Controlling Crystallization for Improved Cryopreservation

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Cryopreservation has had huge benefits for the world at large, including preservation of blood and stem cells, along with assisted reproductive technologies. [1] However, there are many cell types that cannot be stored using current cryopreservation methods, and no organs. [2-4] In fact, 60% of all donated hearts and lungs in the USA are discarded due to inadequate storage methods, and this waste could be overcome with cryopreservation. [5]

The main challenge in improving cryopreservation outcomes is the sheer number of variables that influence success such as cooling rate, vessel volume, crystal seeding, and the ongoing reliance on predominantly just two cryoprotective agents, both of which are toxic: dimethylsulfoxide (DMSO) and glycerol. [6, 7]

We have developed high-throughput methods of evaluating each of these variables to optimize cryopreservation protocols for specific cell types, especially those with previous poor cryopreservation outcomes. This includes designing new cryoprotectants and building novel methods of seeding ice crystals to control the freezing process.

Methods including cryomicroscopy, differential scanning calorimetry, and cell assays provide fundamental information which feeds into the optimised protocols.

These results provide new avenues of cryopreservation for cell types which cannot be preserved with existing methods. This in turn has wide-ranging benefits, especially in the biomedical field.

Keywords:

Cryopreservation, Crystallization, Freezing, Deep Eutectic Solvent

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