

CometAssay™ Control Cells

For Single Cell Gel Electrophoresis Assay

Catalog # 4256-010-CC

Sufficient materials for 10 assays.

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I. QUICK REFERENCE PROCEDURE (Assay Protocol)

The Assay Protocol described below is written as a Quick Reference. Reagents and detailed instructions including reagent preparation are provided with Trevigen's CometAssay™ Kits (Please See Section XI).

This page is designed to be photocopied and used as a checklist:

- 1. Prepare Lysis Solution and chill at 4°C for at least 20 minutes before use.
- 2. Melt LMAgarose in a microwave and cool in a 37°C water bath for at least 20 minutes.
- 3. Combine 50 µl of CometAssay™ control cells (e.g. CC0) with 500 µl molten LMAgarose (at 37°C), pipette up and down three times to mix, and immediately spread 50 µl per well over a 2 well, or 30 ul per well for a 20 well CometSlide.™
- 4. Repeat step 3 for samples CC1, CC2, and CC3, respectively.
- 5. Place slides flat at 4°C **in the dark** for 10-30 minutes.
- 6. Immerse slides in prechilled Lysis Solution at 4°C, for 30 minutes.
- 7. Immerse slides in freshly prepared Alkaline Solution, pH>13 for 20 minutes at room temperature, in the dark.
- 8. Transfer slides from Alkaline Solution to the CometAssay™ ES unit (cat# 4250-050-ES) containing 950 ml freshly prepared pre-chilled running solution, and apply overlay. For other horizontal electrophoresis units, carefully pour cold Alkaline Solution until level just covers samples (not to exceed 0.5 cm). Set the voltage to 1 Volt/cm. Add or remove buffer until the current is 300 mA and perform electrophoresis for 20 minutes. For the CometAssay™ ES unit, run at 21 volts for 30 minutes.
- 9. Very gently drain excess electrophoresis solution, immerse slides twice in dH₂O for 10 minutes each, then in 70% ethanol for 5 minutes.
- 10. Dry samples on slide warmer at ≤ 45°C for 10-15 minutes.
- 11. Place 100 µl of diluted SYBR® Green I onto each circle of dried agarose for 1 hour. Gently tap slide to remove excess SYBR solution. Allow slide to dry completely at room temperature in the dark.
- 12. View slide by epifluorescence microscopy. (SYBR® Green I has excitation and emission wavelengths of 494 nm and 521 nm, respectively. A fluorescein filter is adequate.)

II. Background

Trevigen's CometAssay™, or single cell gel electrophoresis assay, provides a simple and effective method for evaluating DNA damage in cells. The principle of the assay is based upon the ability of denatured, cleaved DNA fragments to migrate out of the cell under the influence of an electric field, whereas undamaged DNA migrates slower and remains within the confines of the nucleoid when a current is applied. Evaluation of the DNA "comet" tail shape and migration pattern allows for assessment of DNA damage. In this assay, cells are immobilized in a bed of low melting point agarose, on a Trevigen CometSlide™. Following gentle cell lysis, samples are treated with alkali to unwind and denature the DNA and hydrolyze sites of DNA damage. The samples are then submitted to electrophoresis and staining with a fluorescent DNA intercalating dye. The sample is then visualized by epifluorescence microscopy. Quantitative and statistical data can readily be generated by analysis of the results using one of several commercially available image analysis software packages which calculate percent DNA in the tail.

Trevigen has developed a set of suspension cell preparations containing different levels of DNA damage to be used as controls with Trevigen's CometAssay™ Kits. When performing alkaline electrophoresis, the four control cell populations show incremental increases in percent DNA in the tail. The healthy control cell population (CC0) was treated with Etoposide under various conditions to increase the amount of damage in populations CC1, CC2 and CC3, respectively. Etoposide is a DNA synthesis inhibitor that induces double-stranded and single-stranded DNA breaks. These cryopreserved controls are designed to act as controls to standardize and compare alkaline electrophoresis methods between individual users and laboratories.

