

(For Research Use Only. Not For Use In Diagnostic Procedures!)

Human F8 (Coagulation factor VIII) ELISA Kit

Cat #: orb562440

Size: 48T/96T

Please do not mix and use the reagents from different kits or different batches. Otherwise, it might not work properly.

Please read the manual carefully before use. Feel free to contact us if you have any questions.

Please provide the batch number (see kit label) for more rapid responses and services.

It's strongly recommended to use this kit within the expiry date printed on the label of kit.

Product Features

Application	In vitro quantitative determination of F8 concentrations in plasma, cell culture supernatant and other biological samples.		
Reactivity	Human	Detection Method	Sandwich
Range	0.156-10ng/ml	Sensitivity	0.094ng/ml
Detection Duration	4 hours (excluding balancing and sample preparation)		
Samples needed for single well (Max)	Plasma: 50ul, Cell Culture Supernatant: 100ul, cell or tissue lysate: 100ul, Other liquid samples: 50ul		
Specificity	Specifically recognize F8, no obvious cross reaction with other analogues		
Storage	2-8°C (for sealed box), please do not freeze! See the label on kit for the expiry date		

Principle of the Assay

This kit is based on the sandwich enzyme-linked immune-sorbent assay technology. Anti F8 antibody was pre-coated onto the 96-well plate. The biotin conjugated anti F8 antibody was used as the detection antibody. The standards and pilot samples were added to the wells subsequently. After incubation, unbound conjugates were removed by wash buffer. Then, biotinylated detection antibody was added to react with F8 which have been bound to coated antibody. After washing off unbound conjugates, HRP-Streptavidin was added. After three washings, TMB substrates were added to visualize HRP enzymatic reaction. TMB was catalyzed by HRP to produce a blue color product that turned yellow after adding a stop solution. Read the O.D. absorbance at 450nm in a microplate reader. The concentration of F8 in the sample was calculated by drawing a standard curve. The concentration of the target substance is proportional to the OD450 value.

Kit Components and Storage

The sealed kit can be stored at 2-8 °C. The storage condition for opened kit is specified in the table below:

Item	Size (48T)	Size (96T)	Storage Condition for Opened Kit
ELISA Microplate (Dismountable)	8×6	8×12	Put the rest of the strips into a sealed foil bag with the desiccant. Stored for 1 month at 2-8°C; Stored for 6 months at -20°C
Lyophilized Standard	1 vial	2 vials	Put the rest of the standards into a desiccant bag. Stored for 1 month at 2-8°C; Stored for 6 months at -20°C
Biotin-labeled Antibody (Concentrated, 100X)	60ul	120ul	2-8°C (Avoid Direct Light)
HRP-Streptavidin Conjugate (SABC, 100X)	60ul	120ul	
TMB Substrate	5ml	10ml	
Sample Dilution Buffer	10ml	20ml	2-8°C
Antibody Dilution Buffer	5ml	10ml	
SABC Dilution Buffer	5ml	10ml	
Stop Solution	5ml	10ml	
Wash Buffer (25X)	15ml	30ml	
Plate Sealer	3 pieces	5 pieces	
Product Description	1 copy	1 copy	

Note: The liquid reagent bottle contains slightly more reagent than indicated on the label. Please use the pipette accurately measure and do proportional dilution.

Required Instruments and Reagents

1. Microplate reader (wavelength: 450nm)
2. 37°C incubator (CO₂ incubator for cell culture is not recommended.)
3. Automated plate washer or multi-channel pipette/5ml pipettor (for manual washing purpose)
4. Precision single (0.5-10µL, 5-50µL, 20-200µL, 200-1000µL) and multi-channel pipette with disposable tips (calibration is required before use.)
5. Sterile tubes and Eppendorf tubes with disposable tips
6. Absorbent paper and loading slot
7. Deionized or distilled water

Sample Collection and Storage

1. Plasma

EDTA-Na₂/K₂ is recommended as the anticoagulant. Centrifuge the samples for 15 minutes at 1000×g 2-8°C within 30 minutes after collection. Collect the supernatant to detect immediately. Or you can aliquot the supernatant and store it at -20°C or -80°C for future experiment. For other anticoagulant types and uses, please refer to the sample preparation guideline.

