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Study of fluorescence quenching properties of 5-hydroxy-1,10-phenanthroline in the presence of heavy metal ions in acetonitrile

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Absorption and emission spectra of 5-hydroxy-1,10-phenanthroline, **1** in acetonitrile shows that maximum absorption and emission at 268 nm and 403 nm, respectively. The divalent cations of Fe, Co, Cd, Pb and Mn showed the complex formation with 5-hydroxy-1,10-phenanthroline with a single isobestic point in the absorption spectra. However, divalent cations of Ni, Cu and Zn did not show complex formation. According to the gathered emission spectra, Fe(II), Cd(II), Co(II) and Pb(II) were seemed to form fluorescence active complexes with **1**.

The Stern-Volmer plot of **1** in the presence of Fe(II), Co(II), Cd(II), Pb(II) and Mn(II) indicated the presence of both static and dynamic quenching by the same quencher.[1,2] However in the emission study no such complex formation was observed with Mn(II) and this is due to the non-fluorescent nature of the complex formed. In the presence of Ni(II) and Zn(II), it indicated the dynamic quenching of fluorescence of the **1**. In the presence of Cu(II) the study implies the presence of accessible and inaccessible fluorophores to divalent copper ion.[1] The divalent cations of Fe, Co and Cd showed the formation of 1:3 complexes whereas Pb and Mn showed the formation of 1:2 complexes.[3]

The static and dynamic quenching constants and formation constants were calculated for different metal ions. Out of all metal ions of interest, it illustrates the strongest static quenching towards the Fe(II) ions.

The ratiometric study of **1** revealed greater sensitivity towards Fe(II) with a minimum detection for 0.35 μmol dm^{-3} of metal ion concentration. With other metal ions it is a considerable concentration which showed such deviation, i.e. for Cd(II), Co(II), Pb(II) the concentrations were 2.55, 1.80, and 2.87 μmol dm^{-3}, respectively. This illustrates more sensitivity of compound **1** towards Fe(II). According to fluorescence study the ratiometric sensing of Fe(II) using **1** appeared to be more reliable and accurate than the static or dynamic quenching sensing.

However, the interference study by the other metal ions on the unbound and Fe(II) bound 5-hydroxy-1,10-phenanthroline indicates considerable interference from other metal ions. Co(II) and Pb(II) ions specified the quenching of both bound and unbound forms indicating the occurrence of dynamic quenching. Whereas Cd(II), Ni(II) and Mn(II) showed fluorescence enhancement of unbound form and diminishment of bound form indicating a shift in the equilibrium of formation of Fe(II) bound complex more towards the reactants. Cu(II) and Zn(II) ions illustrated a vast decrease in fluorescence intensity of bound form with a insignificant change of unbound form indicating the occurrence of dynamic quenching on bound form only.

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