

Malaria Ab

**3rd Generation Enzyme Immunoassay
for the determination of antibodies to
Plasmodium species
in human serum and plasma**

- for "in vitro" diagnostic use only -



DIA.PRO

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Code MALAB.CE
96/192/480/960 Tests

Malaria Ab

A. INTENDED USE

Enzyme Immunoassay (ELISA) for the determination of antibodies to Plasmodium species in human sera and plasma.

The kit is intended for the screening of blood units and the identification of people that came into contact with the protozoa and developed an immunological response.

The kit is for in vitro diagnostic use only and the test has to be carried out by professional people, opportunely trained.

B. INTRODUCTION

Plasmodium species are obligate intracellular protozoa related to Babesia and Toxoplasma. Plasmodium species reproduce sexually in mosquitoes; mosquitoes transmit the resulting sporozoites into humans where the organisms reproduce asexually. The sporozoites multiply within the liver; resulting merozoites invade erythrocytes where the merozoites multiply or mature into male and female gametocytes which eventually will be taken up by a mosquito during a blood meal.

P.falciparum and *P.vivax* cause approximately 80% and 15%, respectively, of all cases of Malaria.

Malaria is the most severe infectious disease of tropical and subtropical areas of the world that still is heavily affecting millions of people and generating millions of casualties.

The detection of anti *P.species* antibodies can identify in suspected individuals a case of recent or past malaria.

C. PRINCIPLE OF THE TEST

Recombinant proteins representing immunodominant epitopes of Plasmodium species, are coated onto wells of a microplate.

Recombinant proteins have been carefully selected to ensure the screening of all antibodies to *P.species*. Serum or plasma samples are added to these wells and, if antibodies specific to *P.species* (IgG, IgM or IgA) are present in the sample, they will form stable complexes with the recombinant antigens in the well.

Antigen-antibody complexes are then identified through the successive addition of: (1) same biotinylated recombinant proteins specific to *P.species* and; (2) horseradish peroxidase HRP Streptavidin conjugate.

The hydrolytic activity of horseradish peroxidase allows for the quantification of these antibody-antigen complexes.

Peroxidase substrate solution is then added.

During incubation, a blue colour will develop in proportion to the amount of anti *P.species* antibodies bound to the well, thus establishing their presence or absence in the sample. Wells containing samples negative for anti-*P. species* antibody remain colourless.

A stop solution is added to each well and the resulting yellow colour is read on a microplate reader at 450 nm.

D. COMPONENTS

Code MALAB.CE contains reagents for 96/192/480/960 tests.

The following describes the composition of the standard format (192 tests/kit).

Microplate MICROPLATE

n° 2 microplates. 12 strips of 8 breakable wells coated with Plasmodium species specific recombinant antigens. Plates are sealed into a bag with desiccant.

Negative Control CONTROL

1x4.0ml/vial. Ready to use control. Polypropylene vial with plastic screw cap, white color coded. It contains human serum negative for *P.species* antibodies and 0.045% ProClin 300 as preservatives. The negative control is pale yellow color coded. The reagent is pale yellow colored.

Positive Control CONTROL +

1x4.0ml/vial. Ready to use control. Polypropylene vial with plastic screw cap, blue color coded. It contains human serum positive for *P. species* antibodies and 0.045% ProClin 300 as preservatives. The Positive Control is light green colored.

Important Note: *Even if this component has been treated with chemicals able to inactivate P. species, this does not fully ensure the absence of viable pathogens, and therefore, the control should be handled as potentially bio hazardous, in accordance with good laboratory practices.*

Calibrator: CAL ...

2 vials. Borosilicate glass vial with under cap and plastic screw cup, yellow color coded. Dissolve carefully the content of the lyophilized vial with the volume of EIA grade water reported on its label. Mix well on vortex before use.

Important Notes:

1) *When dissolved the Calibrator is not stable. Store in aliquots at -20°C.*

2) *Even if this component has been treated with chemicals able to inactivate P.species, this does not fully ensure the absence of viable pathogens, and therefore, the control should be handled as potentially bio hazardous, in accordance with good laboratory practices.*

Wash buffer concentrate WASHBUF 20X

2x60ml/bottle. 20x concentrated solution. Polypropylene bottle with plastic screw cap, white color coded It contains 0.045% ProClin 300. Once diluted, the wash solution contains 10 mM phosphate buffer saline pH 7.0+/-0.2 and 0.05% Tween 20.

