HYPHEN BioMed
155 rue d'Eragny, 95000 Neuville-sur-Oise, France
Tél : +33 (0)1 34 40 65 10
Fax : +33 (0)1 34 48 72 36
www.hyphen-biomed.com
info@hyphen-biomed.com

CE

ZYMUTEST TOTAL PROTEIN S

 # RK021A

(Complete one step ELISA kit for the assay of Total Protein S)

For in vitro diagnostic use only

Last revision: 17/11/2022

INTENDED USE:

The ZYMUTEST Total Protein S kit is a one step, two-site immuno-assay, for measuring human Total Protein S in plasma, or in any fluid where Total Protein S can be present.

ASSAY PRINCIPLE:

First, the immunoconjugate, which is a monoclonal antibody specific for both forms of Protein S (free or complexed with C4b-Binding Protein) coupled to horse radish peroxidase (HRP), is introduced into the microwells coated with another monoclonal antibody also specific for both Protein S forms. Then, the diluted tested plasma or biological fluid is immediately introduced, and the immunological reaction starts. When present, the Protein S (free or complexed with C4b-BP) binds onto the monoclonal antibody coated solid phase through one epitope, and fixes the second monoclonal antibody coupled to HRP by another epitope. Following a washing step, the peroxidase substrate, 3,3',5,5' – Tetramethylbenzidine (TMB), in presence of hydrogen peroxide (H_2O_2), is introduced and a blue colour develops. When the reaction is stopped with Sulfuric Acid, a yellow colour is obtained. The amount of colour developed is directly proportional to the concentration of human Total Protein S in the tested sample.

TEST SAMPLE:

- Trisodium Citrate anticoagulated human plasma.
- Any biological fluid where Protein S must be measured.

REAGENTS:

1. **COAT: Micro ELISA plate,** containing 12 strips of 8 wells, coated with a mouse monoclonal antibody specific for the two forms of human Protein S, then stabilised; the plate is packed in an aluminium pouch hermetically sealed in presence of a desiccant.
2. **SD:** 2 vials containing 50 ml of **Protein S-Sample Diluent**, ready to use (**contains calcium**).
3. **Cal:** 3 vials of **Plasma Protein S calibrator**, (normal plasma calibrated with a reference plasma pool), lyophilised, prediluted **1:50**.
   Each vial, when restored with **2 ml** of Protein S-Sample Diluent, allows obtaining the plasma calibrator, already diluted **1:50**. The exact Total Protein S concentration is indicated on the flyer provided in the kit.
4. **CI:** 1 vial containing **0.5 ml** of lyophilised **Protein S Control I, (Plasma, high)**
5. **CII:** 1 vial containing **0.5 ml** of lyophilised **Protein S Control II, (Plasma, low)**

   Note: The Total Protein S concentrations and acceptancy ranges for control plasma I and II, and calibrator, can vary from lot to lot, but are precisely indicated for each lot on the flyer provided in the kit.
6. **IC:** 3 vials of **Anti-(h)-Total-Protein S-HRP immunoconjugate**, a mouse monoclonal antibody coupled to HRP, lyophilised.
7. **CD:** 1 vial of 15 ml of **Protein S Conjugate Diluent**, ready to use.
8. **WS:** 1 vial of 50 ml of 20 fold concentrated **Protein S Wash Solution (contains calcium)**.
9. **TMB:** 1 vial of 25 ml of peroxidase substrate: **3,3',5,5' – Tetramethylbenzidine,** containing hydrogen peroxide. Ready to use.
10. **SA:** 1 vial of 6 ml of **0.45 M Sulfuric Acid** (Stop solution). Ready to use.

Note: Use only components from a same kit lot number. Do not mix components from different lots when running the assay.

REAGENTS AND EQUIPMENT REQUIRED BUT NOT PROVIDED:

- **8-channel** or repeating **pipette** allowing dispensing 50-300 µl.
- **1-channel pipettes** at variable volumes from 0 to 20 µl, 20 to 200 µl and 200 to 1000 µl.
- **Micro ELISA plate** washing equipment and shaker.
- Micro ELISA plate **reader** with a wavelength set up at 450 nm.
- Distilled water.

REAGENTS PREPARATION, STORAGE AND STABILITY:

In their original packaging box, before use, when stored at 2-8°C, the unopened reagents are stable until the expiration date printed on the box.

1. **Micro ELISA plate:** open the plastic pouch and take off the required amounts of 8 well strips for the test series. When out of the pouch, the strips must be used within 30 minutes. Unused strips can be stored at **2-8°C for 4 weeks** in their original aluminium pouch, in presence of the desiccant, hermetically closed and protected from any moisture, and stored in the provided microplate storage bag (minigrip).
2. **Protein S-Sample Diluent:** It is ready to use. When open, it can be used for **4 weeks**, stored at **2-8 °C**, and provided that any bacterial contamination is avoided during use. It contains 0.05% Kathon CG.
3. **Plasma Protein S calibrator:** restore each vial with **2 ml** of Protein S-Sample Diluent**,** in order to obtain the calibrator plasma, containing the Total PS concentration **"C%", already diluted 50 fold**. This solution is stable for at least **8 hours** at room temperature.
4. **Protein S Control I** (human plasma, high): restore with **0.5 ml** distilled water.
5. **Protein S Control II** (human plasma, low): restore with **0.5 ml** distilled water.