2. Tissue Sample

Generally, the tissue samples are required to be made into homogenization. Protocol is as below:

- 3.1. Place the target tissue on the ice. Remove the residual blood by washing tissue with pre-cooled PBS buffer (0.01M, pH=7.4). Then weigh for usage.
- 3.2. Use lysate to grind tissue homogenates on the ice. The added volume of lysate depends on the weight of the tissue. Usually, 9mL PBS would be appropriate to 1 gram tissue pieces. Some protease inhibitors are recommended to add into the PBS (e.g. 1mM PMSF).
- 3.3. Do further process using ultrasonic disruption or freeze-thaw cycles (Ice bath for cooling is required during ultrasonic disruption; Freeze-thaw cycles can be repeated twice.) to get the homogenates.
- 3.4. Homogenates are then centrifuged for 5 minutes at 5000×g. Collect the supernatant to detect immediately. Or you can aliquot the supernatant and store it at -20°C or -80°C for future experiment.
- 3.5. Determine the total protein concentration by BCA kit for further data analysis. Usually, the total protein concentration for Elisa assay should be within 1-3mg/ml. Some tissue samples such as liver, kidney, pancreas which contains a higher endogenous peroxidase concentration may react with TMB substrate and cause false positives. In that case, try to use 1% H₂O₂ for inactivation (15min) and perform the assay again.

Notes: PBS buffer or the mild RIPA lysis can be used as lysates. While using RIPA lysis, make the PH=7.3. Avoid using any reagents containing NP-40 lysis buffer, Triton X-100 surfactant, or DTT due to their severe inhibition for kits' working. We recommend using 50mM Tris+0.9%NaCL+0.1%SDS, PH7.3. You can prepare it yourself or contact us for purchasing.

3. Cell Culture Supernatant

Collect the supernatant: Centrifuge at 2500 rpm at 2-8°C for 5 minutes, then collect the clarified cell culture supernatant to detect immediately. Or you can aliquot the supernatant and store it at -80°C for future experiment.

4. Cell Lysate

4.1. Suspension Cell Lysate: Centrifuge at 2500 rpm at 2-8°C for 5 minutes and collect cells. Then add pre-cooled PBS into the collected cells and mix gently. Recollect cells by repeating centrifugation. Add 0.5-1ml cell lysate and appropriate protease inhibitor (e.g. PMSF, working concentration: 1mmol/L). Lyse the cells on ice for 30min-1h or disrupt the cells by ultrasonic disruption.

5.2. Adherent Cell Lysate: Absorb supernatant and add pre-cooled PBS to wash three times. Add 0.5-1ml cell lysate and appropriate protease inhibitor (e.g. PMSF, working concentration: 1mmol/L). Scrape the adherent cells with cell scraper. Lyse the cell suspension added in the centrifuge tube on ice for 30min-1h or disrupt the cells by ultrasonic disruption.

5.3. During lysate process, use the tip for pipetting or intermittently shake the centrifugal tube to completely lyse the protein. Mucilaginous product is DNA which can be disrupted by ultrasonic cell disruptor on ice. (3~5mm probe, 150-300W, 3~5 s/time, 30s intervals for 1~2s working).

5.4. At the end of lysate or ultrasonic disruption, centrifuge at 10000rpm at 2-8°C for 10 minutes. Then, the supernatant is added into EP tube to detect immediately. Or you can aliquot the supernatant and store it at -80°C for future experiment.

Notes: Read notes in tissue sample.

5. Other Biological Sample

Centrifuge the samples for 15 minutes at 1000×g at 2-8°C. Collect the supernatant to detect immediately. Or you can aliquot the supernatant and store it at -80°C for future experiment.