Conjugate # 1 CONJ 1

8 vials. Borosilicate glass vial with under cap and plastic screw cup, white color coded The vial contains lyophilized biotinylated *P.species* recombinant antigens. Vials are to be fully dissolved with 6 ml of the conjugate # 2.

Conjugate # 2 CONJ 2

1x60ml/bottle. Polypropylene bottle with plastic screw cap, red color coded. The solution contains HRP conjugated with streptavidin in Tris saline Buffer supplemented with 0.045% ProClin 300, Tween 20 and BSA. This component is red colored.

Chromogen/Substrate SUBS TMB

1x50ml/bottle. Polypropylene amber bottle with plastic screw cap, black color coded Ready-to-use component. It contains 50 mM citrate buffer pH 3.5-3.8, 4% dimethylsulphoxide, 0.03% tetra-methyl-benzidine or TMB and 0.02% hydrogen peroxide or H₂O₂.

Note: *To be stored protected from light as sensitive to strong illumination.*

Sulphuric Acid H₂SO₄ 0.3 M

1x32ml/vial. Polypropylene vial with plastic screw cap, white color coded. It contains 0.3 M H₂SO₄ solution.

Attention: Irritant (H315, H319; P280, P302+P352, P332+P313, P305+P351+P338, P337+P313, P362+P363).

Sample Diluent: DILSPE

1x25ml/vial. Polypropylene vial with plastic screw cap green color coded. Contains Tris buffer supplemented with 0.045% ProClin 300 and Tween 20; used for specimen dilution. This component is green in colour.

Plate sealing foils n° 4

Package insert n° 1

Upon request:

Calibration Curve: **CAL N° ...**

5x2.0 ml/vial. Ready to use standard curve ranging: 0-0.5-1-2.5-5 WHO IU/ml.

(CAL1=0IU/ml, CAL2=0.5IU/ML, CAL3=1IU/ml, CAL4=2.5IU/ml, CAL5=5mlIU/ml).

Contains serum proteins, 0.3 mg/ml gentamicine sulphate and 0.045% ProClin 300 as preservatives.

Standards are colored with decreasing intensity of alimentary blue dye.

Important note: Only upon specific request, Dia.Pro can supply reagents for 96, 480, 960 tests , as reported below :

Microplate	n°1	n°5	n°10
Negative Control	1x2.0ml/vial	1x10ml/vial	1x20ml/vial
Positive Control	1x2.0ml/vial	1x10ml/vial	1x20ml/vial
Calibrator	n°1 vial	n°5 vials	n°10 vials
Wash buff 20X conc	1x60ml/bottle	5x60ml/bottles	4x150ml/bottles
Conjugate # 1	n° 5 vials	n°20 vials	n°40 vials
Conjugate # 2	1x36ml/vial	3x50ml/bottle	6x50ml/bottle
Chrom/Substrate	1x25ml/vial	3x42ml/bottle	2x125ml/bottles
Sulphuric Acid	1x15ml/vial	2x40ml/bottles	2x80ml/bottles
SampleDiluent	1x15ml/vial	1x65ml/bottle	1x140ml/bottle
Plate seal foils	n° 2	n° 10	n° 20
Pack. insert	n° 1	n°1	n° 1
Number of tests	96	480	960
Code	MALAB.CE.96	MALAB.CE.480	MALAB.CE.960

E. MATERIALS REQUIRED BUT NOT PROVIDED

1. Calibrated Micropipettes (200ul and 10ul) and disposable plastic tips.
2. EIA grade water (bidistilled or deionised, charcoal treated to remove oxidizing chemicals used as disinfectants).
3. Timer with 60 minute range or higher.
4. Absorbent paper tissues.
5. Calibrated ELISA microplate thermostatic incubator capable to provide a temperature of +37°C.
6. Calibrated ELISA microwell reader with 450nm (reading) and with 620-630nm (blinking) filters.
7. Calibrated ELISA microplate washer.
8. Vortex or similar mixing tools.

F. WARNINGS AND PRECAUTIONS

1. The kit has to be used by skilled and properly trained technical personnel only, under the supervision of a medical doctor responsible of the laboratory.
2. When the kit is used for the screening of blood units and blood components, it has to be used in a laboratory certified and qualified by the national authority in that field (Ministry of Health or similar entity) to carry out this type of analysis.
3. All the personnel involved in performing the assay have to wear protective laboratory clothes, talc-free gloves and glasses. The use of any sharp (needles) or cutting (blades) devices should be avoided. All the personnel involved should be trained in biosafety procedures, as recommended by the Center for Disease Control, Atlanta, U.S. and reported in the National Institute of Health's publication: "Biosafety in Microbiological and Biomedical Laboratories", ed. 1984.
4. All the personnel involved in sample handling should be vaccinated for HBV and HAV, for which vaccines are available, safe and effective.
5. The laboratory environment should be controlled so as to avoid contaminants such as dust or air-born microbial agents, when opening kit vials and microplates and when performing the test. Protect the Chromogen/Substrate from strong light and avoid vibration of the bench surface where the test is undertaken.
6. Upon receipt, store the kit at 2..8°C into a temperature controlled refrigerator or cold room.

