
Product Manual

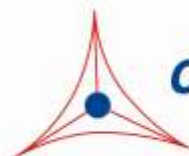
DAG (Diacylglycerol) Assay Kit

Catalog Number

MET-5028

100 assays

FOR RESEARCH USE ONLY
Not for use in diagnostic procedures



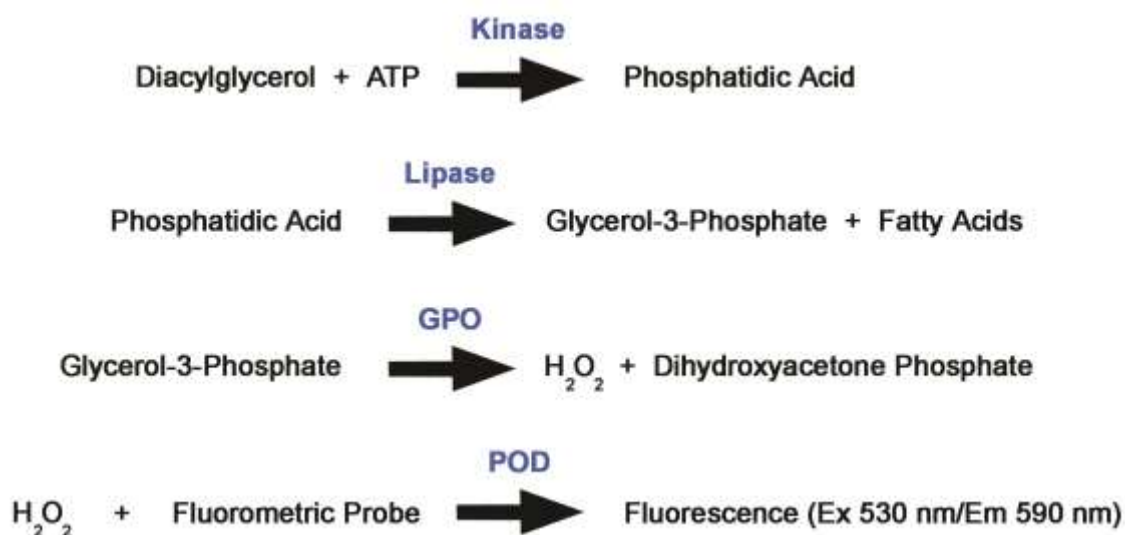
CELL BIOLABS, INC.

Creating Solutions for Life Science Research

Introduction

Diacylglycerols (DAG) are key intermediates in the biosynthesis of many cellular lipids and play a fundamental role in biochemical signaling. Structurally, diacylglycerol is a glyceride consisting of 2 fatty acid chains linked by a central glycerol backbone. Diacylglycerol acts as a precursor to many lipids (e.g. triglycerides, phospholipids); however, DAG also functions as a second messenger signaling lipid, produced through hydrolysis of PIP2 by phospholipase C, which initiates intracellular Ca^{2+} release and PKC activation. Ultimately, the PKC enzymes are involved with many modifications to normal cellular physiology, affecting hundreds of substrates.

Cell Biolabs' DAG Assay Kit measures diacylglycerol content in samples by a coupled enzymatic reaction system. First, kinase is used to phosphorylate DAG samples, yielding phosphatidic acid. Next, a lipase is used to hydrolyze phosphatidic acid to glycerol-3-phosphate. Finally, the glycerol-3-phosphate product is oxidized by glycerol-3-phosphate oxidase (GPO), producing hydrogen peroxide which reacts with the kit's Fluorometric Probe (Ex. 530-560 nm/Em. 585-595 nm).



The DAG Assay Kit is a simple, fluorometric assay that quantitatively measures total DAG (diacylglycerol) in cell lysates using a 96-well microtiter plate format. Each kit provides sufficient reagents to perform up to 100 assays*, including blanks, standards and unknown samples. The kit contains a DAG Standard and has a detection sensitivity limit of ~15 μM .

