

Ecologiena[®]

**Supersensitive
BPA ELISA KIT
(Microplate)
User's Guide**



TOKIWA CHEMICAL INDUSTRIES CO.,LTD.
常盤化学工業株式会社

**Supersensitive BPA(Bisphenol A) ELISA KIT
(Microplate)
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LIMITED WARRANTY

Tokiwa Chemical Industries CO., Ltd. (the Company, hereunder) warrants its products. (the Product, hereunder) to be manufactured in accordance with its specifications and free from defects in material. This warranty is expressly limited to the refund of the price of any defective Product or the replacement of any defective Product with new Product. This warranty applies only when the Buyer gives written notice to the Company within thirty (30) days after the receipt of the Product by the Buyer. In addition, this warranty applies under conditions of normal use, but does not apply to defects that result from intentional damage, negligence or unreasonable use.

THE COMPANY MAKES NO WARRANTIES, EITHER EXPRESS OR IMPLIED, EXCEPT AS PROVIDED HEREIN, INCLUDING WITHOUT LIMITATION THEREOF, WARRANTIES AS TO MARKETABILITY, MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR USE, OR NON-INFRINGEMENT OF ANY INTELLECTUAL PROPERTY RIGHTS. IN NO EVENT SHALL THE COMPANY BE LIABLE FOR ANY INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES OF ANY NATURE, OR LOSSES OR EXPENSES RESULTING FROM ANY DEFECTIVE PRODUCT OR THE USE OF ANY PRODUCT.

The design of the Product is under constant review and every effort is made to keep this guide up to date, the Company reserves the right to change specifications and equipment at any time without prior notice.

Kit Feature

- ✧ Bisphenol A (BPA) monoclonal antibody binds exclusively with BPA and does not show cross-reaction with other chemicals of similar structures. A monoclonal antibody is uniform in quality, generating very little lot-to-lot variation.
- ✧ The quantitative analysis ranges from 0.05µg/L to 10µg/L (ppb), sensitive enough to detect BPA in field specimens.
- ✧ With ease of handling, the total time for measurement is only 2.5 hours.
- ✧ The ELISA measurement is highly reproducible; the coefficient of variation (CV) is generally under 10%.
- ✧ The kit, a 96-well microplate format, enables simultaneous measurement of multiple samples at more reasonable cost.

Measuring Principle

1. Competitive Reaction

The test is based on the recognition of BPA by specific monoclonal antibodies. BPA present in the sample and a BPA-enzyme conjugate (i.e. BPA labeled with a coloring enzyme:HRP) are premixed and added into each well of a microplate, and allowed to compete for limited number of binding sites of specific antibodies immobilized on the surface of the wells. When the BPA concentration is higher relative to the enzyme conjugate, the BPA will predominantly bind the antibody and vice versa.

