

RayBio[®] C-Series Human Heat Shock Protein Antibody Array

For the semi-quantitative detection of 9 human proteins in cell and tissue lysates.

Patent Pending Technology

AAH-HSP-1-2 (2 Sample Kit)

AAH-HSP-1-4 (4 Sample Kit)

AAH-HSP-1-8 (8 Sample Kit)

User Manual

Last revised December 6th, 2019

Caution:
Extraordinarily useful information enclosed



ISO 13485 Certified

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Please read the entire manual carefully before starting your experiment

I. Introduction

Heat shock proteins (HSP) are a family of functionally related molecular chaperones, which play critical roles in protein folding, intracellular trafficking of proteins, and coping with proteins denatured by heat shock and other stresses. HSPs are found in virtually all living organisms, from bacteria to humans.

HSP family includes 5 major classes according to their molecular weights, i.e., the small heat-shock proteins (sHSPs), HSP33, HSP60, HSP70 and HSP90/ HSP100. The smaller 8-kD protein ubiquitin, which marks proteins for degradation and is regarded as co-chaperone, also belongs to HSP family.

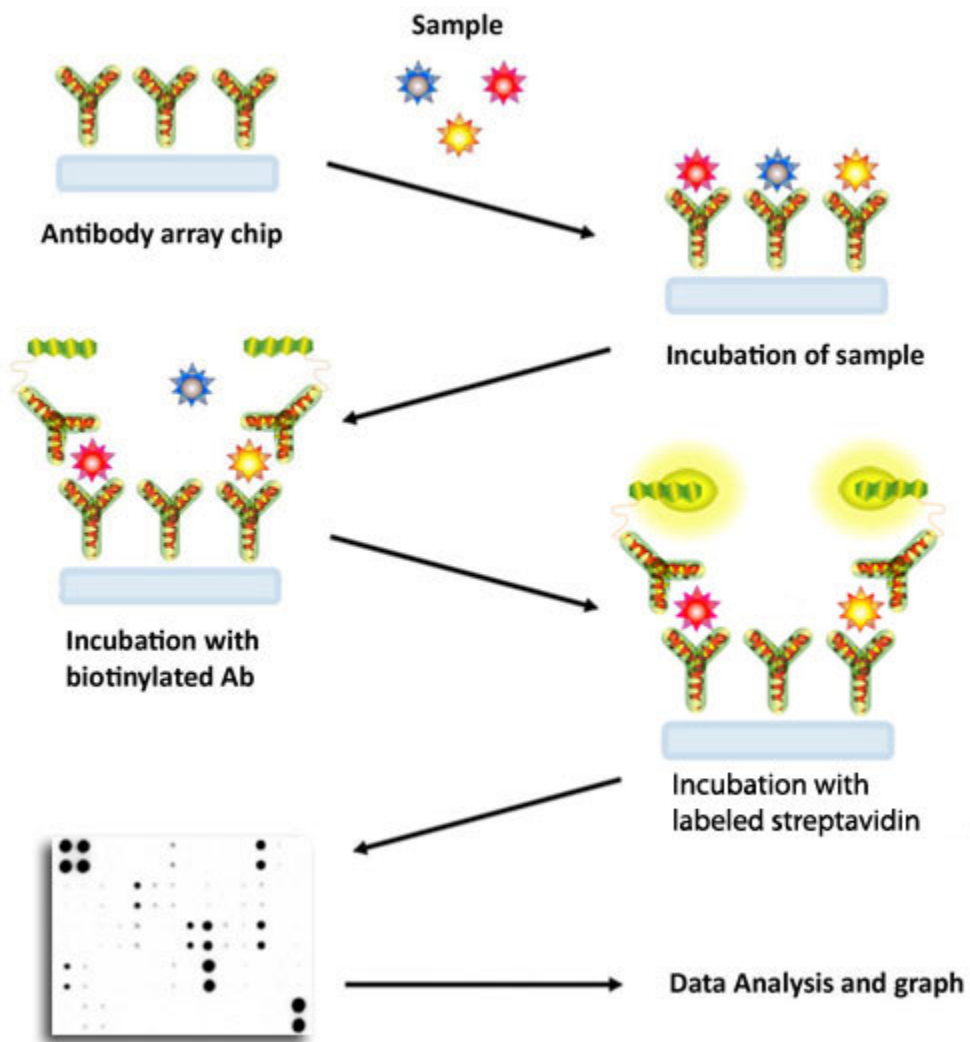
In addition to their roles in protein trafficking and stress response, HSPs are also important in cardiovascular functions and modulation of immune responses. Some HSPs have been under investigation as therapeutic targets in cancer.

