

# Studies on antibacterial and antimicrobial Activity of Macrocyclic Cr(III) and Fe(II) Complexes with Schiff base ligands.

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## ABSTRACT

All over the world wide intersection which provide to comparative studies on macrocyclic metal Cr(III) and Fe(II) complexes with macrocyclic ligands. Consequently under the current communication, in coordination of our earlier interest. Very recently there has been a phenomenal growth in studies of Cr(III) and Fe(II) complexes. The complexes of the chelating ligands were synthesized using metal halides. The complexes of a new hydrogen bonded macrocyclic ligand derived from metal ion catalysed template synthesis of 1,2-Diamino-4,5-dinitrobenzene and diacetylmonoxime with Cr(III) and Fe(II) have been synthesized. Analyses with characterizations have been done on the basis of their elemental analyses, conductivity, magnetic moment in addition to spectral data and UV- visible. On the basis of electronic spectra and magnetic moment data suggest that the metal complexes have high spin octahedral paramagnetic extra hydrogen bonded more stable macrocyclic ring structure. Spectroscopic studies indicate that the coordination occurs with metal ions through two equatorial oxime-amine chelating ligands by neutral poly dentate donor azomethine nitrogen while other position of metal ions satisfied by two halides ions in facial and axial mode with Cr(III) and Fe (II) and formed three, five member and one six member extra hydrogen bonded more stable cyclic ring structure of complexes. The Cr(III) and Fe (II) complexes and ligands have been screened for antibacterial, antimicrobial activity and in the applied medicinal chemistry with other area of industries.

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**Keyword-** Stable ring structure, Conductivity, Medicinal Chemistry, Azomethine, Facial and axial mode.

## INTRODUCTION

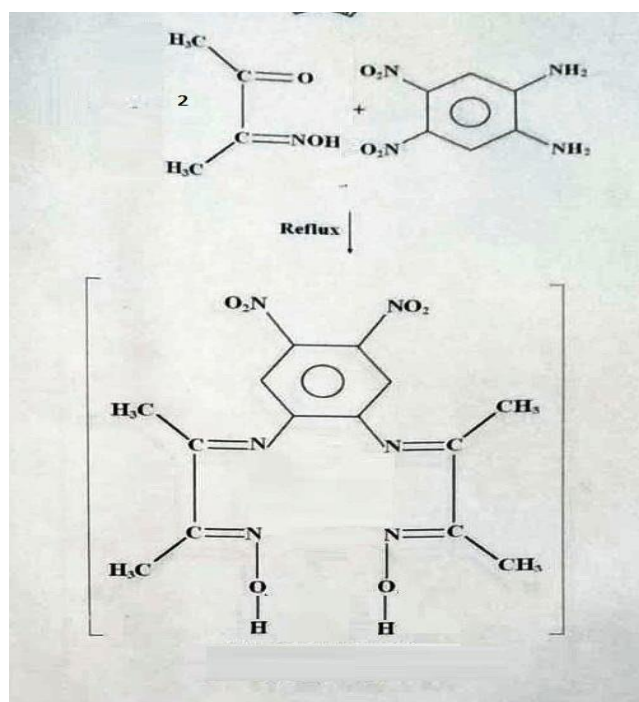
Coordination chemistry has received great attention in the field of inorganic chemistry during current time in all over the world. The reasons due to this interest are the fundamental importance in exchange interaction reaction with theory of bonding in new magnetic materials research and in understanding their important roles which play in large number of widely different processes of technological and biological importance<sup>5-9</sup>. Consequently in the resent communication in continuation of our earlier interest in the field. The metal complexes were prepared by refluxing hot ethyl alcohol solution of metal halide salts with the components of the ligand namely 1,2-Diamino-4,5-dinitrobenzene and diacetylmonoxime. The stoichiometry of the complexes have been found to be of the type  $[Cr(H_2L)X_2]$  and  $[Fe(H_2L)X_2]$ . The chelating of ligand with Cr(III) and Fe(II) are expected to form complexes with different three dimensional cyclic ring geometry. It may enhance their biological activity as antibacterial and antimicrobial activity after chelatio. Which may find their importance in the applied medicinal chemistry with antibacterial and antimicrobial activity and other area of chemical industries.

