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Product Manual

# CytoSelect™ 96-Well Phagocytosis Assay (*E. coli* Substrate)

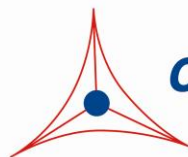
Catalog Number

CBA-222

96 assays

**FOR RESEARCH USE ONLY**  
Not for use in diagnostic procedures

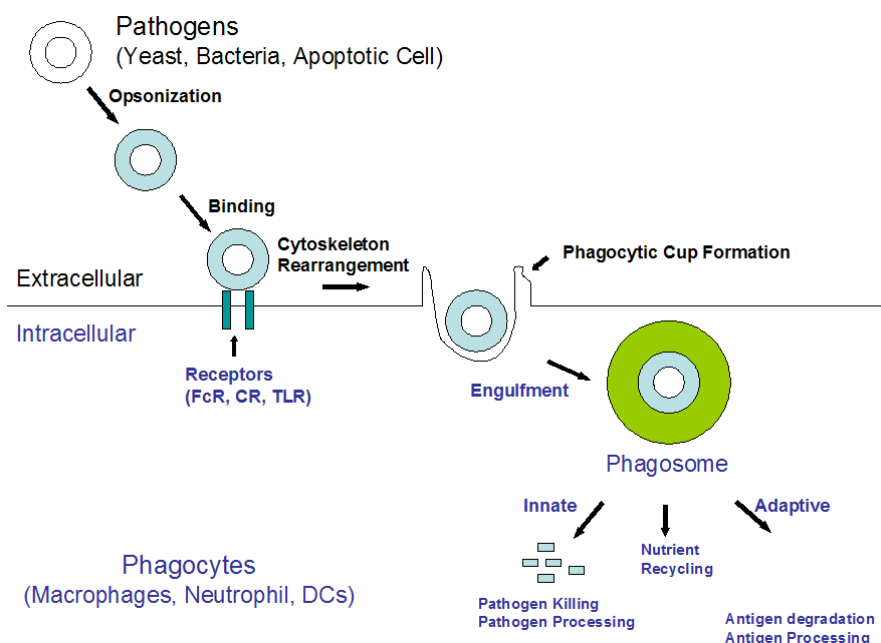
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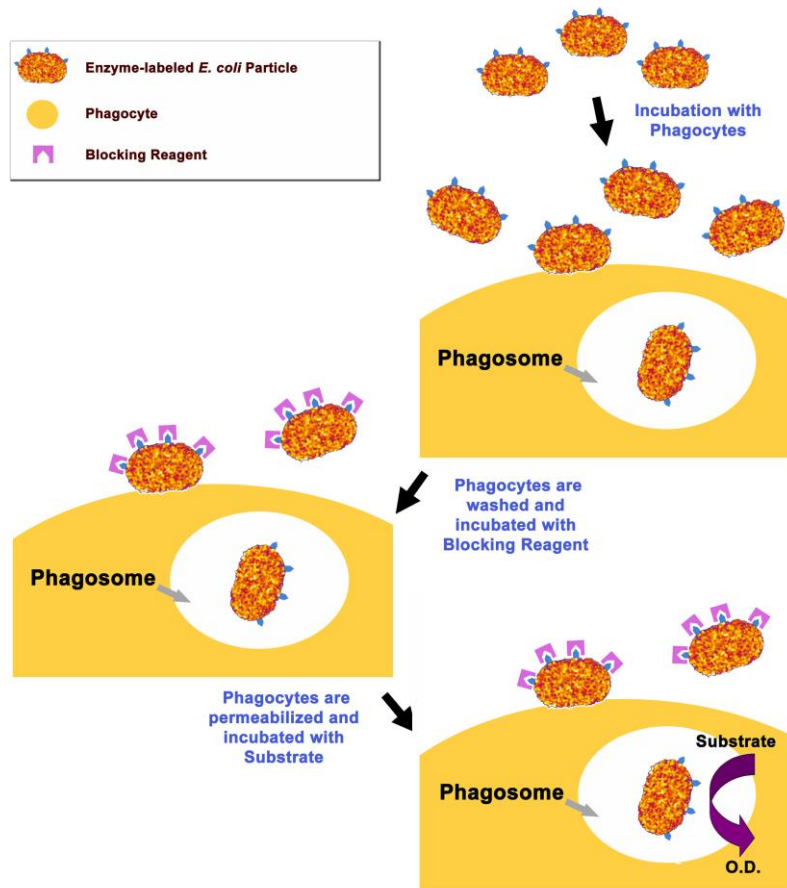
## Introduction

