Green “turn-off” luminescent nanosensor for the sensitive analysis of Finerenone in various matrices: Application of recent greenness assessment techniques

SUPPORTING INFORMATION

Instrumentation

A Cary Eclipse Fluorescence Spectrophotometer (Agilent Technologies, Germany) was employed to assess the fluorescence intensities. The fluorometer featured a 150-W xenon lamp and a 1-cm quartz cell (Agilent Technologies, Germany) and was linked to a computer operating Cary Eclipse software, ADL Shell Application (Agilent Technologies, Inc.). Temperature investigations were performed using a Jeio Tech (Lab Companion) UCP-02 Ultrasonic Cleaner (Korea), equipped with a temperature controller. The pH of the buffers was calibrated using a Hanna Instruments HI2211 pH meter (Romania). The UV Spectrophotometer T80 UV–Vis 1800 (PG Instruments Ltd., UK) was utilized. The deionized water utilized in this study was obtained from a Hamilton-Aqua-Metric system (USA). The Fourier transform infrared (FT-IR) spectrometer (Agilent Technologies, USA) was utilized to get FT-IR spectra. Transmission electron microscopy (TEM, Quanta FEG 250, Czech Republic), operating at an accelerating voltage of 100 kV, was utilized to analyze the morphology and size of the particles.

Chemicals and reagents

Finerenone (FNR) reference material, demonstrating a purity of 99.89%, was supplied by P&C Labs (Cairo, Egypt). The pharmaceutical formulation of FNR (Finoxlab® 20 mg tablets), manufactured by P&C Labs (Cairo, Egypt), was obtained from a local pharmacy. All chemicals and solvents utilized in the investigation were of analytical grade purity. A 0.04 M Britton-Robinson buffer was formulated by combining 0.04 M phosphoric acid (≥85%, Adwic Co., Egypt), 0.04 M boric acid (99.9%, El-Nasr Chemical Company, Egypt), and 0.04 M acetic acid (96%, Sigma-Aldrich, Germany) with a suitable quantity of 0.2 M sodium hydroxide (≥98%, Adwia Co., Egypt). Methanol (HPLC grade), acetonitrile, absolute ethanol, isopropanol,

anhydrous citric acid, reduced glutathione, and sodium bicarbonate were sourced from Sigma-Aldrich (Germany), demonstrating a purity of ≥99%. Human plasma specimens were acquired from the National Medical Institute in Damanhour, Egypt, and stored in frozen conditions until utilized.

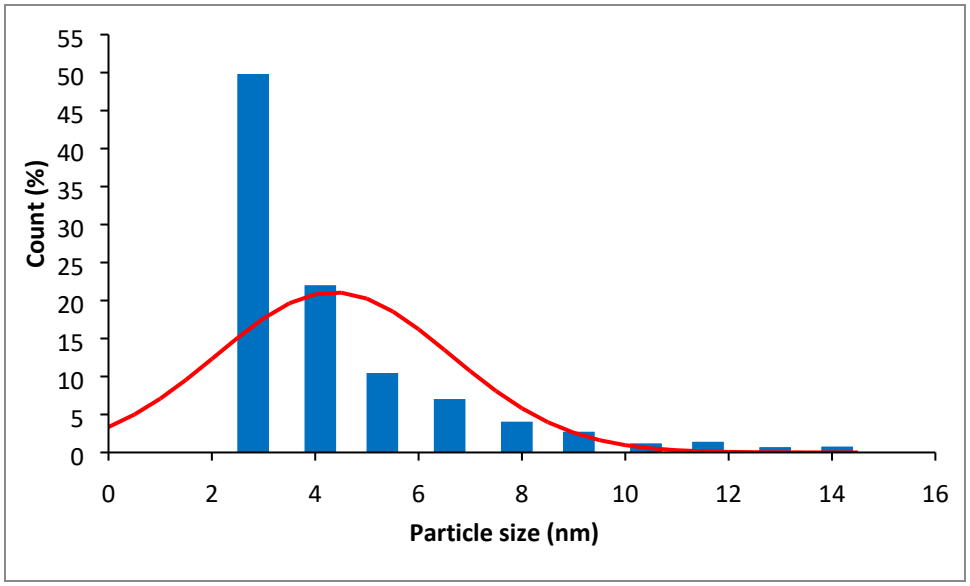

Fig. S1. Normal particle size distribution of the synthesized N,S-CQDs. The solid red curve represents the fitted normal (Gaussian) distribution.

