Electronic Supplementary Material (ESI) for Analytical Methods.

Supplementary Data file

Dual Modulation of Blue-Fluorescent Carbon Dots for Simultaneous Detection of Topotecan and Pantoprazole

Ashraf M. Mahmoud[a], Yahya S. Alqahtani[a], Mohamed M. El-Wekil[b], Al-Montaser Bellah H. Ali[b*]

[a] Department of Pharmaceutical Chemistry, College of Pharmacy, Najran University, Najran, Saudi Arabia

[b] Department of Pharmaceutical Analytical Chemistry, Faculty of Pharmacy, Assiut University, Assiut, Egypt.

*e-mail: Almontaser_bellah@aun.edu.eg, Almontaser_bellah@yahoo.com

Measurement of fluorescence quantum yield of B@NCDs

The quantum yield (QY) of B@NCDs was calculated according to the following equation using quinine sulfate (QS) as a reference in 0.1 M H_2SO_4 (QY = 54 %). By measuring the absorbance (less than 0.05) and emission spectra of a certain concentration of B@NCDs and quinine sulfate at the same excitation wavelength at 360 nm, the absorbance and fluorescence integral area were substituted into the following formula:

$$\phi_{B@NCDs} = \phi_{QS} \times \frac{F_{B@NCDs}}{F_{QS}} \times \frac{A_{QS}}{A_{B@NCDs}} \times \frac{\eta_{B@NCDs}}{\eta_{QS}}$$

$\Phi_{B@NCDs}$ represents the quantum yield of B@NCDs, ϕ_{QS} represents the quantum yield of QS, $F_{B@NCDs}$ is the fluorescence intensity of B@NCDs, F_{QS} is the fluorescence intensity of quinine sulphate, A refers to the absorbance value and η refers to the refractive index of the solvent (distilled water). The synthesized B@NCDs were dissolved in distilled water (η = 1.33) and quinine sulfate was dissolved in 0.1 M H_2SO_4 (η = 1.33).

