Smartphone-Based Visual Detection of Bilirubin Using Yellow Emitting Carbon Dots

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Quantum Yield of Y-CDs

The fluorescence quantum yield of Y-CDs was measured using fluorescein as a reference based on the following equation,

$$\Phi_{CDs} = \Phi_{ref}\left(\frac{I_{CDs}}{I_{Ref}}\right)\left(\frac{\eta_{CDs}}{\eta_{ref}}\right)$$

where Φ stands for quantum yield, I is the integrated fluorescence intensity of luminescent spectra, and η is the refractive index. The subscript *Ref* refers to reference with known quantum yield and CDs for the Y-CD in this equation. For standard solutions from each were prepared and their absorbance and fluorescent spectra were recorded at the maximum excitation wavelength of Y-CDS and fluorescein. The data was plotted and the slope of the Y-CDs and fluorescein were found

$$\Phi_{CDs} = 91\left(\frac{135840}{338005}\right)\left(\frac{1.334}{1.336}\right) = 36.5\%$$

Thus, the fluorescence QY% of the Y-CDs was 36.5%

Table S1 Quantum yield measurements of Y-CDs using fluorescein in 0.1 M NaOH as reference.

Different Soln. of CDs and Ref separately		Integrated FL		Abs	
CDs solutions	fluorescein solution	CDs	Ref	CDs	Ref
Std 1	Std 1	2983	5705	0.016	0.006
Std 2	Std 2	10387	18275	0.073	0.043
Std 3	Std 3	12286	21671	0.083	0.052
Std 4	Std 4	14895	28577	0.104	0.074

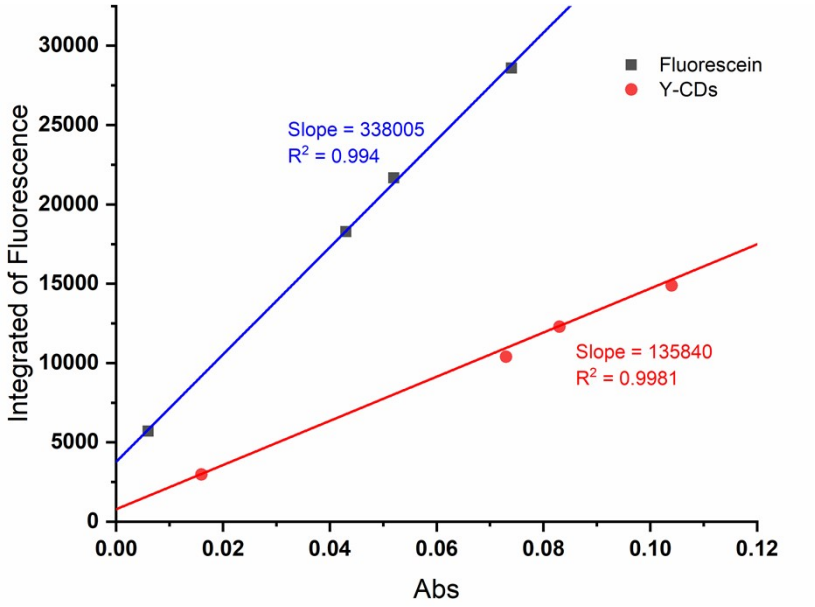

Fig S1: fluorescence of CDs and Fluorescein as reference for determination of QY%

pH study

to study the influence of the pH on the fluorescence intensity of the Y-CDs, different buffer solutions with various pH ranges were used. The results revealed that the optimum pH is a phosphate-buffered saline solution (pH = 7.4)