**Note: Each sample replicate requires 2 assays, one treated with Kinase Mixture (+Kin) and one without (-Kin). DAG is calculated from the difference in fluorescence readings from the 2 wells.*

Related Products

1. MET-5019: Total Phosphatidic Acid Assay Kit (Fluorometric)
2. MET-5024: Phosphatidylglycerol/Cardiolipin Assay Kit (Fluorometric)
3. STA-369: OxiSelect™ Human Oxidized LDL ELISA Kit (MDA-LDL Quantitation)
4. STA-390: Total Cholesterol Assay Kit

5. STA-391: HDL and LDL/VLDL Cholesterol Assay Kit
6. STA-394: HDL Cholesterol Assay Kit
7. STA-397: Serum Triglyceride Quantification Kit (Fluorometric)
8. STA-399: Free Glycerol Assay Kit (Fluorometric)
9. STA-600: Phosphatidylcholine Assay Kit
10. STA-601: Sphingomyelin Assay Kit
11. STA-619: Free Fatty Acid Assay Kit (Fluorometric)

Kit Components

1. DAG Standard (Part No. 50281D): One 1 mL vial of 2 mM 1-2-dioleoyl-*sn*-glycerol.
2. 10X Assay Buffer (Part No. 50192D): One 1.5 mL vial.
3. Kinase Mixture (Part No. 50282D): Two 1 mL vials containing ATP.
4. Lipase Solution (Part No. 50193D): Three 1.4 mL vials.
5. Enzyme Mixture (Part No. 50194D): Three 1.75 mL vials.
6. Fluorometric Probe (Part No. 261901): One 110 μ L amber vial.

Materials Not Supplied

1. Standard 96-well fluorescence black microtiter plate
2. PBS (containing Magnesium and Calcium)
3. Extraction reagents for cellular lipids (methanol, chloroform, 1M NaCl)
4. 10 μ L to 1000 μ L adjustable single channel micropipettes with disposable tips
5. 50 μ L to 300 μ L adjustable multichannel micropipette with disposable tips
6. Multichannel micropipette reservoir
7. Fluorescence microplate reader capable of reading excitation in the 530-560 nm range and emission in the 585-595 nm range

Storage

Store the entire kit at -80°C . Avoid multiple freeze/thaws by aliquoting. The Fluorometric Probe is light sensitive and should be maintained in amber tubes.

Preparation of Reagents

- DAG Standard: Thaw at 37°C for 1-2 hours. Once homogeneous and vortexed well, maintain the standard at 37°C during assay preparation. The solution is stable for 1 week at room temperature; however, the solution must be warmed to 37°C to ensure homogeneity. For longer term storage, the solution should be aliquoted and frozen at -80°C to avoid multiple freeze/thaws.
- 1X Assay Buffer: 10X Assay Buffer should be thawed/maintained at 4°C during assay preparation. Dilute the 10X Assay Buffer with deionized water. Stir to homogeneity. The 1X solution is stable

for 1 month at 4°C. For longer term storage, any unused 10X stock material should be aliquoted and frozen at -80°C to avoid multiple freeze/thaws.

- Kinase Mixture, Lipase Solution, and Enzyme Mixture: Thaw at 4°C. Once homogeneous and mixed well, maintain the solution at 4°C during assay preparation. The solution should be aliquoted and frozen at -80°C to avoid multiple freeze/thaws.

Note: These components are provided in multiple tubes to minimize multiple freeze/thaws.

- Fluorometric Probe: Thaw and maintain at room temperature during assay preparation. Any unused material should be aliquoted and frozen at -80°C to avoid multiple freeze/thaws.
- PEU (pre-equilibrated upper phase) Solution: Mix 50 mL of chloroform, 50 mL of methanol, and 45 mL of 1M NaCl in a glass container. Shake or mix the solution well, then allow it to separate into 2 phases. Use the upper phase for washing during the extraction.

Preparation of DAG Standard

Thaw the DAG Standard at 37°C (see Preparation of Reagents above). Mix well by vortexing to ensure the solution is homogeneous. Freshly prepare a dilution series of the standard in the concentration range of 0 µM – 2 mM by diluting the standard stock solution (provided at 2 mM) in 1X Assay Buffer (see Table 1). Standards should be prepared fresh, vortexed well and used immediately.

Standard Tubes	2 mM DAG Standard (µL)	1X Assay Buffer (µL)	Final DAG Standard (µM)
1	100	0	2000
2	50 of Tube #1	50	1000
3	50 of Tube #2	50	500
4	50 of Tube #3	50	250
5	50 of Tube #4	50	125
6	50 of Tube #5	50	62.5
7	50 of Tube #6	50	31.2
8	0	50	0

Table 1. Preparation of DAG Standards

Preparation of Samples

- Urine, plasma and serum: This kit is not recommended for these samples.
- Cell lysates:

For adherent cells, remove media and wash cells twice with cold PBS. Harvest ~1x 10⁷ cells by using a rubber policeman. Do not use proteolytic enzymes. Centrifuge at 1500 x g for 10 minutes. Carefully remove the supernatant and resuspend in 1 mL of cold PBS. Proceed to step 1 of the extraction procedure below.