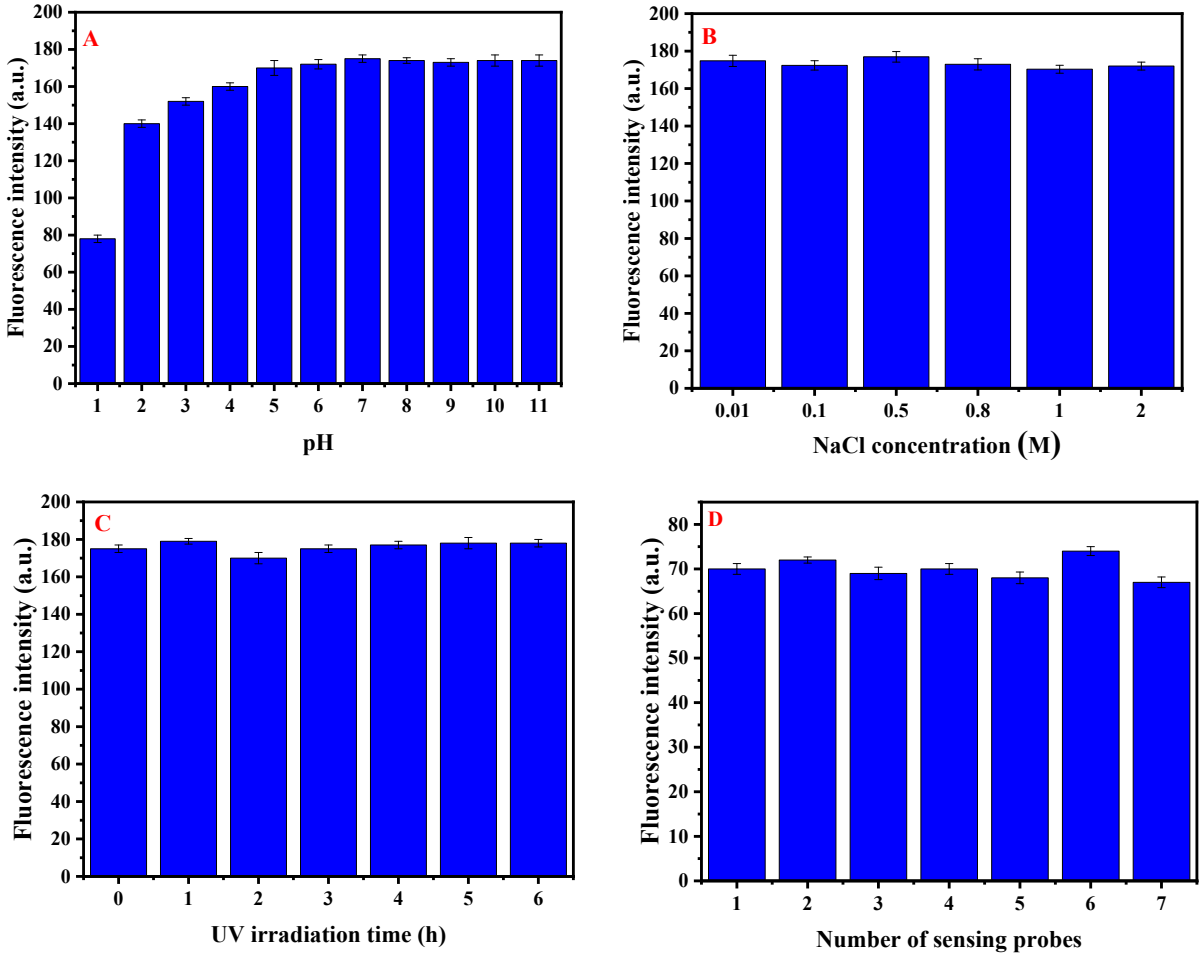

Fig. S1. Stability of the fluorescence response of B@NCDs under various conditions: (A) Effect of pH (1.0 – 11.0), (B) Effect of NaCl concentration (0.01 – 2.0 M), and (C) Effect of UV irradiation time (0 – 6 hrs). (D) reproducibility of the B@NCDs sensing probe for the detection of PNT.

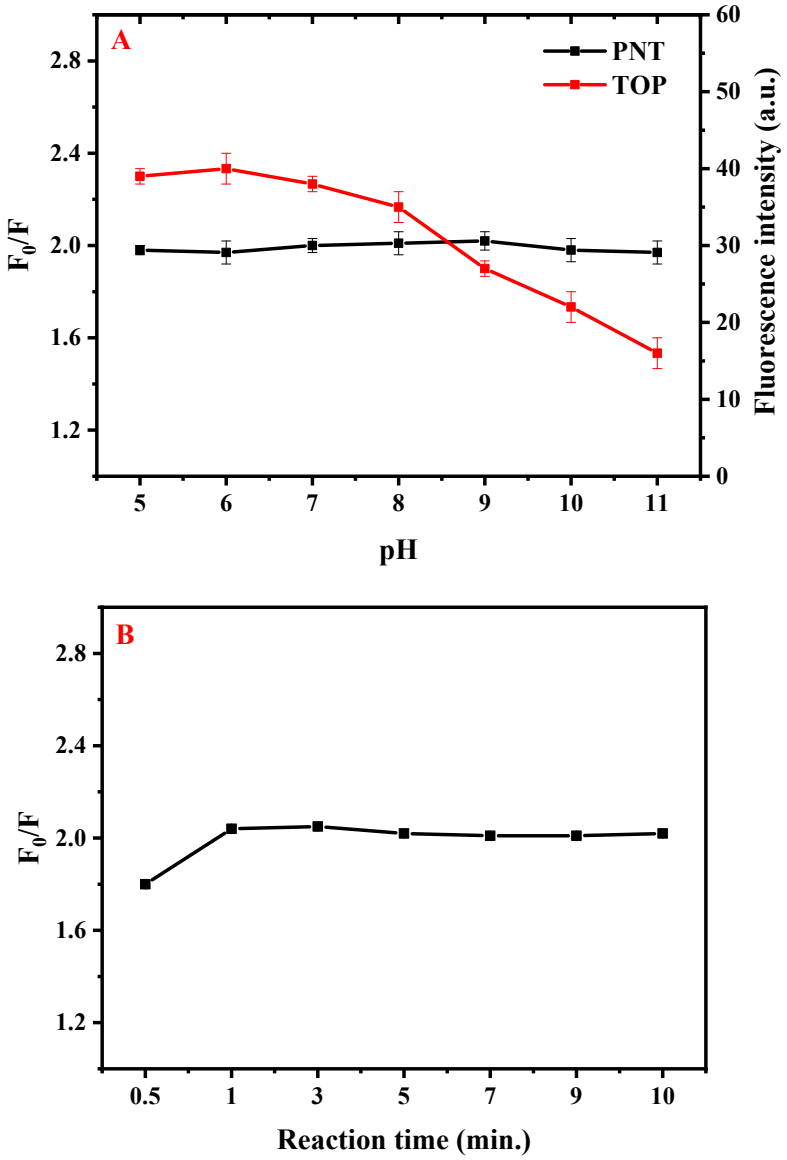

Fig. S2. Influence of (A) pH (5.0 – 11.0) on fluorescence intensity ratio F_0/F of B@NCDs for detection of PNT and fluorescence intensity of TOP, and (B) reaction time (0.5 – 10.0 min.) on fluorescence intensity ratio F_0/F of B@NCDs for detection of PNT.

