4-(p-hydroxyphenyl)-2 amino thiazole was prepared by known methods⁶⁻⁹. The solvents were purified by standard methods¹⁰.

Synthesis of 4-(p-hydroxyphenyl)-2-aminothiazole;



Synthesis of 2-hydroxy-5-chloro acetophenone 4-(p-hydroxyphenyl)-2 imino thiazole [HCAT]: A solution of 4-(p-hydroxyphenyl)-2 imino thiazole (0.02M) in 25ml of ethanol was added to an ethanolic solution(25ml) of 2-hydroxy-5-chloro acetophenone (0.02M) and the reaction mixture was refluxed on a water bath for 4h. After cooling a pale yellow coloured crystalline solid was separated out. It was filtered and washed with ethanol, crystallized from DMF and dried under reduced pressure at ambient temperature. The purity of ligand was checked by elemental analysis and m.p. It was also characterized by IR and ¹H NMR spectral studies. Yield:70%; m.p. 310⁰C

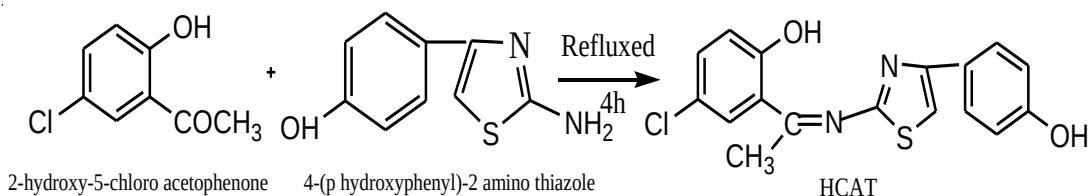


Table1. Analytical data of the Ligand.

Ligand	Molecular Formula	Formula Weight	Color and nature	Elemental Analysis				
				C% found (Cal.)	H% Found (Cal.)	N% Found (Cal.)	Cl% Found (Cal.)	S% Found (Cal.)
HCAT	C ₁₇ H ₁₃ N ₂ O ₂ SCl	344.6	Yellow Crystalline	59.38 (59.19)	03.70 (03.77)	08.5 (08.12)	10.11 (10.30)	09.22 (09.31)

Preparation of complexes: All the metal complexes were prepared in a similar way by following method. To a hot solution of ligand HCAT (0.02M) in 25ml of ethanol a suspension of respective metal salts was added drop wise with constant stirring. The reaction mixture was refluxed on a water bath for 4-5 h. The precipitated complexes were filtered, washed with ethanol followed by ether and dried over fused calcium chloride. Yield: 50-55%

Table 2. Analytical data and molar conductance of the compounds.

Compounds	Colour	Mol. wt.	Analysis % Found (calc.)					μ_{eff} B.M.	Λ_{M} ($\Omega^{-1} \text{cm}^2 \text{mol}^{-1}$)
			M	C	H	N	Cl		
[CrL ₂ (H ₂ O)Cl] H ₂ O	Green	810.7	6.32 (6.41)	50.25 (50.32)	3.36 (3.45)	6.81 (6.90)	13.08 (13.13)	3.96	18.9
[MnL ₂ (OAc)] H ₂ O	Brown	837.1	6.40 (6.55)	51.51 (51.60)	3.60 (3.70)	6.51 (6.68)	8.32 (8.48)	4.8	18.8
[FeL ₂ (H ₂ O)Cl] H ₂ O	Black	814.6	6.72 (6.86)	50.01 (50.08)	3.32 (3.43)	6.73 (6.87)	13.01 (13.07)	5.4	22.6
[VOL ₂]	Green	754.2	6.63 (6.76)	54.01 (50.09)	3.05 (3.18)	7.33 (7.42)	9.32 (9.41)	1.60	12.8
[ZrL ₂ (OH) ₂] 2H ₂ O	Yellow	848.4	10.68 (10.74)	47.93 (48.09)	3.46 (3.53)	6.52 (6.60)	8.26 (8.36)	Dia	11.7
[UO ₂ L ₂]	Orange	957.3	24.73 (24.87)	42.51 (42.61)	2.41 (2.50)	5.74 (5.84)	7.32 (7.41)	Dia	12.9

