SMARTFREEZCRYO

CELL

Controlled directional freezing to maximize cell viability

CELL

CELL controlled rate directional freezer *by SMARTFREEZ*

CELL is a controlled-rate freezer featuring a bottom-up heat transfer geometry. This innovative design minimizes cryoconcentration and mechanical stresses, enhancing cell viability during cryopreservation.

- Enables precise control over ice nucleation, preventing the supercooling effect and increasing reproducibility between experiments.
- Promotes controlled ice crystal growth, both in velocity and direction.
- Preserves cell integrity more effectively, enabling significantly higher survival rates with reduced concentrations of the cryoprotectant dimethyl sulfoxide (DMSO).
- Flexible and Scalable: Fits 6 to 48 cryovials or up to 3 cryobags (30 mL each). Customized holders for vials and bags are available to meet specific needs.

The CELL bottom-up freezing geometry

uniform ice growth velocity, attenuating mechanical stresses during freezing

CELL

Improving cell viability and reproducibility

Conventional methods for freezing cells in vials and bags often result in supercooling within the container, leading to high ice growth velocities that place significant stress on cells.
With the CELL freezer, these stresses are minimized by preventing supercooling. Freezing begins with the induction of ice nucleation, forming a thin ice layer at the bottom of the vials (Figure 1).
Ice then grows upward from this nucleation layer at a controlled rate, reducing cryoconcentration and minimizing mechanical stresses caused by pressure.

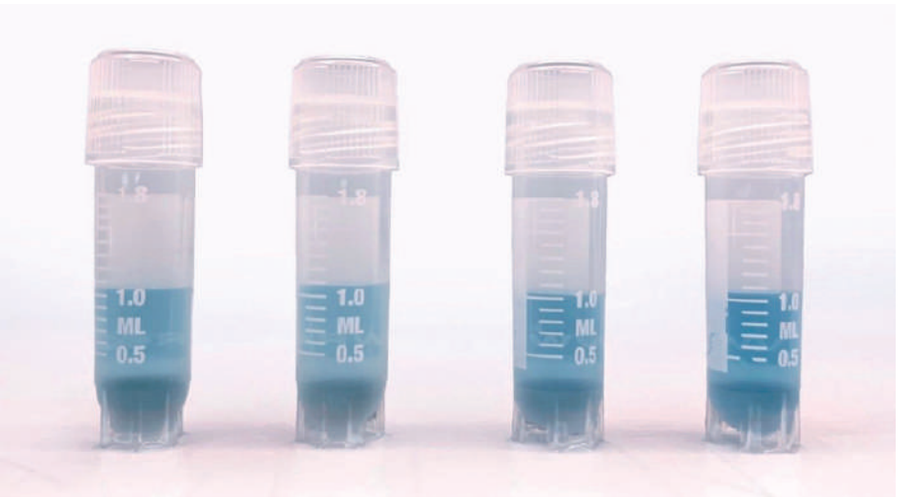


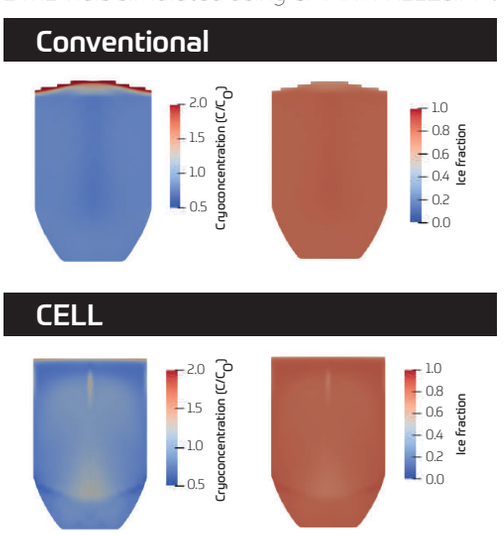
Fig. 1 *- Ice Nucleation layer (in dark blue) formed after controlled nucleation in 2 mL vials.*

Quality by Design optimization
of cryopreservation protocols

A digital twin is available for the CELL freezer, enabling you to design tailored, optimal cryopreservation methods efficiently. This streamlines development, reduces trial-and-error, and conserves biological material.