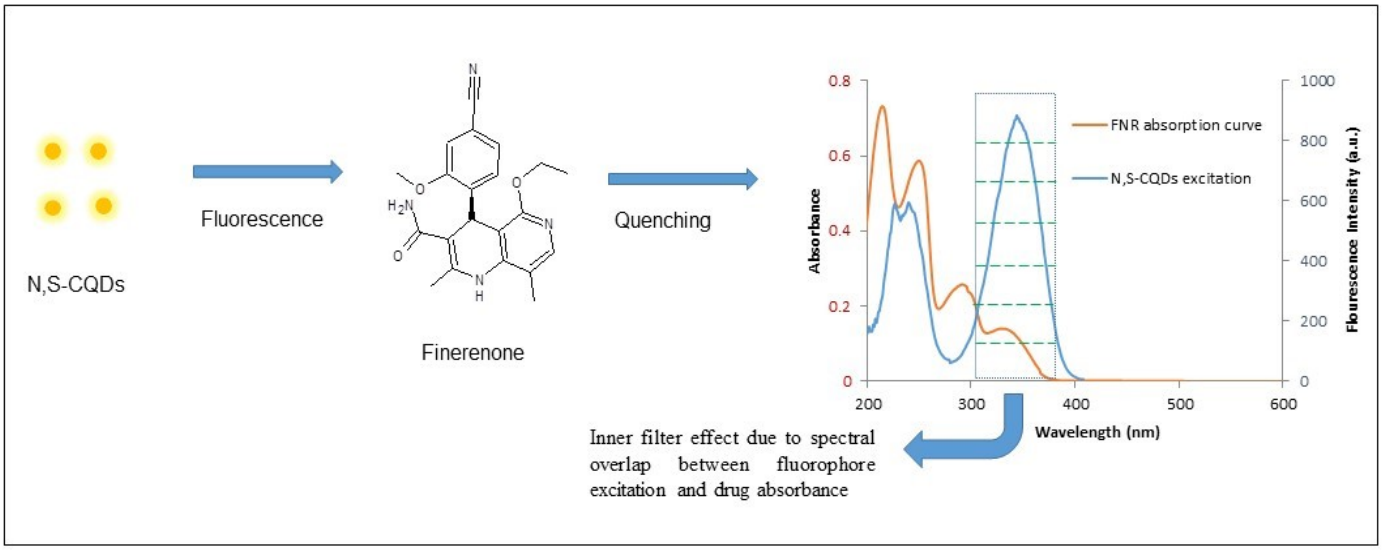

Fig. S2. Schematic diagram summarizing the sensing mechanism.

