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Biomass Derived Carbon Dot as Nanoswitch, Logic Gate Operation, and Electrochemical Sensor for Flavonoids

Sneha Mathew[a], Beena Mathew*[a]

Electronic Supplementary Information

Characterization techniques

FT-IR experiments were done using Perkin Elmer-400 FT-IR spectrometer. The fluorescent studies were done using Shimadzu RF-6000 spectro fluorophotometer and UV-vis absorption spectra were recorded by a Shimadzu UV-3600 spectrometer. X-ray photoelectron spectroscopy (XPS) studies were conducted on a Thermo Scientific^{TM} ESCALAB^{TM} Xi^{+} X-ray Photoelectron spectrometer. A high-resolution transmission electron microscope (HR-TEM) by a JEOL JEM-2100 microscope was used to examine the morphological properties. The structure was determined using a powder X-ray diffractometer (Bruker AXS D8 Advance X-ray diffractometer) using Cu Kα radiation at 1.5406 A^{0} wavelength. The particle size and zeta potential measurements were performed using the Horiba SZ-100 scientific nanoparticle analyzer. Electrochemical studies were carried out on a three-electrode Biologic SP 200 workstation.

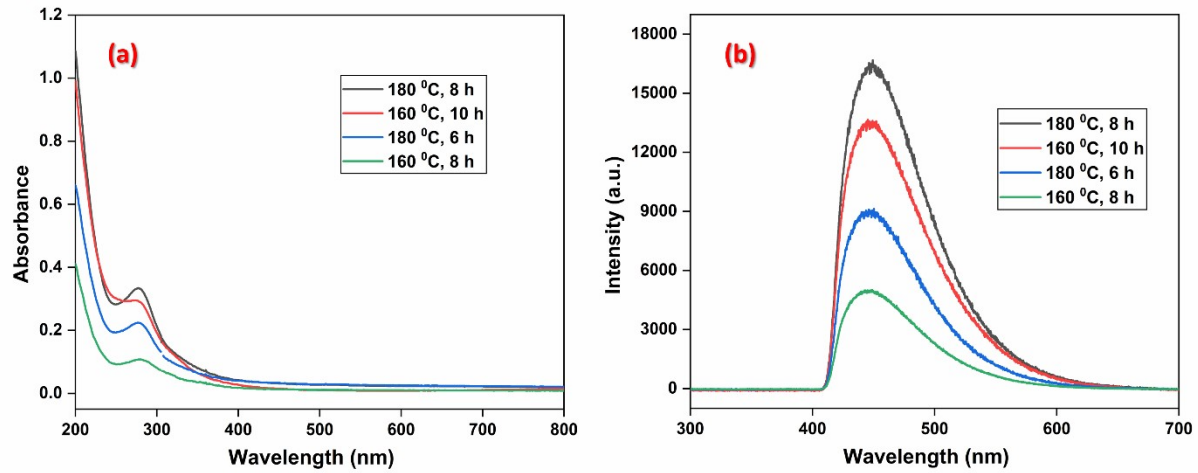

Fig. S1. Optimization of the synthesis of CDs : (a) absorbance spectra, and (b) emission spectra