Notes for Samples

1. Blood collection tubes should be disposable and non-endotoxin. Avoid using hemolyzed and lipemia samples.
2. The best sample storage condition: less than 5 days at 2-8°C; within 6 months at -20°C; within 2 years at -80°C. Stored in liquid nitrogen for a longer storage. When melting frozen samples, rapid water bath at 15-25°C can decrease the effect of ice crystal (0°C) on the sample. After melting, centrifuge to remove the precipitate, and then mix well.
3. The detection range of this kit is not equivalent to the concentration of analyze in the sample. For analyses with higher or lower concentration, please properly dilute or concentrate the sample.
4. Pretest is recommended for special samples without reference data to validate the validity.
5. Recombinant protein may not be matched with the capture or detection antibody in the kit, resulting in the undetectable assay.

Precautions for Kits

1. When using different Elisa kits, labeling is required to avoid mixed components and failed assay.
2. After opening the kit, please refer to the table of storage condition for coated plate and standards (Dampness may decrease the activity.). If any component is missing or damaged during the assay or storage, please contact us to order a new one to replace.
3. Sterile and disposable tips are required during the assay. After use, the reagents bottle cap has to be tightened to avoid the microbial contamination and evaporation.
4. While washing manually, please keep tips or pipettors used for adding wash buffer away from the wells. Insufficient washing or contamination can easily cause false positives and high background.
5. During the assay, prepare required reagents for next step in advance. After washing, add the reagent into the well in time to avoid dryness. Otherwise, dry plate will result in the failed assay.
6. Before confirmation, reagents from other batches or sources should not be used in this kit.
7. Don't reuse tips and tubes to avoid cross contamination.
8. After loading, seal the plate to avoid the evaporation of the sample during incubation. Complete the incubation process at recommended temperature.
9. Please wear the lab coat, mask and gloves to protect yourself during the assay. Especially, for the detection of blood or other body fluid samples, please follow regulations on safety protection of biological laboratory.

Recommended Sample Dilution Ratio

Please refer to shipped instructions or contact us for samples, dilution as well background info.

The matrix components in plasma will affect the test results, which it need to be diluted at least 1/2 with Sample Dilution Buffer before testing!

If other dilution ratio for your sample model is required, please refer to the universal dilution ratio below. (The ratio is suitable for single-well assay. For duplicate assay, please follow the calculation: volume of sample and diluent x number of duplicate well)

For 2-fold dilution (1/2): One step dilution. Add 60ul sample into 60ul sample diluent and mix gently.

For 5-fold dilution (1/5): One step dilution. Add 24ul sample into 96ul sample diluent and mix gently.

For 10-fold dilution (1/10): One step dilution. Add 12ul sample into 108ul sample diluent and mix gently.

For 20-fold dilution (1/20): One step dilution. Add 6ul sample into 114ul sample diluent and mix gently.

For 50-fold dilution (1/50): One step dilution. Add 3ul sample and 47ul normal saline (0.9% NaCl) into 100ul sample diluent and mix gently.

For 100-fold dilution (1/100): One step dilution. Add 3ul sample and 177ul normal saline into 120ul sample diluent and mix gently.

For 1000-fold dilution (1/1000): Two step dilution. Create a 50-fold dilution first (normal saline is used throughout the dilution). Then, create a 20-fold dilution and mix gently.

For 10000-fold dilution (1/10000): Two step dilution. Create a 100-fold dilution first (normal saline is used throughout the dilution). Then, create the same dilution again and mix gently.

For 100000-fold dilution (1/100000): Three step dilution. Create a 50-fold dilution and 20-fold dilution respectively (normal saline is used in the first two steps.) Finally, create a 100-fold dilution and mix gently.

Notes: The volume in each dilution is not less than 3ul. Dilution factor should be within 100-fold. Mixing during dilution is required to avoid foaming.

Reagent Preparation and Storage

Take the Elisa kit from the fridge around 20 minutes earlier and equilibrate to room temperature (18-25°C).

For repeated assays, please just take the strips and standards required for the current assay, store the rest of the materials according to the relevant condition.

