

**NOTE: Revised Kit Format  
and Protocol**

---

**Product Manual**

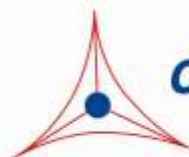
# **Global DNA Methylation ELISA Kit (5'-methyl-2'-deoxycytidine Quantitation)**

**Catalog Number**

<b>STA-380</b>	<b>96 assays</b>
<b>STA-380-5</b>	<b>5 x 96 assays</b>

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

---



**CELL BIOLABS, INC.**  
*Creating Solutions for Life Science Research*

## **Introduction**

Epigenetic changes refer to stable, heritable, and reversible modifications. DNA methylation is one such epigenetic change and has been shown to be associated with almost every biological process. DNA methylation can increase the functional complexity of prokaryotic and eukaryotic genomes by providing additional avenues for the control of cellular processes. DNA methylation is also dynamic and thus can control the timing of cellular events.

In prokaryotes, DNA methylation occurs at the C-5 or N-4 positions of cytosine, as well as the N-6 position of adenine. Multiple enzymes that are capable of methylating bacterial DNA have been identified and are named DNA-MTases. Initially, DNA methylation in bacteria was reported to be associated with restriction-modification systems, wherein foreign DNA that lacks DNA methylation can be recognized and degraded by host methylation-sensitive restriction enzymes. Further studies in bacteria also implicated DNA methylation in the maintenance of the DNA replication fidelity, gene expression regulation, and virulence.

In plants, DNA methylation is found in the sequence context of CpG or CpNpG and has been implicated in normal plant development and regulation of transcription and transposition. At least two classes of DNA methyltransferases (DNMTs) have been identified and characterized in plants. These include the MET1 family of methyltransferases, which preferentially methylate cytosine in CpG context and function both as de novo and maintenance DNMTs, and a second class of DNMTs, named chromomethylases (CMTs), which are unique to plants and methylate cytosine in a CpNpG sequence context.

In mammalian cells, DNA methylation is predominantly found at CpG dinucleotides, most of which reside within gene promoter regions, but in some instances, such as in the case of mouse and human embryonic stem cells, DNA methylation can also be found in non-CpG contexts. DNA methylation in mammalian cells is associated with repression of transcription and maintenance of genomic stability. Due to its important role in genome maintenance and other biological processes, deregulation of DNA methylation is associated with multiple human diseases including cancer. Three major enzymes are required for either de novo methylation (DNMT3A and DNMT3B) or maintenance methylation (DNMT1) in mammalian cells.

There are several methods of detecting total 5-methylcytosine content in the genome. DNA can be digested into single nucleotides and total genomic 5-methylcytosine can be quantitated by high performance liquid chromatography, thin-layer chromatography, or liquid chromatography/mass spectroscopy, but all of these methods are labor intensive and technically demanding.

Cell Biolabs' Global DNA Methylation ELISA Kit is a competitive enzyme immunoassay developed for rapid detection and quantitation of 5'-methyl-2'-deoxycytidine (5MedCyd) in urine directly, or extracted cell or tissue DNA samples. The quantity of 5MedCyd in an unknown sample is determined by comparing its absorbance with that of a known 5MedCyd standard curve. The kit has a 5MedCyd detection sensitivity range of 78 nM to 20,000 nM. Each kit provides sufficient reagents to perform up to 96 assays, including standard curve and unknown samples.

## **Assay Principle**

The Global DNA Methylation ELISA Kit is a competitive ELISA for the quantitative measurement of 5MedCyd. The unknown 5MedCyd samples or 5MedCyd standards are first added to the 5MedCyd DNA Conjugate Coated plate. After a brief incubation, an Anti-5MedCyd antibody is added, followed by an HRP conjugated secondary antibody. The 5MedCyd content in unknown samples is determined by comparison with a predetermined 5MedCyd standard curve.

