

**Dual-Modulation ratiometric fluorescence strategy for cobalt and topotecan detection using Red-Emissive carbon dots**

Authors	<b>Ali M Alaseem, Khalid Alhazzani, Ahmed Z Alanazi, Saud M Alsanad, Osama A Alkhamees, Glowi Alasiri, Mohamed M El-Wekil, Al-Montaser Bellah H Ali</b>
Publication Year	2024
Grant Number	IMSIU-RG23083
DOI link	<a href="https://doi.org/10.1016/j.microc.2024.110645">https://doi.org/10.1016/j.microc.2024.110645</a>

**Abstract:** A new ratiometric fluorescence strategy for sensitive and selective detection of cobalt ions ( $\text{Co}^{2+}$ ) and topotecan (TOP) is proposed. The dual-probe system consists of redemissive nitrogen and sulphur doped carbon dots (R-NS@CDs) and TOP. For  $\text{Co}^{2+}$  detection, the fluorescence of R-NS@CDs at 680 nm is enhanced upon addition of  $\text{Co}^{2+}$ , while complexed TOP emission peak at 545 nm remains constant. This enables ratiometric detection of  $\text{Co}^{2+}$  over a range of 5.0–160.0 ng mL<sup>-1</sup>. The mechanism of R-NS@CDs fluorescence enhancement by  $\text{Co}^{2+}$  is elucidated using FTIR, fluorescence spectroscopy, zeta potential measurements, and TEM imaging. For the detection of TOP, a ratiometric probe system comprising R-NS@CDs and  $\text{Co}^{2+}$  was utilized. TOP forms a complex with  $\text{Co}^{2+}$  bounded to RNS@CDs, quenching the R-NS@CDs- $\text{Co}^{2+}$  fluorescence and simultaneously the native TOP fluorescence is enhanced. This allows ratiometric quantification of TOP from 1.090.0 ng mL<sup>-1</sup>. The method provides high selectivity and low detection limits of 1.51 ng mL<sup>-1</sup> for  $\text{Co}^{2+}$  and 0.37 ng mL<sup>-1</sup> for TOP. Practical applicability is demonstrated through selective detection of  $\text{Co}^{2+}$  in environmental water samples and TOP in real plasma samples. The built-in self-calibration enabled by dual analyte modulation of R-NS@CDs makes this a simple and powerful analytical approach.