III. Precautions and Limitations

1. For Research Use Only. Not for use in diagnostic procedures.
2. The physical, chemical, and toxicological properties of the CometAssay™ Control Cells may not have been fully investigated. Therefore, Trevigen recommends the use of gloves, lab coats, and eye protection while using any of these chemical reagents. Trevigen assumes no liability for damage resulting from handling or contact with these products.

IV. Materials Supplied

CometAssay™ Control Cells should be stored in liquid nitrogen.

<u>Components</u>	<u>Description</u>	<u>Cap Color</u>	<u>Catalog #</u>	<u>Amount</u>
CC0	Healthy Cells	White	4256-010-CC0	500 µl
CC1	Treated Cells	Yellow	4256-010-CC1	500 µl
CC2	Treated Cells	Green	4256-010-CC2	500 µl
CC3	Treated Cells	Red	4256-010-CC3	500 µl
Data Sheet	Lot specific			

V. Materials/Equipment Required But Not Supplied

Equipment:

1. 20–200 µl, 200–1,000 µl pipettors, and tips
2. Table Top Centrifuge (vertical rotor)
3. Water Bath
4. -80°C Freezer
5. Liquid Nitrogen Storage System
6. CometAssay™ ES (cat# 4250-050-ES) or other horizontal electrophoresis unit.

Reagents:

1. Ice cold 1X PBS pH 7.4, Ca⁺⁺ and Mg⁺⁺ free
2. Isopropanol
3. CometAssay™ Kit¹ (required)

¹ Available from Trevigen; refer to Section XI. for ordering information.

VI. Preparation of Control Cells

Control cells should be prepared immediately before starting the CometAssay™ protocol.

Storage

CometAssay™ Control Cells are stored using a Liquid Nitrogen Storage System. To avoid the accumulation of damage due to freeze thaw, the control cells should be aliquotted and cryopreserved as described below.

1. Recover cells by submerging in 37 °C water bath to quickly thaw cells, and place on ice.
2. Gently invert to mix and transfer 50 µl aliquots into freezing vials.
3. Freeze at -80 °C with -1 °C per minute freezing rate. This can be done by placing the vials in a Styrofoam box containing room temperature Isopropanol and placing in a -80 °C freezer overnight. Vials are placed in a plastic box or rack then placed in room temperature isopropanol. The lid of the Styrofoam container is put in place then the box is placed in the -80 °C freezer.
4. Transfer to Liquid Nitrogen System for long-term storage.

Assay Preparation Protocol:

1. Remove 50 µl aliquots of CC0, CC1, CC2 and CC3 CometAssay™ Control Cells from Liquid Nitrogen Storage.
2. Quickly thaw cells by submerging in 37 °C water bath, and add 600 µl of ice cold 1X PBS (Ca⁺⁺ and Mg⁺⁺ free).
3. Centrifuge cells at 150 x g for 5 minutes and gently remove supernatant, except for about 50 µl.

NOTES: 1) A cell pellet will not be visible after centrifugation.

2) Removing supernatant completely will result in cell loss.

4. Gently resuspend cell pellet in 50 µl of ice cold 1X PBS.

5. Immediately use the cells in the CometAssay™ protocol described for Alkaline Electrophoresis.

VII. Assay Protocol

The assay protocol is the same as listed in the checklist on page 1.

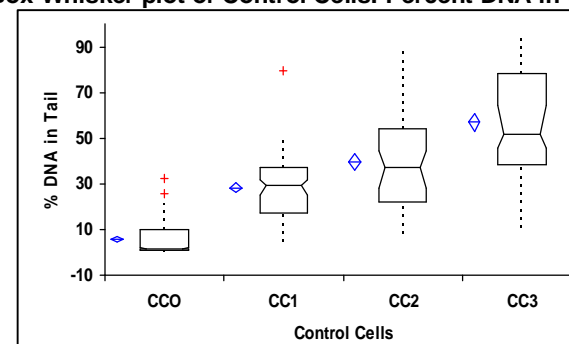
VIII. Data Interpretation

When excited the DNA-bound intercalating dye emits green light. In healthy cells the fluorescence is confined to the nucleoid: undamaged DNA is supercoiled and thus does not migrate very far out of the nucleoid under the influence of an electric current. In cells that have accrued damage to the DNA, the alkali treatment unwinds the DNA, releasing fragments that migrate from the cell when subjected to an electric field. The negatively charged DNA migrates toward the anode and the extrusion length reflects increasing relaxation of supercoiling, which is indicative of damage. When using alkaline electrophoresis conditions, the distribution of DNA between the tail and the head of the comet is used to evaluate the degree of DNA damage.

