Supplementary information

Biomass carbon dots derived from *wedelia trilobata* for the direct detection of glutathione and their imaging application in living cells

Caizhen Liang[a], Xiaobao Xie*[a], Dandan Zhang[a], Jin Feng[a], Shunying Lu[a], Qingshan Shi*[a]

[a] *Guangdong Provincial Key laboratory of Microbial Culture Collection and Application, State Key Laboratory of Applied Microbiology Southern China, Guangdong Institute of Microbiology, Guangdong Academy of Sciences, Guangzhou 510070, R.P.China*

*Corresponding author

Email Address: xiexb@gdim.cn (Xiaobao Xie); shiqingshan@hotmail.com (Qingshan Shi).

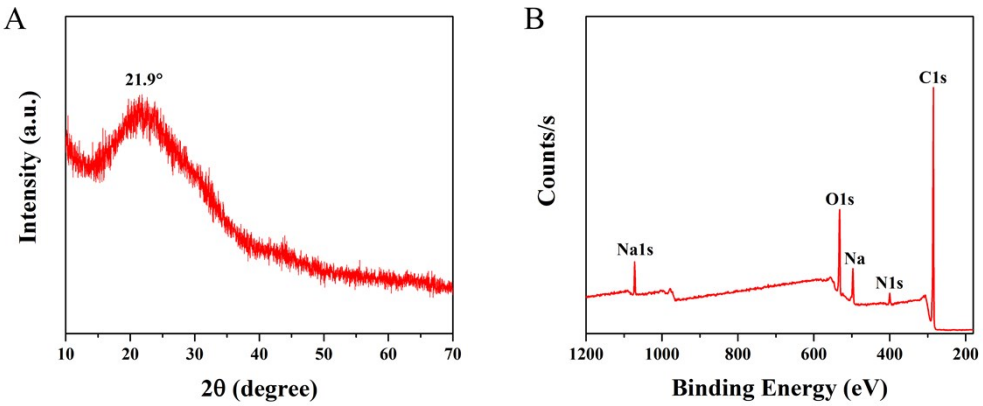

Fig. S1. (A) XRD spectrum of wCDs; (B) Full-survey XPS of wCDs.

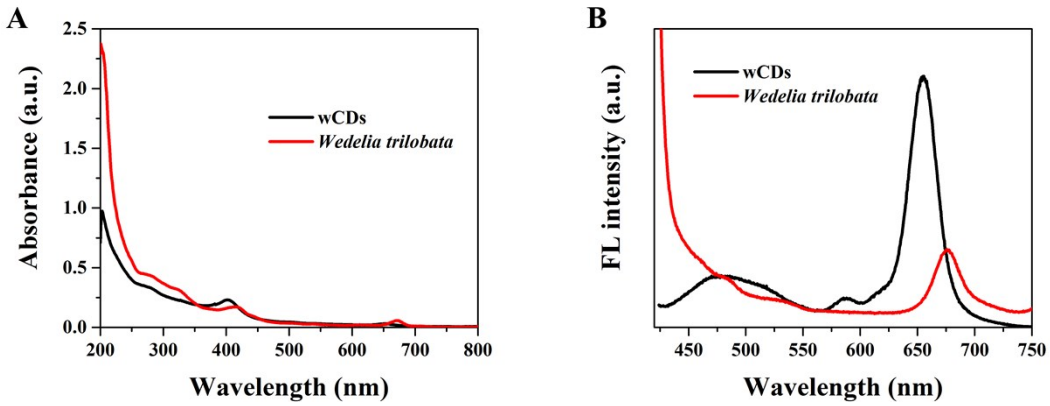

Fig. S2 The absorption spectra (A) and fluorescence spectra (B) of wCDs and *Wedelia trilobata*.