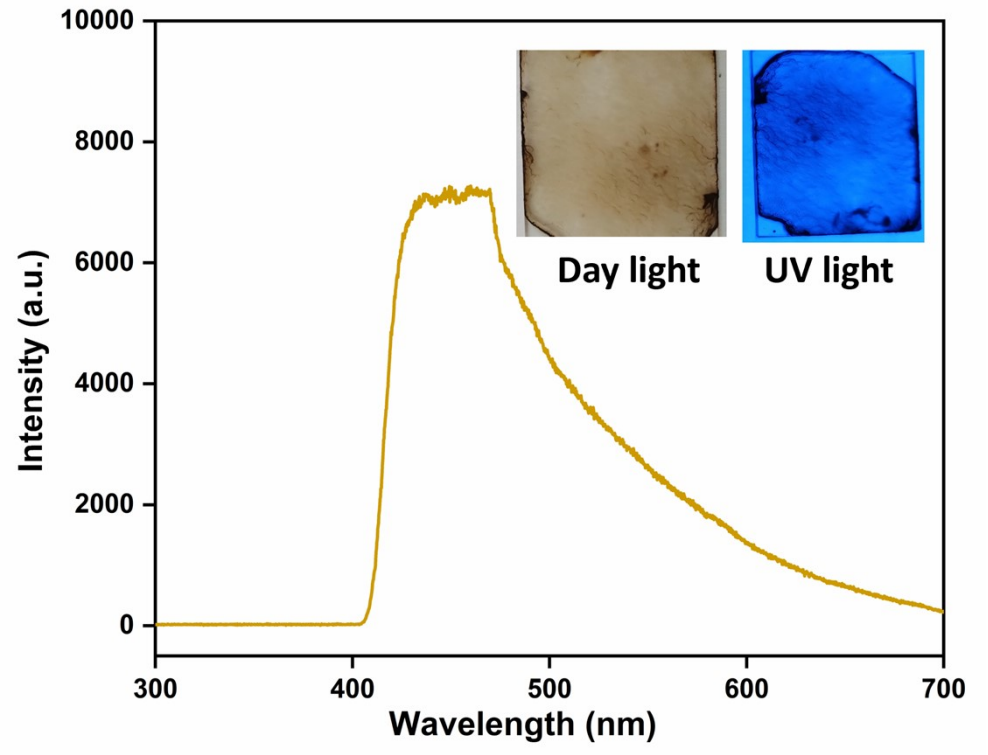

Fig. S2. Emission spectrum of CDs in solid state, inset showing images of CDs in day light and UV light

