Electronic Supplementary Information (ESI)

In situ synthesis of NIR-Light emission carbon dots derived from spinach for bio-imaging application

Liping Li,[a,b,c,1] Ruiping Zhang,[d,1] Chunxiang Lu,*[a] Jinghua Sun,[e] Lingjie Wang,[e] Botao Qu,[e] Tingting Li,[e] Yaodong Liu *[a] and Sijin Li *[f]

[a] National Engineering Laboratory for Carbon Fiber Technology, Institute of Coal Chemistry, Chinese Academy of Sciences, Taiyuan 030001, P. R. China.

[b] University of Chinese Academy of Sciences, Beijing 100049, P. R. China.

[c] Key Laboratory of Carbon Materials, Institute of Coal Chemistry, Chinese Academy of Sciences, Taiyuan 030001, P. R. China.

[d] Imaging Department of Shanxi Provincial Cancer Hospital, Imaging Department of Affiliated Tumor Hospital of Shanxi Medical University; Shanxi Key Scientific and Technological Innovation Platform for Precision Diagnosis and Treatment of Head and Neck Cancer, The First Hospital of Shanxi medical University, Taiyuan 030013, P. R. China

[e] Shanxi Medical University, Taiyuan 030001, P. R. China.

[f] Nuclear Medicine Department of The First Hospital of Shanxi medical University, Taiyuan 030001, P. R. China. E-mail: 769272365@qq.com

[1] *These authors are first authors with equal contribution.*

Synthesis of CDs-180 and CDs-120:

The CDs-180 and CDs-120 were prepared at 180 °C and 120 °C, and the other conditions and procedure for the preparation of CDs-180 and CDs-120 were the same as those for R-CDs.

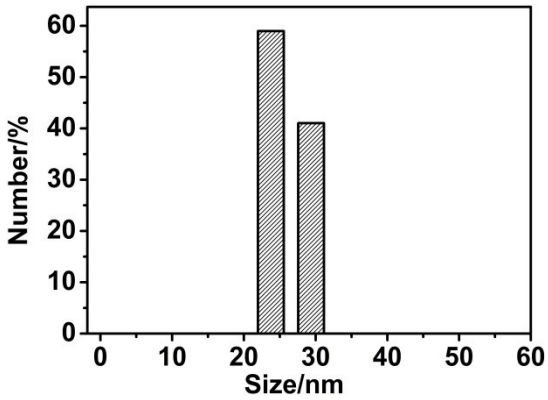

Figure S1. The DLS analysis of the R-CDs

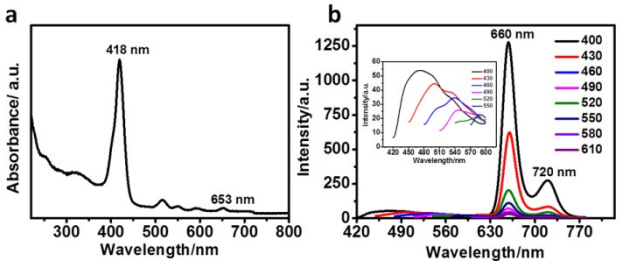

Figure S2. (a) UV-visible absorption and (b) PL emission spectra of the TP-CDs under different excitation wavelengths. (Insert is the PL emission of the TP-CDs from 420-600 nm).

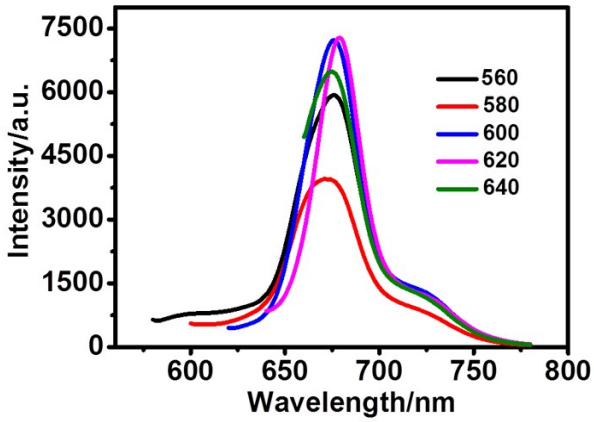

Figure S3. The PL emission of R-CDs at 600-800 nm under different excitation wavelengths

