Simplified Cell Cycle Phase Analysis with the Muse™ Cell Cycle Assay

Cell Cycle Regulation: Key to Cell Health and Proliferation

The cell cycle represents one of the most significant and fundamental processes in eukaryotic cells, resulting in cell growth and division into two daughter cells. The regulation of cell cycle is critical to cell survival, as it governs the repair of genetic damage and the prevention of uncontrolled cell division. Defects in cell cycle regulation are a characteristic feature of tumour cells, and mutations in the genes involved in controlling the cell cycle are extremely common in cancer. Cell cycle analysis has become increasingly important in the understanding of the action of anticancer compounds or studying mechanisms of cell division.

The Muse™ Cell Cycle Assay allows for the facile, rapid, and quantitative measurements of percentage of cells in the G0/G1, S, and G2/M phases of cell cycle on the Muse™ Cell Analyzer. The assay simplifies an analysis that has traditionally required complicated instrumentation and training, and enables users to easily obtain information on cell cycle distribution on their benchtops.

Principle of the Assay

The Muse™ Cell Cycle Assay uses the nuclear DNA stain, propidium iodide (PI), to distinguish cells at different stages of the cell cycle, which differ in DNA content. Resting cells (G0/G1) contain two copies of each chromosome. As cells begin cycling, they synthesize chromosomal DNA (S phase). Fluorescence intensity from the DNA intercalating dye, PI, increases until all chromosomal DNA has doubled (G2/M phase). At this state, the G2/M cells fluoresce with twice the intensity of the G0/G1 population. The G2/M cells eventually divide into two cells. The assay thus utilizes the differential staining of cells based on DNA content. Ethanol-fixed cells are treated with a premixed Muse™ Cell Cycle Reagent and acquired using the Muse™ Cell Cycle software module (Figure 1).

Muse® Cell Cycle Assay Features

- Quick determination of cells in all 3 phases of cell cycle
- Premixed single reagent—no reagent preparation needed
- Highly simplified acquisition and analysis
- Minimal number of cells required
- Works with both adherent and suspension cells
- Accurate and precise

Figure 1. Muse™ Cell Cycle Assay protocol steps
Touchscreen Interface Greatly Simplifies Cell Cycle Data Acquisition and Analysis

The Muse™ Cell Cycle software module guides you through setup, acquisition, and analysis in a few simple steps.

- Intuitive touchscreen guides users to the answers.
- Results include percentage of populations automatically displayed after acquisition, and a histogram with three markers to demarcate the G0/G1, S, and G2/M cell cycle phases.
- Easy raw data and Excel® export features allow for archiving of results and additional analysis.

Versatile and Accurate

The Muse™ Cell Cycle Assay can be used for a variety of cellular treatment conditions and for studying the impact of cell cycle-disrupting compounds (Figure 3). The assay works well with both suspension and adherent cell types (Figures 3 and 4). Results obtained from the simple, easy-to-use Muse™ Cell Analyzer are equivalent to those from traditional analysis methods, such as the guava® Personal Cell Analyzer (PCA) flow cytometry system as shown in Table 1.

Accuracy Compared to Traditional Analysis Method

<table>
<thead>
<tr>
<th></th>
<th>G0/G1</th>
<th>S</th>
<th>G2/M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muse™ Cell Analyzer</td>
<td>50.31 ±1.54</td>
<td>30.3 ±0.48</td>
<td>19.39 ±1.61</td>
</tr>
<tr>
<td>guava® PCA</td>
<td>47.79 ±1.00</td>
<td>33.79 ±1.20</td>
<td>18.42 ±0.25</td>
</tr>
</tbody>
</table>

Table 1. Population percentages for the Muse™ Cell Analyzer compared to the guava® PCA flow cytometry system. Percentages shown are averages of three individual samplings and their standard deviation.

Figure 2. Results obtained for Jurkat cells stained with Muse™ Cell Cycle Kit, acquired on the Muse™ Cell Analyzer, and analyzed with the Muse™ Cell Cycle software module.

Figure 3. Impact of cell cycle-disrupting compounds on Jurkat cells analyzed using the Muse™ Cell Cycle Assay. Nocodazole, a microtubule disrupter, leads to cell cycle arrest in G2/M phase; etoposide, a known anti-cancer compound, also causes G2/M arrest.

Figure 4. Cell cycle profiles of MCF-7 (left) and PC-3 cells obtained with the Muse™ Cell Cycle Assay.

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