A Novel Approach to Improving Photodynamic Therapy through Analysis of the Effects of Induced Hypoxia and Utilization of Bioluminescence

Prindle, Shannen (School: Garden City High School)

Photodynamic therapy (PDT) is a form of a cancer treatment that involves administering a photosensitizing drug and irradiating it with an external light source. Upon exposure, the photosensitizer produces a highly reactive oxygen species (ROS) which is toxic to the macromolecules within cells and results in their death. This project revolved around developing a novel approach to overcoming two major obstacles involved in PDT through the investigation of the effects of hypoxia induction and the utilization of bioluminescence. These primary drawbacks to the current PDT methodology are the low penetration depth of the external light source and the insufficient amount of ROS produced due to large tumors and/or the presence of hypoxic regions within them. A cell viability assay was performed after culturing cancerous mammalian cells under hypoxic and normoxic conditions when photosensitive and/or bioluminescent reagents were present. The effectiveness of each individual experimental combination was analyzed and it was found that the methylene blue (MB) photosensitizer used was viable, with 0% cell viability at 25 micromolar concentration of MB and beyond. Despite this, the MB control and two experimental plates all had nearly the same trends in their data below 250 micromolar, indicating that the emissions peak of the bioluminescent reagent (Luciferin) most likely did not match the MB absorption peak well enough. Although the results are not significant enough to show whether hypoxia negatively affects PDT through bioluminescence, this research will provide valuable knowledge in the effort to improve PDT and develop a non-invasive, effective cure for cancer.