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A biophysical study of Ru(II) polypyridyl complexes of 2-(4-(pyrimidine-5-yl)phenyl)-1*H*-imidazo[4,5-f][1,10]phenanthroline [NPPIP] ligand, its DNA binding affinity and biological activity

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Ru(II) polypyridyl complexes of $[Ru(A)_2NPPIP]$ $(ClO_4)_2.2H_2O$, where NPPIP = 2-(4-(pyrimidine-5-yl)phenyl)-1*H*-imidazo[4,5-f][1,10]phenanthroline and A = phen = (1,10-phenanthroline)(1), bpy = bipyridine(2) and dmb = 4,4'-dimethyl-2,2'-bipyridine(3), have been synthesized and characterized using various spectroscopic techniques. The interaction of these complexes with DNA has been studied using biophysical methods, including absorption, emission, and viscosity measurements. The results indicate that the Ru(II) polypyridyl complex binds to DNA primarily through intercalation. Among the complexes, the phen complex exhibits the strongest DNA binding affinity, followed by bpy and dmb, highlighting the influence of the ancillary ligand on DNA binding specificity. This has been further confirmed by the binding constants (K_b), which have been determined to be 2.5×10^5 M^{-1}(from UV-Vis absorption) and 7.2×10^6 M^{-1}(from fluorescence emission studies), and the Stern-Volmer quenching constant (K_{sv}), which was 9.2×10^3. Antimicrobial studies on Gram-negative (*E. coli* and *K. pneumoniae*) and Gram-positive (*S. aureus* and E. *faecalis*) bacteria show significant activity. Additionally, the anti-cancer potential of the complexes has been evaluated using the MTT assay against the MCF-7 cell line, demonstrating strong anticancer activity correlated with their DNA binding properties.

Keywords: Ru(II) polypyridyl complexes, DNA binding, Binding constant, Antimicrobial, Anticancer