12-9-2021

Effectiveness of Cannabidiol and Resveratrol Against Diesel Exhaust Particle-Induced Lung Cell Cytotoxicity

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Effectiveness of Cannabidiol and Resveratrol Against Diesel Exhaust Particle-Induced Lung Cell Cytotoxicity

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BIOLOGICAL ENGINEERING

Background

Environmental air pollution is a significant health risk factor in the modern world. One major compound in air pollution that adds to these worldwide health issues is diesel exhaust particulate (DEP). DEP, as a micro-pollutant or fine particulate matter, can easily enter the body through the respiratory system and cause significant damage leading to lung cancer, asthma, vascular disfunction, infertility, cardiovascular disease, etc.[1]

Environmental air pollution within the Salt Lake Valley.

Antioxidants, such as resveratrol, have been previously shown to have protective properties against DEP-induced cytotoxicity in A549 cells.[4] Cannabinoids, which are derived from the cannabis or hemp plant, have also been found to have powerful antioxidant properties, though they have not been thoroughly explored.
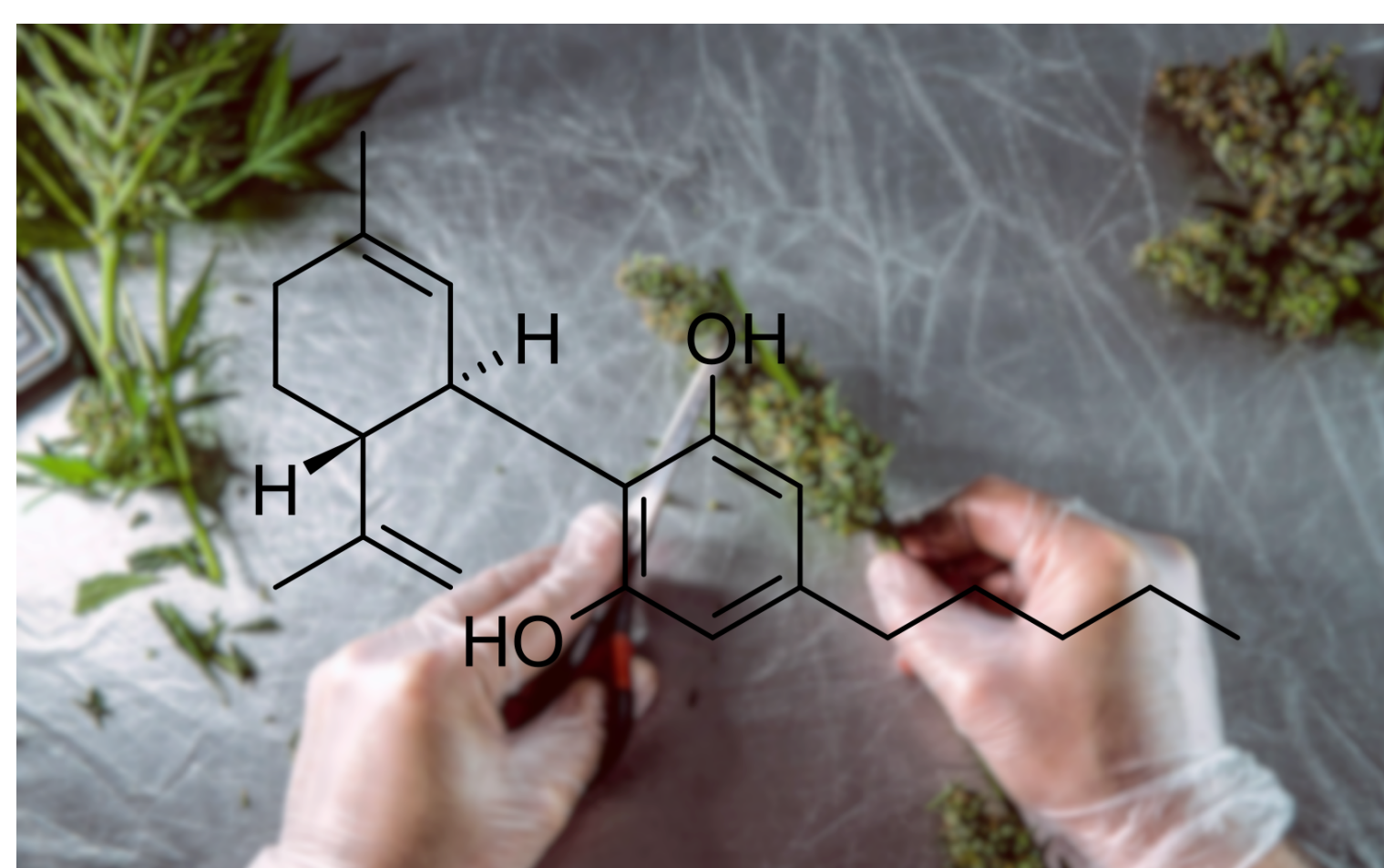
Hemp extract from Eukaflo cannabis company and CBD chemical structure