For suspension cells, collect ~1 x 10⁷ cells by centrifugation at 1500 x g for 10 minutes. Carefully remove the supernatant and wash the cell pellet with cold PBS. Repeat PBS wash/centrifugation once more. Carefully discard the supernatant and resuspend in 1 mL of cold PBS. Proceed to step 1 of the extraction procedure below:

Extraction Procedure

1. Sonicate the 1 mL of cell suspension on ice.
2. Add 1.5 mL of methanol to the sonicated sample.
3. Add 2.25 mL of 1 M NaCl and 2.5 mL of chloroform to the sample. Vortex well.
4. Centrifuge at 1500 x g for 10 minutes at 4°C to separate the phases.
5. Carefully remove the upper aqueous phase and discard.
6. Wash the lower chloroform phase 2 times with 2 mL of pre-equilibrated upper phase (PEU) (see Preparation of Reagents Section). Separate the phases each time by centrifuging at 1500 x g for 10 minutes at 4°C. Carefully remove the upper phase and discard each time.
7. After the final wash, carefully transfer the lower organic phase to a glass vial or tube (a syringe works well). Avoid transferring any remaining upper, aqueous phase.
8. Dry the lower phase in a speedvac or under a gentle stream of nitrogen.
9. Resuspend the dried sample with 50 µL of 1X Assay Buffer (1:20 of the original volume). Samples may be stored at -80°C for up to a month.

Note: Not all dried samples will be solubilized completely, but the Assay Buffer will solubilize the DAG in the samples. The supernatant may be removed for use in the assay.

Assay Protocol

Note: A freshly prepared standard curve should be used each time the assay is performed. Maintain the Kinase Mixture, Lipase Solution, and Enzyme Mixture at 4°C during assay preparation.

1. Prepare and mix all reagents thoroughly before use. Each sample, including unknowns and standards, should be assayed in duplicate or triplicate.

Note: Each unknown sample replicate requires two paired wells, one to be treated with Kinase Mixture (+Kin) and one without (-Kin) to determine phosphatidic acid background (1X Assay Buffer will be added in place of the Kinase Mixture).

2. Add 20 µL of the DAG standards, samples or blanks to the 96-well microtiter plate.
3. Add 20 µL of Kinase Mixture to the standards and to one half of the paired sample wells, and mix the well contents thoroughly.
4. Add 20 µL of 1X Assay Buffer to the other half of the paired sample wells and mix thoroughly.
5. Incubate at 37°C for 2 hours.
6. Transfer 20 µL of the mixture to a 96-well plate suitable for fluorescence measurement.
7. Add 40 µL of Lipase Solution to each well.
8. Incubate at 37°C for 30 minutes.
9. During the step 8 incubation, separately prepare the desired volume of Detection Enzyme Mixture according to Table 2 below, based on the number of tests to be performed. Maintaining all components and mixtures at 4°C throughout this step, add components in the following sequence:

- a. In a tube, add the appropriate volume of Enzyme Mixture.
- b. To the Enzyme Mixture, add the corresponding volume of Fluorometric Probe. Mix well and immediately use.

Note: Detection Enzyme Mixture may appear slightly pink in color. This is normal background and should be subtracted from all absorbance values.

Enzyme Mixture (mL)	Fluorometric Probe (μL)	Total Volume of Detection Enzyme Mixture (mL)	# of Tests in 96-well Plate (100 μL/test)
5	50	5.05	100
2.5	25	2.525	50
1.25	13	1.263	25

Table 2. Preparation of Detection Enzyme Mixture

10. Transfer 50 μL of the above Detection Enzyme Mixture (from step 9) to each well.
11. Cover the plate wells to protect the reaction from light.
12. Incubate at room temperature for 10 minutes.
13. Read the plate with a fluorescence microplate reader equipped for excitation in the 530-560 nm range and for emission in the 585-595 nm range.

Calculation of Results

1. Determine the Average Relative Fluorescence Unit (RFU) values for each sample, control, and standard.
2. Subtract the average zero standard value from itself and all standard values.
3. Graph the standard curve (see Figure 1).
4. Subtract the sample well values without Kinase Mixture (-Kin) from the sample well values containing Kinase Mixture (+Kin) to obtain the difference.

$$\text{Net RFU} = (\text{RFU}_{+\text{Kin}}) - (\text{RFU}_{-\text{Kin}})$$

Example of Results

The following figures demonstrate typical DAG Assay Kit results. One should use the data below for reference only. This data should not be used to interpret actual results.

