

Critical Review: DNA aptasensors, Are they ready for monitoring organic pollutants in natural and treated water sources?

Supporting Information

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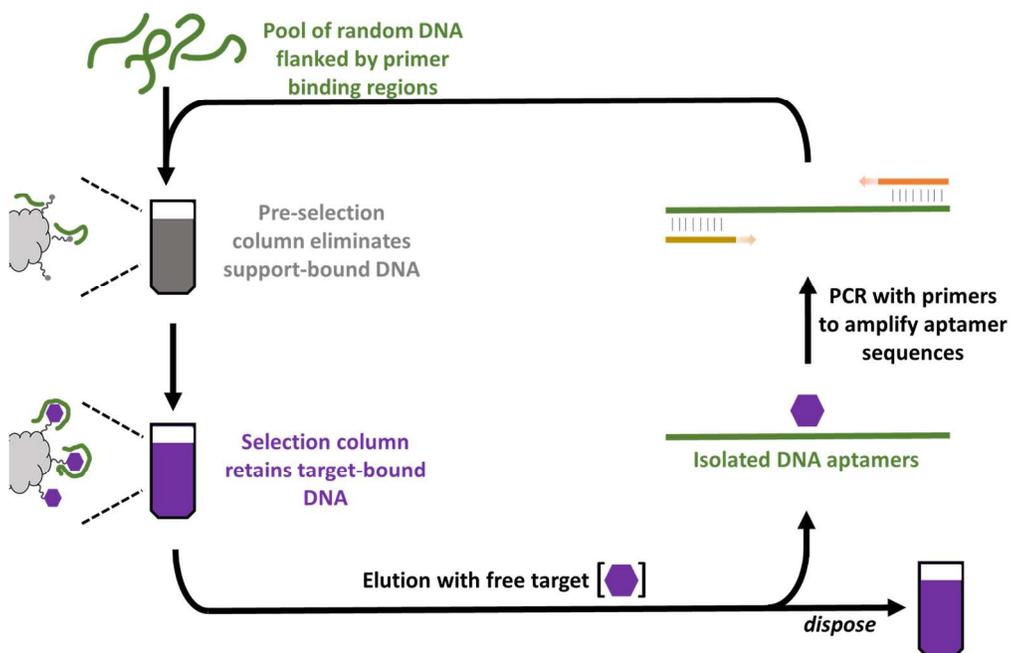


Figure S1. SELEX process used for DNA aptamer selections modified from ¹

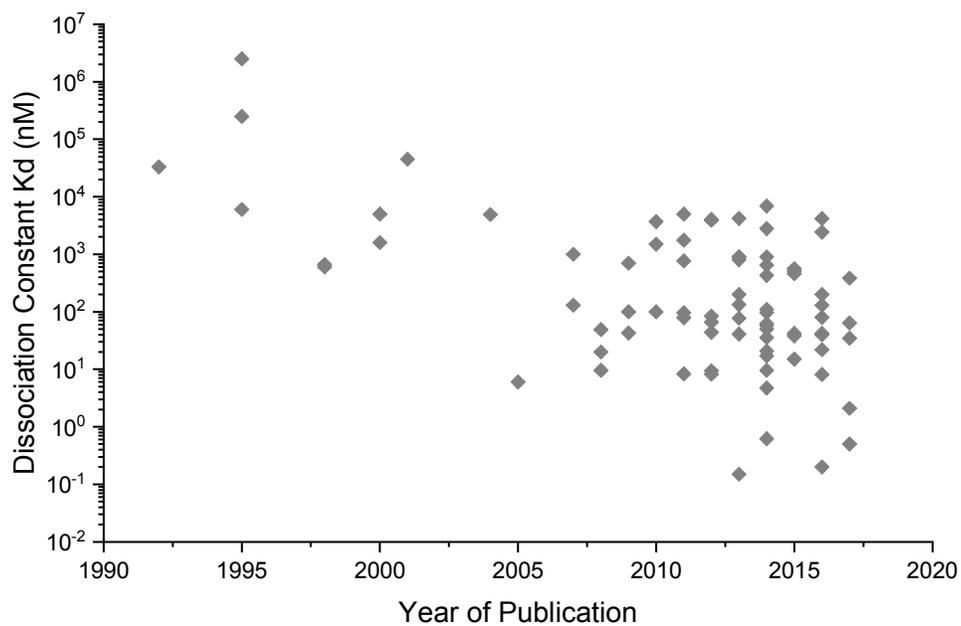
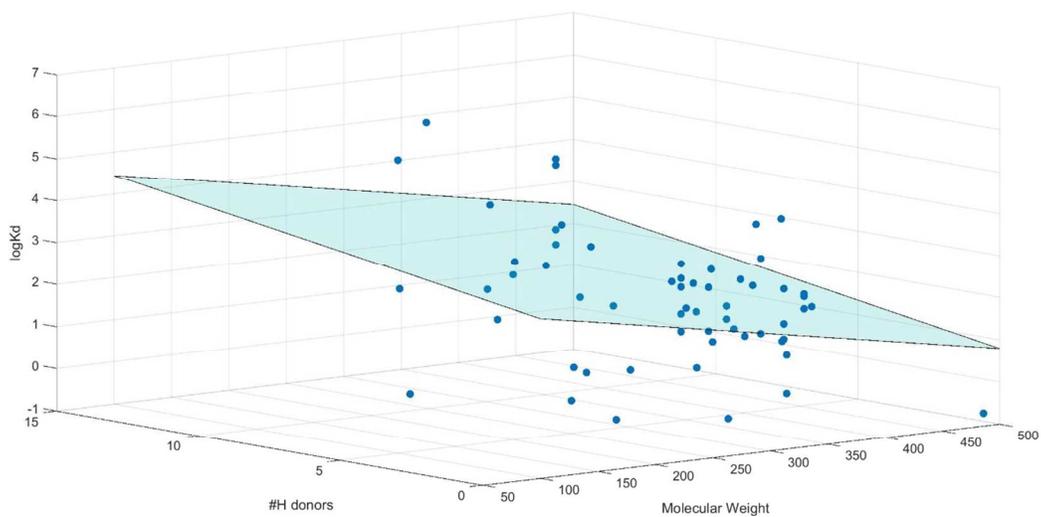
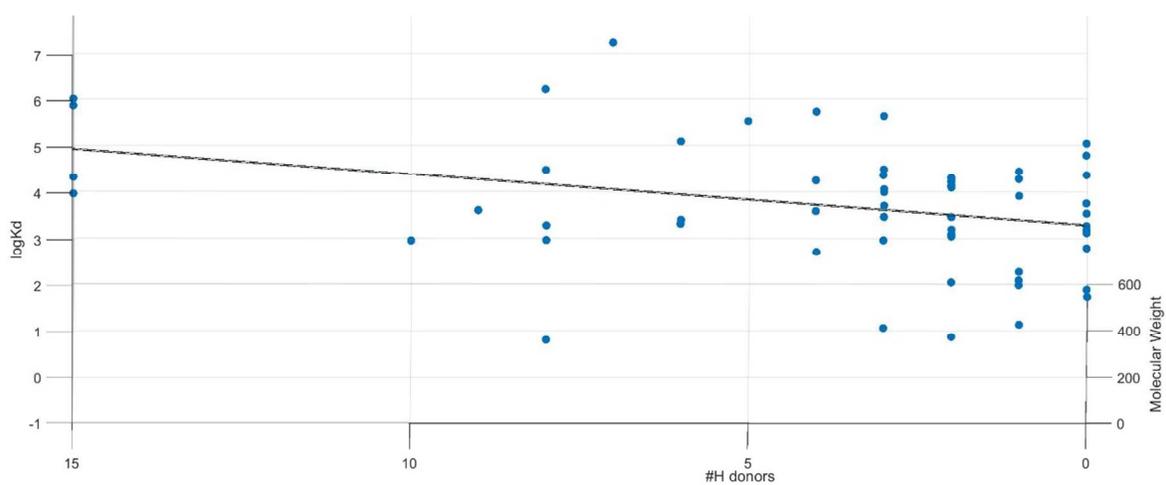