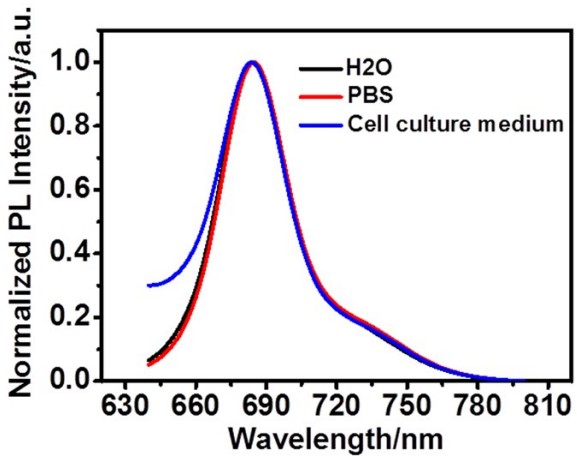

Figure S4. Fluorescence emission spectra of the R-CDs (20 ppm) in water, PBS, and McCoy's 5A (modified) media.

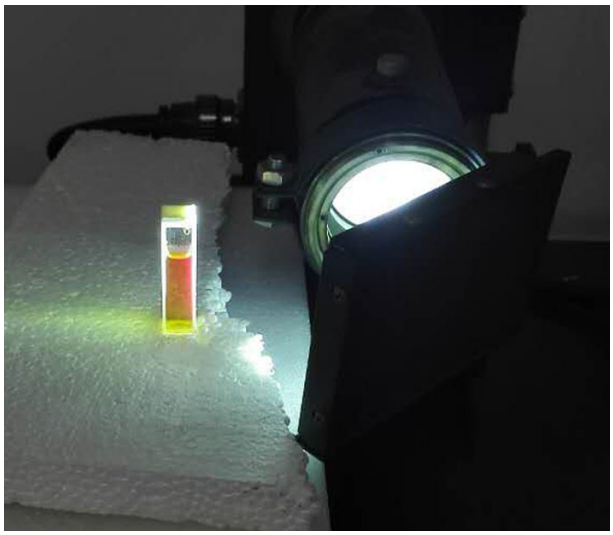

Figure S5. The optical photograph of the R-CDs under continuous irradiation of a mercury lamp (350 W).

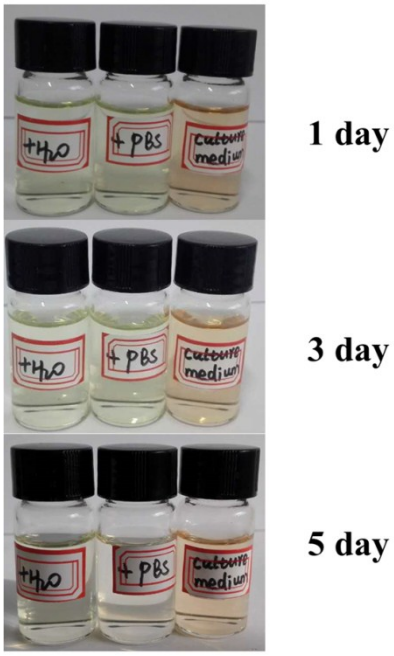

Figure S6. The dispersed stability of R-CDs in water, PBS, and cell culture medium.

