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Optimization of oocyte cryoprotectant loading rate

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Freezing oocytes is a delicate process and current methods result in high mortality rates. Before freezing, cells are typically loaded with cryoprotectants (CPAs) to reduce freezing damage, however osmotically induced cell volume changes during the loading process can also damage the cell. The purpose of this study is to determine an optimal piecewise linear rate of CPA concentration change that increases the intracellular concentration of CPA to the necessary level in the fastest time, while maintaining the cell volume within predetermined “safe” boundaries. In order to determine the optimum rates, a series of computer models generating the cell volume and intracellular concentration of permeating solute as a function of time were developed in Mathematica. The first model used a step wise function with set concentration values to approximate rate of concentration change. The values obtained from this model were used as guidelines in the final model, which utilized genetic algorithms to search for the best rate of change for each step of a two step process. In the future, we would like to determine the optimal solution for multi-step processes.