

**\*\*REPRESENTATIVE DATASHEET\*\*****Matched-Pair Antibody Set  
for ELISA of human  
Protein S antigen (PS)**

Sufficient reagent for 5 x 96 well plates

**Product #:** PS-EIA  
**Lot #:** XXXX  
**Expiry Date:** XXXX1395 Sandhill Drive, Ancaster, Ontario, Canada L9G 4V5  
905-304-9896 • 800-903-6020 • fax 905-304-9897**Store at -10 to -20°C**

For Research Use Only

Not for use in diagnostic procedures.

**Description of Protein S (PS)**

Protein S (PS) is a vitamin K-dependent glycoprotein produced in the liver, endothelium and megakaryocytes. The concentration of PS in plasma is ~25 µg/ml (~325 nM) where it acts as a cofactor in the anticoagulant activity of activated Protein C. A deficiency of Protein S (quantitative or qualitative) is a risk factor for vascular thrombosis. Protein S is expressed as a single chain molecule with a molecular weight of 77 kDa. The structure of PS is similar to many other vitamin-K dependent coagulation proteins, consisting of an N-terminal calcium binding domain of 10 γ-carboxyglutamic acid (gla) residues, followed by a thrombin-sensitive loop region and 4 EGF-like domains. The C-terminal domain does not contain the usual catalytic triad of a proenzyme, but seems instead to be involved in the binding of PS to C4b-binding protein (C4bp). Protein S binds to activated Protein C (APC) in the presence of calcium and negatively charged phospholipid surface to allow APC to proteolytically inactivate coagulation cofactors Va and VIIIa. Enzymatic regulation of PS cofactor activity is through cleavage of PS in the thrombin-sensitive loop region by thrombin or other enzymes, resulting in the loss of calcium binding properties and APC cofactor activity. Another regulatory mechanism is to reduce the availability of PS by the binding of PS to C4bp. In plasma, approximately 60% of Protein S circulates in non-covalent complex with C4bp, making it unavailable for APC cofactor activity. The binding of PS to C4bp may be important in localizing C4bp to damaged cell membranes where it may control activation of complement by the classical pathway<sup>1-3</sup>.

**Principle of Sandwich-style ELISA**

Affinity-purified polyclonal antibody to PS is coated onto the wells of a microtitre plate. Any remaining binding sites on the plastic wells are blocked with bovine serum albumin. The plates are washed and plasma or other fluids containing PS are applied. The coated antibody will capture the PS in the sample. After washing the plate to remove unbound material, a peroxidase conjugated second antibody to PS is added to the plate to bind to the captured PS. After washing the plate to remove unbound conjugated antibody, the peroxidase activity is expressed by incubation with o-phenylenediamine (OPD). After a fixed development time the reaction is quenched with the addition of H<sub>2</sub>SO<sub>4</sub> and the colour produced is quantified using a microplate reader. The colour generated is proportional to the concentration of PS in the sample.

**Supplied Materials:**

- 1. Capture Antibody (PS-EIA-C):** One yellow-capped vial containing 0.5 ml of affinity-purified polyclonal anti-Protein S antibody for coating plates.
- 2. Detecting Antibody (PS-EIA-D):** One red-capped vial containing 0.5 ml of peroxidase conjugated polyclonal anti-Protein S antibody for detection of captured Protein S.

**Note:** Antibodies are supplied in a 50% (v/v) glycerol solution for storage at -10 to -20°C. Keep vials tightly capped. Do not store in frost-free freezers.

**Materials Required but not Provided:**

This paired antibody set has been optimized for performance using the buffers and conditions described below. Most reagents are available as part of the VisuLize™ Buffer Pak (see Related Products section) or may be prepared as described below.

