



SensoLyte[®] Rh110 Enterokinase Activity Assay Kit *Fluorimetric*

Revision Number: 1.1	Last updated: October 2014
Catalog #	AS-72210
Kit Size	100 Assays (96-well plate)

- **Optimized Performance:** This kit is optimized to detect enterokinase enzyme activity
- **Enhanced Value:** It provides ample reagents to perform 100 assays in a 96-well plate format
- **High Speed:** The entire process can be completed in one hour.
- **Assured Reliability:** Detailed protocol and references are provided.

Kit Components, Storage and Handling

Component	Description	Quantity
Component A	Rh110 Enterokinase substrate, Ex/Em=490 nm/520 nm upon cleavage	2 mM, 50 μ L
Component B	Rh110, fluorescence reference standard, Ex/Em=490 nm/520 nm	2 mM, 10 μ L
Component C	Recombinant bovine enterokinase	40 μ L
Component D	2X Assay Buffer	25 mL
Component E	Enterokinase Inhibitor	50 mM, 20 μ L

Other Materials Required (but not provided)

- 96-well microplate: Black, flat-bottom, 96-well plate with non-binding surface.
- Fluorescence microplate reader: Capable of detecting emission at 520 nm with excitation at 490 nm.

Storage and Handling

- Store all kit components at -20°C, except for Component C
- Store Component C at -80°C
- Protect Components A and B from light and moisture.
- Component D can be stored at room temperature for convenience.

Introduction

Enterokinase or enteropeptidase is a heterodimeric serine protease produced by cells in the duodenal wall. It converts trypsinogen to trypsin, indirectly activating a number of pancreatic digestive enzymes.^{1,2} Enterokinase is a key enzyme for intestinal digestion of proteins. Its deficiency may cause severe protein malabsorption leading to impaired development and growth.³ Enterokinase also plays an important role in acute experimental and clinical pancreatitis.⁴ The high degree of specificity exhibited by enteropeptidase for cleaving affinity or other tags from recombinant proteins makes it an ideal tool for use in biochemical applications.^{5,6}

The SensoLyte[®] Rh110 Enterokinase Assay Kit employs a fluorogenic substrate for the detection of enterokinase activity. Upon protease cleavage, this substrate generates the Rh110 (rhodamine 110) fluorophore with bright green fluorescence that can be detected at excitation/emission=490/520 nm. The longer-wavelength spectra and higher extinction coefficient of the Rh110 provide greater sensitivity and less interference from other reaction components. The assays are performed in a convenient 96-well microplate format.

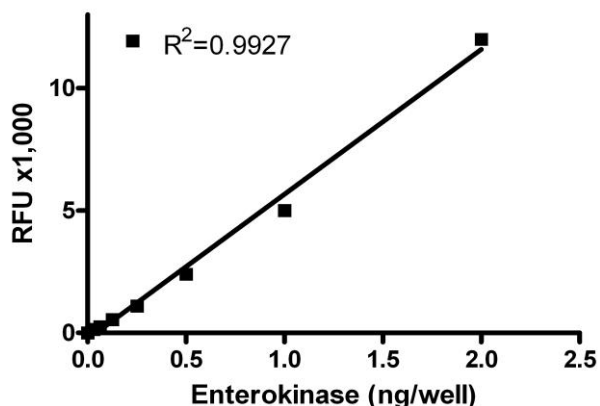


Figure 1. Sensitivity of the assay has been tested using serial dilution of bovine enterokinase. Fluorogenic Rh110-based substrate was incubated with the indicated amount of enzyme and fluorescence was measured after 30 min (FlexStation 384II, Molecular Devices). The assay can detect as low as 0.3 ng/mL of active enzyme.

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 compounds using recombinant enzyme.

1. Prepare working solutions.

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

1.1 1X assay buffer: Add 10 mL of 2X assay buffer (Component D) to 10 mL of deionized water.

1.2 Enterokinase substrate solution: Dilute enterokinase substrate (Component A) 100-fold in 1X assay buffer. Refer to Table 1. For each experiment, prepare fresh substrate solution. If not using the entire plate, adjust the amount of substrate to be diluted accordingly.

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

Components	Volume
Enterokinase substrate (Component A)	50 μ L
1X assay buffer	4.95 mL
Total volume	5 mL

1.3 Enterokinase diluents: Dilute the enterokinase enzyme (Component C) 100-fold in 1X assay buffer. This amount of enzyme is enough for a full 96-well plate. If not using the entire plate, adjust the amount of enzyme to be diluted accordingly.

Note: Prepare enzyme diluents immediately before use. Do not vortex the enzyme solution. Prolonged storage or vigorous agitation of the diluted enzyme will cause denaturation. Store the enzyme solution on ice.

1.4 Enterokinase inhibitor, E-64: Dilute the 50 mM inhibitor solution (Component E) 10-fold in 1X assay buffer to get 5 mM diluted inhibitor solution. Add 10 μ L of the diluted inhibitor into each of the inhibitor control well.

2. Set up the enzymatic reaction.

2.1 Add test compounds and diluted enzyme solution to the microplate wells. The suggested volume of enzyme solution for one well of a 96-well plate is 40 μ L and test compound is 10 μ L.

2.2 Simultaneously set up the following control wells, as deemed necessary:

- **Positive control** contains the diluted enterokinase without test compound.
- **Inhibitor control** contains the diluted enterokinase and inhibitor.
- **Vehicle control** contains enzyme and vehicle used in delivering test compound (e.g. DMSO, concentration not to exceed 1%).
- **Test compound control** contains 1X assay buffer and test compound. Some test compounds have strong autofluorescence and may give false results.
- **Substrate control** contains 1X assay buffer.