## Materials and method

The metal halide salts are used for synthetic and analytical work in experiment were of reagent grade solvent and purified by standard suitable method and dry before use in laboratory.

### Ligand synthesis

The Schiff base ligands ( $H_2L$ ) was synthesized by the condensation of two reactant molecules of diacetylmonoxime with 1,2-Diamino-4,5-dinitrobenzene under suitable condition in alcoholic medium. The reaction between the reactant molecules is occurs as in Figure - 1



The chemical reaction of synthesis of Ligands ( $H_2L$ )

Figure - 1

### Preparation of complexes.

#### 1. $[Cr(H_2L)Cl_2]Cl$

0.01 mole of alcoholic solution of chromic chloride with 0.02 mole of diacetylmonoxime and 0.1 mole of dinitroorthophenylenediamine were refluxed for 4 hour in a water bath. The green coloured of solid complexes are separated out. It was filtered, washed dried and analysed. The synthesis chemical reaction is given below.

#### 2. $[Cr(H_2L)Br_2]Br$

0.01 mole of alcoholic solution of chromic bromide with 0.02 mole of diacetylmonoxime and 0.1 mole dinitroorthophenylenediamine were refluxed for 4 hour in water bath. The green coloured of solid complexes are separated out.

### 3. $[\text{Cr}(\text{H}_2\text{L})(\text{NO}_3)_2]\text{NO}_3$

0.01 mole of alcoholic solution of chromic nitrate with 0.02 mole of diacetylmonoxime and 0.1 mole of dinitroorthophenylenediamine were refluxed for 4 hours in water bath. The green coloured solid complexes are separated out.

### 4. $[\text{Cr}(\text{H}_2\text{L})\text{ClO}_4]\text{ClO}_4$

0.01 mole of alcoholic solution of perchlorate with 0.02 mole of diacetylmonoxime and 0.1 mole of dinitroorthophenylenediamine were refluxed for 4 hours in a water bath. The green coloured solid complexes are separated out.

### 5. $[\text{Fe}(\text{H}_2\text{L})\text{Cl}_2]$

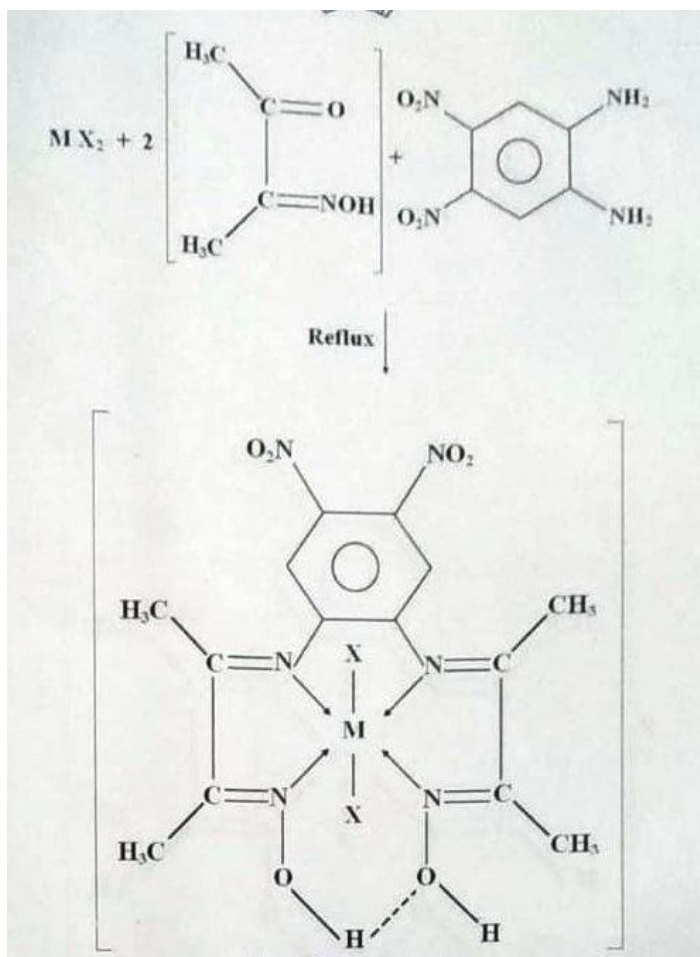
The synthesis of Fe (II) complexes with the alcoholic solution of ferric chloride was kept in bright sunlight for six hours. When intense yellow colour of ferric chloride changed to faint green, almost colourless due to reduction of Fe (III) to Fe (II). The components of the ligand were added to it in inert atmosphere. On refluxing dark red colour of solid complexes are separated out. The reaction between them is shown below.