2. Chromogenic Reaction

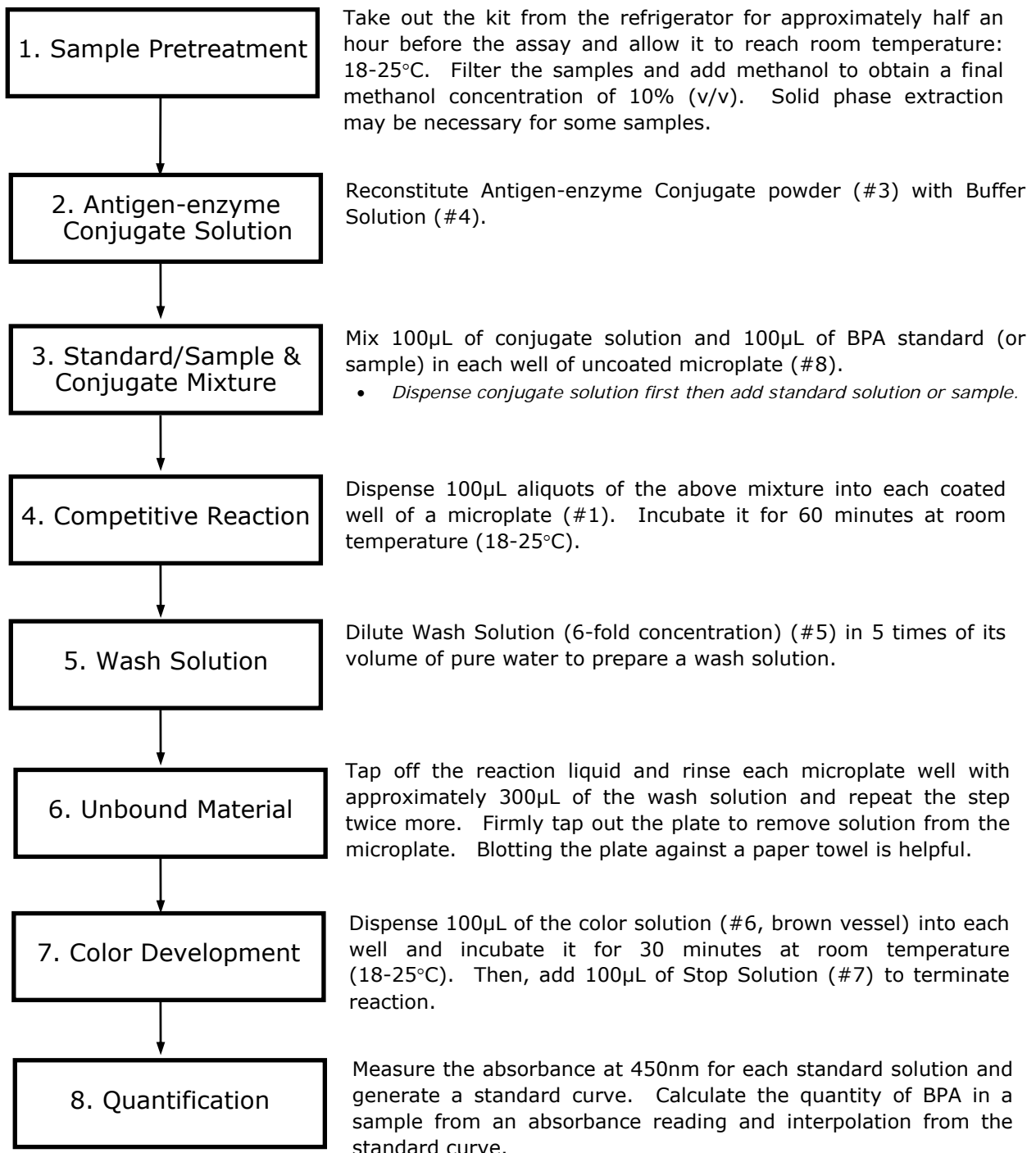
Unbound BPA and excess BPA-enzyme conjugates are washed out. The presence of BPA is detected by adding a chromogenic substrate:TMB. The enzyme-labeled BPA bound to the BPA antibody in the plate, catalyzes the conversion of the substrate to a colored product. After an incubation period, the reaction is stopped by the addition of a diluted acid. The higher the BPA concentration in a sample, for example, leads to less antigen-enzyme conjugate bound to the antibody binding sites in a microplate well, generating a lighter color, i.e. lower absorbance.

3. Quantitative Analysis

The standard curve, a dose-response curve obtained from known concentrations of BPA standards, is determined from the absorbance at 450nm. The BPA concentration in each sample is accurately calculated by interpolation using the absorbance intensity obtained from the standard curve.

Flowchart for BPA Measurement

<Please follow the steps described in Test Protocol (PP 6-9)>



Kit Content

#	Contents	Volume	Quantity	Storage
1	MoAb-Coated Microplate	96 Wells	1 Plate	2-8°C
2	BPA Standard 0µg/L (10% Methanol)	1.5mL each	1 Vial each	2-8°C
	BPA Standard 0.05µg/ (10% Methanol)			
	BPA Standard 0.3µg/L (10% Methanol)			
	BPA Standard 1.0µg/L (10% Methanol)			
	BPA Standard 10µg/L (10% Methanol)			
3	Antigen-enzyme Conjugate powder		2 Vials	2-8°C
4	Buffer Solution	7mL	2 Vials	2-8°C
5	Wash Solution (6-fold concentration)	50mL	1 Vial	2-8°C
6	Color Solution (TMB) <i>- brown vessel -</i>	15mL	1 Vial	2-8°C
7	Stop Solution (Citric acid)	15mL	1 Vial	2-8°C
8	Uncoated Microplate	96 Wells	1 Plate	---
9	Adhesive Plate Cover	---	1	---
10	Instruction Booklet	---	1	---