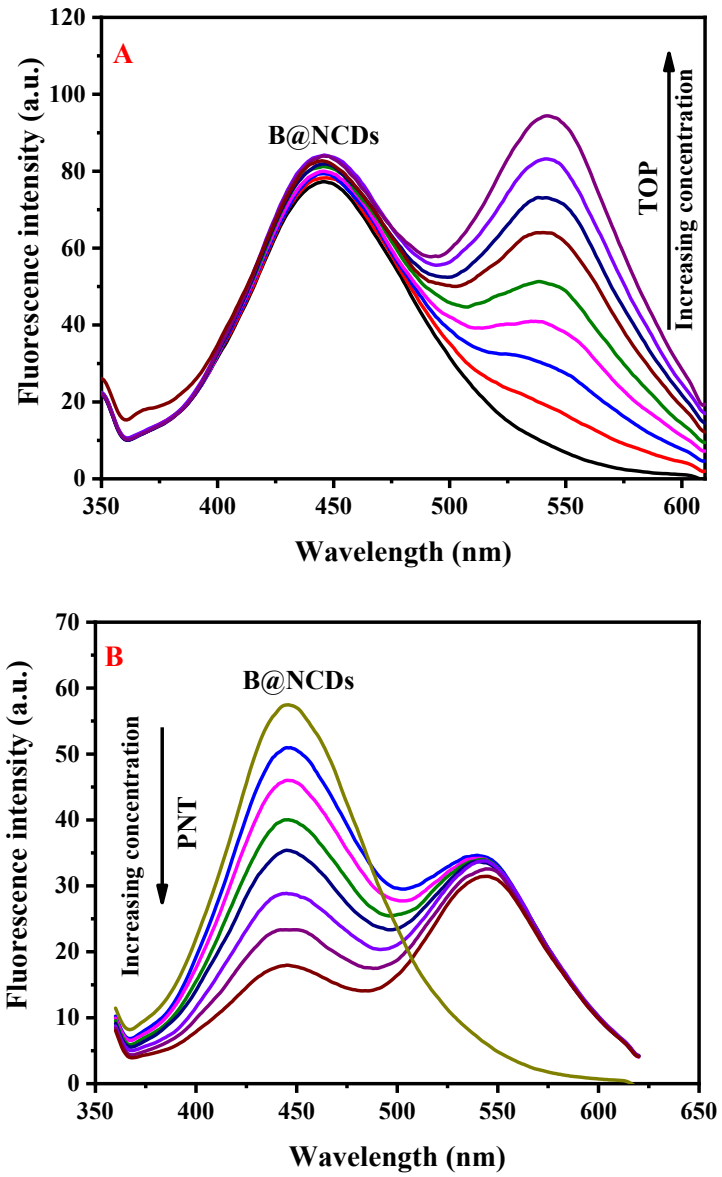

Fig. S3. The influence of different concentrations of (A) TOP (0.005 – 0.14 μg mL^{-1}) at 545 nm in presence of PNT and (B) PNT (1.0 – 80.0 μg mL^{-1}) on the fluorescence emission of B@NCDs at 447 nm in presence of TOP.

Table S1. Comparison of this work with other reported methods for the detection of TOP.

Method	Linear range ($\mu g\ mL^{-1}$)	LOD ($\mu g\ mL^{-1}$)	Ref.
Electrochemical (SWV)	275 – 366,000	123.5	[1]
Electrochemical (SWV)	320 – 366,000	137.3	[2]
Electrochemical (DPV)	46 – 7320	10.1	[3]
Electrochemical (DPV)	320 – 41,175	169.3	[4]
Reversed-phase liquid chromatography	0.00025 – 0.08	------	[5]
HPLC	0.0002 – 0.05	------	[6]
LC/tandem MS	0.001 – 0.4	------	[7]
Fluorometric	0.005 – 0.140	0.0016	**This work**

Table S2. Comparison of this work with other reported methods for the detection of PNT.