In this study, A549 human lung carcinoma cells were used as a cell model to determine the effectiveness of cannabinoids' antioxidant properties against DEP-induced oxidative stress and cytotoxicity.

Materials and Methods

A549 cells were grown to 80-90% confluence, seeded, and treated according to experiment flow chart:
- Antioxidant concentrations of 10 uM resveratrol or 1 uM CBD
- DEP concentrations of 0, 10, 25, 50, and 100 ug/mL

Raman spectra collected using a Renshaw Confocal Raman Microscope:
- Cells from each condition were tested at random with five spectra collected per cell until approximately 90-100 spectra were collected for each condition.

Cell assay data was collected using a Guava Muse Cell Analyzer:
- All flow cytometer data was collected through cell assays including Annexin V Cell Death (cell viability) and Oxidative Stress (ROS) tests.

Raman data was then analyzed using unsupervised machine learning algorithms in Python, such as UMAP, PCA, and PHATE.[2]
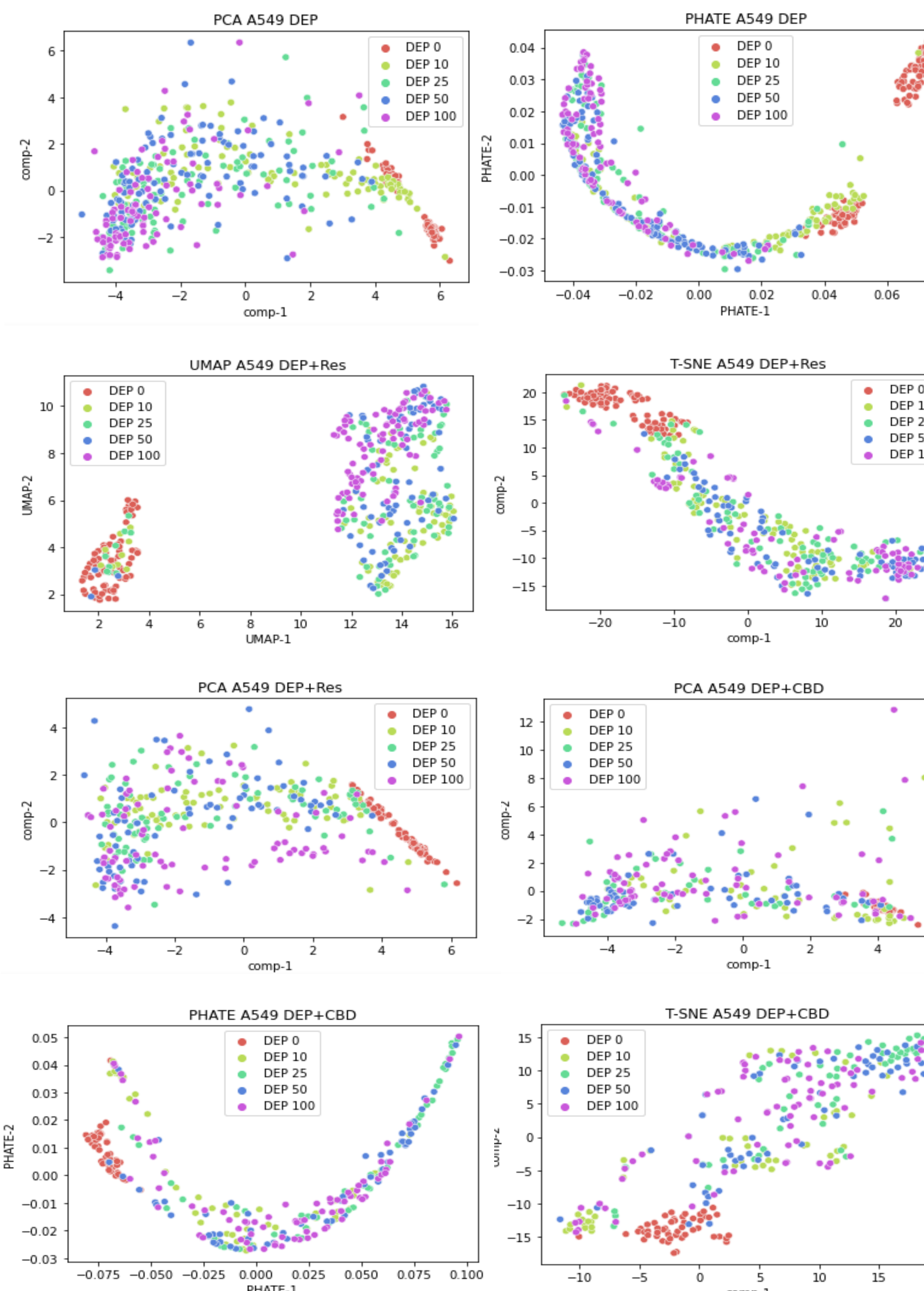
Experiment protocol flow chart and Raman spectroscopy cellular imaging
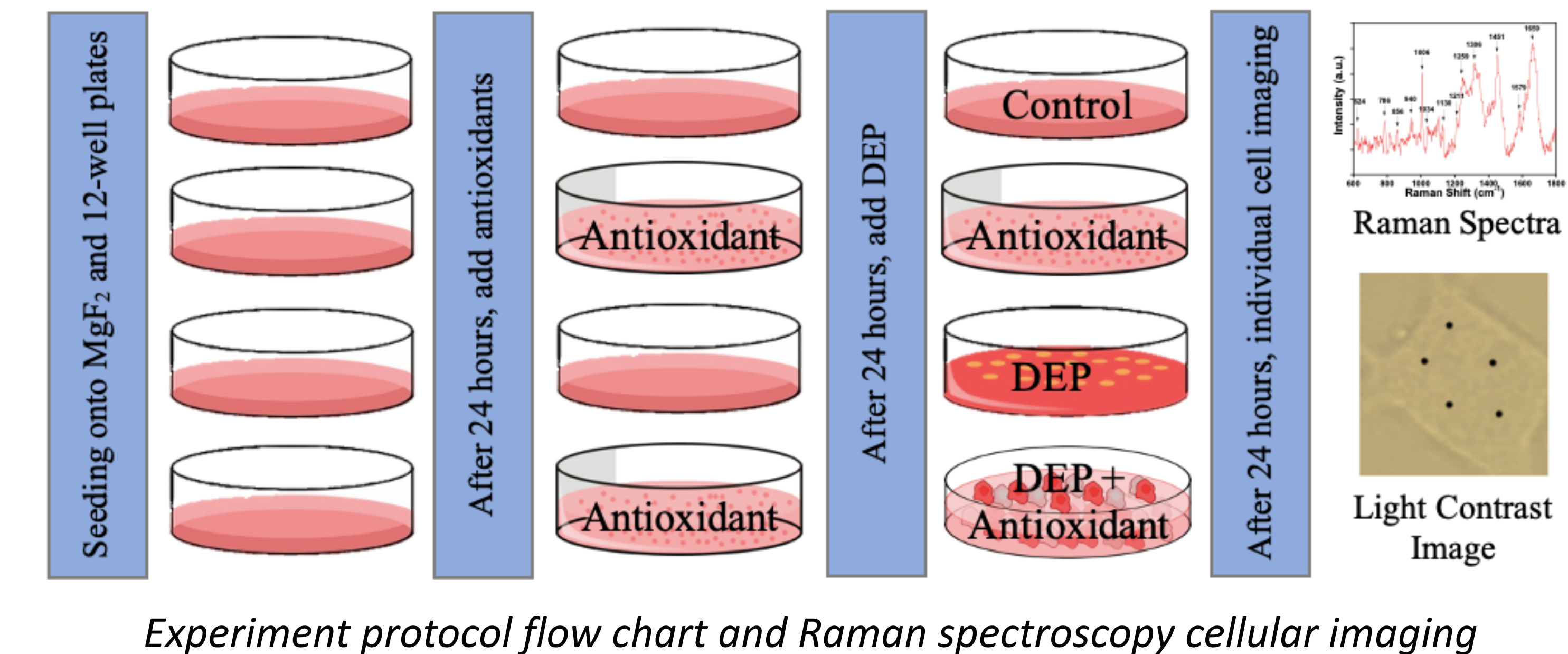
Preliminary Results

