Modified Zinc Sulfide Quantum Dots based fluorometric approach for the determination of Moxifloxacin antibiotics in food samples

Reena K. Sajwan[a$], Shailja Pandey[a,b$], Rahul Kumar[a,c], Tarun Kumar Dhiman[a], Sergei A. Eremin,[d,e] and Pratima R. Solanki[a*]

[a]Special Centre for Nanosecinece, Jawaharlal Nehru University, New Delhi-110067, India
[b]University School of Basic and Applied Sciences, Guru Gobind Singh Indraprastha University, New Delhi, 110078, India
[c]Schools of Physical Sciences, Jawaharlal Nehru University, New Delhi, 110067, India
[d]Department of Chemical Enzymology, M.V. Lomonosov Moscow State University, Moscow, Russia
[e]A.N. Bach Institute of Biochemistry, Research Centre of Biotechnology of the Russian Academy of Sciences, Moscow, Russia

$Both the auothers contribute equally
[*]Corresponding author: Email: Partima@mail.jnu.ac.in; Pratimarsolanki@gmail.com

ABSTRACT

The uncontrolled use of antibiotics in humans and animals is the main reason behind the abandoned growth of antibacterial resistance [1]. This problem caused a major threat to the public as well as animal health. So that it is most important to develop a technique that can detect the evidence of antibiotics in real food and water samples, and can be successfully used for the safety of food and environment. Here, we have reported a fluorometric nanosensor based on mercaptopropionic acid modified zinc sulfide (MZnS) quantum dots (QDs) use to detect the amount of moxifloxacin (MOXI) in water and food samples. MOXI is a fourth generation fluoroquinolone antibacterial agent that shows activity against a broad spectrum of gram positive and negative bacteria. MOXI is successfully used in the treatment of mainly acute bacterial sinusitis occurred by the receptive microorganisms, bronchitis due to bacteria, pneumonia, soft tissue, and skin infections[2]. On the other hand, the undefined utilization of MOXI may lead threaten to human health and their secretion in the form of urine may caused for environmental contamination. MOXI can be detected by various analytical methods. Although, these analytical techniques are very sensitive with minimum detection range along with the short linear response, but fail to on spot analysis. In the reported work firstly, TOP capped ZnS (TZnS) QDs [5] were synthesized at very high elevated temperature, and then surface modification opted to transfer the QDs in to hydrophilic form which is suitable for aqueous phase application. The particle size

of the synthesized QD was determined with the help of a transmission electron microscope. The microscopically views of the TZnS and MZnS QDs show the uniformly dispersed narrow sized QDs have an average particle size of the order of 2.1 ± 1.5 nm and 2.5 ± 0.9 nm, respectively. The optical property of the synthesized QDs was characterized with UV-Vis and fluorescence spectroscopy, respectively. The MZnS QDs shows the wavelength dependent emission property when excited with different excitation wavelength from 270- 390 nm. The fluorescence emission spectra show a maximum emission peak at 453 nm at 340 nm excitation wavelength. The fluorescence emission spectra of ZnS QDs were shifted to the higher wavelength after the ligand exchange. The shift in the fluorescence spectra gives evidence that the surface modification takes place significantly. After the significant surface modification, water soluble MZnS QDs were prepared and tested against the presence of MOXI. Under the optimized conditions such as pH value, incubation time, and amount of the MZnS QDs, the nanosensor performed very well. Along with the MOXI concentration varies from 1-100 μM, the fluorescence intensity of MZnS QDs increased about 41.3-fold from its initial value[6]. The reported nanosensor shows good selectivity towards the MOXI and is sensible enough to detect the lowest concentration of MOXI of the limit 0.203 μM. Further, the applicability of the nanosensor has been tested MOXI presence in real and spiked real samples, and it was found that the nanosensor is capable enough to detect the amount of MOXI presented in the spiked real samples. After the real sample analysis, the developed nanosensor successfully has proven its applicability for the determination of MOXI presence with a good recovery percentage. So after performing all the necessary analysis the developed nanosensor can be used potentially in food and environmental safety applications.

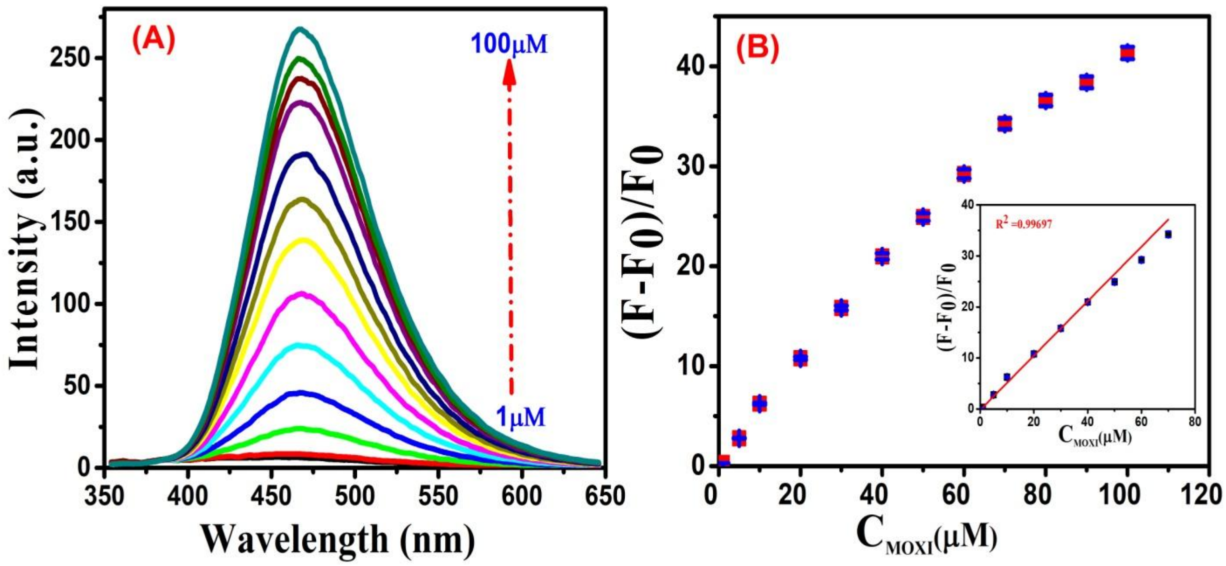

Fig. 1: (A) Fluorescence intensity enhancement of nanosensor with the concentration of MOXI (1-100 µM). (B) Fluorescence intensity enhancement percentage of nanosensor.

Table 1: comparative table of different methods used for the determination of MOXI

Techniques	Medium	Linear Response (µM)	Lower Limit of Detection (µM)	References
H.P.L.C.		0.31 – 39.85	0.31	[3]
L.C.-M.S.		0.01 – 0.25	0.01	[4]
Atomic absorption spectroscopic	HCl (10 mM) + NH_4	99.64 – 1096.1	3.74	[7]
Potentiometric	ZnO nano-road	0.05 - 10000	0.13	[8]
Electro-chemical	Molecularly Imprinted Polymer	3.13 - 200	0.06	[9]
Fluoresence	MZnS QDs	1 - 100	0.20	Current work

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