### 6. $[\text{Fe}(\text{H}_2\text{L})\text{Br}_2]$

The synthesis of Fe (II) complexes with the alcoholic solution of ferric bromide was kept in bright sunlight for six hours. When intense brown colour of ferric bromide changed to faint green, almost colourless due to reduction of Fe (III) to Fe (II). The components of the ligand were added to it in inert atmosphere. On refluxing dark red colour of solid complexes are separated out.

### 7. $[\text{Fe}(\text{H}_2\text{L})(\text{NO}_3)_2]$

The synthesis of Fe(II) complexes with alcoholic solution of ferric chloride was kept in bright sunlight for six hours. When intense brown colour of ferric nitrate changed to faint green almost coloured due to reduction of Fe (III) to Fe(II).The components of the ligand were added to it in inert atmosphere. On refluxing dark red colour of solid complexes are separated out. The reaction between them is shown below as Figure -2



M = Cr (III), Fe (II)

X = Cl<sup>-</sup>, Br<sup>-</sup>, NO<sub>3</sub><sup>-</sup>, ClO<sub>4</sub><sup>-</sup>

The chemical reaction of preparation of Complexes of [Mn(H<sub>2</sub>L)X<sub>2</sub>]

Figure- 2

## Results and discussion.

The complexes with intra-molecular hydrogen bonded macrocyclic ligand derived from metal ion catalysed template synthesis of 1,2-Diamino-4,5-dinitrobenzene and diacetylmonoxime with Cr(III) and Fe(II) have been synthesized. Characterizations have been done on the basis of their elemental analyses, conductivity, Magnetic moment with spectral data of I.R and UV-visible.

## Elemental analysis

The physical and analytical data of the complexes are given in table – 1. This is in satisfactory agreement with the calculated values. The suggested molecular formula are supported by the subsequent spectral as well as magnetic moment, molar conductivity in 10<sup>-3</sup> M solution of DMSO, the value of  $\lambda_m$  (Table –2) show that Cr (III) and Fe (II) complexes are non-electrolytic in nature.

## Physical and analytical data for the complexes

Complexes	Colour	Yield %	Elemental analysis Calculation. (Found)			
			M%	N%	C%	H%
[Cr(H <sub>2</sub> L)Cl <sub>2</sub> ]Cl	Green	78	11.75(11.74)	18.27(18.26)	36.56(36.54)	3.48(3.47)
[Cr(H <sub>2</sub> L)Br <sub>2</sub> ]Br	Green	77	9.08(9.07)	14.13(14.12)	28.27(28.26)	2.71(2.68)
[Cr(H <sub>2</sub> L)(NO <sub>3</sub> ) <sub>2</sub> ]NO <sub>3</sub>	Green	73	9.839(8.2)	22.90(22.89)	30.53(30.52)	2.90(2.89)
[Cr(H <sub>2</sub> L)ClO <sub>4</sub> ]ClO <sub>4</sub>	Green	79	8.29(8.28)	12.87(12.86)	25.74(25.74)	2.46(2.45)
[Fe(H <sub>2</sub> L)Cl <sub>2</sub> ]	Red	96	13.12(13.10)	19.68(19.66)	39.32(39.32)	3.74(3.73)
[Fe(H <sub>2</sub> L)Br <sub>2</sub> ]	Red	91	10.86(10.83)	16.27(16.26)	32.55(32.54)	3.12(3.11)
[Fe(H <sub>2</sub> L)(NO <sub>3</sub> ) <sub>2</sub> ]	Red	92	11.68(11.65)	23.32(23.31)	35.05(34.01)	3.32(3.31)

