

CB1 Redistribution[®] Assay

For High-Content Analysis

051-01.04

Number	Description
R04-051-01	Recombinant U2OS cells stably expressing human Cannabinoid receptor 1 (CB1) (GenBank Acc. NM_016083) fused to the N-terminus of enhanced green fluorescent protein (EGFP). U2OS cells are adherent epithelial cells derived from human osteosarcoma. Expression of CB1-EGFP is controlled by a standard CMV promoter and continuous expression is maintained by addition of G418 to the culture medium.

Quantity: 2 cryo-vials each containing 1.0×10^6 cells in a volume of 1.0 ml Cell Freezing Medium.

Storage: Immediately upon receipt store cells in liquid nitrogen (vapor phase).

Warning: Please completely read these instructions and the material safety data sheet for DMSO before using this product. This product is for research use only. Not intended for human or animal diagnostic or therapeutic uses. Handle as potentially biohazardous material under at least Biosafety Level 1 containment. Safety procedures and waste handling are in accordance with the local laboratory regulations.

CAUTION: This product contains Dimethyl Sulfoxide (DMSO), a hazardous material. Please review Material Safety Data Sheet before using this product.

Introduction

The Redistribution[®] Technology

The Redistribution[®] technology monitors the cellular translocation of GFP-tagged proteins in response to drug compounds or other stimuli and allows easy acquisition of multiple readouts from the same cell in a single assay run. In addition to the primary readout, high content assays provide supplementary information about cell morphology, compound fluorescence, and cellular toxicity.

The CB1 Redistribution[®] Assay

Cannabinoid receptor 1 (CB1) is a Gi-coupled G protein-coupled receptor (GPCR/7TM receptor), which is activated by the endogenous ligands arachidonyl ethanolamine (anandamide, an eicosanoid), palmitoyl-ethanolamine (PEA), and oleamide. These ligands are called endocannabinoids. Cannabinoids, which are the primary psychoactive chemicals in marijuana, are agonists for the CB1 receptor, and CB1 mediates most of the effects of cannabinoids in the central nervous system. Both cannabinoids and endocannabinoids stimulate appetite, and recent studies indicate clinical effects of CB1 antagonists in the treatment of obesity, and of agonists in the treatment of eating disorders and body weight regulation [1]. Rimonabant, a CB1 receptor antagonist developed by Sanofi-Aventis, has shown effect on weight loss in clinical trials [2]. CB1 receptors are rapidly internalized following agonist binding and receptor activation. Agonists such as CP55,940, HU210, and WIN55,212-2 have been shown to cause rapid receptor internalization [3].

The CB1 receptor internalization assay is available in both agonist and antagonist format with WIN55,212-2 as reference agonist and AM251 as reference antagonist. The CB1 agonist Redistribution[®] assay format is designed to screen for agonists of CB1 translocation by monitoring the internalization of a membrane-localized CB1-EGFP fusion protein to endosomes. The CB1 antagonist Redistribution[®] assay format is designed to screen for antagonists of CB1 internalization. Compounds are assayed for their ability to antagonize CB1 internalization induced by WIN55,212-2.

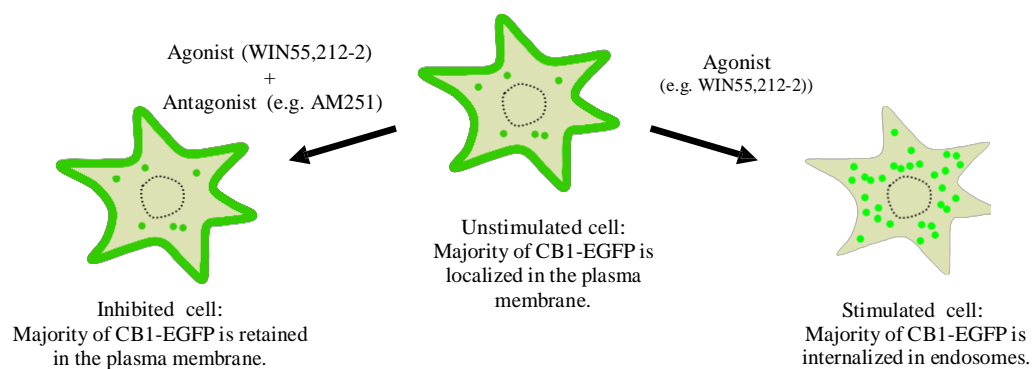


Figure 1: Illustration of the CB1 translocation event.

