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Electrochemical studies of DNA interaction and antimicrobial activities of Mn^{II}, Fe^{III}, Co^{II} and Ni^{II} Schiff base tetraazamacrocyclic complexes

Anuj Kumar*¹, Vinod Kumar Vashistha², Prashant Tevatia¹, and Randhir Singh¹

¹Department of Chemistry, Gurukula Kangri University, Haridwar-249404, India

²Department of Chemistry, GLA University, Mathura, Uttar Pradesh-281406, India

Ph. No. +91 9761565732; E-mail anujkumar9791@gmail.com

Abstract

Tetraazamacrocyclic complexes of Mn^{II}, Fe^{III}, Co^{II} and Ni^{II} have been synthesized by template method. These tetraazamacrocyclic complexes have been analyzed with various techniques like molar conductance, IR, UV-Vis, mass spectral and cyclic voltammetric studies. On the basis of all these studies, octahedral geometry has been assigned to these tetraazamacrocyclic complexes. The DNA binding properties of these macrocyclic complexes have been investigated by electronic absorption spectra, fluorescence spectra, cyclic voltammetric and differential pulse voltammetric studies. The cyclic voltammetric data showed that i_{pc} and i_{pa} were effectively decreased in the presence of calf thymus DNA, which is a strong evidence for the interaction of these macrocyclic complexes with the calf thymus DNA (ct-DNA). The heterogeneous electron transfer rate constant found in the order: $K_{Co^{II}} > K_{Ni^{II}} > K_{Mn^{II}}$ which indicates that Co^{II} macrocyclic complex has formed a strong intercalated intermediate. The stern-volmer quenching constant (K_{SV}) and voltammetric binding constant were found in the order $K_{SV}(Co^{II}) > K_{SV}(Ni^{II}) > K_{SV}(Mn^{II})$ and $K^+(Co^{II}) > K^+(Ni^{II}) > K^+(Mn^{II})$ which shows that Co^{II} macrocyclic complex exhibits the high interaction affinity towards ct-DNA by the intercalation binding. Biological studies of the macrocyclic complexes compared with the standard drug like Gentamycin, have shown antibacterial activities against *E. coli*, *P. aeruginosa*, *B. cereus*, *S. aureus* and antifungal activity against *C. albicans*.

Keywords: Schiff base, fluorescence quenching, electrochemical studies and antibacterial activity.

1. Introduction

Schiff bases are very attractive and have attained recognition for their roles in many biological processes. In recent years, lots of investigations have been done on the coordination chemistry of transition metal complexes with Schiff base ligands in order to mimic the physical and chemical behaviour perceived in biological processes [1,2]. The design and synthesis of new drugs that enhance the contrast between normal and diseased tissues and the simultaneous advances in relevant technology strongly contributed to the recent developments in this area. The stabilization of unusual oxidation states of the transition metal ion by macrocyclic ligand is very much significant. Such unusual oxidation states have brought additional attention to the chemistry of the macrocyclic complexes [3-4].

Polyaza Schiff-base macrocyclic complexes have found a great focus on the interaction with the DNA which has an interest in the development of probes of DNA structure and design of new synthetic models of naturally occurring macrocyclic systems. Metal complexes that exhibit interactions with DNA have been investigated with the aim of emerging analyses for nucleic acid structures and chemotherapy agents [5]. By changing the ligand environment, it is possible to study the DNA binding and cleavage abilities of metal complexes. Such studies are also important for determining the mechanism of metal ion toxicity [6,7]. There is a curiosity to know the mechanism of exact binding and cleavage mode of macrocyclic complexes with the DNA [8,9]. Therefore, scientists emphasize to design new and effective macrocyclic complexes and to study them by various techniques to understand the exact mode of binding and cleavage of DNA with macrocyclic complexes.

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