Results and Discussion

The Schiff base ligand HCAT and its complexes have been characterized on the basis of ¹H NMR, IR spectral data, elemental analysis, molar conductance, magnetic susceptibility measurements and thermogravimetric analysis data. All these values and analytical data is consistent with proposed molecular formula of ligand. All the compounds are colour solid and stable in air. They are insoluble in water but soluble in coordinating solvents like DMF and DMSO. The molar conductance values in DMF(10⁻³M) solution at room temperature (Table 2) shows all the complexes are non electrolytes¹¹ The ¹H NMR spectra of ligand HCAT shows

signals at δ 12.09, (1H, s, phenolic OH), δ 9.51 (1H, s, phenolic OH), δ 7.55, 7.54, 7.53 and 7.52 (4H, m, phenyl), δ 6.81, 6.80, and 6.78 (3H, s, Phenyl), 6.68 (1H, s, thiophene), and 2.56 (3H, s, methyl)¹²⁻¹⁵ IR spectra of ligand and metal complexes shows $\nu(\text{C}=\text{N})$ peaks at 1620cm^{-1} and absence of C=O peak at around $1700\text{--}1750\text{ cm}^{-1}$ indicates the Schiff base formation.¹⁶⁻¹⁹ IR spectra of complexes are shown in Table 3.

Table 3. IR spectra of ligand and metal complexes

Compound	$\nu(\text{O}-\text{H})$ hydrogen bonded	$\nu(\text{C}=\text{N})$ imine	$\nu(\text{C}-\text{O})$ phenolic	$\nu(\text{M}-\text{O})$	$\nu(\text{M}-\text{N})$	$\nu(\text{C}-\text{S})$
HCAT	3119	1620	1514	--	--	1122
$[\text{CrL}_2(\text{H}_2\text{O})\text{Cl}] \cdot \text{H}_2\text{O}$	--	1590	1506	475	409	1115
$[\text{MnL}_2(\text{OAc})] \cdot 2\text{H}_2\text{O}$	--	1562	1462	498	420	1090
$[\text{FeL}_2(\text{H}_2\text{O})\text{Cl}] \cdot \text{H}_2\text{O}$	--	1602	1504	512	440	1080
$[\text{VOL}_2]$	--	1598	1506	514	445	1098
$[\text{ZrL}_2(\text{OH})_2] \cdot 2\text{H}_2\text{O}$	--	1600	1498	445	412	1108
$[\text{UO}_2\text{L}_2]$	--	1585	1440	550	480	1082

Plant growth development and Environmental application of metal complexes

Some metals complexes result to increase the growth due to changes in physiological and biochemical activities, especially when some type of metal complexes inhibit plant growth and development. Some of the metal complexes used in crop production include herbicides, fungicides, insecticides, and fertilisers.

A ploughshare is a cobalt, Copper and nickel metal complexes used in agriculture to increase the production of crops. They are used prior to the seedling stage to loosen up the soil. Essential observed that cobalt (Co), copper (Cu), iron (Fe), manganese (Mn), molybdenum (Mo), nickel (Ni), and zinc (Zn) complexes with Schiff base plays a beneficial role in plant growth and development. Synthetic Action on Insecticides: Schiff base ligand was derived from the condensation of thiazole and 2-hydroxy-5-chloro acetophenone. Their metal complexes show high activity against insects²⁰. 2-amino-4-phenylthiazole acts as intermediate in synthesis of photostable pyrethroid insecticides²¹. Fluorination on aldehyde part of Schiff base increases insecto acaricidal activity²². Schiff bases and their metal complexes with Cr (III), Mn (III) show insecticidal activities against bollworm²³. Most metals complexes cause environmental and atmospheric pollution, and may be lethal to humans. Heavy metals can become strongly toxic by mixing with different environmental elements, such as water, soil, and air, and humans and other living organisms can be exposed to them through the food chain. Arsenic, cadmium, chromium, copper, nickel, lead and mercury are the most common metals which can pollute the environment. The heavy metals Mn, Fe, Co, Ni, Cu, Zn, and Mo are micronutrients or trace elements for plants. They are essential for growth and stress resistance as well as for biosynthesis and function of different biomolecules such as carbohydrates, chlorophyll, nucleic acids, growth chemicals, and secondary metabolites. Nitrogen(N) containing Schiff base metal complexes is made available to the plant from the air and soil. But most of the needed elements that are nutrients for plants come from the soil. They are not all equally important but all play a role in plant growth.

Conclusions

The Schiff bases ligand and their metal complexes shows more activity towards the environmental and plant growth development. This study applicable to geometry of metal complexes

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