Figure S2. Dissociation constant (K_d) of aptamers for small molecule targets (MW 60-1700Da) plotted against the year of publication

(i)



(ii)



(iii)

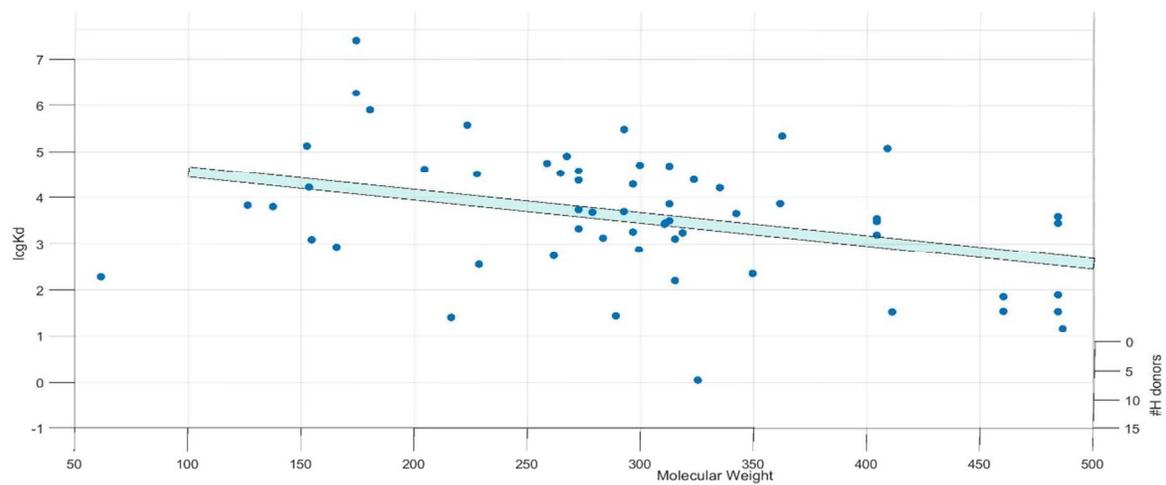
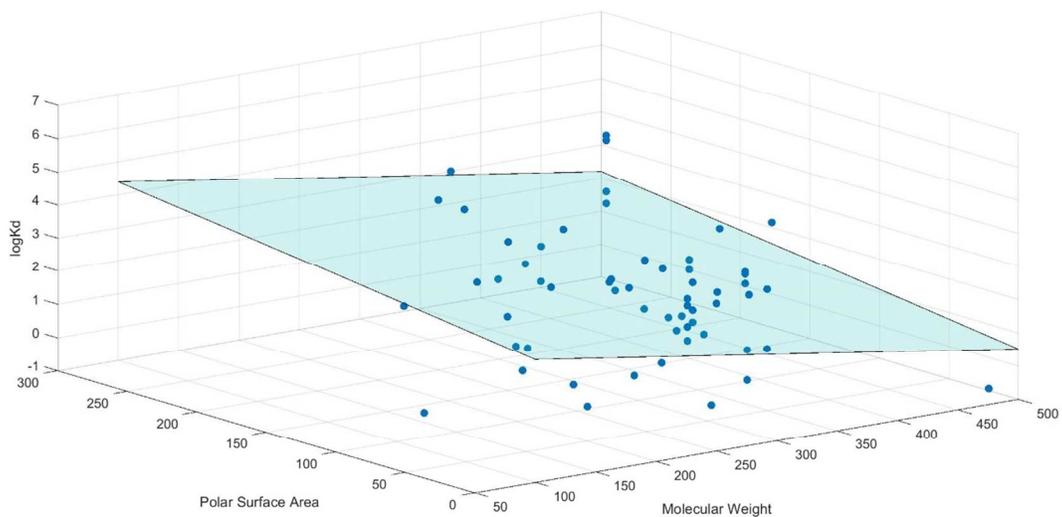
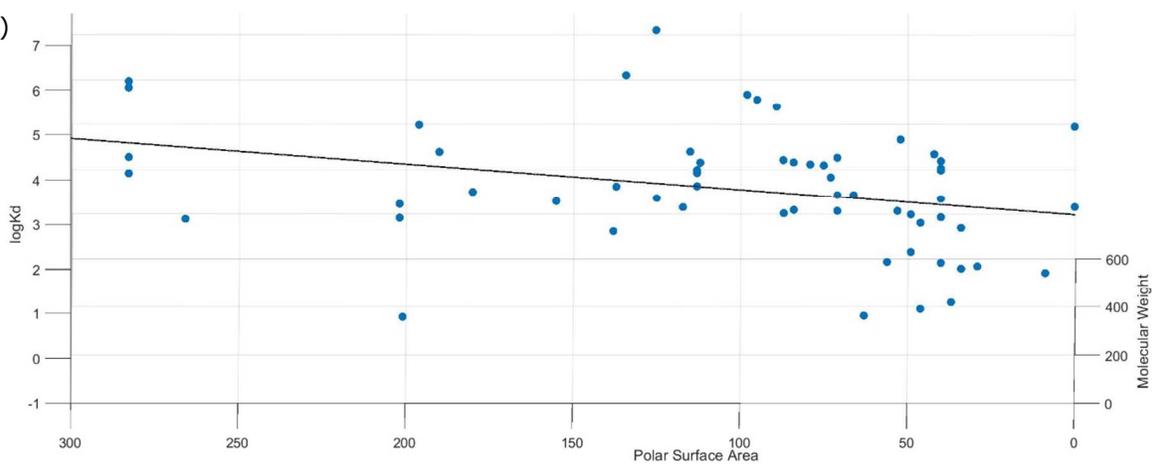


Figure S3A. (i) Scatter plot showing molecular weight and number of hydrogen bond donors against $\log K_d$. Plane corresponds to the multiple linear regression fit. Side view of plot with (ii) hydrogen donors and (iii) molecular weight on the horizontal axis.