Other Essential Reagents/Materials

Common to both environmental/biological analysis

1. Glass disposable test tubes (e.g. ASAHI TECHNO GLASS, item No. 9831-1207)
**Be sure to use disposable tubes to avoid BPA adsorption.*
2. Micropipettes (20µL - 200µL and 100µL - 1000µL, e.g. Gilson Pipetman P-200, P-1000) and tips
3. Multichannel pipettes (50µL - 300µL e.g. Finnpipette Digital 8-channel Pipettor) and tips
4. Microplate reader (450nm wavelength) (e.g. TECAN Sunrise Remote)
5. Stop watch
6. Strip ejector (e.g. COSTAR, No.2578)
7. Methanol (HPLC grade)
8. Pure water

For environmental samples

When Sample Concentration is NOT Required.

- 1-8. Same as above
9. Glass fiber filters (e.g. ADVANTEC Co., item No. 36481047 Φ47mm) and filtering equipment

When Sample Concentration through SPE is Required.

- 1-9. Same as above
10. Solid phase extraction cartridge (e.g. NEXUS SPE Cartridge#:1210-3102 ABS ELUT-NEXUS,200MG 6ML,30/PK : VARIAN)
11. Dichloromethane

For biological samples

Sample Concentration through SPE (Isolute Multimode) is Required.

- 1-7. Same as above
12. Solid phase extraction cartridge(e.g. Isolute Multimode#904-0050-B: Biotage)
13. β -glucuronidase (example)

Distributor	Product No.	Origin	Optimum pH	Activity (Fishman units)
NIPPON BIOTEST	type-AI	Pomacea canaliculata	5.0	22,000 units/mL
Sigma-Aldrich	G0751	Helix pomatia	5.0	>300,000units/g solid

14. Acetic acid Buffer solution (pH 5.0)
 - Sodium Acetate 1.2 g
 - Acetic Acid 1 ml
 - L-Ascorbic Acid 0.15 g
 - EDTA-2Na 0.01 g
 - Pure Water 100 ml

IMPORTANT

- Comparative tests should be performed if an alternate supplier is used for specified reagents or materials.

Sample Clean-up

For Field(environmental) Samples

Filter raw water samples through the specified glass fiber filter (1 μ m pore diameter). If the BPA concentrations in samples are over the LOQ (0.05 μ g/L), add methanol to the filtrate to be at a final methanol concentration of 10% (v/v), and perform the ELISA as in Test Protocol.

If the BPA concentrations in samples are lower the LOQ (0.05 μ g/L), concentrate the analyte with NEXUS cartridge, and perform the ELISA as in Test Protocol. An example of the SPE procedure is described as follows;

[Example of analyte concentration with a NEXUS cartridge]

- 1) Pour the filtrate, prepared above, through a NEXUS cartridge preconditioned with dichloromethane (10mL), methanol (5mL) and pure water (5mL).
- 2) Wash the cartridge with pure water and methanol: pure water =1:1. Dry the cartridge for 45 minutes. Drying time can be shortened once a recovery of BPA is verified.
- 3) Elute the analyte with dichloromethane (6mL), then evaporate the solvent with nitrogen.
- 4) Add 100% methanol to the residue and stir the mixture with a vortex mixer. Terminate the mixing and pour pure water to adjust the content at 10% methanol (v/v).

For Biological Samples (Only for serum samples)

<Analysis of free BPA>

Clean-up the sample with Isolute Multimode cartridge, and perform the ELISA as in Test Protocol. An example of the clean-up procedure with the cartridge is described as follows;

[Example of the sample clean-up with a Isolute Multimode cartridge]

- 1) Pour the biological sample through an Isolute Multimode cartridge preconditioned with methanol (10mL) and pure water (6mL).
- 2) Wash the cartridge with 35%(v/v) methanol solution (methanol : pure water =35:65, 6mL).
- 3) Elute the analyte with methanol (2.5mL), then evaporate the solvent with nitrogen.
- 4) Add 100% methanol to the residue and stir the mixture with a vortex mixer. Terminate the mixing and pour pure water to adjust the content at 10% methanol (v/v).

