

Supporting information

A Comprehensive Review of Competitive Lateral Flow Assays Over the Past Decade

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S1. Law of mass action assumptions when modelling binding assays

The Law of Mass action does provide a useful framework for bridging the theoretical understanding of thermodynamic principles and immunoassay techniques¹. To that establish this connection, few assumptions must be made:

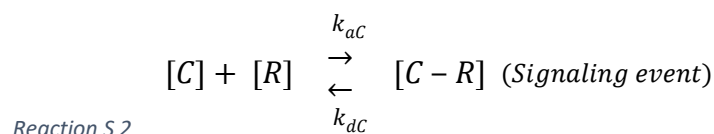
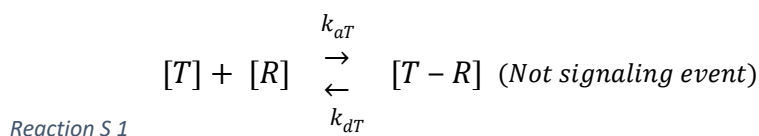
- Homogeneous distribution: The antigen and the antibody are uniformly distributed and consists of a single molecular species.
- Single epitope: The antigen just possesses one epitope for binding.
- Single binding site: The antibody has a single binding site that recognizes one epitope of the antigen with a consistent affinity.
- Independent Binding: Binding is an independent process without any allosteric effects.
- Equilibrium Reaction: The reaction is assumed to be at equilibrium.
- Complete Separation: The separation of bound from free antigen must be complete.
- Non-specific Binding: There is non-specific binding taking place.

Since it is impossible to find an existing system that meets all the assumptions, discrepancies might arise between the theoretical prediction and the actual empirical data from experiments.

S2. Development of the analytical solution for competitive assays

To build the panel B to D in Figure 4 in the main text we adapted the analytical model previously described and published by D.V. Sotnikov and co-workers.²

To list and label the components relevant in the competition assay we first plot the reactions as they were described in the main text:



Where [T] is the free target concentration, [R] is the free receptor concentration, [T-R] target-receptor complex concentration, k_{aT} kinetic association constant, k_{dT} kinetic dissociation constant, [C] is the free competitor concentration (labelled synthetic target), [C-R] is the concentration of the complex receptor (R) and competitor (C), k_{aC} kinetic association constant for C and R, k_{dC} kinetic dissociation constant for C and R.

Previous reactions can be summarized as in the main text in reaction 2.

The equilibrium situation can be modelled applying the law of mass action and express the system in terms of differential equations:

$$\text{Equation S 1} \quad \frac{\partial [T-R]}{\partial t} = \frac{-\partial [T]}{\partial t} = k_{aT}[T][R] - k_{dT}[T-R]$$

¹ Davies C. Chapter 2.1 - Principles of Competitive and Immunometric Assays (Including ELISA)1. In: Wild D, editor. The Immunoassay Handbook (Fourth Edition). Oxford: Elsevier; 2013. p. 29–59.

² Sotnikov D V, Zherdev A V, Dzantiev BB. Mathematical modeling of bioassays. Biochemistry (Moscow). 2017 Dec;82(13):1744–66.

$$\text{Equation S 2} \quad \frac{\partial[C-R]}{\partial t} = \frac{-\partial[C]}{\partial t} = k_{ac}[C][R] - k_{dc}[C-R]$$

$$\text{Equation S 3} \quad \frac{\partial[R]}{\partial t} = \frac{-\partial[C]}{\partial t} + \frac{-\partial[T]}{\partial t}$$

Which in turn, accounting for the law of mass conservation:

$$\text{Equation S 4} \quad [T]_0 = [T] + [T-R]$$

$$\text{Equation S 5} \quad [C]_0 = [C] + [C-R]$$

$$\text{Equation S 6} \quad [R]_0 = [R] + [T-R] + [C-R]$$

Where $[T]_0$ is the target initial concentration, $[T]$ is the free target concentration, $[T-R]$ target-receptor complex concentration, $[C]_0$ is the competitor initial concentration, $[C]$ is the free competitor concentration, $[C-R]$ labelled target-receptor complex concentration, $[R]_0$ is the initial receptor concentration, $[R]$ is the free receptor concentration.

$$\text{Equation S 7} \quad 0 = k_{aT}[T][R] - k_{dT}[T-R]$$

$$\text{Equation S 8} \quad 0 = k_{aC}[C][R] - k_{dC}[C-R]$$

The same situation described by Equation S 2 and Equation S 3 can be expressed in term of the equilibrium association constants:

$$\text{Equation S 9} \quad \frac{[T-R]}{[R]} = \frac{k_{aT}}{k_{dT}}[R] = K_{aT}[R]$$

Where K_{aT} is the global equilibrium association constant for the R and T reaction, as described in Equation 1 in the main text.

$$\text{Equation S 10} \quad \frac{[C-R]}{[C]} = \frac{k_{aC}}{k_{dC}}[R] = K_{aC}[R]$$

Where K_{aC} is the global equilibrium association constant for the R and C reaction.