(i)



(ii)



(iii)

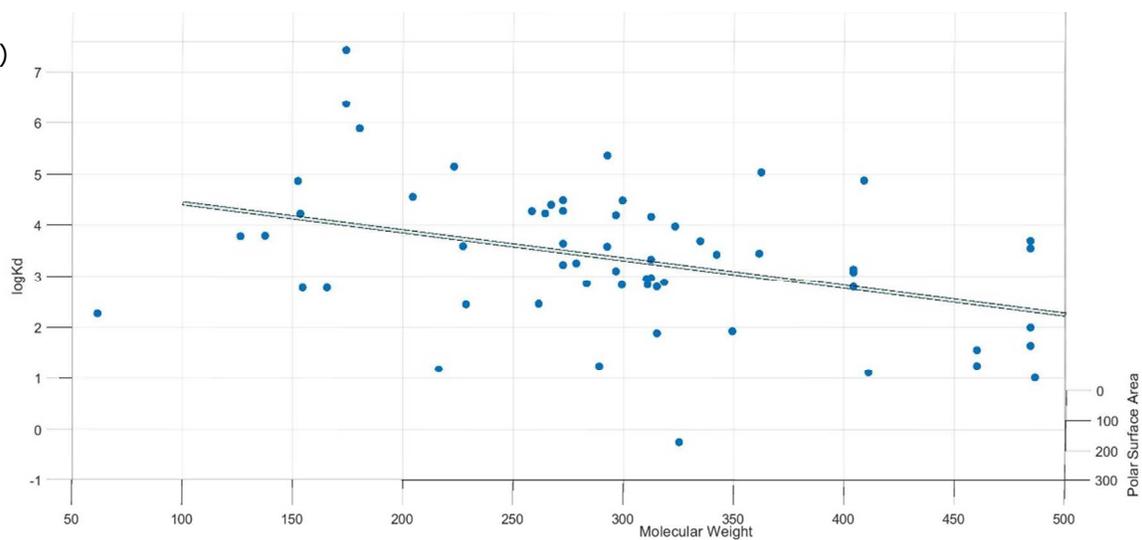


Figure S3B. (i) Scatter plot showing target molecular weight and polar surface area against $\log K_d$. Plane corresponds to the multiple linear regression fit. Side view of plot with (ii) polar surface area (iii) molecular weight on the horizontal axis.

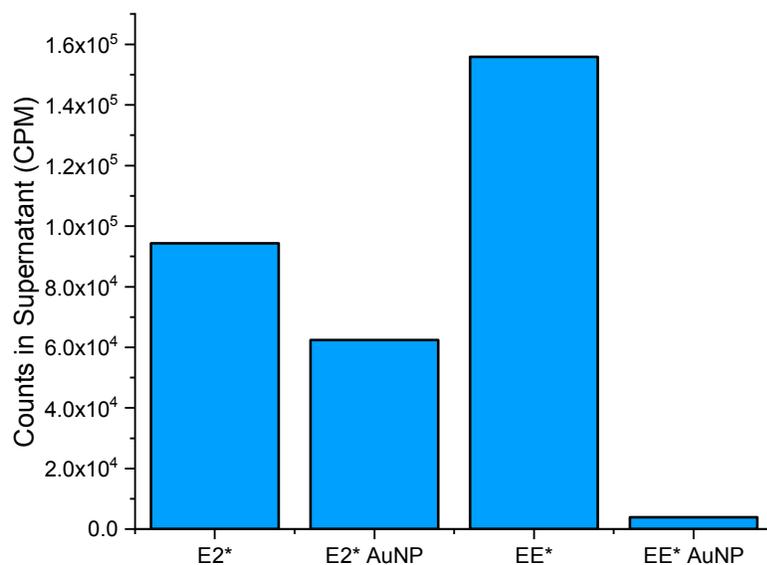


Figure S4. Non-specific adsorption of 1pmol 2,4,6,7-3H-estradiol (81 Ci/mmol) and 6,7-3H-ethynylestradiol (60 Ci/mmol) to 100uL of 20nM citrate capped gold nanoparticles (AuNPs). Y-axis has the counts (cpm) in the supernatant post-centrifugation in the presence and absence of AuNPs.

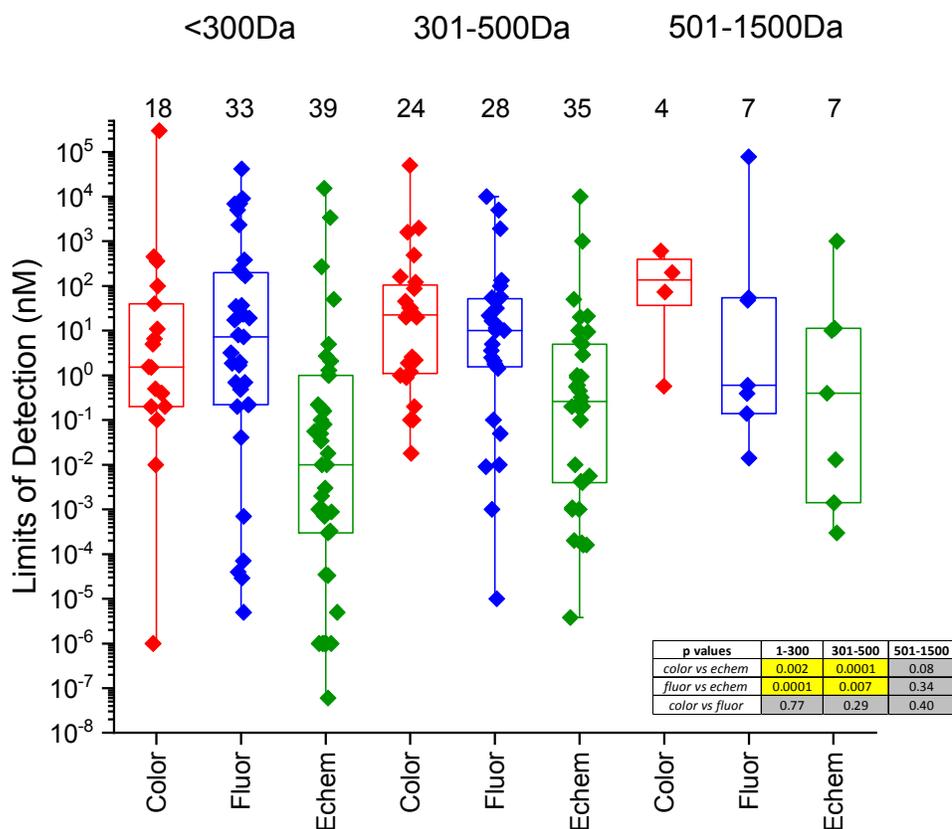


Figure S5. Box plot of LODs for the colorimetric, fluorescence and electrochemical platforms split into three molecular weight categories. The p-value is obtained by comparing any two platforms using an independent samples t-test. The number against each box indicates the number of samples used to create each box.