<Analysis of total BPA>

Before clean-up the sample with Isolute Multimode cartridge, BPA conjugate should be hydrolyzed by the enzyme. An example of the clean-up procedure for the enzymatic hydrolysis is described as follows;

[Example of the Enzymatic Hydrolysis]

- 1) Mix the biological sample (0.1mL), acetic acid buffer solution (pH5.0, 0.2mL) and β -Glucuronidase(0.01mL).
- 2) Incubate the mixed sample above at 37°C for 18hr (or more).
- 3) Clean-up the sample with Isolute Multimode cartridge as in this section above, and perform the ELISA as in Test Protocol.

When using β -glucuronidase except for NIPPON BIOTEST, please adjust the activity of enzyme solution to approximately 22,000 Fishman units / mL.

For urine samples as well as other biological samples, interferences in the samples are not effectively eliminated with this procedure.

IMPORTANT

- Dichloromethane is a possible carcinogen, classified as Group B in NTP and as Group 2B in IARC. Follow the applicable regulation when you use it.
- Keep the methanol concentration to be 10%. Higher methanol content may result in inaccurate readings.
- Use a new cartridge for each filtrate.

Test Protocol

IMPORTANT

- For research use only, not for human use.
- Take out all the kit contents from the refrigerator and let them reach room temperature (18-25°C) for approximately 30 minutes prior to the assay.
- Do not mix reagents from different kits.
- Store reagents under refrigeration (2-8°C)
- Do not use expired kits.
- Dispose of kit components in accordance with applicable regulations after use.
- Duplicate measurement is recommended for more accurate determination.

CAUTION

Wear appropriate protective clothing, gloves and eyewear to avoid any accidental contacts.

1. Antigen-enzyme Conjugate Solution

Reconstitute a bottle of antigen-enzyme conjugate powder (#3) with buffer solution (#4) to prepare antigen-enzyme conjugate solution.

- Store the conjugate solution at 2-8°C; it will be stable for approximately 2 weeks. 7mL is sufficient for approximately 50 wells.
- Mix by filling the tip and expelling the contents with a pipette. Be sure not to generate bubbles when you transfer liquid.
- Mix a pair of reconstituted solutions when you use them altogether.

2. Conjugate Solution and Mixture of Standard/Sample

Transfer 100 μ L of conjugate solution, and then transfer 100 μ L of BPA standard or 100 μ L of sample, prepared as 10 % (v/v) methanol solution, into each well of the uncoated microplate (#8) and mix by filling the tip and expelling the contents with a pipette.

- Dispense conjugate solution first then add standard solution or sample, to avoid adsorption on the inner surface of the well.
- Mix by filling the tip and expelling the contents with a pipette. Be sure not to

- generate bubbles when you transfer liquid.
- Use 10% methanol as a blank.

3. Competitive Reaction

Dispense 100 μ L aliquots of the mixture, prepared in the above Section 2, into each coated well of the microplate (#1). Tap the plate lightly to make the liquid level horizontal. Incubate the microplate for 60 minutes at room temperature (18-25 $^{\circ}$ C).

- Split the microplate, with a strip ejector for example, to use necessary number of wells. This microplate is breakable into 12 strips, each of which consists of 8 wells. Place back the unused plate strips in the packet, seal and store them at 2-8 $^{\circ}$ C.
- Be sure not to generate bubbles when you transfer liquid to avoid erroneous reading. To remove them, tap a plate lightly.
- Cover a microplate with film to avoid contamination and evaporation.
- Do not move or shake a microplate during the reaction.
- A temperature-controlled bath (18-25 $^{\circ}$ C) is recommended.
- Secure the constant reaction time for each well, particularly to measure multiple samples.

4. Wash Solution

Dilute Wash Solution (6-fold concentration) (#5) in 5 times of its volume of pure water to prepare a wash solution, e.g. 20mL of concentrate and 100mL of pure water.

- Prepare the necessary amount of solution if you plan to run assays on different days with a split plate. The rule of thumb is 1.2mL of wash solution is required per well, i.e. approximately 120 mL for a whole plate.
- The wash solution must be stored at 2-8 $^{\circ}$ C; it will be stable approximately for a month after preparation.