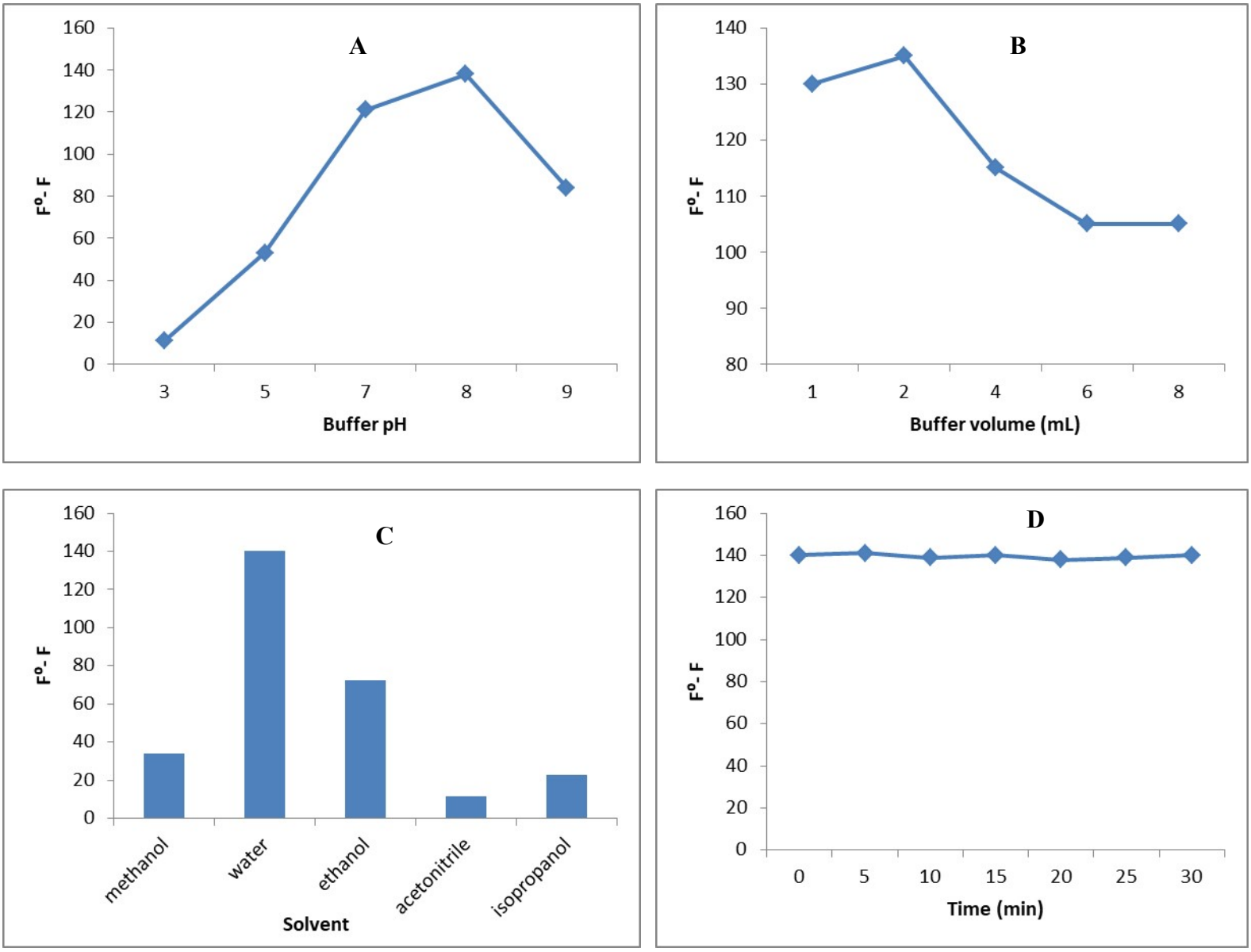

Fig. S3. Optimization of the analysis conditions for FNR using N,S-CQDs, (A) effect of BR-buffer pH, (B) effect of BR-buffer volume, (C) effect of diluting solvent, and (D) effect of reaction time.

