PAD4 Inhibitor Screening Assay Kit (AMC)

Item No. 701320

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Safety Data
This material should be considered hazardous until further information becomes available. Do not ingest, inhale, get in eyes, on skin, or on clothing. Wash thoroughly after handling. Before use, the user must review the complete Safety Data Sheet, which has been sent via email to your institution.

Precautions
Please read these instructions carefully before beginning this assay.

If You Have Problems
Technical Service Contact Information
- Phone: 888-526-5351 (USA and Canada only) or 734-975-3888
- Fax: 734-971-3641
- Email: techserv@caymanchem.com
- Hours: M-F 8:00 AM to 5:30 PM EST

In order for our staff to assist you quickly and efficiently, please be ready to supply the lot number of the kit (found on the outside of the box).

Storage and Stability
This kit will perform as specified if stored as directed in the Materials Supplied section, on page 3, and used before the expiration date indicated on the outside of the box.

Materials Needed But Not Supplied
1. A plate reader with the ability to measure fluorescence using an excitation wavelength of 355-365 nm and an emission wavelength of 445-455 nm
2. Adjustable pipettes and a multichannel pipette
3. A source of pure water; glass distilled water or HPLC-grade water is acceptable
4. A 37°C incubator
5. Microcentrifuge tubes and test tubes or vials capable of holding volumes of >3 ml
INTRODUCTION

Background

Protein arginine deiminases (PADs) are guanidino-modifying enzymes belonging to the amidinotransferase superfamily and are designated PAD1-4 and PAD6. All enzymes are cytosolic except for PAD4 which is localized in the nucleus. PAD4 is a homodimer that functions as a transcriptional coregulator to catalyze the conversion of specific arginine residues to citrulline in a calcium-dependent manner. PAD4 substrates include histones H2A, H3, and H4, whose post-translational modifications play a large role in gene regulation. PAD4 itself can undergo autocitrullination at several sites which inhibit its enzymatic activity and may play an important role in regulating citrullination in cells. PAD4 activity is increased in rheumatoid arthritis, producing an abundance of citrulline-containing proteins that generate an immune response resulting in production of autoantibodies that ultimately attack the host tissues. PAD4 has also been implicated in several other diseases including multiple sclerosis, Alzheimer’s disease, glaucoma, and cancer.

About This Assay

Cayman’s PAD4 Inhibitor Screening Assay Kit (AMC) provides a convenient method for screening human PAD4 inhibitors. This assay utilizes a fluorescent substrate (Z-Arg-AMC) consisting of an arginine residue, a carboxybenzyl group, and a fluorophore (7-amino-4-methylcoumarin, AMC). Acylation of AMC onto the arginine residue masks the fluorescence of the fluorophore. In the absence of PAD4, the substrate remains unaltered, allowing the developer to release free AMC. In the presence of PAD4, the arginine of the substrate is citrullinated, and while the reaction is quenched by the addition of developer, free AMC is not released. Fluorescence is analyzed with an excitation wavelength of 355-365 nm and an emission wavelength of 445-455 nm. The fluorescent signal is inversely proportional to the amount of citrullination by PAD4.

PRE-ASSAY PREPARATION

Reagent Preparation

1. DTT (1 M) Assay Reagent - (Item No. 700416)
   This vial contains 1 M DTT. Once thawed, the reagent is ready to use and can be stored at -20°C, limiting freeze-thaw cycles.

2. PAD Assay Buffer (AMC) - (Item No. 701321)
   This vial contains 10 ml of 50 mM Tris, pH 7.5, 50 mM NaCl and 10 mM CaCl$_2$. Immediately prior to use, add 50 μl of 1 M DTT and mix. This buffer should be used in the assay and for diluting reagents. After addition of DTT, the buffer should be used within the same day. If not using the entire plate, prepare the required amount of buffer by adding 1 M DTT at a ratio of 1:200.

3. PAD4 (human recombinant) Assay Reagent (AMC) - (Item No. 701322)
   This vial contains 200 μl of human recombinant PAD4. Thaw the enzyme on ice, and then gently mix 150 μl of PAD4 with 2,100 μl of PAD Assay Buffer (AMC) in a test tube. The diluted enzyme is stable for four hours on ice. If not using the entire plate, dilute the protein 1:15 in PAD Assay Buffer (AMC), and aliquot the remaining protein for storage at -80°C. Avoid repeated freeze-thaw cycles.