Accounting for different affinities of R towards the C and T, Equation S 4 to 10 can be rearranged into:

$$\text{Equation S 11} \quad [R]^3 + a[R]^2 + b[R] + c = 0$$

Where:

$$\text{Equation S 12} \quad a = K_{dT} + K_{dC} + [T]_0 + [C]_0 - [R]_0$$

$$\text{Equation S 13} \quad b = K_{dC}([T]_0 - [R]_0) + K_{dT}([C]_0 - [R]_0) + K_{dT}K_{dC}$$

Equation S 14 $c = -K_{dT}K_{dC} [R]_0$

Using trigonometric formulas, Sotnikov and co-workers described possible solutions as:

Equation S 15
$$[R] = -\frac{a}{3} + \frac{2}{3}\sqrt{(a^3 - 3b)} \cos \frac{\theta}{3}$$

Equation S 16
$$\theta = \cos^{-1} \left(\frac{-2a^3 + 9ab - 27c}{2\sqrt{(a^3 - 3b)^3}} \right)$$

At this point it is possible to write the formula to estimate [C-R] which is the most interesting for model results:

Equation S 17
$$[C - R] = \frac{[C]_0 \left(2\sqrt{(a^3 - 3b)} \cos \frac{\theta}{3} - a \right)}{3K_{dC} + (2\sqrt{(a^3 - 3b)} \cos \frac{\theta}{3} - a)}$$

S3. Analytical solution for lateral flow competitive assays

Sotnikov and co-workers came up with an elegant way to obtain an analytical expression to model competitive lateral flow assays,³ Upgrading the initial model proposed by Qian and Bau.⁴

In the upgraded model proposed few approximations and assumptions were made:

- There are two separate reaction areas in the system: the area prior to the detection zone and the detection zone itself. The migration of substances in the fluid is uniform and steady along the entire front.
- The assay comprises two parts: First, the analyte in the sample interacts with labelled antibodies, before the sample front reaches the analytical zone. Second, the target-labelled antibody complexes interact in the test line.
- Reagents are uniformly distributed in the reaction volume.
- The reaction of the antibody is irreversible, and present same affinity for the target.
- Kinetics of complex formation processes are not limited by reagent's diffusion.
- Movement rates of all reagents along flow migration are assumed to be the same.

To build Figure 3 in the main text, we adopted the expression proposed by Sotnikov et al.³ to estimate [C-R], which is the ultimate parameter associated to the assay's signal:

Equation S 18
$$[C - R] = [R]_0 \left(1 - \left(\frac{[T]_0 - [C]_0 e^{B([C]_0 - [T]_0)}}{[T]_0 - [C]_0 e^{bk_{aT}([C]_0 - [T]_0)}} \right)^{\frac{k_{aC}}{k_{aT}}} \right)$$

³ Sotnikov D V., Byzova NA, Zvereva EA, Bartosh A V., Zherdev A V., Dzantiev BB. Mathematical modeling of immunochromatographic test systems in a competitive format: Analytical and numerical approaches. Biochem Eng J. 2020 Dec 15;164:107763.

⁴ Qian S, Bau HH. Analysis of lateral flow biodetectors: competitive format. Anal. Biochem. 2004 Mar 15;326(2):211–24.

Where $[C-R]$ is the competitor and receptor complex, $[R]_0$ is the initial receptor concentration, $[T]_0$ is the initial target concentration, $[C]_0$ is the initial immobilized target concentration, B is the migration time of the reaction mix from sample addition until the mix reached the detection line, b is the total duration of the assay starting from the sample's contacting the labelled target.

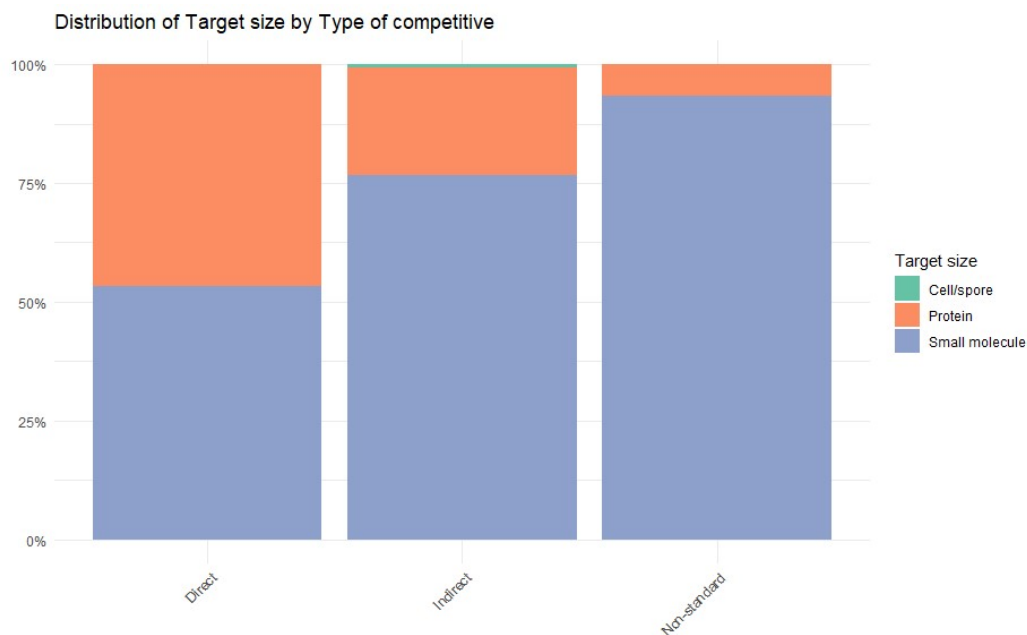
S4. FIGURE: Distribution of target size by type of competitive

Figure S 1: The figure illustrates the distribution of different target sizes across three competitive assay types: direct, indirect, and non-standard competitive assays. The target size categories include small molecules (< 1 kDa), proteins (10-200 kDa), and cells/spores (> 200 KDa).