Equations to calculate Cohen's d

Cohen's d-value is calculated using equations S1 and S2, where the means of two data sets are x_1 and x_2 . The two data sets contain n_1 and n_2 number of samples with standard deviations SD_1 and SD_2 .

$$d = \frac{\bar{x}_1 - \bar{x}_2}{SD_{pooled}} \quad (S1)$$

$$SD_{pooled} = \sqrt{\frac{(n_1 - 1)SD_1^2 + (n_2 - 1)SD_2^2}{n_1 + n_2 - 2}} \quad (S2)$$

Table S1. Comprehensive list of small organics for which DNA aptamers have been developed between 1992 and 2017 including those noted in the reviews by McKeague and DeRosa² and Pfeiffer and Mayer³. Molecular weight (MW) of the target, the lowest (best) reported K_d and year of publication are listed.

Target	Mol. Wt	Lowest K_d [nM]	Year	Ref
Reactive green 19	1419	3.3E+04	1992	⁴
Adenosine	267	6.0E+03	1995	⁵
L-argininamide	174	2.5E+05	1995	⁶
L-arginine	174	2.5E+06	1995	⁶
Cellobiose	342	6.0E+02	1998	⁷
Sulforhodamine B	558.7	6.6E+02	1998	⁸
Cholic acid	408.6	5.0E+03	2000	⁹
Hematoporphyrin	598.7	1.6E+03	2000	¹⁰
L-tyrosinamide	180	4.5E+04	2001	¹¹
Sialyllactose	633.6	4.9E+03	2004	¹²
Ethanolamine	61	6.0E+00	2005	¹³
(R)-thalidomide	258	1.0E+03	2007	¹⁴
17 β -estradiol	272	1.3E+02	2007	¹⁵
Daunomycin	527.5	2.0E+01	2008	¹⁶
Ochratoxin A	403.8	4.9E+01	2008	¹⁷
Oxytetracycline	460	9.6E+00	2008	¹⁸
8-hydroxy-2-deoxyguanosine	283	1.0E+02	2009	¹⁹
Diclofenac	296	4.3E+01	2009	²⁰
Dopamine	153	7.0E+02	2009	²¹
(S) and (R) ibuprofen	206	1.5E+03	2010	²²
Adenosine triphosphate	347	3.7E+03	2010	²³
Fumonisin B1	721.8	1.0E+02	2010	²⁴
Acetamiprid	222.7	5.0E+03	2011	²⁵
Bisphenol A	228	8.3E+00	2011	²⁶
Chloramphenicol	323	7.7E+02	2011	²⁷
Kanamycin	484.5	7.9E+01	2011	²⁸
L-tryptophan	204	1.8E+03	2011	²⁹
Ochratoxin A	403.8	9.6E+01	2011	³⁰
Ampicillin	349	9.4E+00	2012	³¹
Digoxin	781	8.2E+00	2012	³²
Kanamycin A	484	3.9E+03	2012	³³
Lysergamine	269	4.4E+01	2012	³⁴
Polychlorinated biphenyl (PCB77)	292	4.0E+03	2012	³⁵
Polychlorinated biphenyls (PCB72 and PCB101)	292	6.6E+01	2012	³⁶
Sulfadimethoxine	310	8.4E+01	2012	³⁷
Abscisic acid	264	8.0E+02	2013	³⁸

Codeine	299	9.1E+02	2013	³⁹
N-glycolylneuraminic acid	325	1.5E-01	2013	⁴⁰
N-methyl-mesoporphyrin	580.7	8.8E+02	2013	⁴¹
Okadaic acid	805	7.7E+01	2013	⁴²
Saxitoxin	299	1.3E+02	2013	⁴³
Streptomycin	581.6	2.0E+02	2013	⁴⁴
Xanthine	152	4.2E+03	2013	⁴⁵
Zearalenone	318	4.1E+01	2013	⁴⁶
17 β -estradiol	272	9.0E+02	2014	⁴⁷
17 β -estradiol	272	5.0E+01	2014	⁴⁸
Aflatoxin B1	312	9.7E+01	2014	⁴⁹
Aflatoxin B1	312	6.5E+02	2014	⁵⁰
Aflatoxin M1	328	3.6E+01	2014	⁴⁹
Atrazine	215.7	6.2E-01	2014	⁵¹
Bromacil	261	9.6E+00	2014	⁵²
Cortisol	362	6.9E+03	2014	⁵³
Cylindrospermopsin	415	5.7E+01	2014	⁵⁴
Fumonisin B-1	721.8	6.2E+01	2014	⁵⁵
Kanamycin A	484	2.8E+03	2014	⁵⁶
Ochratoxin A	403.8	1.1E+02	2014	⁵⁷
Oxytetracycline	460	4.7E+00	2014	⁵⁸
Progesterone	314.5	1.7E+01	2014	⁵⁹
T-2 toxin	466.5	2.1E+01	2014	⁶⁰
Trinitrotoluene	227	4.3E+02	2014	⁶¹
17 β -estradiol	272	5.6E+02	2015	¹
17 α -ethynylestradiol	296	4.6E+02	2015	¹
Anatoxin-a	165	1.5E+01	2015	⁶²
Brevetoxin-2	895	4.2E+01	2015	⁶³
Edifenfos	310.4	3.8E+01	2015	⁶⁴
Melamine	126	5.1E+02	2015	⁶⁵
1-3 beta D glucans	1700	8.0E+01	2016	⁶⁶
Aflatoxin B1	312	4.2E+01	2016	⁶⁷
Bromodiphenyl ether(BDE47)	485.8	2.0E-01	2016	⁶⁸
Gonyautoxin 1/4	411	8.1E+00	2016	⁶⁹
Malachite Green	364.9	2.4E+03	2016	⁷⁰
Okdaic Acid	805	4.0E+01	2016	⁷¹
Ofloxacin	361	1.3E+02	2016	⁷²
Patulin	154	2.2E+01	2016	⁷³
Thioflavin T	318.9	4.2E+03	2016	⁷⁴
Tyramine	137	2.0E+02	2016	⁷⁵

Benzylpenicillin	334.4	3.8E+02	2017	⁷⁶
Testosterone	288.4	5.0E-01	2017	⁷⁷
Dibutyl Phthalate (DBP)	278	6.4E+01	2017	⁷⁸
Kanamycin	484.5	3.5E+01	2017	⁷⁹
Progesterone	314.5	2.1E+00	2017	⁸⁰

Table S2. DNA aptamers developed for some proteins. Molecular weight (MW) of the target, the lowest (best) reported K_d and year of publication are listed.

Target	Mol. Wt	Lowest K_d [nM]	Year	Ref
Thrombin	36,000	2.5×10^1	1992	⁸¹
Human Immunoglobulin E	190,000	6.0×10^0	1996	⁸²
Platelet Derived Growth Factor	25,000-29,000	9.4×10^{-2}	1996	⁸³
Immunoglobulin E	190,000	2.7×10^1	2004	⁸⁴
Ricin	62,925	5.8×10^1	2006	⁸⁵
Abrin	260,000	2.8×10^1	2007	⁸⁶
CFP-10.ESAT-6 (TB)	16,000	1.6×10^0	2012	⁸⁷
EpCAM	34,932	3.3×10^1	2014	⁵⁰
Protein A	42,000	2.1×10^{-2}	2015	⁸⁸

Table S3. P-values, proportionality constants and intercepts of single and two variable linear regression models with $\log K_d$ as the dependent variable.