4. PAD Substrate (AMC) - (Item No. 701323)
   This vial contains 200 μl of fluorescent substrate. Transfer 150 μl of substrate to a clean 5 ml test tube, and then add 2,850 μl of PAD Assay Buffer (AMC). Protect from light. If not using the entire plate, dilute the substrate 1:20 in PAD Assay Buffer (AMC). Store unused reagent at -20°C.
5. PAD Developer (AMC) - (Item No. 701324)
   This vial contains a lyophilized powder. Reconstitute the contents of the vial with 6 ml of Milli-Q water. One vial is enough to assay a 96-well plate. Store unused reagent at -20°C.

6. Cl-Amidine Inhibitor Assay Reagent - (Item No. 700567)
   This vial contains 950 nmol of inhibitor. Reconstitute with 950 µl of PAD Assay Buffer (AMC) to yield a concentration of 1 mM. The final concentration in the assay will be 100 µM.

**Plate Set Up**

There is no specific pattern for using the wells on the plate. However, it is necessary to have three wells designated as 100% initial activity and three wells designated as background wells. It is suggested that each inhibitor be assayed in triplicate and the contents of each well are recorded on the template sheet provided on page 18. It is also recommended that the positive control inhibitor be assayed in triplicate. A typical layout of samples and inhibitors to be measured in triplicate is shown in Figure 1.

![Sample plate format](image)

**Figure 1. Sample plate format**
**Pipetting Hints**

- It is recommended that a multichannel pipette be used to deliver reagents to the wells. This saves time and helps maintain more precise incubation times.
- Before pipetting each reagent, equilibrate the pipette tip in that reagent (i.e., slowly fill the tip and gently expel the contents, repeat several times).
- Do not expose the pipette tip to the reagent(s) already in the well.

**General Information**

- The final volume of the assay is 100 µl in all the wells.
- All reagents, except the enzyme, must be equilibrated to room temperature before beginning the assay.
- It is not necessary to use all the wells on the plate at one time.
- It is recommended to assay the samples in triplicate, but it is the user’s discretion to do so.
- The assay is performed at 37°C.
- Monitor the fluorescence with an excitation wavelength of 355-365 nm and an emission wavelength of 445-455 nm.

**Performing the Assay**

1. **100% Initial Activity Wells** - add 20 µl of diluted PAD4 (human recombinant) Assay Reagent (AMC) and 5 µl of solvent (same solvent used to dissolve the inhibitor) to three wells.

2. **Background Wells** - add 20 µl of PAD Assay Buffer (AMC) and 5 µl of solvent (the same solvent used to dissolve the inhibitor) to three wells.

3. **Inhibitor Wells** - add 20 µl of diluted PAD4 (human recombinant) Assay Reagent (AMC) and 5 µl of inhibitor to three wells. **NOTE:** Inhibitors can be dissolved in PAD Assay Buffer (AMC), ≤20% methanol, ≤10% ethanol, or ≤10% DMSO and should be added to the assay in a volume of 5 µl. Increasing the amount of solvent will diminish the sensitivity of this assay. In the event that an appropriate concentration of inhibitor is unknown, it is recommended that several dilutions of the inhibitor are assayed.

4. **Positive Control Wells** - add 20 µl of diluted PAD4 (human recombinant) Assay Reagent (AMC) and 5 µl of reconstituted Cl-Amidine Inhibitor Assay Reagent to three wells.

<table>
<thead>
<tr>
<th>Well</th>
<th>PAD 4 (human recombinant) Assay Reagent (AMC) (µl)</th>
<th>PAD Assay Buffer (AMC) (µl)</th>
<th>Inhibitor (µl)</th>
<th>Solvent (µl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100% Initial activity wells</td>
<td>20</td>
<td>-</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td>Background wells</td>
<td>-</td>
<td>20</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td>Inhibitor wells</td>
<td>20</td>
<td>-</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>Positive Control wells</td>
<td>20</td>
<td>-</td>
<td>5</td>
<td>-</td>
</tr>
</tbody>
</table>

**Table 1.** Pipetting summary

5. Cover the plate with the plate cover and incubate for 10 minutes at 37°C.
6. Remove the plate cover, and add 25 µl of diluted PAD Assay Substrate (AMC) to all wells being used.
7. Cover the plate with the plate cover and incubate for 20 minutes at 37°C.
8. Remove the plate cover, and add 50 µl of PAD Developer (AMC) to all wells being used.
9. Cover the plate with the plate cover and incubate for 10 minutes at room temperature.
10. Remove the plate cover and read the fluorescence at an excitation wavelength of 355-365 nm and an emission wavelength of 445-455 nm.
Calculations

1. Determine the average fluorescence of the background (BW), 100% initial activity (IA), positive control (PC), and inhibitor wells.