To evaluate the degree of damage, the Control Cells were processed using the CometAssay™ System under defined electrophoresis conditions. In the example below, alkaline electrophoresis was performed on two-well slides (4250-050-03) for 20 minutes at 30V (300 mAmps) using CometAssay™ Kit (4250-050-K). Images were captured and analyzed using Loats Associates, Inc Comet Analysis System. Data was exported into Analyze-it™ (www.analyse-it.com) for Microsoft Excel to graphically represent the spread of data.

In Figure 1, data collected from 50 cells for each Control Cell population (lot# 12161M6) are shown as side-by-side vertical box plots for comparison. The diamond shows the mean and confidence interval around the mean. The notched box shows the median, lower and upper quartiles, and the 75% confidence interval around the median. For each lot of Control Cells, population values are provided in a data sheet. An example is provided below.

Figure 1: Box-Whisker plot of Control Cells: Percent DNA in Comet Tail



% DNA by Etoposide	n	Mean	SD	SE	75% CI of Mean	Median	IQR	75% CI of Median
CC0	50	5.757	7.7270	1.0928	4.485 to 7.029	1.640	8.925	1.290 to 2.230
CC1	50	28.374	14.0080	1.9810	26.068 to 30.680	28.990	20.313	25.180 to 31.840
CC2	50	39.736	21.8164	3.0853	36.144 to 43.328	37.050	32.183	27.790 to 44.630
CC3	50	56.800	23.5893	3.3360	52.916 to 60.683	51.905	40.240	45.460 to 64.390

In Table 2, a one-way Analysis of Variance (ANOVA) was used to test for a difference between means of the treated control cells (CC1, CC2 and CC3). A $p < 0.0001$ was obtained indicating a significant difference. In addition, contrasts between the three treated control cells indicated that they belonged to different populations.

Table 2: One-way ANOVA and contrasts between treated Control Cells

n		150			
% DNA by Etoposide	n	Mean	SD	SE	
CC1	50	28.374	14.008	1.9810	
CC2	50	39.736	21.816	3.0853	
CC3	50	56.800	23.589	3.3360	
Source of variation	SSq	DF	MSq	F	p
Etoposide	20471.839	2	10235.919	24.99	<0.0001
Within cells	60203.173	147	409.545		
Total	80675.012	149			
Contrast	Difference	Tukey 95% CI			
CC1 v CC2	-11.362	-20.945 to -1.779		(significant)	
CC1 v CC3	-28.426	-38.009 to -18.843		(significant)	
CC2 v CC3	-17.064	-26.647 to -7.481		(significant)	

IX. Troubleshooting Guide

PROBLEM	CAUSE	ACTION
No visible Control Cells.	Loss of cells when pipetting off the supernatant.	Recommend using a vertical rotor when pelleting cells. Gently remove supernatant except for 50 µl to avoid cell loss.
Majority of cells in Untreated Control Cells have large comet tails.	Unwanted damage to cells occurred during preparation of Control Cells Electrophoresis solution too hot Intracellular activity LMAgarose too hot	Handle cells gently to avoid physical damage. Avoid excessive mixing with pipet. Be sure that no more than 150x g is used. Control temperature by performing the assay at 4 °C. Pre-chill the electrophoresis solution. Keep cells on ice and prepare Control Cells immediately before combining with molten LMAgarose. Ensure Lysis Solution was chilled before use. Ensure PBS used is calcium and magnesium free. Cool LMAgarose to 37 °C before adding cells.