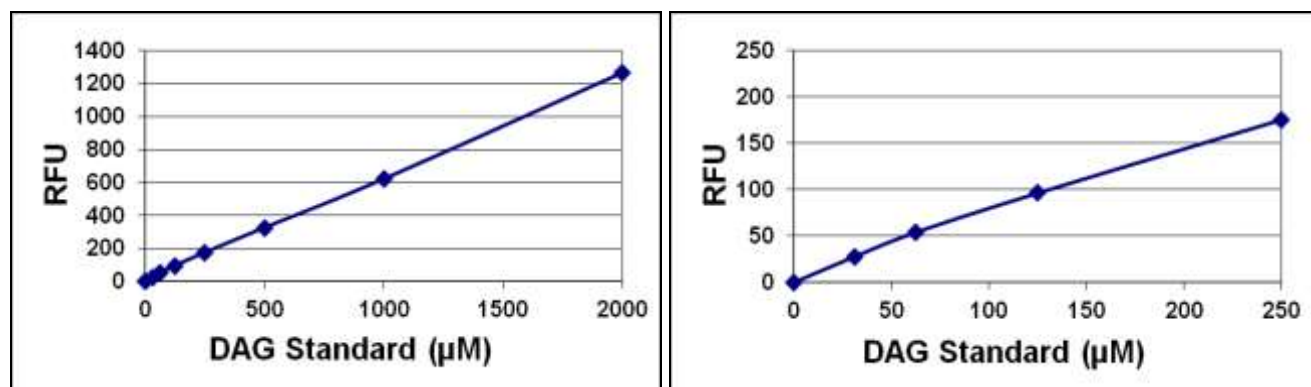


Figure 1: DAG Assay Standard Curve. DAG standard curve was performed according to the Assay Protocol. Background has been subtracted.

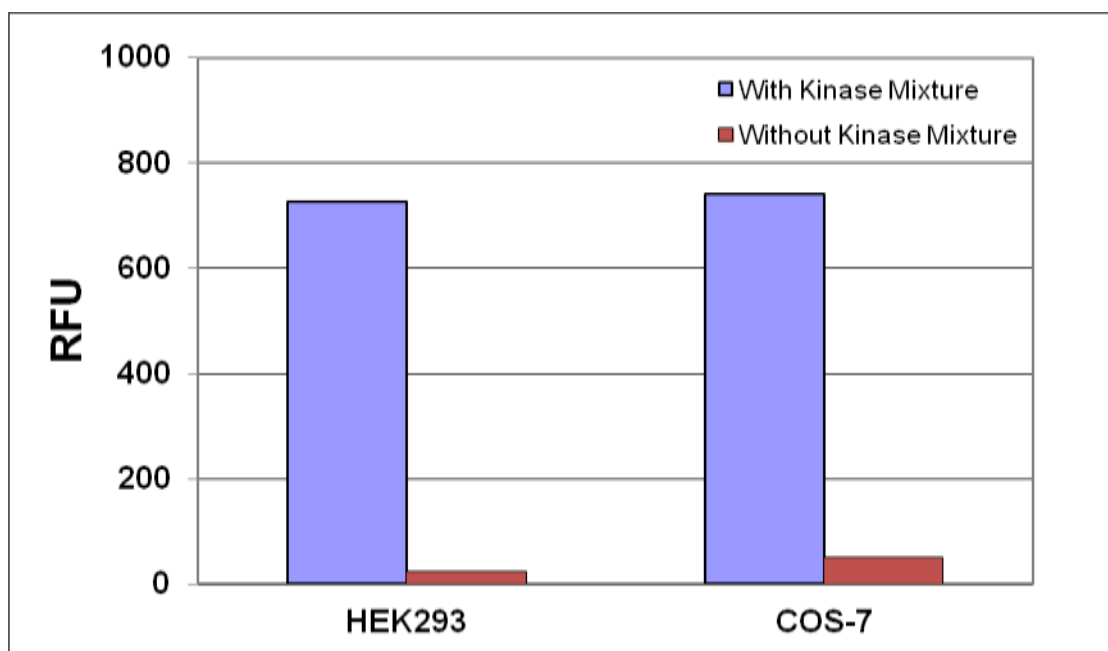


Figure 2: DAG Detection of Lipid Extracts. HEK293 and COS-7 lipid extracts were prepared according to the extraction procedure above. DAG samples were tested according to the Assay Protocol (phosphatidic acid background was determined +/- Kinase Mixture). Negative control values (without DAG) have been subtracted.