1. Wash Buffer

Dilute 30ml (15ml for 48T) concentrated wash buffer to 750ml (375ml for 48T) wash buffer with deionized or distilled water and mix well. (The recommended resistivity of ultrapure water is 18MΩ.) Alternatively, take appropriate amount of concentrated wash buffer according to the requirement of assay, then create a 25-fold dilution and mix well. Store the rest of the solution at 2-8°C.

Crystals formed in the concentrated wash buffer can be heated by water bath at 40°C till complete dissolution.

(Heating temperature should be below 50°C.) Mix well for the next step. It's better to use up the prepared wash buffer in one day. Store the rest of the buffer at 2-8°C within 48h.

2. Standards

2.1. Centrifuge standards tube for 1min at 10000xg. Label it as Zero tube.

2.2. Add 1ml sample dilution buffer into the standard tube. Tighten the tube cap and let it stand for 2min at room temperature. Invert the tube several times to mix gently. (Or you can mix it using a low-speed vortex mixer for 3-5 seconds.)

2.3. Centrifuge the tubes for 1min at 1000xg, making the liquid towards the bottom of tube and removing possible bubbles.

2.4. Standard dilution: Label 7 EP tubes with 1/2, 1/4, 1/8, 1/16, 1/32, 1/64 and blank respectively. Add 0.3ml of the sample dilution buffer into each tube. Add 0.3ml solution from zero tube into 1/2 tube and mix them thoroughly. Transfer 0.3ml from 1/2 tube into 1/4 tube and mix them thoroughly. Transfer 0.3ml from 1/4 tube into 1/8 tube and mix them thoroughly, so on till 1/64 tube. Now blank tube only contains 0.3ml sample dilution buffer. The standard concentration from zero tube to blank tube is 10ng/ml, 5ng/ml, 2.5ng/ml, 1.25ng/ml, 0.625ng/ml, 0.312ng/ml, 0.156ng/ml, 0ng/ml.



Notes: Store the zero tube with dissolved standards at 2-8°C and use it within 12h. Other diluted working solutions containing standards should be used in 2h.

3. Preparation of Biotin-labeled Antibody Working Solution

The working solution should be prepared within 30min before the assay and can't be stored for a long time.

- 3.1. Calculate the total volume of the working solution required in the assay: 100ul/well x quantity of wells. (It's better to prepare additional 100ul-200ul.)
- 3.2. Centrifuge for 1min at 1000xg in low-speed and add the concentrated biotin-labeled antibody into the bottom of tube.
- 3.3. Dilute the biotinylated detection antibody with antibody dilution buffer in 1:99 ratio and mix them thoroughly. (e.g. Add 10ul concentrated biotin-labeled antibody into 990ul antibody dilution buffer.)

4. Preparation of HRP-Streptavidin Conjugate (SABC) Working Solution

The working solution should be prepared within 30min before the assay and can't be stored for a long time.

- 4.1. Calculate the total volume of the working solution required in the assay: 100ul/well x quantity of wells. (It's better to prepare additional 100ul-200ul.)
- 4.2. Centrifuge for 1min at 1000xg in low-speed and add the concentrated SABC into the bottom of tube.
- 4.3. Dilute the concentrated SABC with SABC dilution buffer in 1:99 ratio and mix them thoroughly. (e.g. Add 10ul concentrated SABC into 990ul SABC dilution buffer.)

Procedure Summary of the Assay

Step 1: Add 100ul standard or sample into each well, seal the plate and incubate for 90 minutes at 37°C.

Washing: Wash the plate twice without immersion.

Step 2: Add 100ul biotin-labeled antibody working solution into each well, seal the plate and incubate for 60 minutes at 37°C.

Washing: Wash the plate three times and immerse for 1min each time.

Step 3: Add 100ul SABC working solution into each well, seal the plate and incubate for 30 minutes at 37°C.

Washing: Wash the plate five times and immerse for 1min each time.

Step 4: Add 90ul TMB substrate solution, seal the plate and incubate for 10-20 minutes at 37°C. (Accurate TMB visualization control is required.)

