INTENDED USE

The Rabbit Anti-Circumsporozoite Protein (CSP) IgG ELISA Kit detects and quantifies CSP-specific IgG in rabbit serum or plasma of vaccinated or immunized animals. This immunoassay is suitable for:

- Determining immune status of animals
- Assessing efficacy of vaccines, including dosage, adjuvantcy, route of immunization, and timing
- Qualifying and/or standardizing vaccine batches and protocols

The assay is for research use only (RUO).

GENERAL INFORMATION

Malaria is a parasitic disease spread by mosquitoes. The causative agent is the parasitic protozoan Plasmodium. Four Plasmodium species infect humans: *P. falciparum*, *P. vivax*, *P. ovale,* and *P. malariae*; *P. berghei* infects rodents. *P. falciparum* is the most widespread and also potentially fatal form. The life cycle of the malaria is complex with phases both in human host and the insect vector, the female anopheline mosquito. Parasites may encode in the order of 2000 proteins, several hundred of which are antigenic. The best-characterized protein of sporozoites is Circumsporozoite protein-1 (CSP-1), an approximate 60 kDa protein located on the surface of developing and mature sporozoites and present in developing exoerythrocytic forms. The central domain of CSP-1 is composed of an extensive array of tandemly repeated short sequences (NANP)n and (NVDP)n. **RTS,S** (GSK) is the most clinically advanced malaria vaccine. RTS contains CSP-1 (207-395 aa) of *P. falciparum* that is fused to HBsAg (adw serotype, 226aa). The ADI Anti-CSP IgG ELISA will quantify antibodies specific to the CSP antigen regardless of carrier protein used for immunization. Additional ELISA kits are available for antibodies to HBsAg.

PRINCIPLE OF THE TEST

The Rabbit Anti-CSP IgG ELISA kit is based on the binding of rabbit anti-CSP IgG in samples to CSP immobilized on the microwells. Anti-CSP IgG antibody is detected by anti-Rabbit IgG specific antibody conjugated to HRP enzyme. After a washing step, chromogenic substrate (TMB) is added and color is developed by the enzymatic reaction of HRP on the substrate which is directly proportional to the amount of anti-CSP IgG present in the sample. Stopping Solution is added to terminate the reaction and absorbance at 450nm is then measured using an ELISA reader. The activity of rabbit IgG antibody in samples is calculated relative to anti-CSP Calibrators.

PRODUCT SPECIFICATIONS

Specificity
Purified recombinant CSP-1 (*P. falciparum*, 207-397 aa) is used as coating antigen; thus the assay is specific for antibodies directed to CSP. The anti-Rabbit IgG HRP conjugate reacts with rabbit IgG antibodies that bind to CSP on the plate. IgA, IgM, and IgE class antibodies would not be measured above background signals.

Assay Sensitivity
The CSP coating level, HRP conjugate, and Low NSB Sample Diluent are optimized to differentiate anti-CSP IgG from background (non-antibody) signal with rabbit serum samples diluted 1:100.

Calibrator Values
The calibrators are dilutions of antibody reactive to CSP. Values are assigned as arbitrary anti-CSP activity units.

KIT CONTENTS

The microtiter well plate and all other reagents, if unopened, are stable at 2-8°C until the expiration date printed on the box label. Stabilities of the working solutions are indicated under Reagent Preparation.

To Be Reconstituted: Store as indicated.

Component	Preparation Instructions
Wash Solution Concentrate (100x) Cat. No. WB-100, 10ml	Dilute the entire volume 10ml + 990ml with distilled or deionized water into a clean stock bottle. Label as **Working Wash Solution** and store at ambient temperature until kit is used entirely.
Sample Diluent Concentrate (20x) Cat. No. SD-20T, 10ml	Dilute the entire volume, 10ml + 190ml with distilled or deionized water into a clean stock bottle. Label as **Working Sample/Conjugate Diluent** and store at 2-8°C until the kit lot expires or is used up.
Anti-Rabbit IgG - HRP Conjugate Concentrate (100x) Part H-RbG-2a11, 0.15ml	Peroxidase conjugated anti-Rabbit IgG in buffer with protein, detergents, and antimicrobial as stabilizers. Dilute fresh as needed; 10ul of concentrate to 1ml of **Working Sample/Conjugate Diluent** is sufficient for 1 8-well strip. Use within the working day and discard. Return 100X to 2-8°C storage.

Ready For Use: Store as indicated on labels.