7. Do not interchange components between different lots of the kits. It is recommended that components between two kits of the same lot should not be interchanged.

8. Check that the reagents are clear and do not contain visible heavy particles or aggregates. If not, advise the laboratory supervisor to initiate the necessary procedures for kit replacement.

9. Avoid cross-contamination between serum/plasma samples by using disposable tips and changing them after each sample. Do not reuse disposable tips.

10. Avoid cross-contamination between kit reagents by using disposable tips and changing them between the use of each one. Do not reuse disposable tips.

11. Do not use the kit after the expiration date stated on the external container and internal (vials) labels.

12. Treat all specimens as potentially infective. All human serum specimens should be handled at Biosafety Level 2, as recommended by the Center for Disease Control, Atlanta, U.S. in compliance with what reported in the Institutes of Health's publication: "Biosafety in Microbiological and Biomedical Laboratories", ed. 1984.

13. The use of disposable plastic-ware is recommended in the preparation of the liquid components or in transferring components into automated workstations, in order to avoid cross contamination.

14. Waste produced during the use of the kit has to be discarded in compliance with national directives and laws concerning laboratory waste of chemical and biological substances. In particular, liquid waste generated from the washing procedure, from residuals of controls and from samples has to be treated as potentially infective material and inactivated before waste. Suggested procedures of inactivation are treatment with a 10% final concentration of household bleach for 16-18 hrs or heat inactivation by autoclave at 121°C for 20 min..

15. Accidental spills from samples and operations have to be adsorbed with paper tissues soaked with household bleach and then with water. Tissues should then be discarded in proper containers designated for laboratory/hospital waste.

16. The Sulphuric Acid is irritant. In case of spills, wash the surface with plenty of water

17. Other waste materials generated from the use of the kit (example: tips used for samples and controls, used microplates) should be handled as potentially infective and disposed according to national directives and laws concerning laboratory wastes.

G. SPECIMEN: PREPARATION AND RECOMMANDATIONS

1. Blood is drawn aseptically by venipuncture and plasma or serum is prepared using standard techniques of preparation of samples for clinical laboratory analysis. No influence has been observed in the preparation of the sample with citrate, EDTA and heparin.

2. Avoid any addition of preservatives to samples; especially sodium azide as this chemical would affect the enzymatic activity of the conjugate, generating false negative results.

3. Samples have to be clearly identified with codes or names in order to avoid misinterpretation of results. When the kit is used for the screening of blood units, bar code labeling and electronic reading is strongly recommended.

4. Haemolysed (red) and visibly hyperlipemic ("milky") samples have to be discarded as they could generate false results. Samples containing residues of fibrin or heavy particles or microbial filaments and bodies should be discarded as they could give rise to false results.

5. Sera and plasma can be stored at +2°...+8°C in primary collection tubes for up to five days after collection.

Do not freeze primary tubes of collection. For longer storage periods, sera and plasma samples, carefully removed from the primary collection tube, can be stored frozen at -20°C for several months. Any frozen samples should not be frozen/thawed more than once as this may generate particles that could affect the test result.

6. If particles are present filter using 0.2-0.8µ filters to clean up the sample for testing.
7. Do not use heat inactivated samples as they could give origin to false reactivity.

H. PREPARATION OF COMPONENTS AND WARNINGS

A study conducted on an opened kit has not pointed out any relevant loss of activity up to 2 months.

Microplates:

Allow the microplate to reach room temperature (about 1 hr) before opening the container. Check that the pouch is not broken or that some defect is present indicating a problem of storage. In this case call Dia.Pro's customer service.

Unused strips have to be placed back into the aluminum pouch, in presence of desiccant supplied, firmly zipped and stored at +2°..8°C. When opened the first time, residual strips are stable up to two months.

Negative Control:

Ready to use. Mix well on vortex before use.

Positive Control:

Ready to use. Mix well on vortex before use. Handle this component as potentially infective, even if a potential infectious agent, if present in the control, has been chemically inactivated.