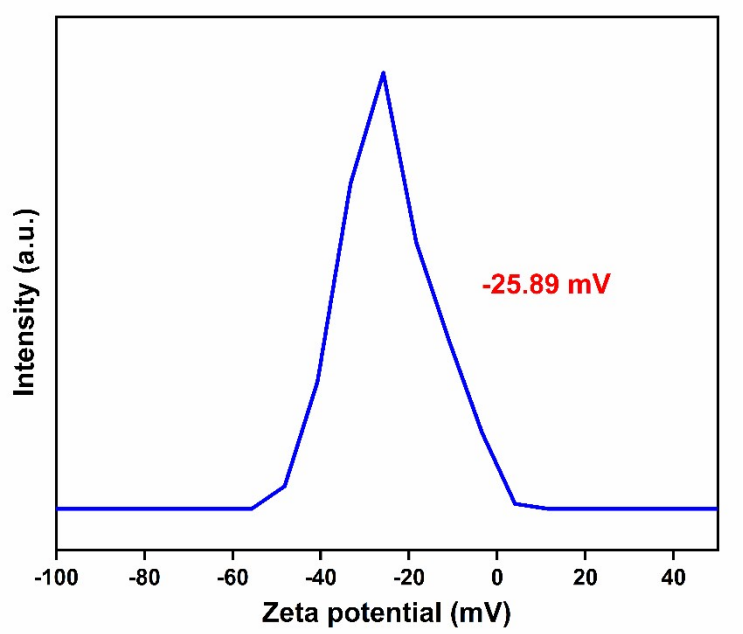

Fig. S3. Zeta potential curve of carbon dots

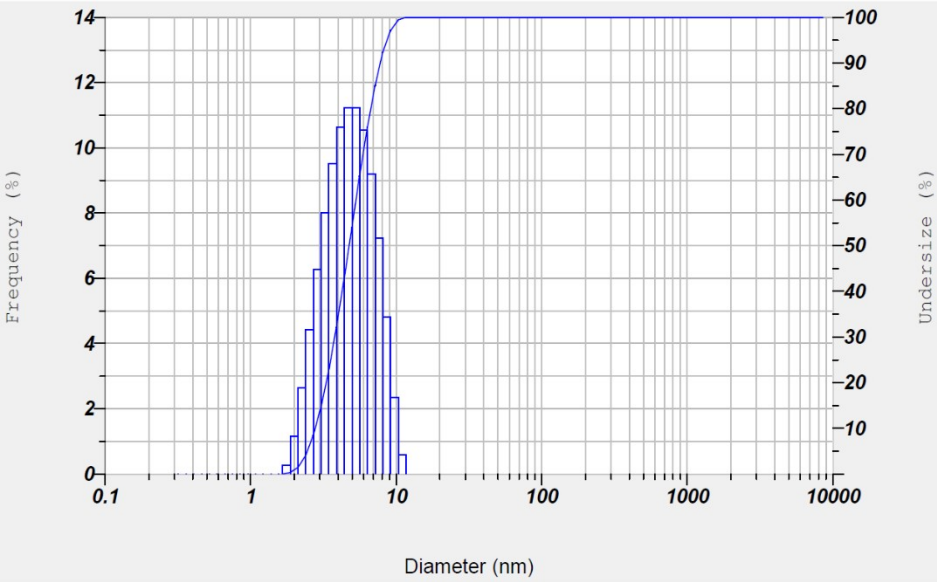

Fig. S4. DLS analysis of carbon dots

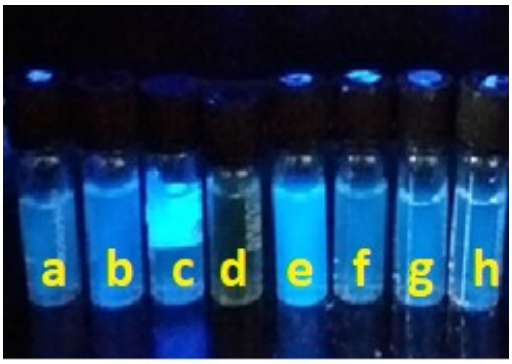

Fig. S5. Photographs of sensing ((a) ziram, (b) carbendazim, (c) pyridine, (d) trinitrophenol, (e) CD (f) diuron, (g) bisphenol, and (h) acephate)

