

**SYNTHESIS, CHARACTERIZATION AND ANTIBACTERIAL
ACTIVITY OF RUTHENIUM (II) COMPLEXES OF BIDENTATE
SCHIFF BASE LIGANDS**

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DECLARATION AND RECOMMENDATION


Declaration


This thesis is my original work and has not been submitted for an award of diploma or conferment of degree in any institution or University.

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Recommendations

This thesis has been examined, passed and submitted with our approval as University supervisors.

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DEDICATION

I dedicate this thesis to my cherished wife, Ronah Chebet, and my dear daughter, Talulla.

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ABSTRACT

Increased bacterial resistance to available antibiotics remains a concern globally; therefore, there is a need for novel antibiotics with unique mechanisms of action to combat multidrug-resistant organisms. This is important in ensuring that both the human and animal health is well protected. Schiff bases containing pyridine imine pharmacophore possess significant antibacterial activity. The objectives of this study were to; – Prepare ruthenium (II) complexes of bidentate Schiff base ligands – Investigate the complex formed – Perform bioassay of the prepared complexes on some selected bacterial strains. The Schiff base ligands were synthesized by reacting 4-bromoaniline, 4-aminophenol, and aniline with 2-pyridine carboxaldehyde in a 1:1 ratio, while refluxing the mixture for 3-4 hours. To obtain the respective ruthenium (II) metal and ruthenium cymene complexes, hydrated ruthenium (II) chloride and ruthenium p-cymene were combined with the Schiff base ligands in a 2:1 ratio, followed by heating for 3 hours under reflux. The characterization process of the complexes involved proton nuclear magnetic resonance spectroscopy, melting point determination, UV/VIS spectroscopy and Fourier-transform infrared spectroscopy (FT-IR). In the FT-IR spectra, the peaks related to C=N symmetrical vibration appeared in the range of 1600 cm^{-1} –1620 cm^{-1} , which shifted as compared to the free pyridine-imine ligands (1632–1625 cm^{-1}), confirming the intended complex formation. The UV-vis spectra of the ligands exhibited the absorption bands in the ranges of 275-337 nm which correspond to the transition of non-bonding electrons of azomethine nitrogen. After the complexation process, it was observed that the bands corresponding to the $n \rightarrow \pi^*$ transition for the azomethine present in the bidentate ligand shifted to the lower frequencies indicating the interaction of imine nitrogen atoms with the metal ion. The synthesized ligands and their metal complexes were evaluated for antibacterial activity against two bacterial strains: *Staphylococcus aureus* which is Gram-positive and *Escherichia coli* which is Gram-negative, by disc diffusion method with four concentrations. The zones of inhibition were between 8 - 17 millimeters, therefore did not surpass the inhibition zones of gentamicin which was used as the positive control. Statistical analysis using two-way ANOVA highlighted that there was a difference ($p \leq 0.05$) in the means of the different values to some extent, suggesting that the hydroxyl and bromo groups, as well as the ability of ligands to coordinate with ruthenium (II), were responsible for mediating antibacterial activities. It was also observed that, Ruthenium (II) complexes were more active against the bacterial strains than the free Schiff base ligands. Also, complexes formed with substituted Schiff base ligands, 4-aminophenol and 4-bromoaniline exhibited higher antibacterial activity compared to complexes formed with unsubstituted Schiff base ligands. Based on these

results, it can be suggested that the synthesized compounds possess potential antibacterial activity.