Step 5: Add 50ul stop solution. Read at 450nm immediately and calculate.

Detailed Procedure of the Assay

When diluting samples and reagents, they must be mixed completely. It's recommended to plot a standard curve for each test.

1. Set standard, pilot samples, control (blank) wells on the pre-coated plate respectively, and then, records their positions. It's recommended to measure each standard and sample in duplicate to decrease experimental errors.
2. Standards and samples loading: Aliquot 100ul of zero tube, 1st tube, 2nd tube, 3rd tube, 4th tube into each standard well. Also add 100ul sample dilution buffer into the control (blank) well. Then, add 100ul pilot samples into each sample well. Seal the plate and static incubate for 90 minutes at 37°C. (Add the solution to the bottom of each well. Mix gently and without touch the sidewall and foam the sample.)
3. Wash twice: Remove the cover, then absorb the liquid in the plate or tap the plate on a clean absorbent paper two or three times. Add 350ul wash buffer into each well without immersion. Discard the liquid in the well and tap on the absorbent paper again. Repeat the washing step twice.
4. Biotin-labeled Antibody: Add 100ul biotin-labeled antibody working solution into each well. Seal the plate and static incubate for 60 minutes at 37°C.
5. Wash three times: Remove the cover, then absorb the liquid in the plate or tap the plate on a clean absorbent paper two or three times. Add 350ul wash buffer into each well and immerse for 1min. Discard the liquid in the well and tap on the absorbent paper again. Repeat the washing step three times.
6. HRP-Streptavidin Conjugate (SABC): Add 100ul SABC working solution into each well. Seal the plate and static incubate for 30 minutes at 37°C. (Put the whole bottle of TMB into the 37°C incubator to equilibrate for 30min.)
7. Wash five times: Remove the cover, and then wash the plate with wash buffer five times. Read washing method in step 5.
8. TMB Substrate: Add 90ul TMB Substrate into each well, seal the plate and incubate at 37°C in dark within 10-20 minutes. Run the microplate reader and preheat for 15min.
(Notes: Please do not use the reagent reservoirs used by HRP couplings. The reaction time can be shortened or extended according to the actual color change, but not more than 30 minutes. You can terminate the reaction when apparent gradient appeared in standard wells. Weaker or stronger color intensity is unacceptable.)
9. Stop: Keep the liquid in the well after staining. Add 50ul stop solution into each well. The color will turn yellow immediately. The order for adding stop solution and TMB substrate solution is the same.
10. OD Measurement: Read the O.D. absorbance at 450nm in a microplate reader immediately and calculate.