Component	Part	Amt	Contents
CSP Ag Microwell Strip Plate	970-301	8-well strips (12)	Coated with recombinant CSP-1 and post-coated with stabilizers.
Anti-CSP Calibrators			
1 U/ml 2.5 U/ml 5 U/ml 10 U/ml	970-203B 970-203C 970-203D 970-203E	0.65 ml 0.65 ml 0.65 ml 0.65 ml	Four (4) vials, each containing anti-CSP levels in arbitrary activity Units; diluted in buffer with protein, detergents, and antimicrobial as stabilizers.
Anti-CSP Positive Control	970-203 PC	0.65 ml	Antiserum with anti-CSP reactivity. [value range on label]
Low NSB Sample Diluent Reduces non-specific binding	TBTm **Not** for HRP Conjugate dilution.	30 ml	Buffer with protein, detergents, and antimicrobial as stabilizers. Use as is for sample dilution. See **Assay Design**, page 3.
TMB Substrate	80091	12 ml	Chromogenic substrate for HRP containing TMB and peroxide.
Stop Solution	80101	12 ml	Dilute sulfuric acid.

Materials Required But Not Provided:

- Pipettors and pipettes that deliver 100ul and 1-10ml. A multi-channel pipettor is recommended.
- Disposable glass or plastic 5-15ml tubes for diluting samples and Anti-Rabbit IgG HRP Concentrate.
- Stock bottle to store diluted Wash Solution; 200ml to 1L.
- Distilled or deionized water to dilute reagent concentrates.
- Microwell plate reader at 450 nm wavelength.

PRECAUTIONS AND SAFETY INSTRUCTIONS

Calibrators, Sample Diluent, and Antibody HRP contain bromonitrodioxane (BND: 0.05%, w/v). Stop Solution contains dilute sulfuric acid. Follow good laboratory practices and avoid ingestion or contact of any reagent with skin, eyes, or mucous membranes. All reagents may be disposed of down a drain with copious amounts of water. MSDS for TMB, sulfuric acid, and BND can be requested.

LIMITATIONS OF THE ASSAY

Quantitation of Antibody in a Sample
The ELISA measures anti-CSP activity, a combination of antibody concentration and avidity for the CSP antigen. Antibodies with substantially different total IgG concentrations may display similar anti- CSP activities due to differences in avidity. The quantitation or activity of the samples is, therefore, appropriately expressed in activity Units (titer), rather than mass units of IgG (e.g., ug/ml).

Calibrator Curve Quantitation
To quantitate antibody activity from a calibrator curve (such as provided with the kit), the dilution curve of the samples must be parallel to the calibrator curve, to avoid different values being obtained from different regions of the curve. Antibodies that are not matched in anti-CSP avidity will often have non-parallel dilution curves. In these cases, antibody activity is best expressed as a titer relative to a reference positive such as the 1 U/ml Calibrator, or another Calibrator in the kit (see Calculation of Results).

ASSAY DESIGN AND SET-UP

Sample Collection and Handling
Serum and other biological fluids may be used as samples with proper dilution to avoid solution matrix interference. For serum, collect blood by venipuncture, allow clotting, and separate the serum by centrifugation at room temperature. If samples will not be assayed immediately, store refrigerated for up to a few weeks, or frozen for long-term storage.

Antibody Stability & Dilution
Initial dilution of serum into **Working Sample Diluent** (WSD) is recommended to stabilize antibody activity. This enhances reproducible sampling, and stabilizes the antibody activity for years, stored refrigerated or frozen. Further dilution into **Low NSB Sample Diluent** (LNSD), which provides the lowest assay background, should be at least 10 times the initial dilution and performed the same day as the assay.

Example: Initial (1:5): **10**ul serum + **40**ul WSD [or 0.1ml + 0.4ml]
Further (1:50): **10**ul initial (1:5) + **90**ul LNSD (1:50)

Assay Design
Review Calculation of Results (p. 5-7) and Limits of the Assay (above) before proceeding:

- Select the proper sample dilutions accounting for expected potency of positives and minimizing non-specific binding (NSB) and other matrix effects; for example, net signal for non-immune samples should be <0.5 OD. This is usually 1/100 or greater dilution for rabbit sera with normal levels of IgG and IgM.
- Run a Sample Diluent **Blank**. This signal is an indicator of proper assay performance, especially of washing efficacy, and is used for net OD calculations, if required (**See Method A, B)**. Blank OD should be <0.3.
- Run the Anti-CSP **Positive Control**; value range is on the vial label.
- Run a set of **Calibrators**. Calibrators validate that the assay was performed to specifications; results can be used to normalize between-assay variation for enhanced precision. Reading values off a Calibrator curve, **Method C**, has limitations. See Limits of the Assay (above).
- Run a range of sample dilutions for expected higher positives that allows calculation of antibody **Titer** (when specific titer is at least 4-fold higher than non-immune)**. See Method D.**
- Run samples in duplicate if used for quantitation; non-immunes that are significantly lower than immunes may be run in singlicate. The Calibrators that are used for quantitation, e.g., for between-assay normalization, should be run in duplicate. When determining titer from a dilution curve, singlicates can be run if more than two dilution points are used for titer calculations.

