The Effects of Galactose on MCF10A- AKT Cancer Cells

Justin Heo, justinheo10@gmail.com
Arnold O. Beckman High School, Class of 2020
USC Viterbi Department of Chemical Engineering, SHINE 2019

SHINE
Summer High School Intensive in Next-Generation Engineering

USC Viterbi School of Engineering

Introduction and objective

The main focus of the Graham lab is to utilize both experimental and statistical methods to develop new models and approaches to cancers and other human diseases. Using quantitative technologies like mass spectrometry, the lab generates data for both proteins and metabolites that drive cancer. With data that encompasses proteins, genes, and metabolites, predictive models of tumor phenotypes can be created using biology, statistics, and engineering. To implement these system biology models into clinical care, the lab collaborates with physicians, chemists, and oncologists. This summer, I was under the supervision of Dr. Graham's PhD student, Dongqing Zheng, whose research focuses on the oxidative stress that AKT proteins face, while grown in galactose.

Professor's Research

The lab focuses on AKT and MYC, which are both related to cancer. Specifically, AKT is part of the (PI3K)-AKT pathway, a very common pathway that becomes dysregulated. Since the pathway directly deals with cell proliferation, metabolism, and survival, aberrant activation can lead to the survival and proliferation of tumor cells in cancers. On the other hand, MYC is a proto-oncogene that is usually restrained through checkpoint mechanisms like apoptosis. However, when activated, MYC can enforce tumor growth through DNA replication, cell proliferation, and protein synthesis. Galactose is a monosaccharide that is used to support the growth of cells by providing a source of energy for the cells. However, when operated with AKT cells, the AKT cancer cells die off at a more significant rate than AKT cells grown in glucose.

Impact of Professor's Research

To counteract this cell death, both the drug nifedipine and the enzyme catalase can be used to promote the AKT cells to regain their viability while in galactose. By studying different combinations of nifedipine and catalase, my professor's/mentor's research seeks to find the combination of nifedipine and catalase that leads to the best promotion of AKT viability. With this information, a treatment could be formulated to inhibit this certain combination of nifedipine and catalase in order to prevent AKT cells from regaining viability.

Skills Learned

- Pipetting
- Centrifugation
- Cell culture
  - Media preparation
  - Sterilization technique
  - Cell counting
  - Aspirating media, cells, etc.
  - Cell incubation

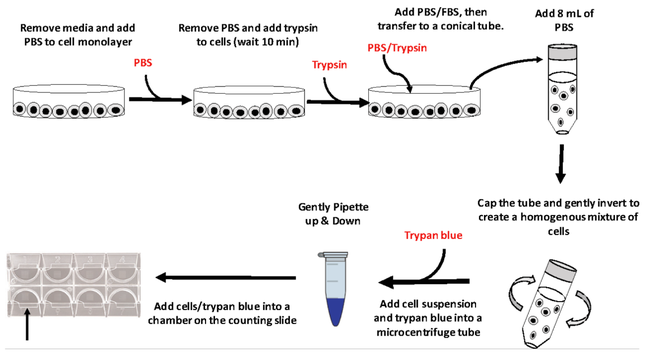

Figure 1. A schematic outlining the experimental procedure to count cells.
PC: semanticscholar.org