2.3 Using the 1X assay buffer, bring the total volume of all controls to 50 μ L.

2.4 Optional: Pre-incubate the plate for 10 min. at assay temperature. Any temperature (the *assay temperature*) from room temperature to 37°C may be used, as long as the subsequent incubations are performed at the same temperature.

3. Run the enzymatic reaction.

3.1 Add 50 μ L of the enterokinase substrate solutions into each well. For best accuracy, it is advisable to have the substrate solution equilibrated to the assay temperature. Mix the reagents completely by shaking the plate gently for 30 sec.

3.2 Measure fluorescence signal:

- **For kinetic reading:** Immediately start measuring fluorescence at Ex/Em=490 nm/520 nm continuously and record data every 5 min. for 30 to 60 min.
- **For end-point reading:** Incubate the reaction for 30 to 60 min. Keep plate from direct light. Mix the reagents and measure fluorescence intensity at Ex/Em=490 nm/520 nm.

3.3 For methods of data analysis: Refer to Appendix I.

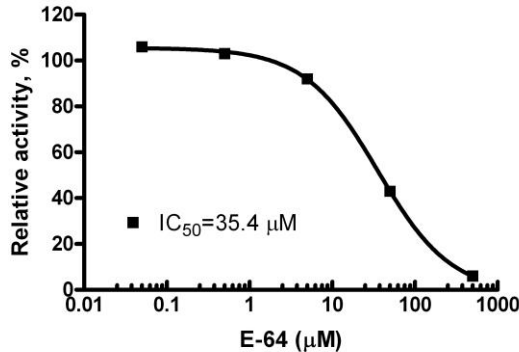


Figure 2. Inhibition of enterokinase activity by E-64 was measured with Sensolyte® Rh110 Enterokinase Assay Kit.

Protocol B. Measuring enterokinase activity in biological samples.

1. Prepare working solutions.

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

- 1.1 The enterokinase substrate solution: Dilute enterokinase substrate (Component A) in 2X assay buffer (Component D). Refer to Table 1. If not using the entire plate, adjust the amount of substrate to be diluted accordingly.

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

Components	Volume
Enterokinase substrate (Component A)	50 μL
2X assay buffer (Component D)	4.95 mL
Total volume	5 mL

2. Set up the enzymatic reaction.

- 2.1 Add 50 μL of enterokinase containing sample.
- 2.2 Set up the following control wells at the same time, as deemed necessary:
- Positive control contains purified active enterokinase
 - Substrate control contains deionized water.
- 2.3 Bring the total volume of all controls to 50 μL.
- 2.4 Optional: Pre-incubate the plate for 10 min. at assay temperature. Any temperature (the *assay temperature*) from room temperature to 37°C may be used, as long as the subsequent incubations are performed at the same temperature.

3. Run the enzymatic reaction.

- 3.1 Add 50 μL of the enterokinase substrate solutions into each well. For best accuracy, it is advisable to have the substrate solution equilibrated to the assay temperature. Mix the reagents completely by shaking the plate gently for 30 sec.
- 3.2 Measure fluorescence signal:

- For kinetic reading: Immediately start measuring fluorescence at Ex/Em=490 nm/520 nm continuously and record data every 5 min. for 30 to 60 min.
- For end-point reading: Incubate the reaction for 30 to 60 min. Keep plate from direct light. Mix the reagents and measure fluorescence intensity at Ex/Em=490 nm/520 nm.

3.3 For methods of data analysis: Refer to Appendix I.

Appendix I. Data Analysis

- The fluorescence reading from the substrate control well is used as the background fluorescence. This background reading should be subtracted from the readings of the other wells containing substrate. All fluorescence readings are expressed in relative fluorescence units (RFU).
- For kinetics analysis:
 - Plot data as RFU versus time for each sample. To convert RFUs to the concentration of the product of the enzymatic reaction, please refer to Appendix II for establishing a fluorescence reference standard.
 - Determine the range of initial time points during which the reaction is linear. Typically, the first 10-15% of the reaction will be the optimal range.
 - Obtain the initial reaction velocity (V_o) in RFU/min by determining 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 analysis:
 - Plot data as RFU versus 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

- Fluorescence reference standard: Dilute the 2 mM fluorescence standard solution (Component B) 100-fold to 20 μ M in 1X assay buffer. Do 2-fold serial dilutions to get concentrations of 10, 5, 2.5, 1.25, 0.625, and 0.313 μ M, include an assay buffer blank. Add 50 μ L/well of these serially diluted reference solutions.
- Add 50 μ L/well of the diluted enterokinase substrate solution (refer to Protocol A, Step 1.2 for preparation).

Note: The enterokinase substrate solution is added to the reference standard to normalize for the intrinsic substrate fluorescence. If multiple concentrations of substrate are used, this step must be performed for each concentration.

- Measure the fluorescence of the reference standard and substrate control wells at Ex/Em=490 nm/520 nm. Use the same setting of sensitivity as used in the enzyme reaction.
- Plot the reference standard curve as RFU (relative fluorescent units) versus concentration.

- The final concentrations of fluorescence reference standard are 10, 5, 2.5, 1.25, 0.625, 0.313, 0.156 and 0 μ M. This reference standard is used to calibrate the variation of different instruments and different experiments. Since the proteolytic cleavage of the Rh110 substrate consists of two steps, with both the intermediate and final products having fluorescence, the Rh110 reference standard cannot serve as an indicator of the amount of enzymatic reaction final product.

References :

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3. Antonowicz, I., *Ciba Found Symp.* **70**, 169 (1979).
4. Mann, NS. and Mann, SK. *Proc Soc Exp Biol Med.* **206**, 114 (1994).
5. Forsberg, G. et al. *J Protein Chem.* **11**, 201 (1992).
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