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Synthesis, Spectral Characterization, DNA Cleavage, and Antimicrobial Activity of Transition Metal (II) Complexes of Pyranochromene Derivatives

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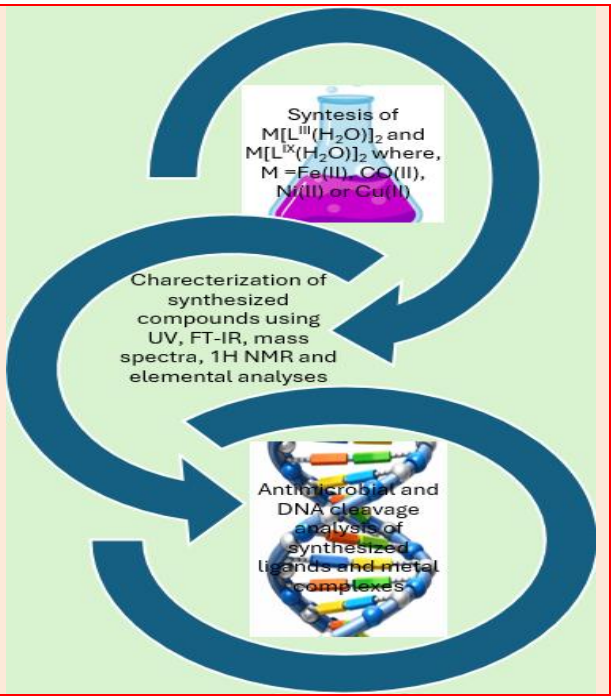
Abstract

New ligands L^{III} = 3-acetyl-4-hydroxy-7-methylpyrano [3,2-*c*]chromene-2,5-dione, L^{IX} = 4-hydroxy-7-methyl-3-(3-oxobutanoyl)pyrano[3,2-c]chromene-2,5-dione and their metal(II) complexes $M[L^{III}(H_2O)]_2$ and $M[L^{IX}(H_2O)]_2$ were synthesized using transition metals iron, cobalt, nickel and characterized by UV, FT-IR, mass spectra, 1H NMR and elemental analysis,. The conductivity of metal complexes was determined. In the presence of H_2O_2 at 37°C, complexes can efficiently cleave Calf Thymus DNA. Ligands and their metal (II) complexes also show good *in vitro* antimicrobial activity. Copper complexes of both ligands have highest DNA cleavage ability and also shows maximum zone of inhibition indicating higher antimicrobial activities.



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Introduction

The search for innovative molecular combinations to develop novel antimicrobial and antiviral agents has attracted substantial global attention in recent years [1, 2], primarily due to the escalating concern over the rapid emergence of antibiotic-resistant bacteria. This alarming trend is further intensified by the significant lack of newly developed antibiotic classes, resulting in what is widely referred to as an “antibacterial crisis” [3]. Similarly, fungal infections are emerging as a major cause of morbidity and mortality, particularly among immunocompromised individuals. The increasing prevalence of mycoses is largely attributed to the progressive development of resistance to antifungal agents used in clinical practice, along with the limited diversity of available antifungal drug classes, which significantly restricts therapeutic options [4].

In biological systems, metal ions such as zinc and copper play indispensable roles in maintaining normal physiological functions [5]. Transition metals including copper, iron, and manganese participate in a wide range of biochemical processes, encompassing electron transfer, enzymatic catalysis, and structural stabilization. These metals are commonly localized at the active sites of proteins and enzymes, where they facilitate essential cellular reactions [5]. Despite their vital importance, deregulations of these essential metals during normal biochemical processes has been associated with the onset and progression of various pathological conditions, including cancer [6]. Cellular functions require these “trace metals” only in minute but strictly regulated concentrations, as both deficiency and excess can disrupt cellular functions. In recent years, substantial progress has been achieved in exploiting transition metal complexes for therapeutic applications in the treatment of several human diseases. The ability of transition metals to adopt multiple oxidation states and to coordinate with negatively charged biomolecules underlies their diverse reactivity