## **Related Products**

1. STA-301: OxiSelect™ BPDE Protein Adduct ELISA Kit
2. STA-320: OxiSelect™ Oxidative DNA Damage ELISA Kit (8-OHdG Quantitation)
3. STA-321: OxiSelect™ DNA Double-Strand Break Assay
4. STA-322: OxiSelect™ UV-Induced DNA Damage ELISA Kit (CPD Quantitation)
5. STA-323: OxiSelect™ UV-Induced DNA Damage ELISA Kit (6-4PP Quantitation)
6. STA-324: OxiSelect™ Oxidative DNA Damage Quantitation Kit (AP Sites)
7. STA-325: OxiSelect™ Oxidative RNA Damage ELISA Kit (8-OHG Quantitation)
8. STA-350: OxiSelect™ Comet Assay Kit (3-Well)
9. STA-355: OxiSelect™ 96-Well Comet Assay Kit
10. STA-357: OxiSelect™ BPDE DNA Adduct ELISA Kit

## **Kit Components**

### **Box 1 (shipped at room temperature)**

1. DNA High-Binding Plate (Part No. 232404): One 96-well strip plate.
2. Anti-5MedCyd Antibody (Part No. 238001): One 5 µL vial.
3. Secondary Antibody, HRP Conjugate (Part No. 231009): One 20 µL vial.
4. Assay Diluent (Part No. 310804): One 50 mL bottle.
5. 10X Wash Buffer (Part No. 310806): One 100 mL bottle.
6. Substrate Solution (Part No. 310807): One 12 mL amber bottle.
7. Stop Solution (Part. No. 310808): One 12 mL bottle.
8. 5MedCyd Standard (Part No. 238002): One 100 µL vial of 4 mM 5MedCyd in 1X PBS.

### **Box 2 (shipped on blue ice packs)**

1. 5MedCyd DNA Conjugate (Part No. 238005): One 50 µL vial of 5MedCyd DNA Conjugate.

## **Materials Not Supplied**

1. 5MedCyd samples such as urine, or DNA extracted from cells or tissues

2. DNA Extraction Kit
3. Sodium Acetate, pH 5.2
4. Tris Buffer, pH 7.5
5. 1X PBS, 1X PBS containing 0.1% BSA
6. Nuclease P1, Alkaline Phosphatase
7. 10  $\mu$ L to 1000  $\mu$ L adjustable single channel micropipettes with disposable tips
8. 50  $\mu$ L to 300  $\mu$ L adjustable multichannel micropipette with disposable tips
9. Multichannel micropipette reservoir
10. Microplate reader capable of reading at 450 nm (620 nm as optional reference wave length)

### **Storage**

Upon receipt, aliquot and store the Anti-5MedCyd Antibody, 5MedCyd Standard and 5MedCyd DNA Conjugate at  $-20^{\circ}\text{C}$  to avoid multiple freeze/thaw cycles. Store all other components at  $4^{\circ}\text{C}$ .

### **Preparation of Reagents**

- 5MedCyd DNA Conjugate Coated Plate: Dilute the proper amount of 5MedCyd DNA Conjugate to 1:200 in 1X PBS (e.g. For 48 wells, add 25  $\mu$ L of 5MedCyd DNA Conjugate to 4.975 mL of PBS). Add 100  $\mu$ L of the 5MedCyd DNA Conjugate dilution to each well to be tested and incubate overnight at  $4^{\circ}\text{C}$ . Remove the 5MedCyd DNA Conjugate coating solution and wash once with  $\text{dH}_2\text{O}$ . Blot plate on paper towels to remove excess fluid. Add 200  $\mu$ L of Assay Diluent to each well and block for 1 hour at room temperature. Transfer the plate to  $4^{\circ}\text{C}$  and only remove the Assay Diluent immediately before use.

*Note: The 5MedCyd DNA Conjugate coated wells are not stable and should be used within 24 hrs after coating. Only coat the number of wells to be used immediately.*

- 1X Wash Buffer: Dilute the 10X Wash Buffer to 1X with deionized water. Stir to homogeneity.
- Anti-5MedCyd Antibody and Secondary Antibody: Immediately before use, dilute the Anti-5MedCyd Antibody 1:1000 and Secondary Antibody 1:1000 with Assay Diluent. Do not store diluted solutions.