Additional materials required

The following reagents and materials need to be supplied by the user.

- Dulbecco's Modified Eagle Medium (DMEM), high glucose, without L-Glutamine, Sodium Pyruvate (Thermo Scientific, Fisher Scientific cat.# SH30081)
- L-Glutamine supplement, 200 mM (Thermo Scientific, Fisher Scientific cat.# SH30034)
- Fetal Bovine Serum (FBS) (Thermo Scientific, Fisher Scientific cat.# SH30071)
- Penicillin/Streptomycin, 100X solution (Thermo Scientific, Fisher Scientific cat.# SV30010),
- Trypsin-EDTA, 0.05% (Thermo Scientific, Fisher Scientific cat.# SH30236)
- G418, 50mg/ml (Thermo Scientific, Fisher Scientific cat.# SC30069)
- Dimethylsulfoxide (DMSO) (Fisher Scientific, cat.# BP231)
- Dulbecco's Phosphate-Buffered Saline (PBS), w/o calcium, magnesium, or Phenol Red (Thermo Scientific, Fisher Scientific cat.# SH30028)
- Hepes Buffer, 1 M, Free Acid (liquid) (Thermo Scientific, Fisher Scientific cat.# SH30237)
- WIN55212-2 (Enzo, cat.# #CR105-0010)
- AM521 (Cayman Chemicals, cat.# 71670)
Note: AM251 is only used in the antagonist mode of the assay.
- Hoechst 33258 (Fisher Scientific, cat.# AC22989)
- Triton X-100 (Fisher Scientific, cat.# AC21568)
- 10% formalin, neutral-buffered solution (approximately 4% formaldehyde) (Fisher Scientific, cat.# 23-305-510)
Note: is not recommended to prepare this solution by diluting from a 37% formaldehyde solution.
- 96-well microplate with lid (cell plate) (e.g. Nunc 96-Well Optical Bottom Microplates, Thermo Scientific cat.# 165306)
- Black plate sealer
- Nunc EasYFlasks with Nunclon Delta Surface, T-25, T-75, T-175 (Thermo Scientific, cat.# 156367, 156499, 159910)

Reagent preparation

The following reagents are required to be prepared by the user.

- Cell Culture Medium: DMEM supplemented with 2mM L-Glutamine, 1% Penicillin-Streptomycin, 0.5 mg/ml G418 and 10% FBS
- Cell Freezing Medium: 90% Cell Culture Medium without G418 + 10% DMSO.
- Plate Seeding Medium: DMEM supplemented with 2mM L-Glutamine, 1% Penicillin-Streptomycin, 0.5 mg/ml G418 and 10% FBS
- Assay Buffer: DMEM supplemented with 2mM L-Glutamine, 1% Penicillin-Streptomycin, 1% FBS and 10 mM Hepes Buffer
- Control Compound Stock (agonist mode): 10 mM WIN55212-2 stock solution in DMSO. Prepare by dissolving 10 mg WIN55212-2 (MW = 522.61) in 1914 μ l DMSO. Store at -20°C.
- Control Compound Stock (antagonist mode): 10 mM AM251 stock solution in DMSO. Prepare by dissolving 5 mg AM521 (MW = 555.2) in 900 μ l DMSO. Store at -20°C.
Note: AM251 is only used in the antagonist mode of the assay.
- Fixing Solution: 10% formalin, neutral-buffered solution (approximately 4% formaldehyde).
Note: It is not recommended to prepare this solution by diluting from a 37% formaldehyde solution.
- Hoechst Stock: 10 mM stock solution is prepared in DMSO.
- Hoechst Staining Solution: 1 μ M Hoechst in PBS containing 0.5% Triton X-100. Prepare by dissolving 2.5 ml Triton X-100 with 500 ml PBS. Mix thoroughly on a magnetic stirrer. When Triton X-100 is dissolved add 50 μ l 10 mM Hoechst 33258. Store at 4°C for up to 1 month

The following procedures have been optimized for this cell line. As early as possible, create and store at least one aliquot of cells for back-up.

