

Example Experiment

Characterizing ERK Activation in Response to EGF Treatment in HeLa Cells



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I. Background

Accurate quantification of protein expression and/or post-translational modifications is important for advancing both basic and translational research. Given the flexibility, reproducibility, and higher throughput of the In-Cell Western™ Assay, it offers a convenient alternative to Western blotting and is a powerful platform for meaningful *in situ* analyses. The In-Cell Western microplate format can be used to analyze:

- Protein phosphorylation and signaling ([1](#) - [3](#))
- Off-target effects of drugs on signaling pathways ([4](#))
- Timing and kinetics of signaling events ([5](#) , [6](#))
- Quantification of viral load ([7](#) - [11](#))
- Genotoxicity assays ([12](#), [13](#))
- Cell proliferation and apoptosis assays ([14](#))
- Bacterial-induced epithelial signaling ([15](#))
- Glycoprotein analysis ([16](#), [17](#))
- Library screening ([18](#) - [20](#))
- Screening of monoclonal antibody clones ([21](#))

II. Introduction

Due to the multifaceted roles of the epidermal growth factor receptor (EGFR) signaling pathway, it is not surprising that the perturbation of this pathway can promote malignant behavior in cancer cells, such as increased cell survival, proliferation, migration, invasion, and the epithelial-mesenchymal transition. Consequently, EGFR has emerged as an attractive target for anti-cancer therapy and understanding how new therapies impact this multi-dimensional pathway is of great importance. The information obtained from this experimental protocol could be used to identify appropriate experimental conditions to screen for and characterize compounds that modulate this branch of the EGFR signaling pathway.

III. Experimental Design

In the following In-Cell Western example, we present a protocol for monitoring ERK phosphorylation in response to stimulation of the EGFR pathway by the epidermal growth factor (EGF). EGF stimulates cellular proliferation, differentiation, and survival by binding to the EGFR, thereby triggering a signal transduction cascade that initiates a variety of biochemical and molecular changes, including the phosphorylation and activation of ERK.

Exploring EGFR and its corresponding signaling pathways can provide critical knowledge in understanding both its normal function and role in disease. In the following protocol, changes in phospho- and total-ERK protein levels are detected and characterized in HeLa cells treated with a serial dilution of EGF.

IV. Required Reagents

LI-COR Reagents

- IRDye® 800CW Goat anti-Rabbit Secondary Antibody (LI-COR P/N 926-32211)
- CellTag™ 700 Stain (LI-COR P/N 926-41090)
- Intercept® (PBS) Blocking Buffer (licor.com/intercept)

Additional Reagents

- HeLa cells (ATCC, P/N CCL-2)
- 1X PBS wash buffer
- Tissue culture reagents (serum, DMEM, trypsin, 1X PBS)
- 20% Tween® 20
- Epidermal Growth Factor (Millipore, P/N 01-107)
- 37% formaldehyde
- 10% Triton® X-100
- Black-sided 96-well or 384-well microplates with clear well bottoms
- Primary antibodies

Note: Long passage HeLa cells are not suitable for the assay because of high basal level phosphorylation of ERK. As a result, ordering a low passage new sample of this cell line from ATCC is highly recommended. No starvation is needed or recommended.

V. Prepare Cells

1. Allow HeLa cell growth in a T75 flask using standard tissue culture procedures until ~80% confluency is achieved ($\sim 1.5 \times 10^7$ cells; DMEM, 10% FBS; Gibco®).

2. Remove growth media and wash cells with sterile 1X PBS (room temperature (RT)).
3. Add trypsin and incubate 3-5 minutes at 37 °C to displace cells.
4. Neutralize displaced cells with culture media and pellet by centrifugation (500 x g).
5. Remove supernatant and disrupt the cell pellet manually by hand-tapping the collection tube.

Note: To maintain cell integrity, do not pipet or vortex during pellet disruption.

6. Resuspend cells in 20 mL of complete media and count cells using a hemocytometer.
7. Reconstitute and dilute cells with complete media to a concentration of 75,000 cells/mL.
8. Manually mix the cell suspension thoroughly.
9. Under sterile conditions, dispense 200 µL of the cell suspension per well in a 96-well plate (15,000 cells plated per well).
10. Incubate cells at 37 °C and monitor cell density until cells are consistently confluent in each well. This should take approximately 2 to 3 days.