### **Preparation of Standard Curve**

Thaw the 5MedCyd Standard at room temperature and mix thoroughly by pipetting. Freshly prepare a dilution series of 5MedCyd Standard in the concentration range of 20  $\mu\text{M}$  – 0.078  $\mu\text{M}$  (20,000 nM – 78 nM) by diluting the 5MedCyd Standard in Assay Diluent (Table 1).

Standard Tubes	4 mM 5MedCyd Standard ( $\mu\text{L}$ )	Assay Diluent ( $\mu\text{L}$ )	Final 5MedCyd Concentration ( $\mu\text{M}$ )
1	5	995	20
2	250 of Tube #1	250	10
3	250 of Tube #2	250	5
4	250 of Tube #3	250	2.5
5	250 of Tube #4	250	1.25
6	250 of Tube #5	250	0.625
7	250 of Tube #6	250	0.313
8	250 of Tube #7	250	0.156
9	250 of Tube #8	250	0.078
10	0	250	0

**Table 1. Preparation of 5MedCyd Standards**

## **Preparation of Samples**

### **I. Urine**

Clear urine samples can be diluted 5- to 50-fold in 1X PBS containing 0.1% BSA before use in the assay. Samples containing precipitates should be centrifuged at 3000 g for 10 minutes, or filtered through 0.45  $\mu\text{m}$  filter, prior to use in the assay.

### **II. Cell or Tissue DNA Samples**

1. Extract DNA from cell or tissue samples by a desired method or commercial DNA Extraction kit.
2. Dissolve extracted DNA in water at 0.1-1 mg/mL.
3. Convert DNA sample to single-stranded DNA by incubating the sample at 95°C for 5 minutes and then rapidly chilling on ice.
4. Digest DNA sample to nucleosides by incubating the denatured DNA with 5-10 units of nuclease P1 for 2 hrs at 37°C in 20 mM Sodium Acetate, pH 5.2, and following with treatment of 5-10 units of alkaline phosphatase for 1 hr at 37°C in 100 mM Tris, pH 7.5.
5. Centrifuge the reaction mixture for 5 minutes at 6000 g and use the supernatant for the 5MedCyd ELISA assay.

*Note: Based on LC/MS analysis, there are about 10 ng 5MedCyd per  $\mu\text{g}$  of normally methylated human genomic DNA or 1 ng 5MedCyd per  $\mu\text{g}$  of hypomethylated human genomic DNA.*

*Therefore, we recommend using at least 1  $\mu\text{g}$  of digested normally methylated human DNA or 10  $\mu\text{g}$  of digested hypomethylated human DNA per assay.*

## **Assay Protocol**

1. Prepare and mix all reagents thoroughly before use. Each 5MedCyd sample including unknown and standard should be assayed in duplicate. High content 5MedCyd samples should be diluted in 1X PBS containing 0.1% BSA.

2. Add 50  $\mu\text{L}$  of unknown sample or prepared 5MedCyd standard to the wells of the 5MedCyd DNA Conjugate Coated Plate. Incubate at room temperature for 10 minutes on an orbital shaker.
3. Add 50  $\mu\text{L}$  of the diluted Anti-5MedCyd Antibody to each well, mix well and incubate at room temperature for 2 hours on an orbital shaker.
4. Wash microwell strips 4 times with 250  $\mu\text{L}$  1X Wash Buffer per well with thorough aspiration between each wash. After the last wash, empty wells and tap microwell strips on absorbent pad or paper towel to remove excess 1X Wash Buffer.
5. Add 100  $\mu\text{L}$  of the diluted Secondary Antibody-HRP Conjugate to all wells.
6. Incubate at room temperature for 1 hour on an orbital shaker.
7. Wash microwell strips 4 times according to step 4 above. Proceed immediately to the next step.
8. Warm Substrate Solution to room temperature. Add 100  $\mu\text{L}$  of Substrate Solution to each well, including the blank wells. Incubate at room temperature on an orbital shaker. Actual incubation time may vary from 2-30 minutes.  
*Note: Watch plate carefully; if color changes rapidly, the reaction may need to be stopped sooner to prevent saturation.*
9. Stop the enzyme reaction by adding 100  $\mu\text{L}$  of Stop Solution into each well, including the blank wells. Results should be read immediately (color will fade over time).
10. Read absorbance of each microwell on a spectrophotometer using 450 nm as the primary wave length.