S5. FIGURE: Sample type and pretreatment.

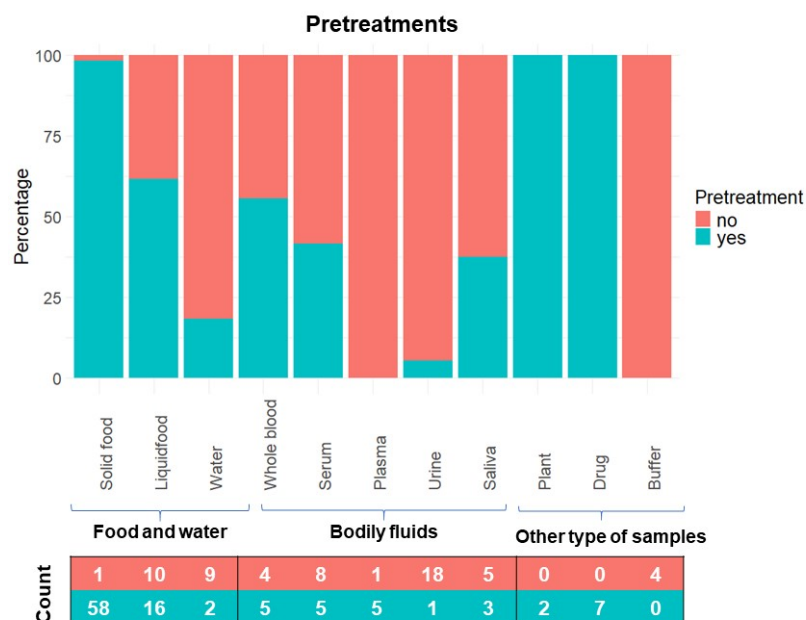


Figure S 2: The figure provides a detailed overview of the sample type used in different articles also reflecting the need of pretreatment. From the study we conclude that pretreated solid food is the most commonly analyzed sample followed by pretreated milk. Drugs, feed, food, soil and plants always require a pretreatment, in contrast with plasma, and buffer which do not require pretreatment. (n=158).

S6. FIGURE: Capture bioreceptor concentration and additional proteins

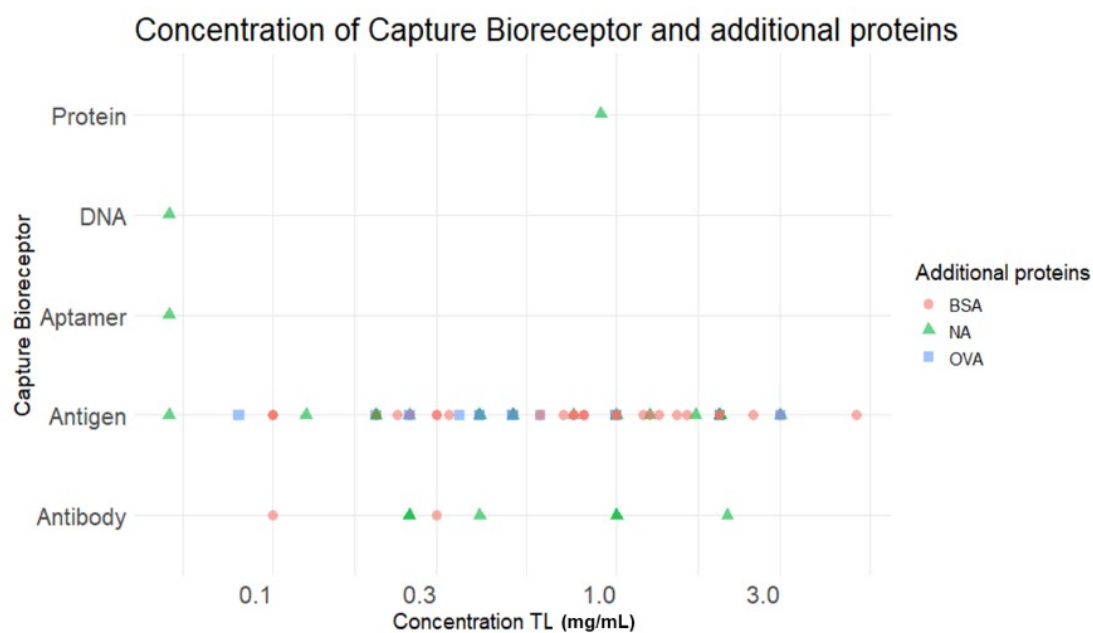


Figure S 3: This figure represents the concentration of different capture bioreceptors (antibody, antigen, aptamer, protein and DNA) and their corresponding concentration on the TL (mg/mL). Each point symbolizes a unique measurement and is color-coded to indicate the addition of auxiliary proteins: BSA or OVA. (n = 156).