Flow Cytometry:
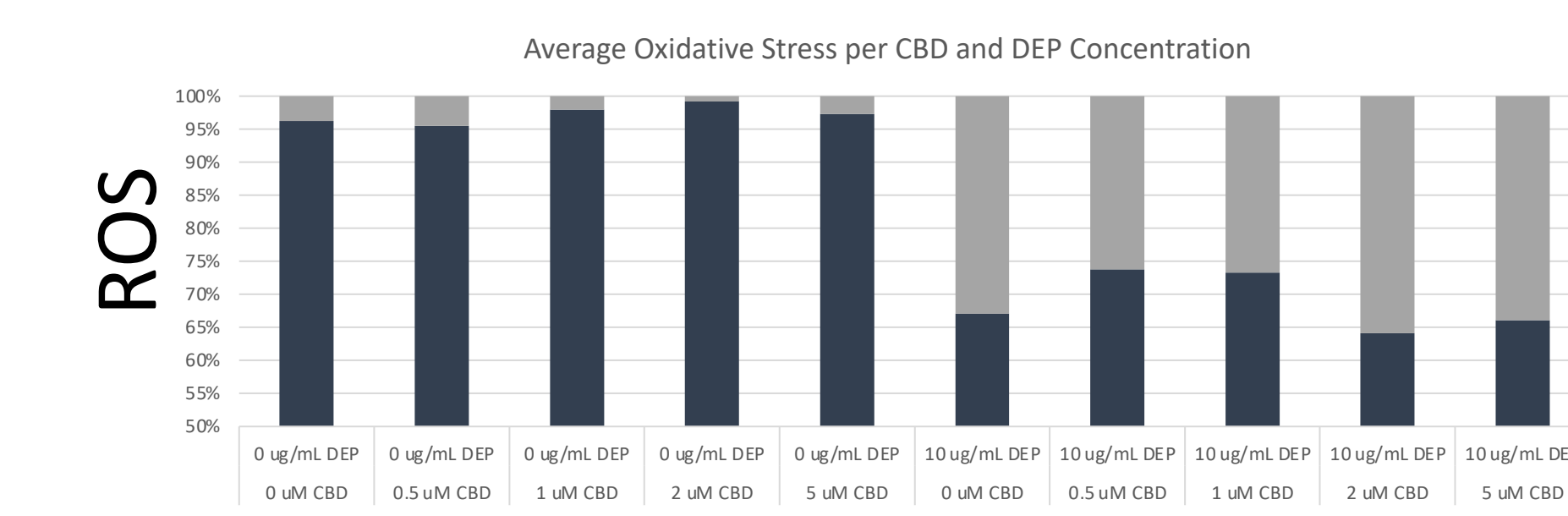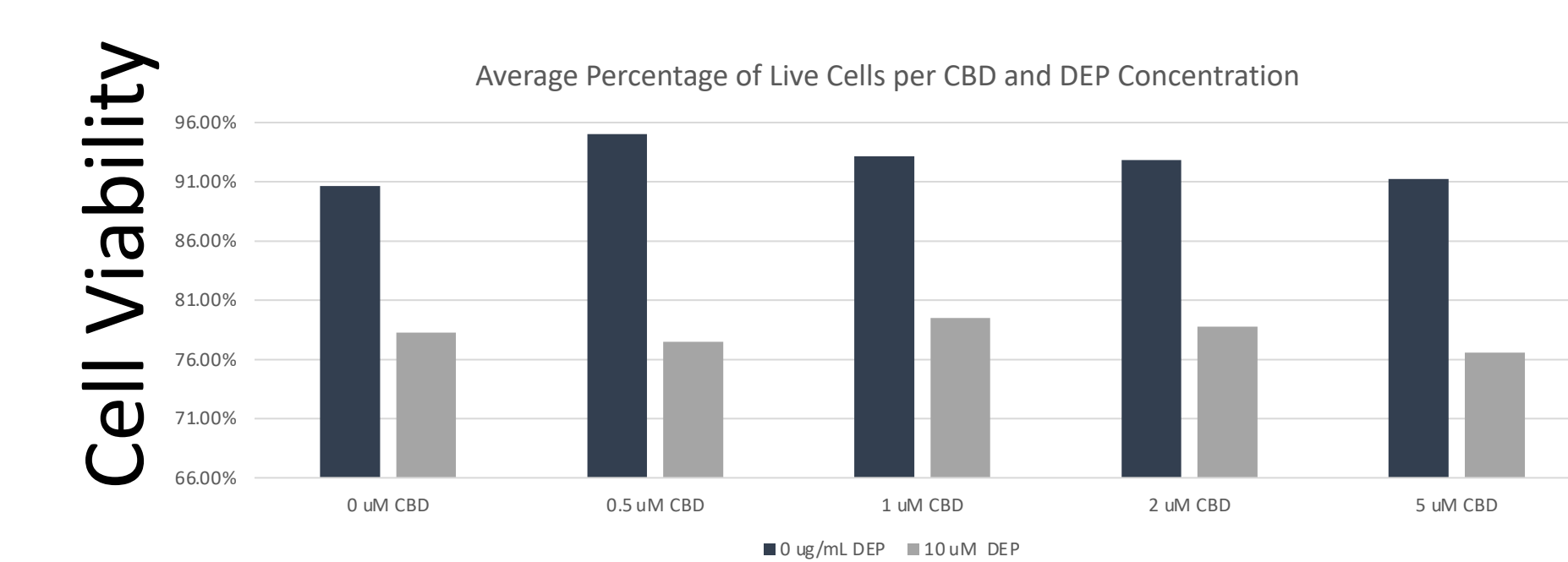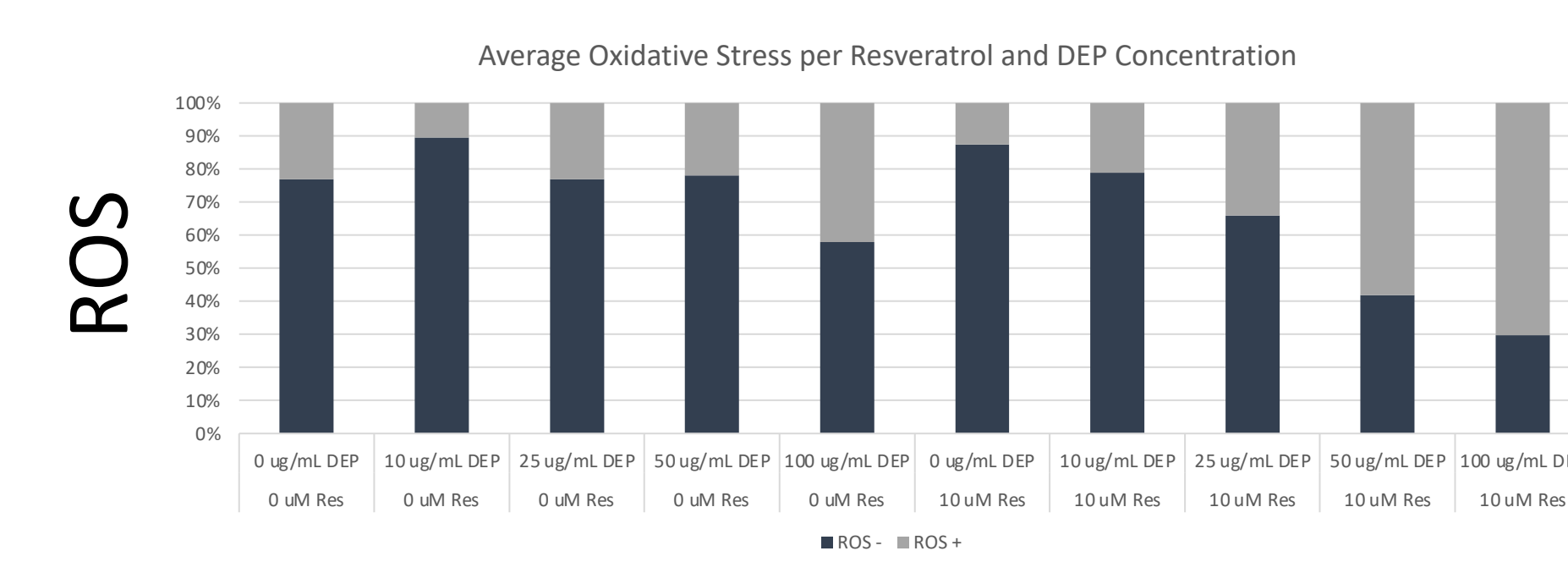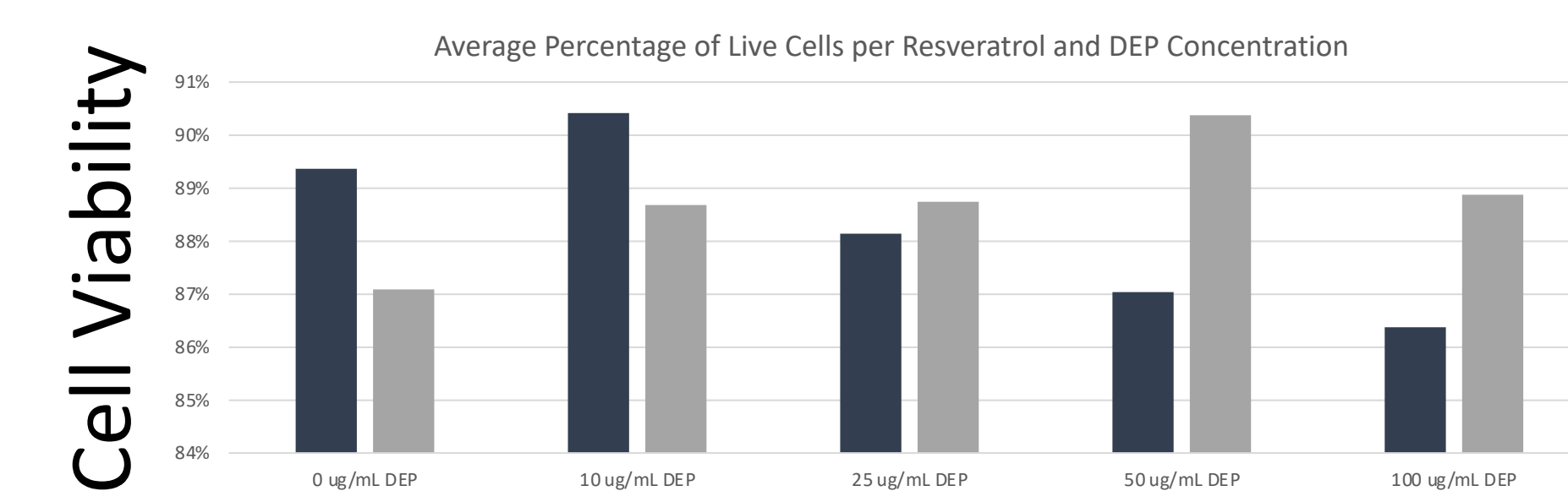
Raman Spectroscopy:

Future Experiments

DEP have also been linked to neurological disorders such as ADHD, learning disabilities in children, and early onset Alzheimer's.[1] Future experiments will be conducted using SH-SY5Y human neuroblastoma cells to determine the protective capabilities of cannabinoids against DEP-induced neuron damage.

Additionally, as the production of cannabinoids is a growing industry in Utah, the optimization of antioxidant yield from cannabis crops is an important area of study. In partnership with the Utah cannabis company Eukaflo, the Raman spectral differences between cannabis species will be studied to develop a portable Raman microscope for agricultural use.

References

1. Sunyer, J.; Dadvand, P. Pre-Natal Brain Development as a Target for Urban Air Pollution. Basic & Clinical Pharmacology & Toxicology 2019, 125 (S3), 81–88.

2. Zhang, W. et. al. Label-Free Discrimination And Quantitative Analysis Of Oxidative Stress Induced Cytotoxicity And Potential Protection Of Antioxidants Using Raman Micro-Spectroscopy And Machine Learning. Analytica Chimica Acta 2020, 1128, 221-230.