- 1. Coating Buffer:** 50 mM Carbonate  
1.59g of Na<sub>2</sub>CO<sub>3</sub> and 2.93g of NaHCO<sub>3</sub> up to 1 litre. Adjust pH to 9.6. Store at 2-8°C up to 1 month.
- 2. PBS:** (base for wash buffer and blocking buffer)  
8.0g NaCl, 1.15g Na<sub>2</sub>HPO<sub>4</sub>, 0.2g KH<sub>2</sub>PO<sub>4</sub> and 0.2g KCl, up to 1 litre. Adjust pH to 7.4, if necessary. Store up to 1 month at 2-8°C, discard if there is evidence of microbial growth.
- 3. Wash Buffer:** PBS-Tween (0.1%,v/v)  
To 1 litre of PBS add 1.0 ml of Tween-20.  
Check that the pH is 7.4. Store at 2-8°C up to 1 week.
- 4. Blocking Buffer:** PBS-BSA (1%, w/v)  
Dissolve 2.5 g of Bovine Serum Albumin (Sigma-RIA grade) in 200 ml of PBS. Adjust pH to 7.4, if required, then make up to 250 ml with PBS. Aliquot and store frozen at -20°C.
- 5. Sample Diluent:** HBS-BSA-T20  
5.95g HEPES (free acid), 1.46 g NaCl, 2.5 g Bovine Serum Albumin (Sigma, RIA grade) dissolved in 200 ml H<sub>2</sub>O. Add 0.25 ml of Tween-20, check and adjust pH to 7.2 with NaOH, then make up to a final volume of 250 ml with H<sub>2</sub>O. Aliquot and store frozen at -20°C.
- 6. Substrate Buffer:** Citrate-Phosphate buffer pH 5.0  
2.6g Citric acid and 6.9g Na<sub>2</sub>HPO<sub>4</sub> up to a final volume of 500 ml with purified H<sub>2</sub>O. Store at 2-8°C up to 1 month.
- 7. OPD Substrate:** (o-Phenylenediamine.2HCl) TOXIC!  
(5mg tablets: Sigma # P-6912). Make up immediately before use. Dissolve 5mg OPD in 12 ml substrate buffer then add 12 µl 30% H<sub>2</sub>O<sub>2</sub>. Do not store.

**8. Stopping Solution:** 2.5 M H<sub>2</sub>SO<sub>4</sub>

**Caution: VERY CORROSIVE! GENERATES HEAT ON DILUTION!** Where stock sulphuric acid is 18 Molar, add 13.9 ml to 86 ml H<sub>2</sub>O. Store at room temperature.

**9. Other:**

Microplates, 96-well Immulon 4-HBX (<http://www.labsystems.fi>)  
Microplate washer (optional)  
Microplate reader.  
Optional: VisuLize™ Buffer Pak  
Optional: VisuCal™ Antigen Calibrator Plasma

## Assay Procedure:

### 1. Coating of plates:

Dilute the capture antibody 1/100 in coating buffer (preferably in a polypropylene tube) and immediately add 100 µl to every well in the plate. Incubate overnight at 2-8°C.

### 2. Blocking:

Empty contents of plate and add 150 µl of blocking buffer to every well and incubate for 90 minutes @ 22°C. Wash plate X 3 with wash buffer.

### 3. Samples:

**Total Protein S:** Reference plasma is diluted 1/400 (100%) then serial 1/2's down to 1/12,800 (3.13%). Sample plasmas are diluted 1/800, 1/1,600 & 1/3,200.

**Free Protein S:** Reference plasma and samples are PEG precipitated before use<sup>2</sup>. Reference plasma supernatant is diluted 1/200 (100%) then serial 1/2's down to 1/6,400 (3.13%). Sample plasma supernatants are diluted 1/400, 1/800 & 1/1600. All dilutions are made in HBS-BSA-T20 sample diluent. Apply 100 µl/well and incubate plate @ 22°C for 120 minutes. Wash plate X 3 with wash buffer.

### 4. Detecting Antibody:

Dilute the detecting antibody 1/100 in HBS-BSA-T20 sample diluent and apply 100 µl to each well. Incubate plate @ 22°C for 90 minutes. Wash plate X 3 with wash buffer.

### 5. OPD Substrate:

Apply 100 µl of freshly prepared OPD substrate to every well. Allow colour to develop for 5-10 minutes then stop colour reaction with the addition of 50 µl/well of 2.5 M H<sub>2</sub>SO<sub>4</sub>. The plate can be read at a wavelength of 490 nm.

## Calculation of Results:

The construction of a proper reference curve is of no less importance than any other aspect of the assay. A reference curve should be constructed by plotting the known concentration of standards versus absorbance. This can be done manually using graph paper, or by using curve-fitting computer software. In our experience, the dose response curves of most immunoassays tend to be sigmoid in shape. Although linear regions can be identified within the curve, the best overall fit is often obtained using an algorithm that provides a weighted theoretical model of fit throughout the entire curve, such as a 4-parameter or 5-parameter logistic curve fit<sup>4,5</sup>. In general, the simplest model that defines the concentration-response relationship should be used<sup>6</sup>.