VI. Treat Cells

1. Warm serum-free media (DMEM, Gibco) to 37 °C. Dispense 100 µL of DMEM per well in the 96-well microplate.
2. Make serial dilutions of EGF in a separate microplate ranging from 0.2 to 100 ng/mL. Leave the first and second wells without EGF (resting cells as control). See "Experimental Results" on page 10.
3. Carefully remove complete media from plate wells by aspiration or manual displacement.
4. Transfer DMEM and EGF from the dilution plate into the experimental plate.
5. Incubate at 37 °C for 7.5 minutes.

VII. Fix and Permeabilize Cells

Fix Cells

1. Prepare fresh Fixing Solution as follows:

1X PBS	45 mL
37% Formaldehyde	5 mL
<hr/>	
3.7% Formaldehyde	50 mL

2. When incubation period is complete, carefully remove activation media manually or by aspiration to avoid detaching the cells.
3. Using a multi-channel pipettor, add 150 μ L of fresh Fixing Solution (RT). Add the solution by pipetting down the sides of the wells carefully to avoid detaching the cells from the well bottom.
4. Allow incubation on bench top for 20 minutes at RT with no shaking.

Permeabilize Cells

1. Prepare Triton[®] Washing Solution as follows:

1X PBS	495 mL
10% Triton X-100	5 mL
<hr/>	
1X PBS + 0.1% Triton X-100	500 mL

2. Remove Fixing Solution to an appropriate waste container (contains formaldehyde).
3. Using a multi-channel pipettor, add 200 μ L Triton Washing Solution (RT). Add the solution down the sides of the wells carefully to avoid detaching the cells.
4. Allow plate to shake on a rotator for 5 minutes at RT.
5. Repeat washing steps 4 more times, removing wash manually each time.

Important: Do not allow cells to become dry during washing. Immediately add the next wash after manual disposal.

VIII. Block Cells

1. Using a multi-channel pipettor, add 150 μ L of Intercept[®] Blocking Buffer to each well. Add the solution by pipetting down the sides of the wells carefully to avoid detaching the cells.
2. Allow blocking for 1.5 hours at RT with moderate shaking on a plate shaker.

IX. Primary Antibodies

Dilute Primary Antibodies

1. Dilute the antibodies in Intercept Blocking Buffer. Combine the following solutions as defined below for ERK target analysis:
Phospho-ERK (Rabbit; 1:100 dilution in the combined solution; Cell Signaling Technology, P/N 9101)
Total ERK2 (Mouse; 1:75 dilution in the combined solution; Santa Cruz Biotechnology, P/N SC-1647)
2. Mix the primary antibody solution thoroughly before adding to wells.

Incubate with Primary Antibodies

1. Remove blocking buffer from the blocking step and add 50 μ L of the desired primary antibody or antibodies in Intercept Blocking Buffer to cover the bottom of each well.
2. Make sure to include control wells without primary antibody to serve as a source for background well intensity (Figure 1). Only add 50 μ L of Intercept Blocking Buffer to control wells.
3. Incubate with primary antibody for 2 hours with gentle shaking at RT.

Wash

1. Prepare Tween[®] Washing Solution as follows:

1X PBS	995 mL
20% Tween 20	5 mL
<hr/>	
1X PBS + 0.1% Tween 20	1000 mL

2. Remove primary antibody solution.
3. Using a multi-channel pipettor, add 200 μ L Tween Washing Solution (RT). Add solution down the sides of the wells carefully to avoid detaching the cells from the well bottom.

4. Allow wash to shake on plate shaker for 5 minutes at RT.
5. Repeat washing steps 4 more times.

X. Secondary Antibodies

Dilute Secondary Antibodies

1. Dilute the fluorescently-labeled secondary antibodies in Intercept® Blocking Buffer as specified below. To lower background, add Tween® 20 to the diluted antibody to a final concentration of 0.2%. Recommended dilution range is 1:200 to 1:1,200.
Goat anti-Rabbit IRDye® 680RD (1:800 dilution in the combined solution)
Goat anti-Mouse IRDye 800CW (1:800 dilution in the combined solution)

Note: Minimize exposure of the antibody vials to light.

2. Mix the antibody solutions and add 50 µL of the secondary antibody solution to each well.

Incubate with Secondary Antibodies

1. Incubate for 60 minutes with gentle shaking at RT. Protect plate from light during incubation.

Wash

1. Remove secondary antibody solution.
2. Using a multi-channel pipettor, add 200 µL of Tween Washing Solution at RT (see "Wash" on the previous page). Add solution down the sides of the wells carefully to avoid detaching the cells from the well bottom.
3. Allow wash to incubate on a plate shaker for 5 minutes at RT.
4. Repeat washing steps 4 more times. Protect plate from light during washing.