Wash buffer concentrate:

The 20x concentrated solution has to be diluted with EIA grade water up to 1200 ml and mixed gently end-over-end before use. As some salt crystals may be present into the vial, take care to dissolve all the content when preparing the solution.

In the preparation avoid foaming as the presence of bubbles could give origin to a bad washing efficiency.

Note: Once diluted, the wash solution is stable for 1 week at +2..8° C.

Conjugate # 1 & Conjugate #2 mix solution:

The Conjugate # 1 & Conjugate #2 mix solution must be prepared immediately before the dispensation of the Sample Diluent. Add 6 ml Conjugate # 2 directly to one vial of Conjugate # 1 and mix gently by inversion to dissolve the lyophilized powder. This preparation is sufficient for 24 tests, or 3 complete strips.

Important Note: Any unused portion of this reconstituted Conjugate # 1 Solution may be stored at 2...8°C for no more than 12 hours.

Conjugate # 2:

Ready to use reagent. Mix well on vortex before use.

Chromogen/Substrate:

Ready to use. Mix well on vortex before use.

Be careful not to contaminate the liquid with oxidizing chemicals, air-driven dust or microbes. Do not expose to strong illumination, oxidizing agents and metallic surfaces.

If this component has to be transferred use only plastic, possible sterile disposable container.

Sulphuric Acid:

Ready to use. Mix well on vortex before use.

Attention: Irritant (H315, H319; P280, P302+P352, P332+P313, P305+P351+P338, P337+P313, P362+P363).

Legenda:

Warning H statements:

H315 – Causes skin irritation.

H319 – Causes serious eye irritation.

Precautionary P statements:

P280 – Wear protective gloves/protective clothing/eye protection/face protection.

P302 + P352 – IF ON SKIN: Wash with plenty of soap and water.

P332 + P313 – If skin irritation occurs: Get medical advice/attention.

P305 + P351 + P338 – IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

P337 + P313 – If eye irritation persists: Get medical advice/attention.

P362 + P363 – Take off contaminated clothing and wash it before reuse.

Sample Diluent:

Ready to use. Mix well on vortex before use.

Calibrator:

Dissolve carefully the content of the lyophilized vial with the volume of EIA grade water reported on its label.

Mix well on vortex before use.

I. INSTRUMENTS AND TOOLS USED IN COMBINATION WITH THE KIT

1. **Micropipettes** have to be calibrated to deliver the correct volume required by the assay and must be submitted to regular decontamination (household alcohol, 10% solution of bleach, hospital grade disinfectants) of those parts that could accidentally come in contact with the sample. They should also be regularly maintained in order to show a precision of 1% and a trueness of +/-2%. Decontamination of spills or residues of kit components should also be carried out regularly.

2. The **ELISA incubator** has to be set at +37°C (tolerance of +/-0.5°C) and regularly checked to ensure the correct temperature is maintained. Both dry incubators and water baths are suitable for the incubations, provided that the instrument is validated for the incubation of ELISA tests.

3. The **ELISA washer** is extremely important to the overall performances of the assay. The washer must be carefully validated in advance, checked for the delivery of the right dispensation volume and regularly submitted to maintenance according to the manufacturer's instructions for use. In particular the washer, at the end of the daily workload, has to be extensively cleaned out of salts with deionized water. Before use, the washer has to be extensively primed with the diluted Washing Solution. The instrument weekly has to be submitted to decontamination according to its manual (NaOH 0.1 M decontamination suggested).

5 washing cycles (aspiration + dispensation of 350ul/well of washing solution + 20 sec soaking = 1 cycle) are sufficient to ensure the assay with the declared performances. If soaking is not possible add one more cycle of washing. An incorrect washing cycle or salt-blocked needles are the major cause of false positive reactions.

4. Incubation times have a tolerance of ±5%.

5. The **ELISA reader** has to be equipped with a reading filter of 450nm and with a second filter of 620-630nm, mandatory for blanking purposes. Its standard performances should be (a) bandwidth ≤ 10 nm; (b) absorbance range from 0 to ≥ 2.0; (c) linearity to ≥ 2.0; repeatability ≥ 1%. Blanking is carried out on the well identified in the section "Assay Procedure". The optical system of the reader has to be calibrated regularly to ensure that the correct optical density is measured. It should be regularly maintained according to the manufacturer's instructions.