In mammals, phagocytosis by phagocytes (e.g., macrophages, dendritic cells, and neutrophils) is essential for a variety of biological events, including tissue remodeling and the continuous clearance of dying cells. Furthermore, phagocytosis represents an early and crucial event in triggering host defenses against invading pathogens. Phagocytosis comprises a series of events, starting with the binding and recognition of particles by cell surface receptors, followed by the formation of actin-rich membrane extensions around the particle. Fusion of the membrane extensions results in phagosome formation, which precedes phagosome maturation into a phagolysosome. Pathogens inside the phagolysosome are destroyed by lowered pH, hydrolysis, and radical attack (Figure 1). These early events that are mediated by the innate immune system are critical for host survival. As a result of this process, pathogen-derived molecules can be presented at the cell surface (antigen presentation), allowing the induction of acquired immunity.



**Figure 1: Phagocytosis Processes.**

Cell Biolabs' CytoSelect™ 96-well Phagocytosis Assay (*E. coli*) uses enzyme-labeled, *E. coli* particles as a phagocytosis pathogen; however, it does **not** involve subjective manual counting of *E. coli* particles inside cells. Instead, external particles are blocked before the colorimetric detection of engulfed *E. coli* particles (Figure 2). This format provides a quantitative, high-throughput method to accurately measure phagocytosis. The CytoSelect™ 96-well Phagocytosis Assay (*E. coli*) provides a robust system for screening TLR ligands, phagocytosis activators or inhibitors. Each kit provides sufficient quantities to perform 96, 48, 24 tests in a 96, 48, 24-well plate, respectively.



## **Related Products**

1. CBA-220: CytoSelect™ 96-Well Phagocytosis Assay (Red Blood Cell, Colorimetric Format)
2. CBA-224: CytoSelect™ 96-Well Phagocytosis Assay (Zymosan, Colorimetric Format)
3. CBA-210: CytoSelect™ Leukocyte-Endothelium Adhesion Assay
4. CBA-212: CytoSelect™ Leukocyte Transmigration Assay

## **Kit Components**

1. *E. coli* Suspension (Part No. 122201): One 1 mL tube of enzyme-labeled, fixative-inactivated *E. coli* in PBS/1% BSA
2. Fixation Solution (Part No. 122402): One 20 mL bottle of 3.2% Buffered Formaldehyde Solution
3. 10X Blocking Reagent (Part No. 122202): One 1.5 mL tube
4. 10X Permeabilization Solution (Part No. 122404): One 1.5 mL tube of PBS/1% Triton X-100
5. Substrate (Part No. 310807): One 12 mL amber bottle
6. Stop Solution (Part No. 310808): One 12 mL bottle
7. Phagocytosis Inhibitor (Part No. 122006): One 20 µL amber tube of 2 mM Cytochalasin D in DMSO

## **Materials Not Supplied**

1. Phagocytes and Culture Medium
2. PBS
3. 37°C Incubator, 5% CO<sub>2</sub> Atmosphere
4. Light Microscope
5. 96-well Mitrotiter Plate
6. 96-well Microtiter Plate Reader

## **Storage**

Upon receipt, aliquot and store the *E. coli* Suspension at -20°C to avoid multiple freeze/thaw cycles. Store all other kit components at 4°C.

## **Preparation of Reagents**

- *E. coli* Suspension: Thaw *E. coli* Suspension at 4°C. Either nonopsonized or opsonized *E. coli* particles can be used in phagocytosis assay. **For opsonization, it is recommended to use the entire 1 mL suspension (due to the small particle pellet during centrifugation).** To opsonize *E. coli* particles, incubate particles with desired serum or IgG for 30 minutes at 37°C, pellet particles by centrifugation at 10,000 xg for 1 minute, and wash a few times with sterile 1X PBS. Prior to using, resuspend the particles in the same volume of sterile 1X PBS. Store at 4°C.
- 1X Blocking Reagent: Prepare the appropriate volume for the number of samples being tested. IMMEDIATELY prior to using, dilute the provided 10X Blocking Reagent 1:10 in 1X PBS. Store at 4°C.
- 1X Permeabilization Solution: Prepare the appropriate volume for the number of samples being tested. Prior to using, dilute the provided 10X Permeabilization Solution 1:10 in 1X PBS. Store at 4°C.