The "back-fit" test is a simple and reliable method to determine if a curve-fitting method is appropriate. In this test, the apparent concentrations for the absorbance values of each standard point are read from the reference curve. The derived values are compared to the assigned values. An appropriate curve fitting method will produce derived values that closely match assigned values throughout the range of the curve, within user-defined limits<sup>6</sup>. The coefficient of determination ( $R^2$ ) is a valuable indicator of the overall fit, but should not be used by itself in the selection of a curve fitting method, as a poor fit in a particular region of the curve may not be evident from this value alone<sup>5,6</sup>.

**In the quality control of this product we have determined that under the conditions described above, a reference curve that is constructed using serial dilutions of normal pooled plasma, will produce a correlation coefficient ( $R^2$ ) of at least 0.980 using a log-log fit, and an  $R^2$  of at least 0.990 using a 4-parameter logistic curve fit algorithm.** However, the performance characteristics of in-house assays developed using this product in other laboratories may vary slightly from ours. Different curve fitting methods may be employed but we recommend that the back-fit test be applied as evidence that the fitting method is appropriate.

## Technical Notes:

- This paired antibody product is intended to facilitate the end user in establishing an in-house immunoassay for research purposes only. It must not be used for diagnostic applications. Assay validation is the responsibility of the end user and should be done according to user-defined protocols<sup>6</sup>.
- Reference calibrators should be of the same matrix and anticoagulant as the samples to be tested (example serum or plasma, citrate or EDTA).
- Do not use samples diluted less than 1/20, as falsely high readings may result.
- The optimal colour development time should be determined empirically as the time required to obtain an absorbance of at least 1.000 at 490 nm for the 100% reference point, not to exceed 20 minutes.
- Rheumatoid factor in samples may interfere in ELISA by binding to the capture and/or detecting antibodies.
- The wells should not be allowed to become dry. Keep plate covered or in a humid chamber during incubations.
- Antibodies are supplied in a 50% glycerol solution and can be centrifuged briefly in a micro-centrifuge to gather residual reagent from the cap and walls of the tube.

## References:

1. Broze GJ, Milelich JP; Biochemistry and Physiology of Protein C, Protein S and Thrombomodulin; in Hemostasis and Thrombosis, 3<sup>rd</sup> Edition, eds. RW Colman, J Hirsh, VJ Marder and EW Salzman, pp 259-276, J.B. Lippincott Co., Philadelphia PA, USA, 1994.
2. Comp PC, Doray D, Patton D, Esmon CT; An Abnormal Plasma Distribution of Protein S Occurs in Functional Protein S Deficiency. Blood 67, pp 504-508, 1986.
3. Schwalbe RA, Dahlback B, Nelsestuen GL; Independent Association of Serum Amyloid P Component, Protein S and Complement C4b with C4b-binding Protein and Subsequent Association of the Complex with Membranes; JBC 265, pp 21749-21757, 1990.
4. Nix, B, Wild D, in Immunoassays, A Practical Approach, editor J.P. Gosling, pp. 239-261, Oxford University Press, 2000.
5. NCCLS. Evaluation of the Linearity of Quantitative Analytical Methods; Proposed Guideline - Second Edition. NCCLS Document EP6-P2 (ISBN 1-56238-446-5, NCCLS, Wayne, Pennsylvania USA, 2001.
6. FDA Guidance for Industry. Bioanalytical Method Validation; May 2001, available on the internet: [www.fda.gov/cder/guidance/index.htm](http://www.fda.gov/cder/guidance/index.htm)

## Related Products:

Cat #: EIA-PAK-1	VisuLize™ Buffer Pak: 5 plates, buffers, substrate
Cat #: EIA-CSA-1	VisuCal™ Antigen Calibrator, 1 x 1ml
Cat #: EIA-CSA-5	VisuCal™ Antigen Calibrator, 5 x 1ml
Cat #: GAPS-IG	Goat anti-human Protein S, whole IgG from antiserum
Cat #: GAPS-AP	Goat anti-human Protein S, affinity purified IgG
Cat #: GAPS-HRP	Goat anti-human Protein S, peroxidase labelled IgG
Cat #: SAPS-IG	Sheep anti-human Protein S, IgG from antiserum
Cat #: SAPS-AP	Sheep anti-human Protein S, affinity purified IgG
Cat #: SAPS-HRP	Sheep anti-human Protein S, peroxidase labelled IgG
Cat #: PS-DP	Human plasma deficient in PS, immune depleted
Cat #: PS-LDP	Human plasma deficient in PS, lyophilized

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