Regression	Independent Variable(s)	p-value	Proportionality Constant	Intercept
Single Variable Models	log Koc	0.04	-0.20	2.42
	log D	0.05	-0.07	2.12
	Length	0.03	-0.01	3.03
Two Variable Models	MW	0.04	-0.002	2.53
	#h don	0.03	0.081	
	MW	0.02	-0.003	2.56
	PSA	0.04	0.005	
	MW	0.00	-0.006	3.10
	log KH	0.03	-0.051	
	MW	0.05	-0.002	2.73
	log D	0.02	-0.085	
	log D	0.00	-0.149	3.32
	ΔH_{vap}	0.04	-0.013	
	log D	0.00	-0.152	6.23
ΔS_{vap}	0.04	-37.980		

Table S4. List of aptasensors developed for various small organic molecules including sensor platform, limit of detection (LOD), upper and lower limits of the detection range and matrices tested. Compounds with an asterisk (*) are EPA regulated. PEC – photoelectrochemical. SERS-surface enhances Raman spectroscopy. SPR-surface plasmon resonance. NR-not reported.

Target	Sensor Platform	LOD [nM]	Detection Range [nM]		Matrices	Year	Ref
Dopamine	Colorimetric	3.6E+02	5.4E+02	5.4E+03	NR	2011	⁸⁹
	Electrochemical	1.0E-02	1.0E-02	1.0E+01	Exocytotic fluid	2013	⁹⁰
	Electrochemical	1.0E+00	5.0E+00	1.5E+02	Human serum	2014	⁹¹
	Glucose meter	3.0E+00	8.0E+01	1.0E+05	Human serum	2015	⁹²
	Electrochemical	3.4E+03	5.0E+03	7.5E+04	Serum	2016	⁹³
	Electrochemical	2.1E+00	5.0E+00	3.0E+02	Serum	2016	⁹⁴
L-Tryptophan	Electrochemical	1.5E+04	6.3E+04	2.0E+06	NR	2013	⁹⁵
	Fluorescence	7.0E+03	1.0E+04	5.0E+05	Fetal bovine serum	2015	⁹⁶
	Fluorescence	6.8E+03	1.0E+04	5.0E+05	NR	2015	⁹⁶
Omethoate	SERS	2.4E+04	NR	NR	Apple juice	2014	⁹⁷
	Fluorescence	2.3E+01	2.3E+01	4.7E+04	Cabbage sample	2014	⁹⁸
	Fluorescence	2.4E+03	NR	NR	Tangerine peels	2015	⁹⁹
	Fluorescence	2.3E+02	7.0E+02	1.0E+04	Apple peels	2016	¹⁰⁰
	Colorimetric	1.0E+02	1.0E+02	1.0E+04	Soil samples	2016	¹⁰¹
	Fluorescence	4.1E-02	1.0E-01	1.7E+01	River water, cabbage samples	2017	¹⁰²
	Fluorescence	2.9E-05	1.0E-04	1.0E+03	River water, cabbage samples	2017	¹⁰²
Carbofuran*	ECL	8.8E-04	2.0E-02	8.0E+00	Fruit and vegetable samples	2016	¹⁰³
Acetamiprid	Electrochemical	1.0E+00	5.0E+00	6.0E+02	Wastewater, tomato samples	2013	¹⁰⁴
	Colorimetric	5.0E+00	7.5E+01	7.5E+03	Soil samples	2013	¹⁰⁵
	Colorimetric	4.5E+02	4.5E+02	4.5E+04	NR	2014	¹⁰⁶
	Colorimetric	4.0E+01	1.0E+02	1.0E+04	Wastewater	2015	¹⁰⁷
	Electrochemical	3.3E-04	1.0E-04	5.0E+00	Wastewater, vegetable samples	2015	¹⁰⁸
	PEC	1.8E-01	5.0E-01	8.0E+02	Cucumber samples	2016	¹⁰⁹
	Fluorescence	7.3E+00	5.0E+01	1.0E+03	Vegetable samples	2016	¹¹⁰
	Fluorescence	7.0E-01	7.0E-01	1.5E+02	River water, cabbage samples	2016	¹¹¹
	Fluorescence	3.2E+00	5.0E+01	1.0E+03	Tea samples	2016	¹¹²
	Chemiluminescence	6.2E-02	8.0E-01	6.3E+02	Wastewater, Soil, cucumber	2016	¹¹³
BPA	Colorimetric	2.0E-01	4.0E-02	4.4E+02	Tap water, lake water	2013	¹¹⁴
	Colorimetric	4.0E-01	4.0E+00	4.0E+04	NR	2013	¹¹⁵
	Fluorescence	4.0E-05	4.0E-04	4.0E+01	Urine, water samples	2013	¹¹⁵
	Electrochemical	1.0E-03	4.0E-04	4.0E+00	Drinking water	2013	¹¹⁶
	PEC	1.8E-02	1.8E-02	3.2E+00	Bottled water, livixium of plastic bottles & plastic wraps	2013	¹¹⁷
	Electrochemical	5.0E+00	1.0E+01	1.0E+04	Milk	2014	¹¹⁸

