

Review

A Bottom-Up Approach for Developing Aptasensors for Abused Drugs: Biosensors in Forensics

Eda Aydindogan^{1,*}, Simge Balaban¹, Serap Evran^{1,2,*}, Hakan Coskunol³, Suna Timur^{1,2,4,*}

1. Department of Biochemistry, Institute of Natural and Applied Sciences, Ege University, 35100, Bornova, Izmir, Turkey
2. Department of Biochemistry, Faculty of Science, Ege University, 35100, Bornova, Izmir, Turkey
3. Department of Mental Health and Diseases, Faculty of Medicine, Ege University, 35100, Bornova, Izmir, Turkey
4. Central Research Testing and Analysis Laboratory Research and Application Center, Ege University, 35100, Bornova, Izmir, Turkey

* Correspondence: suna.timur@ege.edu.tr (S.T.), ORCID: 0000-0002-3129-8298; edacelikbas@ku.edu.tr (E.A.); ORCID: 0000-0003-4882-6445.

Received: 15 September 2019; Accepted: 30 September 2019; Published: date

Supplementary Material

Table S1. Binding affinity and post-SELEX optimization of aptamers selected for abused drugs.

Target	Type	Name	K_d	Post-SELEX optimization	Reference
Cocaine	DNA	MNS-4.1	$\sim 0.4\text{-}10\ \mu\text{M}$	Shortening the S_1 stem of MNS-4.1 yields MNS-7.9 with a K_d of $\sim 20\ \mu\text{M}$.	[81]
Codeine	RNA	FC5	$4.00 \pm 0.13\ \mu\text{M}$	Truncation of FC5 yields FC5L mini-aptamer lacking the 3' constant terminal sequence.	[90]
Codeine	RNA	FC45	$2.50 \pm 0.06\ \mu\text{M}$	Truncation of FC45 yields FC45L mini-aptamer lacking the 3' constant terminal sequence.	[90]
Codeine	DNA	HL7-14	$0.91 \pm 0.19\ \mu\text{M}$	Truncation of six bases from the 3' end of HL71 yields HL7-11. Removing two G bases from HL7-11 yields HL7-14.	[91]
Methamphetamine	DNA	aptaMETH	$\sim 100\ \text{nM}$	None	[92]
Ephedrine	DNA	EP08	$2.86 \pm 0.24\ \mu\text{M}$	None	[93]

Table S2. Literature survey of the optical aptasensors for abused drugs.

Drug	LOD	Samples	Method	Reference
Cocaine	15 μ M	N/A	Colorimetric	[137]
Cocaine	2 μ M	N/A	Colorimetric	[138]
Cocaine	2.8 μ M	Serum	ELAA	[126]
Cocaine	293 pM	Serum	Fluorescence-based	[128]
Cocaine	1.0 pM	N/A	Chemiluminescence-based	[133]
Cocaine	2.36 μ g	N/A	Colorimetric	[119]
Cocaine	3.2 pM	Serum	Chemiluminescence-based	[134]
Cocaine	1 μ M	Urine	Fluorescence-based	[129]
Cocaine	10 μ M	Serum	Colorimetric	[120]
Cocaine	165.2 nM	Serum	Fluorescence-based	[130]
Cocaine	50 nM	Plasma, Serum and Urine	Colorimetric	[121]
Cocaine	0.48 nM	N/A	Chemiluminescence	[135]
Cocaine	10^{-6} - 10^{-5} M	N/A	SPR	[136]
Cocaine	2.0 nM	Serum	Fluorescence	[131]
Cocaine	200 nM	Serum, Urine and Saliva	Fluorescence	[86]
Cocaine	0.5 nM	Urine	Colorimetric	[124]
Methamphetamine	0.1 nM	Urine	Colorimetric	[122]
Methamphetamine	0.5 nM	Urine	Colorimetric	[122]
Methamphetamine	1 nM	Serum	Fluorescence-based	[132]
Methamphetamine	500 nM	N/A	Colorimetric	[127]
Methamphetamine	0.82 μ M	Urine	Colorimetric	[123]
Methamphetamine	5.0 mM	N/A	Colorimetric	[125]

Abbreviations: N/A: Not Applicable, ELAA: Enzyme Linked Aptamer Assay, SPR: Surface Plasmon Resonance.

Table S3. Literature survey of the electrochemical aptasensors for abused drugs.

Drug	LOD	Samples	Method	Reference
Cocaine	150 pM	Serum	Amperometric and impedimetric	[178]
Cocaine	105 pM	Serum	Amperometric	[179]
Cocaine	100 pM	Serum	Amperometric and impedimetric	[180]
Cocaine	1.5 nM	Urine and saliva	Amperometric and impedimetric	[11]
Cocaine	5.0 pM	Serum	Amperometric and impedimetric	[181]
Cocaine	21 nM	N/A	Amperometric	[182]
Cocaine	1.29 pM for EIS 2.22 pM for DPV	Serum, Urine, and Saliva	Amperometric and impedimetric	[183]
Cocaine	0.3 μ M	Serum	Amperometric and impedimetric	[184]
Cocaine	11 μ M	Serum	Amperometric and impedimetric	[185]
Cocaine	100 nM	Serum	Impedimetric	[194]
Cocaine	1 nM	N/A	Amperometric	[193]
Cocaine	0.1 μ M	Plasma, Serum, Saliva, and Urine	Amperometric	[186]
Cocaine	1.3 nM	Urine	Amperometric and impedimetric	[187]
Benzoylcegonine	0.72 μ M	Serum, Urine and Saliva	Amperometric and impedimetric	[188]
Methamphetamine	10 nM	N/A	Amperometric	[189]
Methamphetamine	N/A	N/A	Impedimetric	[195]
Codeine	3.2 pM	Serum	Amperometric and impedimetric	[190]
Codeine	0.3 pM	Serum	Amperometric and impedimetric	[191]
Codeine	3 pM	N/A	Amperometric and impedimetric	[91]
Codeine	37 pM	N/A	Amperometric	[192]

Abbreviations: N/A: Not Applicable.