Table – 1

## I.R Spectral data for the complexes.

Complexes	V C=N (Oxime)	V C=N	V M=N	V M=O
[Cr(H <sub>2</sub> L)Cl <sub>2</sub> ]Cl	1491	1591	441	396
[Cr(H <sub>2</sub> L)Br <sub>2</sub> ]Br	1494	1596	461	401
[Cr(H <sub>2</sub> L)(NO <sub>3</sub> ) <sub>2</sub> ]NO <sub>3</sub>	1501	1601	464	404
[Cr(H <sub>2</sub> L)ClO <sub>4</sub> ]ClO <sub>4</sub>	1504	1606	471	400
[Fe(H <sub>2</sub> L)Cl <sub>2</sub> ]	1491	1609	480	406
[Fe(H <sub>2</sub> L)Br <sub>2</sub> ]	1503	1594	491	410
[Fe(H <sub>2</sub> L)(NO <sub>3</sub> ) <sub>2</sub> ]	1502	1591	474	406

Table-2

## Infrared spectra.

Table-2. Lists the most useful infrared assignments for those bands most diagnostic of the mode of coordination of ligand. The most important band in the infrared spectra of 1,2-diamino-4,5-dinitrobenzene is due to  $\nu_s$  and  $\nu_{as}$  of -NH<sub>2</sub> groups. The I.R. spectra of diacetylmonoxime exhibits  $\nu_{C=O}$  and  $\nu_{C=N}$ . In the spectra of the complexes  $\nu_{NH_2}$  of 1,2-diamino-4,5-dinitrobenzene and  $\nu_{C=O}$  of diacetylmonoxime is significantly absent indicating Schiff base condensation during macrocyclization. The  $\nu_{C=N}$  oxime shows a downward shift indicating its involvement in coordination. In the far I.R. region two bands one in the region 440-610 cm<sup>-1</sup> and another in the region 395-415 cm<sup>-1</sup> may be assigned to  $\nu_{M-N}$  and  $\nu_{M-O}$  respectively. In the halogen complexes, a band in region 295-350 cm<sup>-1</sup> may be attributed to  $\nu_{M-X}$  (X= Cl, Br)

## Electronic spectra and magnetic moment studies

The UV-visible spectra of the complexes were recorded for their solutions in ethyl alcohol and DMSO solvents in the range (200-1000) nm. The ligand field spectra of Cr(III) complexes exhibit two bands in the region 624 and 455 nm which are assignable to  ${}^4A_{2g} \rightarrow {}^4T_{2g}$  and  ${}^4A_{2g} \rightarrow {}^4T_{1g}$  transition the  $\nu_2/\nu_1$  ratio is 1.35 which is very close of value of 1.42 obtained for pure octahedral Cr(III) complexes. Electronic spectra and magnetic

moment data of Cr(III) and Fe(II) complexes support paramagnetic high spin octahedral geometry. These Schiff base ligands and their metal complexes have been investigated as potential antibacterial and antimicrobial agents in long history of medical application. Recently greater variety of these ligands and their complexes containing hetero atoms represent good antimicrobial and antibacterial activity.