	SERS	3.0E+00	3.0E+00	3.0E+02	NR	2014	¹¹⁹
	Optical	3.5E-02	9.0E-02	2.2E+01	Tap water	2014	¹²⁰
	Electrochemical	1.0E-06	1.0E-06	1.0E-02	NR	2014	¹²¹
	Fluorescence	1.9E+00	2.0E+00	1.0E+02	Wastewater	2014	¹²²
	Fluorescence	2.2E-01	4.4E-01	4.4E+01	Tap water, river water	2015	¹²³
	SERS	1.0E-05	1.0E-05	1.0E+02	Tap water	2015	¹²⁴
	Electrochemical	5.6E-02	1.0E-01	1.0E+02	Human serum	2015	¹²⁵
	ECL	2.2E-01	4.4E-01	2.2E+03	NR	2015	¹²⁶
	Colorimetric	5.0E-01	1.5E+02	6.1E+02	Tap water	2015	¹²⁷
	Electrochemical	8.0E-02	1.0E-01	1.0E+02	NR	2015	¹²⁸
	Fluorescence	7.0E-01	2.2E+00	4.4E+02	Bottled water	2015	¹²⁹
	Electrochemical	6.0E-08	1.0E-07	1.0E-03	River water	2016	¹³⁰
	Electrochemical	1.0E-06	1.0E-06	1.0E-02	plastic bottle, printing paper	2016	¹³¹
	Colorimetric	1.5E+00	1.5E+00	5.0E+02	Tap water, river water	2016	¹³²
	Fluorescence	8.0E+00	4.4E+01	3.5E+02	Tap water	2016	¹³³
	Fluorescence	5.0E-06	1.0E-05	1.0E+01	Tap, lake, river water	2016	¹³⁴
	ECL	1.6E-01	2.0E-01	4.4E+02	Bottled water	2016	¹³⁵
	SPR	1.6E-02	4.4E-02	2.2E+02	Bottled water	2016	¹³⁶
	Electrochemical	1.0E-02	1.0E-02	1.0E+03	NR	2016	¹³⁷
	Electrochemical	1.0E-06	1.0E-06	1.0E-02	Serum	2017	¹³⁸
	Electrochemical	5.0E-02	1.0E-01	1.0E+01	Bottled water, milk, juice	2017	¹³⁹
	Fluorescence	7.0E-04	4.0E-03	4.4E+01	NR	2017	¹⁴⁰
	Fluorescence	2.0E+00	2.0E+00	2.0E+01	River water	2017	¹⁴¹
	Colorimetric	6.6E+00	1.9E+01	2.9E+02	Plastic bottle extract	2017	¹⁴²
	Electrochemical	3.5E-05	1.0E-04	1.0E-03	Plastic bottle extract	2017	¹⁴³
Phorate	SERS	4.0E+02	4.0E+02	3.8E+03	Apple juice	2014	⁹⁷
	Fluorescence	1.9E+01	1.9E+01	3.8E+04	Cabbage sample	2014	⁹⁸
	Fluorescence	3.8E+02	NR	NR	Tangerine peels	2015	⁹⁹
	Fluorescence	2.0E+02	6.0E+02	1.0E+04	Apple peels	2016	¹⁰⁰
	Colorimetric	1.0E-02	1.0E-02	1.3E+03	Apple sample	2016	¹⁴⁴
Adenosine	Colorimetric	3.0E+05	3.0E+05	2.0E+06	NR	2006	¹⁴⁵
	Fluorescence	5.0E+03	5.0E+03	1.0E+06	NR	2013	¹⁴⁶
	Fluorescence	9.1E+03	9.1E+03	1.0E+05	NR	2017	¹⁴⁷
	Fluorescence	2.0E-01	3.0E-01	1.7E+02	Urine	2017	¹⁴⁸
	Fluorescence	4.2E+04	4.2E+04	1.1E+06	Serum	2017	¹⁴⁹
Estradiol	Electrochemical	1.0E-01	1.0E-02	1.0E+00	NR	2007	¹⁵
	Optical	2.1E+00	5.0E+00	8.0E+01	Wastewater	2012	¹⁵⁰
	Electrochemical	2.0E-03	1.0E-02	1.0E+01	Human urine	2012	¹⁵¹
	PEC	3.3E-05	5.0E-05	1.5E-02	Lake water, wastewater	2014	¹⁵²
	Colorimetric	4.0E-01	4.0E-01	4.0E+05	NR	2014	¹⁵³

	Fluorescence	2.2E-01	8.2E-01	2.1E+01	Bottled water, Wastewater	2014	¹⁵⁴
	Electrochemical	5.0E-06	1.0E-05	1.0E+00	Rivulet water	2014	¹⁵⁵
	Optical	5.0E+00	5.0E+00	1.0E+02	NR	2014	⁴⁸
	Electrochemical	7.0E-04	1.0E-03	1.0E+00	Urine	2015	¹⁵⁶
	Colorimetric	1.0E-01	1.0E-01	1.0E+04	Synthetic saliva	2015	¹⁵⁷
	Electrochemical	8.0E-04	5.0E-03	6.0E-01	Wastewater	2015	¹⁵⁸
	Colorimetric	1.0E-06	1.0E-06	1.0E+01	Tap, lake, river water	2015	¹⁵⁹
	Colorimetric	1.1E+01	3.6E+01	3.3E+02	Tap water	2015	¹⁶⁰
	Electrochemical	1.0E-06	1.0E-06	1.0E+01	NR	2015	¹⁶¹
	Colorimetric	2.0E-01	2.0E-01	8.0E-01	NR	2015	¹⁶²
	Electrochemical	5.0E+01	5.0E+01	1.6E+03	NR	2015	¹⁶³
	Electrochemical	1.0E-06	1.0E-06	1.0E+03	Urine	2015	¹⁶⁴
	Fluorescence	7.0E-05	1.0E-04	1.0E+00	NR	2016	¹⁶⁵
	Colorimetric	1.6E+00	1.6E+00	3.5E+02	Water	2016	¹⁶⁶
	Fluorescence	3.7E+01	8.0E+01	4.0E+02	Fetal Bovine Serum	2016	¹⁶⁷
	Fluorescence	4.8E-01	4.8E-01	2.0E+02	Water	2017	¹⁶⁸
Isocarbophos	SERS	3.4E+03	NR	NR	Apple juice	2014	⁹⁷
	Fluorescence	1.7E+01	1.7E+01	3.5E+04	Cabbage sample	2014	⁹⁸
	Fluorescence	3.5E+01	3.5E+02	3.5E+04	Tangerine peels	2015	⁹⁹
	Fluorescence	1.7E+02	5.0E+02	1.0E+04	Apple peels	2016	¹⁰⁰
PCB72*	Electrochemical	1.0E-03	3.0E-03	3.4E+02	Fish samples	2015	¹⁶⁹
	Electrochemical	1.3E+00	1.3E+00	3.4E+02	Fish samples	2016	¹⁷⁰
PCB 77*	Fluorescence	1.7E+00	1.7E+00	3.4E+02	NR	2012	³⁵
	SERS	1.0E+03	1.0E+03	1.0E+06	NR	2014	¹⁷¹
	SERS	1.0E+01	1.0E+01	1.0E+05	NR	2015	¹⁷²
	SERS	3.3E+01	3.3E+01	1.0E+03	NR	2016	¹⁷³
	Electrochemical	3.4E-02	7.0E-01	6.9E+02	Tap water	2016	¹⁷⁴
Diclofenac	Electrochemical	2.7E+02	2.7E+02	5.0E+03	Blood, serum	2012	¹⁷⁵
	Electrochemical	2.7E+00	1.0E+01	2.0E+02	Urine	2016	¹⁷⁶
Codeine	Electrochemical	3.0E-03	1.0E-02	1.0E+02	NR	2013	³⁹
	Electrochemical	3.0E-04	1.0E-03	1.0E+02	NR	2016	¹⁷⁷
Cocaine	Fluorescence	1.0E+04	1.0E+04	2.5E+06	Serum	2001	¹⁷⁸
	Colorimetric	5.0E+04	5.0E+04	5.0E+05	NR	2006	¹⁴⁵
	Electrochemical	1.0E+04	1.0E+04	5.0E+05	Fetal calf serum, human saliva	2006	¹⁷⁹
	Colorimetric	2.0E+03	2.0E+04	2.0E+05	NR	2008	¹⁸⁰
	Electrochemical	1.0E+03	1.0E+03	1.0E+07	Blood, cellular lysate	2009	¹⁸¹
	Fluorescence	5.6E+01	1.0E+02	1.0E+04	Saliva, serum, urine	2016	¹⁸²
	Fluorescence	5.0E+01	5.0E+01	1.0E+04	Saliva	2017	¹⁸³
	Electrochemical	5.0E+01	5.0E+01	1.0E+05	Saliva, serum	2017	¹⁸⁴
	Fluorescence	5.0E+03	5.0E+03	5.0E+06	Serum, urine	2017	¹⁸⁵

