



SensoLyte® 490 MMP-1 Assay Kit

Fluorimetric

Revision# 1.3	Last updated: July 2021
Catalog #	AS-71128
Kit Size	500 Assays (96-well plate)

- **Convenient Format:** All essential assay components are included.
- **Optimized Performance:** Optimal conditions for the detection of MMP-1 activity.
- **Enhanced Value:** Less expensive than the sum of individual components.
- **High Speed:** Minimal hands-on time.
- **Assured Reliability:** Detailed protocol and references are provided.

Kit Components, Storage and Handling

Component	Description	Quantity
Component A	MMP-1 substrate (270 µL) EDANS/DabcylPlus™ FRET peptide Ex/Em=340 nm/490 nm upon cleavage	270 µL
Component B	EDANS, fluorescence reference standard (1 mM, 10 µL), Ex/Em=340 nm/490 nm	1 mM, 10 µL
Component C	APMA, 4-aminophenylmercuric acetate	1 M, 100 µL
Component D	Assay buffer	60 mL
Component E	Stop solution	30 mL

Other Materials Required (but not provided)

- Recombinant MMP-1: AnaSpec Cat###55575-1, 55575-10, 72004.
- 96-well microplate: Black, flat-bottom plate with non-binding surface.
- Fluorescence microplate reader: Capable of detecting emission at 490 nm with excitation at 340 nm.

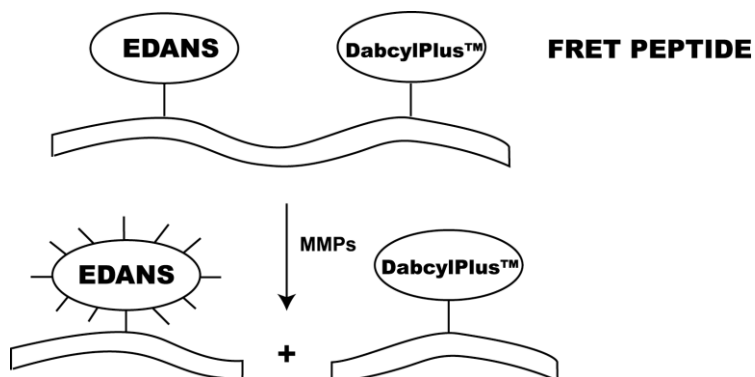
Storage and Handling

- Store all components at -20°C
- Protect Components A and B from light
- Components C and D can be stored at 4 °C for convenience

Introduction

Matrix metalloproteinases (MMPs) belong to a family of secreted or membrane-associated zinc endopeptidases capable of digesting extracellular matrix components.^{1,2} MMP-1 (collagenase) is involved in tumor development and metastasis,^{3,4} and rheumatoid arthritis.⁵ It is proposed as a therapeutic target for these diseases.

The SensoLyte® 490 MMP-1 Assay Kit provides a convenient assay for high throughput screening of MMP-1 inducers and inhibitors. It detects MMP-1 activity in a variety of biological samples using a EDANS/DabcyIPlus™ fluorescence resonance energy transfer (FRET)⁶ peptide. In the intact FRET peptide, the fluorescence of EDANS is quenched by DabcyIPlus™. Upon cleavage into two separate fragments by MMP-1 (**Scheme 1**), the fluorescence of Edans is recovered, and can be monitored at excitation/emission wavelengths = 340 nm/490 nm. DabcyIPlus™ is a quencher that is more water-soluble than DabcyI.



Scheme 1. Proteolytic cleavage of EDANS/DabcyI Plus™ FRET peptide by MMPs.

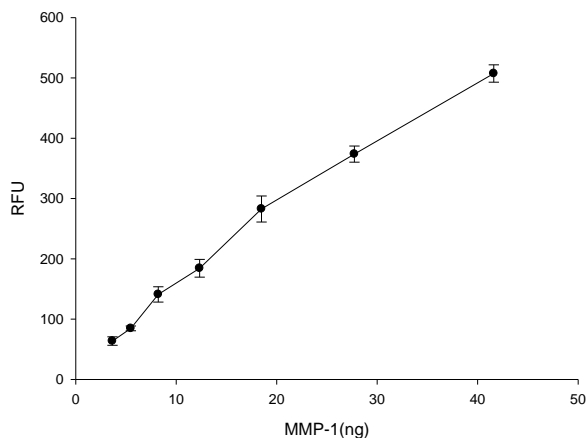


Figure 1. Sensitivity of SensoLyte® 490 MMP-1 assay kit.

Active recombinant MMP-1 was serially diluted in assay buffer. Enzyme at each dilution was mixed with MMP-1 FRET substrate and then incubated at RT for 30 min. Endpoint fluorescence signal was recorded at Ex/Em=340±30 nm/490±30 nm on Flex800 (Bio-Tek, VT). The assay is able to detect as low as 3.6 ng of active MMP-1. Note: Sensitivity also depends on the endogenous activity of MMP-1 in different preparation. MMP-1 from different sources might vary in its endogenous activity. (Mean±S.D., n=3).