2. Subtract the average fluorescence of the background wells from the average fluorescence of the 100% initial activity and inhibitor wells. Take the absolute values.

3. Determine the percent inhibition or percent initial activity for each inhibitor using one of the following equations:

   \[
   \text{% Inhibition} = \left( \frac{\text{100\% Initial Activity} - \text{Inhibitor Activity}}{\text{100\% Initial Activity}} \right) \times 100
   \]

   \[
   \text{% Initial Activity} = \left( \frac{\text{Inhibitor Activity}}{\text{100\% Initial Activity}} \right) \times 100
   \]

4. Graph the percent inhibition or percent initial activity as a function of the inhibitor concentration to determine the IC\textsubscript{50} value (concentration at which there was 50% inhibition). Inhibition of human recombinant PAD4 by Cl-Amidine is shown in Figure 2 (see page 14).

Performance Characteristics

Z’ Factor:

Z’ Factor is a term used to describe the robustness of an assay, which is calculated using the equation below. \(^8\)

\[
Z' = 1 - \frac{3\sigma_{c+} + 3\sigma_{c-}}{|\mu_{c+} - \mu_{c-}|}
\]

Where \(\sigma\): Standard deviation

\(\mu\): Mean

\(c+\): Positive control

\(c-\): Negative control

The theoretical upper limit for the Z’ factor is 1.0. A robust assay has a Z’ factor >0.5. A typical Z’ factor for Cayman’s PAD4 Inhibitor Screening Assay Kit (AMC) was determined to be 0.86.
Sample Data:
The data shown here is an example of inhibition data typically produced with this kit; however, your results will not be identical to these. Do not use the data below to directly compare to your samples. Your results could differ substantially.

Figure 2. Inhibition of human recombinant PAD4 by Cl-Amidine. “Veh.” represents 100% initial activity vehicle control.

Figure 3. Typical Z’ data for the PAD4 Inhibitor Screening Assay Kit (AMC). Data shown from wells of both positive (circles) and negative (diamonds) controls prepared as described in the kit booklet. The calculated Z’ factor from this experiment was 0.86. The dashed lines correspond to three standard deviations from the mean for each control value.
## Troubleshooting

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Causes</th>
<th>Recommended Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erratic values; dispersion of duplicates/triplicates</td>
<td>A. Poor pipetting/technique</td>
<td>A. Be careful not to splash the contents of the wells</td>
</tr>
<tr>
<td></td>
<td>B. Bubble in the well(s)</td>
<td>B. Carefully tap the side of the plate with your finger to remove bubbles</td>
</tr>
<tr>
<td>100% Initial activity wells do not show lower fluorescence than background wells</td>
<td>A. Enzyme was not added to the well(s)</td>
<td>A. Make sure to add all of the components to the well(s)</td>
</tr>
<tr>
<td></td>
<td>B. DTT was not added to buffer</td>
<td>B. Make sure to add DTT to buffer just prior to use</td>
</tr>
<tr>
<td>The plate reader exhibited ‘MAX’ values for the wells</td>
<td>The gain setting is too high</td>
<td>Reduce the gain and re-read</td>
</tr>
<tr>
<td>No inhibition was seen with inhibitor</td>
<td>A. The inhibitor concentration is not high enough</td>
<td>Increase the inhibitor concentration and re-assay</td>
</tr>
<tr>
<td></td>
<td>B. The compound is not an inhibitor of PAD4</td>
<td></td>
</tr>
<tr>
<td>Poor signal</td>
<td>DTT was not added to buffer just prior to use</td>
<td>Make sure to add DTT to buffer just prior to use</td>
</tr>
</tbody>
</table>

**References**

Warranty and Limitation of Remedy

Buyer agrees to purchase the material subject to Cayman’s Terms and Conditions. Complete Terms and Conditions including Warranty and Limitation of Liability information can be found on our website.

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