Cell thawing procedure

1. Rapidly thaw frozen cells by holding the cryovial in a 37°C water bath for 1-2 minutes. Do not thaw cells by hand, at room temperature, or for longer than 3 minutes, as this decreases viability.
2. Wipe the cryovial with 70% ethanol.
3. Transfer the vial content into a T75 tissue culture flask containing 25 ml Cell Culture Medium and place flask in a 37°C, 5% CO₂, 95% humidity incubator.
4. Change the Cell Culture Medium the next day

Cell harvest and culturing procedure

For normal cell line maintenance, split 1:8 every 3-4 days. Maintain cells between 5% and 95% confluence. Passage cells when they reach 80-95% confluence. All reagents should be pre-warmed to 37°C.

1. Remove medium and wash cells once with PBS (10 ml per T75 flask and 12 ml per T175 flask).
2. Add trypsin-EDTA (2 ml per T75 flask and 4 ml per T175 flask) and swirl to ensure all cells are covered.
3. Incubate at 37°C for 3-5 minutes or until cells round up and begin to detach.
4. Tap the flask gently 1-2 times to dislodge the cells. Add Cell Culture Medium (6 ml per T75 flask and 8 ml per T175 flask) to inactivate trypsin and resuspend cells by gently pipetting to achieve a homogenous suspension.
5. Count cells using a cell counter or hemocytometer.
6. Transfer the desired number of cells into a new flask containing sufficient fresh Cell Culture Medium (total of 20 ml per T75 flask and 40 ml per T175 flask).
7. Incubate the culture flask in a 37°C, 5% CO₂, 95% humidity incubator.

Cell freezing procedure

1. Harvest the cells as described in the “Cell harvest and culturing procedure”, step 1 – 5.
2. Prepare a cell suspension containing 1×10^6 cells per ml (5 cryogenic vials = 5×10^6 cells).
3. Centrifuge the cells at 250g (approximately 1100 rpm) for 5 minutes. Aspirate the medium from the cells.
4. Resuspend the cells in Cell Freezing Medium at 1×10^6 cells per ml until no cell aggregates remain in the suspension.
5. Dispense 1 ml of the cell suspension into cryogenic vials.
6. Place the vials in an insulated container or a cryo-freezing device (e.g. Nalgene "Mr. Frosty" Freezing Container, Thermo Scientific, Fisher Scientific cat.# 15-350-50) and store at -80°C for 16-24 hours.
7. Transfer the vials for long term storage in liquid nitrogen.

Cell plating procedure

The cells should be seeded into 96-well plates 18-24 hours prior to running the assay. Do not allow the cells to reach over 95% confluence prior to seeding for an assay run. The assay has been validated with cells in up to passage 27 split as described in the “Cell harvest and culturing procedure”

1. Harvest the cells as described in the “Cell harvest and culturing procedure”, step 1-5 using Plate Seeding Medium instead of Cell Culture Medium.
2. Dilute the cell suspension to 40,000 cells/ml in Plate Seeding Medium.
3. Transfer 200 µl of the cell suspension to each well in a 96-well tissue culture plate (cell plate). This gives a cell density of 8000 cells/well.
Note: At this step, be careful to keep the cells in a uniform suspension
4. Incubate the cell plate on a level vibration-free table for 1 hour at room temperature (20-25°C). This ensures that the cells attach evenly within each well.
5. Incubate the cell plate for 18-24 hours in a 37°C, 5% CO₂, 95% humidity incubator prior to starting the assay