Note: when restored, Protein S controls are stable for **8 hours** at room temperature, **24 hours at 2-8°C** or **2 months** frozen at **–20°C** or below.

Warning: Plasma Protein S calibrator(3) and controls (4&5) are prepared with normal human plasma. This latter was tested with registered methods and found negative for HIV antibodies, HBs Ag and HVC antibodies. However, no assay may warrant the total absence of infectious agents. Any product of human origin must then be handled with all the required cautions, as being potentially infectious.

6. **Anti-(h)-Total-Protein S-HRP immunoconjugate**: each vial must be restored with **4 ml** of Protein S Conjugate Diluent. Let the pellet to be completely dissolved before use, and shake the vial gently in order to homogeneize the content. The restored conjugate is stable for at least **24 hours** at room temperature or for at least **4 weeks at 2-8°C.**
7. **Protein S Conjugate Diluent**: It is ready to use. When open, it can be used for **4 weeks**, stored at **2-8 °C**, and provided that any bacterial contamination is avoided during use. It contains 0.05% Kathon CG.
8. **Protein S Wash Solution**: Incubate the vial for 15-30 minutes in a water bath at **37°C** until complete dissolution of solids, when present. Shake the vial and dilute the amount required 1:20 in distilled water (the 50 ml contained in the vial allow preparing 1 liter of Wash Solution). The Protein S Wash Solution must be stored at **2-8°C** in its original vial and used within **4 weeks** following opening. The diluted Wash Solution must be used within **7 days**, when protected from any contamination and stored at **2-8°C**. It contains 0.05% Kathon CG. This Protein S Wash Solution contains calcium and must be used for Protein S assay.
9. **TMB substrate**: It is ready to use. When open, it can be used for **4 weeks**, stored at **2-8 °C**, and provided that any bacterial contamination is avoided during use.
10. **Stop solution** : 0.45 M Sulfuric Acid, ready to use.

Note: Bring the kit at room temperature, at least 30 min. before use. Store the unused reagents at 2-8°C.

The stability studies performed at 30°C show that the reagents keep their performances and can be shipped at room temperature without any damage

PROCEDURE:

Specimen collection:

Blood (9 vol.) must be collected on 0.109M citrate anticoagulant (1 vol.); plasma supernatant is decanted following a 20 min. centrifugation at 2,500 g; citrated plasma should be tested **within 8 hours** or stored frozen at –20°C or below for up to 6 months, and thawed for 15 min. at 37°C just before use. Thawed specimen must be tested within **4 hours**.

Tested plasma or sample:

The sample must be tested diluted **fifty fold (1:50)** in the Protein S-Sample Diluent. For expected Protein S concentrations > 100 %, plasma or samples must be tested at a higher dilution, i.e 1:100 or more. If the dilution factor is **D**, concentrations obtained must then be multiplied by the complementary dilution factor which is **D:50** (i.e. x2 for 1/100 etc…). For low Protein S levels (<10%) the sample can be tested at a lower dilution **D'**, and the concentration obtained must be divided by **50**:**D'**.
Plasma Protein S controls I and II must be tested at **1:50** dilution.

Calibration:

Total Protein S concentrations are expressed as **% of a normal pooled human plasma.** For the Total Protein S assay, the **100% concentration** corresponds to a normal pooled human plasma **diluted 1:50**, which is the standard assay dilution.
Using the Protein S calibrator provided in the kit (2 ml of plasma calibrator already prediluted **1:50** and with a Total Protein S concentration "**C**" indicated, for each lot of reagents, on the flyer provided in the kit), prepare the following standard solutions:

Total Protein S concentration (%)	C	C/2	C/4	C/10	C/20	0
Vol. of Protein S calibrator	1 ml	0.5 ml	0.25 ml	0.1 ml	0.05 ml	0 ml
Vol. of Protein S- Sample Diluent	0 ml	0.5 ml	0.75 ml	0.9 ml	0.95 ml	1 ml

Mix gently for a complete homogeneisation.
The standard dilutions are stable for at least **4 hours** at room temperature.

Assay procedure:

Remove the required number of strips from the aluminium pouch, for the series of measures to be performed. Then, put the strips in the frame provided. In the different wells of the micro ELISA plate, introduce the reagents and perform the various assay steps as indicated on the following table:

Reagent	Volume	Procedure
Immunoconjugate anti-(h)-Total Protein S-HRP. (Restored with 4 ml of Protein S Conjugate Diluent)	**100 µl**	Introduce the Anti-(h)-Total Protein S- HRP immunoconjugate in the micro ELISA plate wells
Protein S calibrator or tested sample or Protein S Sample Diluent (blank)	**100 µl**	Introduce **immediately** the standard solutions or the tested samples in the corresponding micro ELISA plate well
Mix gently on a plate shaker or manually and incubate for 1 hour at room temperature		
Protein S Wash Solution (20 fold diluted in distilled water).	**300 µl**	Proceed to 5 successive washings using the washing instrument. **(a)**
TMB/H_2O_2 Substrate	**200 µl**	Immediately after the washing, introduce the substrate into the wells. ***Nota :*** The substrate distribution, row by row, must be accurate and at exact time intervals **(b, c)**.
Incubate for exactly 5 minutes at room temperature (18-25 °C) (d)		
0.45 M Sulfuric Acid (5)	**50 µl**	Following exactly the same time intervals than for the addition of substrate, stop the colour development by introducing the 0.45M sulfuric acid **(c).**
Wait for 10 minutes in order to allow the colour to stabilize and measure absorbance at 450 nm (A450). Subtract the blank value.		