### **Example of Results**

The following figures demonstrate typical Global DNA Methylation ELISA results. One should use the data below for reference only. This data should not be used to interpret actual results.

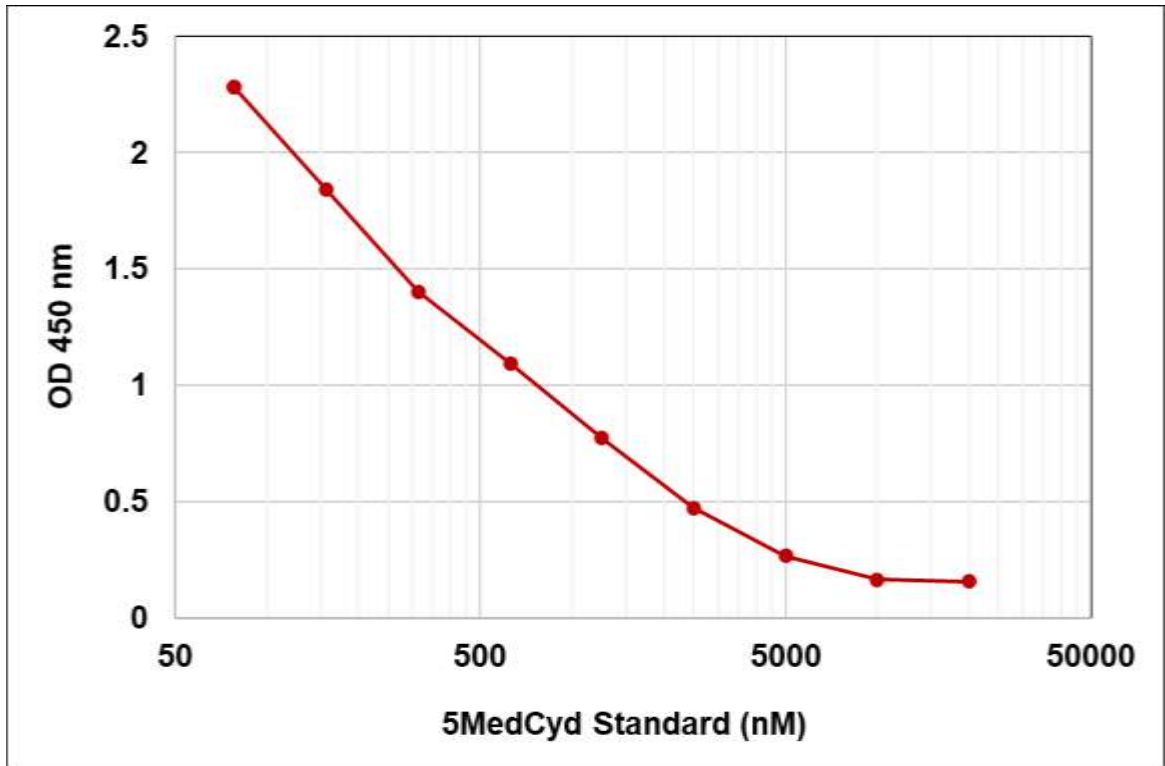


Figure 1: 5MedCyd ELISA Standard Curve.

