CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

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Project Number

38449

Project Title

Alkaloid Quantification of Catharanthus roseus and Vinca major and Its Effects on Cell Viability

Abstract

Objectives/Goals

The goal of my project is to determine whether a common relative of an exotic plant known to produce anti-cancer compounds has the same properties that would make it a good candidate for chemotherapy. Catharanthus roseus contains alkaloids known to kill cancer cells. Vinca major is a common ornamental plant that may be an alternative source for chemotherapy drug discovery. My objective is to investigate the amount, identity, and toxicity of these alkaloids from leaves and flowers of these two species in order to determine which would be a better chemotherapy candidate.

Methods/Materials

Catharanthus roseus plants were grown and three wild populations of Vinca major were collected in Santa Cruz County. Alkaloids were extracted from dried flowers and leaves using methanol. Total alkaloids were quantified following the reaction with Dragendorff#s reagent using a spectrophotometer. Individual alkaloids were then separated and identified by comparison to known standards using an HPLC-MS. The effect of these alkaloids on E. coli cell growth was determined using OD600 on a plate reader.

Results

On average, C. roseus leaves have 3x higher alkaloid concentration than flowers of the same species, which is highly significant in a T-test ($p=0.0002$). C. roseus leaves have only 4% higher alkaloid concentration than V. major leaves, but the difference is not significant. From the HPLC-MS data, I identified three known compounds (vindoline, catharanthine, and vincristine) and two unknown compounds across all samples. On average, C. roseus leaves decrease the max OD600 by 12% (lower final cell count) compared to V. major leaves. C. roseus flowers had a slightly lower max OD600 than C. roseus leaves.

Conclusions/Discussion

I accomplished my goal of comparing the alkaloid concentration, individual compound identification, and effects on cell growth for C. roseus and its understudied, close relative, V. major. I successfully determined that leaves of both species had comparable alkaloid concentrations, but differed in the makeup of their individual compounds. C. roseus flowers had dramatically less total alkaloids than in their leaves, potentially due to the absence of vindoline. I was able to test the toxicity of all samples on E. coli cells and found that C. roseus leaves and flowers had the largest negative effect on cell growth. Thus, I conclude that C. roseus is the best candidate for chemotherapy.

Summary Statement

Although V. major is a close relative of C. roseus and had high average total alkaloid concentration, C. roseus flowers had the greatest effect on cell viability and are the best candidate in chemotherapy.

Help Received

Dr. Amelia Fuller of SCU provided HPLC equipment and Cayman Chem supplied discounted alkaloid standards.