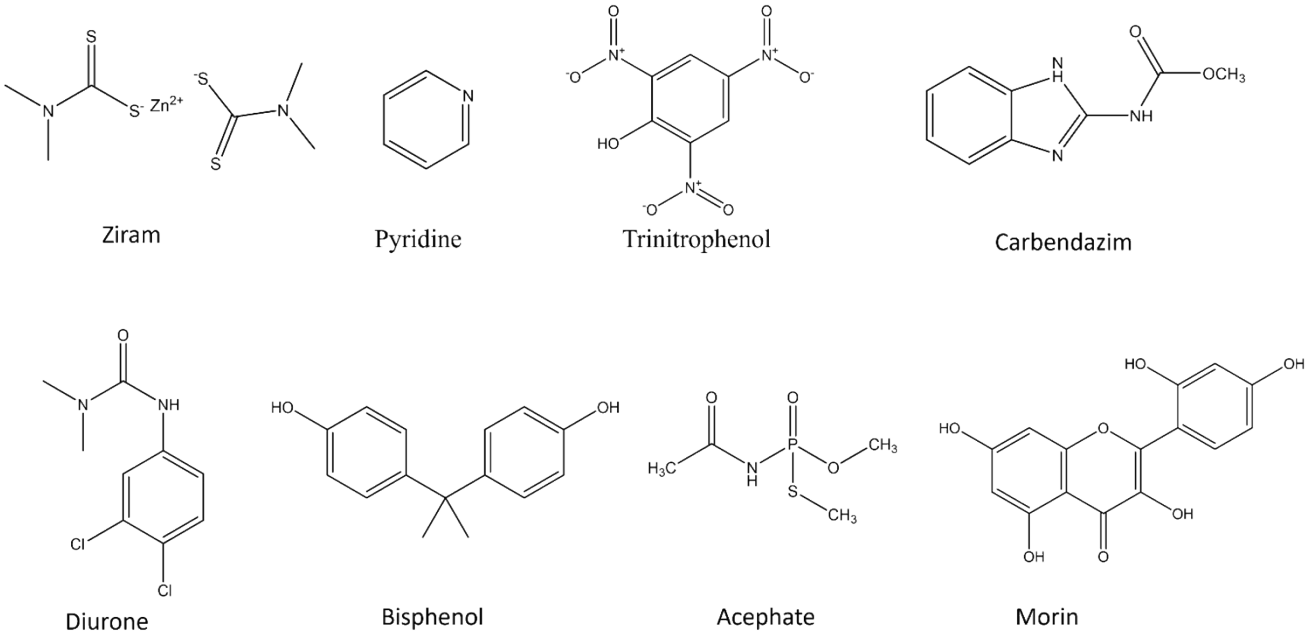

Fig. S6. The structure of analyte compounds used for fluorescence analysis

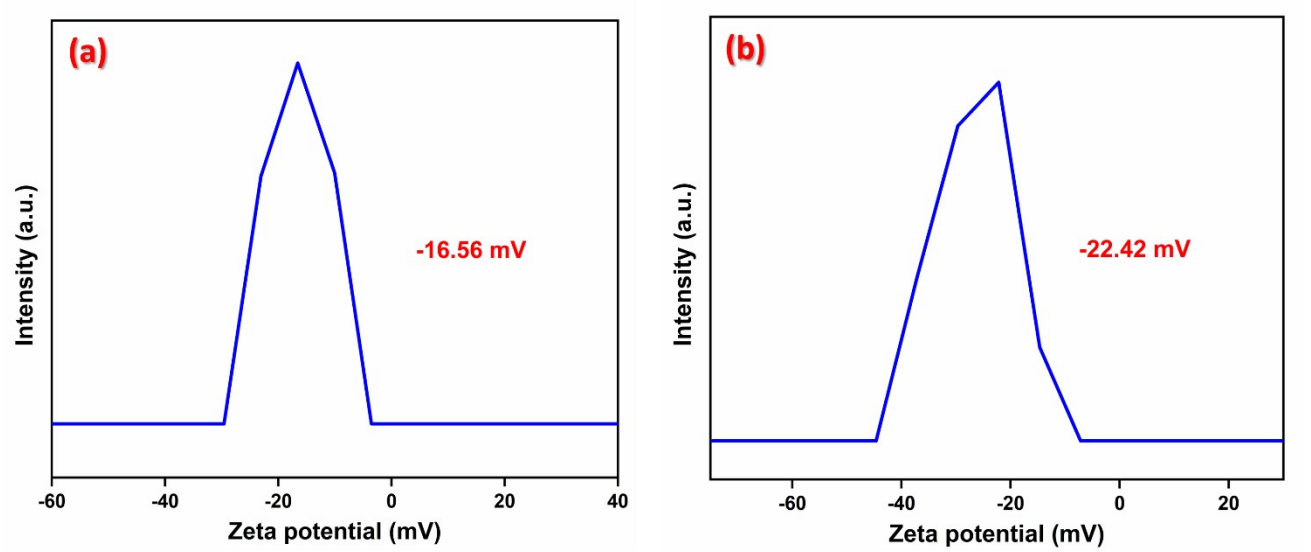

Fig. S7. Zeta potential curves of carbon dots in the presence of (a) trinitrophenol and (b) trinitrophenol and ciprofloxacin