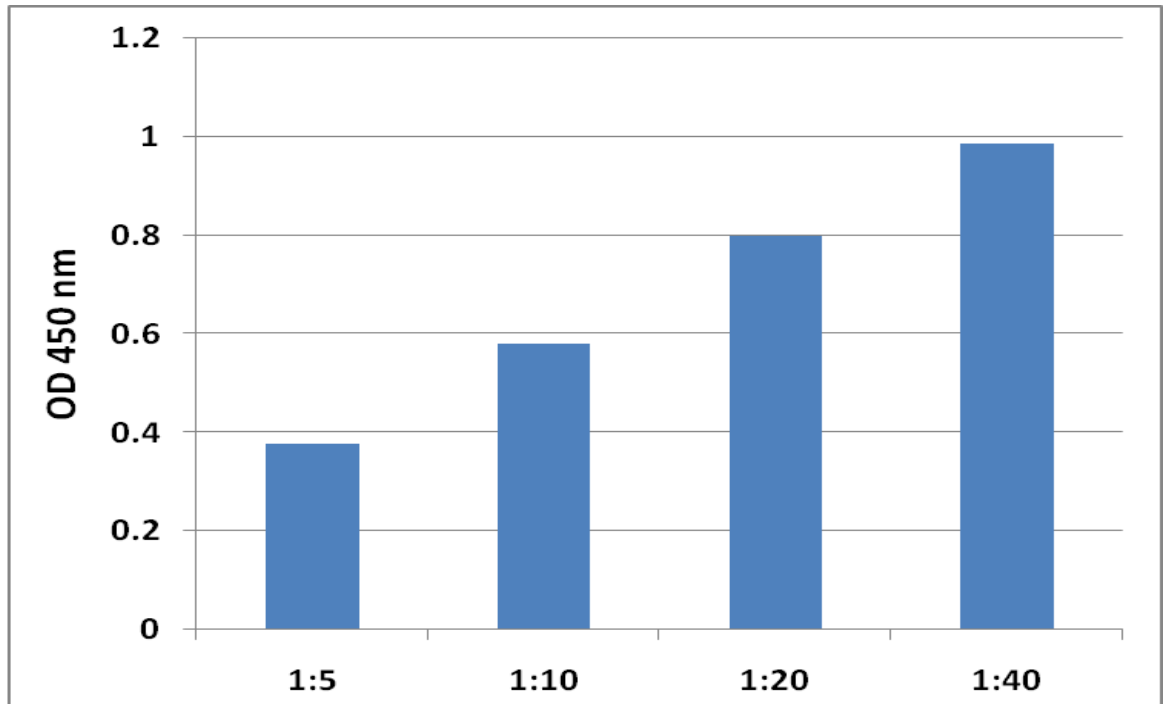


Figure 2: 5MedCyd level in Human Urine Sample. Human urine was first diluted 5-, 10-, 20- and 40-fold in 1X PBS containing 0.1% BSA before use in the assay.

## **References**

1. Robertson, K.D. (2005) *Nat. Rev. Genet.* 6:597-610.
2. Low, D.A., N.J. Weyand, and M.J. Mahan (2001) *Infect. Immun.* 69:7197-7204.
3. Jones, P.A., and S.B. Baylin (2007) *Cell* 128:683-692.
4. Noyer-Weidner, M., and T.A. Trautner (1993) *EXS* 64:39-108.
5. Finnegan, E.J., R.K. Genger, W.J. Peacock, and E.S. Dennis (1998) *Annu. Rev. Plant Physiol. Plant Mol. Biol.* 49:223-247.
6. Zilberman, D., M. Gehring, R.K. Tran, T. Ballinger, and S. Henikoff (2007) *Nat. Genet.* 39:61-69.
7. Finnegan, E.J., and K.A. Kovac (2000) *Plant Mol. Biol.* 43:189-201.
8. Ramsahoye, B.H., D. Biniszkiwicz, F. Lyko, V. Clark, A.P. Bird, and R. Jaenisch (2000) *Proc. Natl. Acad. Sci. USA* 97:5237-5242.
9. Lister, R., M. Pelizzola, R.H. Dowen, R.D. Hawkins, G. Hon, J. Tonti-Filippini, J.R. Nery, L. Lee (2009) *Nature* 462:315-322.
10. Chen, T., and E. Li (2004) *Curr. Top. Dev. Biol.* 60:55-89.