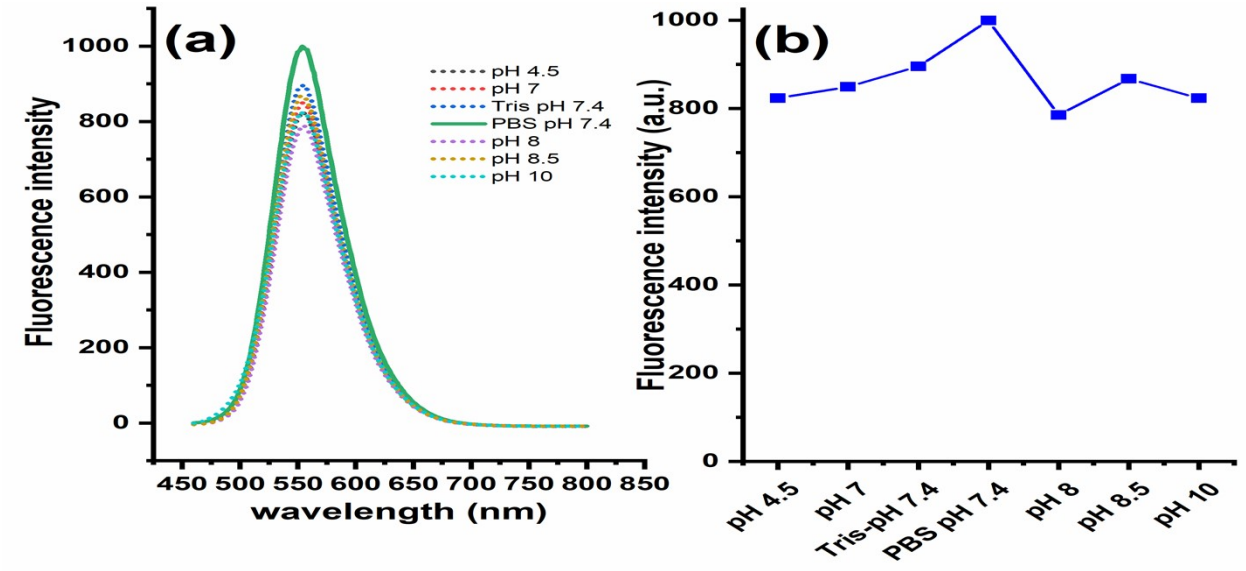

Fig S2: (a) The fluorescence intensity of Y-CD at various pH solutions 4.5–10 with various buffer solutions. (b) Fluorescence spectra of the Y-CD at various buffer solutions from 4.5 to 10.

Response time Study

The response time for quenching of the Y-CDs after the addition of bilirubin was studied. When bilirubin was added, the fluorescence of Y-CDs was immediately quenched and tended to remain stable after 5 minutes, as seen in Fig. S3. This finding suggests that Y-CDs may be utilized to detect bilirubin quickly and effectively. In the standard clinical method, the color change utilizing diazotization reaction needs 30 minutes to assess free bilirubin.

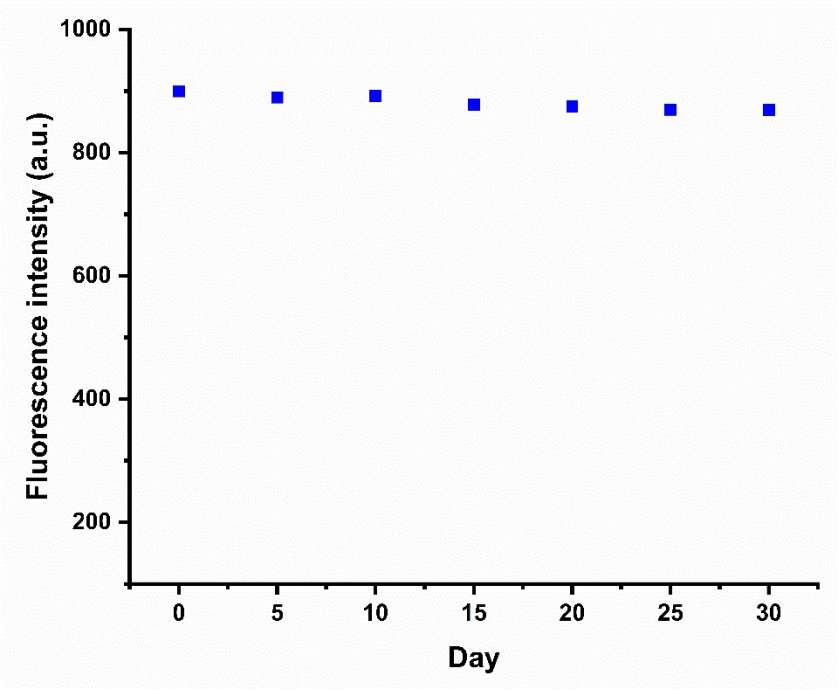

Fig S3: stability of Y-CDs during the one month refreezing at 4°C

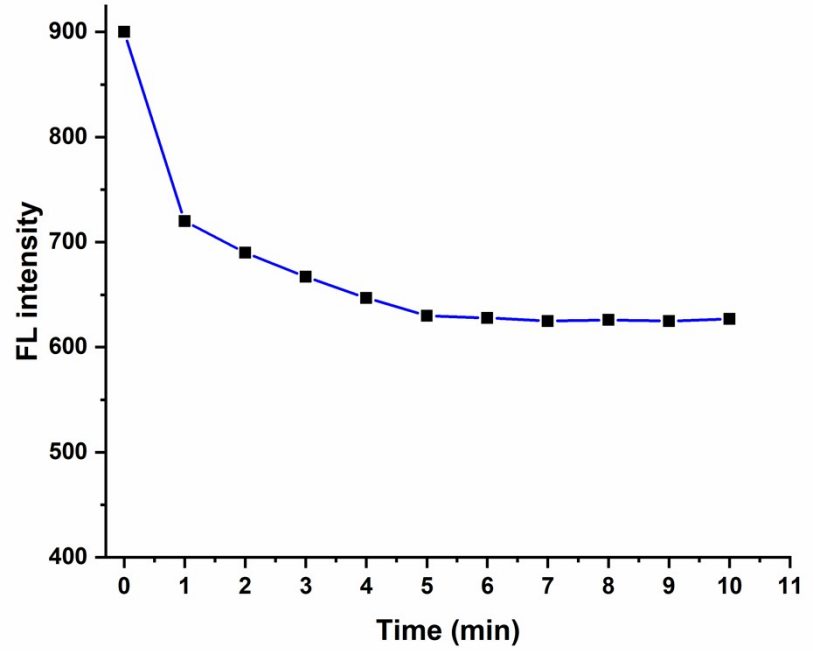

Fig S4: The fluorescence intensity of Y-CDs after the addition of bilirubin as a function of time.