5. Unbound Material

Rinse each microplate well with approximately 300 μ L of the wash solution and repeat the step twice more. Then, firmly tap out the plate to remove solution from the microplate. Blotting the plate against a paper towel, a clean cloth or a lint-free towel is helpful.

- Be sure to remove any remaining solution, which may cause a measurement error.
- Be sure the bottom of the plate is free from any fingerprints or dirt. Otherwise absorbance readings will be significantly altered.
- Do not discharge any untreated waste liquid. For example, soak cloth or paper in fluid for incineration.

6. Color Development

Dispense 100 μ L of the color solution (#6, a brown vessel) into each microplate well and incubate the microplate for 30 minutes at room temperature (18-25 $^{\circ}$ C). Then, add 100 μ L of Stop Solution (#7) to terminate the reaction.

- A temperature-controlled bath (18-25 $^{\circ}$ C) is recommended.
- Secure the constant reaction time for each well, particularly to measure multiple samples.
- Each well colored with a blue color from the color solution will turn yellow once the stop solution is added.

7. Quantification

Read the absorbance at 450nm for each standard solution and samples with a plate reader.

- Measure the absorbance within 15 minutes after the reaction is stopped.
- Prepare a standard curve based on at least duplicate standards for every assay.
- Be sure the bottom of the plate is free from any fingerprints or dirt. Otherwise absorbance readings will be significantly altered.
- The assay must be performed within the range between 0.05µg/L and 10µg/L. Samples of concentration beyond 10µg/L must be diluted with 10% methanol and re-tested. If the concentration of BPA in a sample is completely unknown, more than one dilution of each pretreated sample is recommended to be included in the assay.

Several options are available for the calculation of the BPA concentration in samples.

(1) Computer aided Calculation

Calculate using microplate analysis software.

A 4-parameter logistic fitting software is recommended, for example " Delta Soft " from BioMetallics, Inc., Princeton, NJ (<http://www.microplate.com>).

(2) Graph Paper (Section Paper) aided Fitting

Calculate using Log-Linear (or Log-Log) Graph Paper (Section Paper) Fitting.

X-axis : BPA concentration

Y-axis : Optical Density(OD) or Inhibition Rate(B/B₀%)

Inhibition Rate(B/B₀%) = (Sample or standard OD)/(OD at BPA standard=0)

(Example)

Standard OD or B/B₀%

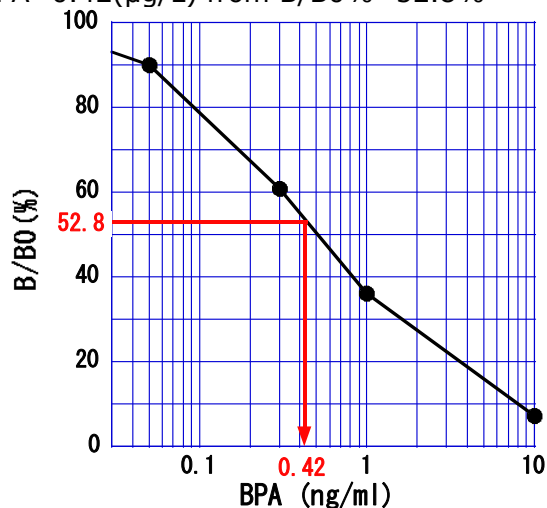
BPA (µg/L)	OD	B/B ₀ %
0	1.319	100
0.05	1.187	90.0
0.30	0.802	60.8
1.0	0.475	36.0
10.0	0.094	7.1

Example:

BPA (µg/L)	OD	B/B ₀ %
0.42	0.696	52.8

Log-Linear Graph Paper Calculation

BPA=0.42(µg/L) from B/B₀%=52.8%



APPENDIX

Plate Layout

BPA MoAb-Coated Microplate has 96 wells breakable into 8 x 12 strips.

Example 1) Full Plate Format

Five different concentrations of BPA standards (0, 0.05, 0.3, 1.0, 10µg/L) are assayed in duplicates. The standards take up 10 wells, leaving the rest of 86 wells for samples. With duplicate measurement, the whole plate can take 43 samples altogether.

