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Experimental study on micro-solid particulate spray vitrification for biological material long-term preservation.

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Long-term preservation of cells and tissues require adequate freezing protocols in order to increase viability after storage in liquid nitrogen temperatures. Way of cooling down the biological material to cryogenic temperatures is noticed as a most dangerous stage in preservation. Possible cryo-injuries caused by direct action of ice or volumetric increase inside the single cell are formed mainly during this time. Delicate structure of cell could be affected by several damages concerning to intra- and extracellular ice formation. To avoid this problem novel solutions have been presented in nowadays research included development in the cryo-containers and different cooling techniques. One of the most popular technique presented is vitrification – amorphous solidification of a supercooled liquid without any internal crystallization. To reach the ice-free state of cell suspension is requiring to add cryoprotectants into solution and reach high enough cooling rates during freezing process. Ordinary cryopreservation protocols for vitrification are designed based on inefficient liquid nitrogen plunging methods. The paper presents novel method for cryopreservation by usage of micro-solid nitrogen particulate spray cooling. Particulate spray is considered as potential solution to reach high enough cooling rates thanks to avoid film boiling formation, and to enhance heat transfer coefficient due to forced convection of the coolant. Especially for water solution with cryoprotectant, the experimental set-up was constructed in order to check the thermal performances and vitrification achievements. Presented investigation shows capabilities of high heat flux spray cooling. To clarify increase performance of micro-solid nitrogen spray, obtained data were compared with standard cryopreservation techniques reported in literature.

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