	Electrochemical	1.0E-03	3.0E-03	3.3E+00	Human serum, urine, saliva	2017	¹⁸⁶
Sulfadimethoxine	Fluorescence	3.2E+01	3.2E+01	1.6E+03	Milk	2012	³⁷
	Colorimetric	1.6E+02	1.6E+02	3.2E+03	NR	2013	¹⁸⁷
	Colorimetric	1.6E+03	NR	NR	NR	2014	¹⁸⁸
	PEC	5.5E-01	1.0E+00	1.0E+02	Milk	2016	¹⁸⁹
	Colorimetric	2.2E+00	3.2E+00	1.6E+03	Lake water	2017	¹⁹⁰
	Colorimetric	3.2E+01	3.2E+01	3.2E+06	Milk	2017	¹⁹¹
Progesterone	Electrochemical	2.9E+00	3.2E+01	1.9E+02	Tap water	2014	⁵⁹
	Colorimetric	2.6E+00	2.6E+00	8.0E+02	Tap water, urine	2016	¹⁹²
	Colorimetric	8.9E-01	8.9E-01	5.0E+02	Human serum, urine	2016	¹⁹³
	Fluorescence	5.0E+00	3.2E+01	3.2E+02	Tap water, artificial urine	2017	⁸⁰
Ciprofloxacin	Colorimetric	1.2E+00	4.0E+00	5.0E+02	Water, serum, milk	2017	¹⁹⁴
	Electrochemical	2.6E-01	8.0E-01	4.0E+02	Water, serum, milk	2017	¹⁹⁵
Ampicillin	Fluorescence	1.4E+00	1.4E+00	1.4E+02	Milk	2012	³¹
	Electrochemical	1.0E-01	1.0E-01	1.0E+03	Milk	2013	¹⁹⁶
	Electrochemical	1.1E-03	5.0E-03	1.0E+01	Milk	2015	¹⁹⁷
	Electrochemical	4.0E-03	2.0E-02	4.0E+01	Milk	2016	¹⁹⁸
Chlorpyrifos*	Electrochemical	9.4E-01	2.8E+00	2.9E+05	Vegetable samples	2016	¹⁹⁹
Profenofos	SERS	1.4E+04	NR	NR	Apple juice	2014	⁹⁷
	Fluorescence	1.3E+01	1.3E+01	2.7E+04	Cabbage sample	2014	⁹⁸
	Fluorescence	1.3E+02	2.7E+02	2.7E+04	Tangerine peels	2015	⁹⁹
	Fluorescence	1.0E+02	3.0E+02	1.0E+04	Apple peels	2016	¹⁰⁰
DEHP*	Electrochemical	1.0E-02	1.0E-02	1.0E+02	NR	2017	⁷⁸
OTA	Colorimetric	2.0E+01	2.0E+01	6.3E+02	NR	2011	²⁰⁰
	Fluorescence	1.9E+03	2.0E+03	3.5E+04	NR	2011	²⁰¹
	Fluorescence	2.2E+01	5.0E+01	5.0E+02	1% red wine	2011	²⁰¹
	Electrochemical	2.0E-01	2.0E+00	2.2E+01	Wheat extracts	2011	²⁰²
	Fluorescence	5.0E-02	1.0E-01	2.5E+02	Maize samples	2012	²⁰³
	Fluorescence	2.5E+00	2.5E+00	2.5E+03	Red wine	2017	²⁰⁴
	Fluorescence	1.7E+01	2.0E+01	5.0E+02	Red wine, beer	2017	²⁰⁵
	Luminescence	2.0E-03	2.0E-03	6.2E+02	Beer	2017	²⁰⁶
	Fluorescence	3.6E+00	3.6E+00	5.0E+03	White wine	2017	²⁰⁷
	Fluorescence	1.0E-05	2.0E-04	2.0E-01	Cereal samples	2017	²⁰⁸
Lincomycin	ECL	1.6E-04	5.0E-03	1.0E+00	Meat samples	2017	²⁰⁹
Tetracycline	Electrochemical	1.0E+01	1.0E+01	1.0E+04	NR	2009	²¹⁰
	Electrochemical	5.0E+00	1.0E+01	5.0E+04	Milk	2012	²¹¹
	Colorimetric	3.3E+01	2.0E+02	1.0E+05	Milk	2012	²¹²
	Colorimetric	1.2E+02	1.2E+02	5.0E+03	Milk	2013	²¹³
	Colorimetric	4.6E+01	4.6E+01	4.0E+02	Milk	2013	²¹⁴
	Colorimetric	1.8E-02	2.0E-02	2.3E+02	Honey	2014	²¹⁵

	Colorimetric	1.0E-01	1.0E-01	1.0E+00	NR	2014	²¹⁶
	Fluorescence	1.2E+01	1.2E+01	1.3E+02	Milk	2014	²¹⁷
	Electrochemical	3.2E-01	1.0E+00	1.0E+04	Milk	2014	²¹⁸
	Electrochemical	5.6E-03	1.0E-01	1.0E+06	Milk	2014	²¹⁹
	Colorimetric	8.8E+01	4.5E+02	4.5E+03	Milk	2015	²²⁰
	Colorimetric	2.0E-01	2.0E-01	2.3E+03	Honey	2015	²²¹
	Electrochemical	4.2E-03	1.0E-01	1.0E+06	Milk	2015	²²²
	Fluorescence	2.1E+00	2.1E+00	3.0E+02	Rat serum, tap water	2015	²²³
	Electrochemical	4.5E-01	1.5E+00	3.5E+03	Milk, serum	2016	²²⁴
	Electrochemical	3.8E-06	1.0E-05	1.0E+03	Serum, milk, honey	2016	²²⁵
	Electrochemical	6.0E-01	1.0E+00	5.0E+03	NR	2016	²²⁶
	Electrochemical	2.0E+01	1.0E+02	2.0E+03	Milk	2016	²²⁷
	Chemiluminescence	4.0E-02	1.0E-01	1.1E+01	Milk	2016	²²⁸
	Fluorescence	1.0E-02	2.0E-02	2.3E+02	Milk, homogenized pork	2017	²²⁹
	SPR	5.0E-09	5.0E-09	2.0E-07	River water	2017	²³⁰
Oxytetracycline	Electrochemical	1.0E+00	1.0E+00	1.0E+02	NR	2009	²³¹
	Colorimetric	2.5E+01	2.5E+01	1.0E+03	NR	2010	²³²
	Optical	2.2E+02	2.2E+02	2.2E+04	NR	2010	²³³
	Cantilever	2.0E-01	1.0E+00	1.0E+02	NR	2013	²³⁴
	Fluorescence	1.0E+01	1.0E+02	2.0E+03	Lake water	2013	²³⁵
	Electrochemical	2.1E+01	2.2E+01	1.3E+03	Mouse blood serum, urine	2013	²³⁶
	Colorimetric	2.0E+01	2.0E+01	2.2E+03	Milk	2014	⁵⁸
	PEC	9.0E-01	4.0E+00	1.5E+02	NR	2015	²³⁷
	Fluorescence	1.8E+00	2.2E+00	1.1E+02	Milk, honey, pork	2015	²³⁸
	Luminescence	8.0E-02	1.0E-01	2.2E+02	Milk	2015	²³⁹
	Fluorescence	1.0E+01	1.0E+01	2.0E+02	Tap water, milk	2015	²⁴⁰
	Colorimetric	1.9E+00	1.9E+00	2.2E+02	Milk, honey, chicken	2015	²⁴¹
	Luminescence	1.0E-01	2.0E-01	2.2E+01	Milk	2015	²⁴²
	Colorimetric	1.0E+00	1.0E+00	1.0E+03	Tap water	2015	²⁴³
	Fluorescence	5.4E+01	5.4E+01	2.2E+03	Tap, river water	2016	²⁴⁴
	Electrochemical	1.8E-04	5.0E-04	5.0E+01	Milk	2016	²⁴⁵
	Fluorescence	1.0E-01	5.0E-01	1.0E+02	Tap water, honey	2016	²⁴⁶
	Chemiluminescence	4.0E-02	1.0E-01	1.1E+01	Milk	2016	²²⁸
	Colorimetric	4.9E+02	4.3E+03	6.1E+04	Milk	2016	²⁴⁷
	Electrochemical	2.0E-04	1.0E-03	1.1E+02	Milk	2016	²⁴⁸
	Electrochemical	1.0E-03	1.0E-03	4.3E+03	Honey	2016	²⁴⁹
	PEC	1.9E-01	2.0E+00	3.0E+02	Tap, lake water, milk, chicken	2017	²⁵⁰
	Fluorescence	1.7E+00	1.7E+00	2.5E+02	Milk	2017	²⁵¹
	SERS	9.0E-09	1.0E-07	1.0E-03	Fishmeal	2017	²⁵²
Kanamycin	Colorimetric	2.5E+01	2.5E+01	8.0E+01	NR	2011	²⁸