Principal of the Assay

With the RayBio® Heat Shock Protein Antibody Array kit, researchers can now simultaneously detect the relative level of 9 HSP related proteins in cell lysates. By monitoring the changes in protein levels in different experimental model systems, researchers can study pathway activation without spending excess time and effort in performing immunoprecipitations and/or Western Blotting.

Each array membrane is pre-printed with capture antibodies; treated or untreated cell lysate is then added to each membrane. After extensive washing, the membranes are incubated with a cocktail of biotin-conjugated anti-apoptotic protein antibodies. After incubation with HRP-Streptavidin, the signals are visualized by chemiluminescence.

II. How It Works



III. Components and Storage

Store kit at $\leq -20^{\circ}\text{C}$ immediately upon arrival. Kit must be used within the 6-month expiration date.

ITEM	COMPONENT	AAH-HSP-1-2	AAH-HSP-1-4	AAH-HSP-1-8	STORAGE TEMPERATURE AFTER THAWING**
1	Human HSP Array C1*	2 membranes	4 membranes	8 membranes	$\leq -20^{\circ}\text{C}$
2	Blocking Buffer	1 vial (25 ml)	1 vial (25 ml)	2 vials (25 ml/ea)	
3	Biotinylated Antibody Cocktail	1 vial	2 vials	4 vials	2-8 °C (up to 3 days after dilution)
4	1,000X HRP-Streptavidin Concentrate	1 vial (50 μl)			2-8 °C
5	20X Wash Buffer I Concentrate	1 vial (10 ml)	1 vial (10 ml)	1 vial (20 ml)	
6	20X Wash Buffer II Concentrate	1 vial (10 ml)	1 vial (10 ml)	1 vial (20 ml)	
7	2X Cell Lysis Buffer Concentrate	1 vial (5 ml)			
8	Detection Buffer C	1 vial (1.5 ml)	1 vial (1.5 ml)	1 vial (2.5 ml)	
9	Detection Buffer D	1 vial (1.5 ml)	1 vial (1.5 ml)	1 vial (2.5 ml)	
10	8-Well Incubation Tray w/ Lid	1 tray			Room Temperature
11	Protease Inhibitor Cocktail	1 vial	1 vial	2 vials	$\leq -20^{\circ}\text{C}$
Other kit components: Plastic Sheets, Array Map Template, User Manual					

*Each package contains 2 or 4 membranes

**For up to 3 months (unless stated otherwise) or until expiration date

IV. Additional Materials Required

- Pipettors, pipet tips and other common lab consumables
- Orbital shaker or oscillating rocker
- Tissue paper, blotting paper or chromatography paper
- Adhesive tape or plastic wrap
- Distilled or de-ionized water
- A chemiluminescent blot documentation system:
 - CCD Camera
 - X-Ray Film and a suitable film processor
 - Gel documentation system
 - Or other chemiluminescent detection system capable of imaging a western blot

NOTE: Don't have the time or the equipment to image your membrane? Let the experts at RayBiotech image and analyze your membranes. Contact us for pricing. Telephone: 770-729-2992 Email: techsupport@raybiotech.com

V. Sample Tips and General Considerations

A. Sample Collection, Preparation and Storage

NOTE: *Optimal methods will need to be determined by each researcher empirically based on researched literature and knowledge of the samples.*

- If not using fresh samples, freeze samples as soon as possible after collection.
- Avoid multiple freeze-thaw cycles. If possible, sub-aliquot samples prior to initial storage.
- It is strongly recommended to add a protease inhibitor cocktail to cell and tissue lysate samples.
- Avoid sonication of 1 ml or less as this can quickly heat and denature proteins.
- Most samples will not need to be concentrated. If concentration is required, a spin column concentrator with a chilled centrifuge is recommended.
- Always centrifuge the samples hard after thawing (~10,000 RPM for 2-5 minutes) in order to remove any particulates that could interfere with detection.
- **General tips for preparing serum, plasma, cell culture media, urine, and lysate samples can be viewed on the online Resources page of the website.**

B. Sample Types and Recommended Dilutions/Amounts

NOTE: *Optimal sample dilutions and amounts will need to be determined by each researcher empirically, but the below recommendations may be used as a starting point. Blocking Buffer (ITEM 2) should be used to dilute samples. Normalize by loading equal amounts of protein per sample.*

- **Cell and Tissue Lysates:** Load 50 to 500 μg of total protein (after a 5-fold to 10-fold dilution to minimize the effects of any detergent(s)). Therefore the original lysate concentration should be 1 to 5 mg/ml.