Protocol

Note 1: For standard curve, please refer to Appendix II (optional).

Note 2: Please use protocol A or B based on your needs.

Protocol A. Screening protease inhibitors using purified or recombinant MMP-1.

1. Activate pro-MMP-1.

- 1.1 Incubate pro-MMP-1 with 1 mM APMA (diluted Component C) for 3 h at 37°C.
Activate pro-MMP-1 immediately before the experiment.

Note 1: Keep activated enzyme on ice. Avoid vigorously vortexing the enzyme. Prolonged storage of activated enzyme will further de-activate the enzyme.

Note 2: APMA can be diluted with assay buffer (Component D). APMA belongs to organic mercury. Handle with care! Dispose it according to appropriate regulations.

Note 3: Activation of zymogen by APMA at higher protein concentration is preferred. After activation, the enzyme may be further diluted.

Note 4: AnaSpec MMP-1 (Cat##55575-1, 55575-10) is catalytic domain enzyme which does not require pre-activation.

2. Prepare working solutions.

Note: Warm all kit components until thawed to room temperature before starting the experiments.

- 2.1 MMP-1 substrate solution: Dilute MMP-1 substrate (Component A) 1: 100 in assay buffer (Component D) according to Table 1.

Table 1. MMP-1 substrate solution for one 96-well plate (100 assays).

Components	Volume
MMP-1 substrate (100X, Component A)	50 µL
Assay buffer (Component D)	5 mL
Total volume	5 mL

- 2.2 MMP-1 diluent: Dilute activated MMP-1 to an appropriate concentration in assay buffer (Component D).

3. Set up enzymatic reaction.

- 3.1 Add test compounds and MMP-1 diluent into microplate. The suggested total volume of MMP-1 diluent and test compound is 50 µL.

- 3.2 Simultaneously set up the following controls.

- Positive control contains MMP-1 diluent without test compound.
- Inhibitor control contains MMP-1 diluent and a known MMP-1 inhibitor.
- Vehicle control contains MMP-1 diluent and vehicle used in delivering test compound (e.g. DMSO).
- Test compound control contains assay buffer and test compound. Some test compounds have strong autofluorescence and may give false results.
- Substrate control contains assay buffer only.

- 3.3 Using the assay buffer (Component D), bring the total volume of all controls to 50 µL.

4. Pre-incubation.

4.1 Incubate the plate at the desired temperature for enzymatic reaction for 10-15 min. Also incubate MMP-1 substrate solution at the same temperature.

5. Initiate the enzymatic reaction.

5.1 Add 50 μ L of MMP-1 substrate solution into the wells. Mix the reagents completely by shaking the plate gently for 30-60 second.

5.2 Measure fluorescence signal:

- For kinetic reading: Immediately start measuring fluorescence intensity at Ex/Em=340 \pm 30 nm/490 \pm 30 nm continuously and record data every 5 minutes for 30 to 60 minutes.
- For end-point reading: Incubate the reaction at 37⁰C for 30 to 60 minutes. Keep the plate from direct light. Optional: Add 50 μ L/well stop solution (Component E). Mix the reagents. Then measure fluorescence intensity at Ex/Em=340 \pm 30 nm/490 \pm 30 nm.

5.3 Data analysis: Refer to Appendix I.

Protocol B. Measuring MMP-1 activity in biological samples.

Note: The FRET substrate in this kit can also be cleaved by MMP-2, 3, 8, 12, and 13. If several MMPs are coexisting in your samples and you want to specifically measure MMP-1's activity, then MMP-1 must first be isolated by immuno-affinity purification or other methods before measuring its specific activity using current assay kit.

1. Prepare MMP-1 containing biological samples.

1.1 Collect synovial fluids or supernatant of cell culture media (e.g. stimulated fibroblast) and centrifuge for 10-15 min at 1,000X g, 4^oC. Collect the supernatant and store at -70^oC until use.

1.2 Tissues samples should be homogenized in assay buffer (Component D) containing 0.1% Triton-X 100, and then centrifuged for 15 min at 10000x g at 4^oC. Collect the supernatant and store at -70^oC until use.

Note: Triton-X 100 is not provided.

2. Activate pro-MMPs.

2.1 Incubate the MMP containing-samples with APMA (Component C) at the final concentration of 1 mM in the assay buffer (Component D) for 3 h at 37^oC. Activate MMP right before the experiment.

Note 1: Keep activated enzyme on ice. Avoid vigorously vortexing the enzyme. Prolonged storage will further deactivate the enzyme.

Note 2: APMA can be diluted with assay buffer (Component D). APMA belongs to the organic mercury class of compounds. Handle with care! Dispose according to appropriate regulations.

3. Prepare working solutions.

Note: Warm all kit components to room temperature until thawed before starting the experiments.