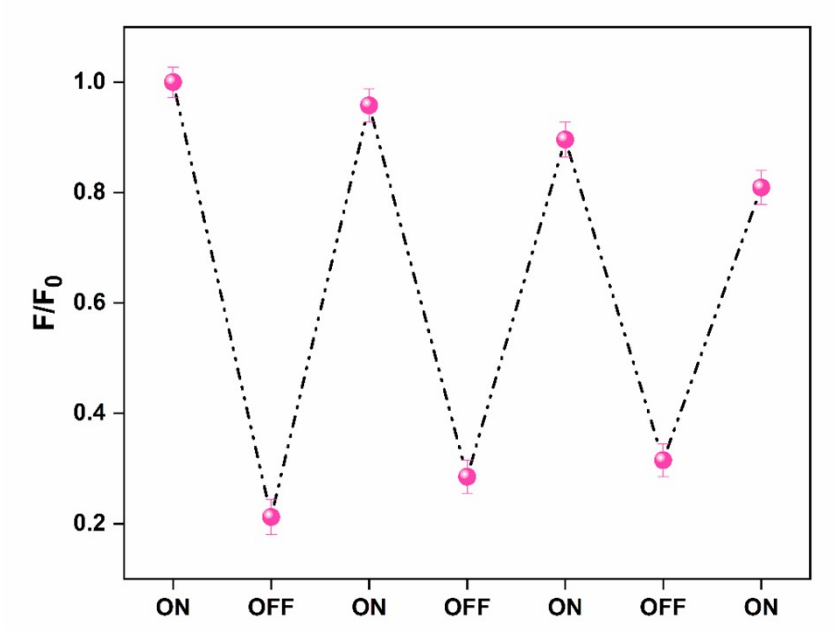

Fig. S8. Reproducibility of different cycles

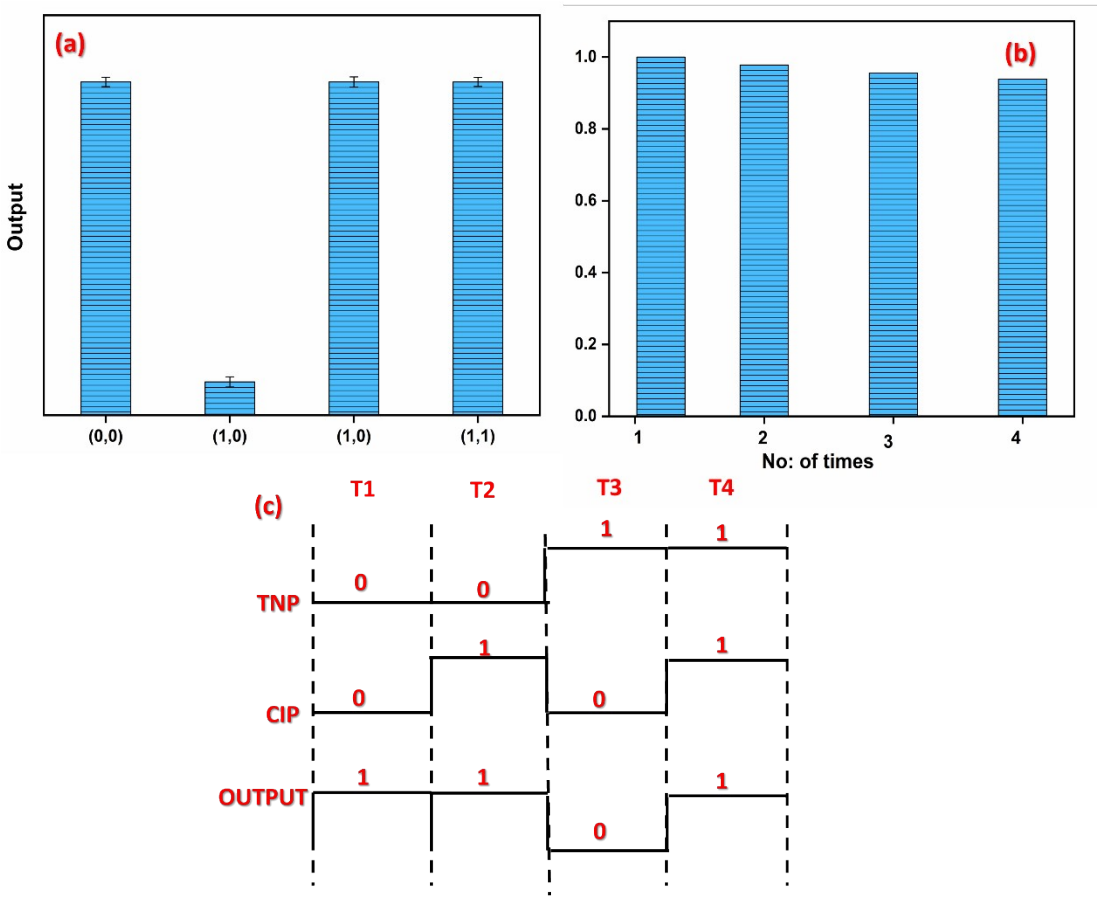

Fig. S9. (a) Error bar, (b) stability, and (c) temporal dynamics of input and output signals

Table S1. Comparison of quantum yield with previously reported works

Carbon source	Excitation (nm)	Emission (nm)	QY (%)	Ref:
Nigella sativa seeds	330	406.2	8.00	[45]
Carica Papaya juice	380	461	7.00	[46]
Apple juice	368	475	4.27	[47]
Trapa bispinosa peel	365	450	1.20	[48]
Eclipta Alba leaves	365	440	8.86	This work

Table S2. Comparison of different electrochemical methods for the sensing of morin

Material	Method	Linear range	Detection limit	Reference
MoS_2/graphene/GCE	DPV	1 - 100 µM	397.00 nM	[50]
SWNT-COOH/GCE	DPV	0.1 - 100 µM	28.90 nM	[51]
AgNPs-AETGO/GCE	CV	0.01 - 5 µM	3.30 nM	[52]
NH_2-MWCNT/ZnO/SPCE	DPV	27.40 - 803.40 µM	2.00 nM	[53]
CD/GCE	DPV	0.05 – 0.35 nM	14.20 pM	This work

References

45 N. Sharma, K. Yun. Dual sensing of tetracycline and l-Lysine using green synthesized carbon dots from Nigella sativa seeds. *Dyes Pigm*. 182 (2020) 108640.