S7. FIGURE: Capture bioreceptor concentration and additional proteins TABLE:

Table S1: Compendium of all articles reviewed. Each work has been analyzed for 19 different parameters. Specifically: **Format (F):** Direct (D), Indirect (I), Dual competitive (T), Aptamer based (A), Restrictive (R), Competition previous to the test (B); **Detection Bioreceptor (DB):** Antibody (Ab), polyclonal antibody (pAb), Monoclonal Antibody (mAb), aptamer (Apt), DNA sequence (DNA), Antibody's variable region (Fab), Protein (Prot), Hormone (Horm); **Concentration of DB ([DB]):**; **Nanoparticle used (NP):** silver nanoparticles (AgNPs), Gold Nanoparticles (AuNPs), Quantum Dots (QD), Gold nano flowers (AuNFs), Gold Nano Cages (GNC), Up Converting NP (UCNP), Prussian Blue Nanocages (PBNCs), Platinum nanoflowers (PtNFs), Europium nanoparticles (EuNPs); **Readout (R):** Optical (O), Luminescent (L), Magnetic (M), Electrochemical (E); **NP size, Capture Bioreceptor (CB):** Antigen (Ag), Aptamer (Apt), Streptavidin (Strep), Antibody (Ab), Protein (Prot); **Test line concentration (TL); Percentage of BSA or OVA used ([B/O]); Blocking agent (BSA/OVA):** Bovine serum albumin (BSA), ovalbumin (OVA); **Pretreatment (Pretr.):**; **Sample type:** Liquid Food (Liquid F), Solid Food (solid F), Whole Blood (WB); **Target (T); T type:** Protein (P), Drug (D), Toxin (T), Other molecules (OM), Pesticide (Ps), Nucleic acid (NAc), Metal Ion (MI), Hormone (H), Microorganism (Mo); **T molecular weight (TMW); Membrane capillary flow time (CFT); Limit of Detection (LoD); Application (Appl.); multiplexed test (MPL X); Dissociation constant (Kd); Reference (Ref):** number referring the entries in the main text.

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F	DB	[DB] ug/ml	NP	R	NP size nm	CB	[TL] mg/ml	[B/O] %	BSA/OVA	Pretr	Sample type	T	T type	T MW g/mol	CFT	LoD ng/ml	Appl.	Mplx	Kd	Ref
I	Ab	20	AgNPs	O	48	Ag	0.0015	2	BSA	yes	Liquid F	SpA	P	56000			Food security	no		104
I	Ab		Fluorescent NP	L	100	Ag		0.03	BSA	no	Saliva	SARS-CoV2 ag	P	55000	120	0.77	Healthcare diagnostics	no		69
I	mAb	1000	AuNPs	O	102.16	Ag			BSA	yes	Solid F	RAC	D	285.38		0.08	Food security	no		60
I	mAb	7	AuNPs	O	25	Ag	1	2	BSA	yes	Solid F	AFB1	T	312.3	135	1	Veterinary / Food security	yes		88
I	mAb	3.5	AuNPs	O	25	Ag	1	2	BSA	yes	Solid F	ZEN	T	318.8	135	5	Veterinary / Food security	-		88
I	mAb	20	Carbon NP	O	247	Ag	0.2		BSA	yes	Solid F	AFB1	T	312.3	140	0.05	Food security	no		70
I	mAb	1.5	AuNPs	O		Ag	0.2		NA	yes	Serum	EPS bmk	OM		95	500	Healthcare diagnostics	no		116
I	mAb	3	AuNPs	O		Ag			NA	no	Buffer	DENV ag	P	75000	170		Healthcare diagnostics	no		156
I	mAb	1	AuNPs	O		Ag	1		BSA	no	Water	ATX-a	T	165.18	70	4	Water security	no		157
I	mAb		Magnetic NP	L		Ag	0.5		BSA	yes	Liquid F	AFM1	T	228	250	0.0012	Food security	no		68
I	mAb	6	AuNPs	O		Ag	0.5		BSA	yes	Solid F	DA	T	311.33	95	1.4	Food security	no		158
I	mAb		AuNPs	O		Ag	0.25		BSA	yes	Solid F	DAS	T	324.33		0.1	Food security	no		94
T	mAb		AuNPs	O		Ab	1		NA	yes	Solid F	CAP	D	323.41	90	0.02	Food security	no		14
I	mAb	2000	AuNPs (silver enhmt)	O	30	Ag			BSA	no	Urine	DACT	Ps	215.7		0.01	Healthcare	no		71
A	Apt		AuNPs	O	15	Apt			NA	no	Buffer	ACE	Ps	243.27	140	0.33	Food security / Environmental monitoring	no	0.58 uM	15
I	Ab		Silica NP	O	14.1	Ag	0.5	1	BSA	yes	Solid F	ENR	D	359.4		0.00195	Food security	no		65
I	mAb		Organic dye	L		Ag			BSA	no	Liquid F	CAP	D	323.41		3	Food security	yes		150
I	mAb		Organic dye	L		Ag			BSA	no	Liquid F	STR	D	1413.51		20	Food security	-		150
I	mAb		AuNPs	O		Ag	2		OVA	yes	Solid F	CLO	Ps	290.7	135		Food security	no		95
B	DNA			O					NA	yes	Serum	HIV RNA	NAC				Drug monitoring	yes		18
I	mAb	1000	AuNPs	O	30	Ag	2		OVA	yes	Drug	N-DEAQ	D	329.43		0.25	Drug monitoring	no		143
I	mAb	1000	AuNPs	O	30	Ag	2		OVA	yes	Drug	N-DEAQ	D	329.43		0.25	Drug monitoring	yes		143
I	mAb	1000	AuNPs	O	30	Ag	0.5		BSA	yes	Drug	AS	D	288.28		0.25	Drug monitoring	-		143
I	pAb	150	Fluorescent NP	L	192.7	Ag	3		NA	no	Serum	VAN	D	1499.55	135	69.2	Drug monitoring	no		181
I	Ab	12400	Fluorescent NP	L	127	Ag	3		BSA	no	Saliva	Cannabinoids (JWH-073)	D	325.44	95	0.16	Drug abuse	no		182
A	Apt	0.25	AuNPs	O	13	Strep	248.16		NA	yes	WB	DETX	D	467.5	95	0.5	Drug monitoring	no	47 nM and 1nM	28
I	mAb	1000	AuNPs	O	30	Ag	2		BSA	yes	Drug	MQ	D	330.3		10	Pharmaceutical Quality Assurance	yes		149
I	mAb	1000	AuNPs	O	30	Ag	1		BSA	yes	Drug	AS	D	288.28		20	Pharmaceutical Quality Assurance	-		149
D	Prot	20	AuNPs	O	20	Ab	0.3		BSA	no	Buffer	TAFC	MI	883	180	3	Healthcare diagnostics	no		159
R	mAb		Fluorescent NP	L	379	Ab	1		NA	yes	WB	CD8 cells	P	32000	140		Immune Health Surveillance	no		17
I	mAb	5	AuNPs	O	15	Ag			OVA	yes	Solid F	DIM	D	413.4	135	0.1	Veterinary / Food security	no		96
I	mAb	20	AuNPs	O		Ag	0.2		OVA	no	Urine	PHTXs	T	822.95		3	Healthcare diagnostics	no		122
I	mAb	100	Fluorescent NP	L		Ag	0.4		OVA	no	Urine	PHTXs	T	822.95		0.1	Healthcare diagnostics	no		122
I	mAb	6400	GNB	O	129	Ag	1.33		BSA	yes	Solid F	FB1	T	257.26		1.76	Food security	no		66