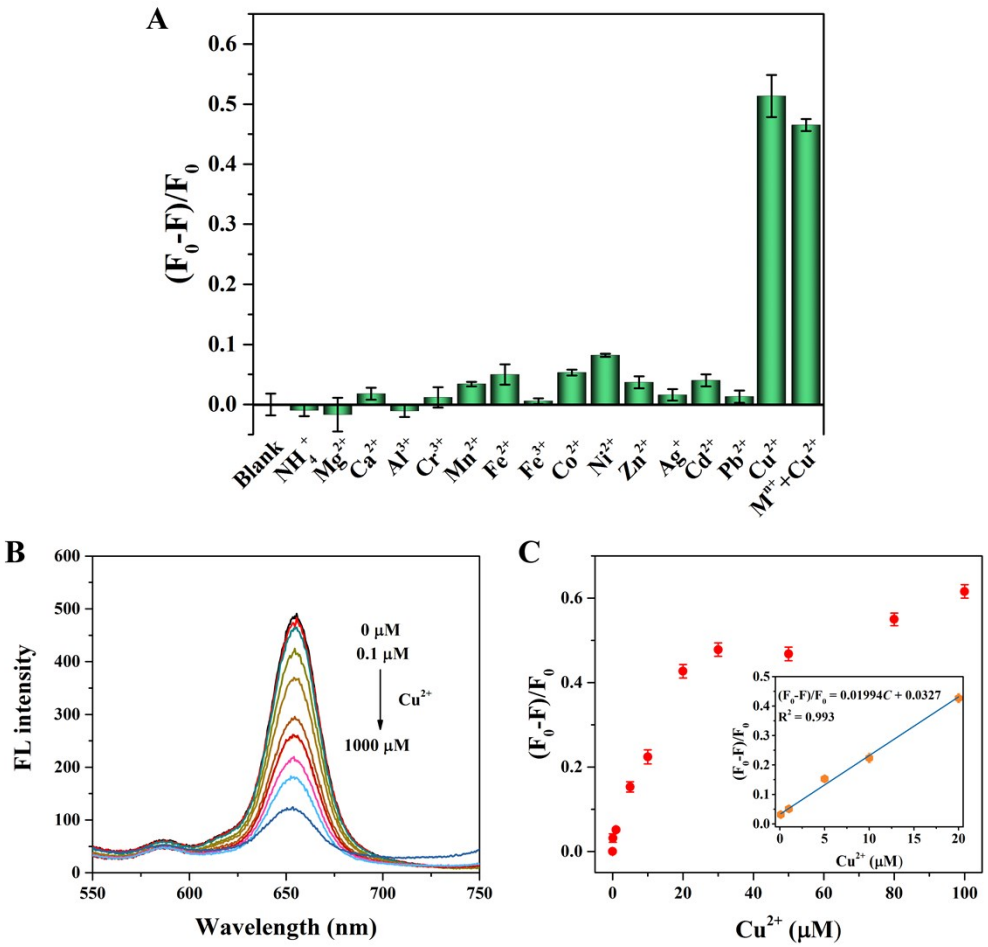

Fig. S3 (A) Fluorescence responses of wCDs toward various cations. M^{n+} + Cu^{2+}: the mixed solution containing all the ions mentioned in the image; (B) Fluorescence spectra of wCDs upon addition of Cu^{2+} at various concentrations (0–1000 μM) in mimic physiological environment (PBS containing 1 mM Mg^{2+}, 1 mM Ca^{2+}, and 50 μM of Mn^{2+}, Zn^{2+}, Fe^{2+}). (C) The dependence of $(F_0\text{-}F)/F_0$ on the Cu^{2+} concentrations. Inset: linearity of response.

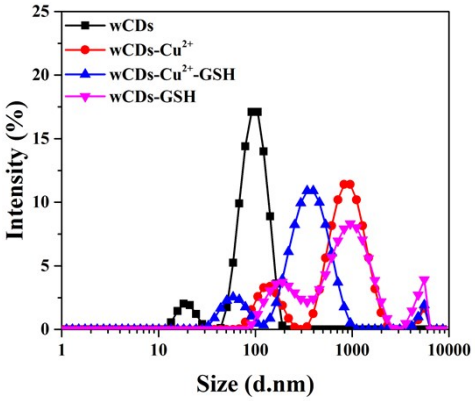

Fig. S4. Size distribution of the wCDs, wCDs-Cu^{2+}, wCDs-Cu^{2+}-GSH, and wCDs-GSH in PBS.

