Trop J Nat Prod Res, June 2025; 9(6): 2721 - 2727 ISSN 2616-0684 (Print)
ISSN 2616-0692 (Electronic)

Tropical Journal of Natural Product Research

Available online at https://www.tjnpr.org

Original Research Article

Synthesis, Characterisation, and Cytotoxic Activity of New Schiff Base Prepared Using 3,3`-Diamino Benzidine and its Complexes with Cu (II), Co (II), and Ni (II) Against Oesophageal Cancer Cell Line (SK-GT-4)

Zahraa T. M. Al-bahrany, Jasim M.S. Alshawi*

Department of Chemistry, College of Education of Pure Sciences, University of Basrah, Basrah, Iraq

ARTICLE INFO

Article history:
Received 15 March 2025
Revised 24 April 2025
Accepted 05 May 2025
Published online 01 July 2025

ABSTRACT

The chemistry of condensed Schiff base compounds, including their potential for drug development and other biological properties, has been the subject of numerous experiments. Amines are important to medicinal chemistry since they are available as natural compounds and are the building blocks of several currently marketed drugs. This study used the condensation reaction between 3,3'-diaminobenzidine and 2-hydroxy-1-naphthaldehyde to synthesise a new chemical compound (Schiff base). Transition metal complexes containing copper(II) (Cu(II)), cobalt(II) (Co(II)), and nickel(II) (Ni(II)) were then created by reacting the ligand with the respective metal chlorides in a molar ratio of 2:1. A range of spectroscopic and characterisation tests were conducted on the ligand and its metal complexes to confirm their structural geometry. Nuclear magnetic resonance (NMR) tests were performed on the novel ligand as a product using proton NMR (^{1}H-NMR), carbon NMR (^{13}C-NMR), mass spectrometer, ultraviolet-visible (UV-Vis) absorption, infrared (IR) and molecular weight determination, molar conductance, and magnetic measurement techniques. The cytotoxicity of the Schiff base ligand and its complexes against the SK-GT-4 cell line, a model for oesophageal cancer, was evaluated using the 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) assay. The results showed that the Co(II) combination was highly active against the SK-GT-4 cells. Additionally, this substance was evaluated biologically and toxicologically on healthy cells. The complex was notable for its remarkable selectivity, allowing it to efficiently target and eradicate cancer cells while causing the least damage to healthy cells.

Keywords: Cancer cell, Cytotoxic Activity, Schiff base, 2-Hydroxy-1-naphthaldehyde, 3,3`-Diaminobenzidine.

Introduction

The creation of flexible ligand-based compounds is a popular topic in coordination chemistry due to their erratic framework connection and possible uses in magnetic, ion exchange, porous, luminescence, and optical devices. Furthermore, because complexes with a metal-organic framework can be activated against diseased cells, particularly cancer cells, without harming healthy cells, they may be valuable in biomedicine. The field of coordination chemistry is a subfield of inorganic chemistry. One strategy of coordination chemistry is the rational design of organic blocking ligands and the use of organic/inorganic bridging ligands to create species with a metal-organic framework.[1,2] The structurally significant role of Schiff bases in inorganic chemistry can be seen by their ability to form stable complexes with most transition metal ions in the periodic table, their various biological uses, ease of production, chelating qualities, and extraordinary stability.[3] Schiff bases are derivatives of aldehydes or ketones where an azomethine or imine group (>C=N-) takes the place of the carbonyl group (C=O).

*Corresponding author. Email: jasim.salih@uobasrah.edu.iq
Tel: +9647705638532

Citation: Al-bahrany ZTM, Alshawi JMS. Synthesis, Characterisation, and Cytotoxic Activity of New Schiff Base Prepared Using 3,3`-Diamino Benzidine and its Complexes With Cu (II), Co (II), and Ni (II) Against Oesophageal Cancer Cell Line (SK-GT-4). Trop. J. Nat. Prod. Res., 2025 9(6): 2721 - 2727 https://doi.org/10.26538/tjnpr/v9i6.49

Official Journal of Natural Product Research Group, Faculty of Pharmacy, University of Benin, Benin City, Nigeria

Schiff bases, which are generated by condensing carbonyl compounds with primary amines,[4] have displayed a range of pharmacological benefits, such as antioxidant qualities,[5] antibacterial effects,[6] anticancer potential,[7,8] and antifungal efficacy.[9] Their applications, including molecular docking studies, antibacterial research, and thermodynamic studies of the formation of complexes with metal ions, have been the focus of multiple inquiries.[10,11] This study used ethanol as a solvent to create a new ligand by reacting 3,3'-diaminobenzidine with 2-hydroxy-1-naphthaldehyde. Specific metal ions were then used to generate metal complexes. Tetra-coordination with binuclear metal centres was present in all the resultant complexes. It was discovered that the di-nuclear nickel (Ni_2L) complex was diamagnetic, but the di-nuclear cobalt (Co_2L) and di-nuclear copper (Cu_2L) complexes both displayed paramagnetic characteristics. According to the hybridisation studies, the Cu and Co complexes showed sp^3 conformation, while the nickel complex showed dsp^2 hybridisation. The 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) assay was used to test the cytotoxicity of the Schiff base ligand and its complexes against the SK-GT-4 cell line, a model for oesophageal cancer. The results showed that the cobalt(II) (Co(II)) complex was highly active against the SK-GT-4 cells. Additionally, at $IC50 = 462.5$, the compound was tested biologically and toxicologically on normal cells, and the complex showed remarkable selectivity by efficiently identifying and killing the cancer cells while causing the least damage to the healthy cells.

Materials and Methods

Cell line sources and cell culture maintenance

An oesophageal cancer model, the SK-GT-4 cell line, was acquired from the IRAQ Biotechnology Cell Banking Centre in Basrah and cultured in an RPMI-1640 medium supplemented with 10% foetal bovine serum, 100 units/mL of the antibiotic penicillin, and 100 g/mL