Assay protocol - agonist mode

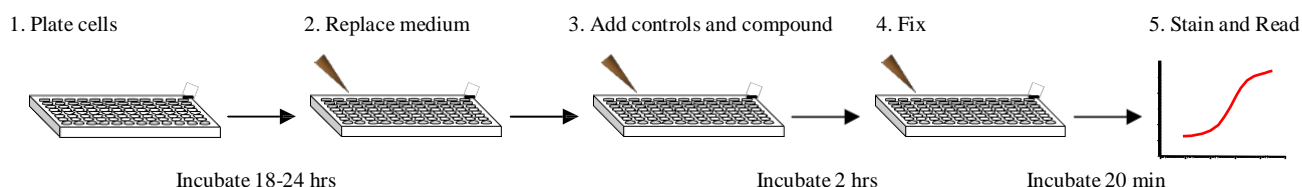


Figure 2: Quick assay workflow overview

The following protocol is based on 1x 96-well plate.

1. Before initiating the assay:

- Prepare Assay Buffer. Ensure Assay Buffer is pre-warmed to 20-37°C.

2. Prepare controls and test compounds

- Dilute controls and test compounds in Assay Buffer to a 2X final concentration. (Volumes and concentrations are indicated below). A final DMSO concentration of 0.25% is recommended, but the assay can tolerate up to 2% DMSO final concentration.
- Mix controls for 1x 96-well plate as indicated below:

	Assay Buffer	Control Stock	DMSO	2X concentration	Final assay concentration	Final DMSO concentration
Negative control	12 ml	----	60 µl	0.5% DMSO	----	0.25%
Positive control	12 ml	2.4 µl WIN55212-2	57.6 µl	2 µM WIN55212-2	1 µM WIN55212-2	0.25%

3. Gently remove Plate Seeding Medium and wash cell plate once with 100 µl Assay Buffer per well.
4. Add 100 µl Assay Buffer per well.
5. Add 100 µl 2X concentrated control or compound solution in Assay Buffer to appropriate wells of the cell plate.
6. Incubate cell plate for 2 hours in a 37°C, 5% CO₂, 95% humidity incubator.
7. Fix cells by gently decanting the buffer and add 150 µl Fixing Solution per well.
8. Incubate cell plate at room temperature for 20 minutes.
9. Wash the cells 4 times with 200 µl PBS per well per wash.
10. Decant PBS from last wash and add 100 µl 1 µM Hoechst Staining Solution.
11. Seal plate with a black plate sealer. Incubate at room temperature for at least 30 minutes before imaging. The plate can be stored at 4°C for up to 3 days in the dark.

Assay protocol - antagonist mode

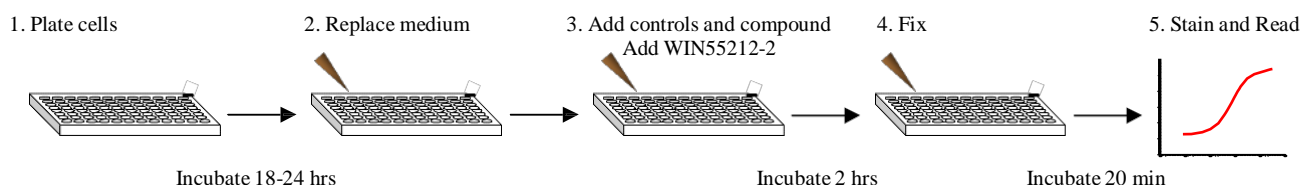


Figure 3: Quick assay workflow overview

The following protocol is based on 1x 96-well plate.

1. Before initiating the assay:

- Prepare Assay Buffer. Ensure Assay Buffer is pre-warmed to 20-37°C.

