Faculty Candidate Presentation

Industrial & Management Systems Engineering

"Stem cells as cellular systems for drug and toxicity screening, as well as development and disease modeling."

Jamie Chilton, Ph.D.

Biography

Jamie Chilton, PhD, is a currently an Adjunct Instructor and Career Consultant specifically dedicated to USF's College of Engineering and the career readiness of USF undergraduate and graduate engineering students. She received her BA in Biochemistry and Molecular Biology (2000) from Agnes Scott College, as well as minoring in Mathematics and completing the requirements for Agnes Scott's Business Prep Program. Dr. Chilton holds a PhD in Biomedical Engineering (2008) from Georgia Institute of Technology College of Engineering and Emory University School of Medicine. At Georgia Tech, she also earned her certificate in Engineering Entrepreneurship and won 2nd place with her team in Georgia Tech's 2005 Business Plan Competition. Dr. Chilton has over 10 years of experience in a variety of research, technology, business, teaching and consulting roles in higher education and private industry, particularly in biotechnology. Her previous work includes developing innovative cell culture systems for disease modeling, drug discovery and toxicity studies for customers ranging from academia and government to large biotech and pharmaceutical companies. Her teaching interests include engineering the organization, behavior, creativity, and technology-based entrepreneurship.

CMC 147
12:30Pm-1:30pm
Monday, March 26th, 2018

Abstract

Improved understanding of how drugs and environmental toxins impact human health and disease is essential to reduce safety issues and pharmaceutical development costs. To better model and predict human physiology, more biologically relevant, in vitro cell culture systems must be developed. In particular, stem cells and their derivatives potentially provide an efficient and economical choice as a cell culture system. In this work, induced pluripotent stem cells (iPSCs) were reliably generated in less than 20 days and demonstrated in vitro characteristics similar to human embryonic stem cells (hESCs). Next, iPSCs and hESCs were induced to differentiate in vitro into both 1) neural progenitors and their neuronal derivatives and 2) mesenchymal progenitors and derivative phenotypes. Resulting progenitor cells were characterized by immunochemistry, flow cytometry and then assayed for differentiation potential to their respective cell lineages. Morphology, time frame for differentiation and marker expression of iPSC-derived progenitors was similar to hESC-derived progenitors for both neural and mesenchymal differentiation in vitro. In addition, proliferative iPSC and hESC neural and mesenchymal progenitors demonstrated robust capacity for being maintained as adherent monolayer cultures for multiple passages. To further explore the capacity of stem cell-derived progenitors to be expanded for high throughput drug screening and investigating mechanisms of Parkinson's disease, neural progenitor-like cells that exhibited greater than 95% immunoreactivity for nuclear receptor related 1 protein (NURR1), a transcription factor essential for the generation of midbrain dopaminergic neurons, were isolated and differentiated into dopaminergic neurons in the presence of leukemia inhibitory factor (LIF), brain derived neurotrophic factor (BDNF), glial derived neurotrophic factor (GDNF), transforming growth factor beta 3 (TGF-β3), forskolin and ascorbic acid (AA). By 3 weeks, approximately 10% of differentiated cells showed immunoreactivity for tyrosine hydroxylase (TH), a key marker of dopaminergic differentiation. Furthermore, high throughput, high content imaging methods reproducibly monitored neuronal differentiation by tracking neurite outgrowth and automatically scoring for different types of neurons within a population using type-specific antibodies. Results show that stem cells and their derivatives are a unique, renewable and scalable cell source to significantly facilitate results in high throughput research and discovery applications.

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