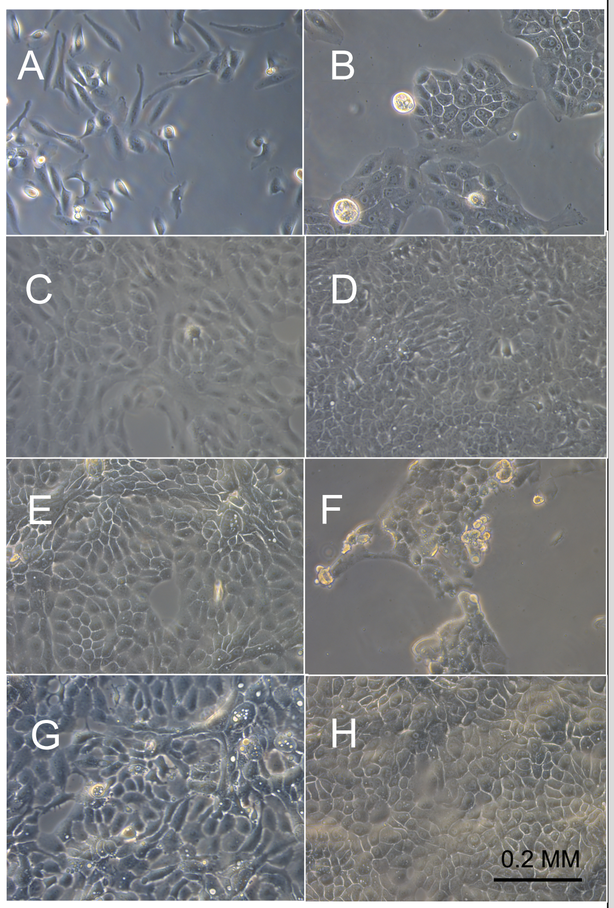

Figure 2. Phase contrast microscopy images of MCF10A cells before and after treatment. 0 hour treatment images for RFP (A) and AKT (B). 44 hour treatment images for RFP in glucose (C), RFP in galactose (D), AKT in glucose (E), AKT in galactose (F), AKT in galactose + catalase (G), and AKT in galactose + nifedipine (H).
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Advice for Future SHINE Students

- Don't be afraid to ask any questions to your mentor, professor, or other SHINE students. Everyone is very nice and is willing to help.
- Make sure you get to know the other people in the program, so you can make new friends while you're at USC.
- Don't be overwhelmed by the research you will have to work on. Everything will be explained to you and your mentor will help keep everything understandable for you.
- Listen to the different professors during the cohort meetings. They offer great insight into other fields that you might be interested in.
- Have fun and make some good memories!

Acknowledgements

I would like to thank Professor Graham and the SHINE team for providing me with an amazing lab to work in and for guiding me throughout my time at SHINE. Thanks to Dr. Katie Mills and Dr. Megan Herrold for hosting the cohort sessions and making them a great part of the program. I would also like to thank my parents for encouraging me to join the program. Special thanks to my mentor Dongqing Zheng for helping me throughout the entire research process, answering all my questions, and allowing me to understand the complexities of his research.

How This Relates to Your STEM Coursework

Biology:
By working with cell cultures and cancer cells, I have worked directly with many of the concepts I learned in Biology. I have learned how to create cell cultures, supply cells with media, and the process needed to count cells. In addition, I have gained a much deeper understanding of cell pathways and the different characteristics of cancer cells.

Chemistry:
This lab has allowed me to utilize many of the ideas I have learned from chemistry, such as using unit conversions, working with pH indicators, and using buffers.

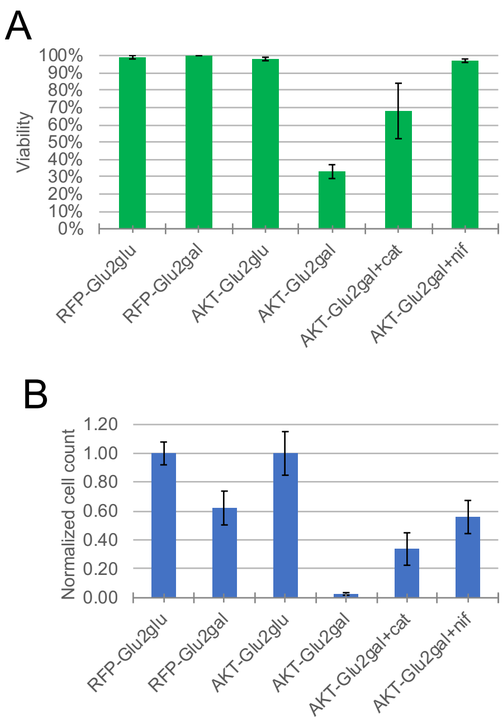

Figure 3. Nifedipine and catalase rescued galactose induced cell death in AKT expressing cells. (A) Bar graph depicting the average viability of each cell condition after the 44 hour treatment. (B) Bar graph illustrating the normalized cell count of each cell condition after the 44 hour treatment.
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