2. Prepare controls and test compounds

- 1 mM AM251 working solution is prepared by diluting 2 μ l 10 mM AM251 stock solution with 18 μ l DMSO. Note: This solution is only stable for approximately 30 minutes at room temperature.
- Dilute controls and test compounds in Assay Buffer to a 4X final concentration. (Volumes and concentrations are indicated below). A final DMSO concentration of 0.25% is recommended, but the assay can tolerate up to 1% DMSO final concentration.
- Mix controls for 1x 96-well plate as indicated below:

	Assay Buffer	Control Stock	DMSO	4X concentration	Final assay concentration	Final DMSO concentration
Negative control	12 ml	----	120 μ l	1% DMSO	----	0.25%
Positive control	12 ml	4.8 μ l 1 mM AM251	115.2 μ l	400 nM AM251	100 nM AM251	0.25%

3. Prepare 4X WIN55212-2 Agonist Solution (4 μ M):

- Prepare fresh by mixing 3 μ l 10 mM WIN55212-2 stock solution with 7.5 ml Assay Buffer. Use the WIN55212-2 Agonist Solution within 20 minutes after preparation

- Gently remove Plate Seeding Medium and wash cell plate once with 100 μ l Assay Buffer per well.
- Add 100 μ l Assay Buffer per well.
- Add 50 μ l 4X concentrated control or compound solution in Assay Buffer to appropriate wells of the cell plate.
- Add 50 μ l 4X WIN55212-2 Agonist Solution to appropriate wells of the cell plate.
- Incubate cell plate for 2 hours in a 37°C, 5% CO₂, 95% humidity incubator.
- Fix cells by gently decanting the buffer and add 150 μ l Fixing Solution per well.
- Incubate cell plate at room temperature for 20 minutes.
- Wash the cells 4 times with 200 μ l PBS per well per wash.
- Decant PBS from last wash and add 100 μ l 1 μ M Hoechst Staining Solution.
- Seal plate with a black plate sealer. Incubate at room temperature for at least 30 minutes before imaging. The plate can be stored at 4°C for up to 3 days in the dark.

Imaging

The translocation of CB1 can be imaged on most HCS platforms and fluorescence microscopes. The filters should be set for Hoechst (350/461 nm) and GFP/FITC (488/509 nm) (wavelength for excitation and emission maxima). Consult the instrument manual for the correct filter settings.

The translocation can typically be analyzed on images taken with a 20x objective or higher magnification.

The primary output in the CB1 Redistribution[®] assay is the formation of spots in the cytoplasm. The data analysis should therefore report an output that corresponds to number, area or intensity of spots in the cytoplasm.

Imaging on Thermo Scientific Arrayscan HCS Reader

This assay has been developed on the Thermo Scientific Arrayscan HCS Reader using a 20x objective (0.63X coupler), XF100 filter sets for Hoechst and FITC and the SpotDetectorV3 BioApplication. The output parameter used was SpotTotalAreaPerObject. The minimally acceptable number of cells used for image analysis in each well was set to 200 cells.

Other BioApplications that can be used for this assay include CompartmentalAnalysisV2 and ColocalizationV3.

High Content Outputs

In addition to the primary readout, it is possible to extract secondary high content readouts from the Redistribution[®] assays. Such secondary readouts may be used to identify unwanted toxic effects of test compounds or false positives. In order to acquire this type of information, the cells should be stained with a whole cell dye which allows for a second analysis of the images for determination of secondary cell characteristics.

Examples of useful secondary high content outputs:

Nucleus size, shape, intensity:	Parameter used to identify DNA damage, effects on cell cycle and apoptosis.
Cell number, size, and shape:	Parameter for acute cytotoxicity and apoptosis.
Cell fluorescence intensity:	Parameter for compound cytotoxicity and fluorescence.

The thresholds for determining compound cytotoxicity or fluorescence must be determined empirically. Note that the primary translocation readout in some cases may affect the secondary outputs mentioned above

Representative Data Examples

The CB1 Redistribution[®] Assay monitors internalization of CB1-EGFP. Example images of the CB1 Redistribution[®] Assay are illustrated in Figure 3. Figure 4A shows a concentration response curve of the reference agonist ligand WIN55,212-2 in the CB1 assay in agonist format. The EC₅₀ of WIN55,212-2 in the CB1 Redistribution[®] Assay is approximately 20 nM. Figure 4B shows a concentration response curve of the reference antagonist AM251 in CB1 antagonist assay mode where 1 μM WIN55,212-2 is used as agonist. The EC₅₀ of AM251 in the CB1 Redistribution[®] antagonist assay is approximately 45 nM.