XI. Image

1. After final wash, remove wash solution completely from wells. Turn the plate upside down and tap or blot gently on paper towels to remove traces of wash buffer. For best results,

scan plate immediately; plates may also be stored at 4 °C for several weeks (sealed and protected from light).

2. Before plate scanning, clean the bottom plate surface and the Odyssey® Imager scanning bed (if applicable) with moist, lint-free tissue to avoid any obstructions during scanning.
3. Scan plate with detection in both 700 and 800 nm channels.

Suggested Scan Settings

All settings may require adjustment for optimal data quality. Higher resolutions or scan qualities can be used, but the scan time will increase.

Instrument	Resolution	Scan Quality	Intensity Setting (700 nm)	Intensity Setting (800 nm)
Odyssey® Classic	169 µM	lowest	5	5
Odyssey CLx	169 µM	lowest	Auto Mode	Auto Mode
Odyssey Sa	200 µM	lowest	7	7
Aerius™ Imager	200 µM	lowest	7	7

XII. Experimental Results

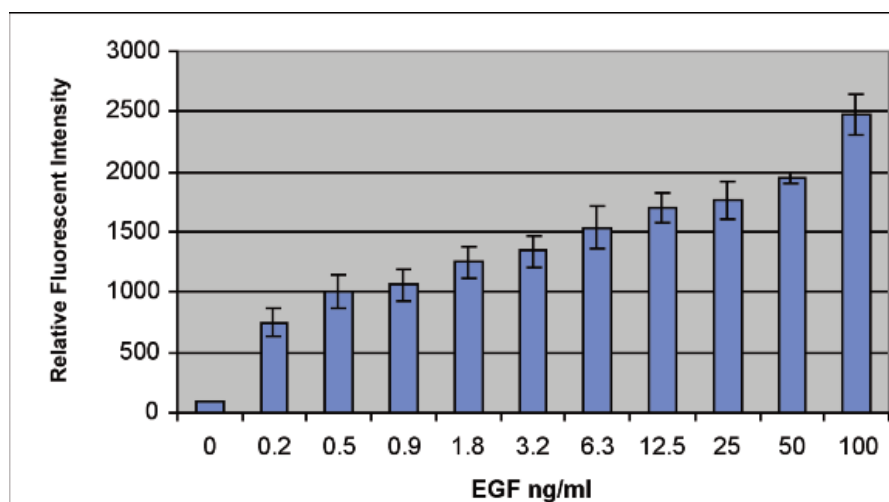
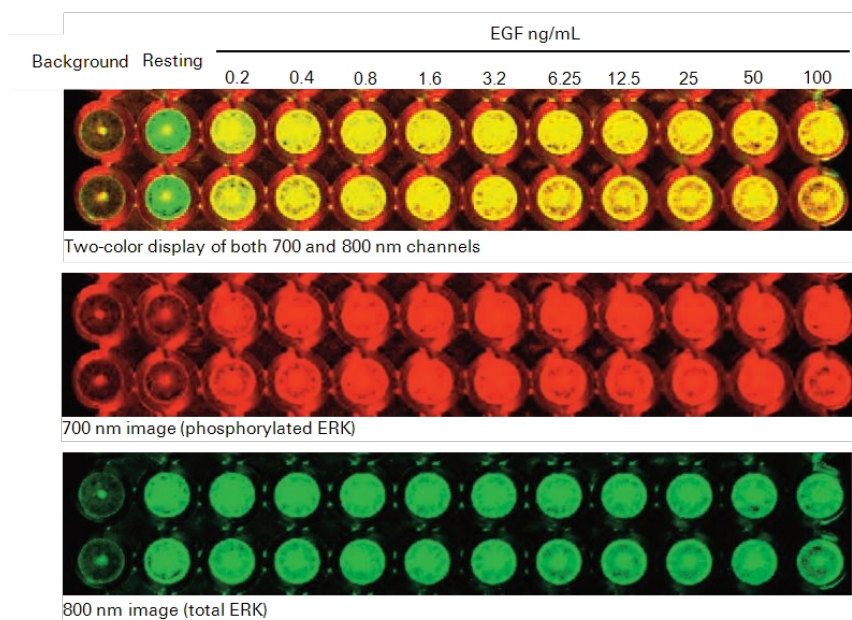


Figure 1. Dose response of HeLa cells to epidermal growth factor (EGF) as measured by specific antibody detecting dual-phosphorylated ERK (Thr202/Tyr204). The image represents a 96-well, two-color In-Cell Western™ Assay with the 800 and 700 nm channels detecting total and phosphorylated ERK, respectively. Background wells were incubated with secondary antibody but no primary antibody. The graph shows data demonstrating percent phosphorylation of ERK.

XIII. References

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