## **Recent Product Citations**

1. Mungala Lengo, A. et al. (2020). Relationship between redox potential of glutathione and DNA methylation level in liver of newborn guinea pigs. *Epigenetics*. doi: 10.1080/15592294.2020.1781024.
2. Holubek, R. et al. (2020). The Recovery of Soybean Plants after Short-Term Cadmium Stress. *Plants (Basel)*. 9(6):E782. doi: 10.3390/plants9060782.
3. Quintanilla-Mena, M. et al. (2019). Biological responses of shoal flounder (*Syacium gunteri*) to toxic environmental pollutants from the southern Gulf of Mexico. *Environ Pollut.* doi: 10.1016/j.envpol.2019.113669.
4. Pennarossa, G. et al. (2019). Rho Signaling-Directed YAP/TAZ Regulation Encourages 3D Spheroid Colony Formation and Boosts Plasticity of Parthenogenetic Stem Cells. *Adv Exp Med Biol.* doi: 10.1007/5584\_2019\_423.
5. Onishi, A. et al. (2019). Urine 5MedC, a Marker of DNA Methylation, in the Progression of Chronic Kidney Disease. *Disease Markers*. doi: 10.1155/2019/5432453.
6. Jarmasz, J.S. et al (2019). DNA methylation and histone post-translational modification stability in post-mortem brain tissue. *Clin Epigenetics*. 11(1):5. doi: 10.1186/s13148-018-0596-7.
7. Pennarossa, G. et al. (2019). Use of a PTFE Micro-Bioreactor to Promote 3D Cell Rearrangement and Maintain High Plasticity in Epigenetically Erased Fibroblasts. *Stem Cell Rev.* 15(1):82-92. doi: 10.1007/s12015-018-9862-5.
8. Pennarossa, G. et al. (2018). Epigenetic Erasing and Pancreatic Differentiation of Dermal Fibroblasts into Insulin-Producing Cells are Boosted by the Use of Low-Stiffness Substrate. *Stem Cell Rev.* 14(3):398-411. doi: 10.1007/s12015-017-9799-0.
9. Shah, S.M. et al. (2017). Retinoic acid induces differentiation of buffalo (*Bubalus bubalis*) embryonic stem cells into germ cells. *Gene* doi: 10.1016/j.gene.2017.05.037.



10. Manzoni, E.F.M. et al. (2016). 5-azacytidine affects TET2 and histone transcription and reshapes morphology of human skin fibroblasts. *Sci. Rep.* **6**:37017.
11. Lynch, E. W. et al. (2016). Cyclical DNA methyltransferase 3a expression is a seasonal and oestrus timer in reproductive tissues. *Endocrinology*. doi:10.1210/en.2015-1988.
12. Shah, S. M. et al. (2016). Testicular cell conditioned medium supports embryonic stem cell differentiation towards germ lineage and to spermatocyte-and oocyte-like cells. *Theriogenology*. doi: 10.1016/j.theriogenology.2016.02.025.
13. Kurdyukov, S. & Bullock, M. (2016). DNA methylation analysis: Choosing the right method. *Biology*. doi:10.3390/biology5010003.
14. Shah, S. M. et al. (2015). Bone morphogenetic protein 4 (BMP4) induces buffalo (*Bubalus bubalis*) embryonic stem cell differentiation into germ cells. *Biochimie*. **119**:113-124.
15. Creppy, E. E. et al. (2014). Study of epigenetic properties of Poly(HexaMethylene Biguanide) hydrochloride (PHMB). *Int J Environ Res Public Health*. **11**:8069-8092.
16. Jefferson, W. et al. (2013). Persistently altered epigenetic marks in the mouse uterus after neonatal estrogen exposure. *Mol Endocrinol*. **27**:1666-1677.

## **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' 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](mailto:tech@cellbiolabs.com)  
[www.cellbiolabs.com](http://www.cellbiolabs.com)

©2011-2021: Cell Biolabs, Inc. - All rights reserved. No part of these works may be reproduced in any form without permissions in writing.