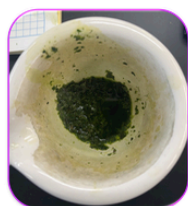


## Some Research Projects (Fall semester 2022 and Spring semester 2023)

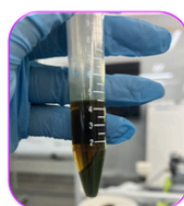
### Enhanced Antioxidant Potential of Alkaloids at Higher Concentrations and Effect on Bacterial Growth

López Ramia, Abigail, Rodríguez Zayas, Jaime L., Rodríguez Luna, Joaris N., Machuca Campis, Joaneliz, Padilla Santiago, Anagenese and Alvarez-Berrios, Merlis P.

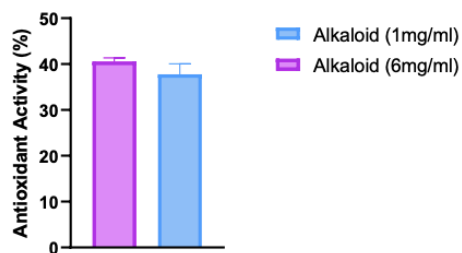
Alkaloids are a group of chemicals made up from plants, they contain nitrogen and can absorb either acid or hydrogen ions. These compounds have garnered significant attention from society due to their application in medicine. Despite various alkaloids have been used as anti-inflammatory, antioxidant and anticancer agents many are still undiscovered by the scientific community. They are known to inhibit bacterial growth by attaching to cell membranes, preventing bacterial replication. *Klebsiella pneumoniae* (*K. pneumoniae*) is a gram-negative bacteria, that causes different types of infections. This bacteria is usually found in human intestines, where it doesn't cause infections. In this investigative research we focused on extracting alkaloids from the *Eucalyptus Orbifolia* leaf. The hypothesis established is that the alkaloids that were extracted from the *Eucalyptus Orbifolia* leaf would not affect the bacteria's growth, *K. pneumoniae*, and that it will have an antioxidant capacity. Having conducted multiple experiments, we have completely validated our hypothesis. We found that alkaloids at a higher concentration (6mg/mL) demonstrated greater antioxidant potential compared to those at a lower concentration (1mg/mL). These alkaloids did not affect the growth of *K. pneumoniae* bacteria, but some antibiotics did have inhibition. Moving forward we wish to explore higher concentrations of alkaloids to determine their antioxidant capacity and see if it will affect the growth of a different bacteria.



**Image 2.** Eucalyptus leaf with acetic acid in ethanol.



**Image 3.** Alkaloids extracted from Eucalyptus leaf.

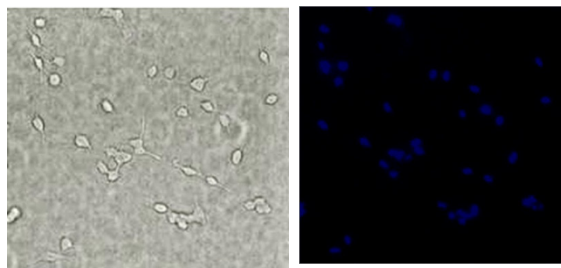


**Graph 1.** Antioxidant activity percentage for alkaloids extracted from *Eucalyptus Orbifolia* leaf. Alkaloid of 6mg/ml has a percentage of 40% while alkaloid of 1mg/ml has a percentage of 39%.