6. When using an **ELISA automated work station**, all critical steps (dispensation, incubation, washing, reading, data handling) have to be carefully set, calibrated, controlled and regularly serviced in order to match the values reported in the section "Internal Quality Control". The assay protocol has to be installed in the operating system of the unit and validated as for the washer and the reader. In addition, the liquid handling part of the station (dispensation and washing) has to be validated and correctly set. Particular

attention must be paid to avoid carry over by the needles used for dispensing and for washing. This must be studied and controlled to minimize the possibility of contamination of adjacent wells. The use of ELISA automated work stations is recommended for blood screening when the number of samples to be tested exceed 20-30 units per run.

7. When using automatic devices, in case the vial holder of the instrument does not fit with the vials supplied in the kit, transfer the solution into appropriate containers and label them with the same label peeled out from the original vial. This operation is important in order to avoid mismatching contents of vials, when transferring them. When the test is over, return the secondary labeled containers to 2..8°C, firmly capped, if not contaminated by the use (in case of an instrument with a fixed needle, without disposable tips).
8. Dia.Pro's customer service offers support to the user in the setting and checking of instruments used in combination with the kit, in order to assure compliance with the requirements described. Support is also provided for the installation of new instruments to be used with the kit.

L. PRE ASSAY CONTROLS AND OPERATIONS

1. Check the expiration date of the kit printed on the external label of the kit box. Do not use if expired.
2. Check that the liquid components are not contaminated by naked-eye visible particles or aggregates. Check that the Chromogen/Substrate is colorless or pale blue by aspirating a small volume of it with a sterile transparent plastic pipette. Check that no breakage occurred in transportation and no spillage of liquid is present inside the box. Check that the aluminum pouch, containing the microplate, is not punctured or damaged.
3. Dilute all the content of the 20x concentrated Wash Solution as described above.
4. Dissolve the Conjugate # 1 as described in the proper section.
5. Allow all the other components to reach room temperature (about 1 hr) and then mix as described.
6. Set the ELISA incubator at +37°C and prepare the ELISA washer by priming with the diluted washing solution, according to the manufacturers instructions. Set the right number of washing cycles as reported in the specific section.
7. Check that the ELISA reader has been turned on at least 20 minutes before reading.
8. If using an automated workstation, turn it on, check settings and be sure to use the right assay protocol.
9. Check that the micropipettes are set to the required volume.
10. Check that all the other equipment is available and ready to use.
11. In case of problems, do not proceed further with the test and advise the supervisor.

M. ASSAY PROCEDURE

The assay has to be carried out according to what reported below, taking care to maintain the same incubation time for all the samples in testing.

Manual assay:

1. Resuspend the content of the correct number of Conjugate # 1 vials with 6 ml of Conjugate #2 before starting to dispense samples and controls *One vial of such mixed conjugate is largely sufficient for 3 strips. It is recommended to dissolve only the vials strictly necessary for the run.*
2. Place the required number of wells in the microplate holder. Leave the 1st well empty for the operation of blanking.
3. Dispense 50 ul Sample Diluent in all the wells, except A1 used for blanking.
4. Then dispense 150 ul of Negative Control in triplicate, 150 ul Positive Control in single and then 150 ul of Calibrator in duplicate in proper wells.

5. Add 150 ul of Samples in each properly identified well and aspirate/dispense the same volume at least 2 times with the same pipette/tip, in order to fully disperse the sample into the diluent.
6. Incubate the microplate for **60 min at +37°C**.

Important note: *Strips have to be sealed with the adhesive sealing foil, supplied, only when the test is carried out manually. Do not cover strips when using ELISA automatic instruments.*

7. Wash the microplate with an automatic washer by delivering and aspirating 350ul/well of diluted washing solution as reported previously (section I.3).
8. Pipette 200 ul of Conjugate # 1 and Conjugate #2 mix, prepared as described before, into each well, except the 1st blanking well, and cover with the sealer.

Important note: *Be careful not to touch the plastic inner surface of the well with the tip filled with the Conjugate. Contamination might occur.*

9. Incubate the microplate sealed for **60 min at +37°C**.
10. Wash as in section 7.
11. Dispense 200 ul of Chromogen/Substrate mixture into each well, the blank well included. Then incubate the microplate at **room temperature (18-25°C) for 30 minutes**. Start the timing immediately after addition of this component to the first well.

Important note: *Do not expose to strong direct illumination. High background might be generated.*

12. Pipette 100 ul Sulphuric Acid into all the wells using the same pipetting sequence as in step 13 to stop the enzymatic reaction. Addition of acid will turn the positive controls and positive samples from blue to yellow.
13. Measure the color intensity of the solution in each well, as described in section I.5, at 450nm filter (reading) and at 620-630nm (background subtraction), blanking the instrument on A1 (mandatory).