## **Assay Protocol: Adherent Phagocytes**

The following assay protocol is written for a 96-well format. Refer to the below table for the appropriate dispensing volumes of other plate formats.

<b>Culture Dish</b>	<b>96-well</b>	<b>48-well</b>	<b>24-well</b>
Phagocyte Seeding Volume (µL/well)	100	200	400
<i>E. coli</i> Suspension (µL/well)	10	20	40
Fixation Solution (µL/well)	100	200	400
Permeabilization Solution (µL/well)	100	200	400

**Table 1:** Dispensing Volumes of Different Plate Formats

## I. Phagocytosis of *E. coli*

1. Harvest and resuspend phagocytic cells in culture medium at  $0.2 - 1 \times 10^6$  cells/mL or the appropriate concentration that yields >80% confluency after overnight incubation. Seed 100  $\mu$ L in each well of a 96-well plate and incubate overnight at 37°C, 5% CO<sub>2</sub>.
2. Treat phagocytes with desired activators or inhibitors.
3. Add 10  $\mu$ L of *E. coli* Suspension to each well. Mix well and immediately transfer the plate to a cell culture incubator for 3 – 6 hours, undisturbed. Each sample including a negative control without *E. coli* particles should be assayed in duplicate.

*Note: The E. coli particle is much smaller than other phagocytosis particles (e.g. Zymosan, RBC, latex bead), requiring longer incubation times to settle on phagocytic cells. Leave the plate undisturbed during this step.*

4. Remove the culture medium by gently aspirating or inverting the plate and blotting on a paper towel. Gently tap several times.
5. Gently add 200  $\mu$ L of cold, serum-free medium (e.g. DMEM, RPMI) to each well. Promptly remove the cold media by gently aspirating or inverting the plate and blotting on a paper towel. Gently tap several times. Repeat four times total.

*Note: For loosely attached cells, complete culture media is preferred to maintain cell attachment*

## II. Removal and blocking of external particles

*Note: Perform steps with care, gently adding solutions as to not disrupt cell attachment*

1. Add 100  $\mu$ L of Fixation Solution to each well, incubating 5 minutes at room temperature.
2. Promptly remove the Fixation Solution by gently aspirating or inverting the plate and blotting on a paper towel. Gently tap several times.
3. Wash twice with 1X PBS.
4. Add 100  $\mu$ L of prediluted 1X Blocking Reagent to each well (see Preparation of Reagents Section). Incubate the plate for 30 minutes at room temperature on an orbital shaker.
5. Promptly remove the Blocking Reagent by gently aspirating or inverting the plate and blotting on a paper towel. Gently tap several times. Wash three times with 1X PBS.

## III. Detection of internalized particles

*Note: Perform steps with care, gently adding solutions as to not disrupt cell attachment*

1. Remove the PBS wash and add 100  $\mu$ L of prediluted 1X Permeabilization Solution (see Preparation of Reagents Section) to each well, incubate 5 minutes at room temperature.
2. Promptly remove the Permeabilization Solution by gently aspirating or inverting the plate and blotting on a paper towel. Gently tap several times. Wash twice with 1X PBS.
3. Promptly remove the PBS by gently aspirating or inverting the plate and blotting on a paper towel. Gently tap several times.
4. Initiate the reaction by adding 100  $\mu$ L of Substrate. Incubate for 10-30 minutes at room temperature.

5. Stop the reaction by adding 100  $\mu\text{L}$  of the Stop Solution and mix by placing the plate on an orbital plate shaker for 30 seconds.
6. Read the absorbance of each well at 450 nm.