Nota:
Distribute calibrators, controls and tested specimen as rapidly as possible (within 10 minutes), in order to obtain an homogeneous immunological kinetics for antigen binding. A too long delay between the distribution of the first and the last wells may induce an influence of immunological kinetics and produce wrong results

a. Only the specific Protein S Washing Solution, which contains calcium, must be used, for this assay, as the monoclonal antibodies are calcium dependent.
b. Never let the plates empty between the addition of the reagents or following the washing step. The next reagent must be added within 3 minutes, in order to prevent the plate from drying, which could damage the immobilized components. If necessary, keep the plate filled with Wash Solution and empty it just before the introduction of the next reagent. The washing instrument must be adjusted in order to wash the plates gently, and to avoid a too drastic emptying, which could lower plate reactivity.
c. For addition of the TMB substrate, the time interval between each row must be accurate and exactly determined. It must be the same when stopping the reaction.
d. Avoid letting the plate in the bright sunlight during incubations and more particularly during colour development. A micro-ELISA plate shaker can be used.
e. For bichromatic readings, a reference wavelength at 690 nm or at 620 nm can be used.

RESULTS:

Users must construct their own calibration curve, obtained using their standard dilutions (see flyer).

On a linear graph paper plot the **Total Protein S concentrations** (%) on abscissa and the corresponding absorbances (**A450**) on ordinates.

From the curve obtained, deduce directly the Total Protein S concentration in samples tested at the standard **1:50 dilution**. When higher dilutions are used (i.e D), the Total Protein S concentration must be multiplied by the complementary dilution factor **(i.e. D:50).** When lower dilutions are used (i.e. D'), the concentration obtained must be divided by **50:D'**.

For **controls I and II**, the concentrations are directly deduced from the calibration curve.

Alternatively, an ELISA software (i.e. Dynex, Biolise, etc...) can be used for the calculation of concentrations.

EXPECTED RANGE:

- The Total Protein S concentration in normal human plasma is usually in the range 70–150%. The concentration is higher in males than in females. It tends to increase with age, and with blood lipid concentration.

BIOCHEMISTRY

- The Protein S concentration in normal human plasma is of about 25 µg/ml (1). About 40% (i.e. 10 µg/ml) is in the Free form and 60% (i.e. 15 µg/ml) circulates in blood as a non-covalent complex with C4b-BP. Only the Free form has an anticoagulant activity as the cofactor of Activated Protein C.
- Protein S is synthesized in liver. It is a vitamin K dependent glycoprotein, with a molecular weight of 80,000 daltons. The balance between the free form and the C4b-BP bound form of protein S plays an important role because only the Free Protein S is active. In the early stages of inflammatory diseases, Free Protein S concentration is decreased as a result of an elevation of C4b-BP. Protein S is decreased in dicoumarol or L-asparaginase therapy, and in hepatic diseases.

PATHOLOGICAL VARIATIONS:

- Total Protein S concentrations are decreased in type I Protein S deficiencies.
- Transitory Free Protein S deficiencies are observed during the early stages of inflammatory diseases, as a result of increased C4b-BP concentrations, which form complexes with Protein S. However, the Total Protein S is normal or increased.
- Abnormal range for Total Protein S is <70%. However, this cut off value must be analysed respectively to the patient context (age, gender, therapy, lipid metabolism, etc…), when diagnosing a Protein S deficiency.

APPLICATIONS:

– Diagnosis of Protein S deficiencies (congenital, acquired or transitory).
  - Type I deficiency: Partial deficiency of total and Free Protein S antigen.
  - Type II deficiency: Normal total and Free Protein S antigen, reduced activity.
  - Type III deficiency: Normal total antigen, decreased activity and free antigen.
– Assay of Protein S in clinical studies.

CHARACTERISTICS

The ZYMUTEST Total Protein S assay is specific for both forms of Protein S (free or complexed with C4b-BP), and is designed with 2, calcium dependent, monoclonal antibodies, which bind as well as to free Protein S as to complexes with C4b-BP.
- Dynamic range: 0 to about 100%.
- Detection threshold ≤ 5%.
- Intra-assay CV: 3-8%.
- Inter-assay CV: 5-10%.
- No significant interference of heparin up to 2 IU/ml, of bilirubin up to 0.1 mg/ml and of haemoglobin up to 10 mg/ml.
- Reference material: International Standard for Protein S (93/590) and normal plasma pools.

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Changes compared to the previous version.