Calculation of Results

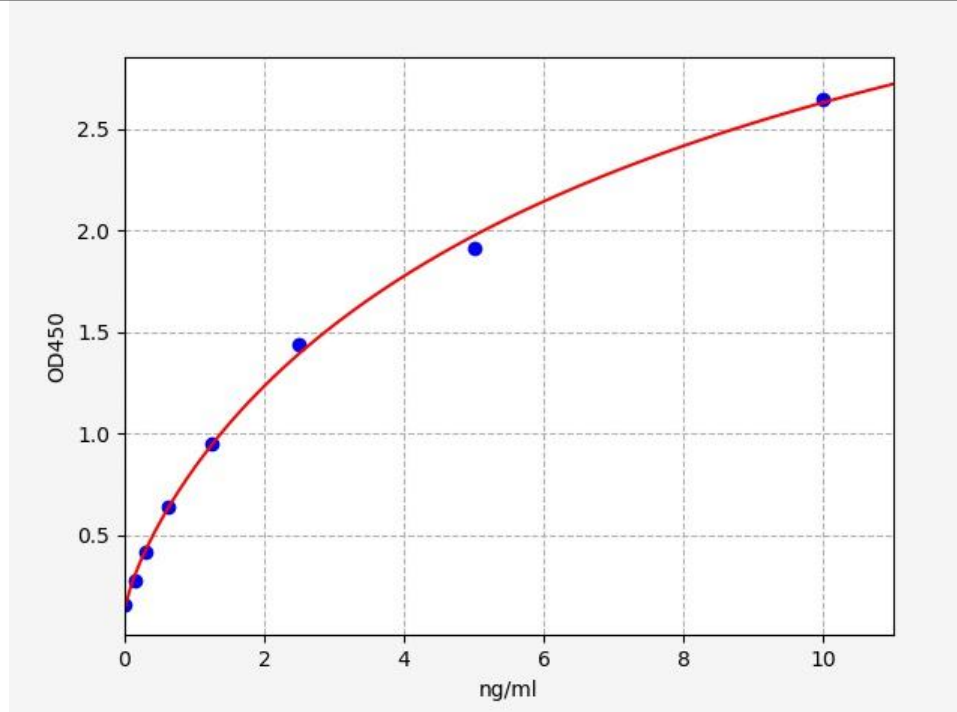
1. Calculate the mean OD450 value of the duplicate readings for each standard, control, and sample. Then, obtain the corrected OD450 by subtracting the OD450 blank.
2. Create a four-parameter logistic curve by plotting the mean absorbance for each standard on the y-axis against the concentration on the x-axis. (Remove the OD450 blank during plotting.) Alternatively, you can use the curve fitting software offered by the microplate reader (e.g. Thermo SkanIt RE software, [Curve Expert 1.3](#) or [1.4](#)).
3. Calculate the sample concentration by substituting OD450 value into the standard curve. Diluted samples should be multiplied by the relevant dilution ratio.

Typical Data & Standard Curve

This product has been tested by Quality Control Department and meets performance specifications mentioned in the manual. (The humidity in the laboratory is 20%-60%, and the temperature is 18°C - 25°C. TMB was balanced to 37°C before color development, and incubated at 37°C for 15 minutes in the dark after adding the enzyme label plate holes.)

The following data of the assay are provided for reference, since experimental environment and operation are different. The establishment of standard curve depends on your own assay.

STD. (ng/ml)	OD-1	OD-2	Average	Corrected
0	0.079	0.083	0.081	0
0.156	0.142	0.148	0.145	0.064
0.312	0.197	0.205	0.201	0.12
0.625	0.358	0.372	0.365	0.284
1.25	0.525	0.547	0.536	0.455
2.5	0.906	0.942	0.924	0.843
5	1.58	1.644	1.612	1.531
10	2.301	2.395	2.348	2.267



Precision

Intra-assay Precision: samples with low, medium and high concentration are tested 20 times on the same plate.

Inter-assay Precision: samples with low, medium and high concentration are tested 20 times on three different plates.

Item	Intra-assay Precision			Inter-assay Precision		
Sample	1	2	3	1	2	3
n	20	20	20	20	20	20
Mean (ng/ml)	0.28	1.24	5.18	0.3	1.24	5.12
Standard deviation	0.02	0.07	0.21	0.02	0.07	0.21
CV (%)	5.84	5.26	3.98	5.89	5.34	4.02

Recovery

Add a certain amount of F8 into the sample. Calculate the recovery by comparing the measured value with the expected amount of F8 in the sample.

Matrix	Recovery Range (%)	Average (%)
EDTA Plasma (n=5)	85-105	92
Heparin Plasma (n=5)	86-98	96

Linearity

Dilute the sample with a certain amount of F8 at 1:2, 1:4 and 1:8 to get the recovery range.

Sample	1:2	1:4	1:8
EDTA Plasma (n=5)	82-99%	84-95%	84-98%
Heparin Plasma (n=5)	90-98%	80-96%	81-98%

Stability

Perform the stability test for the sealed kit at 37°C and 2-8°C and get related data.

Elisa kit (n=5)	37°C for 1 month	2-8°C for 6 months
Average (%)	80	95-100

ELISA Troubleshooting

If the ELISA result is unsatisfied, please take a screenshot for the staining result and store the OD data. Keep used strips as well the rest of the reagents. Contact us to solve your problem with the catalog number and batch number of the kit. You can also refer to the following table to check the reasons.

