

Viscosities of DMSO-NaCl-H₂O Solution at Low Temperatures

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Ice-free cryopreservation, or vitrification with high concentrations of cryoprotectants (CPAs), is considered as a promising method for long-term storage of human tissues and organs. An effective way to reduce the accompanied CPA toxicity, during CPA addition/removal, is to operate at low temperatures. The permeation process of CPA into/out of biomaterials is seriously affected by the viscosity of the CPA solution. Dimethyl sulfoxide (DMSO) is the most common CPA. The objective of the present study is to measure the viscosity of the ternary solution, DMSO – sodium chloride (NaCl) – water, at low temperatures and in a wide range of concentration. A rotary viscometer coupled with a low temperature thermostatic bath was used. Its accuracy was checked with pure *n*-nonane. The measurements were conducted at temperatures from 0°C to -70°C. The highest mass fraction of DMSO was 65% w/w and the lowest mass fraction of DMSO was the value that kept the solutions unfrozen at a pre-set temperature. The concentration of NaCl was kept constant (0.85% w/w, the normal salt content of extracellular fluids). A pseudobinary solute aggregation model was employed to fit the obtained viscosity data. As an example, the impact of solution viscosity on the permeation of DMSO into articular cartilage was qualitatively analyzed.