Table S1 Hydrodynamic diameters of the wCDs, wCDs-Cu^{2+}, wCDs-Cu^{2+}-GSH, and wCDs-GSH dispersions

Sample	Size (d. nm)
wCDs	150.50
wCDs-Cu^{2+}	495.93
wCDs-Cu^{2+}-GSH	256.57
wCDs-GSH	545.77

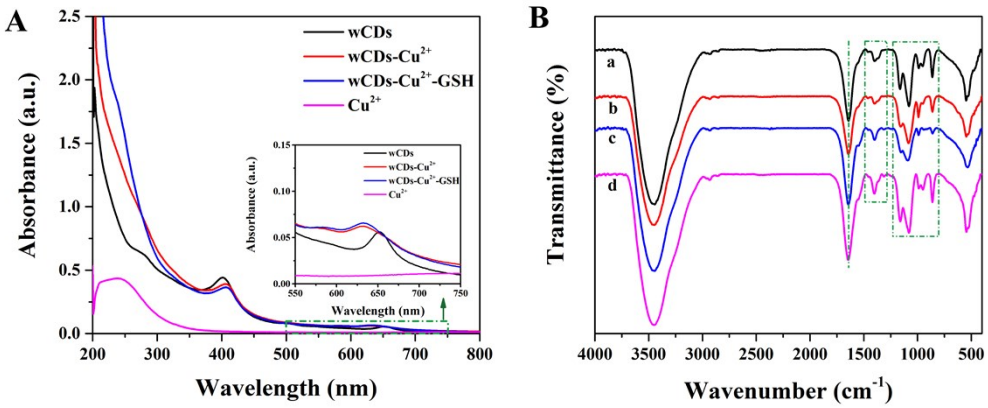

Fig. S5. (A) UV-vis absorption spectra of wCDs, wCDs-Cu^{2+}, wCDs-Cu^{2+}-GSH and Cu^{2+} solutions (Cu^{2+}, GSH: 200 μM); (B) FTIR spectra of (a) wCDs, (b) wCDs-Cu^{2+}, (c) wCDs-Cu^{2+}-GSH, and (d) wCDs-GSH.

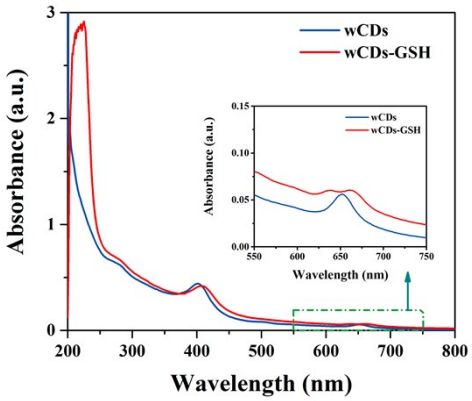

Fig. S6. UV-vis absorption spectra before and after addition of GSH into the wCDs dispersion.

Table S2 Comparison of sensing performance of different CDs-based fluorescence probes for GSH detection

CDs-based probe	CDs precursors	Linear range (μM)	Incubation time	Detection modes	Ref.
CQDs/AuNPs	Citric acid, 2,2'-(Ethylene-dioxy)bis(ethylamine)	0.1–0.6	5 min	Turn off-on	[1]
C-dots–MnO_2	Citric acid ethanediamine	1–10	3 min	Turn off-on	[2]
CNDs/AsO_2^-	Trisodium citrate sodium thiosulphate	10–100	15 min	turn off;	[3]
CDs-Br	Citric acid DETA	0–34	30 min	Bromide-modification, Turn on	[4]
N,S-CDs/AuNPs	3-aminothiophenol	3.8–415.1	20 min	Turn off-on	[5]
CQDs/OPD/Cu^{2+}	Phenylenediamine Citric acid	30–80	> 3 h	Turn off-on	[6]
N-CDs/Ag^+	Neutral red Triethylamine	10–100	-	Sequential detection	[7]
B-CQDs/CC	Citric Acid, NaTPB, borax, boric acid	0.002–0.1	30 min	Turn off-on	[8]
BPMA-CQDs/Cu(II);	Carbon powder, H_2SO_4, HNO_3	0.14–13.3;	16 min	Turn off-on;	[9]
BPMA-CQDs/Ag(I)		0.20–23.3	14 min	Turn off-on	
wCDs	*Wedelia trilobata*	100–3000	20 s	Turn off-on and direct detection	This work

