Corning® CoolCell® Products

Reference List

There is an increasing trend in the use of primary and specialized cell types in 3D cell culture, cancer research, biobanking, and cell therapy applications. The sensitivity of these cell cultures necessitates standardized and reproducible cryopreservation techniques to ensure robust post-thaw cellular integrity and performance.

For example, stem cells require proper cryopreservation to optimize cell viability and ensure maintenance of the undifferentiated state[1]. 3D cell cultures such as organoids can be cryopreserved intact, in fragments, or as dissociated cells at a recommended rate of -1°C/minute using a controlled rate freezer or freezing containers for optimal recovery[2]. For cell therapy production, controlled freezing of the final drug product before long-term storage is essential to ensure consistent integrity and therapeutic effect[3].

Corning CoolCell alcohol-free cell freezing containers ensure a standardized controlled rate of -1°C/minute cell freezing in a -80°C freezer, without alcohol or any fluids. The proprietary Corning CoolCell technology utilizes a thermo-conductive alloy core and highly-insulative outer material to precisely control the rate of heat removal and provide reproducible cell cryopreservation.

Corning CoolCell containers are a cost-effective and smaller-scale alternative to commonly used programmable freezers and demonstrate the same freezing accuracy[4] for use in research to cell therapy clinical trials[3]. CoolCell cryogenic containers are proven for use with a variety of cell types including stem cells, primary cells, PBMC, cell lines, organoids, and encapsulated cells.

The selection below highlights some of the recent publications in which Corning CoolCell containers were used. A list of additional citations follows. For more information about Corning CoolCell products visit **www.corning.com/lifesciences.**

1. Cohen R, et al. Standardized cryopreservation of pluripotent stem cells. Current Protocols in Stem Cell Biology 2014;1C.14.1-1C.14.14. doi: 10.1002/9780470151808.sc01c14s28.
2. Clinton J, and McWilliams-Koeppen, P. Initiation, expansion, and cryopreservation of human primary tissue-derived normal and diseased organoids in embedded three-dimensional culture. Current Protocols in Cell Biology 2019;82:e66. doi: 10.1002/cpcb.66.
3. Foussat A, et al. Effective cryopreservation and recovery of human regulatory T cells. Bioprocess Int 2014;12(3)s:34-38.
4. Thompson M, et al. Validation of a novel portable freezing device in the optimal freezing of peripheral blood mononuclear cells for potential cell therapy use. Cytotherapy 2014;16(S4):S29.

Application	Area	Cell/Organoid Type	Reference
3D Cell Culture	**Organoid Culture**	Gastric (human and mouse)	Bartfield S, et al. Organoids as model for infectious diseases: Culture of human and murine stomach organoids and microinjection of helicobacter pylori. J Vis Exp 2015;(105):e53359. doi: 10.3791/53359.
		Human primary tissue-derived (various tissue types)	Clinton J and McWilliams-Koeppen P. Initiation, expansion, and cryopreservation of human primary tissue-derived normal and diseased organoids in embedded three-dimensional culture. Curr Protoc Cell Biol 2019;82(1):e66. doi: 10.1002/cpcb.66.
		Intestinal crypt-derived (various animals)	Powell R, et al. WRN conditioned media is sufficient for in vitro propagation of intestinal organoids from large farm and small companion animals. Biol Open 2017;6:698-705. doi: 10.1242/bio.021717.
		Liver and pancreas (mouse adult)	Broutier L, et al. Culture and establishment of self-renewing human and mouse adult liver and pancreas 3D organoids and their genetic manipulation. Nat Protoc 2016;11:1724-1743. doi: 10.1038/nprot.2016.097.
		LuCaP prostate cancer (patient-derived xenografts)	Beshiri M, et al. A PDX/organoid biobank of advanced prostate cancers captures genomic and phenotypic heterogeneity for disease modeling and therapeutic screening. Clin Cancer Res 2018;24(17):4332-4345. doi: 10.1158/1078-0432.CCR-18-0409.
		Prostate normal and cancer tissue (human and mouse)	Drost J, et al. Organoid culture systems for prostate epithelial tissue and prostate cancer tissue. Nat Protoc 2016;11(2):347-358. 10.1038/nprot.2016.006.
Cell Therapy	**Gastrointestinal**	Biopsies from ileal and/or colonic tissue from patients with Crohn's disease	Wildenberg M, et al. Evaluation of the effect of storage condition on cell extraction and flow cytometric analysis from intestinal biopsies. Journal of Immunological Methods 2018;459:50-54.
	Immune Cell	CD4+CD25– T Responder cells	Morales J, et al. Automated clinical grade expansion of regulatory T cells in a fully closed system. Front Immunol 2019;10:38. doi: 10.3389/fimmu.2019.00038.
		Differentiated Natural Killer (NK) cells from cord blood CD34+ cells	Domogala A, et al. Cryopreservation has no effect on function of natural killer cells differentiated in vitro from umbilical cord blood CD34+ cells. Cytotherapy 2016;18:754-759. doi: 10.1016/j.jcyt.2016.02.008.
		MNC fraction (human)	Harper H and Rich I. Measuring the potency of a stem cell therapeutic. In: Rich I (ed.) Stem Cell Protoc. Methods Mol Biol, vol 1235. Humana Press, New York, NY. doi: 10.1007/978-1-4939-1785-3_4, 33-48.
		PBMC (Peripheral blood mononuclear cell)	Higdon L, et al. Virtual global transplant laboratory standard operating procedures for blood collection, PBMC isolation, and storage. Transplant Direct 2016;2:e101. doi: 10.1097/TXD.0000000000000613.
			Lemieux J, et al. A global look into human T cell subsets before and after cryopreservation using multiparametric flow cytometry and two-dimensional visualization analysis. J Immunol Methods 2016;434:73-82. doi: 10.1016/j.jim.2016.04.010.
			Tapia-Calle, et al. Distinctive responses in an in vitro human dendritic cell-based system upon stimulation with different influenza vaccine formulations. Vaccines 2017;5(3):21. doi: 10.3390/vaccines5030021
			Thompson M, et al. Validation of a novel portable freezing device in the optimal freezing of peripheral blood mononuclear cells for potential cell therapy use. Cytotherapy 2014;16(S4):S29.
		PBMC; Type 1 Tregs (Ag-Treg)	Foussat A, et al. Effective cryopreservation and recovery of human regulatory T cells. Bioprocess Int 2014;12(3)s:34-38.
		Tumor biopsy-derived TIL	Poschke I, et al. Identification of a tumor-reactive T-cell repertoire in the immune infiltrate of patients with resectable pancreatic ductal adenocarcinoma. OncoImmunology 2016;5(12);e1240859. doi: 10.1080/2162402X.2016.1240859.
		Tumor-infiltrating T cells (TIL) from tumor biopsies	Idorn M, et al. Transfection of tumor-infiltrating T cells with mRNA encoding CXCR2. In: Rhoads R (ed.) Synthetic mRNA. Methods Mol Biol, vol 1428. Humana Press, New York, NY. doi: 10.1007/978-1-4939-3625-0_17.