Plate Set-up
Bring all reagents to room temperature (18-30°C) equilibration (at least 30 minutes).

- Determine the number of wells for the assay run. Duplicates are recommended, including 8 Calibrator wells and 2 wells for each sample and control to be assayed.
- Remove the appropriate number of microwell strips from the pouch and return unused strips to the pouch. Reseal the pouch and store refrigerated.
- Add 200-300ul Working Wash Solution to each well and let stand for about 1-5 minutes. Aspirate or dump the liquid and pat dry on a paper towel before sample addition.

Assay Procedure

ALL STEPS ARE PERFORMED AT ROOM TEMPERATURE. After each reagent addition, gently tap the plate to mix the well contents prior to beginning incubation.

1. 1st Incubation [100ul – 60 min; 4 washes]

- Add 100ul of calibrators, samples, blanks, and controls each to pre-determined wells.
- Tap the plate gently to mix reagents and incubate for 60 minutes.
- Wash wells 4 times and pat dry on fresh paper towels. As an alternative, an automatic plate washer may be used. Improper washes may lead to falsely elevated signals and poor reproducibility.

2. 2nd Incubation [100ul – 30 min; 5 washes]

- Add 100ul of diluted Anti-Rabbit IgG HRP to each well.
- Incubate for 30 minutes.
- Wash wells 5 times as in step 1.

3. Substrate Incubation [100ul – 15 min]

- Add 100ul TMB Substrate to each well. The liquid in the wells will begin to turn blue.
- Incubate for 15 minutes in the dark, e.g., place in a drawer or closet.

Note: If your microplate reader does not register optical density (OD) above 2.0, incubate for less time or read OD at 405-410 nm (results are valid).

4. Stop Step [Stop: 100ul]

- Add 100ul of Stop Solution to each well.
- Tap gently to mix. The enzyme reaction will stop; liquid in the wells will turn yellow.

5. Absorbance Reading

- Use any commercially available microplate reader capable of reading at 450nm wavelength. Use a program suitable for obtaining OD readings and data calculations if available.
- Read absorbance of the entire plate at 450nm using a single wavelength within 30 minutes after Stop Solution addition. If available, program to subtract OD at 630nm to normalize well background.

INTERPRETATION OF RESULTS

Calculation of Results
Consider several data reduction methods to best represent the relationships among experimental and control groups, to determine **Positive Immune** and **Negative Non-immune,** and to **Quantitate** positive antibody levels.

Method A. Antibody Activity **[ELISA Signal & Sample Dilution]**
Represent data as net OD units
(A450 signal; blank subtracted) ÷ dilution = **Total Activity Units**

A Calibrator value in the mid-OD range (e.g., 1 U/ml) can be used to normalize inter-assay values.

Method B. Positive Index
Experimental sample values may be expressed relative to the values of Control or Non-immune samples by calculation of a **Positive Index**. One typical method is as follows:

1. Calculate the net OD mean + 2 SD of the Control/Non-immune samples = **Positive Index**.

2. Divide each sample net OD by the Positive Index. Values above 1.0 are a measure of **Positive** Antibody Activity; below 1.0 are **Negative** for antibody.

A sample value would be **Positive** if significantly above the value of the pre-immune serum sample or a suitably determined non-immune panel or pool of samples tested at the same sample dilution. This calculation **quantifies** the positive Antibody Activity level.

Example:

	Assay Net OD		Calculation using **Positive Index**	
Sample	Control	Exptl	Control	Exptl
1	0.243	2.358	0.49	**4.79**
2	0.351	0.597	0.71	**1.21**
3	0.286	1.421	0.58	**2.89**
4	0.357	1.268	0.73	**2.58**
5	0.512	0.857	**1.04**	**1.74**
6	0.342	1.296	0.70	**2.63**
7	0.298	0.608	0.61	**1.24**
8	0.285	0.369	0.58	0.75
9	0.157	0.864	0.32	**1.76**
10	0.187	0.543	0.38	**1.10**
Mean	0.302			
SD	0.095			
Mean +2 SD	**0.492**	= **Positive Index**		

CALCULATION OF RESULTS (continued)

Method C. Use of a Calibrator Curve

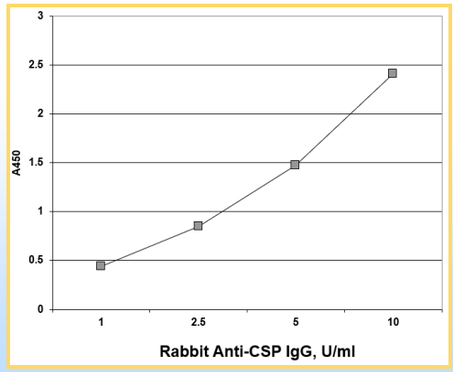
When the dilution curves of samples are parallel to the Calibrator curve (see Limits of the Assay), the Anti-CSP activity units may be determined by interpolation from the Calibrator curve. The results may be calculated using any immunoassay software package. If software is not available, Anti-CSP activity concentrations may be determined as follows:

1. Calculate the mean OD of duplicate samples.
2. On graph paper plot the mean OD of the calibrators (y-axis) against the concentration (U/ml) of Anti-CSP (x-axis). Draw the best fit curve through these points to construct the calibrator curve. A point-to-point construction is most common and reliable.
3. The Anti-CSP activity concentrations in unknown samples and controls can be determined by interpolation from the calibrator curve.
4. Multiply the values obtained for the samples by the dilution factor of each sample.
5. Samples producing signals higher than the 10 U/ml calibrator should be further diluted and re-assayed.

Typical Results:

Wells	Calibrators & Samples		A450 nm
A1,2		**Diluent Blank**	0.08
B1,2	1 U/ml	**Calibrator**	0.44
C1,2	2.5 U/ml	**Calibrator**	0.85
D1,2	5 U/ml	**Calibrator**	1.47
E1,2	10 U/ml	**Calibrator**	2.41
F1,2	**Positive**	**Control**	1.36

Positive Control Result: **2.12** U/ml



CALCULATION OF RESULTS (continued)

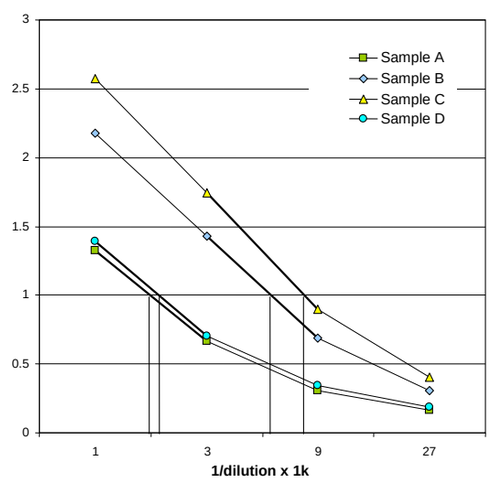
Method D. Titers from Sample Dilution Curves
The titer of antibody activity calculated from a dilution curve of each sample is recommended as the most accurate quantitative method. Best precision can be obtained using the following guidelines:

1. Use an OD value Index in the mid-range of the assay (2.0 – 0.5 OD); this provides the best sensitivity and reproducibility for comparing experimental groups and replicates. An arbitrary 1.0 OD is commonly used.
2. Prepare serial dilutions of each sample to provide a series that will produce signals higher and lower than the selected index. With accurate diluting, duplicates may not be required if at least 4 dilutions are run per sample.
3. A 5-fold dilution scheme is useful to efficiently cover a wide range which produces ODs both above and below 1.0 OD. The dilution scheme can be tightened to 3-fold or 2-fold for more precise comparative data.
4. A Calibrator value in the mid-OD range (e.g., 1 U/ml) can be used to normalize inter-assay values.

Calculations
1. On a log scale of inverse of Sample Dilution as the x-axis, plot the OD values of the two dilutions of each positive sample having ODs above and below the OD value of the Index (arbitrary or selected Calibrator).
2. From a point-to-point line drawn between the two sample ODs, read the dilution value (x-axis) corresponding to the OD of the selected Index
   = **IgG Antibody Activity Units**

Example:

II. A **1.0 OD** Index was used to determine titer of 4 antibodies.



Titer Values
Sample A = 1.72 kU
Sample B = 5.70 kU
Sample C = 1.85 kU
Sample D = 7.90 kU

Instruction Manual No. M-970-200-CSR

Rabbit Anti-Circumsporozoite Protein (CSP) IgG

Cat. #970-200-CSR, 96 tests

For Quantitation of Anti-CSP IgG in Serum

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ELISA Kit Components	Amount	Part
CSP Ag Coated Microwell Strip Plate	8-well strips (12)	970-301
Anti-CSP Positive Control	0.65 ml	970-203PC
Anti-CSP Calibrator 1 U/ml	0.65 ml	970-203B
Anti-CSP Calibrator 2.5 U/ml	0.65 ml	970-203C
Anti-CSP Calibrator 5 U/ml	0.65 ml	970-203D
Anti-CSP Calibrator 10 U/ml	0.65 ml	970-203E
Anti-Rabbit IgG HRP Conjugate (100X)	0.15 ml	H-RbG-2a11
Sample Diluent (20X)	10 ml	SD20T
Low NSB Sample Diluent	30 ml	TBTm
Wash Solution Concentrate (100X)	10 ml	WB-100
TMB Substrate	12 ml	80091
Stop Solution	12 ml	80101
Product Manual	1 ea	M-970-200-CSR