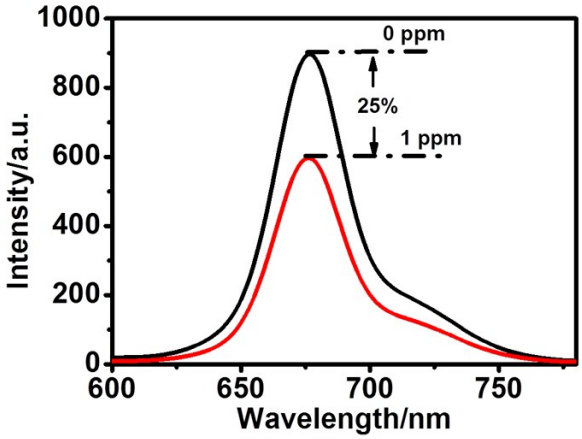

Figure S7. Fluorescence response of the R-CDs in the absence and presence of Cu^{2+} with a concentration of 1 ppm under the 580 nm excitation wavelength.

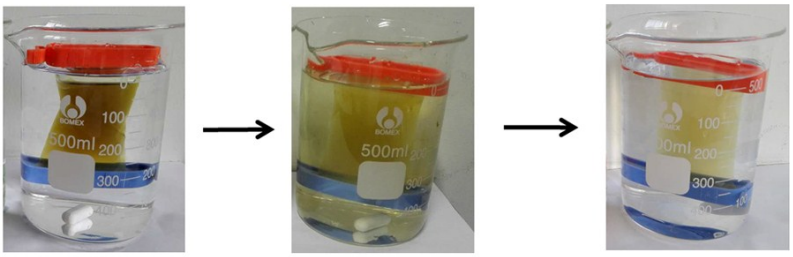

Figure S8. Dialysis process of the R-CDs.

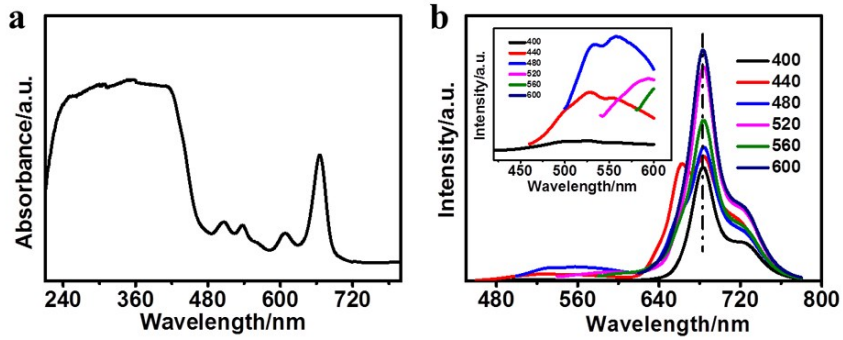

Figure S9. (a) UV-visible absorption and (b) PL emission spectra of the untreated spinach extraction.

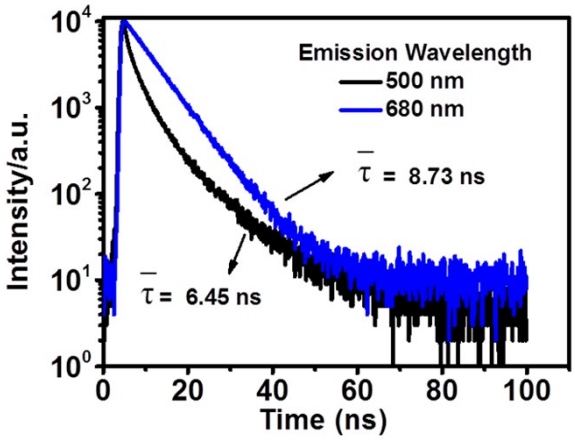

Figure S10. Time-resolved PL decay curves of R-CDs at 500 and 680 nm under 440 nm excitation