### **Assay Protocol: Suspension Phagocytes**

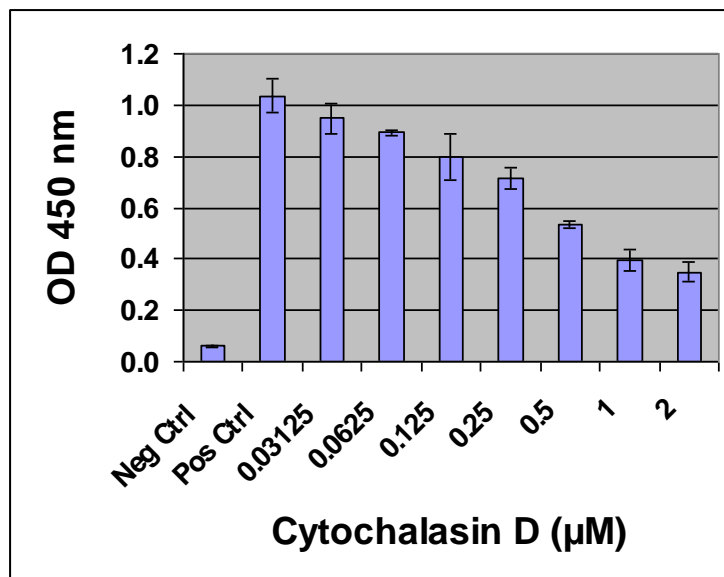
1. Harvest and resuspend phagocytic cells in culture medium at  $0.2 - 1 \times 10^6$  cells/mL. Seed 100  $\mu\text{L}$  in each well of a 96-well plate.
2. Treat phagocytes with desired activators or inhibitors.
3. Add 10  $\mu\text{L}$  of *E. coli* Suspension to each well. Mix well and immediately transfer the plate to a cell culture incubator for 3 – 6 hours, undisturbed. Each sample including a negative control without *E. coli* particles should be assayed in duplicate.

*Note: The E. coli particle is much smaller than other phagocytosis particles (e.g. Zymosan, RBC, latex bead), requiring longer incubation times to settle on phagocytic cells. Leave the plate undisturbed during this step.*

4. Remove the culture medium by centrifugation at 300 x g for 5 minutes, and gently aspirate.
5. Add 200  $\mu\text{L}$  of cold 1X PBS to each well. Promptly remove the PBS Solution by centrifugation and gentle aspiration.
6. Add 100  $\mu\text{L}$  of Fixation Solution to each well, incubate 5 minutes at room temperature.
7. Promptly remove the Fixation Solution by centrifugation at 300 x g for 5 minutes, and gently aspirate.
8. Wash twice with 1X PBS.
9. Add 100  $\mu\text{L}$  of prediluted 1X Blocking Solution to each well (see Preparation of Reagents Section). Incubate the plate for 30 minutes at room temperature on an orbital shaker.
10. Promptly remove the Blocking Solution by centrifugation at 300 x g for 5 minutes, and gently aspirate. Wash three times with 1X PBS.
11. Add 100  $\mu\text{L}$  of prediluted 1X Permeabilization Solution (see Preparation of Reagents Section) to each well, incubate 5 minutes at room temperature.
12. Promptly remove the Permeabilization Solution by centrifugation at 300 x g for 5 minutes, and gently aspirate. Wash twice with 1X PBS.
13. Promptly remove the PBS by centrifugation at 300 x g for 5 minutes, and gently aspirate.
14. Initiate the reaction by adding 100  $\mu\text{L}$  of Substrate. Incubate for 10-30 minutes at room temperature.
15. Stop the reaction by adding 100  $\mu\text{L}$  of the Stop Solution and mix by placing the plate on an orbital plate shaker for 30 seconds.
16. Read the absorbance of each well at 450 nm.

## **Example of Results**

The following figures demonstrate typical results with the CytoSelect™ 96-well Phagocytosis Assay Kit. Absorbance measurements were performed on a Microplate Autoreader EL311 (Bio-Tek Instruments Inc.) with a 450 nm filter. One should use the data below for reference only. This data should not be used to interpret actual results.



**Figure 2. Inhibition of Raw 264.7 Macrophage Phagocytosis by Cytochalasin D.** 50,000 cells/well of Raw 264.7 macrophages were seeded overnight in a 96-well plate. Cytochalasin D was used to pretreat Raw 264.7 cells for 1 hr at 37°C. *E. coli* particles were then added for 4 hours before engulfed particles was determined as described in the Assay Protocol.