Method	Linear range ($\mu g\ mL^{-1}$)	LOD ($\mu g\ mL^{-1}$)	Ref.
Fluorescence (Terbium-1,10-phenanthroline-AgNPs)	43.24 – 4324	31.13	[8]
Fluorescence (SDS)	0.2 – 3.0	0.02	[9]
Electrochemical (DPV)	2594 – 345,920	172.96	[10]
Electrochemical (SWAdSV)	3891.6 – 86,480	389.16	[11]
Electrochemical (SWAdSV)	65 – 10,909	20.76	[12]
Electrochemical (Potentiometric)	4324 – 4,756,400	2983.5	[13]
HPLC	0.03 – 25.00	0.011	[14]
HPLC	0.01 – 50	------	[15]
Fluorometric	1.0 – 80.0	0.36	**This work**

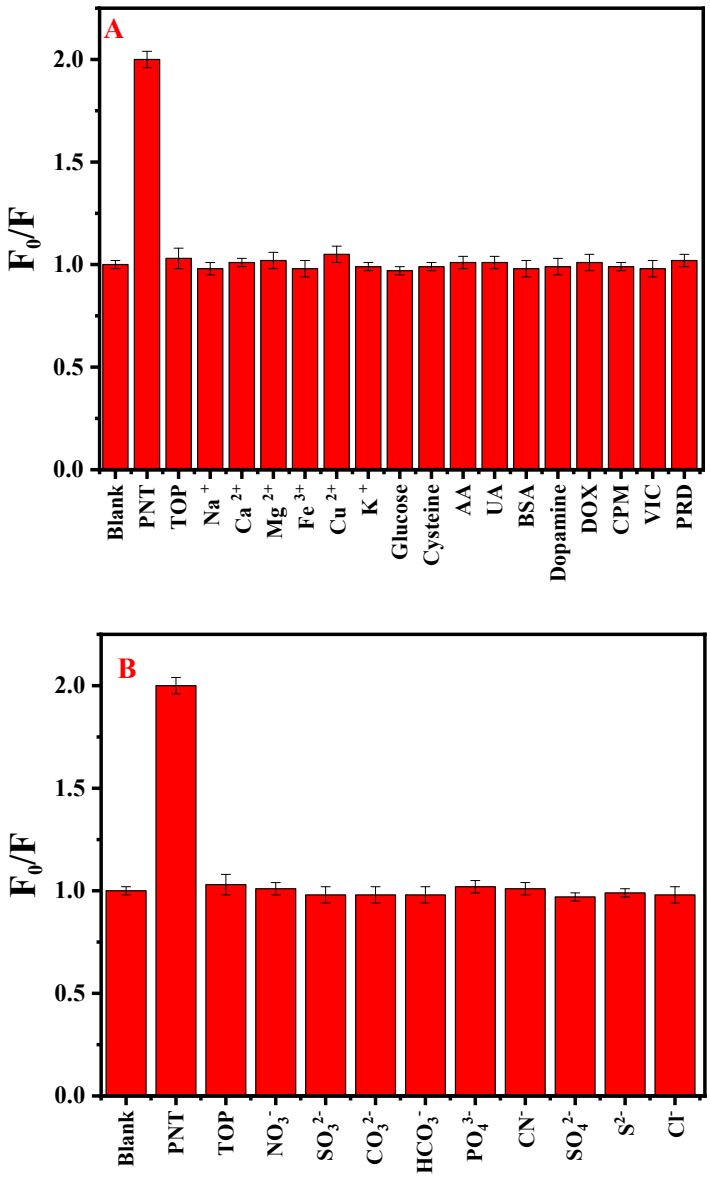

Fig. S4. Relative fluorescence intensity after incorporation of (A) different cations, biological compounds and co-administered drugs (1.0 mg mL^{-1}) and (B) different anions (1.0 mg mL^{-1}) to the prepared B@NCDs.

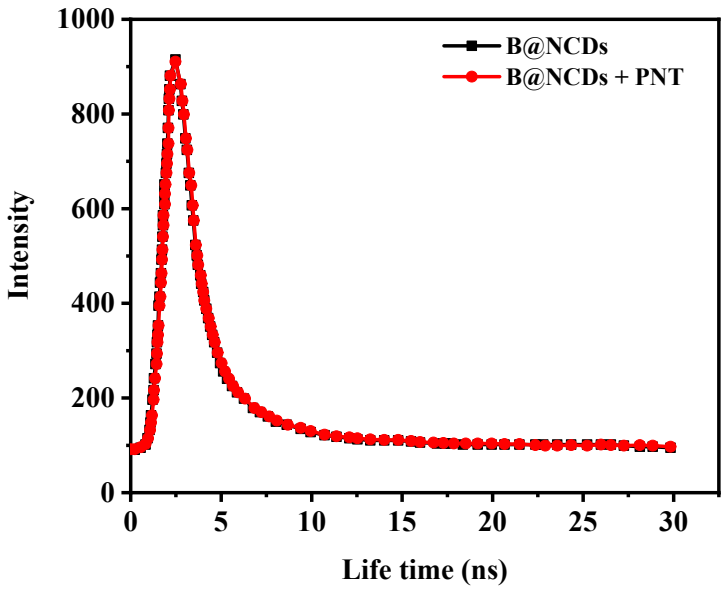

Fig. S5. Fluorescence lifetime of B@NCDs before and after addition of PNT.