3.1 MMP-1 substrate solution: Dilute MMP-1 substrate (Component A) 1: 100 in assay buffer (Component D).

Table 1. MMP-1 substrate solution for one 96-well plate (100 assays).

Components	Volume
MMP-1 substrate (100X, Component A)	50 μ L
Assay buffer (Component D)	5 mL
Total volume	5 mL

3.2 MMP-1 diluent: If you use purified MMP-1 as positive control, then dilute MMP-1 to an appropriate concentration in assay buffer (Component D).

Note: Pro-MMP1 needs to be activated by APMA at higher concentration, and then diluted to a working concentration in assay buffer. Please refer to Step 2.1. Avoid vigorous vortexing of enzyme.

4. Set up the enzymatic reaction.

4.1 Add 50 μ L/well MMP-1 containing sample to 96-well plate.

4.2 Set up the following control:

- Substrate control contains assay buffer (50 μ L/well)
- Positive control: contains MMP-1 diluent (50 μ L/well)

5. Initiate the enzymatic reaction.

5.1 Add 50 μ L/well MMP-1 substrate solution to the sample and control wells. Mix the reagents by shaking the plate gently for 30 seconds.

5.2 Measure fluorescence signal:

- For kinetic reading: Immediately start measuring fluorescence intensity at Ex/Em=340 \pm 30 nm/490 \pm 30 nm continuously and record data every 5 minutes for 30 to 60 minutes.
- For end-point reading: Incubate the reaction at room temperature for 30 to 60 minutes. Keep the plate from direct light. Optional: Add 50 μ L/well stop solution (Component E). Mix the reagents. Then measure fluorescence intensity at Ex/Em=340 \pm 30 nm/490 \pm 30 nm.

5.3 Data analysis: Refer to Appendix I.

Appendix I: Data Analysis

- The fluorescence reading from the substrate control well is the background fluorescence. This background reading has to be subtracted from the readings of the other wells. This reading is the relative fluorescence unit (RFU).
- For kinetic reading:
 - Plot data as RFU versus time for each sample. If you want to convert the RFU to the concentration of the product of enzymatic reaction, please refer to Appendix II for setting up fluorescence reference standard.
 - Determine the range of initial time points during which the reaction is linear. 10-15% conversion appears to be the optimal range.

- Obtain the initial reaction velocity (V_o) in RFU/min. Determine the slope of the linear portion of the data plot.
- A variety of data analyses can be done, e.g., determining inhibition %, EC_{50} , IC_{50} , K_m , K_i , etc.
- For endpoint reading:
 - Plot data as RFU versus the concentration of test compounds.
 - A variety of data analyses can be done, e.g., determining inhibition %, EC_{50} , IC_{50} , etc.

Appendix II: Instrument calibration

- **EDANS fluorescence reference standard:** Dilute 1 mM EDANS (Component B) to 5 μ M in assay buffer (Component D). Do 2-fold serial dilutions to get concentrations of 2.5, 1.25, 0.625, 0.3125, 0.156 and 0.078 μ M, include an assay buffer blank. Add 50 μ L/well of these serially diluted EDANS reference solutions.
- Add 50 μ L/well MMP-1 substrate solution (refer to Protocol A, step 2.1 for preparation).

Note: The MMP-1 substrate solution should be added to the EDANS reference standard to correct the absorptive quenching by the FRET peptide. If multiple concentrations of substrate are used, this step must be performed for each concentration.
- Optional: If the stop solution (Component E) was added into the enzymatic reaction before taking the end-point reading, the same volume of stop solution should be added to reference standard wells for better comparison.
- Measure the fluorescence intensity of the reference standard wells at $Ex/Em=340/490$ nm. Use the same setting of sensitivity as used in the enzyme reaction.
- Plot EDANS fluorescent reference standard as RFU (relative fluorescent unit) versus concentration as in **Figure 2**.

Note: The final concentrations of EDANS reference standard are 2.5, 1.25, 0.625, 0.3125, 0.156, 0.078, 0.039, and 0 μ M. This reference standard is used to calibrate the variation of different instruments and to account for experimental variability. It is also an indicator of the amount of final product of the MMP-1 enzymatic reaction.

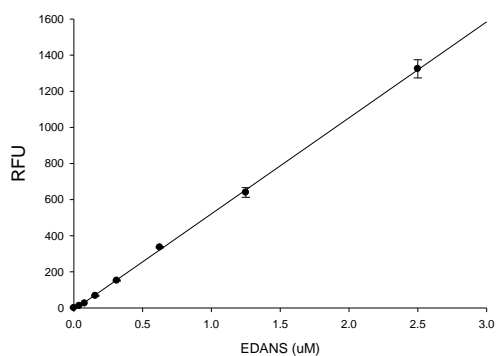


Figure 2. The EDANS reference standard calibration curve.

EDANS was diluted in assay buffer containing MMP-1 substrate. The fluorescence signal was measured by a fluorescence microplate reader (FLx800, Bio-Tek Instruments) with a filter set of Ex/Em=340±40 nm/490±40 nm.

References

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