CHARACTERIZATION OF A 3D MATRIX BIOREACTOR FOR SCALED PRODUCTION OF HUMAN MESENCHYMAL STEM CELLS

Andrew B. Burns, Keck Graduate Institute
Aburns13@kgi.edu
Corinna Doris, Keck Graduate Institute
Kevin Vehar, Keck Graduate Institute
Cameron Bardliving, Keck Graduate Institute
M. Ian Phillips, Keck Graduate Institute
Parviz Shamlou, Keck Graduate Institute

Key Words: Mesenchymal Stem Cells, Computational Fluid Dynamics, Scale-up, Process Modeling

Human Mesenchymal Stem Cells (hMSCs) are multipotent, immune-privileged, and possess the capacity to proliferate ex-vivo, making them a good candidate for stem cell therapy. However, a reliable scalable production system for hMSCs is needed to fuel the growing field of regenerative medicine. Current growth of hMSCs is achieved through adherent 2D methods using tissue culture flasks or cell factory systems. These processes are labor intensive and can lead to low purity and poor yield of hMSCs due to the limited control of culture conditions inherent in these systems. In this work, we are investigating a novel 3D honeycomb matrix culture system for controlled high density hMSC production. We have assessed compatibility of the hMSCs on the honeycomb matrix and developed a scale down model bioreactor for development and characterization. Computational Fluid Dynamic (CFD) modeling is used in parallel with the described in-vitro experimentation to characterize shear profiles and oxygen transport for optimization of the conditions to support high cell density hMSC cultures. These techniques will potentially allow for higher yield and purity of hMSCs to meet the large quantities of cells needed for emerging whole cell therapies.