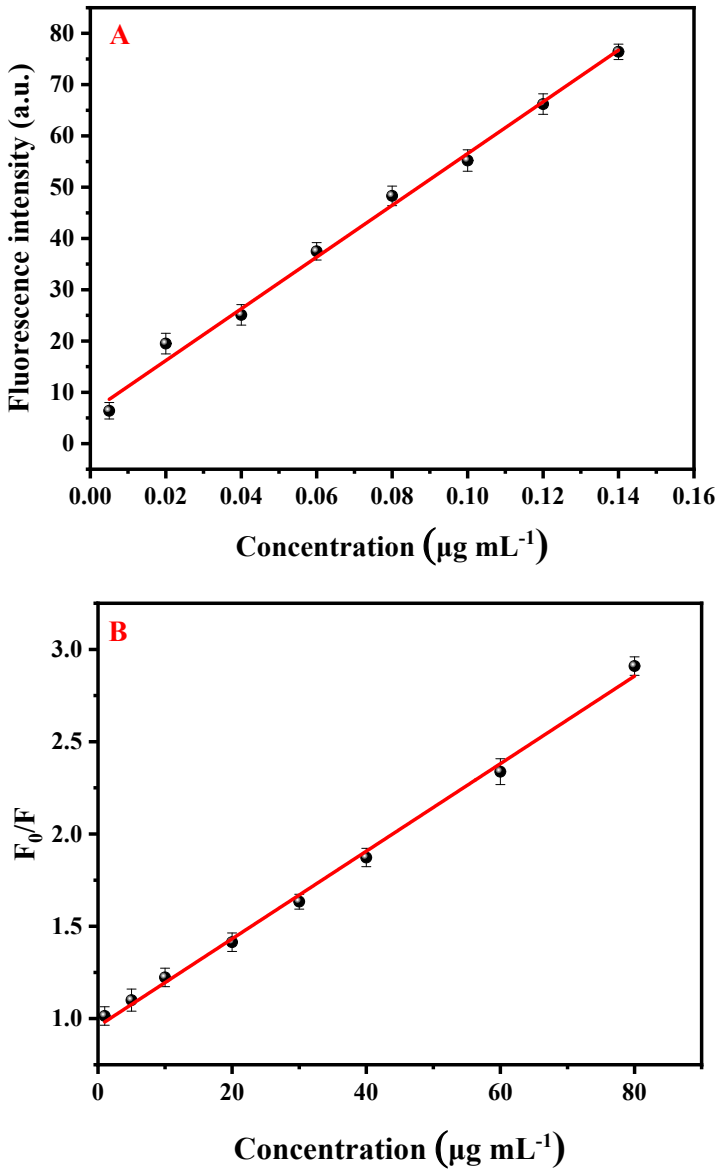

Fig. S6. (A) Plot of corrected fluorescence intensity versus concentration of TOP (0.005 – 0.14 μg mL^{-1}). (B) Plot of (F_0/F) versus concentration of PNT (1.0 – 80.0 μg mL^{-1}).

Table S3. Comparison of the pharmacokinetics of TOP alone and in combination with PNT following intravenous administration in rabbits (*n = 6*).

Parameters	TOP	TOP in presence of PNT
C_{max} (ng mL^{-1})	48.4 ± 2.07	60.2 ± 5.12*
$t_{1/2}\alpha$ (h)	0.01 ± 0.002	0.008 ± 0.003*
$t_{1/2}\beta$ (h)	6.65 ± 0.83	9.24 ± 0.15*
V_c (L kg^{-1})	0.0002 ± 0.005	0.0001 ± 0.002
V_p (L kg^{-1})	0.0025 ± 0.004	0.0021 ± 0.003*
k_{el} (h^{-1})	1.29 ± 0.036	1.26 ± 0.095
CL (L kg^{-1} h^{-1})	0.0003 ± 0.005	0.0002 ± 0.002
MRT (h)	9.39 ± 0.52	13.1 ± 0.98*
AUC_{0-12} (ng hr mL^{-1})	245 ± 25.14	353 ± 23.21*
$AUC_{0-\infty}$ (ng hr mL^{-1})	344 ± 13.72	596 ± 15.23*

*Indicates statistically significant differences between parameters values of TOP and TOP/PNT ($p < 0.05$).

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