Problem	Possible Causes	Solutions
Standard curve without signal	Incorrect order for adding reagents	Confirm the required reagent added in each step. Also repeat the assay and verify.
	Use components from different kits	Use the components included in the same kit. Also repeat the assay and verify.
	Forget to add some reagents	Verify whether the required reagents are added.
Overflow OD	Use components from different kits, or prepare the working solution with higher concentration	Use the components included in the same kit. Also repeat the assay and verify.
Poor standard curve	Inappropriate curve fitting model	Try to plot the curve by different fitting models.
Samples without signal	The amount of pilot sample is lower than the detection range.	Decrease dilution ratio or concentrate the sample.
	The detection target is incompatible with the buffer.	Verify the compatibility of sample storage buffer with the pilot sample.
	Incorrect preparation of sample	Please refer to sample preparation guideline and regularly store.
	Longer storage of sample or freeze-thaw cycle	Aliquot and store samples according to the requirement of assay.
High CV%	Precipitate is formed in the well during staining.	Increase the dilution ratio of the samples.
	Unclean plate	Don't touch the bottom of the plate during the assay.
	Foam is found in the well.	Avoid foaming during reading in a microplate reader.
	Each well is washed unevenly.	Check whether the tube of the washer is smooth.
	Reagents are not completely mixed.	Mix all reagents completely.
	Inconsistent pipetting	Use calibrated pipette and correct pipetting method.
Standard curve with low signal	Standards are improperly reconstituted.	Before opening, shortly centrifuge the lyophilized standard tube till complete dissolution.
	Standards have been degraded.	Follow suggested storage conditions for standards.
	When pipetting, the required volume is incorrect or inaccurate.	Use calibrated pipette and correct pipetting method.
	Expired kit	Don't use expired products.
	Improper storage	Follow suggested storage conditions for all

		components.
	The well is over dried.	The assay and sample loading process can't be terminated. Especially after washing the plate, add reagents immediately. Seal the plate during incubation.
	Slow colorimetric reaction	Before use, equilibrate the whole bottle of TMB substrate for 30min at 37°C. Extend the incubation time.
	The wavelength of the microplate reader is incorrect.	Check the wavelength and read the OD450 value again.
	The well is washed excessively.	Follow suggested washing times in this manual.
High Background	Insufficient washing	Follow suggested washing times in this manual.
	Wash buffer is contaminated.	Use the prepared wash buffer immediately. During manual washing, add wash buffer without touching the well.
	Too many detection reagents or higher concentration.	Use calibrated pipette and correct pipetting method.
	Reading of experimental result is not in time.	Read the experimental result immediately after adding the stop solution.
	TMB substrate is incubated in strong light.	During colorimetry, incubate in the dark.

Declaration

1. Limited to current conditions and scientific techniques, all raw materials are not completely identified and analyzed. This product may have a technology-related quality risk.
2. During the Elisa kit development, some endogenous interferons (not all) in the biological sample have been removed or decreased.
3. The final experimental result is related to the validity of reagents, experimental operation and environment. Our company is only responsible for this kit, excluding sample consumption during using this kit. Before use, please consider and prepare enough samples required by the assay.
4. To get a satisfied experimental result, please use all reagents offered by this kit. Don't use any product from other vendors. Strictly follow instructions of this manual.
5. During procedure of assay, incorrect reagents preparation and parameter setting of the microplate reader may result in the abnormal result. Before experiment, please read this manual carefully and adjust instruments.
6. Even if the assay is performed by the same person, results in two independent assays may be different. Thus, each step in the assay should be controlled to ensure the reproducibility.
7. Before delivery, this kit is subject to the strict QC. Influenced by transportation conditions and experimental devices, the experimental result got by the customer may be different from original data. Inter-assay CV between different batches may be caused by reasons before.
8. This kit is not compared to similar kits from other vendors or methods for testing the same detection target. Thus, experimental results may be inconsistent.
9. This kit is for research use only. For IVD or other purposes, our company is not responsible for any related consequences and doesn't bear any legal liability.