PROBLEM	CAUSE	ACTION
Treated Control Cells show no evidence of comet tail.	Sample was not processed correctly/ Insufficient denaturation in Alkaline Solution.	Ensure each step in protocol was performed correctly. Failure to lyse, denature in alkali, or to properly perform electrophoresis may generate poor results. Increase time in Alkaline Solution up to 1 hour.
Comet tails present but not significant in Treated Control Cells.	Insufficient electrophoresis time.	Increase time of electrophoresis up to 1 hour for alkaline electrophoresis. Increase time of electrophoresis when running at 4 °C.
Cells in LMAgarose did not remain attached to the CometSlide™.	Electrophoresis solution too hot. Cells were not washed to remove medium before combining with LMAgarose. Agarose percentage was too low. LMAgarose was not fully set before samples were processed. LMAgarose unevenly solidified on the slide. LMAgarose was not completely melted Rinse steps were too harsh. LMAgarose after alkali treatment may detach when rinse solutions (e.g. dH ₂ O, EtOH) are poured over slides.	Control temperature by performing the assay at 4 °C. The pH of medium and carry over serum proteins, etc., can reduce the adherence of the agarose. Resuspend cells in 1X PBS. Do not increase ratio of cells to molten agarose by more than 1 to 10. Ensure 0.5 mm dried ring due to agarose disc retraction is seen at the edge of the CometSlide area. Spread the agarose with the side of a pipette tip to ensure uniformity of agarose disc and better adherence. Completely solubilize the agarose before transferring to a 37 °C water bath. Gently submerge slides into pipette box lids or other suitable tray to perform rinses.

X. References

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XI. Related Products Available From Trevigen

Trevigen's CometAssay™ kits include Lysis Solution (Cat#: 4250-050-01), LMAgarose (Cat#: 4250-050-02), CometSlide™, SYBR® Green (4250-050-05), 200 mM EDTA (Cat# 4250-050-04) and full instructions.

CometAssay™ Kits:

Catalog #	Description	Size
4250-050-ESK	CometAssay™ Starter Kit	each
4250-050-ES	CometAssay™ ES	each
4250-050-K	CometAssay™ Kit	50 samples
4251-050-K	CometAssay™ Silver Staining Kit	50 samples
4252-040-K	CometAssay™ Higher Throughput Kit	40 samples
4253-096-K	CometAssay™ Kit 96 Wells	96 samples
4250-050-03	CometSlide™ (2 well)	25 slides
4252-200-01	CometAssay™ HT Slide (20 well)	10 slides
4253-960-03	96 Well CometSlide™	10 slides

FLARE™ Assay Kits:

Catalog #	Description	Damage Recognized	Size
4040-100-FK	Fpg Kit	8-oxoguanine, DNA containing formamidopyrimidine moieties	75 samples
4040-100-FM			100 samples
4045-01K-FK	Endonuclease	Thymine Glycol, 5,6-dihydrothymine, urea, 5-hydroxy-6-hydrothymine, 5,6-dihydro-uracil, alloxan, 5-hydroxy-6-hydrouacil, uracil glycol, 5-hydroxy-5-methylhydantoin, 5-hydroxycytosine, 5-hydroxyuracil, methyl-tartonylurea, thymine ring saturated or fragmentation product	75 samples
4045-01K-FM	III Kit		100 samples
4130-100-FK	hOGG1 Kit	8-oxoguanine, DNA containing formamidopyrimidine moieties	75 samples
4130-100-FM			100 samples
4055-100-FK	T4-PDG Kit	Cis-syn isomers of cyclobutane pyrimidine dimers	75 samples
4055-100-FM			100 samples
4065-100-FK	cv-PDG Kit	Cis-syn and trans-syn isomers of cyclobutane pyrimidine dimers	75 samples
4065-100-FM			100 samples
4100-100-FK	UVDE Kit	Cyclobutane pyrimidine dimers, (6-4) photoproducts	75 samples
4100-100-FM			100 samples

The product accompanying this document is intended for research use only and is not intended for diagnostic purposes or for use in humans.

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