Important notes:

1. *Ensure that no finger prints are present on the bottom of the microwell before reading. Finger prints could generate false positive results on reading.*
2. *Reading has to be carried out just after the addition of the Stop Solution and anyway not any longer than 30 minutes after its addition. Some self oxidation of the chromogen can occur leading to high background.*

Automated assay:

1. Resuspend the content of the correct number of Conjugate # 1 vials with 6 ml Conjugate # 2 before the assay is started. Once the lyophilized powders are dissolved and mixed well, they have to be mixed together into a plastic container and the assay may begin.
Note: *One vial of such mixed conjugates is largely sufficient for 3 strips. It is recommended to dissolve only the vials strictly necessary for the run.*
2. In case the test is carried out automatically with an ELISA system, we suggest to make the instrument dispense 50 ul Sample Diluent first and then 150 ul controls and samples, shaking the microplate to homogenize the dilution. Before the next sample is aspirated, needles (when fixed) have to be duly washed to avoid any cross-contamination among samples or disposable tips have to be changed.
3. For the next operations follow the operative instructions reported before for the Manual Assay.
4. It is strongly recommended to check that the time lap between the dispensation of the first and the last sample will be calculated by the instrument and taken into consideration by delaying the first washing operation accordingly.

Note: When the sample is added the color of the well turns from green to blue. The color change is visible to the naked-eye and its intensity can be read according to the procedure of verification of dispensation (chapter N).

N. ASSAY SCHEME

Method	Operations
Sample Diluent	50 ul
Controls	150 ul
Calibrator(*)	150 ul
Samples	150 ul
1st incubation	60 min
Temperature	+37°C
Wash step	n° 5 cycles with 20" of soaking OR n° 6 cycles without soaking
Conjugate # 1&2 Mix	200 ul
2nd incubation	60 min
Temperature	+37°C
Temperature	+37°C
Wash step	n° 5 cycles with 20" of soaking OR n° 6 cycles without soaking
TMB/H2O2	200 ul
3rd incubation	30 min
Temperature	r.t.
Sulphuric Acid	100 ul
Reading OD	450nm – 620-630nm

Procedure of Verification of Dispensation:

The addition of Sample Diluent, Samples, Conjugate#1+2 mix solution, Chromogen/Substrate, is verified by reading wells at 405nm, according to what defined in the following table:

Steps (addition of)	Volumes do dispense	Verification (reading)
Empty well	////	OD405nm<0.050
Sample Diluent	50 µl	OD405nm≥0.130
After sample addition	150 µl	OD405nm≥0.350
Mixed Conjugate1+2	200 µl	OD405nm≥0.150
Chromogen/Substrate	200 µl	OD405nm≥0.090

(*) Important Notes:

The Calibrator (CAL) does not enter into the Cut Off calculation; therefore its use is not mandatory, but anyway recommended for internal quality control procedure.

An example of dispensation scheme (manual assay) is reported below:

		Microplate											
		1	2	3	4	5	6	7	8	9	10	11	12
A	BLK	S2											
B	NC	S3											
C	NC	S4											
D	NC	S5											
E	CAL(*)	S6											
F	CAL(*)	S7											
G	POS	S8											
H	S1	S9											

Legenda: BLK = Blank NC = Negative Control POS = Positive Control S = Sample CAL(*) = Calibrator – Not Mandatory

O. INTERNAL QUALITY CONTROL

A check is carried out on the controls and the calibrator any time the kit is used in order to verify whether their OD450nm values are as expected and reported in the table below.

Check	Requirements
Blank well	≤ 0.100 OD450nm value
Negative Control (NC)	≤ 0.200 OD450nm value after blanking Absorbance of individual negative control values must be less than or equal to 0.200. If one value is outside this range, discard this value and recalculate mean. If two values are outside this range the run should be repeated.
Positive Control	Mean OD450nm ≥ 0.500

If the results of the test match the requirements stated above, proceed to the next section.

If they do not, do not proceed any further and operate as follows:

Problem	Check
Blank well > 0.100 OD450nm	1. that the Chromogen/Sustrate solution has not got contaminated during the assay
Negative Control (NC) > 0.200 OD450nm after blanking	1. that the washing procedure and the washer settings are as validated in the pre qualification study; 2. that the proper washing solution has been used and the washer has been primed with it before use; 3. that no mistake has been done in the assay procedure (dispensation of positive control instead of negative control); 4. that no contamination of the negative control or of their wells has occurred due to positive samples, to spills or to the enzyme conjugate; 5. that micropipettes haven't got contaminated with positive samples or with the enzyme conjugate 6. that the washer needles are not blocked or partially obstructed.
Positive Control < 0.500 OD450nm	1. that the procedure has been correctly executed; 2. that no mistake has been done in the distribution of controls (dispensation of negative control instead of positive control. In this case, the negative control will have an OD450nm value > 0.150, too. 3. that the washing procedure and the washer settings are as validated in the pre qualification study; 4. that no external contamination of the positive control has occurred.

