CHAPTER-VI

CONCLUDING REMARKS AND FUTURE OUTLOOK

Based on the present work, we would like to conclude that the synthesized binuclear transition metal complexes of binucleating Schiff base ligands are promising materials for biological applications. Thesis divided into six chapters.

Four binucleating Schiff base ligands have been synthesized from

i. Benzene-1,4-dicarbaldehyde and 2,6-diaminopyridine (Precursor) ii. Precursor and 2-hydroxybenzaldehyde (H₂L₁)

iii. Precursor and 5-bromo-2-hydroxybenzaldehyde (H₂L₂)

iv. Precursor and 2-hydroxyacetphenone (H₂L₃)

v. Precursor and 2-hydroxynaphthalene-1-carboxaldehyde (H₂L₄)

Its binuclear Schiff base metal complexes of Cu(II), Co(II), Ni(II) and Mn(II)  ions have been derived from binucleating Schiff base ligands with 2,2′-bipyridyl. The synthesis part has been explained in chapter-IV.

Various techniques were used to elucidate the structure and geometry of the binucleating Schiff base ligands and its binuclear complexes prepared.

The structure and geometry of the binuclear Schiff base complexes derived from binucleating Schiff base ligands have been discussed in Chapter-V with five sub divisions. First division shows the characterization of the precursor. The structure was confirmed through IR and ¹H-NMR. The spectral studies show the presence of azomethine moiety and free amino groups. Second part reveals the structure of binucleating Schiff base ligand (H₂L₁) and its complexes. The structure and geometry were confirmed through IR, UV, ¹H NMR, Magnetic Moment and
Concluding remarks and future outlook

ESR. The 1:2 electrolytic nature of the synthesized complexes were confirmed through molar conductance measurements. The IR spectroscopic data indicate that the Schiff base ligands form Cu(II), Co(II), Ni(II) and Mn(II) complexes with one dibasic Schiff base ligand and one bidentate heterocyclic base. The coordination takes place through the deprotonated hydroxyl group, azomethine nitrogen, nitrogen of pyridine group and nitrogen of bipyridyl moiety. An $^1$H-NMR spectrum confirms the ligand formation. The magnetic susceptibility values at room temperature are consistent with the octahedral geometry without any metal-metal interactions for all the complexes. ESR studies of Cu(II) complexes gave evidence for the octahedral geometry around the metal ion. The electrochemical analysis showed the redox nature of the complexes with one electron process. Investigations on antibacterial activities showed that the complexes are moderately active against bacteria than its ligand. Intercalative binding of complexes with DNA has been identified through electronic spectroscopy and viscosity measurement studies. The cleavage of DNA by the synthesized complexes was recognized by gel electrophoresis technique.

Third division enumerates the structure and characterization of binucleating Schiff base ligand ($H_2L^2$) and its complexes. It was characterized by analytical and different techniques like IR, ESR and UV-Vis spectral studies and magnetic studies. The magnetic measurements showed all the complexes were paramagnetic and suggest octahedral geometry with no metal-metal interactions. The ESR spectra indicate the presence of free electron in the $dx^2-y^2$ orbital. The coordination geometry around Metal ion in all complexes are octahedral with one dibasic ligand and one bidentate heterocyclic base. The coordination takes place through the deprotonated hydroxyl group, azomethine nitrogen, nitrogen of pyridine group and
nitrogen of heterocyclic moiety. All electronic transitions were assigned and the values are consistent with octahedral structure for the complexes. All the synthesized binuclear Schiff base complexes are paramagnetic. The antimicrobial studies showed all the complexes were moderately active against all the microorganisms under study. The DNA binding abilities resulted that the complexes bind to CT-DNA by an intercalative mode. Chemical nuclease activity of these metal complexes with super coiled pUC18 DNA was investigated by gel electrophoresis. From the results, it is found that the metal complexes cleaved DNA efficiently in the presence of H₂O₂.

Fourth part deals with an interesting series of binary complexes of Cu(II), Co(II), Ni(II) and Mn(II) ions from $H^2L^3$ and 2,2'-bipyridyl in appropriate conditions and characterized by analytical and different spectral techniques like IR, ESR and UV -Vis spectral studies and magnetic studies. All the compounds are paramagnetic and the magnetic moments are consistent with the octahedral environment around central metal ion without any metal-metal interactions. The ESR spectral studies indicate that all the complexes have a distorted octahedral geometry. The coordination takes place through the phenolic oxygen, azomethine nitrogen, nitrogen of pyridine ring and nitrogen atom of bipyridyl moiety. All electronic transitions observed were consistent with distorted octahedral structure. All the four complexes were showed moderate to higher activity against both the Gram positive and Gram negative bacteria. The DNA-binding properties of the synthesized complexes have been examined by absorption spectroscopy and viscosity measurements. Evidences are presented that the complexes could interact
with DNA via intercalation mode. DNA cleavage studies show that the synthesized binuclear metal complexes cleave the DNA molecule efficiently.

Fifth division includes an interesting series of binuclear Metal(II) complexes from H$_2$L$^4$ and 2 2’-bipyridine and characterized by analytical and different spectral techniques, like IR, UV -Vis spectral studies and magnetic studies. Based on these data, an octahedral geometry is assigned to all the synthesized complexes. Further, the promising results have been observed for the antimicrobial screening especially for the metal complexes against both the Gram positive and Gram negative bacteria. Binding induced changes in absorption and viscosity measurements confirm an intercalative mode of interaction of complexes with CT-DNA. The DNA cleavage results showed that the homo dinuclear copper complexes can effectively cleave supercoiled DNA to form nicked or linear DNA.

Future Outlook

In the present work, we are able to show that Cu(II), Co(II), Ni(II) and Mn(II) complexes of 2,6-diaminopyridine based Schiff base ligands are biologically active in Antibacterial and DNA interaction studies.

Moreover, structural requirements for anti-tumor activity could be better satisfied by modifying electronic environments of the metal ions. The inclusion of pyridine ring makes it possible to introduce substituents on the ligand, which may improve the solubility and activity of these complexes. It is also desirable to know in more detail about the mechanism of action of the synthesized complexes as well as their general toxicology and other pharmacological properties.