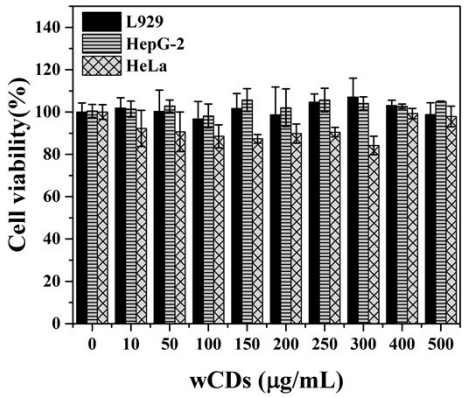

Fig. S7. Cytotoxicity assessment of wCDs with L929, HeLa and HepG-2 cells (mean% ± SD, n=4).

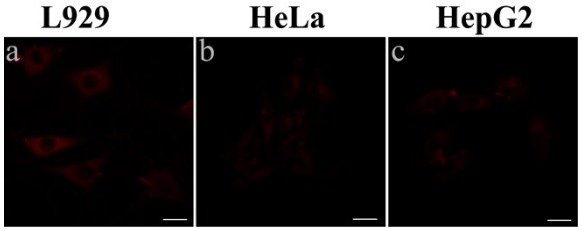

Fig. S8. Confocal fluorescence images of (a) L929, (b) HeLa, and (c) HepG2 cells incubated with 150 μg/mL wCDs for 4 h. λ_{ex} = 405 nm, λ_{em} = 450–700 nm. Scale bar: 20 μm.

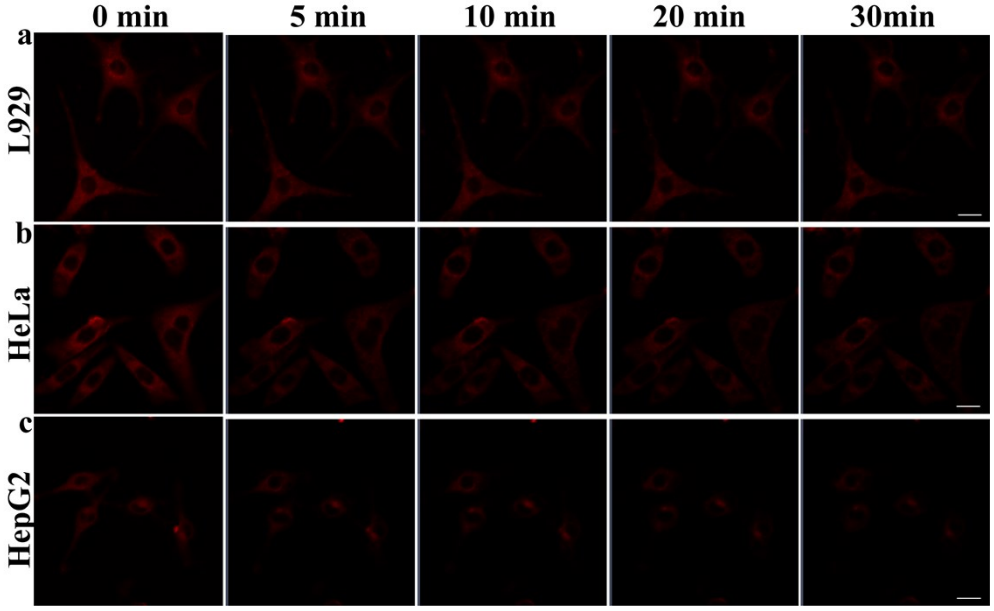

Fig. S9. Confocal fluorescence images of (a) L929, (b) HeLa, and (c) HepG2 cells incubated with 250 μg/mL wCDs for 4 h followed by incubation with 5 mM exogenous GSH during various periods. The fluorescence changes of these cells were monitored directly after the addition of GSH. λ_{ex} = 405 nm, λ_{em} = 450–700 nm. Scale bar: 20 μm.

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