Should these problems happen, after checking, report any residual problem to the supervisor for further actions.

Important Note:

If the Calibrator has used, verify the following data:

Check	Requirements
Calibrator	S/Co > 1.0

If the results of the test doesn't match the requirements stated above, operate as follows:

Problem	Check
Calibrator S/Co < 1	1. that the procedure has been correctly executed; 2. that no mistake has been done in its distribution (e.g.: dispensation of negative control instead); 3. that the washing procedure and the washer settings are as validated in the pre qualification study; 4. that no external contamination of the calibrator has occurred.

Anyway, if all other parameters (Blank, Negative Control, Positive Control), match the established requirements, the test may be considered valid.

P. CALCULATION OF THE CUT-OFF

The tests results are calculated by means of a cut-off value determined with the following formula on the mean OD450nm value of the Negative Control (NC):

$$NC + 0.300 = \text{Cut-Off (Co)}$$

The value found for the test is used for the interpretation of results as described in the next paragraph.

Important note: When the calculation of results is done by the operative system of an ELISA automated work station be sure that the proper formulation is used to calculate the cut-off value and generate the right interpretations of results.

Q. INTERPRETATION OF RESULTS

Test results are interpreted as ratio of the sample OD450nm and the Cut-Off value (or S/Co) according to the following table:

S/Co	Interpretation
< 0.9	Negative
0.9 – 1.1	Indeterminate
> 1.1	Positive

Samples showing a value of S/Co < 0.9 are considered negative and this result indicates that the patient has not been infected by Plasmodium species.

Samples showing a value of S/Co > 1.1 are considered positive and this result is indicative of a recent or past Plasmodium species infection.

Samples showing a S/Co value in the gray-zone 0.9 – 1.1 have to be retested after 2-3 weeks to verify whether or not the result has become positive.

Important notes:

1. Interpretation of results should be done under the supervision of the responsible of the laboratory to reduce the risk of judgment errors and misinterpretations.
2. According to US NIH's directive, any positive result in blood screening should be confirmed by a Confirmatory method capable to detect antibodies to Malaria antigens before a diagnosis of infection is formulated.
3. Nucleic Acid Tests (NATs) for Malaria ssp are not intended to confirm an antibody assay by definition. However they may be used by the responsible of the laboratory to decide whether or not the blood unit can be transfused, even in presence of antibodies (ask DiaPro srl for Malaria ssp RealTime PCR kit).
4. As proved in the Performance Evaluation of the product, the assay is able to detect anti Malaria ssp antibodies earlier than some other commercial kit. Therefore a positive result, not confirmed with these less sensitive commercial kits, can not be considered a false positive result, unless other evidences are present. The sample should be submitted to a Confirmation assay.
5. When test results are transmitted from the laboratory to an informatics centre, attention has to be done to avoid erroneous data transfer.
6. Diagnosis of Malaria infection has to be done and released to the patient only by a qualified medical doctor. The presence of antibodies does not mean, anyway, that the patient is undergoing an infection at the moment of analysis. Antibodies can last for the life of the patient even in absence of Malaria ssp live organisms in blood. The diagnosis of Malaria ssp infection should be done only in presence of other clinical and diagnostic evidences (presence of Malaria antigen in blood by RealTime PCR or other methods).

An example of calculation is reported below:

The following data must not be used instead of real figures obtained by the user.

Negative Control: 0.048 – 0.050 – 0.052 OD450nm
Mean Value: 0.050 OD450nm
Lower than 0.200 – Accepted
Cut-Off = 0.050 + 0.300 = 0.350
Positive Control: 1.000 OD450nm mean value
Higher than 0.500 – Accepted
Calibrator: 0.810 OD450nm mean value
S/Co > 1 – Accepted
Sample 1: 0.070 OD450nm

Sample 2: 1.690 OD450nm

Sample 1 S/Co < 1 = negative

Sample 2 S/Co > 1 = positive

R. PERFORMANCES

1. SENSITIVITY:

The Analytical Sensitivity of the assay, has been defined by means of First WHO Reference Reagent for Anti-malaria (Plasmodium Falciparum) human serum, NIBSC code: 10/198. Results of limiting dilution of the reference standard into a negative specimen (Neg Control) are shown in the table below, reporting the mean values obtained in the analysis of three different lots of the device

WHO IU/ml	OD450 nm	Co/S
10	3.767	10.3
5	2.485	6.8
2.5	1.310	3.6
1	0.547	1.5
0.5	0.276	0.8
0.25	0.161	0.4
Neg. Control	0.060	0.2

The sensitivity shown by the assay is better than 1 WHO IU/ml.