## ***In vitro* evaluation of crude extract and alkaloids obtained from *Citrus aurantifolia* using neuroblastoma cancer cells of *Staphylococcus aureus* bacteria**

Diaz Zayas, Joyce Liann, Diaz Zayas, Joyce Marie, Vazquez Lozada, Abdiel O., Balseiro Montes, Jasef E., Padilla Santiago, Anagenese and Alvarez-Berrios, Merlis,

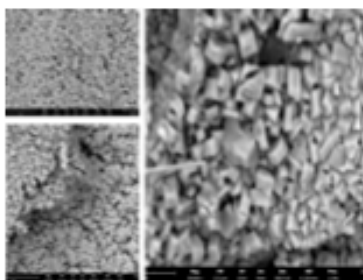
Cancer is considered the leading cause of death worldwide. It is caused by a mutation of the genetic material that results in an excessive and abnormal growth of cells, which spread to other parts of the body, outnumbering healthy cells. Currently there is no cure for cancer, but several treatments have been used such as chemotherapy, immunotherapy and radiotherapy. However, they make people's immune systems vulnerable because these treatments do not distinguish between cancer cells and normal cells. As a result, other tissues in the body may be affected and may be exposed to various bacterial diseases, such as *Staphylococcus aureus*. (*S. aureus*) is a gram-positive, cocciform microorganism that can be found everywhere, whether on surfaces or on human skin. People with weakened immune systems, such as cancer patients, are more susceptible to bacterial infections. The toxins released cause adverse symptoms such as fever, low blood pressure, rash and organ failure. Normally, it is treated with antibiotics such as penicillin, but resistance can be developed. In the last years, the use of natural methods and treatments to combat them has gained significant interest. The leaf of the *Citrus aurantifolia* plant known as lemon plant, and in particular its fruit, has been shown to have some biological activities due to its active components such as limonene. Therefore, in this work the anticancer and antibacterial activity of *Citrus aurantifolia* leaf crude extract and alkaloids (which were brought to the same concentration) using SH-SY5Y neuroblastoma cell line and *Staphylococcus aureus* bacteria were evaluated. In this research we conducted an experiment aimed to determine the anticancer activity using the neuroblastoma cell line SH-SY5Y and antibacterial inhibition activity using the bacteria *Staphylococcus aureus* when exposed to the crude extract and alkaloids obtained from the lemon leaf (*Citrus aurantifolia*). The results showed that the highest concentration (2.5 mg/mL) of the crude extract had higher anticancer activity compared to the alkaloids at the same concentration, emphasizing that the alkaloids had no anticancer activity at the concentrations used. For the antibacterial activity, the crude extract nor alkaloid showed inhibition capacity. For future research we will evaluate higher concentrations of crude extract and alkaloids. In addition, we will consider to encapsulate these compounds in to drug delivery systems.



## Green Chemistry Synthesis of Copper Nanostructures Incorporated in Gelatin-Based Hydrogels for Antioxidant Capacity Analysis

P. Rodríguez-Flores, G. Ramos-Laporte, I. Rivera-Colón, T. Román-Vélez, A. Cruz-Lebrón, D. Torres-Padilla, and M. Álvarez-Berrios

It is scientifically proven that nanotechnology has a vital role in manipulating materials at the atomic and molecular levels to alter product properties and develop novel characteristics. Nanomaterials have been essential for various electronics, pharmaceuticals, agriculture, biomedical science, chemical industry, mechanics, and health care applications. In particular, the synthesis of copper oxide nanoparticles has demonstrated a superior capacity for disease detection and treatment compared with other studied metals. An essential criterion of copper oxide is the ability to control its conduction depending on the temperature, chemical structure, or presence of dopants. Therefore, CuO is classified as a type P semiconductor having a 1.2eV gap ( $E_g$ ). Combined with gelatin-based hydrogels, the copper nanostructures can have excellent antioxidant potential. Alginate is a biocompatible polymer with easy gelification, is non-toxic, and helps wound healing. Eucalyptus also can heal wounds and has a great antioxidant capacity. In this investigation project, we studied the antioxidant capacity of the copper and eucalyptus nanostructures incorporated in gelatin-based hydrogels with different alginate concentrations. We expect copper and eucalyptus hydrogels to have a high antioxidant capacity.



**Image 3.** SEM image of CuO Pellet 500°C (4hrs).