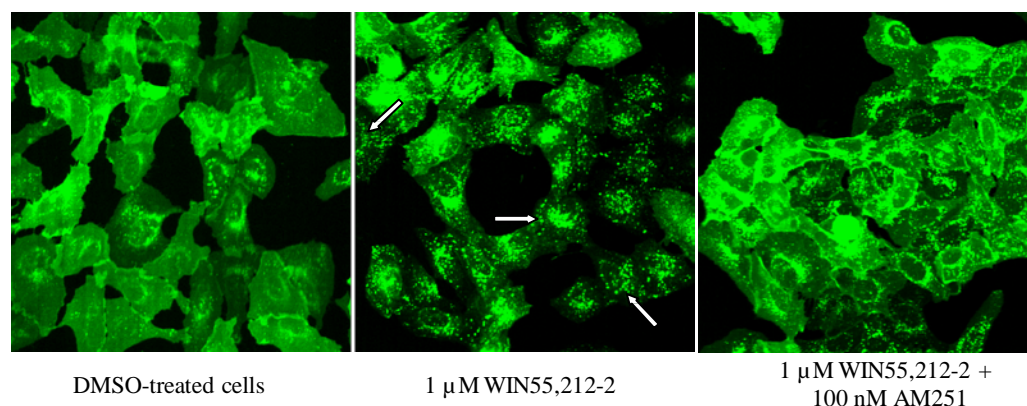


Figure 3. Internalization of CB1-EGFP. Cells were treated with 0.25% DMSO, 1 μM WIN55,212-2 or 1 μM WIN55,212-2 + 100 nM AM251. Arrows indicate WIN55,212-2-induced CB1 internalization detected by the image analysis algorithm.