C. Handling Membranes

- The antibody printed side of each membrane is marked by a dash (-) or number (#) in the upper left corner.
- Do not allow membranes to dry out during the experiment or they may become fragile and break OR high and/or uneven background may occur.
- Grasp membranes by the corners or edges only using forceps. DO NOT touch printed antibody spots.

D. Incubations and Washes

- Perform **ALL** incubation and wash steps under gentle rotation or rocking motion (~0.5 to 1 cycle/sec) using an orbital shaker or oscillating rocker to ensure complete and even reagent/sample coverage. Rocking/rotating too vigorously may cause foaming or bubbles to appear on the membrane surface which should be avoided.
- All washes and incubations should be performed in the Incubation Tray (ITEM 10) provided in the kit.
- Cover the Incubation Tray with the lid provided during all incubation steps to avoid evaporation and outside debris contamination.
- Ensure the membranes are completely covered with sufficient sample or reagent volume during each incubation.
- Avoid forceful pipetting directly onto the membrane; instead, gently pipette samples and reagents into a corner of each well.
- Aspirate samples and reagents completely after each step by suctioning off excess liquid with a pipette. Tilting the tray so the liquid moves to a corner and then pipetting is an effective method.
- Optional overnight incubations may be performed for the following step to increase overall spot signal intensities:
 - Sample Incubation
 - Biotinylated Antibody Cocktail Incubation
 - HRP-Streptavidin Incubation

NOTE: *Overnight incubations should be performed at 4°C (also with gentle rocking/shaking). Be aware that longer incubations can also increase the background response so complete liquid removal and washing is critical.*

VI. Chemiluminescence Detection Tips

- Beginning with adding the detection buffers and ending with exposing the membranes should take no more than 10-15 minutes as the chemiluminescent signals may start to fade at this point.
- Trying multiple exposure times is recommended to obtain optimum results.
- A few seconds to a few minutes is the recommended exposure time range, with 30 seconds to 1 minute being suitable for most samples.

**Don't have time or the equipment to image your membrane? Let the experts at RayBiotech image and analyze your membranes. Contact us for details and pricing.
Telephone: 770-729-2992
Email: techsupport@raybiotech.com**

VII. Component Preparation

NOTE: Thaw all reagents to room temperature immediately before use. If wash buffers contain visible crystals, warm to room temperature and mix gently until dissolved.

NOTE: The Biotinylated Antibody Cocktail (ITEM 3) and the HRP-Streptavidin Concentrate (ITEM 4) vials should be briefly centrifuged (~1000 g) before opening to ensure maximum recovery and mixed well as precipitates may form during storage.

Item	Component	Preparation	Example
1	Antibody Arrays	No Preparation	N/A
2	Blocking Buffer		
3	Biotinylated Antibody Cocktail*	Pipette 150 μ l of Blocking Buffer into the vial. Mix gently and transfer all to a tube containing 1.8 ml of Blocking Buffer.	N/A
4	1,000X HRP-Streptavidin Concentrate	Dilute 1,000-fold with Blocking Buffer. Mix gently with a pipette.	10 μ l of 1,000X concentrate + 9990 μ l of Blocking Buffer = 10 ml of 1X working solution
5	20X Wash Buffer I Concentrate	Dilute each 20-fold with distilled or deionized water.	10 ml of 20X concentrate + 190 ml of water = 200 ml of 1X working solution
6	20X Wash Buffer II Concentrate		
7	2X Cell Lysis Buffer Concentrate	Dilute 2-fold with distilled or deionized water. Pipette 20 μ l of the prepared Protease Cocktail Inhibitor into 1.98 ml of 1X Cell Lysis Buffer. Mix.	10 ml of 2X concentrate + 10 ml of water = 20 ml of 1X solution. 20 μ l of PCI + 1.98 ml of 1X buffer = 2ml of 1X working solution.
8	Detection Buffer C	No Preparation	N/A
9	Detection Buffer D		
10	8-Well Incubation Tray w/ Lid		
11	Protease Inhibitor Cocktail	Pipette 60 μ l of 1X Cell Lysis Buffer into the vial.	N/A

*1 vial is enough to test 2 membranes

VIII. Protocol

NOTE: Prepare all reagents and samples immediately prior to use. See Sections V and VII. **ALL** incubations and washes must be performed under gentle rotation/rocking (~0.5-1 cycle/sec). Make sure bubbles do not appear on or between the membranes to ensure even incubations.