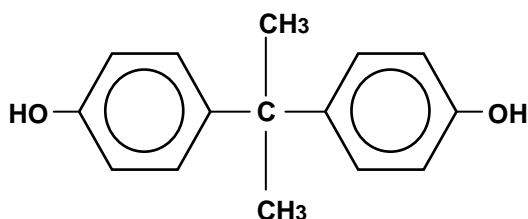
	1	2	3	4	5	6	7	8	9	10	11	12
A	0	0	S04	S04	S12	S12	S20	S20	S28	S28	S36	S36
B	0.05	0.05	S05	S05	S13	S13	S21	S21	S29	S29	S37	S37
C	0.3	0.3	S06	S06	S14	S14	S22	S22	S30	S30	S38	S38
D	1.0	1.0	S07	S07	S15	S15	S23	S23	S31	S31	S39	S39
E	10	10	S08	S08	S16	S16	S24	S24	S32	S32	S40	S40
F	S01	S01	S09	S09	S17	S17	S25	S25	S33	S33	S41	S41
G	S02	S02	S10	S10	S18	S18	S26	S26	S34	S34	S42	S42
H	S03	S03	S11	S11	S19	S19	S27	S27	S35	S35	S43	S43

Example 2) Partial Plate Format

Five different concentrations of BPA standards are assayed in duplicates. The plate is split into two for independent assays. Half a plate can take up to 19 samples with duplicate measurement.

	1	2	3	4	5	6	7	8	9	10	11	12
A	0	0	S04	S04	S12	S12	0	0	S04	S04	S12	S12
B	0.05	0.05	S05	S05	S13	S13	0.05	0.05	S05	S05	S13	S13
C	0.3	0.3	S06	S06	S14	S14	0.3	0.3	S06	S06	S14	S14
D	1.0	1.0	S07	S07	S15	S15	1.0	1.0	S07	S07	S15	S15
E	10	10	S08	S08	S16	S16	10	10	S08	S08	S16	S16
F	S01	S01	S09	S09	S17	S17	S01	S01	S09	S09	S17	S17
G	S02	S02	S10	S10	S18	S18	S02	S02	S10	S10	S18	S18
H	S03	S03	S11	S11	S19	S19	S03	S03	S11	S11	S19	S19

2. Chemical Structure of BPA Standard

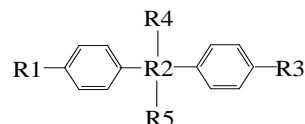


3. Cross-reactivity Pattern

1) Endocrine disruptors, Estrogens, Surfactants, Humic acid and Equol

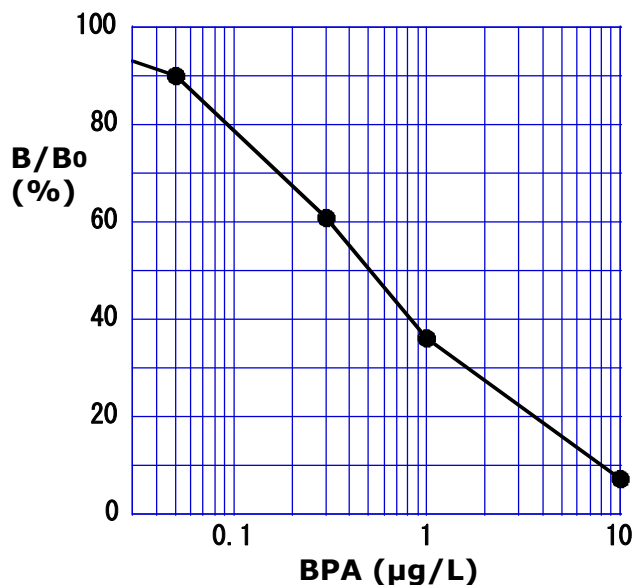
Compounds		% Reactivity
Endocrine Disruptors	Bisphenol A (BPA)	100
	Diethylhexylphthalate (DEHP)	<0.05
	Nonylphenol (NP)	0.19
Estrogens	17 β -Estradiol (E2)	<0.05
	Estrone (E1)	<0.05
Surfactants	Linear alkylbenzene sulfonate (LAS)	<0.05
	Alkylphenol Ethoxylate (APE)	<0.05
	Alkyl Ethoxylate (AE)	<0.05
Humic substance	Humic acid Na	<0.05
Phyto Estrogen	Equol	44