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F	DB	[DB] ug/ml	NP	R	NP size nm	CB	[TL] mg/ml	[B/O] %	BSA/OVA	Pretr	Sample type	T	T type	T MW g/mol	CFT	LoD ng/ml	Appl.	Mplx	Kd	Ref
I	Fab	340	AuNPs	O	15	Ag		1	BSA	yes	Plant	DME	H	376.51	90	250	Pharmaceutical Quality Assurance	no		141
I	mAb		AuNPs	O	25	Ag			BSA	yes	Solid F	FIPs	Ps	437.4		0.1	Food security	no	7.6 x 10 ⁹ L/mol	147
I	mAb	250	AuNPs (silver enhmt)	O	17	Ag	0.125		NA	yes	Solid F	CHL	Ps	323.13		0.025	Food security	yes		63
I	mAb	750	AuNPs (silver enhmt)	O	17	Ag	0.25		NA	yes	Solid F	IMI	Ps	256.23		0.041	Food security	-		63
I	mAb	1250	AuNPs (silver enhmt)	O	17	Ag	0.75		NA	yes	Solid F	OXY	Ps	496.9		0.063	Food security	-		63
I	pAb		Enzyme	E		Ag	5	0.5	BSA	no	Urine	COT	D	177.24	95	189.7	Drug abuse	no		123
I	pAb	175	Carbon NP	O	170	Ag	0.4		NA	no	Liquid F	CM-CAS	P	66000	80	160	Food security	no		106
I	mAb	3	AuNPs	O	40	Ag	0.5		NA	no	Urine	mAlb	P	70000		10000	Healthcare diagnostics	no	10.41 -172 nM	124
I	mAb	200	AuNPs	O	15	Ag	0.6		OVA	yes	Solid F	PA	OM	169.19		39.22	Food security	no	6.05 x 10 ⁹	105
I	mAb	4	Silica NP	O	66	Ag	0.3		BSA	yes	Solid F	FZD	D	201.19		0.08	Veterinary / Food security	no		92
I	mAb	10	AuNPs	O	30	Ag	0.5		BSA	yes	Solid F	LCM	D	811.02	90	0.4	Food security	no		61
I	mAb	150	QD	L	20	Ag	0.2		BSA	yes	Solid F	LCM	D	811.02	90	0.2	Food security	no		61
I	mAb	10	AuNPs	O	40	Ag	0.5		BSA	yes	Solid F	LCM	D	811.02	90	0.0014	Food security	no		61
I	mAb	4	PBNCs	O	950	Ag	1		BSA	yes	Solid F	AFB1	T	312.3		0.023	Food security	no		87
I	mAb	8345	AuNPs (silver enhmnt)	O	39	Ag	2	5	OVA	yes	Solid F	BBT	D	239.3		0.00011	Veterinary / Food security	no		64
I	mAb	1000	AuNPs	O		Ag			BSA	no	Urine	TFV	D	305.24	90	1.4	Drug monitoring	no		160
I	mAb	20	AuNPs	O	15.3	Ag	1		OVA	yes	Solid F	Fipronil	Ps	437.4		5	Food security	no		161
I	pAb		PTNFs	O	51.1	Ag	0.5		OVA	no	Urine	DHEA	H	256.37	140	10	Drug monitoring	no		131
I	mAb		Fluorescent NP	L	210	Ag	0.2		BSA	no	Liquid F	COL	D	1221.62		1.89	Food security	yes		102
I	mAb		Fluorescent NP	L	210	Ag	0.4		BSA	no	Liquid F	Baci	D	893.94		7.85	Food security	-		102
D	Horm	150000	AuNPs	O	16.5	Ab			NA	no	Urine	LH	H	25000			Body molecules monitoring	no		162
I	mAb	20	AuNPs	O	16.5	Ag			NA	no	Urine	LH	H	25000			Body molecules monitoring	no		162
I	mAb	8	AuNPs	O	30	Ag	0.05		NA	yes	Solid F	DNT	D	199.2		1.45	Veterinary / Food security	no		163
I	mAb	10	AuNPs	O	7.5	Ag	0.7		BSA	yes	Solid F	DAS	T	303.3		0.78	Food security	no		164
D	Apt	5	AuNPs	O	40	Apt			NA	no	Serum	CA125	P	32500			Healthcare diagnostics	no		117
I	mAb	20	AuNPs	O	37	Ag	0.00025		OVA	yes	Liquid F	MPO	P	74000	100	1.5	Food security	no		115
I	mAb	1	QD	L	7	Ag	0.5		BSA	yes	Solid F	FA	OM	441.4	75	500	Food security	no		107
I	mAb	40	AuNPs	O	40	Ag	0.1		BSA	no	Urine	OHdG	P	283.24	120	3	Healthcare diagnostics	no		125
I	mAb		PBNCs	O	150	Ag	1		OVA	yes	Urine	Glycocholic acid	OM	465.5	140	200	Body molecules monitoring	no		126
A	Apt			L		DNA		1.5	BSA	yes	Water	AMP	D	371.4		2.71	Water security	no		27
I	mAb	1700	Ultramarineblue NP	O	205	Ag	0.8		BSA	yes	Solid F	RAC	D	244.3		2	Veterinary / Food security	no		93
I	mAb	500	AuNPs	O	28	Ag			OVA	yes	Liquid F	Zeranol	H	330.5	135	10	Food security	no		110
I	mAb		AuNPs	O	40	Ag			BSA	yes	Solid F	OTA	T	305.2	135	5000	Food security	no	3.7 x 10 ⁸ L/mol	148
I	mAb		AuNFs	O		Ag			BSA	yes	Solid F	OTB	T	311.2	135	1000	Food security	no	3.7 x 10 ⁸ L/mol	148