	Electrochemical	9.4E+00	5.0E+01	9.0E+03	Milk	2012	²⁵³
	PEC	2.0E-01	1.0E+00	2.3E+02	NR	2014	²⁵⁴
	Fluorescence	9.0E-03	1.0E-02	3.0E+00	Human serum	2014	²⁵⁵
	Electrochemical	5.8E+00	1.0E+01	1.0E+02	Milk	2014	²⁵⁶
	Optical	1.0E+00	1.0E+01	6.0E+02	Milk	2017	²⁵⁷
	Colorimetric	1.0E-01	1.0E-01	1.0E+02	Milk, meat samples	2017	²⁵⁸
	Electrochemical	2.0E-01	2.5E+00	1.6E+02	Milk	2017	²⁵⁹
	Electrochemical	1.6E-04	2.0E-03	1.0E+02	Milk	2017	²⁶⁰
	Fluorescence	1.0E-03	1.0E-03	2.0E-02	Milk, blood serum	2017	²⁶¹
Adenosine Triphosphate	Electrochemical	1.0E+01	1.0E+01	1.0E+06	Cell lysate	2007	²⁶²
	Colorimetric	6.0E+02	4.4E+03	1.3E+05	NR	2007	²⁶³
	Electrochemical	1.0E+03	1.0E+03	4.0E+06	Cell lysate	2009	¹⁸¹
	Fluorescence	7.8E+04	7.8E+04	1.1E+06	Serum	2017	¹⁴⁹
	qPCR	1.7E+01	5.0E+01	5.0E+06	NR	2017	²⁶⁴
Streptomycin	Colorimetric	2.0E+02	2.0E+02	1.2E+03	Honey	2013	⁴⁴
	Electrochemical	1.1E+01	3.0E+01	1.5E+03	Milk, rat serum	2016	²⁶⁵
	Colorimetric	7.3E+01	7.3E+01	2.0E+03	Milk, serum	2016	²⁶⁶
	Fluorescence	4.8E+01	4.8E+01	2.0E+03	Milk, serum	2016	²⁶⁶
	Fluorescence	5.5E+01	5.5E+01	1.1E+03	Milk, blood serum	2016	²⁶⁷
Fumonisin B1	Fluorescence	1.4E-01	1.4E-01	6.9E+02	Maize samples	2012	²⁰³
	Fluorescence	1.4E-02	1.4E-02	1.4E+02	Maize samples	2013	²⁶⁸
	ECL	4.0E-01	7.0E-01	6.9E+02	Wheat samples	2014	²⁶⁹
	Electrochemical	1.4E-03	1.4E-03	1.4E+03	Wheat samples	2015	²⁷⁰
	Cantilever	4.6E+01	1.4E+02	5.5E+04	NR	2015	²⁷¹
Digoxin	Fluorescence	6.0E-01	6.0E-01	6.0E+01	Rat serum	2015	²⁷²
	Electrochemical	1.3E-02	2.5E-02	2.5E-01	Urine, plasma	2015	²⁷³
	Fluorescence	3.9E-01	3.9E-01	3.0E+01	Serum	2015	²⁷⁴
	Colorimetric	5.7E-01	5.7E-01	3.0E+01	Serum	2015	²⁷⁴
	Electrochemical	3.0E-04	1.0E-03	1.0E+02	Serum	2016	²⁷⁵

Table S5. Limits of detection for the most sensitive aptasensors, commercial ELISA kits, lab-based ELISAs and immunosensors developed in lab for environmentally relevant compound detection. Compounds with the * sign are regulated in accordance with the Safe Drinking Water Act.

Target	Aptasensor	Ref	Comm ELISA	Ref	Lab ELISA	Ref	Immunosensor	Ref
Carbofuran*	8.80E-04	¹⁰³	2.20E+00	²⁷⁶	4.50E-02	²⁷⁷	4.50E-02	²⁷⁸
PCBs*	1.00E-03	¹⁶⁹	7.70E-01	²⁷⁹	2.70E-01	²⁸⁰	3.10E-04	²⁸¹
Chlorpyrifos*	9.40E-01	¹⁹⁹	2.80E-01	²⁸²	2.80E-01	²⁸³	1.80E-02	²⁸⁴
BPA	6.00E-08	¹³⁰	4.00E-02	²⁸⁵	1.30E-01	²⁸⁶	5.00E-06	²⁸⁷
E2	1.00E-06	^{159, 161, 164}	3.10E-04	²⁸⁸	2.30E-02	²⁸⁹	5.50E-05	²⁹⁰
SDM	5.50E-01	¹⁸⁹	3.20E+00	²⁹¹	1.60E-02	²⁹²	NR	-
Progesterone	8.90E-01	¹⁹³	1.70E-02	²⁹³	6.00E-02	²⁹⁴	2.00E-04	²⁹⁵
Ciprofloxacin	2.60E-01	¹⁹⁵	2.10E+00	²⁹⁶	9.00E-02	²⁹⁷	3.00E-02	²⁹⁸
Lincomycin	1.60E-04	²⁰⁹	4.90E-01	²⁹⁹	3.70E-01	³⁰⁰	NR	-
TET	5.00E-09	²³⁰	1.10E-01	³⁰¹	1.00E-01	³⁰²	1.40E-02	³⁰³
OTC	9.00E-09	²⁵²	3.20E+00	³⁰⁴	2.80E-01	³⁰⁵	NR	-

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