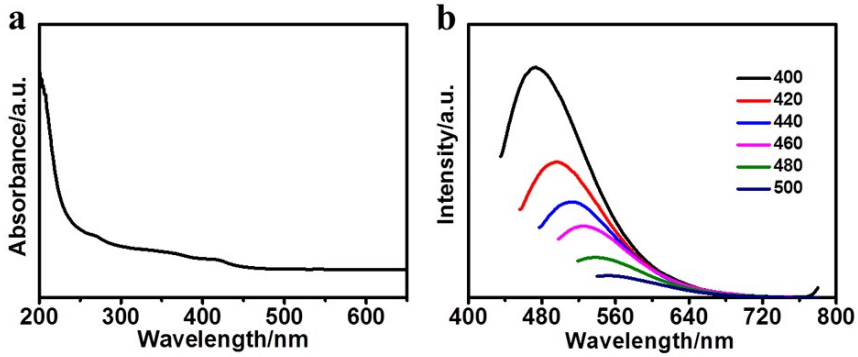

Figure S11. (a) UV-visible absorption and (b) PL emission spectra of the CDs-180.

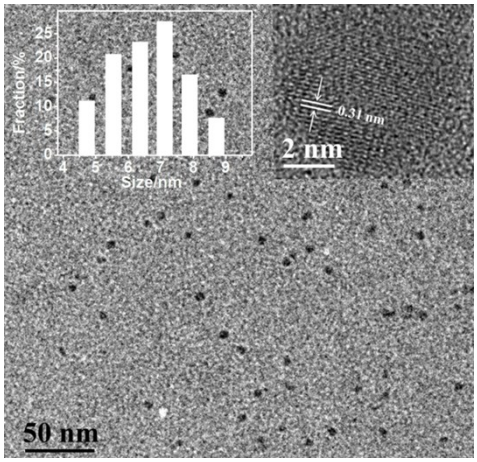

Figure S12 The TEM image of the CDs-180. Insert: the size distribution (left) and HRTEM images (right) of the CDs-180.

Table S1. Representative examples of red emission carbon dots from different precursors and their optical properties.

Starting materials	Emission peak (nm)	QY(%)	Refs.
Graphite/$K_2S_2O_8$	610	n.d.	1
p-phenylenedimine	603	26.1	2
Urea and p-phenylenedimine	625	24	3
Grapheme oxide/ H_2O_2/ NH_4OH	630	1	4
Polythiophene phenylpropionic acid	640	n.d.	5

n.d.=not determined

Table S2. QY of R-CDs under excitation at 420 nm.

Sample	Solvent	λ_{ex}/ nm	Φ_1/%	Φ_2/%	Φ_3/%	Φ_4/%	Φ_5/%	Φ_{ave}/%	Φ_{corr}/%
Rh-6G	Ethanol	488	79.89	82.68	80.02	81.89	80.03	80.90	95
R-CDs	Ethanol	420	12.49	14.33	15.74	14.08	12.81	13.06	15.34

Table S3. QY of CDs-120 under excitation at 420 nm.

Sample	Solvent	λ_{ex}/ nm	Φ_1/%	Φ_2/%	Φ_3/%	Φ_4/%	Φ_5/%	Φ_{ave}/%	Φ_{corr}/%
Rh-6G	Ethanol	488	79.89	82.68	80.02	81.89	80.03	80.90	95
R-CDs	Ethanol	420	12.94	13.89	12.26	12.19.	14.03	13.89	16.31

Reference:

1. T. Xiaoyun, L. Yunchao, L. Xiaohong, Z. Shixin, F. Louzhen and Y. Shihe, *Chem. Commun.*, 2015, **51**, 2544-2546.
2. K. Jiang, S. Sun, L. Zhang, Y. Lu, A. G. Wu, C. Z. Cai and H. W. Lin, *Angew. Chem. Int. Edit.*, 2015, **54**, 5360-5363.
3. H. Ding, S. B. Yu, J. S. Wei and H. M. Xiong, *ACS Nano*, 2016, **10**, 484-491.
4. C. C. Ke, Y. C. Yang and W. L. Tseng, *Part. Part. Syst. Char.*, 2016, **33**, 132-139.
5. J. Ge, Q. Jia, W. Liu, L. Guo, Q. Liu, M. Lan, H. Zhang, X. Meng and P. Wang, *Adv. Mater.*, 2015, **27**, 4169-4177.