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F	DB	[DB] ug/ml	NP	R	NP size nm	CB	[TL] mg/ml	[B/O] %	BSA/OVA	Pretr	Sample type	T	T type	T MW g/mol	CFT	LoD ng/ml	Appl.	Mplx	Kd	Ref
I	mAb	1000	Fluorescent NP	L		Ag	1.5		BSA	no	Plasma	P4	H	314.5	180	1	Body molecules monitoring	no		183
I	mAb	4	AuNPs	O		Ag	0.8		BSA	no	Urine	Fentanyl	D	337.5	80	1	Drug abuse	no		127
I	mAb	1000	AuNPs	O	17	Ag			OVA	yes	Serum	Digoxin	D	776		0.5	Drug monitoring	no	IC50 0.45ng/ml	165
I	pAb		AuNPs	O	40	Ag	1		BSA	yes	Solid F	FB (1 and 2)	T	409.5	140	1000	Food security	no		90
I	mAb		AuNPs	O		Ag	1		BSA	yes	Solid F	CPA	T	359.4		1	Food security	no		166
B	mAb		QD	L		Ab	0.25		NA	yes	Liquid F	CAP	D	323.83		0.01	Food security	Yes		19
B	mAb		QD	L		Ab	0.25		NA	yes	Liquid F	AFM1	T	347.39		0.0006	Food security	-		19
I	mAb		QD	L		Ag			BSA	yes	Liquid F	CAP	D	323.83		0.2	Food security	no		19
I	mAb		QD	L		Ag			BSA	yes	Liquid F	AFM1	T	347.39		0.1	Food security	no		19
A	Apt		AuNPs	O	13	Strep			NA	no	Water	P4	H	314.5	95	1.5725	Water security	no	17 nM	26
I	mAb	3.2	GNCs	O	48.4	Ag			NA	yes	Solid F	ZEN	T	308.33		0.25	Food security	no		130
D	Hapten	100	Magnetic NP	M	198	Ab	3000		NA	no	Urine	Mor, FNT, MAMP	D	285.32	140	0.2	Drug abuse	yes		129
D	DNA		AuNPs	O	35	Apt	0.05		NA	no	Serum	PCA3	P	22500	180	0.000225	Healthcare diagnostics	no		54
I	pAb		AuNPs	O		Ag			NA		other	Per a 2/Per a 9	Ps			1250000	Enviromental monitoring	no		52
D	folate		Fluorescent NP	L		Prot	0.9		NA	yes	Serum	FA	OM	441.37	180	13.4	Body molecules monitoring	no		118
I	mAb	1000	AuNPs	O	30	Ag	0.8		BSA	yes	Solid F	Trans-resveratrol	OM	228.24		50	Food security	no		167
I	mAb	80	UCNP	L	145	Ag	3		OVA	yes	Solid F	OP	Ps		90	3.44	Food security	no		184
I	mAb		AuNPs	O	40	Ag	2		NA	no	Liquid F	CM-CAS	P	66000		1.03	Food security	no	4.5 x 10^10 L/mpi	168
I	mAb	175	AuNPs	O		Ag	0.2		BSA	yes	Saliva	Cortisol	H	362.47		0.5	Body molecules monitoring	no		77
I	mAb	100	AuNPs	O	20	Ag	0.75	1	BSA	yes	Solid F	RAC	D	244.3			Veterinary / Food security	no		97
I	mAb		AuNPs	O		Ag			BSA	yes	Solid F	OP	D	244.18			Veterinary / Food security	no	3.24 X 10^9 L/mol	98
I	mAb	0.48	AuNPs	O	40	Ag	0.25		BSA	yes	Solid F	DON	T	304.38		10	Food security	Yes		86
I	mAb	0.88	AuNPs	O	40	Ag	0.3		BSA	yes	Solid F	FB1	T	699.82		30	Food security	-		86
I	mAb	0.3	AuNPs	O	40	Ag	0.23		BSA	yes	Solid F	AFB1	T	312.3		10	Food security	-		86
I	mAb	200	AuNPs	O	20	Ag	0.25		BSA	no	Water	Uranium (VI)	MI	238		8.6544	Water security	no		169
I	mAb	5000	Magnetic NP	M	198	Strep	5		NA	no	Serum	ft4	H	300000	140	0.000016	Body molecules monitoring	no		53
I	mAb	8	AuNPs	O	15	Ag	0.25		BSA	yes	Solid F	DON	T	304.38		2.5	Food security	no		170
I	Ab	3	AuNPs	O	20	Ag	0.6		BSA	no	Saliva	6-MAM	D	277.31	135	4	Drug monitoring	no		133
I	mAb	3.5	AuNPS	O	24	Ag	1		BSA	yes	Liquid F	AFM1	T	347.39		0.05	Food security	Yes		91
I	Ab	4.5	AuNPs	O	40	Ag	0.25		BSA	yes	Saliva	Cortisol	H	362.47		0.0099	Body molecules monitoring	no		72
I	mAb	6000	AuNPs	O	30	Ag	1		BSA	yes	Drug	DHA	D	282.25		50	Pharmaceutical Quality Assurance	no		171
A	Apt	125	AuNPs	O	25	Strep			NA	no	Water	CAP	D	323.83	135	5	Water security	no		25
A	Apt	125	AuNPs	O	25	Strep			NA	no	Water	AFB1	T	312.3	135	1	Water security	no		20
A	Apt	50	AuNPs	O	10	Ag	0.2		NA	yes	Liquid F	AMP	D	371.39		100	Food security	no	263 and 600 nM	25