In addition the sensitivity of the system was also assessed on the panel supplied by NIBSC, UK, for antibodies to Plasmodium species.

Results of three lots of product,, expressed as S/Co values, are summarized in the table below:

Member ID	Plasmodium species	S/Co
71/281 Version 3.0, dated 14/04/2008	p. Vivax	>5.0
72/348 Version 3.0, dated 14/04/2008	p. Vivax	>2.0
72/092 Version 3.0, dated 04/06/2015	p. Falciparum	>1.1
71/326 Version 3.0, dated 14/04/2008	p. Vivax	>5.0
72/096 Version 1.0, dated 08/07/2015	p. Malariae	>5.0
72/345 Version 3.0, dated 14/04/2008	p. Falciparum	>5.0
72/341 Version 3.0, dated 14/04/2008	p. Falciparum	>5.0

Moreover, the sensitivity of the Product Malaria Ab was assessed on the Panel EFS Ac anti-PALUDEEN, lot n° 07.191026 (DQ030), supplied by the Etablissement Francais Du Sang (EFS), France, with the following results:

Sample	ID	S/Co
Ac PALU n° 1	6914478877	>2.5
Ac PALU n° 2	69081724786	>2.0
Ac PALU n° 3	4406095555	>4.0
Ac PALU n° 4	Diluent	<0.9

Finally, the sensitivity has been examined testing the Control Sample CRS PAL lot 2701163 (Contrôle interne monoparamétrique Ac anti-plasmodium) supplied by the Etablissement Francais Du Sang (EFS) with three lots of the device. The control has been found always positive obtaining an index value higher than 1.2 (S/Co>1.2).

The Diagnostic Sensitivity of the assay has been calculated on a panel of samples positive for antibodies to Plasmodium species, previously classified positive by a reference method. The test shows a sensitivity > 95% on plasma and sera.

2. DIAGNOSTIC SPECIFICITY:

It has been calculated on panels of negative blood donors, previously determined negative by the reference method (Diamed/Biorad).

The assay shows a specificity > 98% on plasma and sera.

3. REPRODUCIBILITY:

It has been evaluate by examining the negative control, the calibrator and the positive control in 16 replicates in three different runs carried out with the device lot # 0407.

Results are reported in the tables below:

Negative Sample (N = 16)

Mean values	1st run	2nd run	3 rd run	Average value
OD 450nm	0.136	0.146	0.153	0.145
Std.Deviation	0.009	0.014	0.011	0.011
CV %	6.4	9.3	7.5	7.7

Calibrator (N = 16)

Mean values	1st run	2nd run	3 rd run	Average value
OD 450nm	0.889	0.860	0.844	0.864
Std.Deviation	0.051	0.048	0.094	0.064
CV %	4.3	3.8	7.0	5.0

Positive Sample (N = 16)

Mean values	1st run	2nd run	3 rd run	Average
OD 450nm	3.191	3.300	3.175	3.222
Std.Deviation	0.062	0.098	0.103	0.088
CV %	1.9	3.0	3.2	2.7

From the data above the following statistical values have been derived :

Mean values N = 48	Negative Sample	Calibrator	Positive Sample
OD450nm	0.145	0.864	3.222
Std.Deviation	0.011	0.064	0.088
CV %	7.7	5.0	2.7

REFERENCES

1. Garcia LS et al. Update on Malaria. Clin Microbiol News Lett; 1992, 14:65-9
2. Krogstad DJ et al. Plasmodium species (Malaria) principles and practice of infectious diseases, 4th ed, MandellGL et al., 1995, 2415-27.
3. Smith JH et al. Malaria: clinical laboratory features. Clin Microbiol News Lett, 1995,17(24): 185-8.

All the IVD Products manufactured by the company are under the control of a certified Quality Management System in compliance with EN ISO 13485 rule. Each lot is submitted to a quality control and released into the market only if conforming with the EC technical specifications and acceptance criteria.

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