CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
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Project Number
S0705

Project Title
Using Capacitance to Distinguish between Living and Dead Cells

Abstract

Objectives/Goals
To analyze capacitance as a rapid means to estimate viable cell numbers in culture and to apply this method to the evaluation of several frequently used cryoprotective agents by measuring the viability of cells post freezing.

Methods/Materials
The instrument for these measurements consisted of a capacitance probe and an impedance meter. The probe was constructed using stainless steel wires held in place with silicone rubber in a glass tube. The wires are connected to the instrument using small coax cables. The construction of a bridge circuit to measure capacitance was attempted. Most of the capacitance measurements were obtained using commercial LCR meters (HP 4275 and HP 4285). CHO cells used were grown in a serum-free medium, in a humidified CO(2) incubator at 37 deg C. The cells were concentrated using centrifugation (15' at 1000 x g). Actively growing cells were used for the freezing experiments. The cells were then centrifuged and re-suspended in the freezing solution and cooled to -80 deg C using Nalgene's "Mr. Frosty" to control the rate of cooling.

Results
Measurements of the capacitance of the media with and without CHO cells at different frequencies showed that measurements at 75KHz gave the best signal to the media background ratio. At this frequency the measured capacitance was shown to be a linear function of cell number. Additionally using this method, a solution of dimethylsulfoxide (DMSO) and carboxymethylcellulose was shown to protect CHO cells better than the other formulations examined.

Conclusions/Discussion
Capacitance was capable of measuring viable cell number of CHO cells in the range of 0.5 to 7 x 10^6 cells per mL. It is possible that improvements in the probe design could allow the measurement of fewer numbers of cells. Additionally, the results indicate that the use of capacitance to measure viable cell number is useful in screening cryoprotective agents and conditions for the viable freezing of cells, as I was able to predict the viability of the cultures at 48 hours after their recovery from the freezer.

Summary Statement
By measuring the impedance of cell suspensions I was able to indirectly measure viable cell density and apply this technique to the rapid screening of cryoprotective agents for use in freezing cells.

Help Received
Used electronics equipment at Vista Biologicals Corporation