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F	DB	[DB] ug/ml	NP	R	NP size nm	CB	[TL] mg/ml	[B/O] %	BSA/OVA	Pretr	Sample type	T	T type	T MW g/mol	CFT	LoD ng/ml	Appl.	Mplx	Kd	Ref
I	mAb	1000	AuNPs	O	40	Ag	0.08		OVA	yes	Liquid F	NEO	D	1406.5		0.00037	Food security	Yes		62
I	mAb	8000	AuNPs	O	40	Ag	0.35		OVA	yes	Liquid F	QNs	D	319.34		0.00055	Food security	-		62
I	pAb		AuNPs	O	40	Ag	2.5		BSA	no	Urine	TFV	D	635.63	180	1000	Drug monitoring	no		172
I	mAb	2000	Fluorescent NP	L	200	Ag	1		BSA	yes	Solid F	β -agonists	D	250	95	0.05	Veterinary / Food security	Yes		99
I	mAb		AuNPs	O	24.1	Ag			BSA	yes	Liquid F	Gentamicin	D	1404.9	135	10	Food security	Yes		111
I	mAb		AuNPs	O	24.1	Ag			BSA	yes	Liquid F	NEO	D	1406.5	135	100	Food security	-		111
I	mAb		AuNPs	O	24.1	Ag			BSA	yes	Liquid F	KN	D	1407.3	135	100	Food security	-		111
A	Apt		AuNPs	O		DNA			NA	yes	Solid F	OTA	T	393.48	140	0.4	Food security	no		24
I	mAb	15	AuNPs	O	15	Ag	0.25		OVA	yes	Plant	MG	D	235	90	600	Drug abuse	no		142
I	mAb		AuNPs + QD	L		Ag	0.75		BSA	yes	Solid F	TTX	T	319.27	180	0.2	Food security	no		67
I	mAb		EuNPs	L	200	Ag	0.5		NA	no	Serum	HBcAg	P	21000			Healthcare	no		185
I	Apt		Fluorescent NP	L		Ag			BSA	yes	Solid F	AFB1	T	312.3	140	0.1	Food security	no		85
I	mAb	3	AuNPs	O	40	Ag			NA	no	Urine	mAlb	P	66500			Body molecules monitoring	no	10.41 nM	124
A	Apt		AuNPs	L	24	DNA	0.05		NA	no	Water	Hg2+	MI	200.59	90	0.13	Water security	no		23
I	Ab	400	Blue latex beads	O	400	Ag			NA	no	WB	HbA	P	64450	135		Body molecules monitoring	Yes		113
I	Ab	100	Blue latex beads	O	400	Ag			NA	no	WB	HbS	P	64450	135		Body molecules monitoring	-		113
I	Ab	40	AgNPs	O	63.6	Ag	1.2	6.7	BSA	yes	Solid F	OTA	T	393.48		0.5	Food security	no		109
I	mAb		AuNPs	O	35	Ag		1	BSA	yes	Serum	Ab anti-glycoProt B (gB)	Ab	150000	90		Healthcare	no		59
I	Ab		AuNPs	O	40	Ag	2		NA		other	Deltamethrin	Ps	393.41		26.3254	Insecticide levels	no		173
I	Apt		AuNPs	O	13	Ag	2		NA	yes	Solid F	β -conglutin	P	45000	170	2.475	Food security	no		80
I	pAb		Enzyme	L		Ag	1		NA	no	Urine	Albumin	P	66437	180	2500	Healthcare diagnostics	no		73
I	mAb	500	UCNP	L	50	Ag	0.5		BSA	yes	Solid F	AFB1	T	312.3	135	0.03	Food security	no		84
I	pAb		AuNPs	O	20.19	Ag			BSA	yes	Liquid F	OTC	D	480.92	180		Food security	no		112
D	Prot		AuNPs	O		Ab			NA	yes	WB	HbA	P	64450			Body molecules monitoring	Yes		114
D	Prot		AuNPs	O		Ab			NA	yes	WB	HbB	P	64450			Body molecules monitoring	-		114
D	Prot		AuNPs	O		Ab			NA	yes	WB	HbC	P	64450			Body molecules monitoring	-		114
I	mAb		AuNPs	O	40	Ag	0.5		NA	yes	Solid F	Alternaria brassicae conidia	Mo		135		Healthcare risk	no		174
A	Apt		AuNPs	O	20	DNA			NA	no	Water	Hg(II)	MI	200.59	135	1	Water security	no		22
I	mAb		AuNPs	O		Ag			NA	no	Serum	K immunoglobulin	P	22000		1.4	Body molecules monitoring	Yes		119
I	mAb		AuNPs	O		Ag			NA	no	Serum	λ immunoglobulin	P	22000		1.7	Body molecules monitoring	-		119
I	mAb	30	Magnetic NP	M		Ag	0.4		NA	yes	other	Salmonella bacteria	Mo			12000	Food security	no		57
I	mAb	0.13	AuNPs	O		Ag	1		BSA	yes	Solid F	AFB1	T	312.3	120	0.6	Food security	no		83
I	mAb	0.2	AuNPs	O		Ag	1.6		BSA	yes	Solid F	ZEAA	T	302.4	120	6	Food security	no		83
I	Ab		AuNPs	O		Ag			NA	yes	Saliva	cortisol	H	362.5		0.2	Body molecules monitoring	no		132