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Cell Therapy	Neuronal	Primary cell cultures from Parkinson's disease biopsies	Xu H, et al. Neurotrophic factor expression in expandable cell populations from brain samples in living patients with Parkinson's disease. FASEB J 2015;27:4157-4168. doi: 10.1096/fj.12-226555.
	Other	Human amnion epthelial cells (hAECs)	Gramignoli R, et al. Isolation of human amnion epithelial cells according to current good manufacturing procedures. Curr Protoc Stem Cell Biol 2016;37:1E.10.1-1E.10.13. doi: 10.1002/cpsc.2.
		Murine heart endothelial cells (MHEC5-T)	von Bomhard A, et al. Cryopreservation of endothelial cells in various cryoprotective agents and media-Vitrification versus slow freezing methods. PLoS ONE 2016;11(2):e0149660. doi:10.1371/ journal.pone.0149660.
		General	Buckler R, et al. Technological developments for small-scale downstream processing of cell therapies. Cytotherapy 2016;18:301-306.
	Pancreas	Native human pancreatic islets (intact or single cells)	Rawal S, et al. Long-term cryopreservation of reaggregated pancreatic islets resulting in successful transplantation in rats. Cryobiology 2017;76:41-50.
	Stem Cell	hESC and iPSC lines	Cohen R, et al. Standardized cryopreservation of pluripotent stem cells. Curr Protoc Stem Cell Biol 2014;28:1C.14.1-1C.14.14. doi: 10.1002/9780470151808.sc01c14s28.
		hPSC lines (various); hPSC-RPE and hPSC-LESC cells	Hongisto H, et al. Xeno- and feeder-free differentiation of human pluripotent stem cells to two distinct ocular epithelial cell types using simple modifications of one method. Stem Cell Res Ther 2017;8:291. doi: 10.1186/s13287-017-0738-4.
		mESC (germline-competent)	Czechanski A, et al. Derivation and characterization of mouse embryonic stem cells from permissive and nonpermissive strains. Nat Protoc 2014;9(3);559-574. doi: 10.1038/nprot.2014.030.
		MSC (clinical BM-derived)	Moll G, et al. Do cryopreserved mesenchymal stromal cells display impaired immunomodulatory and therapeutic properties? Stem Cells 2014;32(9): 2430-2442. doi: 10.1002/stem.1729.
		MSC (horse BM- and UCB-derived)	Bertoni L, et al. Intra-articular injection of 2 different dosages of autologous and allogeneic bone marrow- and umbilical cord-derived mesenchymal stem cells triggers a variable inflammatory response of the fetlock joint on 12 sound experimental horses. Stem Cells Int 2019;9431894. doi.org/10.1155/2019/9431894.
		MSC (human adipose-derived)	Hoogduijn M, et al. Effects of freeze-thawing and intravenous infusion on mesenchymal stromal cell gene expression. Stem Cells Dev 2016;25(8):586-597. doi: 10.1089/scd.2015.0329
	Various	D1-mesenchymal stem cells, murine C2C12 myoblasts, human insulin secreting cell line 1.1B4, human retinal pigment epithelial cell line Arpe-19 encapsulated in alginate microcapsules	Gurruchaga H, et al. Low molecular-weight hyaluronan as a cryoprotectant for the storage of microencapsulated cells. Int J Pharm 2018;548:206-216.
Cancer	Breast cancer	Patient triple-negative breast cancer cells	Le Gallo M, et al. Tumor analysis: freeze-thawing cycle of triple-negative breast cancer cells alters tumor CD24/CD44 profiles and the percentage of tumor-infiltrating immune cells. BMC Res Notes 2018;11:401. https://doi.org/10.1186/s13104-018-3504-5.
	Neuroblastoma	Primary neuroblastoma explants	Braekeveld N, et al. Neuroblastoma patient-derived orthotopic xenografts reflect the microenvironmental hallmarks of aggressive patient tumours. Cancer Lett 2016;375:384-389.
	Osteosarcoma	MG63 cells encapsulated in alignate fibers	Cagol N, et al. Effect of cryopreservation on cell-laden hydrogels: Comparison of different cryoprotectants. Tissue Eng 2018; Part C:24(1):20-31. doi: 10.1089/ten.tec.2017.0258.

For more specific information on claims, visit the Certificates page at **www.corning.com/lifesciences**.

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