The SMARTFREEZ*SIM*® simulation platform provides data to analyze the impact of your parameters on key stresses affecting cell viability (Figure 2).

Fig. 2 *- Cryoconcentration and Ice fraction in 2 mL vials simulated using* SMARTFREEZ*SIM*®.



Case study 1

Impact of freezing geometry

on the cryopreservation of Hematopoietic stem cells

Umbilical cord blood mononuclear cells were frozen using the CELL freezer and a conventional radial freezing method.

Flow cytometry analysis for the CD34+ cells (hematopoietic stem cells and hematopoietic progenitor cells) revealed that when using 10 % DMSO (v/v), CD34 marker expression level was approximately three times higher with the CELL freezer compared to the conventional method. Additionally, the bottom-up freezing geometry allows DMSO concentration to be reduced to 2.5 % with minimal impact on expression levels (Figure 3).

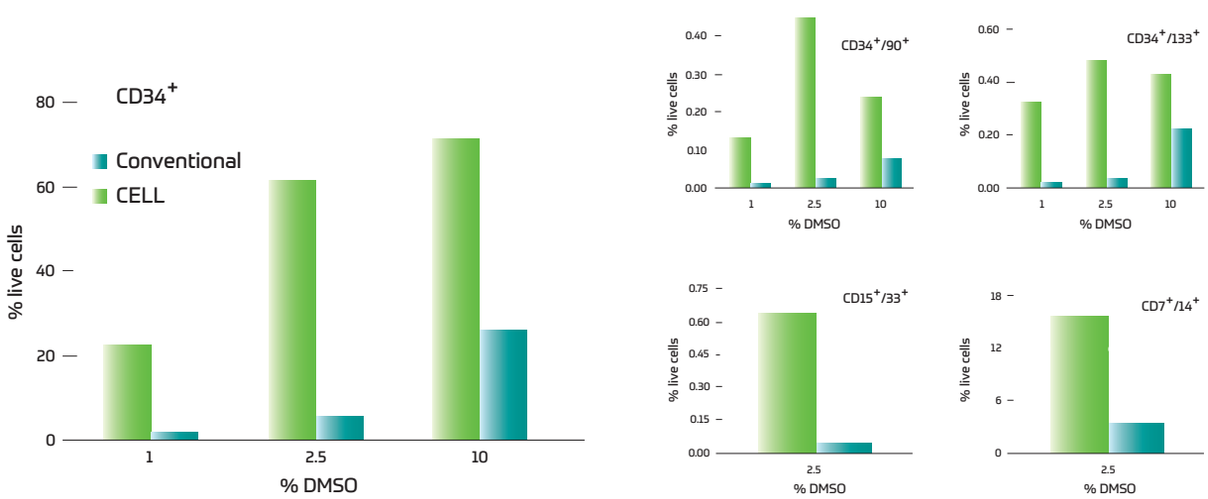


Fig. 3 *- Expression of CD34+ and the subpopulations CD34+/CD90+, CD34+/CD133+, CD15+/CD33+, CD7+/CD14+ after freezing, using the CELL and conventional radial freezing method.*

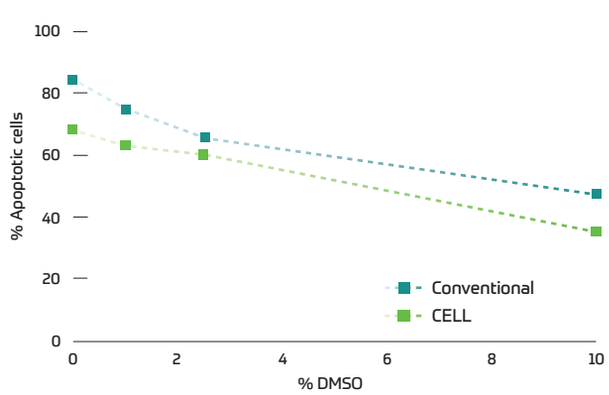


Fig. 4 *- Apoptotic cells (%) after freezing using the CELL and conventional radial freezing method.*

When comparing both methods, the conventional radial freezing method consistently shows 10 % to 20 % more cells in an apoptotic state than the controlled freezing method using the CELL freezer (Figure 4).