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F	DB	[DB] ug/ml	NP	R	NP size nm	CB	[TL] mg/ml	[B/O] %	BSA/OVA	Pretr	Sample type	T	T type	T MW g/mol	CFT	LoD ng/ml	Appl.	Mplx	Kd	Ref
I	mAb	1	AuNPs	O	40	Ag	0.325		BSA	no	WB	Vit B12	OM	1355.4	180	12.5	Body molecules monitoring	no		78
A	Apt		AuNPs	O	10	DNA			NA	no	Buffer	OTA	T	307.3	140	0.5	Pharmaceutical Quality Assurance	no		21
I	mAb		QD	L		Ag			NA	no	WB	C-reactive Prot	P	25000		1	Body molecules monitoring	Yes		120
I	mAb	4000	QD	L		Ag		1	BSA	no	Water	PUE	H	478.5	135	5.8	Water security	no		186
I	mAb		AuNPs	O		Ag			NA	yes	Solid F	SEB	T	31500		250	Food security	no		175
I	mAb	10	AuNPs	O		Ag	0.5		OVA	no	Urine	Phenylethanolamine	OM	167.2	135	0.13	Veterinary / Food security	no	1.09 x 10 ¹⁰ L/mol	128
I	mAb	100	AuNPs	O	15	Ag	2	1	BSA	no	Water	3-PBA	OM	164.2	135	1000	Enviromental monitoring	no		176
D	Horm		Enzyme	L		Ab			NA	no	Liquid F	P4	H	314.5	150	0.8	Food security	no		74
I	pAb		Enzyme	L		Ag			BSA	yes	Solid F	FB	T	721.8		6000	Food security	Yes		75
I	pAb		Enzyme	L		Ag			BSA	yes	Solid F	AFB1	T	312.3		1500	Food security	-		75
I	mAb	5000	Magnetic NP	M	300	Ag			NA	no	Liquid F	B. antracis spores	Mo		135		Food security	no		103
I	mAb	1.2	AuNPs	O		Ag	0.1		BSA	no	Urine	CLP	D	219.3		150	Veterinary / Food security	no		177
D	Horm		Enzyme	L		Ab			NA	no	Saliva	Cortisol	H	362.5		0.3	Body molecules monitoring	no		76
I	mAb		AuNPs	O	20	Ag	1		BSA	no	Urine	OHdG	OM	258.22		2.07	Body molecules monitoring	no		81
I	mAb	2500	AuNPs	O	30	Ag	2		BSA	yes	Drug	ATS/DHA	D	288.28		100	Pharmaceutical Quality Assurance	no		144
I	mAb		AuNPs	O	40	Ag	0.4		OVA	yes	Solid F	BPA	OM	228.31	120	100	Food security	no		178
I	Fab	100	AuNPs	O	20	Ag	0.1		BSA	no	Solid F	OTA	T	393.41	180	800	Food security	no		79
D	Toxine		AuNPs	O	40	Ab	2.1		NA	yes	Solid F	AFB1	T	312.3	240		Food security	no		82
D	Metal ion Prot	800	AuNPs	O	20	Ab			NA	yes	Water	Cd2+	MI	112.41	240		Water security	no		55
D		1901	AuNPs	O		Ab	0.4		NA	no	Liquid F	hLF	P	80000		10000	Food security	no		50
I	pAb	1455	AuNPs	O		Ag	1.25		NA	no	Liquid F	hLF	P	80000			Food security	-		50
I	mAb		AuNPs	O	37	Ag	1.25		BSA	yes	Solid F	CA	D	196.22	135	0.22	Food security	Yes		56
I	mAb		AuNPs	O	37	Ag	0.75		BSA	yes	Solid F	MA	OM	126.12	135	0.26	Food security	-		56
I	mAb	350	Carbon NP	O		Ag			OVA	yes	Solid F	CCPU	D	223.23	90	0.089	Food security	no		100
D	Horm	50	Enzyme	E		Ab	0.1	5	BSA	no	Saliva	cortisol	H	362.5		0.1	Body molecules monitoring	no		51