2) Substances of Similar Structure to BPA



compound	R1	R2	R3	R4	R5	Cross-Reactivities (%)
Bisphenol A (BPA)	OH	C	OH	CH ₃	CH ₃	100
Bisphenol E (BPE)	OH	C	OH	H	CH ₃	6.0
Bis(p-hydroxyphenyl)methane	OH	C	OH	H	H	1.8
Bisphenol B (BPB)	OH	C	OH	CH ₃	C ₂ H ₅	15.6
2,2'-Bis(4-hydroxyphenyl)-1-propanol	OH	C	OH	CH ₃	CH ₂ OH	1.7
BPA Diacetate	OOCCH ₃	C	OOCCH ₃	CH ₃	CH ₃	0.2
1,2-Bis(4-hydroxyphenyl)-2-propanol	OH	CH ₂ C	OH	OH	CH ₃	0.4
4,4'-Bis(p-hydroxyphenyl) pentanoic acid	OH	C	OH	CH ₃	C ₂ H ₄ COOH	<0.1
4,4'-dihydroxydiphenyl ether	OH	O	OH	-	-	0.2
p, p'-dihydroxybenzophenone	OH	C	OH	-	O	<0.1
Bisphenol S (BPS)	OH	SO ₂	OH	-	-	0.2
Bis[4-(2-hydroxyethoxy)phenyl]sulfone	O(CH ₂) ₂ OH	SO ₂	O(CH ₂) ₂ OH	-	-	<0.1
BPA Dimethacrylate		C		CH ₃	CH ₃	0.7
BPA Diglycidyl Ether		C		CH ₃	CH ₃	<0.1
BPX-33		C		CH ₃	CH ₃	<0.1

4. BPA Standard Curve

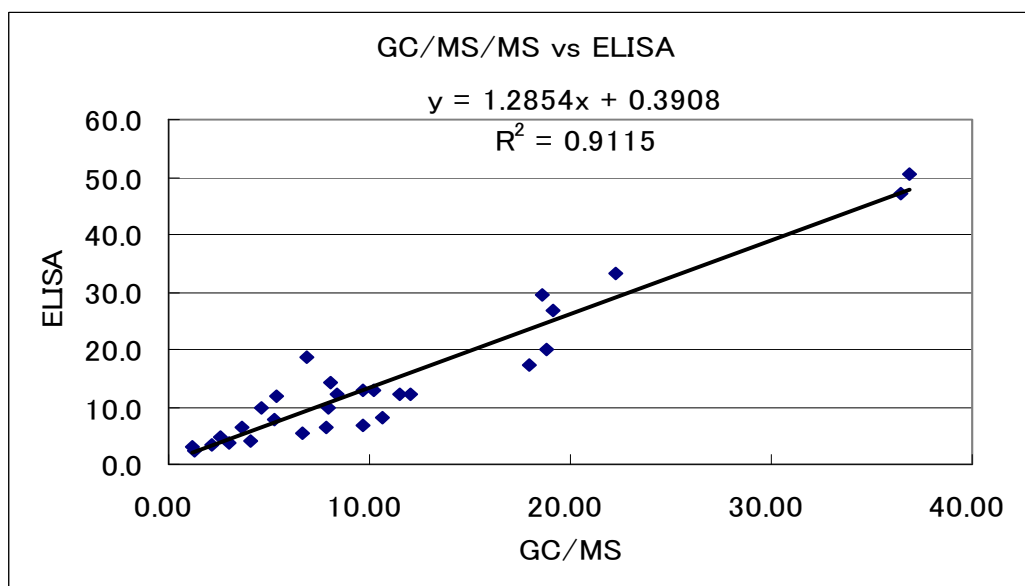


This test kit has a wide detection range between 0.05µg/L and 10µg/L. Samples within this range can be directly applied to the assay only after filtration.

Samples with BPA content outside of the range must be either diluted with 10% methanol or extracted with solid phase concentration prior to analysis.

5. Comparison with Traditional Method

The BPA ELISA shows an extremely high correlation with GC/MS/MS.



Shiraishi et al. (2002), Report of Special Research from the National Institute for Environmental Studies JAPAN (SR-46, p22)



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