References

1. Yang, C. and Kazanietz, M.G. (2003) *Trends Pharmacol. Sci.* **24**, 602-608.
2. Brose, N. et al. (2004) *Curr. Opin. Neurobiol.* **14**, 328-340.

3. Athenstaedt, K. and Daum, G. (1999) *Eur. J. Biochem.* **266**, 1-16.
4. Kanoh, H. et al. (2002). *J. Biochem. (Tokyo)* **131**, 629-633.
5. Corbalan-Garcia, S. and Gomez-Fernandez, J.C. (2006) *Biochim. Biophys. Acta* **1761**, 633-654
6. Wang, Q.J. (2006). *Trends Pharmacol. Sci.* **27**, 317-323.

Recent Product Citations

1. Chiang, Y.P. et al. (2021). Sphingomyelin synthases 1 and 2 exhibit phosphatidylcholine phospholipase C activity. *J Biol Chem.* doi: 10.1016/j.jbc.2021.101398.
2. Chiang, Y.P. et al. (2021). Sphingomyelin synthase related protein is a mammalian phosphatidylethanolamine phospholipase C. *Biochim Biophys Acta Mol Cell Biol Lipids.* **1866**(11):159017. doi: 10.1016/j.bbalip.2021.159017.
3. Brekk, O.R. et al. (2020). Cell type-specific lipid storage changes in Parkinson's disease patient brains are recapitulated by experimental glycolipid disturbance. *Proc Natl Acad Sci U S A.* doi: 10.1073/pnas.2003021117.
4. Koundouros, N. et al. (2020). Metabolic Fingerprinting Links Oncogenic PIK3CA with Enhanced Arachidonic Acid-Derived Eicosanoids. *Cell.* doi: 10.1016/j.cell.2020.05.053.
5. Day, P. et al. (2019). Inhibitors of diacylglycerol metabolism suppress CCR2 receptor signalling in human monocytes. *Br J Pharmacol.* doi: 10.1111/bph.14695.
6. Badi, R.M. et al. (2019). Resveratrol protects against hepatic insulin resistance in a rat's model of non-alcoholic fatty liver disease by down-regulation of GPAT-1 and DGAT2 expression and inhibition of PKC membranous translocation. *Clin Exp Pharmacol Physiol.* doi: 10.1111/1440-1681.13074.
7. Garcia, D. et al. (2019). Genetic Liver-Specific AMPK Activation Protects against Diet-Induced Obesity and NAFLD. *Cell Rep.* **26**(1):192-208.e6. doi: 10.1016/j.celrep.2018.12.036.
8. Fanning, S. et al. (2019). Lipidomic Analysis of α -Synuclein Neurotoxicity Identifies Stearoyl CoA Desaturase as a Target for Parkinson Treatment. *Mol Cell.* **73**(5):1001-1014.e8. doi: 10.1016/j.molcel.2018.11.028.
9. Kang, R. et al. (2018). Lipid Peroxidation Drives Gasdermin D-Mediated Pyroptosis in Lethal Polymicrobial Sepsis. *Cell Host Microbe.* **24**(1):97-108.e4. doi: 10.1016/j.chom.2018.05.009.
10. Tanaka, N., et al. (2017). Growth arrest and DNA damage-inducible 45 α protects against nonalcoholic steatohepatitis induced by methionine- and choline-deficient diet. *Biochim Biophys Acta.* pii: S0925-4439(17)30299-5. doi: 10.1016/j.bbadis.2017.08.017

Warranty

These products are warranted to perform as described in their labeling and in Cell Biolabs literature when used in accordance with their instructions. THERE ARE NO WARRANTIES THAT EXTEND BEYOND THIS EXPRESSED WARRANTY AND CELL BIOLABS DISCLAIMS ANY IMPLIED WARRANTY OF MERCHANTABILITY OR WARRANTY OF FITNESS FOR PARTICULAR PURPOSE. CELL BIOLABS's sole obligation and purchaser's exclusive remedy for breach of this warranty shall be, at the option of CELL BIOLABS, to repair or replace the products. In no event shall CELL BIOLABS be liable for any proximate, incidental or consequential damages in connection with the products.

Contact Information

Cell Biolabs, Inc.
7758 Arjons Drive
San Diego, CA 92126
Worldwide: +1 858-271-6500
USA Toll-Free: 1-888-CBL-0505
E-mail: tech@cellbiolabs.com
www.cellbiolabs.com

©2017-2022: Cell Biolabs, Inc. - All rights reserved. No part of these works may be reproduced in any form without permissions in writing.