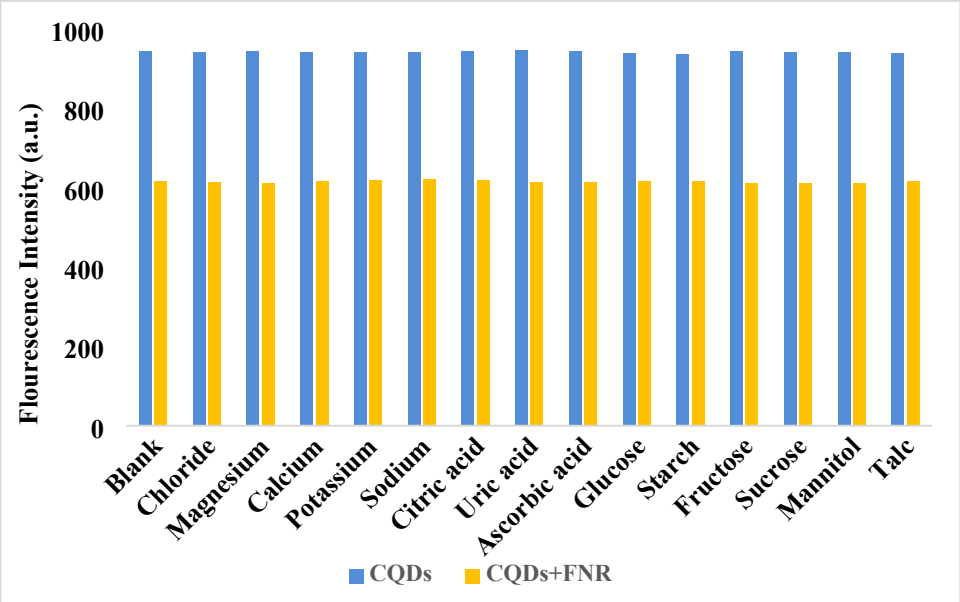

Fig. S4. Selectivity of the developed method towards FNR (7 µg/mL) and the presence of interfering substances (10 times).

Table S1: Application of the Carbon Footprint Reduction Index (CaFRI) for the evaluation of the suggested spectrofluorimetric methodology.

Related Questions	Answer
ENERGY	Green zone
1 - An energy reduction program or clean energy sources are adopted throughout the procedures:	No
2 - Total electrical power use of analytical instruments:	0.1-1.5 KW
3 - Energy-intensive non-analytical equipment is essential:	No
4 - Number of samples analyzed per hour:	>30 samples per hour
CO_2 EMISSION	Yellow zone
5 - The carbon footprint of the electrical power of analytical instruments is known	No
6 - Emission factor:	0.1-0.3 Kg CO_2 /KWh
STORAGE	Green zone
7 - Sample Storage:	Storage under normal conditions
TRANSPORTATION	Green zone
8 - The sample has to be transported to an analytical Laboratory:	Yes
9 - Distance between the sample field and the laboratory:	<1 mile
10 - Number of samples transported in one shipment:	Not applicable
11 - An eco-friendly vehicle is used in transportation:	Yes
PERSONNEL	Green zone
12 - Number of personnel required for one sample analysis:	One person
13 - Automation:	Semiautomatic
WASTE	Green zone
14 - Waste amount:	<10g or ml per sample
15 - Waste disposal:	Waste disposable by analyst
RECYCLING	Red zone
17 - Total number of pictograms:	<3
18 - Total amount of organic solvents per sample:	<5mL

19 - Total amount of reagents per sample:	1-3 mL
Total CaFRI scores	74

Table S2: Comparison of the proposed spectrofluorimetric method with reported approaches in the literature for FNR analysis.

Analytical method	Linearity (concentration range)	LOD	Application	References
UV-Spectrophotometry	2-14µg/ml	1.220µg/ml	Bulk and commercial dosage form	[1]
UV-Spectrophotometry	10-50 µg/ml	2.08 µg/ml	synthetic mixture	[2]
Fluorescence spectroscopy	1–200 ng/mL	0.280 ng/mL	Bulk powder, tablets, and human plasma	[3]
HPLC–MS/MS	0.10 - 200 µg/L	Not mentioned	Human plasma	[4]
RP-HPLC	50 to 150 µg/ml)	0.261 µg/ml	Bulk powder	[5]
RP-HPLC	1 - 50 µg/mL	0.02 µg/mL	Bulk powder	[6]

Fluorescence spectroscopy	0.30 – 9.00 µg/ml	0.098 µg/ml	Bulk powder, tablets, and human plasma	This study

References

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