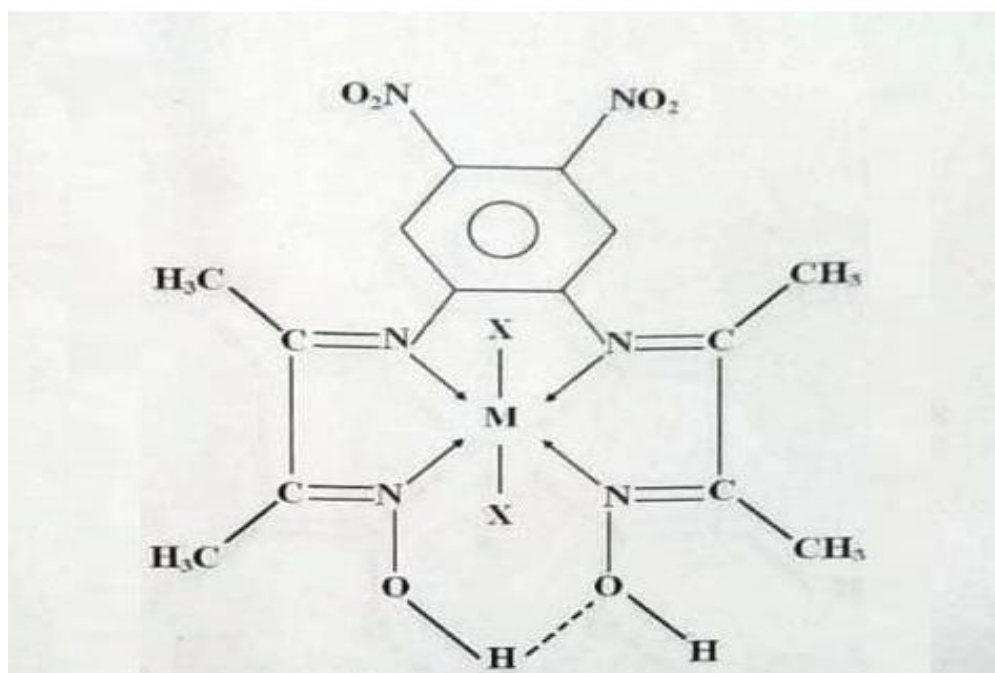
### Biological activity.

On the basis of experimental proofs the Cr(III) and Fe (II) complexes have work more effective action as compared to free ligands and its metal ions.. The antibacterial and antimicrobial activity of the synthesized Cr(III) and Fe (II) complexes was tested against both Gram-negative and Gram-positive bacteria and other microorganism.. The tested solutions of complexes were prepared in suitable solvent. It seems that enhanced biological activity for the complex compound of Cr(III) and Fe (II) is due to its electron donating group and the poly-conjugated nature of the compound. On the basis of conjugation compounds provide large surface areas which enhance greater extent of lipophilic and absorbing nature. The complexes are more active as compared to the greater dissolving ability in fats, oils, lipids and non-polar suitable organic solvent with more absorbing nature of the complexes as a result which controls the growth or increases the ratio of death of the bacteria and other microorganism.. Therefore the results indicated that chelation improved the effect of antibacterial and antimicrobial activity compared to the ligand and free metal ions, known as antibiotic drugs.<sup>19-20</sup>

### CONCLUSION.

On the basis of above experimental studies it is concluded that the Schiff base ligands (H<sub>2</sub>L) acts as a polydentate manner and coordination is proposed through equatorial oxime N moiety with central metal ion of complexes while two halogen atoms are capsulated in facial and axial mode with Cr (III) and Fe (II) metal ion and proposed stable two 5-membered capsulated cyclic ring structure while intra-molecular hydrogen between two stable five members cyclic ring structure enhance their extra stability of complexes. On the basis of physicochemical and spectroscopic observation it is proposed that the geometry of the type Cr(III) and Fe (II) metal ion complexes are monomeric high spin octahedral paramagnetic intra-molecular hydrogen bonded macrocyclic stable ring structure of the metal complexes. Which provide the extra stability of complexes.

On the basis of electronic spectra and magnetic moment data suggest that the high spin octahedral paramagnetic hydrogen bonded macrocyclic stable ring structure of the metal complexes can be proposed to have the following structures.



M = Cr (III), Fe (II)

X = Cl<sup>-</sup>, Br<sup>-</sup>, NO<sub>3</sub><sup>-</sup>, ClO<sub>4</sub><sup>-</sup>

Octahedral paramagnetic structure of the metal complexes

Figure- 3

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