1. Remove the kit from storage and allow the components to equilibrate to room temperature.
2. Carefully remove the Antibody Arrays (ITEM 1) from the plastic packaging and place each membrane (printed side up) into a well of the Incubation Tray (ITEM 10). One membrane per well.

NOTE: The antibody printed side is marked by a dash (-) or number (#) in the upper left corner.

A. Blocking

3. Pipette 2 ml of Blocking Buffer (ITEM 2) into each well and incubate for 30 minutes at room temperature.
4. Aspirate blocking buffer from each well with a pipette.

B. Sample Incubation

5. Pipette 1 ml of diluted or undiluted sample into each well and incubate for 1.5 to 5 hours at room temperature OR overnight at 4°C.

NOTE: Longer incubations can help maximize the spot signal intensities. However, doing so can also increase the background response so complete liquid removal and washing is critical.

6. Aspirate samples from each well with a pipette.

C. First Wash

NOTE: The 20x Wash Buffer Concentrates I and II (ITEM 5 and 6) must be diluted 20-fold before use. See section VII for details.

7. Wash Buffer I Wash: Pipette 2 ml of **1X** Wash Buffer I into each well and incubate for 5 minutes at room temperature. Repeat this 2 more times for a total of 3 washes using fresh buffer and aspirating out the buffer completely each time.
8. Wash Buffer II Wash: Pipette 2 ml of **1X** Wash Buffer II into each well and incubate for 5 minutes at room temperature. Repeat this 1 more time for a total of 2 washes using fresh buffer and aspirating out the buffer completely each time.

D. Biotinylated Antibody Cocktail Incubation

NOTE: The Biotinylated Antibody Cocktail (ITEM 3) must be prepared before use. See Section VII for details

9. Pipette 1 ml of the **prepared** Biotinylated Antibody Cocktail into each well and incubate for 1.5 to 2 hours at room temperature OR overnight at 4°C.
10. Aspirate Biotinylated Antibody Cocktail from each well.

E. Second Wash

11. Wash membranes as directed in Steps 7 and 8.

F. HRP-Streptavidin Incubation

NOTE: The 1,000X HRP-Streptavidin Concentrate (ITEM 4) must be diluted before use. See section VII for detail.

12. Pipette 2 ml of **1X** HRP-Streptavidin into each well and incubate for 2 hours at room temperature OR overnight at 4°C.
13. Aspirate HRP-Streptavidin from each well.

G. Third Wash

14. Wash membranes as directed in Steps 7 and 8.

H. Chemiluminescence Detection

NOTE: *Do not allow membranes to dry out during detection.*

15. Transfer the membranes, printed side up, onto a sheet of chromatography paper, tissue paper, or blotting paper lying on a flat surface (such as a benchtop).
16. Remove any excess wash buffer by blotting the membrane edges with another piece of paper.
17. Transfer and place the membranes, printed side up, onto a plastic sheet (provided) lying on a flat surface.

NOTE: *Multiple membranes can be placed next to each other and fit onto a single plastic sheet. Use additional plastics sheets if necessary.*

18. Into a single clean tube, pipette equal volumes (1:1) of Detection Buffer C (ITEM 8) and Detection Buffer D (ITEM 9). Mix well with a pipette.

EXAMPLE: *250 μ l of Detection Buffer C + 250 μ l of Detection Buffer D = 500 μ l (enough for 1 membrane)*

19. Gently pipette 500 μ l of the Detection Buffer mixture onto each membrane and incubate for 2 minutes at room temperature (DO NOT ROCK OR SHAKE). Immediately afterwards, proceed to Step 20.

NOTE: *Exposure should ideally start within 5 minutes after finishing Step 19 and completed within 10-15 minutes as chemiluminescence signals will fade over time. If necessary, the signals can usually be restored by repeating washing, HRP-Streptavidin and Detection Buffers incubations (Steps 11-19).*

20. Place another plastic sheet on top of the membranes by starting at one end and gently "rolling" the flexible plastic sheet across the surface to the opposite end to smooth out any air bubbles. The membranes should now be "sandwiched" between two plastic sheets.

