Faculty of Science
Chemistry Department

Structural characterization, spectroscopic studies, biological and antioxidant evaluation of some transition metal complexes

Submitted By

Ibrahim Shaban Abdel Rahman Elsayed

Master in Inorganic and analytical chemistry, Faculty of Science, Ain Shams University, 2012.

A Thesis submitted in partial Fulfillment of

The Requirement for the Ph.D Degree

In Inorganic chemistry

Supervised by

Prof. Dr. Mostafa Mohamed Hassan Khalil

Prof. of Inorganic Chemistry, Faculty of science, Ain Shams University

Prof. Dr. Ayman Ahmed Abdel Aziz

Prof. of Inorganic Chemistry, Faculty of science, Ain Shams University

Dr. Gehad Mohamed Ahmed Attiya

Lecturer of Inorganic Chemistry, Faculty of science, Ain Shams University

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Thesis Advisors **Thesis Approval**

Prof. Dr. Mostafa Mohamed Hassan Khalil ……
Prof. of Inorganic Chemistry
Faculty of science, Ain Shams University

Prof. Dr. Ayman Ahmed Abdel Aziz ……
Prof. of Inorganic Chemistry
Faculty of science, Ain Shams University

Dr. Gehad Mohamed Ahmed Attiya ……
Lecturer of Inorganic Chemistry
Faculty of science, Ain Shams University

Head of Chemistry department

Prof. Dr. Ibrahim H. A. Badr

2018

Dedication to

Allah

The most merciful who blessed my effort, showed me way and provided me with power to present this work in an acceptable form

My Father

My beloved wife

Deep gratefulness

for

their patience kind support and continuous encouragement during the whole time of the work .

Ibrahim Shaban Abdel Rahman Elsayed

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Ibrahim Shaban Abdel Rahman Elsayed

English Abstract

Abstract

Schiff bases are important due to their vivid applications owing to their characteristic properties such as high synthesis flexibility, varied coordinating ability, thermal stability, novel structures, biological activities and medicinal utility. So, different types of Schiff bases have been synthesized by various workers.

Schiff base metal complexes have a variety of applications in clinical and pharmacological areas. Some of them having structural similarities to natural biological substances have been used as models in biological macrosystems, radiopharmaceutical cancer targeting, dioxygen carriers and medical substrates.

In the present work, novel tetradentate dianionic Schiff base ligand, N,N′-bis(2-carboxyphenylimine)-2,5-thiophenedicarboxaldhyde (H_2L^1) and some first row d-transition metal chelates (Co(II), Cu(II), Ni(II) and Zn(II)) were synthesized and characterized using various physicochemical and spectroscopic methods. The spectroscopic data suggested that Schiff base ligand coordinates through both deprotonated carboxylic oxygen and imine nitrogen atoms. The free Schiff base and its metal chelates were screened for their antimicrobial

activities for various pathogenic bacteria and fungi using the agar well diffusion method. The antibacterial and antifungal activities of all the newly synthesized compounds are significant compared to the standard drugs ciprofloxacin and nystatin. The antioxidant activities of the compounds were determined by reduction of 1,1-diphenyl-2-picrylhydrazyl and compared with that of vitamin C as a standard. DNA binding ability of the novel Schiff base and its complexes was investigated using absorption spectroscopy, fluorescence spectroscopy, viscosity measurements and thermal denaturation. The obtained results clearly demonstrate that the binding affinity with calf thymus DNA follows the order: Cu(II) complex > Ni(II) complex > Zn(II) complex > Co(II) complex >H_2L^1. Furthermore, the DNA cleavage activity of the newly synthesized ligand and its metal complexes was investigated using supercoiled plasmid DNA (pUC18) gel electrophoresis.

In addition, Co(II), Ni(II) Cu(II) and Cu(II) complexes of the new unsymmetrical Schiff base ligand 2,2'-(((1E,2E)-1,2-di(pyridin-2-yl)ethane-1,2-diylidene)bis (azaneylylidene))diphenol (H_2L^2) were synthesized. H_2L^2 was derived by condensation of 2.2'-pyridil and o-aminophenol in the ratio 1:2. Fourier Transform infrared

spectroscopy (FT-IR), NMR spectroscopy, elemental analysis, mass spectroscopy, electron spin resonance (ESR), magnetic moment and molar conductivity measurements have been used to characterize the Schiff base ligand and its complexes. Antimicrobial activity data showed that, the complexes have significant growth inhibitory activity against the bacteria strains (*B. subtilis, S. aureus, , E. coli, and K. pneumoniae*) and the fungi strains (*C. albicans and A. niger*) as compared to the parent ligand. UV-Vis absorption, fluorescence, and viscometric measurements were used to investigate binding properties of the synthesized Schiff base and its complexes with Calf Thymus DNA under physiological conditions. The data have shown that, the compounds can bind to Calf Thymus DNA via an intercalative mode in the order Cu (II) > Zn (II) ≈ Ni (II) > Co (II) > H_2L^2. The antioxidant properties of Schiff base ligand and its metal complexes were determined by $DPPH^{\bullet}$ and $HO^{\bullet}$ assays. Among the compounds Cu(II)-complex was noted to be the most powerful scavenger for radicals.