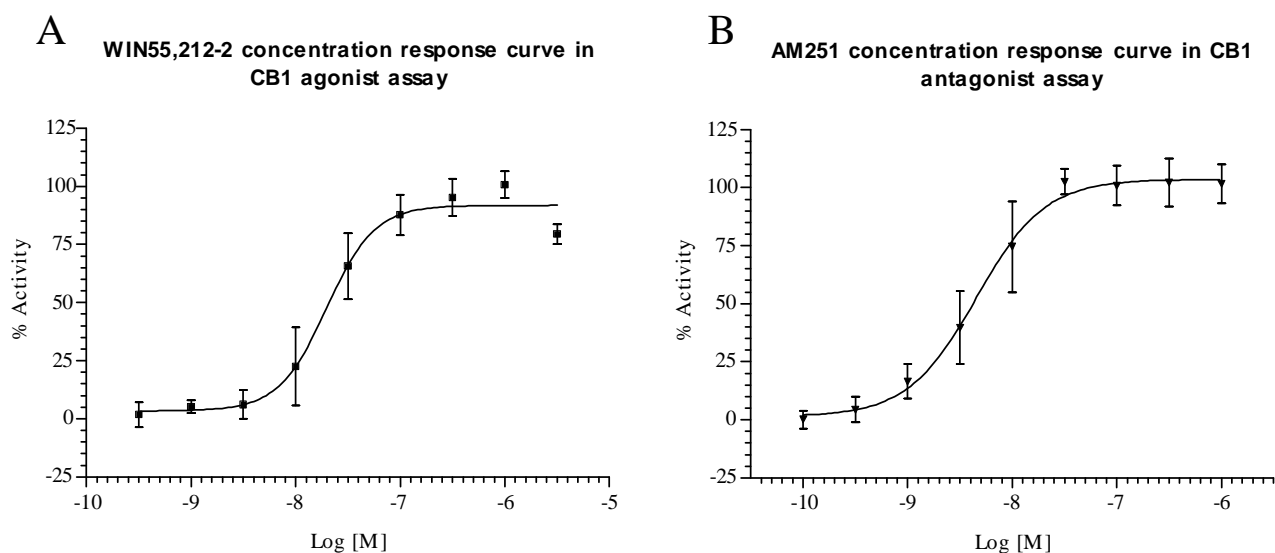


Figure 4. Concentration response curves in the CB1 agonist and antagonist assays. Concentration response was measured in 9 point half log dilution series. Cells were incubated with test compound for 2 hours. Cells were then fixed and internalization was measured by image analysis detecting cytoplasmic foci. A) WIN55,212-2 concentration response curve in the CB1 agonist Redistribution assay (n=8). The EC₅₀ value of WIN55,212-2 is approximately 20 nM. % activity was calculated relative to the positive (1 μ M WIN55,212-2) and negative control (0.25% DMSO). B) AM251 concentration response curve in the CB1 antagonist Redistribution assay where 1 μ M WIN55,212-2 is used as agonist (n=6). The EC₅₀ value of AM251 is approximately 45 nM. % activity was calculated relative to the positive (100 nM AM251) and negative control (0.25% DMSO).

Product qualification

Assay performance has been validated with an average $Z' = 0.55 \pm 0.21$. The cells have been tested for viability. The cells have been tested negative for mycoplasma and authenticated to be U2OS cells by DNA fingerprint STR analysis.

Related Products

Product #	Type	Product description	Cell line
R04-061-01	Profiling	CB2 Redistribution [®] Assay (agonist)	U2OS
R04-061-02	Profiling	CB2 Redistribution [®] Assay (antagonist)	U2OS
R04-017-02	Profiling	Gq-coupled GPCRs – NFATc1 Redistribution [®] Assay	U2OS
R04-045-02	Profiling	Gs/Gi-coupled GPCRs – PKA Redistribution [®] Assay	CHO-K1

References

1. Van Gaal, L.F. et al., Lancet, 365(9468):1389-97, 2005.
2. Hsieh, C. et al., J. Neurochem., 73(2):493-501, 1999.
3. Kirkham, T.C. Behav. Pharmacol., 16(5-6):297-313, 2005.

Licensing Statement

Use of this product is limited in accordance with the Redistribution terms and condition of sale.

The CMV promoter and its use are covered under U.S. Pat. Nos. 5,168,062 and 5,385,839 owned by the University of Iowa Research Foundation, Iowa City, Iowa, and licensed for research purposes use only. Any other use of the CMV promoter requires a license from the University of Iowa Research Foundation, 214 Technology Innovation Center, Iowa City, IA 52242, USA.

This product and/or its use is subject of patent nos. US 6,518,021; EP 1,199,564; EP 0,986,753; US 6,172,188; EP 0,851,874 including continuations, divisions, reissues, extensions, and substitutions with respect thereto, and all United States and foreign patents issuing therefrom to Fisher BioImage ApS, and the patents assigned to Aurora/ The Regents of the University of California (US5,625,048, US6,066,476, US5,777,079, US6,054,321, EP0804457B1) and the patents assigned to Stanford (US5,968,738, US5,804,387) including continuations, divisions, reissues, extensions, and substitutions with respect thereto, and all United States and foreign patents issuing therefrom.

For European customers:

The CB1 Redistribution cell line is genetically modified with a vector expressing CB1 fused to EGFP. As a condition of sale, use of this product must be in accordance with all applicable local legislation and guidelines including EC Directive 90/219/EEC on the contained use of genetically modified organisms.

Redistribution is a registered trademark of Fisher BioImage ApS

<p>The Thermo Scientific Redistribution assays are part of the Thermo Scientific High Content Platform which also includes Thermo Scientific HCS Reagent Kits, Thermo Scientific Arrayscan HCS Reader, Thermo Scientific CellInsight Personal Cell Imager, Thermo Scientific ToxInsight IVT platform, BioApplication image analysis software and high-content informatics. For more information on Thermo Scientific products for high content and Cellomics, visit www.thermoscientific.com/cellomics, or call 800-432-4091 (toll free) or 412-770-2500.</p>	LC06703403
---	------------