NOTE: Avoid "sliding" the top plastic sheet along the membranes' printed surface.

21. Transfer the sandwiched membranes to the chemiluminescence imaging system such as a CCD camera (recommended) and expose.

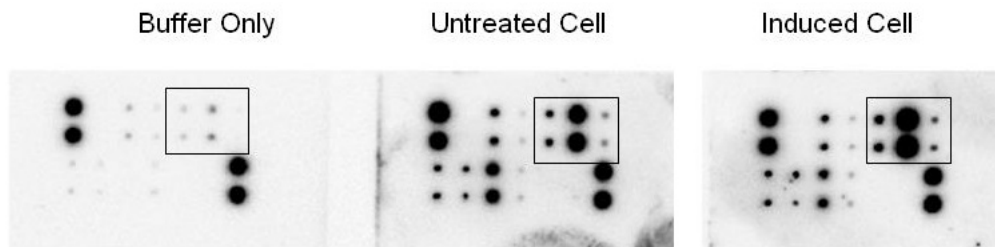
NOTE: Optimal exposure times will vary so performing multiple exposure times is strongly recommended. See Section VI for additional details.

I. Storage

22. To store, without direct pressure, gently sandwich the membranes between 2 plastic sheets (if not already), tape the sheets together or use plastic wrap to secure them, and store at $\leq -20^{\circ}\text{C}$ for future reference.

IX. Typical Results

Typical Results obtained with RayBio Human Heat Shock Protein Antibody Array



Heat shock protein profiling in induced HepG2 cultured cells

HepG2 cells were treated with 100 μM hydrogen peroxide for 24 hours. 500 μg of cell lysates from both untreated and induced HepG2 cells were incubated overnight with RayBio[®] Human Heat Shock Protein Antibody Array membranes. Control membrane was incubated with blocking buffer.

Note the strong signals of the Positive Control Spots in the upper left and lower right corners. (See below for further details on the control spots.)

The signal intensity for each antigen-specific antibody spot is proportional to the relative concentration of the antigen in that sample. Comparison of signal intensities for individual antigen-specific antibody spots between and among array images can

be used to determine relative differences in expression levels of each analyte sample-to-sample or group-to-group.

X. Interpreting the Results

A. Control Spots

Positive Control Spots (POS) - Controlled amount of biotinylated antibody printed onto the array. Used for normalization and to orientate the arrays.

Negative Control Spots (NEG) - Buffer printed (no antibodies) used to measure the baseline responses. Used for determining the level of non-specific binding of the samples.

Blank Spots (BLANK) - Nothing is printed here. Used to measure the background response.

B. Data Extraction

Visual comparison of array images may be sufficient to see differences in relative protein expression. However, most researchers will want to perform numerical comparisons of the signal intensities (or more precisely, signal densities), using 2-D densitometry. Gel/Blot documentation systems and other chemiluminescent or phosphorescent detection systems are usually sold as a package with compatible densitometry software.

Any densitometry software should be sufficient to obtain spot signal densities from your scanned images. One such software program, ImageJ, is available for free from the NIH website along with an array plug-in.

We suggest using the following guidelines when extracting densitometry data from our array images:

- For each array membrane, identify a single exposure that exhibits a high signal to noise ratio (strong spot signals and low background response). Strong Positive Control Spot signals but not too strong that they are "bleeding" into one another is ideal. The exposure time does not need to be identical for each array, but Positive Control signals on each array image should have similar intensities.
- Measure the density of each spot using a circle that is roughly the size of one of the largest spots. Be sure to use the same extraction circle dimensions (area, size, and shape) for measuring the signal densities on every array for which you

wish to compare the results.

- For each spot, use the summed signal density across the entire circle (ie, total signal density per unit area).

C. Data Analysis

NOTE: RayBiotech offers Microsoft[®] Excel-based Analysis Software Tools for each array kit for automatic analysis. Please visit the website at www.raybiotech.com or contact us for ordering information.

Once the raw numerical densitometry data is extracted, the background must be subtracted and the data normalized to the Positive Control signals to analyze.

