2019 Belmont Undergraduate Research Symposium

Chemistry

Moderator: Kimberlee Entsminger, Ph.D.

April 11, 2019, 3:45-5 p.m.
Inman 312

3:45 – 4:15 p.m.

Antioxidant Properties of Three *Salvia* Species and the Anti-proliferative Effects of *Salvia Officinalis* on Triple Negative Breast Cancer Cells

Claire Marie Holden
Faculty Advisors: Kimberlee Entsminger, PhD and Marilyn Thompson Odom, PhD

Medicinal plants such as sage that are rich in antioxidants can be used as alternative treatments for diseases like cancer that manifest themselves due to an accumulation of free oxygen radicals in the electron transport chain. Sage contains many of these antioxidants including polyphenolics, terpenes, and flavonoids. Previous research has explored these antioxidants found in sage, but their efficacy on breast cancer cells has not been tested. The purpose of this study was to determine which of three sage species has the highest antioxidant activity and therefore the ability to decrease triple negative breast cancer (TNBC) cell proliferation. Three *Salvia* species were tested for antioxidant activity: *Salvia lyrata*, *Salvia greggii*, and *Salvia officinalis*. Methanol extractions and steam distillations were performed to isolate the essential oil from the sage. The antioxidant activity of the *Salvia officinalis* was then assessed using total phenolics and DPPH radical assays. Triple negative breast cancer cells were plated and treated with the essential oil of *Salvia officinalis*. Following treatment, crystal violet assays were performed to assess viable cell density and cytotoxicity. In this presentation, antioxidant activity of three sages will be discussed as well as the cytotoxicity of *Salvia officinalis* to TNBC cells.

4:15 – 4:30 p.m.

Exploration and Range of Natural Indicators

Jaela Scaife
Faculty Advisor: Danielle Garrett, Ph.D.

Many schools struggle with hands-on labs due to inhibiting factors such as budgets, resources, and accessibility to proper chemical disposal. Green chemistry has become an essential part of the chemical world by focusing on having minimal impact on the environment yet still being cost effective. Greener chemistry options in the lab enhance the quality of the lab experience, make a positive impact on the environment, and allow teachers to meet educational standards. Acid-base chemistry is a fundamental topic taught in most classrooms, allowing students to determine pH, perform titrations, and better understand the mathematics behind chemistry. An essential part of the titration is the indicator, which can often be expensive and harmful to the environment. The goal of this research is to determine more cost effective, greener alternatives to commercial indicators such as cranberries, blueberries, or even red roses. This study focuses on the

development of optimal extraction techniques for such natural indicators. The progress toward synthesis of cranberry and blueberry indicators is reported here including shifts in both pH and absorbance values.

4:30 – 4:45 p.m.

Computational Study of PRL-3 in Complex with the Selective Inhibitor of Nuclear Export Selinexor

Christopher Joseph Hansen
Faculty Advisors: Marilyn Thompson Odom and Rachel Rigsby, Ph.D.

Phosphatase of regenerating liver 3, is part of the PRL family of phosphatases responsible for cellular proliferation and growth of various cancers. Western Blot analyses shows that PRL-3, among other proteins, decreases in expression when Triple Negative Breast Cancer, TNBC, cells are treated with Selinexor. Selinexor is marketed to be selective inhibitor of nuclear export or a SINE drug and is currently in clinical trials for treating various cancers. Past work has shown that selinexor kills HCC1143, and BT549 TNBC cell lines 24-48 hours after treatment. It has been suggested in other studies that gene knock-outs of PRL-3 leads to the unviability of cancer lines. Molecular docks using AutoDock Vina shows potential binding of selinexor into the active site of PRL-3 with moderate binding affinity. This computational work suggests binding *in vitro* which could be responsible for the death of TNBC cells, likely through direct inhibition of PRL-3.

4:45 – 5:00 p.m.

Reducing the Cost of Acid Dissociation Analysis Through Natural Indicators

Preston Medley
Faculty Advisor: Danielle Garrett, Ph.D.

Analysis of the effects of temperature on the dissociation of acids in water currently requires the use of harsh lab-grade pH indicators, and expensive spectrophotometers. For this reason, these analyses are off-limits to public schools that do not have the budget for spectrophotometers or the storage capacity for pH indicators. Previous research has shown the viability of basic, inexpensive colorimeters built from craft foam and basic electronic components. The aim of this research is to determine a baseline procedure for the analysis of temperature effects on dissociation of acid in water, using distilled white vinegar as a source of acetic acid. To do this, production-level spectrophotometers and pH indicators are used to determine a calibration curve for a standard set of vinegar-water solutions. Once a linear calibration curve is achieved, the effects of temperature or the equilibrium constant of a representative solution are determined by exposing three identical solutions to heat, cold, and room temperature as they come to equilibrium. While this is done, a reliable pH indicator that can be made at home or easily in a lab setting is being developed in parallel research. Once this natural indicator is finalized, it will be substituted for the production indicator and the spectrophotometer will be substituted with the home-made colorimeter. Research is ongoing, as the calibration curve phase is complete, but temperature effects on K_{eq} are still being investigated.