46 B. S. B. Kasibabu, S. L. D'souza, S. Jha, S. K. Kailasa. Imaging of bacterial and fungal cells using fluorescent carbon dots prepared from *carica papaya* juice. *J. Fluoresce*. 25 (2015) 803-810.

47 V. N. Mehta, S. Jha, H. Basu, R. K. Singhal, S. K. Kailasa. One-step hydrothermal approach to fabricate carbon dots from apple juice for imaging of mycobacterium and fungal cells. *Sens. Actuators B: Chem.* 213 (2015) 434-443.

50 C.S. Lee, C.S. Kim. Large-scale preparation of MoS_2/Graphene composites for electrochemical detection of morin. ACS Appl. *Nano Mater* 4 (2021) 6668-6677.

51 G. Ziyatdinova, E. Ziganshina, H. Budnikov. Electrooxidation of morin on glassy carbon electrode modified by carboxylated single-walled carbon nanotubes and surfactants. *Electrochim. Acta* 145 (2014) 209-216.

52 M. L. Yola, V. K. Gupta, T. Eren, A. E. Şen, N. Atar. A novel electro-analytical nanosensor based on graphene oxide/silver nanoparticles for simultaneous determination of quercetin and morin. *Electrochim. Acta* (2014) 120, 204-211.

53 N. Sebastian, W. C. Yu, D. Balram. Synthesis of amine-functionalized multi-walled carbon nanotube/3D rose flower-like zinc oxide nanocomposite for sensitive electrochemical detection of flavonoid morin. *Anal. Chim. Acta* (2020) 1095, 71-81.