Case study 2

Reducing DMSO concentration

during freezing of hIPSc

Human-induced pluripotent stem cells (hIPSc) were frozen using the CELL freezer and a conventional freezing method, with varying DMSO concentrations and cooling rates.

The CELL freezer enabled a reduction of DMSO content to below 5 % (v/v) while maintaining a cell survival rate of 80 % (Figure 5).

- A cooling rate of 1 °C/min allowed the DMSO content to be reduced to 4 % (v/v) while maintaining cell viability above 90 %.
- A cooling rate of 5 °C/min allowed the DMSO content to be reduced to 2 % (v/v) while maintaining approximately 80 % cell viability.

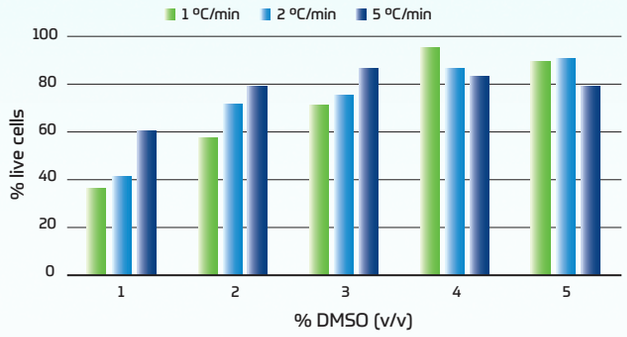


Fig. 5 *- Percentage of live cells after freezing using the CELL freezer (bottom-up freezing) for DMSO concentrations below 5 % v/v.*

CELL 's bottom-up freezing geometry significantly improves cell survival at both 1 % and 5 % DMSO concentrations (v/v). At 1 % DMSO and a cooling rate of 5 °C/min, bottom-up freezing resulted in six times more live cells compared to conventional radial freezing (Figure 6).

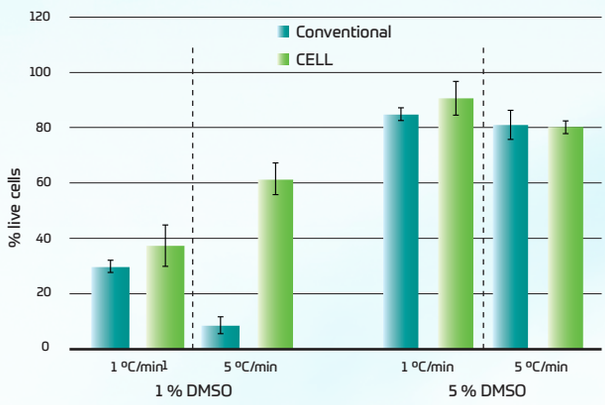


Fig. 6 *- Percentage of live cells after freezing using CELL (bottom-up freezing) and conventional freezing method (radial freezing) for DMSO concentrations of 1 and 5 % (v/v).*

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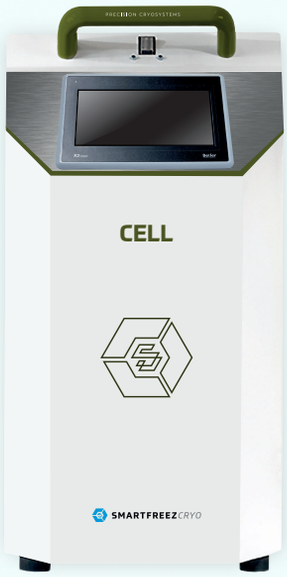

Key

Specifications

CAPACITY	• *1 holder for 48 x 2 mL vials* • *1 holder for 3 x 30 mL bags*
DIMENSIONS (mm)	*460 (d) x 360 (w) x 600 (h)*
TEMPERATURE	*-85 °C to 25 °C*
WEIGHT	*40 Kg*
PATENT STATUS	*Pending*

- *Developed to support GMP compliance*
- *21 CFR Part 11 compliant for electronic records*

Customizable to your needs

The CELL freezer can be configured for vials and bags of different sizes and shapes.

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