Background Subtraction: Select values which you believe best represent the background. If the background is fairly even throughout the membrane, the Negative Control Spots (NEG) and/or Blank Spots (BLANK) should be similar and are accurate for this purpose.

Positive Control Normalization: The amount of biotinylated antibody printed for each Positive Control Spot is consistent from array to array. As such, the intensity of these Positive Control signals can be used to normalize signal responses for comparison of results across multiple arrays, much like housekeeping genes and proteins are used to normalize results of PCR gels and Western Blots, respectively.

To normalize array data, one array is defined as "Reference Array" to which the other arrays are normalized to. The choice of the Reference Array is arbitrary.

NOTE: The RayBio[®] Analysis Software Tools always designate Array 1/Sample 1 as the Reference Array.

Next, the simple algorithm below can be used to calculate and determine the signal fold expression between like analytes.

$$X(Ny) = X(y) * P1/P(y)$$

Where:

P1=mean signal density of Positive Control spots on reference array

P(y)=mean signal density of Positive Control spots on Array "y"

X(y)= X(Ny)=normalized signal intensity for spot "X" on Array "y"

For example:

Let's determine the relative expression of IL-6 on two different arrays (Arrays 1 and 2). Let's assume that the duplicate signals for the IL-6 spots on each array are identical (or that the signal intensity used in the following calculation is the mean of the two duplicate spots). Also assume the following:

$$P1 = 2500$$

$$P2 = 2700$$

$$IL-6 (1) = 300$$

$$IL-6 (2) = 455$$

$$\text{Then } IL-6(N2) = 455 * 2500 / 2700 = 421.30$$

The fold increase of IL-6(N2) vs IL-6(1) = $421.3 / 300 = 1.40$ -fold increase or a 40% increase in the signal intensity of IL-6 in Array 2 vs. Array 1.

XI. Array Map

Each antibody is spotted in		A	B	C	D	E	F	G
		1	POS	NEG	HSP27	HSP32	HSP40	HSP60
2								
3	HSP90	GRP75	Ubiquitin+1	HSP10	NEG	NEG	NEG	POS
4								

XII. Troubleshooting Guide

Problem	Cause	Recommendation
No Signals (not even positive control spots)	Chemiluminescent imager is not working properly	Contact imager manufacturer
	Too Short Exposure	Expose the membranes longer
	Degradation of components due to improper storage	Store entire kit at $\leq -20^{\circ}\text{C}$. Do not use kit after expiration date. See storage guidelines.
	Improper preparation or dilution of the HRP-Streptavidin	Centrifuge vial briefly before use, mix well, and do not dilute more than 1000-fold
	Waiting too long before exposing	The entire detection process should be completed in 10-15 minutes
Signals from Positive Control Spots visible, but no other spots visible	Low sample protein levels	Decrease sample dilution, concentrate samples, or load more protein initially
	Skipped Sample Incubation Step	Samples must be loaded after the blocking step
	Incubations Too Short	Ensure the incubations are performed for the appropriate time or try the optional overnight incubation(s)
Uneven Signals and/or Background	Bubbles present on or below membrane	Don't rock/rotate the tray too vigorously or pipette the sample or reagent with excessive force
	Insufficient sample or reagent volume	Load enough sample and reagent to completely cover the membrane
	Insufficient mixing of reagents	Gently mix all reagents before loading onto the membrane, especially the HRP-Streptavidin and Biotin Antibody Cocktail
	Rocking/Rotating on an uneven surface while incubating	Rock/rotate on a flat surface or the sample or reagent can "pool" to one side
High Background Signals or all Spots Visible	Too much HRP-Streptavidin or Biotinylated Antibody Cocktail	Prepare these signal enhancing components precisely as instructed
	Prepare these signal enhancing components precisely as instructed	Do not let the membranes dry out during the experiment. Cover the incubation tray with the lid to minimize evaporation
	Too High of Sample Protein Concentration	Increase dilution of the sample or load less protein
	Exposed Too Long	Decrease exposure time
	Insufficient Washing	Ensure all the wash steps are carried out and the wash buffer is removed completely after each wash step
	Non-specific binding	Ensure the blocking buffer is stored and used properly

XIII. Notes

RayBio[®] C-Series: Membrane-Based Antibody Arrays

A variety of C-Series array kits are available, detecting anywhere from 10 to 274 proteins simultaneously, visit <http://www.raybiotech.com/c-series-membrane-based-antibody-arrays.html> for details.

This product is for research use only.



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