

Description of Factor XII (F.XII)

Factor XII (F.XII, Hageman factor) is a 76 kDa, single chain glycoprotein produced in the liver. In plasma, F.XII circulates as a protease zymogen at a concentration of approximately 30 µg/ml (400 nM). Upon vascular injury F.XII binds to negatively charged extravascular surfaces such as cartilage and skin, which facilitate activation of the zymogen to the active serine protease. Cleavage of F.XII by kallikrein after residue Arg353 produces the enzyme α F.XIIa, consisting of a 28 kDa light chain containing the protease domain, and a 52 kDa heavy chain containing the anionic surface-binding domain. Substrates for surface bound F.XIIa include the zymogens prekallikrein (PK) and factor XI (F.XI) as well as the procofactor highmolecular weight kinogen (HK). The activation of these substrates results in positive feedback activation of F.XII. Further cleavage of α F.XIIa by kallikrein produces the 28 kDa fragment β F.XIIa (Hageman factor fragment). β F.XIIa has reduced procoagulant activity as it lacks the anionic surface-binding domain, but is capable of fluid-phase activation of PK, factor VII and complement C1. The activity of F.XIIa in plasma is regulated predominantly by C1-Inhibitor, with relatively minor contributions by α 2antiplasmin, α 2macroglobulin and antithrombin, even in the presence of therapeutic levels of heparin 1-3.

Principle of Sandwich-style ELISA

Affinity-purified antibody to F.XII is coated onto the wells of a microtitre plate. Any remaining binding sites on the plastic wells are blocked with an excess of bovine serum albumin. The plates are washed and plasma or other fluids containing F.XII are applied. The coated antibody will capture the F.XII in the sample. After washing the plate to remove unbound material, a peroxidase conjugated second antibody to F.XII is added to the plate to bind to the captured F.XII. 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 H₂SO₄ and the colour produced is quantified using a microplate reader. The colour generated is proportional to the concentration of F.XII present in the sample.

Supplied Materials:

1. Capture Antibody (FXII-EIA-C): One yellow-capped vial containing 0.5 ml of polyclonal affinity purified anti-F.XII antibody for coating plates.

2. Detecting Antibody (FXII-EIA-D): One red-capped vial containing 0.5 ml of peroxidase conjugated polyclonal anti-F.XII antibody for detection of captured F.XII.

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:

1. Coating Buffer: 50 mM Carbonate

1.59g of Na₂CO₃ and 2.93g of NaHCO₃ 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 Na₂HPO₄, 0.2g KH₂PO₄ 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 H₂O. 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 H₂O.

Aliquot and store frozen at -20°C.

6. Substrate Buffer: Citrate-Phosphate buffer pH 5.0

2.6g Citric acid and 6.9g Na₂HPO₄ up to a final volume of 500 ml with purified H₂O. 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% H₂O₂. Do not store.

8. Stopping Solution: 2.5 M H₂SO₄

Caution: VERY CORROSIVE! GENERATES HEAT ON DILUTION! Where stock sulphuric acid is 18 Molar, add 13.9 ml to 86 ml H₂O.

Store at room temperature.

9. Other:

Microplates, 96-well Immulon 4-HBX (<http://www.labsystems.fi>)

Microplate washer (optional)

Microplate reader.

Document OPI0088, rev 2

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 @ 2-8oC or for 2 hours @ 22°C.

2. Blocking:

Empty contents of plate and add 150 µl of blocking buffer to every well and incubate for 90 minutes @ 22oC.

Wash plate X 3 with wash buffer.

3. Samples:

Reference plasma is diluted 1/500 (100%) then serial 1/2's down to 1/16000 (3.13%). Sample plasmas are diluted 1/1000, 1/2000 & 1/4000. All dilutions are made in HBS-BSA-T20 sample diluent. Apply 100 µl/well and incubate plate @ 22oC for 60 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 @ 22oC for 60 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 H₂SO₄. 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 4,5. In general, the simplest model that defines the concentration-response relationship should be used 6.

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 limits⁶. The coefficient of determination (R²) 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 ^{5,6}

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 (R²) of at least 0.980 using a loglog fit, and an R² of at least 0.990 using a 4-parameter logistic curve fit algorithm. However, the performance characteristics of inhouse 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 protocols⁶.

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.