## **References**

1. Hornef, M.W. et al. (2002) *Nat. Immunol.* **3**:1033-1040.
2. Lei, B. et al. (2001) *Nat. Med.* **7**:1298-1305.
3. Ojielo, C.I. et al. (2003) *J. Immunol.* **171**:4416-4424.
4. Foukas, L.C. et al. (1998) *J. Biol. Chem.* **273**:14813-14818.
5. Grunwald, U. et al. (1996) *J. Immunol.* **157**:4119-4125.

## **Recent Product Citations**

1. Choe, U. et al. (2023). Identification and elucidation of cross talk between SLAM Family Member 7 (SLAMF7) and Toll-like receptor (TLR) pathways in monocytes and macrophages. *Sci Rep.* **13**(1):11007. doi: 10.1038/s41598-023-37040-0.
2. Ono, M. et al. (2023). Water-soluble protein from walleye pollock (*Gadus chalcogrammus*) suppresses lipopolysaccharide-induced inflammation by attenuating TLR4-MyD88 expression in macrophages. *Food Chem (Oxf)*. **6**:100165. doi: 10.1016/j.fochms.2023.100165.
3. Bae, W.Y. et al. (2022). Investigation of Immunostimulatory Effects of Heat-treated *Lactiplantibacillus plantarum* LM1004 and its Underlying Molecular Mechanisms. *Food Sci Anim Resour.* doi: 10.5851/kosfa.2022.e50.

4. Lajqi, T. et al. (2022). Gut Microbiota-Derived Small Extracellular Vesicles Endorse Memory-like Inflammatory Responses in Murine Neutrophils. *Biomedicines*. **10**(2):442. doi: 10.3390/biomedicines10020442.
5. Ali, M.S. et al. (2021). Aronia melanocarpa Extract Fermented by Lactobacillus plantarum EJ2014 Modulates Immune Response in Mice. *Antioxidants (Basel)*. **10**(8):1276. doi: 10.3390/antiox10081276.
6. Lee, H. et al. (2021). Toxic effects of dietary copper and EGCG on bioaccumulation, antioxidant enzyme and immune response of Korean bullhead, Pseudobagrus fulvidraco. *Fish Shellfish Immunol*. doi: 10.1016/j.fsi.2021.01.010.
7. Yu, Y.B. et al. (2020). Effects of dietary ascorbic acid on growth performance, hematological parameters, antioxidant and non-specific immune responses in starry flounder, Platichthys stellatus. *Aquac Rep*. doi: 10.1016/j.aqrep.2020.100419.
8. Yun, S. et al. (2019). Enhanced bath immersion vaccination through microbubble treatment in the cyprinid loach. *Fish and Shellfish Immunology*. doi: 10.1016/j.fsi.2019.05.021.
9. Koumakis, E. et al. (2019). Novel function of PiT1/SLC20A1 in LPS-related inflammation and wound healing. *Sci Rep*. **9**(1):1808. doi: 10.1038/s41598-018-37551-1.
10. Lin, H.P. et al. (2018). Identification of novel macropinocytosis inhibitors using a rational screen of Food and Drug Administration-approved drugs. *Br J Pharmacol*. **175**(18):3640-3655. doi: 10.1111/bph.14429.
11. Boddaert, J. et al. (2018). CD8 signaling in microglia/macrophage M1 polarization in a rat model of cerebral ischemia. *PLoS One*. **13**(1):e0186937. doi: 10.1371/journal.pone.0186937.
12. He, T. et al. (2017). Interleukin-17A-promoted MSC2 polarization related with new bone formation of ankylosing spondylitis. *Oncotarget*. **8**(57):96993-97008. doi: 10.18632/oncotarget.20823.
13. Martin, I. et al. (2015). Fasciola hepatica fatty acid binding protein inhibits TLR4 activation and suppresses the inflammatory cytokines induced by lipopolysaccharide in vitro and in vivo. *J Immunol*. doi:10.4049/jimmunol.1401182.
14. Zhu, X. et al. (2014). Deletion of class A scavenger receptor deteriorates obesity-induced insulin resistance in adipose tissue. *Diabetes*. **63**:562-577.

## **Warranty**

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